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DELTA_IA-MDS_MS300_UM_EN_20221122

Delta High Performance Compact Drive - MH300 Series User Manual

Digitized Automation for a Changing World

Delta High Performance Compact Drive MH300 Series User Manual

www.deltaww.com

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The contents of this user manual are only for the use of the AC motor drives manufactured by Delta. Except as defined in special mandatory laws, Delta provides this user manual “as is” and does not offer any kind of warranty through this user manual for using the product, either express or implied, including but not limited to the following: (i) this product will meet your needs or expectations; (ii) the information contained in the product is current and correct; (iii) the product does not infringe any rights of any other person. You shall bear your own risk to use this product.

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Delta reserves the right to make changes to the user manual and the products described in the user manual without prior notice and afterwards.

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

☑ Disconnect AC input power before connecting any wiring to the AC motor drive.

☑ Even if the power has been turned off, a charge may still remain in the DC-link capacitors with hazardous voltages before the POWER LED is OFF. Do not touch the internal circuits and components.

☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Take anti-static measures before touching these components or the circuit boards.

☑ Never modify the internal components or wiring.

☑ Ground the AC motor drive by using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed.

☑ DO NOT install the AC motor drive in a location with high temperature, direct sunlight or inflammable materials or gases.

CAUTION

☑ Never connect the AC motor drive output terminals U/T1, V/T2 and W/T3 directly to the AC mains circuit power supply.

☑ After finishing the wiring of the AC motor drive, check if U/T1, V/T2 and W/T3 are short-circuited to ground with a multimeter. Do NOT power the drive if short circuits occur. Eliminate the short circuits before the drive is powered.

☑ The rated voltage of power system to install motor drives is listed below. Ensure that the installation voltage is in the correct range when installing a motor drive.
For 115V models, the range is between 85–132 V.
For 230V models, the range is between 170–264 V.
For 460V models, the range is between 323–528 V.

☑ Refer to the table below for short circuit rating:

Model (Power)	Short circuit rating
115V	5 kA
230V	5 kA
460V	5 kA

☑ Only qualified persons are allowed to install, wire and maintain the AC motor drives.

☑ Even if the three-phase AC motor is stopped, a charge with hazardous voltages may still remain in the main circuit terminals of the AC motor drive.

☑ The performance of electrolytic capacitor will degrade if it is not charged for a long time. It is recommended to charge the drive which is stored in no charge condition every 2 years for 3~4 hours to restore the performance of electrolytic capacitor in the motor drive. Note: When power up the motor drive, use adjustable AC power source (ex. AC autotransformer) to charge the drive at 70%~80% of rated voltage for 30 minutes (do not run the motor drive). Then charge the drive at 100% of rated voltage for an hour (do not run the motor drive). By doing these, restore the performance of electrolytic capacitor before starting to run the motor drive. Do NOT run the motor drive at 100% rated voltage right away.

☑ Pay attention to the following precautions when transporting and installing this package (including wooden crate and wood stave)

1. If you need to deworm the wooden crate, do not use fumigation or you will damage the drive. Any damage to the drive caused by using fumigation voids the warranty.
2. Use other methods, such as heat treatment or any other non-fumigation treatment, to deworm the wood packaging material.
3. If you use heat treatment to deworm, leave the packaging materials in an environment of over 56°C for a minimum of thirty minutes.

☑ Connect the drive to a three-phase three-wire or three-phase four-wire Wye system to comply with UL standards.

☑ If the motor drive produces a leakage current of over AC 3.5mA or over DC 10mA on the Protective Earthing conductor, the minimum specifications required of the Protective Earthing conductor to be installed have to comply with the national, local laws and regulations or follow IEC61800-5-1 to do grounding.

☑ MH300 series is designed for the application of general industrial environment. Non-linear load causes harmonic current, if the drive uses with public low voltage (e.g. the power supplies to houses), then you have to assemble an appropriate restraint equipment (e.g. isolation transformer or input reactor) to restrain the interference may be caused. Contact with Delta for more information.

NOTE:

- In the pictures in this manual, the cover or safety shield is disassembled only when explaining the details of the product. During operation, install the top cover and wiring correctly according to the provisions. Refer to the operation descriptions in the manual to ensure safety.
- The figures in this instruction are only for reference and may be slightly different depending on your model, but it will not affect your customer rights.
- The content of this manual may be revised without prior notice. Consult our distributors or download the latest version at http://www.deltaww.com/iadownload_acmotordrive.

Table of Contents

CHAPTER 1 INTRODUCTION 1-1

1-1 Nameplate Information........ 1-2
1-2 Model Name........ 1-3
1-3 Serial Number........ 1-3
1-4 Apply After Service by Mobile Device........ 1-4
1-5 RFI Jumper........ 1-5

CHAPTER 2 DIMENSIONS.. 2-1

2-1 Frame A........ 2-2
2-2 Frame B........ 2-3
2-3 Frame C........ 2-4
2-4 Frame D........ 2-5
2-5 Frame E........ 2-6
2-6 Frame F........ 2-7
2-7 Frame G........ 2-8
2-8 Frame H........ 2-9
2-9 Frame I........ 2-10
2-10 Digital Keypad........ 2-11

CHAPTER 3 INSTALLATION 3-1

3-1 Mounting Clearance........ 3-2
3-2 Airflow and Power Dissipation........ 3-3

CHAPTER 4 WIRING 4-1

4-1 System Wiring Diagram........ 4-3
4-2 Wiring 4-4

CHAPTER 5 MAIN CIRCUIT TERMINALS 5-1

5-1 Main Circuit Diagram........ 5-4
5-2 Main Circuit Terminals........ 5-5

CHAPTER 6 CONTROL TERMINALS 6-1

6-1 Control Terminal Specifications........ 6-4

CHAPTER 7 OPTIONAL ACCESSORIES 7-1

7-1 All Brake Resistors and Brake Units Used in AC Motor Drives........ 7-2
7-2 Magnetic Contactor / Air Circuit Breaker and Non-Fuse Circuit Breaker........ 7-6
7-3 Fuse Specification Chart 7-10
7-4 AC / DC Reactors........ 7-13

7-5 Zero Phase Reactors....7-43
7-6 EMC Filter....7-46
7-7 EMC Shield Plate....7-54
7-8 Capacitive Filter....7-59
7-9 The Assembly of NEMA Kit....7-61
7-10 The Assembly of Fan Kit....7-74
7-11 Keypad Panel Mounting 7-78
7-12 DIN-Rail Mounting....7-79
7-13 Mounting Adapter Plate....7-81
7-14 Digital Keypad – KPC-CC01....7-85

CHAPTER 8 OPTION CARDS....8-1

8-1 Option Card Installation....8-2
8-2 EMM-PG01L -- PG Card (Line Driver) 8-13
8-3 EMM-PG01O -- PG Card (Open Collector) 8-16
8-4 EMM-PG01R -- PG Card (Resolver/Encoder Signal Input) 8-19
8-5 EMM-D33A -- Three-point Digital Input/Three-point Digital Output Extension 8-22
8-6 EMM-A22A -- Two Sets of Analog Input/Two Sets of Analog Output Extension 8-23
8-7 EMM-R2CA -- Relay Output Extension (Three-point N.C. Output Terminal) 8-24
8-8 EMM-R3AA -- Relay Output Extension (Three-point N.O. Output Terminal) 8-25
8-9 EMM-BPS02 -- +24V Power Extension Card 8-26
8-10 CMM-DN02 -- Communication Extension Card, DeviceNet 8-28
8-11 CMM-EIP02 -- Communication Extension Card, EtherNet/IP 8-31
8-12 CMM-EIP03 -- Communication Extension Card, EtherNet/IP 8-35
8-13 CMM-PD02 -- Communication Extension Card, PROFIBUS DP 8-39
8-14 CMM-EC02 -- Communication Extension Card, EtherCAT....8-41
8-15 Delta Standard Fieldbus Cables....8-44

CHAPTER 9 SPECIFICATION....9-1

9-1 115V Models....9-2
9-2 230V Models....9-3
9-3 460V Models....9-6
9-4 General Specifications....9-8
9-5 Environment for Operation, Storage and Transportation....9-9
9-6 Derating Curve....9-10

CHAPTER 10 DIGITAL KEYPAD 10-1

10-1 KPMH-LC01 Keypad....10-2
10-2 Descriptions of Keypad Functions....10-2
10-3 Keypad Operation Process....10-3
10-4 Reference Table for the 16-segment Digital Keypad LED Display....10-9

CHAPTER 11 SUMMARY OF PARAMETERS SETTINGS 11-1

CHAPTER 12 DESCRIPTIONS OF PARAMETER SETTINGS 12.1-00-1

12-1 Descriptions of Parameter Settings……………………………………………12.1-00-1
00 Drive Parameters……………………………………………………………12.1-00-2
01 Basic Parameters……………………………………………………………12.1-01-1
02 Digital Input / Output Parameters………………………………………12.1-02-1
03 Analog Input / Output Parameters………………………………………12.1-03-1
04 Multi-Stage Speed Parameters……………………………………………12.1-04-1
05 Motor Parameters……………………………………………………………12.1-05-1
06 Protection Parameters (1) ………………………………………………12.1-06-1
07 Special Parameters…………………………………………………………12.1-07-1
08 High-function PID Parameters……………………………………………12.1-08-1
09 Communication Parameters………………………………………………12.1-09-1
10 Speed Feedback Control Parameters……………………………………12.1-10-1
11 Advanced Parameters………………………………………………………12.1-11-1
12 Tension Control Parameters………………………………………………12.1-12-1
13 Macro (User-defined) ……………………………………………………12.1-13-1
14 Protection Parameters (2) ………...12.1-14-1
12-2 Adjustment & Applications…………………………………………………12.2-1

CHAPTER 13 WARNING CODES 13-1

CHAPTER 14 FAULT CODES 14-1

CHAPTER 15 CANopen OVERVIEW.. 15-1

15-1 CANopen Ovreview...15-3
15-2 Wiring for CANopen..15-7
15-3 CANopen Communication Interface Descriptions...15-8
15-4 CANopen Supporting Index...15-20
15-5 CANopen Fault Codes...15-28
15-6 CANopen LED Function...15-33

CHAPTER 16 PLC FUNCTION APPLICATIONS... 16-1

16-1 PLC Summary...16-2
16-2 Notes Before PLC Use..16-3
16-3 Turn On...16-5
16-4 Basic Principles of PLC Ladder Diagrams...16-16
16-5 Various PLC Device Functions..16-28
16-6 Introduction to the Command Window...16-40
16-7 Display and Treatment of PLC Related Faults and Codes..................................16-114
16-8 Explanation of each PLC Mode Control (Speed, Torque) 16-115
16-9 Count Function Using Pulse Input..16-118

16-10 CANopen Master Control Applications..16-119
16-11 Modbus Remote IO Control Applications (Use MODRW) 16-130

CHAPTER 17 SAFE TORQUE OFF FUNCTION……………………...…………………….17-1

17-1 Basic Function Description………...17-2
17-2 Safe Torque Off Terminal Function Description..17-3
17-3 Wiring Diagram...17-4
17-4 Failure Rate of the Drive Safety Function...17-5
17-5 Reset the Parameter Settings…..17-5
17-6 Timing Diagram Description..17-6
17-7 Fault Codes and Troubleshooting Instructions……...……………………………17-9
17-8 Test and Fault Confirmation………………………..……………………………17-11

APPENDIX A. MODBUS PROTOCOL……………………………….………………………..A-1

A-1 Code Description………...A-2
A-2 Data Format...A-2
A-3 Communication Protocol...A-4
A-4 Address List...A-9
A-5 Exception Response…...A-16

APPENDIX B. REVISION HISTORY……………………………….………………………..B-1

Issued Edition: 01
Firmware Version: V1.04 (Refer to Parameter 00-06 on the product to get the firmware version.)
Issued Date: 2023/2

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Chapter 1 Introduction

1-1 Nameplate Information

1-2 Model Name

1-3 Serial Number

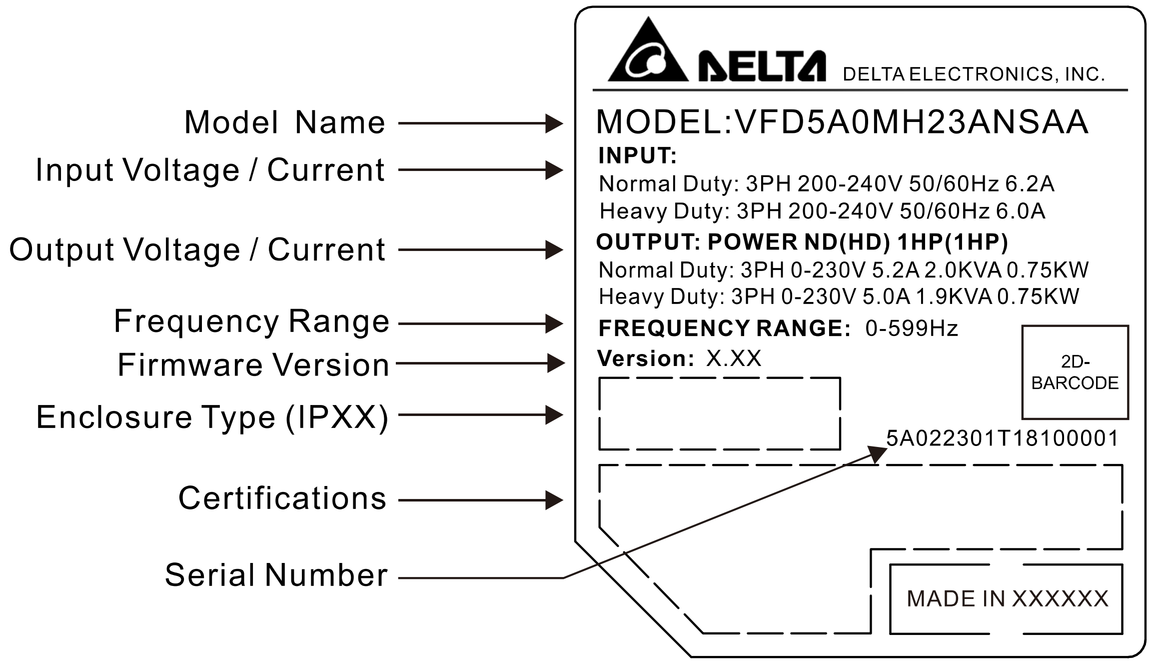
1-4 Apply After Service by Mobile Device

1-5 RFI Jumper

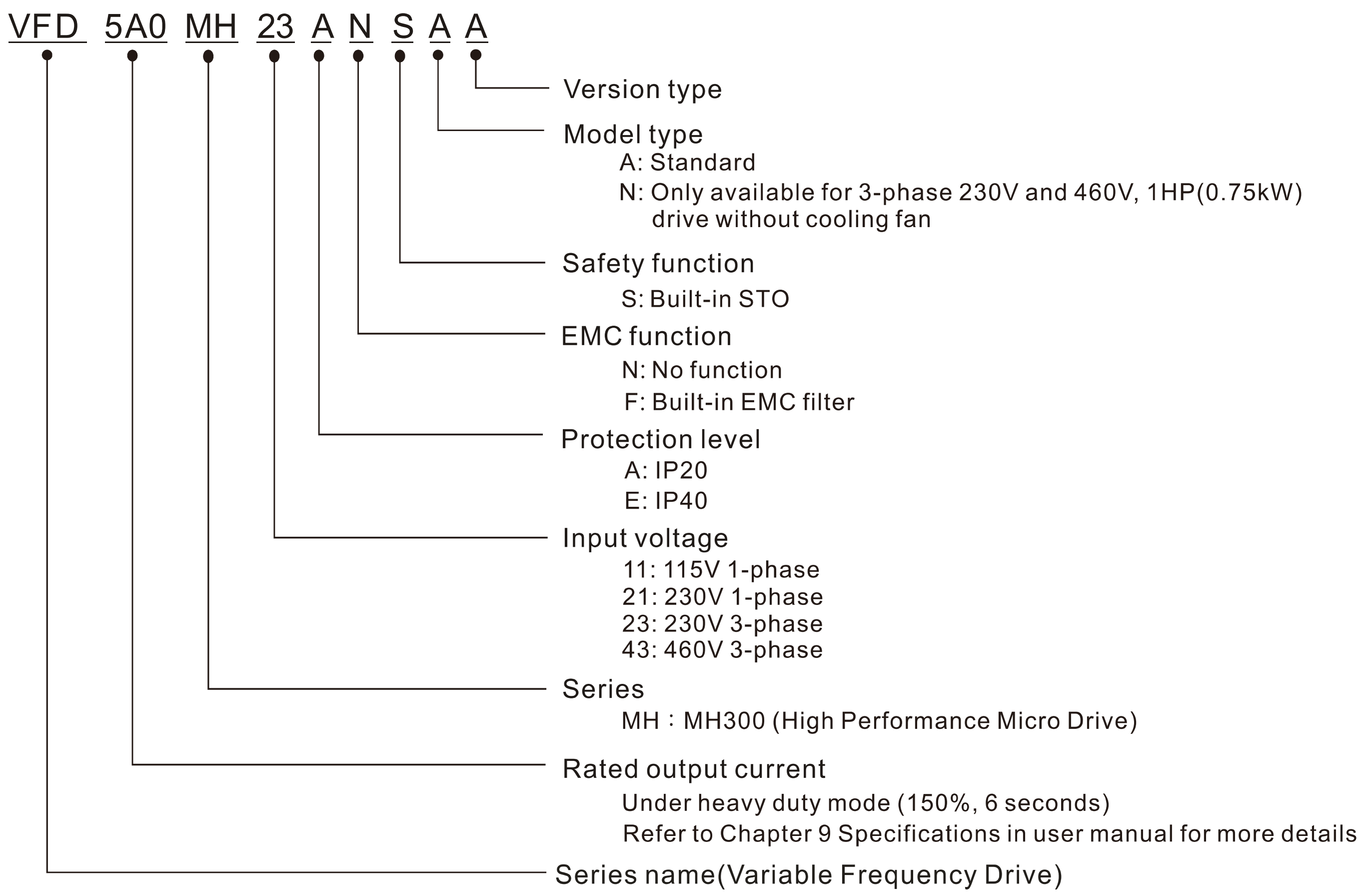
After receiving the AC motor drive, check for the following. Inspect the unit after unpacking to ensure that it was not damaged during shipment. Make sure that the part number printed on the package matches the part number indicated on the nameplate.

1. Make sure that the mains voltage is within the range indicated on the nameplate. Install the AC motor drive according to the instructions in this manual.
2. Before applying power, make sure that all devices, including mains power, motor, control board, and digital keypad are connected correctly.
3. When wiring the AC motor drive, make sure that the wiring for the input terminals “R/L1, S/L2, T/L3”, and the output terminals "U/T1, V/T2, W/T3” are correct to prevent damage to the drive.
4. When power is applied, use the digital keypad (KPMH-LC01) to select the language and set parameters. When executing a trial run, begin with a low speed and then gradually increase the speed to the desired speed.

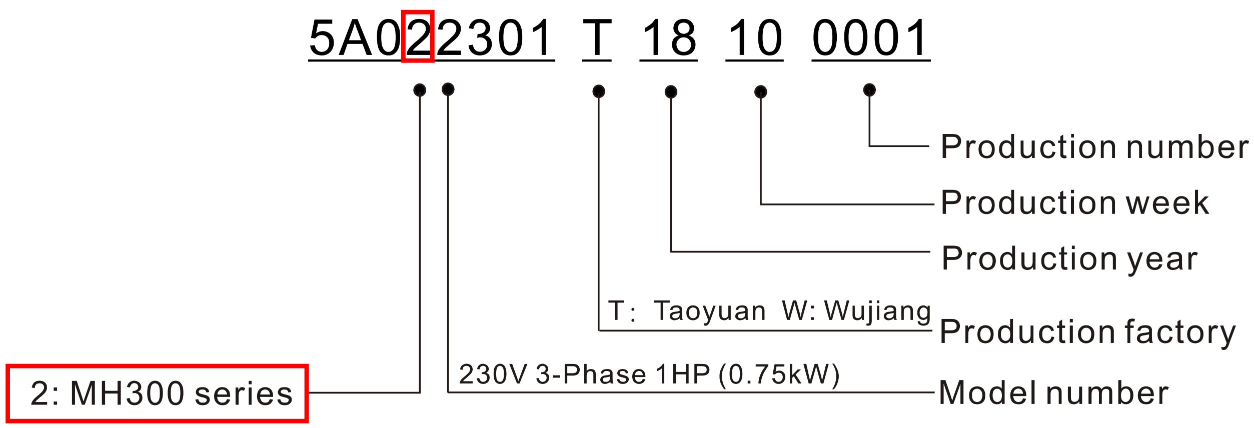
1-1 Nameplate Information



1-2 Model Name



1-3 Serial Number

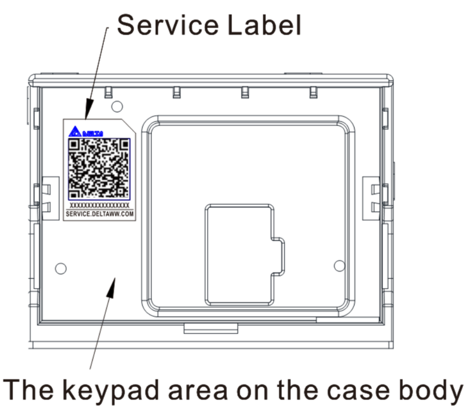


1-4 Apply After Service by Mobile Device

1-4-1 Location of Service Link Label

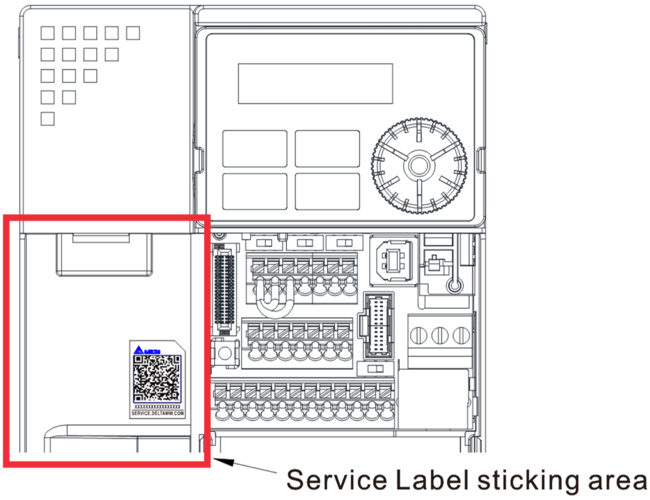
Frame A, B

Service link label (Service Label) will be pasted on the keypad area on the case body, as below drawing shown.

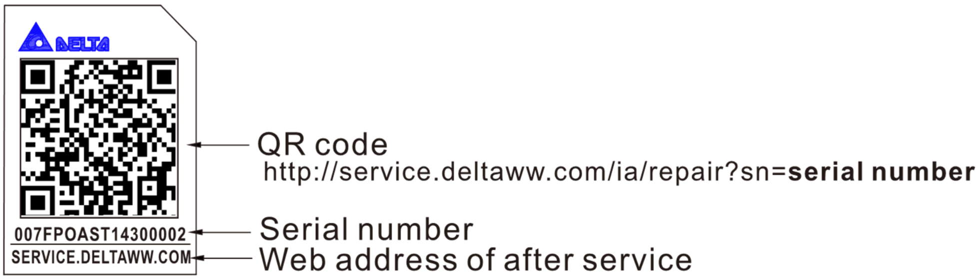


Frame C–I

Service link label (Service Label) will be pasted on the area as below drawing shown.



1-4-2 Service Link Label



Scan QR Code to apply

1. Find out the QR code sticker (as above shown).
2. Use a Smartphone to run a QR Code reader APP.
3. Point your camera to the QR Code. Hold your camera steady so that the QR code comes into focus.
4. Access the Delta After Service website.
5. Fill your information into the column marked with an orange star.
6. Enter the CAPTCHA and click "Submit" to complete the application.

Cannot find out the QR Code?

1. Open a web browser on your computer or smart phone.
2. Key in https://service.deltaww.com/ia/repair in address bar and press enter.
3. Fill your information into the columns marked with an orange star.
4. Enter the CAPTCHA and click "Submit" to complete the application.

1-5 RFI Jumper

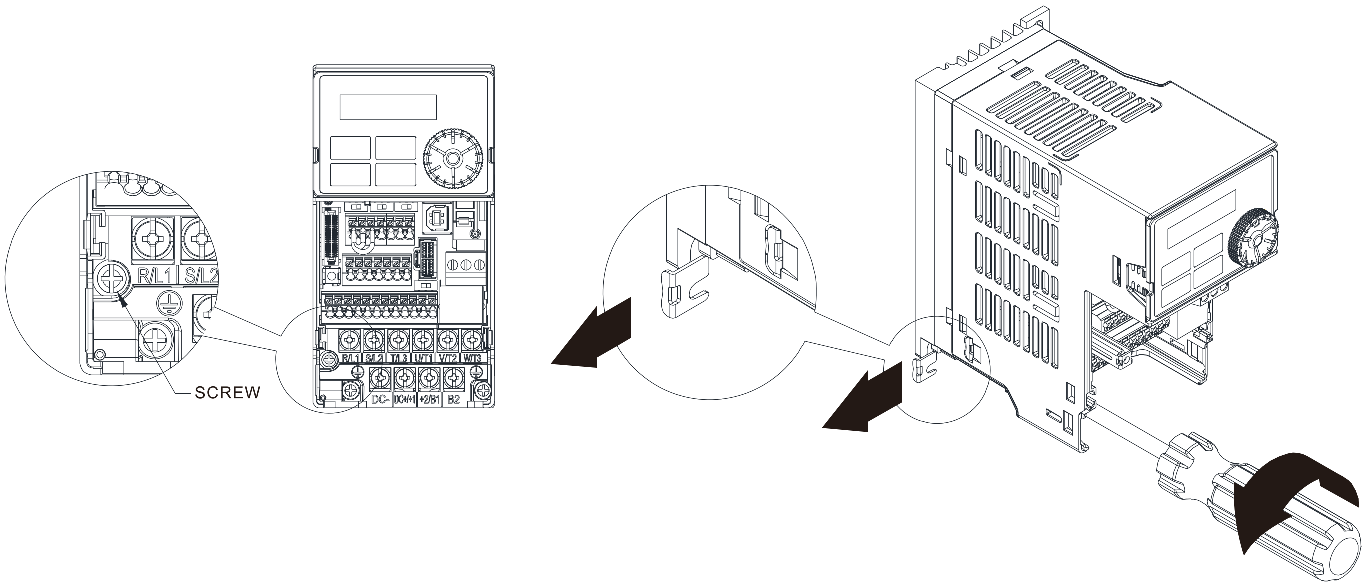
The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to protect the drive against mains surges or voltage spikes.
Because the Varistors / MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.

(1) In models with a built-in EMC filter, the RFI jumper connects the filter capacitors to ground to form a return path for high frequency noise in order to isolate the noise from contaminating the mains power. Removing the RFI jumper strongly reduces the effect of the built-in EMC filter.

(2) Although a single drive complies with the international standards for leakage current, an installation with several drives with built-in EMC filters can trigger the RCD. Removing the RFI jumper can help, but the EMC performance of each drive is no longer guaranteed.

Non-built-in EMC filter models

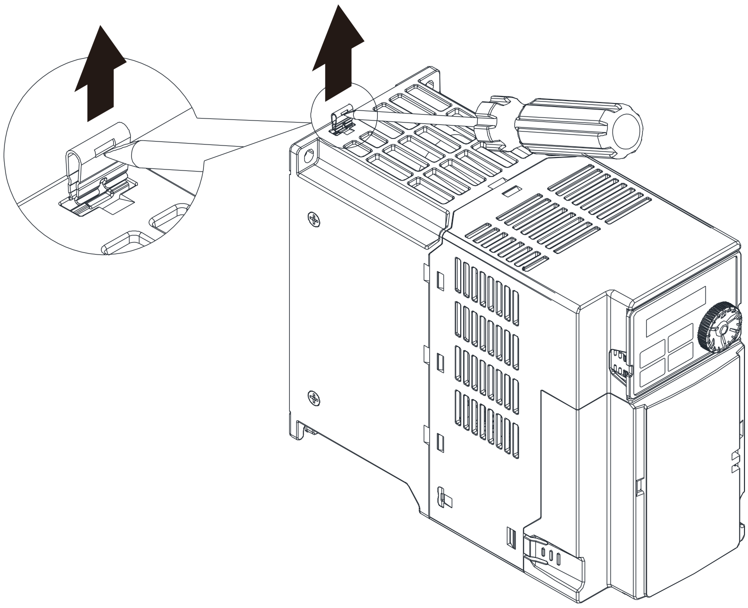
Frame A–I
Loosen the screw and remove the RFI jumper (as shown below). Fasten the screw again after you remove the RFI jumper.
Screw Torque: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)



Built-in EMC filter models

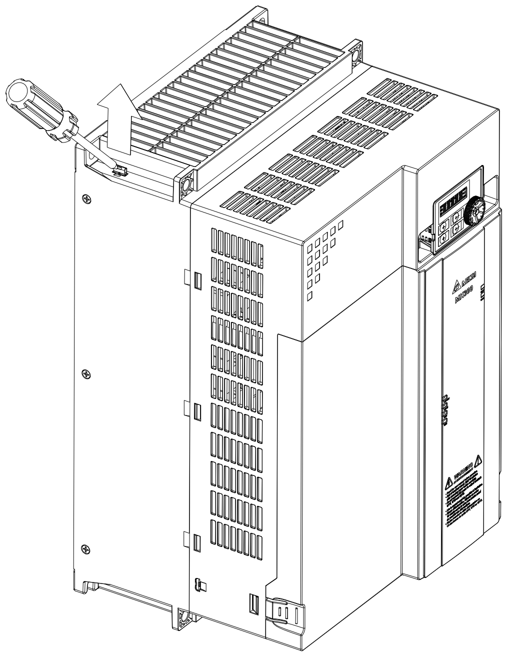
Frame B–F

Remove the RFI jumper with a screwdriver (as shown below).



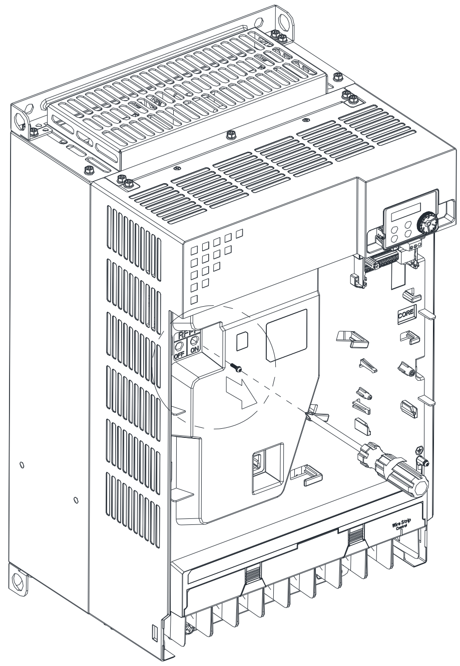
Frame G

Remove the RFI jumper with a screwdriver (as shown below).

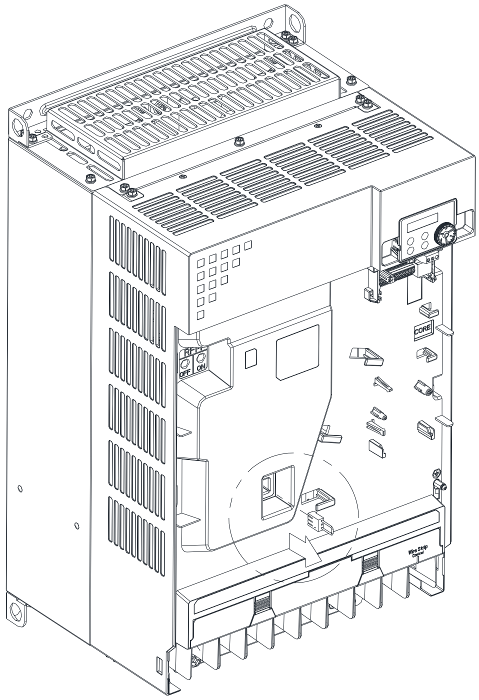


Frame H–I

1. Remove RFI ON (frame H) or the screw of RFI-1 ON (frame I)
   Screw Torque: 6–8 kg-cm / (5.2–6.9 lb-in.) / (0.59–0.78 Nm)



2. Remove the RFI jumper RFI-2 (frame I).



Isolating main power from ground:

When the power distribution system of the drive is a floating ground system (IT Systems) or an asymmetric ground system (Corner Grounded TN Systems), you must remove the RFI jumper. Removing the RFI jumper disconnects the internal capacitors from ground to avoid damaging the internal circuits and to reduce the ground leakage current.

Important points regarding ground connection:

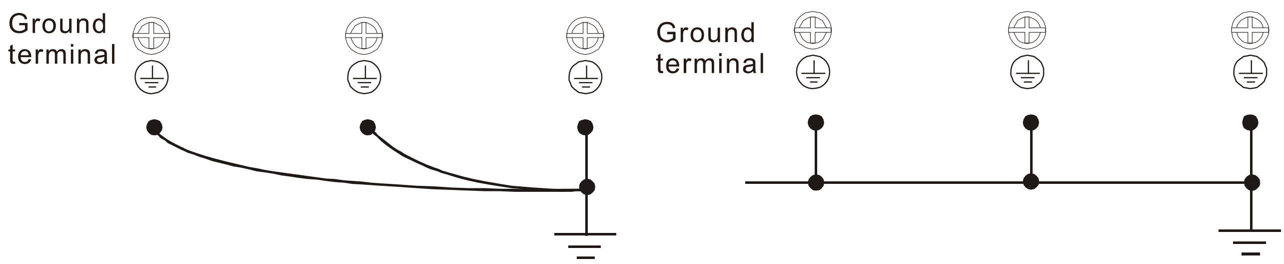
☑ To ensure the safety of personnel, proper operation, and to reduce electromagnetic radiation, you must properly ground the drive during installation.

☑ The diameter of the cables must comply with the local safety regulations.

☑ The shields of shielded cables must be connected to the ground of the drive to meet safety regulations.

☑ The shields of shielded power cables can only be used as the ground for equipment when the above points are met.

☑ When installing more drives, do not connect ground terminals of each drive to the ground with single point and series connection, but connects with single point and parallel connection. See the following pictures.



Correct wiring setup for ground wires - single point and parallel connection

Wrong wiring setup for ground wires - single point and series connection

Pay particular attention to the following points:

☑ Do not remove the RFI jumper while the power is on.

☑ Removing the RFI jumper also disconnects the built-in EMC filter capacitors. Compliance with the EMC specifications is no longer guaranteed.

☑ Do not remove the RFI jumper if the mains power is a symmetrical grounded power system in order to maintain the efficiency for EMC circuit.

☑ Do not remove the RFI jumper while conducting high voltage tests. When conducting a high voltage test to the entire facility, you must disconnect the mains power and the motor if the leakage current is too high.

Floating Ground System (IT Systems)

A floating ground system is also called an IT system, an ungrounded system, or a high impedance / resistance (greater than 30 Ω) grounded system.

☑ Disconnect the RFI jumper.

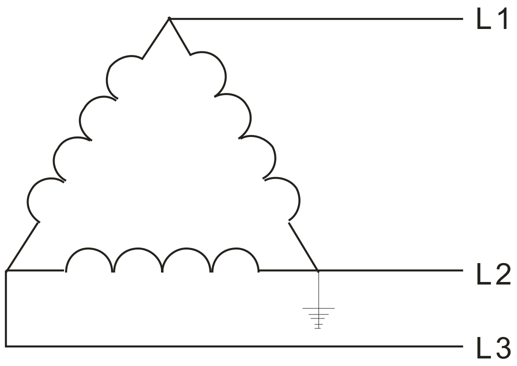
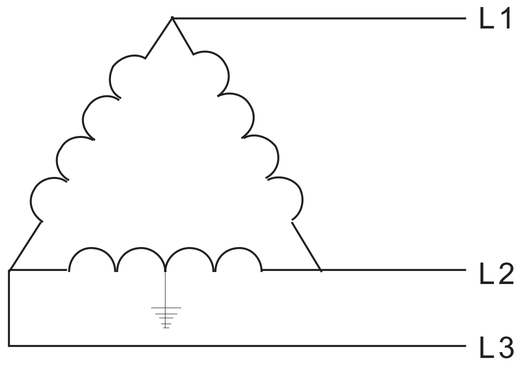
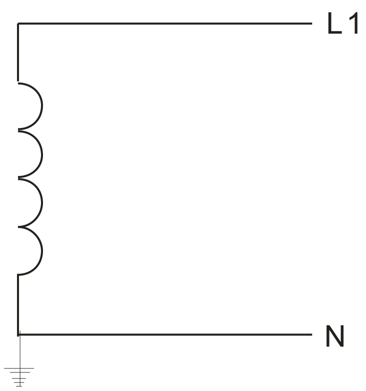
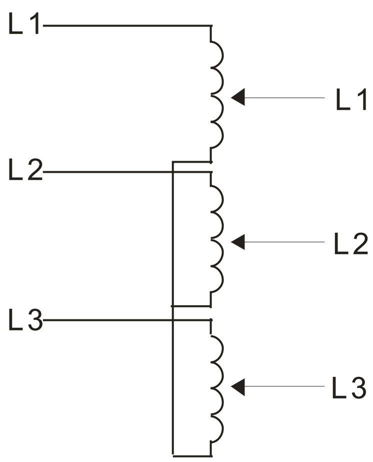
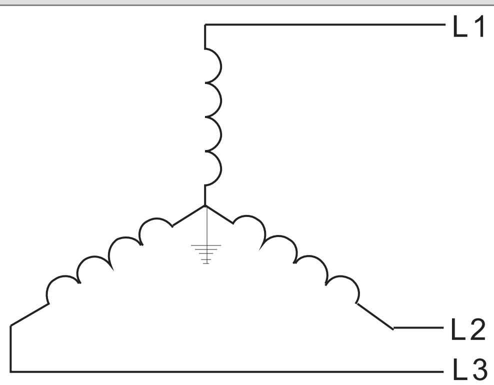
☑ Check whether there is excess electromagnetic radiation affecting nearby low-voltage circuits.

☑ In some situations, the transformer and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main circuit and the control terminals to increase suppression.

☑ Do not install an external EMC filter. The EMC filter is connected to ground through the filter capacitors, thus connecting the power input to ground. This is very dangerous and can easily damage the drive.

Asymmetric Ground System (Corner Grounded TN Systems)
Caution: Do not remove the RFI jumper while there is power to the input terminal of the drive.

In the following four situations, you must remove the RFI jumper. This is to prevent the system from grounding through the RFI and filter capacitors and damaging the drive.

<table>
<tr><th colspan="2">You must remove the RFI jumper</th></tr>
<tr><td>1. Grounding at a corner in a triangle configuration
</td><td>2. Grounding at a midpoint in a polygonal configuration
</td></tr>
<tr><td>3. Grounding at one end in a single-phase configuration
</td><td>4. No stable neutral grounding in a three-phase autotransformer configuration
</td></tr>
<tr><th colspan="2">You can use the RFI jumper</th></tr>
<tr><td>Internal grounding through RFI capacitors, which reduces electromagnetic radiation. In a symmetrically grounding power system with higher EMC requirements, you can install an EMC filter. As a reference, the diagram on the right is a symmetrical grounding power system.</td><td></td></tr>
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Chapter 2 Dimensions

2-1 Frame A
2-2 Frame B
2-3 Frame C
2-4 Frame D
2-5 Frame E
2-6 Frame F
2-7 Frame G
2-8 Frame H
2-9 Frame I
2-10 Digital Keypad

2-1 Frame A

A1: VFD1A6MH11ANSAA; VFD1A6MH11ENSAA; VFD1A6MH21ANSAA; VFD1A6MH21ENSAA

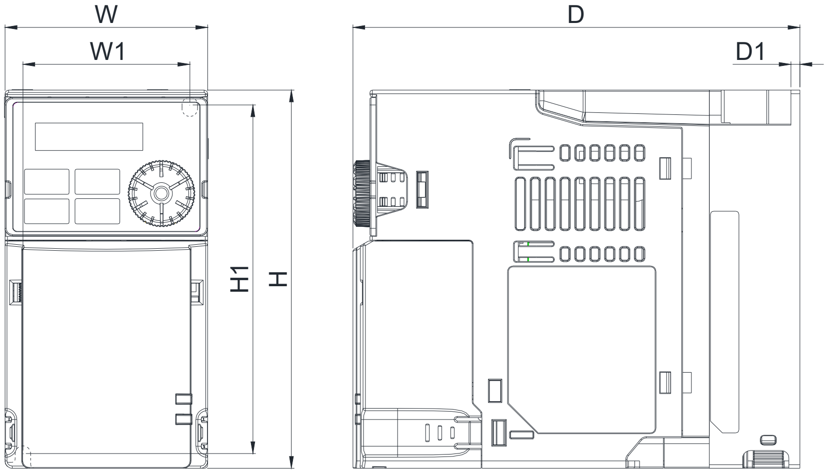
A2: VFD2A5MH11ANSAA; VFD2A5MH11ENSAA; VFD2A8MH21ANSAA; VFD2A8MH21ENSAA; VFD1A6MH23ANSAA; VFD1A6MH23ENSAA; VFD2A8MH23ANSAA; VFD2A8MH23ENSAA; VFD1A5MH43ANSAA; VFD1A5MH43ENSAA

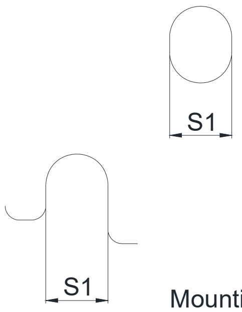
A3: VFD5A0MH23ANSAA; VFD5A0MH23ENSAA; VFD3A0MH43ANSAA; VFD3A0MH43ENSAA

A4: VFD5A0MH23ANSNA; VFD5A0MH23ENSNA; VFD3A0MH43ANSNA; VFD3A0MH43ENSNA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
A1	68.0 (2.68)	128.0 (5.04)	130.0 (5.12)	56.0 (2.20)	118.0 (4.65)	3.0 (0.12)	5.2 (0.20)
A2	68.0 (2.68)	128.0 (5.04)	144.0 (5.67)	56.0 (2.20)	118.0 (4.65)	3.0 (0.12)	5.2 (0.20)
A3	68.0 (2.68)	128.0 (5.04)	150.0 (5.91)	56.0 (2.20)	118.0 (4.65)	3.0 (0.12)	5.2 (0.20)
A4	68.0 (2.68)	128.0 (5.04)	162.0 (6.38)	56.0 (2.20)	118.0 (4.65)	3.0 (0.12)	5.2 (0.20)





Mounting Hole

2-2 Frame B

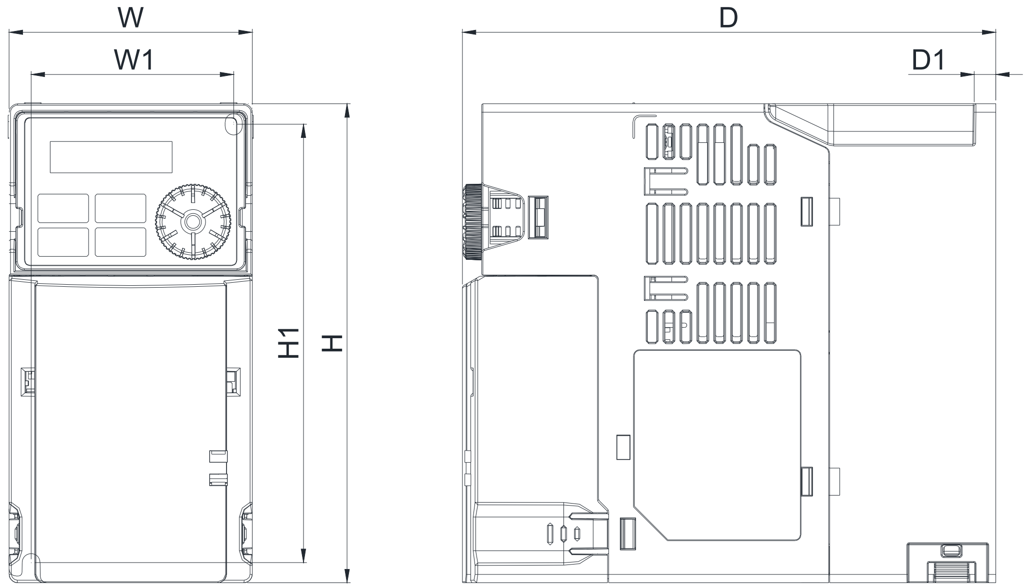
B1: VFD7A5MH23ANSAA; VFD7A5MH23ENSAA; VFD4A2MH43ANSAA; VFD4A2MH43ENSAA

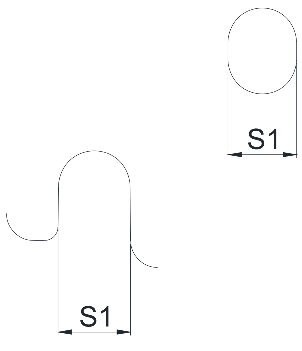
B2: VFD5A0MH21ANSAA; VFD5A0MH21ENSAA

B3: VFD1A6MH21AFSAA; VFD2A8MH21AFSAA; VFD5A0MH21AFSAA; VFD1A5MH43AFSAA; VFD3A0MH43AFSAA; VFD4A2MH43AFSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
B1	72.0 (2.83)	142.0 (5.59)	158.0 (6.22)	60.0 (2.36)	130.0 (5.12)	6.4 (0.25)	5.2 (0.20)
B2	72.0 (2.83)	142.0 (5.59)	162.0 (6.38)	60.0 (2.36)	130.0 (5.12)	3.0 (0.12)	5.2 (0.20)
B3	72.0 (2.83)	142.0 (5.59)	174.0 (6.85)	60.0 (2.36)	130.0 (5.12)	4.3 (0.17)	5.2 (0.20)





Detail A (Mounting Hole)

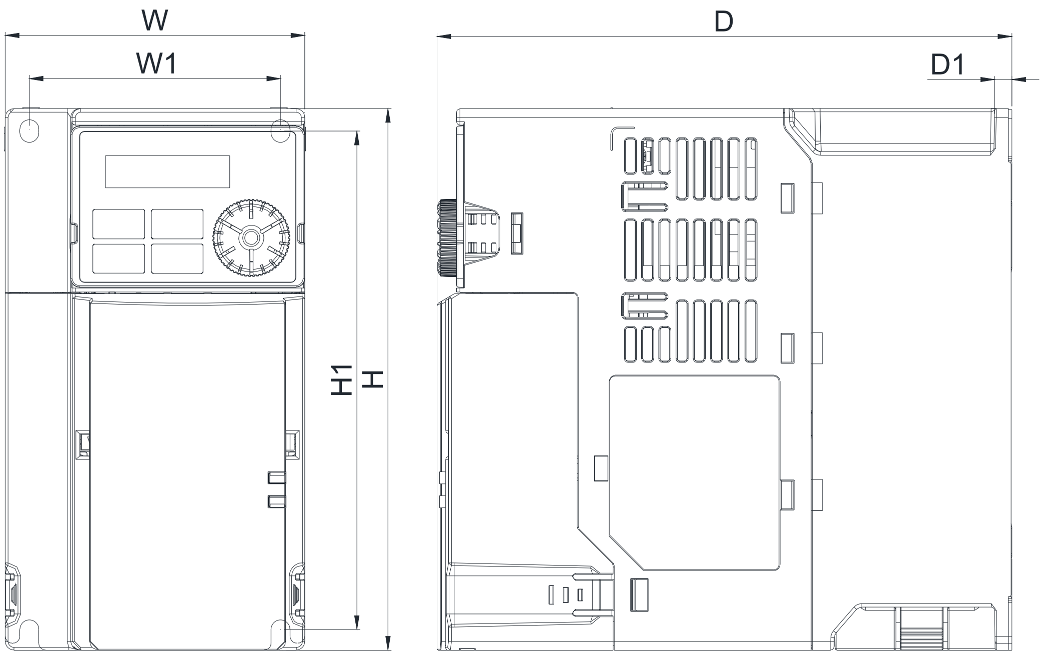
2-3 Frame C

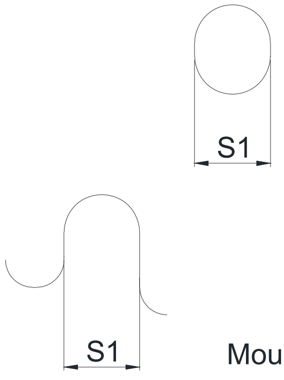
C1: VFD5A0MH11ANSAA; VFD5A0MH11ENSAA; VFD7A5MH21ANSAA; VFD7A5MH21ENSAA; VFD11AMH21ANSAA; VFD11AMH21ENSAA; VFD11AMH23ANSAA; VFD11AMH23ENSAA; VFD17AMH23ANSAA; VFD17AMH23ENSAA; VFD5A7MH43ANSAA; VFD5A7MH43ENSAA; VFD9A0MH43ANSAA; VFD9A0MH43ENSAA

C2: VFD7A5MH21AFSAA; VFD11AMH21AFSAA; VFD5A7MH43AFSAA; VFD9A0MH43AFSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
C1	87.0 (3.43)	157.0 (6.18)	167.0 (6.57)	73.0 (2.87)	144.5 (5.69)	5.0 (0.20)	5.5 (0.22)
C2	87.0 (3.43)	157.0 (6.18)	194.0 (7.64)	73.0 (2.87)	144.5 (5.69)	5.0 (0.20)	5.5 (0.22)





Mounting Hole

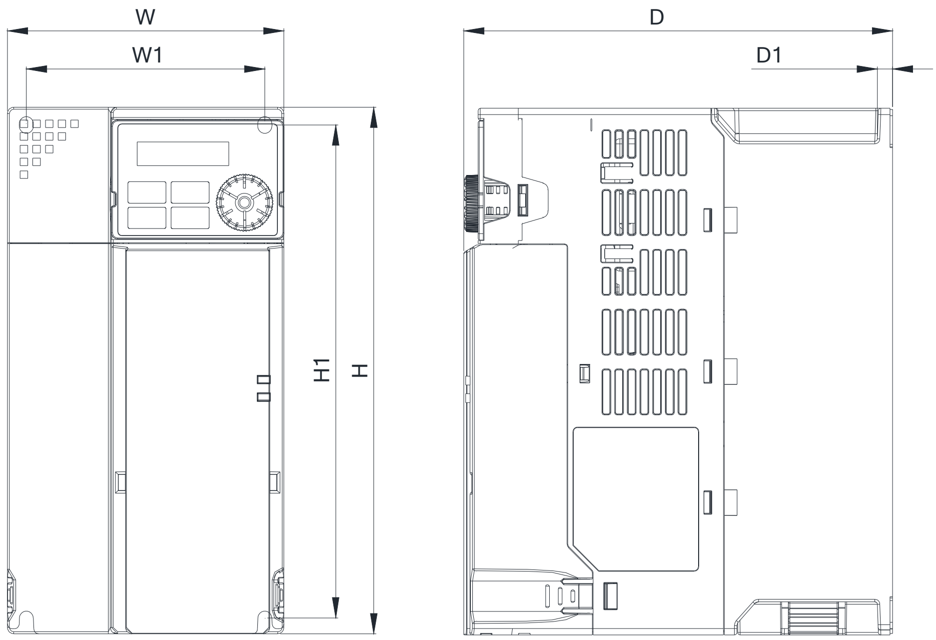
2-4 Frame D

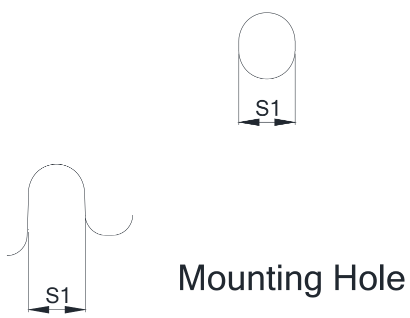
D1: VFD25AMH23ANSAA; VFD25AMH23ENSAA; VFD13AMH43ANSAA; VFD13AMH43ENSAA; VFD17AMH43ANSAA; VFD17AMH43ENSAA

D2: VFD13AMH43AFSAA; VFD17AMH43AFSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
D1	109.0 (4.29)	207.0 (8.15)	169.0 (6.65)	94.0 (3.70)	193.8 (7.63)	6.0 (0.24)	5.5 (0.22)
D2	109.0 (4.29)	207.0 (8.15)	202.0 (7.95)	94.0 (3.70)	193.8 (7.63)	6.0 (0.24)	5.5 (0.22)





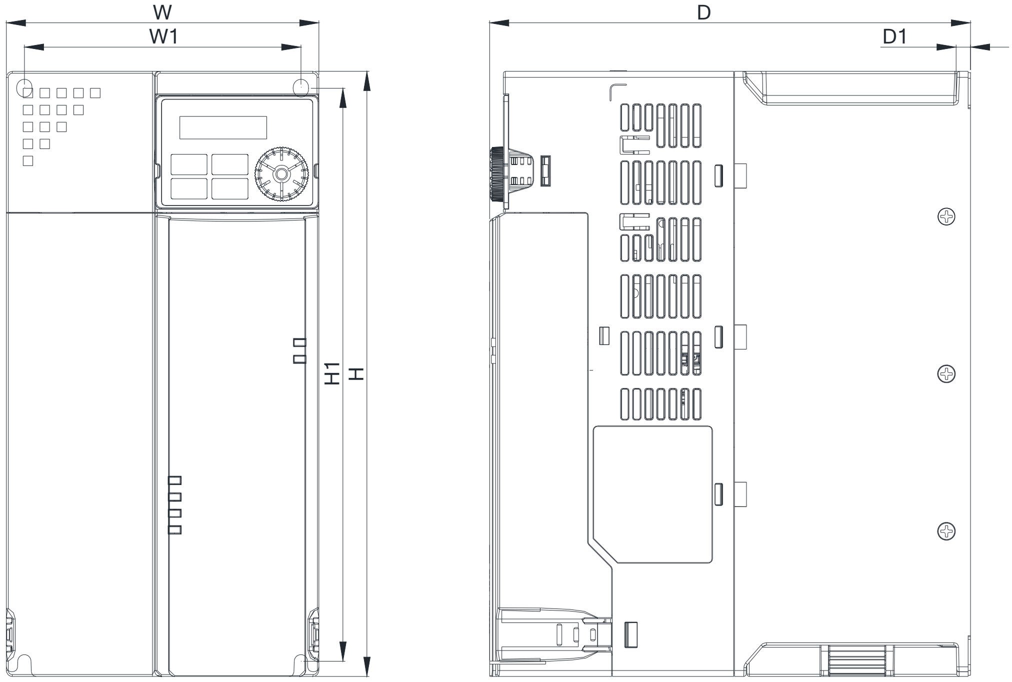
2-5 Frame E

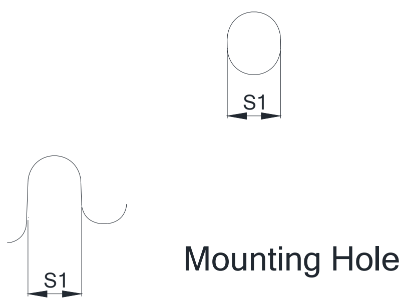
E1: VFD33AMH23ANSAA; VFD33AMH23ENSAA; VFD49AMH23ANSAA; VFD49AMH23ENSAA;
VFD25AMH43ANSAA; VFD25AMH43ENSAA; VFD32AMH43ANSAA; VFD32AMH43ENSAA

E2: VFD25AMH43AFSAA; VFD32AMH43AFSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
E1	130.0 (5.12)	250.0 (9.84)	200.0 (7.87)	115.0 (4.53)	236.8 (9.32)	6.0 (0.24)	5.5 (0.22)
E2	130.0 (5.12)	250.0 (9.84)	234.0 (9.21)	115.0 (4.53)	236.8 (9.32)	6.0 (0.24)	5.5 (0.22)





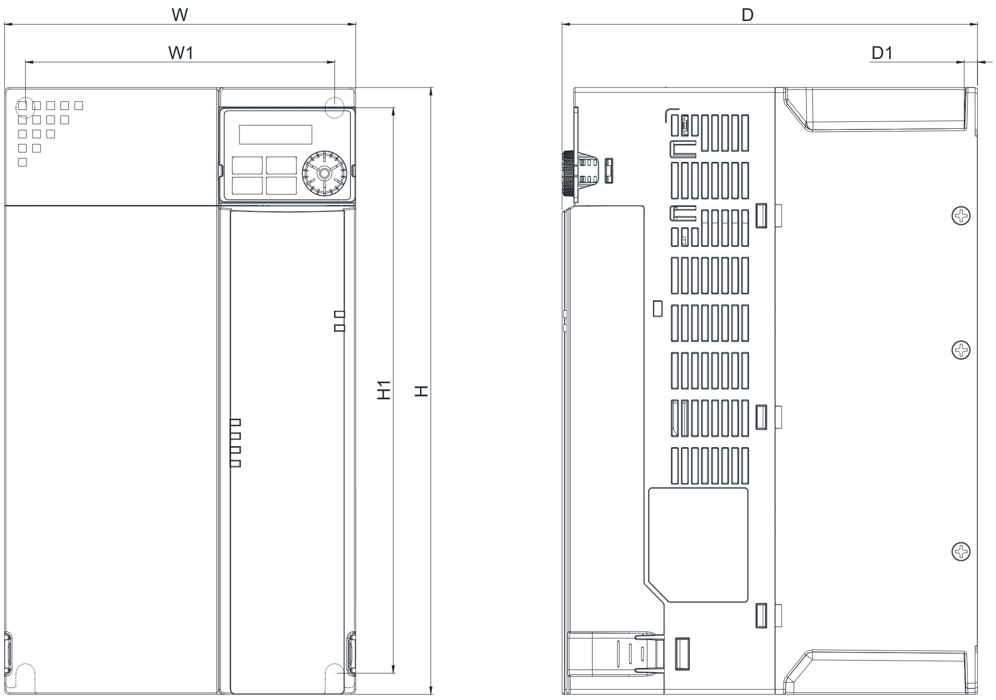
2-6 Frame F

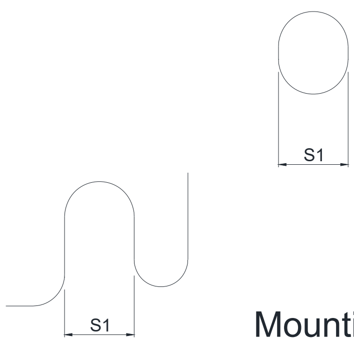
F1: VFD65AMH23ANSAA; VFD65AMH23ENSAA; VFD38AMH43ANSAA; VFD38AMH43ENSAA; VFD45AMH43ANSAA; VFD45AMH43ENSAA

F2: VFD38AMH43AFSAA; VFD45AMH43AFSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
F1	175.0 (6.89)	300.0 (11.81)	207.0 (8.15)	154.0 (6.06)	279.5 (11.00)	6.5 (0.26)	8.4 (0.33)
F2	175.0 (6.89)	300.0 (11.81)	259.0 (10.20)	154.0 (6.06)	279.5 (11.00)	6.5 (0.26)	8.4 (0.33)





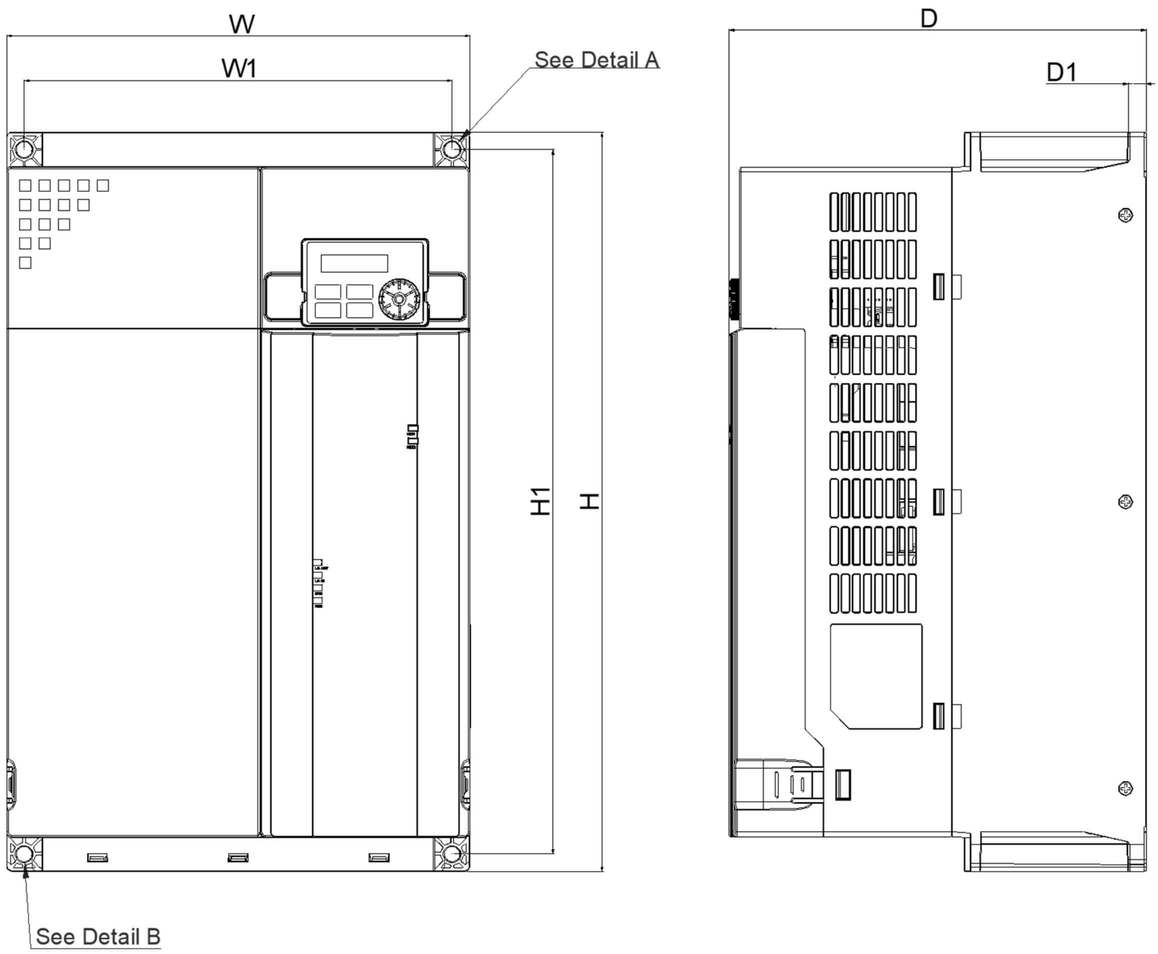
Mounting Hole

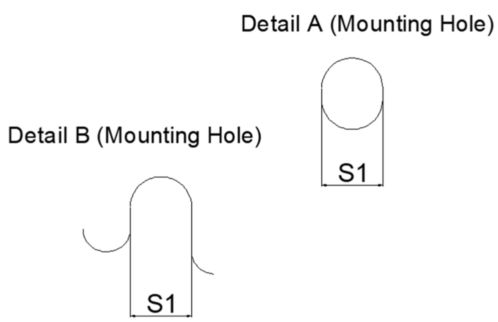
2-7 Frame G

G: VFD60AMH43AFSAA; VFD60AMH43ANSAA; VFD75AMH23ANSAA; VFD90AMH23ANSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	D1	S1
G	250.0 (9.84)	400.0 (15.75)	225.0 (8.86)	231.0 (9.09)	381.0 (15.00)	10.0 (0.39)	8.5 (0.33)



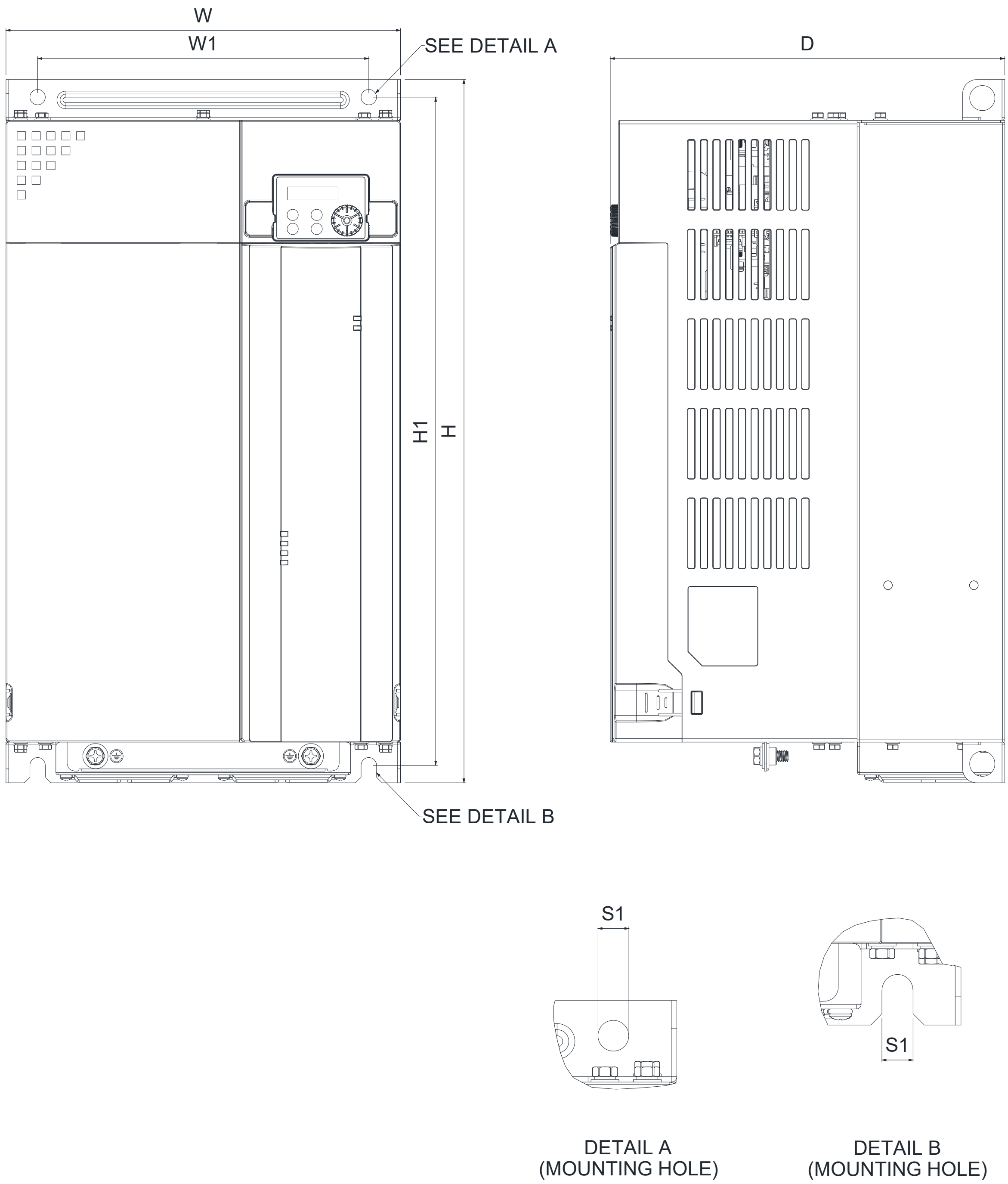


2-8 Frame H

H: VFD75AMH43AFSAA; VFD75AMH43ANSAA; VFD91AMH43AFSAA; VFD91AMH43ANSAA

Unit: mm (inch)

Frame	W	H	D	W1	H1	S1
H	280.0 (11.02)	500.0 (19.69)	280.0 (11.02)	235.0 (9.25)	475.0 (18.70)	11.0 (0.43)

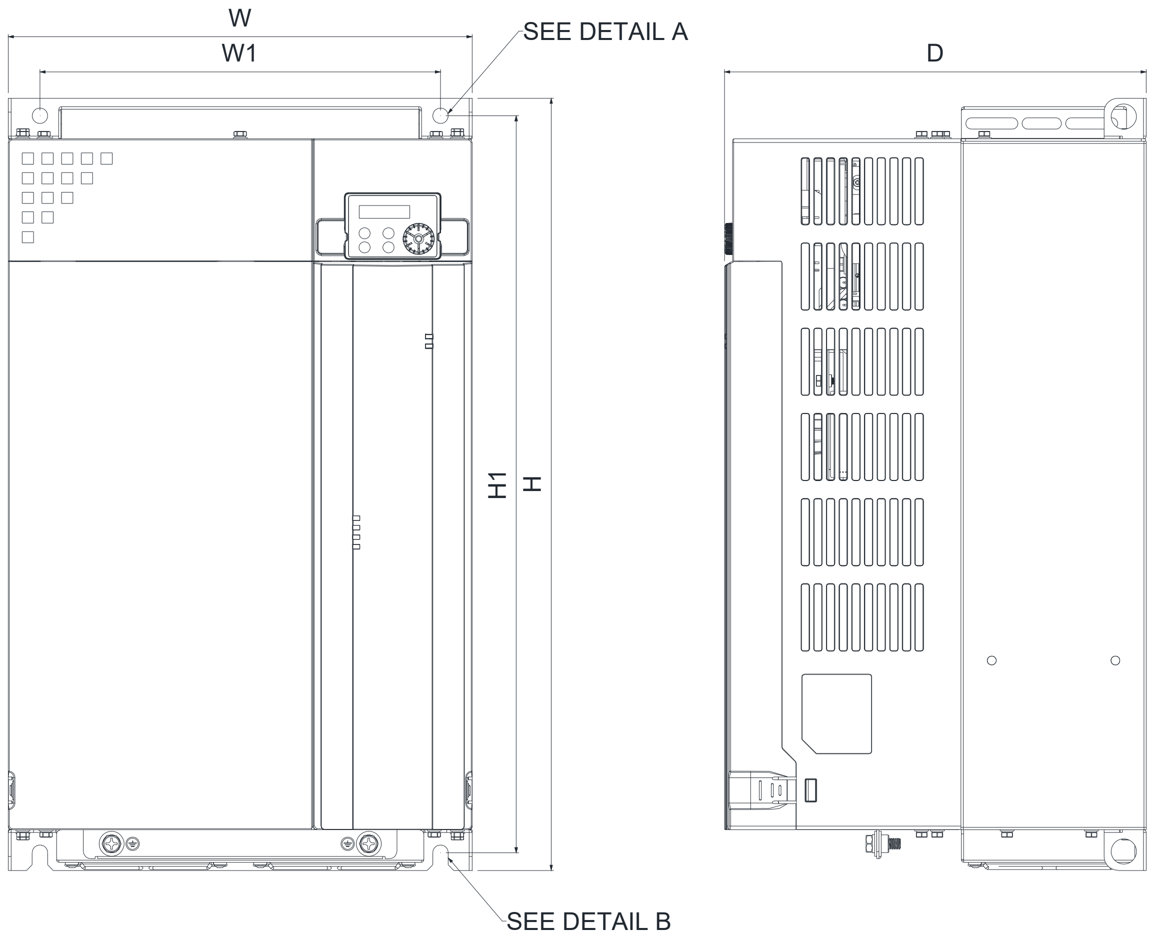


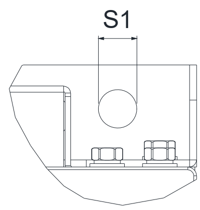
2-9 Frame I

I: VFD112MH43AFSAA; VFD112MH43ANSAA; VFD120MH23ANSAA; VFD146MH23ANSAA; VFD150MH43AFSAA; VFD150MH43ANSAA

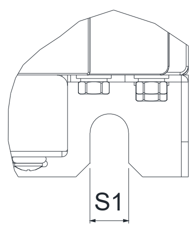
Unit: mm (inch)

Frame	W	H	D	W1	H1	S1
I	330.0 (12.99)	550.0 (21.65)	300.0 (11.81)	285.0 (11.22)	525.0 (20.67)	11.0 (0.43)





DETAIL A
(MOUNTING HOLE)



DETAIL B
(MOUNTING HOLE)

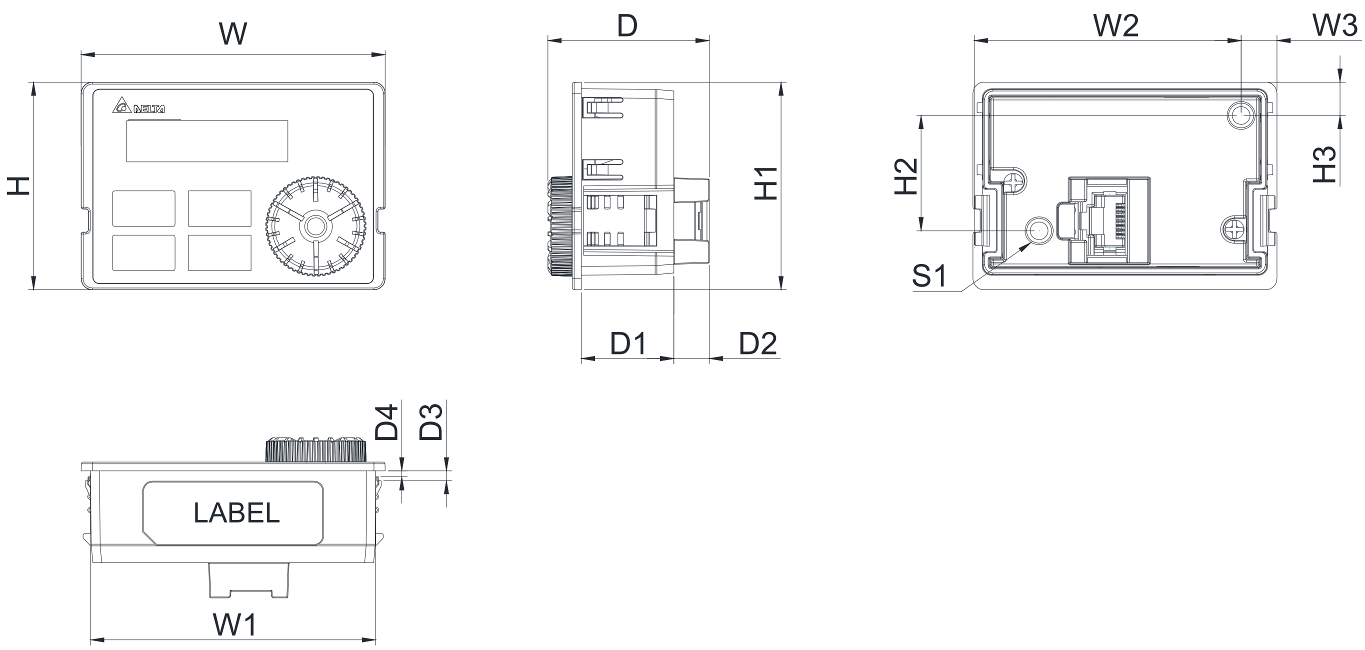
2-10 Digital Keypad

KPMH-LC01

Unit: mm (inch)

W	W1	W2	W3	H	H1	H2
68.0 (2.67)	63.8 (2.51)	45.2 (1.78)	8.0 (0.31)	46.8 (1.84)	42.0 (1.65)	26.0 (1.02)

H3	D	D1	D2	D3	D4	S1
7.5 (0.30)	36.1 (1.41)	22.7 (0.89)	7.9 (0.30)	2.2 (0.09)	1.3 (0.05)	M3*0.5(2X)



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Chapter 3 Installation

3-1 Mounting Clearance

3-2 Airflow and Power Dissipation

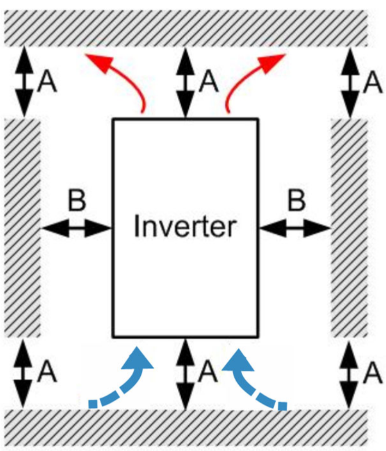
3-1 Mounting Clearance

- ☑ Prevent fiber particles, scraps of paper, shredded wood (sawdust), metal particles, etc. from adhering to the heat sink.
- ☑ Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separator between the AC motor drives to prevent mutual heating and to prevent the risk of accidental fire.
- ☑ Install the AC motor drive in Pollution Degree 2 environments only: normally only non-conductive pollution occurs and temporary conductivity caused by condensation is expected.
- ☑ To ensure the environment to install drives is in Pollution Degree 2, the drives should be installed in an IP54 cabinet or in a pollution-controlled environment. Pollution Degree 2 (IEC / EN 60664-1) is that temporary electric conduction may occur when dew forms, electrical equipment in control panel and thermostatic chamber just causes non-conductive pollution.

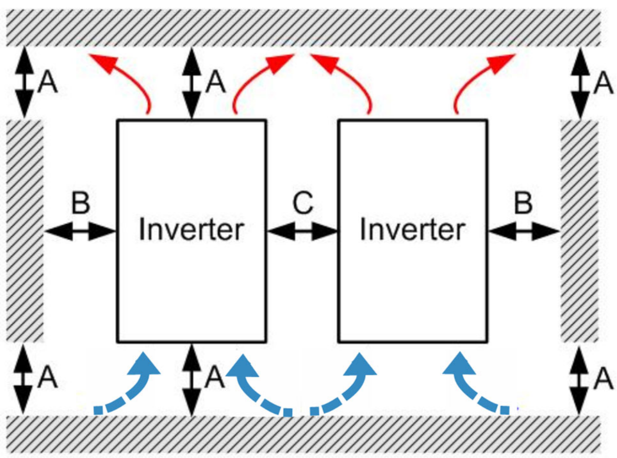
The following figures are for instruction, and the actual drives shall prevail.

Airflow direction: inflow outflow distance

Single drive installation



Side-by-side horizontal installation



Frame A–F

Installation method	A (mm)	B (mm)	C (mm)	Ambient temperature (°C)	
				Max. (Without derating)	Max. (derating)
Single drive installation	50	30	-	50	60
Side-by-side horizontal installation	50	30	30	50	60
Zero stack installation	50	30	0	40	50

Frame G–I

Installation method	A (mm)	B (mm)	C (mm)	Ambient temperature (°C)	
				Max. (Without derating)	Max. (derating)
Single drive installation	100	50	-	50	60
Side-by-side horizontal installation	100	50	50	50	60
Zero stack installation	100	50	0	40	50

NOTE: The minimum mounting clearances A–C in the table above apply to AC motor drives installation. Failing to follow the minimum mounting clearances may cause the fan to malfunction and cause heat dissipation problems.

3-2 Airflow and Power Dissipation

Frame	Airflow rate for cooling			Power Dissipation		
	Model No.	Flow Rate (Unit: cfm)	Flow Rate (Unit: m^3 / hr)	Loss External (Heat sink, unit: W)	Internal (Unit: W)	Total (Unit: W)
A	VFD1A6MH11ANSAA VFD1A6MH11ENSAA	0.0	0.0	8.0	10.0	18.0
	VFD2A5MH11ANSAA VFD2A5MH11ENSAA			14.2	13.1	27.3
	VFD1A6MH21ANSAA VFD1A6MH21ENSAA			8.0	10.3	18.3
	VFD2A8MH21ANSAA VFD2A8MH21ENSAA			16.3	14.5	30.8
	VFD1A6MH23ANSAA VFD1A6MH23ENSAA			8.6	10.0	18.6
	VFD2A8MH23ANSAA VFD2A8MH23ENSAA			16.5	12.6	29.1
	VFD5A0MH23ANSAA VFD5A0MH23ENSAA	10.0	16.99	33.2	15.0	48.2
	VFD5A0MH23ANSNA VFD5A0MH23ENSNA	0	0	33.2	15.0	48.2
	VFD1A5MH43ANSAA VFD1A5MH43ENSAA	0.0	0.0	17.6	11.1	28.7
	VFD3A0MH43ANSAA VFD3A0MH43ENSAA	10.0	16.99	32.6	20.0	52.6
	VFD3A0MH43ANSNA VFD3A0MH43ENSNA	0	0	32.6	20.0	52.6
B	VFD1A6MH21AFSAA	0.0	0.0	8.0	10.3	18.3
	VFD2A8MH21AFSAA	10.0	16.99	16.3	14.5	30.8
	VFD5A0MH21ANSAA VFD5A0MH21ENSAA VFD5A0MH21AFSAA			31.1	22.5	53.6
	VFD7A5MH23ANSAA VFD7A5MH23ENSAA			50.1	24.2	74.3
	VFD1A5MH43AFSAA			17.6	11.1	28.7
	VFD3A0MH43AFSAA			32.6	20.0	52.6
	VFD4A2MH43ANSAA VFD4A2MH43ENSAA VFD4A2MH43AFSAA			45.9	21.7	67.6
C	VFD5A0MH11ANSAA VFD5A0MH11ENSAA	16.0	27.2	31.1	26.2	57.3
	VFD7A5MH21ANSAA VFD7A5MH21ENSAA VFD7A5MH21AFSAA			46.5	31.0	77.5
	VFD11AMH21ANSAA VFD11AMH21ENSAA VFD11AMH21AFSAA			70.0	35	105
	VFD11AMH23ANSAA VFD11AMH23ENSAA			76.0	30.7	106.7
	VFD17AMH23ANSAA VFD17AMH23ENSAA			108.2	40.1	148.3

Frame	Airflow rate for cooling			Power Dissipation		
	Model No.	Flow Rate (Unit: cfm)	Flow Rate (Unit: m^3 / hr)	Loss External (Heat sink, unit: W)	Internal (Unit: W)	Total (Unit: W)
C	VFD5A7MH43ANSAA VFD5A7MH43ENSAA VFD5A7MH43AFSAA	16.0	27.2	60.6	22.8	83.4
	VFD9A0MH43ANSAA VFD9A0MH43ENSAA VFD9A0MH43AFSAA			93.1	42	135.1
D	VFD25AMH23ANSAA VFD25AMH23ENSAA	23.4	39.7	192.8	53.3	246.1
	VFD13AMH43ANSAA VFD13AMH43ENSAA VFD13AMH43AFSAA			132.8	39.5	172.3
	VFD17AMH43ANSAA VFD17AMH43ENSAA VFD17AMH43AFSAA			164.7	55.8	220.5
E	VFD33AMH23ANSAA VFD33AMH23ENSAA	53.7	91.2	244.5	79.6	324.1
	VFD49AMH23ANSAA VFD49AMH23ENSAA			374.2	86.2	460.4
	VFD25AMH43ANSAA VFD25AMH43ENSAA VFD25AMH43AFSAA			234.5	69.8	304.3
	VFD32AMH43ANSAA VFD32AMH43ENSAA VFD32AMH43AFSAA			319.8	74.3	394.1
F	VFD65AMH23ANSAA VFD65AMH23ENSAA	67.9	115.2	492.0	198.2	690.2
	VFD38AMH43ANSAA VFD38AMH43ENSAA VFD38AMH43AFSAA			423.5	181.6	605.1
	VFD45AMH43ANSAA VFD45AMH43ENSAA VFD45AMH43AFSAA			501.1	200.3	701.4
G	VFD75AMH23ANSAA	232.0	394.2	581.3	100.0	681.3
	VFD90AMH23ANSAA	266.0	451.9	732.5	107.0	839.5
	VFD60AMH43AFSAA			670.8	122.0	792.8
	VFD60AMH43ANSAA			655.3	122.0	777.3
H	VFD75AMH43AFSAA	322.0	547.1	872.8	157.0	1029.8
	VFD75AMH43ANSAA			896.8	135.0	1031.8
	VFD91AMH43AFSAA			993.5	166.0	1159.5
	VFD91AMH43ANSAA			1029.0	150.0	1179.0
I	VFD120MH23ANSAA	455.0	773.1	926.0	124.0	1050.0
	VFD146MH23ANSAA	493.0	837.6	1144.9	132.0	1276.9
	VFD112MH43AFSAA	455.0	773.1	1197.6	177.0	1374.6
	VFD112MH43ANSAA			1219.9	165.0	1384.9
	VFD150MH43AFSAA	493.0	837.6	1455.0	195.0	1650.0
	VFD150MH43ANSAA			1495.0	180.0	1675.0

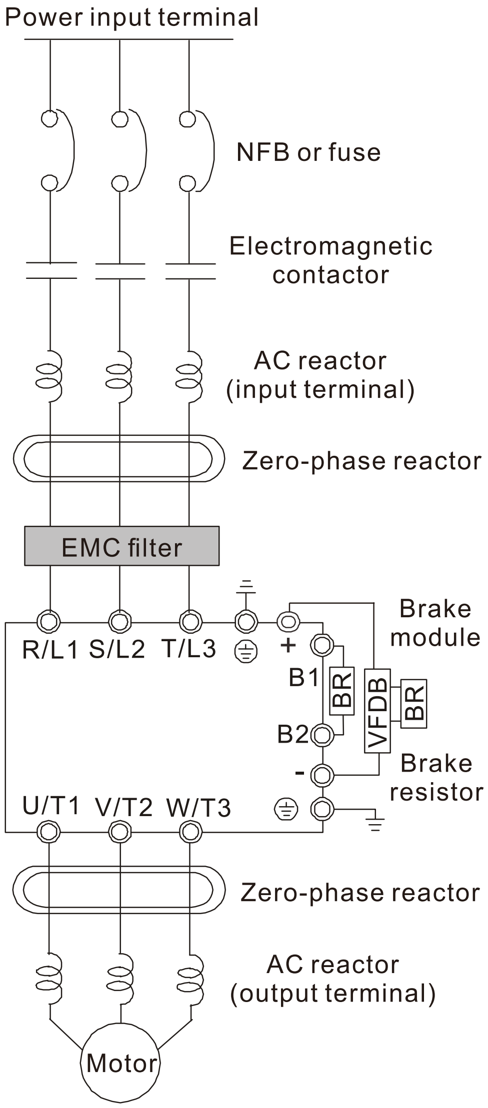
Chapter 4 Wiring

4-1 System Wiring Diagram
4-2 Wiring

After removing the front cover, verify that the power and control terminals are clearly visible. Read the following precautions to avoid wiring mistakes.

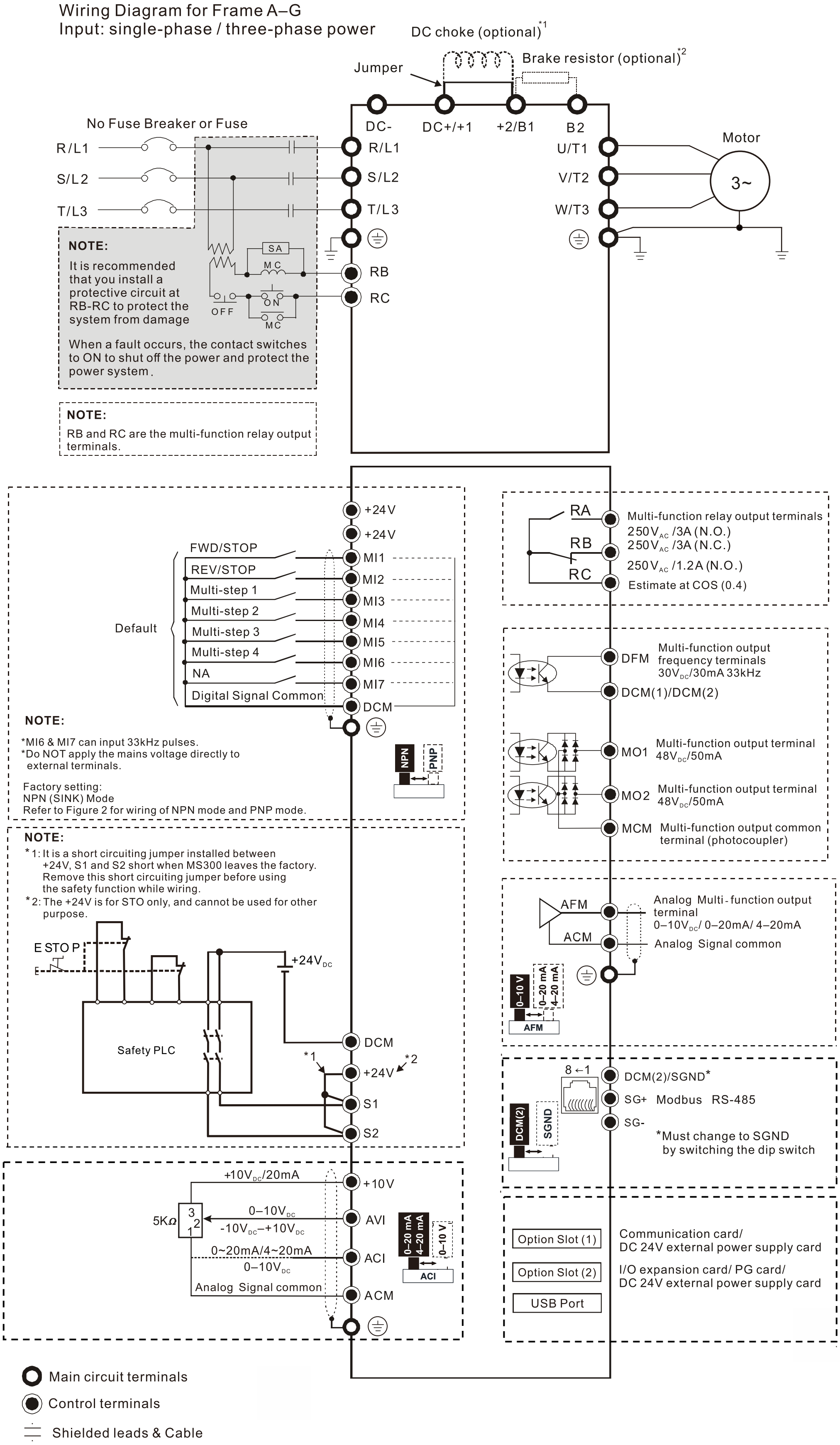
DANGER	☑ It is crucial to **cut off the AC motor drive power** before doing any wiring. A charge with hazardous voltages may still remain in the DC bus capacitors even after the power has been turned off for a short time. Measure the remaining voltage with a DC voltmeter on +1/DC+ and DC- before doing any wiring. For your safety, do not start wiring before the voltage drops to a safe level (less than 25 V_{DC}). Installing wiring with a residual voltage may cause injuries, sparks and short-circuits. ☑ Only qualified personnel familiar with AC motor drives are allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shocks. ☑ The terminals R/L1, S/L2, and T/L3 are for mains power input. If mains power is incorrectly connected to other terminals, it may result in damage to the equipment. The voltage and current must be in the range indicated on the nameplate (see Section 1-1). ☑ All units must be grounded directly to a common ground terminal to prevent electrical shocks or damage from lightning. ☑ Tighten the screw of the main circuit terminals to prevent sparks due to loosening of the terminals resulted from vibration.
CAUTION	☑ When wiring, choose wires that comply with local regulations for your safety. ☑ Check the following items after you finish the wiring: 1. Are all connections correct? 2. Are there any loose wires? 3. Are there any short-circuits between the terminals or to ground?

4-1 System Wiring Diagram



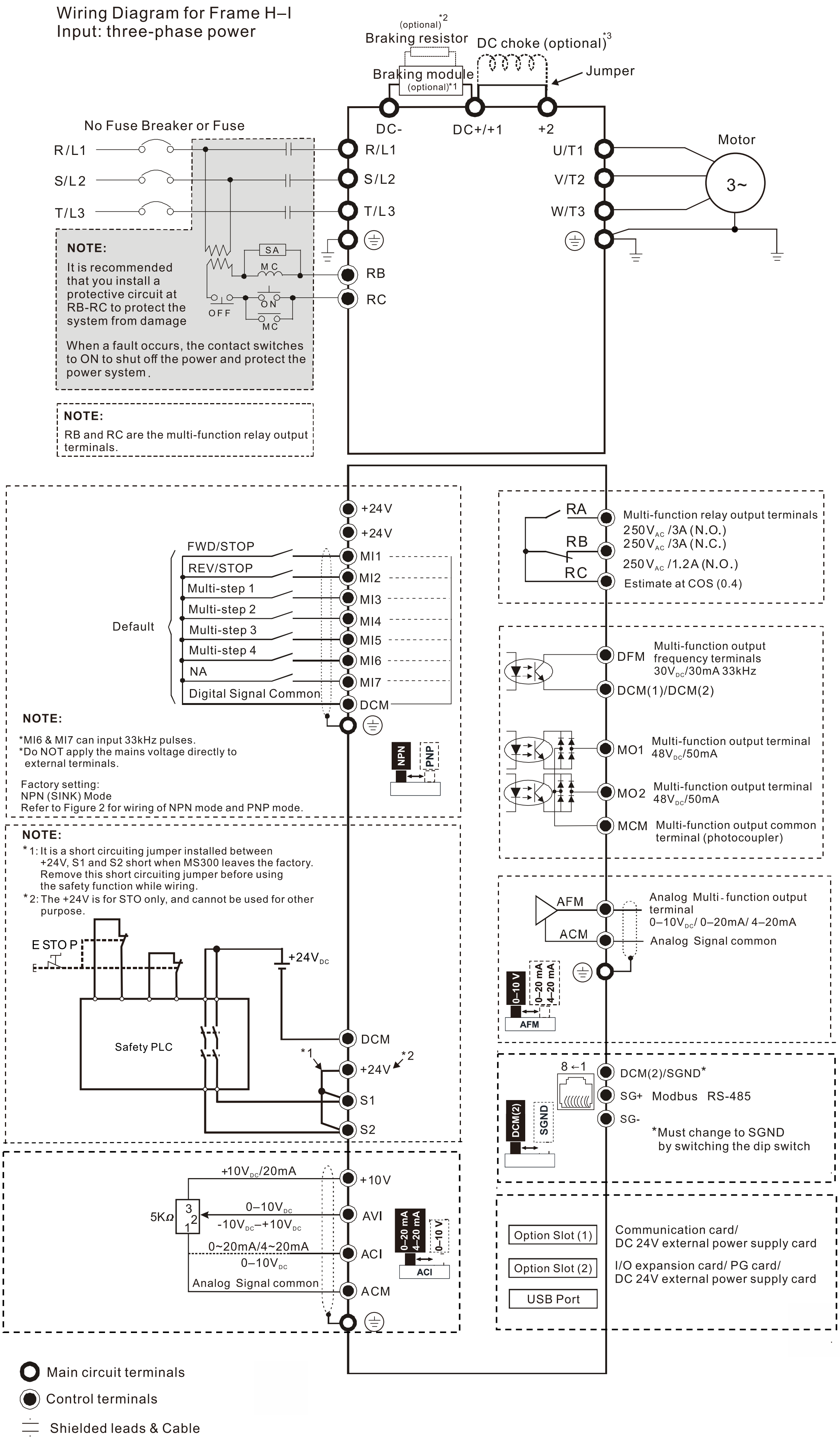
Power input terminal	Please refer to Chapter 9 Specification Table in the user manual for detail.
NFB or fuse	There may be a large inrush current during power on. Refer to Section 7-2 NFB to select a suitable NFB or Section 7-3 Fuse Specification Chart.
Electromagnetic contactor	Switching the power ON/OFF before the magnetic contactor more than one per hour can damage the drive.
AC reactor (input terminal)	When the mains power capacity is > 500kVA or when the drive is preceded by a capacitor bank, the instantaneous peaks voltage and current may destroy the drive. In that case it is recommended to install an AC input reactor that also improves the power factor and harmonics. The cable between reactor and drive should be < 10m. Please refer to Section 7-4.
Zero-phase reactor	Used to reduce radiated emission, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10MHz. Please refer to Section 7-5.
EMC filter	Can be used to reduce electromagnetic interference. Please refer to Section 7-6.
Brake module & Brake resistor (BR)	Used to shorten the deceleration time of the motor. Please refer to Section 7-1.
AC reactor (output terminal)	The wiring length of the motor affects switching current peaks. It is recommended to install an AC output reactor when the motor wiring length exceeds the value listed in Section 7-4.

4-2 Wiring



*1 Refer to Section 7-4 AC / DC Reactor for more details about the specifications of DC reactor.

*2 Refer to Section 7-1 Brake Resistors and Brake Units Used in AC Motor Drives for more details about the specifications of brake resistor.

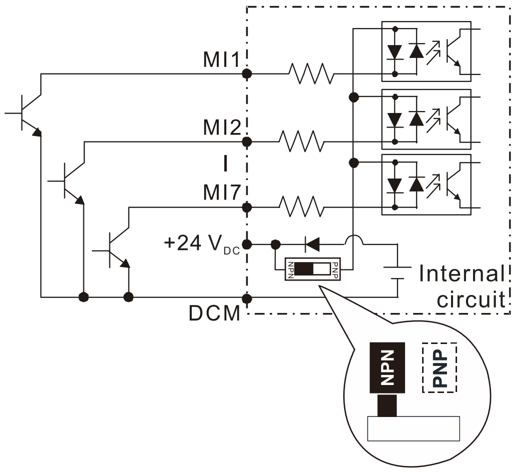


*1 & *2 Refer to Section 7-1 Brake Resistors and Brake Units Used in AC Motor Drives for more details about the specifications of brake module and brake resistor.

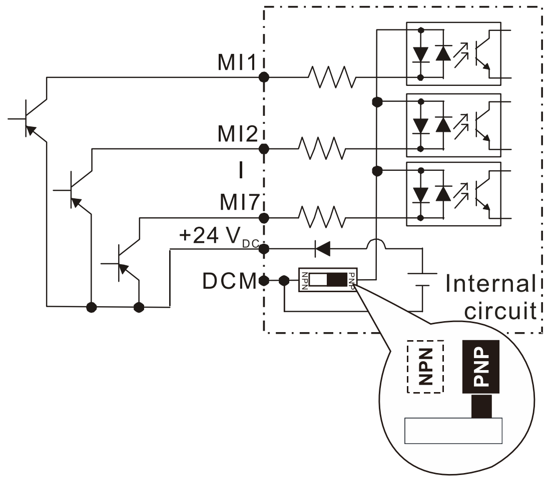
*3 Refer to Section 7-4 AC / DC Reactor for more details about the specifications of DC reactor.

SINK (NPN) / SOURCE (PNP) Mode

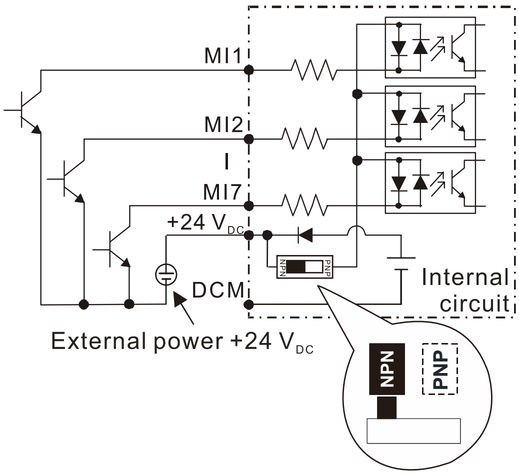
1 Sink Mode
with internal power (+24 V_{DC})



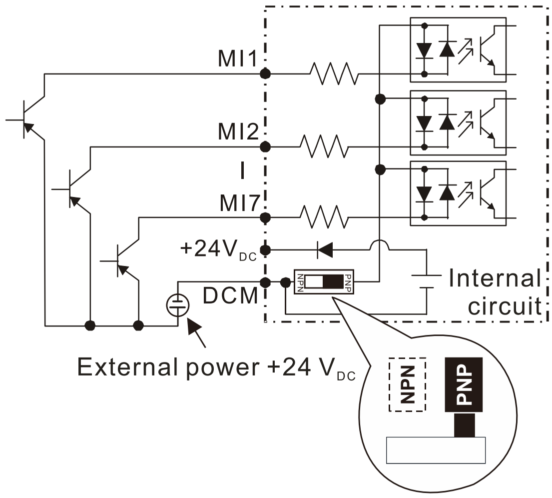
2 Source Mode
with internal power (+24 V_{DC})



3 Sink Mode
with external power



4 Source Mode
with external power



Chapter 5 Main Circuit Terminals

5-1 Main Circuit Diagram

5-2 Main Circuit Terminals

DANGER

- ☑ Securely fasten the main circuit terminal screws to prevent sparking caused by loose screws due to vibration.
- ☑ When needed, only use an inductive filter at the motor output terminals U/T1, V/T2, W/T3 of the AC motor drive. DO NOT use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
- ☑ DO NOT connect brake resistors directly to +1/DC+ to DC-, +2/B1 to DC- to prevent damage to the drive.
- ☑ Ensure proper insulation of the main circuit wiring in accordance with the relevant safety regulations.

CAUTION

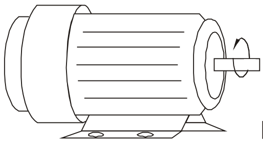
Main power terminals

- ☑ R/L1, S/L2 and T/L3 have no phase-sequence requirement; they can be connected in any sequence.
- ☑ Add a magnetic contactor (MC) at the power input to quickly cut off power and reduce malfunction when activating the AC motor drive protection function. Both ends of the MC should have an R-C surge absorber.
- ☑ Ensure that voltages and currents are within specification.
- ☑ Although the leakage current of one single MH300 drive is less than 10 mA d.c., electric shock may still occur due to the leakage current from other equipment such as motors and leads. Therefore, it is recommended that you install one of the followings to prevent danger caused by electric shock.
    1. Use a copper wire with a cross-section of 10 mm^2 or above or an aluminum wire of 16 mm^2 as the connection between the casing and the ground.
    2. Install an Earth Leakage Circuit Breaker (ELCB).
- ☑ Due to the high frequency current of the leakage current of the AC motor drive, select a Type B ELCB specifically for the drive when using an ELCB. For tripping or malfunctions on the usage of ELCB, refer to Section 7-8 Capacitive Filter for details. The power system of the AC motor drive affects the power factor, so select a MCCB with larger capacity.
- ☑ Use conduits or shielded cables for the power wiring, and ground both ends of the conduit or shielded cables.
- ☑ DO NOT start or stop the drive by turning the power ON or OFF. Start and stop the drive with the RUN / STOP command. If you still need to run or stop the drive by turning the power ON or OFF, it is strongly recommended that you do so no more often than ONCE per hour.
- ☑ To comply with UL standards, connect the drive to a three-phase three-wire or three-phase four-wire Wye system type of mains power system.

Output terminals for main circuit

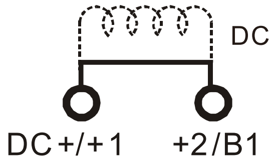
- ☑ Use a well-insulated motor that is suitable for operation with an inverter.
- ☑ When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3 respectively, the motor rotates

counterclockwise (as viewed from the shaft end of the motor, refer to the pointed direction in the figure below) when it receives a forward operation command. To permanently reverse the direction of rotation, exchange any two motor leads.

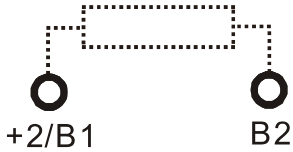


Terminals for connecting DC reactor, external brake resistor and DC circuit

- ☑ These are the terminals for connecting the DC reactor to improve the power factor and harmonics. At delivery they are shorted by a jumper. Remove the jumper before connecting the DC reactor.
- ☑ You must tightly fasten the jumper when it does not connect the DC reactor, use DC+/+1, +2/B1 to execute common DC bus, or connect with a brake resistor; otherwise the drive might lose power or break the terminals.



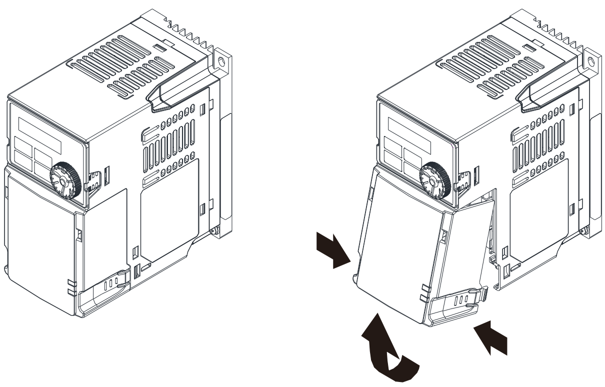
- ☑ Connect a brake resistor in applications with frequent deceleration, short deceleration time, too low braking torque, or increased braking torque.



- ☑ Connect the external brake resistor to the terminals +2/B1, B2 on AC motor drives.
- ☑ DO NOT short-circuit or connect a brake resistor directly to DC+/+1 and DC-, +2/B1 and DC-; otherwise the drive will be damaged.
- ☑ Connect DC+/+1 and DC- in common DC bus applications. Refer to Section 5-2 (Main Circuit Terminal) for the wiring terminal specification and the wire gauge information.

Remove the front cover

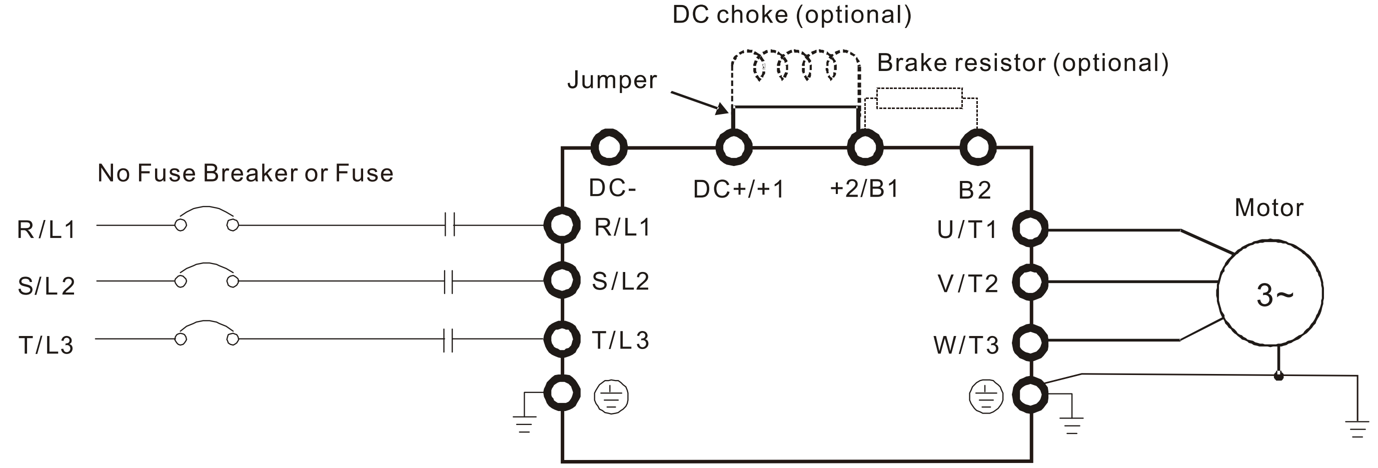
- 📖 Remove the front cover before connecting the main circuit terminals and control circuit terminals. Remove the cover according to the figure below.
- 📖 The figure below shows the Frame A model for example. Removing the cover on the other frame sizes is similar.



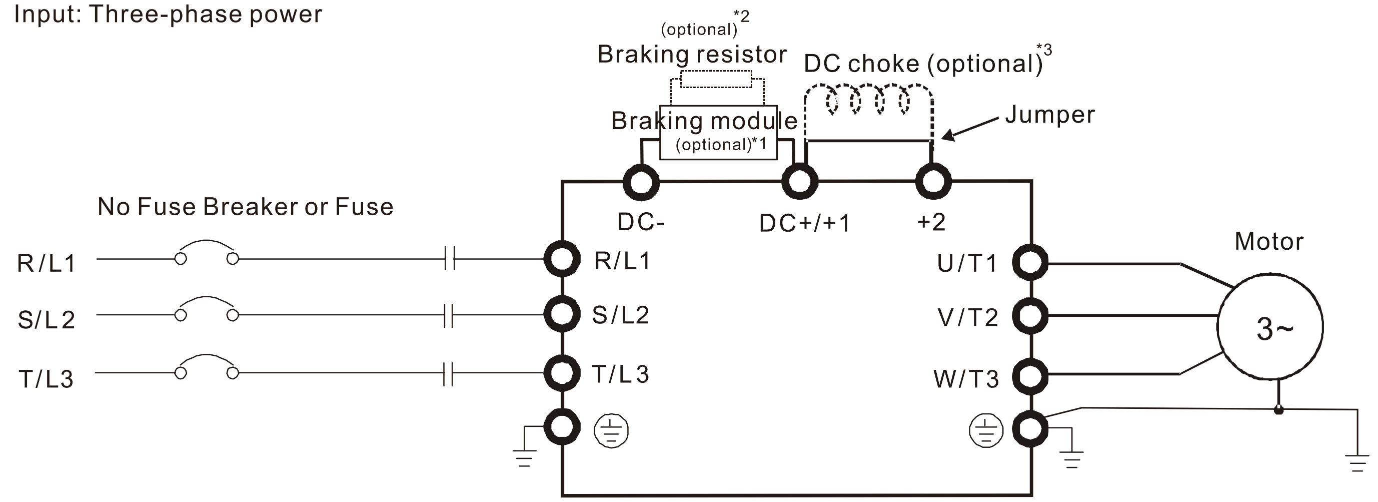
Press the clip on both sides, and take out the front cover by rotating.

5-1 Main Circuit Diagram

Frame A - G
Input: Single-phase / Three-phase power



Frame H - I
Input: Three-phase power



Terminals	Descriptions
R/L1, S/L2	Mains input terminals one-phase
R/L1, S/L2, T/L3	Mains input terminals three-phase
U/T1, V/T2, W/T3	Motor output terminals for connecting three-phase IM and PM motors
+1, +2	Connections for DC reactor to improve the power factor and harmonics. Remove the jumper when using a DC reactor.
DC+, DC-	Connections for brake unit (VFDB series) Common DC bus
B1, B2	Connections for brake resistor (optional)
⏚	Ground connection, comply with local regulations.

5-2 Main Circuit Terminals

- Use the specified ring lug for main circuit terminal wiring. See Fig.1 and Fig.2 for ring lug specifications. For other types of wiring use the wires that comply with the local regulation.
- After crimping the wire to the ring lug (must be UL approved), UL and CSA approved R/C (YDPU2/8), install heat shrink tubing rated at a minimum of 600 V_{AC} insulation over the live part. Refer to Figure 2 below.
- Main circuit terminals:
  R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2
  Note: Single-phase models are with no T/L3 terminal.

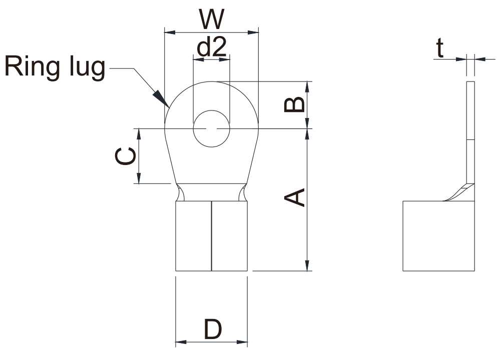


Fig.1

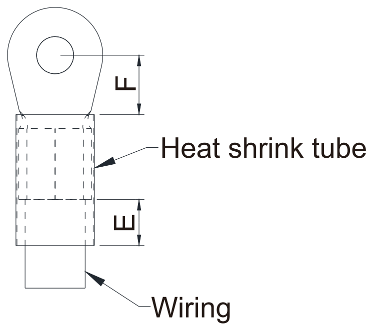


Fig.2

Dimensions of Ring Lug

The part number of the ring terminals (produced by K.S. Terminals) in the table below are for reference only. You can buy other ring terminals of your choice to match with different frame sizes.

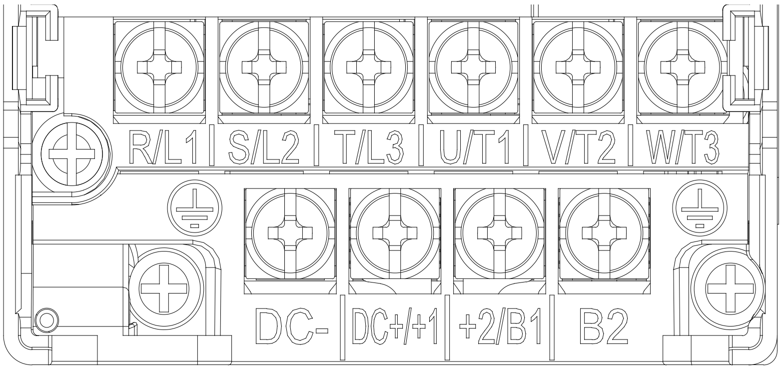
Unit: mm

Frame	AWG	Kit P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
A	18	RNBS1-3.7	9.8	3.2	4.8	4.1	3.7	13.0	4.2	6.6	0.8
	16	RNBS2-3.7									
	14	RNBS2-3.7									
B	18	RNBS1-4	12.1	3.6	6.1	5.6	4.3	13.0	4.5	7.2	1
	16	RNBS1-4									
	14	RNBS2-4									
	12	RNBS5-4									
C	14	RNBS2-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	12	RNBS5-4									
	10	RNBS5-4									
	8	RNBS8-4									
D	10	RNBS5-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	8	RNBS8-4									
E	6	RNB14-5	27.1	6.1	10.5	11.5	5.3	13.0	6.5	12.6	1.7
	4	RNBS22-5									
F	6	RNBS14-6	35.0	9.0	13.3	14.0	6.2	13.0	10.0	19.5	1.8
	4	RNBS22-6									
	2	RNBS38-6									
G	6	RNB14-8	38.7	12.0	13.5	17.5	8.4	13.0	13.0	24.0	1.8
	4	RNB22-8									
	2	RNBS38-8									
	1/0	RNB60-8									

<table>
<tr><th>Frame</th><th>AWG</th><th>Kit P/N</th><th>A (MAX)</th><th>B (MAX)</th><th>C (MIN)</th><th>D (MAX)</th><th>d2 (MIN)</th><th>E (MIN)</th><th>F (MIN)</th><th>W (MAX)</th><th>t (MAX)</th></tr>
<tr><td rowspan="6">H</td><td>4</td><td>RNB22-8</td><td rowspan="6">40.0</td><td rowspan="6">11.0</td><td rowspan="6">10.0</td><td rowspan="6">23.0</td><td rowspan="6">8.3</td><td rowspan="6">13.0</td><td rowspan="6">14.0*2</td><td rowspan="6">24.0</td><td rowspan="6">4.5</td></tr>
<tr><td>2</td><td>RNBS38-8</td></tr>
<tr><td>1</td><td>SQNBS60-8</td></tr>
<tr><td>1/0</td><td>SQNBS60-8</td></tr>
<tr><td>2/0</td><td>SQNBS80-8</td></tr>
<tr><td>3/0</td><td>SQNBS80-8</td></tr>
<tr><td rowspan="6">I</td><td>1/0</td><td>RNB60-8</td><td rowspan="6">50.0</td><td rowspan="6">16.0</td><td rowspan="6">10.0</td><td rowspan="6">27.0</td><td rowspan="6">8.3</td><td rowspan="6">13.0</td><td rowspan="6">14.0</td><td rowspan="6">28.0</td><td rowspan="6">6.0</td></tr>
<tr><td>2/0</td><td>RNB70-8</td></tr>
<tr><td>3/0</td><td>RNB80-8</td></tr>
<tr><td>4/0</td><td>SQNBS100-8</td></tr>
<tr><td>250 MCM</td><td>SQNBS150-8</td></tr>
<tr><td>300 MCM</td><td>SQNBS150-8</td></tr>
</table>

*1. AWG: Refer to the following tables for the wire size specification for models in each frame.
*2: F(MAX) = 16.5

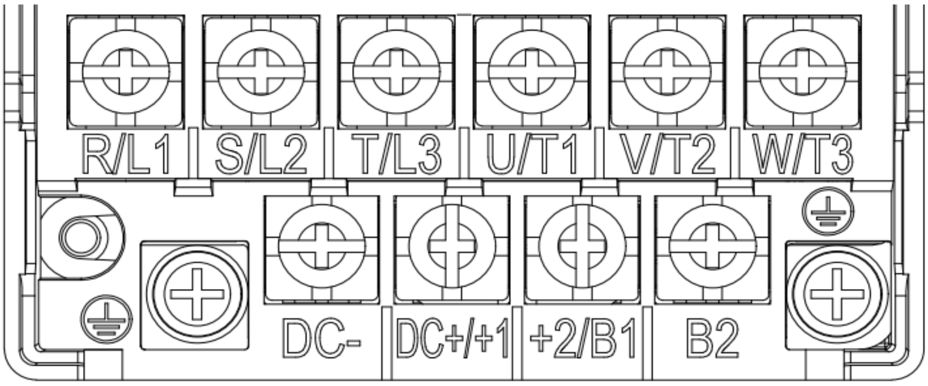
Frame A



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD2A5MH11ANSAA, VFD2A5MH11ENSAA models: If you install at Ta 40°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD1A6MH11ANSAA	2.5 mm² (14 AWG)	2.5 mm² (14AWG)	M3.5 9 kg-cm (7.8 lb-in.) (0.88 Nm)	2.5 mm² (14 AWG)	2.5 mm² (14 AWG)	M3.5 9 kg-cm (7.8 lb-in.) (0.88 Nm)
VFD1A6MH11ENSAA						
VFD2A5MH11ANSAA						
VFD2A5MH11ENSAA						
VFD1A6MH21ANSAA		1.5 mm² (16AWG)				
VFD1A6MH21ENSAA						
VFD2A8MH21ANSAA		2.5 mm² (14AWG)				
VFD2A8MH21ENSAA						
VFD1A6MH23ANSAA		0.75 mm² (18AWG)				
VFD1A6MH23ENSAA						
VFD2A8MH23ANSAA						
VFD2A8MH23ENSAA						
VFD5A0MH23ANSAA		2.5 mm² (14AWG)				
VFD5A0MH23ENSAA						
VFD5A0MH23ANSNA						
VFD5A0MH23ENSNA						
VFD1A5MH43ANSAA		0.75 mm² (18AWG)				
VFD1A5MH43ENSAA						
VFD3A0MH43ANSAA		1.5 mm² (16AWG)				
VFD3A0MH43ENSAA						
VFD3A0MH43ANSNA						
VFD3A0MH43ENSNA						

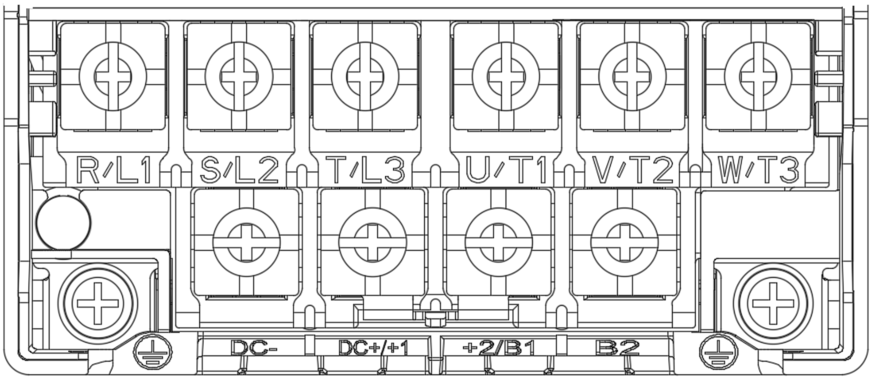
Frame B



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,
DC-, DC+/+1, +2/B1, B2</th><th colspan="3">Terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th></tr>
<tr><td>VFD1A6MH21AFSAA</td><td rowspan="12">4 mm^2
(12 AWG)</td><td>1.5 mm^2
(16 AWG)</td><td rowspan="12">M4
15 Kg-cm
(13.0 lb-in.)
(1.47 Nm)</td><td rowspan="2">2.5 mm^2
(14 AWG)</td><td rowspan="2">2.5 mm^2
(14 AWG)</td><td rowspan="12">M4
15 Kg-cm
(13.0 lb-in.)
(1.47 Nm)</td></tr>
<tr><td>VFD2A8MH21AFSAA</td><td>2.5 mm^2
(14 AWG)</td></tr>
<tr><td>VFD5A0MH21ANSAA</td><td rowspan="5">4 mm^2
(12 AWG)</td><td rowspan="5">4 mm^2
(12 AWG)</td><td rowspan="5">4 mm^2
(12 AWG)</td></tr>
<tr><td>VFD5A0MH21ENSAA</td></tr>
<tr><td>VFD5A0MH21AFSAA</td></tr>
<tr><td>VFD7A5MH23ANSAA</td></tr>
<tr><td>VFD7A5MH23ENSAA</td></tr>
<tr><td>VFD1A5MH43AFSAA</td><td>0.75 mm^2
(18 AWG)</td><td rowspan="5">2.5 mm^2
(14 AWG)</td><td rowspan="5">2.5 mm^2
(14 AWG)</td></tr>
<tr><td>VFD3A0MH43AFSAA</td><td>1.5 mm^2
(16 AWG)</td></tr>
<tr><td>VFD4A2MH43ANSAA</td><td rowspan="3">2.5 mm^2
(14 AWG)</td></tr>
<tr><td>VFD4A2MH43ENSAA</td></tr>
<tr><td>VFD4A2MH43AFSAA</td></tr>
</table>

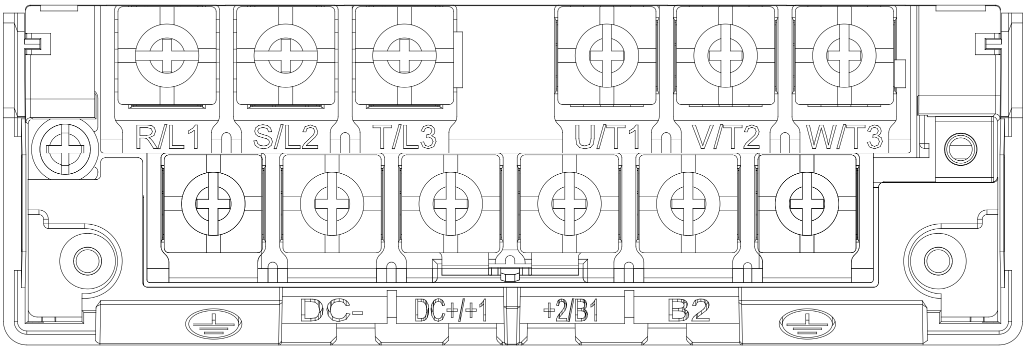
Frame C



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD5A0MH11ANSAA	10 mm² (8 AWG)	10 mm² (8 AWG)	M4 20 Kg-cm (17.4 lb-in.) (1.96 Nm)	10 mm² (8 AWG)	10 mm² (8 AWG)	M4 20 Kg-cm (17.4 lb-in.) (1.96 Nm)
VFD5A0MH11ENSAA						
VFD7A5MH21ANSAA						
VFD7A5MH21ENSAA						
VFD7A5MH21AFSAA						
VFD11AMH21ANSAA						
VFD11AMH21ENSAA						
VFD11AMH21AFSAA						
VFD11AMH23ANSAA		6 mm² (10 AWG)		6 mm² (10 AWG)	6 mm² (10 AWG)	
VFD11AMH23ENSAA						
VFD17AMH23ANSAA		10 mm² (8 AWG)		10 mm² (8 AWG)	10 mm² (8 AWG)	
VFD17AMH23ENSAA						
VFD5A7MH43ANSAA		2.5 mm² (14 AWG)		2.5 mm² (14 AWG)	2.5 mm² (14 AWG)	
VFD5A7MH43AFSAA						
VFD5A7MH43ENSAA						
VFD9A0MH43ANSAA		4 mm² (12 AWG)		4 mm² (12 AWG)	4 mm² (12 AWG)	
VFD9A0MH43ENSAA						
VFD9A0MH43AFSAA						

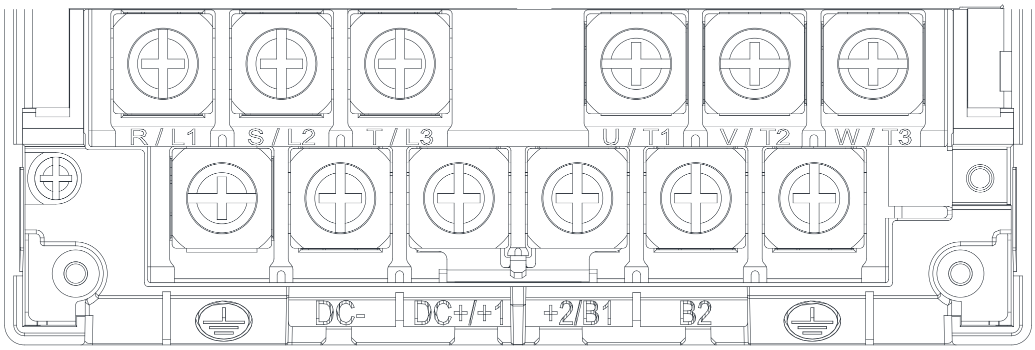
Frame D



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD25AMH23ANSAA: If you install at Ta 45°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,
DC-, DC+/+1, +2/B1, B2</th><th colspan="3">Terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th></tr>
<tr><td>VFD25AMH23ANSAA</td><td rowspan="8">10 mm^2
(8 AWG)</td><td rowspan="2">10 mm^2
(8 AWG)</td><td rowspan="8">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td><td rowspan="2">10 mm^2
(8 AWG)</td><td rowspan="2">10 mm^2
(8 AWG)</td><td rowspan="8">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td></tr>
<tr><td>VFD25AMH23ENSAA</td></tr>
<tr><td>VFD13AMH43ANSAA</td><td rowspan="3">6 mm^2
(10 AWG)</td><td rowspan="3">6 mm^2
(10 AWG)</td><td rowspan="3">6 mm^2
(10 AWG)</td></tr>
<tr><td>VFD13AMH43ENSAA</td></tr>
<tr><td>VFD13AMH43AFSAA</td></tr>
<tr><td>VFD17AMH43ANSAA</td><td rowspan="3">10 mm^2
(8 AWG)</td><td rowspan="3">10 mm^2
(8 AWG)</td><td rowspan="3">10 mm^2
(8 AWG)</td></tr>
<tr><td>VFD17AMH43ENSAA</td></tr>
<tr><td>VFD17AMH43AFSAA</td></tr>
</table>

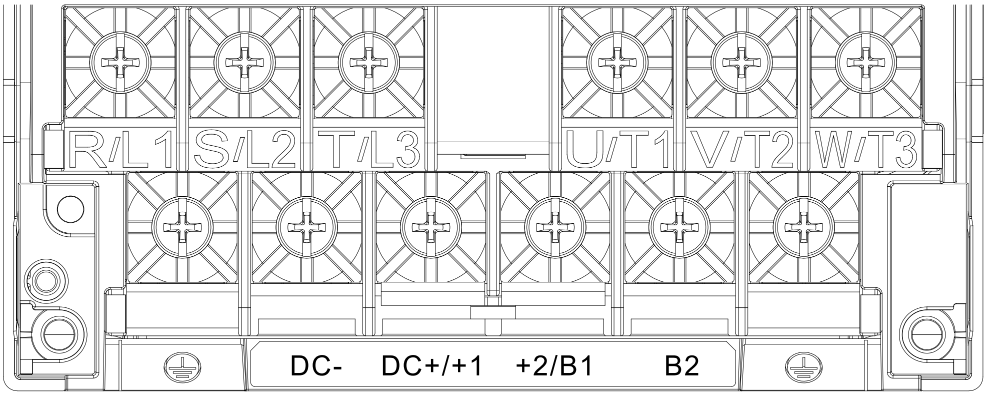
Frame E



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD33AMH23ANSAA, VFD33AMH23ENSAA models: If you install at Ta 40°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For VFD49AMH23ANSAA, VFD49AMH23ENSAA models: If you install at Ta 35°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For VFD32AMH43ANSAA, VFD32AMH43ENSAA, VFD32AMH43AFSAA models: If you install at Ta 45°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.
- ** These drives must be wired with the specified ring lug dimensions.

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD33AMH23ANSAA	16 mm² (6 AWG)	16 mm² (6 AWG)	M5 25 Kg-cm (21.7 lb-in.) (2.45 Nm)	16 mm² (6 AWG)	16 mm² (6 AWG)	M5 25 Kg-cm (21.7 lb-in.) (2.45 Nm)
VFD33AMH23ENSAA						
VFD49AMH23ANSAA**	25 mm² (4 AWG)	25 mm² (4 AWG)		25 mm² (4 AWG)		
VFD49AMH23ENSAA**						
VFD25AMH43ANSAA	16 mm² (6 AWG)	16 mm² (6 AWG)		16 mm² (6 AWG)		
VFD25AMH43ENSAA						
VFD25AMH43AFSAA						
VFD32AMH43ANSAA						
VFD32AMH43ENSAA						
VFD32AMH43AFSAA						

Frame F

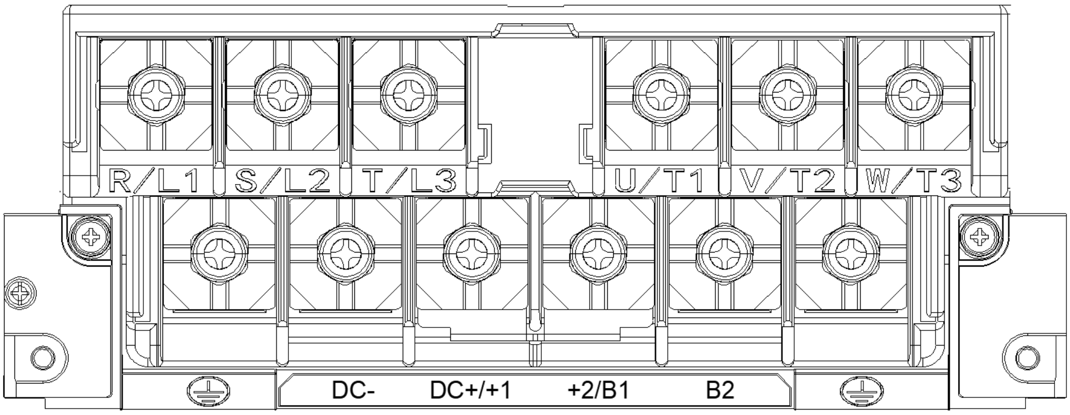


IP20

- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD65AMH23ANSAA, VFD65AMH23ENSAA models: If you install at Ta 35°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD65AMH23ANSAA	35 mm^2 (2 AWG)	35 mm^2 (2 AWG)	M6 40 Kg-cm (34.7 lb-in.) (3.92 Nm)	35 mm^2 (2 AWG)	16 mm^2 (6 AWG)	M6 40 Kg-cm (34.7 lb-in.) (3.92 Nm)
VFD65AMH23ENSAA						
VFD38AMH43ANSAA		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)		
VFD38AMH43ENSAA						
VFD38AMH43AFSAA						
VFD45AMH43ANSAA		35 mm^2 (2 AWG)		35 mm^2 (2 AWG)		
VFD45AMH43ENSAA						
VFD45AMH43AFSAA						

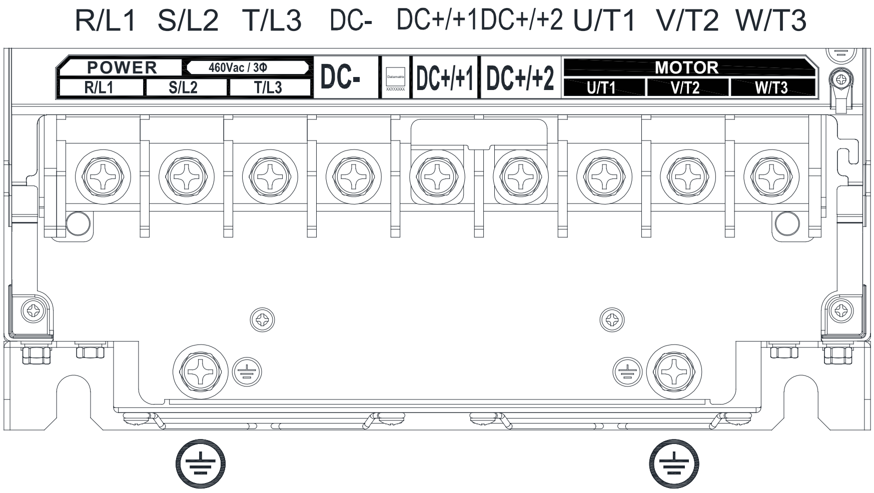
Frame G



- If you install at Ta 50°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 50°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD90AMH23ANSAA: If you install at Ta 40°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,
DC-, DC+/+1, +2/B1, B2</th><th colspan="3">Terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th></tr>
<tr><td>VFD60AMH43AFSAA</td><td rowspan="4">50 mm^2
(1/0 AWG)</td><td rowspan="4">35 mm^2
(2 AWG)</td><td rowspan="4">M8
80 Kg-cm
(69.4 lb-in.)
(7.84 Nm)</td><td rowspan="2">25 mm^2
(4 AWG)</td><td rowspan="4">16 mm^2
(6 AWG)</td><td rowspan="4">M8
80 Kg-cm
(69.4 lb-in.)
(7.84 Nm)</td></tr>
<tr><td>VFD60AMH43ANSAA</td></tr>
<tr><td>VFD75AMH23ANSAA</td><td rowspan="2">35 mm^2
(2 AWG)</td></tr>
<tr><td>VFD90AMH23ANSAA</td></tr>
</table>

Frame H



- If you install at Ta 40°C (with conduit box) / 50°C (without conduit box) above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 40°C (with conduit box) / 50°C (without conduit box) environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

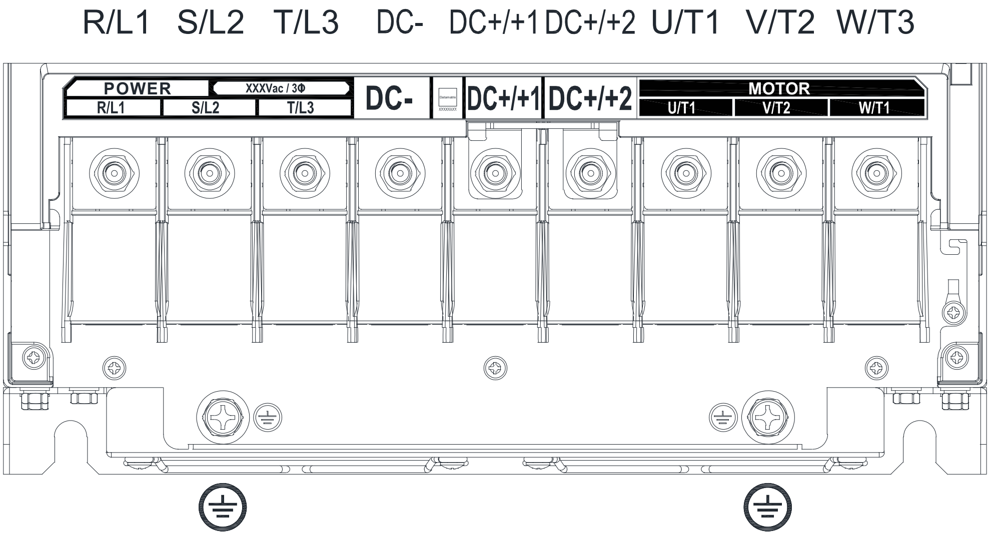
Install the drive with conduit box

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD75AMH43AFSAA	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	M8 80 Kg-cm (69.4 lb-in.) (7.84 Nm)	70 mm^2 (2/0 AWG)	25 mm^2 (4 AWG)	M8 80 Kg-cm (69.4 lb-in.) (7.84 Nm)
VFD75AMH43ANSAA						
VFD91AMH43AFSAA		70 mm^2 (2/0 AWG)			35 mm^2 (2 AWG)	
VFD91AMH43ANSAA						

Install the drive without conduit box

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD75AMH43AFSAA	95 mm^2 (3/0 AWG)	50 mm^2 (1 AWG)	M8 80 Kg-cm (69.4 lb-in.) (7.84 Nm)	95 mm^2 (3/0 AWG)	25 mm^2 (4 AWG)	M8 80 Kg-cm (69.4 lb-in.) (7.84 Nm)
VFD75AMH43ANSAA						
VFD91AMH43AFSAA		95 mm^2 (3/0 AWG)			50 mm^2 (1/0 AWG)	
VFD91AMH43ANSAA						

Frame I



- If you install at Ta 40°C (with conduit box) / 50°C (without conduit box) above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- If you install at Ta 40°C (with conduit box) / 50°C (without conduit box) environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C.
- For VFD150MH43AFSAA, VFD150MH43ANSAA models: If you install at Ta 30°C (with conduit box) / 40°C (without conduit box) above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
- For UL installation compliance, use copper wires when installing.
  The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Install the drive with conduit box

Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1			Terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw & Torque (±10%)
VFD120MH23ANSAA	120 mm^2 (4/0 AWG)	95 mm^2 (3/0 AWG)	M8 180 Kg-cm (156.2 lb-in.) (17.65 Nm)	150 mm^2 (300 MCM)	95 mm^2 (3/0 AWG)	M8 180 Kg-cm (156.2 lb-in.) (17.65 Nm)
VFD146MH23ANSAA		120 mm^2 (4/0 AWG)				
VFD112MH43AFSAA		95 mm^2 (3/0 AWG)			70 mm^2 (2/0 AWG)	
VFD112MH43ANSAA						
VFD150MH43AFSAA		120 mm^2 (4/0 AWG)			95 mm^2 (3/0 AWG)	
VFD150MH43ANSAA						

Install the drive without conduit box

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,
DC-, DC+/+1</th><th colspan="3">Terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw & Torque (±10%)</th></tr>
<tr><td>VFD120MH23ANSAA</td><td rowspan="6">150 mm^2
(300 MCM)</td><td>150 mm^2
(250 MCM)</td><td rowspan="6">M8
180 Kg-cm
(156.2 lb-in.)
(17.65 Nm)</td><td rowspan="6">150 mm^2
(300 MCM)</td><td rowspan="2">95 mm^2
(3/0 AWG)</td><td rowspan="6">M8
180 Kg-cm
(156.2 lb-in.)
(17.65 Nm)</td></tr>
<tr><td>VFD146MH23ANSAA</td><td>150 mm^2
(300MCM)</td></tr>
<tr><td>VFD112MH43AFSAA</td><td rowspan="2">120 mm^2
(4/0 AWG)</td><td rowspan="2">70 mm^2
(2/0 AWG)</td></tr>
<tr><td>VFD112MH43ANSAA</td></tr>
<tr><td>VFD150MH43AFSAA</td><td rowspan="2">150 mm^2
(300 MCM)</td><td rowspan="2">95 mm^2
(3/0 AWG)</td></tr>
<tr><td>VFD150MH43ANSAA</td></tr>
</table>

Chapter 6 Control Terminals

6-1 Control Terminals Specifications

CAUTION

Analog input terminals (AVI, ACI, ACM)

☑ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (less than 20 m) with proper grounding. If the noise is inductive, connecting the shield to the ACM terminal can reduce interference.

☑ Use twisted-pair wire for weak analog signals.

☑ If the analog input signals are affected by noise from the drive, connect a capacitor and ferrite core as shown in the following diagram.

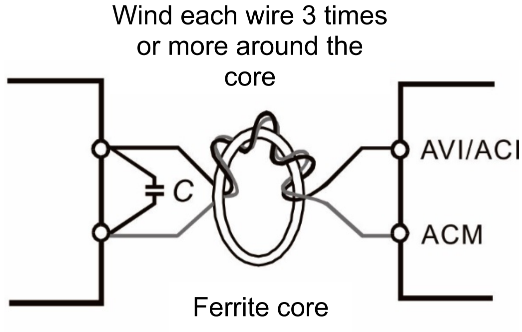


Fig. 6-1

Contact input terminals (MI1–MI7, DCM, +24 V)

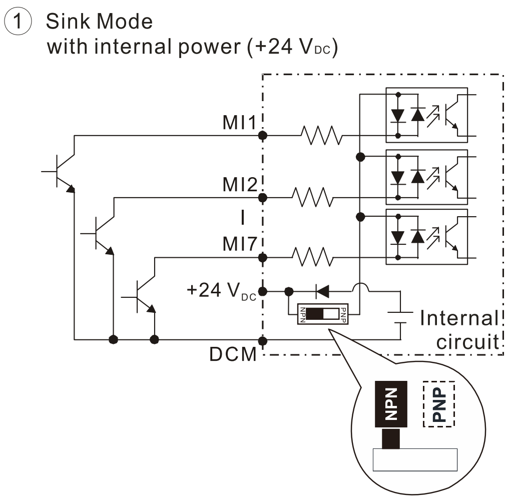


Fig. 6-2

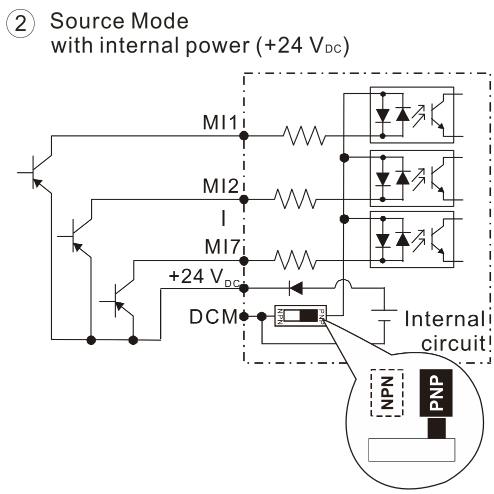


Fig. 6-3

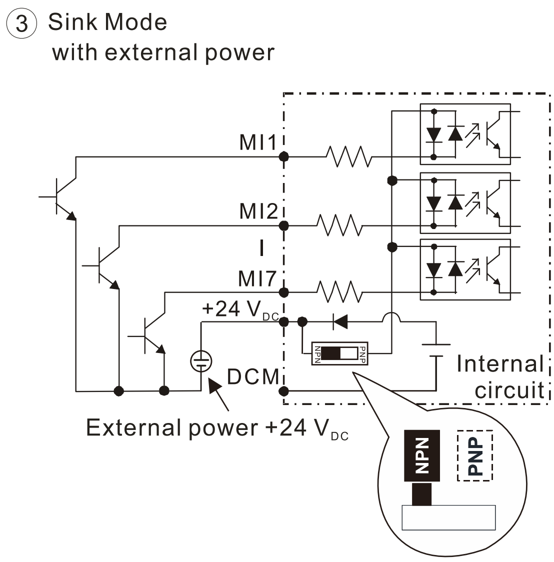


Fig. 6-4

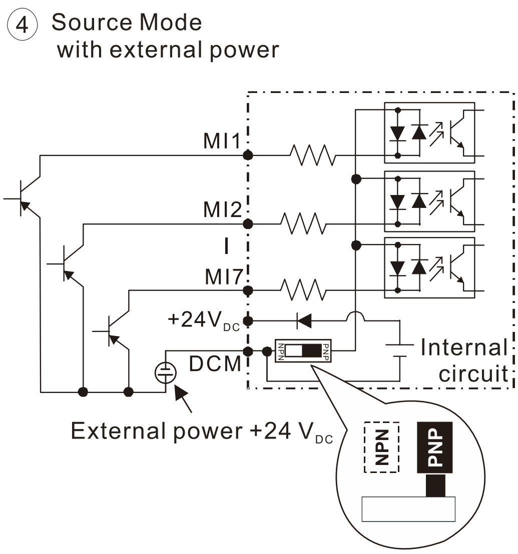


Fig. 6-5

☑ When the photo coupler is using the internal power supply, the switch connection for Sink and Source modes are as shown in the picture above: MI-DCM: Sink mode, MI-+24 V: Source mode.

Transistor output terminals (MO1, MO2, MCM)

☑ Make sure to connect the digital outputs to the correct polarity. See the wiring diagram when connecting a relay to the digital output, connect a surge absorber across the coil, and check the polarity.

6-1 Control Terminal Specifications

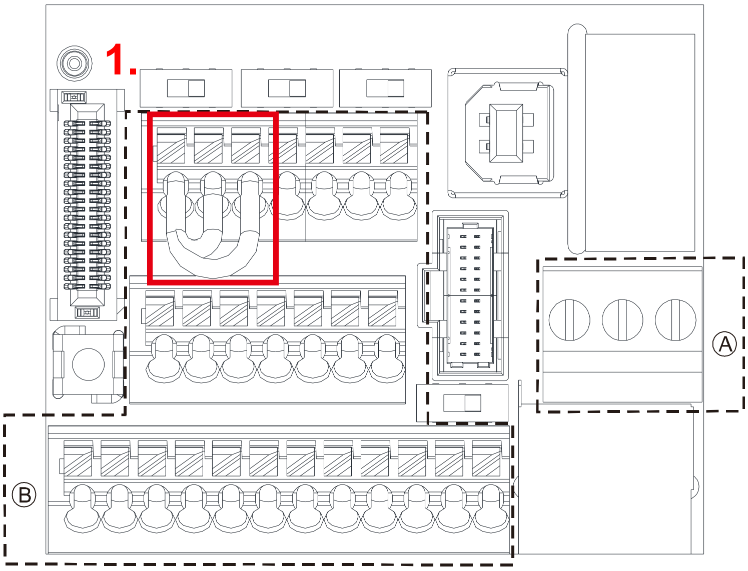


Fig. 6-6 Control Terminal Distribution Diagram

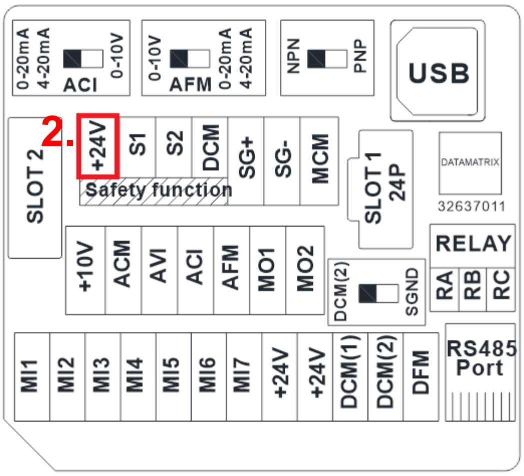


Fig. 6-7 Control Terminal Location Map

Wiring precautions:

- The default condition is +24V / S1 / S2 shorted by jumper, as shown 1. in the Fig. 6-6. Refer to Chapter 4 WIRING for more details
- The +24V of safety function is for STO only, as shown 2. in the Fig. 6-7, and cannot be used for other purpose.
- The RELAY terminal uses the PCB terminal block (as shown area Ⓐ in the Fig. 6-6):
  1. Tighten the wiring with a 2.5 mm (wide) x 0.4 mm (thick) slotted screwdriver.
  2. The ideal length of stripped wire at the connection side is 6–7 mm.
  3. When wiring bare wires, make sure they are perfectly arranged to go through the wiring holes.
- The Control terminal uses a spring clamp terminal block (as shown area Ⓑ in the Fig. 6-6):
  1. When removing wires, use the slotted screwdriver to press down the terminal, and the suggested force is 1.5 kgf.
     The specification of slotted screwdriver: 2.5 mm (wide) x 0.4 mm (thick).
  2. The ideal length of stripped wire at the connection side is 9 mm.
  3. When wiring bare wires, make sure they are perfectly arranged to go through the wiring holes.

Wiring Specifications of Control Terminal

Function name	Conductor	Stripping length (mm)	Maximum wire gauge	Minimum wire gauge	Screw size tightening torque (±10%)
RELAY Terminals	Conductor cross section solid wire	6~7	$1.5mm^2$ (16AWG)	$0.2\ mm^2$ (24AWG)	5 Kg-cm (4.3 lb-in.) (0.49 Nm)
	Conductor cross section stranded wire				
Control Terminals	Conductor cross section solid wire	9	$0.75mm^2$ (18AWG)	$0.2\ mm^2$ (24AWG)	
	Conductor cross section stranded wire				
	Stranded with ferrules with plastic sleeve	9	$0.5mm^2$ (20AWG)		

Table 6-1

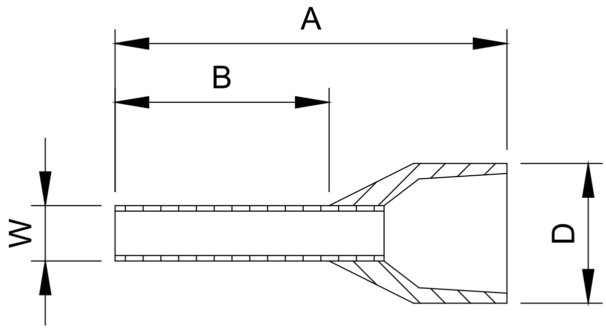


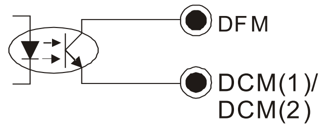
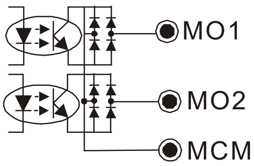
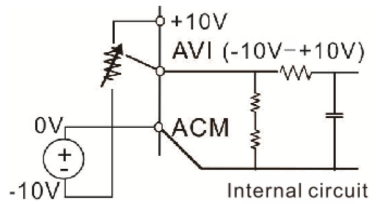
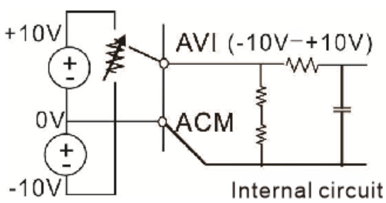
Fig. 6-8

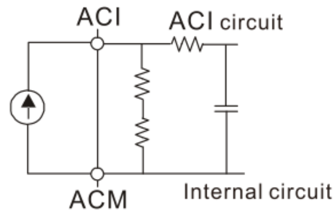
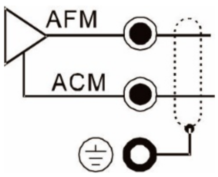
Recommended model and size of crimp terminals Unit: mm

AWG	Vendor	Vendor P/N	A(MAX)	B(MAX)	D(MAX)	W(MAX)
0.2 mm^2 (24AWG)	PHOENIX CONTACT	AI 0,25- 8 YE	12.5	8	2.6	1.1
0.34 mm^2 (22AWG)		AI 0,34- 8 TQ	12.5	8	3.3	1.3
0.5 mm^2 (20AWG)		AI 0,5 - 8 WH	14	8	3.5	1.4
Recommended model and specifications of crimp tool: CRIMPFOX 10S - 1212045, Manufacturer: PHOENIX CONTACT DNT13-0101, Manufacturer: DINKLE						

Table 6-2

Terminals	Terminal Function	Description
+24 V	Digital control signal common (Source)	+24 V ± 10% 100 mA When used in parallel, if the +24V terminal is used with a feedback sensor, unequal current may occur, and there will be a risk of failure.
MI1–MI7	Multi-function input 1–7	Refer to Pr.02-01–02-07 to program the multi-function inputs MI1–MI7. Source mode ON: the activation current is 3.3 mA ≥ 11 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC} Sink mode ON: the activation current is 3.3 mA ≤ 13 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC} ● When Pr.02-00 = 0, MI1 and MI2 can be programmed. ● When Pr.02-00 ≠ 0, the function of MI1 and MI2 is according to Pr.02-00 setting. ● When Pr.02-07 = 0, MI7 is pulse input terminal ● MI7 uses pulse input, the maximum input frequency = 33 kHz.

Terminals	Terminal Function	Description
DFM	Digital frequency meter  	DFM is a pulse-signal output; Duty-cycle: 50% Minimum load impedance R_L: 1 kΩ / 100 pf Maximum current: 30 mA Maximum voltage: 30 V_{DC} ± 1% (when 30 V_{DC} / 30 mA / R_L = 100 pf) Maximum output frequency: 33 kHz Internal current limiting resistor R: ≥ 1 KΩ Output load impedance R_L Capacitive load ≤ 100 pf Resistive load ≥1 kΩ resistance determines the output voltage value. DFM-DCM voltage = external voltage * (R_L / (R_L+R))
DCM (1)	Digital frequency signal common (Sink)	
DCM (2)	Digital frequency signal common (Sink), it can switch to SGND	
MO1	Multi-function Output 1 (photo coupler)	The AC motor drive output various monitoring signals, such as drive in operation, frequency reached, and overload indication through a transistor (open collector).  Max 48 V_{DC} 50 mA
MO2	Multi-function Output 2 (photo coupler)	
MCM	Multi-function Output Common	
RA	Multi-function relay output 1 (Relay N.O. a)	Resistive load 3 A (N.O.) / 3 A (N.C.) 250 V_{AC} 5 A (N.O.) / 3 A (N.C.) 30 V_{DC} Inductive load (COS 0.4) 1.2 A (N.O.) / 1.2 A (N.C.) 250 V_{AC} 2.0 A (N.O.) / 1.2 A (N.C.) 30 V_{DC} Various kinds of monitor signals output, e.g.: operation, frequency reached、overload indication etc.
RB	Multi-function relay output 1 (Relay N.C. b)	
RC	Multi-function relay common (Relay)	
+10 V	Potentiometer power supply	Power supply for analog frequency setting: +10.5±0.5 V_{DC} / 20 mA
AVI	Analog voltage frequency command   	Impedance: 20 kΩ Range: 0–10 V / -10– +10V = 0–maximum output frequency (Pr.01-00) Mode switching by setting Pr.03-00, Pr.03-28 AVI resolution = 12 bits

Terminals	Terminal Function	Description
ACI	Analog current frequency command 	Impedance: 250 Ω Range: 0–20 mA / 4–20 mA / 0–10 V = 0–maximum output frequency (Pr.01-00) Mode switching by setting Pr.03-01, Pr.03-29 ACI resolution = 12 bits
AFM	Multi-function analog voltage output 	Switch: The AFM default is 0–10 V (voltage mode). Use the switch and Pr.03-31 to change to current mode (0–20 mA / 4–20 mA). You must follow the indication on the back side of the front cover or page 6-2 of the user manual when using the switch. Voltage mode Range: 0–10 V (Pr.03-31=0) corresponding to the maximum operating range of the control object Maximum output current: 2 mA Maximum load: 5 kΩ Current mode Range: 0–20 mA (Pr.03-31=1) / 4–20 mA (Pr.03-31=2) corresponding to the maximum operating range of the control object Maximum load: 500 Ω
ACM	Analog Signal Common	Common for analog terminals
S1,S2 DCM	Default: S1 / S2 shorted for +24 V Rated voltage: 24 V_{DC} ±10%; Maximum voltage: 30 V_{DC} ±10% Activation current: 6.67 mA ±10% STO activation mode Input voltage level: 0 V_{DC} < S1-DCM < 5 V_{DC} or 0 V_{DC} < S2-DCM < 5 V_{DC} STO response time ≤ 20 ms S1 / S2 operates until the AC motor drive stops outputting current. STO cut-off mode Input voltage level: 11 V_{DC} < S1-DCM < 30 V_{DC} and 11 V_{DC} < S2-DCM < 30 V_{DC} Power removal safety function according to EN 954-1 and IEC/EN 61508 **Note:** refer to user manual Chapter 17 SAFE TORQUE OFF FUNCTION for more details.	
SG+ SG- SGND	Modbus RS-485 Note: refer to parameter group 09 of Chapter 12 DESCRIPTION OF PARAMETER SETTINGS in user manual for more information.	
RJ45	PIN 1: CAN_H PIN 2: CAN_L PIN 3, 7: SGND PIN 4: SG- PIN 5: SG+ PIN 6: Reserved PIN 8: +10 VS (provide KPC-CC01 power supply)	

NOTE: Wire size of analog control signals: 0.75 mm^2 (18 AWG) with shielded wire. Table 6-3

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Chapter 7 Optional Accessories

7-1 All Brake Resistors and Brake Units Used in AC Motor Drives

7-2 Magnetic Contactor / Air Circuit Breaker and Non-Fuse Circuit Breaker

7-3 Fuse Specification Chart

7-4 AC / DC Reactors

7-5 Zero-phase Reactors

7-6 EMC Filter

7-7 EMC Shield Plate

7-8 Capacitive Filter

7-9 The Assembly of NEMA KIT

7-10 The Assembly of Fan Kit

7-11 Keypad Panel Mounting

7-12 DIN-Rail Mounting

7-13 Mounting Adapter Plate

7-14 Digital Keypad – KPC-CC01

The optional accessories listed in this chapter are available upon request. Installing additional accessories to your drive substantially improves the drive's performance. Select accessories according to your need or contact your local distributor for suggestions.

7-1 All Brake Resistors and Brake Units Used in AC Motor Drives

115V, single-phase

Model	Applicable Motor		125% Braking Torque / 10% ED *1							Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Braking Unit VFDB x Q'ty	Equivalent Resistance for each AC motor Drive	Braking Resistor for each Brake Unit Part No. *3	Amount	Usage	Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Max. Peak Power (kW)
VFD1A6MH11XNSXX	0.25	0.2	0.1	-	80W 750Ω	BR080W750	1	-	0.5	190.0	2	0.8
VFD2A5MH11XNSXX	0.5	0.4	0.3	-	80W 200Ω	BR080W200	1	-	1.9	95.0	4	1.5
VFD5A0MH11XNSXX	1	0.75	0.5	-	80W 200Ω	BR080W200	1	-	1.9	63.3	6	2.3

Table 7-1

230V, single-phase

Model	Applicable Motor		125% Braking Torque / 10% ED *1							Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Braking Unit VFDB x Q'ty	Equivalent Resistance for each AC motor Drive	Braking Resistor for each Brake Unit Part No. *3	Amount	Usage	Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Max. Peak Power (kW)
VFD1A6MH21XNSXX VFD1A6MH21AFSAA	0.25	0.2	0.1	-	80 W 750 Ω	BR080W750	1	-	0.5	190.0	2	0.8
VFD2A8MH21XNSXX VFD2A8MH21AFSAA	0.5	0.4	0.3	-	80 W 200 Ω	BR080W200	1	-	1.9	95.0	4	1.5
VFD5A0MH21XNSXX VFD5A0MH21AFSAA	1	0.75	0.5	-	80 W 200 Ω	BR080W200	1	-	1.9	63.3	6	2.3
VFD7A5MH21XNSXX VFD7A5MH21AFSAA	2	1.5	1	-	200 W 91 Ω	BR200W091	1	-	4.2	47.5	8	3.0
VFD11AMH21XNSXX VFD11AMH21AFSAA	3	2.2	1.5	-	300 W 70 Ω	BR300W070	1	-	5.4	38.0	10	3.8

Table 7-2

230V, three-phase

Model	Applicable Motor		125% Braking Torque / 10% ED *1							Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Braking Unit VFDB x Q'ty	Equivalent Resistance for each AC motor Drive	Braking Resistor for each Brake Unit Part No. *3	Amount	Usage	Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Max. Peak Power (kW)
VFD1A6MH23XNSXX	0.25	0.2	0.1	-	80 W 750 Ω	BR080W750	1	-	0.5	190.0	2	0.8
VFD2A8MH23XNSXX	0.5	0.4	0.3	-	80 W 200 Ω	BR080W200	1	-	1.9	95.0	4	1.5
VFD5A0MH23XNSXX	1	0.75	0.5	-	80 W 200 Ω	BR080W200	1	-	1.9	63.3	6	2.3
VFD7A5MH23XNSXX	2	1.5	1	-	200 W 91 Ω	BR200W091	1	-	4.2	47.5	8	3.0
VFD11AMH23XNSXX	3	2.2	1.5	-	300 W 70 Ω	BR300W070	1	-	5.4	38.0	10	3.8
VFD17AMH23XNSXX	5	3.7	2.5	-	400 W 40 Ω	BR400W040	1	-	9.5	19.0	20	7.6
VFD25AMH23XNSXX	7.5	5.5	3.7	-	1000 W 20 Ω	BR1K0W020	1	-	19	16.5	23	8.7
VFD33AMH23XNSXX	10	7.5	5.1	-	1000 W 20 Ω	BR1K0W020	1	-	19	14.6	26	9.9
VFD49AMH23XNSXX	15	11	7.4	-	1500 W 13 Ω	BR1K5W013	1	-	29	12.6	29	11.0
VFD65AMH23XNSXX	20	15	10.2	-	2000 W 8.6 Ω	BR1K0W4P3	2	2 in series	44	8.3	46	17.5
VFD75AMH23ANSAA	25	18.5	14.6	-	2000 W 8 Ω	BR1K0W016	2	2 in parallel	47.5	8.3	46	17.5
VFD90AMH23ANSAA	30	22	17.9	-	3000 W 6.6 Ω	BR1K5W3P3	2	2 in series	57.6	5.8	66	25.1
VFD120MH23ANSAA	40	30	24.4	2015 x 2	4000W 5.1 Ω	BR1K0W5P1	2	2 in series	74.5	4.8	79	30.1
VFD146MH23ANSAA	50	37	30.1	2022 x 2	4800Q 3.9 Ω	BR1K2W3P9	2	2 in series	97.4	3.2	119	45.1

Table 7-3

460V, three-phase

Model	Applicable Motor		125% Braking Torque / 10% ED *1							Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Braking Unit	Equivalent Resistance for each AC motor Drive	Braking Resistor for each Brake Unit			Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Max. Peak Power (kW)
				VFDB x Q'ty		Part No. *3	Amount	Usage				
VFD1A5MH43XNSXX VFD1A5MH43AFSAA	0.5	0.4	0.3	-	80W 750Ω	BR080W750	1	-	1	380.0	2	1.5
VFD3A0MH43XNSXX VFD3A0MH43AFSAA	1	0.75	0.5	-	80W 750Ω	BR080W750	1	-	1	190.0	4	3.0
VFD4A2MH43XNSXX VFD4A2MH43AFSAA	2	1.5	1	-	200W 360Ω	BR200W360	1	-	2.1	126.7	6	4.6
VFD5A7MH43XNSXX VFD5A7MH43AFSAA	3	2.2	1.5	-	300W 250Ω	BR300W250	1	-	3	108.6	7	5.3
VFD9A0MH43XNSXX VFD9A0MH43AFSAA	5	3.7	2.5	-	400W 150Ω	BR400W150	1	-	5.1	84.4	9	6.8
VFD13AMH43XNSXX VFD13AMH43AFSAA	7.5	5.5	3.7	-	1000W 75Ω	BR1K0W075	1	-	10.2	50.7	15	11.4
VFD17AMH43XNSXX VFD17AMH43AFSAA	10	7.5	5.1	-	1000W 75Ω	BR1K0W075	1	-	10.2	40.0	19	14.4
VFD25AMH43XNSXX VFD25AMH43AFSAA	15	11	7.4	-	1500W 43Ω	BR1K5W043	1	-	17.6	33.0	23	17.5
VFD32AMH43XNSXX VFD32AMH43AFSAA	20	15	10.2	-	2000W 32Ω	BR1K0W016	2	2 in series	24	26.2	29	22.0
VFD38AMH43XNSXX VFD38AMH43AFSAA	25	18	12.2	-	2000W 32Ω	BR1K0W016	2	2 in series	24	26.2	29	22.0
VFD45AMH43XNSXX VFD45AMH43AFSAA	30	22	14.9	-	3000W 26Ω	BR1K5W013	2	2 in series	29	23.0	33	25.1
VFD60AMH43AFSAA VFD60AMH43ANSAA	40	30	24.4	-	3000 W 20 Ω	BR1K5W040	2	2 in parallel	38.0	15.2	50	38.0
VFD75AMH43AFSAA VFD75AMH43ANSAA	50	37	30.1	4045 x 1	4800W 15 Ω	BR1K2W015	4	2 in series 2 in parallel	50.7	12.7	60	45.5
VFD91AMH43AFSAA VFD91AMH43ANSAA	60	45	36.6	4045 x 1	6000 W 13 Ω	BR1K5W013	4	2 in series 2 in parallel	58.5	12.7	60	45.5
VFD112MH43AFSAA VFD112MH43ANSAA	75	55	44.7	4030 x 2	8000 W 10.2 Ω	BR1K0W5P1	4	In series	74.5	9.5	80	60.8
VFD150MH43AFSAA VFD150MH43ANSAA	100	75	60.7	4045 x 2	9600 W 7.5 Ω	BR1K2W015	4	2 in series 2 in parallel	101.3	6.3	121	91.7

Table 7-4

*1: Calculation for standard braking torque is (kW) x 125% x 0.8; where 0.8 is the motor efficiency.
Because of the limited resistor power, the longest operation time for 10% ED is 10 seconds (ON: 10 seconds / OFF: 90 seconds).

*2: Calculation for braking resistor is based on a four-pole motor (1800 rpm).

*3: Resistors of 400 W or lower should be fixed to the frame and at a surface temperature below 250°C.
Resistors of 1000 W and above should be fixed on a surface with temperature below 350°C. (If the surface temperature is higher than the temperature limit, install extra cooling system or increase the size of the resistor)

NOTE:

1. Select the resistance value, power and brake usage (ED %) according to Delta rules.
   Definition for Brake Usage ED%

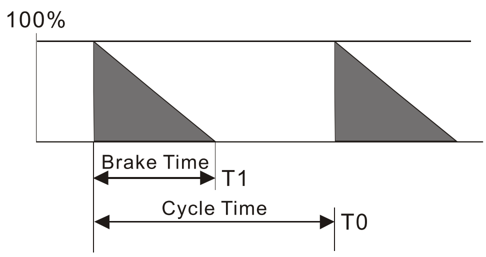
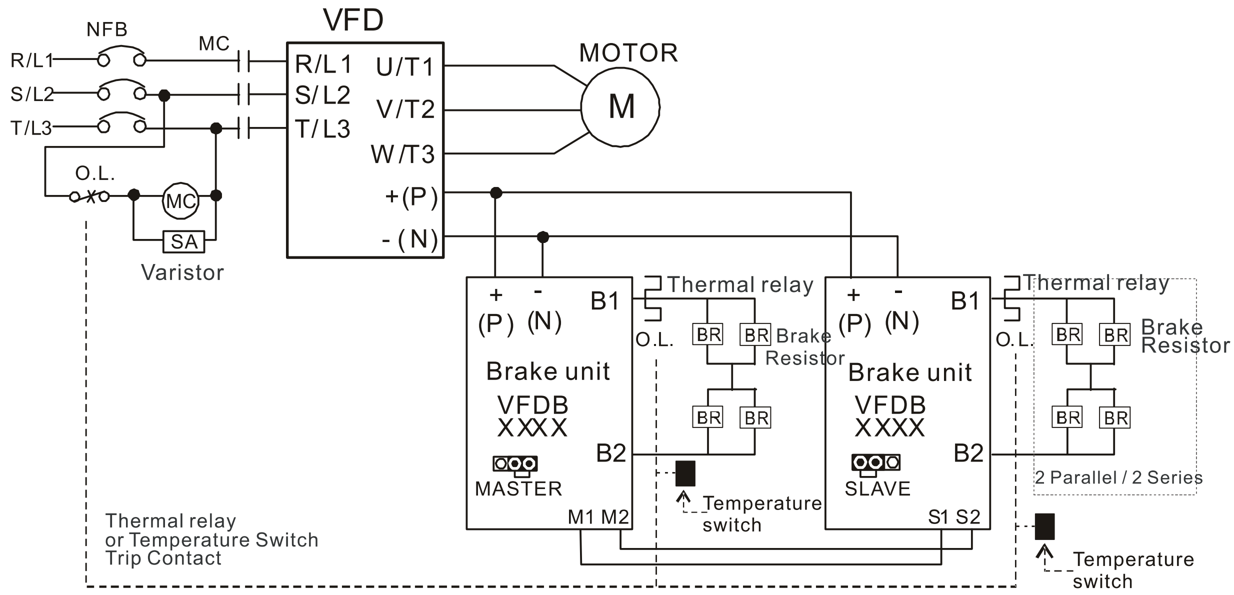


Fig. 7-1

ED% = T1 / T0 x 100 (%)
Explanation: ED (%) is defined to allow enough time for the brake unit and brake resistor to dissipate the heat generated by braking. When the brake resistor gets hot, the resistance increases with the temperature, and the braking torque decreases accordingly.

For safety, install a thermal overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) before the drive for additional protection. The thermal overload relay protects the brake resistor from damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor, brake unit and drive. Attention: Do NOT interrupt the connection of the brake resistor by switching ON / OFF the power.



- When AC Drive is equipped with a DC reactor, please read user manual for the correct wiring for the brake unit input circuit +(P).
- DO NOT connect input circuit -(N) to the neutral point of the power system.

Fig. 7-2

2. Any damage to the drive or other equipment caused by using brake resistors and brake modules that are not provided by Delta voids the warranty.
3. Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult local dealers for the power calculation.
4. When using more than two brake units, the equivalent resistor value of the parallel brake unit cannot be less than the value in the column “Minimum Resistor Value (Ω)”. Read the wiring information in the brake unit user manual thoroughly prior to operation. Visit the following links to get the instruction sheets for the wiring in the brake unit:
   - VFDB2015 / 2022 / 4030 / 4045 / 5055 Braking Modules Instruction Sheet
     https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=1525&DocPath=1&hl=en-US
   - VFDB4110 / 4160 / 4185 Braking Modules Instruction Sheet
     https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=1516&DocPath=1&hl=en-US
   - VFDB6055 / 6110 / 6160 / 6200 Braking Modules Instruction Sheet
     https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=8592&DocPath=1&hl=en-US
5. The suggested value in the tables above are for general application. If the AC motor drive requires frequent braking, increases the watts by two to three times.
6. Thermal Overload Relay (TOR): Choosing a thermal overload relay is based on whether its overload capacity is appropriate for the MH300. The standard braking capacity of the MH300 is 10% ED (Tripping time = 10s). As shown in the figure below, the thermal overload relay continuously operates for 10 seconds and it can withstand a 260% overload (Host starting).

For example, a 460V, 15 kW MH300 has a braking current of 24 A (refer to the tables in this section), so it can use the thermal overload relay with a rated current of 10 A (10 x 260% = 26A > 24A). The specification of each thermal relay may vary among different manufacturers, carefully read the specification before using it.

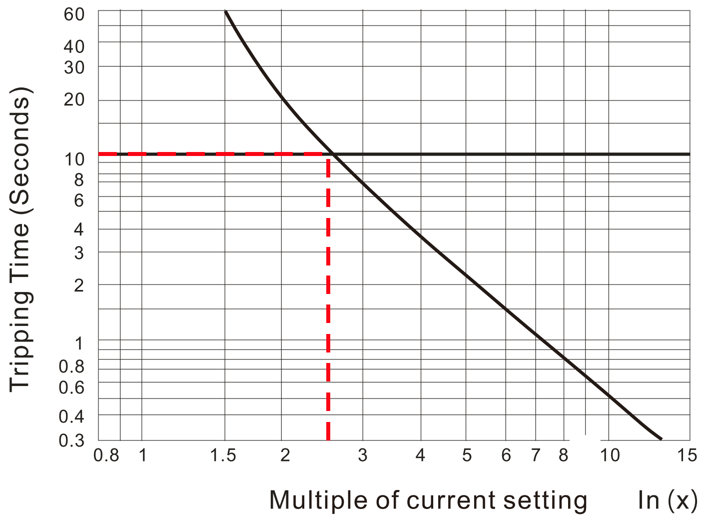


Fig. 7-3

7-2 Magnetic Contactor / Air Circuit Breaker and Non-Fuse Circuit Breaker

Magnetic Contactor (MC) and Air Circuit Breaker (ACB)

It is recommended the surrounding temperature for MC should be ≥ 60°C and that for ACB should be ≥ 50°C. In the meanwhile, consider temperature derating for components with ON/OFF switch in accordance with the ambient temperature of the on-site distribution panel.

115V models

Frame	Model	Heavy Duty Output Current (A)	Heavy Duty Input Current (A)	MC / ACB Selection (A)
A	VFD1A6MH11ANSAA	1.6	6	11
	VFD2A5MH11ANSAA	2.5	9.4	18
C	VFD5A0MH11ANSAA	5	18.8	32

Table 7-5

230V models

Frame	Model	Heavy Duty Output Current (A)	Heavy Duty Input Current (A)	MC / ACB Selection (A)
A	VFD1A6MH21ANSAA	1.6	5.1	9
	VFD2A8MH21ANSAA	2.8	7.3	13
	VFD1A6MH23ANSAA	1.6	1.9	9
	VFD2A8MH23ANSAA	2.8	3.4	9
	VFD5A0MH23ANSAA	5	6	11
B	VFD5A0MH21ANSAA VFD5A0MH21AFSAA	5	11.2	18
	VFD1A6MH21AFSAA	1.6	5.1	9
	VFD2A8MH21AFSAA	2.8	7.3	13
	VFD7A5MH23ANSAA	7.5	9	18
C	VFD7A5MH21ANSAA VFD7A5MH21AFSAA	7.5	16.5	32
	VFD11AMH21ANSAA VFD11AMH21AFSAA	11	24.2	40
	VFD11AMH23ANSAA	11	13.2	22
	VFD17AMH23ANSAA	17	20.4	32
D	VFD25AMH23ANSAA	25	30	55
E	VFD33AMH23ANSAA	33	39.6	65
	VFD49AMH23ANSAA	49	58.8	105
F	VFD65AMH23ANSAA	65	78	130
G	VFD75AMH23ANSAA	75	77	130
	VFD90AMH23ANSAA	90	92	150
I	VFD120MH23ANSAA	120	117	185
	VFD146MH23ANSAA	146	143	225

Table 7-6

460V models

Frame	Model	Heavy Duty Output Current (A)	Heavy Duty Input Current (A)	MC / ACB Selection (A)
A	VFD1A5MH43ANSAA	1.5	2.1	7
	VFD3A0MH43ANSAA	3	4.2	7
B	VFD4A2MH43ANSAA VFD4A2MH43AFSAA	4.2	5.8	9
	VFD1A5MH43AFSAA	1.5	2.1	7
	VFD3A0MH43AFSAA	3	4.2	7
C	VFD5A7MH43ANSAA VFD5A7MH43AFSAA	5.7	6.3	12
	VFD7A3MH43ANSAA VFD7A3MH43AFSAA	7.3	8.1	18
	VFD9A0MH43ANSAA VFD9A0MH43AFSAA	9	9.9	18
D	VFD13AMH43ANSAA VFD13AMH43AFSAA	13	14.3	32
	VFD17AMH43ANSAA VFD17AMH43AFSAA	17.5	19.3	40
E	VFD25AMH43ANSAA VFD25AMH43AFSAA	25	27.5	50
	VFD32AMH43ANSAA VFD32AMH43AFSAA	32	35.2	65
F	VFD38AMH43ANSAA VFD38AMH43AFSAA	38	41.8	65
	VFD45AMH43ANSAA VFD43AMH43AFSAA	45	49.5	75
G	VFD60AMH43ANSAA VFD60AMH43AFSAA	60	63	100
H	VFD75AMH43ANSAA VFD75AMH43AFSAA	75	66	130
	VFD91AMH43ANSAA VFD91AMH43AFSAA	91	80	150
I	VFD112MH43ANSAA VFD112MH43AFSAA	112	110	185
	VFD150MH43ANSAA VFD150MH43AFSAA	150	147	265

Table 7-7

Non-fuse Circuit Breaker

- Comply with the UL standard: Per UL 508
- The rated current of the breaker shall be 1.6–2.6 times of the maximum rated input current of the AC motor drive. Refer to the suggested current value as shown below.
- To compare the time-current characteristic of non-fuse circuit breaker and AC motor drive's overheating protection to make sure tripping operation not to happen.

115V, single-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD1A6MH11ANSXX VFD1A6MH11ENSXX	20
VFD2A5MH11ANSXX VFD2A5MH11ENSXX	25
VFD5A0MH11ANSXX VFD5A0MH11ENSXX	50

Table 7-8

230V, single-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD1A6MH21ANSXX VFD1A6MH21ENSXX VFD1A6MH21AFSXX	15
VFD2A8MH21ANSXX VFD2A8MH21ENSXX VFD2A8MH21AFSXX	20
VFD5A0MH21ANSXX VFD5A0MH21ENSXX VFD5A0MH21AFSXX	30
VFD7A5MH21ANSXX VFD7A5MH21ENSXX VFD7A5MH21AFSXX	45
VFD11AMH21ANSXX VFD11AMH21ENSXX VFD11AMH21AFSXX	70

Table 7-9

230V, three-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD1A6MH23ANSXX VFD1A6MH23ENSXX	15
VFD2A8MH23ANSXX VFD2A8MH23ENSXX	15
VFD5A0MH23ANSXX VFD5A0MH23ENSXX	16
VFD5A0MH23ANSNA VFD5A0MH23ENSNA	16
VFD7A5MH23ANSXX VFD7A5MH23ENSXX	25
VFD11AMH23ANSXX VFD11AMH23ENSXX	40
VFD17AMH23ANSXX VFD17AMH23ENSXX	60
VFD25AMH23ANSXX VFD25AMH23ENSXX	63
VFD33AMH23ANSXX VFD33AMH23ENSXX	90

460V, three-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD1A5MH43ANSXX VFD1A5MH43ENSXX VFD1A5MH43AFSXX	15
VFD3A0MH43ANSXX VFD3A0MH43ENSXX VFD3A0MH43AFSXX	15
VFD3A0MH43ANSNA VFD3A0MH43ENSNA	15
VFD4A2MH43ANSXX VFD4A2MH43ENSXX VFD4A2MH43AFSXX	15
VFD5A7MH43ANSXX VFD5A7MH43ENSXX VFD5A7MH43AFSXX	20
VFD9A0MH43ANSXX VFD9A0MH43ENSXX VFD9A0MH43AFSXX	30
VFD13AMH43ANSXX VFD13AMH43ENSXX VFD13AMH43AFSXX	32
VFD17AMH43ANSXX VFD17AMH43ENSXX VFD17AMH43AFSXX	45
VFD25AMH43ANSXX VFD25AMH43ENSXX VFD25AMH43AFSXX	60

230V, three-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD49AMH23ANSXX VFD49AMH23ENSXX	125
VFD65AMH23ANSXX VFD65AMH23ENSXX	160
VFD75AMH23ANSAA	175
VFD90AMH23ANSAA	200
VFD120MH23ANSAA	225
VFD146MH23ANSAA	300

Table 7-10

460V, three-phase	
Model	The Suggested Rated Input Current of Non-fuse Circuit Breaker (A)
VFD32AMH43ANSXX VFD32AMH43ENSXX VFD32AMH43AFSXX	80
VFD38AMH43ANSXX VFD38AMH43ENSXX VFD38AMH43AFSXX	90
VFD45AMH43ANSXX VFD45AMH43ENSXX VFD45AMH43AFSXX	100
VFD60AMH43ANSAA VFD60AMH43AFSAA	125
VFD75AMH43ANSAA VFD75AMH43AFSAA	150
VFD91AMH43ANSAA VFD91AMH43AFSAA	175
VFD112MH43ANSAA VFD112MH43AFSAA	225
VFD150MH43ANSAA VFD150MH43AFSAA	300

Table 7-11

7-3 Fuse Specification Chart

- Fuse specifications lower than the table shown below are allowed.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. Use UL classified fuses to fulfill this requirement.
- For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. Use UL classified fuses to fulfill this requirement.

115V, single-phase

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	P/N
VFD1A6MH11ANSXX VFD1A6MH11ENSXX	6.8	6.0	7.2	Class T JJS-10
VFD2A5MH11ANSXX VFD2A5MH11ENSXX	10.1	9.4	10.8	Class T JJS-10
VFD5A0MH11ANSXX VFD5A0MH11ENSXX	20.6	18.8	22	Class T JJS-25

Table 7-12

230V, single-phase

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	Normal Duty
VFD1A6MH21ANSXX VFD1A6MH21ENSXX VFD1A6MH21AFSXX	3.8	3.4	7.2	Class T JJS-10
VFD2A8MH21ANSXX VFD2A8MH21ENSXX VFD2A8MH21AFSXX	6.7	5.9	12.8	Class T JJS-15
VFD5A0MH21ANSXX VFD5A0MH21ENSXX VFD5A0MH21AFSXX	10.9	10.5	20.8	Class T JJS-20
VFD7A5MH21ANSXX VFD7A5MH21ENSXX VFD7A5MH21AFSXX	17.9	15.8	34	Class T JJS-35
VFD11AMH21ANSXX VFD11AMH21ENSXX VFD11AMH21AFSXX	26.3	23.1	50	Class T JJS-50

Table 7-13

230V, three-phase

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	Normal Duty
VFD1A6MH23ANSXX VFD1A6MH23ENSXX	2.2	1.9	7.2	Class T JJS-10
VFD2A8MH23ANSXX VFD2A8MH23ENSXX	3.8	3.4	12.8	Class T JJS-15
VFD5A0MH23ANSXX VFD5A0MH23ENSXX	6.2	6.0	20.8	Class T JJS-20
VFD5A0MH23ANSNA VFD5A0MH23ENSNA	6.2	6.0	20.8	Class T JJS-20
VFD7A5MH23ANSXX VFD7A5MH23ENSXX	9.6	9.0	32	Class T JJS-35

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	Normal Duty
VFD11AMH23ANSXX VFD11AMH23ENSXX	15.0	13.2	50	Class T JJS-50
VFD17AMH23ANSXX VFD17AMH23ENSXX	23.4	20.4	78	Class T JJS-80
VFD25AMH23ANSXX VFD25AMH23ENSXX	32.4	30.0	59.4	Class T JJS-60
VFD33AMH23ANSXX VFD33AMH23ENSXX	43.2	39.6	79.2	Class T JJS-80
VFD49AMH23ANSXX VFD49AMH23ENSXX	61.2	58.8	112.2	Class T JJS-110
VFD65AMH23ANSXX VFD65AMH23ENSXX	82.8	78.0	151.8	Class T JJS-150
VFD75AMH23ANSAA	85	77	170	Class T JJS-175
VFD90AMH23ANSAA	103	92	206	Class T JJS-200
VFD120MH23ANSAA	126	117	252	Class T JJS-250
VFD146MH23ANSAA	151	143	302	Class T JJS-300

Table 7-14

460V, three-phase

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	Normal Duty
VFD1A5MH43XNSXX VFD1A5MH43AFSXX	2.0	1.7	7.2	Class T JJS-10
VFD3A0MH43XNSXX VFD3A0MH43AFSXX	3.6	3.3	13.2	Class T JJS-15
VFD3A0MH43ANSNA VFD3A0MH43ENSNA	3.6	3.3	20.8	Class T JJS-20
VFD4A2MH43XNSXX VFD4A2MH43AFSXX	5.1	4.6	18.4	Class T JJS-20
VFD5A7MH43XNSXX VFD5A7MH43AFSXX	7.2	6.3	26	Class T JJS-25
VFD9A0MH43XNSXX VFD9A0MH43AFSXX	11.6	9.9	42	Class T JJS-45
VFD13AMH43XNSXX VFD13AMH43AFSXX	16.0	14.3	31.9	Class T JJS-30
VFD17AMH43XNSXX VFD17AMH43AFSXX	21.8	19.3	43.56	Class T JJS-45
VFD25AMH43XNSXX VFD25AMH43AFSXX	30.8	27.5	61.6	Class T JJS-60
VFD32AMH43XNSXX VFD32AMH43AFSXX	39.6	35.2	79.2	Class T JJS-80
VFD38AMH43XNSXX VFD38AMH43AFSXX	45.7	41.8	91.3	Class T JJS-90
VFD45AMH43XNSXX VFD45AMH43AFSXX	53.9	49.5	107.8	Class T JJS-110
VFD60AMH43ANSAA VFD60AMH43AFSAA	72.5	63	145	Class T JJS-150
VFD75AMH43ANSAA VFD75AMH43AFSAA	77	66	154	Class T JJS-175
VFD91AMH43ANSAA VFD91AMH43AFSAA	97	80	194	Class T JJS-200

Model	Input Current (A)		Specification of Fuse (600 V_{AC})	
	Normal Duty	Heavy Duty	I (A)	Normal Duty
VFD112MH43ANSAA VFD112MH43AFSAA	123	110	246	Class T JJS-250
VFD150MH43ANSAA VFD150MH43AFSAA	173	147	346	Class T JJS-300

Table 7-15

7-4 AC / DC Reactors

AC Input Reactor

Installing an AC reactor on the input side of an AC motor drive can increase line impedance, improve the power factor, reduce input current, and reduce interference generated from the motor drive. It also reduces momentary voltage surges or abnormal current spikes. For example, when the main power capacity is higher than 500 kVA, or when using a switching capacitor bank, momentary voltage and current spikes may damage the AC motor drive's internal circuit. An AC reactor on the input side of the AC motor drive protects it by suppressing surges.

Install an AC input reactor in series with the main power to the three input phases R S T as shown below:

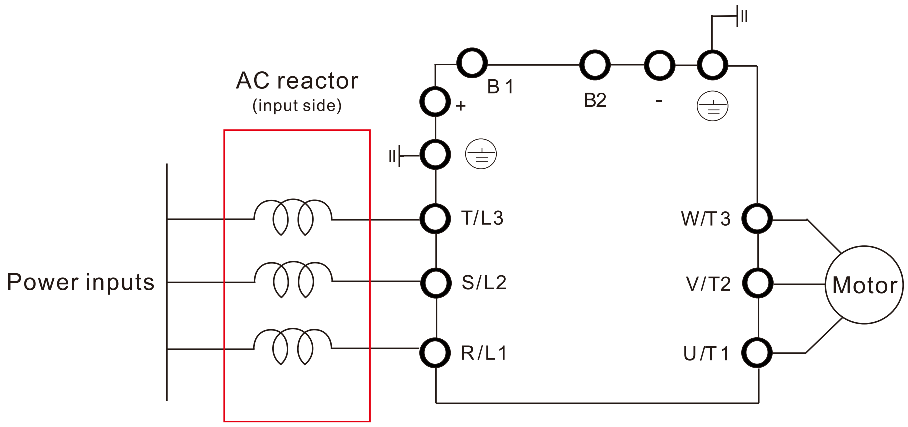


Fig. 7-4

AC Output Reactor

When using drives in long wiring output application, ground fault (GFF), over-current (OC) and motor over-voltage (OV) often occur. GFF and OC cause errors due to the drive's self-protective mechanism; over-voltage damages motor insulation.

The excessive length of the output wires makes the grounded stray capacitance too large, increase the three-phase output common mode current, and the reflected wave of the long wires makes the motor dv / dt and the motor terminal voltage too high. Thus, installing a reactor on the drive's output side can increase the high-frequency impedance to reduce the dv / dt and terminal voltage to protect the motor.

Install an AC output reactor in series with the main power to the three input phases U V W as shown below:

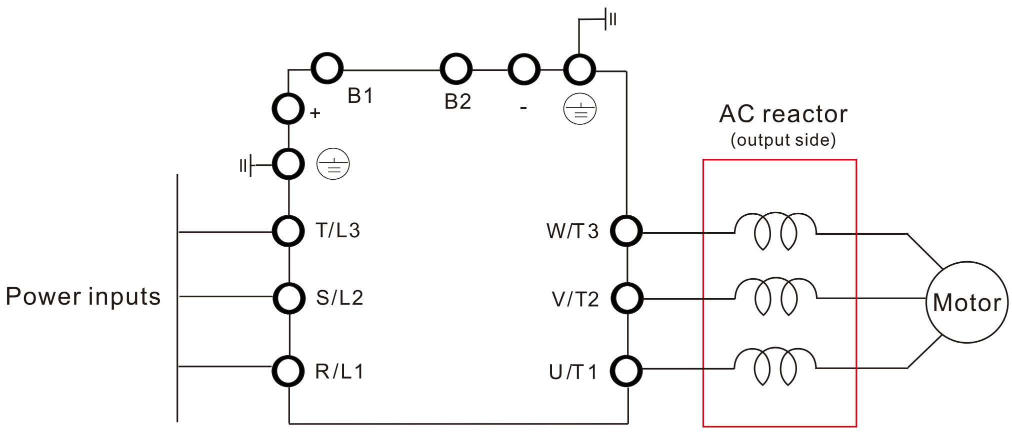


Fig. 7-5

DC Output Reactor

A DC reactor can also improve the power factor, reduce input current, and reduce interference generated from the motor drive. A DC reactor stabilizes the DC BUS voltage. Compared to an AC input reactor, the advantages are smaller size, lower price, and lower voltage drop (lower power dissipation).

Install the DC reactor between terminals +1 and +2. Remove the jumper before installing the DC reactor. See the figure below.

NOTE: 115V models have no DC choke.

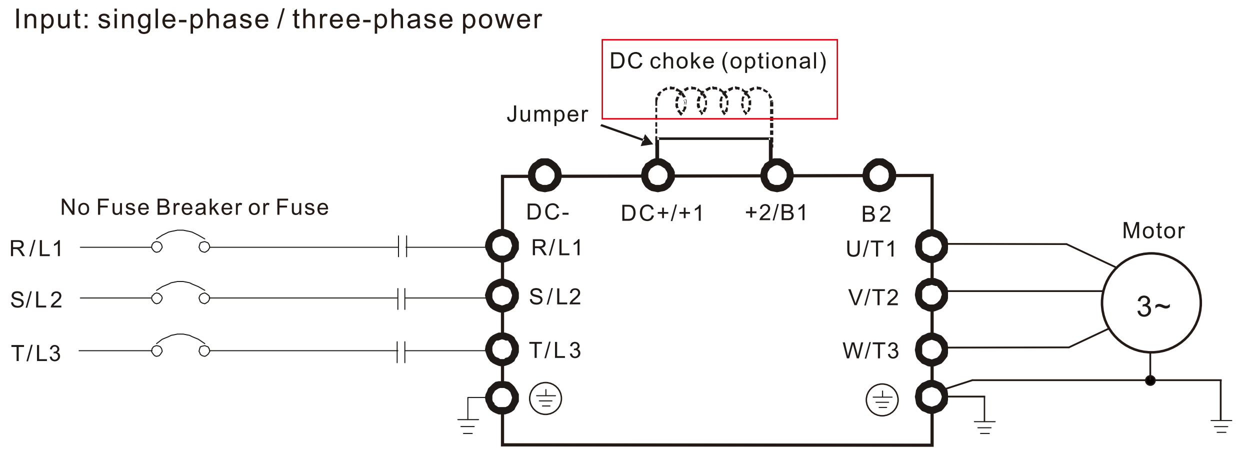


Fig. 7-6

Reactor Selection Table

115V, 50–60 Hz / Single-phase - Normal duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / DC Reactor (mH)	AC Input / DC Reactor		Output Reactor (mH)	AC Output Reactor	
				Delta Part #	Weight (kg)		Delta Part #	Weight (kg)
VFD1A6MH11ANSAA VFD1A6MH11ENSAA	1.8	2.7	3.66	DR008D0366	0.8	2.54	DR005L0254	1.5
VFD2A5MH11ANSAA VFD2A5MH11ENSAA	2.7	4.05	2.66	DR011D0266	1.2	2.54	DR005L0254	1.5
VFD5A0MH11ANSAA VFD5A0MH11ENSAA	5.5	8.25	1.17	DR025D0117	2.8	1.59	DR008L0159	2.5

Table 7-16

115V, 50–60 Hz / Single-phase - Heavy duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / DC Reactor (mH)	AC Input / DC Reactor		Output Reactor (mH)	AC Output Reactor	
				Delta Part #	Weight (kg)		Delta Part #	Weight (kg)
VFD1A6MH11ANSAA VFD1A6MH11ENSAA	1.6	3.2	3.66	DR008D0366	0.8	2.54	DR005L0254	1.5
VFD2A5MH11ANSAA VFD2A5MH11ENSAA	2.5	5	2.66	DR011D0266	1.2	2.54	DR005L0254	1.5
VFD5A0MH11ANSAA VFD5A0MH11ENSAA	5	9.6	1.17	DR025D0117	2.8	2.54	DR005L0254	1.5

Table 7-17

230V, 50–60 Hz / Single-phase - Normal duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / DC Reactor (mH)	AC Input / DC Reactor		Output Reactor (mH)	AC Output Reactor	
				Delta Part #	Weight (kg)		Delta Part #	Weight (kg)
VFD1A6MH21ANSAA VFD1A6MH21ENSAA VFD1A6MH21AFSAA	1.8	2.7	5.857	DR005D0585	0.8	2.54	DR005L0254	1.5
VFD2A8MH21ANSAA VFD2A8MH21ENSAA VFD2A8MH21AFSAA	3.2	4.8	3.66	DR008D0366	0.8	2.54	DR005L0254	1.5
VFD5A0MH21ANSAA VFD5A0MH21ENSAA VFD5A0MH21AFSAA	5	7.5	2.66	DR011D0266	1.2	2.54	DR005L0254	1.5
VFD7A5MH21ANSAA VFD7A5MH21ENSAA VFD7A5MH21AFSAA	8.5	12.75	1.72	DR017D0172	1.9	1.15	DR011L0115	3.0
VFD11AMH21ANSAA VFD11AMH21ENSAA VFD11AMH21AFSAA	12.5	18.75	1.17	DR025D0117	2.8	0.746	DR017LP746	3.6

Table 7-18

230V, 50–60 Hz / Single-phase - Heavy duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / DC Reactor (mH)	AC Input / DC Reactor		Output Reactor (mH)	AC Output Reactor	
				Delta Part #	Weight (kg)		Delta Part #	Weight (kg)
VFD1A6MH21ANSAA VFD1A6MH21ENSAA VFD1A6MH21AFSAA	1.6	3.2	5.857	DR005D0585	0.8	2.54	DR005L0254	1.5
VFD2A8MH21ANSAA VFD2A8MH21ENSAA VFD2A8MH21AFSAA	2.8	5.6	3.66	DR008D0366	0.8	2.54	DR005L0254	1.5
VFD5A0MH21ANSAA VFD5A0MH21ENSAA VFD5A0MH21AFSAA	4.8	9.6	2.66	DR011D0266	1.2	2.54	DR005L0254	1.5
VFD7A5MH21ANSAA VFD7A5MH21ENSAA VFD7A5MH21AFSAA	7.5	15	1.72	DR017D0172	1.9	1.59	DR008L0159	2.5
VFD11AMH21ANSAA VFD11AMH21ENSAA VFD11AMH21AFSAA	11	22	1.17	DR025D0117	2.8	1.15	DR011L0115	3.0

Table 7-19

230V, 50–60 Hz / Three-phase - Normal duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD1A6MH23ANSAA VFD1A6MH23ENSAA	1.8	2.7	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD2A8MH23ANSAA VFD2A8MH23ENSAA	3.2	4.8	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD5A0MH23ANSAA VFD5A0MH23ENSAA VFD5A0MH23ANSNA VFD5A0MH23ENSNA	5	7.5	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD7A5MH23ANSAA VFD7A5MH23ENSAA	8	12	1.585	DR008A0159	1.7	DR008L0159	2.5	3.66	DR008D0366
VFD11AMH23ANSAA VFD11AMH23ENSAA	12.5	18.75	0.746	DR017AP746	3.2	DR017LP746	3.6	2.662	DR011D0266
VFD17AMH23ANSAA VFD17AMH23ENSAA	19.5	29.25	0.507	DR025AP507	3.8	DR025LP507	5.5	1.722	DR017D0172
VFD25AMH23ANSAA VFD25AMH23ENSAA	27	40.5	0.32	DR033AP320	4.5	DR033LP320	6.5	1.172	DR025D0117
VFD33AMH23ANSAA VFD33AMH23ENSAA	36	54	0.216	DR049AP215	6.5	DR049LP215	8.6	0.851	DR033DP851
VFD49AMH23ANSAA VFD49AMH23ENSAA	51	76.5	0.216	DR049AP215	6.5	DR049LP215	8.6	0.574	DR049DP574
VFD65AMH23ANSAA VFD65AMH23ENSAA	69	103.5	0.169	DR075AP170	10	DR075LP170	14.5.	0.432	DR065DP432

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD75AMH23ANSAA VFD75AMH23AFSAA	81	121.5	0.141	DR090AP141	11.5	DR090LP141	15	0.325	DR090DP325
VFD90AMH23ANSAA VFD90AMH23AFSAA	102	153	0.106	DR105AP106	11.8	DR105LP106	11.8	N/A	N/A
VFD120MH23ANSAA VFD120MH23AFSAA	134	201	0.087	DR146AP087	22	DR146LP087	22	N/A	N/A
VFD146MH23ANSAA VFD146MH23AFSAA	160	240	0.070	DR180AP070	26	DR180LP070	26	N/A	N/A

Table 7-20

230V, 50–60 Hz / Three-phase - Heavy duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD1A6MH23ANSAA VFD1A6MH23ENSAA	1.6	3.2	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD2A8MH23ANSAA VFD2A8MH23ENSAA	2.8	5.6	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD5A0MH23ANSAA VFD5A0MH23ENSAA VFD5A0MH23ANSNA VFD5A0MH23ENSNA	4.8	9.6	2.536	DR005A0254	1.2	DR005L0254	1.5	5.857	DR005D0585
VFD7A5MH23ANSAA VFD7A5MH23ENSAA	7.5	15	1.585	DR008A0159	1.7	DR008L0159	2.5	3.66	DR008D0366
VFD11AMH23ANSAA VFD11AMH23ENSAA	11	22	1.152	DR011A0115	2.5	DR011L0115	3.0	2.662	DR011D0266
VFD17AMH23ANSAA VFD17AMH23ENSAA	17	34	0.746	DR017AP746	3.2	DR017LP746	3.6	1.722	DR017D0172
VFD25AMH23ANSAA VFD25AMH23ENSAA	25	50	0.507	DR025AP507	3.8	DR025LP507	5.5	1.172	DR025D0117
VFD33AMH23ANSAA VFD33AMH23ENSAA	33	66	0.32	DR033AP320	4.5	DR033LP320	6.5	0.851	DR033DP851
VFD49AMH23ANSAA VFD49AMH23ENSAA	46	92	0.216	DR049AP215	6.5	DR049LP215	8.6	0.574	DR049DP574
VFD65AMH23ANSAA VFD65AMH23ENSAA	65	130	0.163	DR065AP162	8.5	DR065LP162	12	0.432	DR065DP432
VFD75AMH23ANSAA VFD75AMH23AFSAA	75	140	0.141	DR090AP141	11.5	DR090LP141	15	0.325	DR090DP325
VFD90AMH23ANSAA VFD90AMH23AFSAA	90	180	0.106	DR105AP106	11.8	DR105LP106	11.8	N/A	N/A
VFD120MH23ANSAA VFD120MH23AFSAA	120	240	0.087	DR146AP087	22	DR146LP087	22	N/A	N/A
VFD146MH23ANSAA VFD146MH23AFSAA	146	292	0.070	DR180AP070	26	DR180LP070	26	N/A	N/A

Table 7-21

460V, 50–60 Hz / Three-phase - Normal duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD1A5MH43ANSAA VFD1A5MH43ENSAA VFD1A5MH43AFSAA	1.8	2.7	8.102	DR003A0810	1.5	DR003L0810	1.5	18.709	DR003D1870
VFD3A0MH43ANSAA VFD3A0MH43ENSAA VFD3A0MH43AFSAA VFD3A0MH43ANSNA VFD3A0MH43ENSNA	3	4.5	6.077	DR004A0607	1.8	DR004L0607	2.5	18.709	DR003D1870
VFD4A2MH43ANSAA VFD4A2MH43ENSAA VFD4A2MH43AFSAA	4.6	6.9	4.05	DR006A0405	2.8	DR006L0405	3.0	14.031	DR004D1403

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD5A7MH43ANSAA VFD5A7MH43ENSAA VFD5A7MH43AFSAA	6.5	9.75	2.7	DR009A0270	3.5	DR009L0270	3.6	9.355	DR006D0935
VFD9A0MH43ANSAA VFD9A0MH43ENSAA VFD9A0MH43AFSAA	10.5	15.75	2.315	DR010A0231	4.5	DR010L0231	5.5	5.345	DR010D0534
VFD13AMH43ANSAA VFD13AMH43ENSAA VFD13AMH43AFSAA	15.7	23.55	1.174	DR018A0117	5.3	DR018L0117	6.4	3.119	DR018D0311
VFD17AMH43ANSAA VFD17AMH43ENSAA VFD17AMH43AFSAA	20.5	30.75	0.881	DR024AP881	5.8	DR024LP88 1	7.2	3.119	DR018D0311
VFD25AMH43ANSAA VFD25AMH43ENSAA VFD25AMH43AFSAA	28	42	0.66	DR032AP660	9	DR032LP660	11	2.338	DR024D0233
VFD32AMH43ANSAA VFD32AMH43ENSAA VFD32AMH43AFSAA	36	54	0.639	DR038AP639	9.5	DR038LP639	12	1.754	DR032D0175
VFD38AMH43ANSAA VFD38AMH43ENSAA VFD38AMH43AFSAA	41.5	62.25	0.541	DR045AP541	10.5	DR045LP541	16	1.477	DR038D0147
VFD45AMH43ANSAA VFD45AMH43ENSAA VFD45AMH43AFSAA	49	73.5	0.405	DR060AP405	11.5	DR060LP405	18	1.247	DR045D0124
VFD60AMH43ANSAA VFD60AMH43AFSAA	69	103.5	0.334	DR073AP334	25	DR073LP334	25	0.935	DR060DP935
VFD75AMH43ANSAA VFD75AMH43AFSAA	85	127.5	0.267	DR091AP267	25	DR091LP267	25	N/A	N/A
VFD91AMH43ANSAA VFD91AMH43AFSAA	108	162	0.221	DR110AP221	28	DR110LP221	28	N/A	N/A
VFD112MH43ANSAA VFD112MH43AFSAA	128	192	0.162	DR150AP162	35	DR150LP162	35	N/A	N/A
VFD150MH43ANSAA VFD150MH43AFSAA	180	270	0.135	DR180AP135	42	DR180LP135	42	N/A	N/A

Table 7-22

460V, 50–60 Hz / Three-phase - Heavy duty

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD1A5MH43ANSAA VFD1A5MH43ENSAA VFD1A5MH43AFSAA	1.5	3	8.102	DR003A0810	1.5	DR003L0810	1.5	18.709	DR003D1870
VFD3A0MH43ANSAA VFD3A0MH43ENSAA VFD3A0MH43AFSAA VFD3A0MH43ANSNA VFD3A0MH43ENSNA	2.7	5.4	8.102	DR003A0810	1.5	DR003L0810	1.5	18.709	DR003D1870
VFD4A2MH43ANSAA VFD4A2MH43ENSAA VFD4A2MH43AFSAA	4.2	8.4	6.077	DR004A0607	1.8	DR004L0607	2.5	14.031	DR004D1403
VFD5A7MH43ANSAA VFD5A7MH43ENSAA VFD5A7MH43AFSAA	5.5	11	4.05	DR006A0405	2.8	DR006L0405	3.0	9.355	DR006D0935
VFD9A0MH43ANSAA VFD9A0MH43ENSAA VFD9A0MH43AFSAA	9	18	2.7	DR009A0270	3.5	DR009L0270	3.6	6.236	DR009D0623
VFD13AMH43ANSAA VFD13AMH43ENSAA VFD13AMH43AFSAA	13	26	1.174	DR018A0117	5.3	DR018L0117	6.4	4.677	DR012D0467
VFD17AMH43ANSAA VFD17AMH43ENSAA VFD17AMH43AFSAA	17	34	1.174	DR018A0117	5.3	DR018L0117	6.4	3.119	DR018D0311

Model	Rated Current (Arms)	Saturation Current (Arms)	Input / Output Reactor (mH)	AC Input Reactor		AC Output Reactor		DC Reactor (mH)	DC Reactor Delta Part #
				Delta Part #	Weight (kg)	Delta Part #	Weight (kg)		
VFD25AMH43ANSAA VFD25AMH43ENSAA VFD25AMH43AFSAA	25	50	0.881	DR024AP881	5.8	DR024LP881	7.2	2.338	DR024D0233
VFD32AMH43ANSAA VFD32AMH43ENSAA VFD32AMH43AFSAA	32	64	0.66	DR032AP660	9	DR032LP660	11	1.754	DR032D0175
VFD38AMH43ANSAA VFD38AMH43ENSAA VFD38AMH43AFSAA	38	76	0.639	DR038AP639	9.5	DR038LP639	12	1.477	DR038D0147
VFD45AMH43ANSAA VFD45AMH43ENSAA VFD45AMH43AFSAA	45	90	0.541	DR045AP541	10.5	DR045LP541	16	1.247	DR045D0124
VFD60AMH43ANSAA VFD60AMH43AFSAA	60	120	0.334	DR073AP334	25	DR073LP334	25	0.935	DR060DP935
VFD75AMH43ANSAA VFD75AMH43AFSAA	75	150	0.267	DR091AP267	25	DR091LP267	25	N/A	N/A
VFD91AMH43ANSAA VFD91AMH43AFSAA	91	182	0.221	DR110AP221	28	DR110LP221	28	N/A	N/A
VFD112MH43ANSAA VFD112MH43AFSAA	112	224	0.162	DR150AP162	35	DR150LP162	35	N/A	N/A
VFD150MH43ANSAA VFD150MH43AFSAA	150	300	0.135	DR180AP135	42	DR180LP135	42	N/A	N/A

Table 7-23

The table below shows the THDi specification when using Delta's drives to work with AC / DC reactors.

Drive Spec.	Models without Built-in DC Reactors				Models with Built-in DC Reactors		
Reactor Spec.	No AC / DC Reactor	3% Input AC Reactor	5% Input AC Reactor	4% DC Reactor	No AC/DC Reactor	3% Input AC Reactor	5% Input AC Reactor
5th	73.3%	38.5%	30.8%	25.5%	31.16%	27.01%	25.5%
7th	52.74%	15.3%	9.4%	18.6%	23.18%	9.54%	8.75%
11th	7.28%	7.1%	6.13%	7.14%	8.6%	4.5%	4.2%
13th	0.4%	3.75%	3.15%	0.48%	7.9%	0.22%	0.17%
THDi	91%	43.6%	34.33%	38.2%	42.28%	30.5%	28.4%

Table 7-24

NOTE:

The THDi specification listed here assumes that there is 0.8% resistance (mains electricity) before the reactors and may be slightly different from the actual THDi, depending on the installation and environmental conditions (cables, motors).

Dimensions and Specifications of Reactors

AC Input Reactor

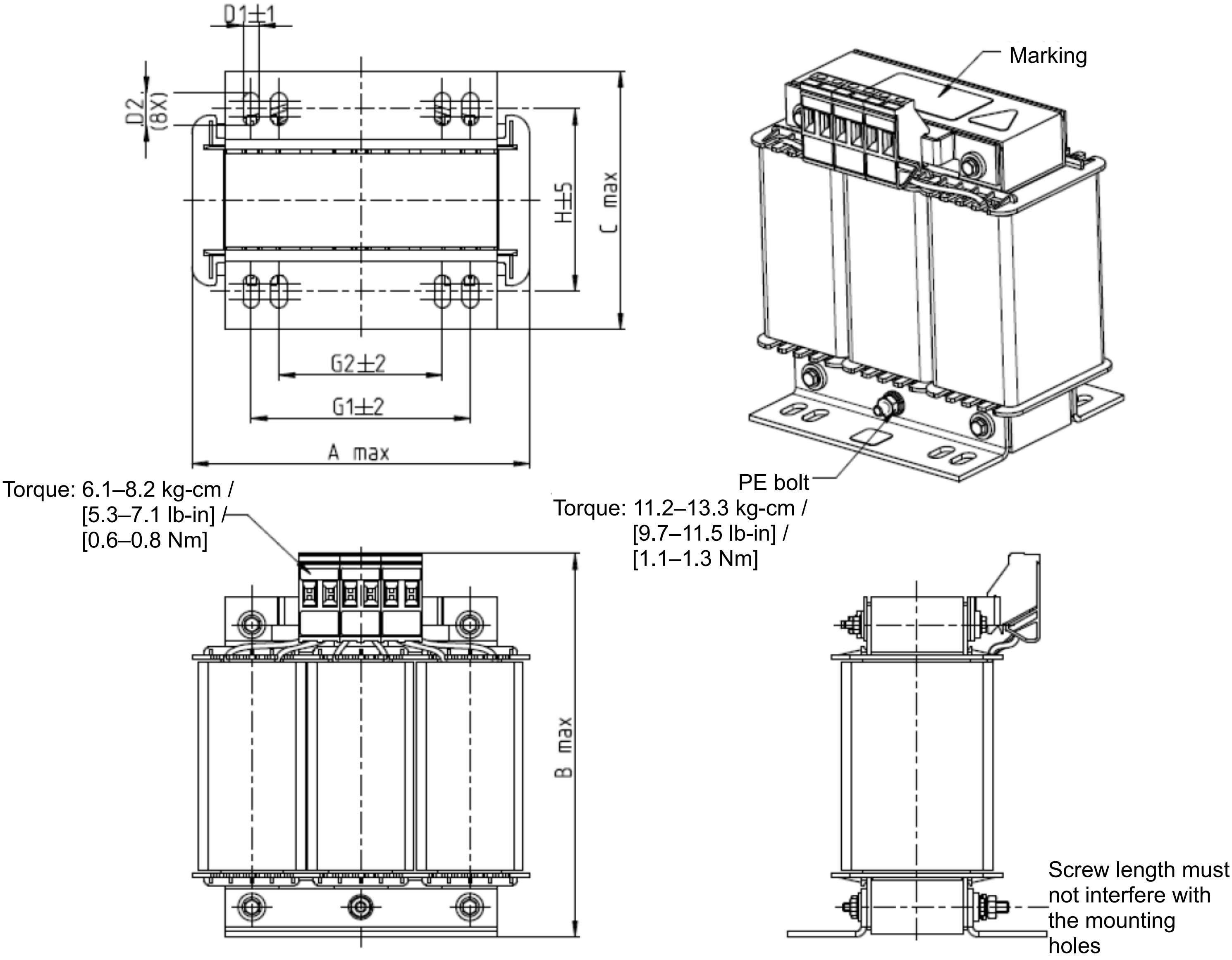


Fig. 7-7

Unit: mm

Delta's Part No. - AC Input Reactor	A	B	C	D1*D2	H	G1	G2	PE D
DR005A0254	100	115	65	6*9	45	60	40	M4
DR008A0159	100	115	65	6*9	45	60	40	M4
DR011A0115	130	135	95	6*12	60	80.5	60	M4
DR017AP746	130	135	100	6*12	65	80.5	60	M4

Table 7-25

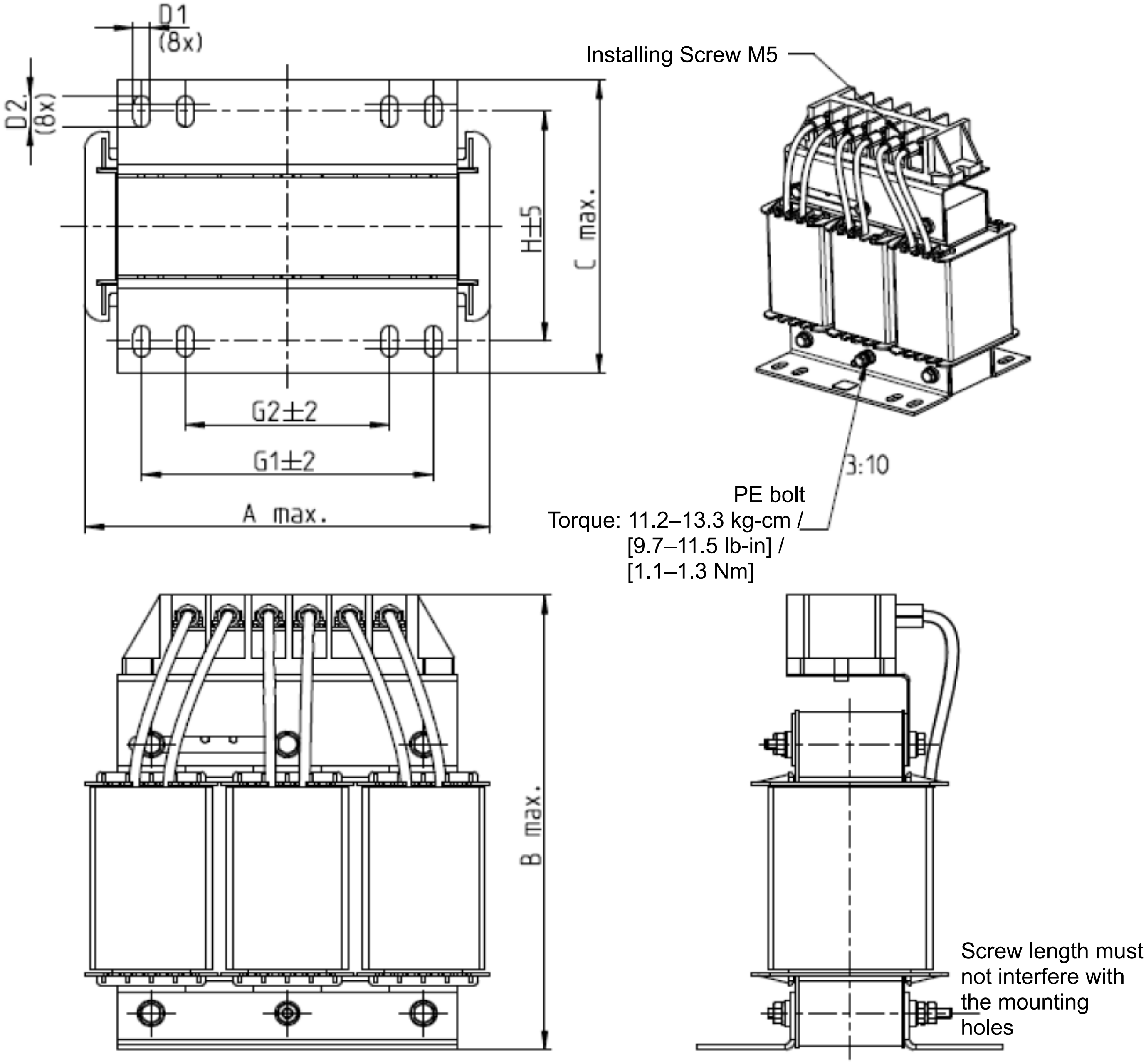


Fig. 7-8

Unit: mm

Delta's Part No. - AC Input Reactor	A	B	C	D1*D2	H	G1	G2	PE D
DR025AP507	130	195	100	6*12	65	80.5	60	M4
DR033AP320	130	195	100	6*12	65	80.5	60	M4
DR049AP215	160	200	125	6*12	90	107	75	M4

Table 7-26

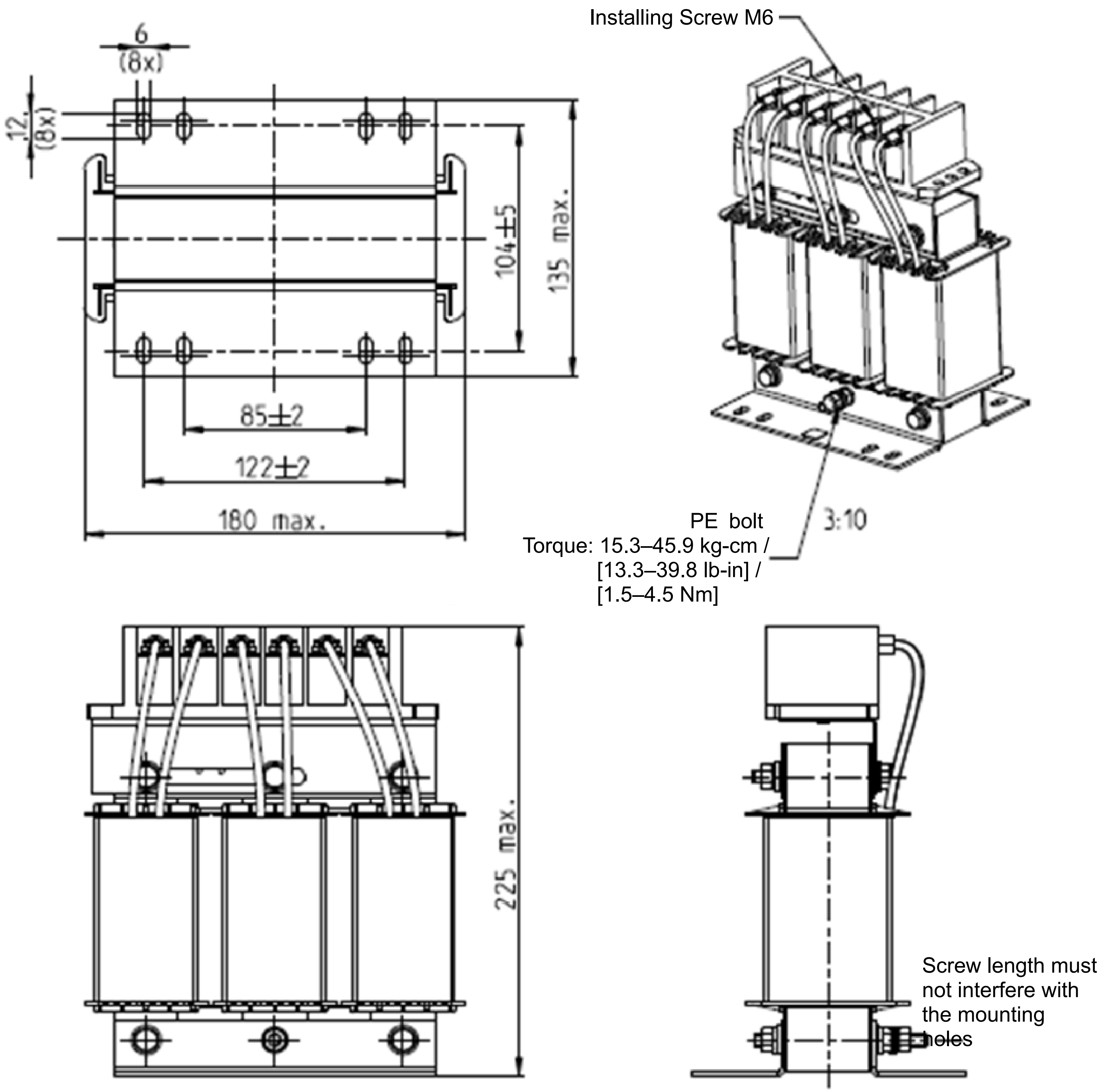


Fig. 7-9

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR065AP162	As shown in the figure above

Table 7-27

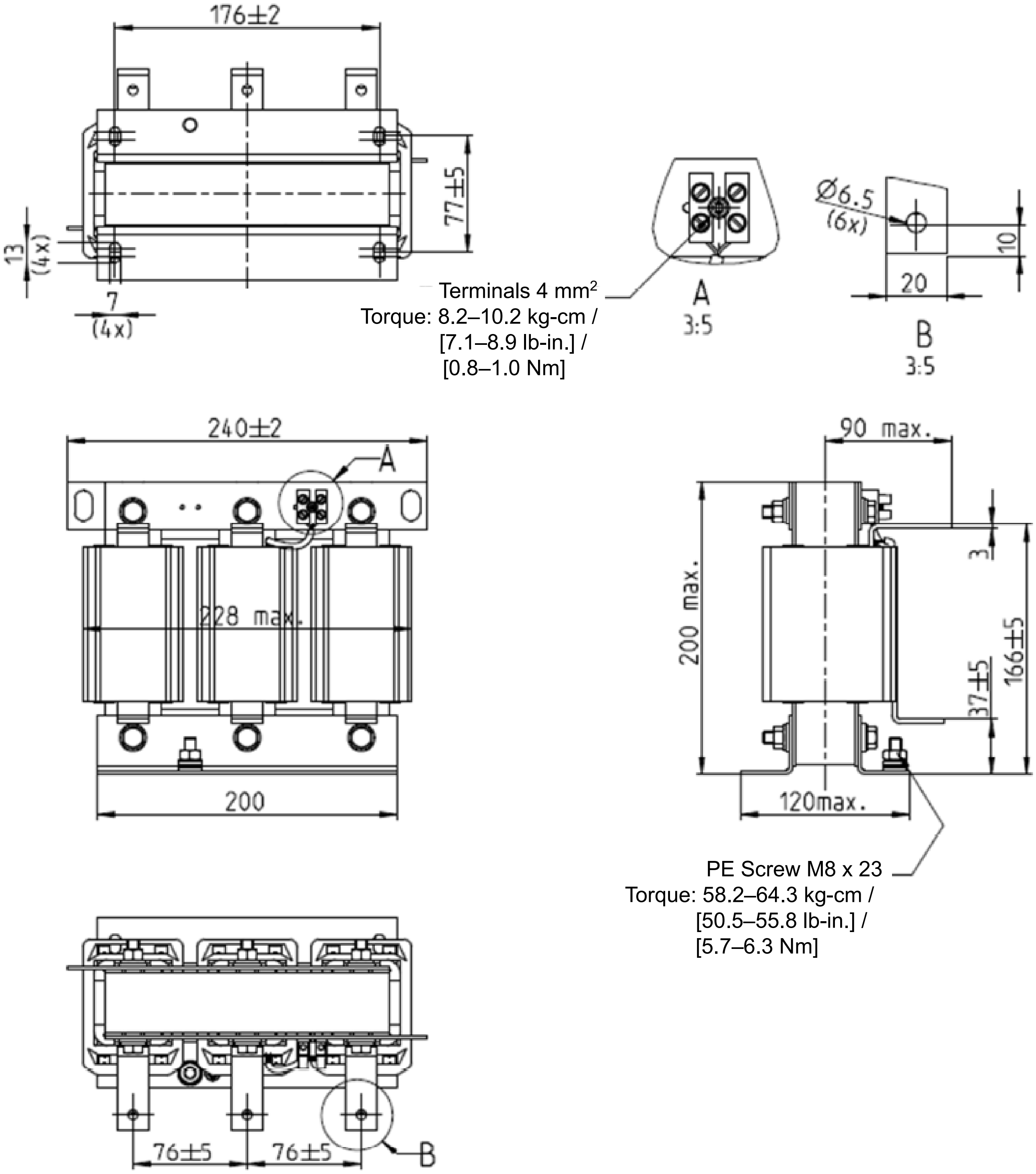


Fig. 7-10

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR075AP170	As shown in the figure above

Table 7-28

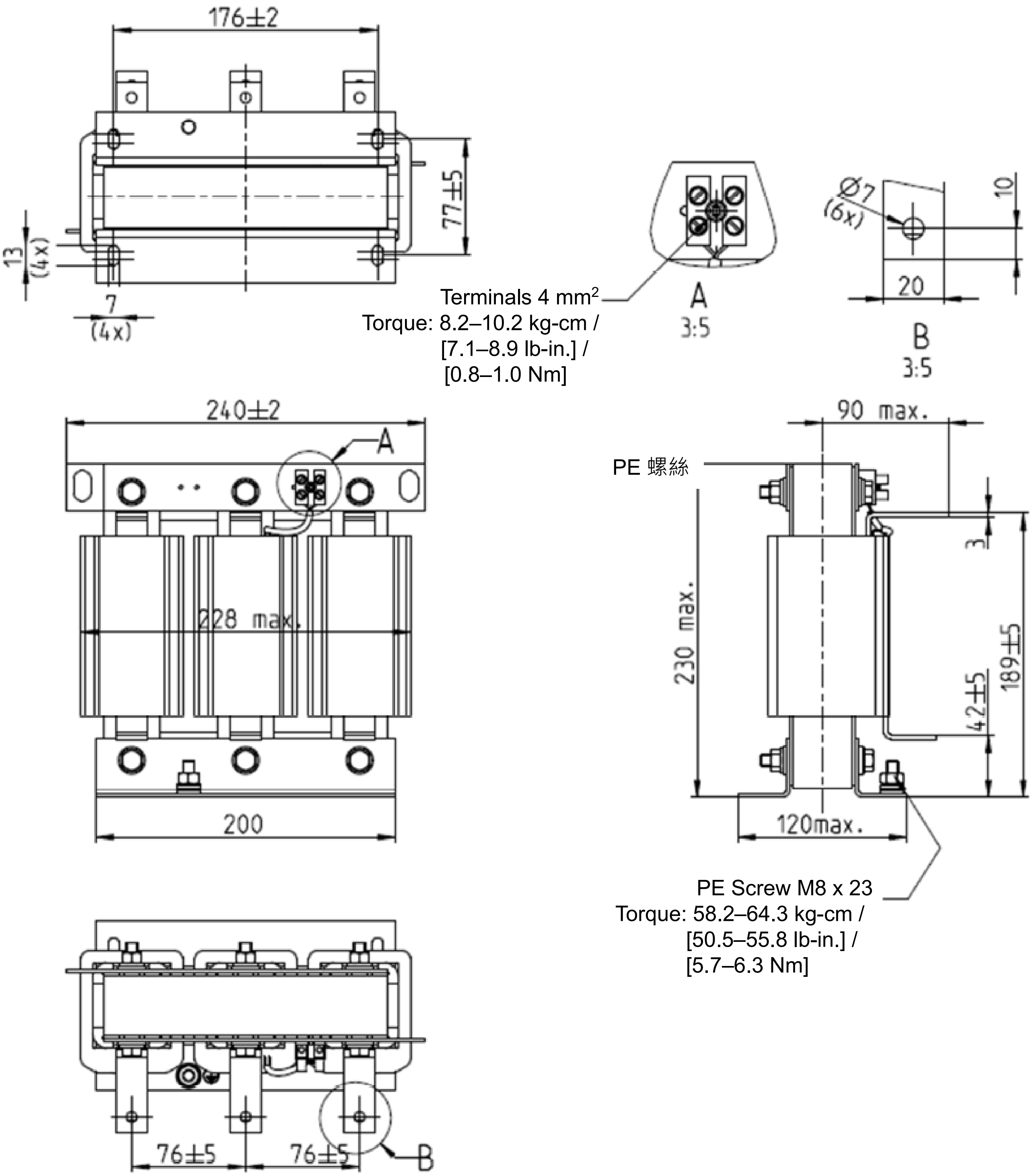


Fig. 7-11

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR090AP141	As shown in the figure above

Table 7-29

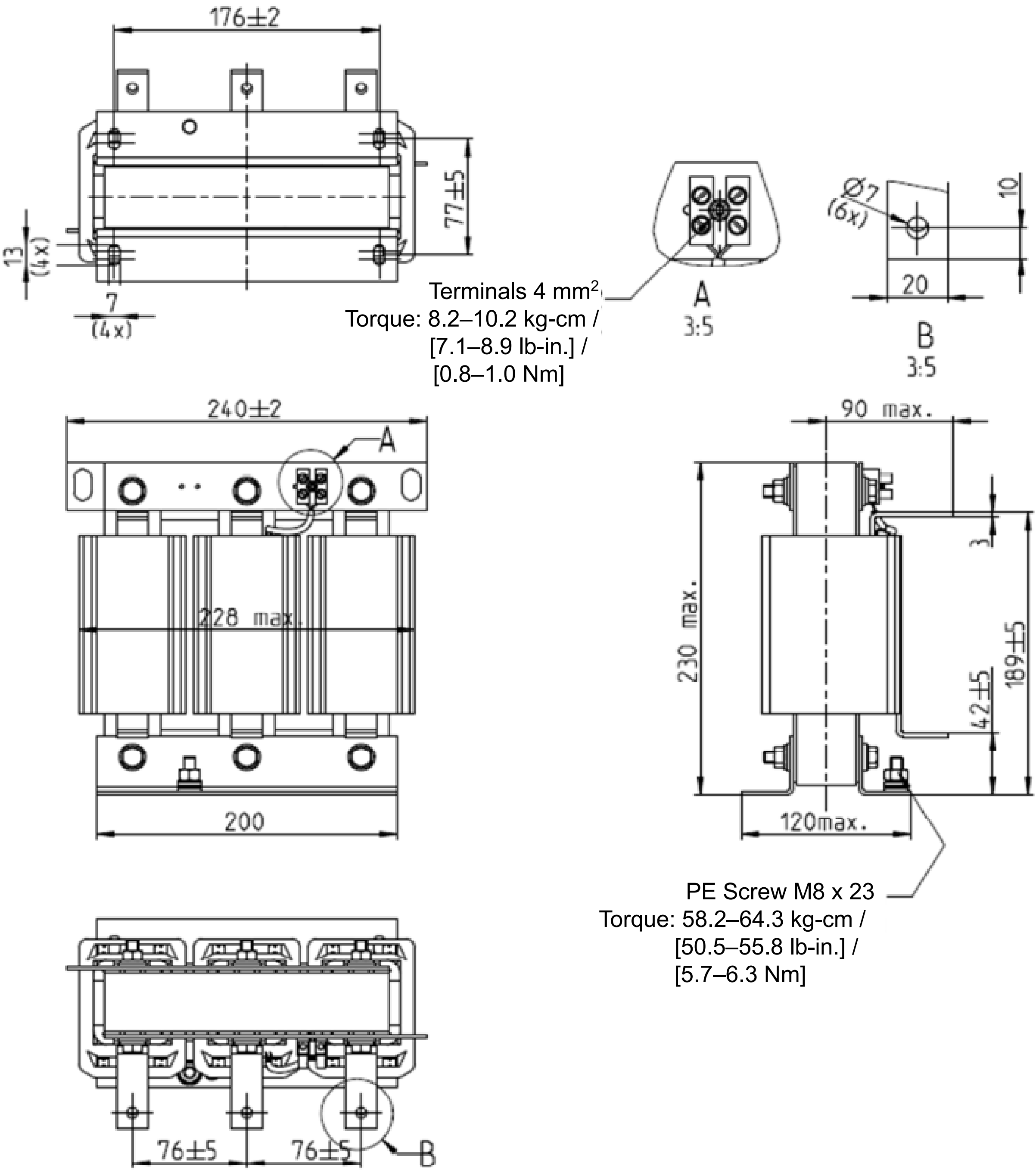


Fig. 7-12

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR105AP106	As shown in the figure above

Table 7-30

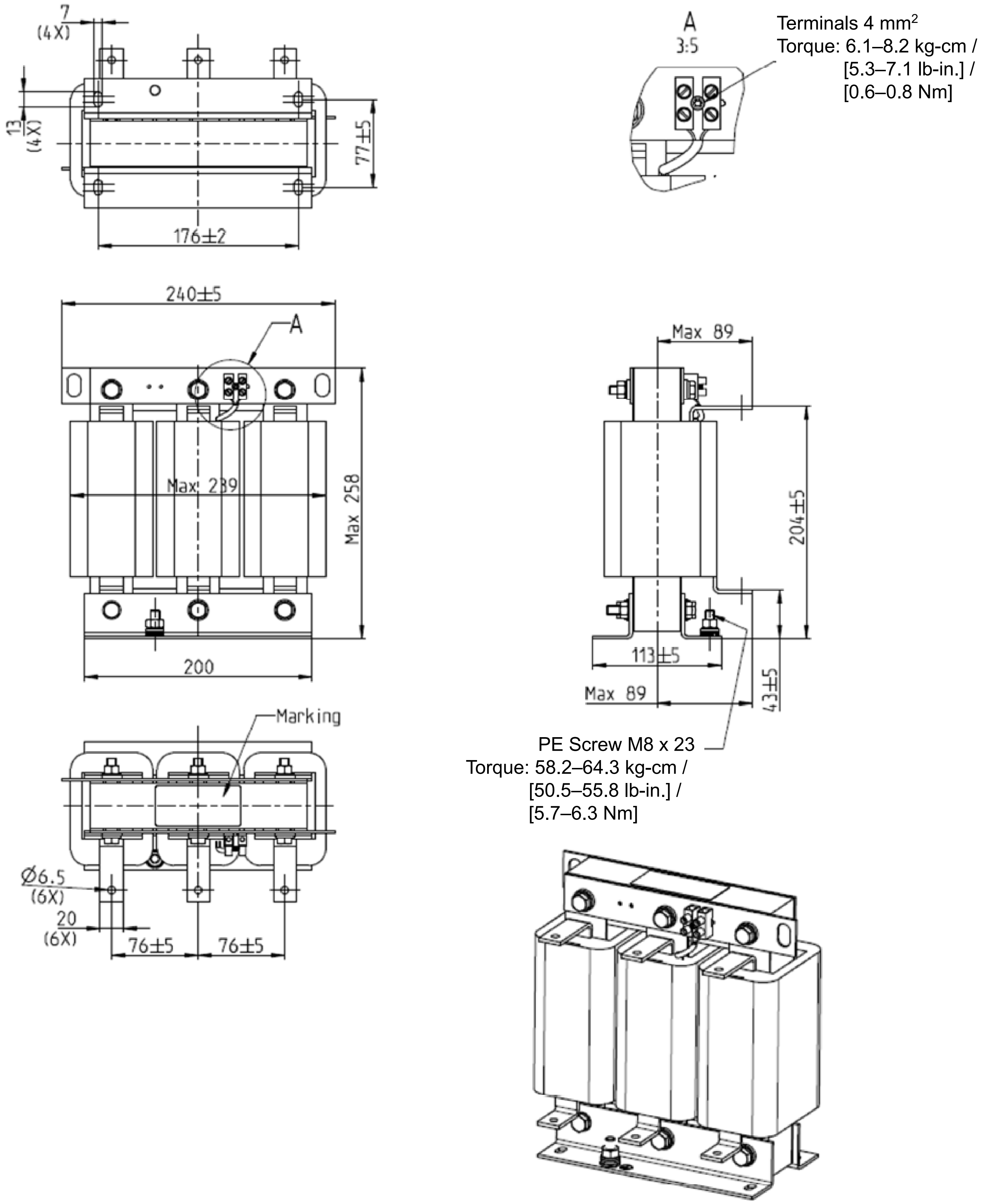


Fig. 7-13

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR146AP087	As shown in the figure above

Table 7-31

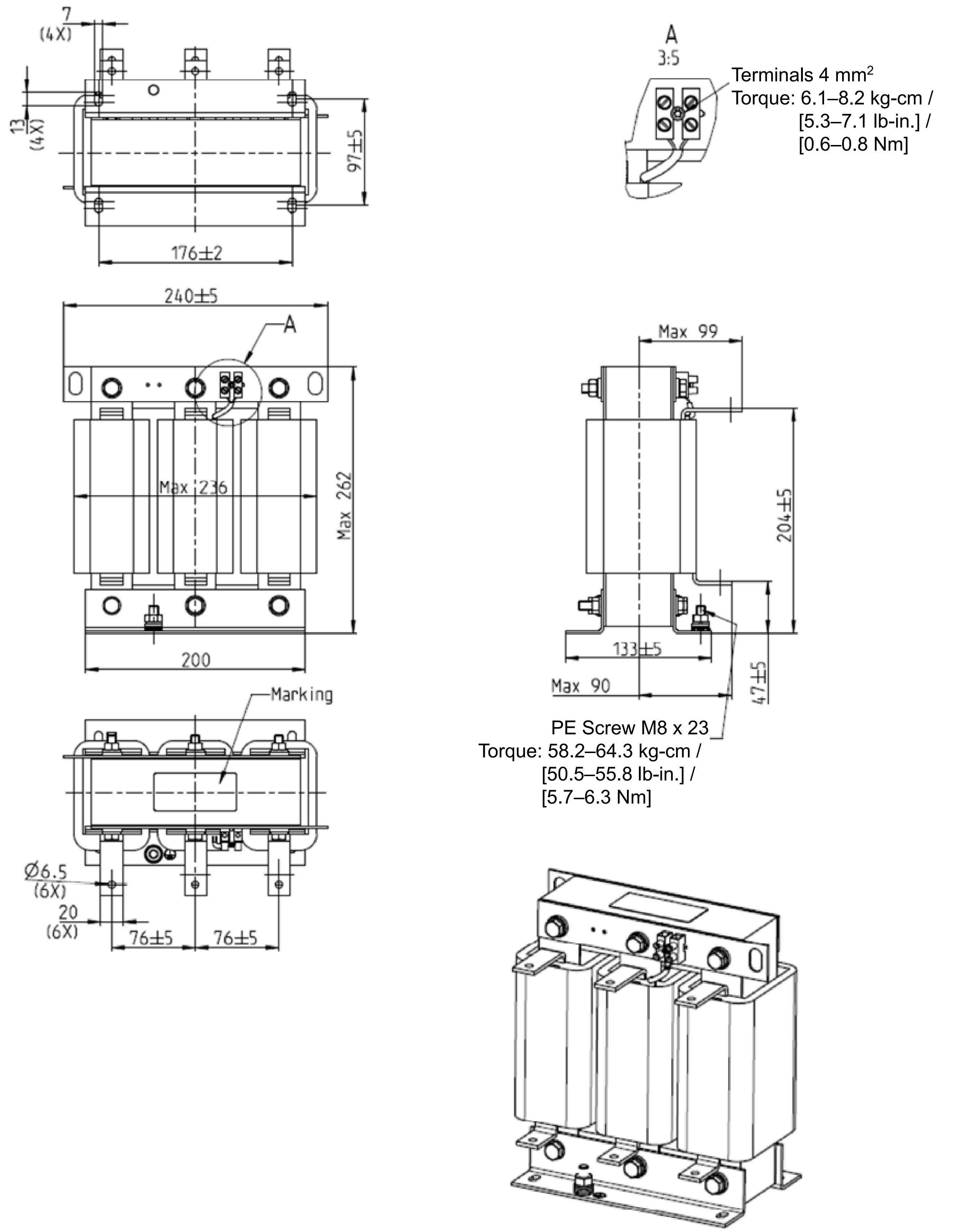


Fig. 7-14

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR180AP070	As shown in the figure above

Table 7-32

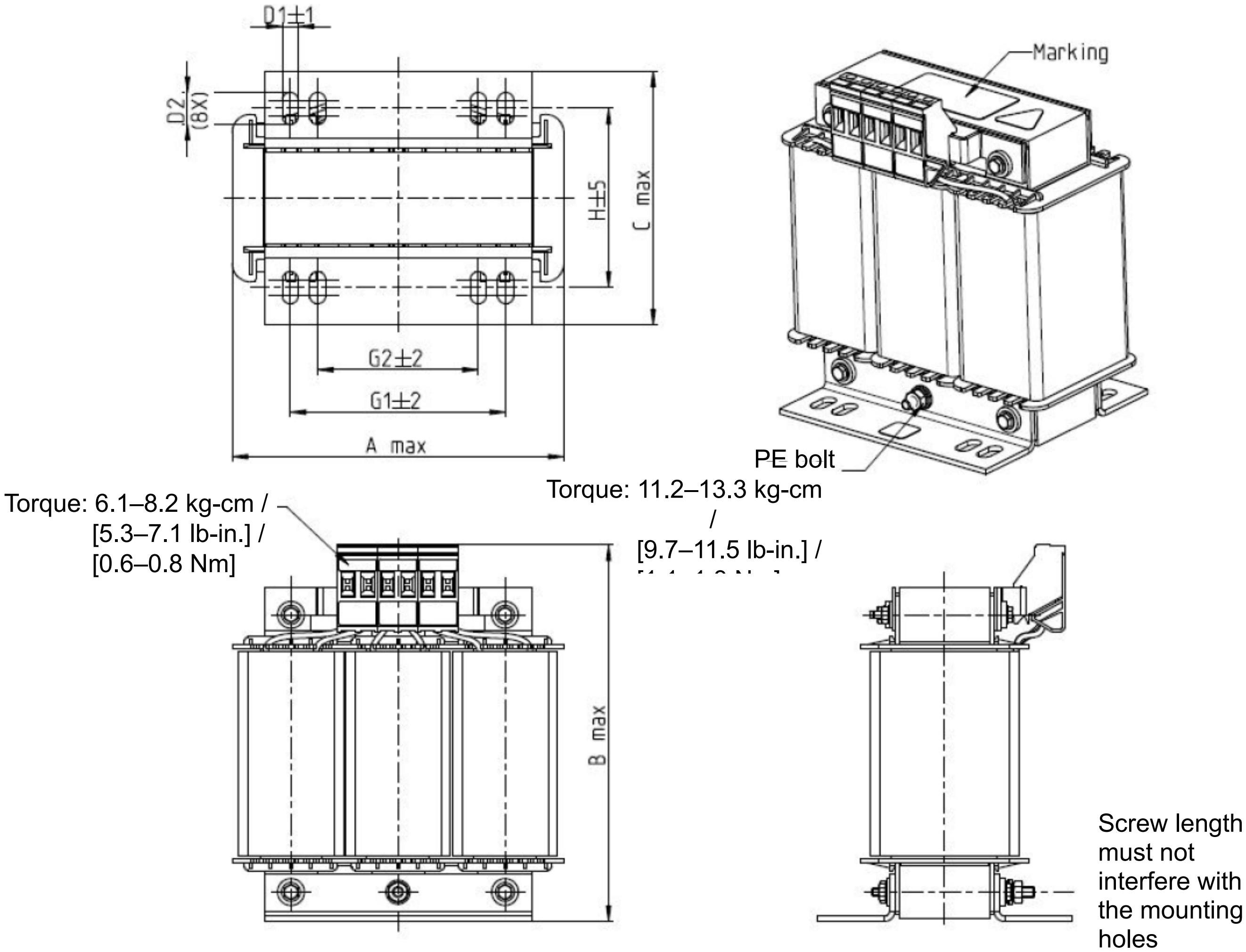


Fig. 7-15

Unit: mm

Delta's Part No. - AC Input Reactor	A	B	C	D1*D2	H	G1	G2	PE D
DR003A0810	100	125	65	6*9	43	60	40	M4
DR004A0607	100	125	65	6*9	43	60	40	M4
DR006A0405	130	135	95	6*12	60	80.5	60	M4
DR009A0270	160	160	105	6*12	75	107	75	M4
DR010A0231	160	160	115	6*12	90	107	75	M4
DR012A0202	160	160	115	6*12	90	107	75	M4
DR018A0117	160	160	115	6*12	90	107	75	M4

Table 7-33

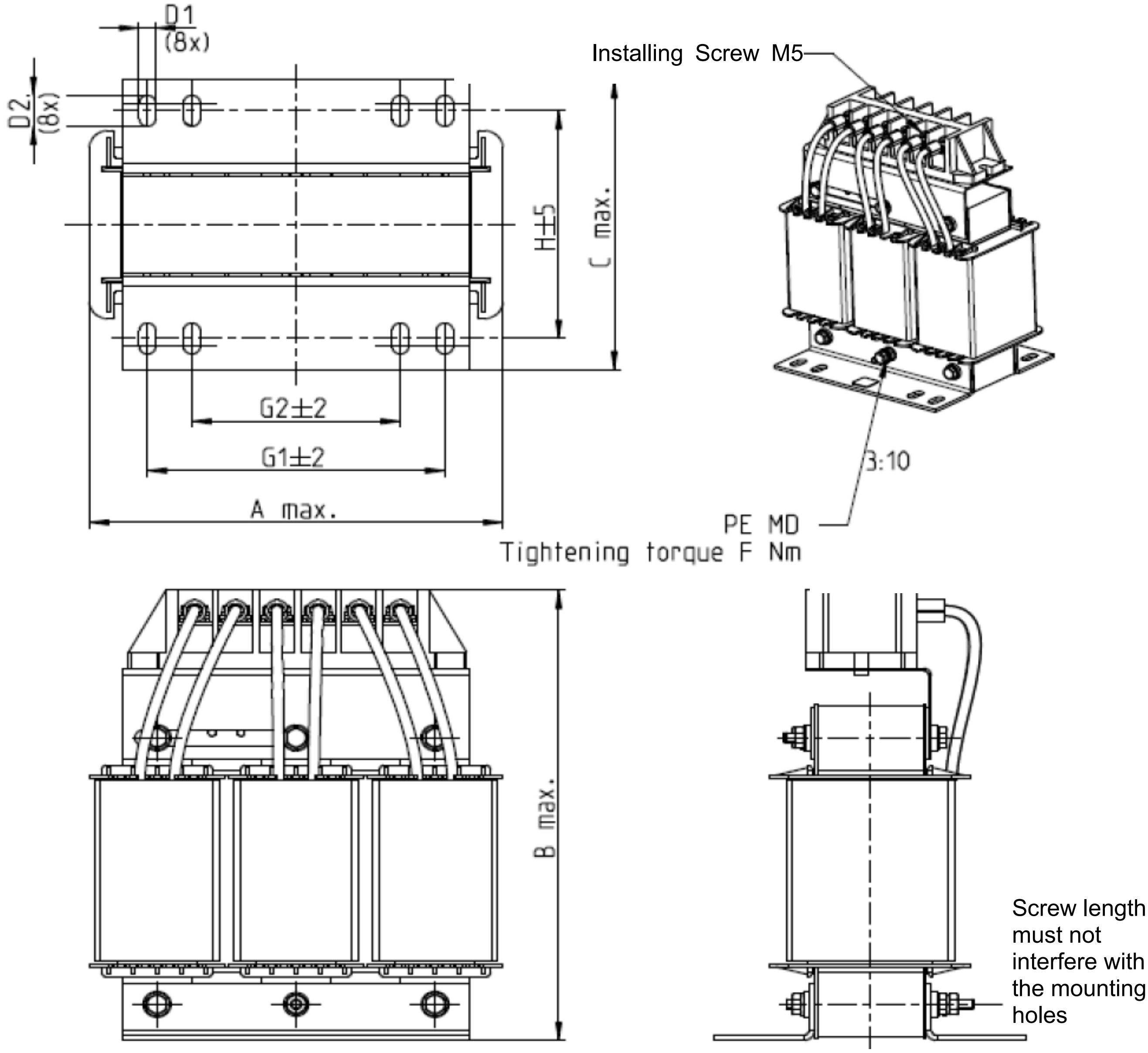


Fig. 7-16

Unit: mm

Delta's Part No. - AC Input Reactor	A	B	C	D1*D2	H	G1	G2	PE D	F
DR024AP881	160	175	115	6*12	90	107	75	M4	11.2–13.3 kg-cm / [9.7–11.5 lb-in.] / [1.1–1.3 Nm]
DR032AP660	195	200	145	6*12	115	122	85	M6	29.1–32.1 kg-cm / [25.3–27.9 lb-in.] / [2.85–3.15 Nm]
DR038AP639	190	200	145	6*12	115	122	85	M6	
DR045AP541	190	200	145	6*12	115	122	85	M6	

Table 7-34

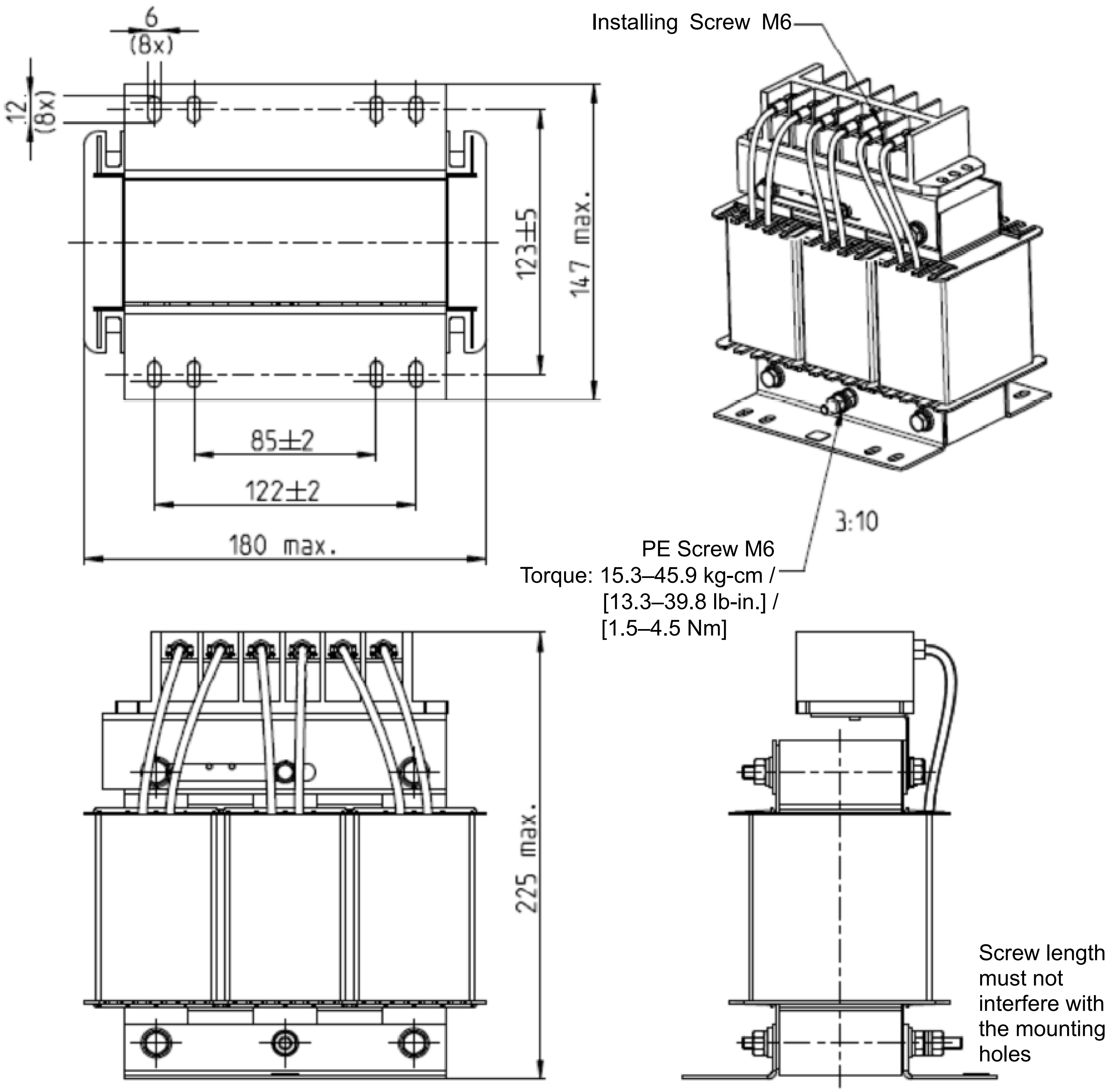


Fig. 7-17

Unit: mm

Delta's Part No. - AC Input Reactor	Dimensions
DR060AP405	As shown in the figure above

Table 7-35

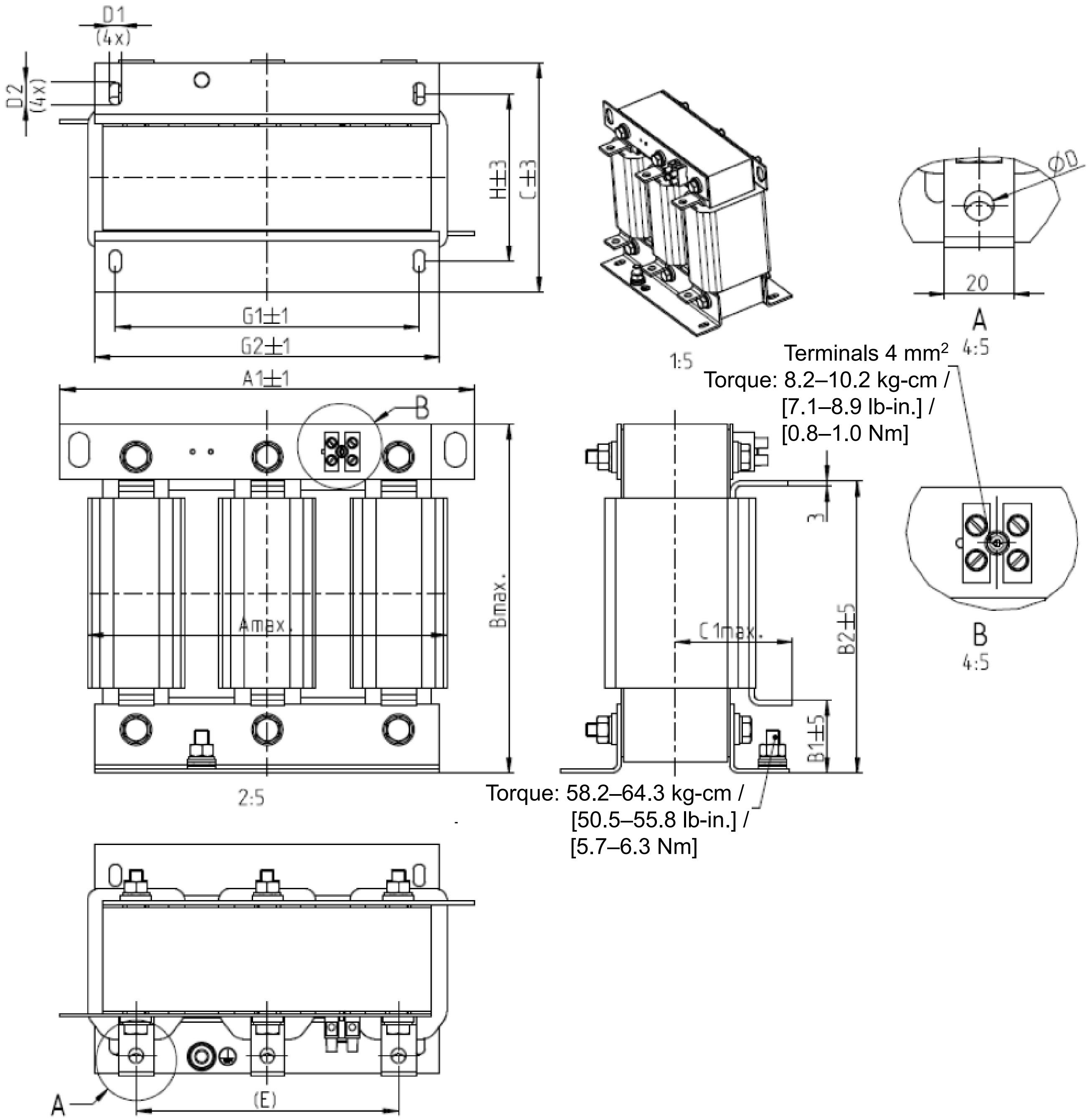


Fig. 7-18

Unit: mm

Delta's Part No. - AC Input Reactor	A	A1	B	B1	B2	C	C1	D	D1*D2	E	G1	G2	H
DR073AP334	228	240	215	40	170	133	75	8.5	7*13	152	176	200	97
DR091AP267	228	240	245	40	195	133	90	8.8	7*13	152	176	200	97
DR110AP221	228	240	245	40	195	138	95	8.5	7*13	152	176	200	102

Table 7-36

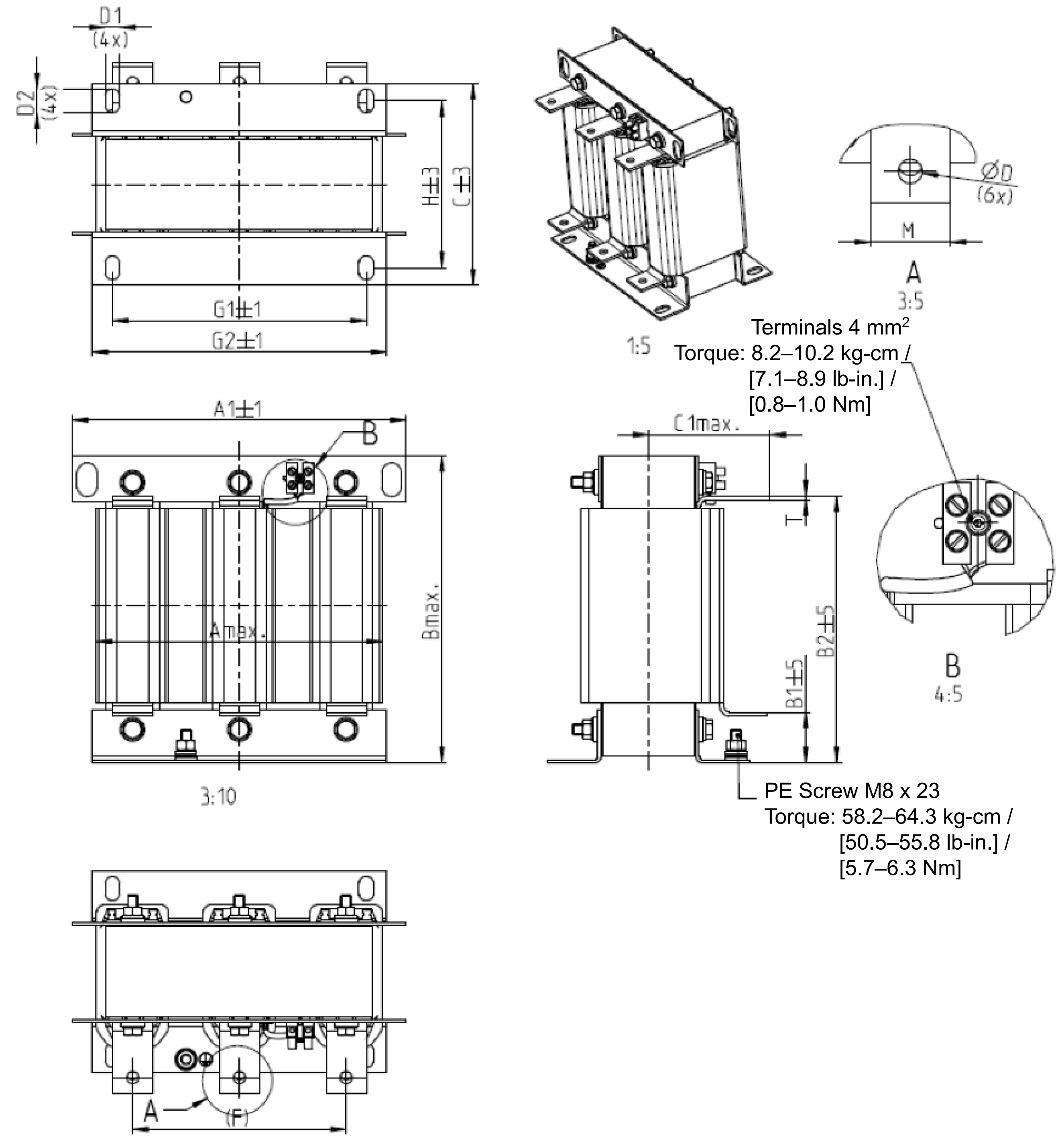


Fig. 7-19

Unit: mm

Delta's Part No. - AC Input Reactor	A	A1	B	B1	B2	C	C1	D	D1*D2	F	G1	G2	H	M*T
DR150AP162	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3
DR180AP135	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3

Table 7-37

AC Output Reactor

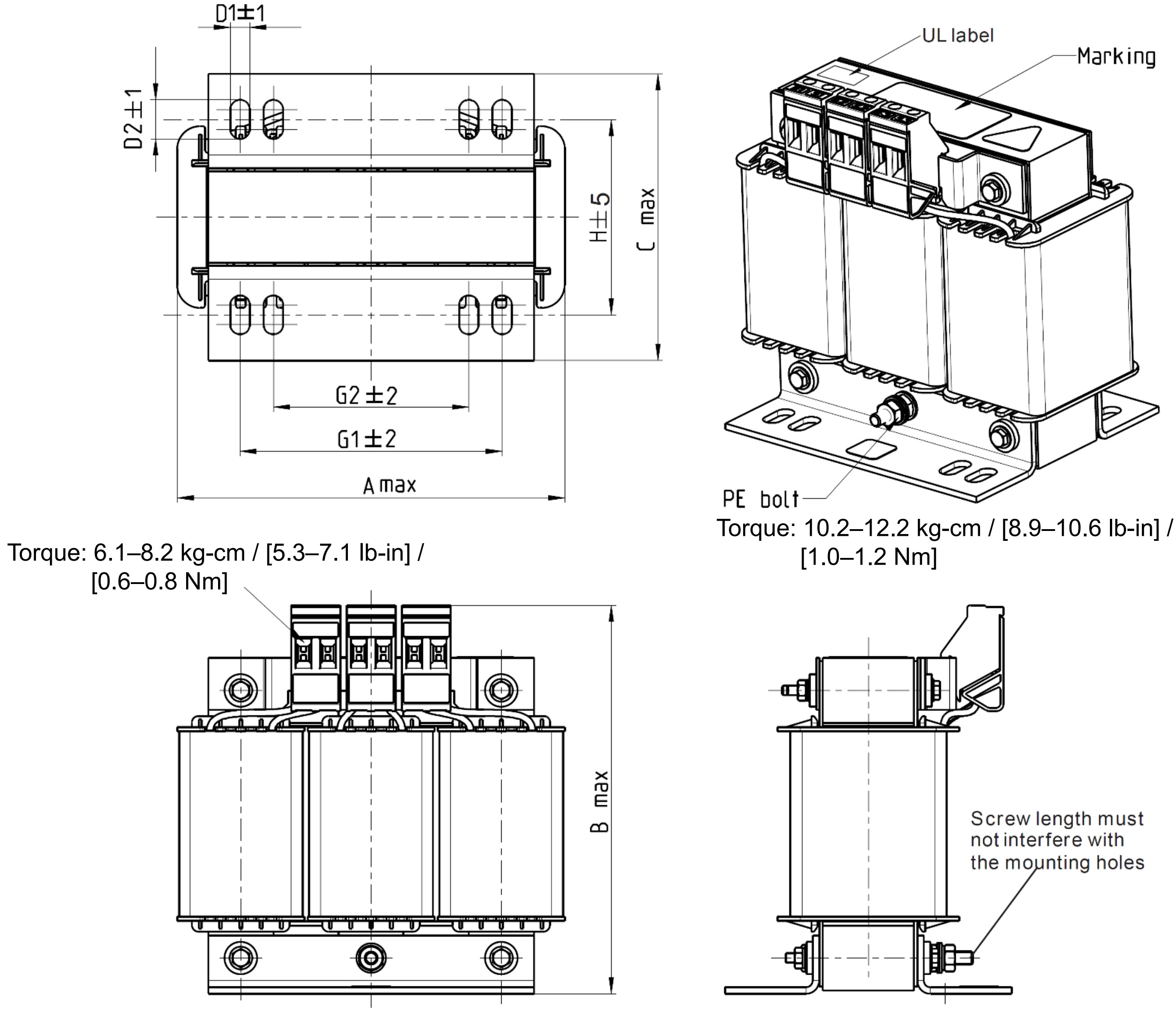


Fig. 7-20

Unit: mm

Delta's Part No. - AC Output Reactor	A	B	C	D1*D2	H	H1	H2	PE D
DR005L0254	96	110	70	6*9	42	60	40	M4
DR008L0159	120	135	96	6*12	60	80.5	60	M4
DR011L0115	120	135	96	6*12	60	80.5	60	M4
DR017LP746	120	135	105	6*12	65	80.5	60	M4
DR025LP507	150	160	120	6*12	88	107	75	M4
DR033LP320	150	160	120	6*12	88	107	75	M4

Table 7-38

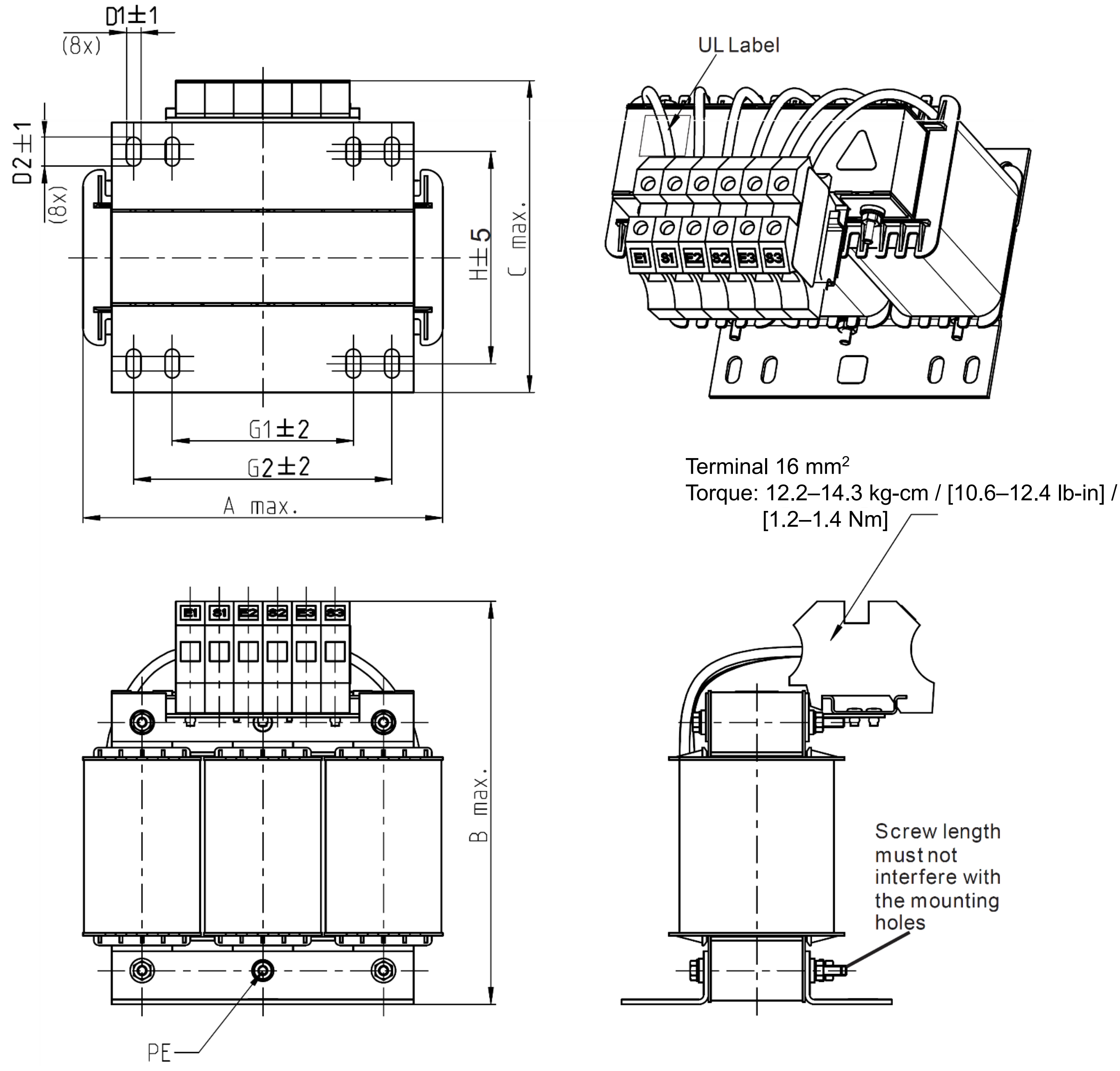


Fig. 7-21

Unit: mm

Delta's Part No. - AC Output Reactor	A	B	C	D1*D2	H	G	G1	Q	M	PE D
DR049LP215	180	205	175	6*12	115	85	122	16	1.2–1.4	M4
DR065LP162	180	215	185	6*12	115	85	122	35	2.5–3.0	M4

Table 7-39

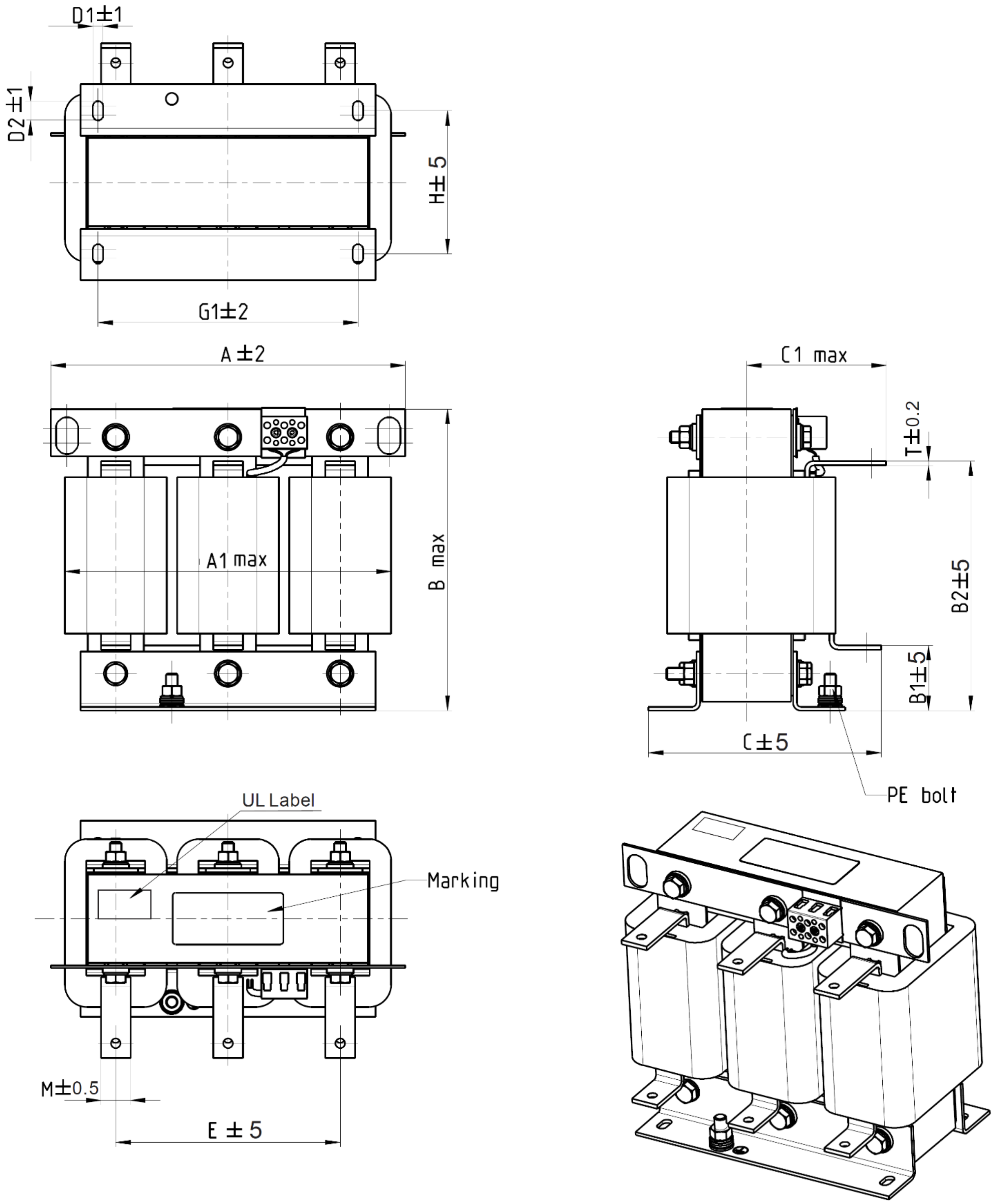


Fig. 7-22

Unit: mm

Delta's Part No. - AC Output Reactor	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR075LP170	240	228	215	44	170	151	100	7*13	152	176	85	20*3
DR090LP141	240	228	215	44	170	151	100	7*13	152	176	85	20*3
DR105LP106	240	228	215	44	170	165	110	7*13	152	176	97	20*3
DR146LP087	240	228	240	45	202	165	110	7*13	152	176	97	30*3
DR180LP070	250	240	250	46	205	175	110	11*18	160	190	124	30*5

Table 7-40

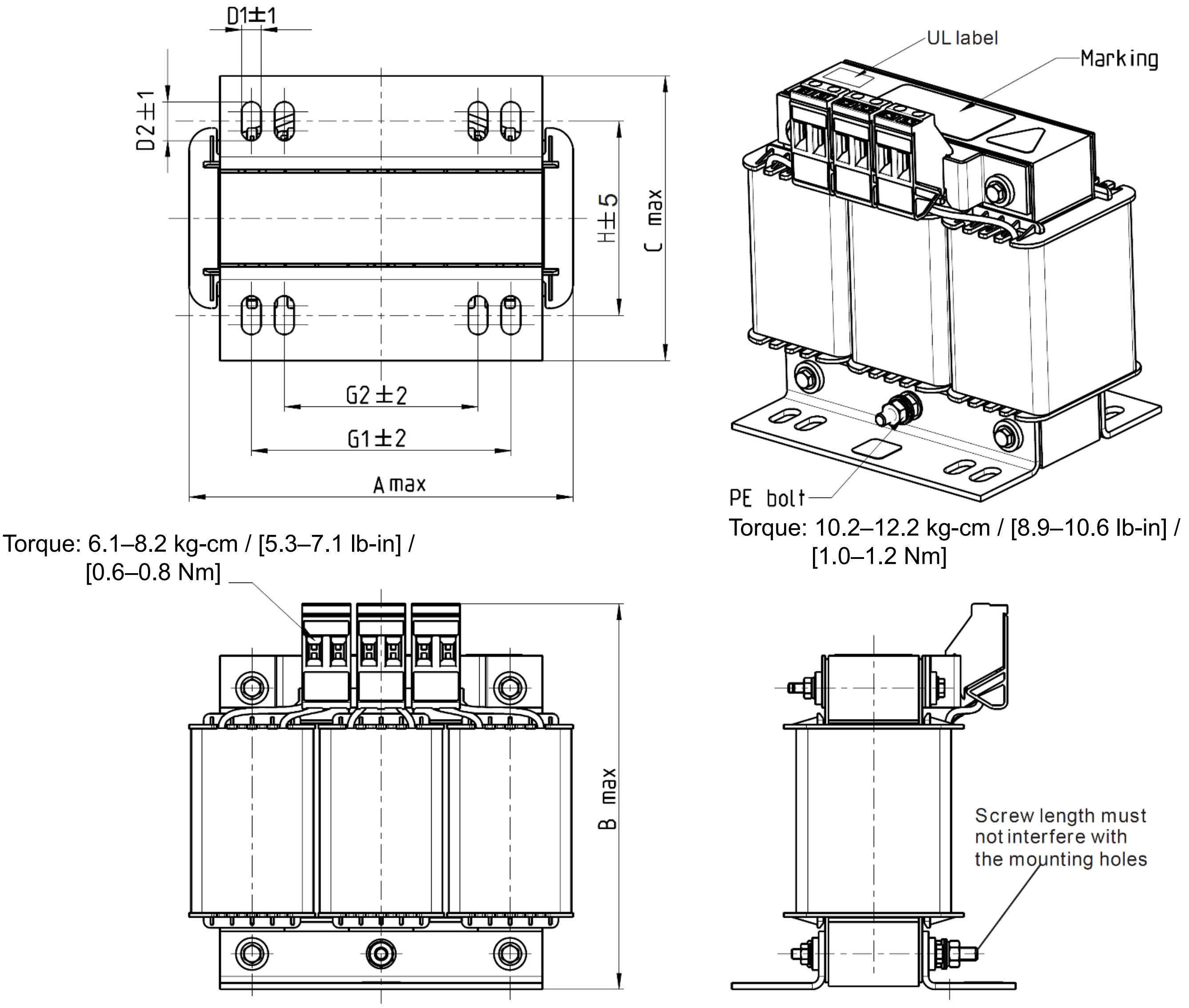


Fig. 7-23

Unit: mm

Delta's Part No. - AC Output Reactor	A	B	C	D1*D2	H	G1	G2	PE
DR003L0810	96	115	65	6*9	42	60	40	M4
DR004L0607	120	135	95	6*12	60	80.5	60	M4
DR006L0405	120	135	95	6*12	60	80.5	60	M4
DR009L0270	150	160	100	6*12	74	107	75	M4
DR010L0231	150	160	115	6*12	88	107	75	M4
DR012L0202	150	160	115	6*12	88	107	75	M4
DR018L0117	150	160	115	6*12	88	107	75	M4
DR024LP881	150	160	115	6*12	88	107	75	M4
DR032LP660	180	190	145	6*12	114	122	85	M6

Table 7-41

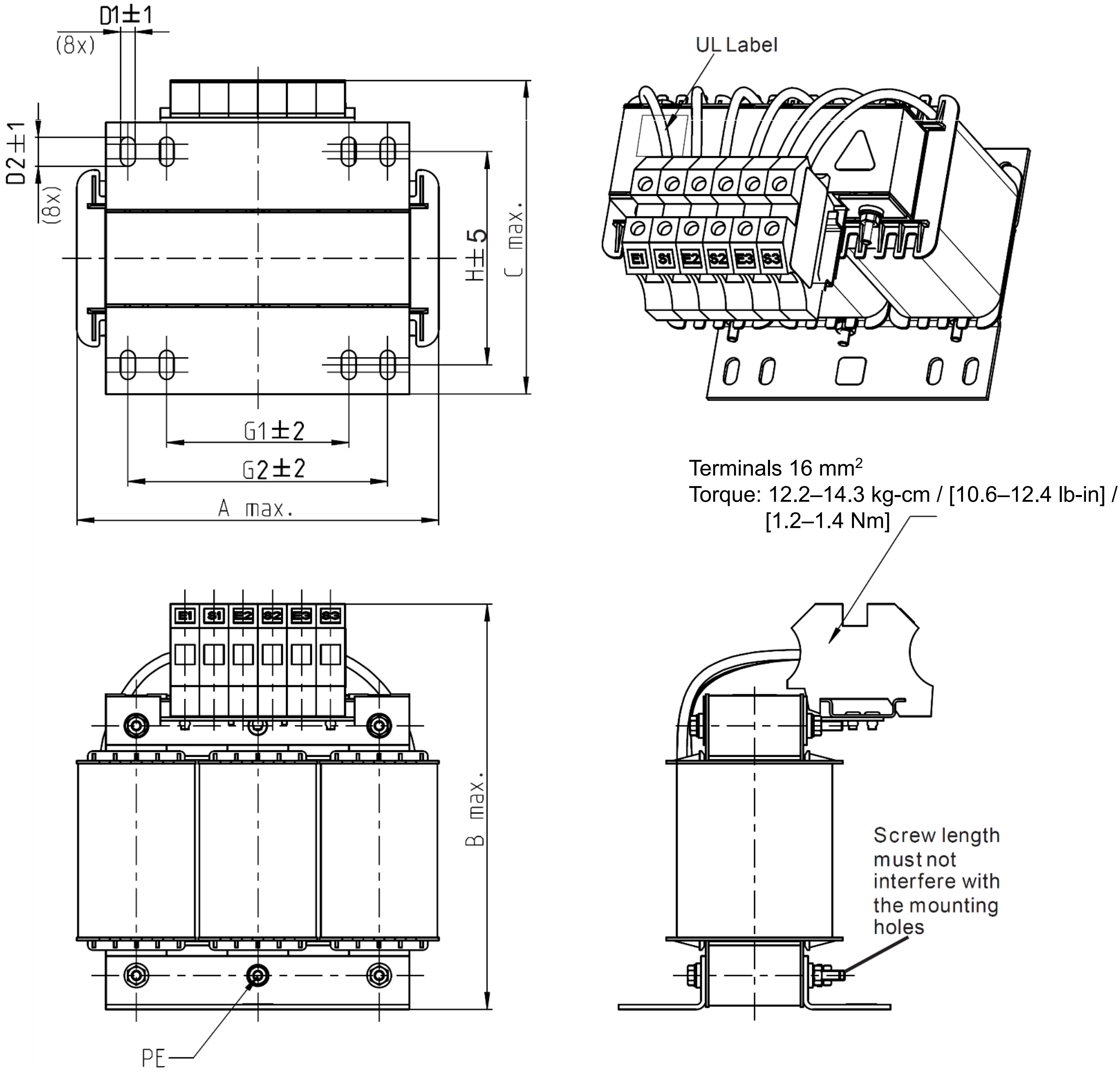


Fig. 7-24

Unit: mm

Delta's Part No. - AC Output Reactor	A	B	C	D1*D2	H	G1	G2	PE
DR038LP639	180	205	170	6*12	115	85	122	M4
DR045LP541	235	245	150	7*13	85	/	176	M6

Table 7-42

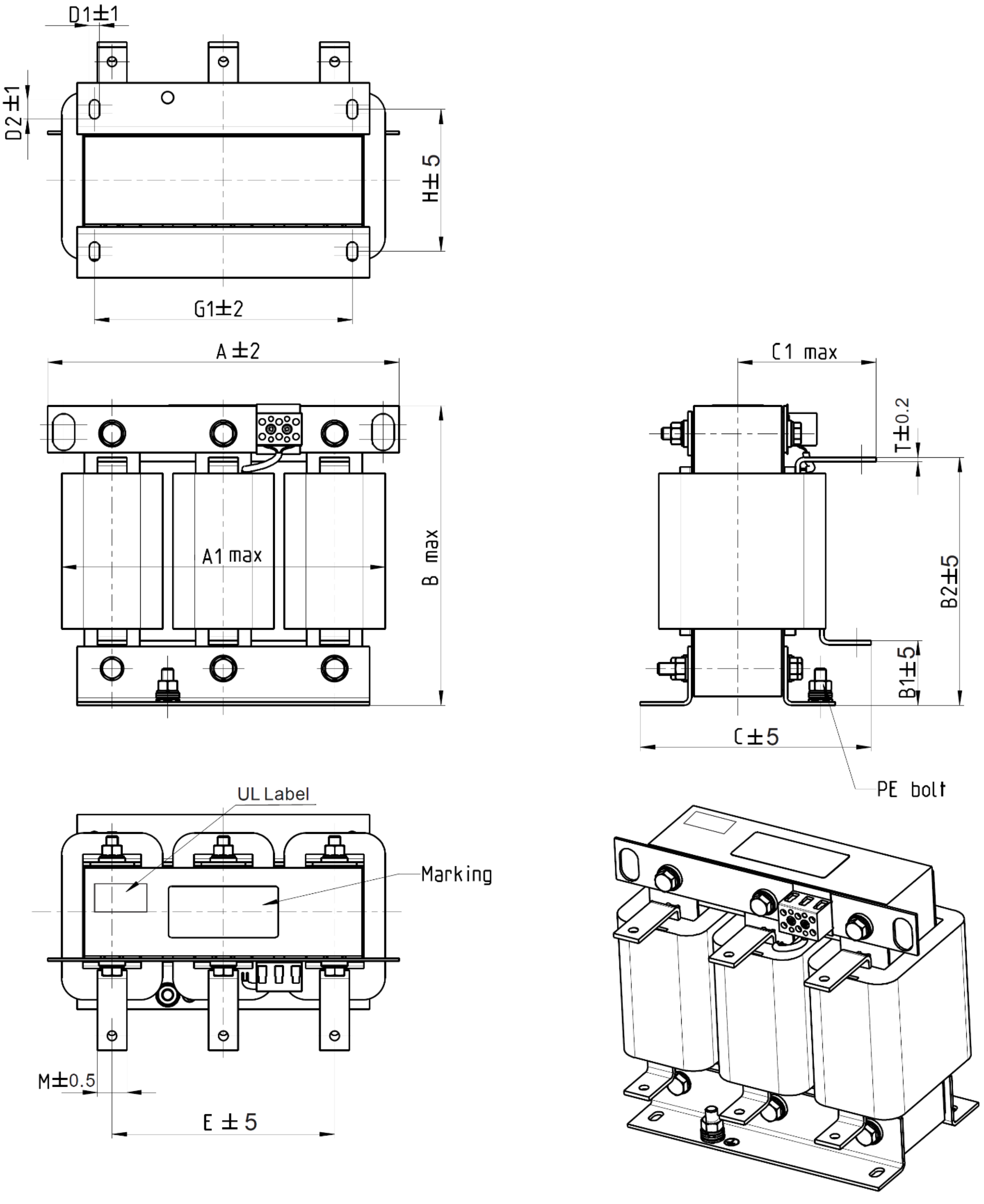


Fig. 7-25

Unit: mm

Delta's Part No. - AC Output Reactor	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR060LP405	240	228	215	44	170	163	110	7*13	152	176	97	20*3
DR073LP334	250	235	235	44	186	174	115	11*18	160	190	124	20*3
DR091LP267	250	240	235	44	186	174	115	11*18	160	190	124	20*3
DR110LP221	270	260	245	50	192	175	115	10*18	176	200	106	20*3

Table 7-43

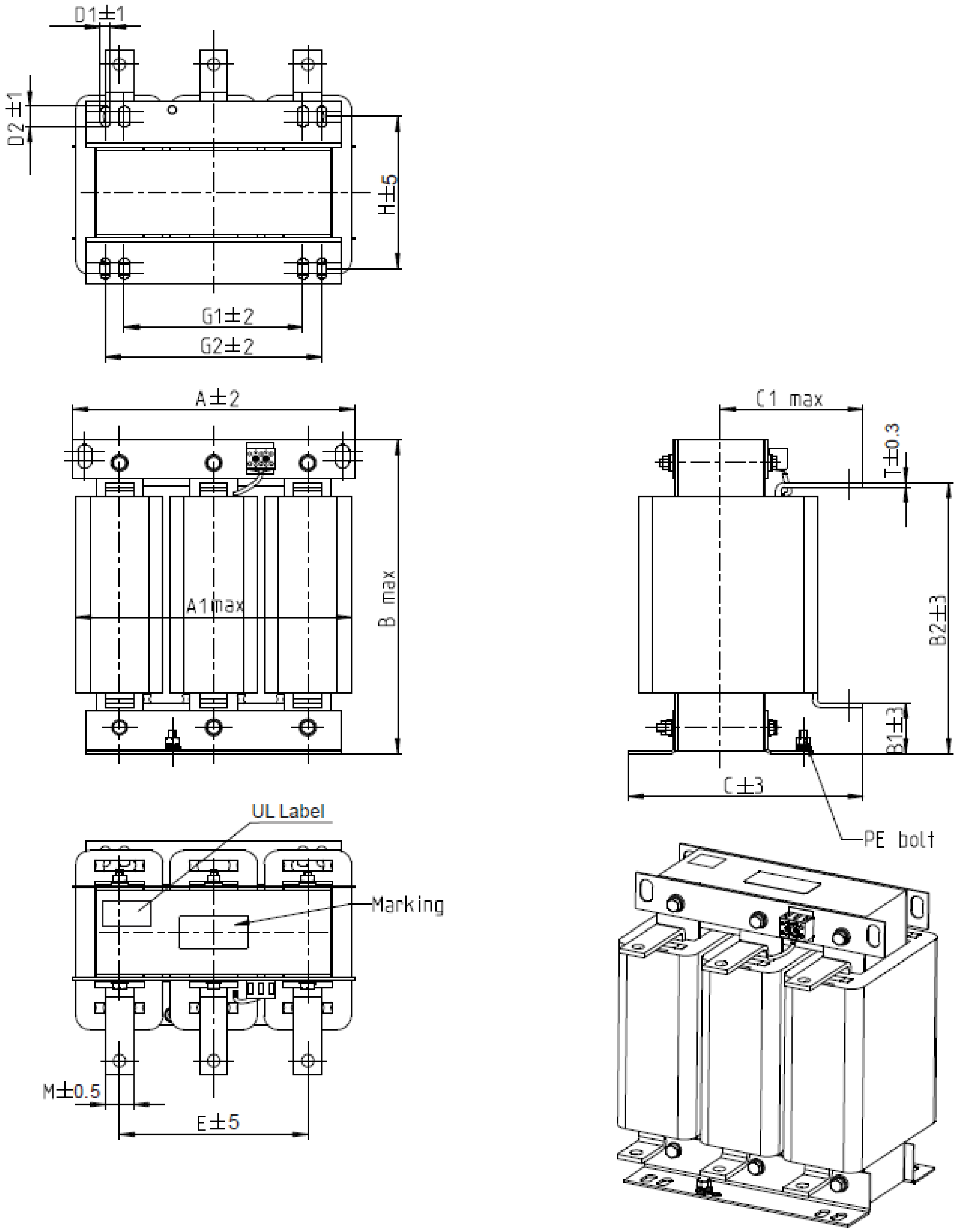


Fig. 7-26

Unit: mm

Delta's Part No. - AC Output Reactor	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	G2	H	M*T
DR150LP162	270	264	265	51	208	192	125	10*18	176	200	/	118	30*3
DR180LP135	300	295	310	55	246	195	125	11*22	200	230	190	142	30*3

Table 7-44

DC Reactor

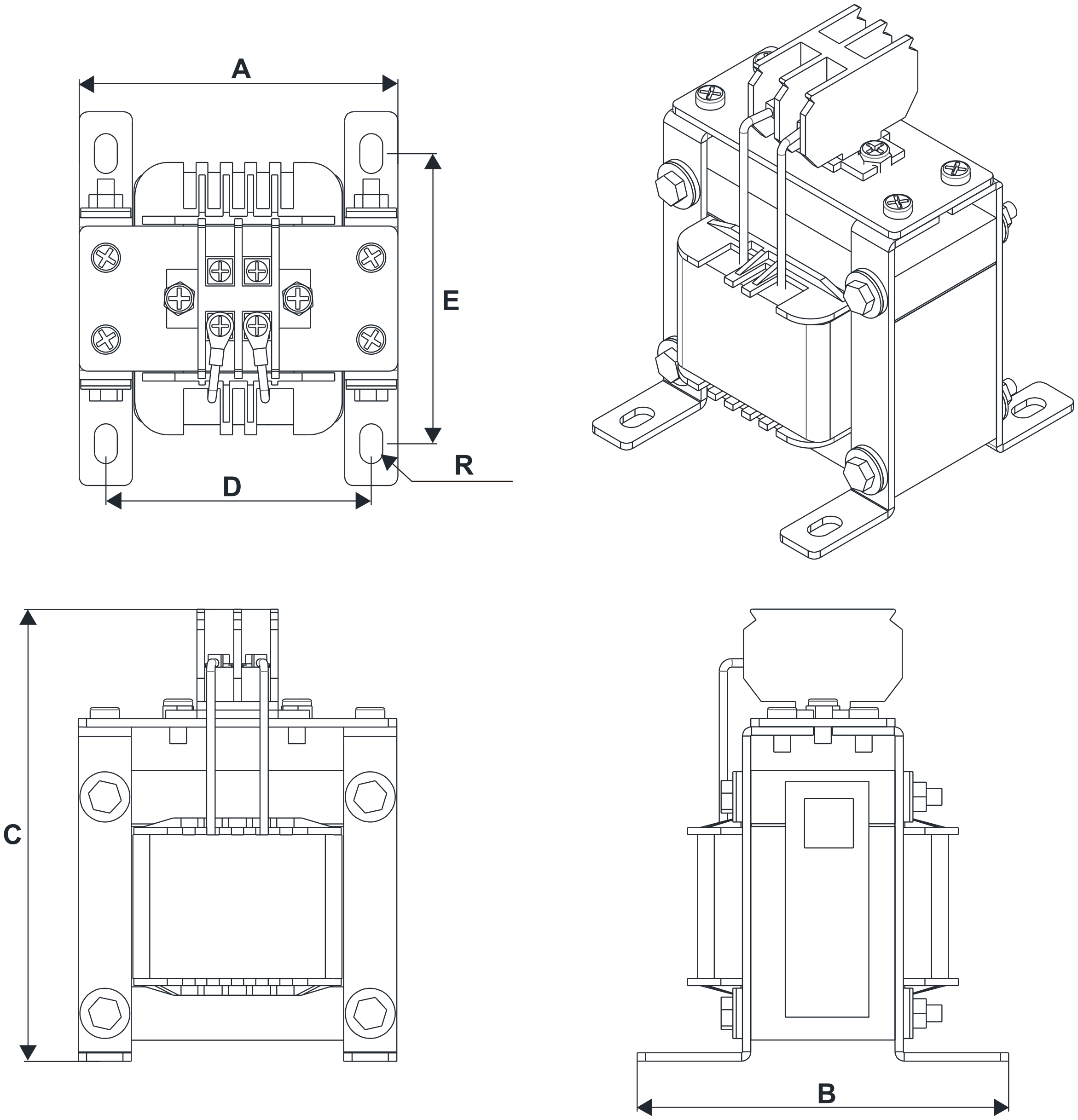


Fig. 7-27

Unit: mm

Delta's Part No. - DC Reactor	A	B	C	D	E	R
DR005D0585	79	78	112	64±2	56±2	9.5*5.5
DR008D0366	79	78	112	64±2	56±2	9.5*5.5
DR011D0266	79	92	112	64±2	69.5±2	9.5*5.5
DR017D0172	79	112	112	64±2	89.5±2	9.5*5.5
DR025D0117	99	105	128	79±2	82.5±2	9.5*5.5
DR033DP851	117	110	156	95±2	87±2	10*6.5
DR049DP574	117	120	157	95±2	97±2	10*6.5
DR065DP432	117	140	157	95±2	116.5±2	10*6.5
DR075DP391	136	135	178	111±2	112±2	10*6.5
DR090DP325	136	135	179	111±2	112±2	10*6.5
DR003D1870	79	78	112	64±2	56±2	9.5*5.5

Delta's Part No. - DC Reactor	A	B	C	D	E	R
DR004D1403	79	92	112	64±2	69.5±2	9.5*5.5
DR006D0935	79	92	112	64±2	69.5±2	9.5*5.5
DR009D0623	79	112	112	64±2	89.5±2	9.5*5.5
DR010D0534	99	93	128	79±2	70±2	9.5*5.5
DR012D0467	99	105	128	79±2	82.5±2	9.5*5.5
DR018D0311	117	110	144	95±2	87±2	10*6.5
DR024D0233	117	120	144	95±2	97±2	10*6.5
DR032D0175	117	140	157	95±2	116.5±2	10*6.5
DR038D0147	136	135	172	111±2	112±2	10*6.5
DR045D0124	136	135	173	111±2	112±2	10*6.5
DR060DP935	136	150	173	111±2	127±2	10*6.5

Table 7-45

Length of the Motor Cable

1. Leakage current affects the motor and remedies

   Due to larger parasitic capacitances in longer motor cables, longer cables increase the leakage current. This can activate the over-current protection and display the incorrect current. In the worst case, it can damage the drive.
   If more than one motor is connected to the AC motor drive, the total motor cable length is the sum of the cable length from the AC motor drive to each motor.
   For 460V models AC motor drives, when an overload relay is installed between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50 m.
   However, the overload relay could still malfunction. To prevent this, install an AC output reactor (optional) to the drive and/or lower the carrier frequency setting (Pr.00-17).

2. Surge voltage affects the motor and remedies

   When a PWM signal from an AC motor drive drives the motor, the motor terminals can easily experience surge voltages (dv/dt) due to IGBT switching and cable capacitance. When the motor cable is very long (especially for the 460V models), surge voltages (dv/dt) may reduce motor insulation quality. To prevent this, follow the rules listed below.

   a. Use a motor with enhanced insulation.
   b. Connect an output reactor (optional) to the output terminals of the AC motor drive.
   c. Reduce the motor cable length to the values in the table below.

   The suggested motor shielded cable length in the following table complies with IEC 60034-17, which is suitable for motors with a rated voltage ≤ 500 V_{AC} and with an insulation level of ≥ 1.35 kV_{p-p}

115V Single-phase Model	Rated Current in Normal Duty (Arms)	Without Output AC reactor		With Output AC Reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD1A6MH11ANSAA VFD1A6MH11ENSAA	1.8	50	75	75	115
VFD2A5MH11ANSAA VFD2A5MH11ENSAA	2.7				
VFD5A0MH11ANSAA VFD5A0MH11ENSAA	5.5				

Table 7-46

230V Single-phase Model	Rated Current in Normal Duty (Arms)	Without Output AC reactor		With Output AC Reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD1A6MH21ANSAA VFD1A6MH21ENSAA VFD1A6MH21AFSAA	1.8	50	75	75	115
VFD2A8MH21ANSAA VFD2A8MH21ENSAA VFD2A8MH21AFSAA	3.2				
VFD5A0MH21ANSAA VFD5A0MH21ENSAA VFD5A0MH21AFSAA	5				
VFD7A5MH21ANSAA VFD7A5MH21ENSAA VFD7A5MH21AFSAA	8.5				
VFD11AMH21ANSAA VFD11AMH21ENSAA VFD11AMH21AFSAA	12.5				

Table 7-47

230V Three-phase Model	Rated Current in Normal Duty (Arms)	Without Output AC reactor		With Output AC Reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD1A6MH23ANSAA VFD1A6MH23ENSAA	1.8	50	75	75	115
VFD2A8MH23ANSAA VFD2A8MH23ENSAA	3.2				
VFD5A0MH23ANSAA VFD5A0MH23ENSAA VFD5A0MH23ANSNA VFD5A0MH23ENSNA	5				
VFD7A5MH23ANSAA VFD7A5MH23ENSAA	8				
VFD11AMH23ANSAA VFD11AMH23ENSAA	12.5				
VFD17AMH23ANSAA VFD17AMH23ENSAA	19.5				
VFD25AMH23ANSAA VFD25AMH23ENSAA	27				
VFD33AMH23ANSAA VFD33AMH23ENSAA	36	100	150	150	225
VFD49AMH23ANSAA VFD49AMH23ENSAA	51				
VFD65AMH23ANSAA VFD65AMH23ENSAA	69				
VFD75AMH23ANSAA VFD75AMH23AFSAA	81				
VFD90AMH23ANSAA VFD90AMH23AFSAA	102				

230V Three-phase Model	Rated Current in Normal Duty (Arms)	Without Output AC reactor		With Output AC Reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD120MH23ANSAA VFD120MH23AFSAA	134	100	150	150	225
VFD146MH23ANSAA VFD146MH23AFSAA	160				

Table 7-48

460V Three-phase Model	Rated Current in Normal Duty (Arms)	Without Output AC reactor		With Output AC Reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD1A5MH43ANSAA VFD1A5MH43ENSAA VFD1A5MH43AFSAA	1.8	35	50	50	90
VFD3A0MH43ANSAA VFD3A0MH43ENSAA VFD3A0MH43AFSAA VFD3A0MH43ANSNA VFD3A0MH43ENSNA	3				
VFD4A2MH43ANSAA VFD4A2MH43ENSAA VFD4A2MH43AFSAA	4.6				
VFD5A7MH43ANSAA VFD5A7MH43ENSAA VFD5A7MH43AFSAA	6.5	50	75	75	115
VFD9A0MH43ANSAA VFD9A0MH43ENSAA VFD9A0MH43AFSAA	10.5				
VFD13AMH43ANSAA VFD13AMH43ENSAA VFD13AMH43AFSAA	15.7				
VFD17AMH43ANSAA VFD17AMH43ENSAA VFD17AMH43AFSAA	20.5	100	150	150	225
VFD25AMH43ANSAA VFD25AMH43ENSAA VFD25AMH43AFSAA	28				
VFD32AMH43ANSAA VFD32AMH43ENSAA VFD32AMH43AFSAA	36				
VFD38AMH43ANSAA VFD38AMH43ENSAA VFD38AMH43AFSAA	41.5				
VFD45AMH43ANSAA VFD45AMH43ENSAA VFD45AMH43AFSAA	49				
VFD60AMH43ANSAA VFD60AMH43AFSAA	69				
VFD75AMH43ANSAA VFD75AMH43AFSAA	85				
VFD91AMH43ANSAA VFD91AMH43AFSAA	108				
VFD112MH43ANSAA VFD112MH43AFSAA	128				
VFD150MH43ANSAA VFD150MH43AFSAA	180				

Table 7-49

7-5 Zero-phase Reactors

You can also suppress interference by installing a zero-phase reactor at the main input or the motor output of the drive, depending on the location of the interference. Delta provides two types of zero-phase reactors to solve interference problems.

A. Casing with mechanical fixed part

This solution is for the main input / motor output side and can withstand higher loading, and be used at higher frequencies. You can get higher impedance by increasing the number of turns.

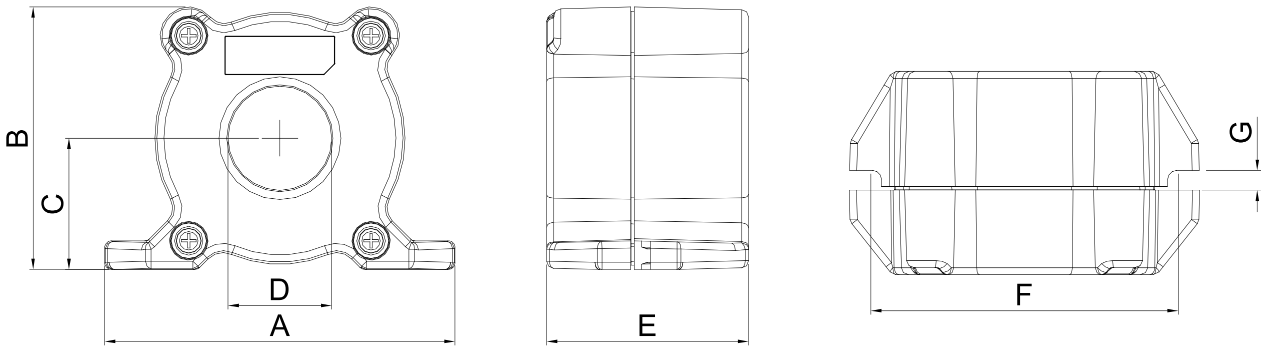


Fig. 7-28

Unit: mm

Model	A	B	C	D	E	F	G (Ø)	Purpose
RF008X00A	99	73	36.5	29	56.5	86	5.5	To use with motor cable
RF004X00A	110	87.5	43.5	36	53	96	5.5	To use with motor cable

Table 7-50

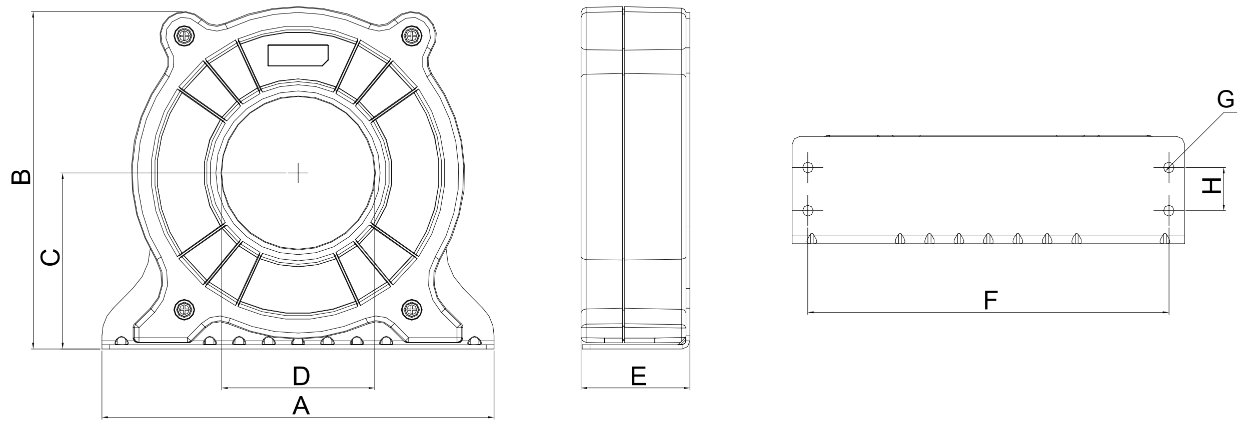


Fig. 7-29

Unit: mm

Model	A	B	C	D	E	F	G (Ø)	Purpose
RF002X00A	200	172.5	90	78	55.5	184	5.5	To use with motor cable

Table 7-51

B. Casing without mechanical fixed part

This solution has higher performance: high initial magnetic permeability, high saturation induction density, low iron loss and perfect temperature characteristic. If the zero-phase reactor does not need to be fixed mechanically, use this solution.

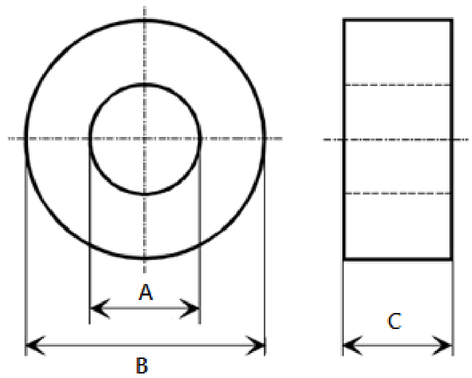


Fig. 7-30

Unit: mm

Model	A	B	C	Purpose
RF008X00N	22.5	43.1	18.5	To use with motor cable
RF004X00N	36.3	53.5	23.4	To use with motor cable
RF410X00N	108.1	70	30.3	To use with motor cable

Table 7-52

Installation

During installation, pass the cable through at least one zero-phase reactor.
Use a suitable cable type (insulation class and wire section) so that the cable passes easily through the zero-phase reactor. Do not pass the grounding cable through the zero-phase reactor; only pass the motor wire through the zero-phase reactor.

With longer motor cables the zero-phase reactor can effectively reduce interference at the motor output. Install the zero-phase reactor as close to the output of the drive as possible. Figure A shows the installation diagram for a single turn zero-phase reactor. If the wire diameter allows several turns, Figure B shows the installation of a multi-turn zero-phase reactor. The more turns, the better the noise suppression effect.

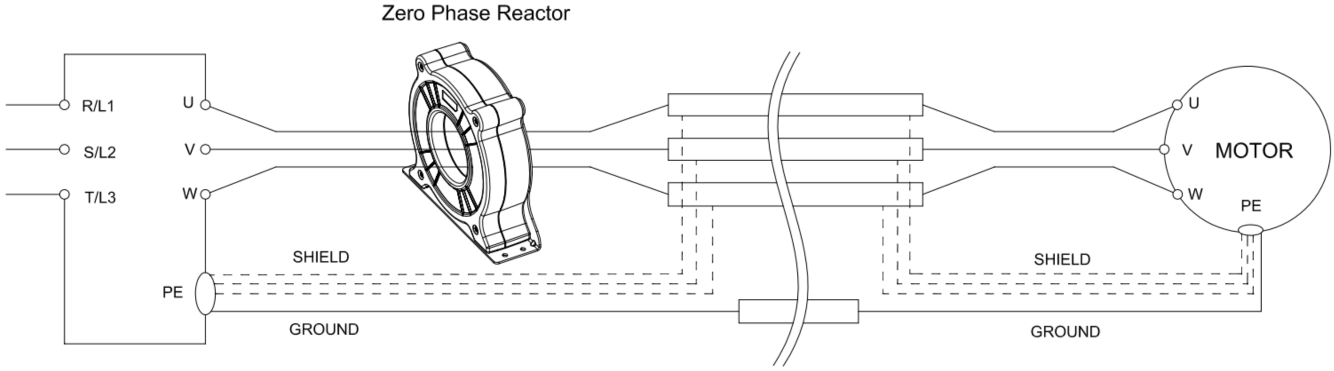


Figure A: Single turn wiring diagram for a shielding wire with a zero-phase reactor

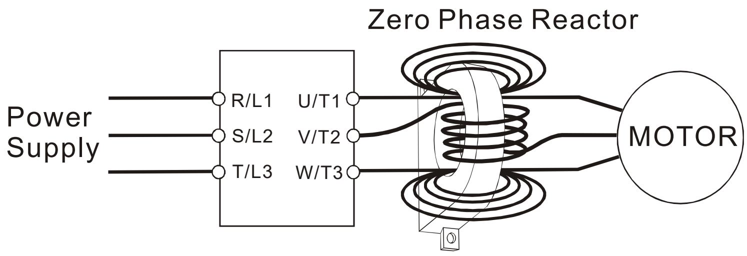


Figure B: Multi-turn zero-phase reactor

Installation notes

Install the zero-phase reactor at the output terminal of the frequency converter (U, V, W). After the zero-phase reactor is installed, it reduces the electromagnetic radiation and load stress emitted by the wiring of the frequency converter. The number of zero-phase reactors required for the drive depends on the wiring length and the drive voltage.

The normal operating temperature of the zero-phase reactor should be lower than 85°C (176°F). However, when the zero-phase reactor is saturated, its temperature may exceed 85°C (176°F). In this case, increase the number of zero-phase reactors to avoid saturation. The following are reasons that might cause saturation of the zero-phase reactors: the drive wiring is too long, the drive has several sets of loads, the wiring is in parallel, or the drive uses high capacitance wiring. If the temperature of the zero-phase reactor exceeds 85°C (176°F) during the operation of the drive, increase the number of zero-phase reactors.

Recommended maximum wiring gauge when installing zero-phase reactor

Model	Recommended wiring gauge	
RF008X00A or RF008X00N	≤ 8 AWG	≤ 8.37 mm^2
RF004X00A or RF004X00N	≤ 4 AWG	≤ 21.15 mm^2
RF002X00A or RF410X00N	≤ 2 AWG	≤ 33.62 mm^2

Table 7-53

Zero-phase Reactor for Signal Cable

To solve interference problems between signal cables and electric devices, install a zero-phase reactor on the signal cable. Install it on the signal cable which is the source of the interference to suppress the noise for a better signal. The model names and dimensions are listed in the table below.

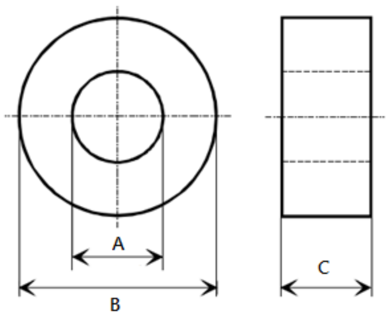


Fig. 7-31

Unit: mm

Model	A	B	C	Purpose
RF026X00N	10.7	17.8	8.0	To use with signal cable
RF020X00N	17.5	27.3	12.3	To use with signal cable

Table 7-54

7-6 EMC Filter

Use EMC filters to enhance the EMC performance for the environment and machines and to comply with EMC regulations, further reducing EMC problems. If you purchase a motor drive without a built-in EMC filter, it is recommended that you select the EMC filters as shown below. For some motor drive models, you need to work with zero-phase reactors to be compliant with EMC regulations. Refer to the table and figure below for the recommended model, setting method, and maximum motor cable length of the EMC filter and zero-phase reactor.

Frame A–F

Frame	Model - MH300	Input Current (A)	Model -EMC Filter	Model -Zero-phase reactor	Conducted emission						Radiated emission		
					C1-motor cable length-30m			C2-motor cable length-100m			C2-motor cable length-100m		
					Position to place zero-phase reactor								
				DELTA	*1	*2	*3	*1	*2	*3	*1	*2	*3
	VFD1A6MH11ANSAA	6.8	EMF11AM21A	RF008X00A or RF008X00N				NA					
	VFD2A5MH11ANSAA	10.1	EMF11AM21A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD1A6MH21ANSAA	5.8	EMF11AM21A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD2A8MH21ANSAA	8.3	EMF10AM23A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
A	VFD1A6MH23ANSAA	2.2	EMF10AM23A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD2A8MH23ANSAA	3.8	EMF10AM23A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD5A0MH23ANSAA	6.2	EMF10AM23A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD1A5MH43ANSAA	2.5	EMF6A0M43A	RF008X00A or RF008X00N			✓	NA					✓
	VFD3A0MH43ANSAA	4.6	EMF6A0M43A	RF008X00A or RF008X00N			✓	NA					✓
	VFD5A0MH21ANSAA	11.7	EMF11AM21A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
B	VFD7A5MH23ANSAA	9.6	EMF10AM23A	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD4A2MH43ANSAA	6.4	EMF6A0M43A	RF008X00A or RF008X00N			✓	NA					✓
	VFD5A0MH11ANSAA	20.6	EMF27AM21B	RF008X00A or RF008X00N				NA					
	VFD7A5MH21ANSAA	18.5	EMF27AM21B	RF008X00A or RF008X00N			✓	NA					✓
	VFD11AMH21ANSAA	27.5	EMF27AM21B	RF008X00A or RF008X00N			✓	NA					✓
C	VFD11AMH23ANSAA	15	EMF24AM23B	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD17AMH23ANSAA	23.4	EMF24AM23B	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD5A7MH43ANSAA	7.2	EMF12AM43B	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD9A0MH43ANSAA	11.6	EMF12AM43B	RF008X00A or RF008X00N		✓	✓	NA				✓	✓
	VFD25AMH23ANSAA	32.4	EMF33AM23B	RF004X00A or RF004X00N	✓	✓		NA			✓	✓	
D	VFD13AMH43ANSAA	16.0	EMF23AM43B	RF004X00A or RF004X00N	✓	✓	✓	NA			✓	✓	✓
	VFD17AMH43ANSAA	21.8	EMF23AM43B	RF004X00A or RF004X00N	✓	✓	✓	NA			✓	✓	✓
	VFD33AMH23ANSAA	43.2	B84143D0050R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
E	VFD49AMH23ANSAA	61.2	B84143D0075R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
	VFD25AMH43ANSAA	30.8	B84143D0050R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
	VFD32AMH43ANSAA	39.6	B84143D0050R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
	VFD65AMH23ANSAA	82.8	B84143D0090R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
F	VFD38AMH43ANSAA	45.7	B84143D0050R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓
	VFD45AMH43ANSAA	53.9	B84143D0075R127	RF004X00A or RF004X00N		✓	✓	NA				✓	✓

Table 7-55

Frame G

Frame	Model - MH300	Input Current (A)	Model -EMC Filter	Model -Zero-phase reactor	Conducted emission									Radiated emission		
					C1-motor cable length-10 m			C2-motor cable length-30 m			C3-motor cable length-100m			C2-motor cable length-100m		
					Position to place zero-phase reactor											
				DELTA	*1	*2	*3	*1	*2	*3	*1	*2	*3	*1	*2	*3
G	VFD75AMH23ANSAA	85	B84143A0120R105	RF008X00A or RF004X00N		✓	✓			✓					✓	✓
	VFD90AMH23ANSAA	103	B84143A0120R105	RF008X00A or RF004X00N		✓	✓			✓					✓	✓
	VFD60AMH43ANSAA	72.5	B84143A0120R105	RF008X00A or RF004X00N	✓		✓			✓						

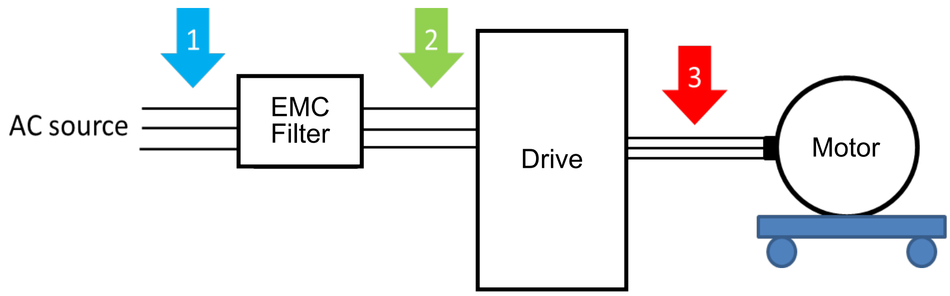
Table 7-56

Frame H–I

Frame	Model - MH300	Input Current (A)	Model -EMC Filter	Model -Zero-phase reactor	Conducted emission									Radiated emission		
					C1-motor cable length-10 m			C2-motor cable length-20 m			C3-motor cable length-100m			C2-motor cable length-100m		
					Position to place zero-phase reactor											
				DELTA	*1	*2	*3	*1	*2	*3	*1	*2	*3	*1	*2	*3
H	VFD75AMH43ANSAA	77	B84143D0150R127	RF002X00A or RF410X00N	✓		✓			✓					✓	✓
	VFD91AMH43ANSAA	97	B84143D0150R127	RF002X00A or RF410X00N	✓		✓			✓					✓	✓
I	VFD120MH23ANSAA	126	B84143D0200R127	RF002X00A or RF410X00N	✓	✓	✓								✓	✓
	VFD146MH23ANSAA	151	B84143D0200R127	RF002X00A or RF410X00N	✓	✓	✓								✓	✓
	VFD112MH43ANSAA	123	B84143D0200R127	RF002X00A or RF410X00N		✓										
	VFD150MH43ANSAA	173	B84143D0200R127	RF002X00A or RF410X00N		✓										

Table 7-57

Zero-phase reactor installation position diagram:



*1 Install at the cable between the power supply and the EMC filter

*2 Install at the cable between the EMC filter and the drive

*3 Install at the cable between the drive and the motor

Dimension

EMF11AM21A, EMF10AM23A, EMF6A0M43A

Screw	Torque
M5 * 2	16–20 kg-cm / (13.9–17.3 lb-in.) / (1.56–1.96 Nm)
M4 * 2	14–16 kg-cm / (12.2–13.8 lb-in.) / (1.38–1.56 Nm)

Table 7-58

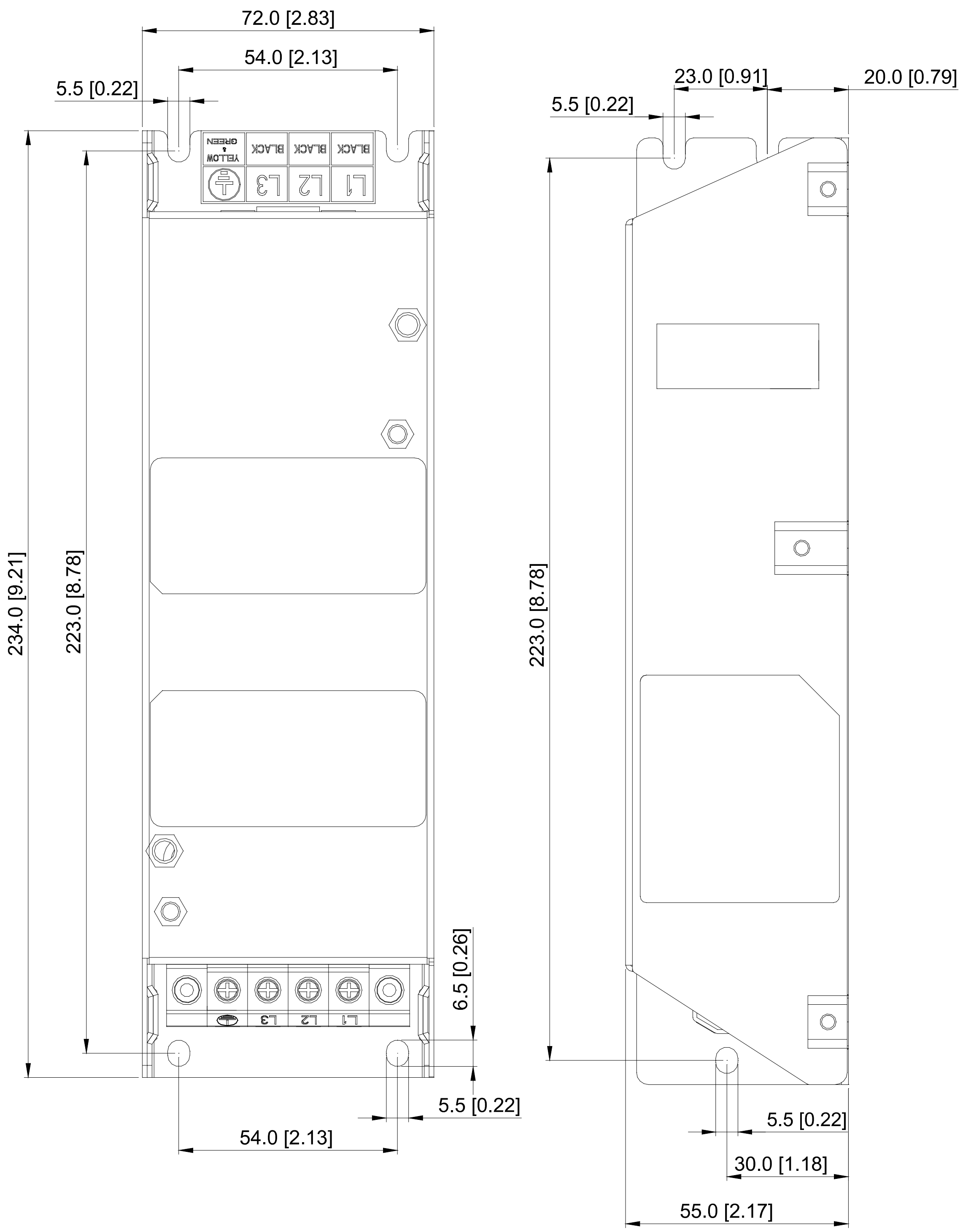


Fig. 7-32

Unit: mm [inch]

EMF27AM21B, EMF24AM23B, EMF33AM23B, EMF12AM43B, EMF23AM43B

Screw	Torque
M5 * 4	16–20 kg-cm / (13.9–17.3 lb-in.) / (1.56–1.96 Nm)

Table 7-59

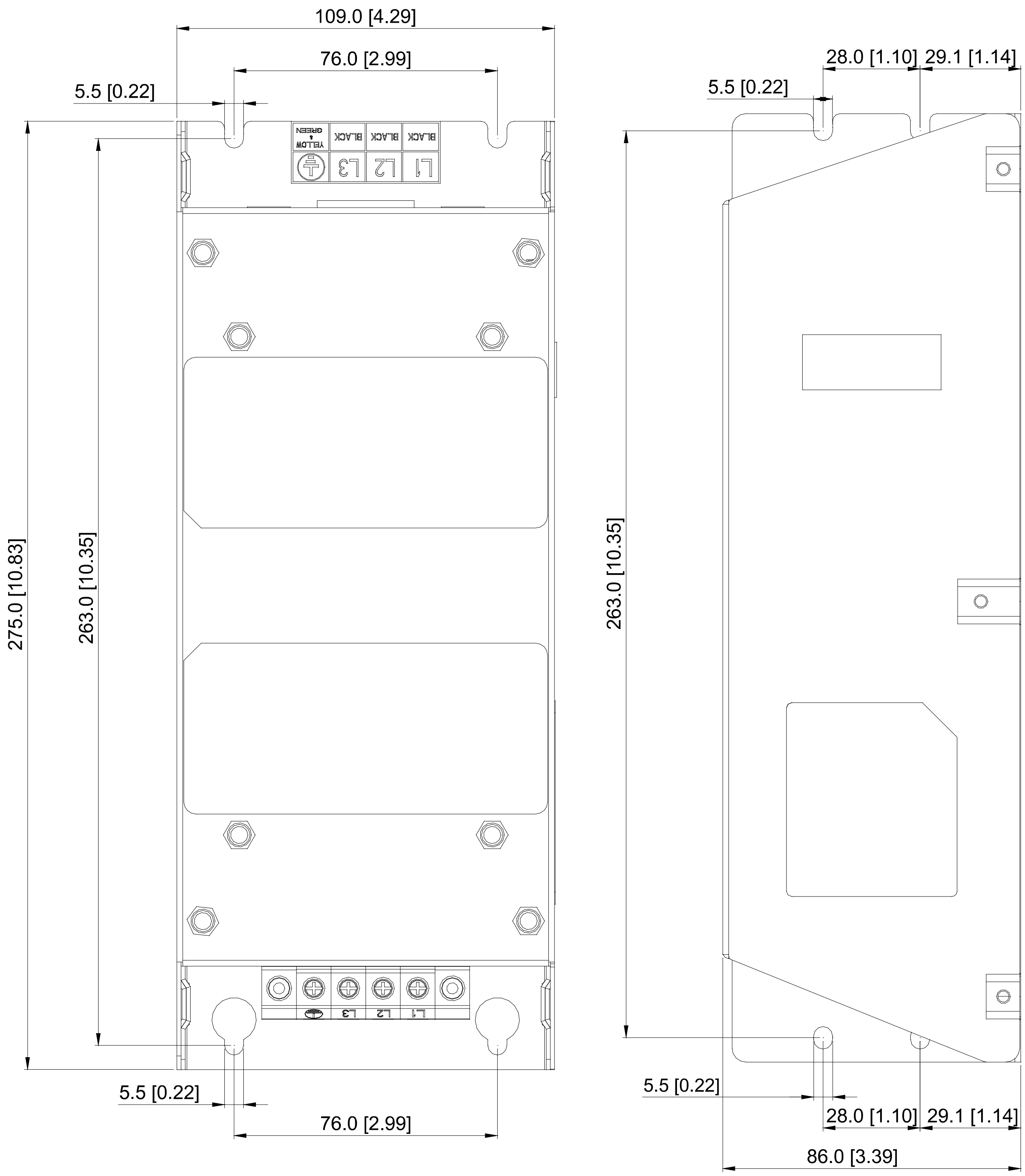


Fig. 7-33

Unit: mm [inch]

TDK B84143D0050R127 (50A)

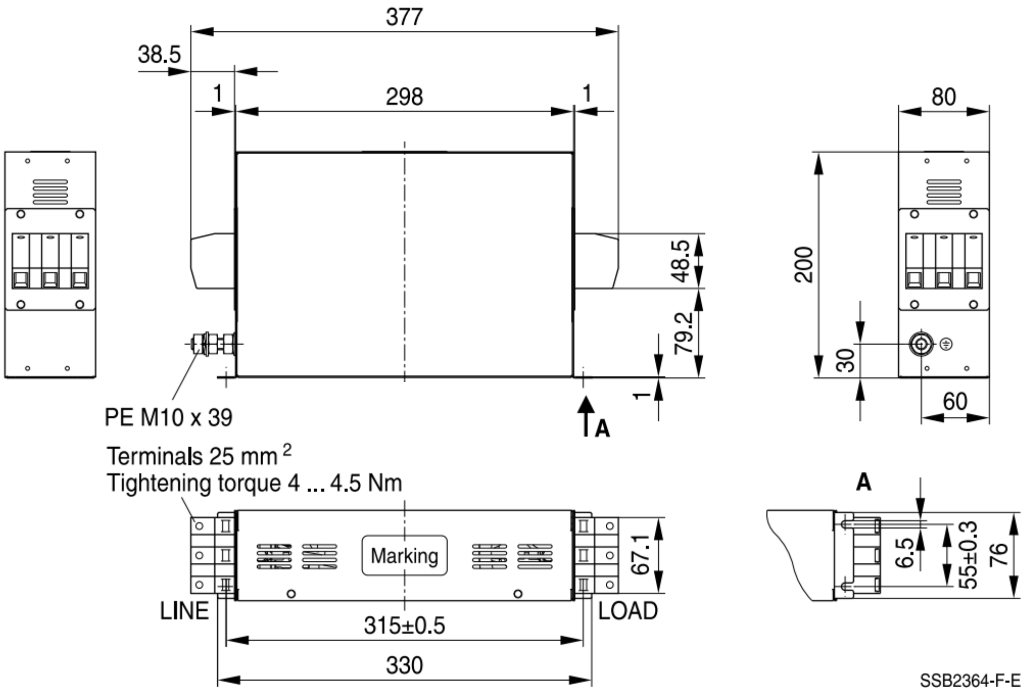


Fig. 7-34

Unit: mm

TDK B84143D0075R127 (75A), TDK B84143D0090R127 (90A)

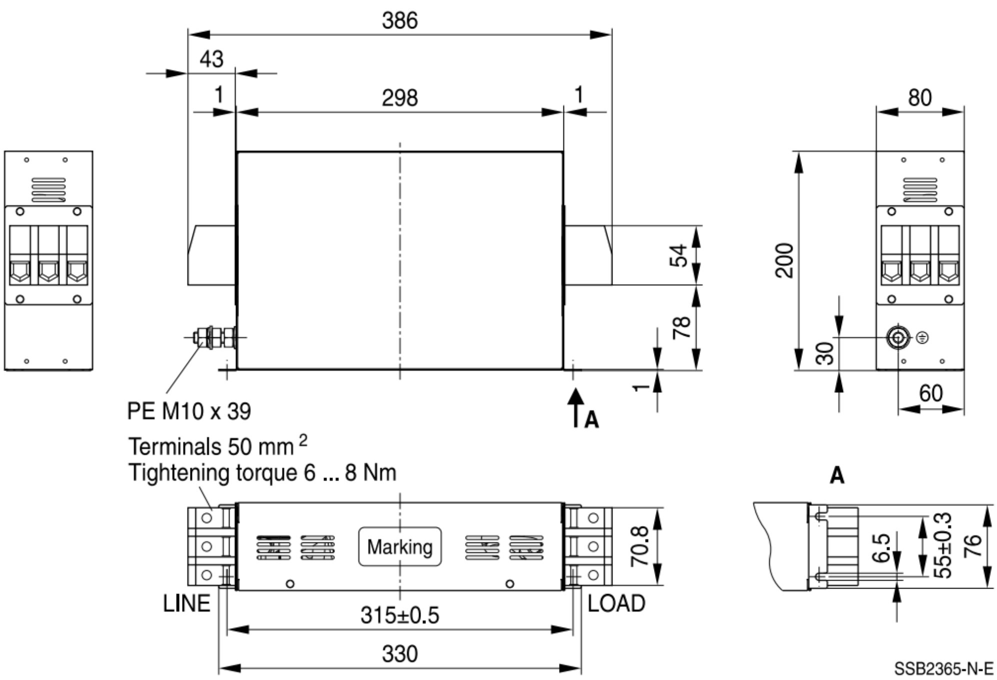


Fig. 7-35

Unit: mm

B84143A0120R105 (120A)

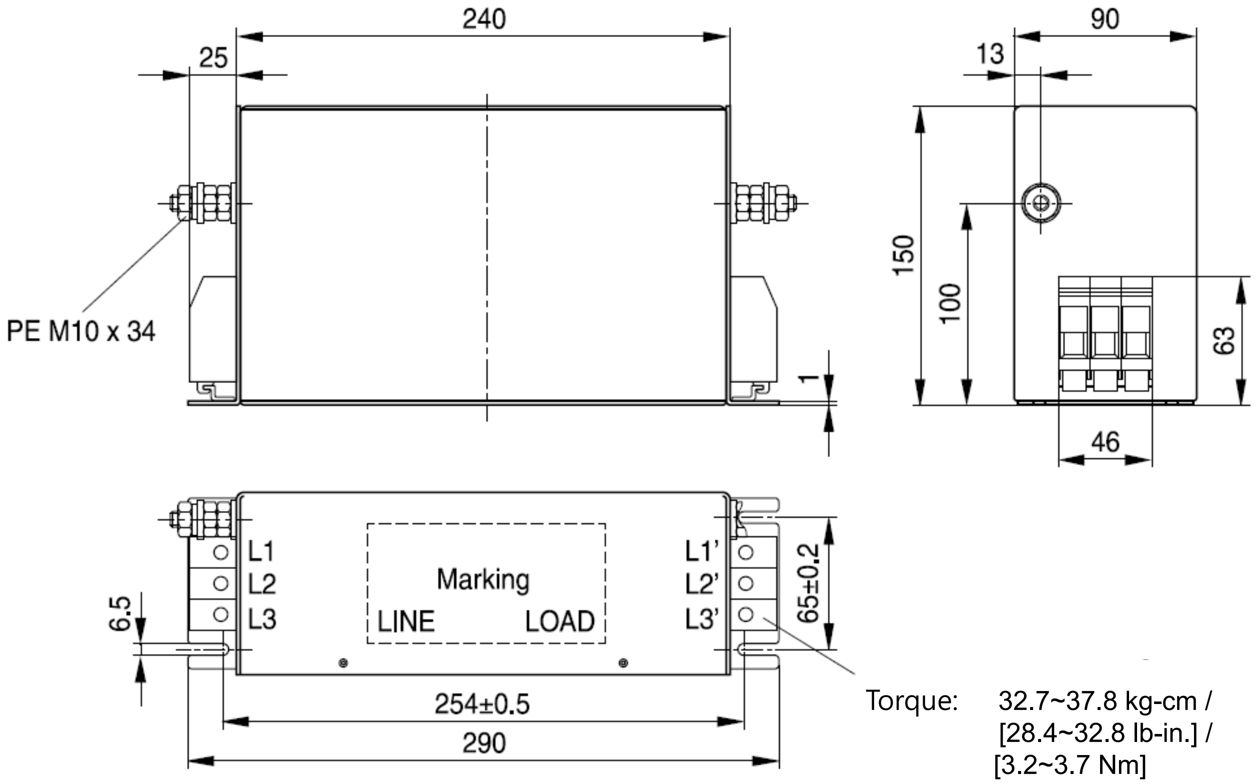


Fig. 7-36

Unit: mm

TDK B84143D0120R127 (120A), B84143D0150R127 (150A)

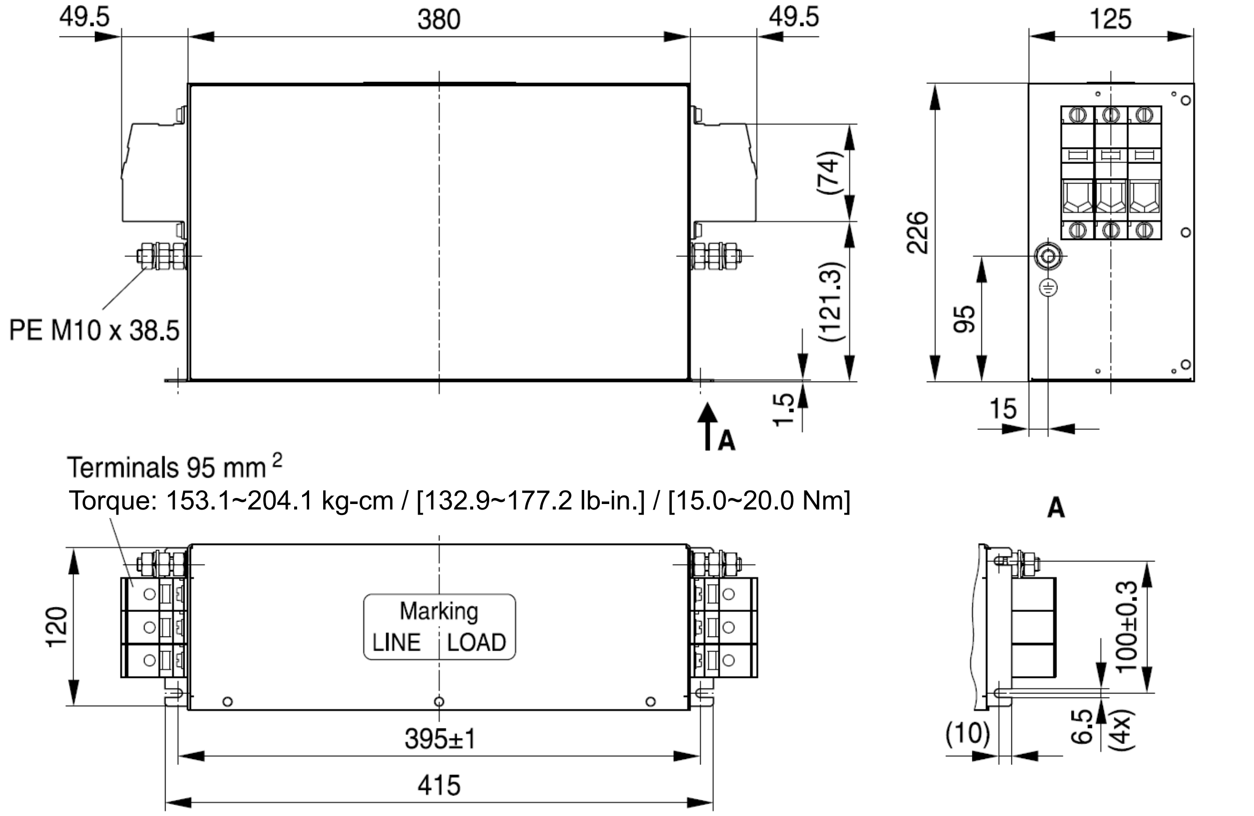


Fig. 7-37

Unit: mm

B84143D0200R127 (200A)

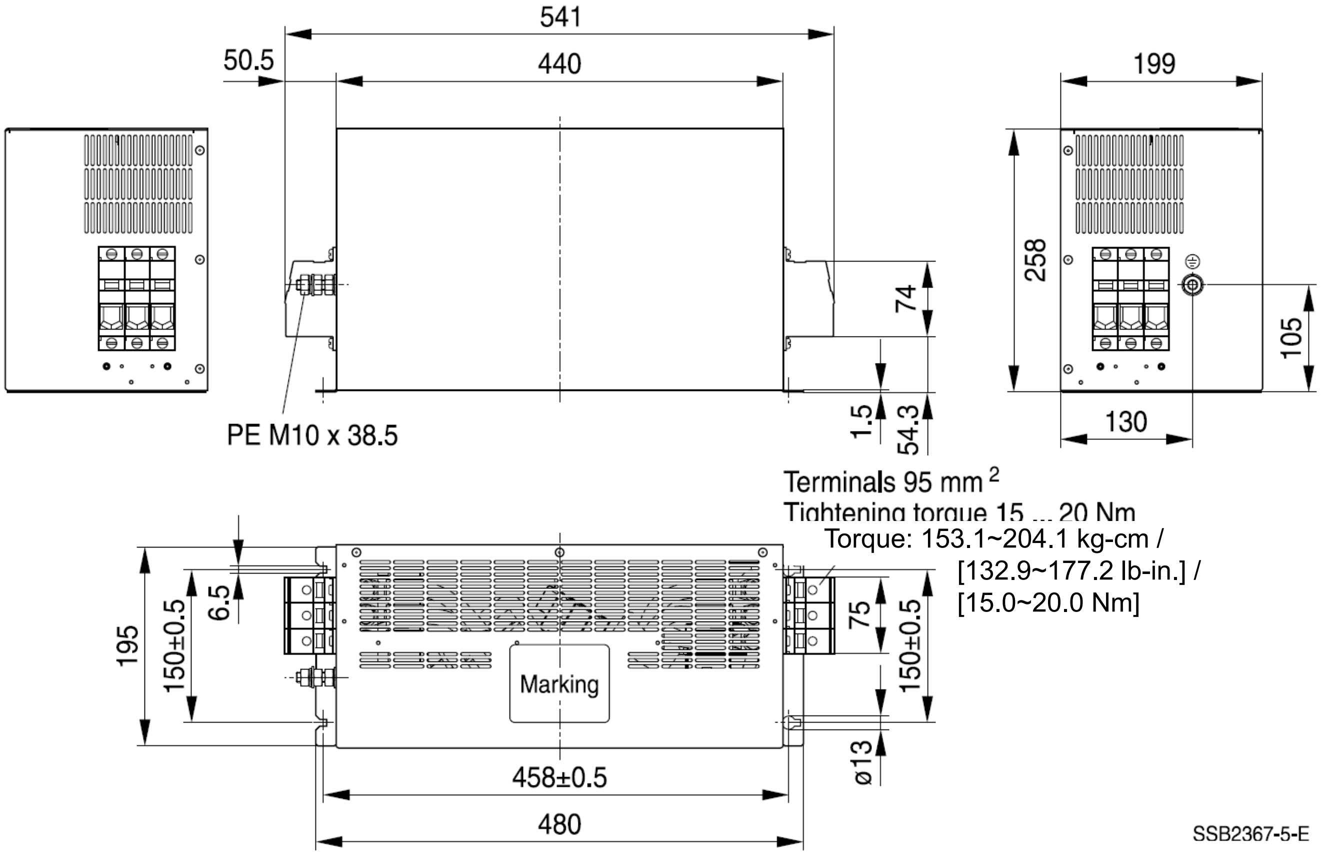


Fig. 7-38

Unit: mm

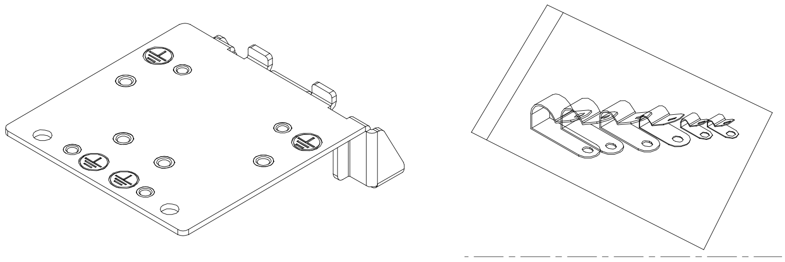
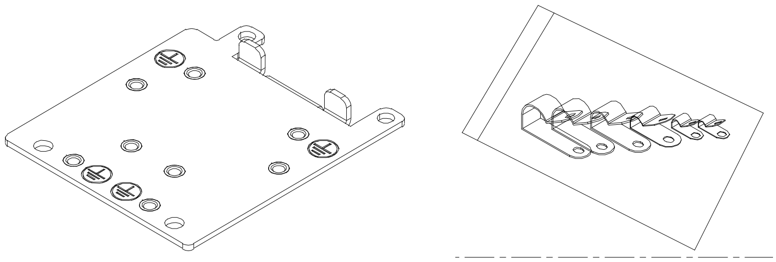
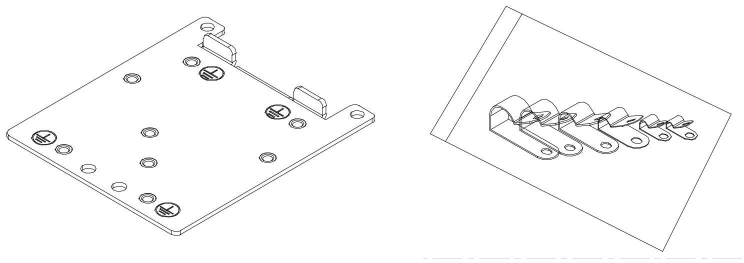
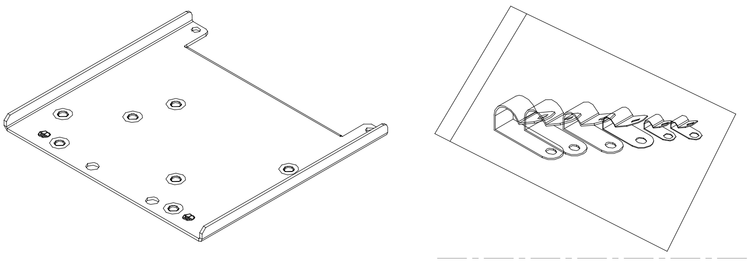
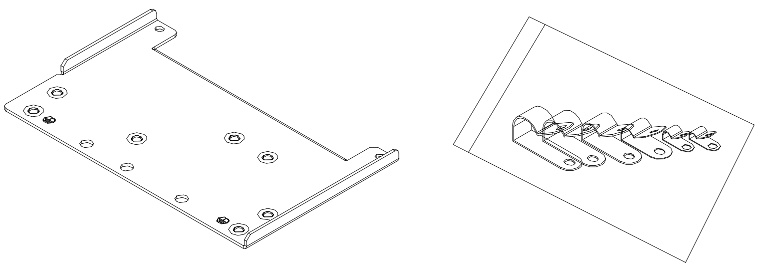
The table below is the maximum shielded cable length for drive models with built-in EMC filters. You can choose the corresponding shielded cable length according to the required noise emission and electromagnetic interference class.

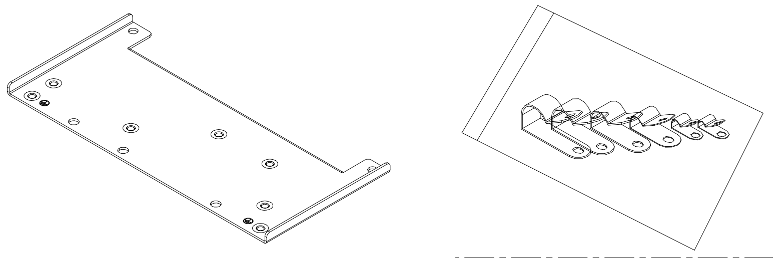
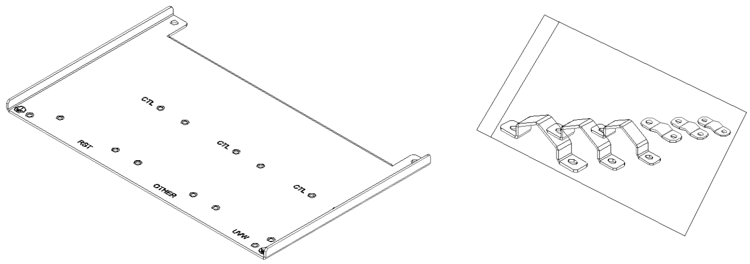
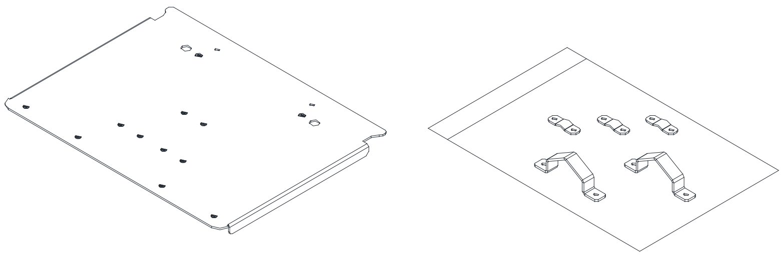
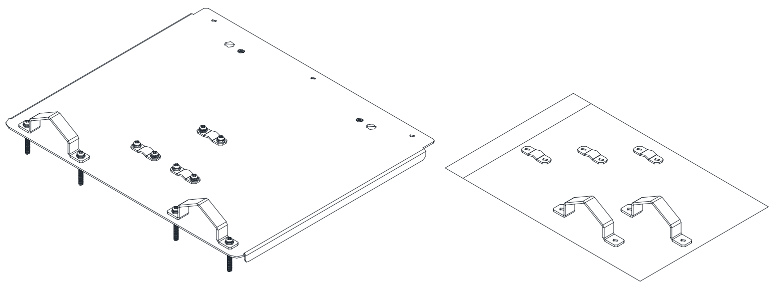
Drives with Built-in EMC		Rated Current (HD)	Comply with EMC (IEC 61800-3) Class C3		Comply with EMC (IEC 61800-3) Class C2	
Frame	Models		Shielded cable length	Fc	Shielded cable length	Fc
B	VFD1A5MH43AFSAA	1.5	30 m	4 kHz	20 m	4 kHz
	VFD3A0MH43AFSAA	3				
	VFD4A2MH43AFSAA	4.2				
	VFD1A6MH21AFSAA	1.6				
	VFD2A8MH21AFSAA	2.8				
	VFD5A0MH21AFSAA	5				
C	VFD5A7MH43AFSAA	5.7				
	VFD9A0MH43AFSAA	9				
	VFD7A5MH21AFSAA	7.5				
	VFD11AMH21AFSAA	11				
D	VFD13AMH43AFSAA	13				
	VFD17AMH43AFSAA	17.5				
E	VFD25AMH43AFSAA	25				
	VFD32AMH43AFSAA	32				
F	VFD38AMH43AFSAA	38				
	VFD45AMH43AFSAA	45				
G	VFD60AMH43AFSAA	60				
H	VFD75AMH43AFSAA	75	N/A	N/A	10 m	4 kHz
	VFD91AMH43AFSAA	91				
I	VFD112MH43AFSAA	112				
	VFD150MH43AFSAA	150				

Table 7-60

7-7 EMC Shield Plate

EMC Shield Plate (for using with shielded cable)

Frame	Model of EMC Shield Plate	Reference Figure
A	MKM-EPA	 Fig. 7-39
B	MKM-EPB	 Fig. 7-40
C	MKM-EPC	 Fig. 7-41
D	MKM-EPD	 Fig. 7-42
E	MKM-EPE	 Fig. 7-43

Frame	Model of EMC Shield Plate	Reference Figure
F	MKM-EPF	 Fig. 7-44
G	MKM-EPG	 Fig. 7-45
H	MKM-EPH	 Fig. 7-46
I	MKM-EPI	 Fig. 7-47

Installation

(Take Frame A model as an example)

1. As shown on the right figures, fix the iron plate on the AC motor drive.

Frame	Screw	Torque
A	M3.5	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
B	M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
C	M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
D	M3	4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
E	M3	4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
F	M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
G	M5	10–12 kg-cm / (8.7–10.4 lb-in) / (0.98–1.18 Nm)
H	M4 x 2	14–16 kg-cm / (12.1–13.9 lb-in) / (1.38–1.56 Nm)
	M8 x 2	75–85 kg-cm / (65.0–73.7 lb-in) / (7.35–8.33 Nm)
I	M4 x 3	14–16 kg-cm / (12.1–13.9 lb-in) / (1.38–1.56 Nm)
	M8 x 2	175–185kg-cm / (151.9–160.6lb-in) / (17.16–18.14Nm)

Table 7-61

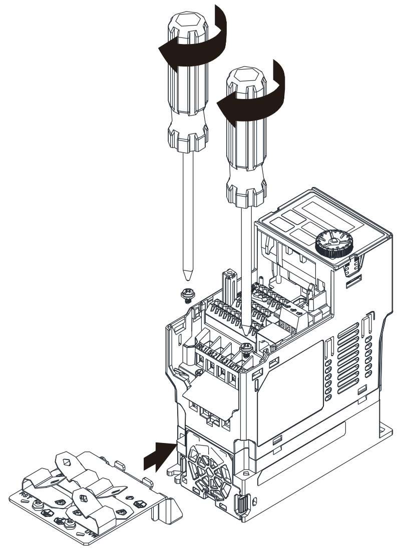


Fig. 7-48

2. After selecting a suitable R-clip according to the wire gauge used, fix the R-clip on the shield plate.

Screw	Torque
M4	6–8 kg-cm / (5.2–6.9 lb-in.) / (0.59–0.78 Nm)

Table 7-62

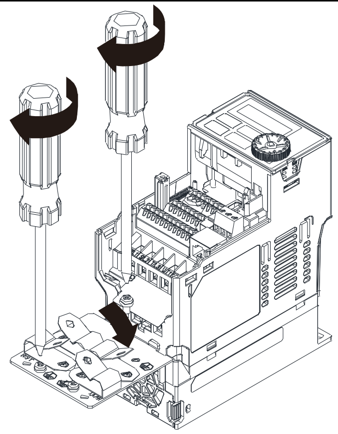


Fig. 7-49

Dimensions of EMC Shield Plate

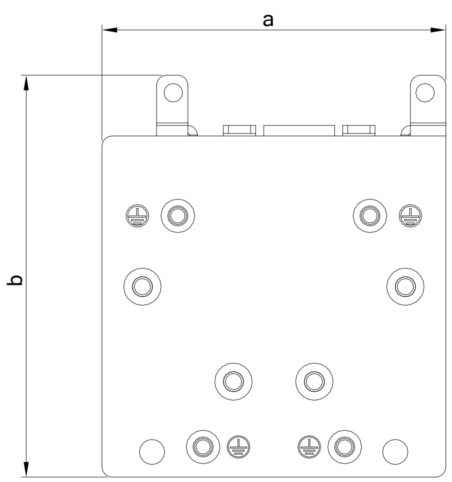


Fig. 7-50

Model	Dimensions of Shield Plate mm (inch)	
	a	b
MKM-EPA	69.3 (2.73)	80.0 (3.15)
MKM-EPB	67.7 (2.67)	79.7 (3.14)
MKM-EPC	78.0 (3.07)	91.0 (3.58)
MKM-EPD	103.4 (4.07)	97.0 (3.82)
MKM-EPE	124.3 (4.89)	77.4 (3.05)
MKM-EPF	168.0 (6.61)	80.0 (3.15)
MKM-EPG	243.5 (9.59)	154.9 (6.10)
MKM-EPH	262.0 (10.31)	201.9 (7.95)
MKM-EPI	304.0 (11.97)	260.7 (10.26)

Table 7-63

Recommended wire mounting method

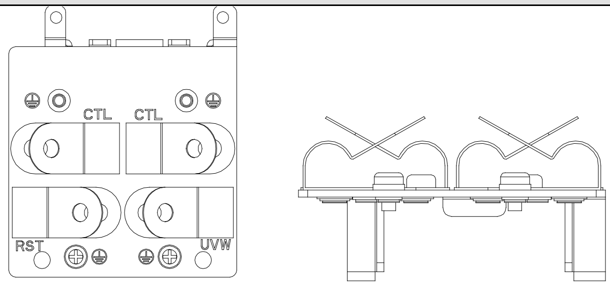
<table>
<tr><th>Frame</th><th>Model of EMC Shield Plate</th><th>Reference Figure</th></tr>
<tr><td>A</td><td>MKM-EPA</td><td>

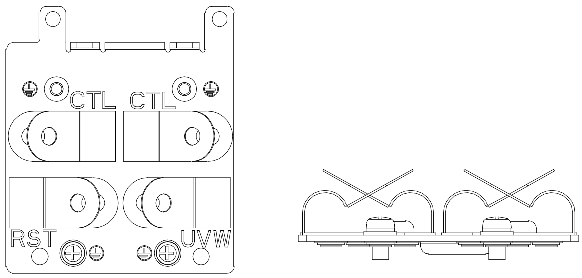
Fig. 7-51</td></tr>
<tr><td>B</td><td>MKM-EPB</td><td>

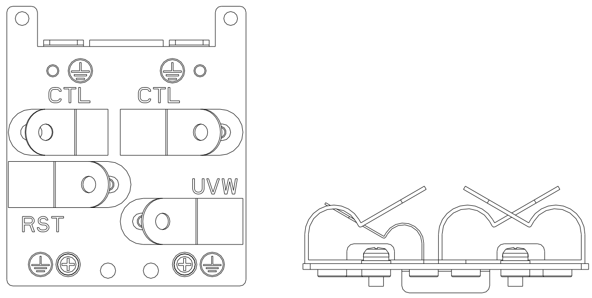
Fig. 7-52</td></tr>
<tr><td>C</td><td>MKM-EPC</td><td>

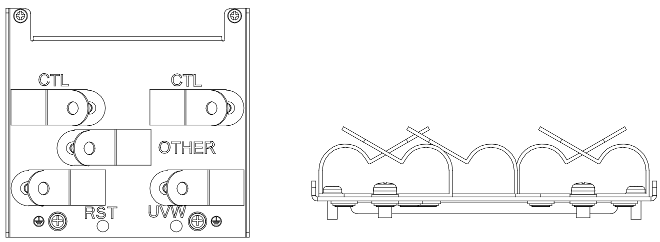
Fig. 7-53</td></tr>
<tr><td>D</td><td>MKM-EPD</td><td>

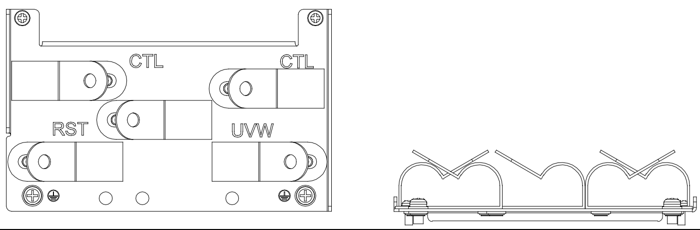
Fig. 7-54</td></tr>
<tr><td>E</td><td>MKM-EPE</td><td>

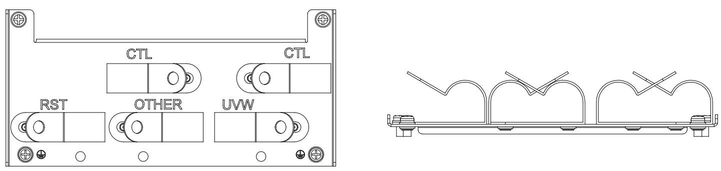
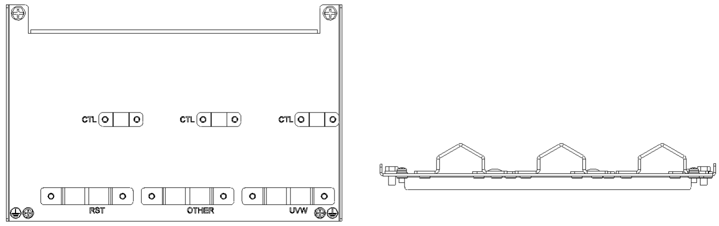
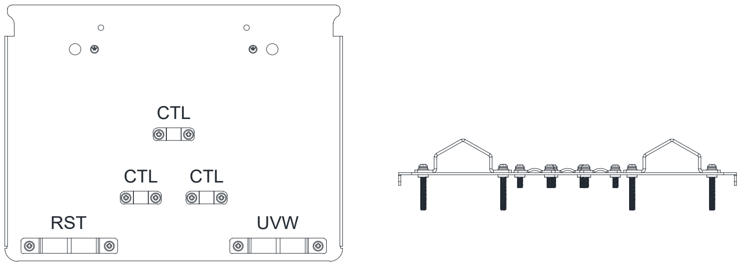
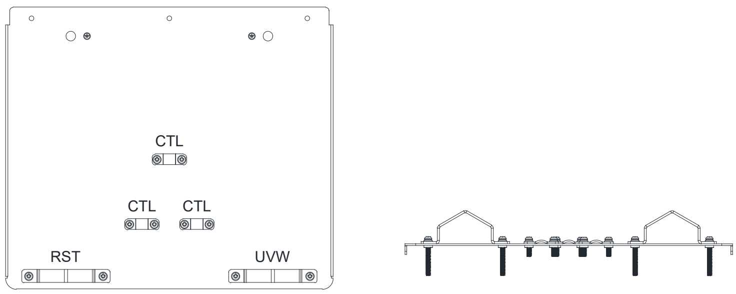
Fig. 7-55</td></tr>
<tr><td>F</td><td>MKM-EPF</td><td>

Fig. 7-56</td></tr>
</table>

Frame	Model of EMC Shield Plate	Reference Figure
G	MKM-EPG	 Fig. 7-57
H	MKM-EPH	 Fig. 7-58
I	MKM-EPI	 Fig. 7-59

7-8 Capacitive Filter

Capacitor Filter is a simple filter accessory, installed to provide simple filtering and eliminating interference.

Installation diagram

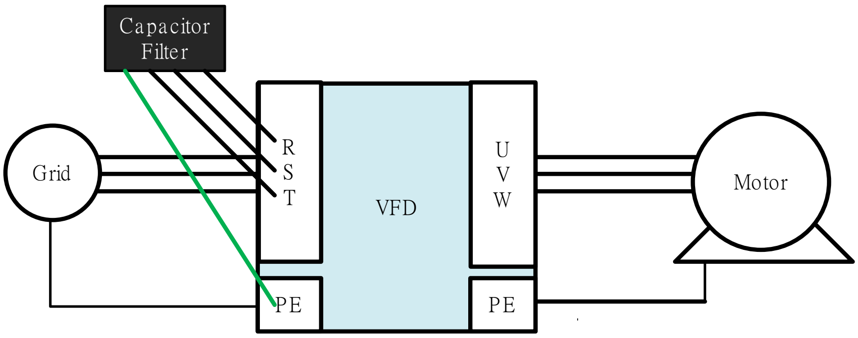


Fig. 7-60

Capacitive filter and drive wiring figure

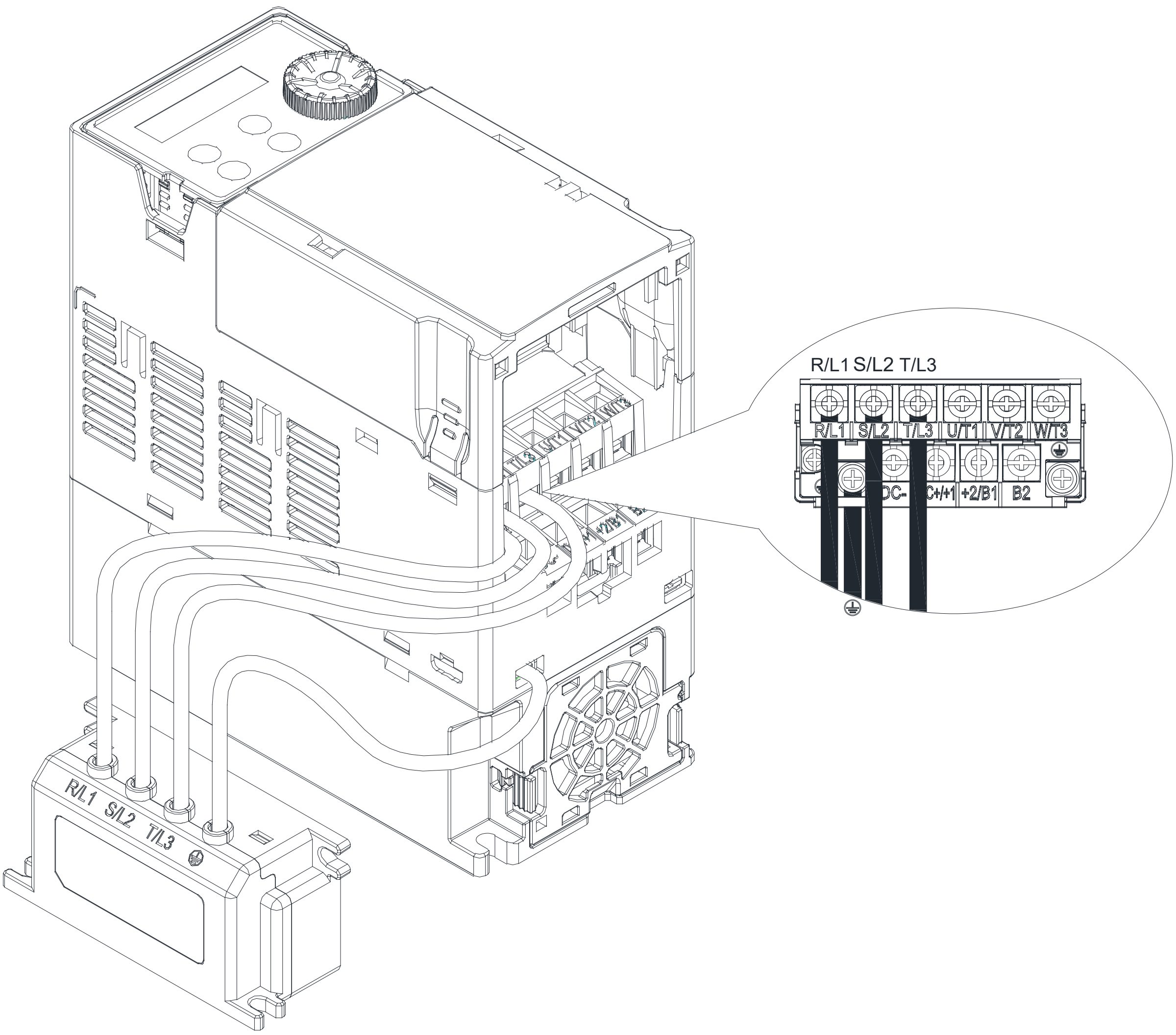


Fig. 7-61

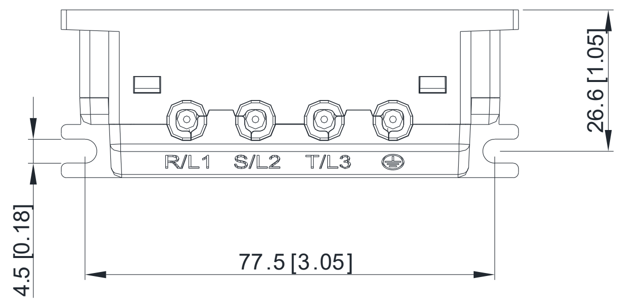
Specifications

Model	Capacitance	Temperature range
CXY101-43A	Cx: 1 μF ± 20 % Cy: 0.1 μF ± 20 %	-40–+85°C

Table 7-64

Dimensions

Unit: mm [inch]



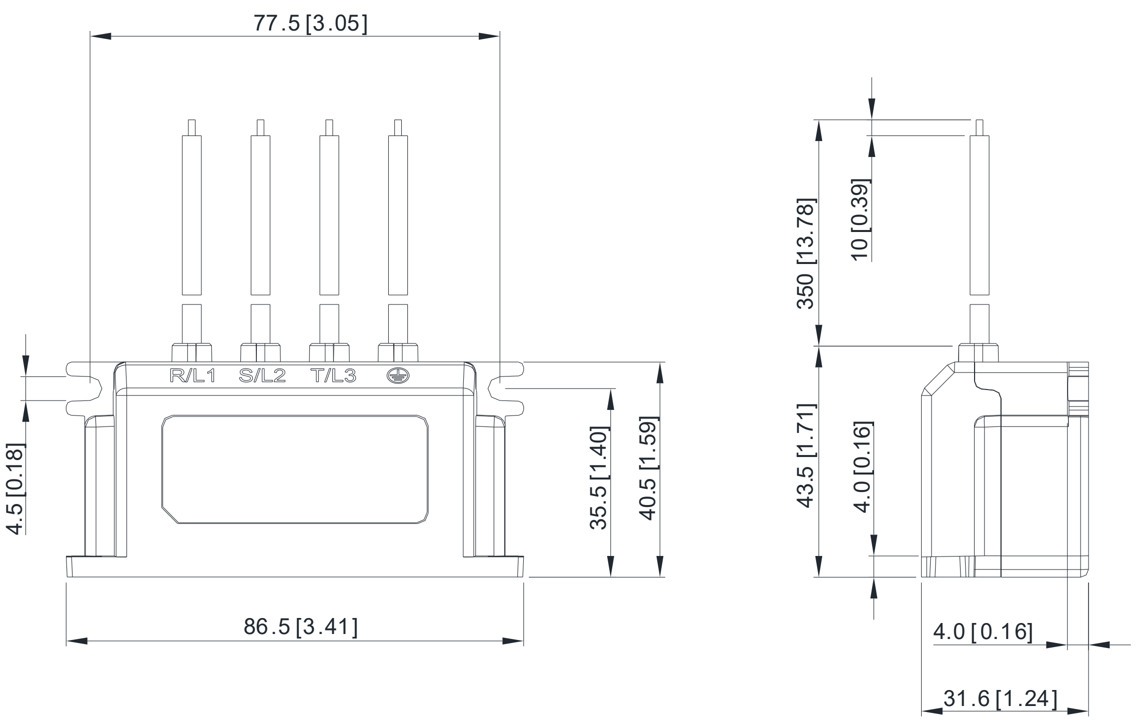


Fig. 7-62

7-9 The Assembly of NEMA KIT

NEMA KIT is in compliance with protection level NEMA 1 / UL Type 1

Frame A (A1, A2, A3, A4)

NEMA KIT model: MKMH-CBA

Unit: mm [inch]

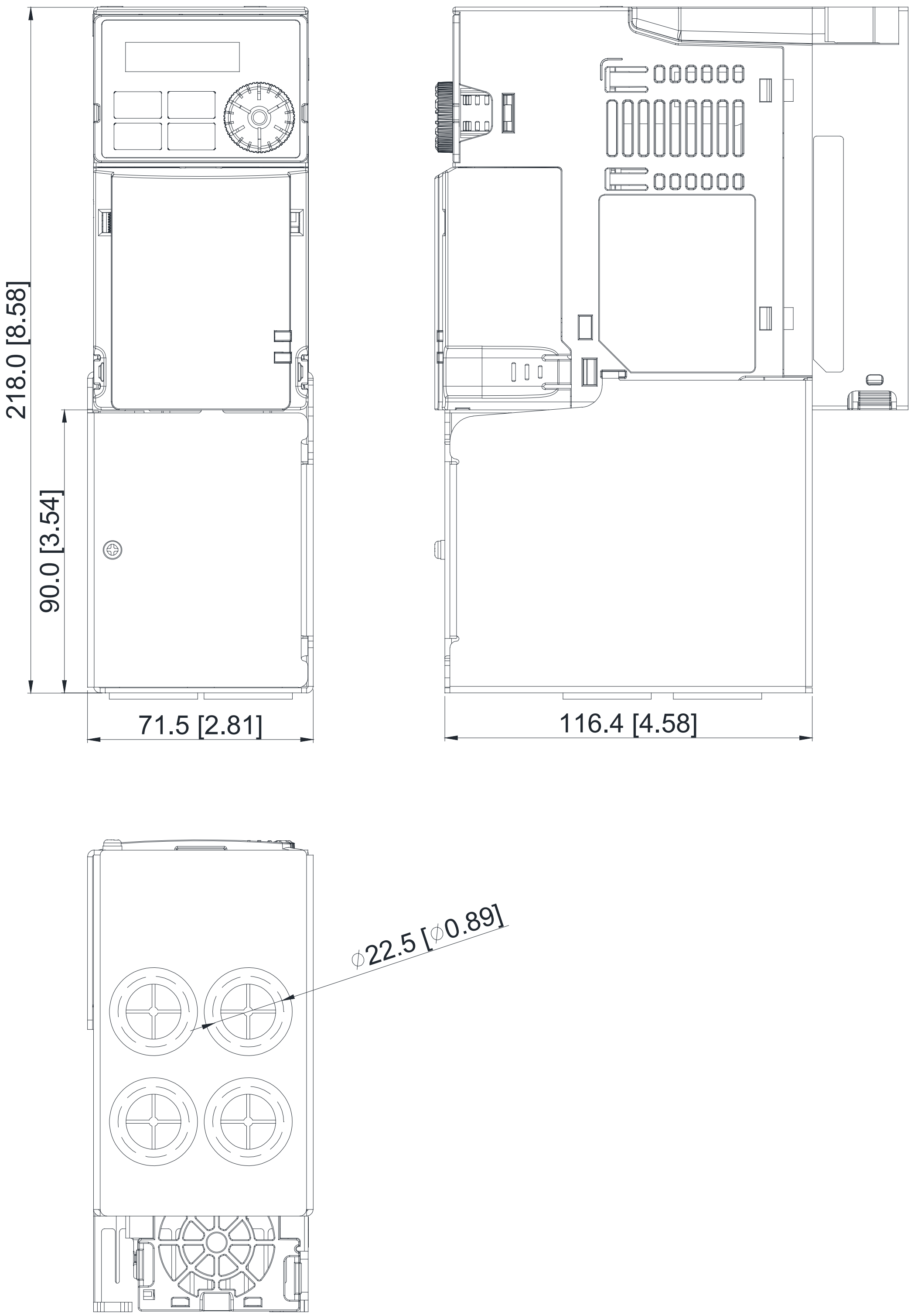


Fig. 7-63

Frame B

NEMA KIT model: MKMH-CBB

Unit: mm [inch]

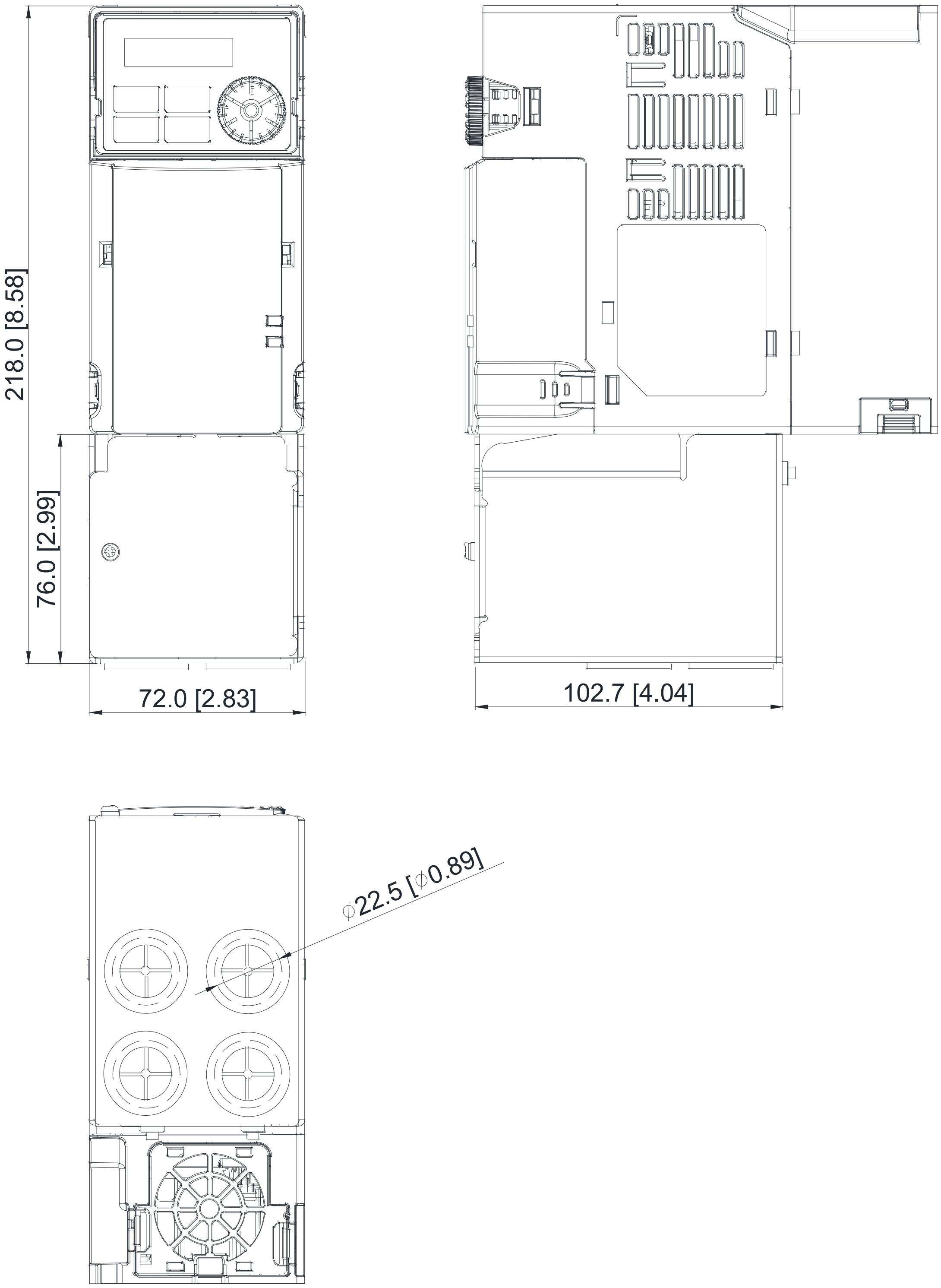


Fig. 7-64

Frame C

NEMA KIT model: MKMH-CBC

Unit: mm [inch]

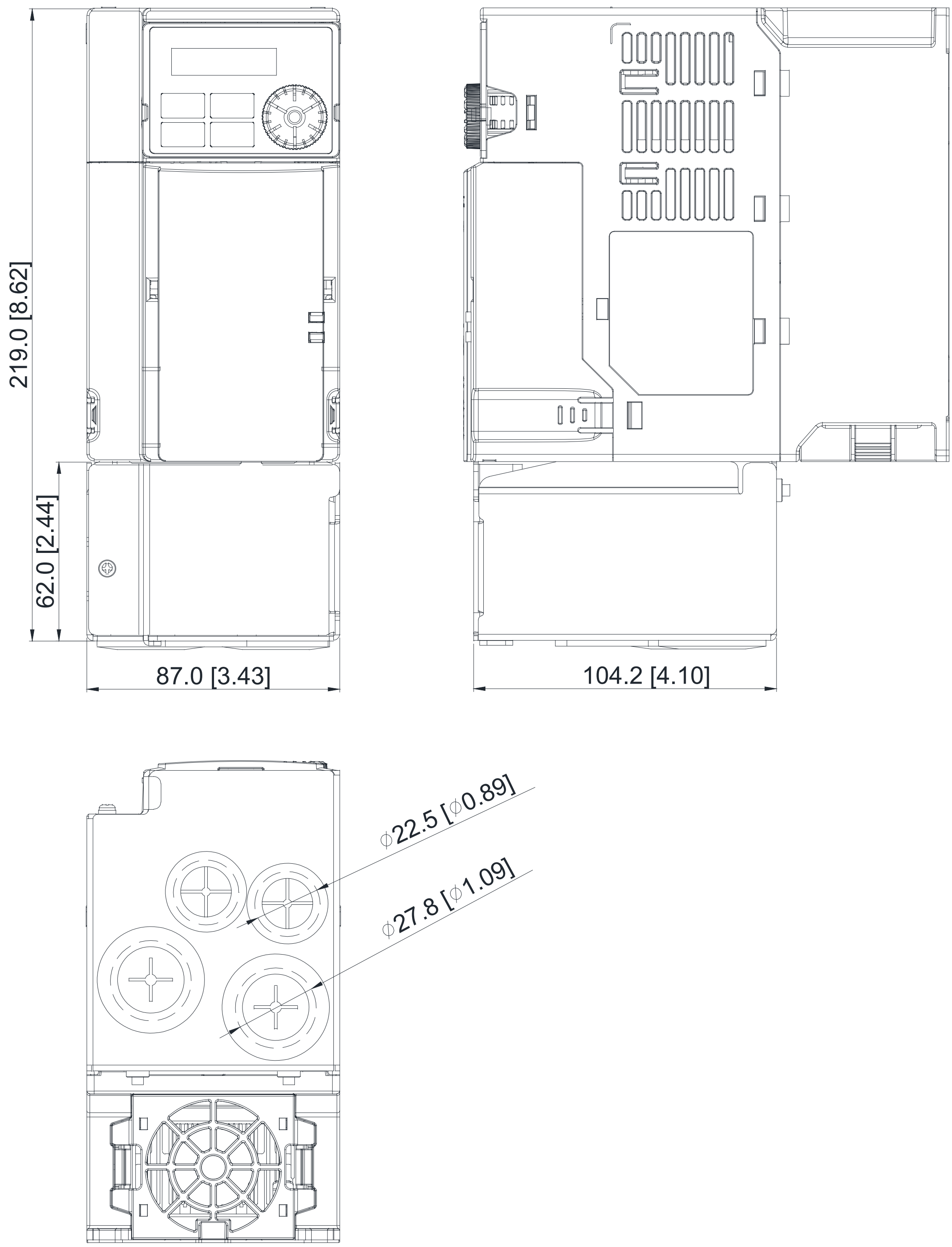


Fig. 7-65

Frame D

NEMA KIT model: MKMH-CBD

Unit: mm [inch]

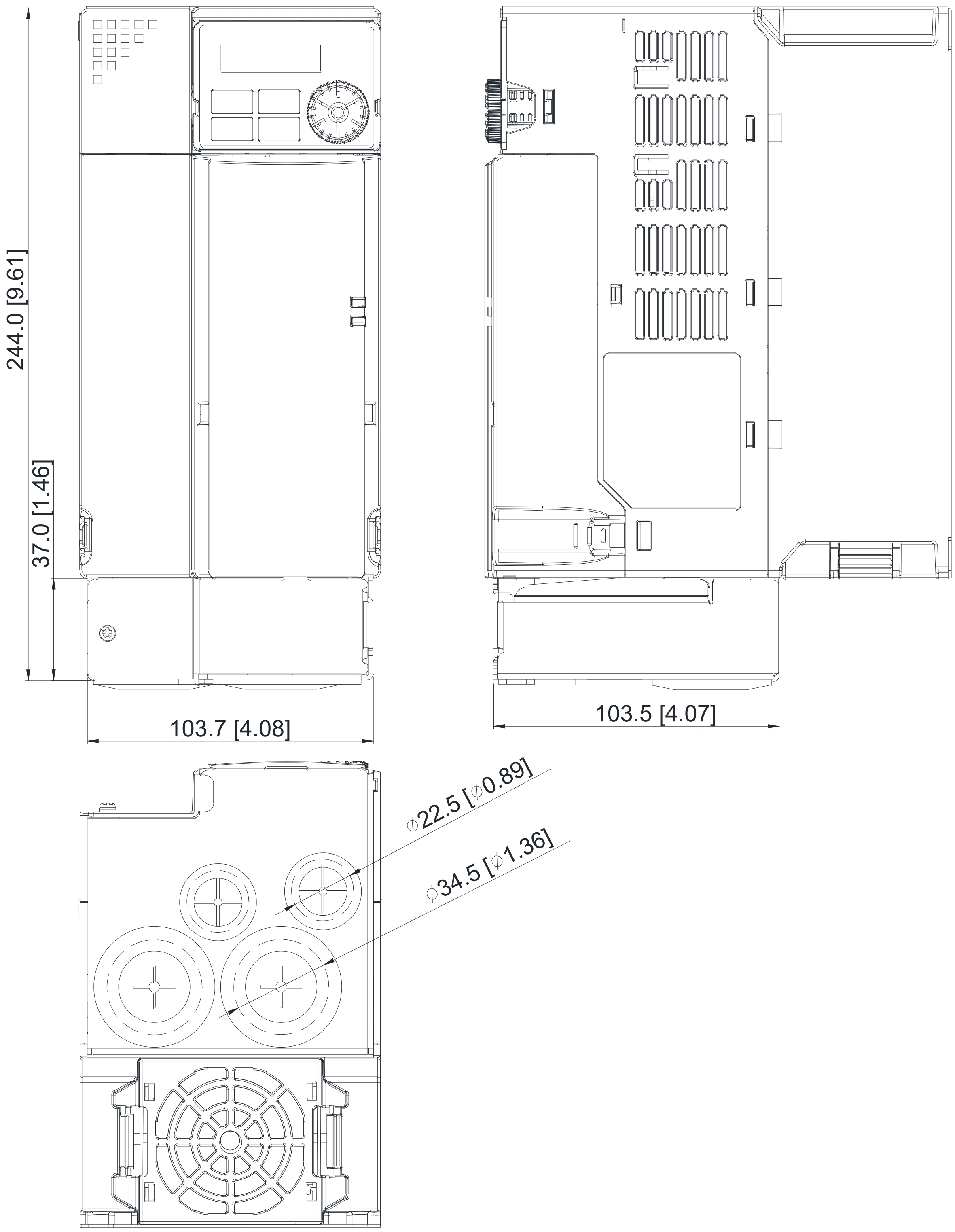


Fig. 7-66

Frame E

NEMA KIT model: MKMH-CBE

Unit: mm [inch]

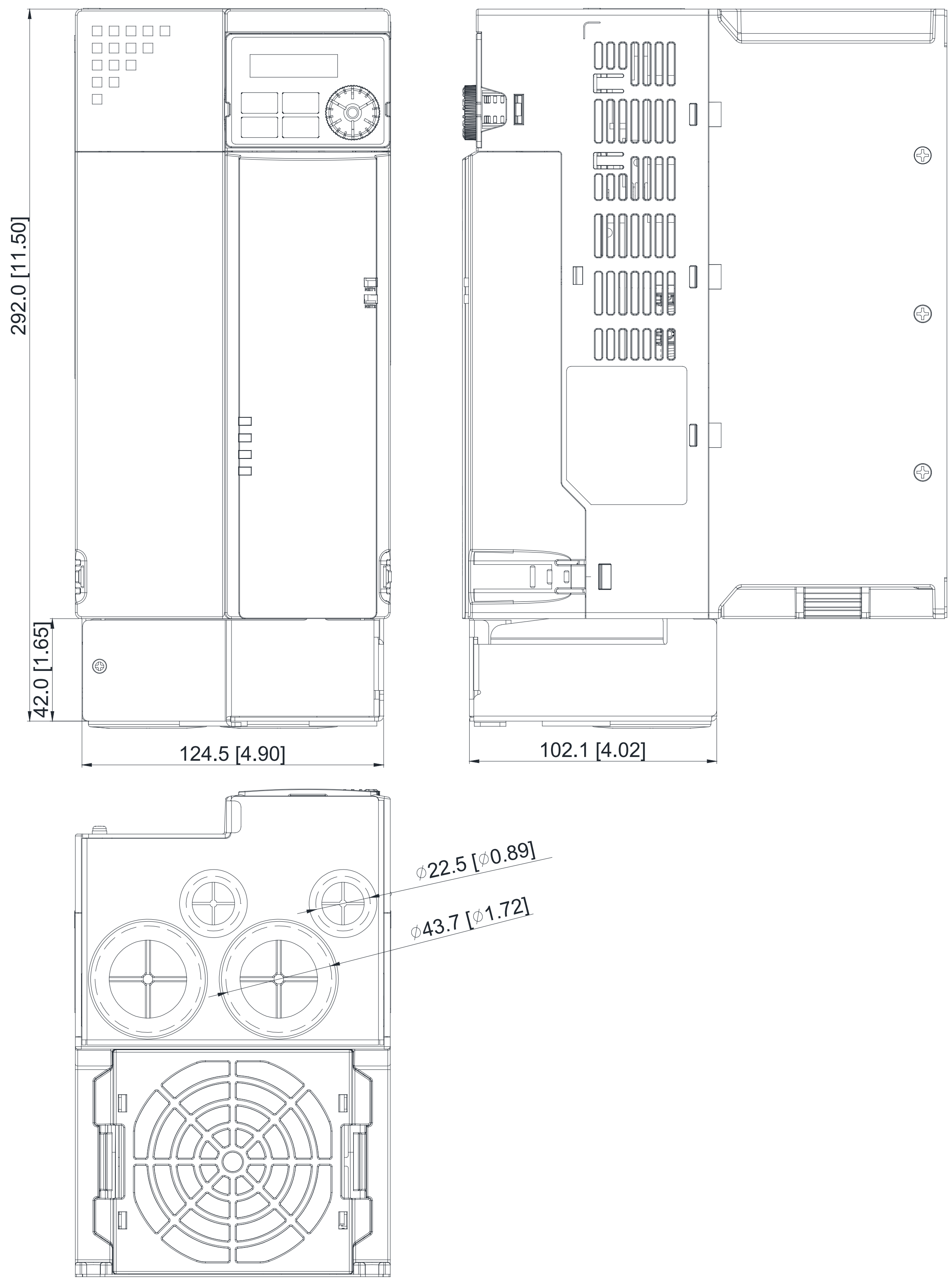


Fig. 7-67

Frame F

NEMA KIT model: MKMH-CBF

Unit: mm [inch]

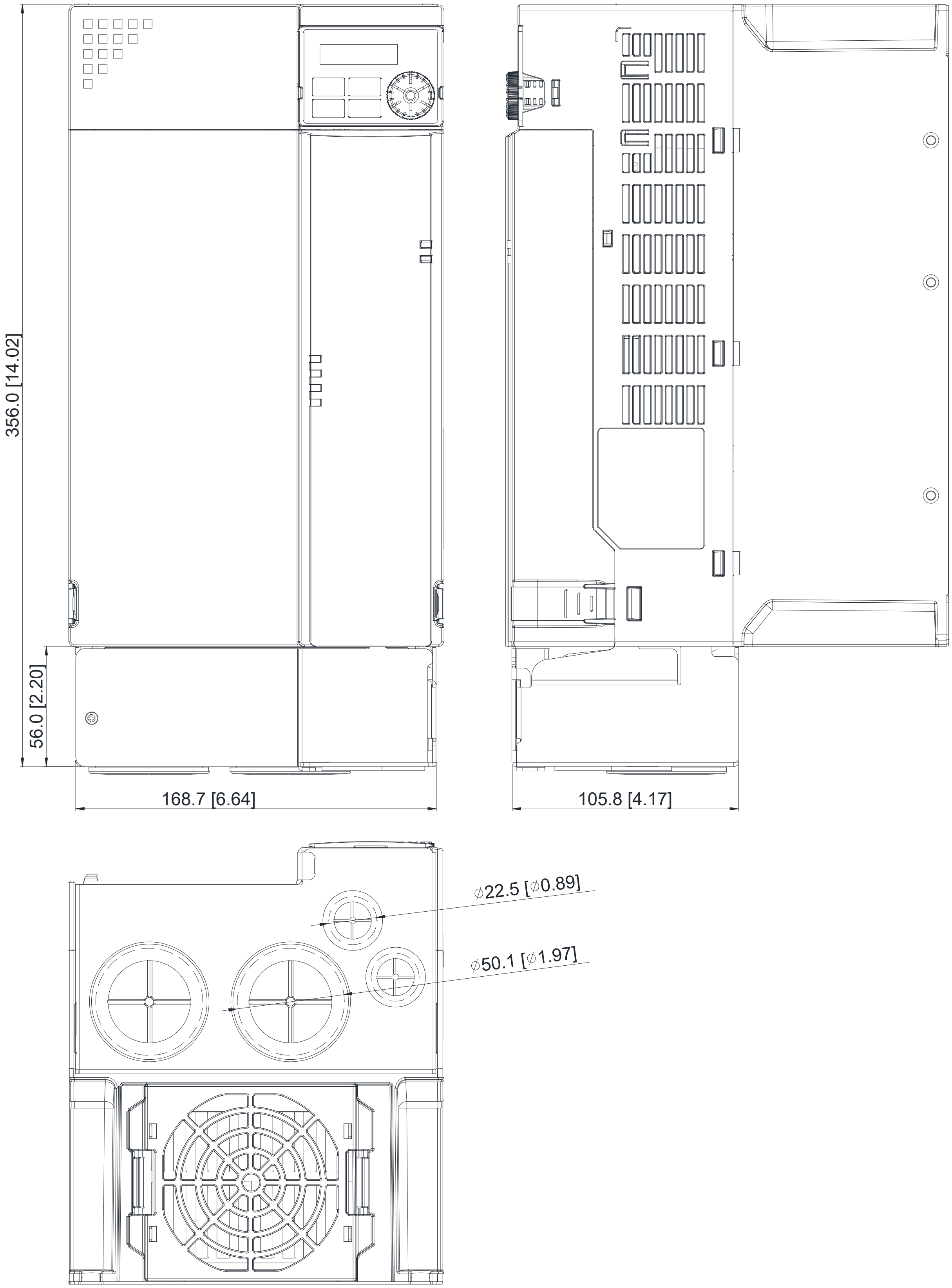


Fig. 7-68

Frame G

NEMA KIT model: MKMH-CBG

Unit: mm [inch]

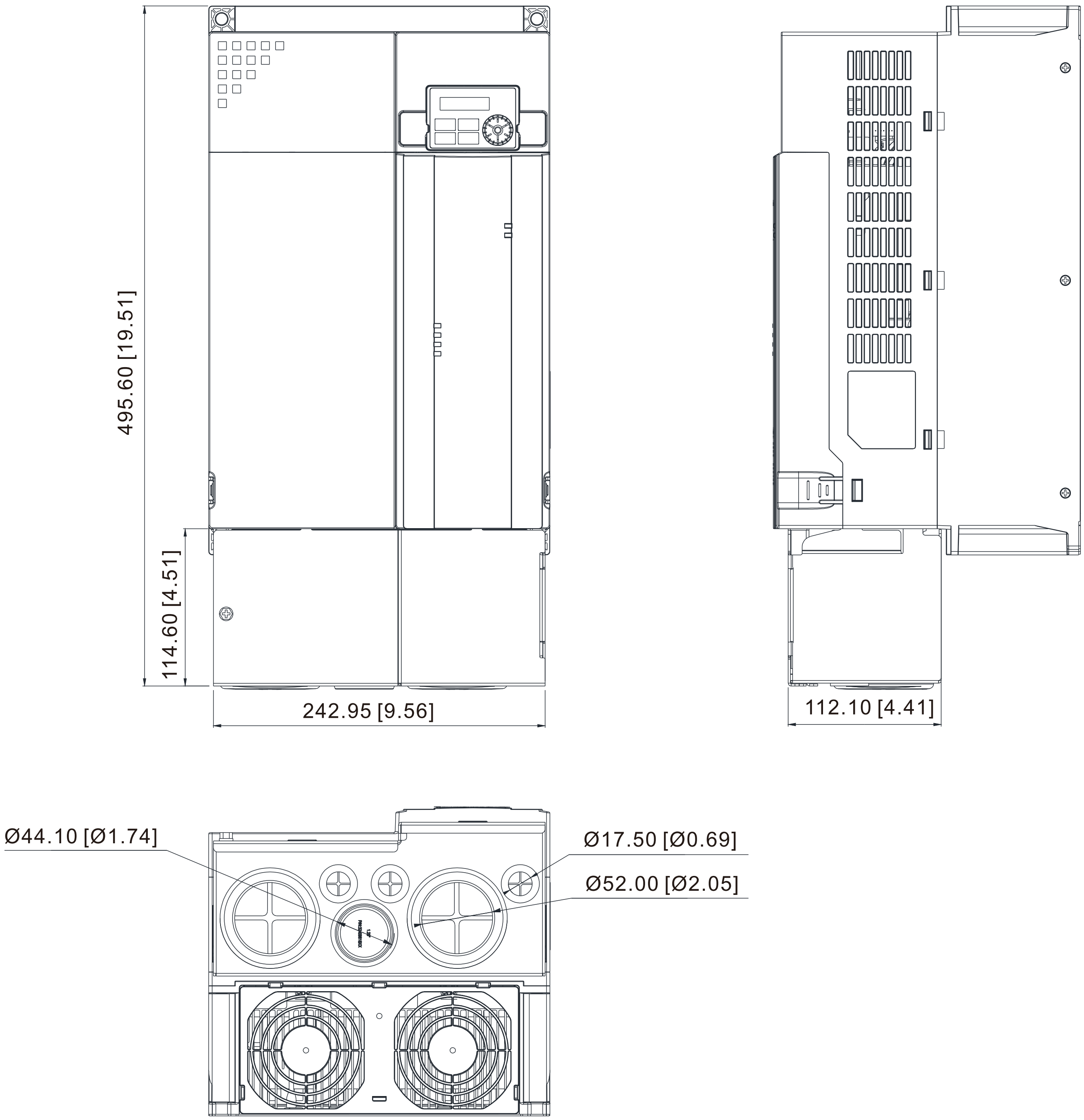


Fig. 7-69

Frame H

NEMA KIT model: MKMH-CBH

Unit: mm [inch]

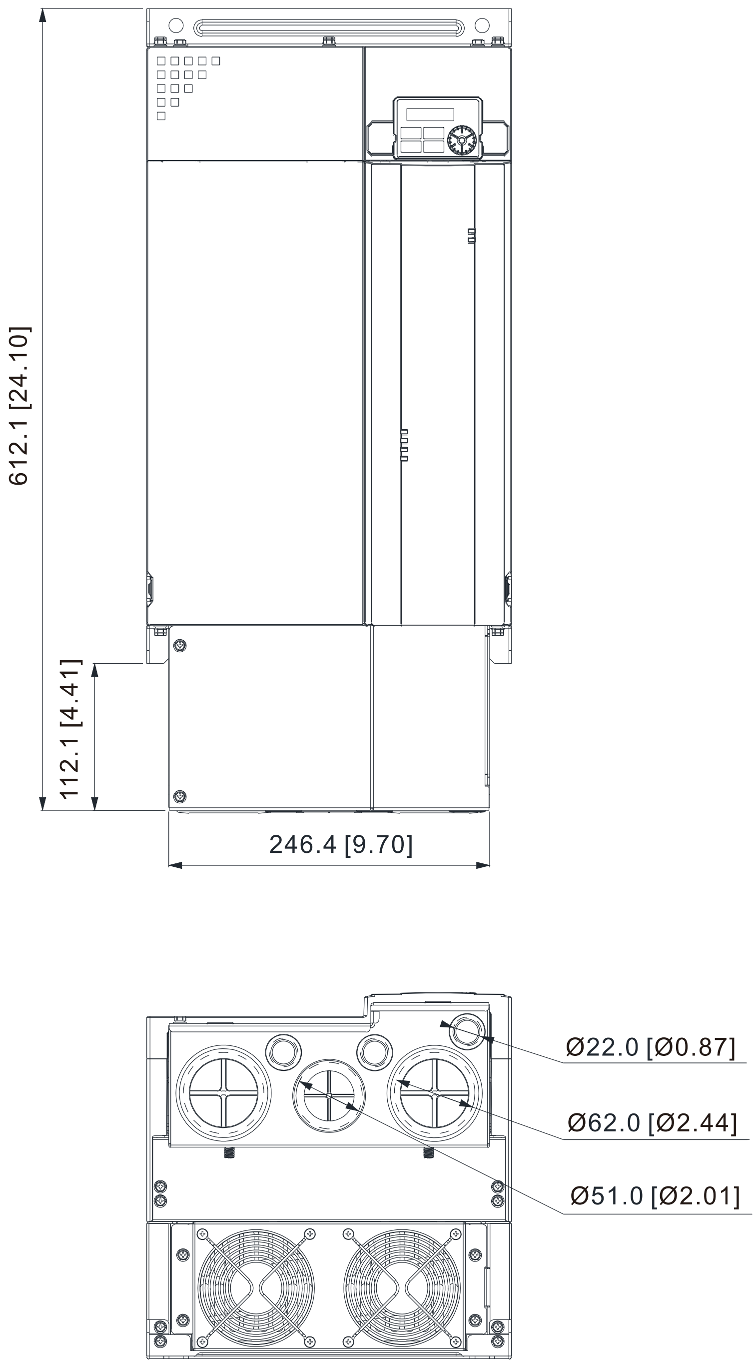
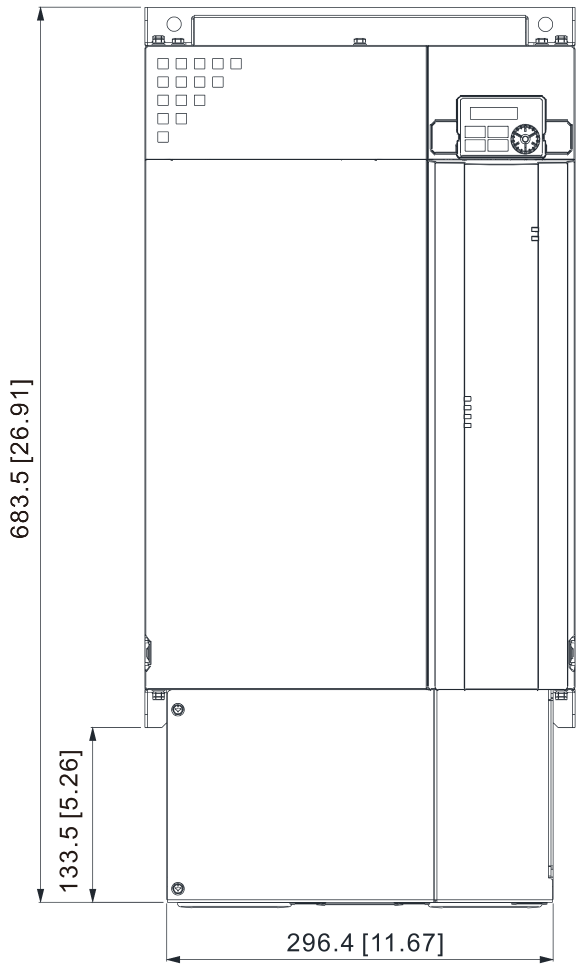


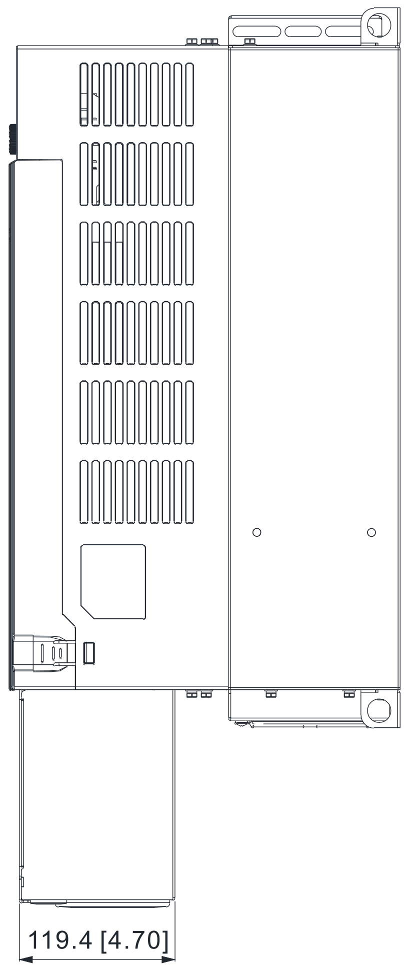
Fig. 7-70

Frame I

NEMA KIT model: MKMH-CBI

Unit: mm [inch]





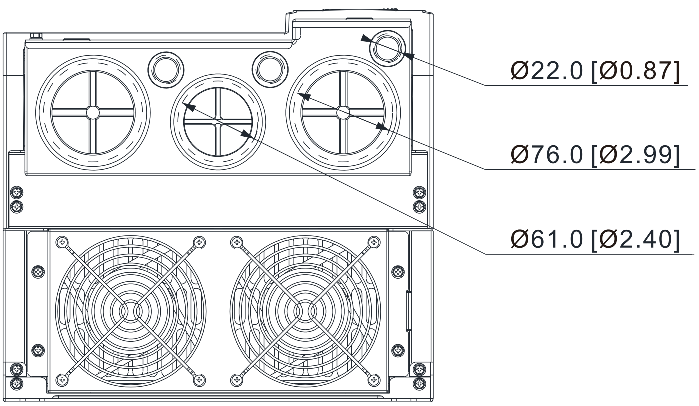


Fig. 7-71

Installation

Recommended screw torque: M3: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)

M3.5: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)

M4: 6–8 kg-cm / (5.2–6.9 lb-in.) / (0.59–0.78 Nm)

Frame A

1)

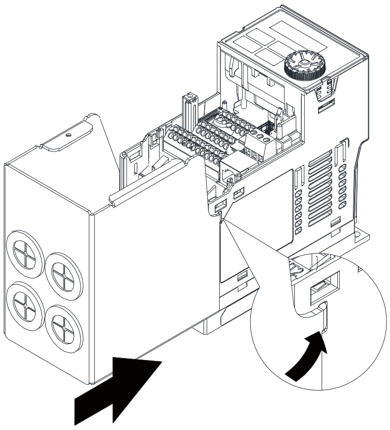


Fig. 7-72

2)

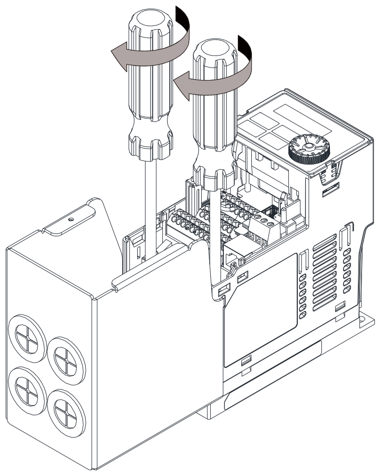


Fig. 7-73

3)

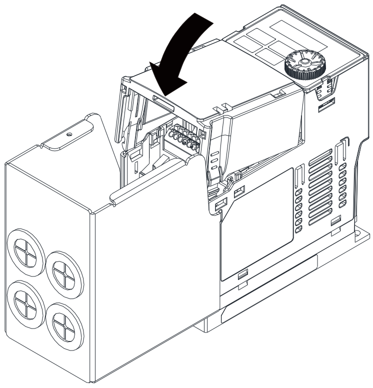


Fig. 7-74

4)

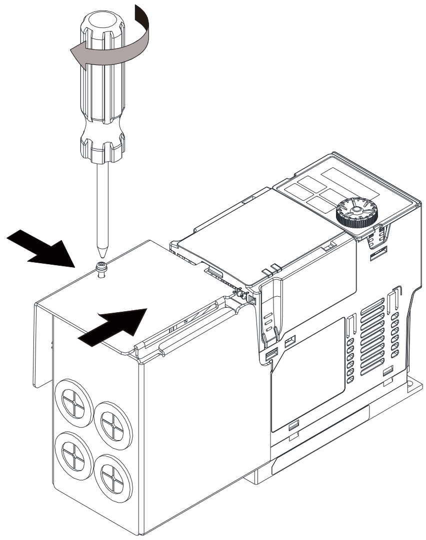


Fig. 7-75

5)

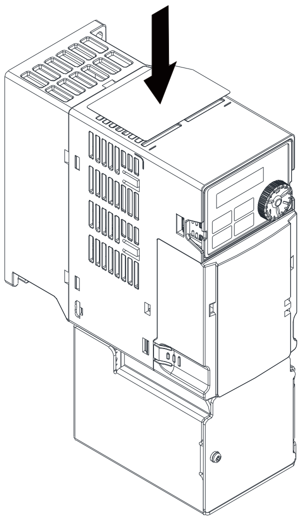
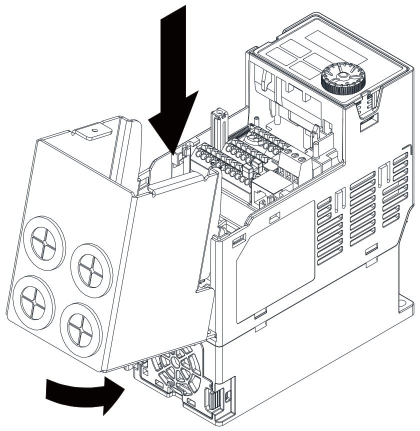
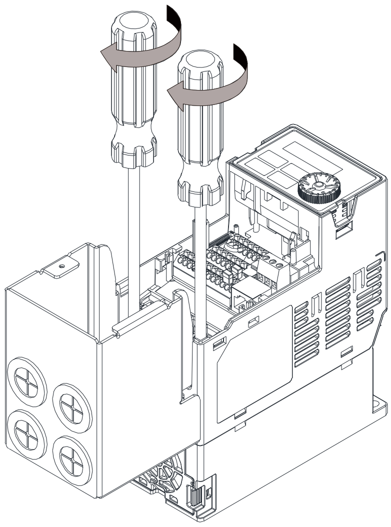
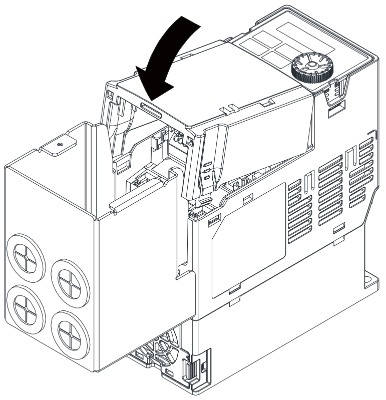
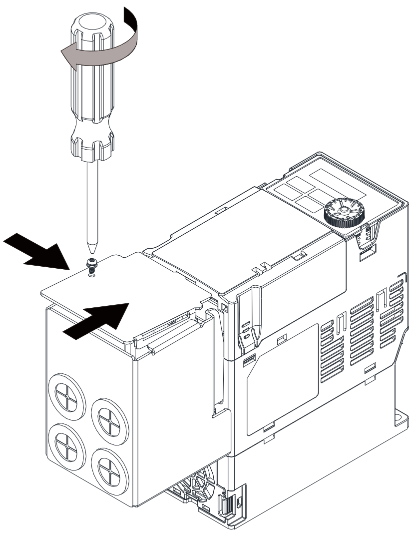


Fig. 7-76

Frame B–F

1)  Fig. 7-77	2)  Fig. 7-78
3)  Fig. 7-79	4)  Fig. 7-80

5)

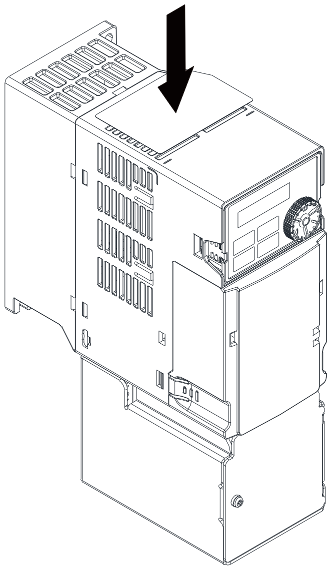


Fig. 7-81

Frame G

Recommended screw torque: M5: 10–12 kg-cm / (8.7–10.4 lb-in.) / (0.98–1.18 Nm)

1)

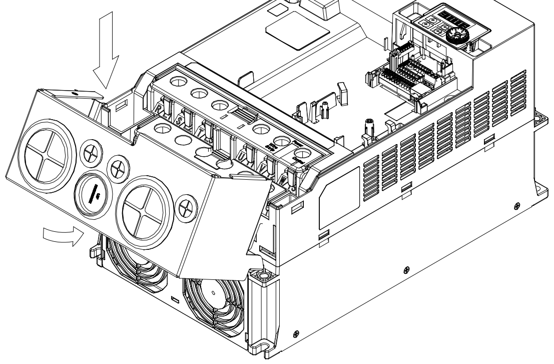


Fig. 7-82

2)

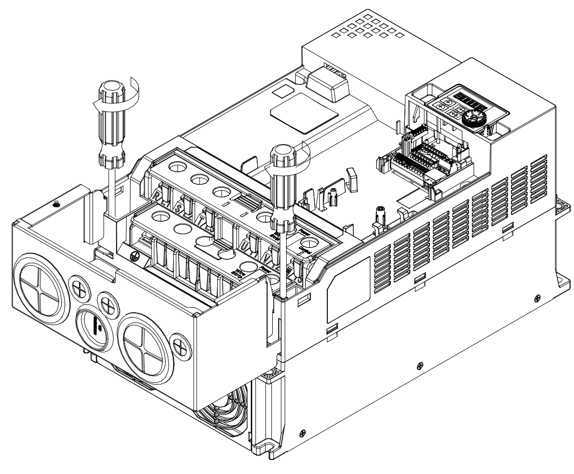


Fig. 7-83

3)

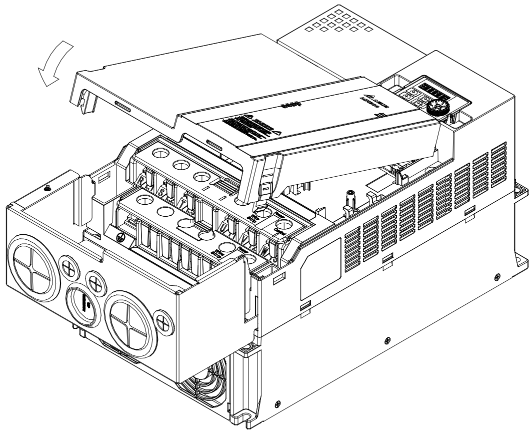


Fig. 7-84

4)

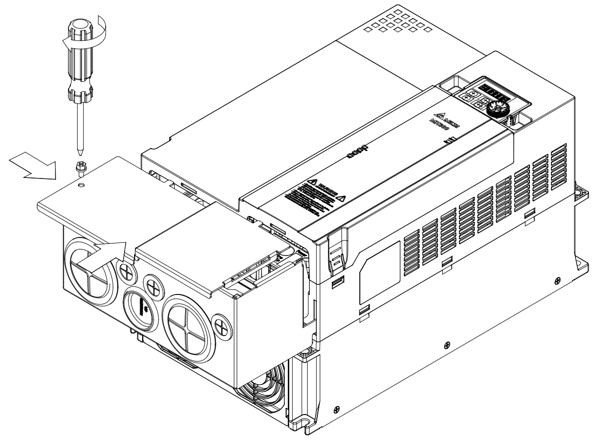


Fig. 7-85

Frame H–I

1) Fix the NEMA KIT on the drive

Frame H
M4*2: 14–16 kg-cm / (12.1–13.9 Ib-in.) / (1.38–1.56 Nm)
M8*2: 75–85 kg-cm / (65.0–73.7 Ib-in.) / (7.35–8.33 Nm)

Frame I
M4*3: 14–16 kg-cm / (12.1–13.9 Ib-in.) / (1.38–1.56 Nm)
M8*2: 175–185 kg-cm / (151.9–160.6 Ib-in.) / (17.16–18.14 Nm)

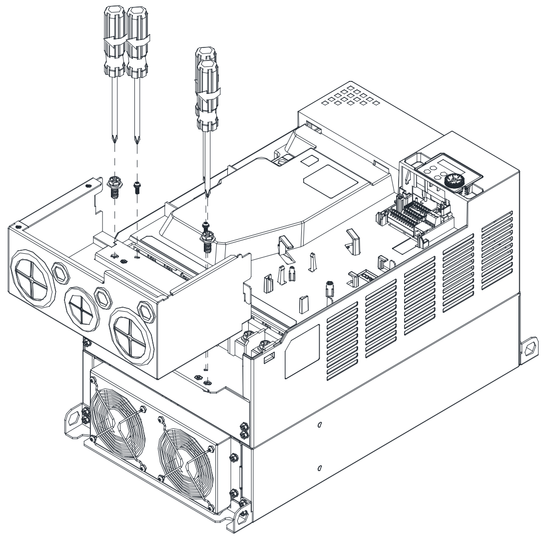


Fig. 7-86

2) Put the front cover of the drive back.

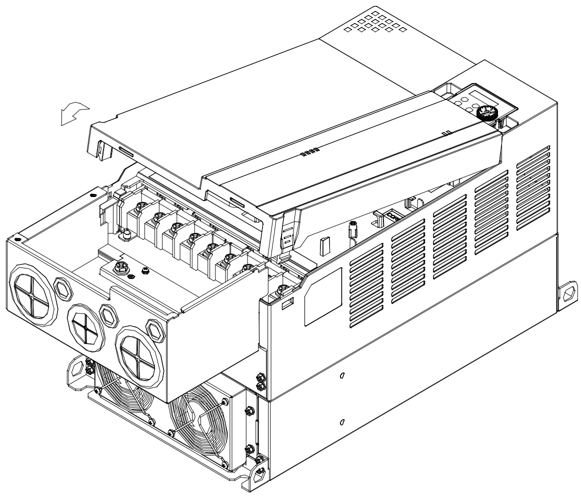


Fig. 7-87

3) Fix the NEMA KIT cover.
M5*2: 24–26 kg-cm / (20.8–22.6 Ib-in.) / (2.35–2.55 Nm)

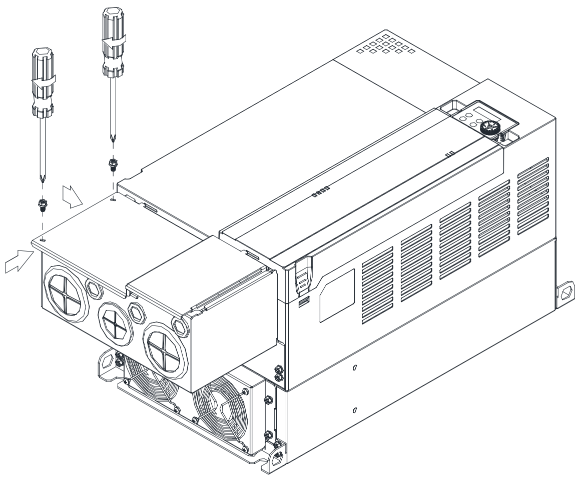
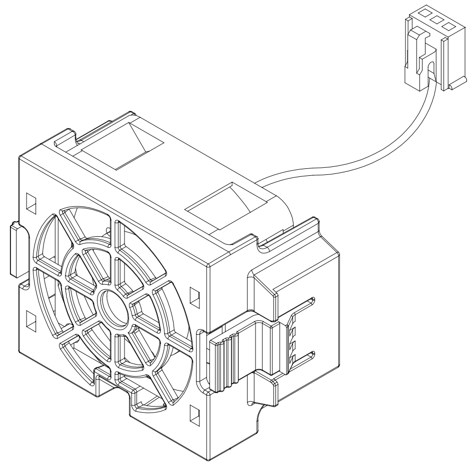
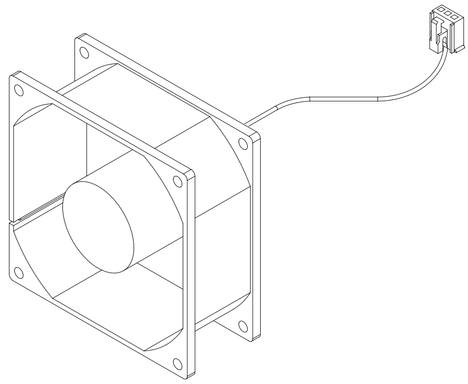
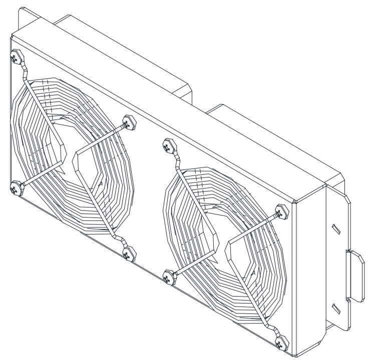


Fig. 7-88

7-10 The Assembly of Fan Kit

Frame	Fan Model	Fan Kit
A	MKM-FKMA	 Fig. 7-89
B	MKM-FKMB	
C	MKM-FKMC	
D	MKM-FKMD	
E	MKM-FKME	
F	MKM-FKMF	
G	MKM-FKMG	 Fig. 7-90
H	MKM-FKMH	 Fig. 7-91
I	MKM-FKMI	

Fan Removal

Frame A–F

1. As shown in the figure on the right, press the tabs on both sides of the fan to remove it.

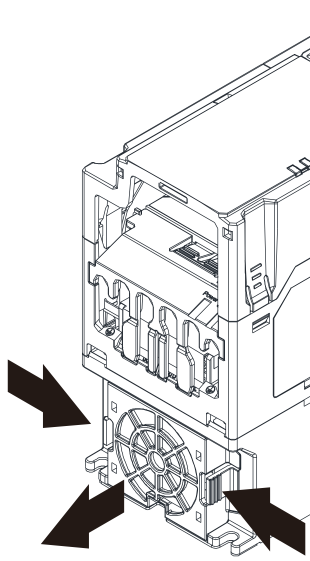


Fig. 7-92

2. Disconnect the power cable when removing the fan.

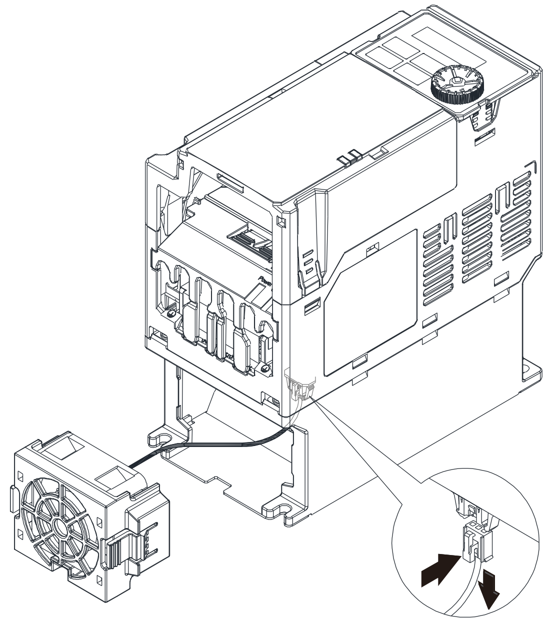
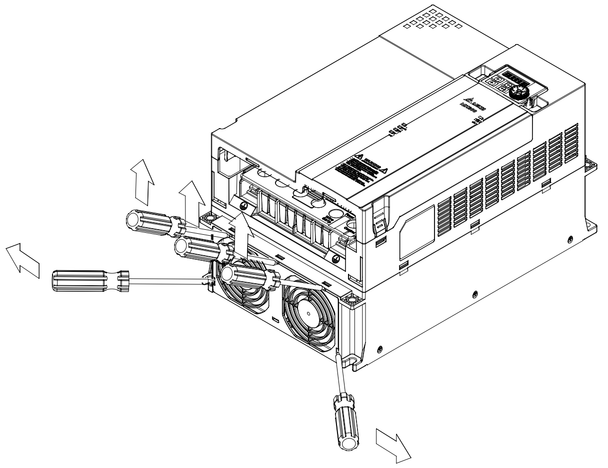
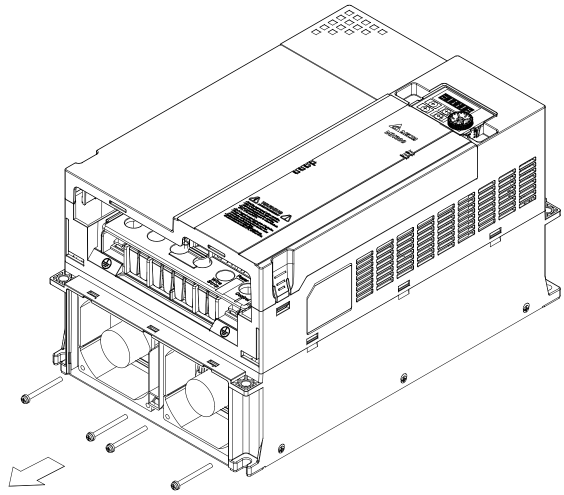
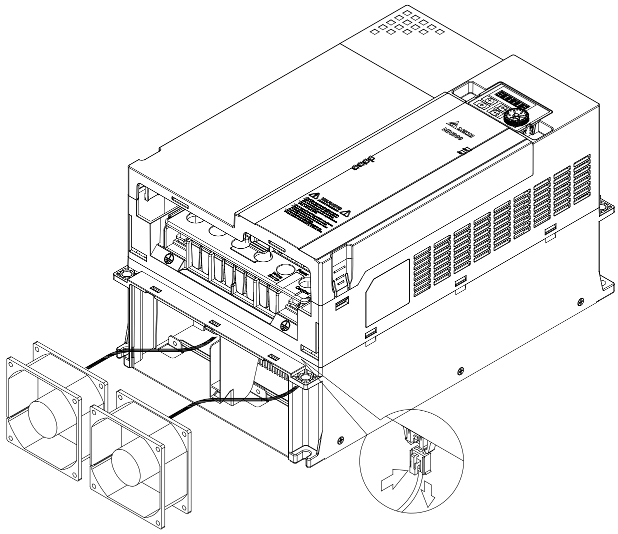
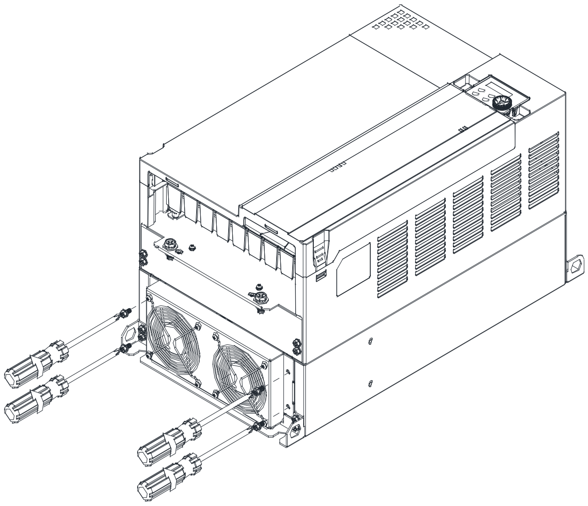
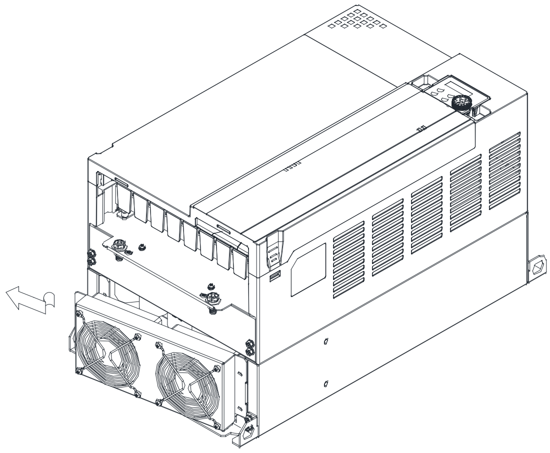
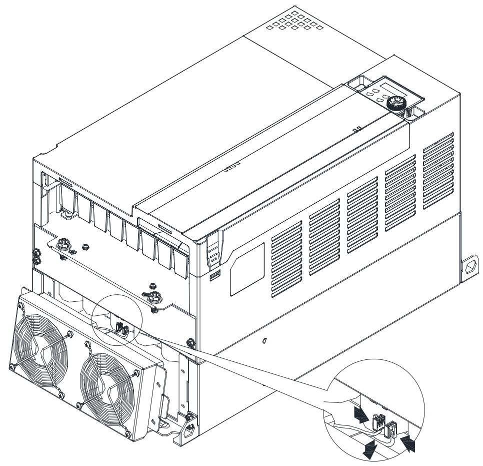


Fig. 7-93

Frame G

1. As shown in the figure on the right, pry open the cover by using slotted screwdriver.	 Fig. 7-94
2. Remove the screws which are at the bottom.	 Fig. 7-95
3. You have to remove the fan cables before taking out the fans. When installing the fans, you should let the labels of fans face inside. Torque: 10–12 kg-cm / (8.7–10.4 Ib-in.) / (1.0–1.2 Nm)	 Fig. 7-96

Frame H–I

1. As shown in the figure on the right, remove four screws. Torque: 24–26 kg-cm / (20.8–22.6 lb-in.) / (2.35–2.55 Nm)	 Fig. 7-97
2. Remove the fan module by rotating it.	 Fig. 7-98
3. Press the clip of fan connector, and then remove the fan connector.	 Fig. 7-99

7-11 Keypad Panel Mounting

KPMH-LC01

Method 1: Direct installation on a plate

Unit: mm [inch]

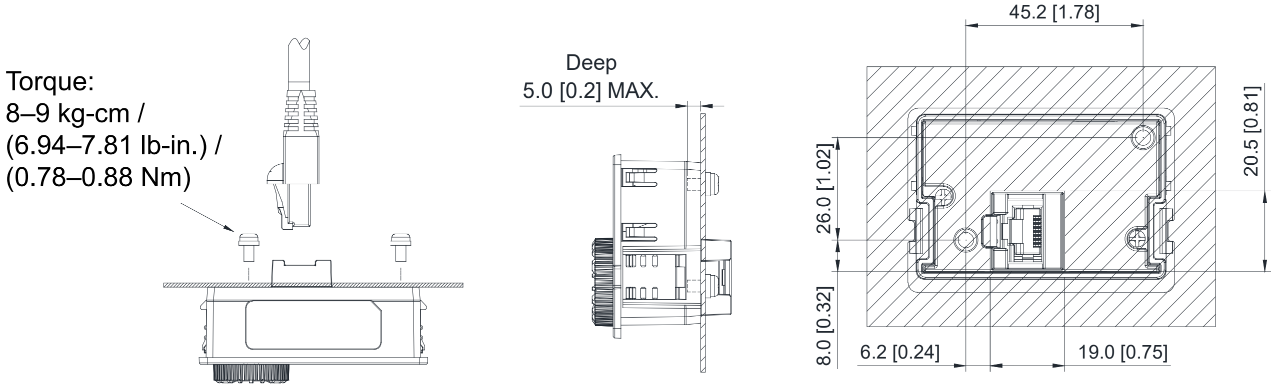


Fig. 7-100

Method 2: Mounting through a plate

Unit: mm [inch]

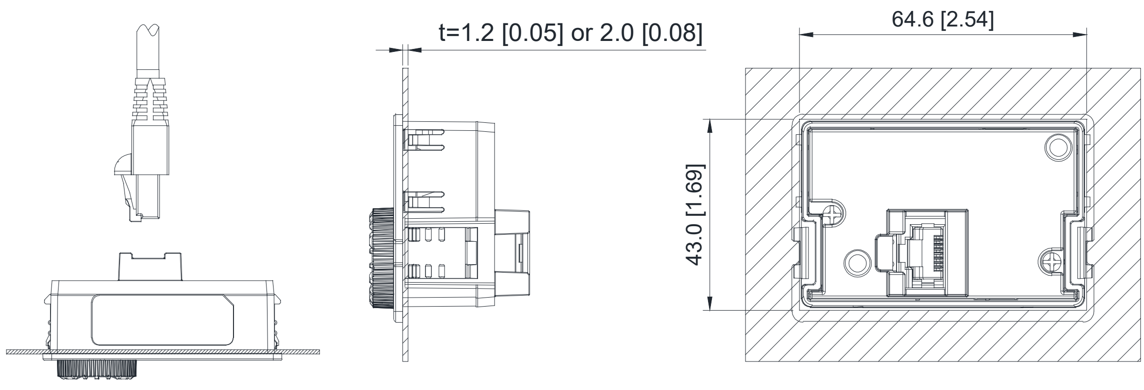


Fig. 7-101

NOTE:

1. Thickness = 1.2 [0.05] or 2.0 [0.08]
2. The extension cable models and cable length specifications are in the following table.

Unit: mm (inch)

Models	Extension Cable Length
CBC-K3FT	900 (35.43)
CBC-K5FT	1500 (59.05)
CBC-K7FT	2100 [82.68]
CBC-K10FT	3000 [118.11]
CBC-K16FT	4900 [192.91]

Table 7-65

7-12 DIN-Rail Mounting

MKM-DRB

Applicable for Frame A and B

Screw	Torque
M4 x 2 pcs	8–10 kg-cm (6.9–8.7 lb-in.) (0.7–98 Nm)

Table 7-66

Unit: mm [inch]

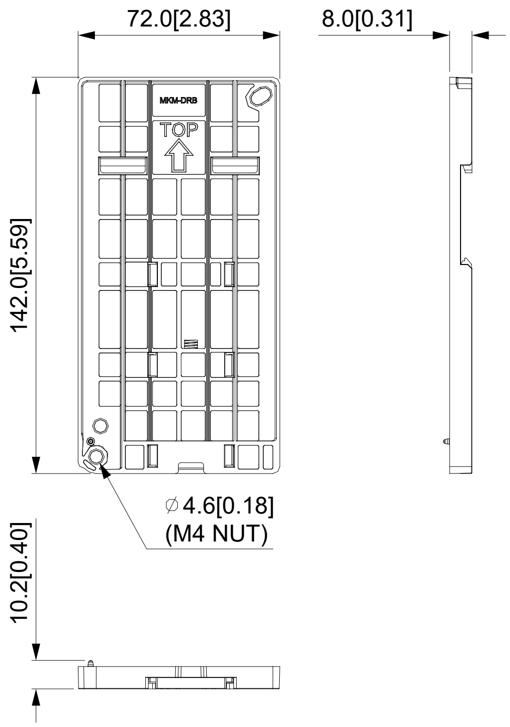


Fig. 7-102

MKM-DRC

Applicable for Frame C

Screw	Torque
M5 x 4 pcs	10–12 kg-cm (8.7–10.4 lb-in.) (0.98–1.18 Nm)

Table 7-67

Unit: mm [inch]

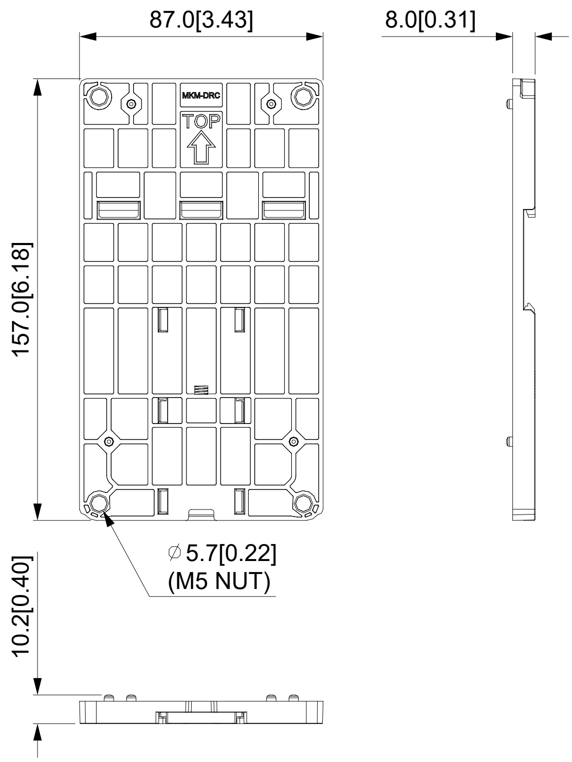


Fig. 7-103

Installation

Model	Screw	Torque
MKM-DRB	M4 x P0.7 x 2 pcs	14–16 kg-cm (12.2 – 13.8 lb-in.) (1.38–1.56 Nm)
MKM-DRC	M5 x P0.8 x 4 pcs	18–20 kg-cm (15.7–17.3 lb-in.) (1.77–1.96 Nm)

Table 7-68

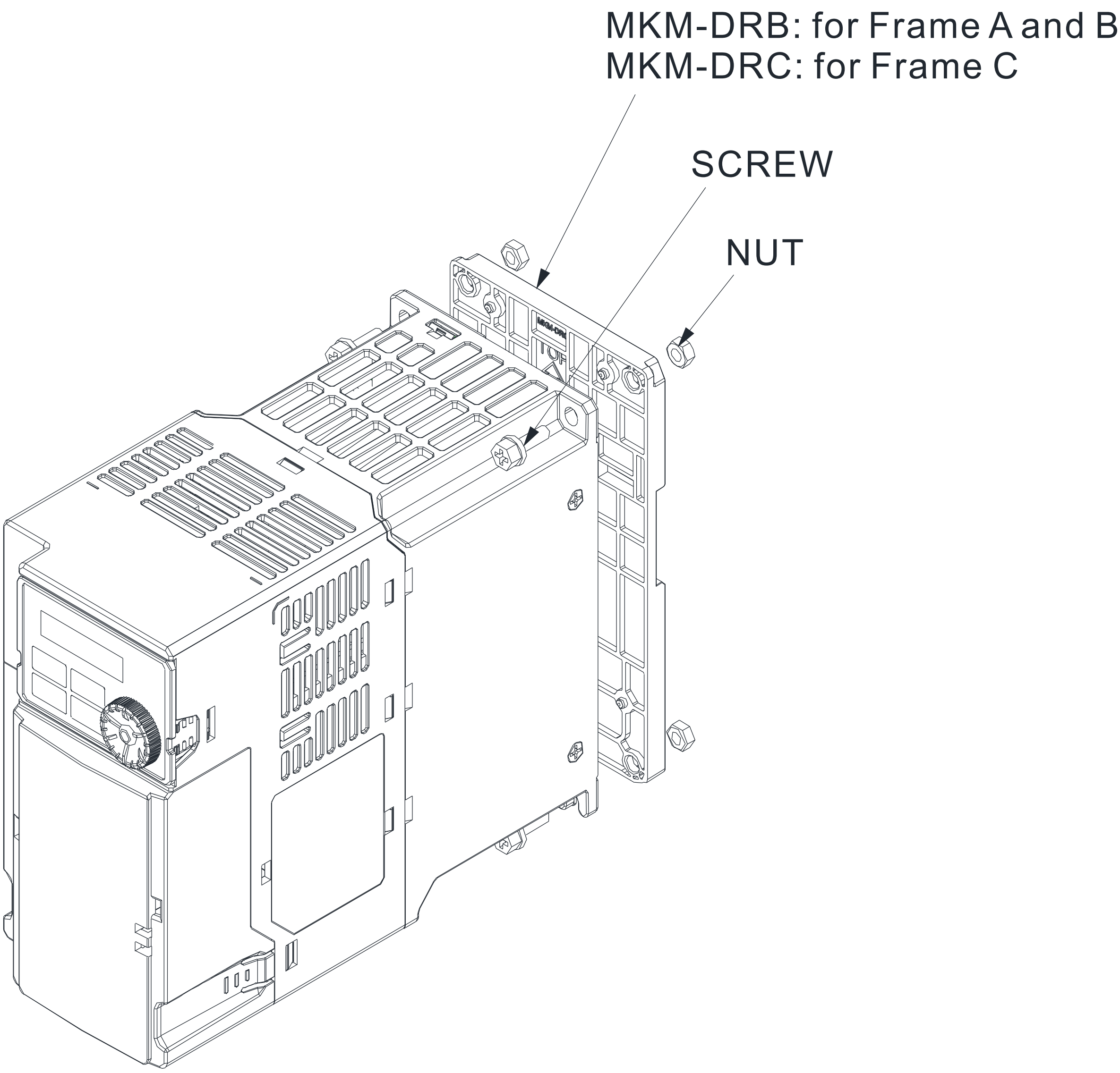


Fig. 7-104

7-13 Mounting Adapter Plate

This mounting adapter accessory is to change the wiring method for the MS300 / MH300 series to provide flexible installation. It changes the wiring from the main input/motor output at the bottom to the main input from the top and the motor output from the bottom. However, when you use the mounting adapter plate to change the drive from the VFD-E / VFD-EL series to the MS300 / MH300 series, you can still use the original wiring method. The following table shows the correspondences.

Series / Models	MS300 / MH300	VFD-E	VFD-EL
MKM-MAPB	Frame A–B	Frame A	Frame A
MKM-MAPC	Frame C	Frame B	Frame B

Table 7-69

MKM-MAPB

Applicable for frame A and B

Unit: mm [inch]

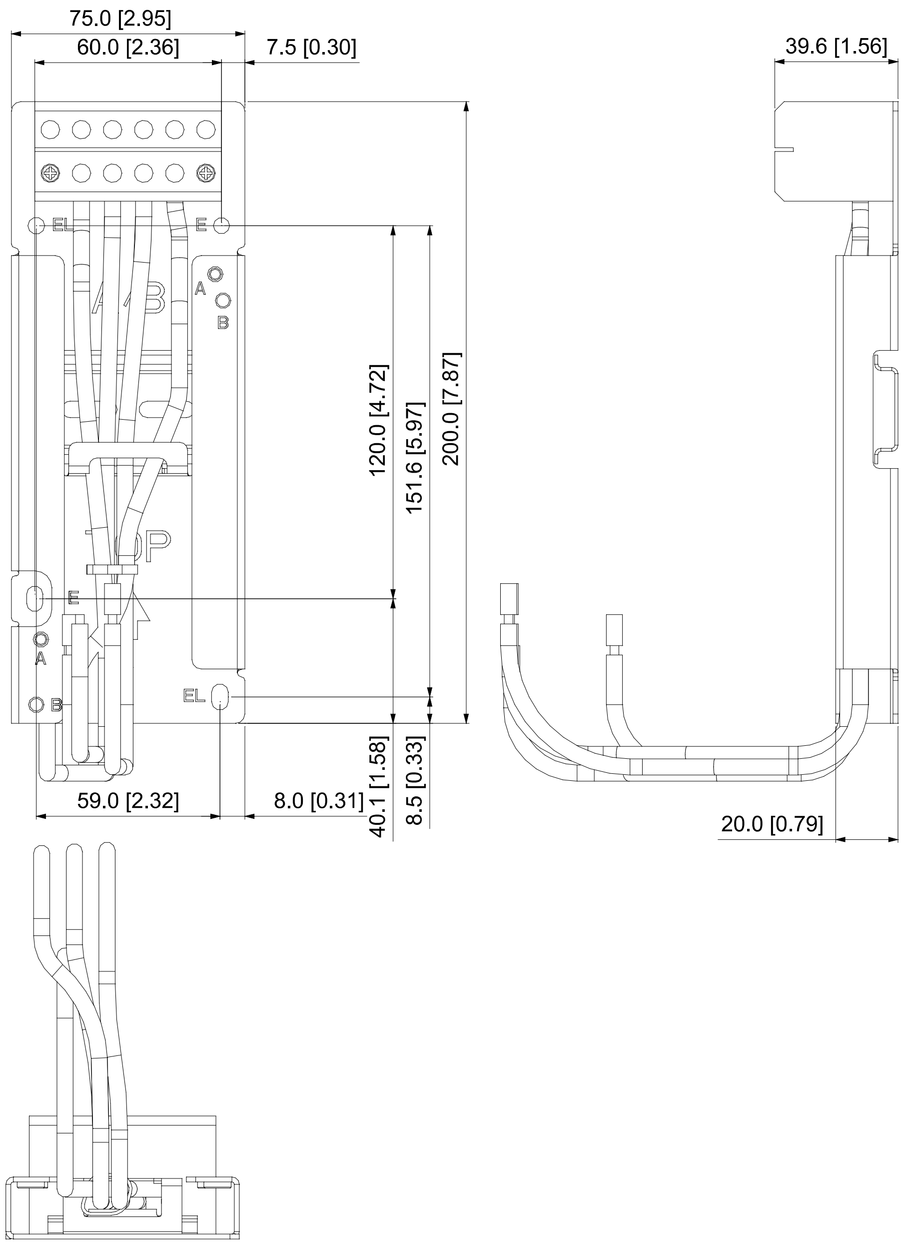


Fig. 7-105

MKM-MAPC

Applicable for frame C

Unit: mm [inch]

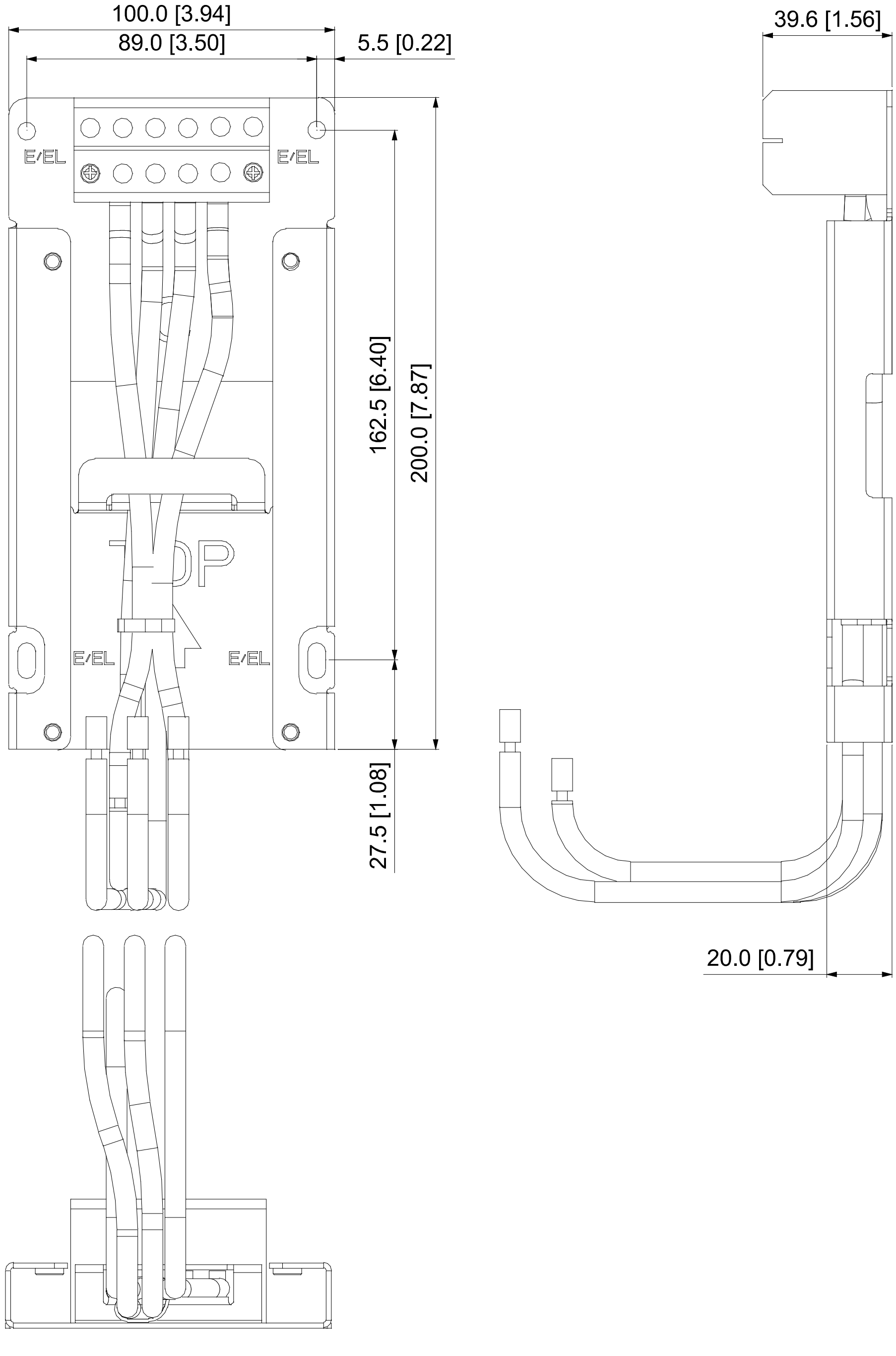


Fig. 7-106

Installation

Frame A and B

Screw	Torque
M4	14–16 kg-cm / (12.4–13.9 lb-in.) / (1.37–1.57 Nm)
M5	16–20 kg-cm / (13.9–17.4 lb-in.) / (1.57–1.96 Nm)

Table 7-70

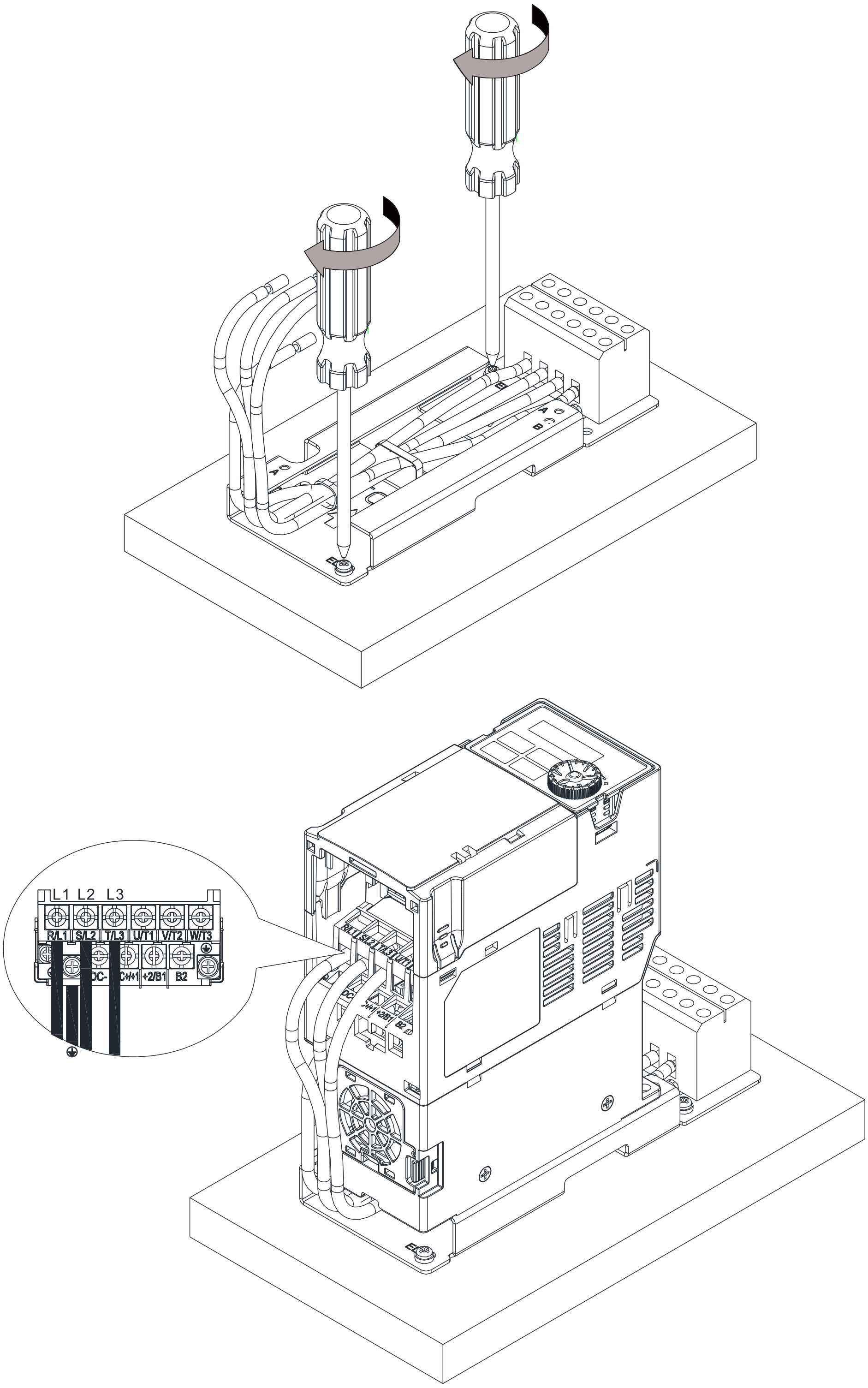


Fig. 7-107

Frame C

Screw	Torque
M4	14–16 kg-cm / (12.4–13.9 lb-in.) / (1.37–1.57 Nm)
M5	16–20 kg-cm / (13.9–17.4 lb-in.) / (1.57–1.96 Nm)

Table 7-71

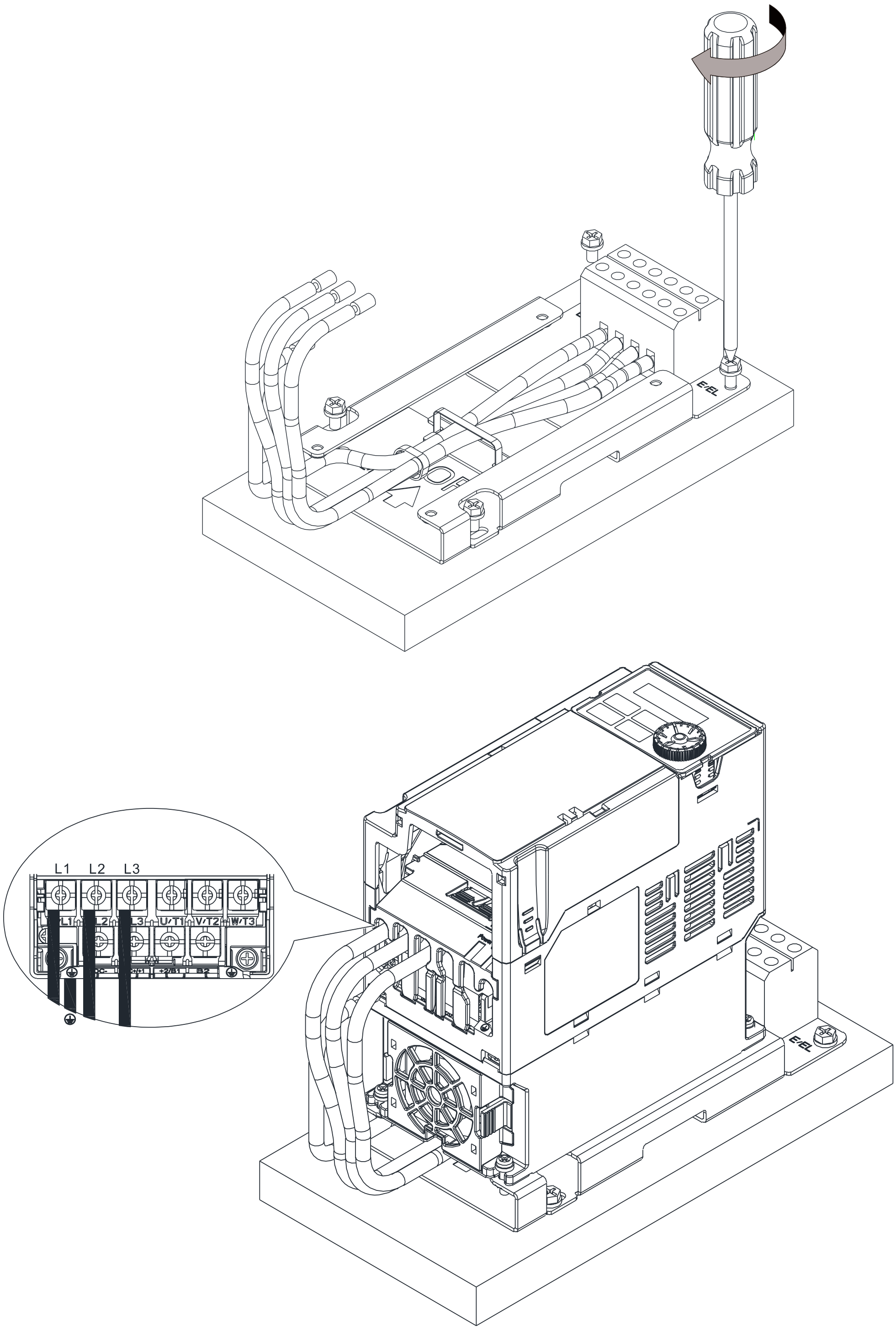


Fig. 7-108

7-14 Digital Keypad – KPC-CC01

7-14-1 Digital Keypad KPC-CC01

The default communication protocol for MH300 is ASCII 9600, 7, N, 2, but the communication protocol for KPC-CC01 is RTU 19200, 8, N, 2. Therefore, you must set MH300 communication parameters so as to connect with the digital keypad KPC-CC01. The setting steps are as follows:

1. Set Pr.09-00 communication address = 1
2. Set Pr.09-01 COM1 transmission speed (Baud rate) = 19.2 Kbps
3. Set Pr.09-04 COM1 communication protocol = 13: 8N2 (RTU)

KPC-CC01

Communication Interface
RJ45 (socket), RS-485 interface

Communication protocol:
RTU19200, 8, N, 2

Installation Method

1. The embedded type can be installed flat on the surface of the control box. The front cover is waterproof.
2. Buy a MKC-KPPK model for wall mounting or embedded mounting. Its protection level is IP66.
3. The maximum RJ45 extension lead is 5 m (16ft).
4. This keypad can only be used on Delta's motor drive C2000, CH2000, CP2000, MS300, MH300, ME300 series, and so on.

Keypad Function Description

Key	Descriptions
RUN	Start Operation Key 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive by the function setting. The RUN LED will be ON. 3. Can be pressed repeatedly at the stop process.
STOP RESET	Stop Command Key. 1. This key has the highest priority when the command is from the keypad. 2. When it receives the STOP command, regardless of whether the AC motor drive is in operation or stop status, the AC motor drive executes the "STOP" command. 3. Use the RESET key to reset the drive after a fault occurs. 4. If you cannot reset after the error: a. The condition which triggers the fault is not cleared. After you clear the condition, you can then reset the fault. b. The drive is in fault status when powered on. After you clear the condition, restart and then you can reset the fault.
FWD REV	Operation Direction Key 1. Only controls the operation direction, NOT the drive activation. FWD: forward, REV: reverse. 2. Refer to the LED descriptions for more details.
ENTER	ENTER Key Goes to the next menu level. If at the last level, press ENTER to execute the command.

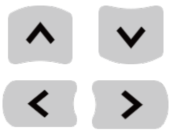
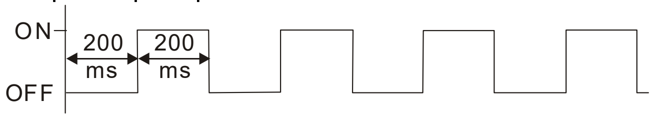
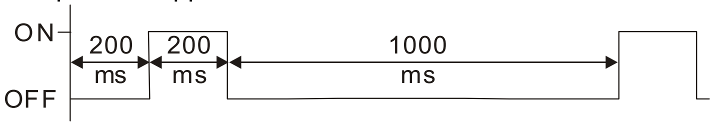
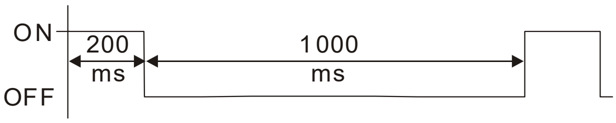
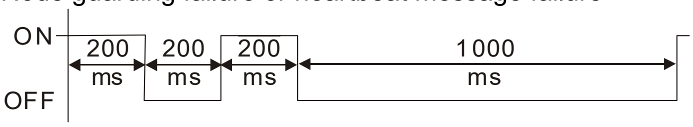
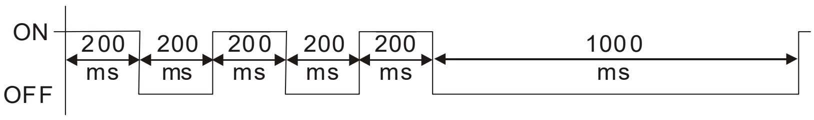
Key	Descriptions
ESC	ESC Key Leaves the current menu and returns to the previous menu; also functions as a return key or cancel key in a sub-menu.
MENU	Returns to the main menu. Menu commands: 1. Parameter Setup 2. Quick Start 3. Application Selection List 4. Changed List 5. Copy Parameter 6. Fault Record 7. Language Setup 8. Time Setup 9. Keypad Locked 10. PLC Function 11. Copy PLC 12. Display Setup 13. Start-up Menu 14. Main Page 15. PC Link 16. Start Wizard
	Direction: Left / Right / Up / Down 1. In the numeric value setting mode, moves the cursor and changes the numeric value. 2. In the menu / text selection mode, selects an item.
F1 F2 F3 F4	Function Key 1. The functions keys have defaults and can also be use-defined. The defaults for F1 and F4 work with the function list below. For example, F1 is the JOG function, and F4 is a speed setting key for adding / deleting user-defined parameters. 2. Other functions must be defined using TPEditor. Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 7-14-3.
HAND	HAND Key 1. Use this key to select HAND mode. In this mode, the drive's parameter settings for frequency command source is Pr.00-30, and that for operation command source is Pr.00-31. 2. Press the HAND key at STOP, then the setting switches to the HAND frequency source and HAND operation source. 3. Press HAND key at RUN, and it stops the AC motor drive first (displays AHSP warning), and switches to HAND frequency source and HAND operation source. 4. Successful mode switching for the KPC-CC01 displays HAND mode on the screen.
AUTO	AUTO Key 1. The default of the drive is AUTO mode. 2. Use this key to select AUTO mode. In this mode, the drive's parameter settings for frequency command source is Pr.00-20, and that for operation command is Pr.00-21. 3. Press the AUTO key at STOP, then the setting switches to the AUTO frequency source and AUTO operation source. 4. Press AUTO key at RUN, and it stops the AC motor drive first (displays AHSP warning), and switches to AUTO frequency source and AUTO operation source. 5. Successful mode switching for the KPC-CC01 displays AUTO mode on the screen

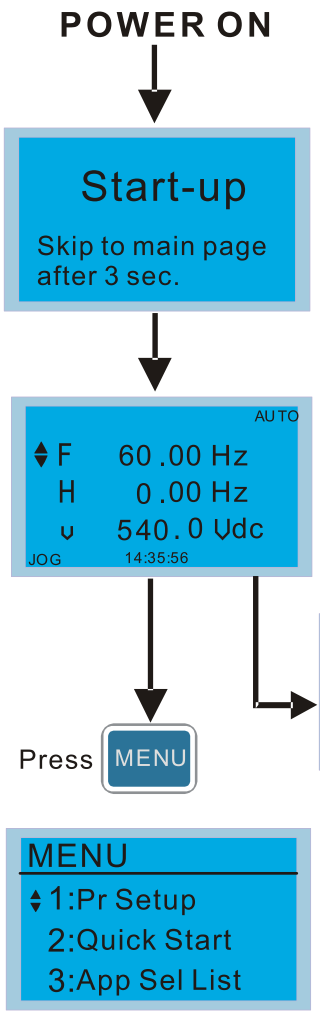
Table 7-72

NOTE:
The defaults for the frequency command and operation command source of HAND / AUTO mode are both from the keypad.

LED Function Descriptions

<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td></td><td>Steady ON: STOP indicator for the AC motor drive.
Blinking: the drive is in standby.
Steady OFF: the drive does not execute the “STOP” command.</td></tr>
<tr><td></td><td>Operation Direction LED
1. Green light: the drive is running forward.
2. Red light: the drive is running backward.
3. Flashing light: the drive is changing direction.
Operation Direction LED under Torque Mode
1. Green light: when the torque command ≥ 0, and the motor is running forward.
2. Red light: when the torque command < 0, and the motor is running backward.
3. Flashing light: when the torque command < 0, and the motor is running forward.</td></tr>
<tr><td>CANopen–RUN</td><td>RUN LED:
<table>
<tr><th>LED status</th><th>Condition</th></tr>
<tr><td>OFF</td><td>CANopen at initial state
No LED</td></tr>
<tr><td>Flashing</td><td>CANopen at pre-operation state
</td></tr>
<tr><td>Single flash</td><td>CANopen at stopped state
</td></tr>
<tr><td>ON</td><td>CANopen at operational state
</td></tr>
</table></td></tr>
<tr><td>CANopen–ERR</td><td>ERR LED:
<table>
<tr><th>LED status</th><th>Condition</th></tr>
<tr><td>OFF</td><td>No failure</td></tr>
<tr><td>Single flash</td><td>At least one packet of CANopen is in failure
</td></tr>
<tr><td>Double flash</td><td>Node guarding failure or heartbeat message failure
</td></tr>
<tr><td>Triple flash</td><td>Synchronization failure
</td></tr>
<tr><td>ON</td><td>Bus off
</td></tr>
</table></td></tr>
</table>

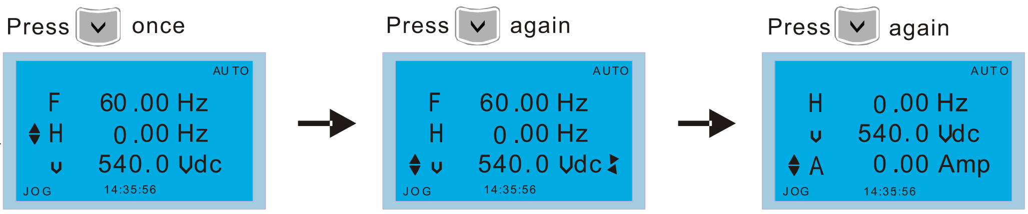
7-14-2 Functions of Digital Keypad KPC-CC01



1) The default Start-up page is Delta Logo. (Default 1 and 2)
2) User can customize their start-up page through the edited function. (Need to purchase the optional accessories.)

→The top line of LCD displays the status of drive.
After you select the main menu, the start-up screen displays in the user-defined format. The page on the left shows the Delta default setting.

→The bottom line of LCD displays time and JOG.



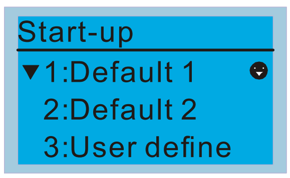
MENU

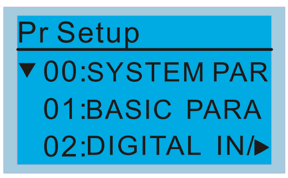
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

NOTE:

1. Start-up screen can only display pictures, not animation.
2. When powered ON, it displays the start-up screen then the main screen. The main screen displays Delta's default setting F/H/A/U. You can set the display order with Pr.00-03 (Start-up display). When you select the U screen, use the left / right keys to switch between the items, and set the display order for the U screen with Pr.00-04 (User display).

Display Icon





● : present setting

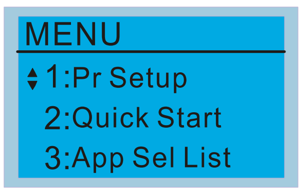
▼ : Scroll down the page for more options

Press ▲▼ for more options

▶ : show complete sentence

Press < > for complete information

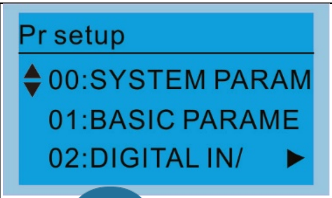
Display item

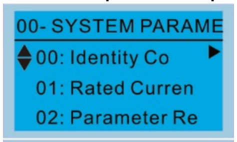
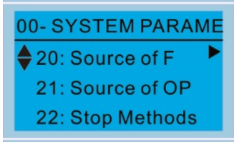
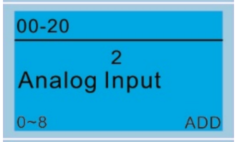
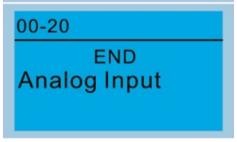
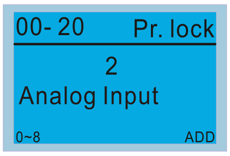


MENU

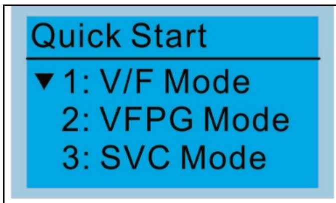
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

1. Parameter Setup

<table>
<tr><td rowspan="6">

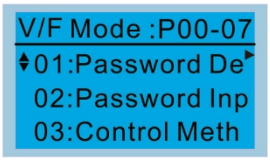
Press ENTER to select.
Press ^ v to select the parameter group.
Once you select a parameter group, press ENTER to go into that group.</td>
<td colspan="2">For example: Setup source for the master frequency command.</td></tr>
<tr><td>
</td><td>In the Group 00 Motor Drive Parameter, use Up / Down keys to select parameter 20: Auto Frequency Command.</td></tr>
<tr><td>
</td><td>Press ENTER to go to this parameter's setting menu.</td></tr>
<tr><td>
</td><td>Use the Up / Down keys to choose a setting.
For example: choose 2 Analogue Input, and then press ENTER key.</td></tr>
<tr><td>
</td><td>After you press ENTER, END is displayed which means that the parameter setting is done.</td></tr>
<tr><td>
</td><td>NOTE: When parameter lock / password protection function is enabled, it displays "Pr. lock" on the upper right corner of the keypad. The parameter cannot be written or is protected by the password under this circumstances.</td></tr>
</table>

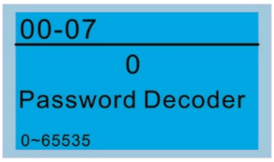
2. Quick Start

<table>
<tr><td>

Press ENTER to select.

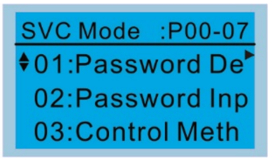
Quick Start:
1. V/F Mode
2. SVC Mode
3. My Mode</td>
<td>Description:
1. VF Mode



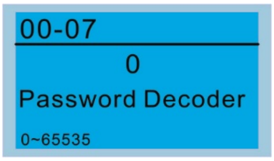
01: Password Decoder

</td>
<td>Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Speed control mode (Pr.00-11)
4. Load selection (Pr.00-16)
5. Carrier frequency (Pr.00-17)
6. Master frequency command source / Source selection of the PID target (AUTO)(Pr.00-20)
7. Operation command source (AUTO) (Pr.00-21)
8. Stop method (Pr.00-22)
9. Digital keypad STOP function (Pr.00-32)
10. Max. operation frequency (Pr.01-00)
11. Output frequency of motor 1 (Pr.01-01)
12. Output voltage of motor 1 (Pr.01-02)
13. Mid-point frequency 1 of motor 1 (Pr.01-03)
14. Min-point voltage 1 of motor 1 (Pr.01-04)
15. Mid-point frequency 2 of motor 1 (Pr.01-05)
16. Mid-point voltage 2 of motor 1 (Pr.01-06)
17. Min. output frequency of motor 1 (Pr.01-07)
18. Min. output voltage of motor 1 (Pr.01-08)
19. Output frequency upper limit (Pr.01-10)
20. Output frequency lower limit (Pr.01-11)
21. Acceleration time 1 (Pr.01-12)
22. Deceleration time 1 (Pr.01-13)
23. Over-voltage stall prevention (Pr.06-01)
24. Derating protection (Pr.06-55)</td></tr>
</table>

25. Software brake chopper action level (Pr.07-00)
26. Speed tracking during start-up (Pr.07-12)
27. Emergency stop (EF) & force to stop selection (Pr.07-20)
28. Torque command filter time (Pr.07-24)
29. Slip compensation filter time (Pr.07-25)
30. Torque compensation gain (Pr.07-26)
31. Slip compensation gain (Pr.07-27)

2. SVC Mode



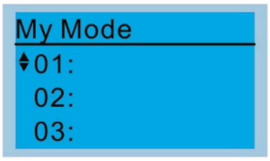
01: Password Decoder



Items

1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Speed control mode (Pr.00-11)
4. Load selection (Pr.00-16)
5. Carrier frequency (Pr.00-17)
6. Master frequency command source (AUTO) / Source selection of the PID target (Pr.00-20)
7. Operation command source (AUTO) (Pr.00-21)
8. Stop method (Pr.00-22)
9. Digital keypad STOP function (Pr.00-32)
10. Max. operation frequency (Pr.01-00)
11. Output frequency of motor 1 (Pr.01-01)
12. Output voltage of motor 1 (Pr.01-02)
13. Min. output frequency of motor 1 (Pr.01-07)
14. Min. output voltage of motor 1 (Pr.01-08)
15. Output frequency upper limit (Pr.01-10)
16. Output frequency lower limit (Pr.01-11)
17. Acceleration time 1 (Pr.01-12)
18. Deceleration time 1 (Pr.01-13)
19. Full-load current for induction motor 1 (Pr.05-01)
20. Rated power for induction motor 1 (Pr.05-02)
21. Rated speed for induction motor 1 (Pr.05-03)
22. Number of poles for induction motor 1 (Pr.05-04)
23. No-load current for induction motor 1 (Pr.05-05)
24. Over-voltage stall prevention (Pr.06-01)
25. Over-current stall prevention during acceleration (Pr.06-03)
26. Derating protection (Pr.06-55)
27. Software brake chopper action level (Pr.07-00)
28. Emergency stop (EF) & force to stop selection (Pr.07-20)
29. Torque command filter time (Pr.07-24)
30. Slip compensation filter time (Pr.07-25)
31. Slip compensation gain (Pr.07-27)

3. My Mode



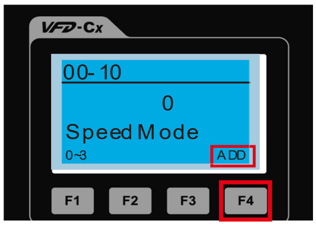
Press F4 in parameter setting screen to save the parameter to My Mode. To delete or correct the parameter, select this parameter and press F4 for DEL in the bottom right corner.

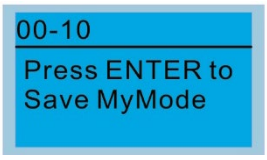
Items

It can save 1–32 sets of parameters (Pr).

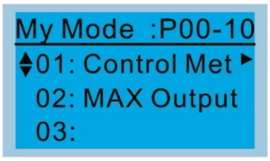
Setup process

1. Go to Parameter Setup function.
   Press ENTER to select the parameter to use. There is an ADD on the bottom right corner of the screen. Press F4 to add this parameter to My Mode.

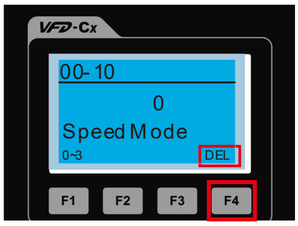


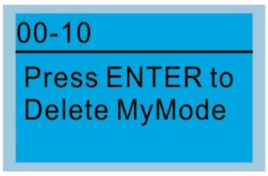


2. The parameter (Pr) displays in My mode if it is properly saved.
   To correct or to delete this parameter, press F4 for DEL.

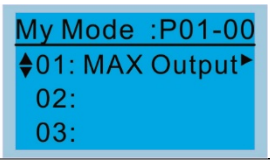


3. To delete a parameter, go to My Mode and select the parameter to delete.
   Press ENTER to enter the parameter setting screen. DEL appears in the bottom left corner of the screen. Press F4 to delete this parameter from My Mode.

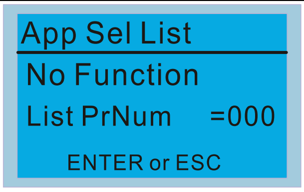




4. After you press ENTER to delete <01 Control Mode>, the <02 Maximum Operating Frequency > automatically replaces <01 Control Mode>.

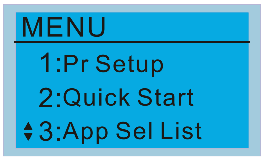


3. Application Selection List

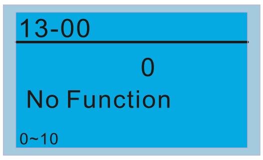


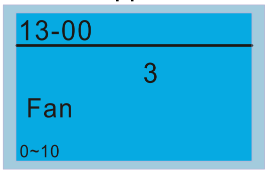
This function enables you to select application and its parameters sets.

Example:
In the menu content, select 3: Application Selection List



Press ENTER to go into the Application Selection List

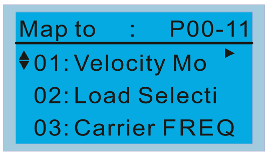




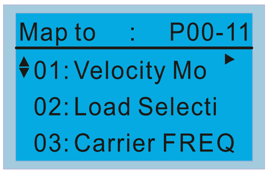
Select Application

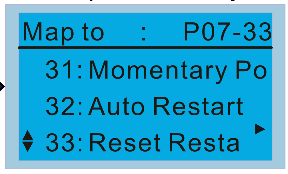
Press ENTER to enter the application selection screen, and the selected application industry is "Fan".

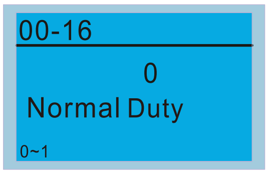
Press ENTER to enter the Fan application screen.



Press the Up / Down keys to select the parameter to set.

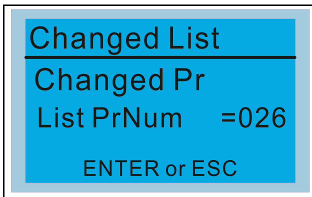






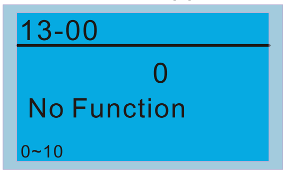
Choose 0: Normal duty or 1: Heavy duty according to your needs, then press ENTER.

4. Changed List

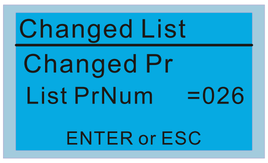


This function records the parameters you have changed.

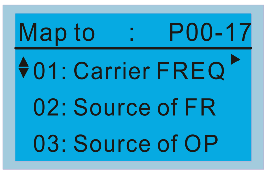
Example:
Set Pr.13-00 Application Selection = 3: Fan



Enter the changed list screen. List PrNum=026 means that there are 26 parameters that have been changed.

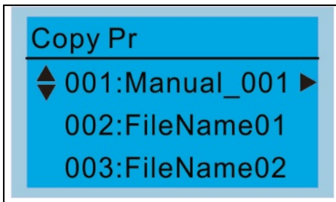


Press ENTER to enter the changed list screen.



Use the Up / Down keys to select the parameters to check or to change.
Press ENTER to enter the parameter.

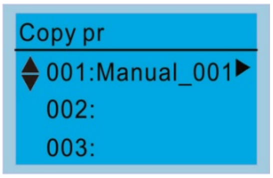
5. Copy Parameter



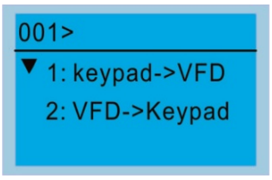
Press ENTER to go to 001–004 content storage

Four groups of parameters are available to copy
The steps are shown in the example below.

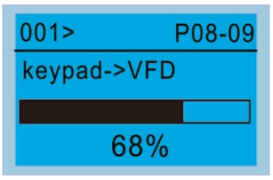
Example: parameter saved in the motor drive.



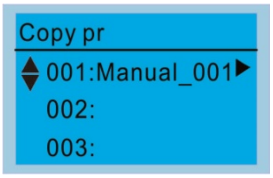
1. Go to Copy Parameter
2. Select the parameter group to copy and press ENTER.



1. Select 1: keypad→VFD
2. Press ENTER to go to the “keypad→VFD” screen.

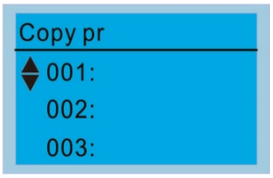


Begin copying parameters until it is done.

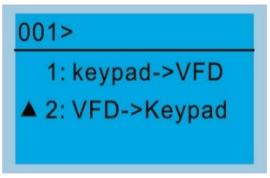


After copying is done, the keypad automatically returns to this screen.

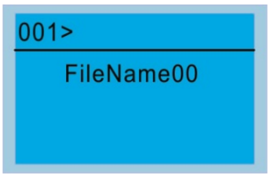
Example: parameter saved in the keypad.



1. Go to Copy parameter
2. Select the parameter group to copy and press ENTER.



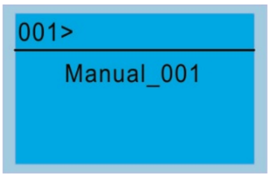
Press ENTER to go to the “VFD→keypad” screen.



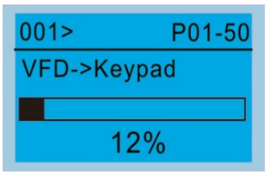
Press the Up / Down keys to select a symbol.
Press the Left / Right keys to move the cursor to select a file name.

String & Symbol Table:

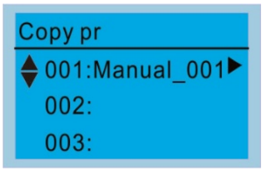
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ' a b c d f g h i j k l m n o p q r s t u v w x y z { | } ~



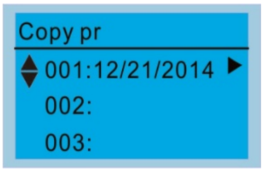
After you confirm the file name, press ENTER.



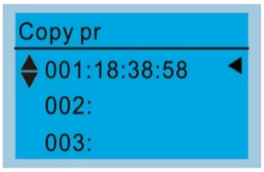
Begin copying parameters until it is done.



After copying parameters is done, the keypad automatically returns to this screen.

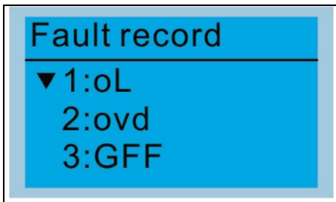


Press the Right key to see the date of the parameters copied.



Press the Right key to see the time of the parameters copied.

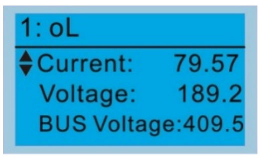
6. Fault Record



Press ENTER to see an error record's details.

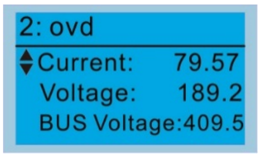
Able to store 6 error codes (Keypad V1.02 and previous versions)
Able to store 30 error codes (Keypad V1.20 and later version)
The most recent error record shows as the first record. Choose an error record to see details such as date, time, frequency, current, voltage, and DC bus voltage)

Press the Up / Down keys to select an error record.
Press ENTER to see that error record's details.



Press the Up / Down keys to scroll through an error record's details such as date, time, frequency, current, voltage, and DC bus voltage.

Press the Up / Down keys to select the next error code. After selecting an error code, press ENTER to see that error record's details.



Press the Up / Down keys to see an error record's details such as date, time, frequency, current, voltage, and DC bus voltage.

NOTE:

The AC motor drive actions are recorded and saved to the KPC-CC01. When you remove the KPC-CC01 and connect it to another AC motor drive, the previous fault records are not deleted. The new fault records of the new AC motor drive continue to be added to the KPC-CC01.

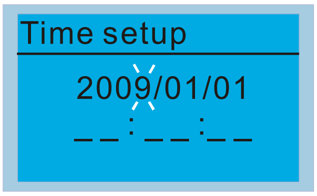
7. Language Setup

Use the Up / Down keys to select the language, and then press ENTER.

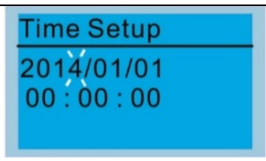
The language setting option is displayed in the language of your choice.
Language setting options:

1. English	5. Русский	9. Polski
2. 繁體中文	6. Español	10. Deutsch
3. 简体中文	7. Português	11. Italiano
4. Türkçe	8. Français	12. Svenska

8. Time Setup



Use the Left / Right keys to select Year, Month, Day, Hour, Minute or Second to change.

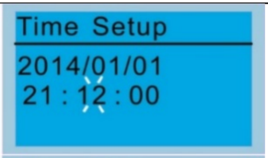
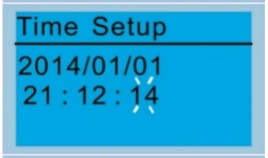
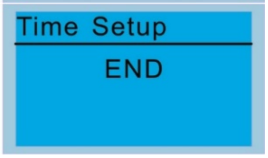


Press the Up / Down keys to set the Year

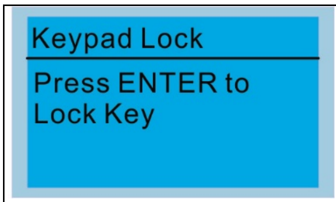
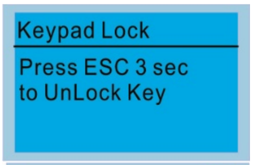
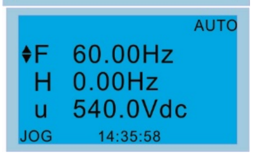
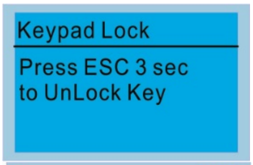
Press the Up / Down keys to set the Month

Press the Up / Down keys to set the Day

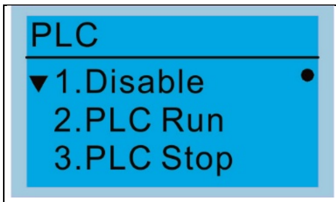
Press the Up / Down keys to set the Hour

		Press the Up / Down keys to set the Minute
		Press the Up / Down keys to set the Second
		Press ENTER to confirm the Time Setup.
	NOTE: Limitation: The charging process for the keypad super capacitor finishes in about 6 minutes. **When the digital keypad is removed, the time setting is saved for 7 days**. After 7 days, you must reset the time.	

9. Keypad Locked

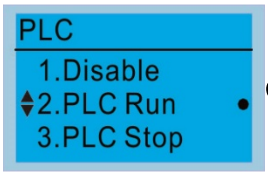
 Press ENTER to lock	Lock the keypad Use this function to lock the keypad. The main screen does not display "keypad locked" when the keypad is locked; however, it displays the message "Press ESC 3 sec to UnLock Key" when you press any key.	
		When the keypad is locked, the main screen does not indicate the lock status.
		Press any key on the keypad; a message displays as shown on the left.
		If you do not press the ESC key, the keypad automatically returns to this screen.
		Press any key on the keypad, a message displays as shown on the left.
		Press ESC for 3 seconds to unlock the keypad; the keypad returns to this screen. All keys on the keypad is functional.
	All keys on the keypad is functional. Turning the power off and on does not lock the keypad.	

10. PLC Function

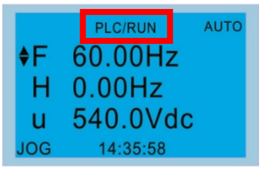


Press the Up /Down keys to select a PLC function, and then press ENTER.

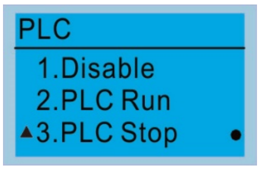
When activating and stopping the PLC function (choosing 2: PLC Run or 3: PLC Stop), the PLC status displays on main screen (Delta default setting).



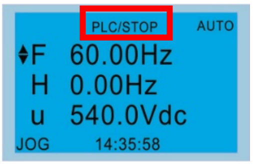
Choose option 2: PLC Run to enable the PLC function.



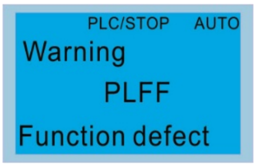
The default on the main screen displays the PLC / RUN status message.



Choose option 3: PLC Stop to disable the PLC function.

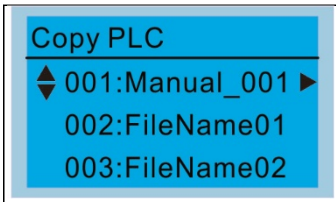


The default on the main screen displays the PLC / STOP status message.



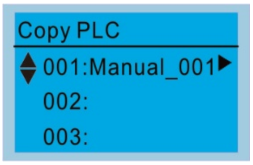
If the PLC program is not available in the control board, the PLFF warning displays when you choose option 2 or 3.
In this case, choose option 1: Disable to clear PLFF warning.

11. Copy PLC

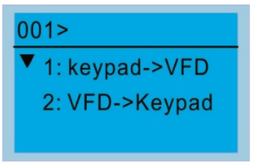


Four groups of parameters are available to copy.
The steps are shown in the example below.

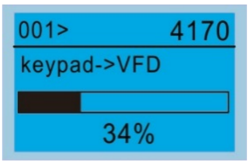
Example: PLC program saved in the motor drive.



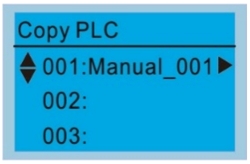
1. Go to Copy PLC
2. Select the PLC program to copy and press ENTER.



1. Select 1: Keypad→VFD
2. Press ENTER to go to the "Keypad→VFD" screen.

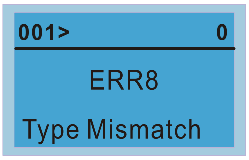


Begin copying the PLC program until it is done.

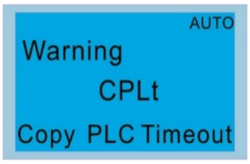


After copying is done, the keypad automatically returns to this screen.

NOTE:

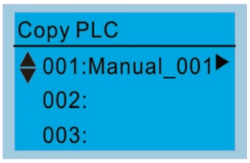


If you select “Option 1: Keypad→VFD”, check if the PLC program is built-in to the KPC-CC01 keypad. If the PLC program is not available in the keypad when you select “Option 1: Keypad→VFD”, an “ERR8 Warning: Type Mismatch” displays on the screen.

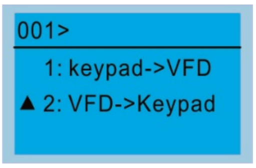


If you unplug the keypad and plug it back while copying the PLC program, the screen displays a CPLt warning.

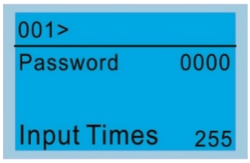
Example: PLC program saved in the keypad.



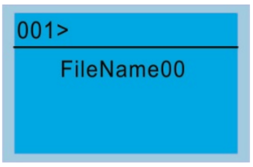
1. Go to Copy PLC.
2. Select the PLC program to copy and press ENTER.



Press ENTER to go to the “VFD→Keypad” screen.



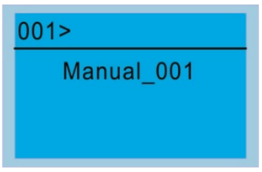
If the WPLSoft editor is installed uses password, enter the password to save the file to the keypad.



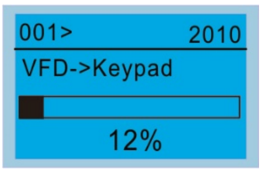
Press the Up / Down keys to select a symbol.
Press the Left / Right keys to move the cursor to select a file name.

String & Symbol Table:

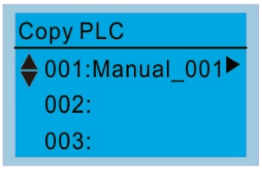
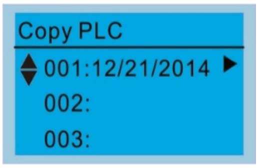
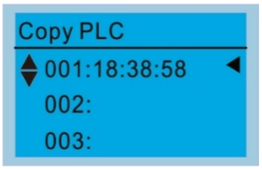
! " # $ % & ' ( ) * + · - · / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A
B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ' a b
c d f g h i j k l m n o p q r s t u v w x y z { | } ~



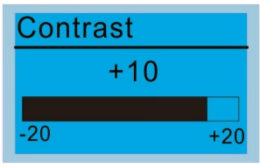
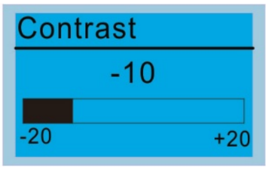
After you confirm the file name, press ENTER.

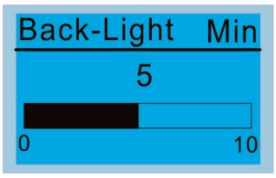


Begin copying the PLC program until it is done.

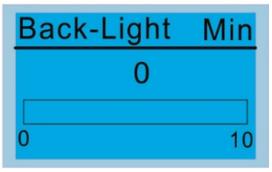
		After copying is done, the keypad automatically returns to this screen.
		Press the Right key to see the date of the program copied.
		Press the Right key to see the time of program copied.

12. Display setup

 Press  to go to the setting screen.	1. Contrast	
		Press the Up / Down keys to adjust the setting value.
		For example, increase Contrast to +10.
		After you set the value, press ENTER to see the screen display after contrast is adjusted to +10.
		Then press ENTER and decrease the Contrast to -10.
		Press ENTER to see screen display after contrast is adjusted to -10.
	2. Back-light	
		Press ENTER to go to the Back-Light Time Setting screen.



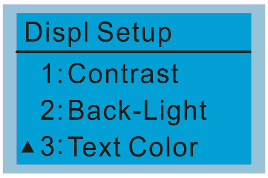
Press the Up / Down keys to adjust the setting value.



When the setting value is 0 Min, the backlight remains on.

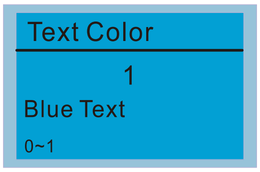
When the setting value is 10 Min, the backlight turns off in 10 minutes.

3. Text Color



Press ENTER go to the Text Color Setting screen.

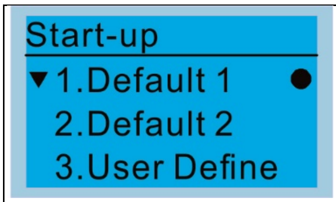
The default value is White Text.



Press the Up / Down keys to adjust the setting value, and then press ENTER.

The setting value changes to Blue Text.

13. Start-up



1. Default 1   DELTA LOGO

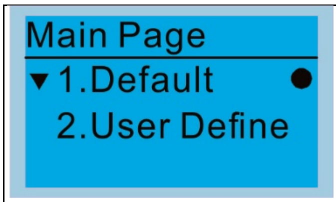
2. Default 2   DELTA Text

3. User Defined: an optional accessory is required (TPEditor & USB / RS-485 Communication Interface-IFD6530) to design your own start-up screen.
If the editor accessory is not installed, the User Define option displays a blank screen.

USB/RS-485 Communication Interface-IFD6530
Refer to Chapter 07 Optional Accessories for more details.

TPEditor
Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 7-14-3.

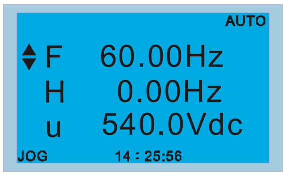
14. Main page



Default screen and editable screen are available.

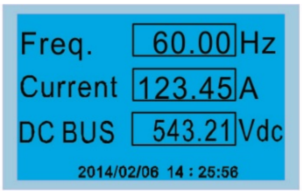
Press ENTER to select.

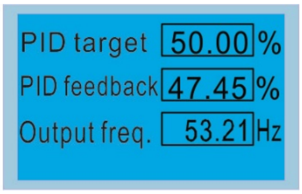
1. Default page



F 60.00Hz >>> H >>> A >>> U (options rotate)

2. User Define: an optional accessory is required (TPEditor & USB / RS-485 Communication Interface-IFD6530) to design your own main screen.
If the editor accessory is not installed, the User Define option displays a blank screen.

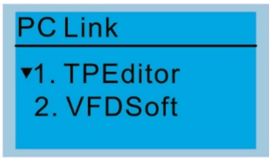




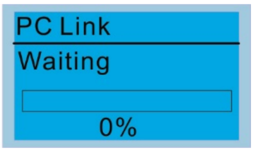
USB/RS-485 Communication Interface-IFD6530
Refer to Chapter 07 Optional Accessories for more details.

TPEditor
Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 7-14-3.

15. PC Link

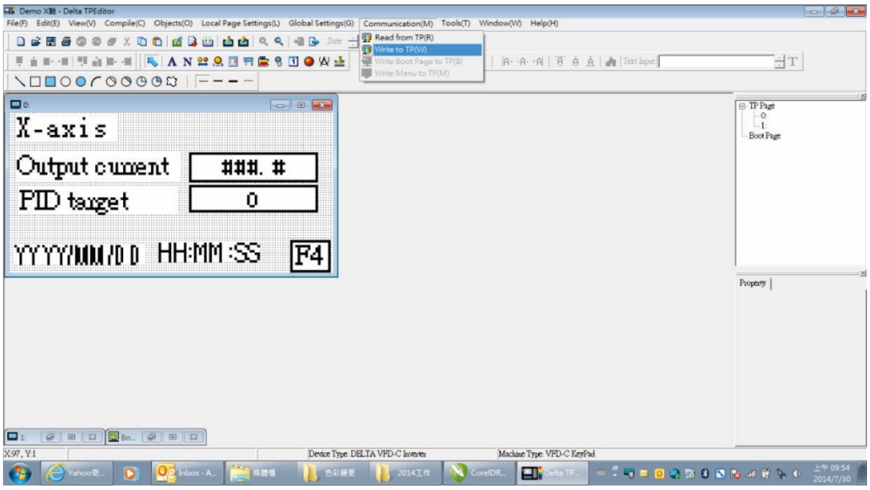


1. TPEditor: This function enables you to connect the keypad to a computer then download and edit user-defined screens.

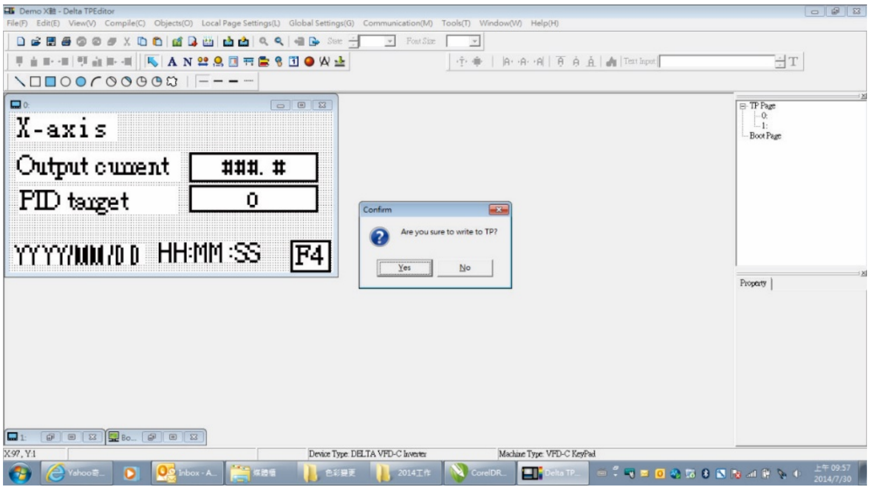


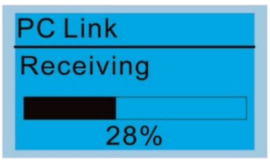
Press ENTER to go to Waiting to connect to PC screen.

In TPEditor, from the **Communication** menu, choose **Write to HMI**.

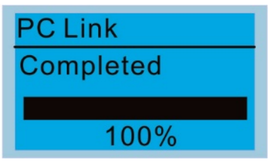


In the **Confirm** message box, click **YES**.





The software starts downloading screens to edit to the KPC-CC01.

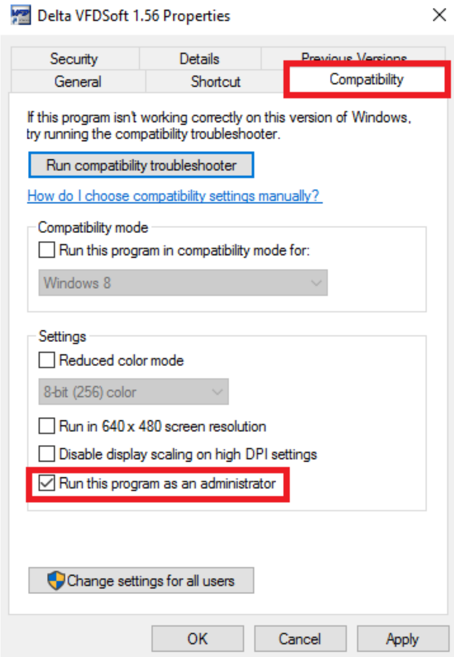


Download completed

2. VFDSoft: this function enables you to link to the VFDSoft then upload the parameters 1–4 you have saved in the KPC-CC01.

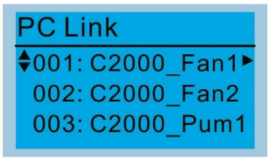
NOTE:

If the Operation System (OS) of your computer is Windows 10, right-click the VFDSoft icon to enter the **Property**. Then, click the **Compatibility** tab and select the **Run this program as an administrator** checkbox. (as shown in the red frames in the figure below)

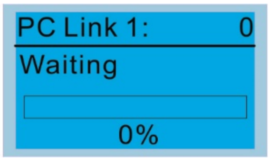


3. Connecting the KPC-CCO1 to a computer

Select 2: VFDSoft, and then press ENTER.

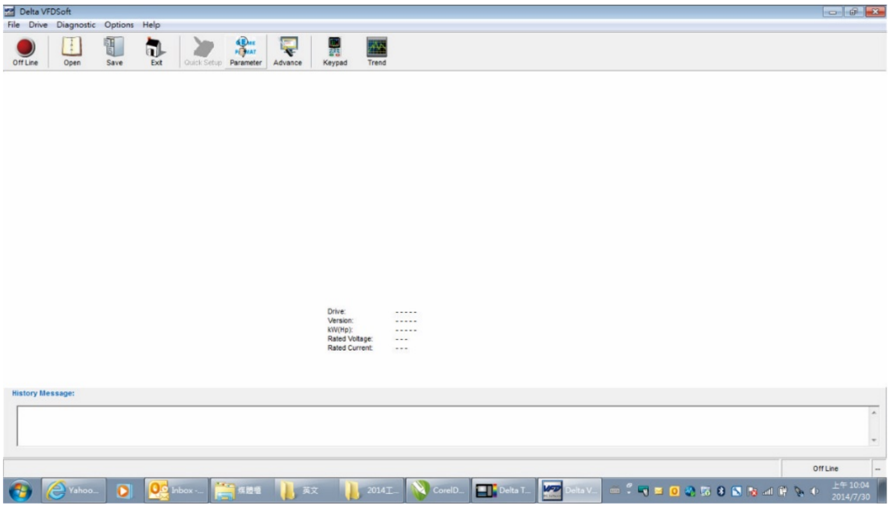


Press the Up / Down keys to select a parameter group to upload to VFDSoft.

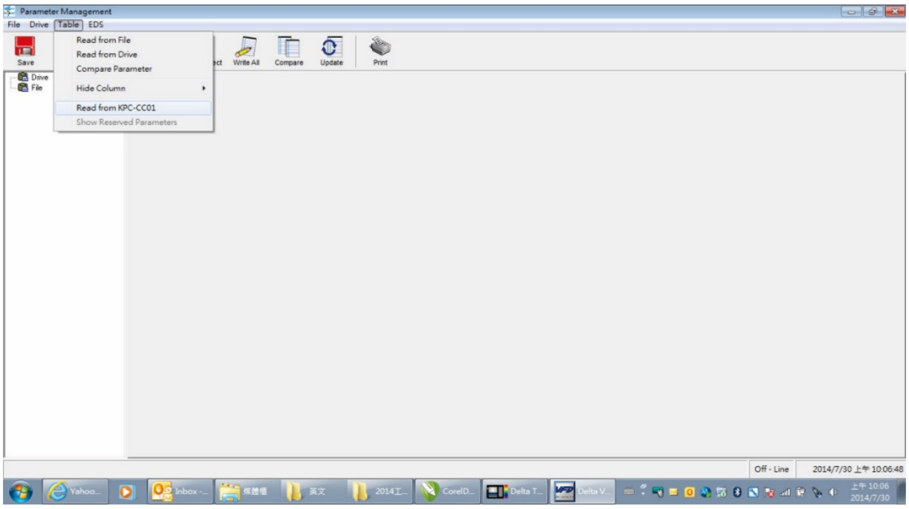


Press ENTER to go to Waiting to connect to PC screen.

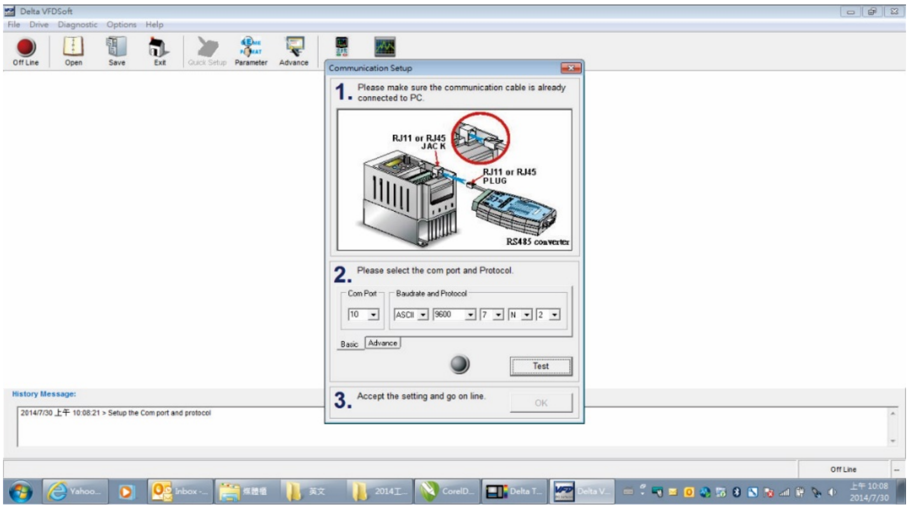
Open VFDSoft and click **Parameter** on the toolbar

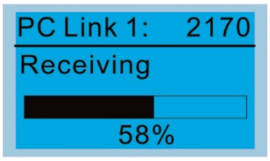


In Parameter Manager, from the **Table** menu, choose **Read from KPC-CC01**.

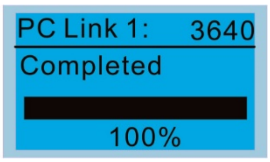


Choose the correct communication port and click **OK**.





Start to upload parameters to VFDSoft



Uploading parameter is completed

Before using the user-defined start-up screen and user-defined main screen, you must preset the start-up screen and the main screen as user- defined. If you do not download the user-defined screen to the KPC-CC01, the start-up screen and the main screen are blank.

16. Start Wizard (applicable for MH300 firmware V1.04 and later)

16.1 New drive start-up setting process

When a new drive is powered on, it directly enters the Start Wizard. There are three modes in the start-up setting process: Start Wizard, Exit Wizard and Test Mode.

(1) Start Wizard:

- In Start Wizard, you can set drive's parameters such as Calendar, Maximum operation frequency and Maximum voltage…; refer to Table 1 for setting items and orders.
- The drive exits Start Wizard when you finish the complete setting process, and will not enter this process when rebooting the power.

(2) Exit Wizard:

- Exit the Start Wizard mode. The drive does not go to Start Wizard when rebooting the power.

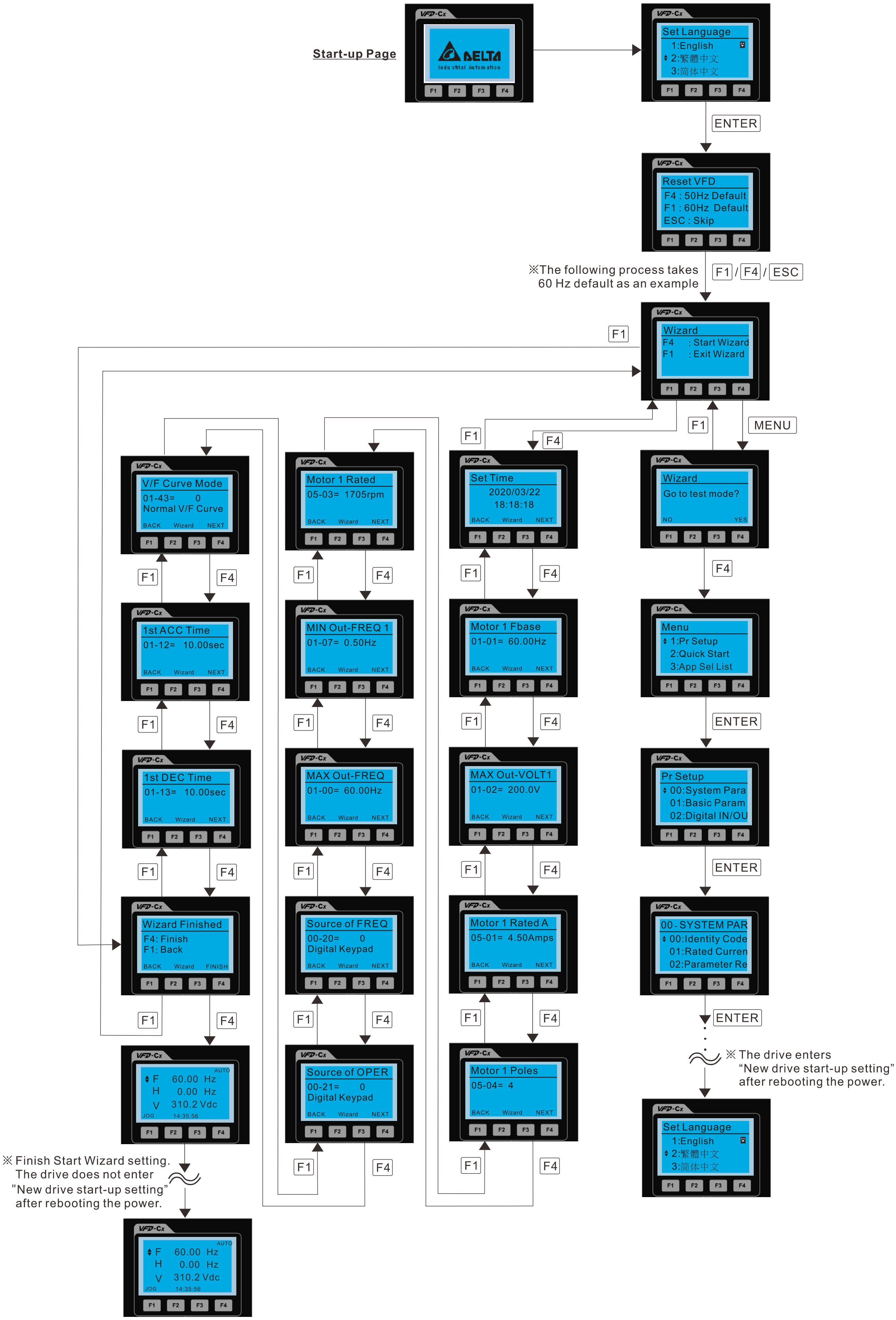
(3) Test Mode:

- This function is hidden to avoid misuse. Refer to the following flow chart to enter Test Mode.
- When the drive is in Test mode, it temporarily disables the Start Wizard and Exit Wizard mode.
- The Test Mode is designed for distributors / suppliers / clients to manage and operate the drive before shipping it out.
- If you enter Test Mode without exiting the Start Wizard process, the drive will begin with the new drive start-up process upon next power on.

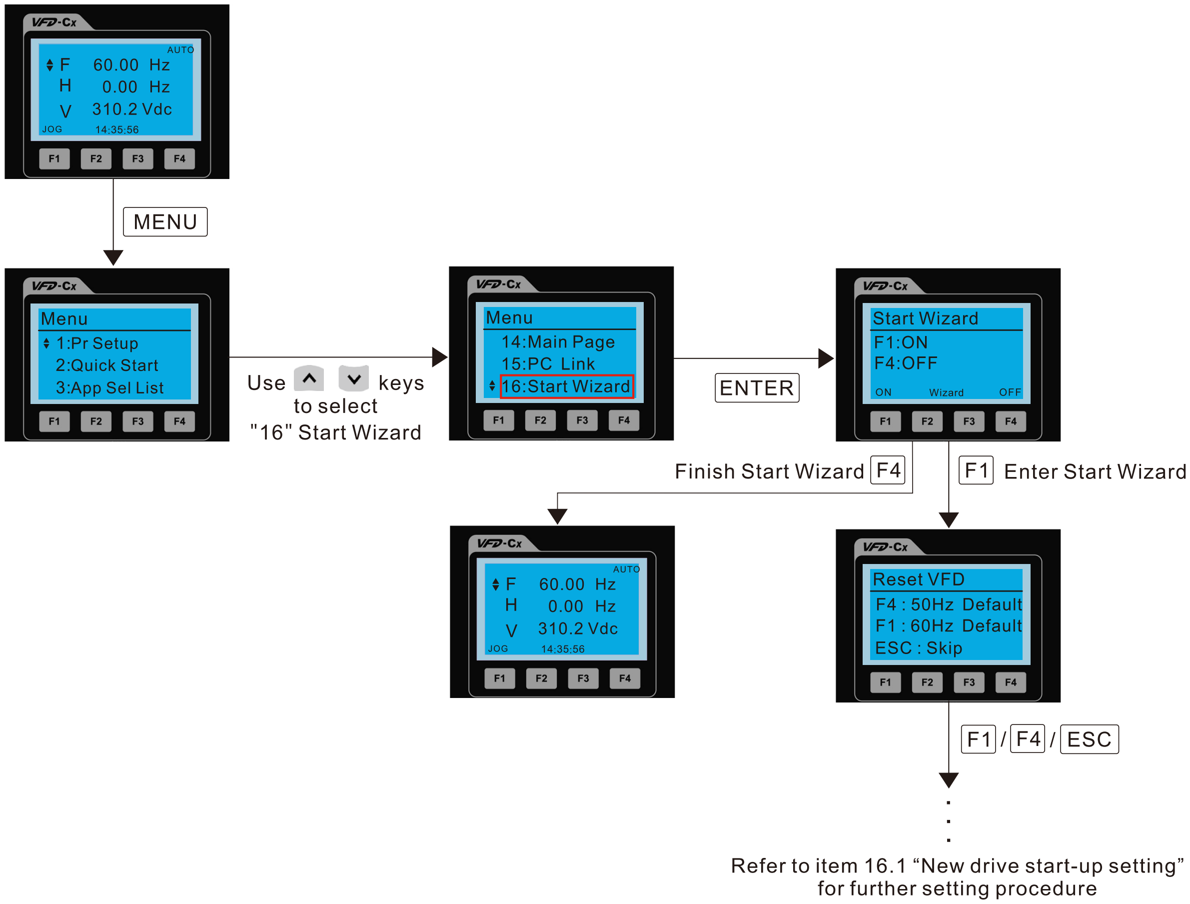
Setting Order	Description	Parameter
1	Calendar	N/A
2	Output frequency of motor 1	01-01
3	Output voltage of motor 1	01-02
4	Full-load current for induction motor 1 (A)	05-01
5	Number of poles for induction motor 1	05-04
6	Rated speed for induction motor 1 (rpm)	05-03
7	Minimum output frequency of motor 1	01-07
8	Maximum operation frequency	01-00
9	Master frequency command source (AUTO) / Source selection of the PID target	00-20
10	Operation command source (AUTO)	00-21
11	V/F curve selection	01-43
12	Acceleration time 1	01-12
13	Deceleration time 1	01-13

Table 7-75 Start Wizard setting items

Flow chart for the above setting process:



16.2 Re-start Start Wizard

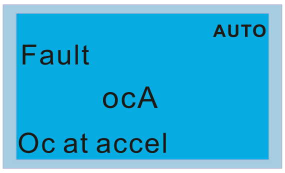


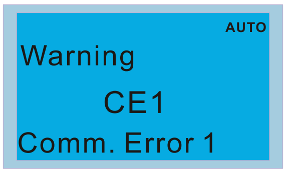
NOTE:

The “16: Start Wizard” on the menu is to set whether the screen shows start wizard when powering on the drive.

Other displays

When a fault occurs, the screen display shows the fault or warning:





1. Press the STOP / RESET key to reset the fault code. If there is no response, contact your local distributor or return the unit to the factory. To view the fault DC bus voltage, output current and output voltage, press MENU and then choose 6: Fault Record.
2. After resetting, if the screen returns to the main page and shows no fault after you press ESC, the fault is cleared.
3. When the fault or warning message appears, the LED backlight blinks until you clear the fault or warning.

Optional accessory: RJ45 Extension Lead for Digital Keypad

Part No.	Description
CBC-K3FT	RJ45 extension lead, 3 feet (approximately 0.9 m)
CBC-K5FT	RJ45 extension lead, 5 feet (approximately 1.5 m)
CBC-K7FT	RJ45 extension lead, 7 feet (approximately 2.1 m)
CBC-K10FT	RJ45 extension lead, 10 feet (approximately 3 m)
CBC-K16FT	RJ45 extension lead, 16 feet (approximately 4.9 m)

Table 7-76

NOTE:

When you need communication cables, buy non-shielded, 24 AWG, four-wire twisted pair, 100 ohms communication cables.

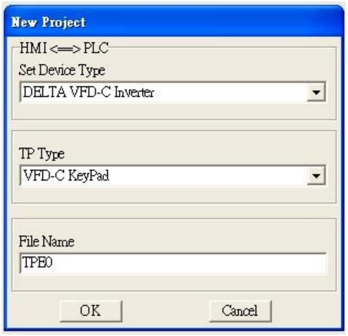
7-14-3 TPEditor Installation Instruction

TPEditor can edit up to 256 HMI (Human-Machine Interface) pages with a total storage capacity of 256 KB. Each page can include 50 normal objects and 10 communication objects.

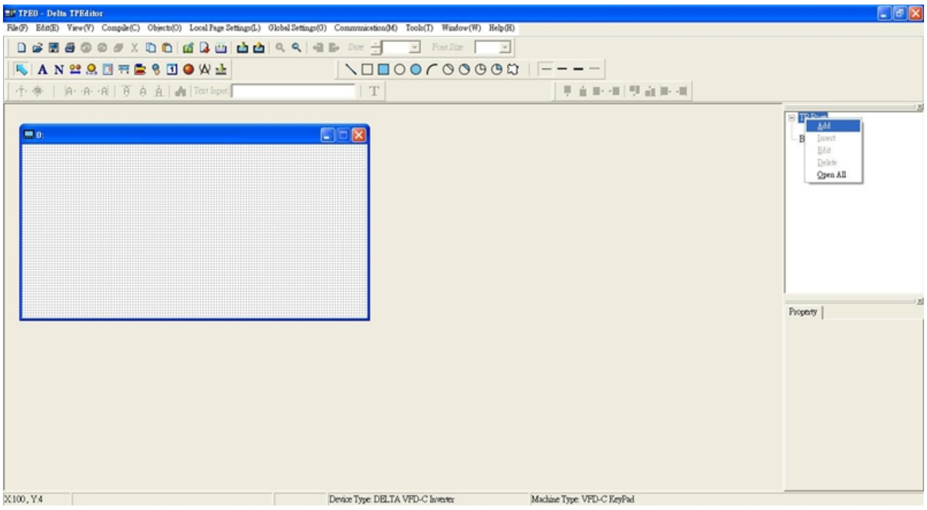
1) TPEditor: Setup & Basic Functions

1. Run TPEditor version 1.60 or later by double-clicking the program icon.

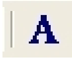
2. On the **File** menu, click **New**. In the New project dialog box, for **Set Device Type**, select **DELTA VFD-C Inverter**. For **TP Type**, select **VFD-C KeyPad**. For **File Name**, enter TPE0 and then click **OK**.

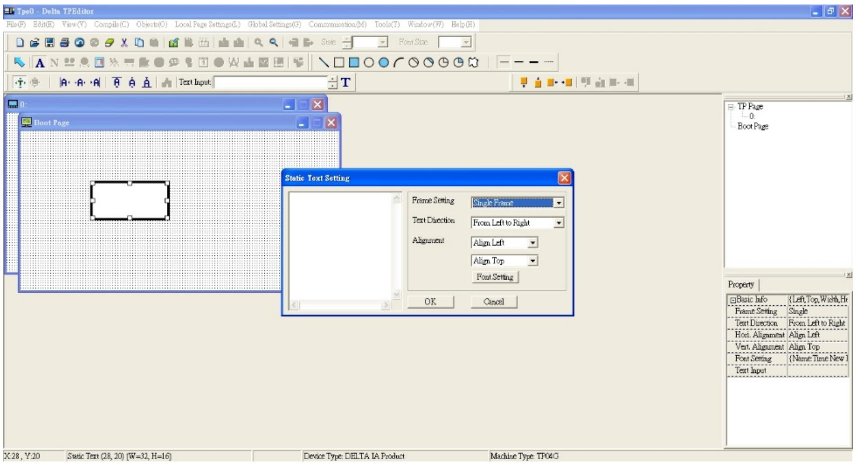


3. The editor displays the Design window. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more page(s) to edit.

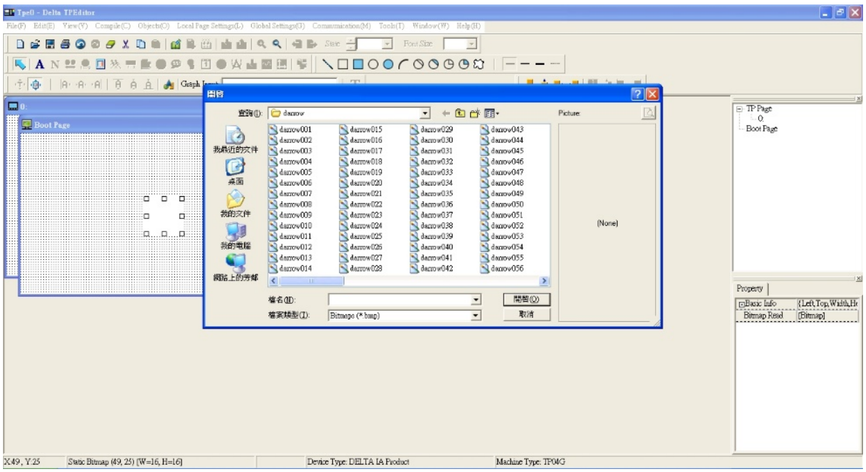


4. Edit the start-up screen.

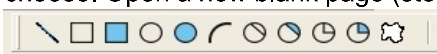
5. Add static text. Open a blank page (step 3), then on the toolbar click . Double-click the blank page to display the **Static Text Setting** dialog box, and then enter the static text.



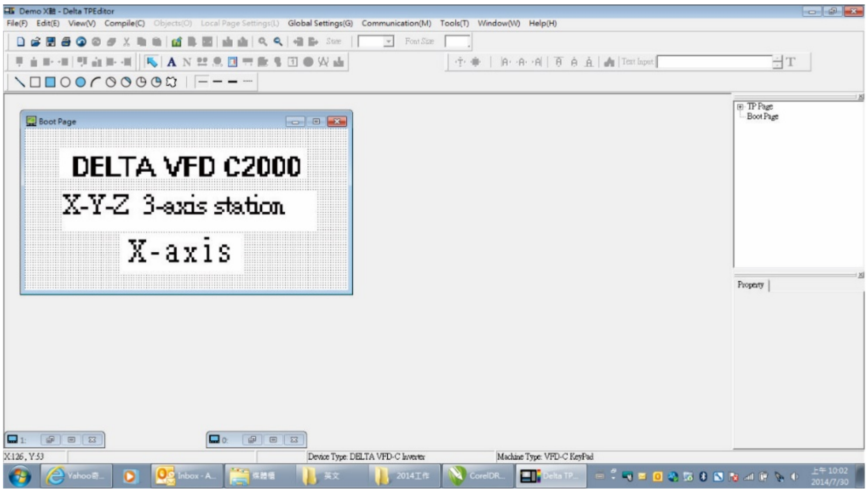
6. Add a static bitmap. Open a blank page (step 3), then on the toolbar, click . Double-click the blank page to display the **Static Bitmap Setting** dialog box where you can choose the bitmap.



You can only use images in the BMP format. Click the image and then click Open to show the image in the page.

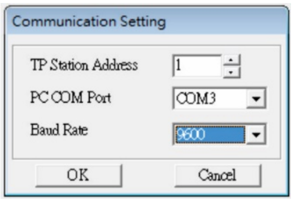
7. Add a geometric bitmap. There are 11 kinds of geometric bitmaps to choose. Open a new blank page (step 3), then on the toolbar click the geometric bitmap icon that you need . In the page, drag the geometric bitmap and enlarge it to the size that you need.

8. When you finish editing the start-up screen, on the **Communication** menu, click **Input User Defined Keypad Starting Screen.**

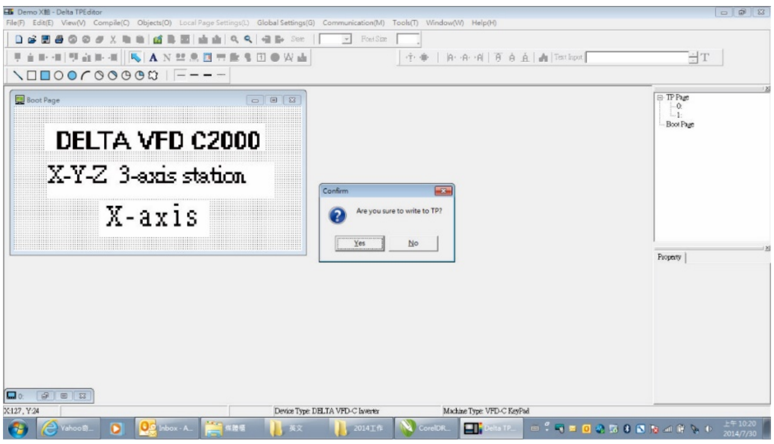


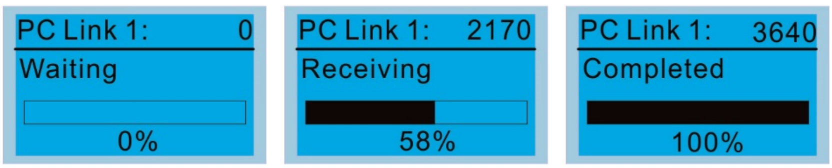
9. Download the new setting: On the **Tool** menu, click **Communication**. Set up the communication port and speed for the IFD6530. There are three speeds available: 9600 bps, 19200 bps, and 38400 bps.

10. On the **Communication** menu, click **Input User Defined Keypad Starting Screen**.



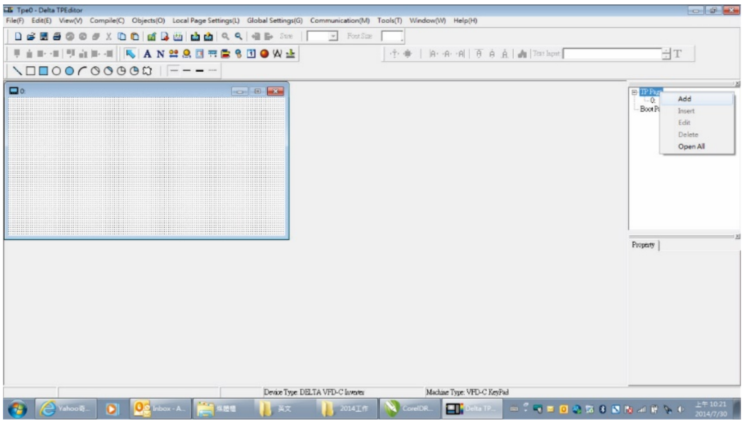
11. The Editor displays a message asking you to confirm the new setting. Before you click **OK**, on the keypad, go to MENU, select PC LINK, press ENTER and then wait for few seconds. Then click **YES** in the confirmation dialog box to start downloading.



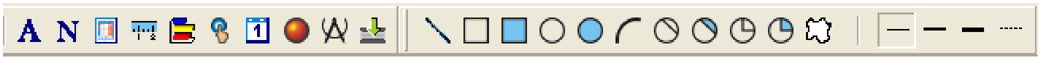


2) Edit the Main Page and Download to the Keypad

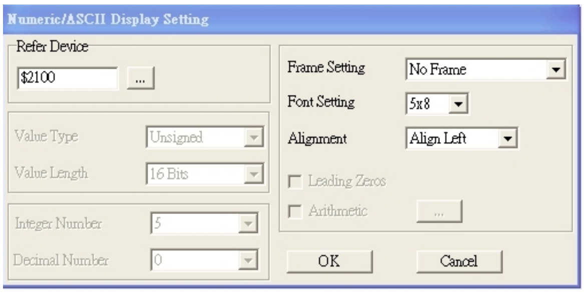
1. In the Editor, add a page to edit. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more pages to edit. This keypad currently supports up to 256 pages.



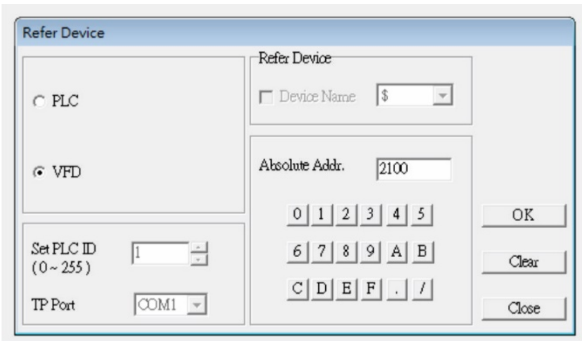
2. In the bottom right-hand corner of the Editor, click the page number to edit, or on the **View** menu, click **HMI Page** to start editing the main page. As shown in the picture above, the following objects are available. From left to right they are: Static Text, ASCII Display, Static Bitmap, Scale, Bar Graph, Button, Clock Display, Multi-state bit map, Units, Numeric Input, the 11 geometric bitmaps, and lines of different widths. Use the same steps to add Static Text, Static Bitmap, and geometric bitmaps as for the start-up page.



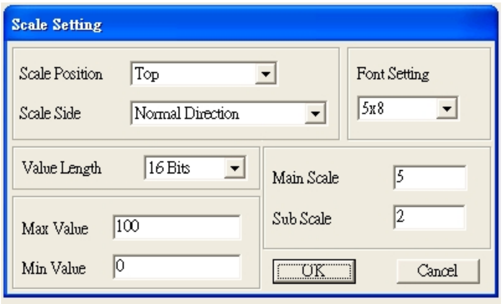
3. Add a numeric/ASCII display. On the toolbar, click the **Numeric/ASCII** button. In the page, double-click the object to specify the **Refer Device**, **Frame Setting**, **Font Setting** and **Alignment**.



Click **[…]**. In the **Refer Device** dialog box, choose the VFD communication port that you need. If you want to read the output frequency (H), set the **Absolute Addr.** to 2202. For other values, refer to the ACMD Modbus Comm Address List (see Pr.09-04 in Chapter 12 Group 09 Communication Parameters).



4. Scale Setting. On the toolbar, click  to add a scale. You can also edit the Scale Setting in the Property Window on the right-hand side of your computer screen.



a. **Scale Position**: specifies where to place the scale.

b. **Scale Side**: specifies whether the scale is numbered from smaller numbers to larger numbers or from larger to smaller.

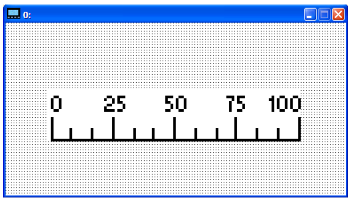
c. **Font Setting**: specifies the font.

d. **Value Length**: specifies 16 bits or 32 bits.

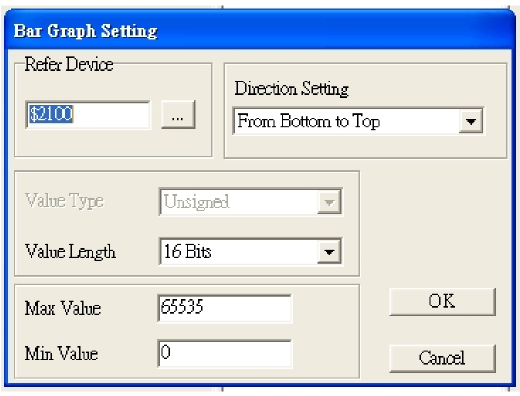
e. **Main Scale & Sub-Scale**: divides the whole scale into equal parts; enter the numbers for the main scale and sub-scale.

f. **Max Value & Min Value**: specifies the numbers on the two ends of the scale. They can be negative numbers, but the maximum and minimum values are limited by the **Value Length** setting. For example, when **Value Length** is **hexadecimal** (**16 bits**), the maximum and the minimum value cannot be entered as -40000.

Clicking **OK** creates a scale as in the picture below.



5. Bar Graph setting. On the toolbar, click  to add a bar graph.

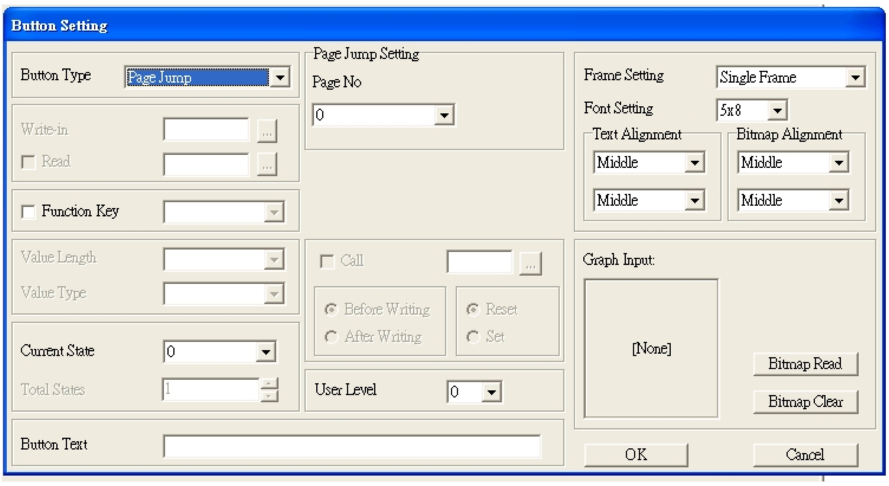


a. **Refer Device**: specifies the VFD communication port.

b. **Direction Setting**: specifies the direction: **From Bottom to Top**, **From Top to Bottom**, **From Left to Right** or **From Right to Left**.

c. **Max Value** and **Min Value**: specifies the maximum value and minimum value. A value smaller than or equal to the minimum value causes the bar graph to be blank (0). A value is bigger or equal to the maximum value causes the bar graph is full (100%). A value between the minimum and maximum values causes the bar graph to be filled proportionally.

6. Button : on the toolbar, click . Currently this function only allows the keypad to switch pages; other functions are not yet available (including text input and insert image). In the blank page, double-click  to open the Button Setting dialog box.

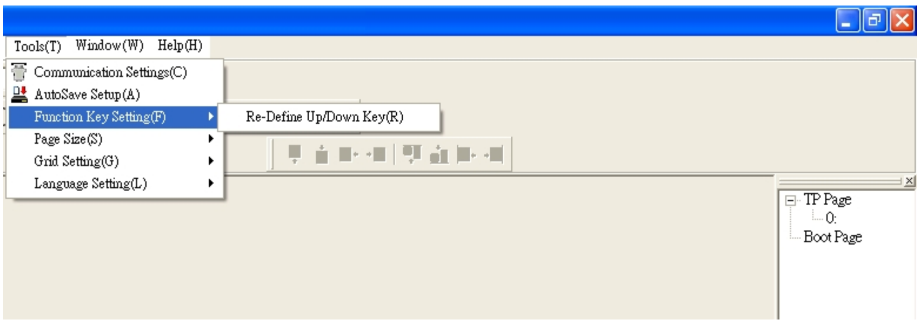


Button Type: specifies the button's functions.

Page Jump and **Constant Setting** are the only functions currently supported.

A. Page Jump Setting

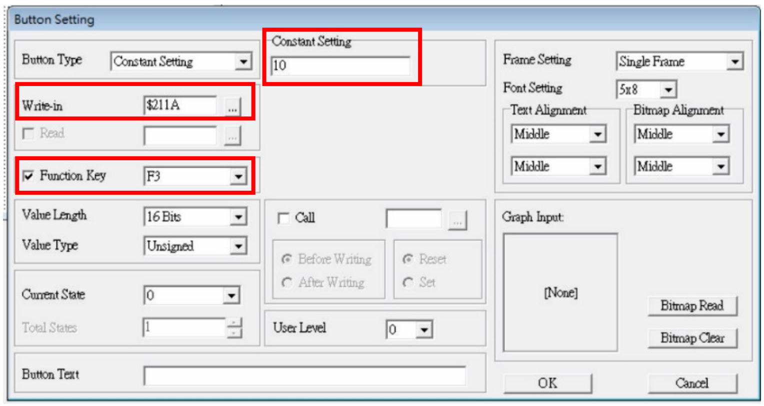
- **Page Jump Setting**: in the **Button Type** list, choose **Page Jump** to show the **Page Jump Setting**.
- **Function Key**: specifies the functions for the following keys on the KPC-CC01 keypad: F1, F2, F3, F4, Up, Down, Left and Right. Note that the Up and Down keys are locked by TPEditor. You cannot program these two keys. If you want to program Up and Down keys, on the **Tool** menu, click **Function Key Setting**, and then click **Re-Define Up/Down Key**.



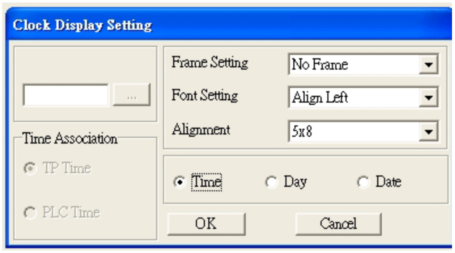
- **Button Text**: specifies the text that appears on a button. For example, when you enter Next Page for the button text, that text appears on the button.

B. Constant setting

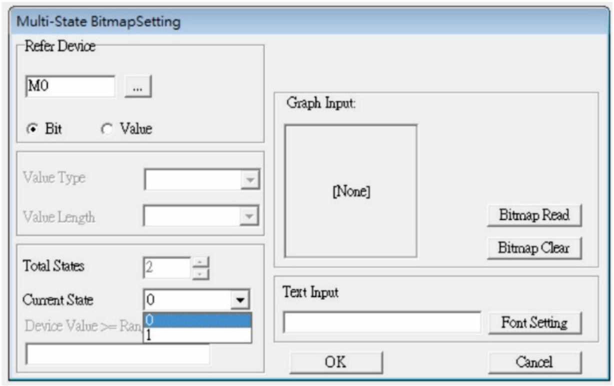
This function specifies the memory address' values for the VFD or PLC. When you press the **Function Key**, it writes a value to the memory address specified by the value for **Constant Setting**. You can use this function to initialize a variable.



7. **Clock Display Setting**: on the toolbar, click . You can display the time, day, or date on the keypad. Open a new page and click once in that window to add a clock display.
   Choose to display **Time**, **Day**, or **Date** on the keypad. To adjust time, go to #8 on the keypad's menu. You can also specify the **Frame Setting**, **Font Setting**, and **Alignment**.

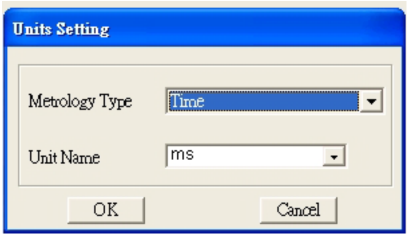


8. Multi-state bitmap: on the toolbar, click . Open a new page and click once in that window to add a Multi-state bitmap. This object reads a bit's property value from the PLC. It defines the image or text that appears when this bit is 0 or 1. Set the initial status (**Current State**) to be 0 or 1 to define the displayed image or text.



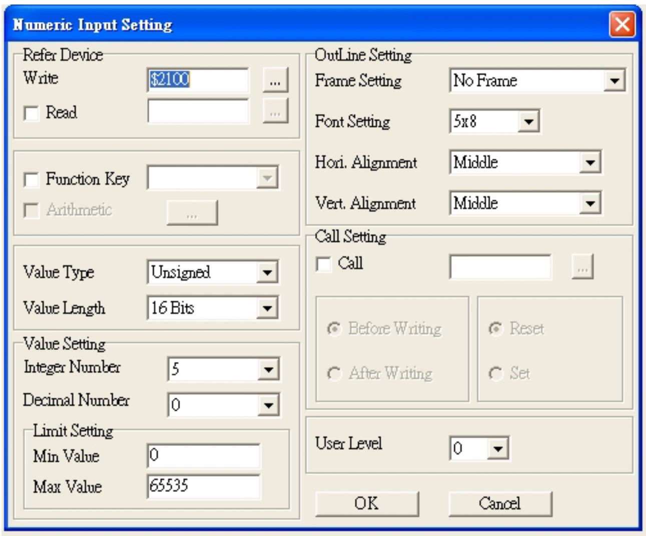
9. Unit Measurement: on the toolbar, click .

   Open a new blank page, and double-click on that window to display the **Units Setting** dialog box. Choose the Metrology Type and the Unit Name. For Metrology, the choices are Length, Square Measure, Volume/Solid Measure, Weight, Speed, Time, and Temperature. The unit name changes automatically when you change metrology type.



10. Numeric Input Setting: on the toolbar, click 

    This object enables you to provide parameters or communication ports (0x22xx) and to input numbers. Open a new file and double click on that window to display the **Numeric Input Setting** dialog box.



a. **Refer Device**: specifies the **Write** and the **Read** values. Enter the numbers to display and the corresponding parameter and communication port numbers. For example, enter 012C to Read and Write Parameter Pr.01-44.

b. **OutLine Setting**: specifies the **Frame Setting**, **Font Setting**, **Hori. Alignment**, and **Vert. Alignment** for the outline.

c. **Function Key**: specifies the function key to program on the keypad in the **Function Key** box. The corresponding key on the keypad starts to blink. Press ENTER to confirm the setting.

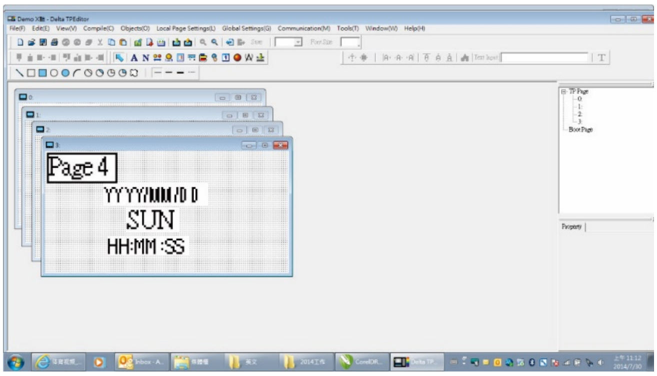
d. **Value Type** and **Value Length**: specify the range of the **Min Value** and **Max Value** for the **Limit Setting**. Note that the corresponding supporting values for MH300 must be 16 bits. 32-bit values are not supported.

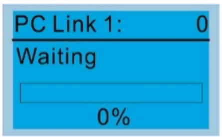
e. **Value Setting**: automatically set by the keypad itself.

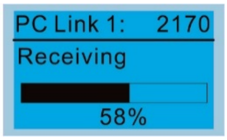
f. **Limit Setting**: specifies the range for the numeric input here.

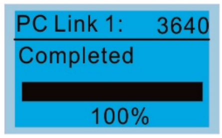
For example, if you set **Function Key** to **F1**, **Min Value** to 0 and **Max Value** to 4, when you press F1 on the keypad, then you can press Up/Down on the keypad to increase or decrease the value. Press ENTER on the keypad to confirm your setting. You can also view the parameter table 01-44 to verify if you correctly entered the value.

11. Download TP Page: Press Up / Down on the keypad to select #13 PC Link.
    Then press ENTER on the keypad. The screen displays “Waiting”. In TPEditor, choose a page that you have created, and then on the **Communication** menu click **Write to TP** to start downloading the page to the keypad.
    When you see “Completed” on the keypad screen, the download is finished. You can then press ESC on the keypad to go back to the menu screen.

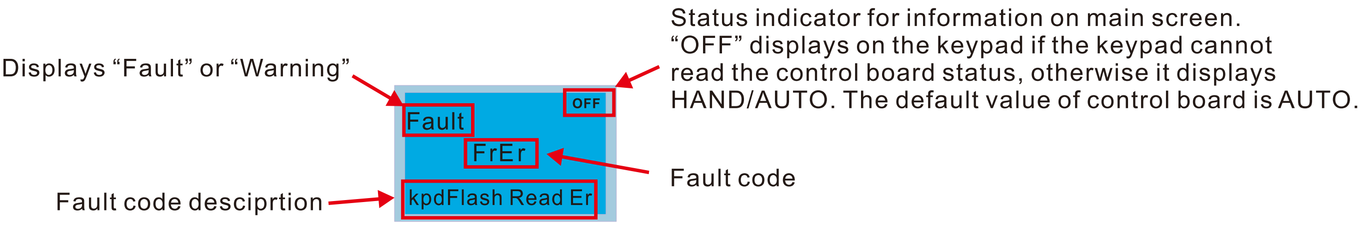








7-14-4 Digital Keypad KPC-CC01 Fault Codes and Descriptions

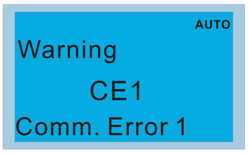
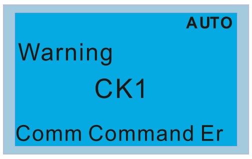
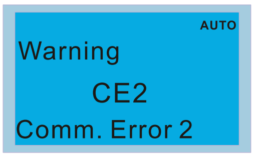
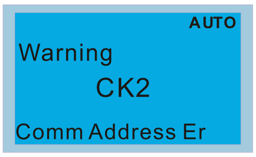
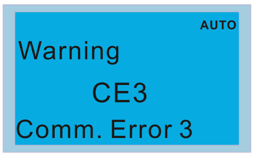
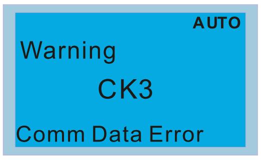


Fault Codes

LCD Display *	Fault Name	Description	Corrective Actions
AUTO Fault FrEr kpd Flash Read Er	Flash memory read error (FrEr)	Keypad flash memory read error	Error in the keypad’s flash memory. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
AUTO Fault FsEr kpd Flash Save Er	Flash memory save error (FsEr)	Keypad flash memory save error	Error in the keypad’s flash memory. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
AUTO Fault FPEr kpd Flash Pr Er	Flash memory parameter error (FPEr)	Keypad flash memory parameter error	Error in the default parameters. It might be caused by a firmware update. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
AUTO Fault VFDr Read VFD Info Er	Reading AC motor drive data error (VFDr)	Keypad error when reading AC motor drive data	Keypad cannot read any data sent from the VFD. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
AUTO Fault CPUEr CPU Error	CPU error (CPUEr)	Keypad CPU error	A serious error in the keypad’s CPU. 1. Check for any problem on CPU clock. 2. Check for any problem on Flash IC. 3. Check for any problem on RTC IC. 4. Verify that the communication quality of the RS-485 cable is good. 5. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.

Table 7-77

Warning Codes

LCD Display *	Warning Name	Description	Corrective Actions
	Communication error 1 (CE1)	RS-485 Modbus illegal function code	Motor drive does not accept the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication command error 1 (CK1)	Keypad communication data, illegal function code (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
	Communication error 2 (CE2)	RS-485 Modbus illegal data address	Motor drive does not accept the keypad's communication address. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication address error (CK2)	Keypad communication data, illegal data address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
	Communication error 3 (CE3)	RS-485 Modbus illegal data value	Motor drive does not accept the communication data sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication data error (CK3)	Keypad communication data, illegal data value (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.

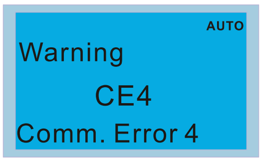
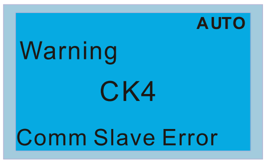
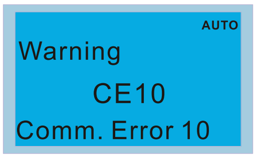
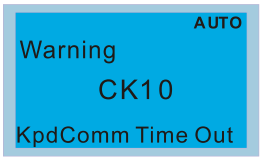
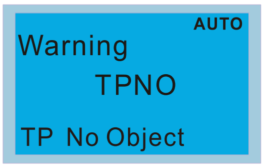
LCD Display *	Warning Name	Description	Corrective Actions
	Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address	Motor drive cannot process the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication slave error (CK4)	Keypad communication data is written to read-only address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
	Communication error 10 (CE10)	RS-485 Modbus transmission time-Out	Motor drive does not respond to the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Keypad communication time out (CK10)	Keypad communication data, transmission time-out (Keypad auto-detect this error and display it).	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
	Keypad communication time out (CK10)	Object not supported by TPEditor	Keypad's TPEditor uses an unsupported object. 1. Verify that the TPEditor is not using an unsupported object or setting. Delete unsupported objects and unsupported settings. 2. Re-edit the object in the TPEditor, and then download it to the keypad. 3. Verify that the motor drive supports the TP functions. If the drive does not support TP function, the main page displays Default. If none of the above solutions works, contact your local authorized dealer for assistance.

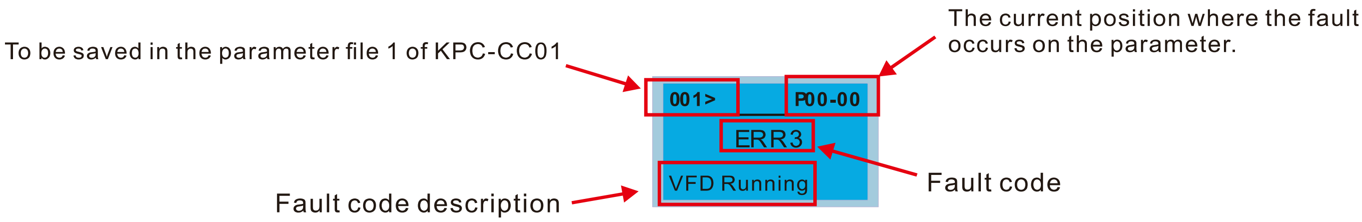
Table 7-78

NOTE:

The warning code CExx only occurs when the communication problem is between the drive and the keypad. It has nothing to do with the drive and other devices. Note the warning code description to find the cause of the error if CExx appears.

File Copy Setting Fault Description:

These faults occur when KPC-CC01 cannot perform the command after clicking the ENTER key in the copy function.



LCD Display *	Fault Name	Description	Corrective Actions
001> P00-00 ERR1 Read Only	Read only (ERR1)	Parameter and file are read-only	The parameter / file is read-only and cannot be written to. 1. Verify the specification in the user manual. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR2 Write Fail	Write in error (ERR2)	Fail to write parameter and file	An error occurred while writing to a parameter / file. 1. Check for any problem on the Flash IC. 2. Shut down the system, wait for ten minutes, and then restart the system. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR3 VFD Running	Drive operating (ERR3)	AC motor drive is in operating status	A setting cannot be changed while the motor drive is in operation. 1. Verify that the drive is not in operation. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR4 Pr Lock	Parameter locked (ERR4)	AC motor drive parameter is locked	A setting cannot be changed because a parameter is locked. 1. Check if the parameter is locked. If it is locked, unlock it and try to set the parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR5 Pr Changing	Parameter changing (ERR5)	AC motor drive parameter is changing	A setting cannot be changed because a parameter is being modified. 1. Check if the parameter is being modified. If it is not being modified, try to change that parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR6 Fault Code	Fault code (ERR6)	Fault code is not cleared	A setting cannot be changed because an error has occurred in the motor drive. 1. Check if any error occurred in the motor drive. If there is no error, try to change the setting again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR7 Warning Code	Warning code (ERR7)	Warning code is not cleared	A setting cannot be changed because of a warning message given to the motor drive. 1. Check if there is a warning message given to the motor drive. If this solution does not work, contact your local authorized dealer for assistance.

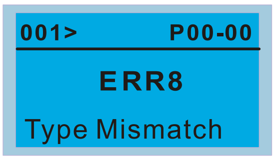
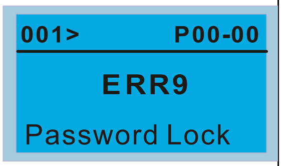
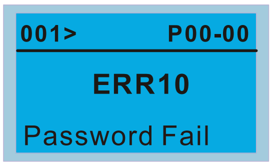
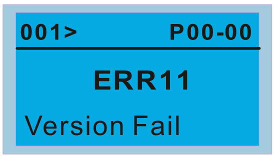
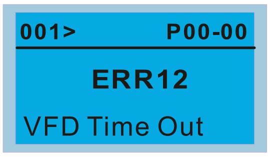
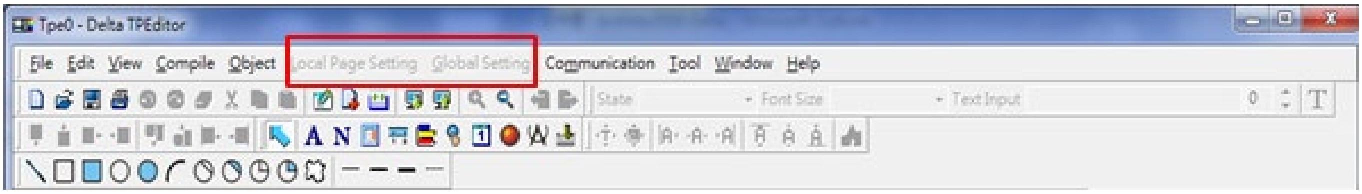
LCD Display *	Fault Name	Description	Corrective Actions
	File type mismatch (ERR8)	File type mismatch	Data to be copied are not the correct type, so the setting cannot be changed. 1. Check if the products' serial numbers to be copied are in the same category. If they are in the same category, try to copy the setting again. If this solution does not work, contact your local authorized dealer for assistance.
	Password locked (ERR9)	File is locked with password	A setting cannot be changed because some data are locked. 1. Check if the data are unlocked or able to be unlocked. If the data are unlocked, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Password fail (ERR10)	File password mismatch	A setting cannot be changed because the password is incorrect. 1. Check if the password is correct. If the password is correct, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Version fail (ERR11)	File version mismatch	A setting cannot be changed because the version of the data is incorrect. 1. Check if the version of the data matches the motor drive. If it matches, try to change the setting again. If none of the above solutions works, contact your local authorized dealer for assistance.
	VFD Time out (ERR12)	AC motor drive copy function time-out	A setting cannot be changed because the data copying time-out expired. 1. Try copying the data again. 2. Check if copying data is authorized. If it is authorized, try to copy the data again. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.

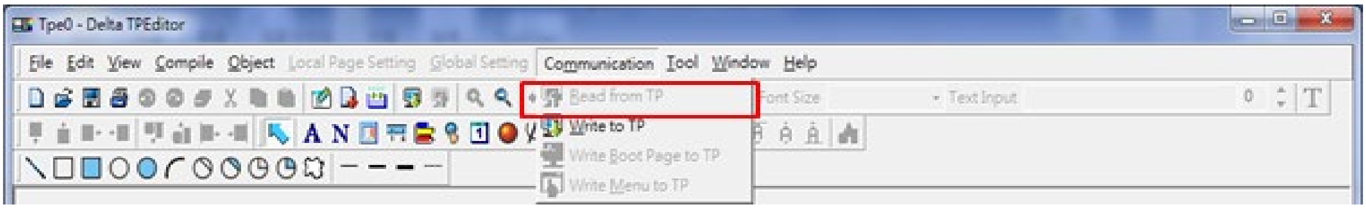
Table 7-79

7-14-5 Unsupported Functions when using TPEditor with the KPC-CC01

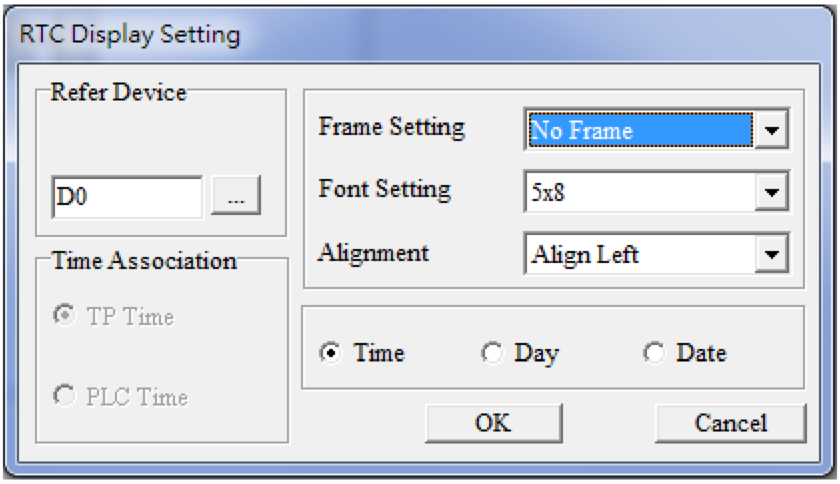
1. **Local Page Setting** and **Global Setting** functions are not supported.



2. In the **Communication** menu, **Read from TP** function is not supported.



3. In the **RTC Display Setting**, you cannot change the **Refer Device**.



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Chapter 8 Option Cards

8-1 Option Card Installation

8-2 EMM-PG01L -- PG Card (Line Driver)

8-3 EMM-PG01O -- PG Card (Open Collector)

8-4 EMM-PG01R -- PG Card (Resolver / Encoder Signal Input)

8-5 EMM-D33A -- Extension for 3-point Digital Input / 3-point Digital Output

8-6 EMM-A22A -- Extension for 2 Sets of Analog Input / 2 Sets of Analog Output

8-7 EMM-R2CA -- Relay Output Extension (2-point N.C. Output Terminal)

8-8 EMM-R3AA -- Relay Output Extension (3-point N.O. Output Terminal)

8-9 EMM-BPS02 -- +24V Power Extension Card

8-10 CMM-DN02 -- Communication Extension Card, DeviceNet

8-11 CMM-EIP02 -- Communication Extension Card, (Single-port) EtherNet/IP, Modbus-TCP

8-12 CMM-EIP03 -- Communication Extension Card, (Dual-port) EtherNet/IP, Modbus-TCP

8-13 CMM-PD02 -- Communication Extension Card, Profibus DP

8-14 CMM-EC02 -- Communication Extension Card, EtherCAT

8-15 Delta Standard Fieldbus Cables

- The option cards in this chapter are optional accessories. Select the applicable option cards for your motor drive, or contact your local distributor for suggestions. The option cards can significantly improve the efficiency of the motor drive.
- To prevent damage to the motor drive during installation, remove the digital keypad and the cover before wiring.
- The option cards do not support hot swapping. Power off the motor drive before you install or remove the option cards.

8-1 Option Card Installation

The mounting position and connection method corresponding to each option card is listed as the table below. For detailed information, refer to following sections.

<table>
<tr><th rowspan="2">Option Card</th><th rowspan="2">Model</th><th rowspan="2">Function</th><th colspan="3">Mounting Position 1</th><th colspan="3">Mounting Position 2</th></tr>
<tr><th>Installation Method</th><th>Connection Method</th><th>Subsection</th><th>Installation Method</th><th>Connection Method</th><th>Subsection</th></tr>
<tr><td rowspan="3">PG Card</td><td>EMM-PG01L</td><td>ABZ (Line Driver)</td><td rowspan="7">Front-mounted</td><td rowspan="7">Connector</td><td rowspan="7">8-1-1</td><td rowspan="7" colspan="2">Not applicable</td><td rowspan="7">N/A</td></tr>
<tr><td>EMM-PG01O</td><td>ABZ (Open Collector)</td></tr>
<tr><td>EMM-PG01R</td><td>Resolver</td></tr>
<tr><td rowspan="2">I/O Card</td><td>EMM-D33A</td><td>Digital Card - 3in 3out</td></tr>
<tr><td>EMM-A22A</td><td>Analog Card - 2in 2out</td></tr>
<tr><td rowspan="2">Relay Card</td><td>EMM-R2CA</td><td>Relay (2 sets of C contact)</td></tr>
<tr><td>EMM-R3AA</td><td>Relay (3 sets of A contact)</td></tr>
<tr><td>Power Adapter</td><td>EMM-BPS02</td><td>DC 24V Power Supply Card</td><td>Back-mounted</td><td>Connector</td><td>8-1-2</td><td rowspan="6">Front-mounted</td><td rowspan="6">Flat Cables</td><td rowspan="6">8-1-4</td></tr>
<tr><td rowspan="5">Communication Card</td><td>CMM-DN02</td><td>DeviceNet</td><td rowspan="5">Back-mounted</td><td rowspan="5">Flat Cables</td><td rowspan="5">8-1-3</td></tr>
<tr><td>CMM-EIP02</td><td>EtherNet/IP</td></tr>
<tr><td>CMM-EIP03</td><td>EtherNet/IP</td></tr>
<tr><td>CMM-PD02</td><td>Profibus DP</td></tr>
<tr><td>CMM-EC02</td><td>EtherCAT</td></tr>
</table>

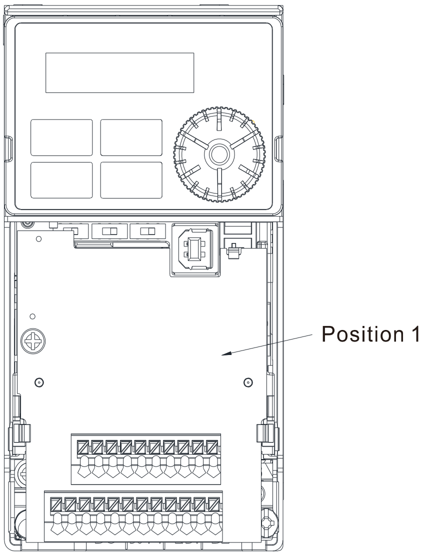
Table 8-1

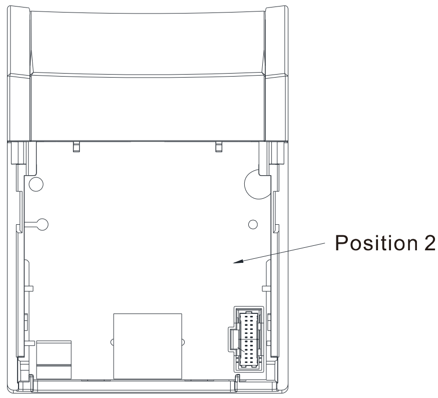
NOTE:
1. Front-mounted: The terminal block and the connector face upward.
2. Back-mounted: The terminal block and the connector face downward.
3. When installing two cards, the installation should be in the sequence of PG / I/O / Relay card → Power adapter → Communication card
4. Refer to the following pages for the cable connection. (Fig.8-2 and Table 8-3)

Mounting Position of Option Cards

Frame A–D
Mounting position 1, 2 (Option card installing kit)

Frame E–I
Mounting position 1, 2





(Option card installing kit)

Figure 8-1

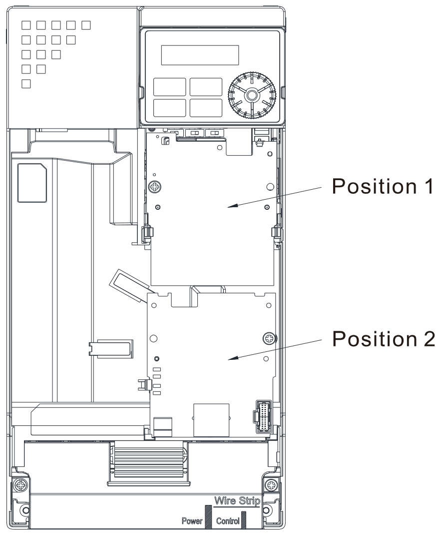


Figure 8-2

NOTE: Position 2 is only applicable for the installation of communication cards and power extension card.

The Wiring of Communication Card

MH300 Control Board Connector

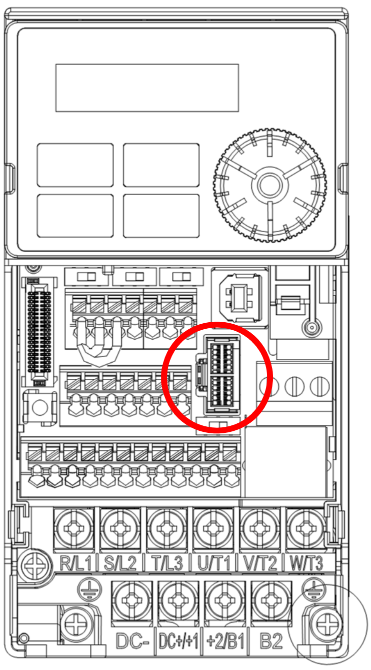


Figure 8-3

Option Card Connector

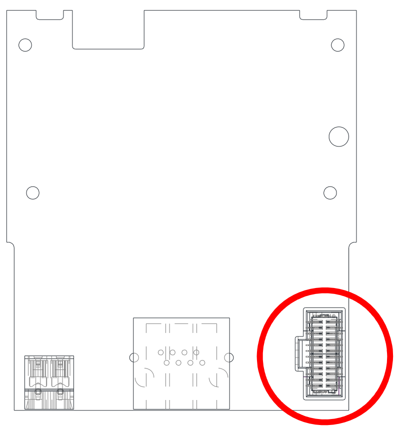


Figure 8-4

NOTE: Do not misuse the cables for the communication cards and for the power card. You must read the descriptions on the cables before wiring.

● Communication Card Cables

To correctly use the communication cards, you must purchase the communication card along with the connection cables. Check your communication card models first. Then, select your applicable connection cables according to the mounting positions by different frames. Two cable length are available for your choice. See the table below to select your applicable communication card cables.

<table>
<tr><td>Communication Card</td><td colspan="2">CMM-DN02, CMM-EIP02, CMM-EIP03, CMM-PD02, CMM-COP02</td><td colspan="2">CMM-EC02 *</td></tr>
<tr><td rowspan="2">Frame</td><td>Mounting Position 1</td><td>Mounting Position 2</td><td>Mounting Position 1</td><td>Mounting Position 2</td></tr>
<tr><td>Model of Cable</td><td>Model of Cable</td><td>Model of Cable</td><td>Model of Cable</td></tr>
<tr><td>A</td><td rowspan="2">CBM-CL01A</td><td>CBM-CC01A</td><td rowspan="2">CBM-CL01A</td><td>CBM-CL01A</td></tr>
<tr><td>B</td><td rowspan="3">CBM-CC02A</td><td rowspan="8">CBM-CL02A</td></tr>
<tr><td>C</td><td rowspan="7">CBM-CL02A</td><td rowspan="7">CBM-CL02A</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td><td rowspan="5">CBM-CL02A</td></tr>
<tr><td>F</td></tr>
<tr><td>G</td></tr>
<tr><td>H</td></tr>
<tr><td>I</td></tr>
</table>

Table 8-2

NOTE: An option card mounting box is included upon purchasing the communication card CMM-EC02, you need to purchase it with CBM-CL01A or CBM-CL02A.

CBM-CL01A
CBM-CC01A

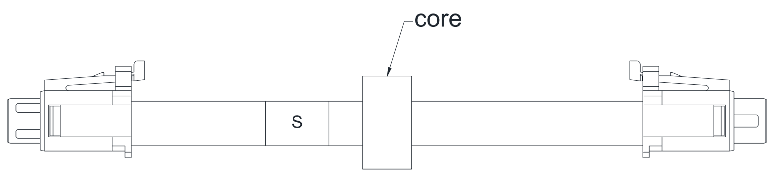


Figure 8-5

CBM-CL02A
CBM-CC02A

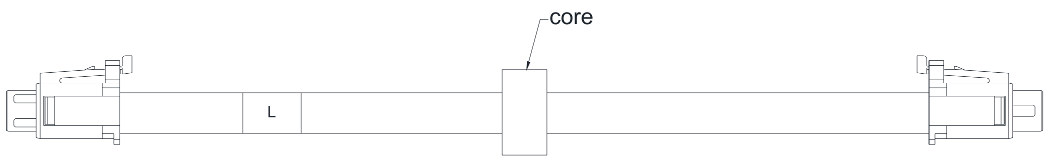


Figure 8-6

NOTE: There is a mounting box included for the model named with CBM-CCxxA.

Power Card Cables

An option card mounting box, a connector and cables with two different lengths are included when you purchase the power card EMM-BPS02 (DC 24 V backup power supply card), so you do not need to purchase it with the connection cables. "**BPS use only**" and "# S" or "# L" are marked on the EMM-BPS02 power card cable. See the table below to select your applicable power card cables according to different mounting positions.

<table>
<tr><td>Power Card</td><td colspan="2">EMM-BPS02</td></tr>
<tr><td rowspan="2">Frame</td><td>Mounting Position 1</td><td>Mounting Position 2</td></tr>
<tr><td>Model of Cable</td><td>Model of Cable</td></tr>
<tr><td>A</td><td rowspan="9">Connector</td><td># S</td></tr>
<tr><td>B</td><td rowspan="8"># L</td></tr>
<tr><td>C</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
<tr><td>G</td></tr>
<tr><td>H</td></tr>
<tr><td>I</td></tr>
</table>

Table 8-3

S

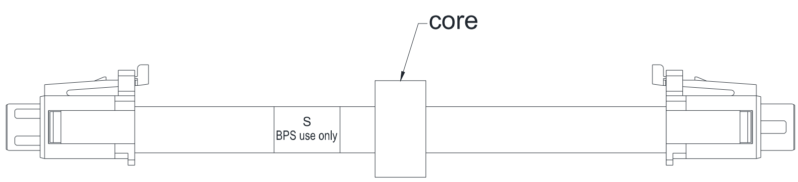


Figure 8-7

L

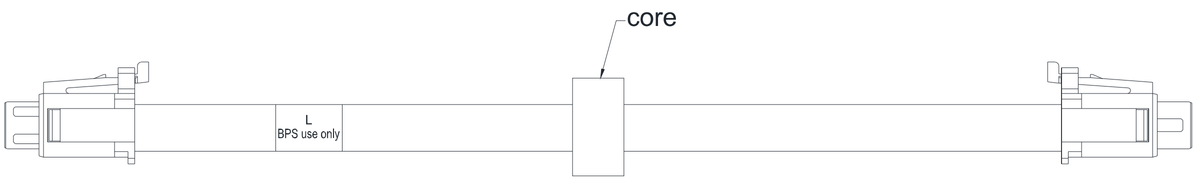


Figure 8-8

8-1-1 PG / I/O / RELAY Card - Mounting Position 1

Installation method: **Front-mounting** the option card, by inserting to a **connector** on the control board.

1. As shown in the Figure 8-9, switch off the power of the motor drive, and then remove the front cover.
2. Mounting the connector: as shown in the Figure 8-10, aim the option card at the connector on the control board and then insert it to the connector.
3. Assembling support frame: as shown in the Figure 8-11, aim the two clips at the two slots on the motor drive and then press downward to have the two clips engage the slots.
4. Assembling the option card: As shown in the figure 8-12, have the terminal block of the option facing up, aim the two holes of the option card to the position column and press downard so that the three clips are engage the option card.
5. As shown in the Figure 8-13, make sure that three clips are properly engage the option card and then fasten the screw [Suggested torque value: 4–6 kg-cm / (3.5–5.2 Ib-in.) / (0.39–0.59 Nm)].
6. As shown in the Figure 8-14, assembly is completed.

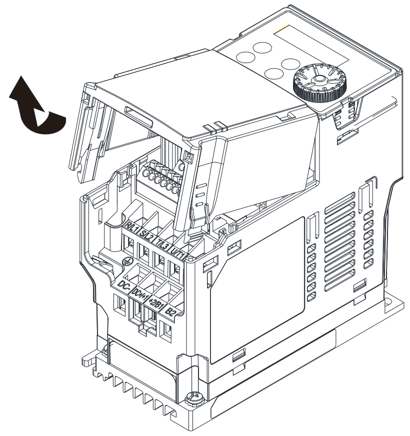


Figure 8-9

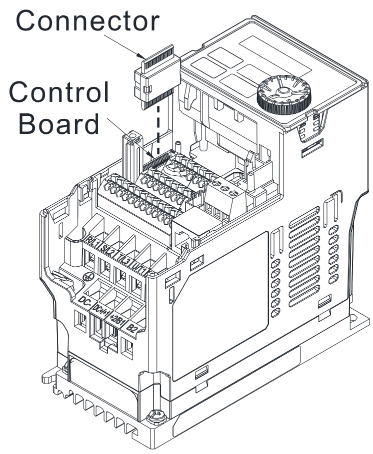


Figure 8-10

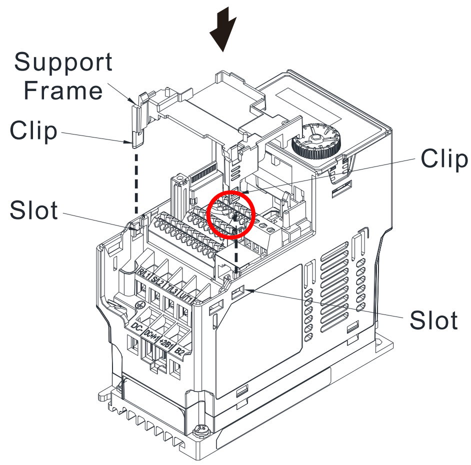


Figure 8-11

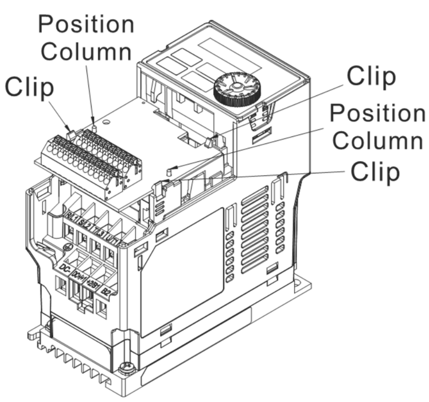


Figure 8-12

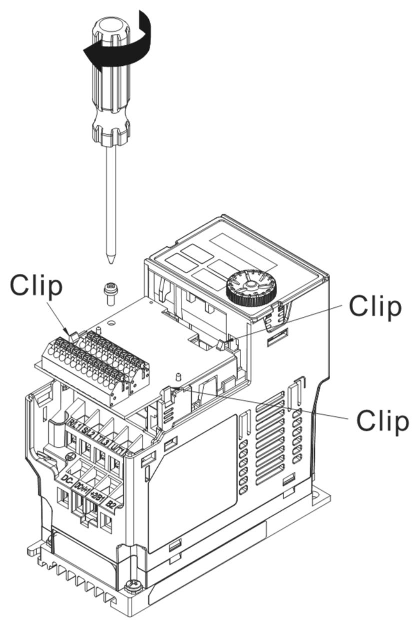


Figure 8-13

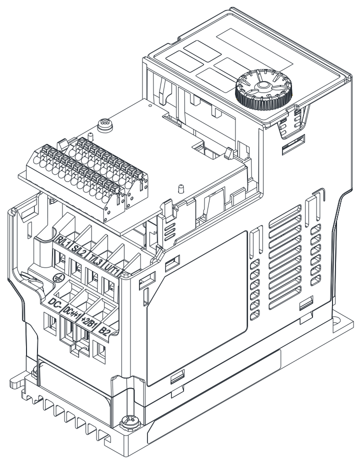


Figure 8-14

8-1-2 Power Adapter - Mounting position 1

Installation method: **Back-mounting** the option card, by inserting to a **connector** on the control board.

1. As shown in the Figure 8-15, shut down the power of the motor drive, and then remove the front cover.
2. Mounting the connector: as shown in the Figure 8-16, aim the option card at the connector on the control board and then insert it to the connector.
3. Assembling support frame: as shown in the Figure 8-17, aim the two clips at the two slots on the motor drive and then press downward to have the two clips engage the slots.
4. Assembling the option card: As shown in the Figure 8-18, have the terminal block of the option facing up, aim the two holes of the option card to the position column and press downward so that the three clips are engage the option card.
5. As shown in the Figure 8-19, make sure that three clips are properly engage the option card and then fasten the screw [Suggested torque value: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)].
6. As shown in the Figure 8-20, assembly is completed.

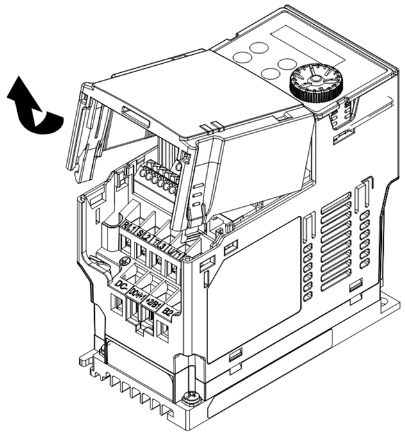


Figure 8-15

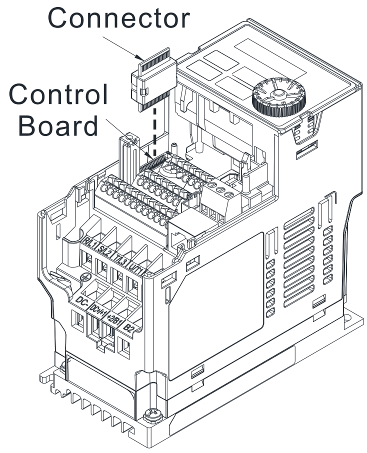


Figure 8-16

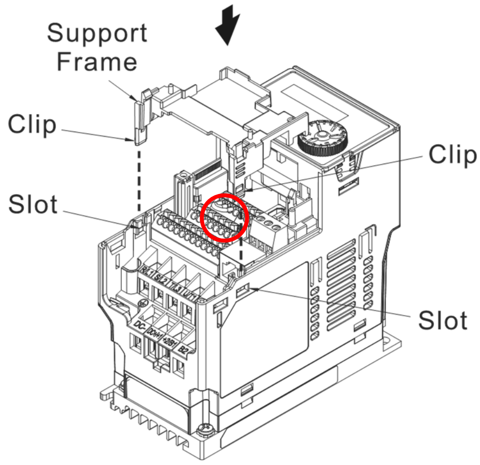


Figure 8-17

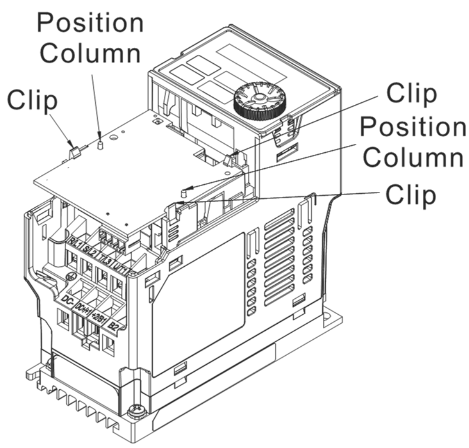


Figure 8-18

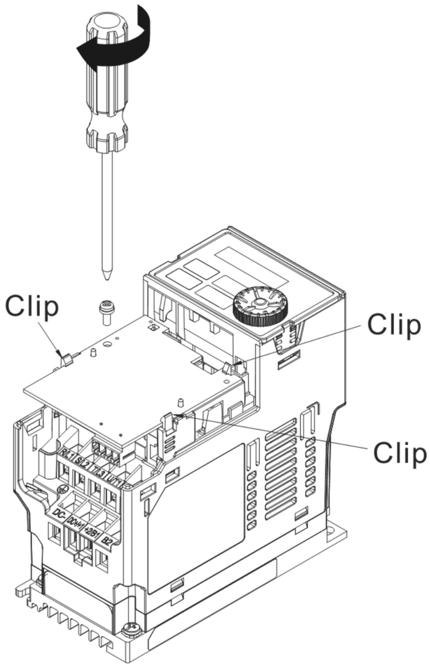


Figure 8-19

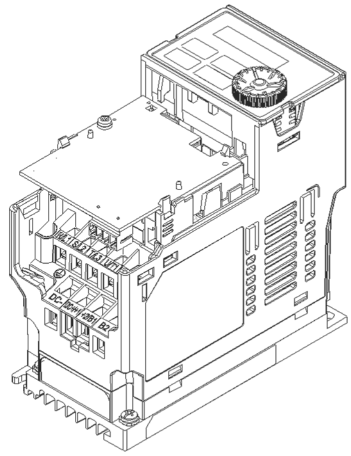


Figure 8-20

8-1-3 Communication Card - Mounting position 1

Installation method: **Back-mounting** the option card, by inserting to a **flat Cables** on the control board.

1. As shown in the Figure 8-21, shut down the power of the motor drive, and then remove the front cover.
2. Assembling connection cables: Connect the connector at one end of the connection cable to the control board connector. For information on connection method, refer to Section 8-1 (see Table 8-2 and Figure 8-3).
3. Assembling support frame: as shown in the Figure 8-22, aim the two clips at the two slots on the motor drive and then press downward to have the two clips engage the slots.
4. Assembling connection cables: Connect the connector at the other end of the connection cable to the connector of communication cards.
5. Assembling the option card: As shown in the Figure 8-23, have the terminal block of the adapter/ option facing up, aim the two holes of the option card to the position column and press downward so that the three clips are engage the option card.
6. As shown in the Figure 8-24, make sure that three clips are properly engage the adapter/ option card and then fasten the screw [Suggested torque value: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)].
7. As shown in the Figure 8-25, assembly is completed.

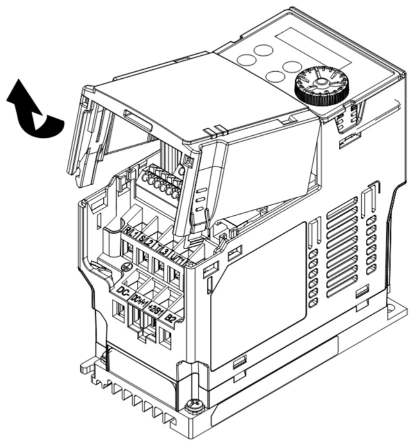


Figure 8-21

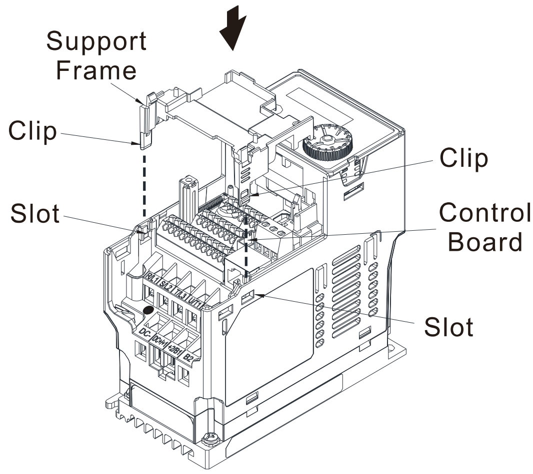


Figure 8-22

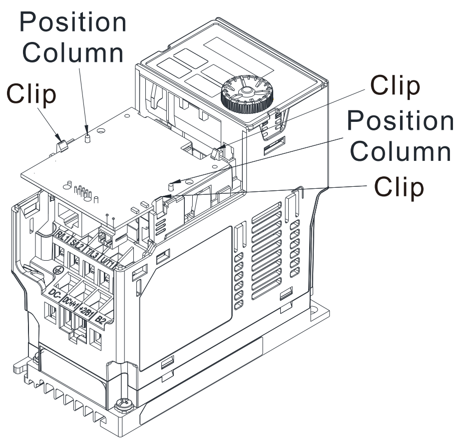


Figure 8-23

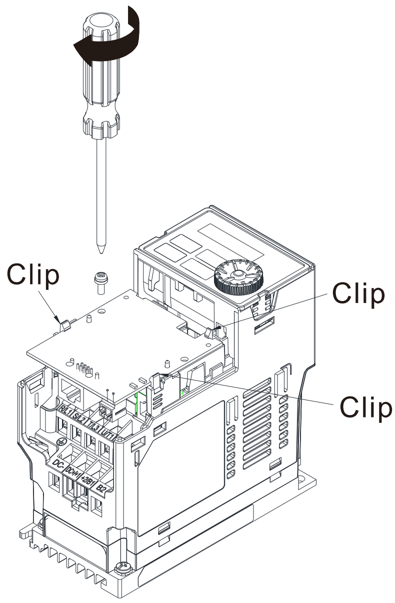


Figure 8-24

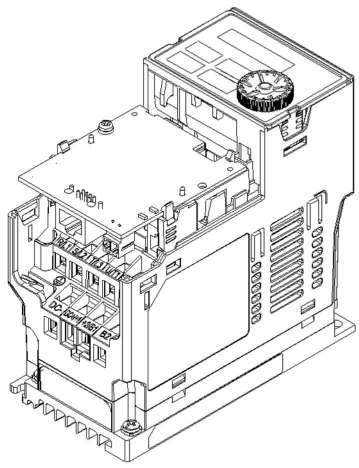


Figure 8-25

8-1-4 Communication Card & Power Adapter - Mounting position 2

Installation method: **Front-mounting** the option card, by inserting to a **flat Cables** on the control board.

Frame A–D

1. As shown in the Figure 8-26, shut down the power of the motor drive and then remove the front cover.
2. Assembling option cards: Detach the upper cover of the installation box for option card by slipping and place the terminal block and connector of the option card upward. Fix the front end of the option card to the slots, and then press another side, as shown in the Figure 8-27.
3. Make sure that two clips at the backside are properly engage the option card, and then fasten the screws [Suggested torque value: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)], as shown in the Figure 8-28.
4. Assembling connection cables: Connect the connector at one end of the connection cable to the control board connector. For information on connection method, refer to Section 8-1 (see Table 8-2 and Figure 8-3).
5. Install the upper cover.
6. Assembling connection cables: Connect the connector at the other end of the connection cable to the connector of option cards.
7. Attach the upper cover to the installation box for option card, as shown in the Figure 8-29.
8. Assembling the installation box for option card: Aim the four clips of the installation box for option card at the slots on the upper cover of the motor drive, and then press downward to have the four clips engage the slots, as shown in the Figure 8-30.
9. As shown in the Figure 8-31, assembly is completed.

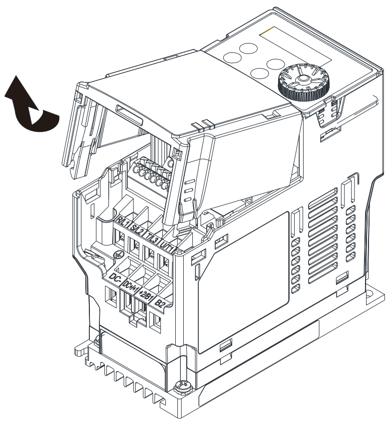


Figure 8-26

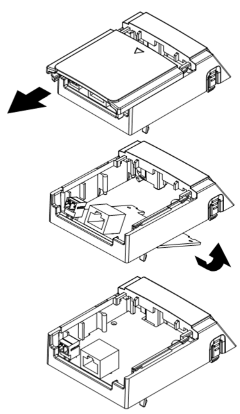


Figure 8-27

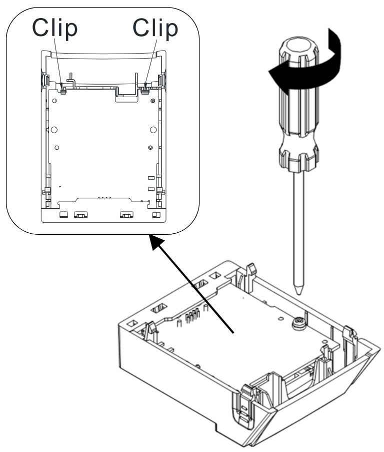


Figure 8-28

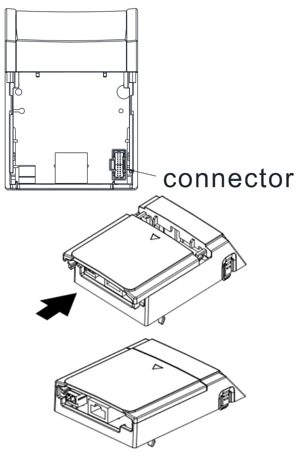


Figure 8-29

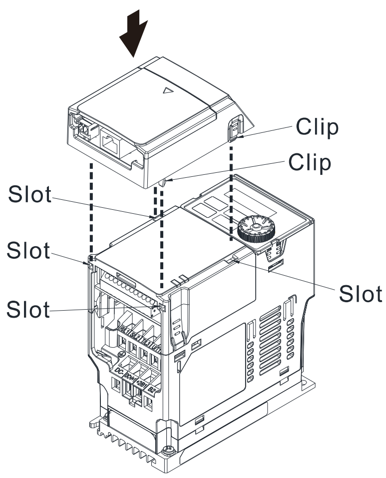


Figure 8-30

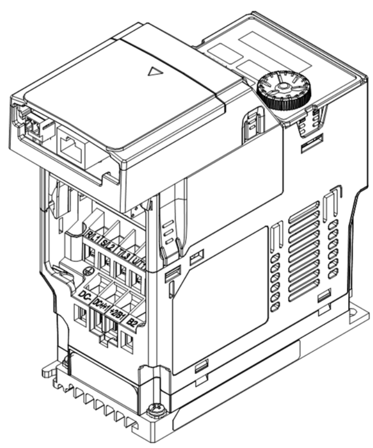


Figure 8-31

Frame E–I

1. As shown in the Figure 8-32, shut down the power of the motor drive and then remove the front cover.
2. Assembling connection cables: Connect the connector at one end of the connection cable to the control board connector. For information on connection method, refer to Section 8-1 (see Table 8-2 and Figure 8-3). Wire them as Figure 8-33 shows and make sure the core place in the groove.
3. Assembling option cards: Place the terminal block and connector of the option card upward. Fix the front end of the option card to the slots, and then press another side, as shown in the Figure 8-34.
4. Make sure that clips are properly engage the option card, and then fasten the screws [Suggested torque value: 4–6 kg-cm / (3.5–5.2 lb-in.) / (0.39–0.59 Nm)], as shown in the Figure 8-35.
5. Assembling connection cables: Connect the connector at the other end of the connection cable to the connector of option cards, as shown in the Figure 8-36.
6. As shown in the Figure 8-37, assembly is completed.

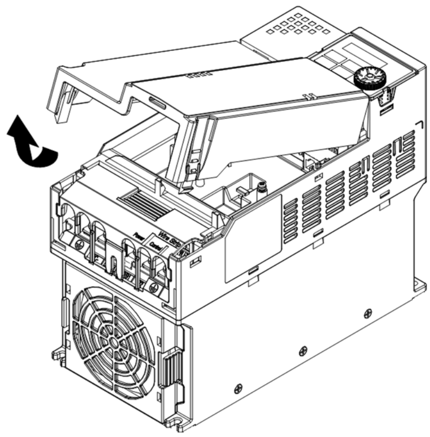


Figure 8-32

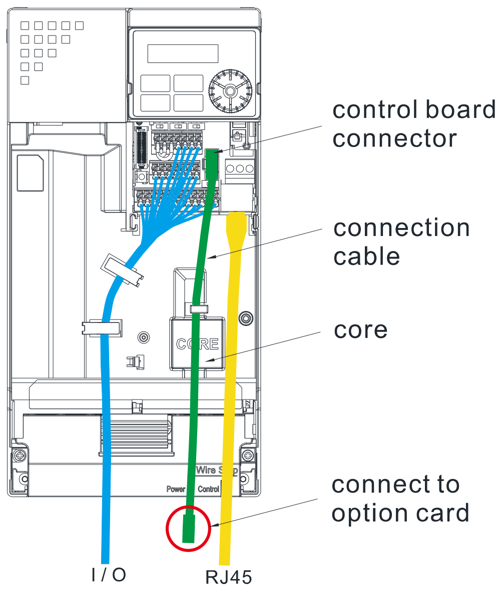


Figure 8-33

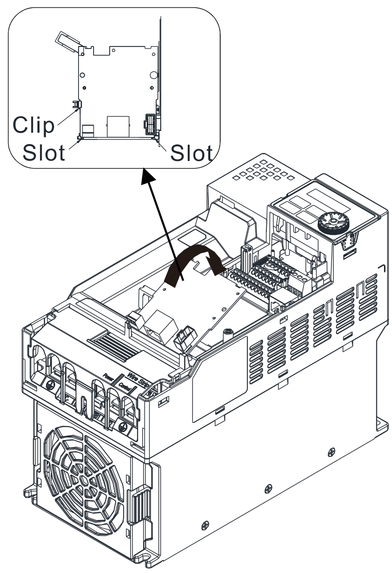


Figure 8-34

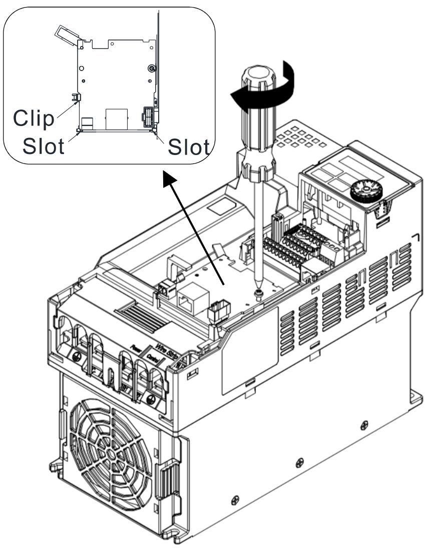


Figure 8-35

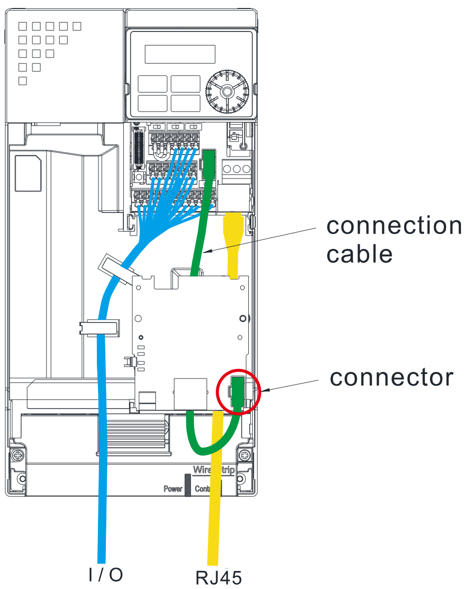


Figure 8-36

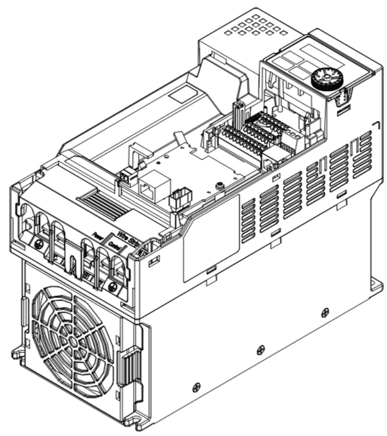


Figure 8-37

NOTE:

- You must ground the option cards listed below when wiring. The ground terminal is included with option card as shown in Figure 8-38

1. CMM-PD02
2. CMM-DN02
3. CMM-EIP02
4. CMM-EIP03
5. CMM-EC02
6. EMM-BPS02
7. EMM-PG01L
8. EMM-PG01O
9. EMM-PG01R
10. EMM-A22A
11. EMM-D33A

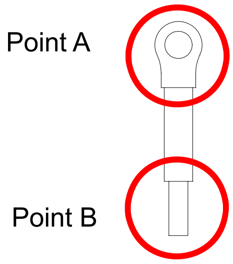


Figure 8-38

- Installation of the ground terminal:

The B side of the ground terminal connects to the ground terminal block on the communication card at No.6 of the CMM-EIP02 shown in Figure 8-39. See each section in Chapter 8 for the ground terminal blocks of the other option cards. The A side of the ground terminal connects to the PE on the drive as the red circles show in Figure 8-40 and 8-43.

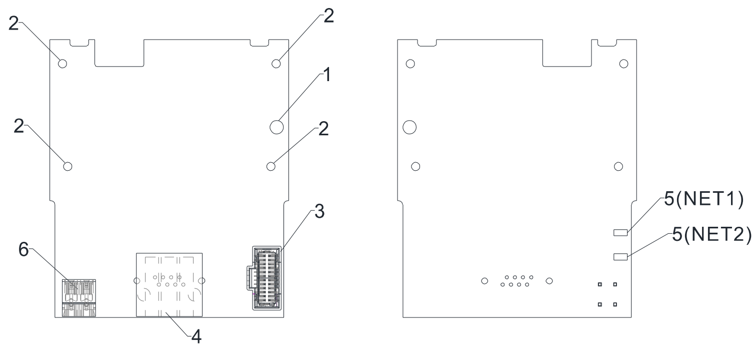


Figure 8-39

Frame A–C

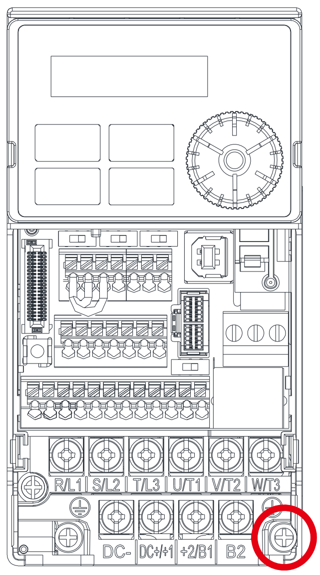


Figure 8-40

Torque (±10%)
Frame A: 9 kg-cm / (7.8 Ib-in.) / (0.88 Nm)
Frame B: 15 kg-cm / (13.0 Ib-in.) / (1.47 Nm)
Frame C: 20 kg-cm / (17.4 Ib-in.) / (1.96 Nm)

Frame D–F

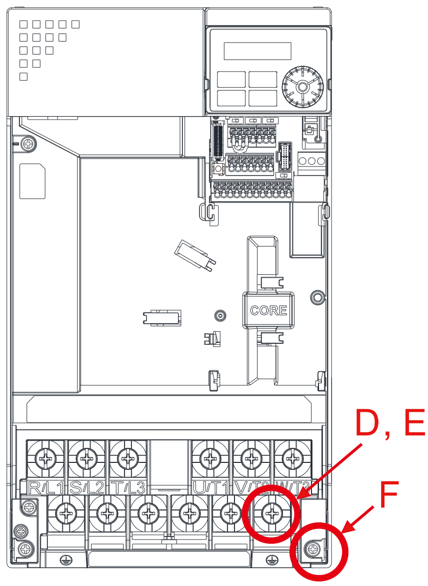


Figure 8-41

Torque (±10%)
Frame D: 20 kg-cm / (17.4 Ib-in.) / (1.96 Nm)
Frame E: 25 kg-cm / (21.7 Ib-in.) / (2.45 Nm)
Frame F: 20 kg-cm / (17.4 Ib-in.) / (1.96 Nm)

Frame G

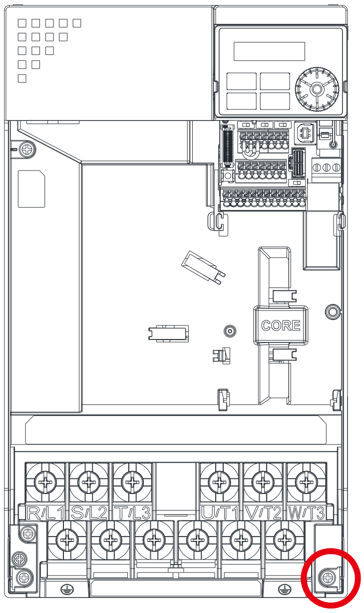


Figure 8-42

Torque (±10%)
Frame G: 14–16 kg-cm / (12.15–13.89 lb-in.) / (1.37–1.57 Nm)

Frame H–I

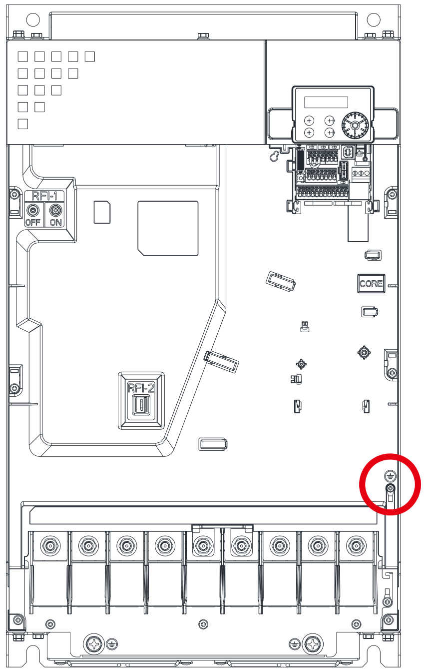


Figure 8-43

Torque (±10%)
Frame H–I: 4–6 kg-cm / (3.47–5.21 lb-in.) / (0.39–0.59 Nm)

8-2 EMM-PG01L -- PG Card (Line Driver)

8-2-1 Product Profile

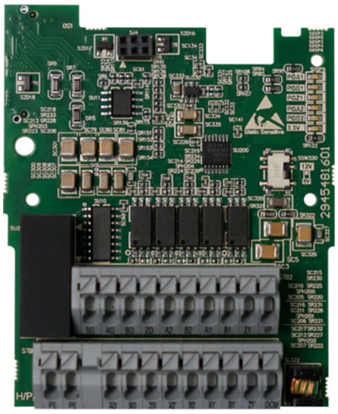


Figure 8-44

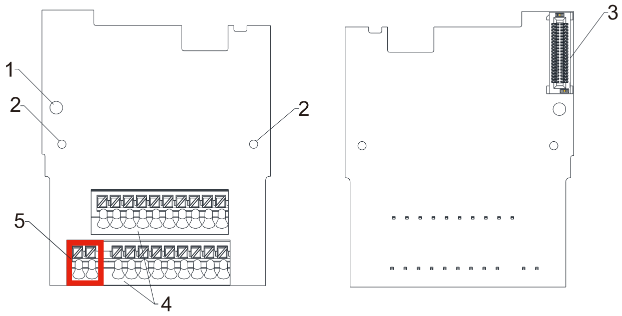


Figure 8-45

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block
5. Ground terminal block

Wire: 0.25–0.75 mm^2 / (24–18 AWG)
Stripping length: 9 mm

8-2-2 Terminal Descriptions

To use with Pr.10-00–Pr.10-02, Pr.10-16–Pr.10-18.

Terminals		Descriptions
PG1	VP	Power output voltage: +5 V ± 5 % or +12 V ± 5 % (Use SSW320 to switch +5 V or +12 V, the default is +5V) Maximum output current: 200 mA (+5V)
	DCM	Common for power and signal
	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$	Encoder input signal (Applicable for Line Driver or Open Collector) Open Collector input voltage +5–24 V (see NOTE) Supports 1-phase and 2-phase input Maximum input signal: 300 kHz
PG2	A2, $\overline{A2}$, B2, $\overline{B2}$	Pulse input signal (Applicable for Line Driver or Open Collector) Open Collector input voltage +5–24 V (see NOTE) Supports 1-phase and 2-phase input Maximum input signal: 300 kHz
PG OUT	AO, $\overline{AO}$, BO, $\overline{BO}$, ZO, $\overline{ZO}$, SG	PG feedback signal output, supports frequency elimination: 1–255 times. Maximum output voltage of the Line driver: 5 V_{DC} Maximum output current: 15 mA Maximum output frequency: 300 kHz SG, the referenced electric potential for PG card output signal, serves as the ground for host controller or PLC to make the output signal become the common point. Do not use common grounding with SG and DCM as it may influence the signal quality.
Ground	PE	Grounding terminal. To decrease noise, properly ground this terminal.

Table 8-4

NOTE: Open Collector application: input current 5–15 mA to each set and each set needs one pull-up resistor. If the input voltage of the open collector is 24 V, power for the encoder must be connected externally. Refer to diagram 2 of PG1 (Figure 8-47).

5V	Recommended pull-up resistor: above 100–220 Ω, 1/2 W
12V	Recommended pull-up resistor: above 510 Ω–1.35 kΩ, 1/2 W
24V	Recommended pull-up resistor: above 1.8 k–3.3 kΩ, 1/2 W

Table 8-5

- PG1 Wiring Diagram

  Figure 8-46 and Figure 8-47 show the wiring diagrams for using open collector encoder.

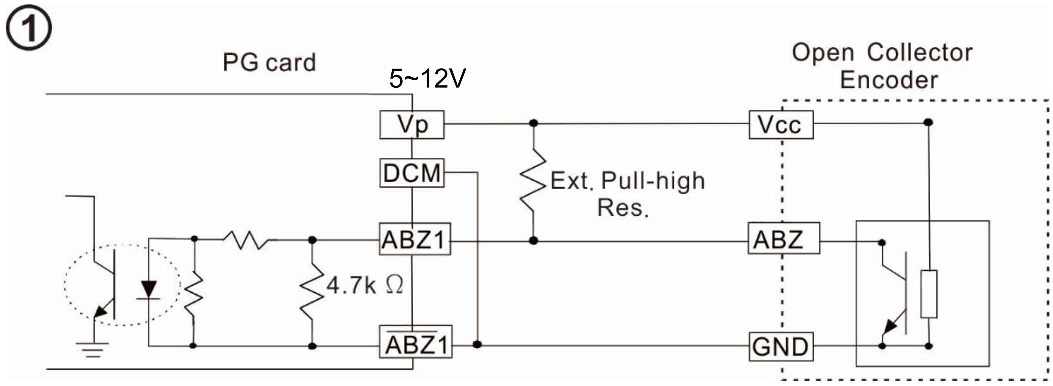


Figure 8-46

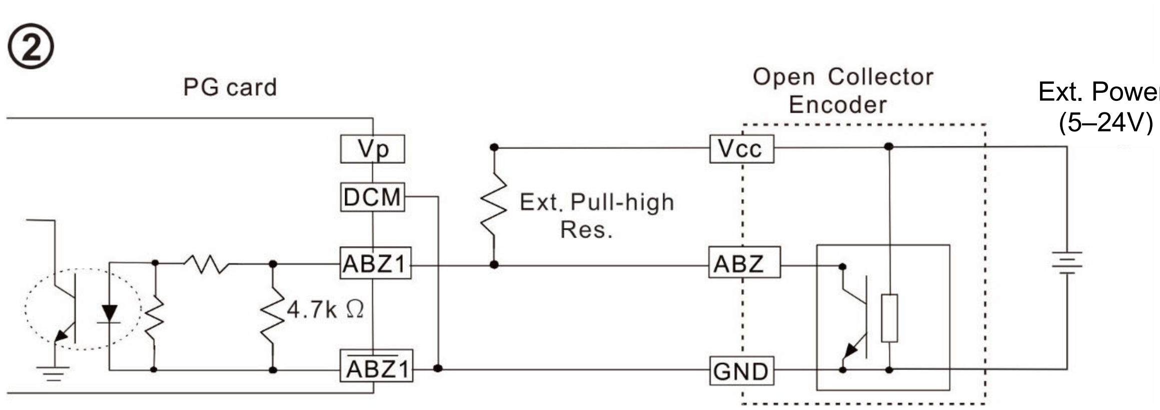


Figure 8-47

- PG2 Wiring Diagram

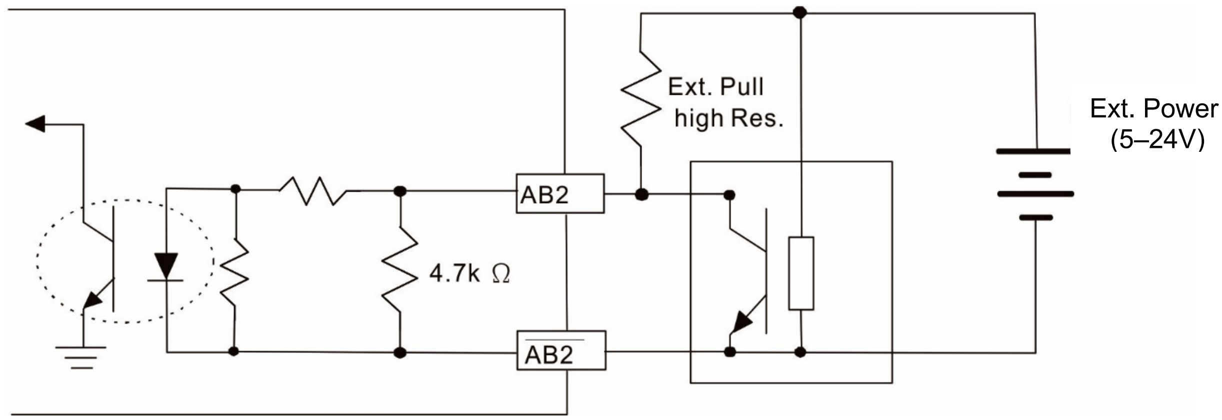


Figure 8-48

8-2-3 EMM-PG01L Wiring Diagram

- Use a shielded cable to prevent interference.
  Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size: 0.0509–1.31 mm^2 / (30–16 AWG).
- Cable length: less than 100 m

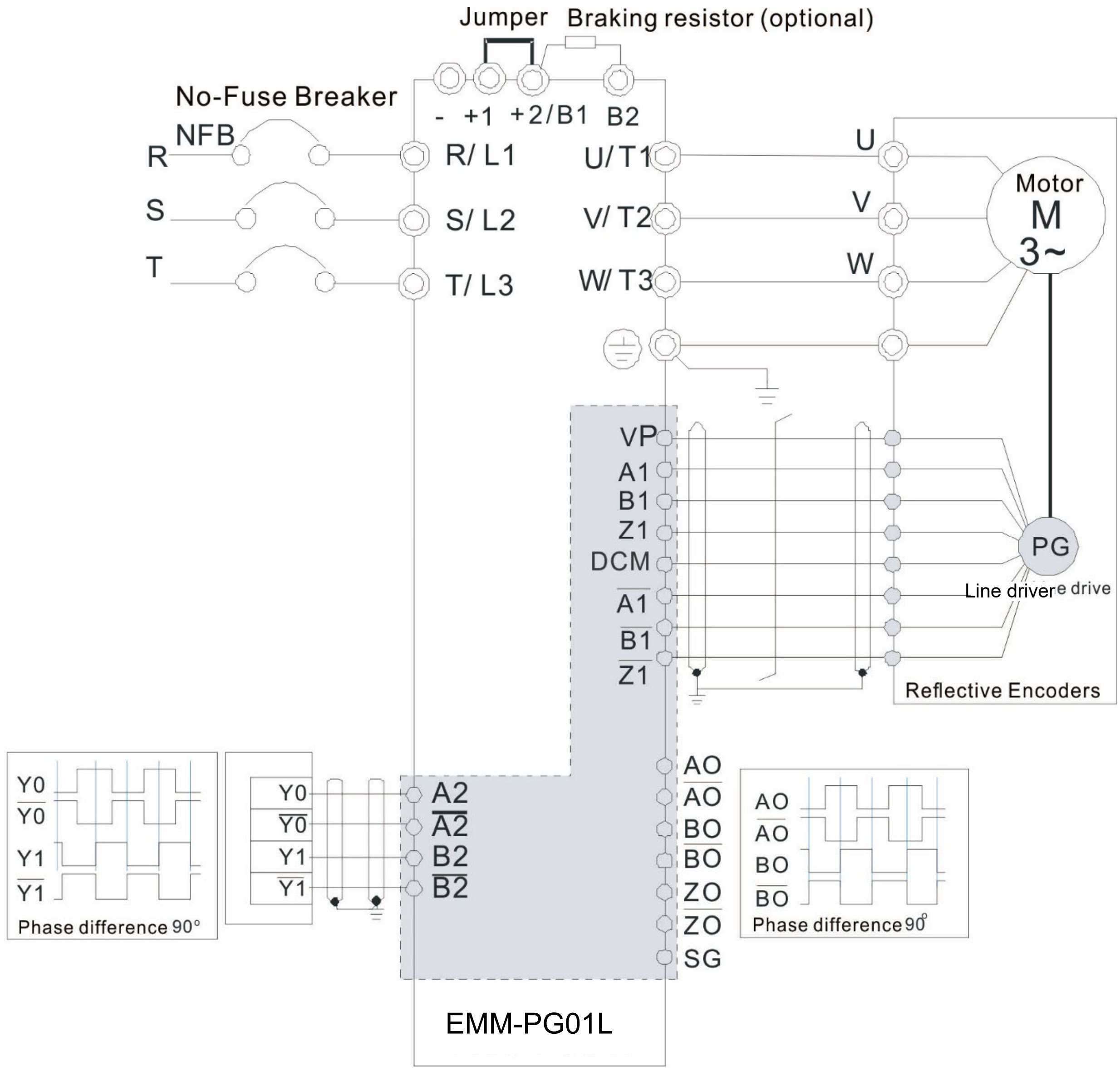


Figure 8-49

8-3 EMM-PG01O -- PG Card (Open Collector)

8-3-1 Product Profile

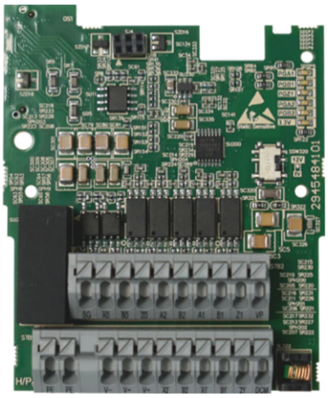
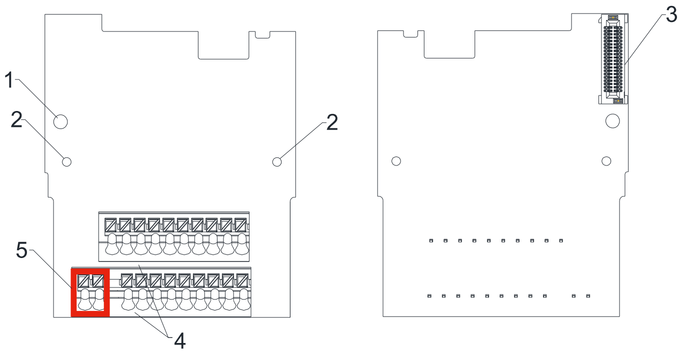


Figure 8-50



1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block
5. Ground terminal block

Figure 8-51

Wire: 0.25–0.75 mm^2 / (24–18 AWG)
Stripping length: 9 mm

8-3-2 Terminal Descriptions

To use with Pr.10-00–Pr.10-02, Pr.10-16–Pr.10-18.

Terminals		Descriptions
PG1	VP	Power output voltage: +5 V ± 5 % or +12 V ± 5 % (Use SSW320 to switch +5 V or +12 V, the default is +5V) Maximum output current: 200 mA (+5V)
	DCM	Common for power and signal
	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$	Encoder input signal (Applicable for Line Driver or Open Collector) Open Collector input voltage +5–24 V (see NOTE) Supports 1-phase and 2-phase input Maximum input signal: 300 kHz
PG2	A2, $\overline{A2}$, B2, $\overline{B2}$	Pulse input signal (Applicable for Line Driver or Open Collector) Open Collector input voltage +5–24 V (see NOTE) Supports 1-phase and 2-phase input Maximum input signal: 300 kHz
PG OUT	V+, V+	Needs an external power source for the PG OUT circuit. Input voltage: +7– +24 V
	V-	The negative side for external power supply
	$\overline{AO}$, $\overline{BO}$, $\overline{ZO}$	PG feedback signal output: Supports frequency elimination: 1–255 times. Open collector's output signal: add a pull-up resistor on each PG out external power (see NOTE) Maximum input frequency: 300 kHz

Table 8-6

NOTE: Open Collector application: input current 5–15 mA to each set and each set needs one pull-up resistor. If the input voltage of the open collector is 24 V, power for the encoder must be connected externally. Refer to diagram 2 of PG1 (Figure 8-53).

5 V	Recommended pull-up resistor: above100–220 Ω, 1/2 W
12 V	Recommended pull-up resistor : above 510 Ω–1.35 kΩ, 1/2 W
24 V	Recommended pull-up resistor : above1.8 k–3.3 kΩ, 1/2 W

Table 8-7

- PG1 Wiring Diagram

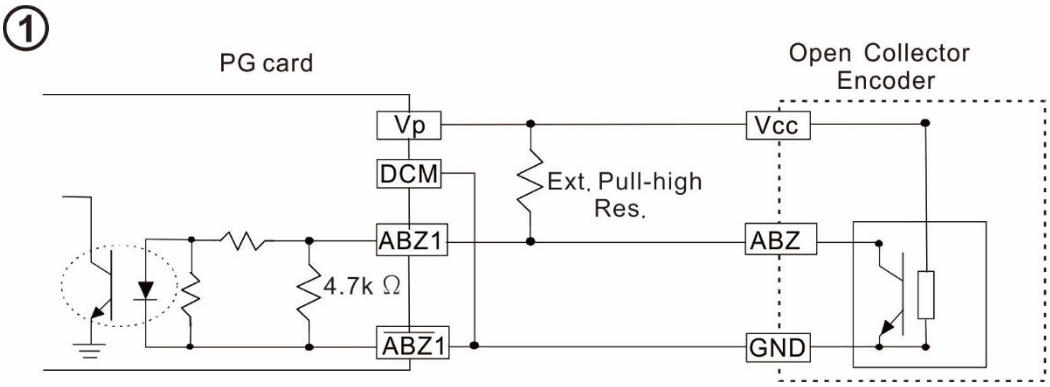


Figure 8-52

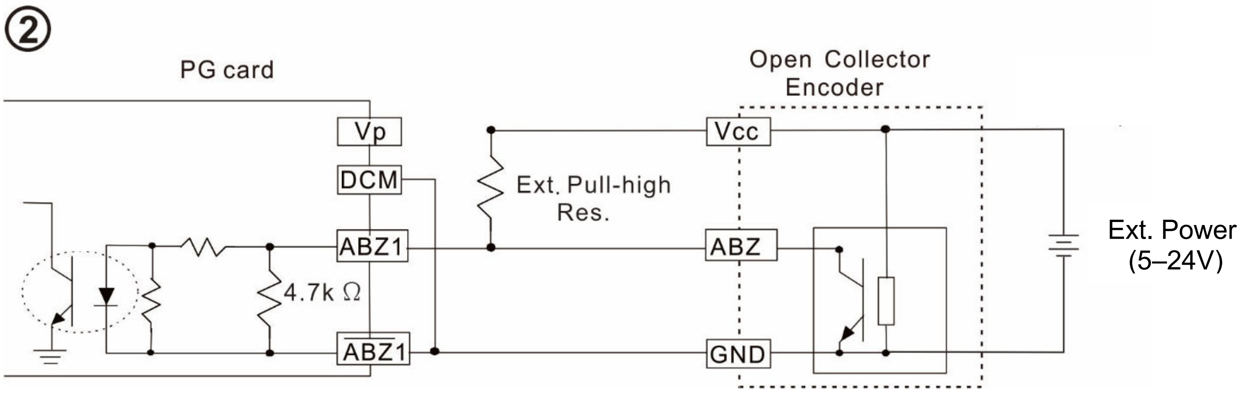


Figure 8-53

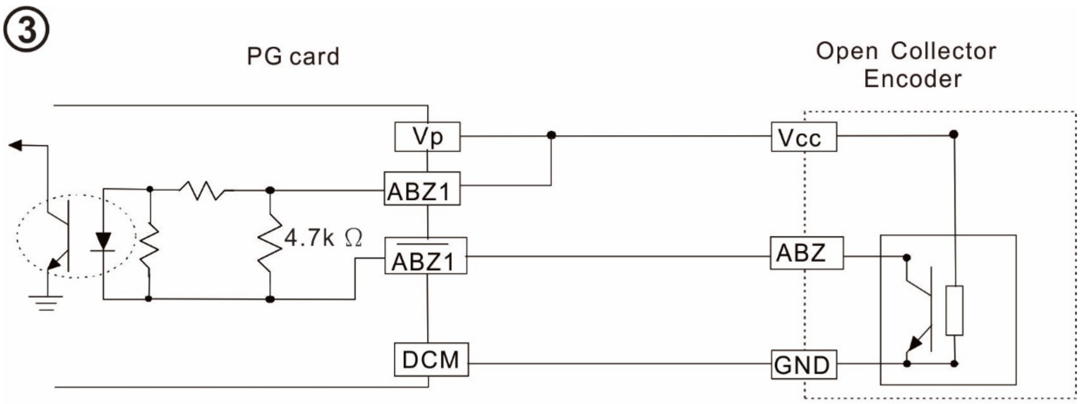


Figure 8-54

- PG2 Wiring Diagram

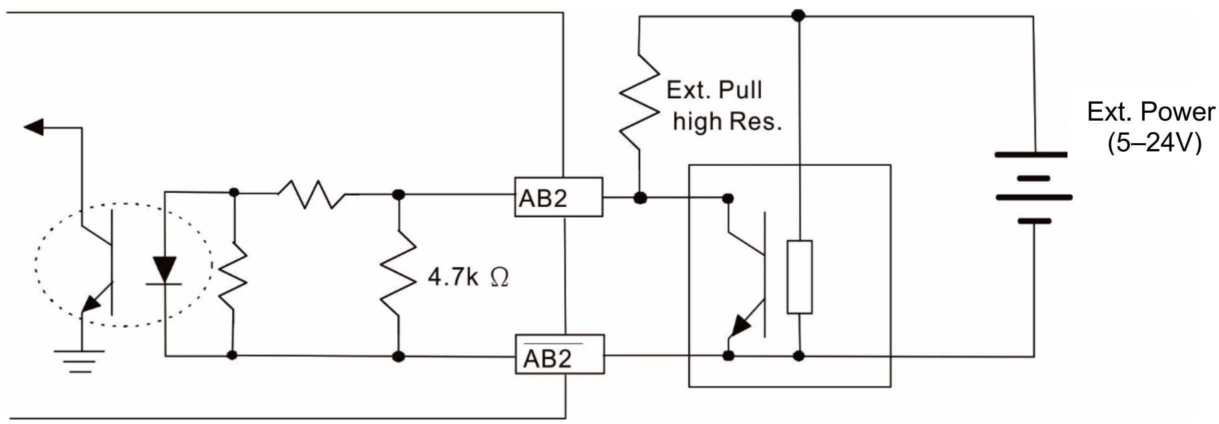


Figure 8-55

8-3-3 EMM-PG01O Wiring Diagram

- Use a shielded cable to prevent interference.
  Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size: 0.0509–1.31 mm^2 / (30–16 AWG)
- Cable length: less than 30 m

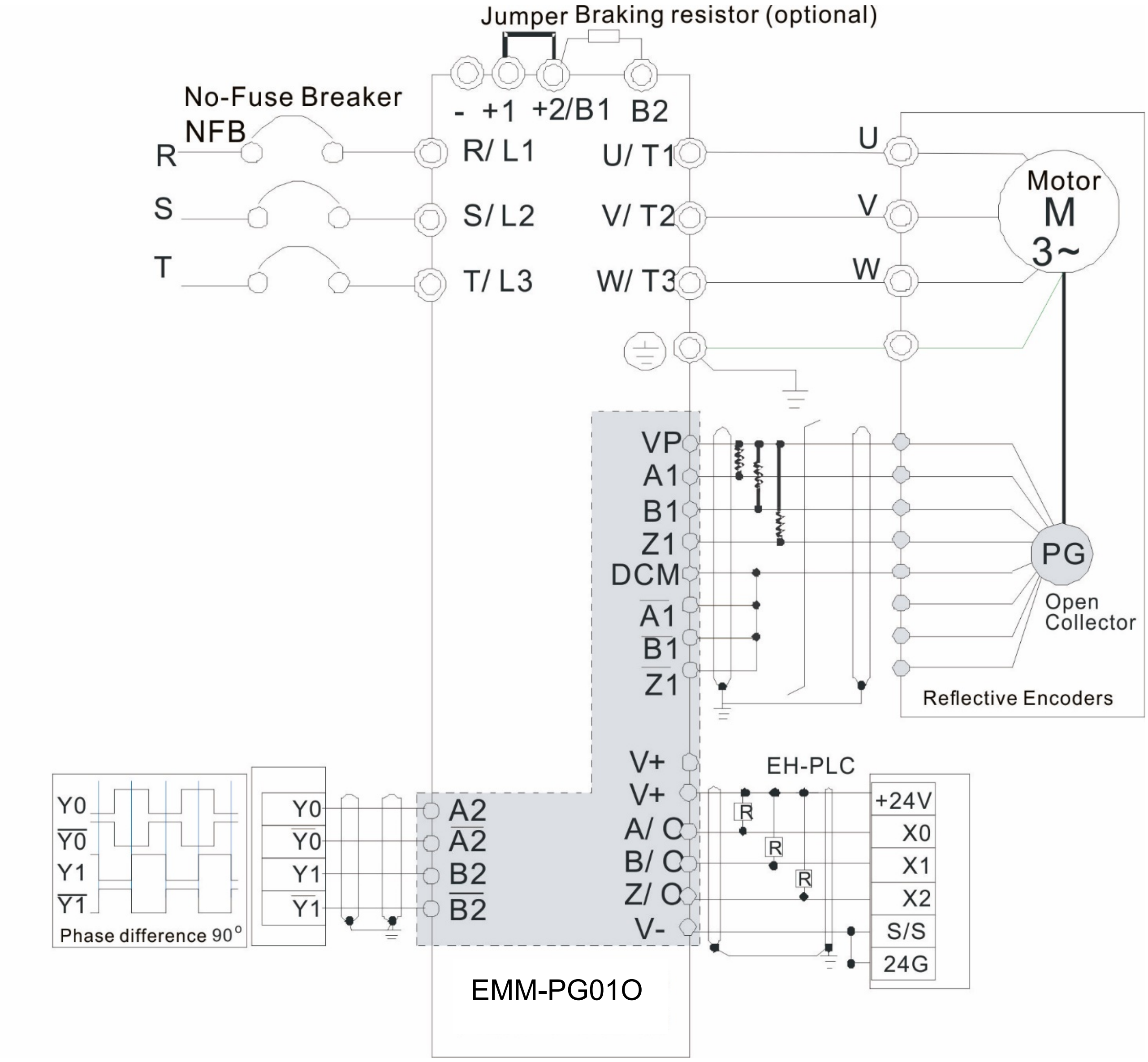


Figure 8-56

8-4 EMM-PG01R -- PG Card (Resolver / Encoder Signal Input)

8-4-1 Product Profile

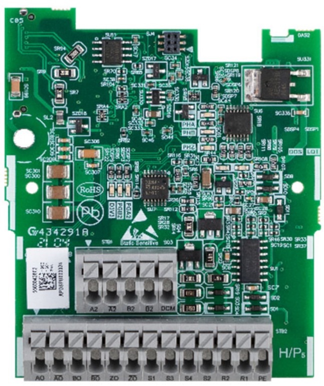


Figure 8-57

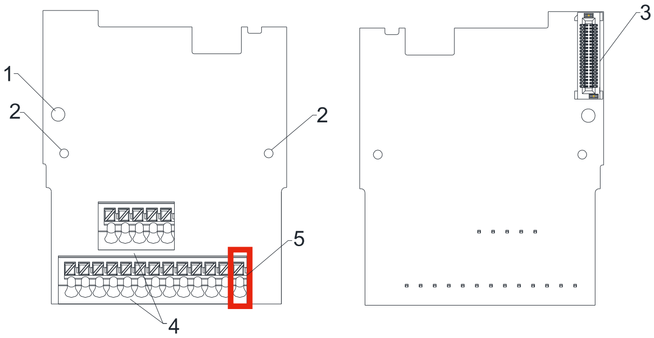


Figure 8-58

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block
5. Ground terminal block

Wire: 0.25–0.75 mm^2 / (24–18 AWG)
Stripping length: 9 mm

8-4-2 Terminal Descriptions

To use with Pr.10-00–Pr.10-02 and Pr.10-30. And Pr.10-30 is using for resolver pole pair.
(When using EMM-PG01R, set Pr.10-00 = 3 and set Pr.10-01 = 1024.)

Terminals		Descriptions
PG1	R1- R2	Resolver Output Power 7 Vrms, 10 kHz
	S1, S3, S2, S4	Resolver input signal (S2, S4 = Sin; S1, S3 = Cos) 3.5 ± 0.175 Vrms, 10 kHz
PG2	A2, $\overline{A2}$, B2, $\overline{B2}$	Pulse input signal (Applicable for Line Driver or Open Collector) Open Collector input voltage: +5–24V (see NOTE 1) Support 1-phase and 2-phase input. Maximum output frequency: 300 kHz
PG OUT	AO, $\overline{AO}$, BO, $\overline{BO}$, ZO, $\overline{ZO}$, DCM	PG Card output signal: supports frequency elimination: 1–255 times Maximum output voltage of Line driver: 5 V$_{DC}$ Maximum output current: 50 mA Maximum output frequency: 300 kHz DCM, the referenced electric potential for PG card output signal, serves as the ground for host controller or PLC to make the output signal become the common point.

Table 8-8

NOTE:

1. Open Collector application: Input current 5–15 mA to each set and each set needs one pull-up resistor.

5 V	Recommended pull-up resistor above: 100–220 Ω, 1/2 W
12 V	Recommended pull-up resistor above: 510 Ω–1.35 kΩ, 1/2 W
24 V	Recommended pull-up resistor above: 1.8 k–3.3 kΩ, 1/2 W

Table 8-9

- PG2 Wiring Diagram

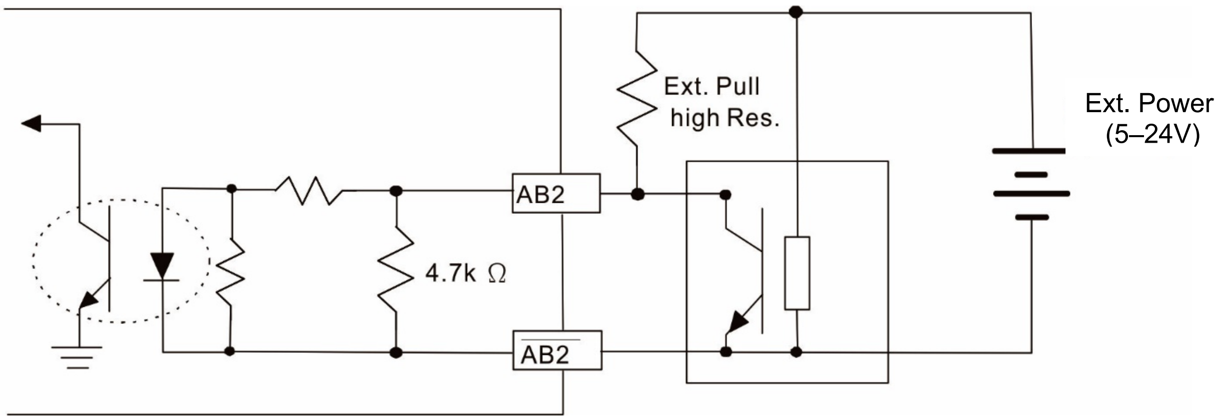


Figure 8-59

2. DOS (Degradation of Signal):

   If the amplitude of the sine wave input of the S1- / S3 and S2- / S4 is lower than or higher than the encoder IC's specification, a red light turns on. The possible reasons for this problem are:

   a. The turns ratio of the resolver encoder is not 1:0.5, which makes the sine wave input of the S1- / S3 and S2- / S4 be not equal to 3.5 ± 0.175 Vrms.
   b. While the motor is running, the motor creates common mode noise that makes the accumulated voltage greater than 3.5 ± 0.175 Vrms.

3. LOT (Loss of Tracking):

   Compare the angle of the S1- / S3 and S2- / S4 sine wave input to the R1-R2 cosine wave. If their difference is more than 5 degrees, a red light turns on. The possible reasons for this problem are:

   a. The output frequency of the PG card is incorrect.
   b. The specification of Resolver's encoder is not 10 kHz.
   c. The motor creates common mode noise while it is running. While the motor is rotating, it causes a big difference between the main winding's cosine wave angle and the sine wave angle of the second and third windings.

8-4-3 EMM-PG01R Wiring Diagram

- Use a shielded cable to prevent interference.
  Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size: 0.0509–1.31 mm^2 / (30–16 AWG)
- Cable length: less than 30 m

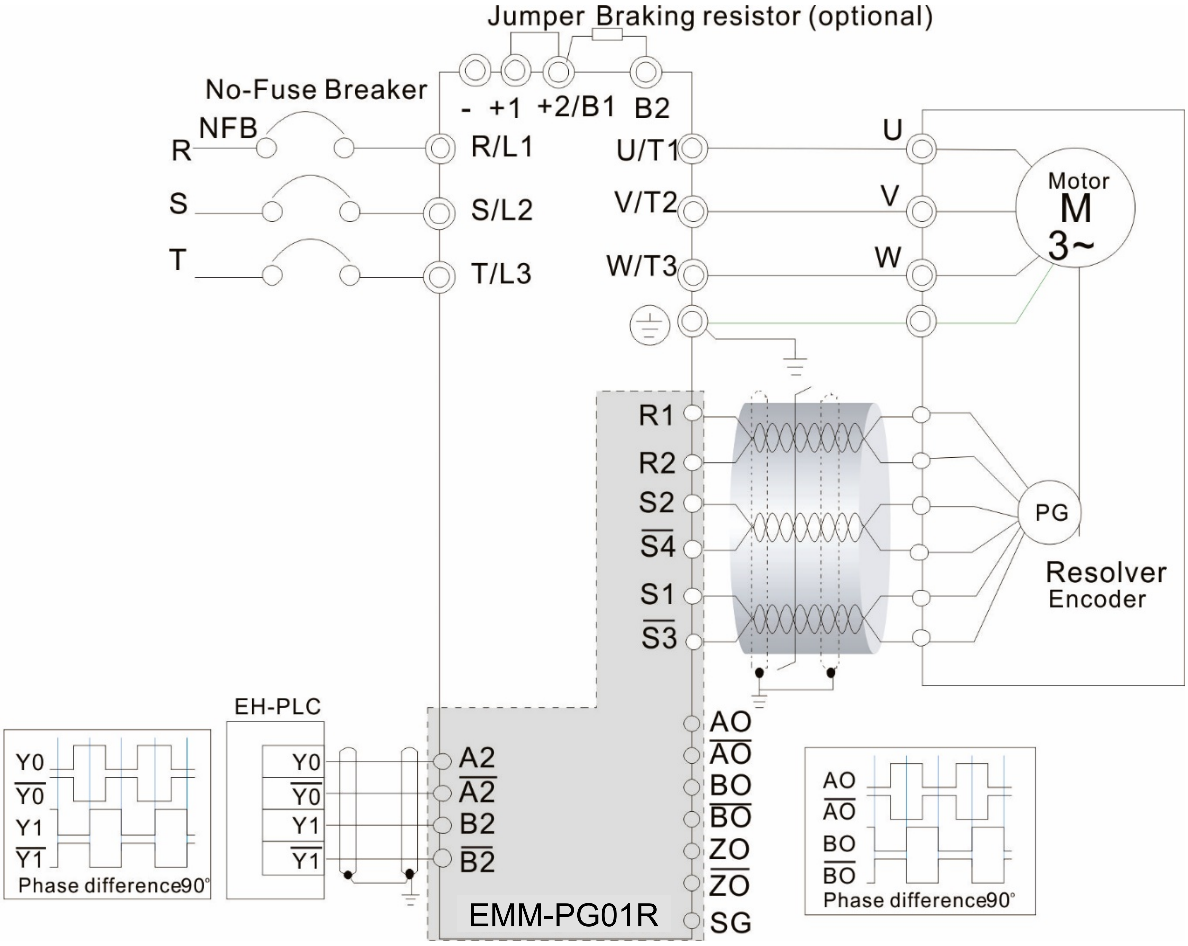


Figure 8-60

8-5 EMM-D33A -- Extension for 3-point Digital Input / 3-point Digital Output

8-5-1 Product Profile

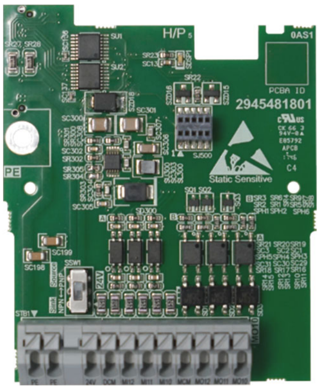


Figure 8-61

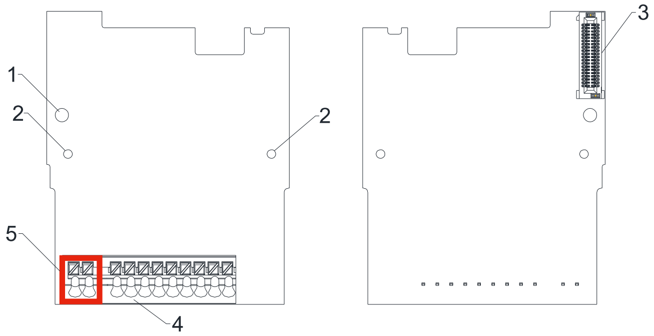


Figure 8-62

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block
5. Ground terminal block

Wire: 0.25–0.75 mm^2 / (24–18 AWG)
Stripping length: 9 mm

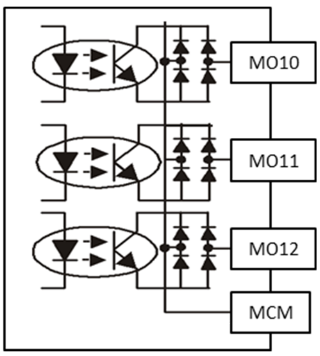
	Terminals	Descriptions
Digital I/O Extension Card	24V, DCM	Output power: +24 V_{DC} ±5% < 30mA
	MI10—MI12	Refer to Pr.02-26–Pr.02-28 to program the multi-function. Choose SINK (NPN) / SOURCE (PNP) by SWW1. Internal power is supplied by terminal 24 V: +24V_{DC}±5 % If external power is +24 V_{DC}, the maximum voltage is 30 V_{DC} and the minimum voltage is 19 V_{DC}. ON: the activation current is 6.5 mA. OFF: leakage current tolerance is 10 μA.
	MO10–MO12	Refer to Pr.02-36–Pr.02-38 to program the multi-function. The motor drive outputs various monitor signals, such as drive in operation, frequency reached and overload indication, through the transistor (open collector). MO output signal: each MO terminal needs a pull-up resistor, the maximum external power voltage is 48 V_{DC} / 50 mA. 
	MCM	Common for multi-function output terminals MO10–MO12 (photo coupler)
	PE	Grounding terminal. To decrease noise, properly ground this terminal.

Table 8-10

8-6 EMM-A22A -- Extension for 2 Sets of Analog Input / 2 Sets of Analog Output

8-6-1 Product Profile

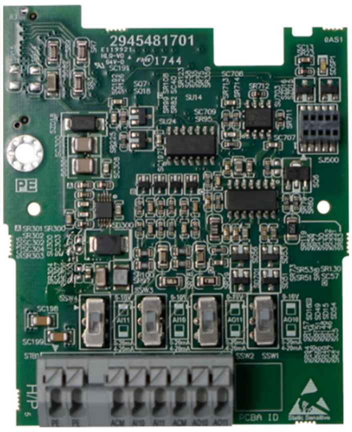
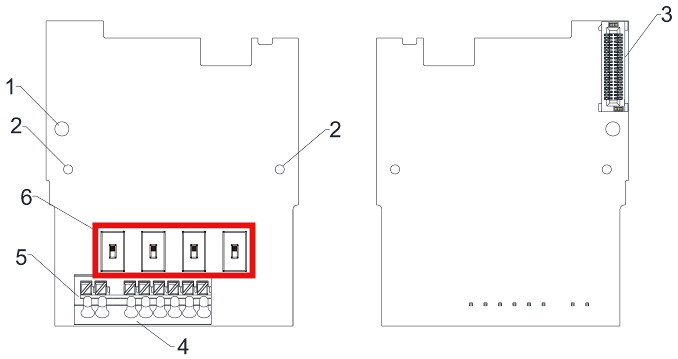


Figure 8-63



1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block
5. Switch (SSW1–SSW4)

Figure 8-64

Wire: 0.25–0.75 mm^2 / (24–18 AWG)
Stripping length: 9 mm

	Terminals	Descriptions
Analog I/O Extension Card	ACM	Common output signal and input signal terminals.
	AI10, AI11	Refer to Pr.14-00–Pr.14-01 to program the multi-function. Two sets of AI ports: SSW3, SSW4 switch for AVI or ACI. (Default is AVI) AVI: input 0–10 V ACI: input 0–20 mA
	AO10–AO11	Refer to Pr.14-12–Pr.14-13 to program the multi-function. Two sets of AO ports: SSW1, SSW2 switch for AVO or ACO. (Default is AVO) AVO: output 0–10 V ACO: output 0–20 mA
	PE	Grounding terminal. To decrease noise, properly ground this terminal.

Table 8-11

8-7 EMM-R2CA -- Relay Output Extension (2-point N.C. Output Terminal)

8-7-1 Product Profile

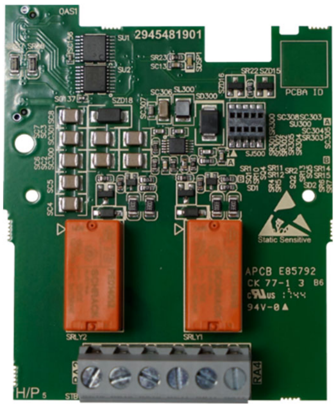


Figure 8-65

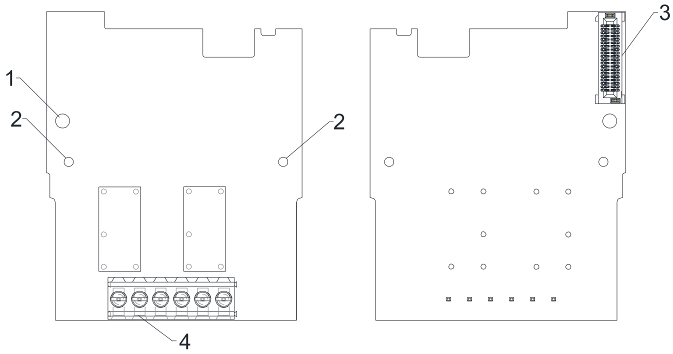


Figure 8-66

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block

Wire: 0.25–1.5 mm^2 / (24–16 AWG)
Stripping length: 6 mm
Torque: 5 kg-cm / (4.3 Ib-in.) / (0.49 Nm)

	Terminals	Descriptions
Relay Extension Card	RA10–RA11 RB10–RB11 RC10–RC11	Refer to Pr.02-36–Pr.02-37 to program the multi-function Resistive load: 5 A (N.O.) / 240 V_{AC} Function: outputs the monitor signals, such as drive in operation, frequency reached, or overload indication.

Table 8-12

8-8 EMM-R3AA -- Relay Output Extension (3-point N.O. Output Terminal)

8-8-1 Product Profile

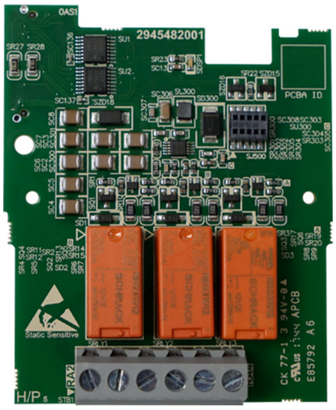


Figure 8-67

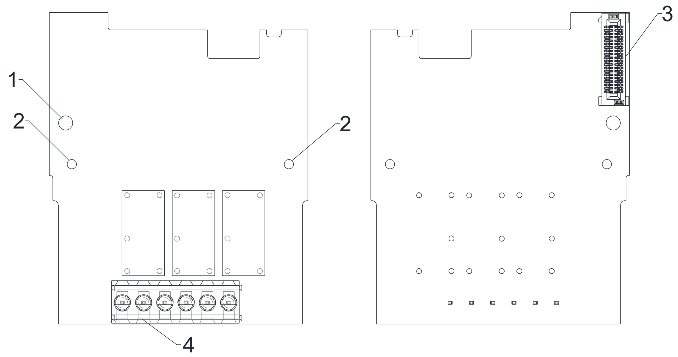


Figure 8-68

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Terminal block

Wire: 0.25–1.5 mm^2 / (24–16 AWG)
Stripping length: 6 mm
Torque: 5 kg-cm / (4.3 Ib-in.) / (0.49 Nm)

	Terminals	Descriptions
Relay Extension Card	RA10–RA12 RC10–RC12	Refer to Pr.02-36–Pr.02-38 to program the multi-function. Resistive load: 6 A (N.O.) / 250 V_{AC} Function: outputs the monitor signals, such as drive in operation, frequency reached, or overload indication.

Table 8-13

8-9 EMM-BPS02 -- +24V Power Extension Card

8-9-1 Product Profile

Figure 8-69

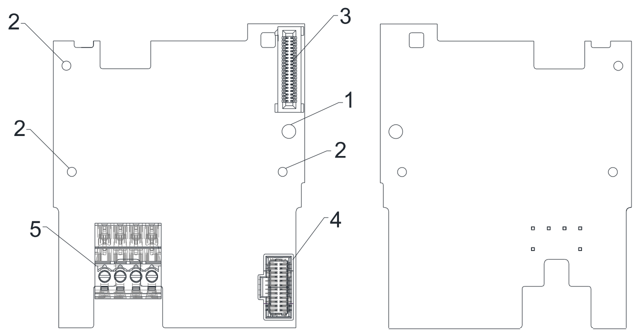


Figure 8-70

Wire: 0.25–0.5 mm² / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 Ib-in.) / (0.2 Nm)

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port (Refer to subsection 8-1-2 for installation)
4. AC motor drive connection port (Refer to subsection 8-1-4 for installation)
5. +24 V terminal block

	Terminal	Description
Extra 24V Power Card	24V GND	Input power: 24 V ±5% Maximum input current: 0.5 A

Table 8-14

8-9-2 Features

1. Provides external power supply.
2. Supports external 24 V_{DC} input.
3. Supports reading and writing parameters and status monitoring of the drive.

8-9-3 Specifications

When the drive is only powered by the EMM-BPS02, communication remains normal, including support for all communication cards and the following functions:

- Reading and writing parameters
- Display with keypad
- Keypad buttons (except the RUN button)
- Analog input with +10 V terminal to supply power
- Multi-input (MI1–MI7) with +24 V terminal or external power supply
- Relay output
- Pulse sequence (MI6, MI7) frequency command

The following functions are not supported:

- DFM digital frequency signal output
- AFM multi-function analog voltage output
- PLC functions

8-9-4 The Cable Connection of +24V Power Card

+24V terminal block

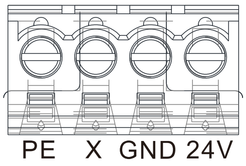


Figure 8-71

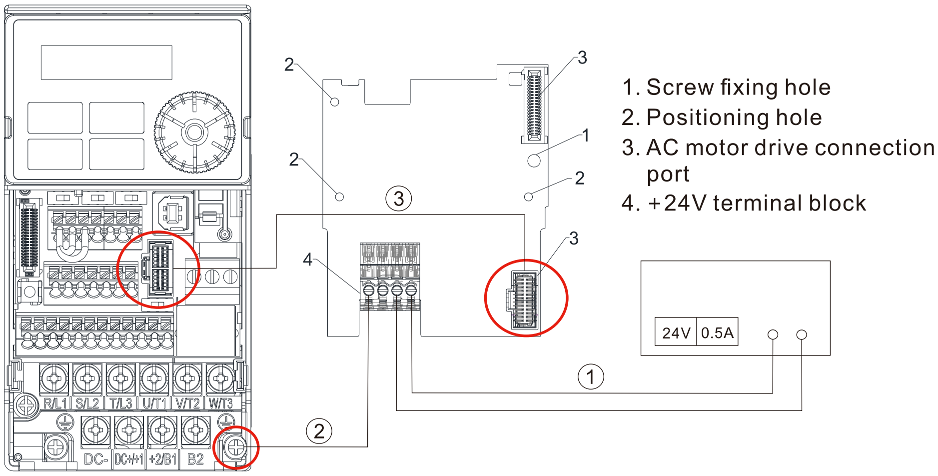


Figure 8-72

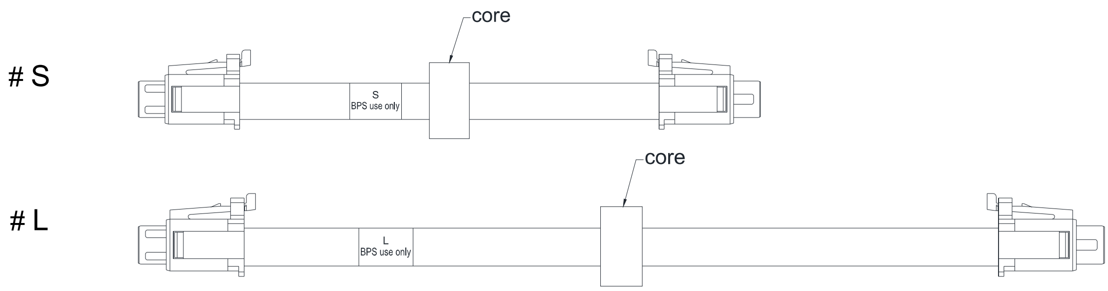


Figure 8-73

Operating procedures (refer to the mark ①②③ in the Figure 8-72)

① Choose the power supply or the host to connect the positive and negative electrodes to +24V power card.

② Connect the ground terminal of +24V power card and the ground terminal of the drive.

③ Connect one side of the cable to the connection port of the drive and another side to the +24V power card’s.

8-10 CMM-DN02 -- Communication Extension Card, DeviceNet

8-10-1 Product Profile

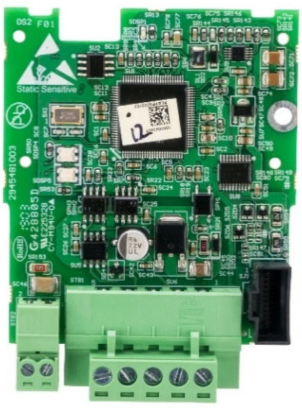


Figure 8-74

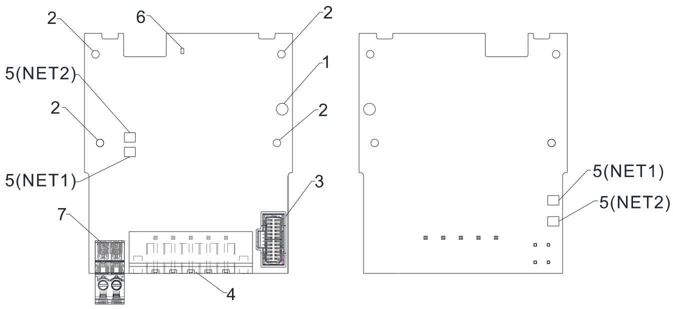


Figure 8-75

Wire: 0.25–0.5 mm^2 / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 lb-in.) / (0.2 Nm)

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication Port
5. Indicator light: NET1 (MS), NET2 (NS)
6. Indicator light: POWER
7. Ground terminal block

8-10-2 Features

1. Based on the high-speed communication interface of Delta's HSSP protocol, the AC motor drive can be controlled in real-time.
2. Supports Group 2 only connection and polling I/O data exchange.
3. For I/O mapping, supports a maximum of 32 words input and 32 words output.
4. Supports EDS file configuration in DeviceNet configuration software.
5. Supports all baud rates on DeviceNet bus: 125 kbps, 250 kbps, 500 kbps and extendable baud rate mode.
6. Node address and baud rate can be set in the AC motor drive.
7. Power is supplied from the AC motor drive.

8-10-3 Specifications

DeviceNet Connector

Interface	5-PIN open pluggable connector. PIN interval: 5.08 mm
Transmission method	CAN
Transmission cable	Shielded twisted-pair cable (with 2 power cables)
Transmission speed	125 kbps, 250 kbps, 500 kbps and extendable baud rate mode
Network protocol	DeviceNet protocol

Table 8-15

AC Motor Drive Connection Port

Interface	24 PIN communication terminal
Transmission method	SPI communication
Terminal function	1. Communication module communicates with AC motor drive through this port. 2. AC motor drive provides power supply to communication module through this port.
Communication protocol	Delta HSSP protocol

Table 8-16

Electrical Specification

Power supply voltage	15 V_{DC} (supplied by AC motor drive)
Insulation voltage	500 V_{DC}
Communication wire power consumption	0.85 W
Power consumption	1 W
Weight	23 g

Table 8-17

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / Storage	Operation: -10–50ºC (temperature), 90% (humidity) Storage: -25–70ºC (temperature), 95% (humidity)
Shock / Vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

Table 8-18

DeviceNet Connector

PIN	Signal	Color	Definition
1	V+	Red	24 V_{DC}
2	H	White	Signal+
3	S	-	Ground
4	L	Blue	Signal-
5	V-	Black	0 V

Table 8-19

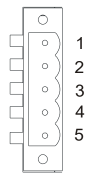


Figure 8-76

8-10-4 Communication Parameter Settings when Connecting AC Motor Drive to DeviceNet

When you connect the AC motor drive to DeviceNet, set up the communication parameters based on the table below.

Parameter	Function	Setting value	Description
00-20	Master frequency command source	8	The frequency command is controlled by the communication card.
00-21	Operation command source	5	The operation command is controlled by the communication card.
09-70	Communication card address	1 (default)	The setting range is 0–63 .
09-71	Communication card speed	2 (default)	500 Kbps

Table 8-20

8-10-5 LED Indicator Light & Troubleshooting

There are three LED indicator lights on CMM-DN02. POWER LED displays the status of the working power. MS LED and NS LED are dual-color LEDs, displaying the connection status and error messages of the communication module.

POWER LED

LED status	Indication	Corrective Action
ON	Working power is in normal status	No action is required
OFF	No power	Check if the connection between the CMM-DN02 and the AC motor drive is normal.

Table 8-21

NS LED

LED status	Indication	Corrective Action
OFF	No power supply or CMM-DN02 does not pass the MAC ID test.	1. Check the power to input CMM-DN02 and see if the connection is normal. 2. Make sure there is at least one node on the bus. 3. Check if the baud rate of CMM-DN02 is the same as that of the other nodes.
Green light flashes	CMM-DN02 is on-line but does not connect to the master.	1. Configure CMM-DN02 to the scan list of the master. 2. Re-download the configured data to the master.
Green light is ON	CMM-DN02 is on-line and normally connects to the master.	No action is required.
Red light flashes	CMM-DN02 is on-line, but I/O connection is timed-out.	1. Check if the network connection is normal. 2. Check if the master operates normally.
Red light is ON	1. Broken communication. 2. MAC ID test failure. 3. No network power supply. 4. CMM-DN02 is off-line.	1. Make sure all MAC IDs on the network are unique. 2. Check if the network installation is normal. 3. Check if the baud rate of CMM-DN02 is the same as that of the other nodes. 4. Check if the node address of CMM-DN02 is illegal. 5. Check if the network power supply is normal.

Table 8-20

MS LED

LED status	Indication	Corrective Action
OFF	No power supply or device is off-line	Check the power supply of CMM-DN02 and see if the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status.
Green light is ON	I/O data is normal	No action is required.
Red light flashes	Mapping error	1. Reset CMM-DN02 2. Re-power the AC motor drive
Red light is ON	Hardware error	1. See the fault codes displayed on the keypad and find the causes. 2. Return the unit to the factory for repair if necessary.
Orange light flashes	CMM-DN02 is connecting with the AC motor drive.	If the flashing lasts for a long period of time, turn off the power to check if the CMM-DN02 and the AC motor drive install correctly and are normally connected to each other.

Table 8-21

8-11 CMM-EIP02 -- Communication Extension Card, (Single-port) EtherNet/IP, Modbus-TCP

8-11-1 Product Profile

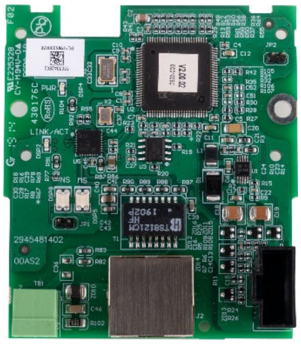


Figure 8-77

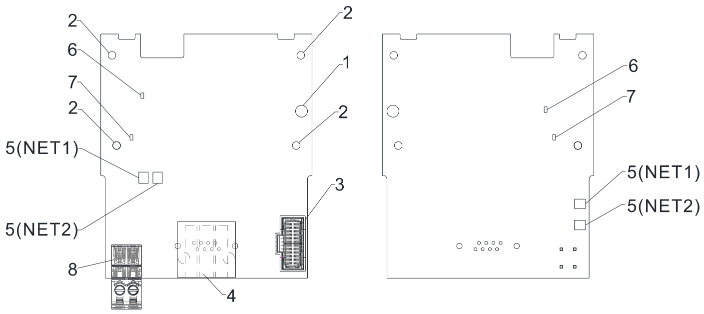


Figure 8-78

Wire: 0.25–0.5 mm^2 / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 lb-in.) / (0.2 Nm)

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication Port
5. Indicator lights: NET1 (NS), NET2 (MS)
6. Indicator light: POWER
7. Indicator light: LINK
8. Ground terminal block

8-11-2 Features

1. Supports Modbus TCP and EtherNet/IP protocol
2. 32 / 32 words read / write parameters correspondence
3. User-defined corresponding parameters
4. MDI / MDI-X auto-detect
5. E-mail alarm
6. IP Filter simple firewall function

8-11-3 Specifications

Network Interface

Interface	RJ45 with Auto MDI / MDIX
Number of ports	1 Port
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100 M
Transmission speed	10/100 Mbps Auto-Detect
Network protocol	ICMP, IP, TCP, UDP, DHCP, HTTP, SMTP, Modbus TCP, EtherNet/IP, Delta Configuration

Table 8-22

Electrical Specification

Weight	25 g
Insulation voltage	500 V_{DC}
Power consumption	0.8 W
Power supply voltage	15 V_{DC}

Table 8-23

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / Storage	Operation: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / Vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

Table 8-24

8-11-4 Installation

Connecting the CMM-EIP01 to the Network

1. Switch off the power supply.
2. Open the front cover of the drive.
3. Connect the CAT-5e network cable to the RJ45 port on the CMM-EIP02 (as shown in the right figure).

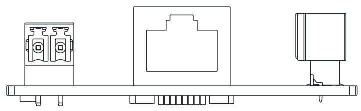


Figure 8-79

RJ45 PIN Definition

PIN	Signal	Definition
1	Tx+	Data transmit positive
2	Tx-	Data transmit negative
3	Rx+	Data receive positive
4	--	N/C
5	--	N/C
6	Rx-	Data receive negative
7	--	N/C
8	--	N/C

Table 8-25

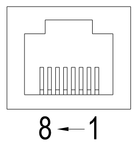


Figure 8-80

8-11-5 Communication Parameter Settings when MH300 Connects to EtherNet

When you connect the MH300 to EtherNet, set up the communication parameters based on the table below. The EtherNet master reads and writes the frequency command words and operation command words for the MH300 after you set the communication parameters.

Parameter	Function	Current Set Value	Definition of Parameter Values
00-20	Frequency command source	8	The frequency command is controlled by the communication card.
00-21	Operation command source	5	The operation command is controlled by the communication card.
09-30	Decoding method for communication	0	The decoding method for Delta AC motor drive
09-75	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
09-76	IP address 1	192	IP address 192.168.1.5
09-77	IP address 2	168	IP address 192.168.1.5

Parameter	Function	Current Set Value	Definition of Parameter Values
09-78	IP address 3	1	IP address 192.168.1.5
09-79	IP address 4	5	IP address 192.168.1.5
09-80	Netmask 1	255	Netmask 255.255.255.0
09-81	Netmask 2	255	Netmask 255.255.255.0
09-82	Netmask 3	255	Netmask 255.255.255.0
09-83	Netmask 4	0	Netmask 255.255.255.0
09-84	Default gateway 1	192	Default gateway 192.168.1.1
09-85	Default gateway 2	168	Default gateway 192.168.1.1
09-86	Default gateway 3	1	Default gateway 192.168.1.1
09-87	Default gateway 4	1	Default gateway 192.168.1.1

Table 8-26

8-11-6 LED Indicator Light & Troubleshooting

There are four LED indicator lights on CMM-EIP02: POWER LED displays the status of the working power, LINK LED displays the connection status of the communication, NET1 displays the network status, NET2 displays the module status.

LED Indicators

LED Indicators	Status		Indication	Corrective Action
NET1 (NS)	The red and green lights flash alternately		Self-test of network status	No action is required
	OFF		Network not connected	Check if the network cable is connected
	Red	ON	Duplicate IP	Check if the IP setting is wrong
		Flashes	Communication time out / disconnected / IP changed	Check if the communication setting is wrong
	Green	ON	Network connection in normal status	No action is required
		Flashes	Sending / receiving network packet	No action is required
NET2 (MS)	The red and green lights flash alternately		Self-test of product status	No action is required
	OFF		No power supply	Check the power supply
	Red	ON	An error cannot be restored occurs	Hardware malfunction, contact with the dealer
		Flashes	An error can be restored occurs	Check if any parameter setting is wrong
	Green	ON	The parameter setting finished	No action is required
		Flashes	No parameter setting	Follow manual instructions to set parameters
POWER	Orange	ON	Power supply in normal status	No action is required
	OFF		No power supply	Check the power supply
LINK	Orange	On	Network connection in normal status	No action is required
		Flashes	Sending / receiving network packet	No action is required
	OFF		Network not connected	Check if the network cable is connected

Table 8-27

Troubleshooting

Abnormality	Cause	Corrective Action
Cannot find communication card	The CMM-EIP02 does not connect to the network	Make sure the CMM-EIP02 correctly connects to the network.
	The PC and the CMM-EIP02 are in different networks and blocked by network firewall	Search by IP or set up relevant settings using the AC motor drive keypad.
Fails to open CMC-EIP02 setup page	The CMM-EIP02 does not connect to the network	Make sure the CMM-EIP02 connects to the network.
	Incorrect communication setting in DCISoft	Make sure the communication setting in DCISoft is set to EtherNet.
	The PC and the CMM-EIP02 are in different networks and blocked by network firewall	Set up with the AC motor drive keypad.
Able to open the CMC-EIP02 setup page but fails to use webpage monitoring	Incorrect network setting in the CMM-EIP02	Check if the network setting for the CMM-EIP02 is correct. For the Intranet setting in your company, please consult your IT staff. For the Internet setting at home, please refer to the network setting instruction provided by your supplier **ISP**.
Fails to send e-mail	Incorrect network setting in the CMM-EIP02	Check if the network setting for the CMM-EIP01 is correct.
	Incorrect mail server setting	Confirm the IP address for the SMTP-Server.

Table 8-28

8-12 CMM-EIP03 -- Communication Extension Card, (Dual-port) EtherNet/IP, Modbus-TCP

8-12-1 Product Profile

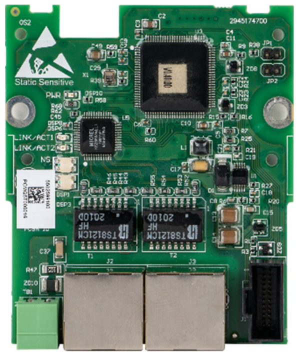


Figure 8-81

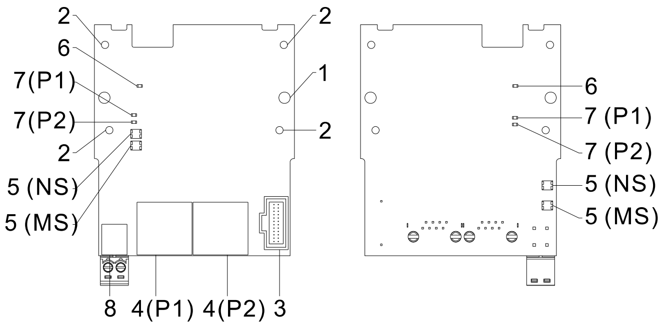


Figure 8-82

Wire: 0.25–0.5 mm^2 / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 Ib-in.) / (0.2 Nm)

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication Port: P1 (PORT 1), P2 (PORT 2)
5. Indicator lights: NS, MS
6. Indicator light of POWER
7. Indicator light of LINK: P1 (PORT 1), P2 (PORT 2)
8. Ground terminal block

8-12-2 Features

1. Supports Modbus TCP and EtherNet/IP protocol
2. 32 / 32 words read / write parameters correspondence
3. User-defined corresponding parameters
4. MDI / MDI-X auto-detect
5. E-mail alarm
6. IP Filter simple firewall function

8-12-3 Specifications

Network Interface

Interface	RJ45 with Auto MDI / MDIX
Number of ports	2 Ports
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100 M
Transmission speed	10/100 Mbps Auto-Detect
Network protocol	ICMP, IP, TCP, UDP, DHCP, HTTP, SMTP, Modbus TCP, EtherNet/IP, Delta Configuration

Table 8-29

Electrical Specification

Weight	30 g
Insulation voltage	500 V_{DC}
Power consumption	1.3 W
Power supply voltage	15 V_{DC}

Table 8-30

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / Storage	Operation: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / Vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

Table 8-31

8-12-4 Installation

Connecting the CMM-EIP03 to the Network

1. Switch OFF the power supply.
2. Open the front cover of the drive.
3. Connect the CAT-5e network cable to the RJ45 port on the CMM-EIP03 (as shown in the right figure).

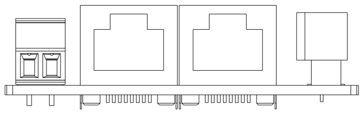


Figure 8-83

RJ45 PIN Definition

PIN	Signal	Definition
1	Tx+	Data transmit positive
2	Tx-	Data transmit negative
3	Rx+	Data receive positive
4	--	N/C
5	--	N/C
6	Rx-	Data receive negative
7	--	N/C
8	--	N/C

Table 8-32

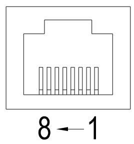


Figure 8-84

8-12-5 Communication Parameter Settings when MH300 Connects to EtherNet

When you connect the MH300 to EtherNet, set up the communication parameters based on the table below. The EtherNet master reads and writes the frequency command words and operation command words for the MH300 after you set the communication parameters.

Parameter	Function	Current Set Value	Definition of Parameter Values
00-20	Frequency command source	8	The frequency command is controlled by the communication card.
00-21	Operation command source	5	The operation command is controlled by the communication card.
09-30	Decoding method for communication	0	The decoding method for Delta AC motor drive
09-75	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
09-76	IP address 1	192	IP address 192.168.1.5
09-77	IP address 2	168	IP address 192.168.1.5

Parameter	Function	Current Set Value	Definition of Parameter Values
09-78	IP address 3	1	IP address 192.168.1.5
09-79	IP address 4	5	IP address 192.168.1.5
09-80	Netmask 1	255	Netmask 255.255.255.0
09-81	Netmask 2	255	Netmask 255.255.255.0
09-82	Netmask 3	255	Netmask 255.255.255.0
09-83	Netmask 4	0	Netmask 255.255.255.0
09-84	Default gateway 1	192	Default gateway 192.168.1.1
09-85	Default gateway 2	168	Default gateway 192.168.1.1
09-86	Default gateway 3	1	Default gateway 192.168.1.1
09-87	Default gateway 4	1	Default gateway 192.168.1.1

Table 8-33

8-12-6 LED Indicator Light & Troubleshooting

There are four LED indicator lights on CMM-EIP03: POWER LED displays the status of the working power, LINK LED displays the connection status of the communication, NET1 displays the network status, NET2 displays the module status.

LED Indicators

LED Indicators	Status		Indication	Corrective Action
NS	The red and green lights flash alternately		Self-test of network status	No action is required
	OFF		Network not connected	Check if the network cable is connected
	Red	ON	Duplicate IP	Check if the IP setting is wrong
		Flashes	Communication time out / disconnected / IP changed	Check if the communication setting is wrong
	Green	ON	A CIP connection is established	No action is required
		Flashes	A CIP connection is not established after power-on	No action is required
MS	The red and green lights flash alternately		Self-test of product status	No action is required
	OFF		No power supply	Check the power supply
	Red	ON	An error cannot be restored occurs	Hardware malfunction, contact with the dealer
		Flashes	An error can be restored occurs	Check if any parameter setting is wrong
	Green	ON	The parameter setting finished	No action is required
		Flashes	No parameter setting	Follow manual instructions to set parameters
POWER	Orange	ON	Power supply in normal status	No action is required
	OFF		No power supply	Check the power supply
LINK	Orange	On	Network connection in normal status	No action is required
		Flashes	Sending / receiving network packet	No action is required
	OFF		Network not connected	Check if the network cable is connected

Table 8-34

Troubleshooting

Abnormality	Cause	Corrective Action
Cannot find communication card	The CMM-EIP03 does not connect to the network	Make sure the CMM-EIP03 correctly connects to the network.
	The PC and the CMM-EIP03 are in different networks and blocked by network firewall	Search by IP or set up relevant settings using the AC motor drive keypad.
Fails to open CMC-EIP03 setup page	The CMM-EIP03 does not connect to the network	Make sure the CMM-EIP03 connects to the network.
	Incorrect communication setting in DCISoft	Make sure the communication setting in DCISoft is set to EtherNet.
	The PC and the CMM-EIP03 are in different networks and blocked by network firewall	Set up with the AC motor drive keypad.
Able to open the CMC-EIP03 setup page but fails to use webpage monitoring	Incorrect network setting in the CMM-EIP03	Check if the network setting for the CMM-EIP03 is correct. For the Intranet setting in your company, please consult your IT staff. For the Internet setting at home, please refer to the network setting instruction provided by your supplier **ISP**.

Table 8-35

8-13 CMM-PD02 -- Communication Extension Card, Profibus DP

8-13-1 Product Profile

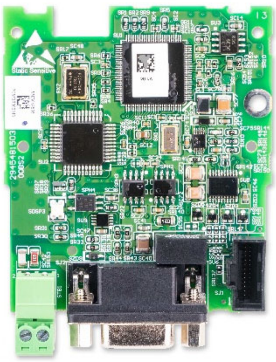


Figure 8-85

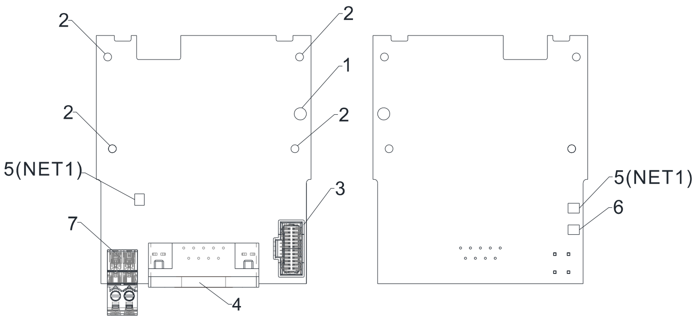


Figure 8-86

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication Port
5. Indicator light: NET1
6. Indicator light: POWER
7. Ground terminal block

Wire: 0.25–0.5 mm^2 / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 Ib-in.) / (0.2 Nm)

8-13-2 Features

1. Supports PZD control data exchange.
2. Supports PKW polling AC motor drive parameters.
3. Supports user diagnosis function.
4. Auto-detects baud rates; supports maximum of 12 Mbps

8-13-3 Specifications

PROFIBUS DP Connector

Interface	DB9 connector
Transmission	High-speed RS-485
Transmission cable	Shielded twisted pair cable
Electrical isolation	500 V_{DC}

Table 8-36

Communication

Message type	Cyclic data exchange
Module name	CMM-PD02
GSD document	DELA08DB.GSD
Product ID	08DB (hex)
Serial transmission speed supported (auto-detection)	9.6 kbps; 19.2 kbps; 93.75 kbps; 187.5 kbps; 125 kbps; 250 kbps; 500 kbps; 1.5 Mbps; 3 Mbps; 6 Mbps; 12 Mbps (bits per second)

Table 8-37

Electrical Specification

Power supply	15 V_{DC} (supplied by AC motor drive)
Insulation voltage	500 V_{DC}
Power consumption	1 W
Weight	28 g

Table 8-38

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation / Storage	Operation: -10–50º C (temperature), 90% (humidity) Storage: -25–70º C (temperature), 95% (humidity)
Shock / Vibration resistance	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc) / IEC 61131-2 & IEC 68-2-27(TEST Ea)

Table 8-39

8-13-4 Installation

PROFIBUS DP Connector pin assignment

PIN	PIN name	Definition
1	-	Not defined
2	-	Not defined
3	Rxd / Txd-P	Sending / receiving data P(B)
4	-	Not defined
5	DGND	Data reference ground
6	VP	Power voltage – positive
7	-	Not defined
8	Rxd / Txd-N	Sending / receiving data N(A)
9	-	Not defined

Table 8-40

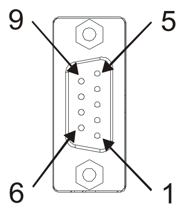


Figure 8-87

8-13-5 LED Indicator Light & Troubleshooting

There are two LED indicators on the CMM-PD02: POWER LED and NET LED. POWER LED displays the status of the working power. NET LED displays the connection status of the communication.

POWER LED

LED status	Indication	Corrective Action
Green light is ON	Working power in normal status.	No action is required
OFF	No power	Check if the connection between the CMM-PD02 and the AC motor drive is normal.

Table 8-41

NET LED

LED status	Indication	Corrective Action
Green light is ON	Normal status	No action is required
Red light is ON	The CMM-PD02 does not connect to PROFIBUS DP bus.	Connect the CMM-PD02 to the PROFIBUS DP bus.
Red light flashes	Invalid PROFIBUS communication address	Set the PROFIBUS address of the CMM-PD02 between 1–125 (decimal)
Orange light flashes	The CMM-PD02 fails to communicate with AC motor drive.	Switch off the power and check whether the CMM-PD02 is been installed correctly and connected normally to the AC motor drive.

Table 8-42

8-14 CMM-EC02 -- Communication Extension Card, EtherCAT

8-14-1 Product Profile

Figure 8-88

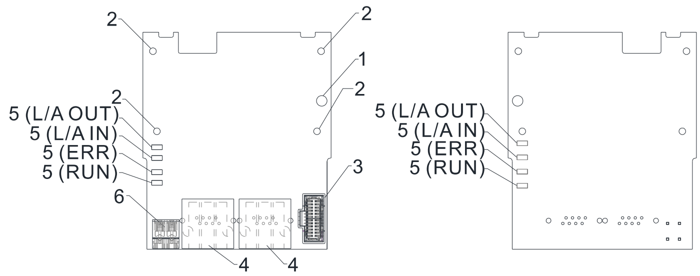


Figure 8-89

Wire: 0.25–0.5 mm^2 / (24–20 AWG)
Stripping length: 7–8 mm
Torque: 2 kg-cm / (1.7 Ib-in.) / (0.2 Nm)

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication Port
5. Indicator lights
6. Ground terminal block

8-14-2 Features

1. Supports speed mode
2. Supports standard CANopen CiA 402 decoding (CoE)
3. Supports reading and writing parameters
4. Supports stop during disconnection

8-14-3 Specifications

Network Interface

Interface	RJ45
Number of ports	2 ports
Transmission method	IEEE 802.3 · IEEE 802.3u
Transmission cable	Category 5e shielding 100M
Transmission speed	100Mbps

Table 8-43

Electrical Specification

Power supply voltage	15 V_{DC}
Power consumption	0.8 W
Insulation voltage	500 V_{DC}
Weight	27 g

Table 8-44

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation / Storage	Operation: -10–50º C (temperature), 90% (humidity) Storage: -25–70º C (temperature), 95% (humidity)
Shock / Vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

Table 8-45

8-14-4 RJ45 PIN Definition

PIN	Signal	Definition
1	Tx+	Data transmit positive
2	Tx-	Data transmit negative
3	Rx+	Data receive positive
4	--	N/C
5	--	N/C
6	Rx-	Data receive negative
7	--	N/C
8	--	N/C

Table 8-46

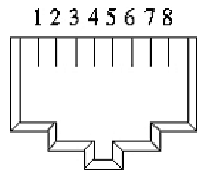


Figure 8-90

8-14-5 Communication Parameter Settings when MH300 Connects to EtherCAT

When operating MH300 with a CMM-EC02 card, you should set the control source and operation source to be controlled by the communication card. Follow the table below to set up the corresponding parameters.

Parameter	Setting Value / Display	Description
00-20	8	The frequency command is controlled by the communication card.
00-21	5	The control command is controlled by the communication card.
09-30	1	Communication decoding method: EtherCAT only supports decoding method 2 (60xx).
09-60	6	Communication card identification: When the drive connects with CMM-EC02, the display shows 6 (EtherCAT Slave).

Table 8-47

8-14-5 LED Indicator Light

LED	Status		Indication
RUN	Green	ON	Normal operation
		Flashes	Pre-operation (The light stays ON for 200 ms and then goes OFF for 200 ms alternately)
			Operate in safe mode (The light stays ON for 200 ms and then goes OFF for 1000 ms alternately)
		OFF	Initial state
ERROR	Red	Flashes	Basic configuration error (The light stays ON for 200 ms and then goes OFF for 200 ms alternately)
			Status switching error (The light stays ON for 200 ms and then goes OFF for 1000 ms alternately)
			Time out (The light stays ON for 200 ms twice, and then goes OFF for 200 ms alternately)
		OFF	No errors
LINK-IN	Green	ON	Network connection is in normal status
		Flashes	Network is in operation
		OFF	Doesn’t connect to network

LED	Status		Indication
LINK-OUT	Green	ON	Network connection is in normal status
		Flashes	Network is in operation
		OFF	Doesn't connect to network

Table 8-48

8-14-6 Network Connection

Pay attention to the connection method for EtherCAT because its packet delivery is directional. When front-mounting the communication card, the delivery direction for CMM-EC02 is from left (IN) to right (OUT). The diagram below shows the correct wiring for front-mounting CMM-EC01.

Front-mounting the communication card:

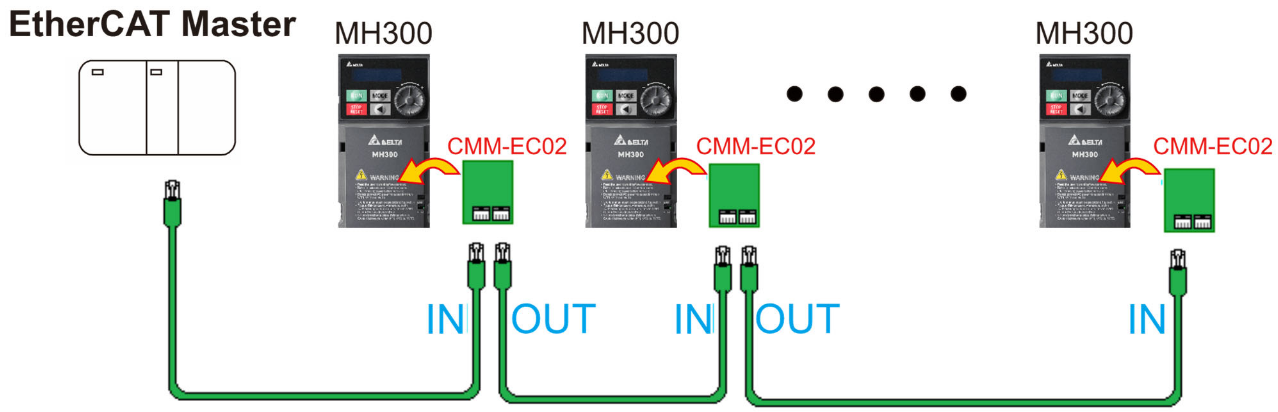


Figure 8-91

After finishing assembling the hardware, supply power to the drive. Then, Pr.09-60 on the drive should display "EtherCAT", with a current value of 6. If not, make sure your version of the drive is correct (MH300 needs firmware version 1.02 or later) and verify if the communication card is correctly connected.

8-15 Delta Standard Fieldbus Cables

Delta Cables	Part Number	Description	Length
CANopen Cable / RJ45 extension cable for keypad	UC-CMC003-01A	CANopen cable, RJ45 connector	0.3 m
	UC-CMC005-01A	CANopen cable, RJ45 connector	0.5 m
	UC-CMC010-01A	CANopen cable, RJ45 connector	1 m
	UC-CMC015-01A	CANopen cable, RJ45 connector	1.5 m
	UC-CMC020-01A	CANopen cable, RJ45 connector	2 m
	UC-CMC030-01A	CANopen cable, RJ45 connector	3 m
	UC-CMC050-01A	CANopen cable, RJ45 connector	5 m
	UC-CMC100-01A	CANopen cable, RJ45 connector	10 m
	UC-CMC200-01A	CANopen cable, RJ45 connector	20 m
DeviceNet Cable	UC-DN01Z-01A	DeviceNet cable	305 m
	UC-DN01Z-02A	DeviceNet cable	305 m
EtherNet / EtherCAT Cable	UC-EMC003-02A	Ethernet / EtherCAT cable, Shielding	0.3 m
	UC-EMC005-02A	Ethernet / EtherCAT cable, Shielding	0.5 m
	UC-EMC010-02A	Ethernet / EtherCAT cable, Shielding	1 m
	UC-EMC020-02A	Ethernet / EtherCAT cable, Shielding	2 m
	UC-EMC050-02A	Ethernet / EtherCAT cable, Shielding	5 m
	UC-EMC100-02A	Ethernet / EtherCAT cable, Shielding	10 m
	UC-EMC200-02A	Ethernet / EtherCAT cable, Shielding	20 m
PROFIBUS Cable	UC-PF01Z-01A	PROFIBUS DP cable	305 m

Table 8-49

Chapter 9 Specification

9-1 115V Models

9-2 230V Models

9-3 460V Models

9-4 General Specifications

9-5 Environment for Operation, Storage and Transportation

9-6 Derating Curve

9-1 115V Models

115V, single-phase

Frame			A				C	
Model VFD_ _ _ _ _ _ _ _ _SAA			1A6MH11_ _		2A5MH11_ _		5A0MH11_ _	
			AN	EN	AN	EN	AN	EN
Applicable Motor Output (kW)			0.2		0.4		0.75	
Applicable Motor Output (HP)			1/4		1/2		1	
Output Rating*1	Heavy duty	Rated Output Capacity (kVA)	0.6		1.0		1.9	
		Rated Output Current (A)	1.6		2.5		5.0	
		Carrier Frequency (kHz) *2	2–15 (Default: 4)					
	Normal Duty	Rated Output Capacity (kVA)	0.7		1.0		2.1	
		Rated Output Current (A) *2	1.8		2.7		5.5	
		Carrier Frequency (kHz)	2–15 (Default: 4)					
Input Rating	Rated Input Current (A)	Heavy Duty	6.0		9.4		18.8	
		Normal Duty	6.8		10.1		20.6	
	Rated Voltage / Frequency		Single-phase, 100–120 V_{AC} (-15%– +10%), 50 / 60 Hz					
	Operating Voltage Range (V_{AC})		85–132					
	Frequency Range (Hz)		47–63					
Weight (kg)			0.71		0.76		1.24	
Cooling Method			Convective cooling				Fan cooling	
EMC Filter			Optional					
Ingress Protection Rating			IP20	IP40*3	IP20	IP40*3	IP20	IP40*3

Table 9-1

NOTE:
1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The IP rating of the wiring area (main circuit terminals and control terminals, frame A / B / C / D / E / F) and the vent near the capacitor (frame C / D / E / F) is IP20.
4. When the load is a shock or impact load, use a higher level model.

9-2 230V Models

230V, single-phase

<table>
<tr><td colspan="3">Frame</td><td colspan="4">A</td><td colspan="4">B</td></tr>
<tr><td colspan="3" rowspan="2">Model VFD_ _ _ _ _ _ _ _ _SAA</td><td colspan="2">1A6MH21_ _</td><td colspan="2">2A8MH21_ _</td><td rowspan="2">1A6MH21AF</td><td rowspan="2">2A8MH21AF</td><td colspan="2">5A0MH21_ _</td></tr>
<tr><td>AN</td><td>EN</td><td>AN</td><td>EN</td><td>AN</td><td>EN</td></tr>
<tr><td colspan="3">Applicable Motor Output (kW)</td><td colspan="2">0.2</td><td colspan="2">0.4</td><td>0.2</td><td>0.4</td><td colspan="2">0.75</td></tr>
<tr><td colspan="3">Applicable Motor Output (HP)</td><td colspan="2">1/4</td><td colspan="2">1/2</td><td>1/4</td><td>1/2</td><td colspan="2">1</td></tr>
<tr><td rowspan="6">Output Rating[1]</td><td rowspan="3">Heavy Duty</td><td>Rated Output Capacity (kVA)</td><td colspan="2">0.6</td><td colspan="2">1.1</td><td>0.6</td><td>1.1</td><td colspan="2">1.9</td></tr>
<tr><td>Rated Output Current (A)</td><td colspan="2">1.6</td><td colspan="2">2.8</td><td>1.6</td><td>2.8</td><td colspan="2">5.0</td></tr>
<tr><td>Carrier Frequency (kHz) [2]</td><td colspan="8">2–15 (Default: 4)</td></tr>
<tr><td rowspan="3">Normal Duty</td><td>Rated Output Capacity (kVA)</td><td colspan="2">0.7</td><td colspan="2">1.2</td><td>0.7</td><td>1.2</td><td colspan="2">2.0</td></tr>
<tr><td>Rated Output Current (A)</td><td colspan="2">1.8</td><td colspan="2">3.2</td><td>1.8</td><td>3.2</td><td colspan="2">5.2</td></tr>
<tr><td>Carrier Frequency (kHz) [2]</td><td colspan="8">2–15 (Default: 4)</td></tr>
<tr><td rowspan="5">Input Rating</td><td rowspan="2">Rated Input Current (A)</td><td>Heavy Duty</td><td colspan="2">5.1</td><td colspan="2">7.3</td><td>5.1</td><td>7.3</td><td colspan="2">11.2</td></tr>
<tr><td>Normal Duty</td><td colspan="2">5.8</td><td colspan="2">8.3</td><td>5.8</td><td>8.3</td><td colspan="2">11.7</td></tr>
<tr><td colspan="2">Rated Voltage / Frequency</td><td colspan="8">Single-phase, 200–240 V_{AC} (-15%– +10%), 50 / 60 Hz</td></tr>
<tr><td colspan="2">Operating Voltage Range (V_{AC})</td><td colspan="8">170–265</td></tr>
<tr><td colspan="2">Frequency Range (Hz)</td><td colspan="8">47–63</td></tr>
<tr><td colspan="3">Weight (kg)</td><td colspan="2">0.71</td><td colspan="2">0.76</td><td>1.34</td><td>1.34</td><td colspan="2">1.25</td></tr>
<tr><td colspan="3">Cooling Method</td><td colspan="5">Convective cooling</td><td colspan="3">Fan cooling</td></tr>
<tr><td colspan="3">EMC Filter</td><td colspan="4">Optional</td><td colspan="2">Built-in</td><td colspan="2">Optional</td></tr>
<tr><td colspan="3">Ingress Protection Rating</td><td>IP20</td><td>IP40[3]</td><td>IP20</td><td>IP40[3]</td><td>IP20</td><td>IP20</td><td>IP20</td><td>IP40[3]</td></tr>
</table>

<table>
<tr><td colspan="3">Frame</td><td>B</td><td colspan="6">C</td></tr>
<tr><td colspan="3" rowspan="2">Model VFD_ _ _ _ _ _ _ _ _SAA</td><td rowspan="2">5A0MH21AF</td><td colspan="3">7A5MH21_ _</td><td colspan="3">11AMH21_ _</td></tr>
<tr><td>AN</td><td>EN</td><td>AF</td><td>AN</td><td>EN</td><td>AF</td></tr>
<tr><td colspan="3">Applicable Motor Output (kW)</td><td>0.75</td><td colspan="3">1.5</td><td colspan="3">2.2</td></tr>
<tr><td colspan="3">Applicable Motor Output (HP)</td><td>1</td><td colspan="3">2</td><td colspan="3">3</td></tr>
<tr><td rowspan="6">Output Rating[1]</td><td rowspan="3">Heavy Duty</td><td>Rated Output Capacity (kVA)</td><td>1.9</td><td colspan="3">2.9</td><td colspan="3">4.2</td></tr>
<tr><td>Rated Output Current (A)</td><td>5.0</td><td colspan="3">7.5</td><td colspan="3">11</td></tr>
<tr><td>Carrier Frequency (kHz) [2]</td><td colspan="7">2–15 (Default: 4)</td></tr>
<tr><td rowspan="3">Normal Duty</td><td>Rated Output Capacity (kVA)</td><td>2.0</td><td colspan="3">3.2</td><td colspan="3">4.8</td></tr>
<tr><td>Rated Output Current (A)</td><td>5.2</td><td colspan="3">8.5</td><td colspan="3">12.5</td></tr>
<tr><td>Carrier Frequency (kHz) [2]</td><td colspan="7">2–15 (Default: 4)</td></tr>
<tr><td rowspan="5">Input Rating</td><td rowspan="2">Rated Input Current (A)</td><td>Heavy Duty</td><td>11.2</td><td colspan="3">16.5</td><td colspan="3">24.2</td></tr>
<tr><td>Normal Duty</td><td>11.7</td><td colspan="3">18.5</td><td colspan="3">27.5</td></tr>
<tr><td colspan="2">Rated Voltage / Frequency</td><td colspan="7">Single-phase, 200–240 V_{AC} (-15%– +10%), 50 / 60 Hz</td></tr>
<tr><td colspan="2">Operating Voltage Range (V_{AC})</td><td colspan="7">170–265</td></tr>
<tr><td colspan="2">Frequency Range (Hz)</td><td colspan="7">47–63</td></tr>
<tr><td colspan="3">Weight (kg)</td><td>1.34</td><td colspan="2">1.24</td><td>1.84</td><td colspan="2">1.24</td><td>1.84</td></tr>
<tr><td colspan="3">Cooling Method</td><td colspan="7">Fan cooling</td></tr>
<tr><td colspan="3">EMC Filter</td><td>Built-in</td><td colspan="2">Optional</td><td>Built-in</td><td colspan="2">Optional</td><td>Built-in</td></tr>
<tr><td colspan="3">Ingress Protection Rating</td><td colspan="2">IP20</td><td>IP40[3]</td><td colspan="2">IP20</td><td>IP40[3]</td><td>IP20</td></tr>
</table>

Table 9-2

NOTE:
1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The IP rating of the wiring area (main circuit terminals and control terminals, frame A / B / C / D / E / F) and the vent near the capacitor (frame C / D / E / F) is IP20.
4. When the load is a shock or impact load, use a higher level model.

230V, three-phase

Frame	A								B	
Model VFD_ _ _ _ _ _ _ _ _ _ _ _A	1A6MH23_ _ _ _		2A8MH23_ _ _ _		5A0MH23_ _ _ _				7A5MH23_ _ _ _	
	ANSA	ENSA	ANSA	ENSA	ANSN	ENSN	ANSA	ENSA	ANSA	ENSA
Applicable Motor Output (kW)	0.2		0.4		0.75		0.75		1.5	
Applicable Motor Output (HP)	0.25		0.5		1		1		2	
Output Rating*1 – Heavy Duty – Rated Output Capacity (kVA)	0.6		1.9		1.9		1.9		2.9	
Output Rating*1 – Heavy Duty – Rated Output Current (A)	1.6		5.0		5.0		5.0		7.5	
Output Rating*1 – Heavy Duty – Carrier Frequency (kHz) *2	2–15 (Default: 4)									
Output Rating*1 – Normal Duty – Rated Output Capacity (kVA)	0.7		1.2		2.0		2.0		3.0	
Output Rating*1 – Normal Duty – Rated Output Current (A)	1.8		3.2		5.2		5.2		8.0	
Output Rating*1 – Normal Duty – Carrier Frequency (kHz) *2	2–15 (Default: 4)									
Input Rating – Rated Input Current (A) – Heavy Duty	1.9		3.4		6.0		6.0		9.0	
Input Rating – Rated Input Current (A) – Normal Duty	2.2		3.8		6.2		6.2		9.6	
Input Rating – Rated Voltage / Frequency	Three-phase, 200–240 V_{AC} (-15%– +10%), 50 / 60 Hz									
Input Rating – Operating Voltage Range (V_{AC})	170–265									
Input Rating – Frequency Range (Hz)	47–63									
Weight (kg)	0.76		0.76		0.81		0.77		1.05	
Cooling Method	Convective cooling						Fan cooling			
EMC Filter	Optional									
Ingress Protection Rating	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3

Frame	C				D		E				F	
Model VFD_ _ _ _ _ _ _ _ _SAA	11AMH23_ _		17AMH23_ _		25AMH23_ _		33AMH23_ _		49AMH23_ _		65AMH23_ _	
	AN	EN	AN4	EN	AN	EN	AN	EN	AN	EN	AN	EN
Applicable Motor Output (kW)	2.2		3.7		5.5		7.5		11		15	
Applicable Motor Output (HP)	3		5		7.5		10		15		20	
Output Rating*1 – Heavy Duty – Rated Output Capacity (kVA)	4.2		6.5		9.5		12.6		18.7		24.8	
Output Rating*1 – Heavy Duty – Rated Output Current (A)	11.0		17.0		25.0		33.0		49.0		65.0	
Output Rating*1 – Heavy Duty – Carrier Frequency (kHz) *2	2–15 (Default: 4)											
Output Rating*1 – Normal Duty – Rated Output Capacity (kVA)	4.8		7.4		10.3		13.7		19.4		26.3	
Output Rating*1 – Normal Duty – Rated Output Current (A)	12.5		19.5		27.0		36.0		51.0		69.0	
Output Rating*1 – Normal Duty – Carrier Frequency (kHz) *2	2–15 (Default: 4)											
Input Rating – Rated Input Current (A) – Heavy Duty	13.2		20.4		30.0		39.6		58.8		78.0	
Input Rating – Rated Input Current (A) – Normal Duty	15.0		23.4		32.4		43.2		61.2		82.8	
Input Rating – Rated Voltage / Frequency	three-phase, 200–240 V_{AC} (-15 %– +10 %), 50 / 60 Hz											
Input Rating – Operating Voltage Range (V_{AC})	170–265											
Input Rating – Frequency Range (Hz)	47–63											
Weight (kg)	1.24		1.24		2.07		3.97		3.97		6.30	
Cooling Method	Fan cooling											
EMC Filter	Optional											
Ingress Protection Rating	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3	IP20	IP40*3

Table 9-3

NOTE:
1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The IP rating of the wiring area (main circuit terminals and control terminals, frame A / B / C / D / E / F) and the vent near the capacitor (frame C / D / E / F) is IP20.
4. When the load is a shock or impact load, use a higher level model.

230V, three-phase

<table>
<tr><td colspan="3">Frame</td><td colspan="4">G</td><td colspan="4">I</td></tr>
<tr><td colspan="3">Model VFD_ _ _ _ _ _ _ _ _SAA</td><td colspan="2">75AMH23AN_ _</td><td colspan="2">90AMH23AN_ _</td><td colspan="2">120MH23AN_ _</td><td colspan="2">146MH23AN_ _</td></tr>
<tr><td colspan="3">Applicable Motor Output (kW)</td><td colspan="2">18.5</td><td colspan="2">22</td><td colspan="2">30</td><td colspan="2">37 (45) *3</td></tr>
<tr><td colspan="3">Applicable Motor Output (HP)</td><td colspan="2">25</td><td colspan="2">30</td><td colspan="2">40</td><td colspan="2">50 (60) *3</td></tr>
<tr><td rowspan="6">Output Rating*1</td><td rowspan="3">Heavy Duty</td><td>Rated Output Capacity (kVA)</td><td colspan="2">28.9</td><td colspan="2">34.4</td><td colspan="2">46.9</td><td colspan="2">57.8</td></tr>
<tr><td>Rated Output Current (A)</td><td colspan="2">75</td><td colspan="2">90</td><td colspan="2">120</td><td colspan="2">146</td></tr>
<tr><td>Carrier Frequency (kHz) *2</td><td colspan="8">2–15 (Default: 4)</td></tr>
<tr><td rowspan="3">Normal Duty</td><td>Rated Output Capacity (kVA)</td><td colspan="2">31.6</td><td colspan="2">37.6</td><td colspan="2">51.3</td><td colspan="2">63.3</td></tr>
<tr><td>Rated Output Current (A)</td><td colspan="2">81</td><td colspan="2">102</td><td colspan="2">134</td><td colspan="2">160</td></tr>
<tr><td>Carrier Frequency (kHz) *2</td><td colspan="8">2–15 (Default: 4)</td></tr>
<tr><td rowspan="5">Input Rating</td><td rowspan="2">Rated Input Current (A)</td><td>Heavy Duty</td><td colspan="2">77</td><td colspan="2">92</td><td colspan="2">117</td><td colspan="2">143</td></tr>
<tr><td>Normal Duty</td><td colspan="2">85</td><td colspan="2">103</td><td colspan="2">126</td><td colspan="2">151</td></tr>
<tr><td colspan="2">Rated Voltage / Frequency</td><td colspan="8">Three-phase, 200–240 V_{AC} (-15%– +10%), 50 / 60 Hz</td></tr>
<tr><td colspan="2">Operating Voltage Range (V_{AC})</td><td colspan="8">170–265</td></tr>
<tr><td colspan="2">Frequency Range (Hz)</td><td colspan="8">47–63</td></tr>
<tr><td colspan="3">Weight (kg)</td><td colspan="2">11.8</td><td colspan="2">11.8</td><td colspan="2">33</td><td colspan="2">33.5</td></tr>
<tr><td colspan="3">Cooling Method</td><td colspan="8">Fan cooling</td></tr>
<tr><td colspan="3">EMC Filter</td><td>Optional</td><td>Built-in</td><td>Optional</td><td>Built-in</td><td>Optional</td><td>Built-in</td><td>Optional</td><td>Built-in</td></tr>
<tr><td colspan="3">Ingress Protection Rating</td><td colspan="8">IP20</td></tr>
</table>

Table 9-4

NOTE:
1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The value in the parentheses is the applicable motor power under normal duty.
4. When the load is a shock or impact load, use a higher level model.

9-3 460V Models

460V, three-phase

Frame			A						B	
Model VFD_ _ _ _ _ _ _ _ _ _ _A			1A5MH43_ _ _ _		3A0MH43_ _ _ _				1A5MH43AFSA	3A0MH43AFSA
			ANSA	ENSA	ANSN	ENSN	ANSA	ENSA		
Applicable Motor Output (kW)			0.4		0.75		0.75		0.4	0.75
Applicable Motor Output (HP)			0.5		1		1		0.5	1
Output Rating[*1]	Heavy Duty	Rated Output Capacity (kVA)	1.1		2.3		2.3		1.1	2.3
		Rated Output Current (A)	1.5		3.0		3.0		1.5	3.0
		Carrier Frequency (kHz) [*2]	2–15 (Default: 4)							
	Normal Duty	Rated Output Capacity (kVA)	1.4		2.5		2.5		1.4	2.5
		Rated Output Current (A)	1.8		3.3		3.3		1.8	3.3
		Carrier Frequency (kHz) [*2]	2–15 (Default: 4)							
Input Rating	Rated Input Current (A)	Heavy Duty	2.1		4.2		4.2		2.1	4.2
		Normal Duty	2.5		4.6		4.6		2.5	4.6
	Rated Voltage / Frequency		Three-phase, 380–480 V_{AC} (-15 %– +10 %), 50 / 60 Hz							
	Operating Voltage Range (V_{AC})		323–528							
	Frequency Range (Hz)		47–63							
Weight (kg)			0.76		0.81		0.77		1.34	1.34
Cooling Method			Convective cooling				Fan cooling			
EMC Filter			Optional						Built-in	
Ingress Protection Rating			IP20	IP40[*3]	IP20	IP40[*3]	IP20	IP40[*3]	IP20	

Frame			B			C						D					
Model VFD_ _ _ _ _ _ _ _ _SAA			4A2MH43_ _			5A7MH43_ _			9A0MH43_ _			13AMH43_ _			17AMH43_ _		
			AN	EN	AF	AN	EN	AF	AN	EN	AF	AN	EN	AF	AN	EN	AF
Applicable Motor Output (kW)			1.5			2.2			3.7			5.5			7.5		
Applicable Motor Output (HP)			2			3			5			7.5			10		
Output Rating[*1]	Heavy Duty	Rated Output Capacity (kVA)	3.2			4.3			6.9			9.9			13.3		
		Rated Output Current (A)	4.2			5.7			9.0			13.0			17.5		
		Carrier Frequency (kHz) [*2]	2–15 (Default: 4)														
	Normal Duty	Rated Output Capacity (kVA)	3.5			5.0			8.0			11.1			15.1		
		Rated Output Current (A)	4.6			6.5			10.5			14.5			19.8		
		Carrier Frequency (kHz) [*2]	2–15 (Default: 4)														
Input Rating	Rated Input Current (A)	Heavy Duty	5.8			6.1			9.9			14.3			19.3		
		Normal Duty	6.4			7.2			11.6			16.0			21.8		
	Rated Voltage / Frequency		Three-phase, 380–480 V_{AC} (-15 %– +10 %), 50 / 60 Hz														
	Operating Voltage Range (V_{AC})		323–528														
	Frequency Range (Hz)		47–63														
Weight (kg)			1.05		1.34	1.24		1.84	1.24		1.84	2.07		2.93	2.07		2.93
Cooling Method			Fan cooling														
EMC Filter			Optional		Built-in	Optional		Built-in	Optional		Built-in	Optional		Built-in	Optional		Built-in
Ingress Protection Rating			IP20		IP40[*3]	IP20		IP40[*3]	IP20		IP40[*3]	IP20		IP40[*3]	IP20		IP40[*3]

Table 9-5

NOTE:

1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The IP rating of the wiring area (main circuit terminals and control terminals, frame A / B / C / D / E / F) and the vent near the capacitor (frame C / D / E / F) is IP20.
4. When the load is a shock or impact load, use a higher level model.

460V, three-phase

Frame			E						F					
Model VFD_ _ _ _ _ _ _ _ _SAA			25AMH43_ _			32AMH43_ _			38AMH43_ _			45AMH43_ _		
			AN	EN	AF	AN	EN	AF	AN	EN	AF	AN	EN	AF
Applicable Motor Output (kW)			11			15			18.5			22		
Applicable Motor Output (HP)			15			20			25			30		
Output Rating[*1]	Heavy Duty	Rated Output Capacity (kVA)	19.1			24.4			29			34.3		
		Rated Output Current (A)	25.0			32.0			38.0			45.0		
		Carrier Frequency (kHz)[*2]	2–15 (Default: 4)											
	Normal Duty	Rated Output Capacity (kVA)	21.3			27.4			31.6			37.3		
		Rated Output Current (A)	28.0			36.0			41.5			49.0		
		Carrier Frequency (kHz)[*2]	2–15 (Default: 4)											
Input Rating	Rated Input Current (A)	Heavy Duty	27.5			35.2			41.8			49.5		
		Normal Duty	30.8			39.6			45.7			53.9		
	Rated Voltage / Frequency		Three-phase, 380–480 V_{AC} (-15%– +10 %), 50 / 60 Hz											
	Operating Voltage Range (V_{AC})		323–528											
	Frequency Range (Hz)		47–63											
Weight (kg)			3.97		5.19	3.97		5.19	6.30		8.56	6.30		8.56
Cooling Method			Fan cooling											
EMC Filter			Optional		Built-in	Optional		Built-in	Optional		Built-in	Optional		Built-in
Ingress Protection Rating			IP20	IP40[*3]	IP20		IP40[*3]	IP20		IP40[*3]	IP20		IP40[*3]	IP20

Frame			G		H				I			
Model VFD_ _ _ _ _ _ _ _ _SAA			60AMH43 _ _		75AMH43 _ _		91AMH43 _ _		112MH43 _ _		150MH43 _ _	
			AN	AF	AN	AF	AN	AF	AN	AF	AN	AF
Applicable Motor Output (kW)			30		37		45		55		75	
Applicable Motor Output (HP)			40		50		60		75		100	
Output Rating[*1]	Heavy Duty	Rated Output Capacity (kVA)	46.9		57.8		70.3		85.9		117.2	
		Rated Output Current (A)	60		75		91		112		150	
		Carrier Frequency (kHz)[*2]	2–15 (Default: 4)									
	Normal Duty	Rated Output Capacity (kVA)	51.3		63.3		76.9		94		128.2	
		Rated Output Current (A)	69		85		108		128		180	
		Carrier Frequency (kHz)[*2]	2–15 (Default: 4)									
Input Rating	Rated Input Current (A)	Heavy Duty	63		66		80		110		147	
		Normal Duty	72.5		77		97		123		173	
	Rated Voltage / Frequency		Three-phase, 380–480 V_{AC} (-15 %– +10 %), 50 / 60 Hz									
	Operating Voltage Range (V_{AC})		323–528									
	Frequency Range (Hz)		47–63									
Weight (kg)			11.7	11.6	25.1	30.6	28.6	32.5	36	42.5	39	48
Cooling Method			Fan cooling									
EMC Filter			Optional	Built-in	Optional	Built-in	Optional	Built-in	Optional	Built-in	Optional	Built-in
Ingress Protection Rating			IP20									

Table 9-6

NOTE:

1. The default is heavy duty mode.
2. The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram in Section 9-6.
3. The IP rating of the wiring area (main circuit terminals and control terminals, frame A / B / C / D / E / F) and the vent near the capacitor (frame C / D / E / F) is IP20.
4. When the load is a shock or impact load, use a higher level model.

9-4 General Specifications

Control Characteristics	Control Method	V/F, SVC, FOC, V/F+PG, FOC+PG, TQC+PG
	Applied Motor	IM (Induction Motor), PM motor control (IPM and SPM)
	Max. Output Frequency	0.00–599.00Hz
	Starting Torque*1	150% / 3 Hz (V/F, SVC, V/F+PG control for IM, Heavy duty) 200% / 0.5 Hz (FOC control for IM, Heavy duty) 200% / 0 Hz (FOC+PG control for IM, Heavy duty) 100% / (1/20 of motor rated frequency) (SVC control for PM, Heavy duty) 150% / 0 Hz (FOC control for PM, Heavy duty) 200% / 0 Hz (Closed loop vector control w/ PG for PM, Heavy duty)
	Speed Control Range*1	1: 50 (V/F, SVC, V/F+PG control for IM, Heavy duty) 1: 100 (FOC control for IM, Heavy duty) 1: 1000 (FOC+PG control for IM, Heavy duty) 1: 20 (SVC control for PM, Heavy duty) 1: 100 (FOC control for PM, Heavy duty) 1: 1000 (Closed loop vector control w/ PG for PM, Heavy duty)
	Overload Capability	Normal duty: 120% of rated current can endure for 1 minute during every 5 minutes 150% of rated current can endure for 3 seconds during every 30 seconds. Heavy duty: 150% of rated current can endure for 1 minute during every 5 minutes 200% of rated current can endure for 3 seconds during every 30 seconds
	Frequency Setting Signal	0–10 V / +10– -10 V 4–20 mA / 0–10 V 1 channel pulse input (33 kHz), 2 channel pulse output (33 kHz)
	Main Function	Multiple motor switches (maximum eight independent motor parameter settings), Fast start-up, Deceleration Energy Back (DEB) function, Wobble frequency function, Fast deceleration function, Master and Auxiliary frequency source selectable, Momentary power loss ride thru, Speed search, Over-torque detection, Torque limit, 16-step speed (max.), Accel./ decel. time switch, S-curve accel. / decel., three-wire sequence, JOG frequency, Upper / lower limits for frequency reference, DC injection braking at start and stop, PID control, Built-in PLC (5K steps), Positioning function, Tension control function, Built-in RS-485 (Modbus) and CANopen.
	Application Macro	Built-in application parameter groups (selected by industry) and user-defined application parameter groups.
Protection Characteristics	Motor Protection	Over-current, Over-voltage, Over-temperature, Phase loss, Over-load
	Stall Prevention	Stall prevention during acceleration, deceleration and running (independent settings)
Accessory	Communication Cards	DeviceNet, EtherNet/IP, Profibus DP, Modbus TCP, EtherCAT
	PG Cards	EMM-PG01L (ABZ, Line Driver) EMM-PG01O (ABZ, Open Collector) EMM-PG01R (Resolver, applicable to permanent magnet synchronous AC motor)
	I/O Extension Cards	EMM-D33A (Digital Card – 3-in 3-out) EMM-A22A (Analog Card – 2-in 2-out) EMM-R2CA (Relay Card, output via 2 C contacts) EMM-R3AA (Relay Card, output via 3 A contacts)
	External DC Power Supply	EMM-BPS02 (DC 24 V power supply card)
Product Compliance*2		UL, CE, RCM, RoHS, REACH
Safety Standard*2		TÜV (SIL 2)

Table 9-7

NOTE:

1. Control accuracy may vary depending on the environment, application conditions, different motors or encoders. For details, contact our company or your local distributor.
2. For information on Certifications and Declaration of Conformity (DoC), visit [Delta | Download Center (deltaww.com)]

9-5 Environment for Operation, Storage and Transportation

DO NOT expose the AC motor drive to bad environmental conditions, such as dust, direct sunlight, corrosive / inflammable gasses, humidity, liquid or vibration. The salt in the air must be less than 0.01 mg/ cm^2 every year.

Environment	Installation location	IEC60364-1/ IEC60664-1 Pollution degree 2, indoor use only.		
	Surrounding Temperature	Operation	IP20 / UL Open Type	-20–50°C -20–60°C (Derating required)
			IP40 / NEMA 1 / UL Type 1 Installed side by side	-20–40°C -20–55°C (Derating required)
		Storage	-40–85°C	
		Transportation	-20–70°C	
		Non-condensation, non-freezing		
	Rated Humidity	Operation	Max. 90%	
		Storage / Transportation	Max. 95%	
		No condense water		
	Air Pressure	Operation	86–106 kPa	
		Storage / Transportation	70–106 kPa	
	Pollution Level	IEC 60721-3-3		
		Operation	Class 3C2; Class 3S2	
		Storage	Class 2C2; Class 2S2	
		Transportation	Class 1C2; Class 1S2	
		Concentrate prohibited		
	Altitude	Operable at altitude below 1000 m (derating if operated over 1000 m)		
Package Drop	Storage Transportation	ISTA procedure 1A (according to weight) IEC 60068-2-31		
Vibration	In Operation	1.0 mm, peak to peak value range from 2–13.2 Hz; 0.7–1.0 G range from 13.2–55 Hz; 1.0 G range from 55–512 Hz; complies with IEC 60068-2-6.		
	Not in Operation	2.5 G peak, from 5 Hz–2 kHz 0.015" maximum displacement		
Impact	In Operation	15 G, 11 ms; complies with IEC / EN 60068-2-27.		
	Not in Operation	30 G*[1]		

Table 9-8

NOTE:

1. 20G for Frame A – D option card installing kit

9-6 Derating for Ambient Temperature and Altitude

- For more information on calculation for derating curve, refer to Pr.06-55.
- When choosing the correct model, consider factors such as ambient temperature, altitude, carrier frequency, control mode, and so on.

  That is, Actual rated current for application (A) = Rated output current (A) x Ambient temp. rated derating (%) x Altitude rated derating (%) x [Normal / Advanced control] carrier frequency rated derating (%)

Protection Level	Operating Environment
IP20 / UL Open Type	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -20–50°C. If the temperature is above 50°C, decrease 2.5% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.
IP40 / NEMA1 / UL Type 1	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -20–40°C. If the temperature is above 40°C, decrease 2.5% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.

Table 9-9

Ambient temperature derating curve

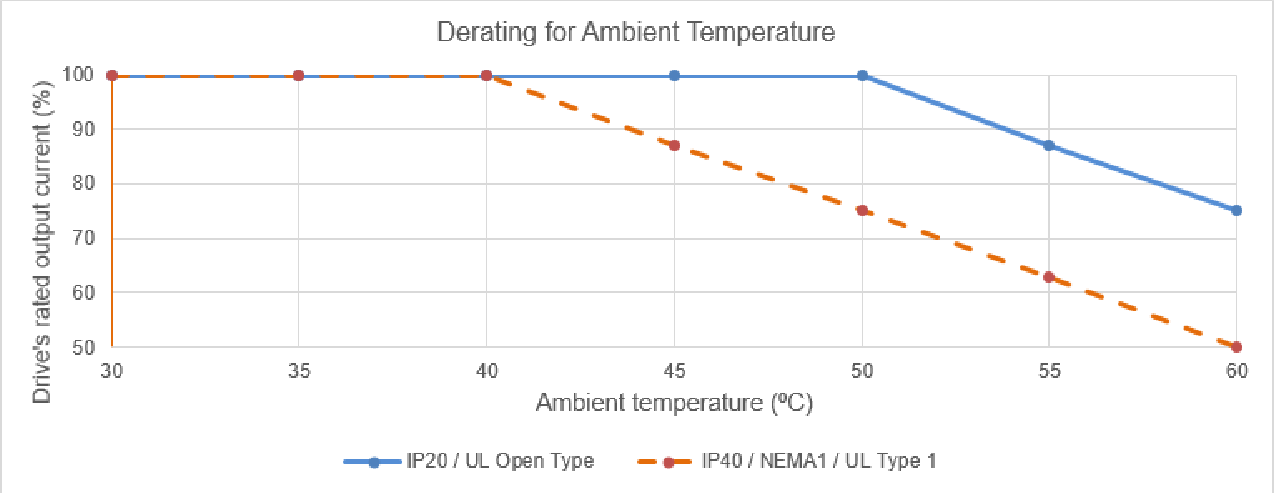


Fig. 9-1

IP20 / UL Open Type:

The rated output current derating (%) in normal duty / heavy duty when carrier frequency is the default value:

Ambient temperature (Ta) / 100% load \ Carrier frequency (kHz)	30	35	40	45	50	55	60
Default	100	100	100	100	100	87	75

Table 9-10

IP40 / NEMA 1 / UL Type 1:

The rated output current derating (%) in normal duty / heavy duty when carrier frequency is the default value:

Ambient temperature (Ta) / 100% load \ Carrier frequency (kHz)	30	35	40	45	50	55	60
Default	100	100	100	87	75	63	50

Table 9-11

Altitude derating curve

Condition	Operating Environment
High Altitude	If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions. For altitudes of 1000–2000 m, decrease the drive's rated current by 1% or lower the temperature by 0.5°C for every 100 m increase in altitude. The maximum altitude for corner grounding is 2000 m. If installing at an altitude higher than 2000 m is required, contact Delta for more information.

Table 9-12

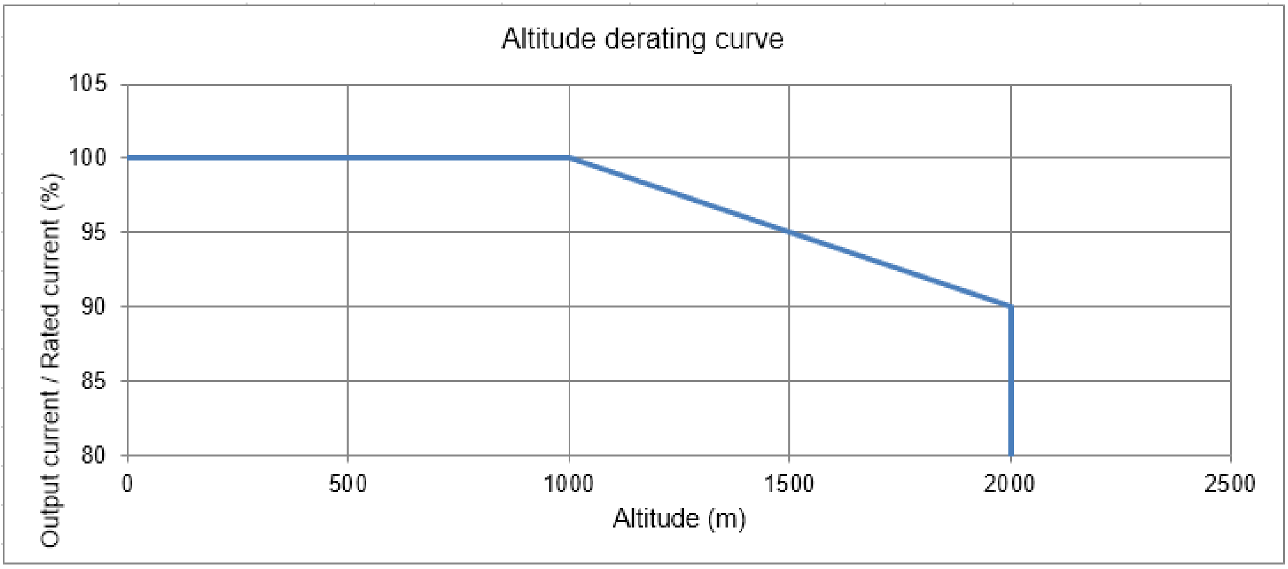


Fig. 9-2

The rated output current derating (%) for different altitudes above sea level:

Altitude (m)	0	1000	1500	2000
Output Current / Rated Current (%)	100	100	95	90

Table 9-13

For IP20 / UL Open Type

Current derating at ambient temperature				
Ambient temperature		40°C	45°C	50°C
Operating altitude (m)	0-1000	100%		
	1001-1500	100%		95%
	1501-2000	100%	95%	90%

Table 9-14

For IP40 / NEMA1 / UL Type 1

Current derating at ambient temperature				
Ambient temperature		30°C	35°C	40°C
Operating altitude (m)	0-1000	100%		
	1001-1500	100%		95%
	1501-2000	100%	95%	90%

Table 9-15

Carrier frequency derating curve

Normal duty (Pr.00-16 = 0)

- Space vector pulse width modulation (SVPWM) mode

230V models

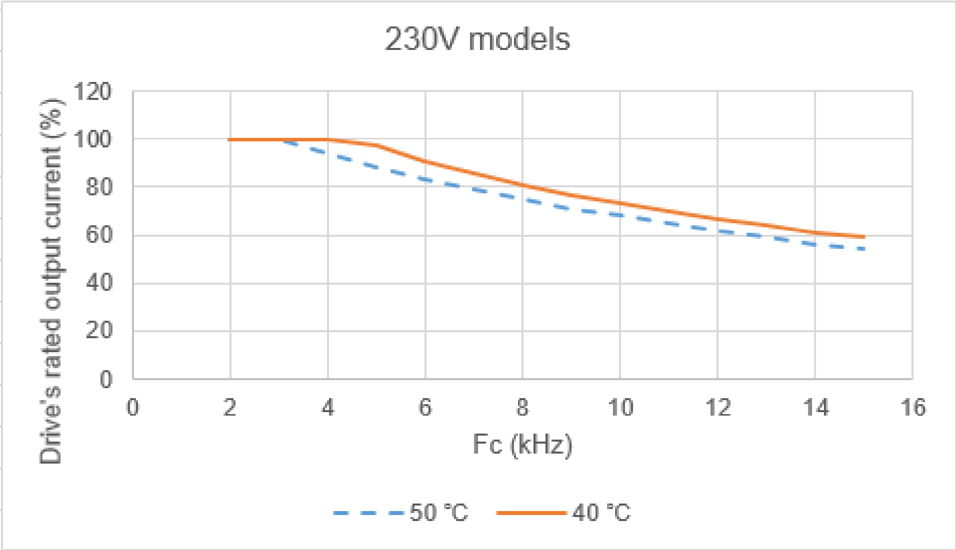


Fig. 9-3

In normal duty, the rated output current of SVPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	94	88	83	79	75	71	68	65	62	59	56	54
40°C	100	100	100	97	91	86	81	77	73	70	67	64	61	59

Table 9-16

460V models

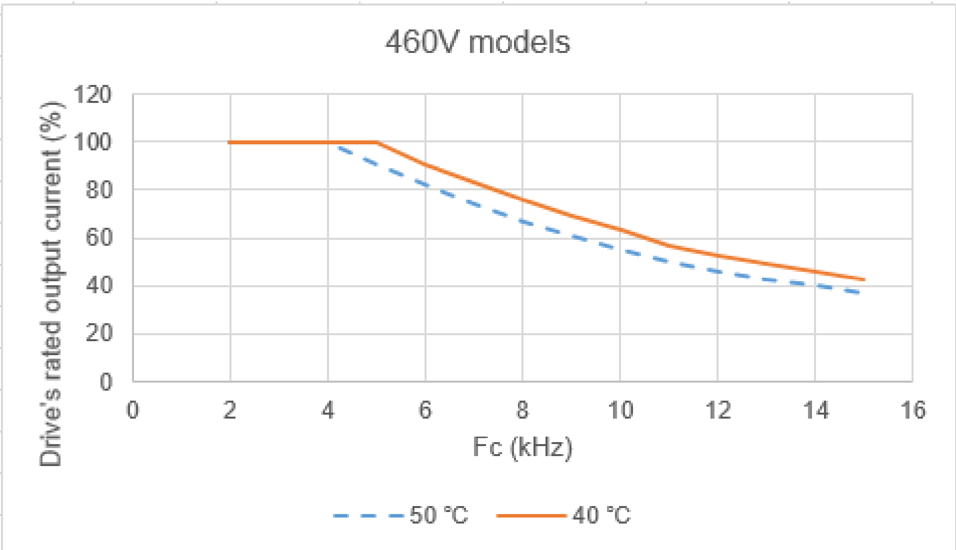


Fig. 9-4

In normal duty, the rated output current of SVPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	91	82	74	67	61	55	50	46	43	40	37
40°C	100	100	100	100	91	83	76	69	63	57	53	49	46	43

Table 9-17

- Dual pulse-width modulation (DPWM) mode

230V models

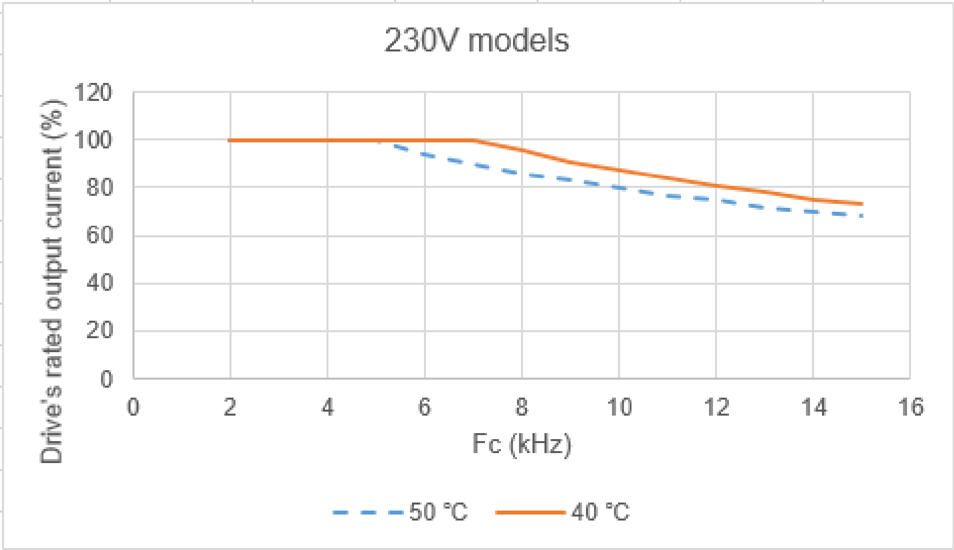


Fig. 9-5

In normal duty, the rated output current of DPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	94	90	86	83	80	77	75	72	70	68
40°C	100	100	100	100	100	100	96	91	87	84	81	78	75	73

Table 9-18

460V models

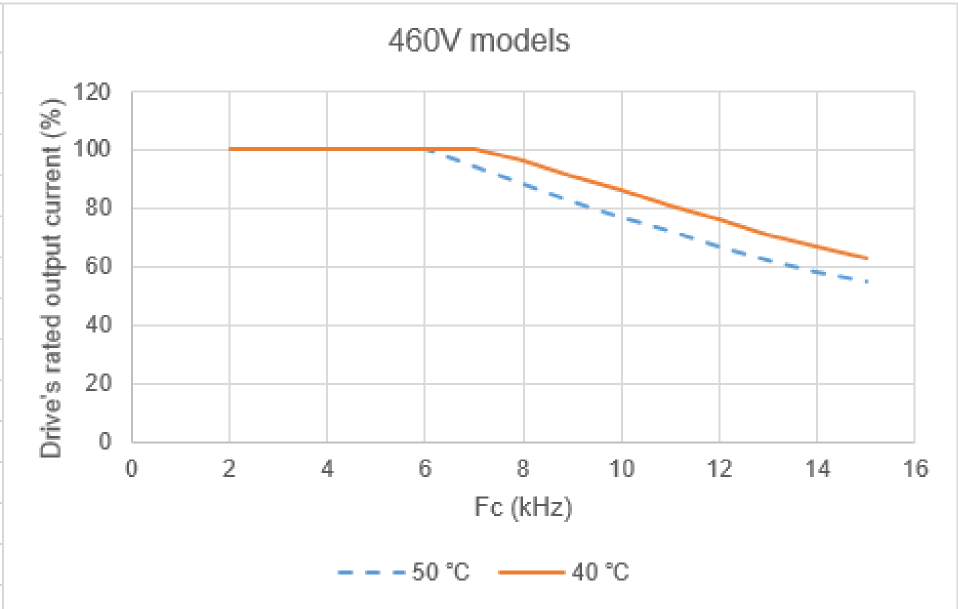


Fig. 9-6

In normal duty, the rated output current of DPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	100	94	88	82	77	72	67	62	58	55
40°C	100	100	100	100	100	100	96	91	86	81	76	71	67	63

Table 9-19

Heavy duty (Pr.00-16 = 1)

- Space vector pulse width modulation (SVPWM) mode

230V models

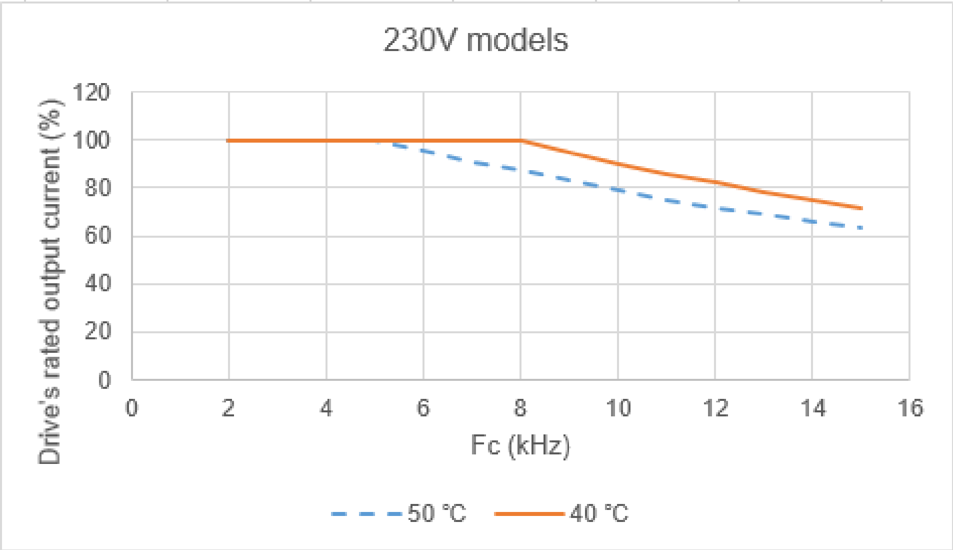


Fig. 9-7

In heavy duty, the rated output current of SVPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	96	91	87	83	79	75	72	69	66	63
40°C	100	100	100	100	100	100	100	95	90	86	82	78	75	72

Table 9-20

460V models

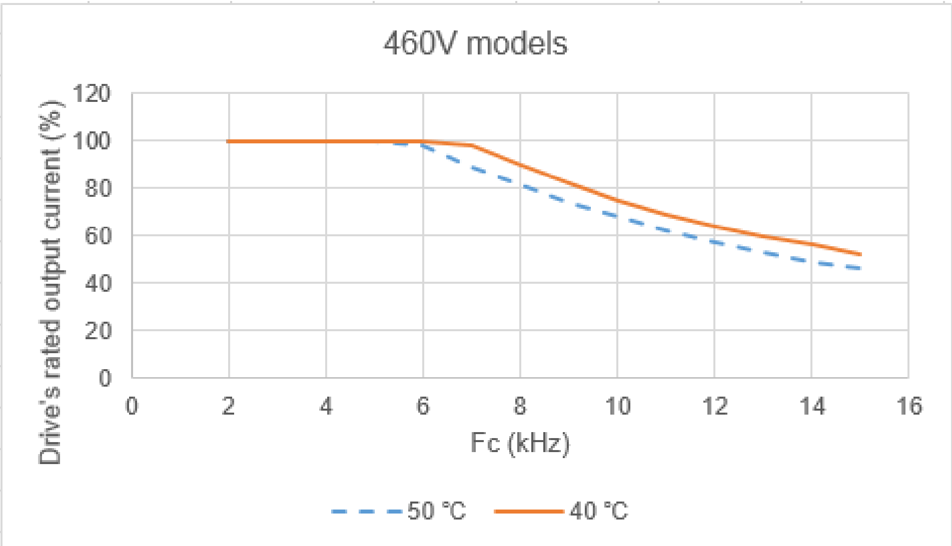


Fig. 9-8

In heavy duty, the rated output current of SVPWM mode in different carrier frequency. (Unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	98	89	81	74	68	62	57	53	49	46
40°C	100	100	100	100	100	98	90	82	75	69	64	60	56	52

Table 9-21

- Dual pulse-width modulation (DPWM) mode

230V models

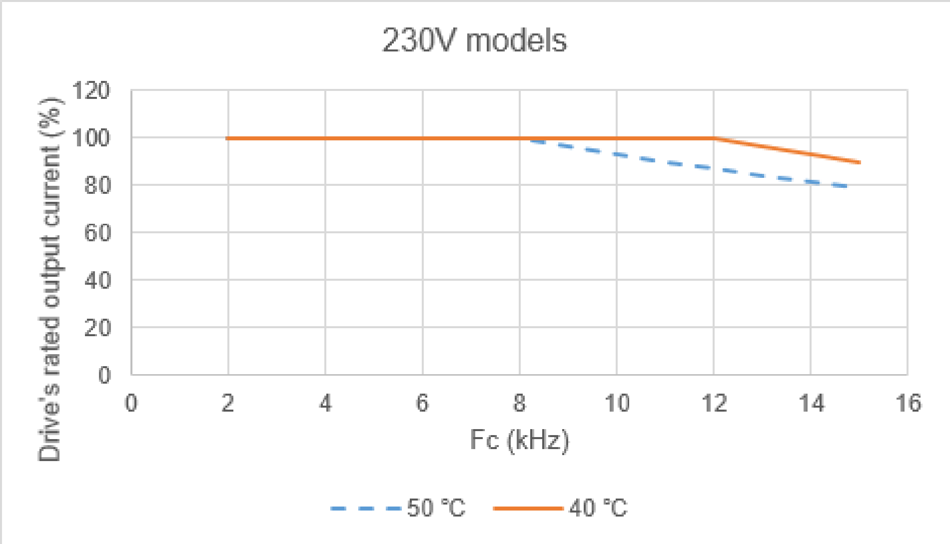


Fig. 9-9

In heavy duty, the rated output current of DPWM mode in different carrier frequency. (Unit: %)

Ambient temperature (Ta) 100% load \ Fc (kHz)	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	100	100	100	96	93	90	87	84	81	79
40°C	100	100	100	100	100	100	100	100	100	100	100	96	93	90

Table 9-22

460V models

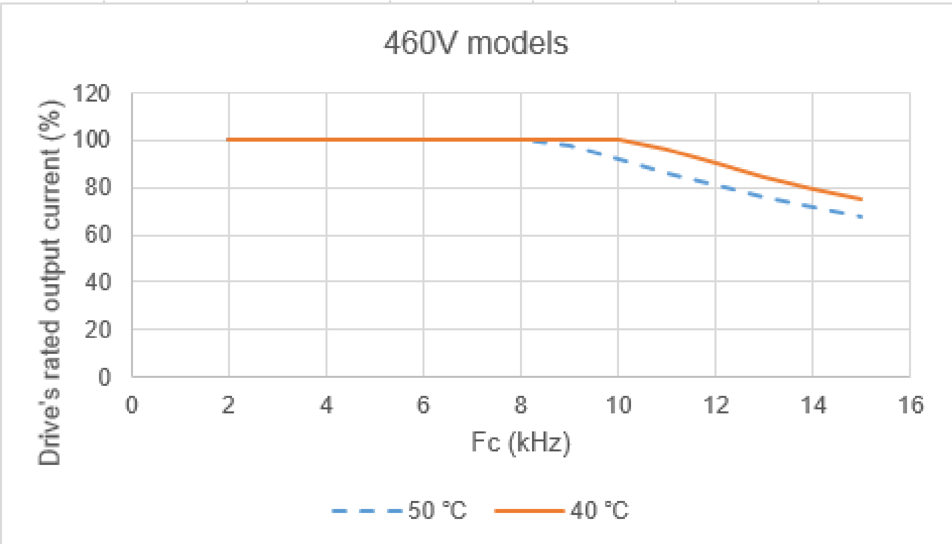


Fig. 9-10

In heavy duty, the rated output current of DPWM mode in different carrier frequency. (Unit: %)

Ambient temperature (Ta) 100% load \ Fc (kHz)	2	3	4	5	6	7	8	9	10	11	12	13	14	15
50°C	100	100	100	100	100	100	100	98	92	86	81	76	72	68
40°C	100	100	100	100	100	100	100	100	100	96	90	84	79	75

Table 9-23

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Chapter 10 Digital Keypad

10-1 KPMH-LC01 Keypad

10-2 Descriptions of Keypad Functions

10-3 Keypad Operation Process

10-4 Reference Table for the 16-segment Digital Keypad LED Display

10-1 KPMH-LC01 Keyboard

Main Display Area
Displays Frequency, Current, Voltage, Steering, User-defined Units, Errors, and more.

Status Display Area

Run Key
Starts the drive.

Stop / Reset Key
Stops the drive and resets after error.

Selection Key for Display Screen
Changes the Display Screen mode.

Digital dial
1.Rotate to adjust the value of frequency or parameters, or select the parameters.
2.Press to:
A. Enter parameter setting page.
B. Save parameter or mode setting.
C. Enter sub-layer page, like APP or COPY functions.

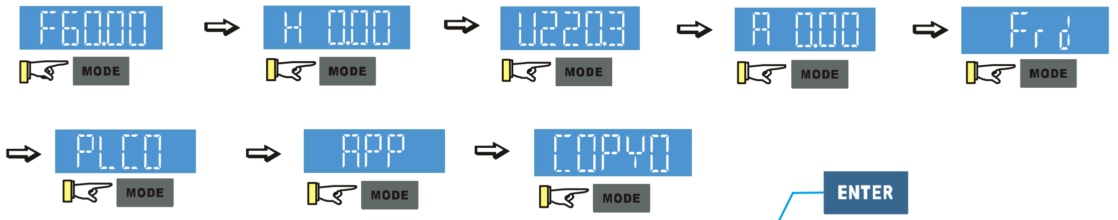
Left Shift Key
Changes the set value and parameters.

10-2 Descriptions of Keypad Functions

Displayed items	Descriptions
	Displays the present frequency setting for the drive
	Displays the actual frequency output to the motor
	Displays the user-defined output of a physical quantity This example is for parameter Pr.00-04 = 30
	Displays the load current
	Forward command
	Reverse command
	Executes / stops the PLC function
	Application selection function
	Parameter copy function
	Displays the count value
	Displays a parameter item
	Displays the content of a parameter value
	Displays an external fault
	Displays the data that has been accepted and automatically stored in the internal memory
	Displays the data set that is not accepted or has exceeded the value
	Displays the drive is in the booting process, and the display will be cleared when the process is finished.

10-3 Keypad Operation Process

A. Main Page Selection



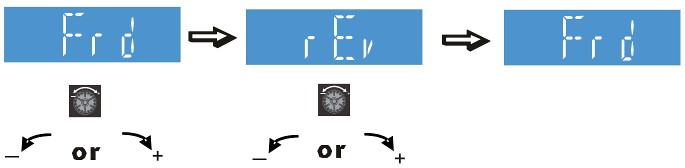
Note 1: Press in page selection mode to enter parameters setting.
Note 2: When Pr.13-00≠0, the APP page then appears.

Setting parameters

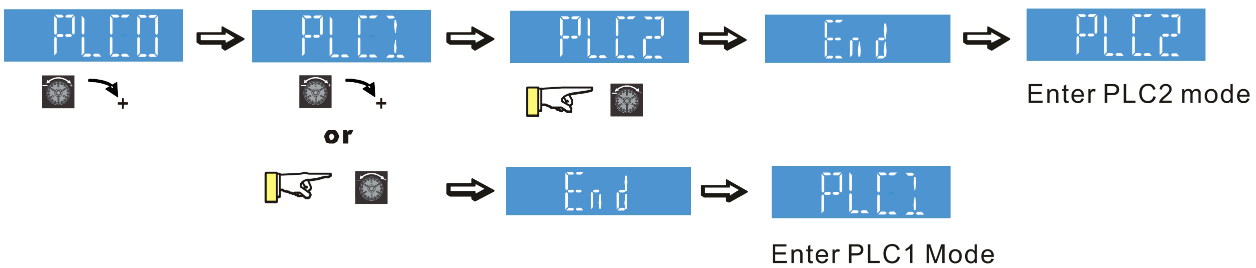
Note: In the parameter setting mode, you can press to return to the selection mode.

To shift data

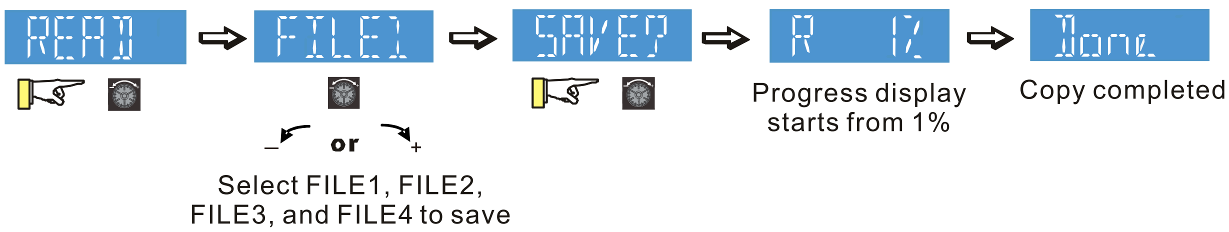
Setting direction (When the operation source is the digital keypad.)



Setting PLC Mode



Copy Parameter (Copy parameter to keypad)

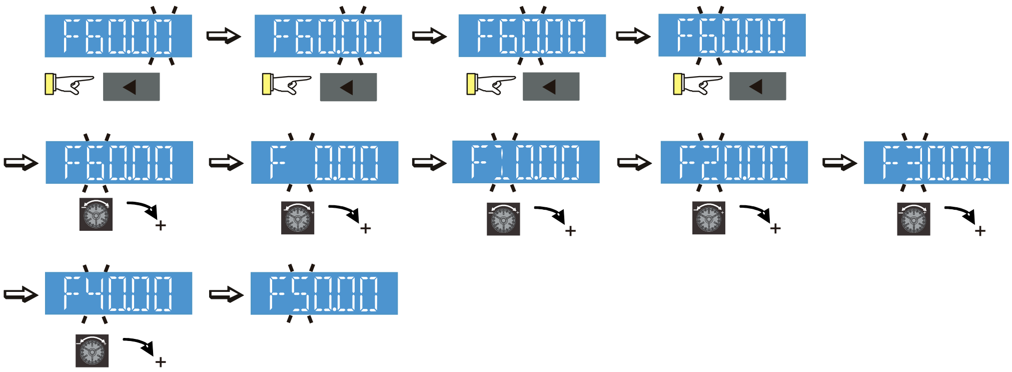


Copy Parameter (Copy parameter to the drive)

B. F Page (Frequency command setting page)

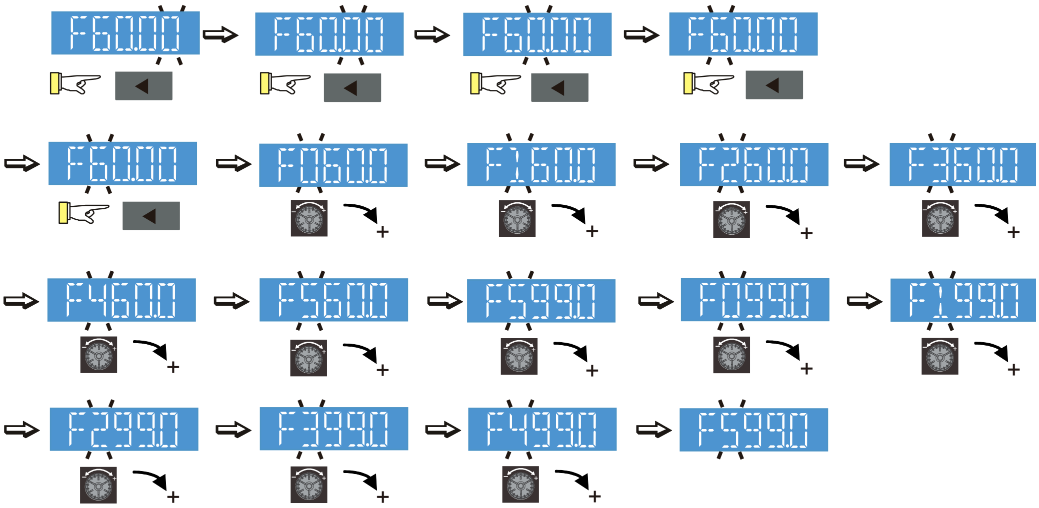
General Mode 1

(maximum operating frequency Pr.01-00 is 2 digits; for example, Pr.01-00 = 60.00 Hz)



General Mode 2

(maximum operating frequency Pr.01-00 is 3 digits; for example, Pr.01-00 = 599.0 Hz)



C. Application Selection Page

The Application Selection page displays APP, but does not show the APP page when Pr.13-00 = 0
The description of Pr.13-00 setting is as follows:

Pr.13-00 = 0
The application selection is inactive and does not show on the display.

F60.00 ⇨ H 0.00 ⇨ U2203 ⇨ A 0.00 ⇨ Frd ⇨ PLC0

MODE MODE MODE MODE MODE

Pr.13-00 = 1 specifies a user-defined application, and the keypad displays “USER”.

APP ⇨ USER ⇨ User-defined parameters displays in sequence ⇨ parameters setting

Pr.13-00 = 2 specifies the Compressor application, and the keypad displays “CoPr”.

APP ⇨ CoPr ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 3 specifies the Fan application, and the keypad displays “FAN”.

APP ⇨ FAN ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 4 specifies the Pump application, and the keypad displays “PUMP”.

APP ⇨ PUMP ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 5 specifies the Conveyor application, and the keypad displays “CnYr”.

APP ⇨ CnYr ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 6 specifies the Machine Tool application, and the keypad displays “CNC”.

APP ⇨ CNC ⇨ Industrial application displays in sequence ⇨ parameters setting

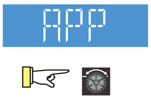
Pr.13-00 = 7 specifies the Packing application, and the keypad displays “PACK”.

APP ⇨ PACK ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 8 specifies the Textile application, and the keypad displays “TILE”.

 ⇨  ⇨ Industrial application displays in sequence ⇨ parameters setting

Pr.13-00 = 9 specifies the PCB Machine application, and the keypad displays “PCB”.

 ⇨  ⇨ Industrial application displays in sequence ⇨ parameters setting

When Pr.13-00 is not 0, the corresponding parameters appear in the APP page according to the setting for Pr.13-00. In each selected application, you can view the parameters by pressing the digital dial button. If Pr.13-00 = 1, you do not set any parameters. In Pr.13-01–Pr.13-50, you cannot enter the other functions of the USER page. The parameters setting in APP is the same as in the other parameters groups: rotate and then press the digital dial to select and set the parameter’s value.
Follow the process below to set the user-defined application selection (Pr.13-00 = 1).

Set Pr.13-00=1 to enable the user-defined application selection.	→	Set Pr.13-01–Pr.13-50 user-defined parameters in sequence.	→	After finishing setting, press MODE to display the APP page, and then press ENTER to display the USEr page. Press digital dial again to display the user-defined parameters.
				↓
To remove a user-defined parameter, return to Pr.13-01–Pr.13-50 and set the parameters as 0.00 from the last defined parameter in sequence.	←	To change a user-defined parameter, return to Pr.13-01–Pr.13-50 to modify the setting value.	←	Use digital dial to select the user-defined parameters, and press digital dial to check and set the setting.

1. Activate the application selection by setting Pr.13-00.
2. After setting Pr.13-00 = 1, you can enter the definitions for Pr.13-01–50.
3. The default setting for Pr.13-01–50 is P 0.00. Press the digital dial to set the corresponding parameters for Pr.13-01–50 in sequence.
4. Setting the corresponding parameters for Pr.13-01–50 is the same as in other parameter groups: rotate and press the digital dial to select and set the parameter’s value.
   Note 1: you cannot set values for read-only parameters.
   Note 2: you must set Pr.13-01, 02…50 in sequence, or the display shows “Err”.
5. To change the corresponding parameters, go back to Pr.13-01–13-50 to modify.
6. After setting, to remove a set parameter, set the last parameter (set to 0.00) first, or the display shows “Err”.
   For example, if there are 5 user-defined parameters (Pr.13-01, 13-02…13-05), to remove Pr.13-02, remove Pr.13-05, then 13-04, then 13-03 and then 13-02.
7. When finished setting, press MODE to go back to APP page, and the press the digital dial again. The Keypad displays “USER”. After you press the digital dial again, the corresponding parameter that you set appears.

Follow the process below to set specific application selection (Pr.13-00 = 2–8).

Set Pr.13-00 = 2-8 (2–8 represent different industries).	→	After selecting your application, press MODE to return to the APP page. Then, press digital dial to enter into the industry-specific short name page. Pressing digital dial again displays the application macro parameters for the industry.	→	Rotate the digital dial to select the defined parameters, and the press it to check the setting.

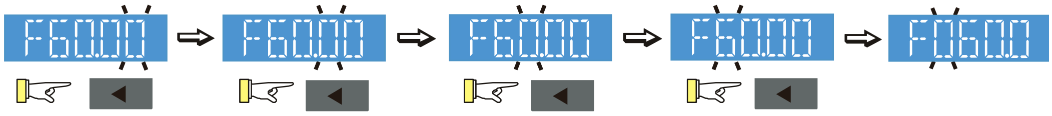
D. Parameter setting

D-1. Unsigned parameter

(Parameter setting range ≥ 0; e.g.: Pr.01-00)

1. Without using the left shift key: rotate the digital dial to select and adjust the parameters.
2. Using the left shift key: After you press the left shift key, and the last digit starts to blink. Press the left shift key to move the blinking cursor to the digit to adjust, and increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise. The value goes to 9 after 0.

   For example: the default setting for Pr.01-00 is 60.00. Pressing the left shift key causes the blinking cursor to move one digit to the left:



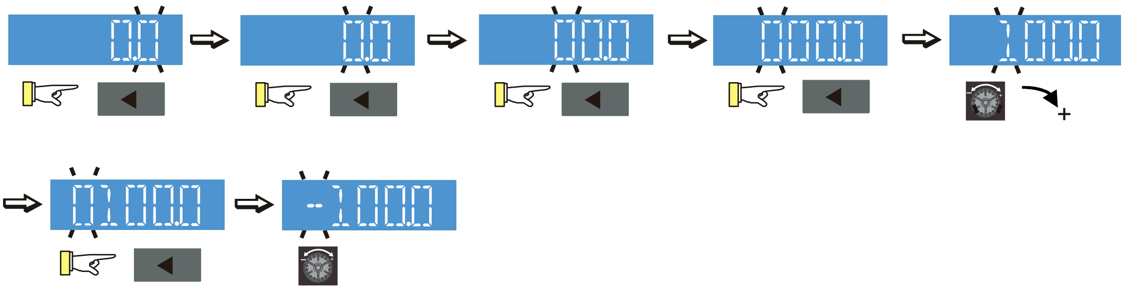
The upper setting limit for Pr.01-00 is 599.00. If you set a value greater than 599.00, "Err" appears after you press the digital dial, and then the keypad shows the upper limit (599.00) for a second to remind you of the incorrect setting. The setting remains as the original value and the cursor returns to the last digit.

D-2. Signed parameter setting status 1

(Parameter setting range can be less than 0, e.g.: 03-03)

1. Without using the left shift key: rotate the digital dial to select and adjust the parameters.
2. Using left shift key: After pressing left shift key, the last digit starts to blink. Press the left shift key to move to the digit to adjust, and increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise, and the value goes to 9 after 0.
3. Press left shift button to shift the blinking cursor one digit to the left. When you shift to the first digit and press the digital dial, the digit "0" changes to "-" (minus).

   For example: the default setting for Pr.03-03 is 0.0. If the value should be -100, then use the left shift key to shift the blinking cursor to the hundreds digit. Rotate the digital dial clockwise to 1, and then press left shift to move to the first digit. Rotate the digital dial from "0" to "-".



The upper limit for Pr.03-03 is 100.0 and lower limit is -100.0. If the value is more than 100.0 or less than -100.0, “Err” appears after you press the digital dial, and then the keypad shows the upper limit (100.0) or lower limit (-100.0) for a second to remind you of the incorrect setting. The setting value remains as the original set value, and the cursor returns to the last digit.

D-3. Signed parameter setting status 2

(Parameter setting range can be less than 0, and the lower limit ≤ -100.00, with two decimal places, e.g. Pr.03-74)

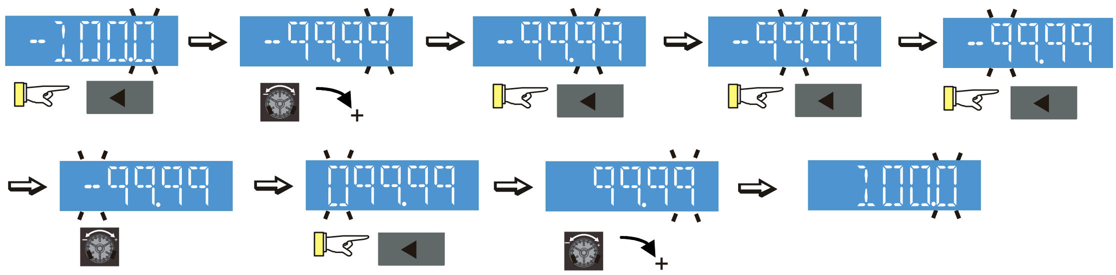
Do not use the left shift key: rotate the digital dial to select and adjust the parameters.

Use the left shift key: After pressing left shift key, and the last digit starts to blink. Press the left shift key to move to the digit to adjust, and then increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise, and the value goes to 9 after 0.

Press left shift button to shift the blinking cursor one digit to the left. When you shift to the first digit and press the digital dial, the digit “0” changes to “-” (minus).

Note: When the parameter value can be set to 2 decimal places, and the set value has hundred digits, then you cannot shift the blinking cursor with the left shift key.

For example: change Pr.03-74 from -100 to 100



The upper limit for Pr.03-74 is 100.00 and lower limit is -100.00. If you set a value of more than 100.0 or less than -100.0, “Err” appears after you press the digital dial, and then the keypad shows the upper limit (100.0) or lower limit (-100.0) (only 1 decimal) for a second to remind you of the incorrect setting. The setting value remains as the original set value. The cursor returns to the last digit.

10-4 Reference Table for the 16-segment Digital Keypad LED Display

Number	0	1	2	3	4	5	6	7	8	9
16-segment display										
Alphabet	A	a	B	b	C	c	D	d	E	e
16-segment display		-								
Alphabet	F	f	G	g	H	h	I	i	J	j
16-segment display				-						
Alphabet	K	k	L	l	M	m	N	n	O	o
16-segment display		-		-		-				
Alphabet	P	p	Q	q	R	r	S	s	T	t
16-segment display		-						-		
Alphabet	U	u	V	v	W	w	X	x	Y	y
16-segment display								-		-
Alphabet	Z	z								
16-segment display		-								

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Chapter 11 Summary of Parameter Settings

00 Drive Parameters

01 Basic Parameters

02 Digital Input / Output Parameters

03 Analog Input / Output Parameters

04 Multi-Step Speed Parameters

05 Motor Parameters

06 Protection Parameters (1)

07 Special Parameters

08 High-function PID Parameters

09 Communication Parameters

10 Speed Feedback Control Parameters

11 Advanced Parameters

12 Tension Control Parameters

13 Macro (User-defined)

14 Protection Parameters (2)

This chapter provides a summary of parameter (Pr.) setting ranges and defaults. You can set, change, and reset parameters through the digital keypad.

NOTE:

1. ✓: You can set this parameter during operation.
2. See Chapter 12 for more details about parameter settings.
3. The following are abbreviations for different types of motors:
   - IM: Induction motor
   - PM: Permanent magnet synchronous AC motor
   - IPM: Interior permanent magnet synchronous AC motor
   - SPM: Surface permanent magnet synchronous AC motor

00 Drive Parameters

Pr.	Parameter Name	Setting Range	Default
00-00	AC motor drive identity code	102: 110 V, 1 Phase, 0.25 HP 103: 110 V, 1 Phase, 0.5 HP 104: 110 V, 1 Phase, 1 HP 302: 230 V, 1 Phase, 0.25 HP 303: 230 V, 1 Phase, 0.5 HP 304: 230 V, 1 Phase, 1 HP 305: 230 V, 1 Phase, 2 HP 306: 230 V, 1 Phase, 3 HP 202: 230 V, 3 Phase, 0.25 HP 203: 230 V, 3 Phase, 0.5 HP 204: 230 V, 3 Phase, 1 HP 205: 230 V, 3 Phase, 2 HP 206: 230 V, 3 Phase, 3 HP 207: 230 V, 3 Phase, 5 HP 208: 230 V, 3 Phase, 7.5 HP 209: 230 V, 3 Phase, 10 HP 210: 230 V, 3 Phase, 15 HP 211: 230 V, 3 Phase, 20 HP 212: 230V, 3 Phase, 25 HP 213: 230V, 3 Phase, 30 HP 214: 230V, 3 Phase, 40 HP 215: 230V, 3 Phase, 50 HP 403: 460 V, 3 Phase, 0.5 HP 404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 407: 460 V, 3 Phase, 5 HP 408: 460 V, 3 Phase, 7.5 HP	Read only

	Pr.	Parameter Name	Setting Range	Default
			409: 460 V, 3 Phase, 10 HP 410: 460 V, 3 Phase, 15 HP 411: 460 V, 3 Phase, 20 HP 412: 460 V, 3 Phase, 25 HP 413: 460 V, 3 Phase, 30 HP 414: 460V, 3 Phase, 40 HP 415: 460V, 3 Phase, 50 HP 416: 460V, 3 Phase, 60 HP 417: 460V, 3 Phase, 75 HP 418: 460V, 3 Phase, 100 HP	
	00-01	AC motor drive rated current	Display by models	Read only
	00-02	Parameter reset	0: No function 1: Write protection for parameters 5: Reset kWh display to 0 6: Reset PLC (including CANopen Master Index) 7: Reset CANopen index (slave) 9: Reset all parameters to defaults with base frequency at 50 Hz 10: Reset all parameters to defaults with base frequency at 60 Hz 11: Reset all parameters to defaults with base frequency at 50 Hz (keep the setting values of user-defined Pr.13-01–13-50) 12: Reset all parameters to defaults with base frequency at 60 Hz (keep the setting values of user-defined Pr.13-01–13-50)	0
✔	00-03	Start-up display selection	0: F (frequency command) 1: H (output frequency) 2: U (multi-function display, see Pr.00-04) 3: A (output current)	0
✔	00-04	Content of Multi-function display (user-defined)	0: Display the output current from the drive to the motor (A) (unit: Amps) 1: Display the counter value (c) (unit: CNT) 2: Display the drive's actual output frequency (H.) (unit: Hz) 3: Display the drive's DC bus voltage (V) (unit: V_{DC}) 4: Display the drive's output voltage (E) (unit: V_{AC}) 5: Display the drive's output power angle (n) (unit: deg) 6: Display the drive's output power (P) (unit: kW) 7: Display the motor speed (r) (unit: rpm)	3

Pr.	Parameter Name	Setting Range	Default
		8: Display the drive's estimated output torque%, motor's rated torque is 100% (t) (unit: %) 9: Display PG feedback (G) (unit: PLS) (refer to Pr.10-00–10-01) 10: Display PID feedback (b) (unit: %) 11: Display signal value of AVI analog input terminal (1.) (unit: %) 12: Display signal value of ACI analog input terminal (2.) (unit: %) 14: Display the drive's IGBT temperature (i.) (unit: ºC) 16: Display digital input status ON / OFF (i) 17: Display digital output status ON / OFF (o) 18: Display the current multi-step speed (S) 19: Display corresponding CPU digital input pin status (d) 20: Display corresponding CPU digital output pin status (0.) 21: Actual motor position (PG1 of PG card) (P.) (The maximum value is 32 bits to display) 22: Pulse input frequency (S.) 23: Pulse input position (q.) 24: Position command tracing error (E.) 25: Overload count (0.00–100.00%) (o.) (unit: %) 26: GFF ground fault (G.) (unit: %) 27: DC bus voltage ripple (r.) (unit: V_{DC}) 28: Display PLC register D1043 data (C) 29: Display permanent magnet synchronous motor pole section (for EMM-PG01R) 30: Display the output of user-defined parameter (U) 31: Display Pr.00-05 user gain (K) 32: Number of actual motor revolutions during operation (PG card plugs in and Z phase signal input) (Z.) 33: Actual motor position during operation (when PG card is connected) (q) 35: Control mode (t.): 0 = Speed control mode (SPD) 1 = Torque control mode (TQR) 36: The current operating carrier frequency of the drive (J.) (unit: Hz) 38: Display the drive status (6.) 39: Display the drive's estimated output torque, positive and negative, using N-m as unit (0.0: positive torque; -0.0: negative torque) (C.)	

Pr.	Parameter Name	Setting Range	Default
		40: Torque command (L.) (unit: %) 41: kWh (J) (unit: kWh) 42: PID target value (h.) (unit: %) 43: PID offset (o.) (unit: %) 44: PID output frequency (b.) (unit: Hz) 46: Auxiliary frequency value (U.) (unit: Hz) 47: Master frequency value (A) (unit: Hz) 48: Frequency value after addition and subtraction of auxiliary and master frequency (L.) (unit: Hz) 51: PMSVC torque offset 52: Signal of analog extension card input terminal AI10 (4.) (unit: %) 53: Signal of analog extension card input terminal AI11 (5.) (unit: %) 55: Display the current reel diameter under the tension control (d) (unit: mm) 56: Display the current line speed under the tension control (L) (unit: m / minute) 57: Display the current tension setting value under the tension control (T) (unit: N)	
00-05	Coefficient gain in actual output frequency	0.00–160.00	1.00
00-06	Firmware version	Read only	Read only
00-07	Parameter protection password input	0–65535 0–4 (the number of password attempts)	0
00-08	Parameter protection password setting	0–65535 0: No password protection / password entered correctly in Pr.00-07 1: Parameters have been locked	0
00-10	Control mode	0: Speed mode 1: Position control mode 2: Torque mode	0
00-11	Speed control mode	0: IMVF (IM V/F control) 1: IMVFPG (IM V/F control + encoder) 2: IM / PM SVC (IM / PM space vector control) 3: IMFOCPG (IM FOC vector control + encoder) 4: PMFOCPG (PM FOC vector control + encoder) 5: IMFOC sensorless (IM field-oriented sensorless vector control) 7: IPM sensorless (Interior PM field-oriented sensorless vector control)	0

	Pr.	Parameter Name	Setting Range	Default
	00-13	Torque control mode	0: IM TQCPG (IM Torque control + encoder) 1: PM TQCPG (PM Torque control + encoder) 2: IMTQC sensorless (IM sensorless torque control)	0
	00-16	Duty selection	0: Normal duty 1: Heavy duty	1
	00-17	Carrier frequency	Normal duty: 2–15 kHz	4
			Heavy duty: 2–15 kHz **NOTE:** When Pr.00-11=5 (IMFOC Sensorless), the maximum carrier frequency is 14 kHz	4
	00-19	PLC command mask	bit 0: Control command controlled by PLC bit 1: Frequency command controlled by PLC bit 3: Torque command controlled by PLC	Read only
✔	00-20	Master frequency command source (AUTO, REMOTE)	0: Inputs from digital keypad 1: Inputs from RS-485 communication 2: Inputs from external analog (refer to Pr.03-00) 3: Inputs from external UP / DOWN terminals (multi-function input terminals) 4: Pulse inputs without direction command (refer to Pr.10-16 without direction) 5: Pulse inputs with direction command (refer to Pr.10-16) 6: CANopen communication card 8: Communication cards (CANopen card not included) 9: PID function (Pr.08-65 should be set as 1) **NOTE:** HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56 or with KPC-CC01 (optional).	0
	00-21	Operation command source (AUTO, REMOTE)	0: Digital keypad 1: External terminals 2: RS-485 communication ~~input~~ 3: CANopen communication card 5: Communication card (CANopen card not included) **NOTE:** HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56 or with KPC-CC01 (optional).	0
✔	00-22	Stop method	0: Ramp to stop 1: Coast to stop	0
✔	00-23	Control of motor direction	0: Enable forward and reverse 1: Disable reverse 2: Disable forward	0

	Pr.	Parameter Name	Setting Range	Default
	00-24	Digital keypad frequency command memory	Read only	Read only
〆	00-25	User-defined characteristics	bit 0–3: user-defined decimal places 0000h --- 0000b: no decimal place 0001h --- 0001b: one decimal place 0002h --- 0010b: two decimal places 0003h --- 0011b: three decimal places bit 4–15: user-defined unit 000xh: Hz 001xh: rpm 002xh: % 003xh: kg 004xh: m/s 005xh: kW 006xh: HP 007xh: ppm 008xh: 1/m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: lb/s 00Dxh: lb/m 00Exh: lb/h 00Fxh: ft/s 010xh: ft/m 011xh: m 012xh: ft 013xh: degC 014xh: degF 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG 01Cxh: psi 01Dxh: atm 01Exh: L/s 01Fxh: L/m	0

Pr.	Parameter Name	Setting Range	Default
		020xh: L/h 021xh: m3/s 022xh: m3/h 023xh: GPM 024xh: CFM xxxxh: Hz	
00-26	Maximum user-defined value	0: Disable 0–65535 (when Pr.00-25 set to no decimal place) 0.0–6553.5 (when Pr.00-25 set to 1 decimal place) 0.00–655.35 (when Pr.00-25 set to 2 decimal places) 0.000–65.535 (when Pr.00-25 set to 3 decimal places)	0
00-27	User-defined value	Read only	Read only
00-29	LOCAL / REMOTE mode	0: Standard HOA function 1: When switching between local and remote, the drive stops. 2: When switching between local and remote, the drive runs with REMOTE settings for frequency and operation status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operation status. 4: When switching between local and remote, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operation status.	0
00-30	Master frequency command source (HAND, LOCAL)	0: Inputs from digital keypad 1: Inputs from RS-485 communication 2: Inputs from external analog (refer to Pr.03-00) 3: Inputs from external UP / DOWN terminals (multi-function input terminals) 4: Pulse inputs without direction command (refer to Pr.10-16 without direction) 5: Pulse inputs with direction command (refer to Pr.10-16) 6: CANopen communication card 8: Communication card (CANopen card not included) 9: PID function **NOTE:** HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56 or with KPC-CC01 (optional).	0

	Pr.	Parameter Name	Setting Range	Default
	00-31	Operation command source (HAND, LOCAL)	0: Digital keypad 1: External terminals 2: RS-485 communication 3: CANopen communication card 5: Communication card (CANopen card not included) **NOTE:** HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56 or with KPC-CC01 (optional).	0
✔	00-32	Digital keypad STOP function	0: Disable STOP key 1: Enable STOP key	0
	00-33	RPWM Mode Selection	0: Disabled 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	0
✔	00-34	RPWM Range	0.0–4.0 kHz	0.0
	00-35	Auxiliary frequency source	0: Master and auxiliary frequency function disabled 1: Inputs from digital keypad 2: Inputs from RS-485 communication 3: Inputs from analog input 4: Inputs from external UP / DOWN (multi-function input terminals) 5: Pulse inputs without direction command (refer to Pr.10-16) 6: CANopen communication card 8: Communication card	0
	00-36	Master and auxiliary frequency command selection	0: Master + auxiliary frequency 1: Master - auxiliary frequency 2: Auxiliary - master frequency	0
	00-47	Output phase order selection	0: Standard 1: Reverse the rotation direction	0
✔	00-48	Display filter time (current)	0.001–65.535 sec.	0.100
✔	00-49	Display filter time (keypad)	0.001–65.535 sec.	0.100
	00-50	Software version (date)	Read only	Read only

01 Basic Parameters

	Pr.	Parameter Name	Setting Range	Default
	01-00	Motor 1 maximum operation frequency	0.00–599.00 Hz	60.00 / 50.00
	01-01	Motor 1 rated / base frequency	0.00–599.00 Hz	60.00 / 50.00
	01-02	Motor 1 rated / base voltage	115V / 230V models: 0.0–255.0 V 460V series: 0.0–510.0 V	220.0 440.0
	01-03	Motor 1 mid-point frequency 1	0.00–599.00 Hz	3.00
〆	01-04	Motor 1 mid-point voltage 1	115V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	11.0 22.0
	01-05	Motor 1 mid-point frequency 2	0.00–599.00 Hz	1.50
〆	01-06	Motor 1 mid-point voltage 2	115V / 230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	5.0 10.0
	01-07	Motor 1 minimum output frequency	0.00–599.00 Hz	0.50
〆	01-08	Motor 1 minimum output voltage	115V / 230V models: 0.0–240.0 V 460V series: 0.0–480.0 V	1.0 2.0
	01-09	Start-up frequency	0.00–599.00 Hz	0.50
〆	01-10	Upper frequency limit	0.00–599.00 Hz	599.00
〆	01-11	Lower frequency limit	0.00–599.00 Hz	0.00
〆	01-12	Acceleration time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-13	Deceleration time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-14	Acceleration time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-15	Deceleration time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-16	Acceleration time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-17	Deceleration time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-18	Acceleration time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
〆	01-19	Deceleration time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00

	Pr.	Parameter Name	Setting Range	Default
✎	01-20	JOG acceleration time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
✎	01-21	JOG deceleration time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	10.00
✎	01-22	JOG frequency	0.00–599.00 Hz	6.00
✎	01-23	First / Fourth acceleration / deceleration exchange frequency	0.00–599.00 Hz	0.00
✎	01-24	S-curve acceleration begin time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.00–250.00 sec.	0.20
✎	01-25	S-curve acceleration arrival time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.00–250.00 sec.	0.20
✎	01-26	S-curve deceleration begin time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.00–250.00 sec.	0.20
✎	01-27	S-curve deceleration arrival time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.00–250.00 sec.	0.20
	01-28	Skip frequency 1 (upper limit)	0.00–599.00 Hz	0.00
	01-29	Skip frequency 1 (lower limit)	0.00–599.00 Hz	0.00
	01-30	Skip frequency 2 (upper limit)	0.00–599.00 Hz	0.00
	01-31	Skip frequency 2 (lower limit)	0.00–599.00 Hz	0.00
	01-32	Skip frequency 3 (upper limit)	0.00–599.00 Hz	0.00
	01-33	Skip frequency 3 (lower limit)	0.00–599.00 Hz	0.00
	01-34	Zero-speed mode	0: Output waiting 1: Zero-speed operation 2: Minimum frequency (refer to Pr.01-07 and Pr.01-41)	0
	01-35	Motor 2 output frequency	0.00–599.00 Hz	60.00 / 50.00
	01-36	Motor 2 Output voltage	115 / 230 V models: 0.0–255.0 V 460 V models: 0.0–510.0 V	220.0 440.0
	01-37	Motor 2 Mid-point frequency 1	0.00–599.00 Hz	3.00
✎	01-38	Motor 2 mid-point voltage 1	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	11.0 22.0

	Pr.	Parameter Name	Setting Range	Default
	01-39	Motor 2 mid-point frequency 2	0.00–599.00 Hz	1.50
✓	01-40	Motor 2 mid-point voltage 2	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	5.0 10.0
	01-41	Motor 2 Minimum output frequency	0.00–599.00 Hz	0.50
✓	01-42	Motor 2 minimum output voltage	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	1.0 2.0
	01-43	V/F curve selection	0: V/F curve determined by Pr.01-00–01-08 1: V/F curve to the power of 1.5 2: V/F curve to the power of 2 16: V/F Separated mode (VFSM)	0
✓	01-44	Auto-acceleration / deceleration setting	0: Linear acceleration and deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto deceleration 3: Auto-acceleration and auto-deceleration 4: Linear, stall prevention by auto-acceleration and deceleration (limited by Pr.01-12–01-21)	0
	01-45	Time unit for acceleration / deceleration and S-curve	0: Unit 0.01 sec. 1: Unit 0.1 sec.	0
✓	01-46	CANopen quick stop time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.00 sec.	1.00
	01-49	Deceleration method	0: No function 1: Over-voltage energy restriction 2: Traction energy control	0
	01-52	Motor 2 maximum operation frequency	0.00–599.00 Hz	60.00/ 50.00
	01-53	Motor 3 maximum operation frequency	0.00–599.00 Hz	60.00/ 50.00
	01-54	Motor 3 output frequency	0.00–599.00 Hz	60.00/ 50.00
	01-55	Motor 3 output voltage	115 / 230 V models: 0.0–255.0 V 460 V models: 0.0–510.0 V	220.0 440.0
	01-56	Motor 3 mid-point frequency 1	0.00–599.00 Hz	3.00
✓	01-57	Motor 3 mid-point voltage 1	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	11.0 22.0
	01-58	Motor 3 mid-point frequency 2	0.00–599.00 Hz	1.50

	Pr.	Parameter Name	Setting Range	Default
✓	01-59	Motor 3 mid-point voltage 2	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	5.0 10.0
	01-60	Motor 3 minimum output frequency	0.00–599.00 Hz	0.50
✓	01-61	Motor 3 minimum output voltage	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	1.0 2.0
	01-62	Motor 4 maximum operation frequency	0.00–599.00 Hz	60.00 / 50.00
	01-63	Motor 4 output frequency	0.00–599.00 Hz	60.00 / 50.00
	01-64	Motor 4 output voltage	115 / 230 V models: 0.0–255.0 V 460 V models: 0.0–510.0 V	220.0 440.0
	01-65	Motor 4 mid-point frequency 1	0.00–599.00 Hz	3.00
✓	01-66	Motor 4 mid-point voltage 1	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	11.0 22.0
	01-67	Motor 4 mid-point frequency 2	0.00–599.00 Hz	1.50
✓	01-68	Motor 4 mid-point voltage 2	115 / 230 V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	5.0 10.0
	01-69	Motor 4 minimum output frequency	0.00–599.00 Hz	0.50
✓	01-70	Motor 4 minimum output voltage	115 / 230V models: 0.0–240.0 V 460 V models: 0.0–480.0 V	1.0 2.0
	01-72	V/F separated mode, Voltage Input Percentage	0.00–100.00	50.00
	01-73	V/F separated mode, Voltage Input Source Selection	0: Digital Keypad 1: RS-485 communication 2: Reserved 3: AVI Analog input 4: ACI Analog input 5: Reserved 6: CANopen communicaton 7: Communication Card	0
	01-74	V/F separated mode, Voltage increasing time	1.00–600.00	0.00
	01-75	V/F separated mode, Voltage decreasing time	1.00–600.00	0.00

Pr.	Parameter Name	Setting Range	Default
01-76	V/F separated mode stop method	0: voltage decrease to 0 first, then frequency decrease to 0. 1: voltage and frequency decrease to 0 at the same time	0
01-77	The deceleration time of VFSM over-current stall prevention	1.00–600.00	0.00

02 Digital Input / Output Parameters

<table>
<tr><th>Pr.</th><th>Parameter Name</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>02-00</td><td>Two-wire / three-wire operation control</td><td>0: No function
1: Two-wire mode 1, power ON for operation control
(M1: FWD / STOP, M2: REV / STOP)
2: Two-wire mode 2, power ON for operation control
(M1: RUN / STOP, M2: FWD / REV)
3: Three-wire, power ON for operation control
(M1: RUN, M2: REV / FWD, M3: STOP)
4: Two-wire mode 1, Quick Start
(M1: FWD / STOP, M2: REV / STOP)
5: Two-wire mode 2, Quick Start
(M1: RUN / STOP, M2: FWD / REV)
6: Three-wire, Quick Start
(M1: RUN, M2: REV / FWD, M3: STOP)
<u>IMPORTANT</u>
1. In Quick Start function, terminal output will keep in ready status, drive will response to the command immediately.
2. When using Quick Start function, the output terminals UVW are with driving voltages in order to output and respond immediately if a Start command is given. Do not touch the terminals or modify the motor wiring to prevent electric shocks.</td><td>1</td></tr>
<tr><td>02-01</td><td>Multi-function input command 1 (MI1)</td><td rowspan="8">0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG operation
[by external control or KPC-CC01 (optional)]
7: Acceleration / deceleration speed inhibit
8: 1st and 2nd acceleration / deceleration time selection
9: 3rd and 4th acceleration / deceleration time selection
10: External fault (EF) input (Pr.07-20)
11: Base Block (B.B.) input from external
12: Output stops
13: Cancel the setting for auto-acceleration / auto-deceleration time
15: Rotating speed command from AVI</td><td>0</td></tr>
<tr><td>02-02</td><td>Multi-function input command 2 (MI2)</td><td>0</td></tr>
<tr><td>02-03</td><td>Multi-function input command 3 (MI3)</td><td>1</td></tr>
<tr><td>02-04</td><td>Multi-function input command 4 (MI4)</td><td>2</td></tr>
<tr><td>02-05</td><td>Multi-function input command 5 (MI5)</td><td>3</td></tr>
<tr><td>02-06</td><td>Multi-function input command 6 (MI6)</td><td>4</td></tr>
<tr><td>02-07</td><td>Multi-function input command 7 (MI7)</td><td>0</td></tr>
<tr><td>02-26</td><td>Input terminal of extension card (MI10)</td><td>0</td></tr>
</table>

Pr.	Parameter Name	Setting Range	Default
02-27	Input terminal of extension card (MI11)	16: Rotating speed command from ACI 18: Forced to stop (Pr.07-20)	0
02-28	Input terminal of extension card (MI12)	19: Frequency up command 20: Frequency down command	0
		21: PID function disabled 22: Clear the counter 23: Input the counter value (MI6) 24: FWD JOG command 25: REV JOG command 26: TQC / FOC mode selection 27: ASR1 / ASR2 selection 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for ∆-connection 31: High torque bias (Pr.11-30) 32: Middle torque bias (Pr.11-31) 33: Low torque bias (Pr.11-32) 35: Enable single-point positioning 37: Enable pulse-train position command position control 38: Disable to write EEPROM function 39: Torque command direction 40: Force coasting to stop 41: HAND switch 42: AUTO switch 43: Enable resolution selection (Pr.02-48) 44: Negative limit switch (NL) 45: Positive limit switch (PL) 46: Homing (ORG) 48: Mechanical gear ratio switch 49: Enable Drive 50: Inputs slave dEb action 51: Selection for PLC mode bit 0 52: Selection for PLC mode bit 1 53: Trigger CANopen quick stop 56: Local / remote selection 70: Force auxiliary frequency return to 0 71: Disable PID function, force PID output return to 0 72: Disable PID function, retain the output value before disabled 73: Force PID integral gain return to 0, disable integral	

	Pr.	Parameter Name	Setting Range	Default
			74: Reverse PID feedback 78: Multi-step position confirmation 79: Position / speed mode switching (0: Speed mode, 1: Position mode) 80: Location command source switching (increase) (0: Internal register, 1: External pulse input) 83: Multi-motors (IM) selection bit 0 84: Multi-motors (IM) selection bit 1 86: Enable initial reel diameter 87: Initial reel diameter 1 88: Initial reel diameter 2 89: PID integration reset 90: Stop calculating the reel diameter 91: Winding mode selection 92: Enable tension control 93: Pause tension PID function 94: Enable to auto switch the reel	
✎	02-09	External terminal UP / DOWN key mode	0: According to acceleration / deceleration time 1: With constant speed (Pr.02-10) 2: Pulse signal (Pr.02-10) 3: Curve 4: Steps (Pr.02-10)	0
✎	02-10	Acceleration / deceleration speed of external terminal UP / DOWN keys	0.001–1.000 Hz/ms	0.001
✎	02-11	Multi-function input response time	0.000–30.000 sec.	0.005
✎	02-12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	0000
✎	02-13	Multi-function output 1 (RY1)	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (Pr.02-22) 4: Desired frequency reached 2 (Pr.02-24) 5: Zero speed (Frequency command) 6: Zero speed including STOP (Frequency command) 7: Over-torque 1 (Pr.06-06–06-08) 8: Over-torque 2 (Pr.06-09–06-11)	11
✎	02-16	Multi-function output 2 (MO1)		0
✎	02-17	Multi-function output 3 (MO2)		0
✎	02-36	Output terminal of extension card (MO10) or (RY10)		0

	Pr.	Parameter Name	Setting Range	Default
🗲	02-37	Output terminal of extension card (MO11) or (RY11)	9: Drive is ready 10: Low voltage warning (Lv) (Pr.06-00) 11: Malfunction indication 13: Over-heat warning (Pr.06-15) 14: Software brake signal indication (Pr.07-00) 15: PID feedback error (Pr.08-13, 08-14) 16: Slip error (oSL) 17: Count value reached; does not return to 0 (Pr.02-20) 18: Count value reached; returns to 0 (Pr.02-19) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation source 25: Forward command 26: Reverse command 29: Output when frequency ≥ Pr.02-34 30: Output when frequency < Pr.02-34 31: Y-connection for the motor coil 32: Δ-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed including STOP (actual output frequency) 35: Error output selection 1 (Pr.06-23) 36: Error output selection 2 (Pr.06-24) 37: Error output selection 3 (Pr.06-25) 38: Error output selection 4 (Pr.06-26) 39: Position reached (Pr.10-19) 40: Speed reached (including STOP) 42: Crane function 43: Motor actual speed detection 44: Low current output (use with Pr.06-71–06-73) 45: UVW output electromagnetic valve switch 46: Outputs master dEb action 49: Homing action completed 50: Output control for CANopen 51: Output control for RS-485 52: Output control for communication cards 66: SO output logic A 67: Analog input level reached	0
🗲	02-38	Output terminal of extension card (MO12) or (RY12)		0

	Pr.	Parameter Name	Setting Range	Default
			68: SO output logic B 69: Maximum reel diameter reached 70: Empty reel diameter reached 71: Broken belt detection 72: Tension PID feedback error 73: Over-torque 3 74: Over-torque 4	
✎	02-18	Multi-function output direction	0000h–FFFFh (0: N.O.; 1: N.C.)	0000
✎	02-19	Terminal counting value reached (returns to 0)	0–65500	0
✎	02-20	Preliminary counting value reached (does not return to 0)	0–65500	0
✎	02-21	Digital output gain (DFM)	1–55	1
✎	02-22	Desired frequency reached 1	0.00–599.00 Hz	60.00 / 50.00
✎	02-23	The width of the desired frequency reached 1	0.00–599.00 Hz	2.00
✎	02-24	Desired frequency reached 2	0.00–599.00 Hz	60.00 / 50.00
✎	02-25	The width of the desired frequency reached 2	0.00–599.00 Hz	2.00
✎	02-34	Output frequency setting for multi-function output terminal	0.00–599.00 Hz	0.00
✎	02-35	External operation control selection after reset and reboot	0: Disable 1: Drive runs if the RUN command remains after reset or reboot.	0
✎	02-47	Motor zero-speed level	0–65535 rpm	0
✎	02-48	Maximum frequency of resolution switch	0.01–599.00 Hz (use with MI setting as 43)	60.00
✎	02-49	Switch delay time of maximum output frequency	0.000–65.000 sec.	0.000
	02-50	Display the status of multi-function input terminal	Monitor the status of multi-function input terminals	Read only
	02-51	Display the status of multi-function output terminal	Monitor the status of multi-function output terminals	Read only

	Pr.	Parameter Name	Setting Range	Default
	02-52	Display the external multi-function input terminals used by PLC	Monitor the status of PLC input terminals	Read only
	02-53	Display the external multi-function output terminals used by PLC	Monitor the status of PLC output terminals	Read only
	02-54	Display the Frequency command executed by external terminal	0.00–599.00 Hz (Read only)	Read only
	02-58	Multi-function output terminal (function 42): brake frequency check point	0.00–599.00 Hz	0.00
	02-70	IO card type	1: EMC-BPS01 (backup power supply) 10: EMM-D33A 11: EMM-A22A 12: EMM-R2CA 13: EMM-R3AA	Read only
	02-74	Internal / external multi-function input terminal selection	0000–FFFFh	0000h
	02-75	Internal multi-function output terminal selection	0000–FFFFh	0000h
✐	02-81	EF activates when the terminal count value reached	0: Terminal count value reached, no EF displays (continues operating) 1: Terminal count value reached, EF is active	0
✐	02-82	Initial frequency command (F) mode after stop	0: Use current frequency command 1: Use zero frequency command 2: Refer to Pr.02-83 to setup	0
✐	02-83	Initial frequency command (F) setting after stop	0.00–599.0 Hz	60.00

03 Analog Input / Output Parameters

<table>
<tr><th></th><th>Pr.</th><th>Parameter Name</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>✎</td><td>03-00</td><td>AVI analog input selection</td><td rowspan="2">0: No function
1: Frequency command
2: Torque command (torque limit in speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: Thermistor input value (PTC)
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive / negative torque limit
11: PT100 thermistor input value
12: Auxiliary frequency input
13: PID compensation value
14: Tension PID feedback signal
15: Line speed
16: Reel diameter
17: Tension PID target value
18: Tension setting value
19: Zero-speed tension
20: Tension taper</td><td>1</td></tr>
<tr><td>✎</td><td>03-01</td><td>ACI analog input selection</td><td>0</td></tr>
<tr><td>✎</td><td>03-03</td><td>AVI analog input bias</td><td>-100.0–100.0%</td><td>0.0</td></tr>
<tr><td>✎</td><td>03-04</td><td>ACI analog input bias</td><td>-100.0–100.0%</td><td>0.0</td></tr>
<tr><td>✎</td><td>03-07</td><td>AVI positive / negative bias mode</td><td rowspan="2">0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center</td><td rowspan="2">0</td></tr>
<tr><td>✎</td><td>03-08</td><td>ACI positive / negative bias mode</td></tr>
<tr><td>✎</td><td>03-10</td><td>Reverse setting when analog signal input is negative frequency</td><td>0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.
1: Negative frequency input is allowed. Positive frequency = run in forward direction; negative frequency = run in reverse direction. The digital keypad or external terminal control cannot switch the running direction.</td><td>0</td></tr>
<tr><td>✎</td><td>03-11</td><td>AVI analog input gain</td><td>-500.0–500.0%</td><td>100.0</td></tr>
<tr><td>✎</td><td>03-12</td><td>ACI analog input gain</td><td>-500.0–500.0%</td><td>100.0</td></tr>
</table>

	Pr.	Parameter Name	Setting Range	Default
✓	03-15	AVI analog input filter time	0.00–20.00 sec.	0.01
✓	03-16	ACI analog input filter time	0.00–20.00 sec.	0.01
✓	03-18	Analog input addition function	0: Disable (AVI, ACI) 1: Enable (analog extension card not included)	0
	03-19	Signal loss selection for analog input 4–20 mA	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display "ACE"	0
✓	03-20	AFM multi-function output	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque 9: AVI 10: ACI 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 18: Torque command 19: PG2 frequency command 20: CANopen analog output 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	0
✓	03-21	AFM analog output gain	0.0–500.0%	100.0
✓	03-22	AFM analog output in REV direction	0: Absolute value of output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0
✓	03-27	AFM output bias	-100.00–100.00%	0.00
✓	03-28	AVI terminal input selection	0: 0–10 V 3: -10–10 V (Pr.03-69–03-74 are valid)	0

Pr.	Parameter Name	Setting Range	Default
03-29	ACI terminal input selection	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	0
03-30	PLC analog output terminal status	Monitor the status of PLC analog output terminals bit 1: AFM bit 2: AO10 bit 3: AO11	Read only
03-31	AFM output selection	0: 0–10 V output 1: 0–20 mA output 2: 4–20 mA output	0
03-32	AFM DC output setting level	0.00–100.00%	0.00
03-35	AFM output filter time	0.00–20.00 sec.	0.01
03-39	VR input selection	0: Disable 1: Frequency command	1
03-44	Multi-function MO output by AI level source	0: AVI 1: ACI 3: Extension card input terminal AI10 4: Extension card input terminal AI11	0
03-45	AI upper level 1	-100.00–100.00%	50.00
03-46	AI lower level 2	-100.00–100.00%	10.00
03-50	Analog input curve selection	0: Normal curve 1: Three-point curve of AVI (& AI10) 2: Three-point curve of ACI (& AI11) 3: Three-point curve of AVI & ACI (& AI10 & AI11) (AI10, AI11 are valid when extension card is installed)	0
03-57	ACI lowest point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	4.00
03-58	ACI proportional lowest point	0.00–100.00%	0.00
03-59	ACI mid-point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	12.00
03-60	ACI proportional mid-point	0.00–100.00%	50.00
03-61	ACI highest point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	20.00
03-62	ACI proportional highest point	0.00–100.00%	100.00
03-63	AVI voltage lowest point	0.00–10.00 V	0.00
03-64	AVI voltage proportional lowest point	-100.00–100.00%	0.00

	Pr.	Parameter Name	Setting Range	Default
✎	03-65	AVI voltage mid-point	0.00–10.00 V	5.00
✎	03-66	AVI voltage proportional mid-point	-100.00–100.00%	50.00
✎	03-67	AVI voltage highest point	0.00–10.00 V	10.00
✎	03-68	AVI voltage proportional highest point	-100.00–100.00%	100.00
✎	03-69	Negative AVI voltage lowest point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	0.00
✎	03-70	Negative AVI voltage proportional lowest point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	0.00
✎	03-71	Negative AVI voltage mid-point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	-5.00
✎	03-72	Negative AVI voltage proportional mid-point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	-50.00
✎	03-73	Negative AVI voltage highest point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	-10.00
✎	03-74	Negative AVI voltage proportional highest point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	-100.00

04 Multi-step Speed Parameters

Pr.	Parameter Name	Setting Range	Default
04-00	1st step speed frequency	0.00–599.00 Hz	0.00
04-01	2nd step speed frequency	0.00–599.00 Hz	0.00
04-02	3rd step speed frequency	0.00–599.00 Hz	0.00
04-03	4th step speed frequency	0.00–599.00 Hz	0.00
04-04	5th step speed frequency	0.00–599.00 Hz	0.00
04-05	6th step speed frequency	0.00–599.00 Hz	0.00
04-06	7th step speed frequency	0.00–599.00 Hz	0.00
04-07	8th step speed frequency	0.00–599.00 Hz	0.00
04-08	9th step speed frequency	0.00–599.00 Hz	0.00
04-09	10th step speed frequency	0.00–599.00 Hz	0.00
04-10	11th step speed frequency	0.00–599.00 Hz	0.00
04-11	12th step speed frequency	0.00–599.00 Hz	0.00
04-12	13th step speed frequency	0.00–599.00 Hz	0.00
04-13	14th step speed frequency	0.00–599.00 Hz	0.00
04-14	15th step speed frequency	0.00–599.00 Hz	0.00
04-50	PLC buffer 0	0–65535	0
04-51	PLC buffer 1	0–65535	0
04-52	PLC buffer 2	0–65535	0
04-53	PLC buffer 3	0–65535	0
04-54	PLC buffer 4	0–65535	0
04-55	PLC buffer 5	0–65535	0
04-56	PLC buffer 6	0–65535	0
04-57	PLC buffer 7	0–65535	0
04-58	PLC buffer 8	0–65535	0
04-59	PLC buffer 9	0–65535	0
04-60	PLC buffer 10	0–65535	0
04-61	PLC buffer 11	0–65535	0
04-62	PLC buffer 12	0–65535	0
04-63	PLC buffer 13	0–65535	0
04-64	PLC buffer 14	0–65535	0
04-65	PLC buffer 15	0–65535	0
04-66	PLC buffer 16	0–65535	0
04-67	PLC buffer 17	0–65535	0
04-68	PLC buffer 18	0–65535	0
04-69	PLC buffer 19	0–65535	0

05 Motor Parameters

Pr.	Parameter Name	Setting Range	Default
05-00	Motor parameter auto-tuning	0: No function 1: Dynamic test for induction motor (IM) 2: Static test for induction motor (IM) 4: Dynamic test for PM synchronous motor magnetic pole 5: Rolling auto-tuning for PM (IPM / SPM) motor 12: FOC sensorless inertia estimation 13: High frequency stall test for PM synchronous motor	0
05-01	Full-load current for induction motor 1 (A)	10–120% of the drive's rated current	Depending on the model power
05-02	Rated power for induction motor 1 (kW)	0.00–655.35 kW	Depending on the model power
05-03	Rated speed for induction motor 1 (rpm)	0–xxxxx rpm 1710 (60 Hz, 4 poles); 1410 (50 Hz, 4 poles)	Depending on the motor's number of poles
05-04	Number of poles for induction motor 1	2–20	4
05-05	No-load current for induction motor 1 (A)	0.00–Pr.05-01 default	Depending on the model power
05-06	Stator resistance (Rs) for induction motor 1	0.000–65.535 Ω	Depending on the model power
05-07	Rotor resistance (Rr) for induction motor 1	0.000–65.535 Ω	0.000
05-08	Magnetizing inductance (Lm) for induction motor 1	0.0–6553.5 mH	0.0
05-09	Stator inductance (Lx) for induction motor 1	0.0–6553.5 mH	0.0
05-13	Full-load current for induction motor 2 (A)	10–120% of the drive's rated current	Depending on the model power
05-14	Rated power for induction motor 2 (kW)	0.00–655.35 kW	Depending on the model power
05-15	Rated speed for induction motor 2 (rpm)	0–xxxxx rpm 1710 (60 Hz, 4 poles); 1410 (50 Hz, 4 poles)	Depending on the motor's number of poles

Pr.	Parameter Name	Setting Range	Default
05-16	Number of poles for induction motor 2	2–20	4
05-17	No-load current for induction motor 2 (A)	0.00–Pr.05-13 default	Depending on the model power
05-18	Stator resistance (Rs) for induction motor 2	0.000–65.535 Ω	Depending on the model power
05-19	Rotor resistance (Rr) for induction motor 2	0.000–65.535 Ω	0.000
05-20	Magnetizing inductance (Lm) for induction motor 2	0.0–6553.5 mH	0.0
05-21	Stator inductance (Lx) for induction motor 2	0.0–6553.5 mH	0.0
05-22	Multi-motors (induction) selection	1: Motor 1 2: Motor 2 3: Motor 3 (V/F or SVC control mode only) 4: Motor 4 (V/F or SVC control mode only)	1
05-23	Frequency for Y-connection / Δ-connection switch for an induction motor	0.00–599.00 Hz	60.00
05-24	Y-connection / Δ-connection switch for an induction motor	0: Disable 1: Enable	0
05-25	Delay time for Y-connection / Δ-connection switch for an induction motor	0.000–60.000 sec.	0.200
05-26	Accumulated Watt-second for a motor in low word (W-sec.)	Read only	0.0
05-27	Accumulated Watt-second for a motor in high word (W-sec.)	Read only	0.0
05-28	Accumulated Watt-hour for a motor (W-hour)	Read only	0.0
05-29	Accumulated Watt-hour for a motor in low word (kW-hour)	Read only	0.0
05-30	Accumulated Watt-hour for a motor in high word (kW-hour)	Read only	0.0
05-31	Accumulated motor operation time (minutes)	0–1439 min.	0

Pr.	Parameter Name	Setting Range	Default
05-32	Accumulated motor operation time (days)	0–65535 days	0
05-33	Induction motor (IM) or permanent magnet synchronous motor selection	0: Induction motor 1: SPM 2: IPM	0
05-34	Full-load current for a permanent magnet synchronous motor	0–120% of the drive's rated current	Depending on the model power
05-35	Rated power for a permanent magnet synchronous motor	0.00–655.35 kW	Depending on the model power
05-36	Rated speed for a permanent magnet synchronous motor	0–65535 rpm	2000
05-37	Number of poles for a permanent magnet synchronous motor	0–65535	10
05-39	Stator resistance for a permanent magnet synchronous motor	0.000–65.535 Ω	0.000
05-40	Permanent magnet synchronous motor Ld	0.00–655.35 mH	0.00
05-41	Permanent magnet synchronous motor Lq	0.00–655.35 mH	0.00
05-42	PG offset angle for a permanent magnet synchronous motor	0.0–360.0°	0.0
05-43	Ke parameter of a permanent magnet synchronous motor	0–65535 (V/krpm)	0
05-64	Full-load current for induction motor 3 (A)	10–120% of the drive's rated current	Depending on the model power
✔ 05-65	Rated power for induction motor 3 (kW)	0.00–655.35 kW	Depending on the model power
✔ 05-66	Rated speed for induction motor 3 (rpm)	0–xxxxx rpm 1710 (60 Hz, 4 poles); 1410 (50 Hz, 4 poles)	Depending on the motor's number of poles
05-67	Number of poles for induction motor 3	2–20	4

Pr.	Parameter Name	Setting Range	Default
05-68	No-load current for induction motor 3 (A)	0.00–Pr.05-64 default	Depending on the model power
05-69	Stator resistance (Rs) for induction motor 3	0.000–65.535 Ω	Depending on the model power
05-70	Full-load current for induction motor 4 (A)	10–120% of the rated current	Depending on the model power
05-71	Rated power for induction motor 4 (kW)	0.00–655.35 kW	Depending on the model power
05-72	Rated speed for induction motor 4 (rpm)	0–xxxxx rpm 1710 (60 Hz, 4 poles); 1410 (50 Hz, 4 poles)	Depending on the motor's number of poles
05-73	Number of poles for induction motor 4	2–20	4
05-74	No-load current for induction motor 4 (A)	0.00–Pr.05-70 default	Depending on the model power
05-75	Stator resistance (Rs) for induction motor 4	0.000–65.535 Ω	Depending on the model power

06 Protection Parameters (1)

	Pr.	Parameter Name	Setting Range	Default
✎	06-00	Low voltage level	115V / 230V models: 150.0–220.0 V_{DC} 460V models: 300.0–440.0 V_{DC}	180.0 360.0
✎	06-01	Over-voltage stall prevention	0: Disabled 115V / 230V models: 0.0–390.0 V_{DC} 460V models: 0.0–780.0 V_{DC}	380.0 760.0
✎	06-02	Selection for over-voltage stall prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage stall prevention 2: Traditional over-voltage and smart over-current stall prevention 3: Smart over-voltage and smart over-current stall prevention	0
✎	06-03	Over-current stall prevention during acceleration	Normal duty: 0–150% (100% corresponds to the rated current of the drive) Heavy duty: 0–200% (100% corresponds to the rated current of the drive)	120 180
✎	06-04	Over-current stall prevention during operation	Normal duty: 0–150% (100% corresponds to the rated current of the drive) Heavy duty: 0–200% (100% corresponds to the rated current of the drive)	120 180
✎	06-05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the 1st acceleration / deceleration time 2: By the 2nd acceleration / deceleration time 3: By the 3rd acceleration / deceleration time 4: By the 4th acceleration / deceleration time 5: By automatic acceleration / deceleration	0
✎	06-06	Over-torque detection selection (motor 1)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
✎	06-07	Over-torque detection level (motor 1)	10–250% (100% corresponds to the rated current of the drive)	120
✎	06-08	Over-torque detection time (motor 1)	0.1–60.0 sec.	0.1

Pr.	Parameter Name	Setting Range	Default
06-09	Over-torque detection selection (motor 2)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
06-10	Over-torque detection level (motor 2)	10–250% (100% corresponds to the rated current of the drive)	120
06-11	Over-torque detection time (motor 2)	0.1–60.0 sec.	0.1
06-12	Current limit	0–250% (100% corresponds to the rated current of the drive)	150
06-13	Electronic thermal relay selection (motor 1)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on shaft) 2: Disable	2
06-14	Electronic thermal relay action time (motor 1)	30.0–600.0 sec.	60.0
06-15	Temperature level over-heat (OH) warning	0.0–110.0ºC	Depending on the model power
06-16	Stall prevention limit level	0–100% (refer to Pr.06-03–06-04)	100
06-17	Fault record 1	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during steady operation (ocn) 4: Ground fault (GFF) 5: IGBT short circuit between upper bridge and lower bridge (occ) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (OrP)	0
06-18	Fault record 2		0
06-19	Fault record 3		0
06-20	Fault record 4		0
06-21	Fault record 5		0
06-22	Fault record 6		0
	Fault record 7 (Pr.14-70)		0
	Fault record 8 (Pr.14-71)		0
	Fault record 9 (Pr.14-72)		0
	Fault record 10 (Pr.14-73)		0

Pr.	Parameter Name	Setting Range	Default
		16: IGBT overheating (oH1) 17: Heatsink overheating (oH2) 18: IGBT temperature detection failure (tH1o) 19: Capacitor hardware error (tH2o) 21: Drive over-load (oL) 22: Electronic thermal relay 1 protection (EoL1) 23: Electronic thermal relay 2 protection (EoL2) 24: Motor overheating (PTC / PT100) (oH3) 26: Over-torque 1 (ot1) 27: Over-torque 2 (ot2) 28: Under current (uC) 29: Limit error (LiT) 31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc (current clamp) hardware error (Hd0) 37: oc (over-current) hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss ACI (AFE) 42: PG feedback error (PGF1) 43: PG feedback loss (PGF2) 44: PG feedback stall (PGF3) 45: PG slip error (PGF4) 48: ACI loss (ACE) 49: External fault (EF) 50: Emergency stop (EF1) 51: External Base Block (B.B.) 52: Enter wrong password three times and locked (Pcod) 54: Illegal command (CE1) 55: Illegal data address (CE2) 56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10) 61: Y-connection / Δ-connection switch error (ydc) 62: Deceleration energy backup error (dEb) 63: Over-slip (oSL) 65: Hardware error of PG card (PGF5) 72: STO Loss (STL1) 76: STO (STo)	

Pr.	Parameter Name	Setting Range	Default
		77: STO Loss 2 (STL2) 78: STO Loss 3 (STL3) 79: U-phase Over-current before run (Aoc) 80: V-phase Over-current before run (boc) 81: W-phase Over-current before run (coc) 82: U-phase output phase loss (oPL1) 83: V-phase output phase loss (oPL2) 84: W-phase output phase loss (oPL3) 87: Low frequency overload protection (oL3) 89: Rotor position detection error (roPd) 101: CANopen guarding error (CGdE) 102: CANopen heartbeat error (CHbE) 104: CANopen bus off error (CbFE) 105: CANopen index error (CidE) 106: CANopen slave station setting error (CAdE) 107: CANopen memory error (CFrE) 111: InrCOM time-out error (InerCOM) 121: Internal communication error (CP20) 123: Internal communication error (CP22) 124: Internal communication error (CP30) 126: Internal communication error (CP32) 127: Firmware version error (CP33) 128: Over-torque 3 (ot3) 129: Over-torque 4 (ot4) 134: Electronics thermal relay 3 protection (EoL3) 135: Electronics thermal relay 4 protection (EoL4) 140: oc hardware error (Hd6) 141: GFF occurs before run (b4GFF) 142: Auto-tuning error 1 (DC test stage) (AUE1) 143: Auto-tuning error 2 (High frequency test stage) (AUE2) 144: Auto-tuning error 3 (Rotary test stage) (AUE3)	
✎ 06-23	Fault output option 1	0–65535 (refer to bit table for fault code)	0
✎ 06-24	Fault output option 2	0–65535 (refer to bit table for fault code)	0
✎ 06-25	Fault output option 3	0–65535 (refer to bit table for fault code)	0
✎ 06-26	Fault output option 4	0–65535 (refer to bit table for fault code)	0
✎ 06-27	Electronic thermal relay selection (motor 2)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on shaft) 2: Disable	2
✎ 06-28	Electronic thermal relay action time (motor 2)	30.0–600.0 sec.	60.0

	Pr.	Parameter Name	Setting Range	Default
✎	06-29	PTC detection selection	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	0
✎	06-30	PTC level	0.0–100.0%	50.0
	06-31	Frequency command for malfunction	0.00–599.00 Hz	Read only
	06-32	Output frequency at malfunction	0.00–599.00 Hz	Read only
	06-33	Output voltage at malfunction	0.0–6553.5 V	Read only
	06-34	DC voltage at malfunction	0.0–6553.5 V	Read only
	06-35	Output current at malfunction	0.00–655.35 Amp	Read only
	06-36	IGBT temperature at malfunction	-3276.7–3276.7ºC	Read only
	06-38	Motor speed at malfunction	-32767–32767 rpm	Read only
	06-39	Torque command at malfunction	-32767–32767%	Read only
	06-40	Status of the multi-function input terminal at malfunction	0000h–FFFFh	Read only
	06-41	Status of the multi-function output terminal at malfunction	0000h–FFFFh	Read only
	06-42	Drive status at malfunction	0000h–FFFFh	Read only
✎	06-44	STO latch selection	0: STO Latch 1: STO No Latch	0
✎	06-45	Output phase loss detection (OPHL) action	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	3
✎	06-46	Detection time of output phase loss	0.000–65.535 sec.	0.500
✎	06-47	Current detection level for output phase loss	0.00–100.00%	1.00
✎	06-48	DC brake time of output phase loss	0.000–65.535 sec.	0.000

	Pr.	Parameter Name	Setting Range	Default
✎	06-49	LvX auto-reset	0: Disable 1: Enable	0
✎	06-53	Treatment for phase loss protection (OrP)	0: Fault and ramp to stop 1: Fault and coast to stop	0
✎	06-55	Derating protection	0: Constant rated current and limit carrier wave by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier wave 2: Constant rated current (same as setting 0), but close current limit	0
✎	06-56	PT100 voltage level 1	0.000–10.000 V	5.000
✎	06-57	PT100 voltage level 2	0.000–10.000 V	7.000
✎	06-58	PT100 level 1 frequency protection	0.00–599.00 Hz	0.00
✎	06-59	Delay time for activating PT100 level 1 frequency protection	0–6000 sec.	60
✎	06-60	Software detection GFF current level	0.0–6553.5%	60.0
✎	06-61	Software detection GFF filter time	0.00–655.35 sec.	0.10
	06-63	Operation time of fault record 1 (Days)	0–65535 days	Read only
	06-64	Operation time of fault record 1 (Minutes)	0–1439 min.	Read only
	06-65	Operation time of fault record 2 (Days)	0–65535 days	Read only
	06-66	Operation time of fault record 2 (Minutes)	0–1439 min.	Read only
	06-67	Operation time of fault record 3 (Days)	0–65535 days	Read only
	06-68	Operation time of fault record 3 (Minutes)	0–1439 min.	Read only
	06-69	Operation time of fault record 4 (Days)	0–65535 days	Read only
	06-70	Operation time of fault record 4 (Minutes)	0–1439 min.	Read only
✎	06-71	Low current setting level	0.0–100.0%	0.0
✎	06-72	Low current detection time	0.00–360.00 sec.	0.00

	Pr.	Parameter Name	Setting Range	Default
✎	06-73	Low current action	0: No function 1: Warn and coast to stop 2: Warn and ramp to stop by the 2nd deceleration time 3: Warn and continue operation	0
	06-90	Operation time of fault record 5 (Day)	0–65535 days	Read only
	06-91	Operation time of fault record 5 (Min.)	0–1439 min.	Read only
	06-92	Operation time of fault record 6 (Day)	0–65535 days	Read only
	06-93	Operation time of fault record 6 (Min.)	0–1439 min.	Read only

07 Special Parameters

	Pr.	Parameter Name	Setting Range	Default
〆	07-00	Software brake level	115V / 230V models: 350.0–450.0 V_{DC} 460V models: 700.0–900.0 V_{DC}	370.0 740.0
〆	07-01	DC brake current level	0–100%	0
〆	07-02	DC brake time at RUN	0.0–60.0 sec.	0.0
〆	07-03	DC brake time at STOP	0.0–60.0 sec.	0.0
〆	07-04	DC brake frequency at STOP	0.00–599.00 Hz	0.00
〆	07-05	Voltage increasing gain	1–200%	100
〆	07-06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by speed before the power loss 2: Speed tracking by minimum output frequency	0
〆	07-07	Allowed power loss duration	0.0–20.0 sec.	2.0
〆	07-08	Base Block time	0.1–5.0 sec.	0.5
〆	07-09	Current limit of speed tracking	20–200%	100
〆	07-10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	0
〆	07-11	Number of times of auto-restart after fault	0–10	0
〆	07-12	Speed tracking during start-up	0: Disable 1: Speed tracking by maximum output frequency 2: Speed tracking by motor frequency at start 3: Speed tracking by minimum output frequency	0
〆	07-13	dEb function selection	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored. 3: dEb low-voltage control, then the drive's voltage increases to 350 V_{DC} / 700 V_{DC} and ramps to stop after low frequency 4: dEb high-voltage control of 350 V_{DC} / 700 V_{DC}, and the drive ramps to stop	0
〆	07-15	Dwell time at acceleration	0.00–600.00 sec.	0.00
〆	07-16	Dwell frequency at acceleration	0.00–599.00 Hz	0.00

	Pr.	Parameter Name	Setting Range	Default
✎	07-17	Dwell time at deceleration	0.00–600.00 sec.	0.00
✎	07-18	Dwell frequency at deceleration	0.00–599.00 Hz	0.00
✎	07-19	Fan cooling control	0: Fan is always ON 1: Fan is OFF after AC motor drive stops for one minute. 2: Fan is ON when AC motor drive runs; fan is OFF when AC motor drive stops. 3: Fan turns ON when temperature (IGBT) reaches around 60°C.	3
✎	07-20	Deceleration of emergency or forced stop	0: Coast to stop 1: Stop by the 1st deceleration time 2: Stop by the 2nd deceleration time 3: Stop by the 3rd deceleration time 4: Stop by the 4th deceleration time 5: System deceleration 6: Automatic deceleration	0
✎	07-21	Automatic energy-saving selection	0: Disable 1: Enable	0
✎	07-22	Energy-saving gain	10–1000%	100
✎	07-23	Auto voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0
✎	07-24	Torque command filter time	0.001–10.000 sec.	0.050
✎	07-25	Slip compensation filter time	0.001–10.000 sec.	0.100
✎	07-26	Torque compensation gain	IM: 0–10 (when Pr.05-33 = 0) PM: 0–5000 (when Pr.05-33 = 1 or 2)	1
✎	07-27	Slip compensation gain	0.00–10.00	0.00 (Default value is 1.00 in SVC mode)
✎	07-29	Slip deviation level	0.0–100.0% 0: No detection	0
✎	07-30	Slip deviation detection time	0.0–10.0 sec.	1.0
✎	07-31	Slip deviation action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0
✎	07-32	Motor shock compensation factor	0–10000	1000

	Pr.	Parameter Name	Setting Range	Default
〆	07-33	Auto-restart interval of fault	0.0–6000.0 sec.	60.0
	07-38	PMSVC voltage feed forward gain	0.00–2.00	1.00
〆	07-62	dEb gain (Kp)	0–65535	8000
〆	07-63	dEb gain (Ki)	0–65535	150
〆	07-71	Torque compensation gain (motor 2)	IM: 0–10 (when Pr.05-33 = 0) PM: 0–5000 (when Pr.05-33 = 1 or 2)	1
〆	07-72	Slip compensation gain (motor 2)	0.00–10.00	0.00 (Default value is 1.00 in SVC mode)
〆	07-73	Torque compensation gain (motor 3)	IM: 0–10 (when Pr.05-33 = 0) PM: 0–5000 (when Pr.05-33 = 1 or 2)	1
〆	07-74	Slip compensation gain (motor 3)	0.00–10.00	0.00 (Default value is 1.00 in SVC mode)
〆	07-75	Torque compensation gain (motor 4)	IM: 0–10 (when Pr.05-33 = 0) PM: 0–5000 (when Pr.05-33 = 1 or 2)	1
〆	07-76	Slip compensation gain (motor 4)	0.00–10.00	0.00 (Default value is 1.00 in SVC mode)

08 High-function PID Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	08-00	Terminal selection of PID feedback	0: No function 1: Negative PID feedback: by analog input (Pr.03-00) 2: Negative PID feedback: by single-phase pulse input (MI7), without direction (Pr.10-16) 3: Negative PID feedback: by single -phase pulse input (MI7), with direction (Pr.10-16) 4: Positive PID feedback: by analog input (Pr.03-00) 5: Positive PID feedback: by single -phase pulse input (MI7), without direction (Pr.10-16) 6: Positive PID feedback: by single -phase pulse input (MI7), with direction (Pr.10-16) 7: Negative PID feedback: by communication protocol 8: Positive PID feedback: by communication protocol	0
✓	08-01	Proportional gain (P)	0.0–5000.0 (When Pr.08-23 bit1 = 0) 0.00–500.00 (When Pr.08-23 bit1 = 1)	1.0 1.00
✓	08-02	Integral time (I)	0.00–100.00 sec.	1.00
✓	08-03	Differential time (D)	0.00–1.00 sec.	0.00
✓	08-04	Upper limit of integral control	0.0–100.0%	100.0
✓	08-05	PID output command limit (positive limit)	0.0–100.0%	100.0
✓	08-06	PID feedback value by communication protocol	-200.00–200.00%	0.00
✓	08-07	PID delay time	0.0–2.5 sec.	0.0
✓	08-08	Feedback signal detection time	0.0–3600.0 sec.	0.0
✓	08-09	Feedback signal fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	0
✓	08-10	Sleep level	0.00–599.00 Hz / 0.00–200.00%	0.00
✓	08-11	Wake-up level	0.00–599.00 Hz / 0.00–200.00%	0.00
✓	08-12	Sleep delay time	0.0–6000.0 sec.	0.0
✓	08-13	PID feedback signal error deviation level	1.0–50.0%	10.0
✓	08-14	PID feedback signal error deviation time	0.1–300.0 sec.	5.0
✓	08-15	PID feedback signal filter time	0.1–300.0 sec.	5.0

	Pr.	Parameter Name	Setting Range	Default
〆	08-16	PID compensation selection	0: Parameter setting 1: Analog input	0
〆	08-17	PID compensation	-100.0–100.0%	0
	08-18	Sleep mode function setting	0: Refer to PID output command 1: Refer to PID feedback signal	0
〆	08-19	Wake-up integral limit	0.0–200.0%	50.0
	08-20	PID mode selection	0: Serial connection 1: Parallel connection	0
	08-21	Enable PID to change the operation direction	0: Operating direction can be changed 1: Operating direction cannot be changed	0
〆	08-22	Wake-up delay time	0.00–600.00 sec.	0.00
〆	08-23	PID control flag	bit 0 = 1: PID running in reverse follows the setting for Pr.00-23. bit 0 = 0: PID running in reverse refers to PID calculated value. bit 1 = 1: PID Kp gain is 2 decimal places. bit 1 = 0: PID Kp gain is 1 decimal place.	2
〆	08-26	PID output command limit (reverse limit)	0.0–100.0%	100.0
〆	08-27	PID command acceleration / deceleration time	0.00–655.35 sec.	0.00
	08-29	Frequency base corresponding to 100.00% PID	0: PID control output 100.00%, corresponding to maximum operation frequency (Pr.01-00) 1: PID control output 100.00%, corresponding to the input value of the auxiliary frequency	0
〆	08-31	Proportional gain 2 (P)	0.0–5000.0 (When Pr.08-23 bit1 = 0) 0.00–500.00 (When Pr.08-23 bit1 = 1)	1.0 1.00
〆	08-32	Integral time 2 (I)	0.00–100.00 sec.	1.00
〆	08-33	Differential time 2 (D)	0.00–1.00 sec.	0.00
〆	08-65	Source of PID target value	0: From frequency command (Pr.00-20, 00-30) 1: From Pr.08-66 2: From RS-485 3: From external analog (refer to Pr.03-00, 03-01) 4: From CANopen 6: From communication cards (CANopen card not included) 7: By the digital dial on the keypad	0
〆	08-66	PID target value setting	-100.00–100.00%	50.00

	Pr.	Parameter Name	Setting Range	Default
✓	08-67	Master and auxiliary reverse running cutoff frequency	0.0–100.0%	10.0
✓	08-68	PID deviation limit	0.00–100.00%	0.00
✓	08-69	Integral separation level	0.00–100.00%	0.00
	08-70	Smart start-up level	0.00–100.00%	5.00
✓	08-71	Smart start-up frequency command	0.00–599.00 Hz	0.00
✓	08-72	Smart start-up acceleration time	0.00–600.00 sec.	3.00
✓	08-75	PID 2 parameter switch condition	0: Does not switch (refer to Pr.08-01–08-03) 1: Auto-switch is based on output frequency 2: Auto-switch is based on the deviation	0
✓	08-76	PID 2 parameter switch deviation 1	0.00–Pr.08-77%	10.00
✓	08-77	PID 2 parameter switch deviation 2	Pr,08-76–100.00%	40.00
✓	08-78	Allowed time to reverse direction after start-up	0.0–6553.5 sec.	0.0
	08-79	WireBreak detected upper level	0–100%	0
	08-80	WireBreak detected lower level	0–100%	0
	08-81	WireBreak detected Time	0.000–65.535 sec.	0.000
	08-82	WireBreak treatment	0: Warn and do not stop 1: ramp to stop 2: coast to stop 3: Warn, PID hold	0

09 Communication Parameters

	Pr.	Parameter Name	Setting Range	Default
✔	09-00	Communication address	1–254	1
✔	09-01	COM1 transmission speed	4.8–115.2 Kbps	9.6
✔	09-02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no error displayed and continue operation	3
✔	09-03	COM1 time-out detection	0.0–100.0 sec.	0.0
✔	09-04	COM1 communication protocol	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	1
✔	09-09	Communication response delay time	0.0–200.0 ms	2.0
	09-10	Communication main frequency	0.00–599.00 Hz	60.00
✔	09-11	Block transfer 1	0–65535	0
✔	09-12	Block transfer 2	0–65535	0
✔	09-13	Block transfer 3	0–65535	0
✔	09-14	Block transfer 4	0–65535	0
✔	09-15	Block transfer 5	0–65535	0
✔	09-16	Block transfer 6	0–65535	0
✔	09-17	Block transfer 7	0–65535	0
✔	09-18	Block transfer 8	0–65535	0
✔	09-19	Block transfer 9	0–65535	0
✔	09-20	Block transfer 10	0–65535	0

	Pr.	Parameter Name	Setting Range	Default
✓	09-21	Block transfer 11	0–65535	0
✓	09-22	Block transfer 12	0–65535	0
✓	09-23	Block transfer 13	0–65535	0
✓	09-24	Block transfer 14	0–65535	0
✓	09-25	Block transfer 15	0–65535	0
✓	09-26	Block transfer 16	0–65535	0
	09-30	Communication decoding method	0: Decoding method 1 1: Decoding method 2	1
	09-31	Internal Communication Protocol	0: Modbus 485 -1: Internal communication slave 1 -2: Internal communication slave 2 -3: Internal communication slave 3 -4: Internal communication slave 4 -5: Internal communication slave 5 -6: Internal communication slave 6 -7: Internal communication slave 7 -8: Internal communication slave 8 -10: Internal communication master -12: Internal PLC control	0
✓	09-33	PLC command force to 0	0–65535	0
	09-35	PLC address	1–254	2
	09-36	CANopen slave address	0: Disable 1–127	0
	09-37	CANopen speed	0: 1 Mbps 1: 500 Kbps 2: 250 Kbps 3: 125 Kbps 4: 100 Kbps (Delta only) 5: 50 Kbps	0
	09-39	CANopen warning record	bit 0: CANopen software disconnection 1 (CANopen guarding time-out) bit 1: CANopen software disconnection 2 (CANopen heartbeat time-out) bit 3: CANopen SDO time-out bit 4: CANopen SDO buffer overflow bit 5: CANopen hardware disconnection warning (Can Bus OFF) bit 6: CANopen error protocol	0
	09-40	CANopen decoding method	0: Delta-defined decoding method 1: CANopen standard DS402 protocol	1

	Pr.	Parameter Name	Setting Range	Default
	09-41	CANopen communication status	0: Node reset 1: Com reset 2: Boot up 3: Pre-operational 4: Operation 5: Stopped	Read only
	09-42	CANopen control status	0: Not ready for use 1: Inhibit start 2: Ready to switch on 3: Switched on 4: Enable operation 7: Quick stop active 13: Error reaction activation 14: Error state	Read only
	09-43	CANopen reset index	bit 0: CANopen reset, internal address 20XX is 0 bit 1: CANopen reset, internal address 264X is 0 bit 2: CANopen reset, internal address 26AX is 0 bit 3: CANopen reset, internal address 60XX is 0	65535
	09-60	Communication card identification	0: No communication card 1: DeviceNet slave 2: PROFIBUS-DP slave 3: CANopen slave / Master 5: EtherNet/IP slave 6: EtherCAT 10: Backup power supply 12: PROFINET	Read only
	09-61	Firmware version of communication card	Read only	Read only
	09-62	Product code	Read only	Read only
	09-63	Error code	Read only	Read only
✔	09-70	Communication card address (for DeviceNet or PROFIBUS)	DeviceNet: 0–63 PROFIBUS-DP: 1–125	1
✔	09-71	DeviceNet speed setting (for DeviceNet)	Standard DeviceNet: 0: 125 Kbps 1: 250 Kbps 2: 500 Kbps 3: 1 Mbps (Delta only)	2

	Pr.	Parameter Name	Setting Range	Default
			Non-standard DeviceNet (Delta only): 0: 10 Kbps 1: 20 Kbps 2: 50 Kbps 3: 100 Kbps 4: 125 Kbps 5: 250 Kbps 6: 500 Kbps 7: 800 Kbps 8: 1 Mbps	
〆	09-72	Other DeviceNet speed setting (for DeviceNet)	0: Disable: In this mode, baud rate must be 125 Kbps, 250 Kbps, 500 Kbps, or 1 Mbps in the standard DeviceNet speed. 1: Enable: In this mode, DeviceNet baud rate must be same as that for CANopen baud rate (0–8).	0
〆	09-75	Communication card IP configuration (for EtherNet)	0: Static IP 1: Dynamic IP (DHCP)	0
〆	09-76	Communication card IP address 1 (for EtherNet)	0–255	0
〆	09-77	Communication card IP address 2 (for EtherNet)	0–255	0
〆	09-78	Communication card IP address 3 (for EtherNet)	0–255	0
〆	09-79	Communication card IP address 4 (for EtherNet)	0–255	0
〆	09-80	Communication card address mask 1 (for EtherNet)	0–255	0
〆	09-81	Communication card address mask 2 (for EtherNet)	0–255	0
〆	09-82	Communication card address mask 3 (for EtherNet)	0–255	0
〆	09-83	Communication card address mask 4 (for EtherNet)	0–255	0

	Pr.	Parameter Name	Setting Range	Default
〆	09-84	Communication card gateway address 1 (for EtherNet)	0–255	0
〆	09-85	Communication card gateway address 2 (for EtherNet)	0–255	0
〆	09-86	Communication card gateway address 3 (for EtherNet)	0–255	0
〆	09-87	Communication card gateway address 4 (for EtherNet)	0–255	0
〆	09-88	Communication card password (low word) (for EtherNet)	0–99	0
〆	09-89	Communication card password (high word) (for EtherNet)	0–99	0
〆	09-90	Reset communication card (for EtherNet)	0: Disable 1: Reset, return to default	0
	09-91	Additional settings for the communication card (for EtherNet)	bit 0: Enable IP filter bit 1: Enable internet parameters (1 bit). When IP address is set, this bit is enabled. After updating the communication card parameters, this bit changes to be disabled. bit 2: Enable login password (1 bit). When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to be disabled.	0
	09-92	Communication card status (for EtherNet)	bit 0: Enable password. When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.	0

10 Speed Feedback Control Parameters

	Pr.	Parameter Name	Setting Range	Default
	10-00	Encoder type selection	0: Disabled 1: ABZ 3: Resolver 1 x PM encoder 5: Pulse input (MI7)	0
	10-01	Encoder pulses per revolution	1–20000	600
	10-02	Encoder input type setting	0: Disable 1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees. 2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees. 3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction). 4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction). 5: Single-phase input (MI7) **NOTE:** 1. When the MH300 inputs the A/B phase pulse, you must connect the MI6 terminal to the A-phase pulse, and the MI7 terminal to the B-phase pulse. 2. When the MH300 uses unidirectional input, it disables the MI6 function and prohibits any signal connection.	0
✓	10-03	Frequency division output setting (denominator)	1–255	1
✓	10-04	Electrical gear at load side A1	1–65535	100
✓	10-05	Electrical gear at motor side B1	1–65535	100
✓	10-06	Electrical gear at load side A2	1–65535	100
✓	10-07	Electrical gear at motor side B2	1–65535	100
✓	10-08	Encoder feedback fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2
✓	10-09	Encoder feedback fault detection time	0: Disabled 0.0–10.0 sec.	1.0

	Pr.	Parameter Name	Setting Range	Default
✎	10-10	Encoder stall level	0: No function 1–120%	115
✎	10-11	Encoder stall detection time	0.0–2.0 sec.	0.1
✎	10-12	Encoder stall action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2
✎	10-13	Encoder slip range	0: No function 0–50%	50
✎	10-14	Encoder slip detection time	0.0–10.0 sec.	0.5
✎	10-15	Encoder stall and slip error action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2
✎	10-16	Pulse input type setting	0: Disabled 1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees. 2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees. 3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction). 4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction). 5: Single-phase input (MI7)	0
✎	10-17	Electrical gear A	1–65535	100
✎	10-18	Electrical gear B	1–65535	100
✎	10-19	Positioning for encoder position	-32767–32767 pulses	0
✎	10-20	Error range for encoder position reached	0–65535 pulses	10
✎	10-21	Filter time (PG2)	0.000–65.535 sec.	0.100
✎	10-24	FOC & TQC function control	0–65535	0
✎	10-25	FOC bandwidth for speed observer	20.0–100.0 Hz	40.0
✎	10-26	FOC minimum stator frequency	0.0–10.0% fN	2.0

	Pr.	Parameter Name	Setting Range	Default
〆	10-27	FOC low-pass filter time constant	1–1000 ms	50
〆	10-28	FOC gain for excitation current rise time	33–100% Tr	100
〆	10-29	Top limit of frequency deviation	0.00–100.00 Hz	20.00
	10-30	Resolver pole pair	1–50	1
〆	10-31	I/F mode, current command	0–150% rated current of the motor	40
〆	10-32	PM FOC sensorless speed estimator bandwidth	0.00–600.00 Hz	5.00
〆	10-34	PM sensorless speed estimator low-pass filter gain	0.00–655.35	1.00
〆	10-35	AMR (Kp)	0.00–3.00	1.00
〆	10-36	AMR (Ki)	0.00–3.00	0.20
〆	10-39	Frequency point to switch from I/F mode to PM sensorless mode	0.00–599.00 Hz	20.00
〆	10-40	Frequency point to switch from PM sensorless mode to I/F mode	0.00–599.00 Hz	20.00
〆	10-42	Initial angle detection pulse value	0.0–3.0	1.0
	10-43	PG card version	0.00–655.35	Read only
〆	10-49	Zero voltage time during start-up	00.000–60.000 sec.	00.000
〆	10-51	Injection frequency	0–1200 Hz	500
〆	10-52	Injection magnitude	0.0–200.0 V	15.0/ 30.0
〆	10-53	Angle detection method	0: Disabled 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	0

11 Advanced Parameters

Pr.	Parameter Name	Setting Range	Default
11-00	System control	bit 0: Auto-tuning for ASR bit 1: Inertia estimate (only in FOCPG mode) bit 2: Zero servo bit 3: Dead time compensation closed bit 7: Save or do not save the frequency	0
11-01	Per unit of system inertia	1–65535 (256 = 1PU)	256
11-02	ASR1 / ASR2 switch frequency	5.00–599.00 Hz	7.00
11-03	ASR1 low-speed bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-04	ASR2 high-speed bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-05	Zero-speed bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-06	ASR1 gain	0–40 Hz (IM) / 1–100 Hz (PM)	10
11-07	ASR1 integral time	0.000–10.000 sec.	0.100
11-08	ASR2 gain	0–40 Hz (IM) / 0–100 Hz (PM)	10
11-09	ASR2 integral time	0.000–10.000 sec.	0.100
11-10	ASR zero speed gain	0–40 Hz (IM) / 0–100 Hz (PM)	10
11-11	ASR zero speed integral time	0.000–10.000 sec.	0.100
11-12	Gain for ASR speed feed forward	0–200%	0
11-13	PDFF gain value	0–200%	30
11-14	ASR output low-pass filter time	0.000–0.350 sec.	0.008
11-15	Notch filter depth	0–20 db	0
11-16	Notch filter frequency	0.00–200.00 Hz	0.00
11-17	Forward motor torque limit	0–500%	500
11-18	Forward regenerative torque limit	0–500%	500
11-19	Reverse motor torque limit	0–500%	500
11-20	Reverse regenerative torque limit	0–500%	500
11-21	Flux weakening curve for motor 1 gain value	0–200%	90
11-22	Flux weakening curve for motor 2 gain value	0–200%	90

	Pr.	Parameter Name	Setting Range	Default
✎	11-23	Flux weakening area speed response	0–150%	65
✎	11-24	APR gain	0.00–40.00 Hz (IM) / 0.00–100.00 Hz (PM)	10.00
✎	11-25	Gain value for the APR feed forward	0–100	30
✎	11-26	APR curve time	0.00–655.35 sec.	10.00
✎	11-27	Maximum torque command	0–500%	100
✎	11-28	Torque offset source	0: Disable 1: Analog signal input 2: RS-485 communication (Pr.11-29) 3: Controlled by external terminal (Pr.11-30–11-32)	0
✎	11-29	Torque offset setting	-100–100.0%	0.0
✎	11-30	High torque command compensation	-100–100.0%	30.0
✎	11-31	Middle torque command compensation	-100–100.0%	20.0
✎	11-32	Low torque command compensation	-100–100.0%	10.0
✎	11-33	Torque command source	0: Digital keypad 1: RS-485 communication (Pr.11-34) 2: Analog signal input (Pr.03-00) 3: CANopen	0
✎	11-34	Torque command	-100.0–100.0% (Pr.11-27 setting value = 100%)	0.0
✎	11-35	Torque command filter time	0.000–1.000 sec.	0.000
	11-36	Speed limit selection	0: Pr.11-37 (forward speed limit) and Pr.11-38 (reverse speed limit) 1: Speed limit source is Pr.00-20 (master frequency command source), and Pr.11-37 / Pr.11-38 2: Pr.00-20 (master frequency command source) 3: Speed limit source is the linear speed of tension control	0
✎	11-37	Forward speed limit (torque mode)	0–120%	10
✎	11-38	Reverse speed limit (torque mode)	0–120%	10
	11-39	Zero torque command mode selection	0: Torque mode 1: Speed mode	0

	Pr.	Parameter Name	Setting Range	Default
✎	11-40	Position Control Command Source	0: Input from internal register 1: Input from external pulse 2: RS-485 3: CANopen 5: Communication card	0
	11-41	PWM mode selection	0: two-phase 2: Space vector	2
✎	11-42	System control flag	0000–FFFFh	0000
✎	11-43	Position Control Maximum Frequency	0.00–599.00 Hz	60.00
✎	11-44	Position Control Acceleration Time	0.00–655.35 sec.	1.00
✎	11-45	Position Control Deceleration Time	0.00–655.35 sec.	1.00
✎	11-46	Torque Output Filter Time (Applied to 230V / 460V Models)	0.000–65.535 sec.	0.050
	11-50	APR S-Curve Time	0.000–1.000	0.300
✎	11-51	Maximum Allowable Position Error	0–65535	1000
✎	11-52	Allowable Position Error Range	0–65535	10
✎	11-53	Allowable Position Error Cumulative Time	0.000–65.535 sec.	0.500
✎	11-54	Treatment to the Large Position Control Error	0: Warn and continue operation (display oPE on keypad) 1: Fault and ramp to stop (display oPEE on keypad) 2: Fault and coast to stop (display oPEE on keypad)	0
✎	11-56	Software Positive Limit (High Word)	-32768–32767	30000
✎	11-57	Software Positive Limit (Low Word)	0–65535	0
✎	11-58	Software Negative Limit (High Word)	-32768–32767	-30000
✎	11-59	Software Negative Limit (Low Word)	0–65535	0
✎	11-60	Position Control Bit	bit0: Enable position memory function bit1: The pulse per revolution at load side counts by ppr bit2: Enable software limit switch function bit8: Set operation control direction	000Ah

Pr.	Parameter Name	Setting Range	Default
		bit9: Speed unit selection bit10: Speed unit selection bit11: Speed unit multiple	
11-62	Encoder at Load Side ppr Number (High Byte)	0–65535	0
11-63	Encoder at Load Side ppr Number (Low Byte)	0–65535	2400
11-64	Single-Point Positioning Rising Speed	0.10–depending on the maximum setting value calculated by setting value of Pr.11-43 and Pr.11-45	10.00
11-68	Homing Method	0000h–0128h	0008h
11-69	Homing Control Time Out	0.0–6000.0 sec.	60.0
11-70	Homing Control 1st Step Speed	0.00–599.00 Hz	8.00
11-71	Homing Control 2nd Step Speed	0.00–599.00 Hz	2.00
11-72	Homing Control Acceleration / Deceleration Time (0–Homing Control 1st Step Speed)	0.00–600.00 sec.	10.00
11-73	Homing Control Offset (Revolution)	-30000–30000 revolutions	0
11-74	Homing Control Offset (Pulse)	Refer to Pr.10-01 setting	0
11-75	Position Record (Revolution)	-30000–30000 revolutions	0
11-76	Position Record (Pulse)	Refer to Pr.10-01 setting	0
11-78	HALT Revived Selection	0: Stopped 1: Continue according to the previous position command	0

12 Tension Control Parameters

	Pr.	Parameter Name	Setting Range	Default
	12-00	Tension control selection	0: Disabled 1: Closed-loop tension, speed mode 2: Closed-loop linear speed, speed mode 3: Closed-loop tension, torque mode 4: Open-loop tension, torque mode	0
	12-01	Winding mode	0: Rewind 1: Unwind	0
	12-02	Mechanical gear A at load side	1–65535	100
	12-03	Mechanical gear B at motor side	1–65535	100
	12-04	PID target source	0: Set by parameter (Pr.12-05) 1: Set by RS-485 2: Analog input	0
✓	12-05	PID target value	0.0–100.0%	50.0
✓	12-06	PID feedback source selection	0: Analog input 1: Pulse input	0
	12-07	Tension PID auto-tuning selection	0: Disabled 1: Reel diameter (Pr.12-08–12-09 corresponds to Pr.12-29; Pr.12-11–12-12 corresponds to Pr.12-28) 2: Frequency (Pr.12-08–12-09 corresponds to Pr. 01-07; Pr.12-11–12-12 corresponds to Pr.01-00)	0
	12-08	Tension PID P gain 1	0.0–1000.0	50.0
	12-09	Tension PID I integral time 1	0.00–500.00 sec.	1.00
	12-11	Tension PID P gain 2	0.0–1000.0	50.0
	12-12	Tension PID I integral time 2	0.00–500.00 sec.	1.00
	12-14	Tension PID output status selection	0: PID output is positive 1: PID outut is negative	0
	12-15	Tension PID output limit	0.00–100.00%	20.00
	12-16	Tension PID output command limit (Negative limit)	0.00–655.35%	20.00
	12-17	Tension PID feedback upper limit	0.0–100.0%	100.0
	12-18	Tension PID feedback lower limit	0.0–100.0%	0.0

	Pr.	Parameter Name	Setting Range	Default
	12-19	Linear speed input command source	0: Disabled 1: Analog input 2: RS-485 communication input 3: PG card pulse input 4: DFM-DCM pulse input 5: Pulse input through MI6 / MI7 terminal	0
	12-20	Maximum linear speed	0.0–6500.0 m/min.	1000.0
	12-21	Minimum linear speed	0.0–6500.0 m/min.	0.0
	12-22	Pulses per meter	0.0–6000.0 pulses/m	0.0
✔	12-23	Current linear speed	0.0–6500.0 m/min.	0.0
✔	12-24	Linear speed low pass filter time	0.00–100.00 sec.	0.10
✔	12-25	Linear speed command acceleration time	0.00–655.35 sec.	0.00
✔	12-26	Linear speed command deceleration time	0.00–655.35 sec.	0.00
	12-27	Reel diameter source	0: Calculated via line speed 1: Calculated via analog input selection 2: Calculated via thickness integral, the encoder installed at reel side inputs by PG card 3: Calculated via thickness integral, the encoder installed at motor side inputs by PG card 4: Calculated via thickness integral, the encoder installed at reel side inputs by MI6 / MI7 terminals 5: Calculated via thickness integral, the encoder installed at motor side inputs by MI6 / MI7 terminals	0
	12-28	Maximum reel diameter	1.0–6000.0 mm	6000.0
	12-29	Empty reel diameter	1.0–6000.0 mm	1.0
	12-30	Initial reel diameter source	0: RS-485 communication input (Pr.12-31) 1: Analog input (Pr.03-00–03-01 = d16)	0
✔	12-31	Initial reel diameter	1.0–6000.0 mm	1.0
	12-32	Initial reel diameter 1	1.0–6000.0 mm	1.0
	12-33	Initial reel diameter 2	1.0–6000.0 mm	1.0
	12-34	Pulses per revolution	1–60000 ppr	1
	12-35	Revolutions per layer	1–10000	1
	12-36	Material thickness	0.001–65.000 mm	0.001
✔	12-37	Reel diameter filter time	0.00–100.00 sec.	1.00
	12-38	Automatic reel diameter compensation	0: Disabled 1: Enabled	0

	Pr.	Parameter Name	Setting Range	Default
✓	12-39	Reel diameter calculation delay time	0.0–6553.5 sec.	0.0
✓	12-40	Current reel diameter	1.0–6000.0 mm	1.0
✓	12-41	Minimum output frequency for reel diameter calculation	0.00–599.00 Hz	1.00
	12-42	Pre-startup mode selection	0: Disabled 1: Pre-startup of rewind mode 2: Pre-startup of unwind mode	0
	12-43	Switching level for pre-startup and PID enable	0.0–100.0% (according to Pr.12-05)	15.0
	12-44	Pre-startup frequency	0.00–599.00 Hz	2.00
✓	12-45	Pre-startup acceleration time	0.01–600.00 sec.	3.00
	12-46	Broken belt detection function	0: Disabled 1: Enabled	0
	12-47	Minimum linear speed of broken belt detection	0.0–3000.0 m/min.	0.0
	12-48	Reel diameter error of broken belt detection	1.0–6000.0 mm	100.0
	12-49	Broken belt detection time	0.00–100.00 sec.	1.00
	12-50	Tension PID feedback error level	0–100%	100
	12-51	Tension PID feedback error detection time	0.0–10.0 sec.	0.5
	12-52	Tension PID feedback error treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	0
	12-54	Tension command source selection	0: RS-485 communication input 1: Analog input	0
	12-55	Maximum tension value	0–65535 N	0
✓	12-56	Tension command setting value	0–65535 N	0
	12-57	Zero-speed tension setting source	0: Disabled 1: RS-485 communication input 2: Analog input	0
✓	12-58	Zero-speed tension setting value	0–65535 N	0
✓	12-59	Zero-speed tension threshold (line speed)	0–100.00%	0

	Pr.	Parameter Name	Setting Range	Default
✓	12-60	Dynamic friction torque compensation	0.0–100.0%	0.0
✓	12-61	Material inertia compensation coefficient	0–30000	0
✓	12-62	Acceleration inertia compensation gain	0.0–1000.0%	0.0
✓	12-63	Inertia compensation filter time	0.00–100.00	5.00
✓	12-64	Deceleration inertia compensation gain	0.0–1000.0%	0.0
	12-65	Tension taper curve selection	0–4 0: No taper 1: Curve taper 2: Linear taper 3: Multi-step curve taper 4: Multi-step linear taper	0
	12-66	Tension taper setting source	0: RS-485 communication input 1: Analog input	0
✓	12-67	Tension taper value	0–100%	0
	12-68	Tension taper curve compensation value	0–60000	0
	12-69	Multi-step taper reel diameter 1	10.0–6000.0	6000.0
	12-70	Multi-step taper reel diameter 2	10.0–6000.0	6000.0
✓	12-71	Multi-step taper value 1	0–100	0
✓	12-72	Multi-step taper value 2	0–100	0
✓	12-73	Pre-drive frequency gain	-50.0–50.0%	0
✓	12-74	Pre-drive acceleration time	0–65535 sec.	0
✓	12-75	Pre-drive deceleration time	0–65535 sec.	0
✓	12-76	Speed limit gain	0–65535 sec.	0
✓	12-77	Tension control flag	bit 0: Closed loop tension speed mode, allowed changing operation direction bit 1: Start-up compensation (switching between zero-speed tension command and normal tension command) bit 2: Acceleration and deceleration compensation (Pr.12-62 Acceleration inertia compensation gain; Pr.12-64 Deceleration inertia compensation gain)	0

Pr.	Parameter Name	Setting Range	Default
		bit 3: Reel diameter calculation by moving average method bit 5: PID output reverse limit selection bit 6: Material thickness range selection	

13 Macro (User-defined)

Pr.	Parameter Name	Setting Range	Default
13-00	Application selection	00: Disabled 01: User-defined parameter 02: Compressor 03: Fan 04: Pump 05: Conveyor 06: Machine tool 07: Packing 08: Textiles 10: Logistics 11: Tension PID function 12: Tension PID and master / auxiliary frequency function	00
13-01 – 13-50	Application parameters (user-defined)		

14 Protection Parameters (2)

<table>
<tr><th>Pr.</th><th>Parameter Name</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>14-00</td><td>Extension card input terminal selection (AI10)</td><td rowspan="2">0: No function
1: Frequency command
(in MH300 series, this function can be the torque limit in torque control mode)
2: Torque command (torque limit in speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: PTC thermistor input value
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive / negative torque limit
11: PT100 thermistor input value
13: PID compensation amount</td><td>0</td></tr>
<tr><td>14-01</td><td>Extension card input terminal selection (AI11)</td><td>0</td></tr>
<tr><td>14-02</td><td>AI10 Analog input bias</td><td>-100.0–100.0%</td><td>0.0</td></tr>
<tr><td>14-03</td><td>AI11 Analog input bias</td><td>-100.0–100.0%</td><td>0.0</td></tr>
<tr><td>14-04</td><td>AI10 positive / negative bias mode</td><td rowspan="2">0: No bias
1: Lower than or equal to bias
2: Higher than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center</td><td>0</td></tr>
<tr><td>14-05</td><td>AI11 positive / negative bias mode</td><td>0</td></tr>
<tr><td>14-06</td><td>AI10 analog input gain</td><td>-500.0–500.0%</td><td>100.0</td></tr>
<tr><td>14-07</td><td>AI11 analog input gain</td><td>-500.0–500.0%</td><td>100.0</td></tr>
<tr><td>14-08</td><td>AI10 analog input filter time</td><td>0.00–20.00 sec.</td><td>0.01</td></tr>
<tr><td>14-09</td><td>AI11 analog input filter time</td><td>0.00–20.00 sec.</td><td>0.01</td></tr>
<tr><td>14-10</td><td>ACI10 analog input 4–20 mA signal loss selection</td><td rowspan="2">0: Disable
1: Continue operation at the last frequency
2: Decelerate to 0 Hz
3: Stop immediately and display “ACE”</td><td>0</td></tr>
<tr><td>14-11</td><td>ACI11 analog input 4–20 mA signal loss selection</td><td>0</td></tr>
<tr><td>14-12</td><td>AO10 extension card output terminal selection</td><td rowspan="3">0: Output frequency (Hz)
1: Frequency command (Hz)
2: Motor speed (Hz)
3: Output current (rms)
4: Output voltage
5: DC bus voltage</td><td>0</td></tr>
<tr><td>14-13</td><td>AO11 extension card output terminal selection</td><td>0</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

	Pr.	Parameter Name	Setting Range	Default
			6: Power factor 7: Power 8: Output torque 9: AVI 10: ACI 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 18: Torque command 19: PG2 frequency command 20: CANopen analog output 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	
✓	14-14	AO10 analog output 1 gain	0.0–500.0 %	100.0
✓	14-15	AO11 analog output 1 gain	0.0–500.0 %	100.0
✓	14-16	AVO10 analog output 1 in REV direction	0: Absolute value of output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0
✓	14-17	AVO11 analog output 1 in REV direction		0
✓	14-18	Extension card (AI10) input selection	0: 0–10 V (AVI10) 1: 0–20 mA (ACI10) 2: 4–20 mA (ACI10)	0
✓	14-19	Extension card (AI11) input selection	0: 0–10 V (AVI11) 1: 0–20 mA (ACI11) 2: 4–20 mA (ACI11)	0
✓	14-20	AVO10 DC output setting level	0.00–100.00%	0.00
✓	14-21	AVO11 DC output setting level	0.00–100.00%	0.00
✓	14-22	AVO10 filter output time	0.00–20.00 sec.	0.01
✓	14-23	AVO11 filter output time	0.00–20.00 sec.	0.01
✓	14-24	AI10 extension card lowest point	Pr.14-18 = 0: 0.00–10.00 V Pr.14-18 ≠ 0: 0.00–20.00 mA or 4–20 mA	0.00
✓	14-25	AI10 extension card proportional lowest point	0.00–100.00%	0.00

	Pr.	Parameter Name	Setting Range	Default
✎	14-26	AI10 extension card mid-point	Pr.14-18 = 0: 0.00–10.00 V Pr.14-18 ≠ 0: 0.00–20.00 mA or 4–20 mA	5.00
✎	14-27	AI10 extension card proportional mid-point	0.00–100.00%	50.00
✎	14-28	AI10 extension card highest point	Pr.14-18 = 0: 0.00–10.00 V Pr.14-18 ≠ 0: 0.00–20.00 mA or 4–20 mA	10.00
✎	14-29	AI10 extension card proportional highest point	0.00–100.00%	100.00
✎	14-30	AI11 extension card lowest point	Pr.14-19 = 0: 0.00–10.00 V Pr.14-19 ≠ 0: 0.00–20.00 mA or 4–20 mA	0.00
✎	14-31	AI11 extension card proportional lowest point	0.00–100.00%	0.00
✎	14-32	AI11 extension card mid-point	Pr.14-19 = 0: 0.00–10.00 V Pr.14-19 ≠ 0: 0.00–20.00 mA or 4–20 mA	5.00
✎	14-33	AI11 extension card proportional mid-point	0.00–100.00%	50.00
✎	14-34	AI11 extension card highest point	Pr.14-19 = 0: 0.00–10.00 V Pr.14-19 ≠ 0: 0.00–20.00 mA or 4–20 mA	10.00
✎	14-35	AI11 extension card proportional highest point	0.00–100.00%	100.00
✎	14-36	AO10 terminal analog signal mode	0: AVO10 (analog voltage signal 0.00–10.00 V) 1: ACO10 (analog current signal 0.0–20.0 mA) 2: ACO10 (analog current signal 4.0–20.0 mA)	0
✎	14-37	AO11 terminal analog signal mode	0: AVO11 (analog voltage signal 0.00–10.00 V) 1: ACO11 (analog current signal 0.0–20.0 mA) 2: ACO11 (analog current signal 4.0–20.0 mA)	0
	14-50	Output frequency at malfunction 2	0.00–599.00 Hz	Read only
	14-51	DC voltage at malfunction 2	0.0–6553.5 V	Read only
	14-52	Output current at malfunction 2	0.00–655.35 Amps	Read only
	14-53	IGBT temperature at malfunction 2	-3276.7–3276.7ºC	Read only
	14-54	Output frequency at malfunction 3	0.00–599.00 Hz	Read only
	14-55	DC voltage at malfunction 3	0.0–6553.5 V	Read only
	14-56	Output current at malfunction 3	0.00–655.35 Amps	Read only

	Pr.	Parameter Name	Setting Range	Default
	14-57	IGBT temperature at malfunction 3	-3276.7–3276.7ºC	Read only
	14-58	Output frequency at malfunction 4	0.00–599.00 Hz	Read only
	14-59	DC voltage at malfunction 4	0.0–6553.5 V	Read only
	14-60	Output current at malfunction 4	0.00–655.35 Amps	Read only
	14-61	IGBT temperature at malfunction 4	-3276.7–3276.7ºC	Read only
	14-62	Output frequency at malfunction 5	0.00–599.00 Hz	Read only
	14-63	DC voltage at malfunction 5	0.0–6553.5 V	Read only
	14-64	Output current at malfunction 5	0.00–655.35 Amps	Read only
	14-65	IGBT temperature at malfunction 5	-3276.7–3276.7ºC	Read only
	14-66	Output frequency at malfunction 6	0.00–599.00 Hz	Read only
	14-67	DC voltage at malfunction 6	0.0–6553.5 V	Read only
	14-68	Output current at malfunction 6	0.00–655.35 Amps	Read only
	14-69	IGBT temperature at malfunction 6	-3276.7–3276.7ºC	Read only
	14-70	Fault record 7	Refer to fault record Pr.06-17–06-22	0
	14-71	Fault record 8	Refer to fault record Pr.06-17–06-22	0
	14-72	Fault record 9	Refer to fault record Pr.06-17–06-22	0
	14-73	Fault record 10	Refer to fault record Pr.06-17–06-22	0
✓	14-74	Over-torque detection action (motor 3)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
✓	14-75	Over-torque detection level (motor 3)	10–250% (100% corresponds to the rated current of the drive)	120

Pr.	Parameter Name	Setting Range	Default
14-76	Over-torque detection time (motor 3)	0.0–60.0 sec.	0.1
14-77	Over-torque detection action (motor 4)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
14-78	Over-torque detection level (motor 4)	10–250% (100% corresponds to the rated current of the drive)	120
14-79	Over-torque detection time (motor 4)	0.0–60.0 sec.	0.1
14-80	Electronic thermal relay selection 3 (motor 3)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	2
14-81	Electronic thermal relay action time (motor 3)	30.0–600.0 sec.	60.0
14-82	Electronic thermal relay selection 4 (motor 4)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	2
14-83	Electronic thermal relay action time (motor 4)	30.0–600.0 sec.	60.0

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Chapter 12 Descriptions of Parameter Settings

12-1 Descriptions of Parameter Settings

12-2 Adjustment & Applications

12-1 Descriptions of Parameter Settings

00 Drive Parameters

✓You can set this parameter during operation.

00-00 AC Motor Drive Identity Code

Default: Read only

Settings Read only

00-01 AC Motor Drive Rated Current Display

Default: Read only

Settings Read only

- Pr.00-00 displays the identity code of the AC motor drive. Use the following specification table to check if Pr.00-01 setting is the rated current of the AC motor drive. Pr.00-01 corresponds to the identity code of the motor.
- The default is the rated current for heavy duty. Set Pr.00-16 to 0 to display the rated current for normal duty.

	115V models-single-phase			230V model-single-phase				
Frame	A	B	C	A / B		B	C	
kW	0.2	0.4	0.75	0.2	0.4	0.75	1.5	2.2
HP	0.25	0.5	1	0.25	0.5	1	2	3
Identity code	102	103	104	302	303	304	305	306
Rated current for heavy duty	1.6	2.5	5.0	1.6	2.8	5.0	7.5	11
Rated current for normal duty	1.8	2.7	5.5	1.8	3.2	5.2	8.5	12.5

230V models-three-phase														
Frame	A			B	C		D	E		F	G		I	
kW	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
HP	0.25	0.5	1	2	3	5	7.5	10	15	20	25	30	40	50
Identity code	202	203	204	205	206	207	208	209	210	211	212	213	214	215
Rated current for heavy duty	1.6	2.8	5.0	7.5	11	17	25	33	49	65	75	90	120	146
Rated current for normal duty	1.8	3.2	5.2	8	12.5	19.5	27	36	51	69	81	102	134	160

460V models-three-phase																
Frame	A/B		B	C		D		E		F		G	H		I	
kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
HP	0.5	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
Identity code	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418
Rated current for heavy duty	1.5	2.7	4.2	5.5	9	13	17	25	32	38	45	60	75	91	112	150
Rated current for normal duty	1.8	3	4.6	6.5	10.5	14.5	19.8	28	36	41.5	49	69	85	108	128	180

00-02 Parameter Reset

Default: 0

Settings 0: No function

1: Write protection for parameters

5: Return kWh display to 0

6: Reset PLC (including CANopen Master Index)

7: Reset CANopen index (Slave)

9: Reset all parameters to defaults with base frequency at 50 Hz)

10: Reset all parameters to defaults with base frequency at 150 Hz)

11: Reset all parameters to defaults with base frequency at 50 Hz)
(keep the setting values of user-defined Pr.13-01–13-50)
12: Reset all parameters to defaults with base frequency at 60 Hz)
(saves the setting value of user-defined Pr.13-01–13-50)

- 1: All parameters are read only except Pr.00-02, 00-07, and 00-08.
  Set Pr.00-02 to 0 before changing other parameter settings.
- 5: You can return the kWh displayed value to 0 even during drive operation.
  For example, you can set Pr.05-26–05-30 to 0.
- 6: Clear the internal PLC programs (includes the related settings of PLC internal CANopen master)
- 7: Reset the related settings of CANopen slave.
- 9 or 10: Reset all parameters to defaults. If you have set a password (Pr.00-08), unlock the password (Pr.00-07) to clear the password you have set before you reset all parameters.
- For settings of 6, 7, 9, 10, 11 and 12, you must reboot the motor drive after you finish the setting.

00-03 Start-up Display Selection

Default: 0

Settings
0: F (frequency command)
1: H (output frequency)
2: U (user-defined) see Pr.00-04
3: A (output current)

- This parameter determines the start-up display page. This is the user-defined choice display according to the setting in Pr.00-04.

00-04 Content of Multi-function Display (User-Defined)

Default: 3

Settings
0: Display the output current from the drive to the motor (A) (unit: Amp)
1: Display the counter value (c) (unit: CNT)
2: Display the drive's actual output frequency (H.) (unit: Hz)
3: Display the drive's DC bus voltage (v) (unit: V_{DC})
4: Display the drive's output value (E) (unit: V_{AC})
5: Display the drive's output power angle (n) (unit: deg)
6: Display the drive's output power (P) (unit: kW)
7: Display the motor speed (r) (unit: rpm)
8: Display the drive's estimated output torque%, motor's rated torque is 100% (t) (unit: %)
9: Display PG feedback (G) (unit: PLS) (refer to Pr.10-00–10-01)
10: Display PID feedback (b) (unit: %)
11: Display signal value of AVI analog input terminal (1.) (unit: %)
12: Display signal value of ACI analog input terminal (2.) (unit: %)
14: Display the drive's IGBT temperature (i.) (unit: ^{o}C)
16: Display digital input status (ON / OFF) (i)
17: Display digital output status (ON / OFF) (o)

18: Display the current multi-step speed (S)
19: Display corresponding CPU digital input pin status (d)
20: Display corresponding CPU digital output pin status (0.)
21: Actual motor position (PG1 of PG card) (P.)
(The maximum value is 32 bits to display)
22: Pulse input frequency (S.)
23: Pulse input position (q.)
24: Position command tracing error (E.)
25: Overload count (0.00–100.00%) (o.) (unit: %)
26: Ground fault GFF (G.) (unit: %)
27: DC bus voltage ripple (r.) (unit: V_{DC})
28: Display PLC register D1043 data (C)
29: Display permanent magnet synchronous motor pole section
(for EMM-PG01R)
30: Display the output of user-defined parameter (U)
31: Display Pr.00-05 user gain (K)
32: Number of actual motor revolutions during operation (PG card plugs in and Z phase signal input) (Z.)
33: Actual motor position during operation (when PG card is connected) (q)
35: Control mode (t.): 0 = Speed control mode (SPD)
1 = Torque control mode (TQR)
36: The current operating carrier frequency of the drive (J.) (unit: Hz)
38: Display the drive status (6.)
39: Display the drive's estimated output torque, positive and negative, using N-m as unit (0.0: positive torque; -0.0: negative torque) (C.)
40: Torque command (L.) (unit: %)
41: kWh (J) (unit: kWh)
42: PID target value (h.) (unit: %)
43: PID offset (o.) (unit: %)
44: PID output frequency (b.) (unit: Hz)
46: Auxiliary frequency value (U.) (unit: Hz)
47: Master frequency value (A) (unit: Hz)
48: Frequency value after addition and subtraction of master and auxiliary frequency (L.) (unit: Hz)
51: PMSVC torque offset
52: Signal of analog extension card input terminal AI10 (4.) (unit: %)
53: Signal of analog extension card input terminal AI11 (5.) (unit: %)
55: Display the current reel diameter under the tension control (d) (unit: mm)
56: Display the current line speed under the tension control (L) (unit: m / min.)
57: Display the current tension setting value under the tension control (T) (unit: N)

Explanation 1

- When Pr.10-01 is set to 1000 and Pr.10-02 is set to 1, 2, the displayed range for PG feedback is between 0–4000.
- When Pr.10-01 is set to 1000 and Pr.10-02 is set to 3, 4, 5, the displayed range for PG feedback is between 0–1000.

Explanation 2

- It can also display negative values when setting analog input bias (Pr.03-03–03-10).

  Example: Assume that AVI input voltage is 0 V, Pr.03-03 is 10.0%, Pr.03-07 is 4 (Bias serves as the center).

Explanation 3

Example: If MI1 and MI6 are ON, the following table shows the status of the terminals.

Normally opened contact (N.O.): (0: OFF, 1: ON)

Terminal	MI7	MI6	MI5	MI4	MI3	MI2	MI1
Status	0	1	0	0	0	0	1

- The value is 0000 0000 0010 0001 in binary and 0021H in HEX. When Pr.00-04 is set to 16 or 19, the u page on the keypad displays 0021h.
- The setting 16 is the ON / OFF status of digital input according to Pr.02-12 setting and the setting 19 is the corresponding CPU pin ON / OFF status of the digital input.
- When MI1 / MI2 default setting is two-wire/ three-wire operation control (Pr.02-00 ≠ 0), and MI3 is set as three-wire, it is not affected by Pr.02-12.
- You can set 16 to monitor the digital input status, and then set 19 to check if the circuit is normal.

Explanation 4

Example: Assume that RY: Pr.02-13 is set to 9 (Drive is ready). After the drive is powered on, if there is no other abnormal status, the contact is ON. The display status is shown below.

Normally opened contact (N.O.):

Terminal	MO2	MO1	RY1
Status	0	0	1

- If Pr.00-04 is set to 17 or 20, it displays in hexadecimal “0001h” with LED u page is ON in the keypad.
- The setting 17 is the ON / OFF status of digital output according to Pr.02-18 setting and the setting 20 is the corresponding CPU pin ON / OFF status of the digital output.
- You can set 17 to monitor the digital output status, and then set 20 to check if the circuit is normal.

Explanation 5

- Setting value 8: 100% means the motor rated torque.

  Motor rated torque = (motor rated power x 60 / 2π) / motor rated rotating speed

Explanation 6

- Setting value 25: when displayed value reaches 100.00%, the drive shows “oL” as an overload warning.

Explanation 7

- Setting value 38:

bit 0: The drive is running forward.

bit 1: The drive is running backward.

bit 2: The drive is ready.

bit 3: Errors occurred on the drive.

bit 4: The drive is running.

bit 5: Warnings occurred on the drive.

00-05 Coefficient Gain in Actual Output Frequency

Default: 1.00

Settings 0.00–160.00

- Sets the user-defined unit coefficient gain. Set Pr.00-04 = 31 to display the calculation result on the screen (calculation = output frequency * Pr.00-05).

00-06 Firmware Version

Default: Read only

Settings Read only

00-07 Parameter Protection Password Input

Default: 0

Settings 0–65535

0–4 (the number of password attempts)

- This parameter allows you to enter your password (which is set in Pr.00-08) to unlock the parameter protection and to make changes to the parameter.
- To avoid problems in the future, be sure to write down the password after you set this parameter.
- Pr.00-07 and Pr.00-08 are used to prevent personnel from setting other parameters by accident. If you forget the password, clear the password setting by entering 9999 and pressing the ENTER key, then enter 9999 again and press ENTER within 10 seconds. After decoding, all the settings return to default.
- When setting is under password protection, all the parameters read 0, except Pr.00-08.

00-08 Parameter Protection Password Setting

Default: 0

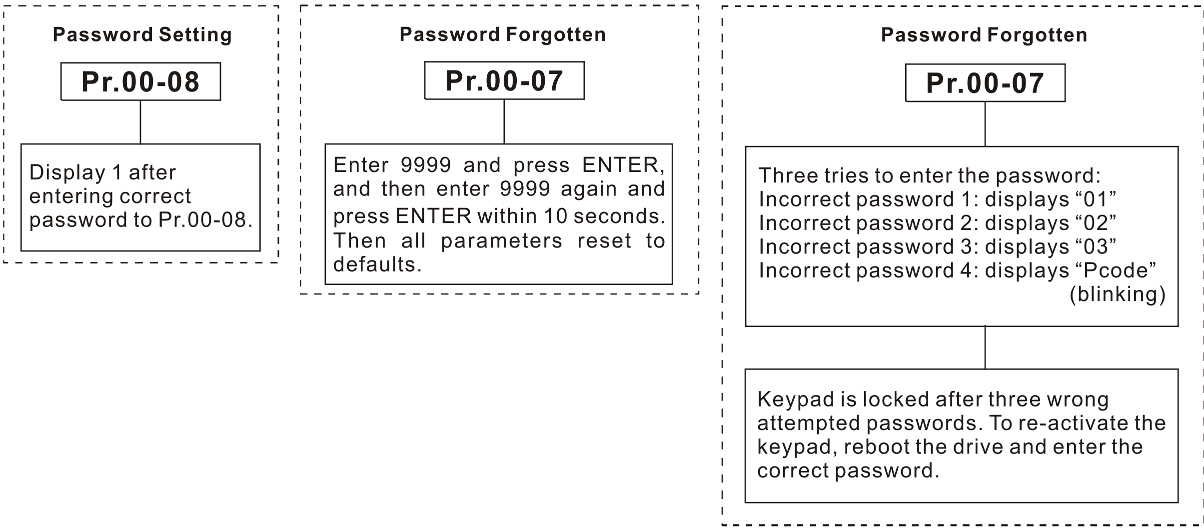
Settings 0-65535

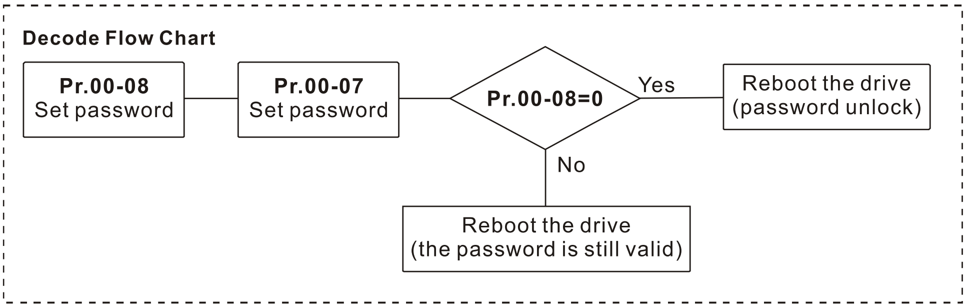
0: No password protection / password entered correctly in Pr.00-07

1: Parameters have been locked

- This parameter is for setting the password protection. Password can be set directly the first time. After you set the password, the value of Pr.00-08 is 1, which means password protection is activated. At this time, if you want to change any of the parameter settings, you must enter the correct password in Pr.00-07 to deactivate the password temporarily, and this would make Pr.00-08 become 0. After you finish setting the parameters, reboot the motor drive and the password is activated again.

- Entering the correct password in Pr.00-07 only temporarily deactivates the password. To permanently deactivate password protection, set Pr.00-08 to 0 manually. Otherwise, password protection is always reactivated after you reboot the motor drive.
- The keypad copy function works only when the password protection is deactivated (temporarily or permanently), and the password set in Pr.00-08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again in the motor drive to activate password protection.





00-10 Control Mode

Default: 0

Settings 0: Speed mode
1: Position control mode
2: Torque mode

- Determines the control mode of the AC motor drive.

00-11 Speed Control Mode

Default: 0

Settings 0: IMVF (IM V/F control)
1: IMVFPG (IM V/F control + Encoder)
2: IM / PM SVC (IM / PM space vector control)
3: IMFOCPG (IM FOC vector control + Encoder)
4: IMFOCPG (PM FOC vector control + Encoder)
5: IMFOC sensorless (IM field-oriented sensorless vector control)
7: IPM sensorless (Interior PM field-oriented sensorless vector control)

📖 Determines the control mode of the AC motor drive:

0: IM V/F control: you can set the proportion of V/F as required and control multiple motors simultaneously.

1: IM V/F control + Encoder pulse input: you can use the encoder for closed-loop speed control.

2: IM sensorless vector control: get the optimal control by auto-tuning the motor parameters.

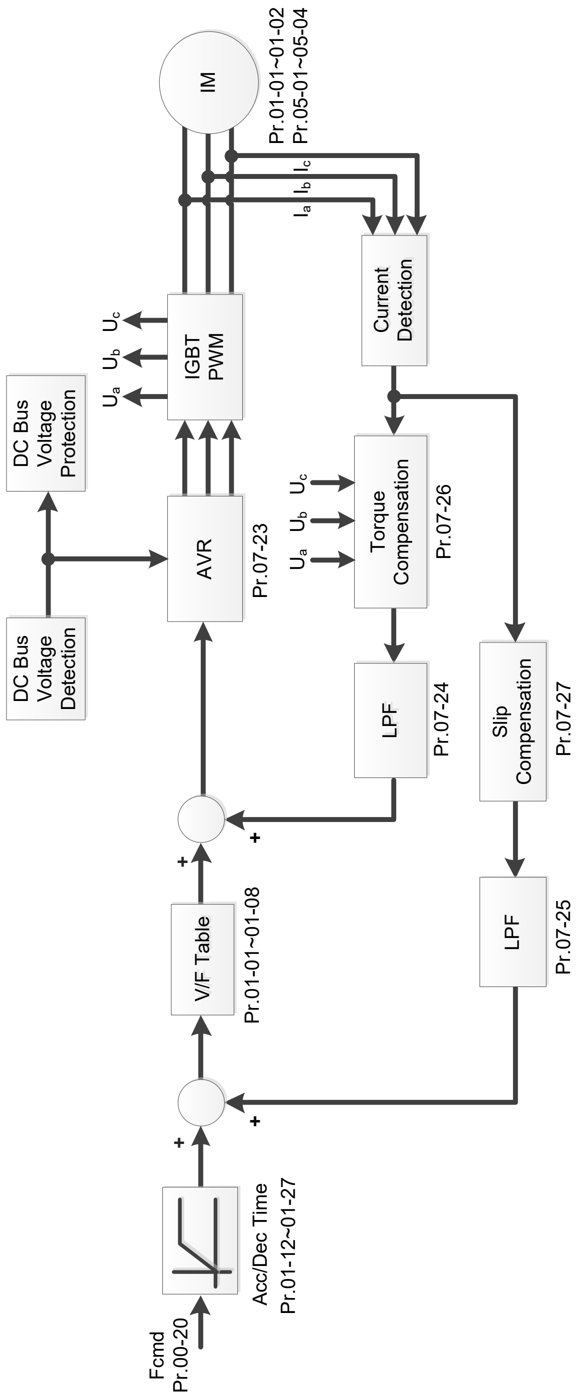
3: IM FOC vector control+ Encoder: not only can increase torque, but also can increase the accuracy of the speed control (1:1000).

4: PM FOC vector control + Encoder: not only can increase torque, but also can increase the accuracy of the speed control (1:1000).

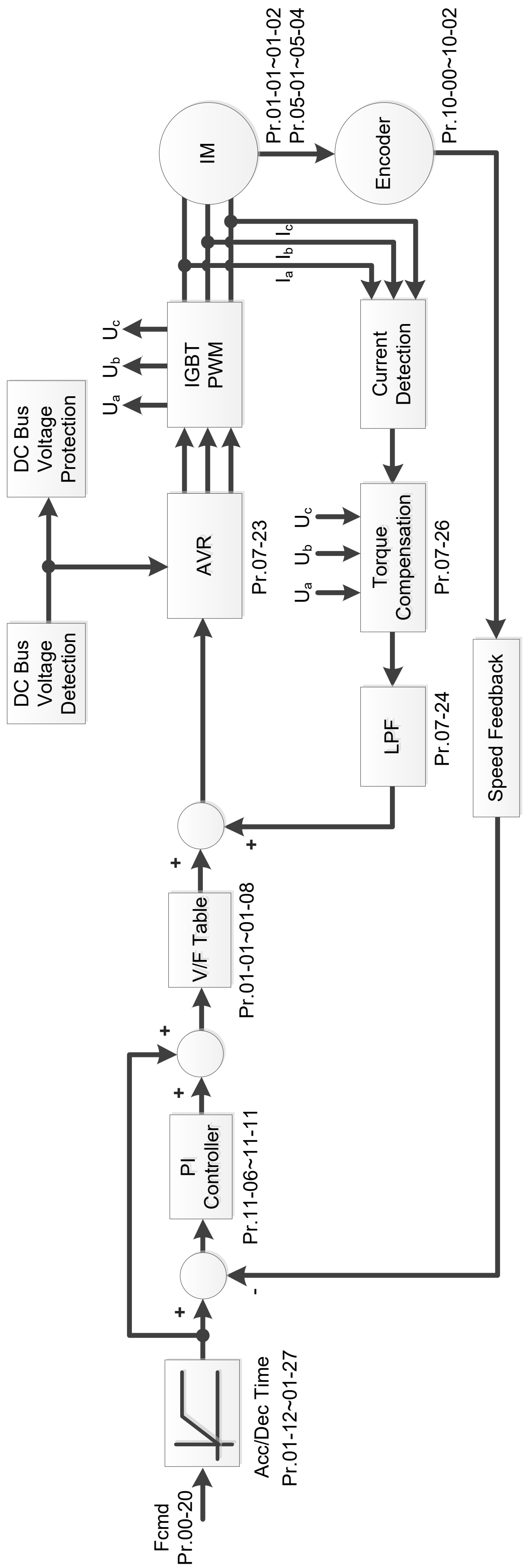
5: IM FOC Sensorless: IM field oriented sensorless vector control

7: IPM Sensorless: interior PM field oriented sensorless vector control

📖 When Pr.00-10 = 0 and you set Pr.00-11 to 0, the V/F control diagram is as follows:

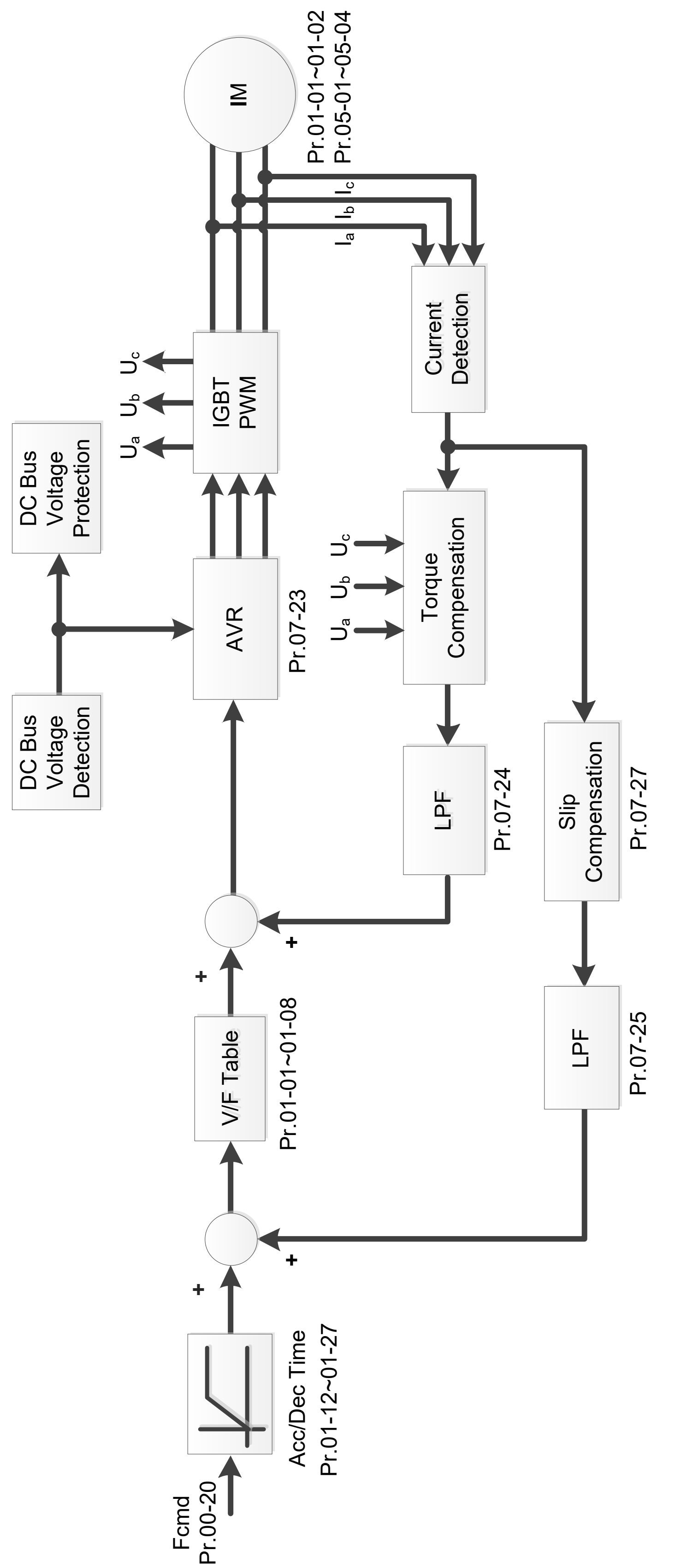


📖 When Pr.00-10 = 0 and you set Pr.00-11 to 1, the V/F control + encoder diagram is as follows:

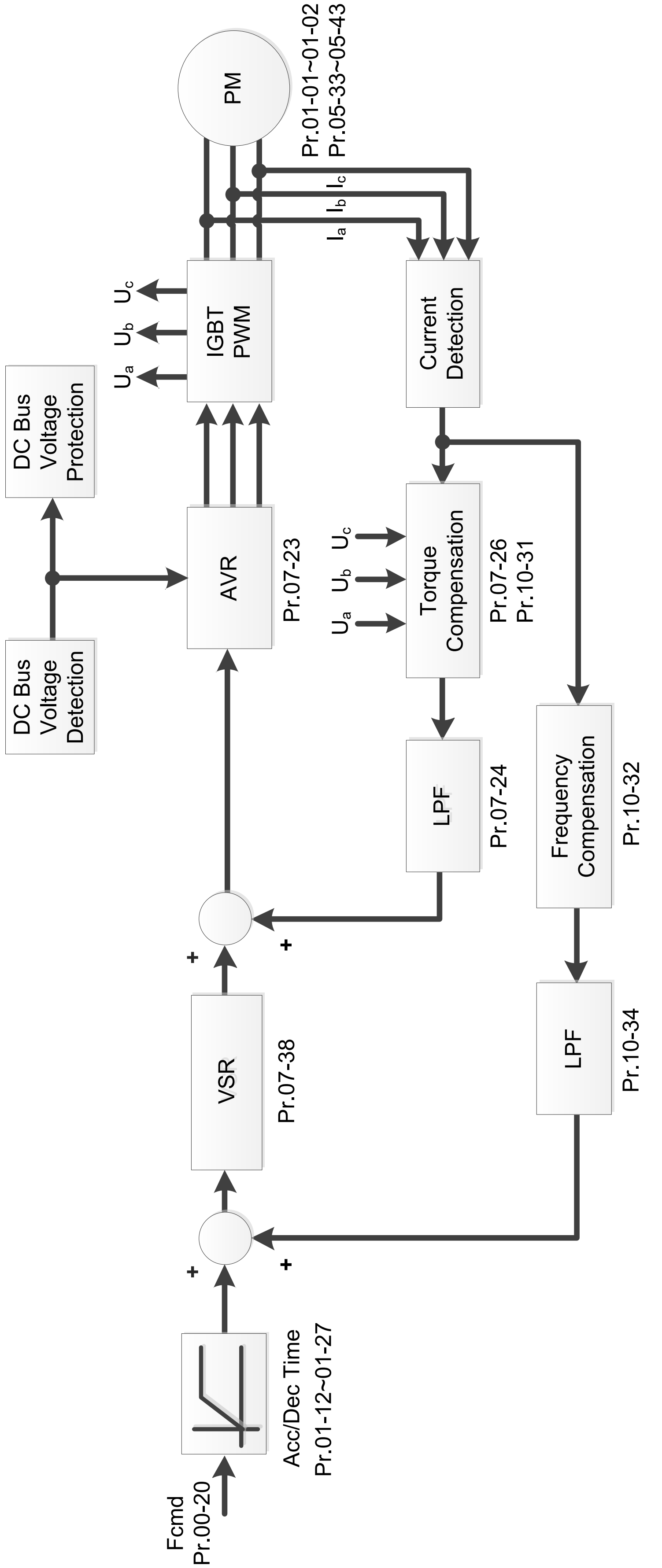


📖 When Pr.00-10 = 0 and you set Pr.00-11 to 2, the sensorless vector control diagram is as follows:

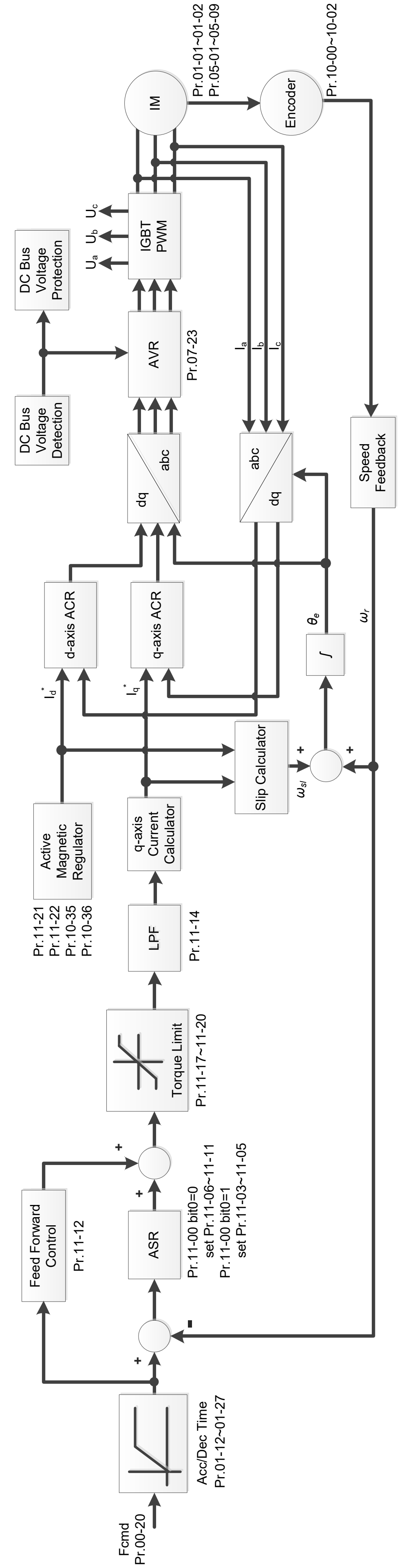
IM Space Vector Control (IMSVC)



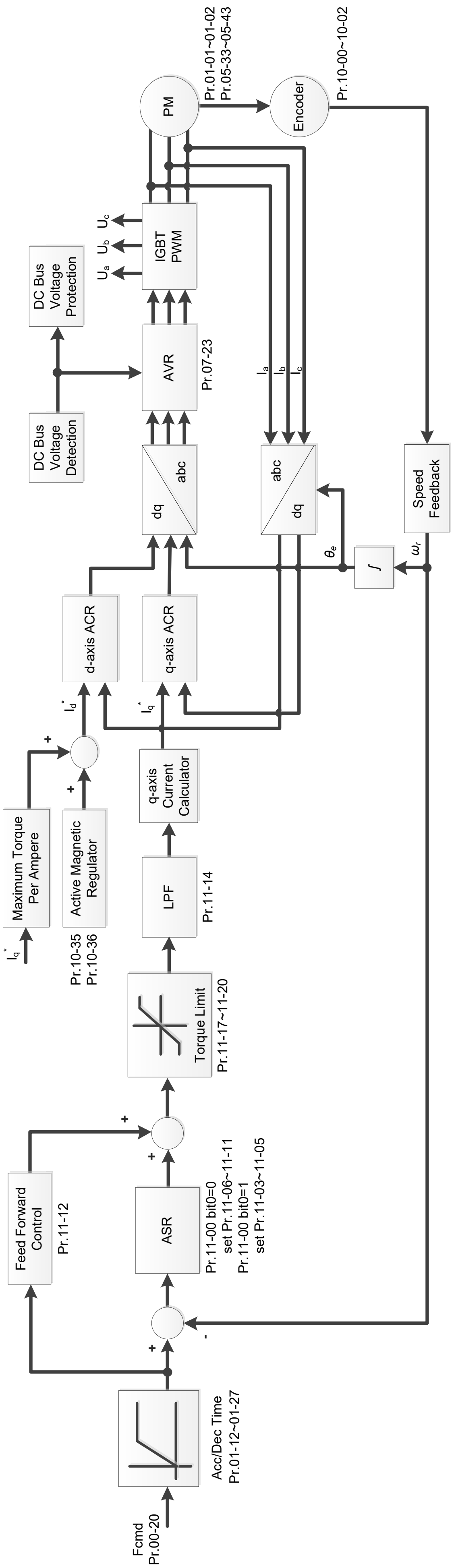
PM Space Vector Control (PMSVC):



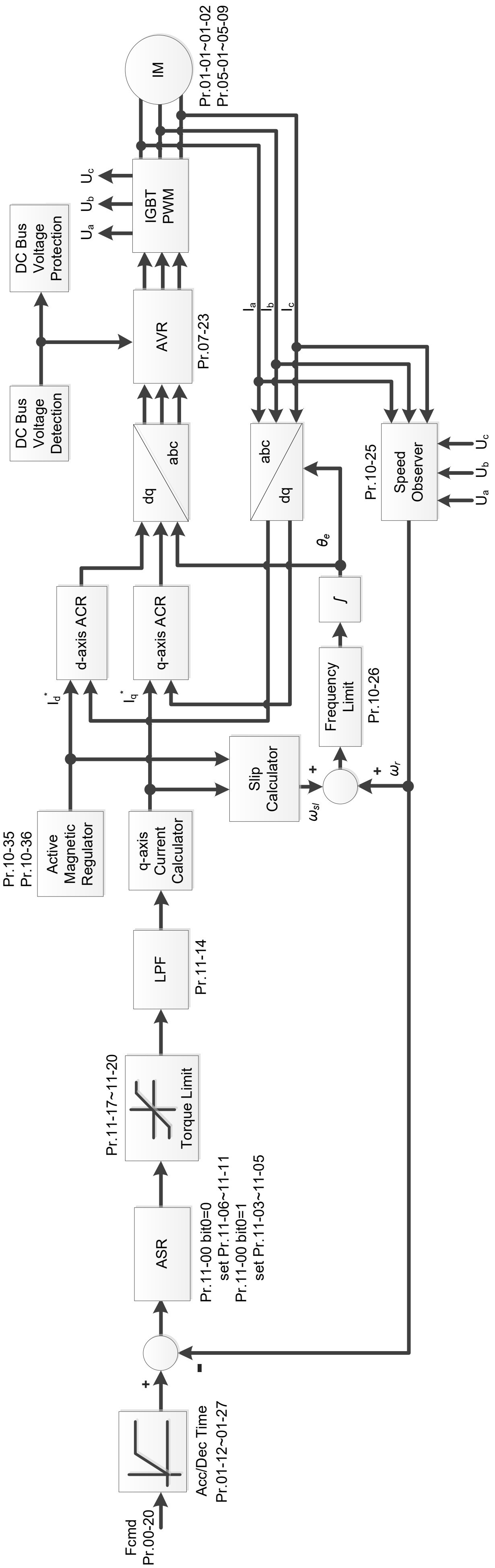
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 3, the IM FOCPG control diagram is as follows:



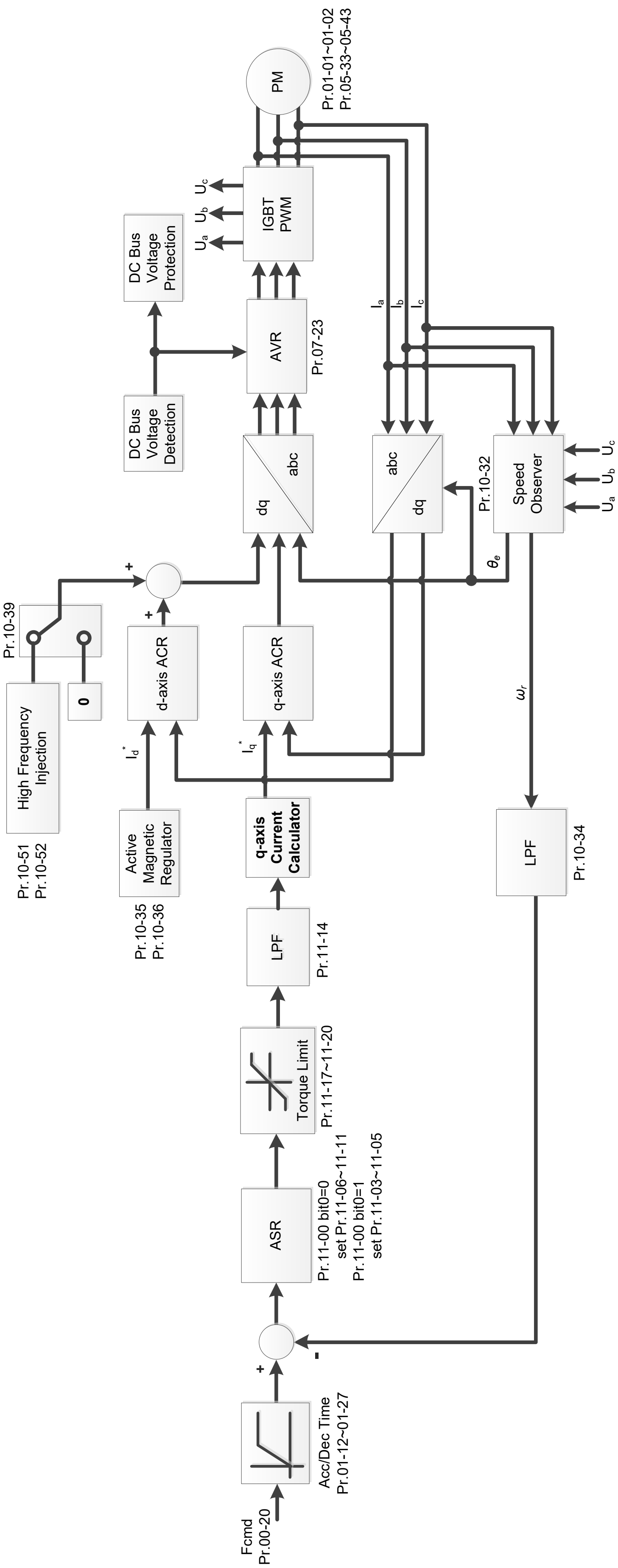
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 4, the PM FOCPG control diagram is as follows:



📖 When Pr.00-10 = 0, and you set Pr.00-11 to 5, IMFOC Sensorless control diagram is as follows:



📖 When Pr.00-10 = 0, and you set Pr.00-11 to 7, IPM FOC sensorless control diagram is as follows:



00-13 Torque Control Mode

Default: 0

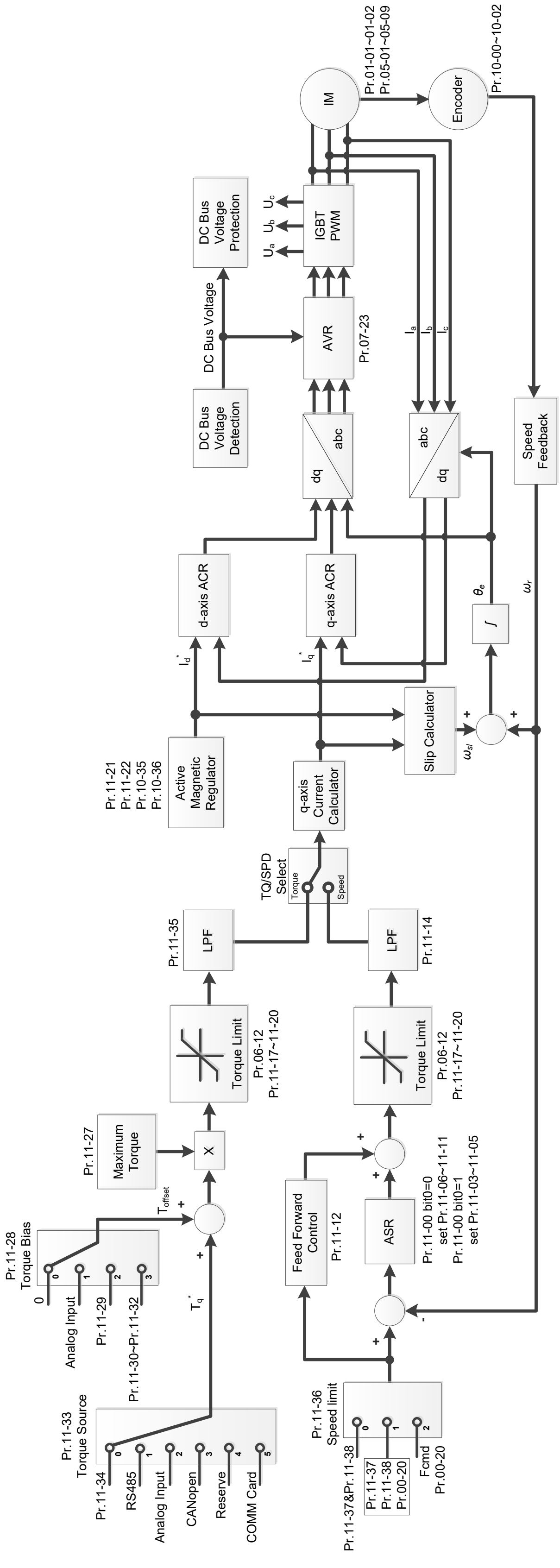
Settings 0: IM TQCPG (IM Torque control + encoder)

1: PM TQCPG (PM Torque control + encoder)

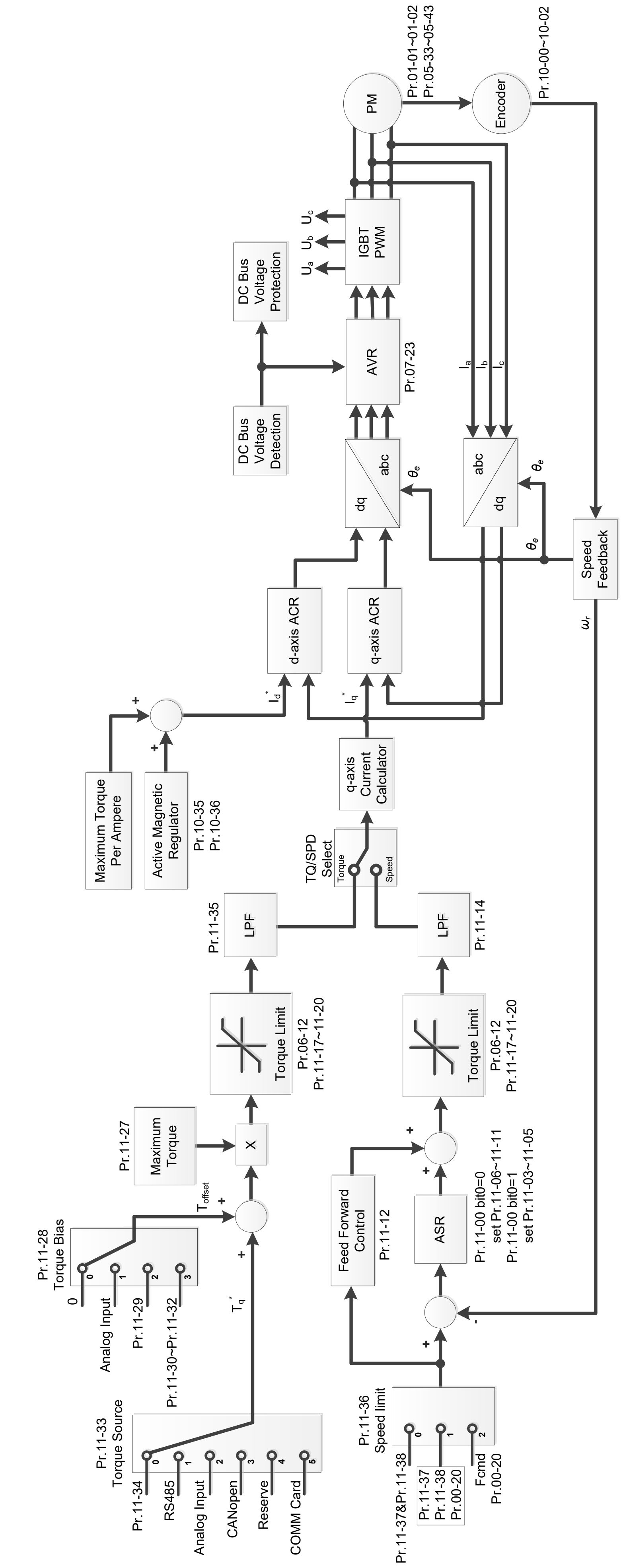
2: IMTQC sensorless (IM sensorless torque control)

📖 See the following pages for more information.

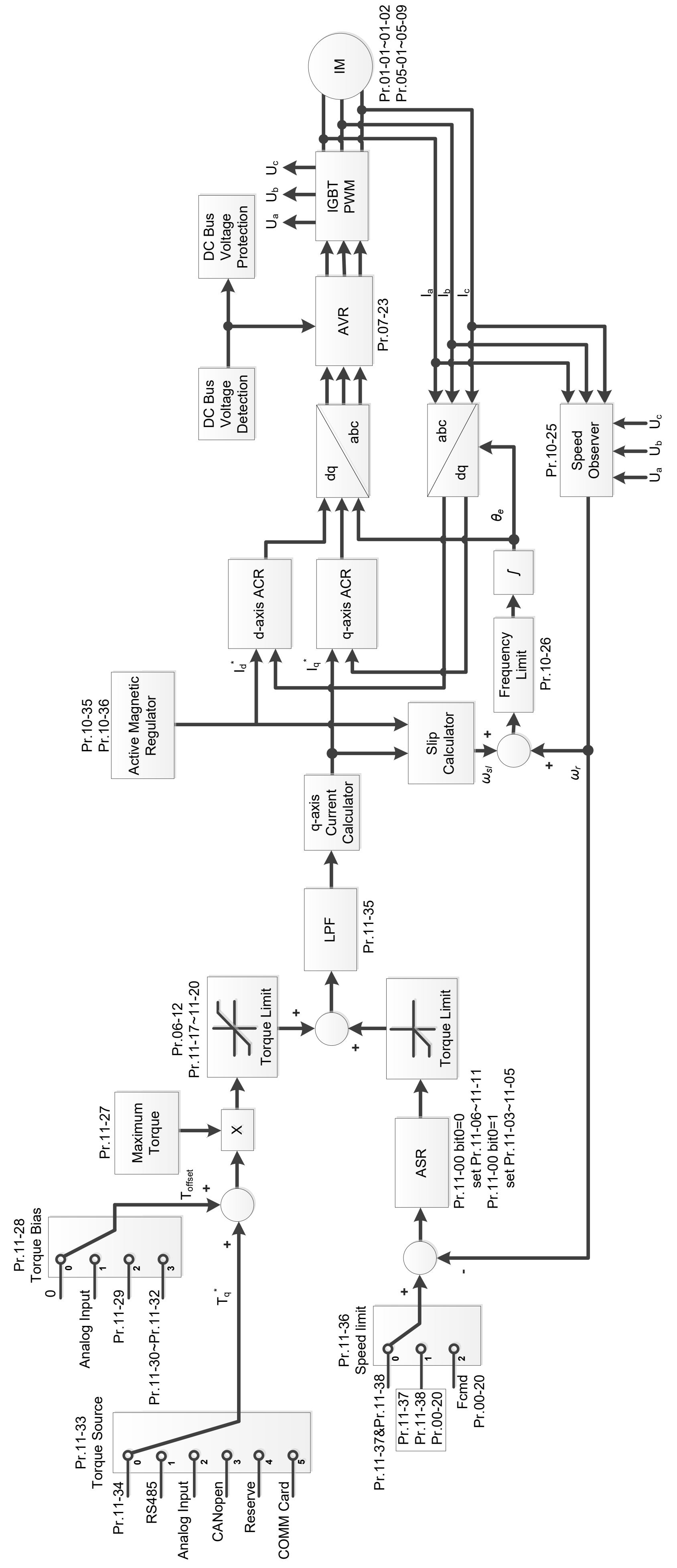
📖 Pr.00-13 = 0, IM TQCPG control diagram is as follows:



📖 Pr.00-13 = 1, PM TQCPG control diagram is as follows:



📖 Pr.00-13 = 2, IM TQC Sensorless control diagram is as follows:



00-16 Duty Selection

Default: 1

Settings 0: Normal duty

1: Heavy duty

- Normal duty: over-load rated output current 150% in 3 seconds (120%, 1 minute). Refer to Pr.00-17 for the setting for the carrier wave. Refer to Pr.00-01 or the specification table for the rated current.
- Heavy duty: over-load rated output current 200% in 3 seconds (150%, 1 minute). Refer to Pr.00-17 for the setting for the carrier wave. Refer to Pr.00-01 or the specification table for the rated current.
- Pr.00-01 varies with the setting value for Pr.00-16. The default value and maximum for Pr.06-03 and Pr.06-04 also vary with the setting value of Pr.00-16.
- In Normal Duty, the default setting of Pr.06-03 and Pr.06-04 is 120%, and the maximum is 150%. However, if DC voltage is higher than 700 V_{DC} (460V models) or 350 V_{DC} (230V models), then the maximum is 145%.
- In Heavy Duty, the default setting of Pr.06-03 and Pr.06-04 is 180%, and the maximum is 200%. However, if DC voltage is higher than 700 V_{DC} (460V models) or 350 V_{DC} (230V models), then the maximum is 165%.

00-17 Carrier Frequency

Default: 4 / 4

Settings Normal load: 2–15 KHz

Heavy load: 2–15 KHz

NOTE:

When Pr.00-11 = 5 (IMFOC Sensorless), the maximum carrier frequency is 14 kHz.

- This parameter determines the PWM carrier frequency for the AC motor drive.

Models	115V / 230V		460V	
	0.25–15 HP (0.2–11 kW)	20–30 HP (15–37 kW)	0.5–20 HP (0.4–15 kW)	25–75 HP (18.5–100 kW)
Settings Range	2–15 kHz			
Default - Normal Duty	4 kHz			
Default - Heavy Duty	4 kHz			

- From the above table, the PWM carrier frequency has significant influences on the electromagnetic noise, the AC motor drive heat dissipation, and the motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency to reduce the temperature rise. Although the motor has quiet operation in the higher carrier frequency, consider the entire wiring and interference.
- When the carrier frequency is higher than the default, decrease the carrier frequency to protect the drive. Refer to Pr.06-55 for related setting and details.

00-19 PLC Command Mask

Default: Read only

Settings bit 0: Control command controlled by PLC
bit 1: Frequency command controlled by PLC
bit 3: Torque command controlled by PLC

- Determines if frequency command, control command or torque command is controlled by PLC.

00-20 Master Frequency Command Source (AUTO, REMOTE)

Default: 0

Settings 0: Inputs from digital keypad
1: Inputs from RS-485 communication
2: Inputs from external analog (refer to Pr.03-00, Pr.03-01)
3: Inputs from external UP / DOWN terminals (multi-function input terminals)
4: Pulse inputs without direction command
(refer to Pr.10-16 without direction)
5: Pulse inputs with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication cards (CANopen card not included)
9: PID function (Pr.08-65 should be set as 1)

NOTE:
HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56 or with KPC-CC01 (optional).

- Determines the master frequency source in the AUTO, REMOTE mode. The default is AUTO mode.
- You can switch the AUTO / HAND mode with the keypad KPC-CC01 (optional) or the multi-function input terminal (MI) to set the master frequency source.
- The default for the frequency source or operation source is for AUTO mode. It returns to AUTO mode whenever you cycle the power. If you use a multi-function input terminal to switch between AUTO and HAND mode, the highest priority is the multi-function input terminal. When the external terminal is OFF, the drive does not accept any operation signal and cannot execute JOG.
- When Pr.00-20 = 9, Pr.08-65 automatically set as 1 at the same time. Pr.08-65 needs to be set as 0 for changing back to other values.

00-21 Operation Command Source (AUTO, REMOTE)

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 communication
5: Communication card (CANopen card not included)

NOTE:
HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56 or with KPC-CC01 (optional).

- Determines the operation frequency source in AUTO, REMOTE mode.

- In the HOA mode, if the multi-function input terminal (MI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.

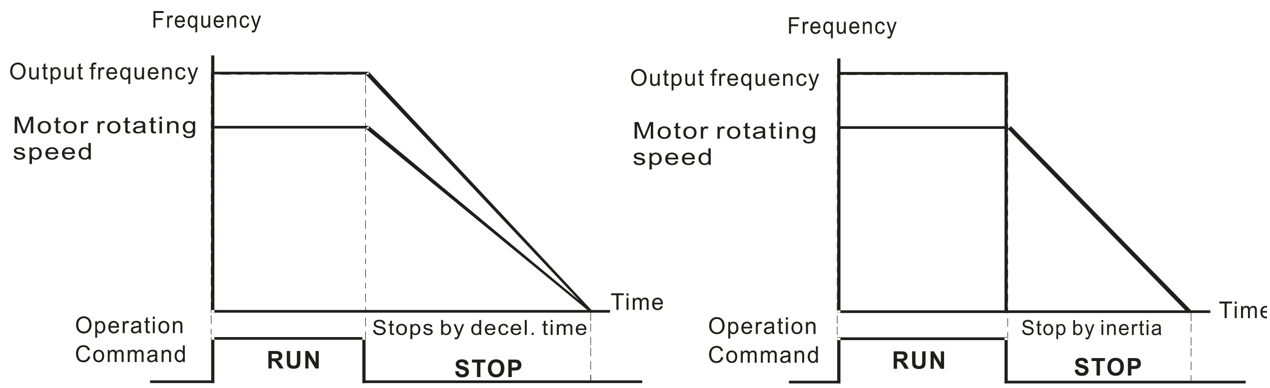
00-22 Stop Method

Default: 0

Settings 0: Ramp to stop

1: Coast to stop

- Determines how the motor is stopped when the drive receives the Stop command.



Ramp to Stop and Coast to Stop

1. Ramp to stop: the AC motor drive decelerates to 0 or the minimum output frequency (Pr.01-09) according to the set deceleration time, and then to stop (according to Pr.01-07).
2. Coast to stop: the AC motor drive stops output immediately, and the motor coasts to stop according to the load inertia.
   - ☑ Use “ramp to stop” for the safety of personnel, or to prevent material from being wasted in applications where the motor must stop immediately after the drive stops. You must set the deceleration time accordingly.
   - ☑ If idling is allowed, or the load inertia is large, use “coast to stop”. For example, blowers, punching machines and pumps.

00-23 Motor direction control

Default: 0

Settings 0: Enable forward and reverse

1: Disable reverse

2: Disable forward

- Enables the AC motor drives to run in the forward and reverse direction. You can use it to prevent a motor from running in a direction that would cause injury or damage to the equipment.

00-24 Digital Keypad Frequency Command Memory

Default: Read Only

Settings Read only

- If the keypad is the frequency command source, when Lv or Fault occurs, this parameter stores the current frequency command.

00-25 User-Defined Characteristics

Default: 0

Settings bit 0–3: user-defined decimal places

0000h–0000b: no decimal place

0001h–0001b: one decimal place

0010h–0010b: two decimal places

0011h–0011b: three decimal places

bit 4–15: user-defined unit

000xh: Hz

001xh: rpm

002xh: %

003xh: kg

004xh: m/s

005xh: kW

006xh: HP

007xh: ppm

008xh: 1/m

009xh: kg/s

00Axh: kg/m

00Bxh: kg/h

00Cxh: lb/s

00Dxh: lb/m

00Exh: lb/h

00Fxh: ft/s

010xh: ft/m

011xh: m

012xh: ft

013xh: degC

014xh: degF

015xh: mbar

016xh: bar

017xh: Pa

018xh: kPa

019xh: mWG

01Axh: inWG

01Bxh: ftWG

01Cxh: psi

01Dxh: atm

01Exh: L/s

01Fxh: L/m

020xh: L/h

021xh: m3/s

022xh: m3/h
023xh: GPM
024xh: CFM
xxxxh: Hz

- bit 0–3: the control frequency F page, user-defined unit (Pr.00-04 = d10, PID feedback value) and the number of decimal places (Pr.00-26) which supports up to three decimal places.
- bit 4–15: the control frequency F page, user-defined unit (Pr.00-04 = d10, PID feedback value) and the displayed units for Pr.00-26.

0 0 0 0 h

user-defined decimal places
0: no decimal place
1: one decimal place
2: two decimal places
3: three decimal places

user-defined unit
0: Hz
1: rpm
2: %
3: kg

- You must convert the setting value to decimal when using the keypad to set parameters.
  Example: Assume that the user-defined unit is inWG and user-defined decimal place is the third decimal point.
  According to the information above, the corresponding unit to inWG is 01Axh (x is the set decimal point), and the corresponding unit to the third decimal place is 0003h, then inWG and the third decimal point displayed in hexadecimal is 01A3h, that is 419 in decimal value. Thus, set Pr.00-25 = 419 to complete the setting.

00-26 Maximum User-Defined Value

Default: 0

Settings 0: Disable
0–65535 (when Pr.00-25 set to no decimal place)
0.0–6553.5 (when Pr.00-25 set to one decimal place)
0.00–655.35 (when Pr.00-25 set to two decimal places)
0.000–65.535 (when Pr.00-25 set to three decimal places)

- When Pr.00-26 is NOT set to 0, the user-defined value is enabled. After selecting the displayed unit and number of decimal points with Pr.00-25, the setting value of Pr.00-26 corresponds to Pr.01-00 (Maximum motor operating frequency), and then the motor operation frequency has a linear relationship with the displayed value on the digital keypad.
  Example:
  When the frequency set in Pr.01-00 = 60.00 Hz, the maximum user-defined value for Pr.00-26 is 100.0%. This also means that Pr.00-25 is set at 0021h to select % as the unit.
  NOTE:
  Set Pr.00-25 before using Pr.00-26. After you finish setting, when Pr.00-26 is not 0, the displayed unit on the keypad shows correctly according to Pr.00-25 settings.

00-27 User-Defined Value

Default: Read only

Settings Read only

- Pr.00-27 displays the user-defined value when Pr.00-26 is not set to 0.

00-29 LOCAL / REMOTE Mode

Default: 0

Settings
0: Standard HOA function
1: Switch Local / Remote, the drive stops
2: Switch Local / Remote, the drive runs as the REMOTE setting for frequency and operation status
3: Switch Local / Remote, the drive runs as the LOCAL setting for frequency and operation status
4: Switch Local / Remote, the drive runs as LOCAL setting when switched to Local and runs as REMOTE setting when switched to Remote for frequency and operating status.

- The default for Pr.00-29 is 0, that is, the standard HOA (Hand-Off-Auto) function. Set the AUTO and HAND frequency and operation source with Pr.00-20, 00-21 and Pr.00-30, 00-31. The external terminal function (MI) = 56 for LOC / REM mode selection is disabled when Pr.00-29=0.
- If Pr.00-29 is not set to 0, the top right corner of digital keypad KPC-CC01 (optional) displays LOC or REM. Set the REMOTE and LOCAL frequency and operation source with Pr.00-20, 00-21 and Pr.00-30, 00-31. Set the multi-function input terminal (MI) = 56 to set the LOC / REM selection. The AUTO key on the KPC-CC01 (optional) is the REMOTE function; the HAND key is the LOCAL function.
- If Pr.00-29 is not set to 0, the AUTO / HAND keys are disabled. In this case, the external terminal (MI) setting = 56 (local / remote selection) has the highest command priority.

✔ 00-30 Master Frequency Command Source (HAND, LOCAL)

Default: 0

Settings
0: Inputs from digital keypad
1: Inputs from RS-485 communication
2: Inputs from external analog (refer to Pr.03-00)
3: Inputs from external UP / DOWN terminals (multi-function input terminals)
4: Pulse inputs without direction command (refer to Pr.10-16 without direction)
5: Pulse inputs with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication cards (CANopen card not included)
9: PID function (Pr.08-65 should be set as 1)

NOTE:
HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56 or with KPC-CC01 (optional).

- Determines the master frequency source in the "HAND, LOCAL" mode.

- You can switch the HAND, LOCAL mode with the keypad KPC-CC01 (optional) or the multi-function input terminal (MI) to set the master frequency source.
- It returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.
- The pulse of Pr.00-20 = 4 (Pulse input without direction command) is input by PG or MI7.

00-31 Operation Command Source (HAND, LOCAL)

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 communication
3: CANopen communication card
5: Communication card (CANopen card not included)
NOTE:
HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56 or with KPC-CC01 (optional).

- Determines the operation frequency source in the "HAND, LOCAL" mode.
- In the HOA mode, if the multi-function input terminal (MI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.

00-32 Digital Keypad STOP Function

Default: 0

Settings 0: Disable STOP key
1: Enable STOP key

- This parameter is valid when the digital keypad is not set as the operation source (Pr.00-21 ≠ 0). When Pr.00-21 = 0, the STOP key on the digital keypad is not affected by this parameter.

00-33 RPWM Mode Selection

Default: 0

Settings 0: Disabled
1: RPWM mode 1
2: RPWM mode 2
3: RPWM mode 3

- Different control modes for Pr.00-33:

Motor	Induction Motor (IM)				Permanent Magnet Synchronous Motor (PM)
Control Mode	VF	SVC	FOCPG	FOC	SVC
0: RPWM mode 1	✓	✓	✓	✓	✓
1: RPWM mode 2	✓	✓	✓	✓	✓
2: RPWM mode 3	✓	✓	✓	✓	✓

- When the RPWM function is enabled, the drive randomly distributes the carrier frequency based on actual Pr.00-17 carrier frequency settings.
- The RPWM function can be applied to all control modes.

- Once the RPWM function is enabled, particularly high frequency audio noise is reduced, and the audio frequency produced by the running motor also changes (usually from a higher to lower).
- Three RPWM modes are provided for different applications. Each mode corresponds to different frequency distribution, electromagnetic noise distribution, and audio frequency.
- The settings for Pr.00-17 (Carrier Frequency) vary with enabling or disabling RPWM.

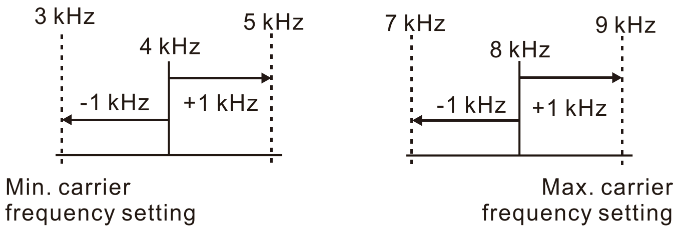
00-34 RPWM Range

Default: 0.0

Settings 0.0–4.0 kHz

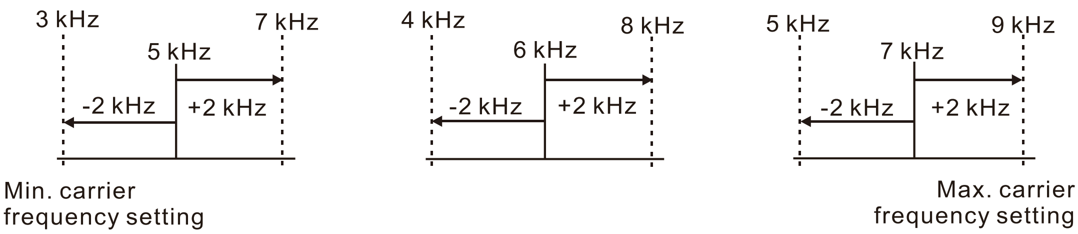
- When the RPWM function is enabled, the minimum carrier frequency setting for Pr.00-17 is 3 kHz, and the maximum is 9 kHz.
- Pr.00-34 is valid only when the RPWM function is enabled (Pr.00-33 ≠ 0).
- When the RPWM function is enabled and Pr.00-17 is set to 4 or 8 kHz, the setting range for Pr.00-34 is 0.0–2.0 kHz.

  When the maximum setting for Pr.00-34 is 2.0 kHz (± 1 kHz). The carrier frequency fluctuation range is according to the diagram below.



- When the RPWM function is enabled and Pr.00-17 is set to 5, 6, or 7 kHz, the setting range for Pr.00-34 is 0.0–4.0 kHz.

  When the maximum setting for Pr.00-34 is 4.0 kHz (± 2 kHz). The carrier frequency fluctuation range is according to the diagram below.



- Example:

  When Pr.00-17 = 4 kHz, Pr.00-33 is enabled (= 1, 2, or 3), Pr.00-34 = 2.0 kHz, then the carrier frequency outputs on the basis of 4 kHz, and the random frequency distribution tolerance is ± 1 kHz, that is, the carrier frequency randomly fluctuates from 3 kHz to 5 kHz.

00-35 Auxiliary Frequency Source

Default: 0

Settings
0: Master and auxiliary frequency function disabled
1: Inputs from digital keypad
2: Inputs from RS-485 communication
3: Inputs from analog input
4: Inputs from external UP / DOWN (multi-function input terminals)
5: Pulse inputs without direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication card

00-36 Master and auxiliary frequency command selection

Default: 0

Settings
0: Master + auxiliary frequency
1: Master - auxiliary frequency
2: Auxiliary - master frequency

- Master and auxiliary frequency command sets the master frequency source according to Pr.00-20, and sets the auxiliary frequency source according to Pr.00-35. Addition and subtraction mode of auxiliary / master frequency is set according to Pr.00-36.
- When Pr.00-36 = 0, 1, 2, acceleration and deceleration by the system (includes S-curve) after adding or subtracting the auxiliary / master frequency, can then be output as a control command.
- If the value received is negative after adding or subtracting the auxiliary / master frequency, then Pr.03-10 determines whether to change the running direction.
- If you set master frequency source (Pr.00-20 = 0) or the auxiliary frequency source (Pr.00-35 = 1) by using the keypad, the F page of the keypad displays the setting frequency that you can use to set the master frequency or the auxiliary frequency. If the master frequency source or the auxiliary frequency source is NOT set by keypad (Pr.00-20 ≠ 0 and Pr.00-35 ≠ 1), the F page of the keypad displays the value after adding or subtracting the auxiliary / master frequency.
- When setting the master frequency source and auxiliary frequency source, Pr.00-35 cannot be set to the same value as Pr.00-20 or Pr.00-30.
- When using the master and auxiliary frequency function, after the master and auxiliary frequencies are added or subtracted, if the value is positive, the output frequency will be limited by the maximum operating frequency (Pr.01-00); if the value is negative, the output frequency will be limited by reverse running cutoff frequency (Pr.08-67) for limiting.

✓ 00-47 Output Phase Order Selection

Default: 0

Settings
0: Standard
1: Exchange the rotation direction

- Without changing the wiring, this parameter can be used to change the rotation direction from forward to reverse or from reverse to forward, and the indicator light won't be changed.
- When using this parameter with Pr.00-23 (Control of motor direction), Pr.00-23 has priority over Pr.00-47.

✎ 00-48 Display Filter Time (Current)

Default: 0.100

Settings 0.001–65.535 sec.

📖 Minimizes the current fluctuation displayed by digital keypad.

✎ 00-49 Display Filter Time (Keypad)

Default: 0.100

Settings 0.001–65.535 sec.

📖 Minimizes the value fluctuation displayed by digital keypad.

00-50 Software Version (Date)

Default: Read only

Settings Read only

📖 Displays the current drive software version by date.

01 Basic Parameters

✓ You can set this parameter during operation.

01-00	Motor 1 Maximum Operation Frequency
01-52	Motor 2 Maximum Operation Frequency
01-53	Motor 3 Maximum Operation Frequency
01-62	Motor 4 Maximum Operation Frequency

Default: 60.00 / 50.00

Settings 00.00–599.00 Hz

- Determines the drive's maximum operation frequency range. This setting corresponds to the maximum value for the analog input frequency setting signal (0–10 V, 4–20 mA, 0–20 mA, ±10 V).

01-01	Motor 1 Rated / Base Frequency
01-35	Motor 2 Rated / Base Frequency
01-54	Motor 3 Rated / Base Frequency
01-63	Motor 4 Rated / Base Frequency

Default: 60.00 / 50.00

Settings 00.00–599.00 Hz

- Set this value according to the motor's rated frequency from the motor's nameplate. If the motor's rated frequency is 60 Hz, set the value to 60 Hz. If the motor's rated frequency is 50 Hz, set the value to 50 Hz.

01-02	Motor 1 Rated / Base Voltage
01-36	Motor 2 Rated / Base Voltage
01-55	Motor 3 Rated / Base Voltage
01-64	Motor 4 Rated / Base Voltage

Default: 220.0 / 440.0

Settings 115V / 230V models: 0.0–255.0 V
460V models: 0.0–510.0 V

- Set this value according to the rated voltage of the motor from the motor's nameplate. If the motor's rated voltage is 220 V, set the value to 220.0 V. If the motor's rated voltage is 200 V, set the value to 200.0 V.
- There are a wide variety of motors, but the power system for each country is different. The convenient and economical way to solve this problem is to use an AC motor drive, which can deal with different voltages and frequencies, while supporting the original characteristics and life of the motor.

01-03	Motor 1 Mid-point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

✓ **01-04**	Motor 1 Mid-point Voltage 1

Default: 11.0 / 22.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-37 Motor 2 Mid-point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

01-38 Motor 2 Mid-point Voltage 1

Default: 11.0 / 22.0

Settings 115V / 230V models: 0.0–240.0 V

460V models: 0.0–480.0 V

01-56 Motor 3 Mid-point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

01-57 Motor 3 Mid-point Voltage 1

Default: 11.0 / 22.0

Settings 115V / 230V models: 0.0–240.0 V

460V models: 0.0–480.0 V

01-65 Motor 4 Mid-point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

01-66 Motor 4 Mid-point Voltage 1

Default: 11.0 / 22.0

Settings 115V / 230V models: 0.0–240.0 V

460V models: 0.0–480.0 V

01-05 Motor 1 Mid-point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

01-06 Motor 1 Mid-point Voltage 2

Default: 5.0 / 10.0

Settings 115V / 230V models: 0.0–240.0 V

460V models: 0.0–480.0 V

01-39 Motor 2 Mid-point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

01-40 Motor 2 Mid-point Voltage 2

Default: 5.0 / 10.0

Settings 115V / 230V models: 0.0–240.0 V

460V models: 0.0–480.0 V

01-58 Motor 3 Mid-point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

01-59 Motor 3 Mid-point Voltage 2

Default: 5.0 / 10.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-67 Motor 4 Mid-point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

01-68 Motor 4 Mid-point Voltage 2

Default: 5.0 / 10.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-07 Motor 1 Minimum Output Frequency

Default: 0.50

Settings 0.00–599.00 Hz

01-08 Motor 1 Minimum Output Voltage

Default: 1.0 / 2.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-41 Motor 2 Minimum Output Frequency

Default: 0.50

Settings 0.00–599.00 Hz

01-42 Motor 2 Minimum Output Voltage

Default: 1.0 / 2.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-60 Motor 3 Minimum Output Frequency

Default: 0.50

Settings 0.00–599.00 Hz

01-61 Motor 3 Minimum Output Voltage

Default: 1.0 / 2.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-69 Motor 4 Minimum Output Frequency

Default: 0.50

Settings 0.00–599.00 Hz

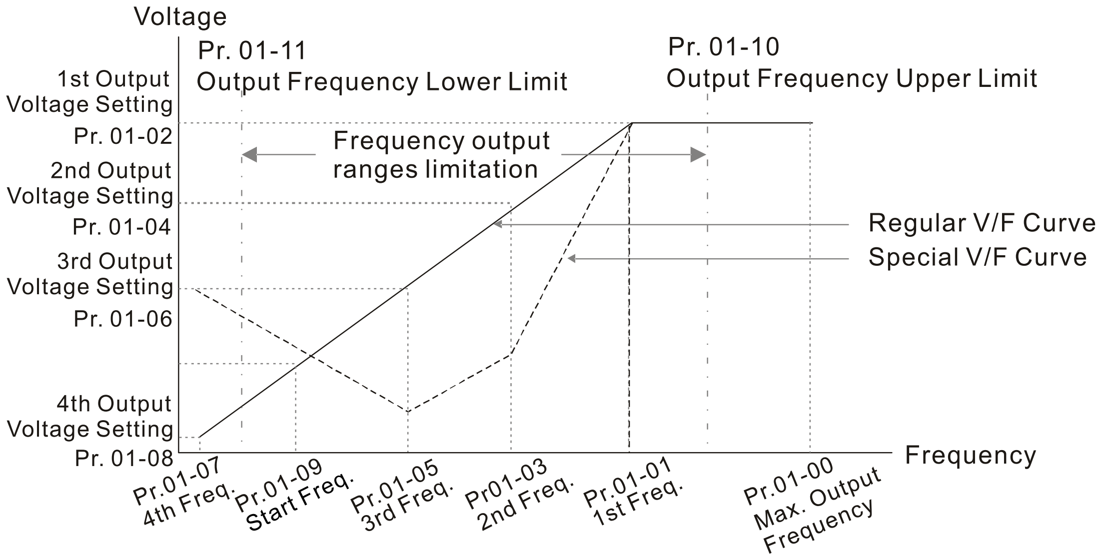
01-70 Motor 4 Minimum Output Voltage

Default: 1.0 / 2.0

Settings 115V / 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

📖 The V/F curve setting is usually set by the motor's allowable loading characteristics. If the loading characteristics exceeds the loading limit of the motor, you must pay more attention to the heat dissipation, dynamic balance, and bearing lubrication of the motor.

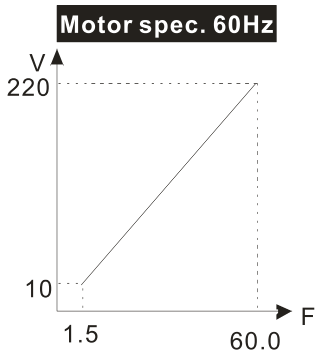
- If the voltage is too high when the motor is at low frequencies, it may cause motor damage, overheating, and may trigger stalling or over-current protection. To prevent motor damage or motor fault, be careful when you set the voltage.
- The diagram below shows the V/F curve for motor 1. You can also find the V/F curve for motor 2 from the same diagram. For multi-motors selection, refer to multi-function input terminal settings 83 and 84 for Pr.02-01–02-07.



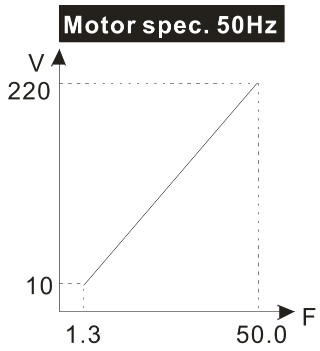
V/F Curve and The Related Parameters

- Common settings for the V/F curve:

(1) General purpose

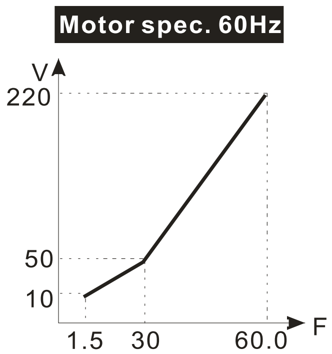


Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	1.50
01-04 01-06	10.0
01-07	1.50
01-08	10.0

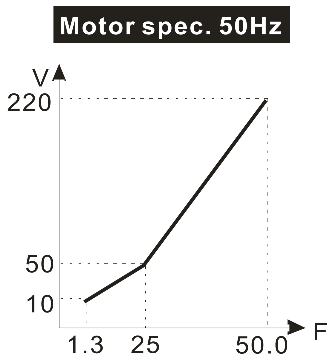


Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	1.30
01-04 01-06	10.0
01-07	1.30
01-08	10.0

(2) For fan and hydraulic machinery



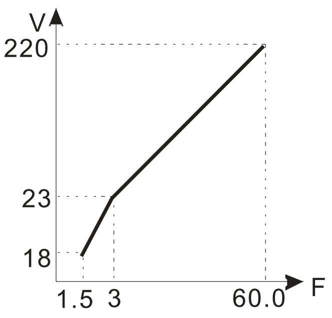
Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	30.0
01-04 01-06	50.0
01-07	1.50
01-08	10.0



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	25.0
01-04 01-06	50.0
01-07	1.30
01-08	10.0

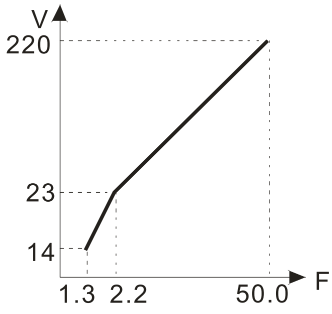
(3) High starting torque

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	3.00
01-04 01-06	23.0
01-07	1.50
01-08	18.0

Motor spec. 50Hz



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	2.20
01-04 01-06	23.0
01-07	1.30
01-08	14.0

01-09 Start-up Frequency

Default: 0.50

Settings 0.00–599.00 Hz

📖 When the starting frequency is higher than the minimum output frequency, the drive's output is from the starting frequency to the setting frequency. Refer to the following diagram for details.

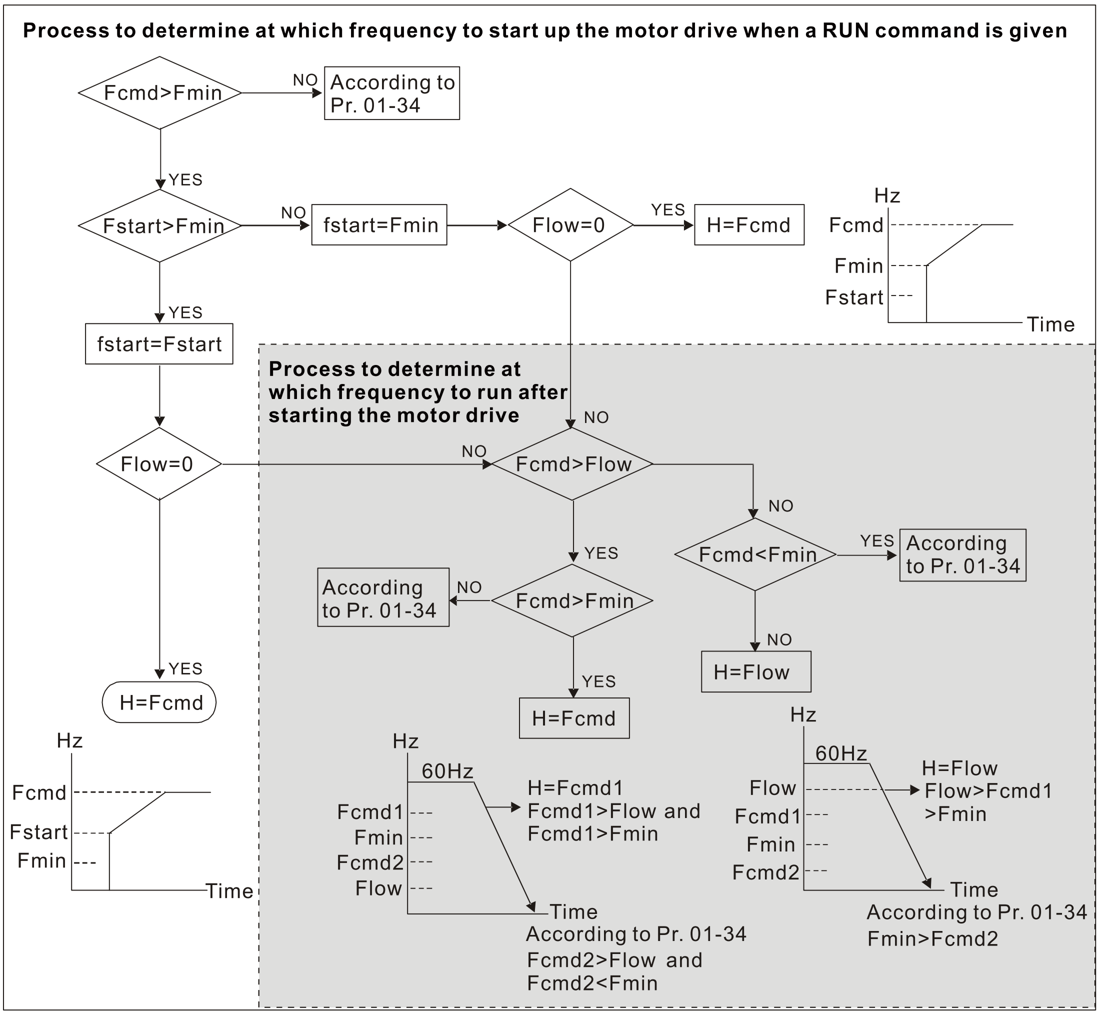
Fcmd = frequency command;

Fstart = start frequency (Pr.01-09);

fstart = actual start frequency of drive;

Fmin = 4th output frequency setting (Pr.01-07 / Pr.01-41);

Flow = output frequency lower limit (Pr.01-11)



- When Fcmd > Fmin and Fcmd < Fstart:
  If Flow < Fcmd, drive runs directly by Fcmd.
  If Flow ≥ Fcmd, drive runs by Fcmd, then rises to Flow according to acceleration time.
- The output frequency goes directly to 0 when decelerating to Fmin.

01-10 Upper Frequency Limit

Default: 599.00

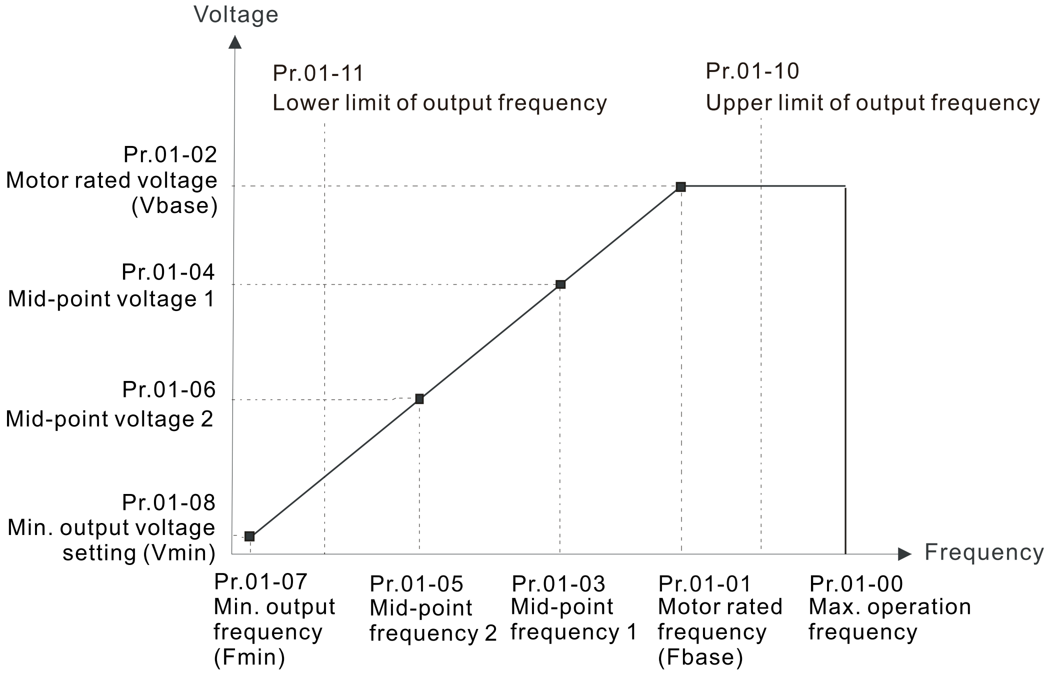
Settings 0.00–599.00 Hz

01-11 Lower Frequency Limit

Default: 0.00

Settings 0.00–599.00 Hz

- If the frequency setting is higher than the upper limit (Pr.01-10), the drive runs with the upper frequency limit. If the frequency setting is lower than lower limit (Pr.01-11) and higher than minimum frequency (Pr.01-07), the drive runs with the lower frequency limit. Set the upper frequency limit > lower frequency limit (Pr.01-10 setting value must be > Pr.01-11 setting value).
- If the PID control is enabled for the drive, the drive's output frequency may exceed frequency command but is still limited by this setting.
- Related parameters: Pr.01-00 Maximum Operation Frequency.



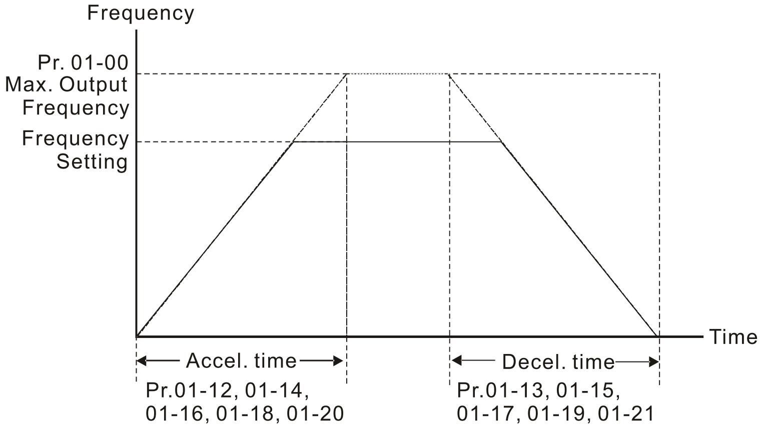
- When the drive starts, it operates from the minimum output frequency (Pr.01-07) and accelerates to the setting frequency. It is not limited by the lower limit frequency.
- Use the settings of upper and lower frequency limit to prevent operator's misuse, overheating caused by operating at a too low frequency, or damage caused by excessive speed.
- If the upper frequency limit setting is 50 Hz and the frequency setting is 60 Hz, the maximum output frequency is 50 Hz.
- If the lower frequency limit setting is 10 Hz and the minimum operation frequency setting (Pr.01-07) is 1.5 Hz, the drive operates at 10 Hz when the frequency command is greater than Pr.01-07 and less than 10 Hz. If the frequency command is less than Pr.01-07, the drive stays in ready status with no output.

✓	**01-12**	Acceleration Time 1
✓	**01-13**	Deceleration Time 1
✓	**01-14**	Acceleration Time 2
✓	**01-15**	Deceleration Time 2
✓	**01-16**	Acceleration Time 3
✓	**01-17**	Deceleration Time 3
✓	**01-18**	Acceleration Time 4
✓	**01-19**	Deceleration Time 4
✓	**01-20**	JOG Acceleration Time
✓	**01-21**	JOG Deceleration Time

Default: 10.00

Settings Pr.01-45 = 0: 0.00–600.00 sec.
Pr.01-45 = 1: 0.0–6000.0 sec.

- Use the acceleration time to determine the time required for the AC motor drive to accelerate from 0 Hz to maximum output frequency (Pr.01-00).
- The acceleration and deceleration time are invalid when using Pr.01-44 Auto-acceleration and Auto-deceleration Setting.
- Select the acceleration and deceleration time 1, 2, 3, and 4 with the multi-function input terminals settings. The defaults are acceleration and deceleration time 1. With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.
- Note that setting the acceleration and deceleration time too short may trigger the protection function (Pr.06-03 Over-current Stall Prevention during Acceleration or Pr.06-01 Over-voltage Stall Prevention).
- Note that setting the acceleration time too short may cause motor damage or trigger drive protection due to over-current during acceleration.
- Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during deceleration or over-voltage.
- Use suitable brake resistors (refer to Chapter 07 Optional Accessories) to decelerate in a short time and prevent over-voltage.
- When you enable Pr.01-24–Pr.01-27 (S-curve acceleration and deceleration begin and arrival time), the actual acceleration and deceleration time are longer than the setting.



Acceleration / Deceleration Time

01-22 JOG Frequency

Default: 6.00

Settings 0.00–599.00 Hz

- You can use both the external terminal JOG and F1 key on the optional keypad KPC-CC01 to set the JOG function. When the JOG command is ON, the AC motor drive accelerates from 0 Hz to the JOG frequency (Pr.01-22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to stop. The JOG acceleration and deceleration time (Pr.01-20, Pr.01-21) are the time to accelerate from 0.0 Hz to the JOG frequency (Pr.01-22). You cannot execute the JOG command when the AC motor drive is running. When the JOG command is executing, other operation commands are invalid.

01-23 First and Fourth Acceleration / Deceleration Exchange Frequency

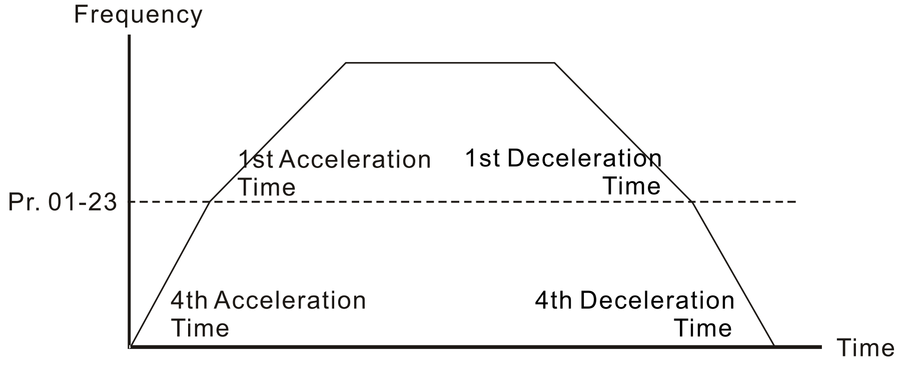
Default: 0.00

Settings 0.00–599.00 Hz

- This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically by the Pr.01-23 setting. If you set the external terminal, it is based on the external terminal first, and not on Pr.01-23.
- Use this parameter to set the switch frequency between acceleration and deceleration slope. The First / Fourth Accel. / Decel. slope is calculated by the Max. Operation Frequency (Pr.01-00) / acceleration / deceleration time.

  Example: When the Max. Operation Frequency (Pr.01-00) = 80 Hz, and Switch Frequency between First and Fourth Accel. / Decel. (Pr.01-23) = 40 Hz:

  a. If Acceleration Time 1 (Pr.01-02) = 10 sec., Acceleration Time 4 (Pr.01-18) = 6 sec., then the acceleration time is 3 sec. for 0–40 Hz and 5 sec. for 40–80 Hz.
  b. If Deceleration Time 1 (Pr.01-13) = 8 sec., Deceleration Time 4 (Pr.01-19) = 2 sec., then the deceleration time is 4 sec. for 80–40 Hz and 1 sec. for 40–0 Hz.



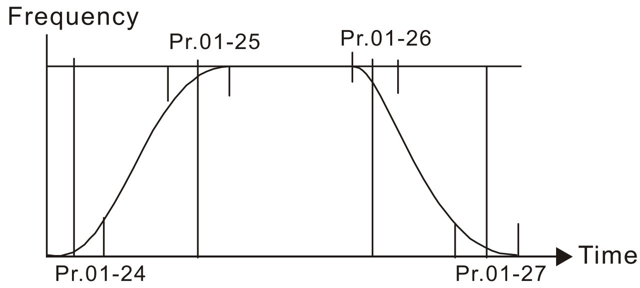
1st/4th Acceleration/Deceleration Frequency Switching

01-24 S-curve for Acceleration Begin Time 1
01-25 S-curve for Acceleration Arrival Time 2
01-26 S-curve for Deceleration Begin Time 1
01-27 S-curve for Deceleration Arrival Time 2

Default: 0.20

Settings Pr.01-45 = 0: 0.00–25.00 sec.
Pr.01-45 = 1: 0.0–250.0 sec.

- Sets a slow start when the drive begins to accelerate at the start. The acceleration and deceleration curve adjust the S-curve acceleration and deceleration according to the parameter value. When you enable this function, the drive has a different acceleration and deceleration curve based on the acceleration and deceleration time.
- The S-curve function is disabled when you set the acceleration and deceleration time to 0.
- When Pr.01-12, 01-14, 01-16, 01-18 ≥ Pr.01-24 and Pr.01-25,
  the actual acceleration time = Pr.01-12, 01-14, 01-16, 01-18 + (Pr.01-24 + Pr.01-25) / 2.
- When Pr.01-13, 01-15, 01-17, 01-19 ≥ Pr.01-26 and Pr.01-27,
  the actual deceleration time = Pr.01-13, 01-15, 01-17, 01-19 + (Pr.01-26 + Pr.01-27) / 2.

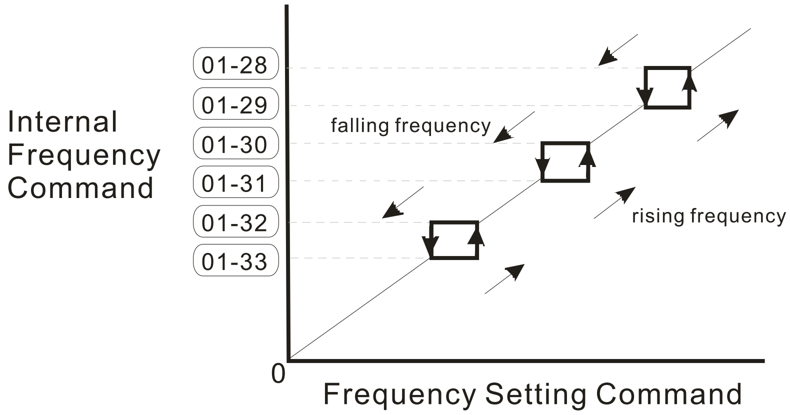


01-28	Skip Frequency 1 (Upper Limit)
01-29	Skip Frequency 1 (Lower Limit)
01-30	Skip Frequency 2 (Upper Limit)
01-31	Skip Frequency 2 (Lower Limit)
01-32	Skip Frequency 3 (Upper Limit)
01-33	Skip Frequency 3 (Lower Limit)

Default: 0.00

Settings 0.00–599.00 Hz

- Sets the AC drive's skip frequency. The drive's frequency setting skips these frequency ranges. However, the frequency output is continuous. There are no limits for these six parameters and you can combine them. Pr.01-28 does not need to be greater than Pr.01-29; Pr.01-30 does not need to be greater than Pr.01-31; Pr.01-32 does not need to be greater than Pr.01-33. Pr.01-28–01-33 can be set as required. There is no size distinction among these six parameters.
- These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.
- You can set the Frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.
- When accelerating and decelerating, the output frequency still passes through the skip frequency ranges.



01-34 Zero-speed Mode

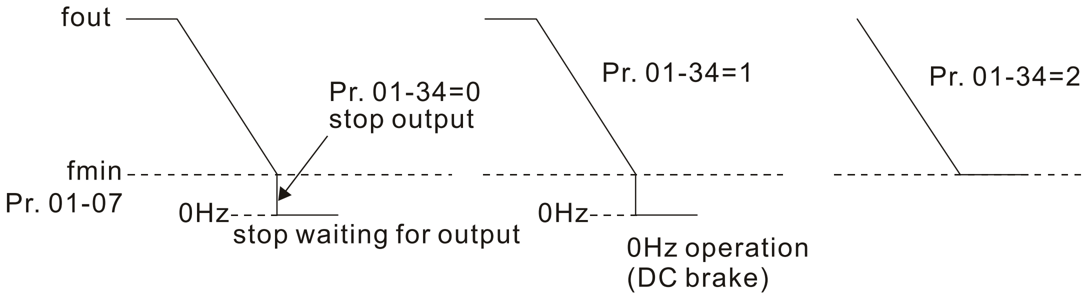
Default: 0

Settings 0: Output waiting

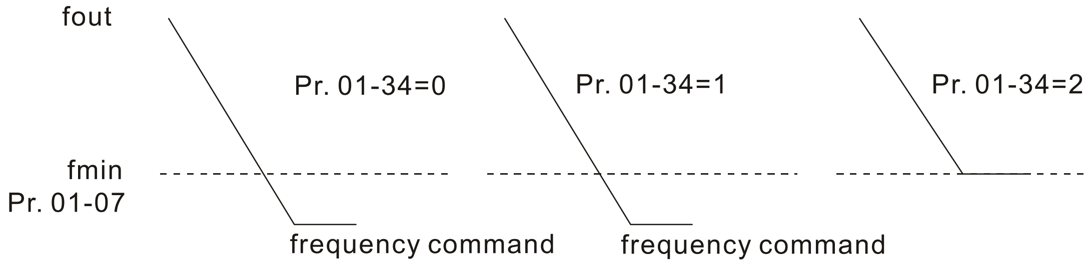
1: Zero-speed operation

2: Fmin (refer to Pr.01-07, 01-41)

- When the frequency command of drive is less than Fmin (Pr.01-07, Pr.01-41), the drive operates using this parameter.
- 0: the AC motor drive is in waiting mode without voltage output from terminals U, V, W.
- 1: the drive executes the DC brake by Vmin (Pr.01-08 and Pr.01-42) in V/F, FOC sensorless, and SVC modes. And it executes zero-speed operation in VFPG and FOCPG mode.
- 2: the AC motor drive runs using Fmin (Pr.01-07, Pr.01-41) and Vmin (Pr.01-08, Pr.01-42) in V/F, VFPG, SVC, FOC sensorless and FOCPG modes.
- In V/F, VFPG, SVC and FOC sensorless modes:



- In FOCPG mode, when Pr.01-34 is set to 2, the AC motor drive operates according to this setting.

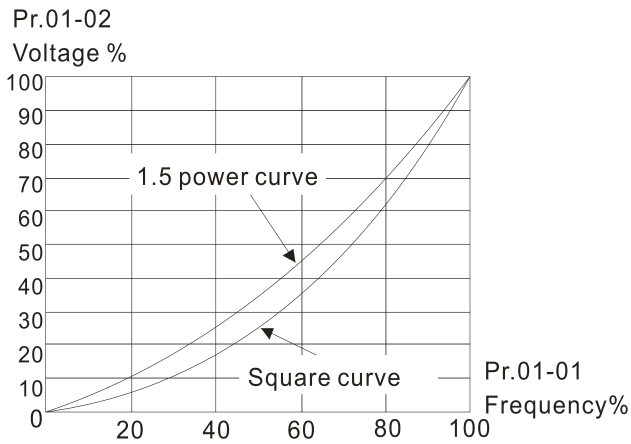


01-43 V/F Curve Selection

Default: 0

Settings 0: V/F curve determined by Pr.01-00–01-08
1: V/F curve to the power of 1.5
2: V/F curve to the power of 2
16: V/F Separated mode (VFSM)

- When setting to 0, refer to Pr.01-01–01-08 for the motor 1 V/F curve. For motor 2, refer to Pr.01-35–01-42.
- When setting to 1 or 2, the second and third voltage frequency settings are invalid.
- If the load on the motor is a variable torque load (torque is in direct proportion to rotating speed, such as the load of a fan or a pump), the load torque is low at low rotating speed. Decreasing the input voltage to make the magnetic field of the input current smaller and reduce flux loss and iron loss for the motor to increase efficiency.
- When you set the V/F curve to high power, it has lower torque at low frequency, and the drive is not suitable for rapid acceleration and deceleration. Do NOT use this parameter for rapid acceleration and deceleration.



- For V/F absolutely separation, the rated voltage of Pr.01-02 corresponds to 100%, and for half separation, the original FV conversion slope corresponds to 100%.

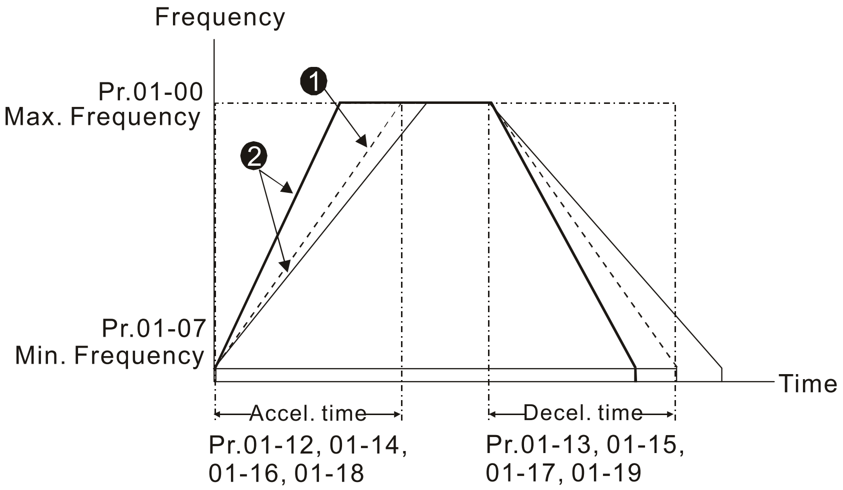
01-44 Auto-Acceleration / Auto-Deceleration Setting

Default: 0

Settings 0: Linear acceleration and linear deceleration
1: Auto-acceleration and linear deceleration
2: Linear acceleration and auto-deceleration
3: Auto-acceleration and auto-deceleration
4: Stall prevention by auto-acceleration and auto-deceleration (limited by Pr.01-12–01-21)

- 0 (linear acceleration and linear deceleration): the drive accelerates and decelerates according to the setting for Pr.01-12–01-19.
- 1 or 2 (auto / linear acceleration and auto / linear deceleration): the drive reduces the mechanical vibration and prevents the complicated auto-tuning processes. It does not stall during acceleration and has no need for a brake resistor. It can also improve operation efficiency and save energy.

- 3 (auto-acceleration and auto-deceleration): the drive auto-detects the load torque and accelerates from the fastest acceleration time and smoothest start current to the setting frequency. When decelerating, the drive auto-detects the load re-generation and stops the motor smoothly with the fastest deceleration time.
- 4 (stall prevention by auto-acceleration and auto-deceleration (limited by Pr.01-12–01-21)): if the acceleration and deceleration is within a reasonable range, the drive accelerates and decelerates according to Pr.01-12–01-19. If the acceleration and deceleration time is too short, the actual acceleration and deceleration time are greater than the acceleration and deceleration time settings.



Acceleration / Deceleration Time

❶ Optimize the acceleration / deceleration time when Pr.01-44 is set to 0.
❷ Optimize the acceleration / deceleration time which load needs actually when Pr.01-44 is set to 3.

01-45 Time Unit for Acceleration / Deceleration and S-Curve

Default: 0

Settings 0: Unit 0.01 sec.
1: Unit 0.1 sec.

01-46 CANopen Quick Stop Time

Default: 1.00

Settings Pr.01-45 = 0: 0.00–600.00 sec.
Pr.01-45 = 1: 0.00–6000.00 sec.

- Use this to set the time to decelerate from the maximum operation frequency (Pr.01-00) to 0.00 Hz by CANopen control.

01-49 Deceleration Method

Default: 0

Settings 0: No function
1: Over voltage energy restriction
2: Traction energy control (TEC)

- 0: decelerate or stop in accordance with the original deceleration setting.
- The actual deceleration time of the motor is higher than the deceleration time setting due to the over-voltage stall prevention.

📖 1: during deceleration, the drive controls the motor according to the setting of Pr.06-01 and the voltage recovery rate of the DC bus. The controller starts when the DC bus voltage reaches 95% of Pr.06-01. When Pr.06-01 is set to 0, the drive controls the motor according to the operating voltage and the voltage recovery rate of the DC bus. This method decelerates according to the setting for the deceleration time. The fastest actual deceleration time is not less than the deceleration time setting.

📖 2: during deceleration, the drive controls the motor according to the setting of Pr.06-01 and the voltage recovery rate of the DC bus. The controller starts when the DC bus voltage reaches 95% of Pr.06-01, auto-tunes the output frequency and the output voltage to accelerate consumption of the regenerative energy according to the drive's capability, and the deceleration time is the result of the drive's auto-tuning. Use this setting when over-voltage occurs due to unexpected deceleration time.

01-72 V/F separated mode, Voltage Input Percentage

Default: 50.00

Settings 0–100.00

📖 For V/F absolutely separation, the rated voltage of Pr.01-02 corresponds to 100%, and for half separation, the original FV conversion slope corresponds to 100%.

01-73 VF separated mode, Voltage Input Source Selection

Default: 0

Settings 0: Digital Keypad
1: RS-485 communication
2: Reserved
3: AVI Analog input
4: ACI Analog input
5: Reserved
6: CANopen communicaton
7: Communication Card

01-74 VF separated mode, Voltage increasing time

Default: 0

Settings 1.00–600.00

01-75 VF separated mode, Voltage decreasing time

Default: 0

Settings 1.00–600.00

01-76 VF separated mode stop method

Default: 0

Settings 0: voltage decrease to 0 first, then frequency decrease to 0.
1: voltage and frequency decrease to 0 at the same time

01-77 The deceleration time of VFSM over-current stall prevention

Default: 0

Settings 1.00–600.00

📖 Set this time < (frequency rise or fall time (Pr.01-12, 01-13) × 100 / speed gain / voltage level %), the half-separation speed limit time will not affect the original V/F graph

02 Digital Input / Output Parameters

⁄⁄ You can set this parameter during operation.

02-00 Two-wire / Three-wire Operation Control

Default: 1

Settings 0: No function

1: Two-wire mode 1, power on for operation control
(M1: FWD / STOP, M2: REV / STOP)

2: Two-wire mode 2, power on for operation control
(M1: RUN / STOP, M2: FWD / REV)

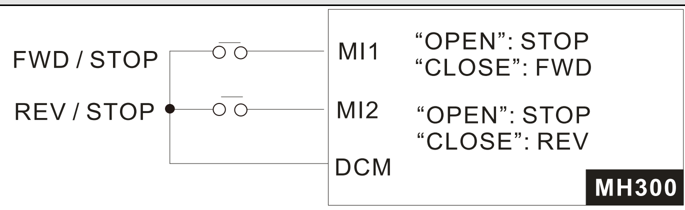
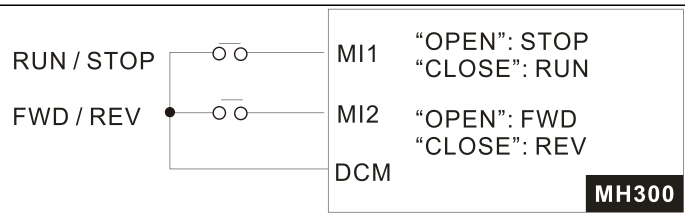
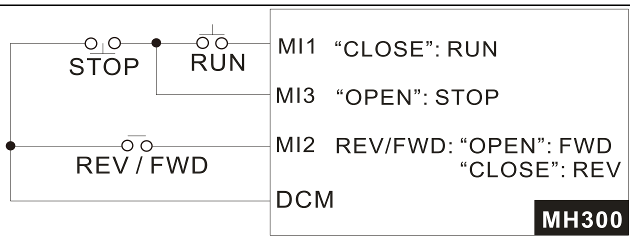
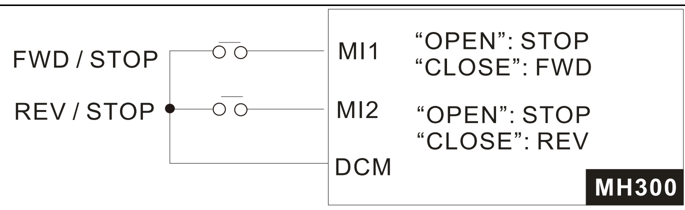
3: Three-wire, power on for operation control
(M1: RUN, M2: REV / FWD, M3: STOP)

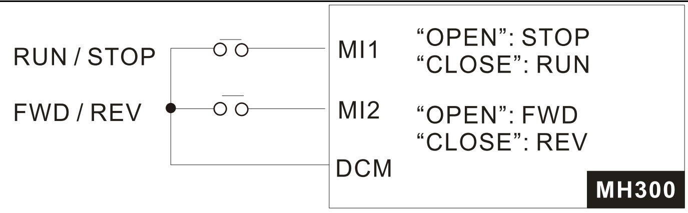
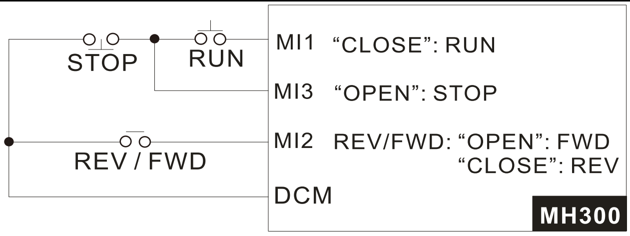
4: Two-wire mode 1, Quick Start
(M1: FWD / STOP, M2: REV / STOP)

5: Two-wire mode 2, Quick Start
(M1: RUN / STOP, M2: FWD / REV)

6: Three-wire, Quick Start
(M1: RUN, M2: REV / FWD, M3: STOP)

- In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately.
- When using the Quick Start function, there is greater potential voltage on the output terminals.
- This parameter sets the configuration of the external drive operation control and the Quick Start function. There are six different control modes listed in the following table.

<table>
<tr><th>Pr.02-00</th><th>External terminal control circuits</th></tr>
<tr><td>Setting value: 1
Two-wire
FWD / STOP
REV / STOP</td><td>
</td></tr>
<tr><td>Setting value: 2
Two-wire
RUN / STOP
FWD / REV</td><td>
</td></tr>
<tr><td>Setting value: 3
Three-wire</td><td>
</td></tr>
<tr><td>Setting value: 4
Two-wire
Quick Start</td><td>
</td></tr>
</table>

<table>
<tr><th>Pr.02-00</th><th>External terminal control circuits</th></tr>
<tr><td>Setting value: 5
Two-wire
Quick Start</td><td>
</td></tr>
<tr><td>Setting value: 6
Three-wire
Quick Start</td><td>
</td></tr>
</table>

02-01 Multi-function Input Command 1 (MI1)
02-02 Multi-function Input Command 2 (MI2)
02-07 Multi-function Input Command 7 (MI7)

Default: 0

02-03 Multi-function Input Command 3 (MI3)

Default: 1

02-04 Multi-function Input Command 4 (MI4)

Default: 2

02-05 Multi-function Input Command 5 (MI5)

Default: 3

02-06 Multi-function Input Command 6 (MI6)

Default: 4

02-26 Input Terminal of extension card (MI10)

Default: 0

02-27 Input Terminal of extension card (MI11)

Default: 0

02-28 Input Terminal of extension card (MI12)

Default: 0

Settings 0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG operation [by external control or KPC-CC01 (optional)]
7: Acceleration / deceleration speed inhibit
8: The first and second acceleration / deceleration time selection
9: The third and fourth acceleration / deceleration time selection
10: External Fault (EF) input (Pr.07-20)
11: Base Block (B.B.) input from external

12: Output stops
13: Cancel the setting for auto-acceleration / auto-deceleration time
15: Rotating speed command from AVI
16: Rotating speed command from ACI
18: Forced to stop (Pr.07-20)
19: Frequency up command
20: Frequency down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (MI6)
24: FWD JOG command
25: REV JOG command
26: TQC / FOC mode selection
27: ASR1 / ASR2 selection
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for ∆-connection
31: High torque bias (Pr.11-30)
32: Middle torque bias (Pr.11-31)
33: Low torque bias (Pr.11-32)
35: Enable single-point positioning
37: Enable pulse-train position command position control
38: Disable to write EEPROM function
39: Torque command direction
40: Force coasting to stop
41: HAND switch
42: AUTO switch
43: Enable resolution selection (Pr.02-48)
44: Negative limit switch (NL)
45: Positive limit switch (PL)
46: Homing (ORG)
48: Mechanical gear ratio switch
49: Enable Drive
50: Inputs slave dEb action
51: Selection for PLC mode bit 0
52: Selection for PLC mode bit 1
53: Trigger CANopen quick stop
56: Local / Remote selection
70: Force auxiliary frequency return to 0
71: Disable PID function, force PID output return to 0
72: Disable PID function, retain the output value before disabled
73: Force PID integral gain return to 0, disable integral

74: Reverse PID feedback
78: Multi-step position confirmation
79: Position / speed mode switching (0: Speed mode, 1: Position mode)
80: Location command source switching (increase)
(0: Internal register, 1: External pulse input)
83: Multi-motors (IM) selection bit 0
84: Multi-motors (IM) selection bit 1
86: Enable initial reel diameter
87: Initial reel diameter 1
88: Initial reel diameter 2
89: PID integration reset
90: Stop calculating the reel diameter
91: Winding mode selection
92: Enable tension control
93: Pause tension PID function
94: Enable to auto switch the reel

- This parameter selects the functions for each multi-function terminal.
- When Pr.02-00 = 0, you can set multi-function options with the multi-function input terminals MI1, MI2.
- When Pr.02-00 ≠ 0, the multi-function input terminals MI1, MI2 work in accordance with the setting values for Pr.02-00.

  Example:

  If Pr.02-00 = 1: multi-function input terminal MI1 = FWD / STOP,
  multi-function input terminal MI2 = REV / STOP.

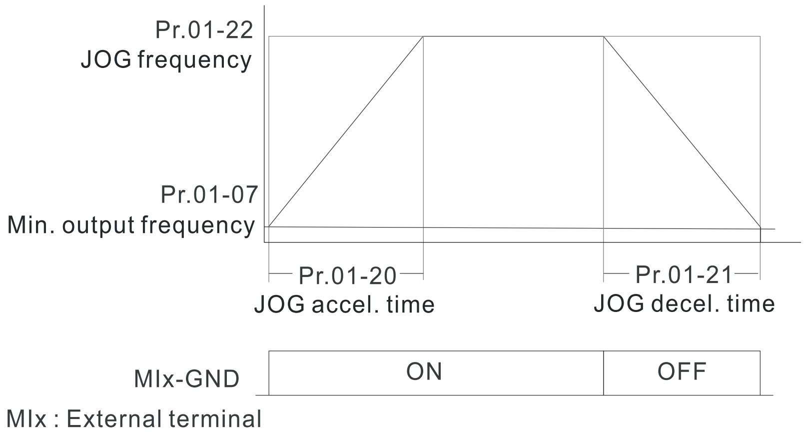
  If Pr.02-00 = 2: multi-function input terminal MI1 = RUN / STOP,
  multi-function input terminal MI2 = FWD / REV.
- When multi-function input terminal MI7 = 0, MI7 is designated as a pulse input terminal.
- If Pr.02-00 is set to three-wire operation control, terminal MI3 is for the STOP contact. The function set previously for this terminal is automatically invalid.

Summary of function settings

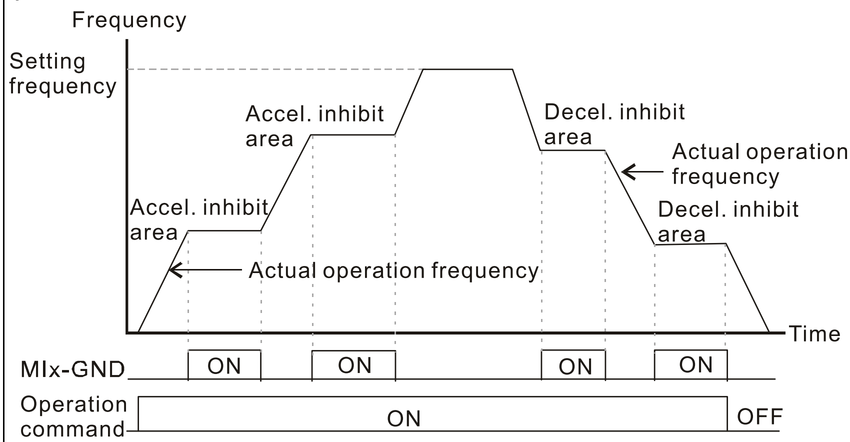
Take the normally opened contact (N.O.) for example, ON: contact is closed, OFF: contact is open.

Settings	Functions	Descriptions
0	No function	
1	Multi-step speed command 1	You can set 15 steps of speed or 15 positions with the digital status of these 4 terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed (refer to Parameter Group 04 Multi-step Speed Parameters).
2	Multi-step speed command 2	
3	Multi-step speed command 3	
4	Multi-step speed command 4	

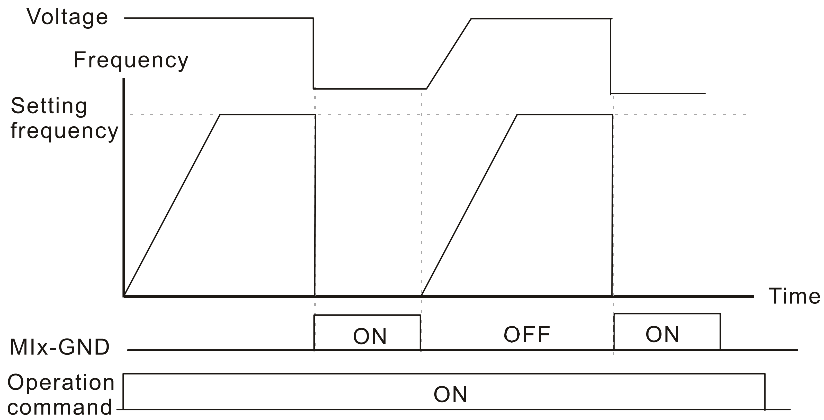
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>5</td><td>Reset</td><td>Use this terminal to reset the drive after clearing a drive fault.</td></tr>
<tr><td>6</td><td>JOG operation</td><td>This function is valid when the source of the operation command is the external terminals.
The JOG operation executes when the drive stops completely. While running, you can still change the operation direction, and the STOP key on the keypad* and the STOP command from communications are valid. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to Pr.01-20–Pr.01-22 for details.
* : This function is valid when Pr.00-32 is set to 1.

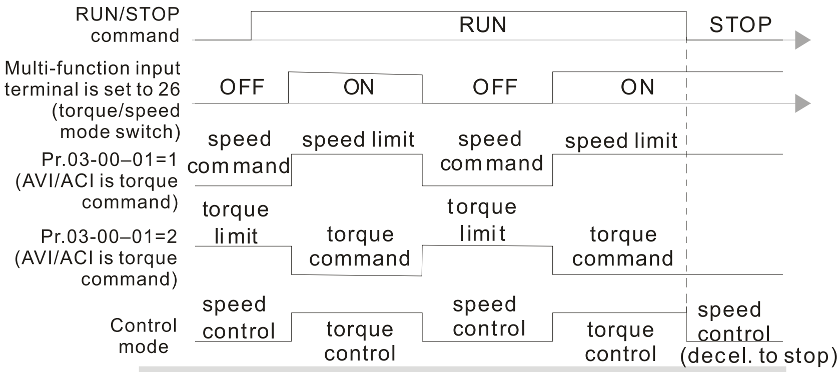
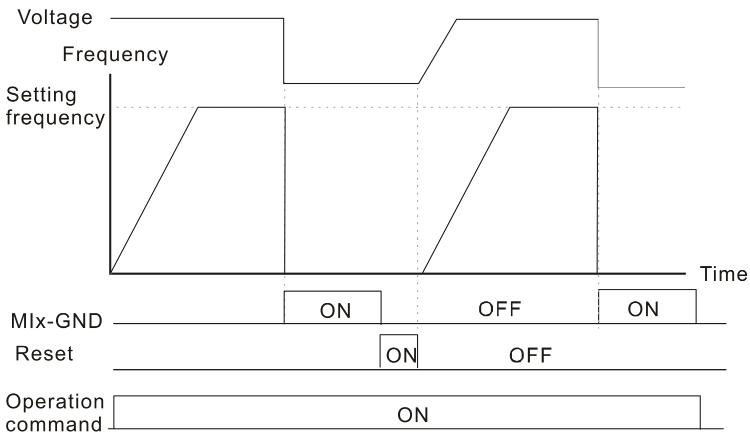


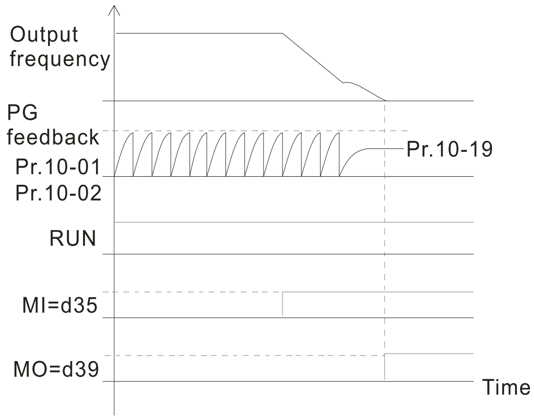
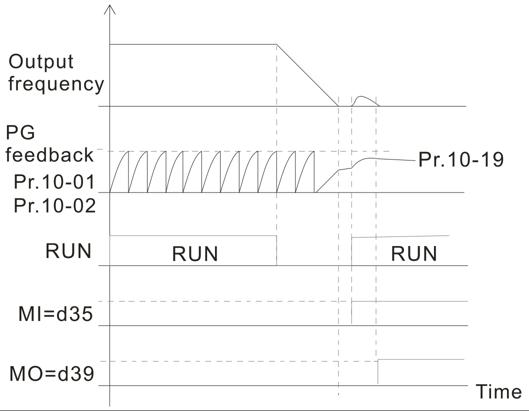
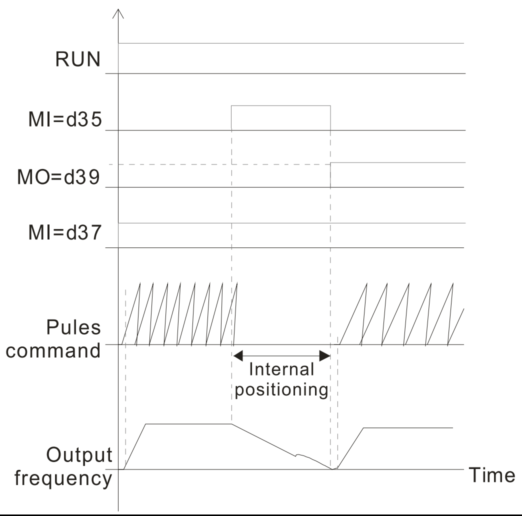
</td></tr>
<tr><td>7</td><td>Acceleration / deceleration speed inhibit</td><td>When you enable this function, the drive stops acceleration or deceleration immediately. After you disable this function, the AC motor drive starts to accelerate or decelerate from the inhibit point.



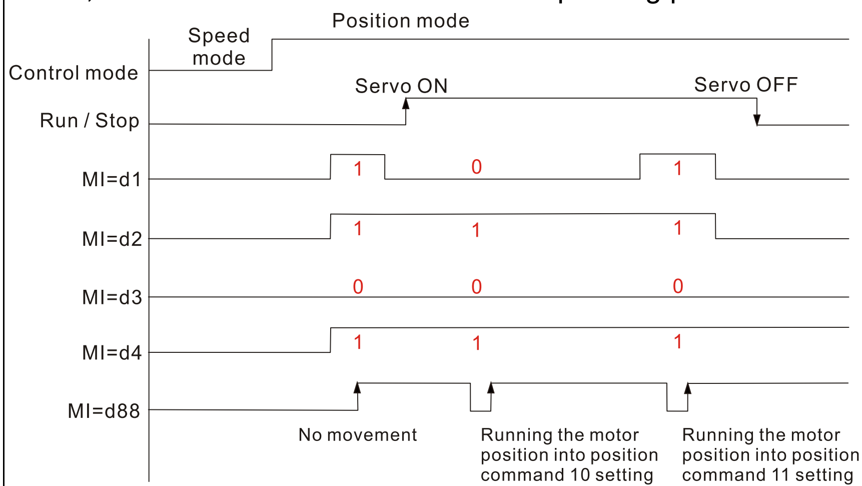
</td></tr>
<tr><td>8</td><td>The first and second acceleration / deceleration time selection</td><td rowspan="2">You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.</td></tr>
<tr><td>9</td><td>The third and fourth acceleration / deceleration time selection</td></tr>
</table>

Settings	Functions	Descriptions
10	External Fault (EF) input (Pr.07-20)	For external fault input. The drive decelerates according to the Pr.07-20 setting, and the keypad shows "EF" (it shows the fault record when an external fault occurs). The drive keeps running until the fault is cleared (terminal status restored) after RESET.
11	B.B. input from external (B.B.: Base Block)	ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to Pr.07-08 for details.
12	Output stops	ON: the output of the drive stops immediately and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency. 
13	Cancel the setting for auto-acceleration / auto-deceleration time	Set Pr.01-44 to one of the 01–04 setting modes before using this function. When this function is enabled, OFF is for auto mode and ON is for linear acceleration / deceleration.
15	Rotating speed command from AVI	ON: force the source of the frequency to be AVI. If the rotating speed commands are set to AVI and ACI at the same time, the priority is AVI > ACI.
16	Rotating speed command from ACI	ON: force the source of the frequency to be ACI. If the rotating speed commands are set to AVI and ACI at the same time, the priority is AVI > ACI.
18	Forced to stop	ON: the drive ramps to stop according to the Pr.07-20 setting.
19	Frequency up command	ON: the frequency of the drive increases or decreases by one unit. If this function remains ON continuously, the frequency increases or decreases according to Pr.02-09 / Pr.02-10. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.00 Hz. If you select Pr.11-00, bit 7 = 1, the frequency is not saved.
20	Frequency down command	
21	PID function disabled	ON: the PID function is disabled.
22	Clear the counter	ON: the current counter value is cleared and displays 0. The drive counts up when this function is disabled.
23	Input the counter value (MI 6)	On: the counter value increases by 1. Use the function with Pr.02-19.

Settings	Functions	Descriptions
24	FWD JOG command	This function is valid when the source of the operation command is external terminal. ON: the drive executes forward JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.
25	REV JOG command	This function is valid when the source of the operation command is external terminal. ON: the drive executes reverse JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.
26	TQC / FOC mode selection	ON: TQC mode. OFF: FOC mode.  Switch timing for torque/speed control (00-20=0/2, Multi-function input terminal is set to 26
27	ASR1 / ASR2 selection	ON: the speed is adjusted by the ASR 2 setting. OFF: the speed is adjusted by the ASR 1 setting. Refer to Pr.11-02 for details.
28	Emergency stop (EF1)	ON: the output of the drive stops immediately, displays “EF1” on the keypad, and the motor is in free run status. The drive keeps running until the fault is cleared after you press RESET on the keypad (EF: External Fault). 
29	Signal confirmation for Y-connection	When the control mode is V/F, ON: the drive operates by the first V/F.
30	Signal confirmation for Δ-connection	When the control mode is V/F, ON: the drive operates by the second V/F.

Settings	Functions	Descriptions
31	High torque bias	Refer to Pr.11-30–11-32 for details.
32	Middle torque bias	
33	Low torque bias	
35	Enable single-point positioning	ON: the AC motor drive executes internal single-point position control according to the setting for Pr.10-19. This function is valid in FOCPG mode only.  
37	Enable pulse-train position command position control	When Pr.00-20 is set to 4 or 5, ON: the input pulse of the PG card is the position command. When using this function, set Pr.11-25 to 0. Example: refer to the following diagram when using this function with MI=d35 returning to homing position. 
38	Disable to write EEPROM function	ON: writing to EEPROM is disabled. Changed parameters are not saved after power off.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>39</td><td>Torque command direction</td><td>For torque control (Pr.00-10=2), when the torque command is AVI or ACI, ON: negative torque.</td></tr>
<tr><td>40</td><td>Force coasting to stop</td><td>ON: during operation, the drive free runs to stop.</td></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">1. When the MI terminal switches to OFF, it executes a STOP command. Therefore, if the MI terminal switches to OFF during operation, the drive stops.
2. Use the optional keypad KPC-CC01 to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
3. The optional digital keypad KPC-CC01 displays the current status of the drive (HAND / OFF / AUTO).
<table><tr><th></th><th>bit 1</th><th>bit 0</th></tr><tr><td>OFF</td><td>0</td><td>0</td></tr><tr><td>AUTO</td><td>0</td><td>1</td></tr><tr><td>HAND</td><td>1</td><td>0</td></tr><tr><td>OFF</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>42</td><td>AUTO switch</td></tr>
<tr><td>43</td><td>Enable resolution selection (Pr.02-48)</td><td>Refer to Pr.02-48 for details.</td></tr>
<tr><td>44</td><td>Negative limit switch (NL)</td><td>Signal input for negative limit switch (NL).
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>45</td><td>Positive limit switch (PL)</td><td>Signal input for positive limit switch (PL).
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>46</td><td>Homing (ORG)</td><td>Origin point input.
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>48</td><td>Mechanical gear ratio switch</td><td>ON: the mechanical gear ratio switches to the second group.
Refer to Pr.10-04–Pr.10-07.</td></tr>
<tr><td>49</td><td>Enable drive</td><td>When the drive is enabled, the RUN command is valid.
When the drive is disabled, the RUN command is invalid.
When the drive is operating, the motor coasts to stop.
This function varies with MO=45.</td></tr>
<tr><td>50</td><td>Inputs slave dEb action</td><td>Enter the message setting in this parameter when the master triggers dEb. This ensures that the slave also triggers dEb, then master and slave stop simultaneously.</td></tr>
<tr><td>51</td><td>Selection for PLC mode (bit 0)</td><td rowspan="2"><table><tr><th>PLC status</th><th>bit 1</th><th>bit 0</th></tr><tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td></tr><tr><td>Trigger PLC to operate (PLC 1)</td><td>0</td><td>1</td></tr><tr><td>Trigger PLC to stop (PLC 2)</td><td>1</td><td>0</td></tr><tr><td>No function</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>52</td><td>Selection for PLC mode (bit 1)</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>53</td><td>Trigger CANopen Quick Stop</td><td>When this function is enabled under CANopen control, it changes to Quick Stop. Refer to Chapter 15 CANopen Overview for more details.</td></tr>
<tr><td>56</td><td>LOCAL / REMOTE selection</td><td>Use Pr.00-29 to select LOCAL / REMOTE mode (refer to Pr.00-29). When Pr.00-29 is not set to 0, the optional digital keypad KPC-CC01 displays the LOC / REM status.
<table>
<tr><th></th><th>bit 0</th></tr>
<tr><td>REM</td><td>0</td></tr>
<tr><td>LOC</td><td>1</td></tr>
</table></td></tr>
<tr><td>70</td><td>Force auxiliary frequency to return to 0</td><td>Forces the auxiliary frequency to return to 0 when using this function. PID keeps operating if PID is the master frequency. When Pr.00-35 ≠ 0, the master frequency is enabled, and then selecting this function with the terminal effectively forces the auxiliary frequency to return to 0.</td></tr>
<tr><td>71</td><td>Disable PID function, force PID output to return to 0</td><td>When the master and auxiliary frequencies are enabled and when using the PID function, ON: PID does not operate, returns the integral value to 0, and forces the PID output to return to 0.</td></tr>
<tr><td>72</td><td>Disable PID function, retain the output value before disabled</td><td>When the master and auxiliary frequency are enabled, and the PID function is enabled, and the terminal contact of this parameter is ON, then PID does not operate, and its output value remains the same as the value before it was disabled.</td></tr>
<tr><td>73</td><td>Force PID integral gain to return to 0, disable integral</td><td>ON: PID continues to operate, disable the integral control, and return the integral value to 0.</td></tr>
<tr><td>74</td><td>PID feedback reversed</td><td>ON: PID negative feedback becomes positive feedback, or PID positive feedback becomes negative feedback.</td></tr>
<tr><td>78</td><td>Multi-step position command confirm</td><td>When the terminal is active and the drive is in Servo ON status under the position control mode (Pr.00-10=1), the drive determines the corresponding P2P positions according to MI1–MI4 ON/OFF status, and the motor moves to that corresponding position.

</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>
1. When the drive starts, the multi-step position commands (MIx = 1–4) are simply to switch between multiple positions, which does not make the motor run. set and activate the multi-function input terminal MI=88 (multi-step position command confirmation) to make the motor move to the corresponding point-to-point position,
2. The route planning immediately changes once there is any change in multi-step position, speed or accel. / decel. time in the process of moving to the targeted position.
◆ Each of the multi-function input terminals (MI1–MI15) can be used for the multi-step positioning position control function. However, a maximum of four terminals, using a binary 4-bit, can be used at the same time to switch between 15 positions.
<table>
<tr><th>Multi-step position</th><th>Multi-step position command 4</th><th>Multi-step position command 3</th><th>Multi-step position command 2</th><th>Multi-step position command 1</th></tr>
<tr><td>0 (Disabled)</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>1</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>2</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>3</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>4</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>5</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>6</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>7</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>8</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>9</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>10</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>11</td><td>ON</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>12</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>13</td><td>ON</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>14</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>15</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
</table>
◆ When MI = 1–4 (multi-step position command 1–4), the terminal is level-triggered.
◆ When MI=36 (enable multi-step positioning teaching function), the terminal is edge-triggered.
When MI=88 (multi-step position command confirmation), the terminal is rising edge-triggered.
</td></tr>
<tr><td>79</td><td>Speed / position control mode switch
0: Speed mode
1: Position mode</td><td>OFF: Speed mode
ON: Position control mode</td></tr>
<tr><td>80</td><td>Position command source switch
0: Inputs from internal register
1: Inputs from external pulse</td><td>Refer to Pr.11-40
OFF: Input from internal register
ON: Input from external pulse-train</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>83</td><td>Multi-motors (IM) selection bit 0</td><td rowspan="2">ON: parameters can be changed
Example: MI1 = 83, MI2 = 84
<table>
<tr><th rowspan="2">MI1</th><th rowspan="2">MI2</th><th rowspan="2">Motor Selection</th><th colspan="2">Related Motor Parameter</th></tr>
<tr><th>Max. Operation Frequency</th><th>V/F Curve Parameter</th></tr>
<tr><td>OFF</td><td>OFF</td><td>Motor 1</td><td>Pr.01-00</td><td>Pr.01-01–01-08</td></tr>
<tr><td>ON</td><td>OFF</td><td>Motor 2</td><td>Pr.01-52</td><td>Pr.01-35–01-42</td></tr>
<tr><td>OFF</td><td>ON</td><td>Motor 3</td><td>Pr.01-53</td><td>Pr.01-54–01-61</td></tr>
<tr><td>ON</td><td>ON</td><td>Motor 4</td><td>Pr.01-62</td><td>Pr.01-63–01-70</td></tr>
</table></td></tr>
<tr><td>84</td><td>Multi-motors (IM) selection bit 1</td></tr>
<tr><td>86</td><td>Enable initial reel diameter</td><td rowspan="3">
<table>
<tr><th>MIx = 88</th><th>MIx = 87</th><th>MIx = 86</th></tr>
<tr><td>OFF</td><td>OFF</td><td>ON: the setting value of Pr.12-31 will be wrote into Pr.12-40.</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON: the setting value of Pr.12-32 will be wrote into Pr.12-40.</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON: the setting value of Pr.12-33 will be wrote into Pr.12-40.</td></tr>
<tr><td>ON</td><td>ON</td><td>ON: the setting value of Pr.12-40 will be back to the default.</td></tr>
</table></td></tr>
<tr><td>87</td><td>Initial reel diameter 1</td></tr>
<tr><td>88</td><td>Initial reel diameter 2</td></tr>
<tr><td>89</td><td>PID integration reset</td><td>ON: the integral items in PID return to zero</td></tr>
<tr><td>90</td><td>Stop calculating the reel diameter</td><td>ON: stop calculating the reel diameter</td></tr>
<tr><td>91</td><td>Winding mode selection</td><td>ON: rewind mode; OFF: unwind mode</td></tr>
<tr><td>92</td><td>Enable tension control</td><td>ON: the output of tension PID equals zero</td></tr>
<tr><td>93</td><td>Pause tension PID function</td><td>ON: PID keeps the present output until the status changes to be OFF and re-starts to calculate tension PID.</td></tr>
<tr><td>94</td><td>Enable to auto switch the reel</td><td>ON: the drive automatically calculates output frequency according to the linear speed and the reel diameter have been detected to match their linear speed.</td></tr>
</table>

02-09 External terminal UP / DOWN Key Mode

Default: 0

Settings 0: By the acceleration / deceleration time

1: Constant speed (Pr.02-10)

2: Pulse signal (Pr.02-10)

3: Curve

4: Steps (Pr.02-10)

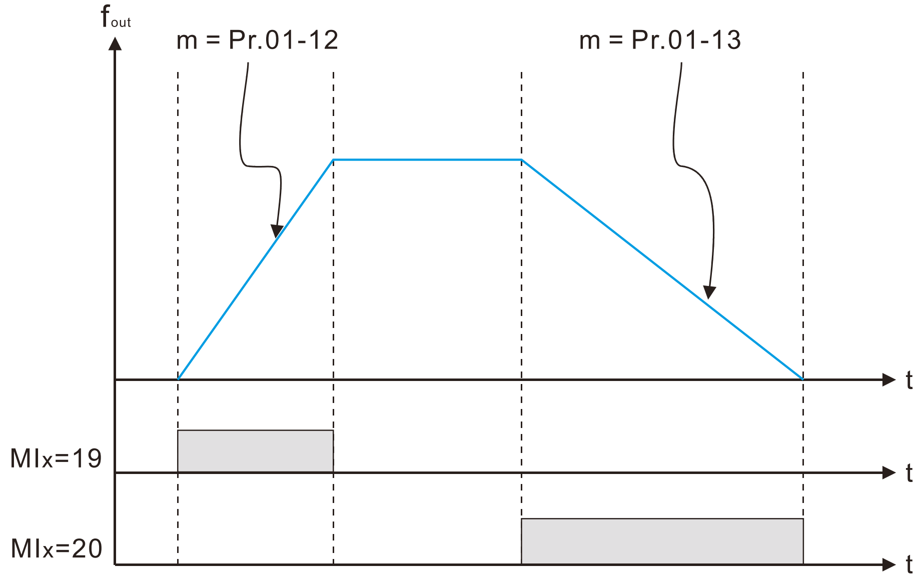
02-10 Acceleration / Deceleration Speed of External terminal UP / DOWN Key

Default: 0.001

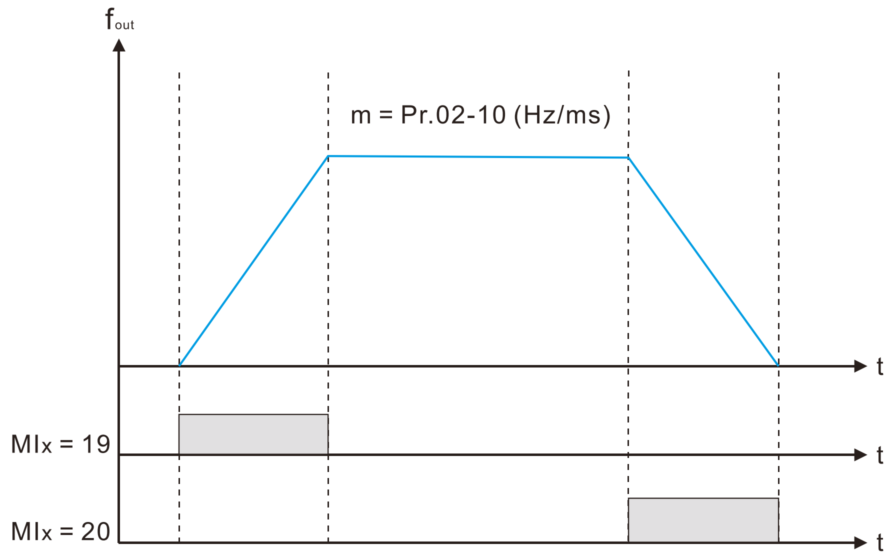
Settings 0.001–1.000 Hz / ms

- Use when the multi-function input terminals are set to 19, 20 (UP / DOWN command). The frequency increases or decreases according to Pr.02-09 and Pr.02-10.
- When Pr.11-00 bit 7=1, the frequency is not saved. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.00 Hz. At this time, the increasing or decreasing frequency command (F) by using the UP or DOWN key is valid only when the drive is running.

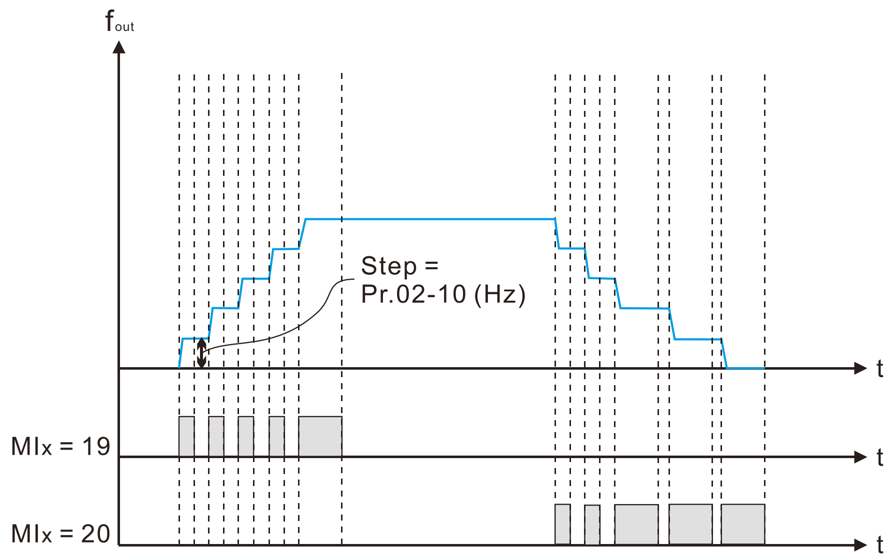
📖 When Pr.02-09 is set to 0: the increasing or decreasing frequency command (F) operates according to the setting for acceleration or deceleration time (refer to Pr.01-12–01-19).



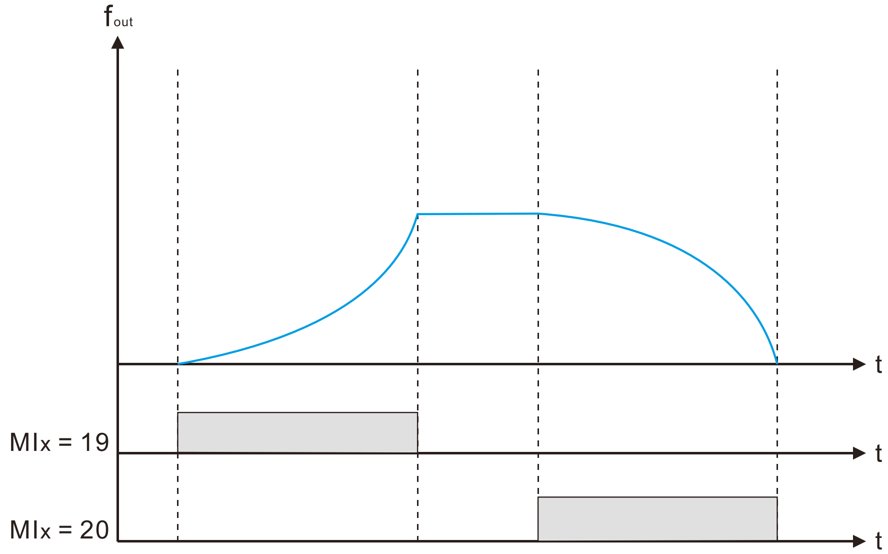
📖 When Pr.02-09 is set to 1: the increasing / decreasing frequency command (F) operates according to the setting of Pr.02-10 (0.01–1.00 Hz/ms).



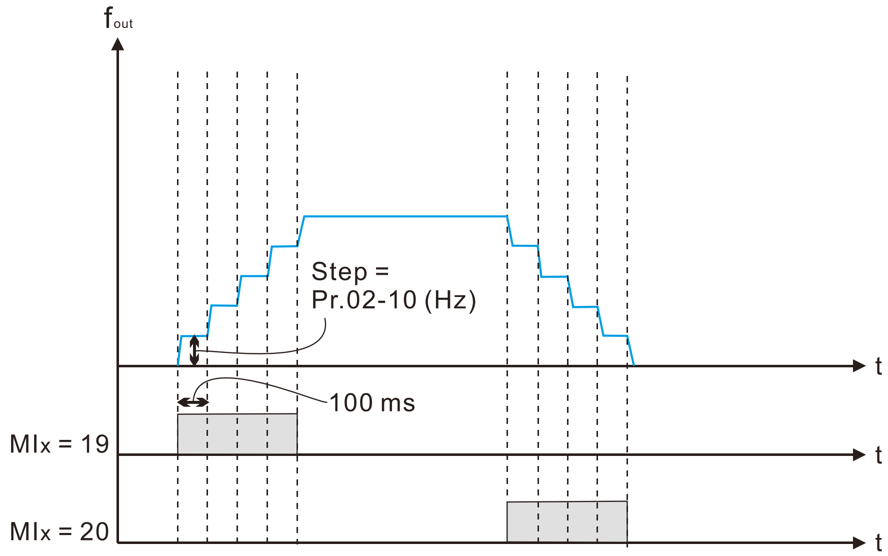
📖 When Pr.02-09 is set to 2: the increasing / decreasing frequency command (F) operates according to the pulse of Pr.02-10.



📖 When Pr.02-09 is set to 3: the increasing / decreasing frequency command (F) operates according to the exponential curve.



📖 When Pr.02-09 is set to 4: the increasing / decreasing frequency command (F) operates according to the setting of Pr.02-10 per every 100 ms.



〆 02-11 Multi-function Input Response Time

Default: 0.005

Settings 0.000–30.000 sec.

📖 Use this parameter to set the response time of the digital input terminals MI1–MI7.

📖 This function is to delay and confirm the digital input terminal signal. The time for delay is also the time for confirmation. The confirmation prevents interference that could cause error in the input to the digital terminals. But in the meanwhile, it delays the response time though confirmation improves accuracy.

〆 02-12 Multi-function Input Mode Selection

Default: 0000

Settings 0000h–FFFFh (0: N.O.; 1: N.C.)

📖 This parameter setting is in hexadecimal.

- This parameter sets the status of the multi-function input signal (0: normally open; 1: normally closed) and it is not affected by the status of SINK / SOURCE.
- bit 0–bit 6 correspond to MI1–MI7.
- The default for bit 0 (MI1) is FWD terminal, and the default for bit 1 (MI2) is REV terminal. You cannot use this parameter to change the input mode when Pr.02-00 ≠ 0.
- You can change the terminal ON / OFF status through communications.
  For example: MI3 is set to 1 (multi-step speed command 1) and MI4 is set to 2 (multi-step speed command 2). Then the forward + second step speed command = 1001_2 = 9_{10} .
- As long as Pr.02-12 = 9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.

bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MI7	MI6	MI5	MI4	MI3	MI2	MI1

- Use Pr.11-42 bit 1 to select whether the FWD / REV terminal is controlled by Pr.02-12 bit 0 and bit 1.

02-13 Multi-function Output 1 (Relay1)

Default: 11

02-16 Multi-function Output 2 (MO1)

Default: 0

02-17 Multi-function Output 3 (MO2)
02-36 Output Terminal of Extension Card (MO10) or (RY10)
02-37 Output Terminal of Extension Card (MO11) or (RY11)
02-38 Output Terminal of Extension Card (MO12) or (RY12)

Default: 0

Settings 0: No function
1: Indication during RUN
2: Operation speed reached
3: Desired frequency reached 1 (Pr.02-22)
4: Desired frequency reached 2 (Pr.02-24)
5: Zero speed (Frequency command)
6: Zero speed, includes STOP (Frequency command)
7: Over-torque 1 (Pr.06-06–06-08)
8: Over-torque 2 (Pr.06-09–06-11)
9: Drive is ready
10: Low voltage warning (Lv) (Pr.06-00)
11: Malfunction indication
13: Over-heat warning (Pr.06-15)
14: Software brake signal indication (Pr.07-00)
15: PID feedback error (Pr.08-13, Pr.08-14)
16: Slip error (oSL)
17: Count value reached (Pr.02-20; does not return to 0)
18: Count value reached (Pr.02-19; returns to 0)

19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention
23: Over-voltage stall prevention
24: Operation source
25: Forward command
26: Reverse command
29: Output when frequency ≥ Pr.02-34
30: Output when frequency < Pr.02-34
31: Y-connection for the motor coil
32: ∆-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed include STOP (actual output frequency)
35: Error output selection 1 (Pr.06-23)
36: Error output selection 2 (Pr.06-24)
37: Error output selection 3 (Pr.06-25)
38: Error output selection 4 (Pr.06-26)
39: Position reached (Pr.10-19)
40: Speed reached (including STOP)
42: Crane function
43: Motor actual speed detection
44: Low current output (use with Pr.06-71–Pr.06-73)
45: UVW output electromagnetic valve ON / OFF switch
46: Outputs when master dEb acts
49: Homing action completed
50: Output control for CANopen
51: Output control for RS-485
52: Output control for communication cards
66: SO output logic A
67: Outputs when analog input level reached
68: SO output logic B
69: Maximum reel diameter reached
70: Empty reel diameter reached
71: Broken belt detection
72: Tension PID feedback error
73: Over-torque 3
74: Over-torque 4

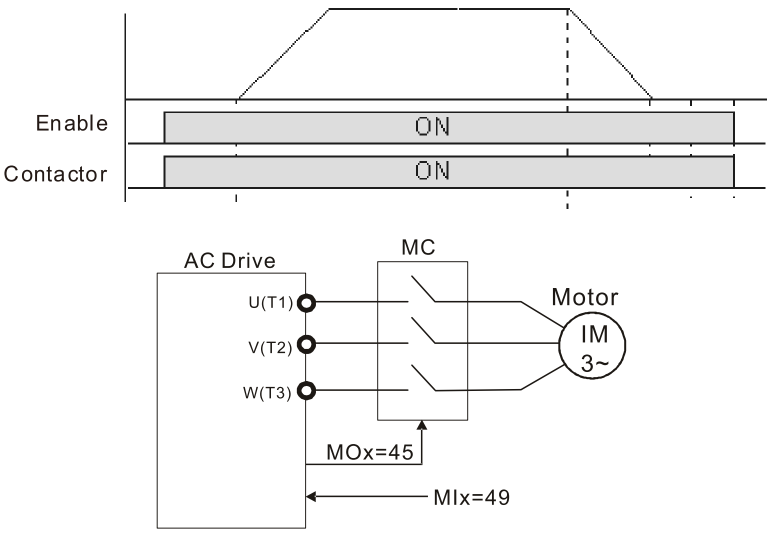
📖 Use this parameter to set the function of the multi-function terminals.

Summary of function settings

Take the normally open contact (N.O.) for example, ON: contact is closed, OFF: contact is open.

Settings	Functions	Descriptions
0	No Function	Output terminal with no function
1	Indication during RUN	Activates when the drive is not in STOP.
2	Operation speed reached	Activates when output frequency of the drive reaches the setting frequency.
3	Desired frequency reached 1 (Pr.02-22)	Activates when the desired frequency (Pr.02-22) is reached.
4	Desired frequency reached 2 (Pr.02-24)	Activates when the desired frequency (Pr.02-24) is reached.
5	Zero speed (Frequency command)	Activates when frequency command = 0 (the drive must be in RUN status).
6	Zero speed, includes STOP (Frequency command)	Activates when frequency command = 0 or stopped.
7	Over-torque 1	Activates when the drive detects over-torque. Pr.06-07 sets the over-torque detection level (motor 1), and Pr.06-08 sets the over-torque detection time (motor 1). Refer to Pr.06-06–06-08.
8	Over-torque 2	Activates when the drive detects over-torque. Pr.06-10 sets the over-torque detection level (motor 2), and Pr.06-11 sets the over-torque detection time (motor 2). Refer to Pr.06-09–06-11.
9	Drive is ready	Activates when the drive is ON with no error detected.
10	Low voltage warn (Lv)	Activates when the DC bus voltage is too low (refer to Pr.06-00 Low Voltage Level).
11	Malfunction indication	Activates when fault occurs (except Lv stop).
13	Over-heat warning	Activates when IGBT or heat sink overheats; to prevent the drive from shutting down due to over-heating (refer to Pr.06-15).
14	Software brake signal indication	Activates when the soft brake function is ON (refer to Pr.07-00).
15	PID feedback error	Activates when the PID feedback signal error is detected.
16	Slip error (oSL)	Activates when the slip error is detected.
17	Count value reached (Pr.02-20)	When the drive executes external counter, this contact activates if the count value is equal to the setting value for Pr.02-20. This contact deactivates when the setting value for Pr.02-20 > Pr.02-19.
18	Count value reached (Pr.02-19)	When the drive executes the external counter, this contact activates if the count value is equal to the setting value for Pr.02-19.

Settings	Functions	Descriptions
19	External interrupt B.B. input (Base Block)	Activates when external interrupt (B.B.) stop output occurs in the drive.
20	Warning output	Activates when a warning is detected.
21	Over-voltage	Activates when over-voltage is detected.
22	Over-current stall prevention	Activates when over-current stall prevention is detected.
23	Over-voltage stall prevention	Activates when over-voltage stall prevention is detected.
24	Operation source	Activates when the source of operation command is not controlled by the digital keypad (Pr.00-21 ≠ 0).
25	Forward command	Activates when the operation direction is forward.
26	Reverse command	Activates when the operation direction is reverse.
29	Output when frequency ≥ Pr.02-34	Activates when the frequency is ≥ Pr.02-34 (actual output H ≥ Pr.02-34).
30	Output when frequency < Pr.02-34	Activates when frequency is < Pr.02-34 (actual output H < Pr.02-34).
31	Y-connection for the motor coil	Activates when Pr.05-24 = 1, the frequency output is lower than Pr.05-23 minus 2 Hz, and the time is longer than Pr.05-25.
32	Δ-connection for the motor coil	Activates when Pr.05-24 = 1, the frequency output is higher than Pr.05-23 plus 2 Hz, and the time is longer than Pr.05-25.
33	Zero speed (actual output frequency)	Activates when the actual output frequency is 0 (the drive is in RUN mode).
34	Zero speed includes stop (actual output frequency)	Activates when the actual output frequency is 0 or stopped.
35	Error output selection 1 (Pr.06-23)	Activates when Pr.06-23 is ON.
36	Error output selection 2 (Pr.06-24)	Activates when Pr.06-24 is ON.
37	Error Output Selection 3 (Pr.06-25)	Activates when Pr.06-25 is ON.
38	Error Output Selection 4 (Pr.06-26)	Activates when Pr.06-26 is ON.
39	Position reached (Pr.10-19)	Activates when the position control point reaches Pr.10-19.
40	Speed reached (including STOP)	Activates when the output frequency reaches the setting frequency or stopped.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>42</td><td>Crane function</td><td>Use this function with Pr.02-34 and Pr.02-58.
Refer to Pr.02-34 and Pr.02-58 for details.</td></tr>
<tr><td>43</td><td>Motor actual speed detection</td><td>Active when the actual motor speed is less than Pr.02-47.</td></tr>
<tr><td>44</td><td>Low current output</td><td>Use this function with Pr.06-71–Pr.06-73.</td></tr>
<tr><td>45</td><td>UVW output electromagnetic valve ON / OFF switch</td><td>Use this function with external terminal input = 49 (drive enabled) and external terminal output = 45 (electromagnetic valve enabled), and then the electromagnetic valve is ON or OFF according to the status of the drive.

</td></tr>
<tr><td>46</td><td>Outputs when master dEb acts</td><td>When dEb rises at the master, MO sends a dEb signal to the slave. Output the message when the master triggers dEb. This ensures that the slave also triggers dEb. Then slave follows the deceleration time of the master to stop simultaneously with the master.</td></tr>
<tr><td>49</td><td>Homing action completed</td><td>Activate when homing action is completed.</td></tr>
<tr><td>50</td><td>Output control for CANopen</td><td>Control the multi-function output terminals through CANopen.
The mapping table of the CANopen DO is shown in the following table:
<table>
<tr><th>Physical terminal</th><th>Setting for related parameters</th><th>Attribute</th><th>Corresponding index</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 50</td><td>RW</td><td>2026-41
bit 0 of initial value 0x01</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 50</td><td>RW</td><td>2026-41
bit 3 of initial value 0x01</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 50</td><td>RW</td><td>2026-41
bit 4 of initial value 0x01</td></tr>
</table>
Refer to subsection 15-3-5 for more information.</td></tr>
<tr><td>51</td><td>Output control for RS-485</td><td>For RS-485 communication control output.</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>52</td><td>Output control for communication cards</td><td>Control the output through communication cards (CMM-PD02, CMM-EIP02, CMM-EC02, CMM-DN02)
<table>
<tr><th>Physical terminal</th><th>Setting for related parameters</th><th>Attribute</th><th>Corresponding Address</th></tr>
<tr><td>RY</td><td>Pr.02-13 = 51</td><td>RW</td><td>bit 0 of 2640</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 51</td><td>RW</td><td>bit 3 of 2640</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 51</td><td>RW</td><td>bit 4 of 2640</td></tr>
</table></td></tr>
<tr><td>66</td><td>SO output logic A</td><td rowspan="2">
<table>
<tr><th rowspan="2">Status of the drive</th><th colspan="2">Status of the safety output</th></tr>
<tr><th>Status A (MO = 66)</th><th>Status B (MO = 68)</th></tr>
<tr><td>Normal</td><td>Broken circuit (open)</td><td>Short circuit (closed)</td></tr>
<tr><td>STO</td><td>Short circuit (closed)</td><td>Broken circuit (open)</td></tr>
<tr><td>STL1–STL3</td><td>Short circuit (closed)</td><td>Broken circuit (open)</td></tr>
</table></td></tr>
<tr><td>68</td><td>SO output logic B</td></tr>
<tr><td>67</td><td>Outputs when analog input level reached</td><td>The multi-function output terminals operate when the analog input level is between the high level and the low level.
Pr.03-44: Select one of the analog input channels (AVI, ACI) to be compared.
Pr.03-45: The high level for the analog input, default is 50%.
Pr.03-46: The low level for the analog input, default is 10%.
If analog input > Pr.03-45, the multi-function output terminal operates. If analog input < 03-46, the multi-function output terminal stops output.</td></tr>
<tr><td>69</td><td>Maximum reel diameter reached</td><td>In tension control mode, when reel diameter reaches Pr.12-22, the contact closes.</td></tr>
<tr><td>70</td><td>Empty reel diameter reached</td><td>In tension control mode, when reel diameter reaches Pr.12-23, the contact closes.</td></tr>
<tr><td>71</td><td>Broken belt detection</td><td>In tension control mode, a broken belt occurs when line speed is higher than Pr.12-40, the error of reel diameter exceeds Pr.12-40, and the detection time exceeds Pr.12-41.</td></tr>
<tr><td>72</td><td>Tension PID feedback error</td><td>In tension control mode, when the difference between the PID target value and the PID feedback exceeds Pr.12-42, and the allowed error detection time for tension PID feedback exceeds Pr.12-43, refer to Pr.12-43 for the error treatment of the tension PID feedback.</td></tr>
<tr><td>73</td><td>Over-torque 3</td><td>Active when over-torque is detected. Pr.14-75 sets the over-torque detection level. Pr.14-76 sets the over-torque detection time (refer to Pr.14-74–14-76).</td></tr>
<tr><td>74</td><td>Over-torque 4</td><td>Active when over-torque is detected. Pr.14-78 sets the over-torque detection level. Pr.14-79 sets the over-torque detection time (refer to Pr.14-77–14-79).</td></tr>
</table>

02-18 Multi-function Output Direction

Default: 0000h

Settings 0000h–FFFFh (0: N.O.; 1: N.C.)

- This parameter is in hexadecimal.
- This parameter is set by a bit. If the bit is 1, the corresponding multi-function output acts in an opposite way.

Example:

Assume Pr.02-13 = 1 (indication when the drive is operating). If the output is positive, the bit is set to 0, and then Relay is ON when the drive runs and is OFF when the drive stops. On the contrary, if the output is negative, and the bit is set to 1, then the Relay is OFF when the drive runs and is ON when the drive stops.

bit 4	bit 3	bit 2	bit 1	bit 0
MO2	MO1	Reserved	Reserved	RY

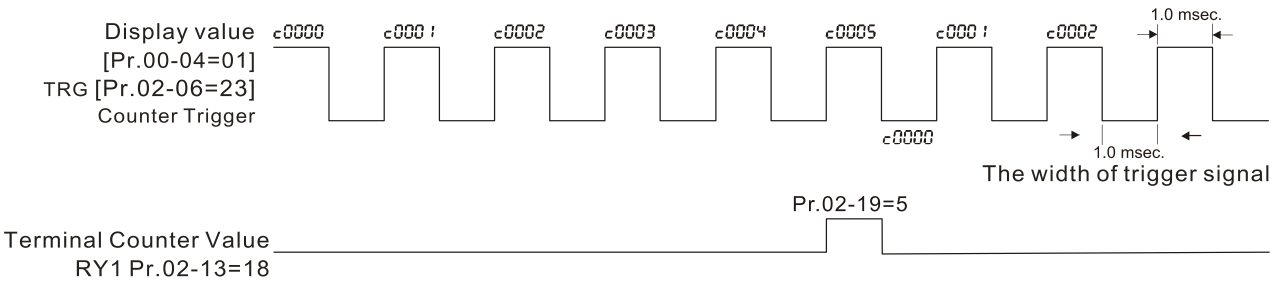
02-19 Terminal Counting Value Reached (returns to 0)

Default: 0

Settings 0–65500

- The counting function is enabled when Pr.02-19 $\neq$ 0.
- You can set the input point for the counter using the multi-function terminal MI6 as a trigger terminal (set Pr.02-06 to 23). When counting is completed, the specified multi-function output terminal is activated [Pr.02-13, Pr.02-16, Pr.02-17, or Pr.02-36–Pr.02-38 (with extension card) is set to 18]. Pr.02-19 cannot be set to 0 at this time.

The timing diagram below show that when counting to 5, RY1 activates and displays 0.



The timing diagram of
the external counting terminals and the counting value reached

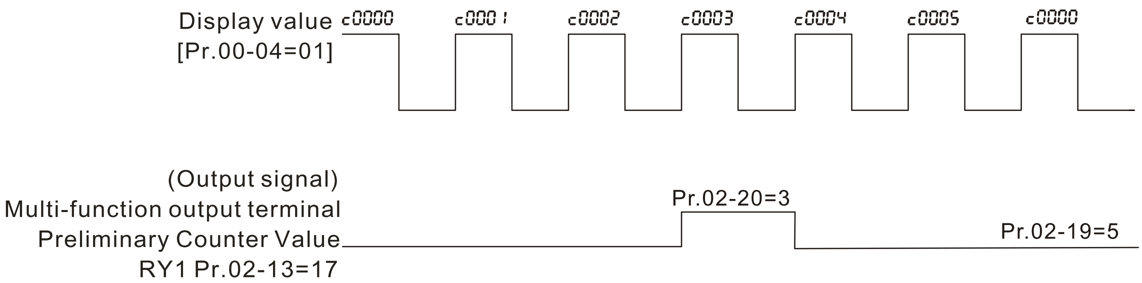
02-20 Preliminary Counting Value Reached (does not return to 0)

Default: 0

Settings 0–65500

- Use this parameter with Pr.02-19.
- When the count value counts from 1 to reach this value, the corresponding multi-function output terminal is activated [Pr.02-13, Pr.02-16, Pr.02-17, or Pr.02-36–Pr.02-38 (with extension card) is set to 17], and keeps counting to the last count value.
- You can use this parameter as the end of counting to make the drive run from the low speed to stop.

The timing diagram is RY1 activates when the count value is three, and the display returns to zero when counts to five:



The timing diagram of
the external counting terminals and the counting value reached

02-21 Digital Output Gain (DFM)

Default: 1

Settings 1–55

Sets the signal for the digital output terminals (DFM-DCM) and the digital frequency output (pulse, work period = 50 %). The output pulse per second = output frequency x Pr.02-21.

02-22 Desired Frequency Reached 1

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

02-23 The width of the desired frequency reached 1

Default: 2.00

Settings 0.00–599.00 Hz

02-24 Desired Frequency Reached 2

Default: 60.00 / 50.00

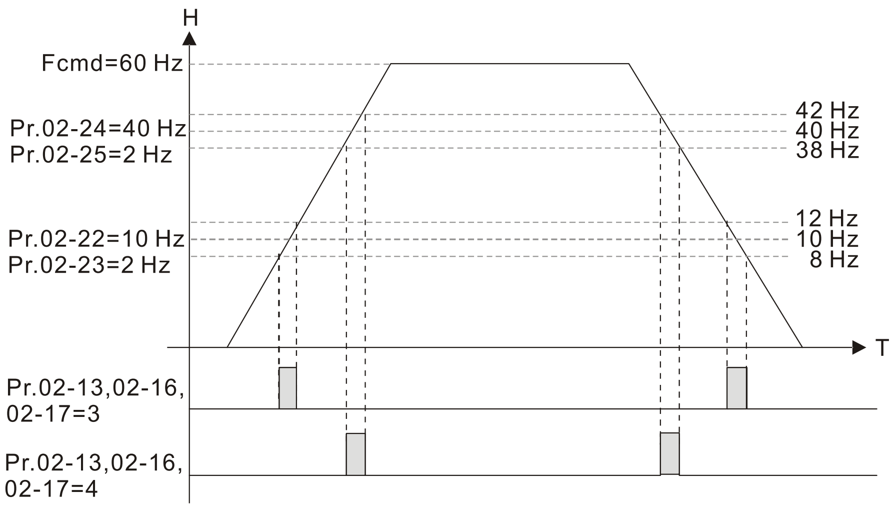
Settings 0.00–599.00 Hz

02-25 The width of the desired frequency reached 2

Default: 2.00

Settings 0.00–599.00 Hz

Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (Pr.02-13, Pr.02-16, and Pr.02-17), this multi-function output terminal is "closed".



02-34 Output Frequency Setting for Multi-function Output Terminal

Default: 0.00

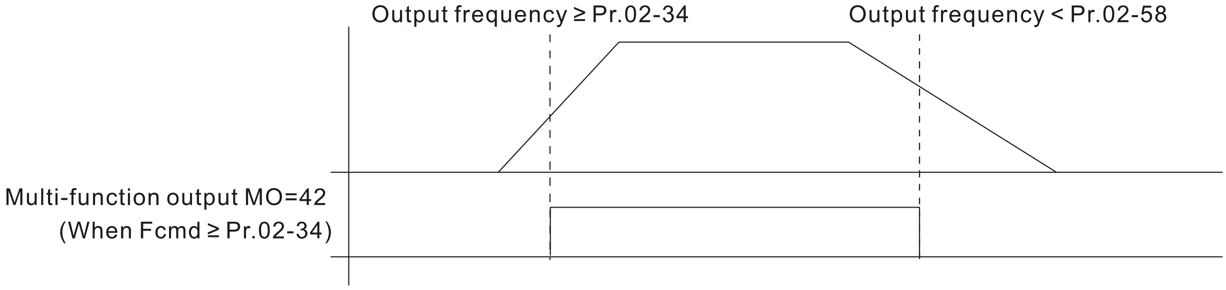
Settings 0.00–599.00 Hz

02-58 Multi-function Output Terminal (Function 42): Brake Frequency Check Point

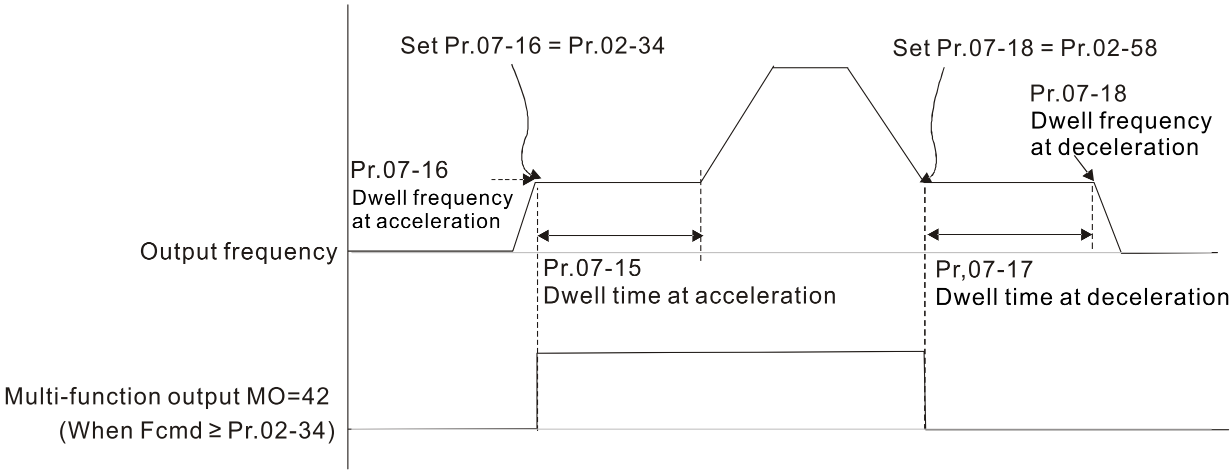
Default: 0.00

Settings 0.00–599.00 Hz

- Use Pr.02-34 with Pr.02-58 for the crane function and select the crane function MO #42 to set the multi-function outputs Pr.02-13, Pr.02-16, and Pr.02-17.
- When the output frequency (H) is lower than the setting for Pr.02-58, multi-function output terminal setting 42 stops after the command breaks off.
- Pr.02-58 must be lower than Pr.02-34 when using MO=42.
- Crane application example:



It is recommended that you use this with the Dwell function as shown in the following diagram:



02-35 External Operation Control Selection after Reset and Reboot

Default: 0

Settings 0: Disable

1: Drive runs if the RUN command remains after reset or reboot.

Set value as 1:

Pay attention that the drive will execute the running command by itself in the following status.

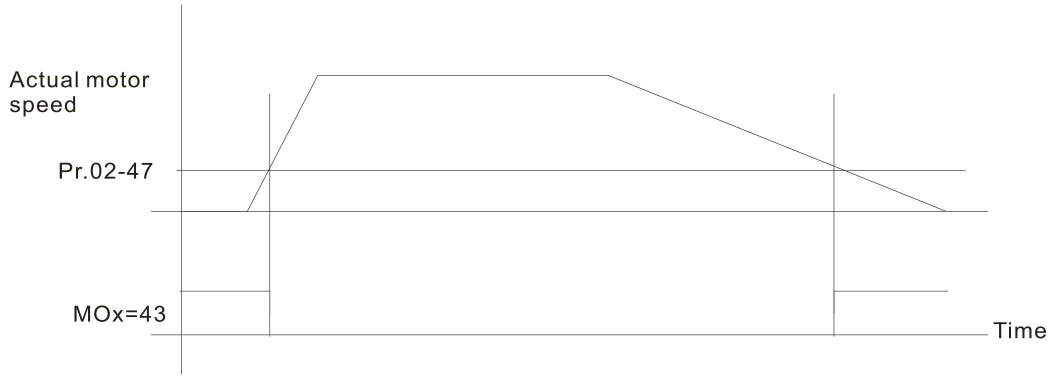
- Status 1: After the drive is powered on and the external terminal for RUN stays ON, the drive runs.
- Status 2: After clearing a fault once a fault is detected and the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.

02-47 Motor Zero-speed Level

Default: 0

Settings 0–65535 rpm

- If Pr.01-11 is set as “no PG feedback” control mode, it calculates by estimated rotating speed. If Pr.01-11 is set as “PG feedback” control mode, it calculates by the actual feedback speed, which means that motor needs to install encoder to feedback the actual rotating speed and use with PG card or MI pulse input terminal.
- Use this parameter to set the level of motor at zero-speed. When the speed is lower than this setting, the corresponding multi-function output terminal that is set to 43 is ON, as shown below:
- When motor installs encoder to feedback and uses with PG card, the accuracy of zero-speed control increases.



02-48 Maximum Frequency of Resolution Switch

Default: 60.00

Settings 0.01–599.00 Hz (use with MI setting as 43).

02-49 Switch Delay Time of Maximum Output Frequency

Default: 0.000

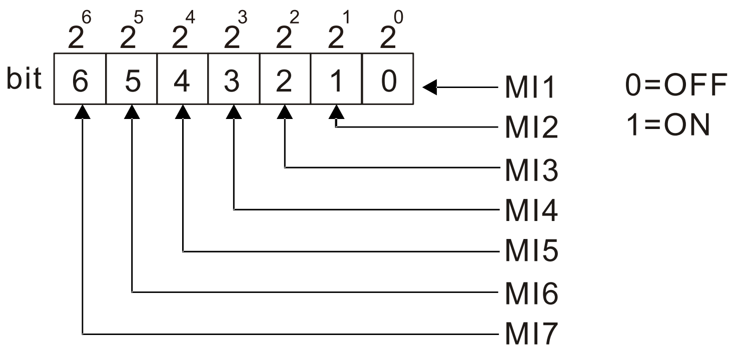
Settings 0.000–65.000 sec.

- Use to improve unstable speed or unstable position due to insufficient analog resolution. Use with the external terminal (setting to 43). After setting this parameter, you also need to adjust the analog output resolution of the controller so as to work with the parameter function.

02-50 Display the Status of the Multi-function Input Terminal

Default: Read only

Settings Monitor the status of the Multi-function Input Terminal



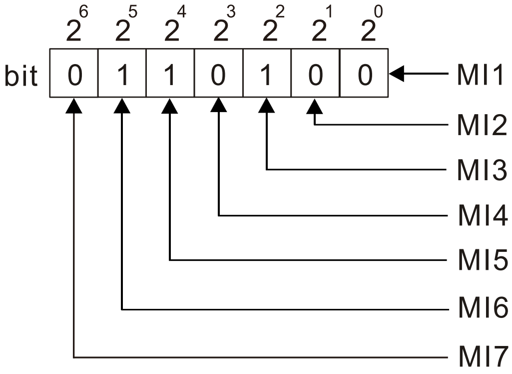
NOTE

$2^6 = 64$ $2^5 = 32$ $2^4 = 16$

$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

📖 Example:

When Pr.02-50 displays 0034h (hex) (that is, the value is 52 (decimal) and 0110100 (binary)), it means that MI3, MI5 and MI6 are ON.



0=OFF
1=ON

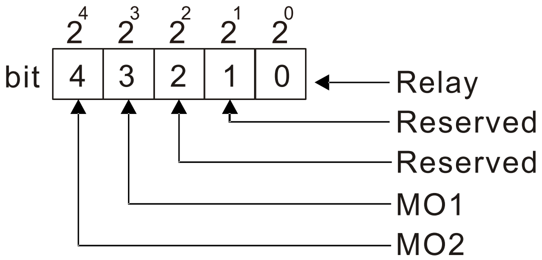
Setting
$= \text{bit } 5 \times 2^5 + \text{bit } 4 \times 2^4 + \text{bit } 2 \times 2^2$
$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2$
$= 32 + 16 + 4$
$= 52$

NOTE
$2^6 = 64$ $2^5 = 32$ $2^4 = 16$
$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

02-51 Display the Status of the Multi-function Output Terminal

Default: Read only

Settings Monitor the status of the Multi-function Output Terminal

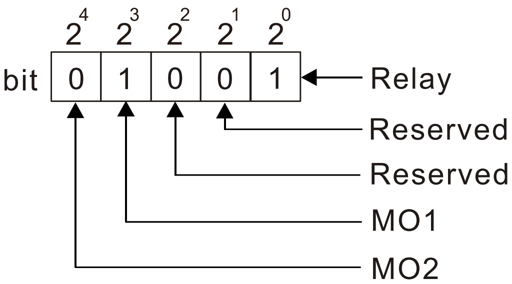


0=OFF
1=ON

NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

📖 Example:

When Pr.02-51 displays 0009h (hex) (that is, the value is 9 (decimal) and 01001 (binary)), it means that Relay and MO1 are ON.



0=OFF
1=ON

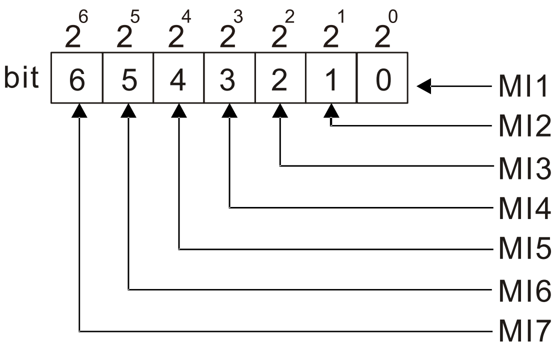
Setting
$= \text{bit } 3 \times 2^3 + \text{bit } 0 \times 2^0$
$= 1 \times 2^3 + 1 \times 2^0$
$= 8 + 1$
$= 9$

NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

02-52 Display the External Multi-function Input Terminals Used by the PLC

Default: Read only

Settings Monitor the status of PLC input terminals

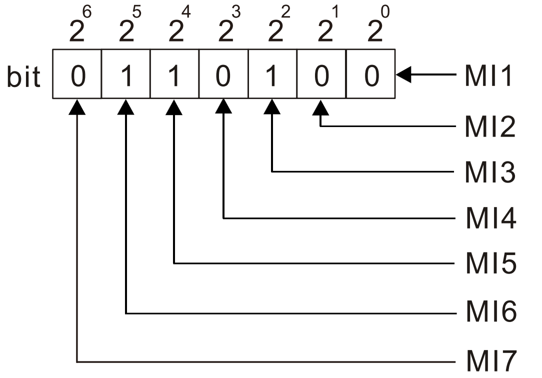


0=OFF
1=ON

NOTE
$2^6 = 64$ $2^5 = 32$ $2^4 = 16$
$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

📖 Example:

When Pr.02-52 displays 0034h (hex) (that is, the value is 52 (decimal) and 0110100 (binary)), it means that MI3, MI5 and MI6 are used by PLC.



0=OFF
1=ON

Setting

$= \text{bit } 5 \times 2^5 + \text{bit } 4 \times 2^4 + \text{bit } 2 \times 2^2$

$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2$

$= 32 + 16 + 4$

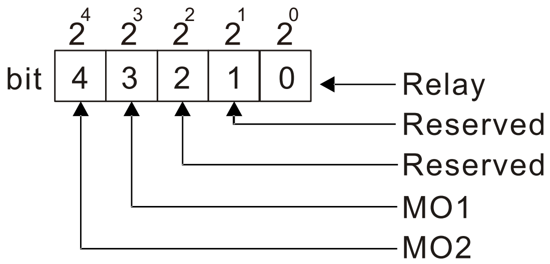
$= 52$

NOTE
$2^6 = 64$ $2^5 = 32$ $2^4 = 16$
$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

02-53 Display the External Multi-function Output Terminals Used by the PLC

Default: Read only

Settings Monitor the status of PLC output terminals

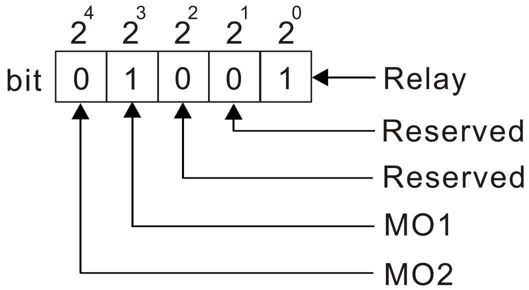


0=OFF
1=ON

NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

📖 Example:

When Pr.02-53 displays 0009h (hex) (that is, the value is 9 (decimal) and 01001 (binary)), it means that Relay and MO1 is used by PLC.



0=OFF
1=ON

Setting

$= \text{bit } 3 \times 2^3 + \text{bit } 0 \times 2^0$

$= 1 \times 2^3 + 1 \times 2^0$

$= 8 + 1$

$= 9$

NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

02-54 Display the Frequency Command Executed by the External Terminal

Default: Read only

Settings 0.00–599.00 Hz (Read only)

📖 When you set the source of the frequency command as the external terminal, if Lv or fault occurs, the external terminal frequency command is saved in this parameter.

02-70 IO Card Types

Default: Read only

Settings Read only

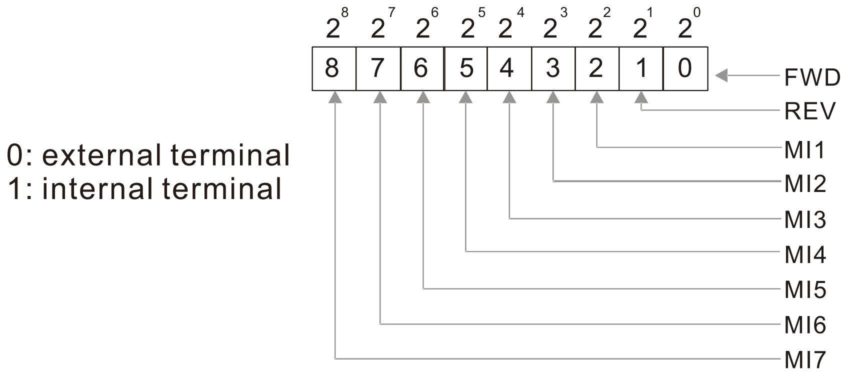
1: EMC-BPS01 (backup power supply)
10: EMM-D33A
11: EMM-A22A
12: EMM-R2CA
13: EMM-R3AA

02-74 Internal / External Multi-function Input Terminal Selection

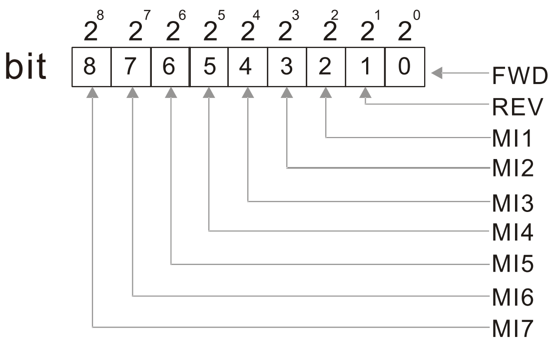
Default: 0000h

Settings 0000–FFFFh

- Selects the terminals MI1–MI7 to be internal terminals or external terminals. When the MIx is set as internal terminal, the corresponding external terminal function is disabled.
- To activate internal terminals via Pr.02-75 setting.



- Setting method: convert the binary 12bit number to hexadecimal number for input.
  Example: if the MI1, MI3, MI4 are triggered by virtual terminals, then Pr.02-74 = 34h.



0: external terminal
1: internal terminal

Settings
$= \text{bit5} \times 2^5 + \text{bit4} \times 2^4 + \text{bit2} \times 2^2$
$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2$
$= 32 + 16 + 4 = 52$

Pr.02-74
$\Rightarrow 52_{10} = 34h$

Note

$2^{12} = 4096$	$2^{11} = 2048$	$2^{10} = 1024$
$2^7 = 128$	$2^6 = 64$	$2^5 = 32$
$2^4 = 16$	$2^3 = 8$	$2^2 = 4$
$2^1 = 2$	$2^0 = 1$	

02-75 Internal Multi-function Output Terminal Selection

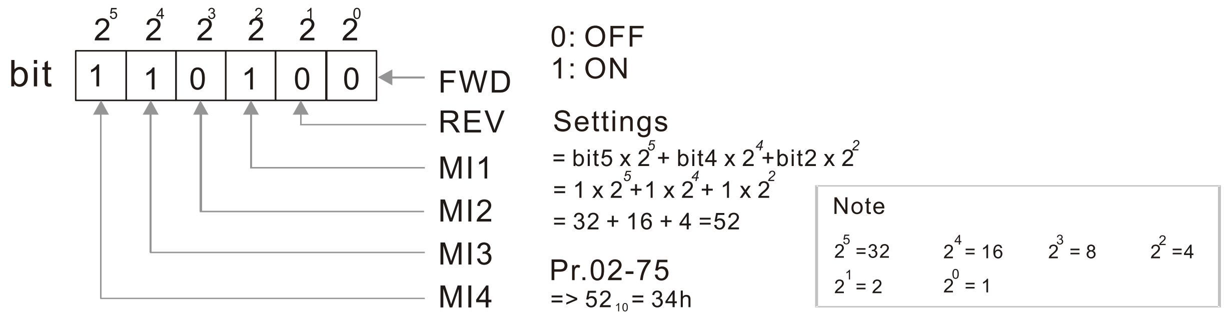
Default: 0000h

Settings 0000–FFFFh

- Sets the internal terminal action (ON / OFF) through digital keypad, communication or PLC.
- The Local / Remote options on the digital keypad have the lowest priority. When the PLC uses the entity DI, the corresponding function of original DI can still be triggered through virtual terminals.

- Pr.02-74 and Pr.02-75 can both be changed during RUN.
- Pr.02-74 and Pr.02-75 are saved after powering off.
- You can choose N.O. (Pr.02-12 bit = 0) or N.C. (Pr.02-12 bit = 1) through the Pr.02-12 MI mode to trigger the virtual terminals.

  Example: Sets Pr.02-75 = 34h to activate MI1, MI3 and MI4.



02-81 EF Activates when the Terminal Count Value Reached

Default: 0

Settings 0: Terminal count value reached, no EF displays (continues operating).

1: Terminal count value reached, EF is active.

02-82 Initial Frequency Command (F) Mode after Stop

Default: 0

Settings 0: Use current Frequency command

1: Use zero Frequency command

2: Refer to Pr.02-83 to set up

02-83 Initial Frequency Command (F) Setting after Stop

Default: 60.00

Settings 0.00–599.0 Hz

03 Analog Input / Output Parameters

✓ You can set this parameter during operation.

✓ 03-00 AVI Analog Input Selection

Default: 1

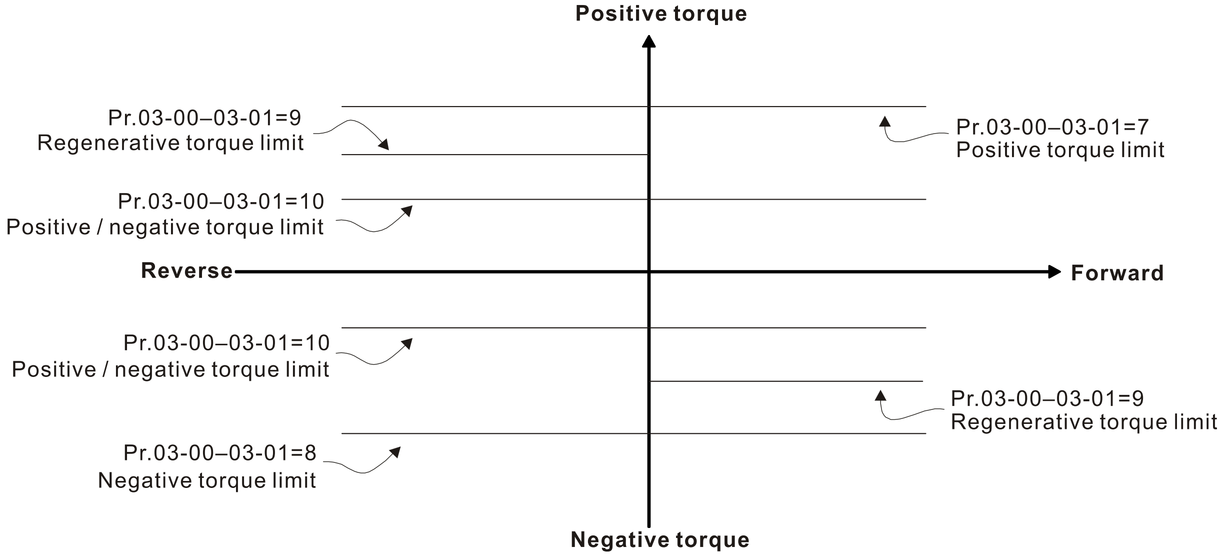
✓ 03-01 ACI Analog Input Selection

Default: 0

Settings
0: No function
1: Frequency command
2: Torque command (torque limit in speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: Thermistor input value (PTC)
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive / negative torque limit
11: PT100 thermistor input value
12: Auxiliary frequency input
13: PID compensation value
14: Tension PID feedback signal
15: Line speed
16: Reel diameter
17: Tension PID target value
18: Tension setting value
19: Zero-speed tension
20: Tension taper

- When you use analog input as the PID reference target input, you must set Pr.00-20 to 2 (external analog input).
  Setting method 1: Pr.03-00–03-01 set 1 as frequency command.
  Setting method 2: Pr.03-00–03-01 set 4 as PID reference target input.
  If the setting value 1 and setting value 4 exist at the same time, the AVI input has highest priority to become the PID reference target input value.
- When you use analog input as the PID compensation value, you must set Pr.08-16 to 1 (source of PID compensation value is analog input). You can see the compensation value with Pr.08-17.
- When you use the frequency command, the corresponding value for 0– ±10 V / 4–20 mA is 0–maximum operation frequency (Pr.01-00).
- When you use the torque command, the corresponding value for 0– ±10 V / 4–20 mA is 0–maximum output torque (Pr.11-27).
- When you use torque compensation, the corresponding value for 0– ±10 V / 4–20 mA is 0–the rated torque.

📖 When the settings for Pr.03-00 and Pr.03-01 are the same, the AVI input is selected first.



03-03 AVI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

📖 Sets the corresponding AVI voltage for the external analog input 0.

03-04 ACI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

📖 Sets the corresponding ACI current for the external analog input 0.

03-07 AVI Positive / Negative Bias Mode
03-08 ACI Positive / Negative Bias Mode

Default: 0

Settings 0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

📖 In a noisy environment, use negative bias to provide a noise margin. Do NOT use less than 1 V to set the operation frequency.

03-10 Reverse Setting when Analog Signal Input is Negative Frequency

Default: 0

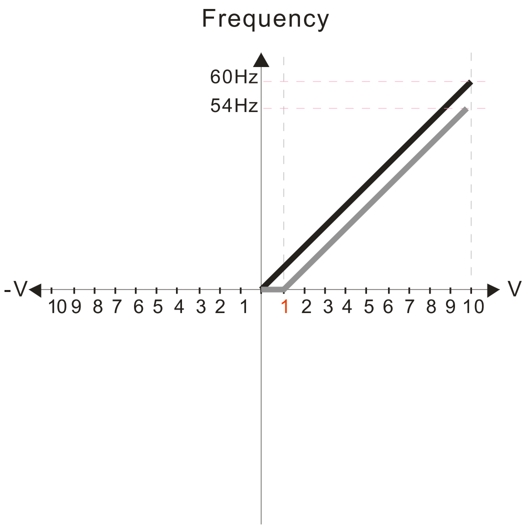
Settings 0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.
1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.

- Use this parameter only for AVI or ACI analog input.
- Requirements for negative frequency (reverse running)
  1. Pr.03-10 = 1
  2. Bias mode = Bias serves as the center
  3. Corresponded analog input gain < 0 (negative); this makes the input frequency negative.

  In using the additional analog input function (Pr.03-18 = 1), when the analog signal is negative after the addition, you can set this parameter to allow or not allow the reverse direction. The result after adding is restricted by the “Condition for negative frequency (reverse running)”.

In the diagram below, black line is voltage-frequency curve with no bias; gray line is voltage-frequency curve with bias.

Diagram 01



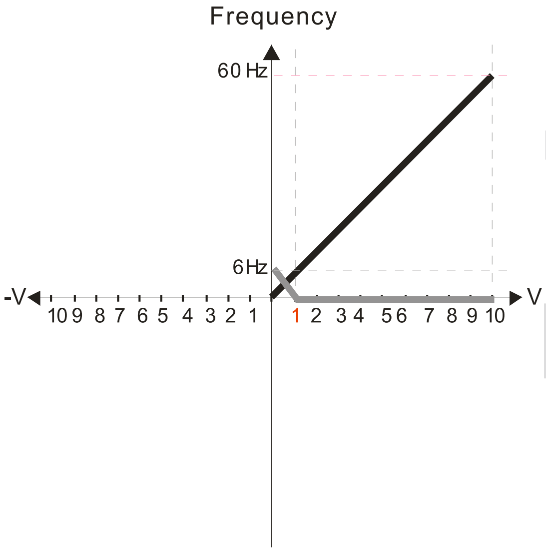
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 02



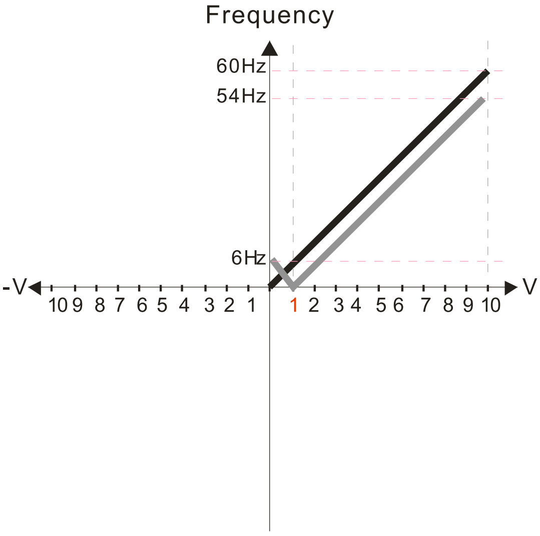
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 03



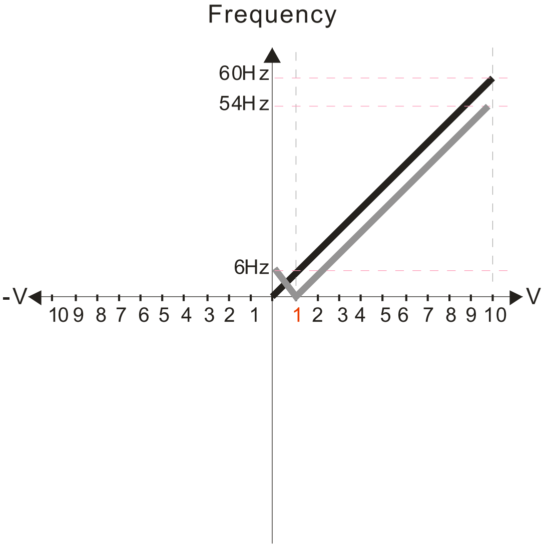
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 04



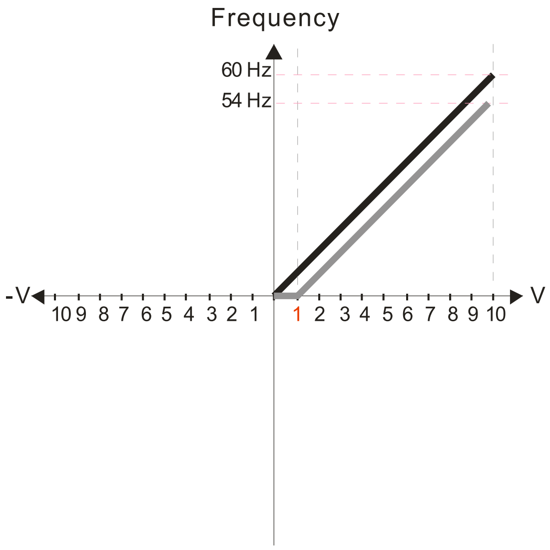
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 05



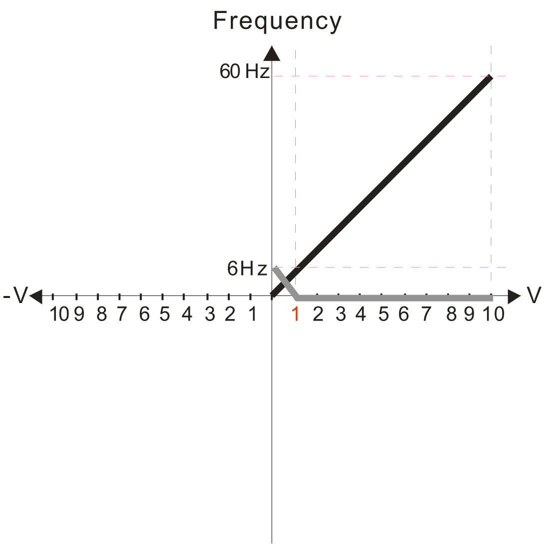
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 06



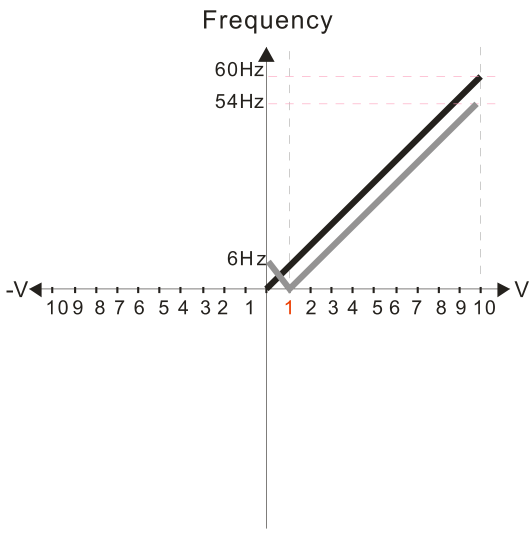
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 07



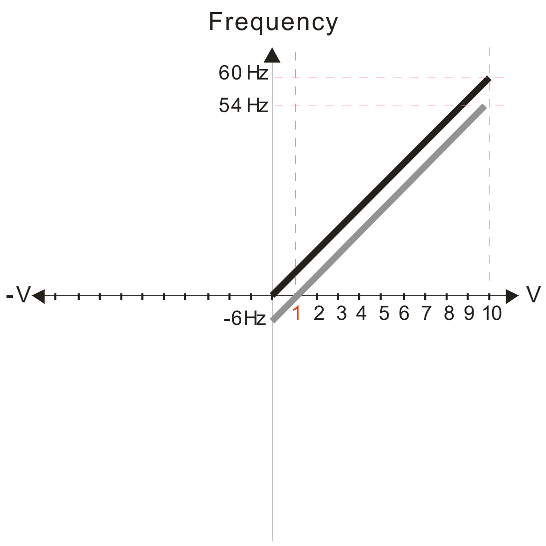
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 08



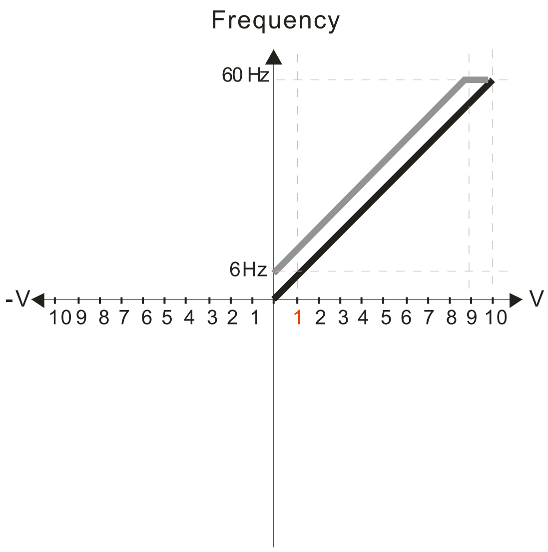
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 09



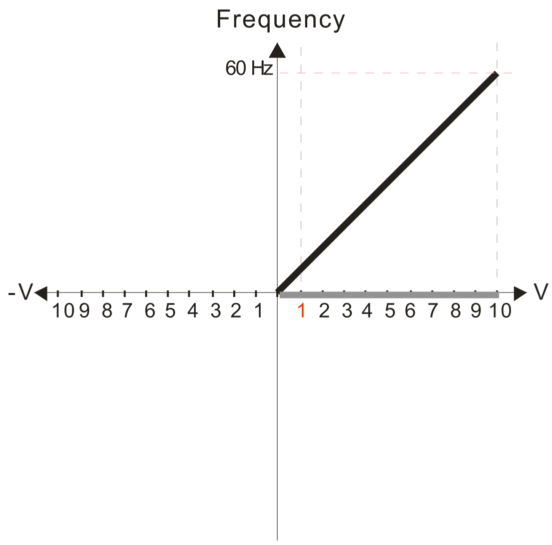
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 10



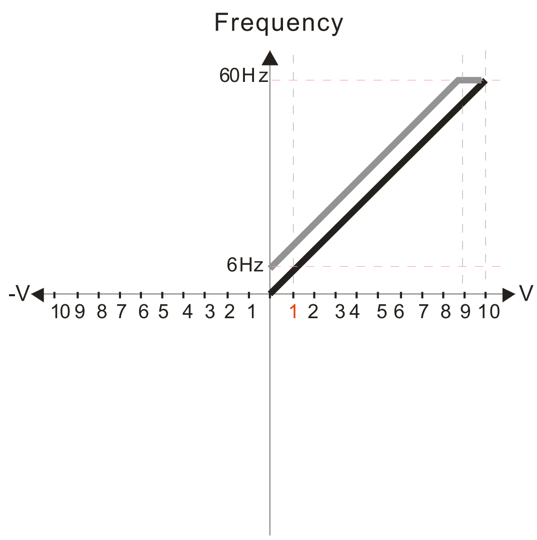
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 11



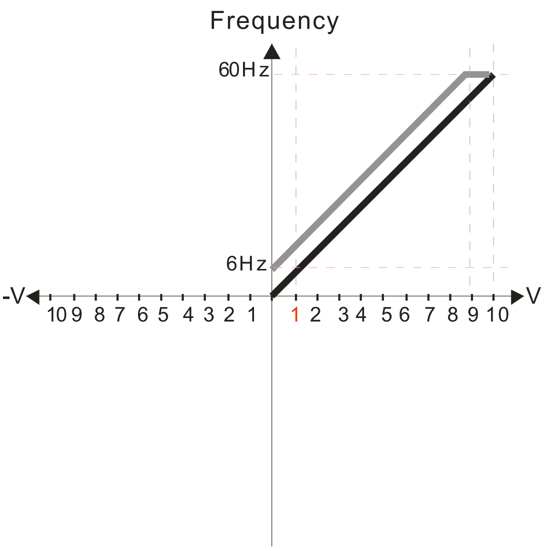
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 12



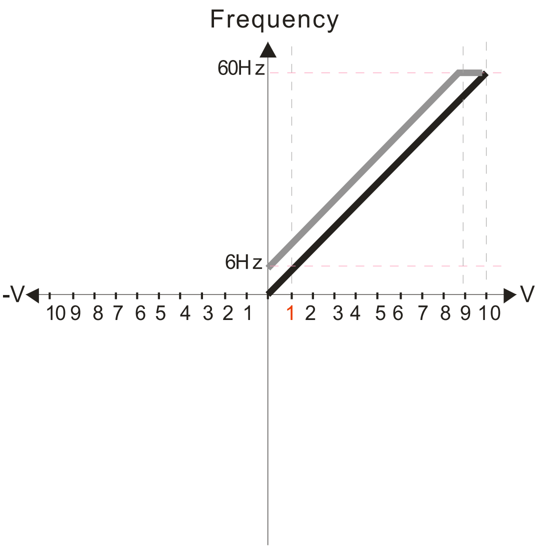
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 13



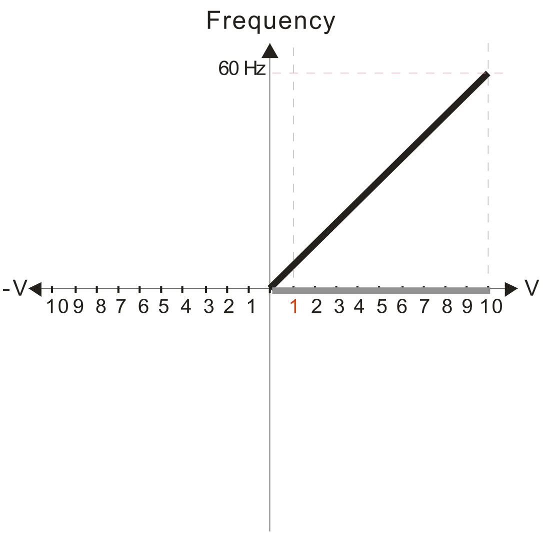
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 14



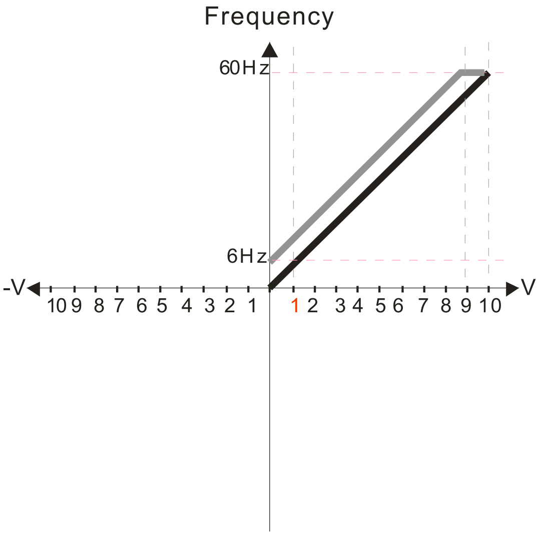
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 15



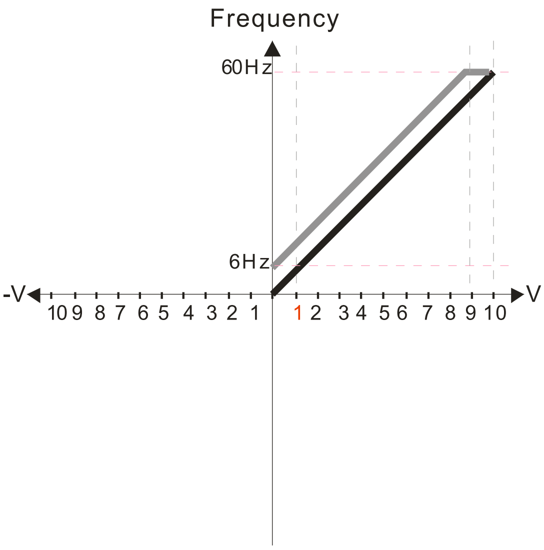
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 16



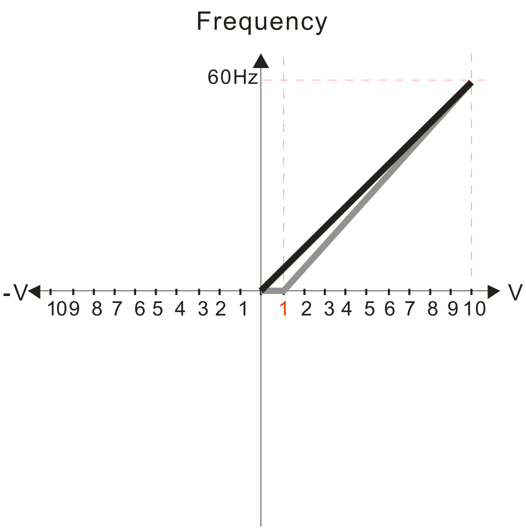
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 17



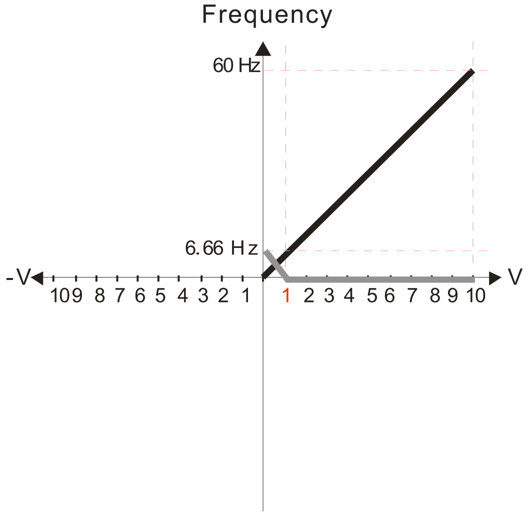
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 18



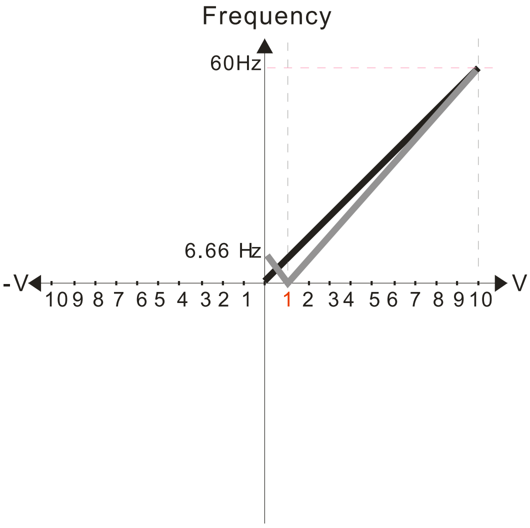
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 19



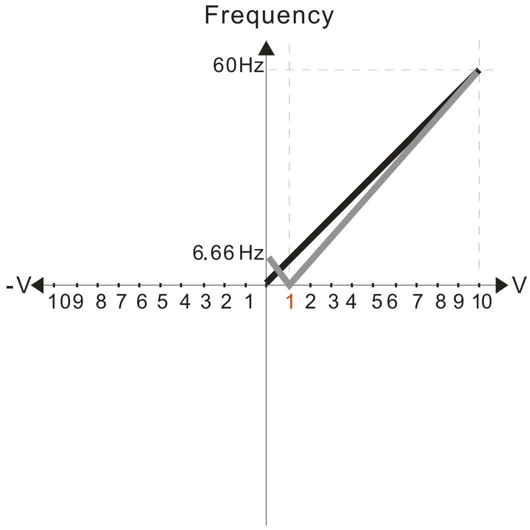
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 20



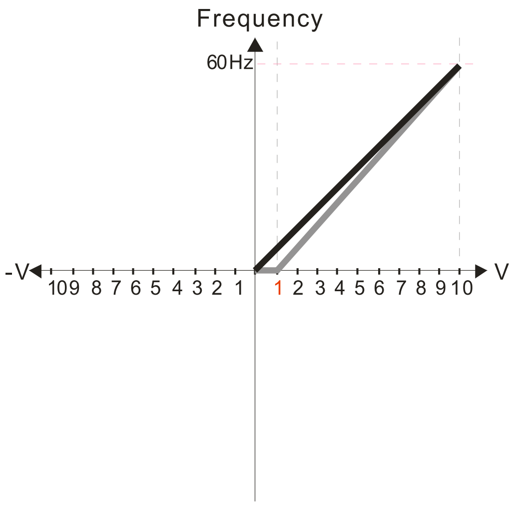
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 21



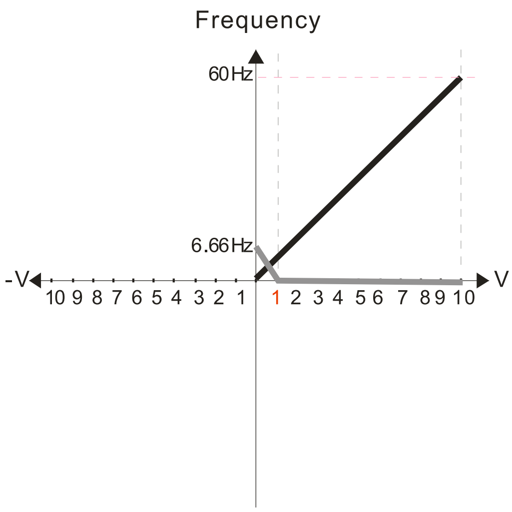
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 22



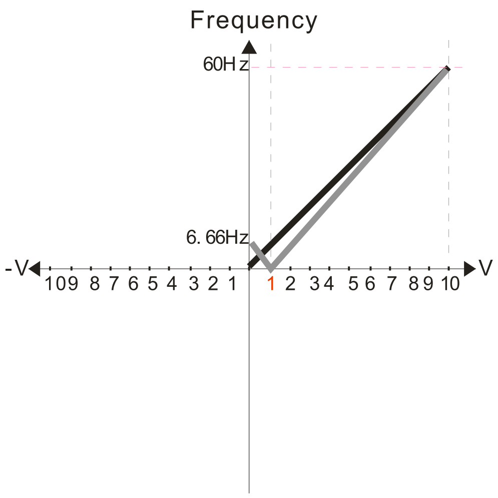
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 23



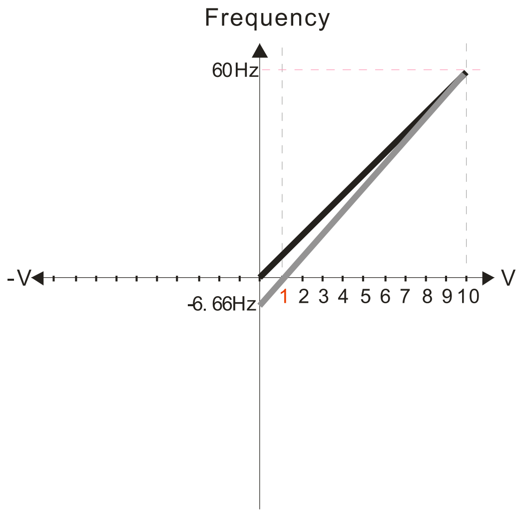
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 24



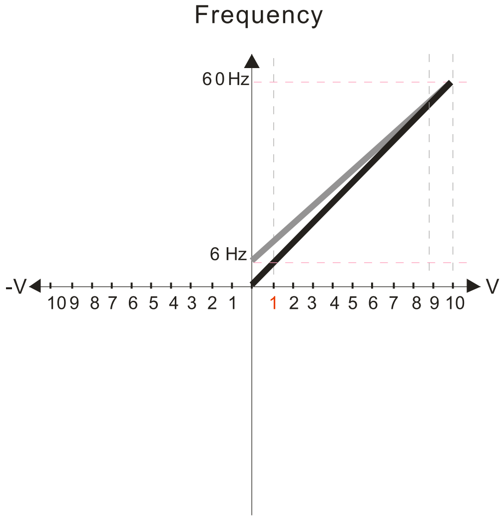
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 25



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

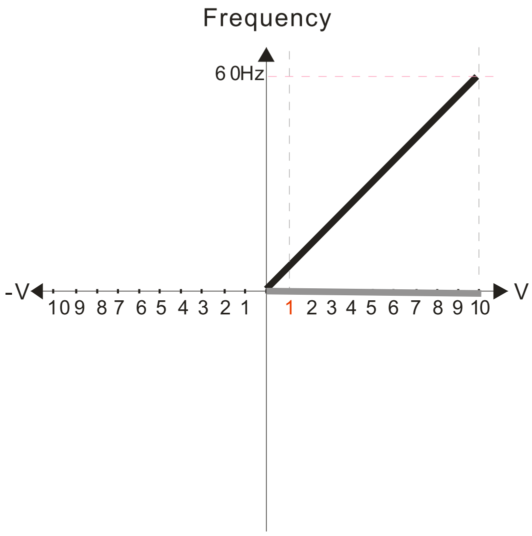
$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)}$ $XV = \frac{100}{-9} = -1.11V$ $\therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\%$

$= -11.1\%$

Calculate the gain:

$Pr.03\text{-}11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$

Diagram 26

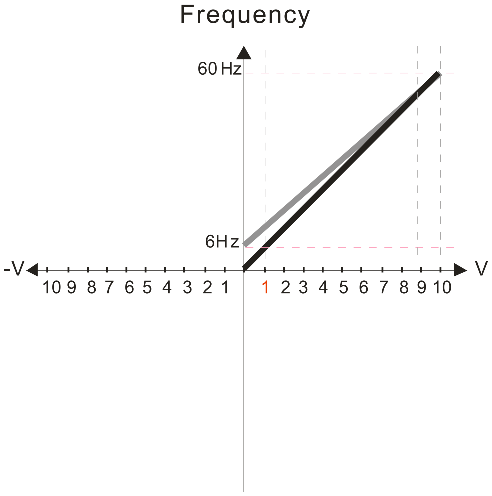


Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Diagram 27



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

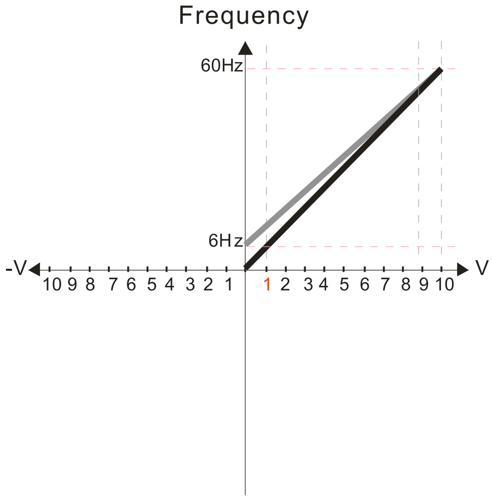
Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\ \%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\ \%$$

Diagram 28



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

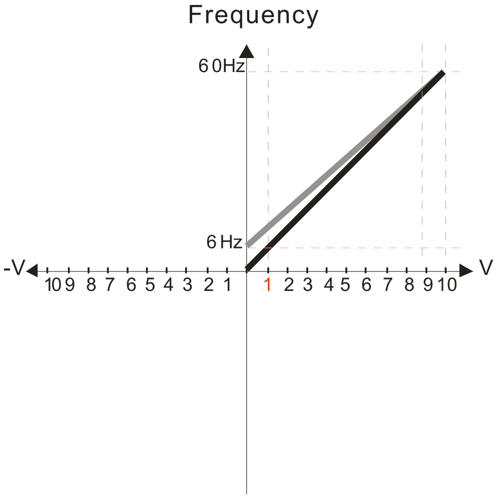
Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\ \%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\ \%$$

Diagram 29



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

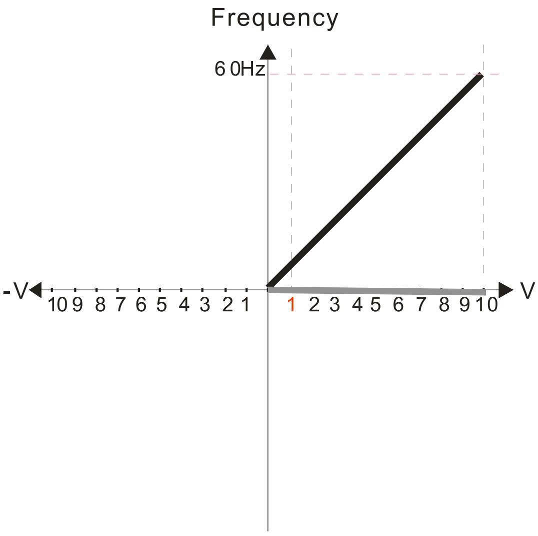
Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Diagram 30

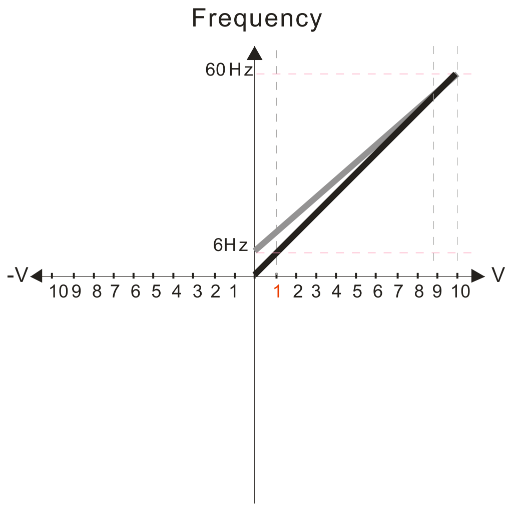


Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Diagram 31



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

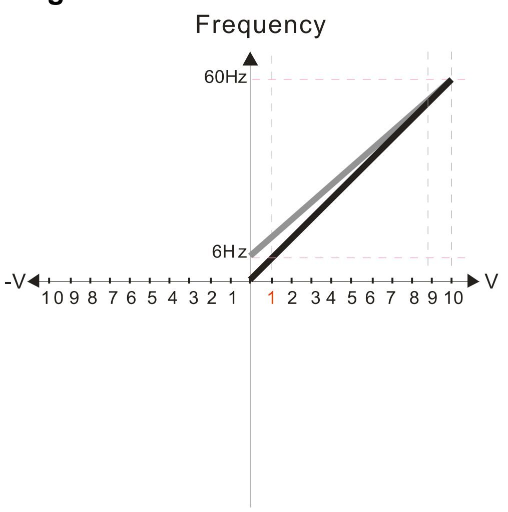
Calculate the bias:

$$\frac{60-6\text{Hz}}{10\text{V}} = \frac{6-0\text{Hz}}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Diagram 32



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$$\frac{60-6\text{Hz}}{10\text{V}} = \frac{6-0\text{Hz}}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

03-11 AVI Analog Input Gain
03-12 ACI Analog Input Gain

Default: 100.0

Settings -500.0–500.0%

Use Pr.03-03–03-12 when the Frequency command source is the analog voltage or current signal.

✎ 03-15 AVI Analog Input Filter Time

✎ 03-16 ACI Analog Input Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

- Use these input delays to filter a noisy analog signal.
- When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

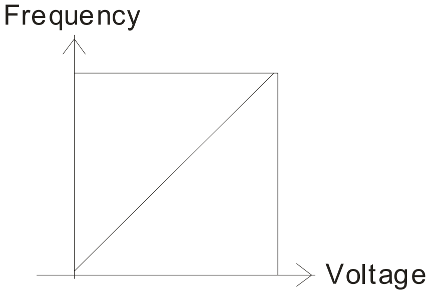
✎ 03-18 Analog Input Addition Function

Default: 0

Settings 0: Disable (AVI, ACI)

1: Enable (analog extension card not included)

- When Pr.03-18 = 1:
  Example: Pr.03-00 = Pr.03-01 = 1, frequency command = AVI + ACI
- When Pr.03-18 = 0 and the analog input selection settings (Pr.03-00 and Pr.03-01) are the same, AVI has priority over ACI. In other words, when Pr.03-00 and Pr.03-01 are both set to 1 (Frequency command), the drive ignores the setting value from ACI but execute the frequency command according to the setting value from AVI.



$$\text{Fcmd} = [(\text{ay} \pm \text{bias}) \times \text{gain}] \times \frac{\text{Fmax(01-00)}}{\text{10V or 16mA or 20mA}}$$

Fcmd: the corresponding frequency of 10V or 20mA

ay : 0~10V, 4~20mA, 0~20mA

bias : Pr.03-03, Pr. 03-04

gain : Pr.03-11, Pr.03-12

03-19 Signal Loss Selection for the Analog Input 4–20 mA

Default: 0

Settings 0: Disable

1: Continue operation at the last frequency

2: Decelerate to 0 Hz

3: Stop immediately and display “ACE”

- Determines the treatment when the 4–20 mA signal is lost, when ACIc (Pr.03-29 = 0).
- When Pr.03-29 ≠ 0, the voltage input to ACI terminal is 0–10 V or 0–20 mA, and Pr.03-19 is invalid.
- When the setting is 1 or 2, the keypad displays the warning code “ANL”. It keeps blinking until the ACI signal is recovered.
- When the motor drive stops, the warning condition does not continue to exist, so the warning disappears.

03-20 AFM Multi-function Output

Default: 0

Settings 0–23

Function Chart

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>0</td><td>Output frequency (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>1</td><td>Frequency command (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>2</td><td>Motor speed (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>3</td><td>Output current (rms)</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>4</td><td>Output voltage</td><td>(2 x rated voltage) is processed as 100%.</td></tr>
<tr><td>5</td><td>DC bus voltage</td><td>450 V (900 V) = 100%</td></tr>
<tr><td>6</td><td>Power factor</td><td>-1.000–1.000 = 100%</td></tr>
<tr><td>7</td><td>Power</td><td>(2 x rated power) is processed as 100%.</td></tr>
<tr><td>8</td><td>Output torque</td><td>Full load torque = 100%</td></tr>
<tr><td>9</td><td>AVI</td><td>0–10 V = 0–100%</td></tr>
<tr><td>10</td><td>ACI</td><td>4–20 mA = 0–100%</td></tr>
<tr><td>12</td><td>Iq current command</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>13</td><td>Iq feedback value</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>14</td><td>Id current command</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>15</td><td>Id feedback value</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>16</td><td>Vq-axis voltage command</td><td>250 V (500 V) = 100%</td></tr>
<tr><td>17</td><td>Vd-axis voltage command</td><td>250 V (500 V) = 100%</td></tr>
<tr><td>18</td><td>Torque command</td><td>Rated current of motor = 100%</td></tr>
<tr><td>19</td><td>PG2 frequency command</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>20</td><td>CANopen analog output</td><td>For CANopen communication analog output
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>2026-A1</td></tr>
<tr><td>AO10</td><td>2026-AB</td></tr>
<tr><td>AO11</td><td>2026-AC</td></tr>
</table></td></tr>
<tr><td>21</td><td>RS-485 analog output</td><td>For RS-485 (Modbus) analog output
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>22</td><td>Communication card analog output</td><td>For Communication analog output
(CMM-EIP02, CMM-PD02, CMM-DN02)
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
</table>

Settings	Functions	Descriptions
23	Constant voltage output	Pr.03-32 controls the voltage output level. 0–100% of Pr.03-32 corresponds to 0–10 V of AFM.

03-21 AFM Analog Output Gain

Default: 100.0

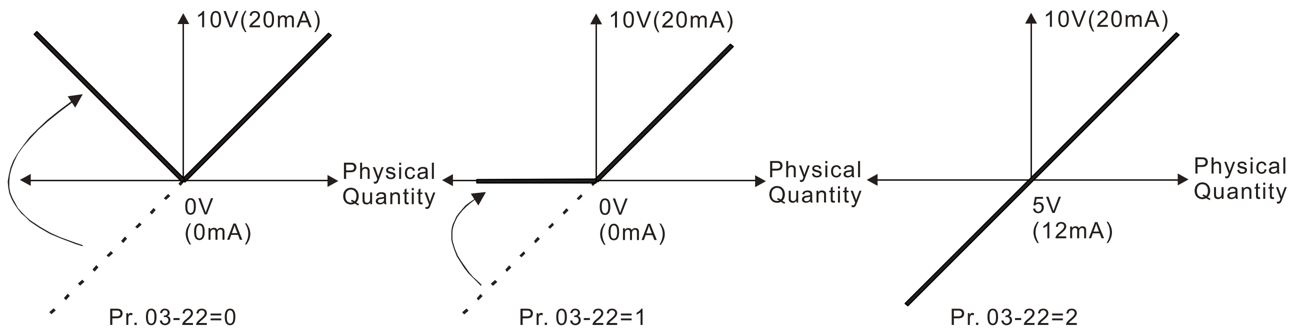
Settings 0.0–500.0%

Adjusts the voltage level outputted to the analog meter from the analog signal (Pr.03-20) output terminal AFM of the drive.

03-22 AFM Analog Output in REV Direction

Default: 0

Settings 0: Absolute value of output voltage
1: Reverse output 0 V; forward output 0–10 V
2: Reverse output 5–0 V; forward output 5–10 V



Selections for the analog output direction

03-27 AFM Output Bias

Default: 0.00

Settings -100.00–100.00%

Example 1: AFM 0–10 V is set to the output frequency, the output equation is
10 V × (output frequency / Pr.01-00) × Pr.03-21 + 10 V × Pr.03-27

Example 2: AFM 0–20 mA is set to the output frequency, the output equation is
20 mA × (output frequency / Pr.01-00) × Pr.03-21 + 20 mA × Pr.03-27

Example 3: AFM 4–20 mA is set to the output frequency, the output equation is
4 mA + 16 mA × (output frequency / Pr.01-00) × Pr.03-21 + 16 mA × Pr.03-27

This parameter sets the corresponding voltage for the analog output 0.

03-28 AVI Terminal Input Selection

Default: 0

Settings 0: 0–10 V
3: -10–10 V

When Pr.03-28 = 0, Pr.03-63–03-68 are valid.

When Pr.03-28 = 3, Pr.03-69–03-74 are valid.

03-29 ACI Terminal Input Selection

Default: 0

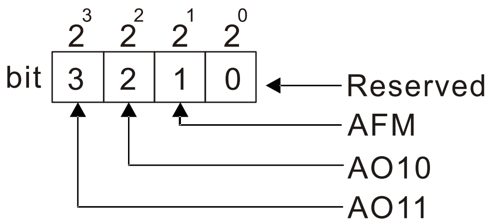
Settings 0: 4–20 mA
1: 0–10 V
2: 0–20 mA

- When you change the input mode, verify that the external terminal switch position (ACI) is correct.
- When you change the setting, proportion to the corresponding AVI and ACI will change to default.

03-30 PLC Analog Output Terminal Status

Default: Read only

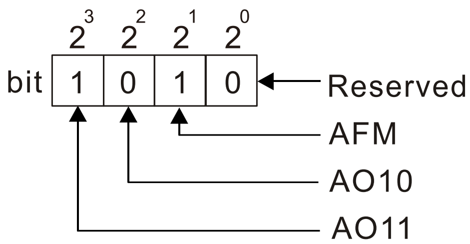
Settings Monitor the status of the PLC analog output terminals
bit 1: AFM
bit 2: AO10
bit 3: AO11



0=OFF
1=ON

NOTE
$2^3=8$ $2^2=4$ $2^1=2$ $2^0=1$

- Example:
When Pr.03-30 displays 000Ah (hex) (that is, the value is 10 (decimal) and 1010 (binary)), it means that AFM and AO11 are used by PLC.



0=OFF
1=ON

<u>Setting</u>
$= \text{bit } 3 \times 2^3 + \text{bit } 1 \times 2^1$
$= 1 \times 2^3 + 1 \times 2^1$
$= 8 + 2$
$= 10$

NOTE
$2^3=8$ $2^2=4$ $2^1=2$ $2^0=1$

03-31 AFM Output Selection

Default: 0

Settings 0: 0–10 V output
1: 0–20 mA output
2: 4–20 mA output

03-32 AFM DC Output Setting Level

Default: 0.00

Settings 0.00–100.00%

✔ 03-35 AFM Output Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

✔ 03-39 VR Input Selection

Default: 1

Settings 0: Disable
1: Frequency command

📖 VR is the abbreviation for Variable Resistor; it is the potentiometer of the keyboard panel KPMH-LC01.

✔ 03-44 Multi-function MO Output by AI Level Source

Default: 0

Settings 0: AVI
1: ACI
3: Extension card input terminal AI10
4: Extension card input terminal AI11

✔ 03-45 AI Upper Level 1

Default: 50

Settings -100–100%

✔ 03-46 AI Lower Level 2

Default: 10

Settings -100–100%

📖 Multi-function output terminal 67 must work with Pr.03-44 to select input channels. When analog input level is higher than Pr.03-45, multi-function output acts; when analog input level is lower than Pr.03-46, multi-function output terminals stop outputting.

📖 When setting levels, AI upper level must be higher than AI lower level.

✔ 03-50 Analog Input Curve Selection

Default: 0

Settings 0: Normal Curve
1: Three-point curve of AVI (& AI10)
2: Three-point curve of ACI (& AI11)
3: Three-point curve of AVI & ACI (& AI10 & AI11)
(AI10, AI11 are valid when expansion card is installed)

✔ 03-57 ACI Lowest Point

Default: 4.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

✔ 03-58 ACI Proportional Lowest Point

Default: 0.00

Settings 0.00–100.00%

03-59 ACI Mid-point

Default: 12.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

03-60 ACI Proportional Mid-point

Default: 50.00

Settings 0.00–100.00%

03-61 ACI Highest Point

Default: 20.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

03-62 ACI Proportional Highest Point

Default: 100.00

Settings 0.00–100.00%

- When Pr.03-29 = 1, the ACI setting is 0–10 V and the unit is voltage (V).
  When Pr.03-29 ≠ 1, the ACI setting is 0–20 mA or 4–20 mA and the unit is current (mA).
- When you set the analog input ACI to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- The requirement for these three parameters (Pr.03-57, Pr.03-59 and Pr.03-61) is Pr.03-57 < Pr.03-59 < Pr.03-61. The values for three proportional points (Pr.03-58, Pr.03-60 and Pr.03-62) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the ACI input value is lower than lowest point setting.
  For example:
  If Pr.03-57 = 2 mA; Pr.03-58 = 10%, then the output becomes 0% when the AVI input is ≤ 2 mA.
  If the ACI input swings between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

03-63 AVI Voltage Lowest Point

Default: 0.00

Settings 0.00–10.00 V

03-64 AVI Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-65 AVI Voltage Mid-point

Default: 5.00

Settings 0.00–10.00 V

03-66 AVI Proportional Mid-point

Default: 50.00

Settings -100.00–100.00%

✓ 03-67 AVI Voltage Highest Point

Default: 10.00

Settings 0.00–10.00 V

✓ 03-68 AVI Proportional Highest Point

Default: 100.00

Settings -100.00–100.00%

- When you set the positive voltage AVI to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency) and the motor runs in the forward direction.
- The requirement for these three parameters (Pr.03-63, Pr.03-65 and Pr.03-67) is Pr.03-63 < Pr.03-65 < Pr.03-67. The values for three proportional points (Pr.03-64, Pr.03-66 and Pr.03-68) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the positive voltage AVI input value is lower than lowest point setting.

  For example:

  If Pr.03-63 = 1 V; Pr.03-64 = 10%, then the output becomes 0% when the AVI input is ≤ 1 V.

  If the AVI input swings between 1 V and 1.1 V, the drive's output frequency oscillates between 0% and 10%.

✓ 03-69 Negative AVI Voltage Lowest Point

Default: 0.00

Settings 0.00–10.00 V
(valid when Pr.03-28 sets as -10–10 V)

✓ 03-70 Negative AVI Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%
(valid when Pr.03-28 sets as -10–10 V)

✓ 03-71 Negative AVI Voltage Mid-point

Default: -5.00

Settings 0.00–10.00 V
(valid when Pr.03-28 sets as -10–10 V)

✓ 03-72 Negative AVI Proportional Mid-point

Default: -50.00

Settings -100.00–100.00%
(valid when Pr.03-28 sets as -10–10 V)

✓ 03-73 Negative AVI Voltage Highest Point

Default: -10.00

Settings 0.00–10.00 V
(valid when Pr.03-28 sets as -10–10 V)

✓ 03-74 Negative AVI Proportional Highest Point

Default: -100.00

Settings -100.00–100.00%
(valid when Pr.03-28 sets as -10–10 V)

- Pr.03-69–Pr.03-74 are valid when Pr.03-28 sets as -10–10 V.
- When you set the negative voltage AVI to the Frequency command, -100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency) and the motor runs in the reverse direction.
- The requirement for these three parameters (Pr.03-69, Pr.03-71 and Pr.03-73) is Pr.03-69 < Pr.03-71 < Pr.03-73. The values for three proportional points (Pr.03-70, Pr.03-72 and Pr.03-74) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the negative AVI input value is lower than the lowest point setting.
  For example:
  If Pr.03-69 = -1 V; Pr.03-70 = 10%, then the output becomes 0% when the AVI input is ≥ -1 V.
  If the AVI input swings between -1 V and -1.1 V, drive’s output frequency oscillates between 0% and 10%.

04 Multi-step Speed Parameters

✗ You can set this parameter during operation.

✗	04-00	1st Step Speed Frequency
✗	04-01	2nd Step Speed Frequency
✗	04-02	3rd Step Speed Frequency
✗	04-03	4th Step Speed Frequency
✗	04-04	5th Step Speed Frequency
✗	04-05	6th Step Speed Frequency
✗	04-06	7th Step Speed Frequency
✗	04-07	8th Step Speed Frequency
✗	04-08	9th Step Speed Frequency
✗	04-09	10th Step Speed Frequency
✗	04-10	11th Step Speed Frequency
✗	04-11	12th Step Speed Frequency
✗	04-12	13th Step Speed Frequency
✗	04-13	14th Step Speed Frequency
✗	04-14	15th Step Speed Frequency

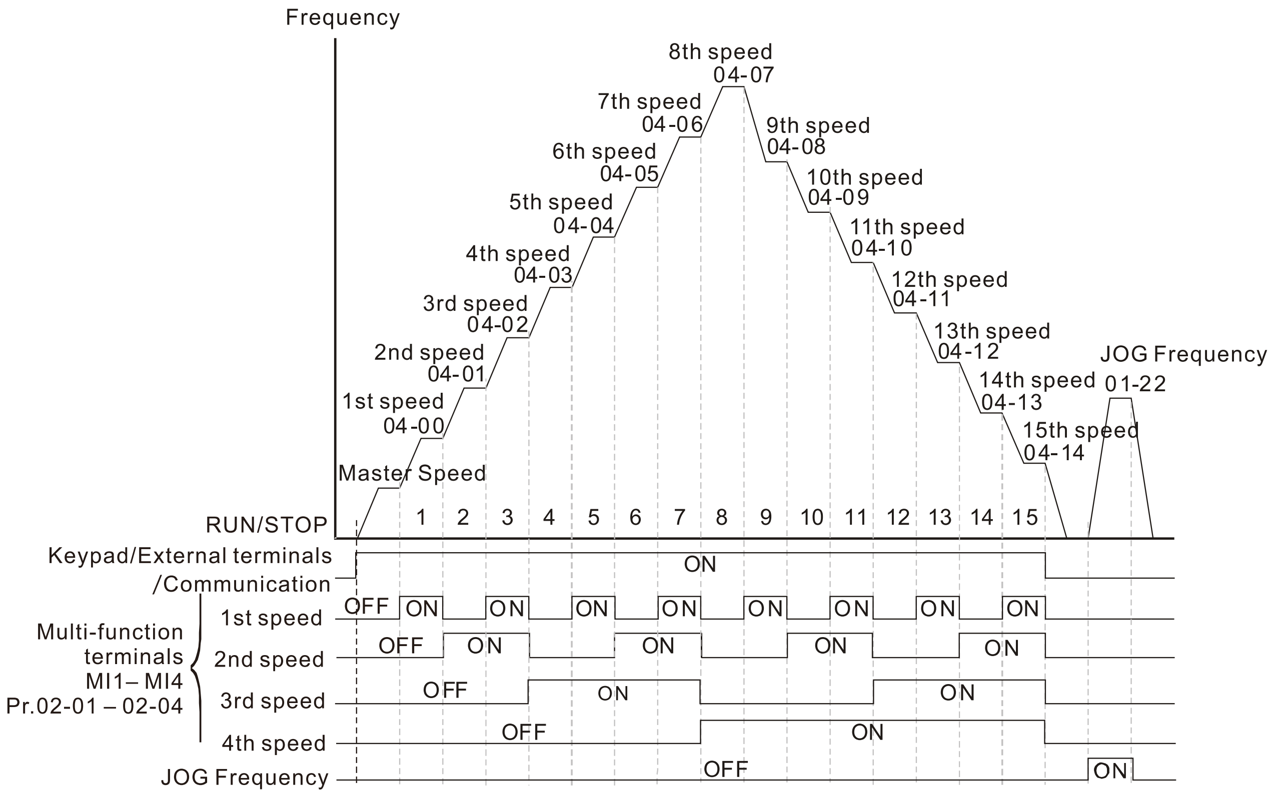
Default: 0.00

Settings 0.00–599.00 Hz

- Use the multi-function input terminals (refer to settings 1–4 of Pr.02-01–02-07 and Pr.02-26–02-28 Multi-function Input Command) to select the multi-step speed command (the maximum is 15th step speed). Pr.04-00 to 04-14 sets the multi-step speed frequency as shown in the following diagram.
- The external terminal/digital keypad / communication controls the RUN and STOP commands with Pr.00-21.
- You can set each multi-step speed between 0.00–599.00 Hz during operation.
- Explanation for the timing diagram of the multi-step speed and external terminals

  The related parameter settings are:

  1. Pr.04-00–04-14: sets the 1st–15th multi-step speed (to set the frequency of each step speed).
  2. Pr.02-01–02-07 and Pr.02-26–02-28: sets the multi-function input terminals (multi-step speed command 1–4).
- Related parameters:
  - Pr.01-22 JOG frequency setting
  - Pr.02-01 multi-function input command 1 (MI1)
  - Pr.02-02 multi-function input command 2 (MI2)
  - Pr.02-03 multi-function input command 3 (MI3)
  - Pr.02-04 multi-function input command 4 (MI4)



Multi-speed via External Terminals

04-50	PLC Buffer 0
04-51	PLC Buffer 1
04-52	PLC Buffer 2
04-53	PLC Buffer 3
04-54	PLC Buffer 4
04-55	PLC Buffer 5
04-56	PLC Buffer 6
04-57	PLC Buffer 7
04-58	PLC Buffer 8
04-59	PLC Buffer 9
04-60	PLC Buffer 10
04-61	PLC Buffer 11
04-62	PLC Buffer 12
04-63	PLC Buffer 13
04-64	PLC Buffer 14
04-65	PLC Buffer 15
04-66	PLC Buffer 16
04-67	PLC Buffer 17
04-68	PLC Buffer 18
04-69	PLC Buffer 19

Default: 0

Settings 0–65535

📖 You can combine the PLC buffer with the built-in PLC function for a variety of applications.

05 Motor Parameters

In this parameter group, the following are abbreviations for different types of motors:

- IM: Induction motor
- PM: Permanent magnet synchronous AC motor
- IPM: Interior permanent magnet synchronous AC motor
- SPM: Surface permanent magnet synchronous AC motor

✎ You can set this parameter during operation.

05-00 Motor Parameter Auto-tuning

Default: 0

Settings
0: No function
1: Dynamic test for induction motor (IM)
2: Static test for induction motor (IM)
4: Dynamic test for PM synchronous motor magnetic pole
5: Rolling auto-tuning for PM (IPM / SPM) motor
12: FOC sensorless inertia estimation
13: High frequency stall test for PM synchronous motor

05-01 Full-load Current for Induction Motor 1 (A)

Default: Depending on the model power

Settings 10–120 % of the drive's rated current

- Sets this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.
  Example: The rated current for a 7.5 HP (5.5 kW) motor is 25 A. The default is 22.5 A.
  The setting range is 2.5–30 A. (25 × 10 % = 2.5 A and 25 × 120 % = 30 A).

✎ 05-02 Rated Power for Induction Motor 1 (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

- Sets the rated power for motor 1. The default is the drive's power value.

✎ 05-03 Rated Speed for Induction Motor 1 (rpm)

Default: Depending on the motor's number of poles

Settings
0–xxxxx rpm (Depending on the motor's number of poles)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

- Sets the rated speed for the motor as indicated on the motor nameplate.

05-04 Number of Poles for Induction Motor 1

Default: 4

Settings 2–20

- Sets the number of poles for the motor (must be an even number).
- Set up Pr.01-01 and Pr.05-03 before setting up Pr.05-04 to make sure the motor operates normally.

05-05 No-load Current for Induction Motor 1 (A)

Default: Depending on the model power

Settings 0.00–Pr.05-01 default

📖 The default is 40% of the motor's rated current.

05-06 Stator Resistance (Rs) for Induction Motor 1

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-07 Rotor Resistance (Rr) for Induction Motor 1

Default: 0.000

Settings 0.000–65.535 Ω

05-08 Magnetizing Inductance (Lm) for Induction Motor 1

Default: 0.0

Settings 0.0–6553.5 mH

05-09 Stator Inductance (Lx) for Induction Motor 1

Default: 0.0

Settings 0.0–6553.5 mH

05-13 Full-load Current for Induction Motor 2 (A)

Default: Depending on the model power

Settings 10–120% of the drive's rated current

📖 Set this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example: The rated current for a 7.5 HP (5.5 kW) motor is 25 A. The default is 22.5 A.
The setting range is 2.5–30 A. (25 × 10 % = 2.5 A and 25 × 120 % = 30 A)

✔ 05-14 Rated Power for Induction Motor 2 (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

📖 Sets the rated power for motor 2. The default is the drive's power value.

✔ 05-15 Rated Speed for Induction Motor 2 (rpm)

Default: Depending on the motor's number of poles

Settings 0–xxxxx rpm (Depending on the motor's number of poles)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

📖 Sets the rated speed for the motor as indicated on the motor nameplate.

05-16 Number of Poles for Induction Motor 2

Default: 4

Settings 2–20

- Sets the number of poles for the motor (must be an even number).
- Set up Pr.01-35 and Pr.05-15 before setting up Pr.05-04 to make sure the motor operates normally.

05-17 No-load Current for Induction Motor 2 (A)

Default: Depending on the model power

Settings 0.00–Pr.05-13 default

- The default is 40% of the motor's rated current.

05-18 Stator Resistance (Rs) for Induction Motor 2

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-19 Rotor Resistance (Rr) for Induction Motor 2

Default: 0.000

Settings 0.000–65.535 Ω

05-20 Magnetizing Inductance (Lm) for Induction Motor 2

Default: 0.0

Settings 0.0–6553.5 mH

05-21 Stator Inductance (Lx) for Induction Motor 2

Default: 0.0

Settings 0.0–6553.5 mH

05-22 Multi-motors (Induction) Selection

Default: 1

Settings
1: Motor 1
2: Motor 2
3: Motor 3 (VF or SVC control mode only)
4: Motor 4 (VF or SVC control mode only)

- Sets the motor operated by the AC motor drive. Multi-motors selection only supports single control mode. For example, when you set motor 1 as SVC control mode, the control mode of motors 2–4 are also set as SVC.

05-23 Frequency for Y-connection / Δ-connection Switch for an Induction Motor

Default: 60.00

Settings 0.00–599.00 Hz

05-24 Y-connection / Δ-connection Switch for an Induction Motor

Default: 0

Settings 0: Disable

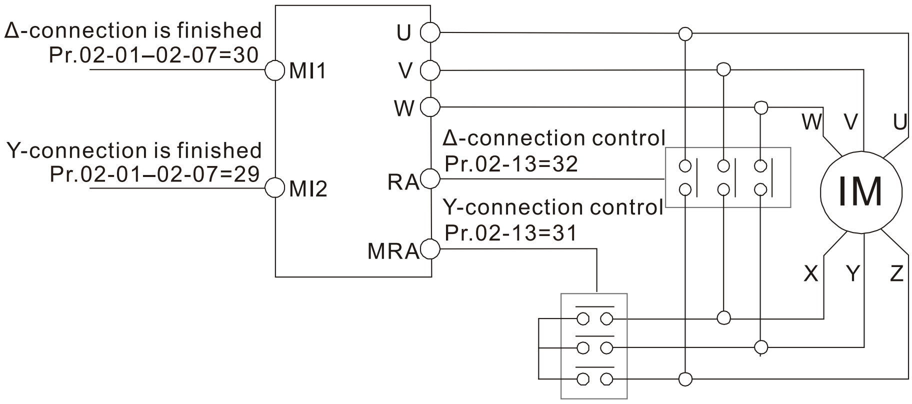
1: Enable

05-25 Delay Time for Y-connection / Δ-connection Switch for an Induction Motor

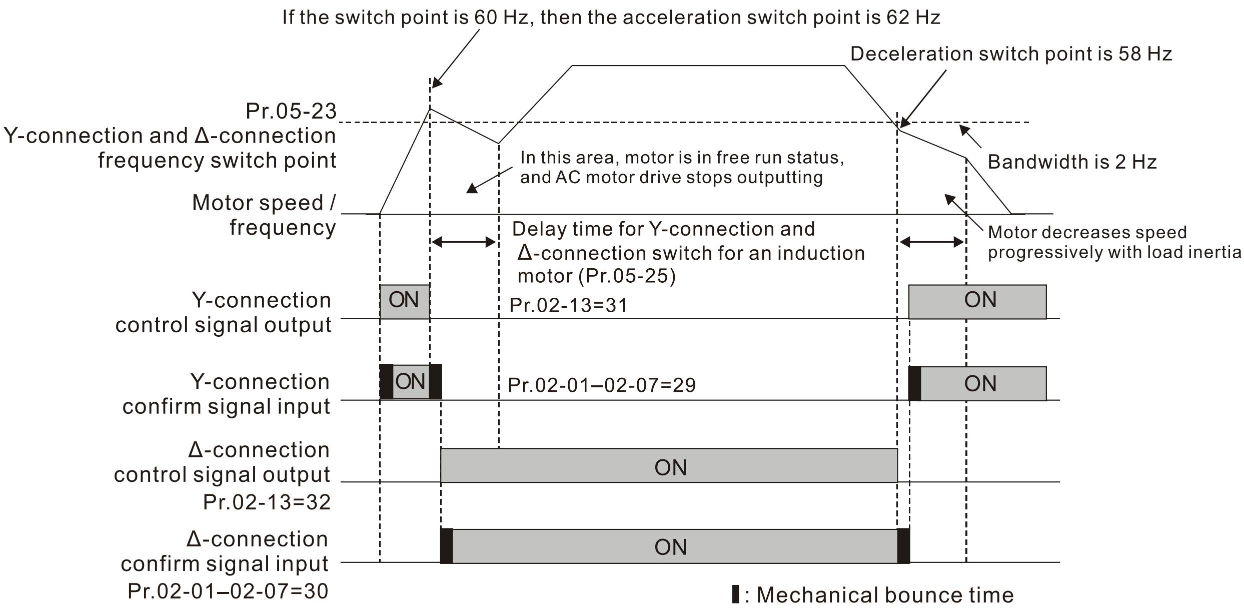
Default: 0.200

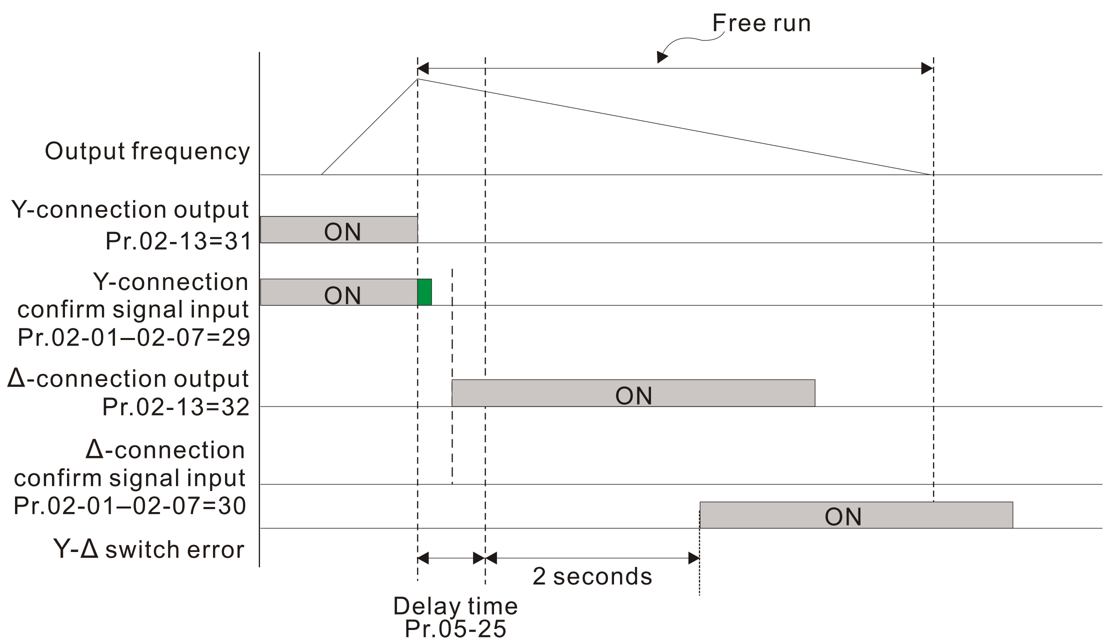
Settings 0.000–60.000 sec.

- You can apply Pr.05-23–Pr.05-25 in a wide range of motors, and the motor coil executes the Y-connection / Δ-connection switch as required. The wide range motors are related to the motor design. In general, the motor has higher torque with low speed Y-connection and has higher speed with high speed Δ-connection
- Pr.05-24 enables and disables the switch of Y-connection / Δ-connection.
- When you set Pr.05-24 as 1, the drive uses the Pr.05-23 setting and current motor frequency, and switches the current motor to Y-connection or Δ-connection. You can switch the relevant motor parameter settings simultaneously.
- Pr.05-25 sets the switch delay time of Y-connection / Δ-connection.
- When the output frequency reaches the Y-connection / Δ-connection switch frequency, the drive delays according to Pr.05-25 before activating the multi-function output terminals.



Y-Δ connection switch: can be used for wide range motor
Y-connection for low speed: higher torque can be used for rigid tapping
Δ-connection for high speed: higher torque can be used for high-speed drilling





05-26 Accumulated Watt-second for a Motor in Low Word (W-sec.)
05-27 Accumulated Watt-second for a Motor in High Word (W-sec.)
05-28 Accumulated Watt-hour for a Motor (W-hour)
05-29 Accumulated Watt-hour for a Motor in Low Word (kW-hour)
05-30 Accumulated Watt-hour for a Motor in High Word (kW-hour)

Default: 0.0

Settings Read only

- Pr.05-26–05-30 records the amount of power the motors consume. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set Pr.00-02 as 5 to return the accumulation record to 0.
- The accumulated total watts of the motor per second = Pr.05-27 x 65536 + Pr.05-26
  Example: when Pr.05-26 = 2548.1 and Pr.05-27 = 15.2, the accumulated total watts of the motor per second = 15.2 x 65536 + 2548.1 = 996147.2 + 2548.1 = 998695.3
- The accumulated total kilowatts of the motor per hour = Pr.05-30 x 65536 + Pr.05-29
  Example: when Pr.05-29 = 3361.4 and Pr.05-30 = 11.2, the accumulated total kilowatts of the motor per hour = 11.2 x 65536 + 3361.4 = 734003.2 + 3361.4 = 737364.6

05-31 Accumulated Motor Operation Time (Min.)

Default: 0

Settings 0–1439

05-32 Accumulated Motor Operation Time (Day)

Default: 0

Settings 0–65535

- Use Pr.05-31 and Pr.05-32 to record the motor operation time. To clear the operation time, set Pr.05-31 and Pr.05-32 as 00. An operation time shorter than 60 seconds is not recorded.

05-33 Induction Motor (IM) or Permanent Magnet Synchronous AC Motor (PM) Selection

Default: 0

Settings 0: Induction Motor
1: SPM
2: IPM

05-34 Full-load Current for a Permanent Magnet Synchronous AC Motor

Default: Depending on the model power

Settings 0–120% of the drive's rated current

05-35 Rated Power for a Permanent Magnet Synchronous AC Motor

Default: Depending on the motor power

Settings 0.00–655.35 kW

📖 Sets the rated power for the permanent magnet synchronous motor. The default is the drive's power value.

05-36 Rated Speed for a Permanent Magnet Synchronous Motor

Default: 2000

Settings 0–65535 rpm

05-37 Number of Poles for a Permanent Magnet Synchronous Motor

Default: 10

Settings 0–65535

05-39 Stator Resistance for a Permanent Magnet Synchronous Motor

Default: 0.000

Settings 0.000–65.535 Ω

05-40 Permanent Magnet Synchronous AC Motor Ld

Default: 0.00

Settings 0.00–655.35 mH

05-41 Permanent Magnet Synchronous AC Motor Lq

Default: 0.00

Settings 0.00–655.35 mH

05-42 PG Offset Angle for a Permanent Magnet Synchronous Motor

Default: 0

Settings 0.0–360.0°

📖 When you set Pr.05-00 as 4, the drive detects the offset angle and writes it into Pr.05-42.

05-43 Ke parameter for a Permanent Magnet Synchronous Motor

Default: 0

Settings 0–65535 V/krpm

05-64 Full-load Current for Induction Motor 3 (A)

Default: Depending on the model power

Settings 10–120% of the drive's rated current

Set this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example: The rated current for a 7.5 HP (5.5 kW) motor is 25 A. The default is 22.5 A.
The setting range is 2.5–30 A. (25 × 10 % = 2.5 A and 25 × 120 % = 30 A)

✎ 05-65 Rated Power for Induction Motor 3 (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

Sets the rated power for motor 3. The default is the drive's power value.

✎ 05-66 Rated Speed for Induction Motor 3 (rpm)

Default: Depending on the motor's number of poles

Settings 0–xxxxx rpm (Depending on the motor's number of poles)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

Sets the rated speed for the motor as indicated on the motor nameplate.

05-67 Number of Poles for Induction Motor 3

Default: 4

Settings 2–20

Sets the number of poles for the motor (must be an even number).

Set up Pr.01-54 and Pr.05-66 before setting up Pr.05-67 to make sure the motor operates normally.

05-68 No-load Current for Induction Motor 3 (A)

Default: Depending on the model power

Settings 0.00–Pr.05-64 default

The default is 40% of the motor's rated current.

05-69 Stator Resistance (Rs) for Induction Motor 3

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-70 Full-load Current for Induction Motor 4 (A)

Default: Depending on the model power

Settings 10–120% of the drive's rated current

- Set this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.
  Example: The rated current for a 7.5 HP (5.5 kW) motor is 25 A. The default is 22.5 A.
  The setting range is 2.5–30 A. (25 × 10 % = 2.5 A and 25 × 120 % = 30 A)

05-71 Rated Power for Induction Motor 4 (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

- Sets the rated power for motor4. The default is the drive's power value.

05-72 Rated Speed for Induction Motor 4 (rpm)

Default: Depending on the motor's number of poles

Settings 0–xxxxx rpm (Depending on the motor's number of poles)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

- Sets the rated speed for the motor as indicated on the motor nameplate.

05-73 Number of Poles for Induction Motor 4

Default: 4

Settings 2–20

- Sets the number of poles for the motor (must be an even number).
- Set up Pr.01-63 and Pr.05-72 before setting up Pr.05-73 to make sure the motor operates normally.

05-74 No-load Current for Induction Motor 4 (A)

Default: Depending on the model power

Settings 0.00–Pr.05-64 default

- The default is 40% of the motor's rated current.

05-75 Stator Resistance (Rs) for Induction Motor 4

Default: Depending on the model power

Settings 0.000–65.535 Ω

06 Protection Parameters (1)

✎ You can set this parameter during operation.

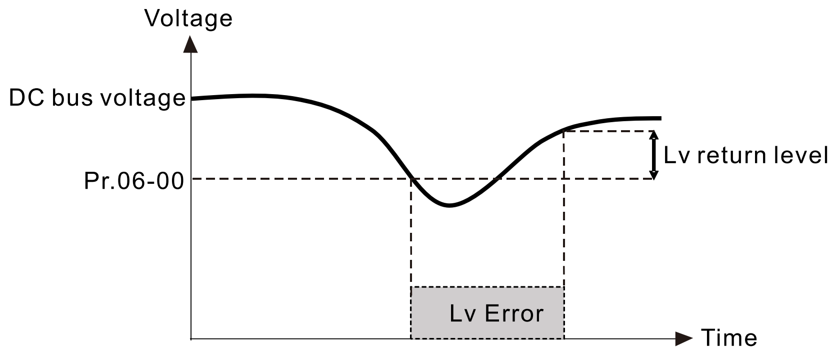
✎ 06-00 Low Voltage Level

Default: 180.0 / 360.0

Settings 115V / 230V models: 150.0–220.0 V_{DC}

460V models: 300.0–440.0 V_{DC}

- Sets the Low Voltage (Lv) level. When the DC bus voltage is lower than Pr.06-00, the drive stops output and the motor free runs to a stop.
- If the Lv fault is triggered during operation, the drive stops output and the motor free runs to a stop. There are three Lv faults, LvA (Lv during acceleration), Lvd (Lv during deceleration), and Lvn (Lv in constant speed) that are triggered according to the status of acceleration or deceleration. You must press RESET to clear the LV fault. The drive automatically restarts if you set to restart after momentary power loss (refer to Pr.07-06 Restart after Momentary Power Loss and Pr.07-07 Allowed Power Loss Duration for details).
- If the Lv fault is triggered when the drive is in STOP status, the drive displays LvS (Lv during stop), which is not recorded, and the drive restarts automatically when the input voltage is higher than the Lv level of 30 V (230V models) or 60 V (460V models).



✎ 06-01 Over-voltage Stall Prevention

Default: 380.0 / 760.0

Settings 0: Disabled

115V / 230V models: 0.0–390.0 V_{DC}

460V models: 0.0–780.0 V_{DC}

- Setting Pr.06-01 to 0.0 disables the over-voltage stall prevention function (connected with braking unit or braking resistor). Use this setting when braking units or resistors are connected to the drive.
- Setting Pr.06-01 to a value > 0 enables the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase deceleration time.
- When setting value exceeds the OV level (as shown in the table below), the OV stall function is deemed to be disabled.

Voltage	OV Stall		OV
	Default	Setting Range	Default (Read only)
230V models	380 V_{DC}	0.0~390.0 V_{DC}	410 V_{DC}
460V models	760 V_{DC}	0.0~780.0 V_{DC}	820 V_{DC}

📖 Related parameters:

- Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
- Pr.02-13 Multi-function Output 1 (Relay 1)
- Pr.02-16–Pr.02-17 Multi-function Output 2–3 (MO1, 2)
- Pr.06-02 Selection for Over-voltage Stall Prevention

✎ 06-02 Selection for Over-voltage Stall Prevention

Default: 0

Settings 0: Traditional over-voltage stall prevention
1: Smart over-voltage stall prevention
2: Traditional over-voltage and smart over-current stall prevention
3: Smart over-voltage and smart over-current stall prevention

📖 A comparison between traditional stall prevention and smart stall prevention:

Type	Over-voltage			Over-current		
	Description	Action	Parameter	Description	Action	Parameter
Traditional	Frequency maintains during deceleration	Deceleration stops	Pr.06-01	Frequency maintains during acceleration	Acceleration stops	Pr.06-03
				Frequency decreases at constant speed	Frequency gradually decreases	Pr.06-04
Smart	Frequency increases during acceleration / deceleration / constant speed	Frequency gradually increases	Pr.06-01	Frequency decreases during acceleration / deceleration	Frequency gradually decreases	Pr.06-03
				Frequency decreases at constant speed	Frequency gradually decreases	Pr.06-04

📖 Pr.06-02 (Selection for stall prevention) can be used with Pr.01-49 (Regenerative energy restriction control method), but Pr.06-02 cannot work with Pr.01-44 (Auto-acceleration and auto-deceleration setting).

📖 When Pr.06-02 or Pr.01-49 is enabled (setting value > 0), Pr.01-44 (Auto-acceleration and auto-deceleration setting) automatically disables (setting value = 0) and cannot be set; when Pr.01-44 is enabled (setting value > 0), Pr.06-02 and Pr.01-49 automatically disable and cannot be set.

📖 If you use smart over-voltage or smart over-current stall prevention for industries that require fast response, you can decrease the deceleration time when needed.

📖 When using smart over-voltage stall prevention, the drive decelerates to stop with the fastest deceleration time according to different working condition, rather than the first to fourth deceleration time (Pr. Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19).

📖 For 220V / 440V 160 kW models and above, the default for Pr.06-02 is automatically set to 1 (Smart over-voltage and traditional over-current stall prevention). If you need to set the deceleration time with Pr. Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19, set Pr.06-02 = 0.

📖 Related parameters:
Pr.01-12–01-19 Acceleration / Deceleration time 1–4
Pr.02-13 Multi-function output (Relay 1)

Pr.02-16–Pr.02-17 Multi-function Output (MO1, 2)

Pr.06-01 Over-voltage stall prevention

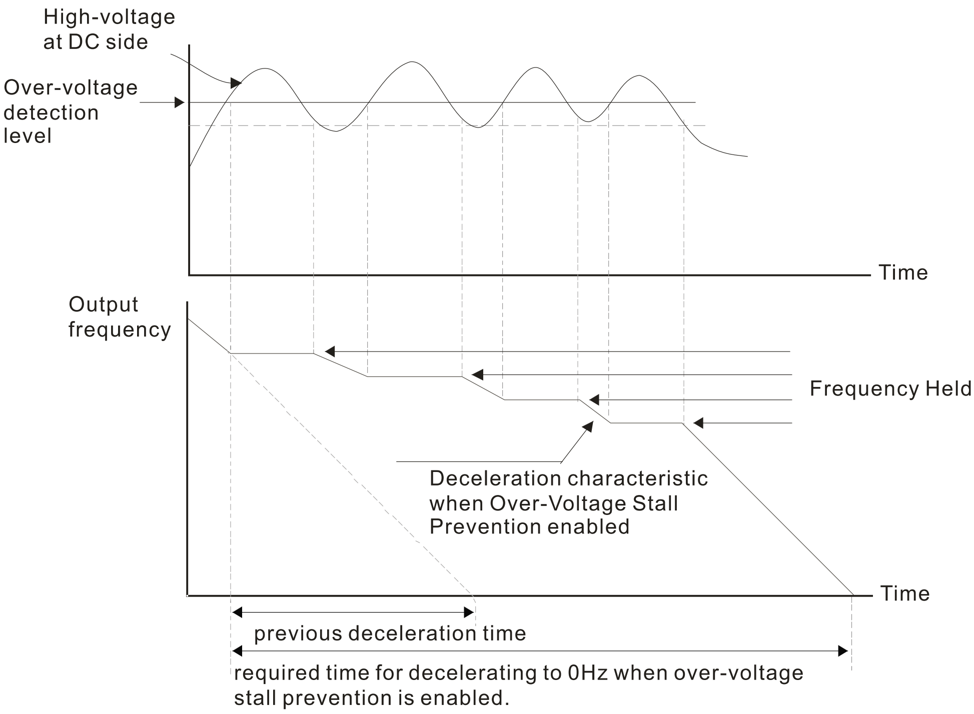
Pr.06-03 Over-current stall prevention during acceleration

Pr.06-04 Over-current stall prevention during operation

Pr.06-05 Acceleration / deceleration time selection for stall prevention at constant speed

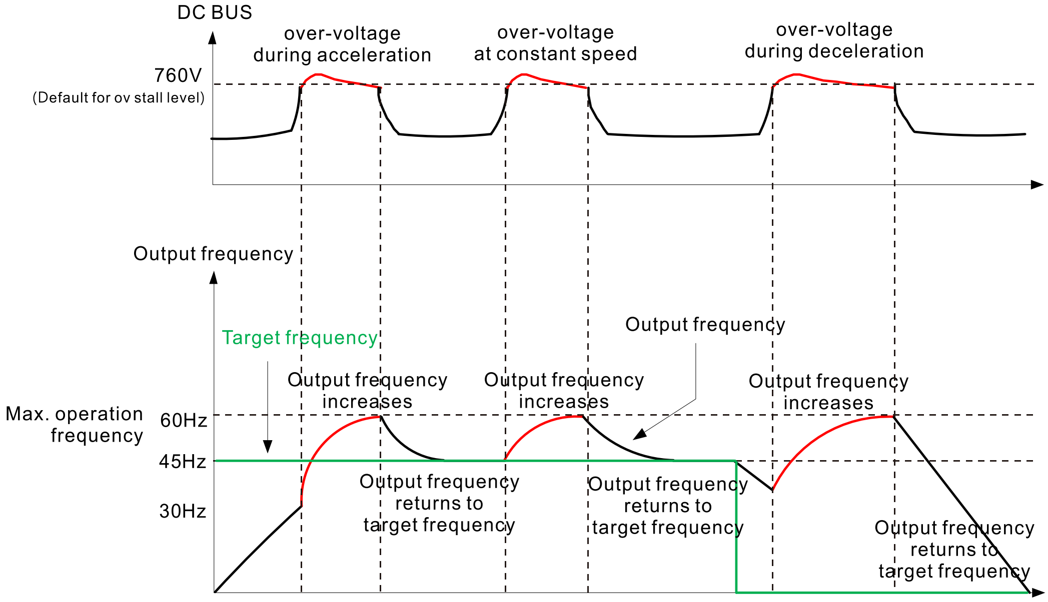
Traditional over-voltage stall prevention

- Used for uncertain load inertia. When it stops under normal load, the over-voltage does not occur during deceleration and fulfills the deceleration time setting. However, load regenerative inertia may occasionally increase and does not trip due to over-voltage when decelerating to stop. In this case, the drive automatically increases the deceleration time until it stops.
- Because of the motor load inertia, the motor may exceed the synchronous speed when the drive decelerates; in this case, the motor becomes generator. If the motor load inertia is larger, or the setting for drive's decelerating time is too small, the motor regenerates energy to the drive, and makes the DC bus voltage increase to the maximum allowable value. Thus, when traditional over-voltage stall prevention is enabled, the drive does not decelerate further and maintains the output frequency until the voltage drops below the setting value again.
- When the over-voltage stall prevention is enabled, the drive deceleration time is larger than the setting time.
- When there is a problem with the deceleration time, this function is disabled. See below for solution:
  1. Increase the deceleration time properly.
  2. Install a brake resistor (refer to Section 7-1 Brake Resistors and Brake Units Selection Chart for details) to dissipate the heat, that is, the electrical energy regenerating from the motor.



Smart over-voltage stall prevention

📖 Adopts closed-loop control and takes the setting for Pr.06-01 over-voltage stall prevention as target command during acceleration, deceleration and constant speed. When the DC bus voltage is higher than the stall prevention level, the controller increases the output frequency gradually according to closed-loop response until the DC bus voltage drops below the stall prevention level, and returns to target frequency based on the previous setting for deceleration time when the DC bus voltage is lower than the stall prevention level. If the DC bus voltage is still higher than the stall prevention level during the adjustment, the output frequency increases to the maximum operation frequency (Pr.01-00).



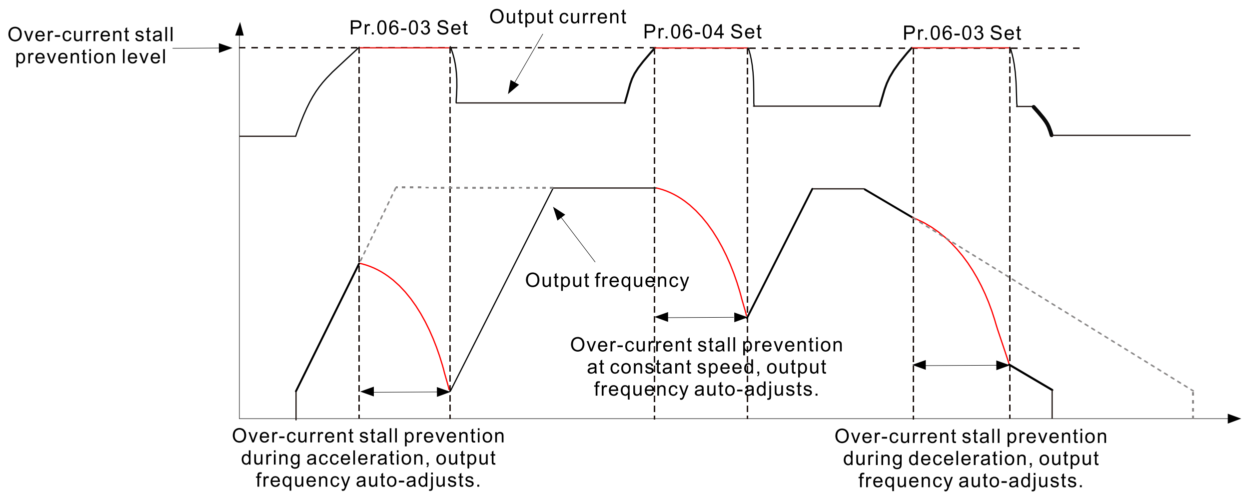
Traditional over-current stall prevention

📖 When the output current exceeds the over-current stall prevention level (Pr.06-03) during acceleration, the output frequency stops accelerating. The output frequency continues to accelerate when the output current drops below the stall prevention level to protect the drive.

📖 When the output current exceeds the over-current stall prevention during operation (Pr.06-04), the output frequency decreases according to the setting for acceleration / deceleration time selection for over-current stall prevention at constant speed (Pr.06-05). When the output current drops below the stall prevention level, the output frequency accelerates to the target frequency according to its previous set acceleration time.

Smart over-current stall prevention

📖 Adopts closed-loop control. It takes the setting for Pr.06-03 over-current stall prevention during acceleration as target command during acceleration and deceleration, and takes Pr.06-04 over-current stall prevention during operation as target command at constant speed. When the output current exceeds the stall prevention level, the controller decreases the output frequency gradually according to the closed-loop response until the current drops below the stall prevention level, and returns to target frequency based on the previous setting when the current is lower than the stall prevention level. If the output current is still higher than the stall prevention level during the adjustment, the output frequency decreases to the minimum output frequency at 0.5 Hz.



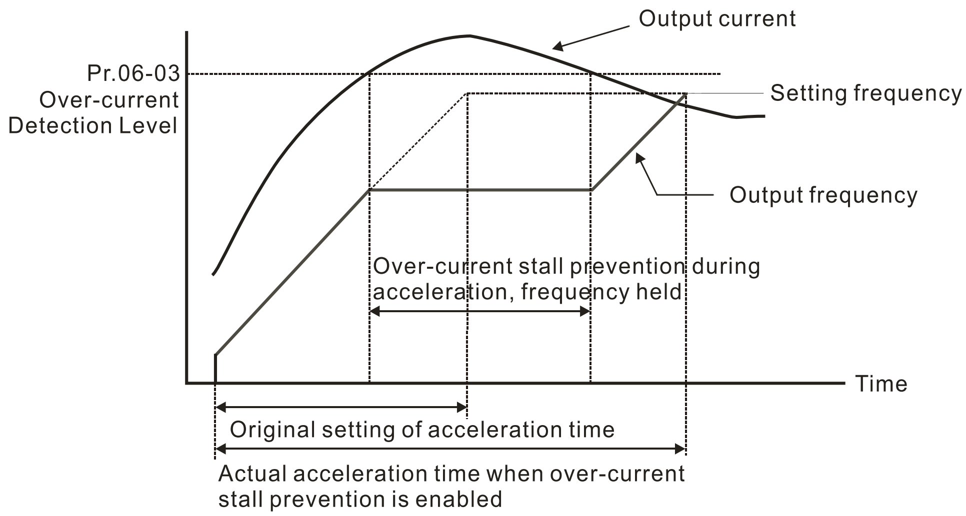
06-03 Over-current Stall Prevention during Acceleration

Default: 120 / 180

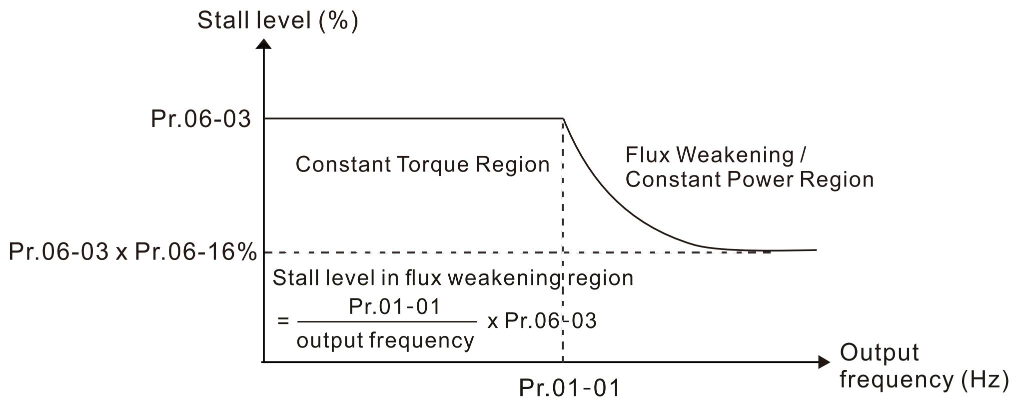
Settings Normal duty: 0–150% (100% corresponds to the rated current of the drive)

Heavy duty: 0–200% (100% corresponds to the rated current of the drive)

- If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may be too high during acceleration, and it may cause motor damage or trigger protection functions (OL or OC). Use this parameter to prevent these situations.
- During acceleration, the output current of the drive may increase abruptly and exceed the setting value of Pr.06-03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.



- Refer to Pr.06-16 for the stall level in flux weakening region. The protection curve:



- When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.
- When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the Pr.06-03 setting value.
- When you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.
  1. Increase the deceleration time to a suitable value.
  2. Set Pr.01-44 Auto Acceleration / Deceleration Setting to 1, 3 or 4 (auto-acceleration)
- Related parameters:
  - Pr.01-12, 01-14, 01-16, 01-18 Acceleration Time 1–4)
  - Pr.01-44 Auto Acceleration / Deceleration Setting
  - Pr.02-13 Multi-function Output 1 (Relay 1)
  - Pr.02-16–02-17 Multi-function Output 2–3 (MO1, 2)

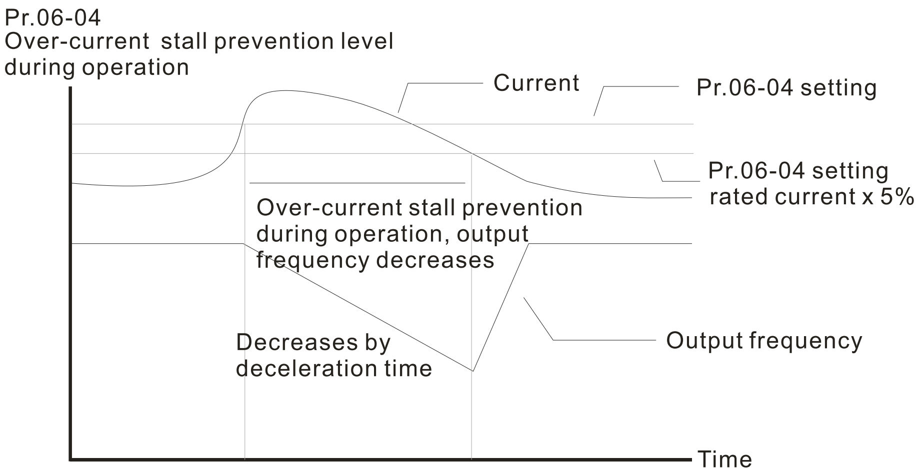
06-04 Over-current Stall Prevention during Operation

Default: 120 / 180

Settings Normal duty: 0–150% (100% corresponds to the rated current of the drive)

Heavy duty: 0–200% (100 % corresponds to the rated current of the drive)

- This is a protection for the drive to decrease output frequency automatically when the motor over-loads abruptly during constant motor operation.
- If the output current exceeds the setting value for Pr.06-04 when the drive is operating, the drive decreases output frequency (according to Pr.06-05) to prevent the motor from stalling. The lower limit for the over-current stall prevention is determined by the maximum value among 0.5 Hz, Pr.01-07 and Pr.01-11.
- If the output current is lower than the setting value for Pr.06-04, the drive accelerates (according to Pr.06-05) again to the setting frequency.



Over-current stall prevention at constant speed

06-05 Acceleration / Deceleration Time Selection for Stall Prevention at Constant Speed

Default: 0

Settings 0: By current acceleration / deceleration time
1: By the 1st acceleration / deceleration time
2: By the 2nd acceleration / deceleration time
3: By the 3rd acceleration / deceleration time
4: By the 4th acceleration/deceleration time
5: By auto-acceleration / auto-deceleration

📖 Sets the acceleration / deceleration time selection when stall prevention occurs at constant speed.

06-06 Over-torque Detection Selection (Motor 1)

Default: 0

Settings 0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

06-09 Over-torque Detection Selection (Motor 2)

Default: 0

Settings 0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

When you set Pr.06-06 and Pr.06-09 to 1 or 3, a warning message displays but there is no error record.
When you set Pr.06-06 and Pr.06-09 to 2 or 4, a warning message displays and there is an error record.

06-07 Over-torque Detection Level (Motor 1)

Default: 120

Settings 10–250% (100% corresponds to the rated current of the drive)

06-08 Over-torque Detection Time (Motor 1)

Default: 0.1

Settings 0.1–60.0 sec.

06-10 Over-torque Detection Level (Motor 2)

Default: 120

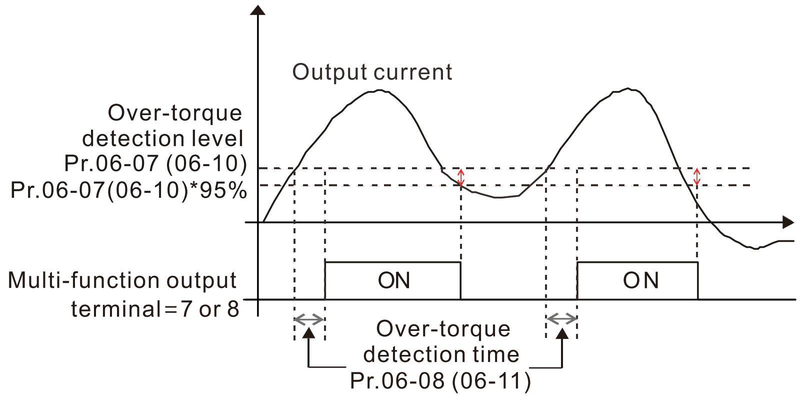
Settings 10–250% (100% corresponds to the rated current of the drive)

06-11 Over-torque Detection Time (Motor 2)

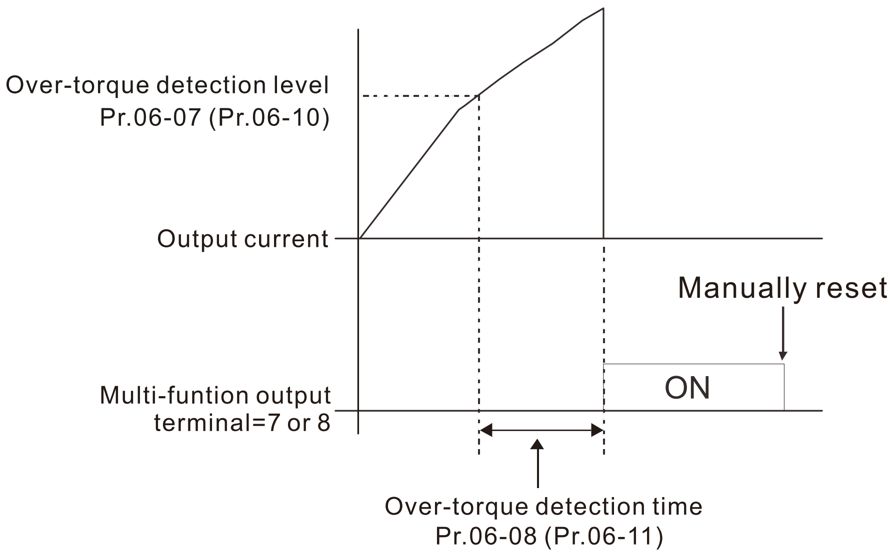
Default: 0.1

Settings 0.1–60.0 sec.

- When the output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and also exceeds the over-torque detection time (Pr.06-08 or Pr.06-11), the over-torque detection follows the setting of Pr.06-06 and Pr.06-09.
- When you set Pr.06-06 or Pr.06-09 to 1 or 3, an ot1 / ot2 warning displays while the drive keeps running. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



- When you set Pr.06-06 or Pr.06-09 to 2 or 4, an ot1 / ot2 warning displays and the drive stops running after over-torque detection. The drive keeps running after you manually reset it.



06-12 Current Limit

Default: 150

Settings 0–250% (100% corresponds to the rated current of the drive)

- Sets the maximum output current of the drive. Use Pr.11-17–Pr.11-20 to set the drive's output current limit.

06-13 Electronic Thermal Relay Selection 1 (Motor 1)
06-27 Electronic Thermal Relay Selection 2 (Motor 2)

Default: 2

Settings 0: Inverter motor (with external forced cooling)

1: Standard motor (motor with fan on the shaft)

2: Disable

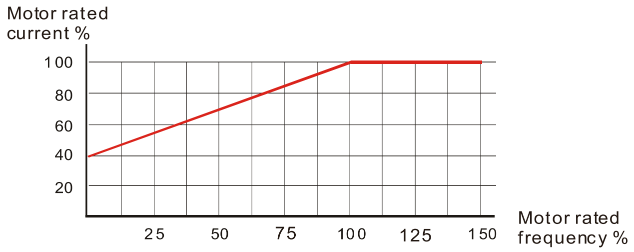
- Prevents self-cooled motor from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.
- Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between cooling capacity and motor speed. Therefore, the action of electronic thermal relays remains stable in low speed to ensure the load capability of the motor in low speed.
- Setting the parameter to 1 is suitable for standard motor (motor fan is fixed on the rotor shaft). For this kind of motor, the cooling capacity is lower in low speed; therefore, the action of an electronic thermal relay reduces the action time to ensure the life of motor.
- When the power is cycled frequently, if the power is switched OFF, the electronic thermal relay protection is reset; therefore, even setting the parameter to 0 or 1 may not protect the motor well. If there are several motors connected to one drive, install an electronic thermal relay in each motor.

06-14 Electronic Thermal Relay Action Time 1 (Motor 1)
06-28 Electronic Thermal Relay Action Time 2 (Motor 2)

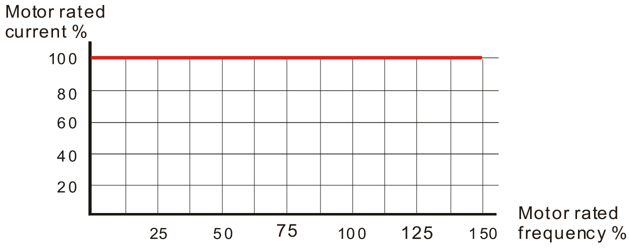
Default: 60.0

Settings 30.0–600.0 sec.

- Set the parameter to 150% of motor rated current and use with the setting of Pr.06-14 and 06-28 to prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL1 / EoL2", and the motor free runs to stop.
- Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



Motor cooling curve with shaft-fixed fan

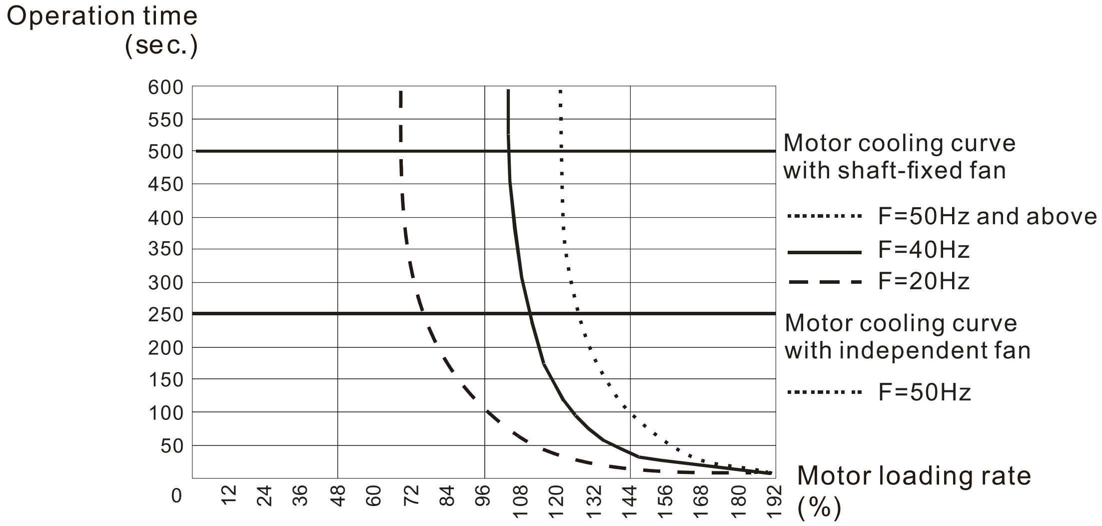


Motor cooling curve with independent fan

- The action of the electronic thermal relay depends on the settings for Pr.06-13 and Pr.06-27.
  1. Pr.06-13 or Pr.06-27 set to 0 (using inverter motor):
     When the output current of the drive is higher than 150% of motor rated current (refer to the motor cooling curve with independent fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14 or Pr.06-28.

2. Pr.06-13 or Pr.06-27 set to 1 (using standard motor):
   When the output current of the drive is higher than 150% of the motor rated current (refer to the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14 or Pr.06-28.

📖 The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following chart: (The motor cooling curve with shaft-fixed fan and motor cooling curve with independent fan F = 50 Hz are the same one.)



06-15 Temperature Level Ove-rheat (OH) Warning

Default: Depending on the model power

Settings 0.0–110.0 ºC

📖 Sets the drive's internal IGBT overheat warning level. When the temperature is higher than Pr.06-15 setting, the oH1 fault displays and the warning remains but it does not affect the drive operation.

📖 Use this parameter to check the motor overheat in advance in order to take precautionary measures to decrease the temperature and maintain the motor's normal operation.

📖 If you set the temperature 5ºC higher than the maximum setting value for Pr.06-15, IGBT overheating occurs and the drive stops. Refer to Chapter 14 oH1 fault descriptions for details.

06-16 Stall Prevention Limit Level (Weak Magnetic Area Current Stall Prevention Level)

Default: 100

Settings 0–100% (Refer to Pr.06-03, Pr.06-04)

📖 This parameter only works in VF, VFPG, and SVC control modes.

📖 Sets the over-current stall prevention level when the motor's operation frequency is larger than Pr.01-01 (base frequency).

Example: When Pr.06-03 = 150%, Pr.06-04 = 100% and Pr.06-16 = 80%.

When the motor's operation frequency is larger than Pr.01-01 (Motor 1 rated / base frequency), the lowest level of over-current stall prevention during acceleration is:

Pr.06-03 x Pr.06-16 = 150 x 80% = 120%. (Refer to Pr.06-03 diagram for the protection curve)

06-17	Fault Record 1
06-18	Fault Record 2
06-19	Fault Record 3
06-20	Fault Record 4
06-21	Fault Record 5
06-22	Fault Record 6

Default: 0

Display 0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
5: IGBT short circuit between upper bridge and lower bridge (occ)
6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage at constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage at constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
17: Heatsink overheating (oH2)
18: IGBT temperature detection failure (tH1o)
19: Capacitor hardware error (tH2o)
21: Drive over-load (oL)
22: Electronic thermal relay protection 1 (EoL1)
23: Electronic thermal relay protection 2 (EoL2)
24: Motor overheating (PTC / PT100) (oH3)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Under current (uC)
29: Limit error (LiT)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware failure (Hd0)
37: oc (over-current) hardware failure (Hd1)

40: Auto-tuning error (AUE)
41: PID loss ACI (AFE)
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)
44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
48: ACI loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External base block (bb)
52: Enter wrong password three times and locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)
58: Modbus transmission time-out (CE10)
61: Y-connection / Δ-connection switch error (ydc)
62: Deceleration energy backup error (dEb)
63: Over-slip (oSL)
65: Hardware error of PG card (PGF5)
72: STO loss (STL1)
76: Safe torque off (STo)
77: STO loss 2 (STL2)
78: STO loss 3 (STL3)
79: U-phase Over-current before run (Aoc)
80: V-phase Over-current before run (boc)
81: W-phase Over-current before run (coc)
82: U-phase output phase loss (oPL1)
83: V-phase output phase loss (oPL2)
84: W-phase output phase loss (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
101: CANopen guarding error (CGdE)
102: CANopen heartbeat error (CHbE)
104: CANopen bus off error (CbFE)
105: CANopen index error (CidE)
106: CANopen slave station setting error (CAdE)
107: CANopen memory error(CFrE)
111: InrCOM time-out error (ictE)
121: Internal communication error (CP20)
123: Internal communication error (CP22)
124: Internal communication error (CP30)

126: Internal communication error (CP32)
127: Firmware version error (CP33)
128: Over-torque 3 (ot3)
129: Over-torque 4 (ot4)
134: Electronic thermal relay 3 protection (EoL3)
135: Electronic thermal relay 4 protection (EoL4)
140: oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tuning error 1 (DC test stage) (AUE1)
143: Auto-tuning error 2 (High frequency test stage) (AUE2)
144: Auto-tuning error 3 (Rotary test stage) (AUE3)

- When the fault occurs and forces stopping, the fault is recorded in this parameter.
- During stop with low voltage Lv (LvS warning), there is no error record. During operation with mid-low voltage Lv (LvA, Lvd, Lvn error), there is a record.
- When dEb function is valid and enabled, the drive executes dEb and records fault code 62 to Pr.06-17–Pr.06-22 and Pr.14-70–Pr.14-73 simultaneously.

06-23 Fault Output Option 1
06-24 Fault Output Option 2
06-25 Fault Output Option 3
06-26 Fault Output Option 4

Default: 0

Settings 0–65535 (refer to bit table for fault code)

- Use these parameters with multi-function output terminal (set to 35–38) for the specific requirement. When the fault occurs, the corresponding terminals activate. Convert the binary value to decimal value before you enter the value for Pr.06-23–Pr.06-26.

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
0: No fault record							
1: Over-current during acceleration (ocA)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during constant speed (ocn)	●						
4: Ground fault (GFF)	●						
5: IGBT short circuit between upper bridge and lower bridge (occ)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
14: Low-voltage at stop (LvS)		●					
15: Phase loss protection (orP)		●					
16: IGBT overheating (oH1)			●				
17: Heatsink overheating (oH2)			●				
18: IGBT temperature detection failure (tH1o)			●				
21: Drive over-load (oL)			●				
22: Electronic thermal relay protection 1 (EoL1)			●				
23: Electronic thermal relay protection 2 (EoL2)			●				
24: Motor overheating (PTC / PT100) (oH3)			●				
26: Over-torque 1 (ot1)			●				
27: Over-torque 2 (ot2)			●				
28: Under current (uC)	●						
29: Limit error (LiT)						●	
31: EEPROM read error (cF2)				●			
33: U-phase error (cd1)				●			
34: V-phase error (cd2)				●			
35: W-phase error (cd3)				●			
36: cc (current clamp) hardware failure (Hd0)				●			
37: oc (over-current) hardware failure (Hd1)				●			
40: Auto-tuning error (AUE)				●			
41: PID loss ACI (AFE)					●		
42: PG feedback error (PGF1)					●		
43: PG feedback loss (PGF2)					●		
44: PG feedback stall (PGF3)					●		
45: PG slip error (PGF4)					●		
48: ACI loss (ACE)					●		
49: External fault input (EF)						●	
50: Emergency stop (EF1)						●	
51: External Base Block (bb)						●	
52: Enter wrong password three times and locked (Pcod)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (CE4)							●
58: Modbus transmission time-out (CE10)							●
61: Y-connection/Δ-connection switch error (ydc)						●	
62: Deceleration Energy Backup Error (dEb)		●					
63: Over-slip (oSL)						●	
65: Hardware error of PG card (PGF5)					●		
72: STO loss (STL1)				●			
76: Safe Torque Off (STo)				●			
77: STO loss 2 (STL2)				●			

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
78: STO loss 3 (STL3)				●			
79: U-phase over-current before run (Aoc)	●						
80: V-phase over-current before run (boc)	●						
81: W-phase over-current before run (coc)	●						
82: U-phase output phase loss (oPL1)	●						
83: V-phase output phase loss (oPL2)	●						
84: W-phase output phase loss (oPL3)	●						
87: Low frequency overload protection (oL3)			●				
89: Rotor position detection error (roPd)					●		
101: CANopen guarding error (CGdE)							●
102: CANopen heartbeat error (CHbE)							●
104: CANopen bus off error (CbFE)							●
105: CANopen index error (CIdE)							●
106: CANopen slave station setting error (CAdE)							●
107: CANopen memory error (CFrE)							●
111: InrCOM time-out error (ictE)							●
121: Internal communication error (CP20)							●
123: Internal communication error (CP22)							●
124: Internal communication error (CP30)							●
126: Internal communication error (CP32)							●
127: Firmware version error (CP33)				●			
128: Over-torque 3 (ot3)			●				
129: Over-torque 4 (ot4)			●				
134: Electronic thermal relay 3 protection (EoL3)			●				
135: Electronic thermal relay 4 protection (EoL4)			●				
140: oc hardware error (Hd6)				●			
141: GFF occurs before run (b4GFF)				●			
142: Auto-tuning error 1 (DC test stage) (AUE1)				●			
143: Auto-tuning error 2 (High frequency test stage) (AUE2)				●			
144: Auto-tuning error 3 (Rotary test stage) (AUE3)				●			

06-29 PTC Detection Selection

Default: 0

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning

Sets the operation mode of a drive after you set Pr.06-29 to define PTC detection.

06-30 PTC Level

Default: 50.0

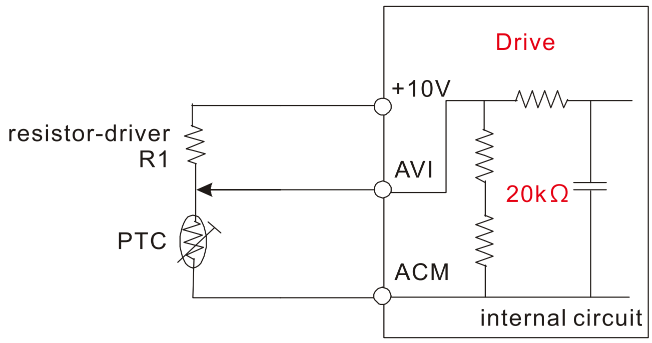
Settings 0.0–100.0%

- Sets AVI / ACI analog input function Pr.03-00–03-01 to 6 [Positive temperature coefficient (PTC) thermistor input value].
- Use this to set the PTC level; the corresponding value for 100% is the analog input maximum value.
- When using the AVI terminal, you must set Pr.03-28 to 0 and switch AVI voltage to 0–10 V. At this time, the AVI input impedance is 20 KΩ.
- When the temperature reaches to the set protection level, the motor acts according to the settings for Pr.06-29 and displays warning “oH3” (if Pr.06-29 = 1–3). When the temperature is lower than the set protection level, you can press RESET key to clear the fault.
- The PTC uses the AVI-input and is connected via resistor-divider as shown below:

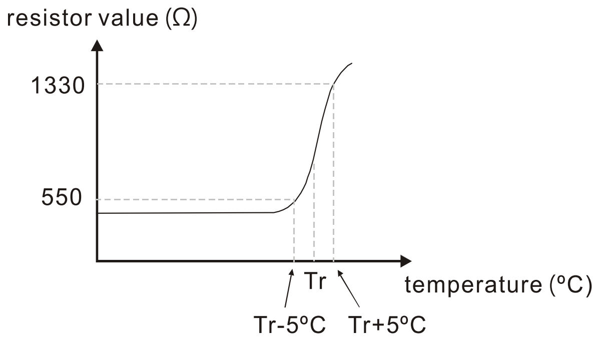
1. The voltage between +10V to ACM: lies within10V–11V.
2. The impedance for AVI is around 20K Ω. Recommended value for resistor-divider 1K–10KΩ.
3. Please contact your motor dealer for the curve of temperature and resistance value for PTC.

   Protection level (Pr.06-30) = V + 10 × (RPTC//20K) / [R1 + (RPTC//20K)]

   - V+10: voltage between +10V-ACM, Range 10.4~11.2V_{DC};
   - RPTC: motor PTC overheat protection level;
   - 20KΩ: is AVI input impedance;
   - R1: resistor-divider (recommended value: 1–10kΩ)



Take the standard PTC thermistor as example: if protection level is 1330Ω, the voltage between +10V-ACM is 10.5V and resistor-divider R1 is 4.4kΩ.



Refer to following calculation for Pr.06-30 setting:

1330//20000 = (1330*20000) / (1330+20000) = 1247.07

10.5 × 1247.07 / (4400+1247.07) = 2.32(V) ≒ 2.3(V)

Pr.06-30 should be set to 2.3/10V*% = 23%

06-31 Frequency Command for Malfunction

Default: Read only

Settings 0.00–599.00 Hz

📖 When a malfunction occurs, check the current Frequency command. If it happens again, it overwrites the previous record.

06-32 Output Frequency at Malfunction

Default: Read only

Settings 0.00–599.00 Hz

📖 When a malfunction occurs, check the current output frequency. If it happens again, it overwrites the previous record.

06-33 Output Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

📖 When a malfunction occurs, check the current output voltage. If it happens again, it overwrites the previous record.

06-34 DC bus Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

📖 When a malfunction occurs, check the current DC voltage. If it happens again, it overwrites the previous record.

06-35 Output Current at Malfunction

Default: Read only

Settings 0.00–655.35 Amp

📖 When a malfunction occurs, check the current output current. If it happens again, it overwrites the previous record.

06-36 IGBT Temperature at Malfunction

Default: Read only

Settings -3276.7–3276.7°C

📖 When a malfunction occurs, check the current IGBT temperature. If it happens again, it overwrites the previous record.

06-38 Motor Speed in rpm at Malfunction

Default: Read only

Settings -32767–32767 rpm

📖 When a malfunction occurs, check the current motor speed in rpm. If it happens again, it overwrites the previous record.

06-39 Torque Command at Malfunction

Default: Read only

Settings -32767–32767%

- When a malfunction occurs, check the current torque command. If it happens again, it overwrites the previous record.

06-40 Status of the Multi-function Input Terminal at Malfunction

Default: Read only

Settings 0000h–FFFFh

06-41 Status of the Multi-function Output Terminal at Malfunction

Default: Read only

Settings 0000h–FFFFh

- When a malfunction occurs, check the current status of the multi-function input/output terminals. If it happens again, it overwrites the previous record.

06-42 Drive Status at Malfunction

Default: Read only

Settings 0000h–FFFFh

- When a malfunction occurs, check the current drive status (communication address 2101H). If it happens again, it overwrites the previous record.

06-44 STO Latch Selection

Default: 0

Settings 0: STO Latch
1: STO no Latch

- Pr.06-44 = 0: STO Alarm Latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.
- Pr.06-44 = 1: STO Alarm no Latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.
- All of the STL1–STL3 errors are "Alarm Latch" mode (in STL1–STL3 mode, the Pr.06-44 function is not effective).

06-45 Output Phase Loss Detection Action (OPHL)

Default: 3

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning

- The OPHL protect function is active when the setting is not 3.

06-46 Detection Time for Output Phase Loss

Default: 0.500

Settings 0.000–65.535 sec.

06-47 Current Detection Level for Output Phase Loss

Default: 1.00

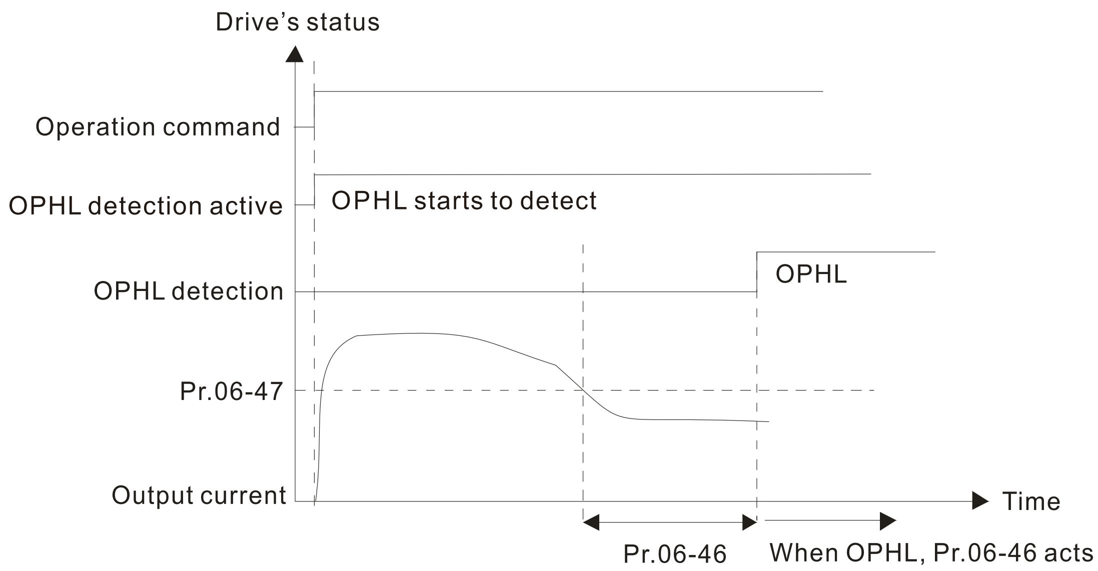
Settings 0.00–100.00%

06-48 DC Brake Time for Output Phase Loss

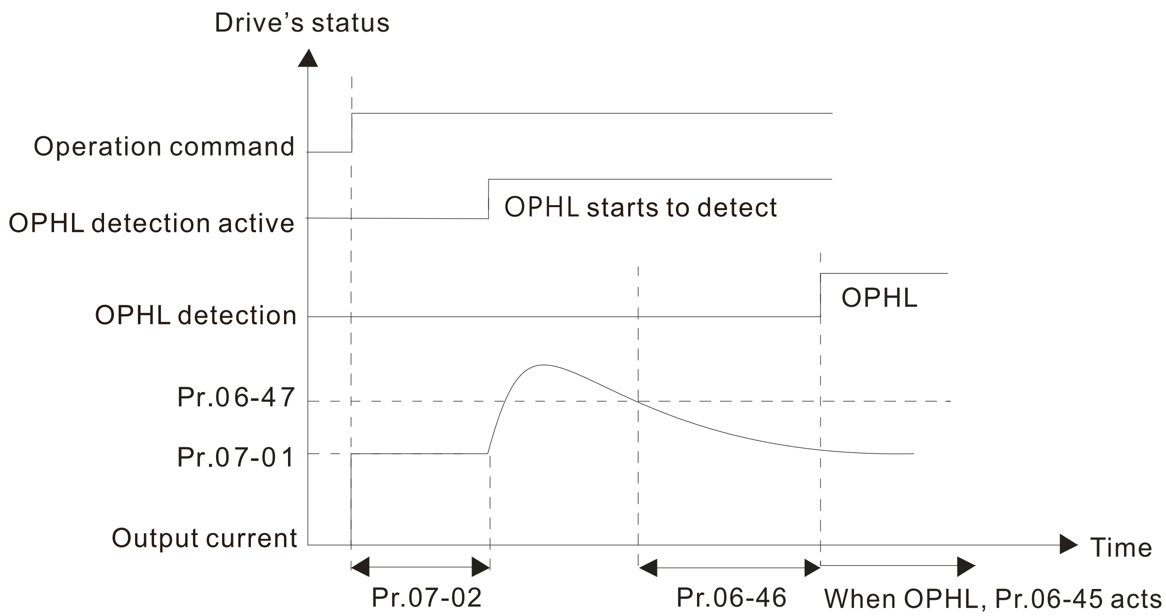
Default: 0.000

Settings 0.000–65.535 sec.

- Setting Pr.06-48 to 0 disables the OPHL detection function.
- The statuses of output phase loss detection are as following:
  - Status 1: The drive is in operation
    When any phase is less than the Pr.06-47 setting, and exceeds the Pr.06-46 setting time, the drive executes according to the Pr.06-45 setting.

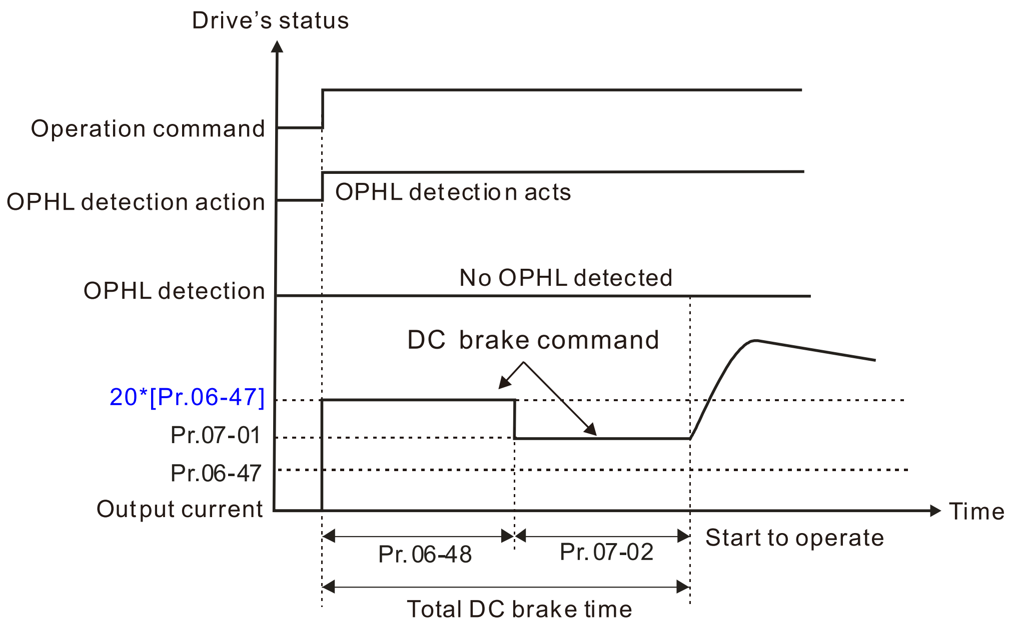


  - Status 2: The drive is in STOP; Pr.06-48 = 0; Pr.07-02 ≠ 0
    After the drive starts, the DC brake operates according to Pr.07-01 and Pr.07-02. During this period, OPHL detection is not active. After the DC brake action is completed, the drive starts to run, and enables the OPHL protection as mentioned above for status 1.

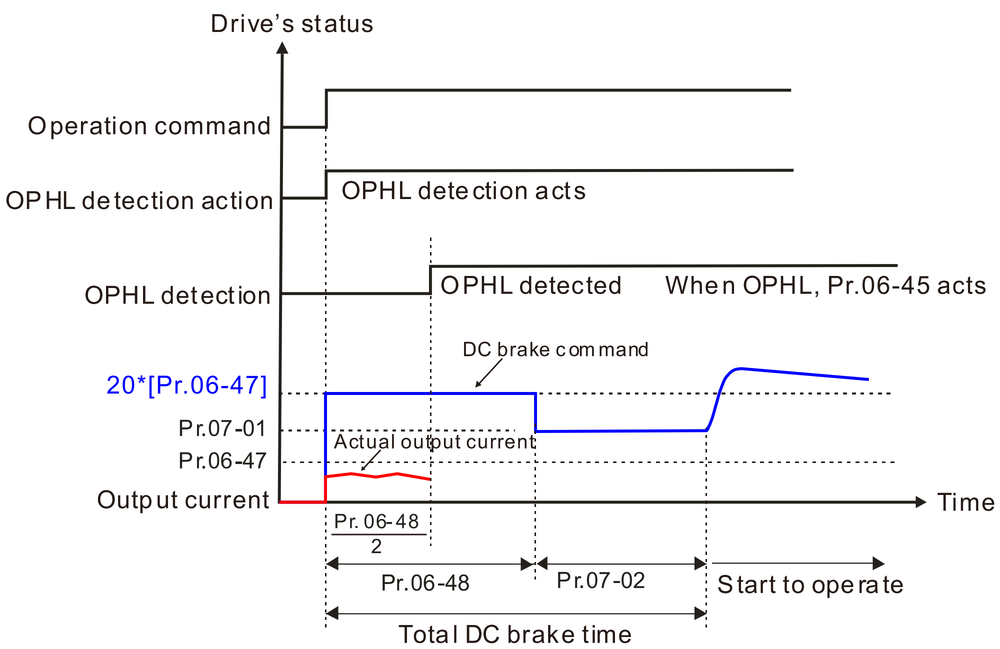


- Status 3: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 ≠ 0
  When the drive starts, it executes Pr.06-48 first, and then executes Pr.07-02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the Pr.06-47 setting value in Pr.06-48 setting time; the other is the Pr.07-01 setting value in Pr.07-02 setting time. In this period.

Status 3-1: Pr.06-48 ≠ 0, Pr.07-02 ≠ 0 (No OPHL detected before operation)



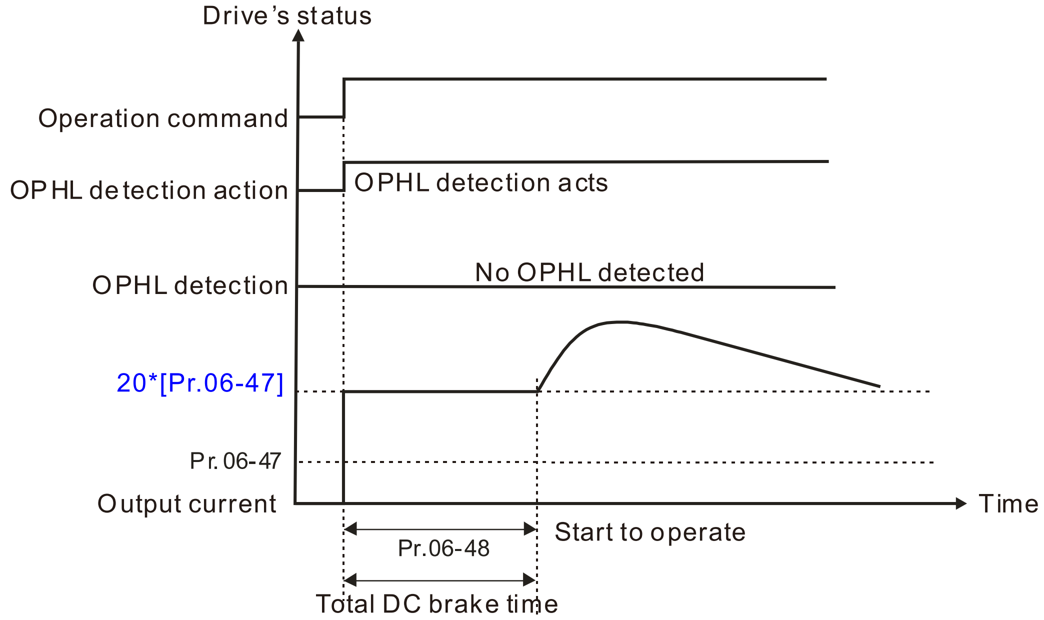
Status 3-2: Pr.06-48 ≠ 0, Pr.07-20 ≠ 0 (OPHL detected before operation)
In this period, if an OPHL occurs within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.



📖 Status 4: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 = 0

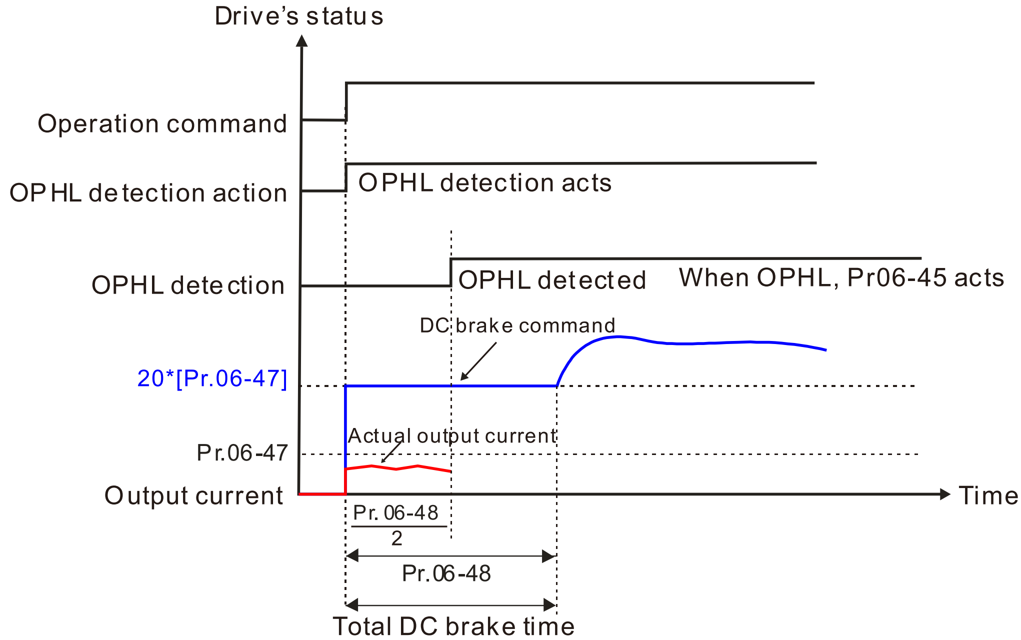
When the drive starts, it executes Pr.06-48 as the DC brake. The DC brake current level is 20 times the Pr.06-47 setting value.

Status 4-1: Pr.06-48 ≠ 0, Pr.07-02 = 0 (No OPHL detected before operation)



Status 4-2: Pr.06-48 ≠ 0, Pr.07-02 = 0 (OPHL detected before operation)

In this period, if an OPHL occurs within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.



06-49 LvX Auto-reset

Default: 0

Settings 0: Disable

1: Enable

06-53 Treatment for Phase Loss Protection (OrP)

Default: 0

Settings 0: Fault and ramp to stop
1: Fault and coast to stop

The drive executes the input phase loss protection according to Pr.06-53.

06-55 Derating Protection

Default: 0

Settings 0: Constant rated current and limit carrier wave by load current and temperature
1: Constant carrier frequency and limit load current by setting carrier wave
2: Constant rated current (same as setting 0), but close current limit

Allowable maximum output frequency and the minimum carrier wave limit in control mode:
For VF, SVC, VFPG modes: Maximum operation frequency (Pr.01-00) x 10 minimum sampling point limit
For FOCPG, FOC Sensorless modes: Maximum operation frequency (Pr.01-00) x 20 minimum sampling point limit

Setting 0:

- Actual over-current stall prevention level = derating ratio × over-current stall prevention level (Pr.06-03 and Pr.06-04).
- Rated current derating level: derating ratio × rated current (Pr.00-01).
- When the operating point is greater than the derating curve, the carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and time.
- Applicable conditions: If overloads are not frequent, and the concern is only about the carrier frequency operating with the rated current for a long time, and changes to the carrier wave due to short overload are acceptable, set to 0.
- Take VFD9A0MH43ANSAA normal duty for example: ambient temperature 50°C, UL Open Type, and independent installation. When the carrier frequency is set to 10 kHz, it corresponds to 75% of the derating ratio. When the output current is higher than the value, it automatically decreases the carrier frequency according to the ambient temperature, output current and overload time. At this time, the over-current stall prevention level is 150%.

Setting 1:

- Actual over-current stall prevention level = derating ratio × over-current stall prevention level (Pr.06-03 and Pr.06-04).
- When the operating point is greater than the derating curve 1, the carrier frequency (Fc) output by the drive is fixed to the default value.
- Applicable conditions: Select this mode if the change of carrier frequency and motor noise caused by ambient temperature and frequent overload are not acceptable. Refer to Pr.00-17.
- Take VFD9A0MH43ANSAA normal duty for example: ambient temperature 50°C, UL Open Type, and independent installation. When the carrier frequency is set to 10 kHz, it

corresponds to 75% of the derating ratio. When the output current is higher than the value, the carrier frequency will not be reduced by this, but if the overload continues for a long time, the oH1 fault (IGBT overheating) or oL fault (the inverter is overloaded) will be triggered due to the IGBT temperature rise, and the motor will eventually stop.

- The oL protection executes when the current is 120% × 75% = 90% for one minute; therefore, it must operate by the curve to keep the carrier frequency.

📖 Setting 2:

- Actual over-current stall prevention level = derating ratio × over-current stall prevention level (Pr.06-03 and Pr.06-04).
- Rated current derating level: derating ratio × rated current (Pr.00-01).
- The protection method and action are set to 0, but this disables the current limit when output current is the derating ratio x 120% of output current in normal load, and derating ratio x 180% of output current in light load.
  The advantage: it can provide a higher starting output current (Pr.06-55 = 0) when the carrier frequency (Pr.00-17) setting is higher than the default value.
  The disadvantage: the carrier frequency derates easily when it overloads.
- For example: when Pr.06-55 = 0 or 1, the over-current stall prevention level = Ratio × Pr.06-03. When Pr.06-55 = 2, the over-current stall prevention level = Pr.06-03.

📖 Use with the settings for Pr.00-16 and Pr.00-17.

📖 The ambient temperature also affects the derating; refer to Section 9-6 Derating for Ambient Temperature, Altitude and Carrier Frequency.

Example:

Take VFD9A0MH43ANSAA in normal duty for example: ambient temperature 50ºC, UL open-type, and independent installation. When the carrier frequency is set to 10 kHz, it corresponds to 75% of the rated output current. The ambient temperature 60ºC corresponds to 75% * 75% of the rated output current.

06-56 PT100 Voltage Level 1

Default: 5.000

Settings 0.000–10.000 V

06-57 PT100 Voltage Level 2

Default: 7.000

Settings 0.000–10.000 V

📖 Condition settings: Pr.06-57 > Pr.06-56.

06-58 PT100 Level 1 Frequency Protection

Default: 0.00

Settings 0.00–599.00 Hz

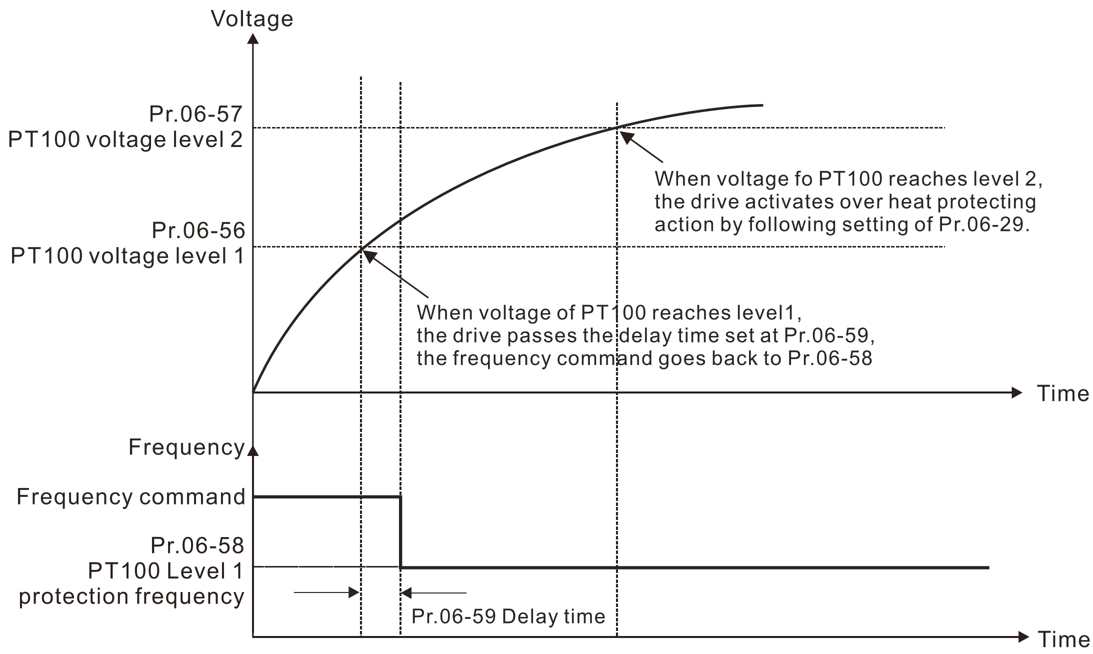
06-59 PT100 activation level 1 protection frequency delay time

Default: 60

Settings 0–6000 sec.

📖 PT100 operation instructions

1. Use voltage type analog input (AVI, ACI voltage 0–10 V) and select PT100 mode.
2. Select one of the voltage type analog inputs below:
   (a) Pr.03-00 =11
   (b) Pr.03-01 = 11 and Pr.03-29 = 1
3. When selecting Pr.03-01 = 11 and Pr.03-29 = 1, you must switch AFM to 0–10 V.
4. The AFM outputs constant voltage or current, then Pr.03-20 = 23. You must switch ACM to 0–20 mA, and set AFM output level to 45% (Pr.03-32 = 45%) of 20 mA = 9 mA.
5. Use Pr.03-32 to adjust the constant voltage or constant current of the AFM output; the setting range is 0–100.00%.
6. There are two types of action levels for PT100. The diagram below shows the PT100 protecting action.



📖 When Pr.06-58 = 0.00 Hz, PT100 function is disabled.

Example:

When using PT100, if the motor temperature is higher than 135°C (275°F), the drive starts to count the delay time for auto-deceleration (Pr.06-59). The drive decreases the motor frequency to the setting for Pr.06-58 when it reaches the delay time count value. The drive operates at the frequency set for Pr.06-58 until the motor temperature is lower than 135°C (275°F). If the motor temperature is higher than 150°C (302°F), the drive automatically decelerates to STOP and displays the warning "OH3".

Set up process:

1. Switch AFM to 0-20 mA on the control board.
2. Wiring:
   Connect external terminal AFM to "+"
   Connect external terminal ACM to "-"
   Connect AFM and AVI to "short-circuit"
3. Pr.03-00 = 11, Pr.03-20 = 23, Pr.03-32 = 45% (9 mA)

4. Refer to the RTD temperature and resistance comparison table
   Temperature = 135°C, resistance = 151.71 Ω, input current: 9 mA, voltage: about 1.37 V_{DC}
   Temperature = 150°C, resistance = 157.33 Ω, input current: 9 mA, voltage: about 1.42 V_{DC}
5. When the RTD temperature > 135°C, the drive decelerates to the specified operation frequency automatically. Then, Pr.06-56 = 1.37 and Pr.06-58 = 10 Hz. When Pr.06-58 = 0, it disables the specified operation frequency.
6. When RTD temperature > 150°C, the drive outputs a fault, decelerates to STOP, and displays the warning "OH3". Then, Pr.06-57 = 1.42 and Pr.06-29 = 1 (fault and ramp to stop).

06-60 Software Detection GFF Current Level

Default: 60.0

Settings 0.0–6553.5%

06-61 Software Detection GFF Filter Time

Default: 0.10

Settings 0.00–655.35 sec.

When the drive detects that the unbalanced three-phase output current is higher than the setting for Pr.06-60, GFF protection activates. The drive then stops output.

06-63 Operation Time of Fault Record 1 (Day)
06-65 Operation Time of Fault Record 2 (Day)
06-67 Operation Time of Fault Record 3 (Day)
06-69 Operation Time of Fault Record 4 (Day)
06-90 Operation Time of Fault Record 5 (Day)
06-92 Operation Time of Fault Record 6 (Day)

Default: Read only

Settings 0–65535 days

06-64 Operation Time of Fault Record 1 (Min.)
06-66 Operation Time of Fault Record 2 (Min.)
06-68 Operation Time of Fault Record 3 (Min.)
06-70 Operation Time of Fault Record 4 (Min.)
06-91 Operation Time of Fault Record 5 (Min.)
06-93 Operation Time of Fault Record 6 (Min.)

Default: Read only

Settings 0–1439 min.

If there is any malfunction when the drive operates, Pr.06-17–06-22 records the malfunctions, and Pr.06-63–06-70 records the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.

Example:

The first error: ocA occurs after motor drive operates for 1000 minutes.

The second error: ocd occurs after another 1000 minutes.

The third error: ocn occurs after another 1000 minutes.

The fourth error: ocA occurs after another 1000 minutes.

The fifth error: ocd occurs after another 1000 minutes.

The sixth error: ocn occurs after another 1000 minutes.

Then Pr.06-17–06-22 and Pr.06-63–06-70 are recorded as follows:

	1st fault	2nd fault	3rd fault	4th fault	5th fault	6th fault
Pr.06-17	ocA	ocd	ocn	ocA	ocd	ocn
Pr.06-18	0	ocA	ocd	ocn	ocA	ocd
Pr.06-19	0	0	ocA	ocd	ocn	ocA
Pr.06-20	0	0	0	ocA	ocd	ocn
Pr.06-21	0	0	0	0	ocA	ocd
Pr.06-22	0	0	0	0	0	ocA
Pr.06-63	1000	560	120	1120	680	240
Pr.06-64	0	1	2	2	3	4
Pr.06-65	0	1000	560	120	1120	680
Pr.06-66	0	0	1	2	2	3
Pr.06-67	0	0	1000	560	120	1120
Pr.06-68	0	0	0	1	2	2
Pr.06-69	0	0	0	1000	560	120
Pr.06-70	0	0	0	0	1	2

※ By examining the time record, you can see that that the last fault (Pr.06-17) happened after the drive ran for 4 days and 240 minutes.

06-71 Low Current Setting Level

Default: 0.0

Settings 0.0–100.0%

06-72 Low Current Detection Time

Default: 0.00

Settings 0.00–360.00 sec.

06-73 Low Current Action

Default: 0

Settings 0: No function

1: Fault and coast to stop

2: Fault and ramp to stop by the second deceleration time

3: Warn and continue operation

- The drive operates according to the setting for Pr.06-73 when the output current is lower than the setting for Pr.06-71 and when the time of the low current exceeds the detection time for Pr.06-72. Use this parameter with the external multi-function output terminal 44 (for low current output).
- The low current detection function does not execute when drive is in sleep or standby status.

07 Special Parameters

✍ You can set this parameter during operation.

✍ 07-00 Software brake chopper action level

Default: 370.0 / 740.0

Settings 115V / 230V models: 350.0–450.0 V_{DC}

460V models: 700.0–900.0 V_{DC}

- Sets the brake transistor level for the DC bus voltage. Choose a suitable brake resistor to achieve the best deceleration. Refer to Chapter 7 Optional Accessories for information about brake resistors.

✍ 07-01 DC Brake Current Level

Default: 0

Settings 0–100%

- Sets the level of the DC brake current output to the motor during start-up and stop. When you set the DC brake current percentage, the rated current is regarded as 100%. Start with a low DC brake current level, and increase it slowly until the proper brake torque is reached. However, to avoid burning the motor, the DC brake current can NOT exceed the rated current. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

✍ 07-02 DC Brake Time at Start-up

Default: 0.0

Settings 0.0–60.0 sec.

- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. If you use the drive with the motor rotating, it may cause motor damage or trigger drive protection due to over-current. This parameter outputs DC current, generating torque to force the motor stop to get a stable start before motor operation. This parameter determines the duration of the DC brake current output to the motor when the drive starts up. Setting this parameter to 0.0 disables the DC brake at start-up.

✍ 07-03 DC Brake Time at STOP

Default: 0.0

Settings 0.0–60.0 sec.

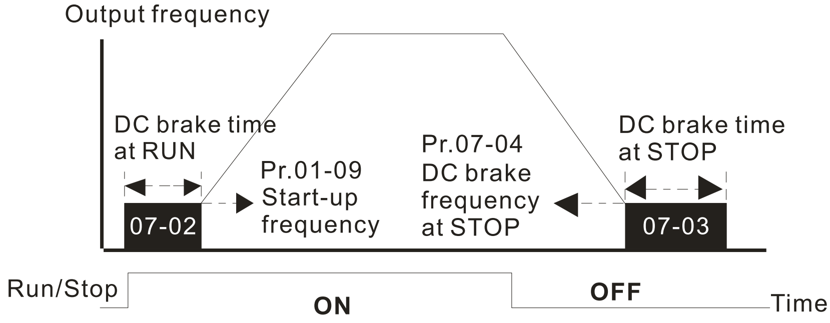
- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. This parameter outputs DC current, generating torque to force the drive stop after the drive stops output to make sure that the motor stops.
- This parameter determines the duration of the DC Brake current output to the motor when braking. To enable DC brake at STOP, set Pr.00-22 (Stop Method) to 0 (ramp to stop).
- Related parameters:
  - Pr.00-22 Stop Method
  - Pr.07-04 DC Brake Frequency at Start

07-04 DC Brake Frequency at STOP

Default: 0.00

Settings 0.00–599.00 Hz

- This parameter determines the start frequency of the DC brake before the drive ramps to stop. When this setting is less than Pr.01-09 (Start-up Frequency), the start frequency of the DC brake starts from the minimum frequency.



DC Brake Output Timing Diagram

- Use the DC brake before running the motor when the load is movable at stop, such as with fans and pumps. The motor is in free operating status and in unknown rotation direction before the drive starts up. Execute the DC brake before you start the motor.
- Use DC Brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.

07-05 Voltage Increasing Gain

Default: 100

Settings 1–200%

- When using speed tracking, adjust Pr.07-05 to slow down the increasing voltage gain if there are errors such as oL or oc; however, the speed tracking time will be longer.

07-06 Restart after Momentary Power Loss

Default: 0

Settings 0: Stop operation
1: Speed tracking by the speed before the power loss
2: Speed tracking by the minimum output frequency

- Determines the operation mode when the drive restarts from a momentary power loss.
- The power system connected to the drive may power off momentarily for many reasons. This function allows the drive to keep outputting after the drive is repowered and does not cause the drive to stop.
- 1: Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.
- 2: Frequency tracking starts from the minimum output frequency and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is little inertia and large resistance.

- In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.

✔ 07-07 Allowed Power Loss Duration

Default: 2.0

Settings 0.0–20.0 sec.

- Determines the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output.
- Pr.07-06 is valid when the maximum allowable power loss time is ≤ 20 seconds and the AC motor drive displays "LU". If the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤ 20 seconds, the operation mode set in Pr.07-06 does not execute.

✔ 07-08 Base Block Time

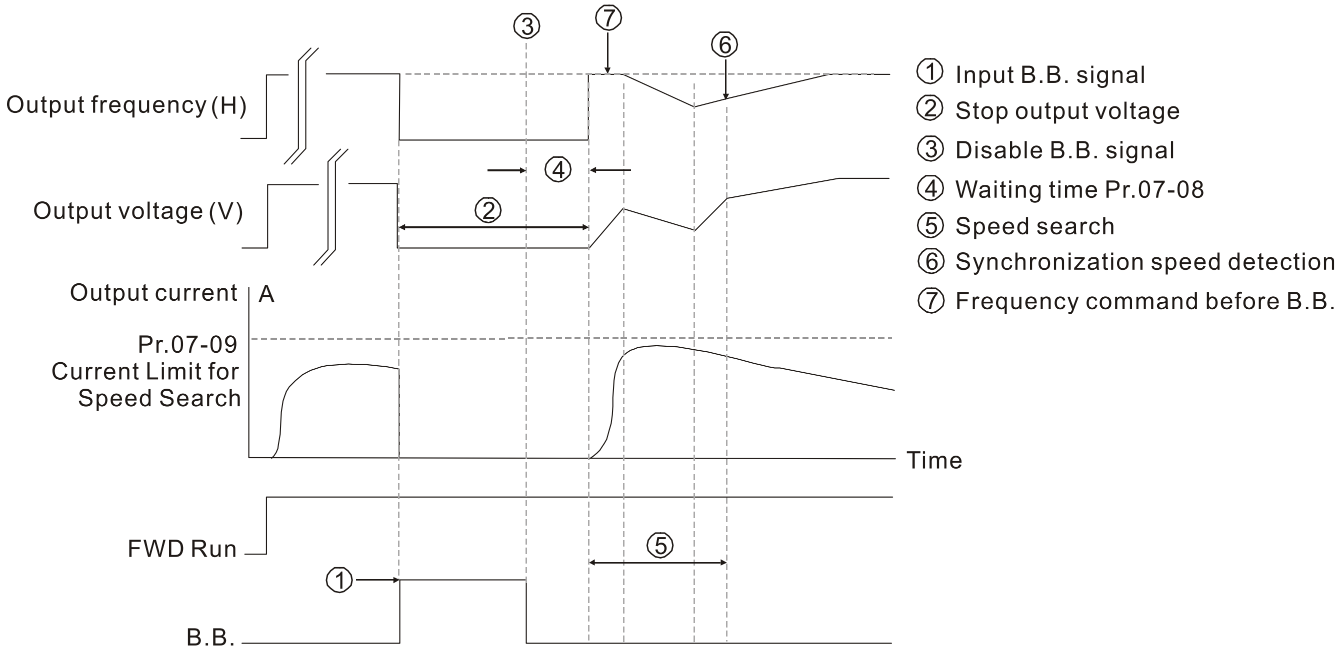
Default: 0.5

Settings 0.1–5.0 sec.

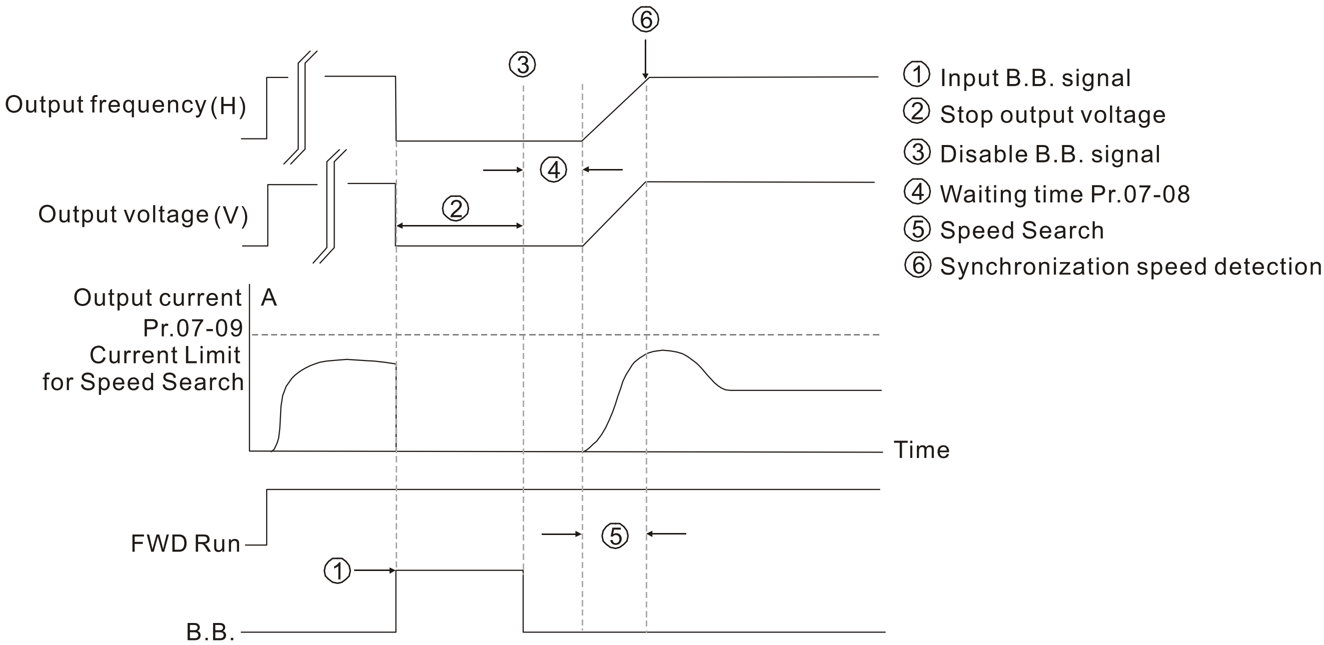
- When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by Pr.07-08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0 V before activating the drive again.
- This parameter is not only for the B.B. time, but also is the re-start delay time after free run.
- The RUN command during a free run operation is memorized, and runs or stops with the last frequency command after the delay time.
- This delay time is only applicable in "Re-start after coast to stop" status, and does not limit ramp to stop. The coast to stop can be caused by various control command source, or by errors.
- Following table is the recommended setting for re-start delay time of each model power. You must set Pr.07-08 according to this table (the default of each model power is based on this table as well).

kW	0.75	1.5	2.2	3.7	5.6	7.5	11.0	15.0
HP	1	2	3	5	7.5	10	15	20
Delay time (sec.)	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

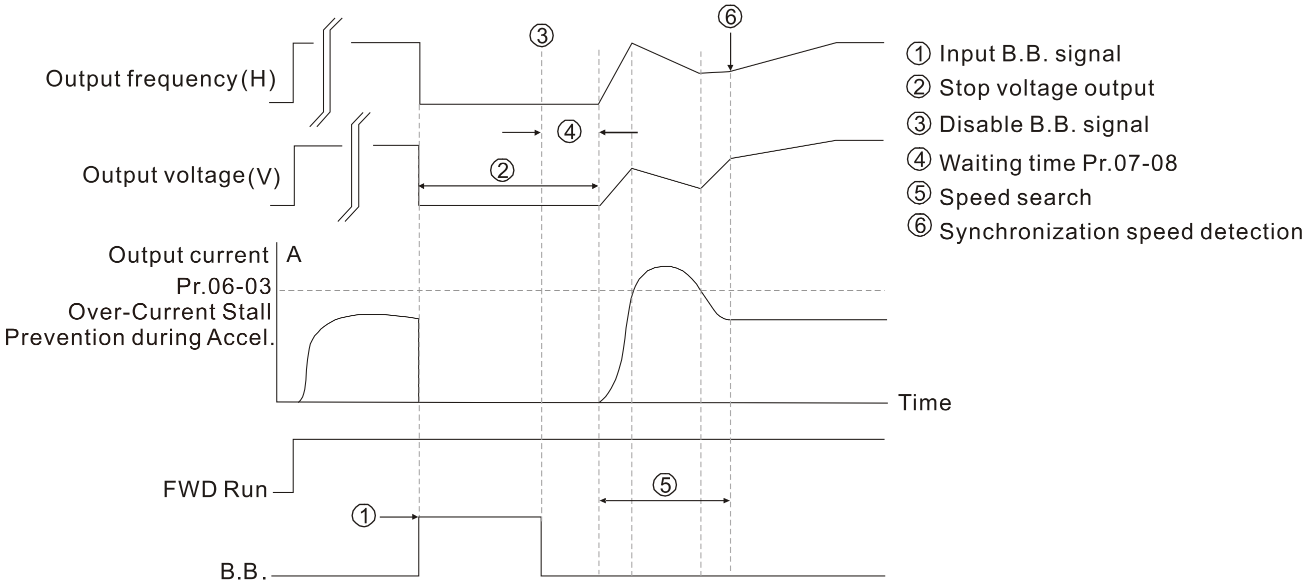
kW	18.5	22.0	30.0	37.0	45.0	55.0	75.0
HP	25	30	40	50	60	75	100
Delay time (sec.)	1.1	1.2	1.3	1.4	1.5	1.6	1.7



B.B. Search with last output frequency downward timing chart



B.B. Search with minimum output frequency upward timing chart



Over-current stall prevention action chart

07-09 Current Limit of Speed Tracking

Default: 100

Settings 20–200%

- The AC motor drive executes speed tracking only if the output current is greater than the value set in Pr.07-09.
- The maximum current for speed tracking affects the synchronous time. The larger the parameter setting is, the faster the synchronization occurs. However, if the parameter setting is too large, the overload protection function may be activated.

07-10 Restart after Fault Action

Default: 0

Settings 0: Stop operation
1: Speed tracking by current speed
2: Speed tracking by minimum output frequency

- In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.
- Faults include: bb, oc, ov, occ. To restart after oc, ov, occ, you can NOT set Pr.07-11 to 0.

07-11 Number of Times of Auto-restart after Fault

Default: 0

Settings 0–10

- After fault (allowed fault: oc, ov, occ) occurs, the AC motor drive can reset and restart automatically up to 10 times.
- If the number of faults exceeds the Pr.07-11 setting, the drive does not reset and restart until you press "RESET" manually and execute the operation command again.

07-12 Speed Tracking during Start-up

Default: 0

Settings 0: Disable
1: Speed tracking by maximum output frequency
2: Speed tracking by motor frequency at start
3: Speed tracking by minimum output frequency

- Speed tracking is suitable for punch, fans and other large inertia loads. For example, a mechanical punch usually has a large inertia flywheel, and the general stop method is coast to stop. If it needs to be restarted again, the flywheel may take 2–5 minutes or longer to stop. This parameter setting allows you to start the flywheel operating again without waiting until the flywheel stops completely.
- In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.

07-13 dEb Function Selection

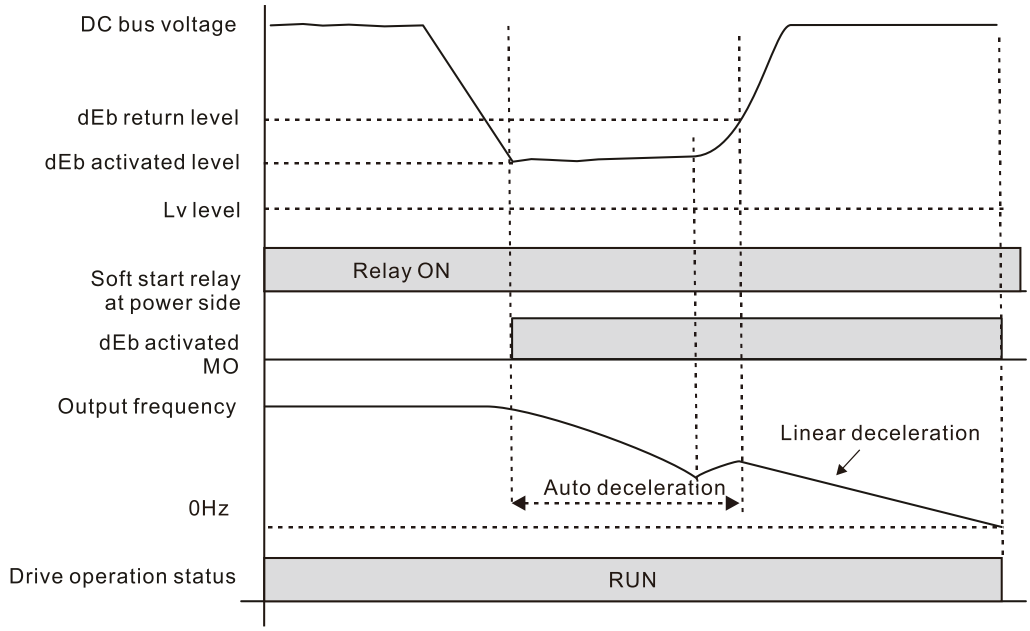
Default: 0

Settings 0: Disable
1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored.
2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored.
3: dEb low-voltage control, then the drive's voltage increases to 350 V_{DC} / 700 V_{DC} and ramps to stop after low frequency
4: dEb high-voltage control of 350 V_{DC} / 700 V_{DC}, and the drive ramps to stop

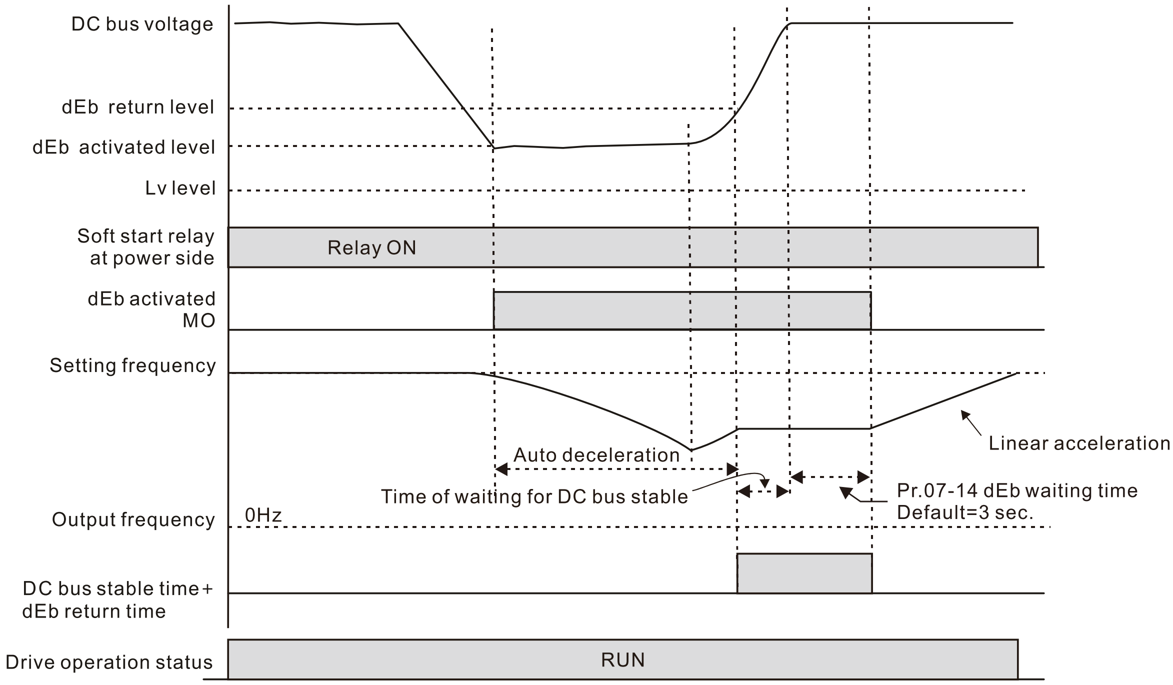
- dEb (Deceleration Energy Backup) lets the motor decelerate to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.
- Lv return level: Default value depends on the drive power model.
  Frame A, B, C, D = Pr.06-00 + 60 V / 30 V (230V models)
  Frame E and above = Pr.06-00 + 80 V / 40 V (230V models)
- Lv level: Default is Pr.06-00.
- During dEb operation, other protection, such as ryF, ov, oc, occ, and EF may interrupt it, and these error codes are recorded.
- The STOP (RESET) command does not work during the dEb auto-deceleration, and the drive continues decelerating to stop. To make the drive coast to stop immediately, use another function (EF) instead.
- The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.
- Even though the Lv warning does not display during dEb operation, if the DC bus voltage is lower than the Lv level, MO = 10 (Low voltage warning) still operates.

📖 The following explains the dEb action:
When the DC voltage drops below the dEb setting level, the dEb function starts to work (soft start relay remains closed), and the drive executes auto-deceleration.

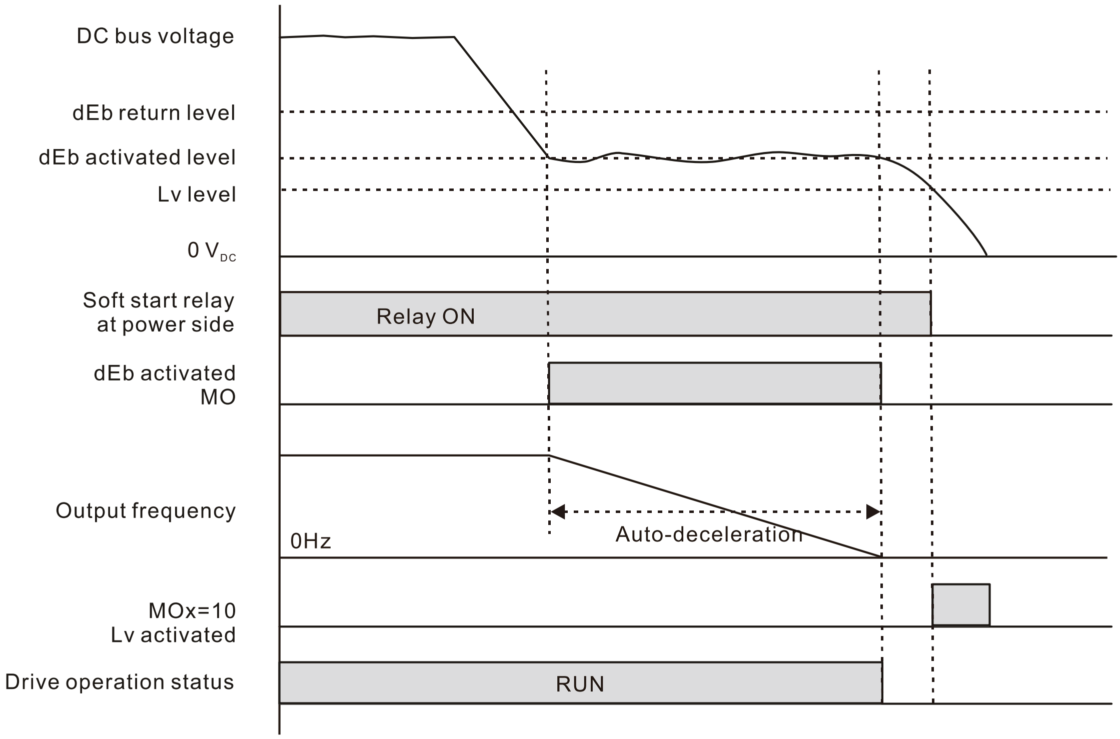
- **Situation 1:** Momentary power loss, or power current too low and unstable, or power supply sliding down because of sudden heavy load.
  Pr.07-13=1, "dEb active, DC bus voltage returns, output frequency does not return" and power recovers.
  When the power recovers and DC bus voltage exceeds the dEb return level, the drive linearly decelerates to 0 Hz and stops. The keypad displays the "dEb" warning until you manually reset it, so that you can see the reason for the stop.



- **Situation 2:** Momentary power loss, or power current too low and unstable, or power supply sliding down because of sudden heavy load.
  Pr.07-13=2 "dEb active, DC bus voltage returns, output frequency returns" and power recovers.
  During the dEb deceleration (includes 0 Hz run), if the power recovers higher than dEb return level, the drive maintains the frequency for three seconds and then accelerates again. The dEb warning on the keypad clears automatically.



- **Situation 3:** Power supply unexpected shut down or power loss.
  Pr.07-13=1 "dEb active, DC bus voltage returns, the output frequency does not return" and the power does not recover.
  The keypad displays the "dEb" warning and stops after decelerating to the lowest running frequency. When the DC bus voltage is lower than the Lv level, the drive disconnects the soft start relay until the power completely runs out.



- **Situation 4:**
  Pr.07-13=2 "dEb active, DC bus voltage returns, the output frequency returns" and power does not recover.
  The drive decelerates to 0 Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The keypad displays "dEb" warning until the drive completely runs out of power.

07-15 Dwell Time at Acceleration

Default: 0.00

Settings 0.00–600.00 sec.

07-17 Dwell Time at Deceleration

Default: 0.00

Settings 0.00–600.00 sec.

07-16 Dwell Frequency at Acceleration

Default: 0.00

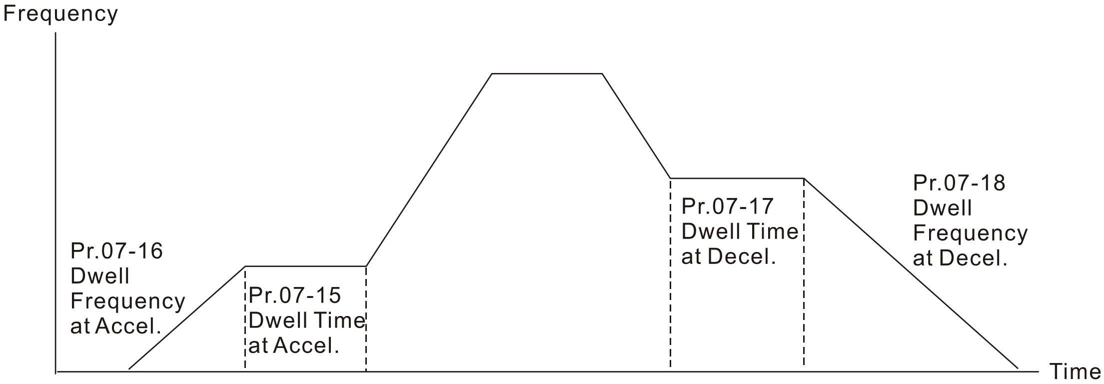
Settings 0.00–599.00 Hz

07-18 Dwell Frequency at Deceleration

Default: 0.00

Settings 0.00–599.00 Hz

- In heavy load situations, the Dwell temporarily maintains stable output frequency. Use this parameter for cranes, elevators, and so on.
- When the load is heavier, use Pr.07-15–Pr.07-18 to avoid ov or oc protection.



Dwell at acceleration / deceleration

07-19 Fan Cooling Control

Default: 3

Settings
0: Fan is always ON
1: Fan is OFF after the AC motor drive stops for one minute.
2: Fan is ON when AC motor drive runs; fan is OFF when AC motor drive stops.
3: Fan turns ON when the temperature (IGBT) reaches around 60°C

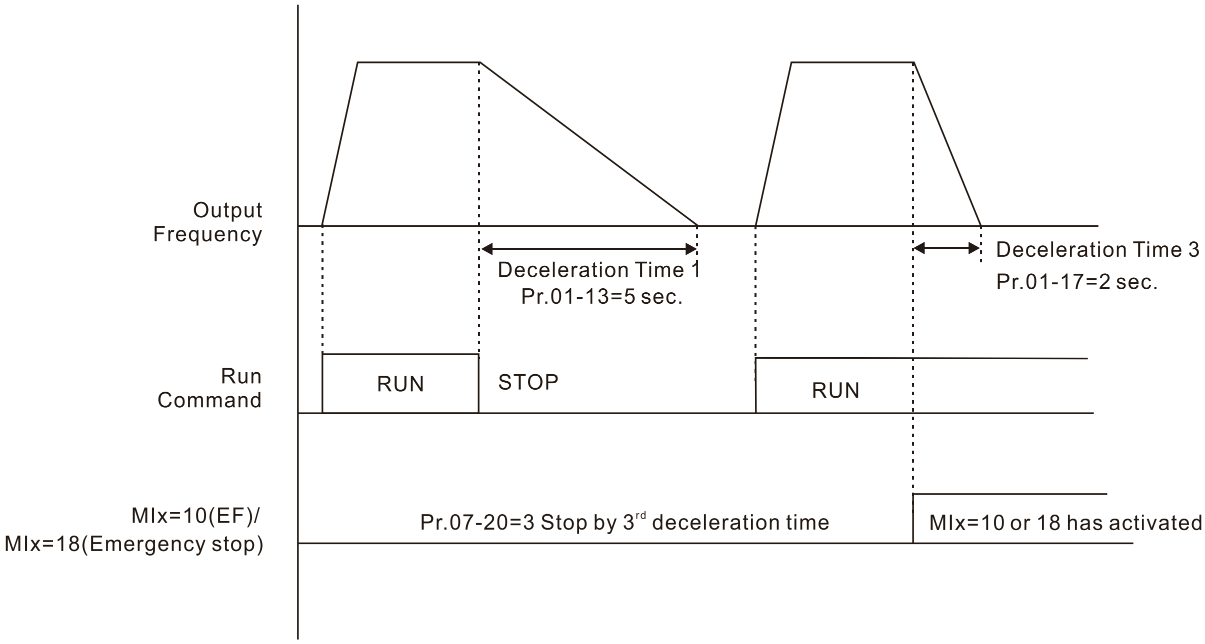
- Use this parameter to control the fan.
- 0: Fan runs immediately when the drive power is turned ON.
- 1: Fan runs when AC motor drive runs. One minute after AC motor drive stops, the fan is OFF.
- 2: Fan runs when AC motor drive runs and stops immediately when AC motor drive stops.
- 3: Fan is ON when the IGBT or capacitance temperature is higher than 60°C.
  Fan is OFF when the the IGBT and capacitance temperature are both lower than 40°C, and the drive stops running.

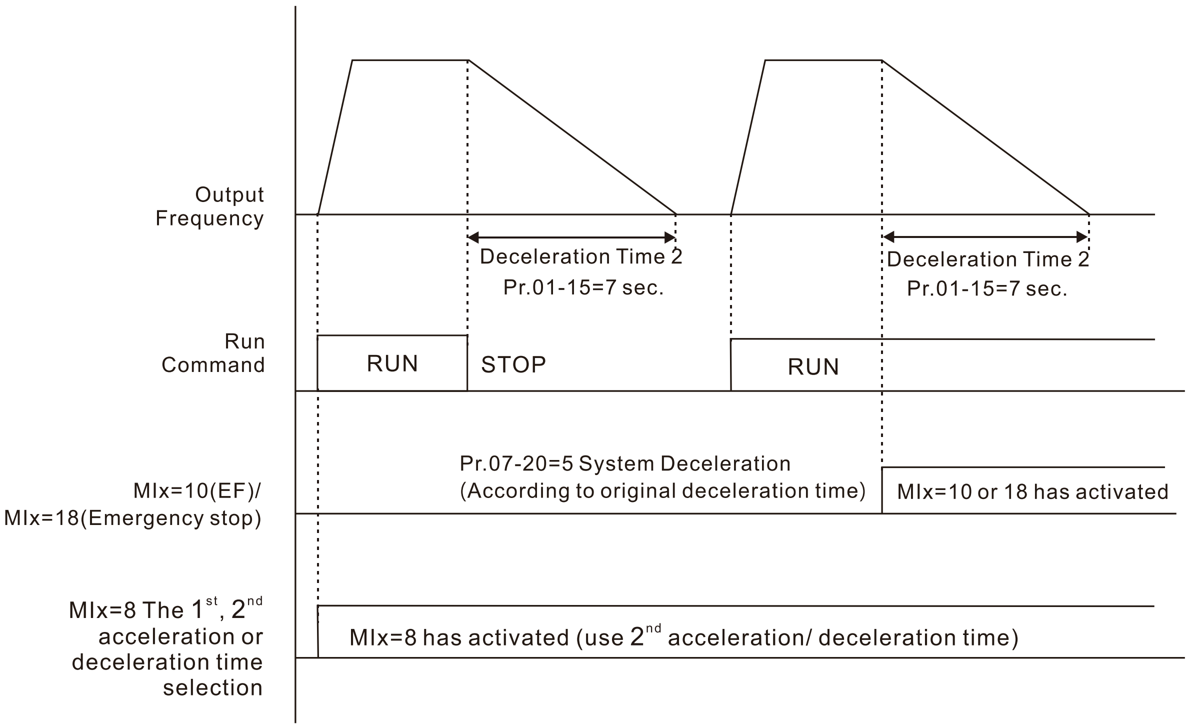
✓ 07-20 Emergency stop (EF) & force to stop selection

Default: 0

Settings 0: Coast to stop
1: Stop by the 1st deceleration time
2: Stop by the 2nd deceleration time
3: Stop by the 3rd deceleration time
4: Stop by the 4th deceleration time
5: System deceleration
6: Automatic deceleration

📖 When the multi-function input terminal is set to EF input (setting 10) or forced to stop (setting 18) and the terminal contact is ON, the drive stops according to the setting of this parameter.





07-21 Automatic Energy-saving Setting

Default: 0

Settings 0: Disable
1: Enable

- When energy-saving is enabled, the motor acceleration operates with full voltage. During constant speed operation, it automatically calculates the best voltage value according to the load power. This function is not suitable for fluctuating loads or loads which are nearly full during operation.
- When the output frequency is constant (that is, constant operation), the output voltage decreases automatically as the load decreases. Therefore, the drive operates with minimum multiplication of voltage and current (electric power).

07-22 Energy-saving Gain

Default: 100

Settings 10–1000%

- When Pr.07-21 is set to 1, use this parameter to adjust the energy-saving gain. The default is 100%. If the result is not satisfactory, adjust it by decreasing the setting value. If the motor oscillates, then increase the setting value.
- In certain applications such as high speed spindles, the temperature rise in the motor is a major concern. When the motor is not in working state, reduce the motor current to a lower level. Reduce this parameter setting to meet this requirement.

07-23 Automatic Voltage Regulation (AVR) Function

Default: 0

Settings 0: Enable AVR
1: Disable AVR
2: Disable AVR during deceleration

- The rated voltage of a 220V motor is usually AC 200 V, 60 Hz / 50 Hz, and the input voltage of the AC motor drive may vary from AC 180 V to 264 V, 50 Hz / 60 Hz. Therefore, when the AC motor drive is used without the AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12%–20% of the rated voltage, it causes higher temperatures, damaged insulation, and unstable torque output, which result in losses due to shorter motor lifetime.
- The AVR function automatically regulates the output voltage of the AC motor drive to the motor rated voltage. For example, if the V/F curve is set at AC 200 V, 50 Hz and the input voltage is at AC 200–264 V, then the drive automatically reduces the output voltage to the motor to a maximum of AC 200 V, 50 Hz. If the input voltage is at AC 180–200 V, the output voltage to motor and input power are in direct proportion.
- 0: When the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.
- 1: When the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The DC bus voltage changes the output voltage, and may cause insufficient or over-current or shock.

- 2: The drive disables the AVR function when decelerating to stop, and may accelerate to brake.
- When the motor ramps to stop, the deceleration time is shorter when setting this parameter to 2 with auto-acceleration and deceleration, and the deceleration is quicker and more stable.

07-24 Torque Command Filter Time

Default: 0.050

Settings 0.001–10.000 sec.

- IMVF and PMSVC control modes only.
- When the setting is too long, the control is stable but the control response is delayed. When the setting is too short, the response is quicker but the control may be unstable. Adjust the setting according to the stability of the control and response times.

07-25 Slip Compensation Filter Time

Default: 0.100

Settings 0.001–10.000 sec.

- IMSVC control mode only.
- Change the compensation response time with Pr.07-24 and Pr.07-25.
- If you set Pr.07-24 and Pr.07-25 to 10 seconds, the compensation response time is the slowest; however, the system may be unstable if you set the time too short.

07-26 Torque Compensation Gain
07-71 Torque Compensation Gain (Motor 2)
07-73 Torque Compensation Gain (Motor 3)
07-75 Torque Compensation Gain (Motor 4)

Default: 1

Settings IM: 0–10 (when Pr.05-33 = 0)
PM: 0–5000 (when Pr.05-33 = 1 or 2)

- IMVF and PMSVC control modes only.
- With a large motor load, a part of drive output voltage is absorbed by the stator winding resistor; therefore, the air gap magnetic field is insufficient. This causes insufficient voltage at motor induction and results in excessive output current but insufficient output torque. Auto-torque compensation can automatically adjust the output voltage according to the load and keep the air gap magnetic fields stable to get the optimal operation.
- In the V/F control, the voltage decreases in direct proportion with decreasing frequency. It reduces the torque decrease at low speed due to the AC while the DC resistor is unchanged. The auto-torque compensation function increases the output voltage at low frequency to get a higher starting torque.
- When the compensation gain is set too high, it may cause motor over-flux and result in a too large output current, overheating the motor or triggering the protection function.
- This parameter affects the output current during operation. The low-speed zone has less impact.
- When the compensation gain is set too large, it may cause motor over-flux and result in a too large output current of the drive, motor overheating or trigger the drive's protection function.

07-27 Slip Compensation Gain
07-72 Slip Compensation Gain (Motor 2)
07-74 Slip Compensation Gain (Motor 3)
07-76 Slip Compensation Gain (Motor 4)

Default: 0.00

(Default value is 1 in SVC mode)

Settings 0.00–10.00

- IMSVC control mode only.
- The induction motor needs constant slip to produce magnetic torque. It can be ignored at higher motor speeds, such as rated speed or 2–3 % of slip.
- In operation, the slip and the synchronous frequency are in reverse proportion to produce the same magnetic torque. The slip is larger with the reduction of the synchronous frequency. The motor may stop when the synchronous frequency decreases to a specific value. Therefore, the slip seriously affects the motor speed accuracy at low speed.
- In another situation, when you use an induction motor with the drive, the slip increases when the load increases. It also affects the motor speed accuracy.
- Use this parameter to set the compensation frequency, and reduce the slip to maintain the synchronous speed when the motor runs at the rated current in order to improve the accuracy of the drive. When the drive output current is higher than Pr.05-05 (No-load Current of Induction Motor 1 (A)), the drive compensates the frequency with this parameter.
- This parameter is set to 1.00 automatically when Pr.00-11 (Speed Control Method) is changed from V/F mode to vector mode. Apply the slip compensation after load and acceleration. Increase the compensation value from small to large gradually; add the output frequency with motor rated slip x Pr.07-27 (Slip Compensation Gain) when the motor is at the rated load. If the actual speed ratio is slower than expected, increase the parameter setting value; otherwise, decrease the setting value.

07-29 Slip Deviation Level

Default: 0

Settings 0.0–100.0%

0: No detection

07-30 Slip Deviation Detection Time

Default: 1.0

Settings 0.0–10.0 sec.

07-31 Slip Deviation Action

Default: 0

Settings 0: Warn and continue operation

1: Fault and ramp to stop

2: Fault and coast to stop

3: No warning

- Parameters Pr.07-29–Pr.07-31 set the allowable slip level/time and the over-slip action when the drive is running.

07-32 Motor Shock Compensation Factor

Default: 1000

Settings 0–10000

- If there are current wave motions in the motor in some specific area, setting this parameter can effectively improve this situation.
- When the current wave motion occurs in low frequency and high-power, increase the value for Pr.07-32.

07-33 Auto-restart Interval of Fault

Default: 60.0

Settings 0.0–6000.0 sec.

- When a reset / restart occurs after a fault, the drive uses Pr.07-33 as a timer and starts counting the number of faults within this time period. Within this period, if the number of faults does not exceed the setting for Pr.07-11, the counting clears and starts from 0 when the next fault occurs.

07-38 PMSVC Voltage Feed Forward Gain

Default: 1.00

Settings 0.50–2.00

- Adjusts the PMSVC voltage feedback forward gain, and to meet the demand of rapid feedback application.
- Pr.07-38 = 1.00 means forward feedback = Ke × motor rotor speed
- Refer to Section 12-2 “PMSVC adjustment” for details.

07-62 dEb Gain (Kp)

Default: 8000

Settings 0–65535

07-63 dEb Gain (Ki)

Default: 150

Settings 0–65535

- Sets the PI gain of DC bus voltage controller when the dEb function activates.
- If the DC bus voltage drops too fast, or the speed oscillation occurs during deceleration after the dEb function activates, adjust Pr.07-62 and Pr.07-63. Increase the Kp setting to quicken the control response, but the oscillation may occur if the setting is too large. Use Ki parameter to decrease the steady-state error to zero, and increase the setting to quicken the response speed.

08 High-function PID Parameters

⌿ You can set this parameter during operation.

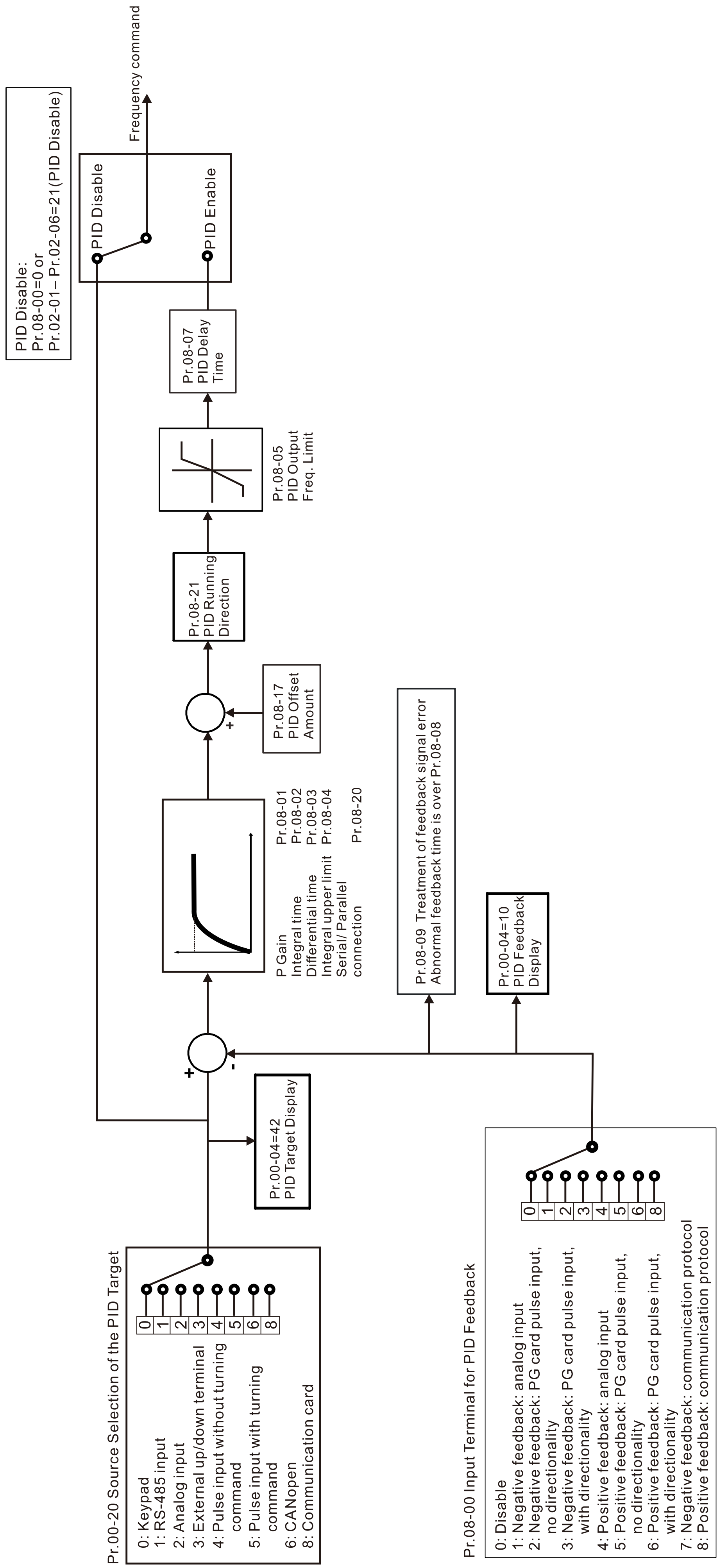
⌿ 08-00 Terminal Selection of PID Feedback

Default: 0

Settings
0: No function
1: Negative PID feedback: by analog input (Pr.03-00)
2: Negative PID feedback: by single-phase pulse input (MI7), without direction (Pr.10-16)
3: Negative PID feedback: by single -phase pulse input (MI7), with direction (Pr.10-16)
4: Positive PID feedback: by analog input (Pr.03-00)
5: Positive PID feedback: by single -phase pulse input (MI7), without direction (Pr.10-16)
6: Positive PID feedback: by single -phase pulse input (MI7), with direction (Pr.10-16)
7: Negative PID feedback: by communication protocol
8: Positive PID feedback: by communication protocol

- Negative feedback means: Error = Target value - Feedback.
  The detection value increases by increasing the output frequency.
- Positive feedback means: Error = Feedback - Target value.
  The detection value decreases by increasing the output frequency.
- When Pr.08-00 ≠ 7 neither ≠ 8, the input value is disabled. The value of the setting does not remain the same after the drive is off.
- The related applicable parameters to set Pr.08-00 include:
  - Pr.00-20 (Master frequency command source (AUTO)
  - Pr.03-00–03-01:
    When Pr.00-20 = 2, set Pr.03-00–03-01 =4 (PID target value)
    When Pr.08-00 = 1 or 4, set Pr.03-00–03-01 = 5 (PID feedback signal)

Refer to the following description for details.


PID Disable:
Pr.08-00=0 or
Pr.02-01～Pr.02-06=21(PID Disable)
Frequency command
PID Disable
PID Enable
Pr.08-07
PID Delay
Time
Pr.08-05
PID Output
Freq. Limit
Pr.08-21
PID Running
Direction
Pr.08-17
PID Offset
Amount
P Gain Pr.08-01
Integral time Pr.08-02
Differential time Pr.08-03
Integral upper limit Pr.08-04
Serial/ Parallel connection Pr.08-20
Pr.08-09 Treatment of feedback signal error
Abnormal feedback time is over Pr.08-08
Pr.00-04=10
PID Feedback
Display
Pr.00-04=42
PID Target Display
Pr.00-20 Source Selection of the PID Target
0: Keypad
1: RS-485 input
2: Analog input
3: External up/down terminal
4: Pulse input without turning command
5: Pulse input with turning command
6: CANopen
8: Communication card
Pr.08-00 Input Terminal for PID Feedback
0: Disable
1: Negative feedback: analog input
2: Negative feedback: PG card pulse input, no directionality
3: Negative feedback: PG card pulse input, with directionality
4: Positive feedback: analog input
5: Positive feedback: PG card pulse input, no directionality
6: Positive feedback: PG card pulse input, with directionality
7: Negative feedback: communication protocol
8: Positive feedback: communication protocol

00-20 Master Frequency Command Source (AUTO, REMOTE)

Default: 0

Settings 0: Inputs from digital keypad
1: Inputs from RS-485 communication
2: Inputs from external analog (refer to Pr.03-00, Pr.03-01)
3: Inputs from external UP / DOWN terminals (multi-function input terminals)
4: Pulse inputs without direction command
(refer to Pr.10-16 without direction)
5: Pulse inputs with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication cards (CANopen card not included)
9: PID function (Pr.08-65 should be set as 1)

NOTE:
HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56 or with KPC-CC01 (optional).

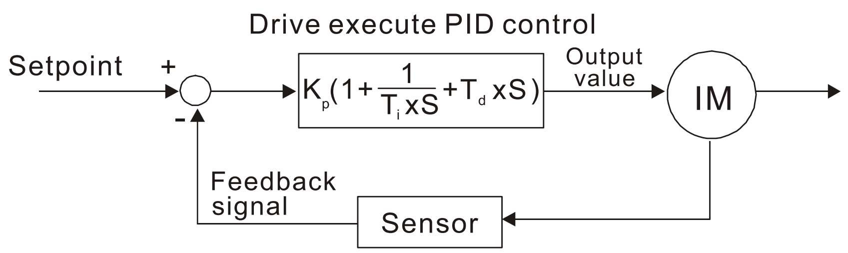
03-00 AVI Analog Input Selection
03-01 ACI Analog Input Selection

Default: 0

Settings 4: PID target value
5: PID feedback signal

1. Common applications for PID control:
   - Flow control: Use a flow sensor to feedback the flow data and perform accurate flow control.
   - Pressure control: Use a pressure sensor to feedback the pressure data and perform precise pressure control.
   - Air volume control: Use an air volume sensor to feedback the air volume data to achieve excellent air volume regulation.
   - Temperature control: Use a thermocouple or thermistor to feedback temperature data for comfortable temperature control.
   - Speed control: Use a speed sensor to feedback motor shaft speed or input another machine speed as a target value for synchronous control.

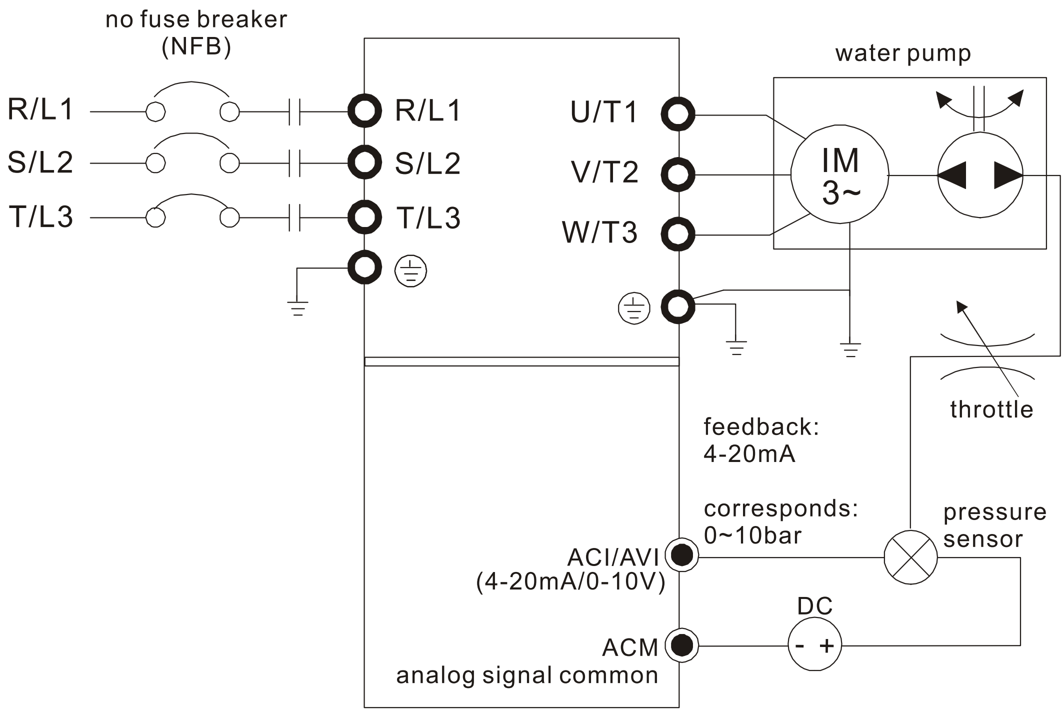
2. PID control loop:



K_P Proportional Gain (P), T_i Integral Time (I), T_d Differential Time (D), S Calculation

3. Concept of PID control:
   - Proportional gain (P):
     The output is proportional to input. With only proportional gain control, there is always a steady-state error.
   - Integral time (I):
     The controller output is proportional to the integral of the controller input. To eliminate the steady-state error, add an “integral part” to the controller. The integral time controls the relation between the integral part and the error. The integral part increases over time even if the error is small. It gradually increases the controller output to eliminate the error until it is zero. This stabilizes the system without a steady-state error by using proportional gain control and integral time control.
   - Differential control (D):
     The controller output is proportional to the differential of the controller input. During elimination of the error, oscillation or instability may occur. Use the differential control to suppress these effects by acting before the error. That is, when the error is near 0, the differential control should be 0. Use proportional gain (P) and differential control (D) to improve the system state during PID adjustment.

4. Using PID control in a constant pressure pump feedback application:
   Set the application’s constant pressure value (bar) to be the set point of PID control. The pressure sensor sends the actual value as the PID feedback value. After comparing the PID set point and PID feedback, an error displays. The PID controller calculates the output by using proportional gain (P), integral time (I) and differential time (D) to control the pump. It controls the drive to use a different pump speed and achieves constant pressure control by using a 4–20 mA signal corresponding to 0–10 bar as feedback to the drive.



- Pr.00-04 = 10 (display PID feedback (b) (%))
- Pr.01-12 Acceleration Time is set according to actual conditions.
- Pr.01-13 Deceleration Time is set according to actual conditions.
- Pr.00-21 = 0 to operate through the digital keypad
- Pr.00-20 = 0, the digital keypad controls the set point.
- Pr.08-00 = 1 (negative PID feedback from analog input)
- ACI analog input Pr.03-01 = 5, PID feedback signal.
- Pr.08-01–08-03 is set according to actual conditions.
  If there is no vibration in the system, increase Pr.08-01 (Proportional Gain (P))
  If there is no vibration in the system, decrease Pr.08-02 (Integral Time (I))
  If there is no vibration in the system, increase Pr.08-03 (Differential Time (D))
- Refer to Pr.08-00–08-21 for PID parameter settings.

08-01 Proportional Gain (P)

Default: 1.00

Settings 0.0–5000.0 (When Pr.08-23 bit1 = 0)
0.00–500.00 (When Pr.08-23 bit1 = 1)

- 1.0: Kp gain is 100%; if the setting is 0.5, Kp gain is 50%.
- Eliminates the system error; usually used to decrease the error and get faster response speed. If you set the value too high, it may cause system oscillation and instability.
- If you set the other two gains (I and D) to zero, proportional control is the only effective parameter.

08-02 Integral Time (I)

Default: 1.00

Settings 0.00–100.00 sec.

- Use the integral controller to eliminate the error during stable system operation. The integral control does not stop working until the error is zero. The integral is affected by the integral time. The smaller the integral time, the stronger the integral action. It is helpful to reduce overshoot and oscillation for a stable system. Accordingly, the speed to lower the steady-state error decreases. The integral control is often used with the other two controls for the PI controller or PID controller.
- Sets the integral time of the I controller. When the integral time is long, there is a small I controller gain, with slower response and slow external control. When the integral time is short, there is a large I controller gain, with faster response and rapid external control.
- When the integral time is too short, it may cause system oscillation.
- Set Integral Time to 0.00 to disable the parameter Pr.08-02.

08-03 Differential Time (D)

Default: 0.00

Settings 0.00–1.00 sec.

- Use the differential controller to show the system error change, as well as to preview the change in the error. You can use the differential controller to eliminate the error in order to improve the system state. Using a suitable differential time can reduce overshoot and shorten adjustment time;

however, the differential operation increases noise interference. Note that a too large differential causes more noise interference. In addition, the differential shows the change and the differential output is 0 when there is no change. Note that you cannot use the differential control independently. You must use it with the other two controllers to for the PD controller or PID controller.

- Sets the D controller gain to determine the error change response. Using a suitable differential time reduces the P and I controllers overshoot to decrease the oscillation for a stable system. A differential time that is too long may cause system oscillation.
- The differential controller acts on the change in the error and cannot reduce the interference. Do not use this function when there is significant interference.

08-04 Upper Limit of Integral Control

Default: 100.0

Settings 0.0–100.0%

- Defines an upper bound for the integral gain (I) and therefore limits the master frequency. The formula is:
- Integral upper bound = Maximum Operation Frequency (Pr.01-00) x (Pr.08-04%). An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage.

08-05 PID Output Command Limit (Positive Limit)

Default: 100.0

Settings 0.0–100.0%

- Defines the percentage of the output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Operation Frequency (Pr.01-00) × Pr.08-05%.

08-06 PID Feedback Value by Communication Protocol

Default: 0.00

Settings -200.00–200.00%

- Use communication to set the PID feedback value when the PID feedback input is set to communication (Pr.08-00 = 7 or 8).

08-07 PID Delay Time

Default: 0.0

Settings 0.0–2.5 sec.

08-20 PID Mode Selection

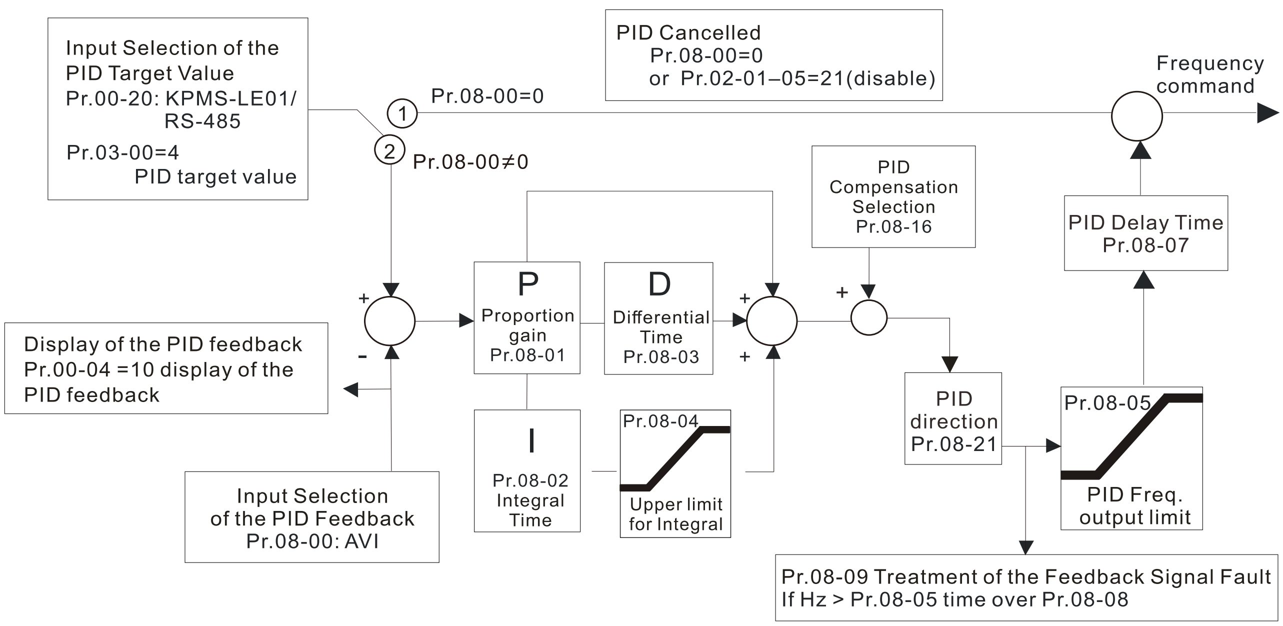
Default: 0

Settings 0: Serial connection
1: Parallel connection

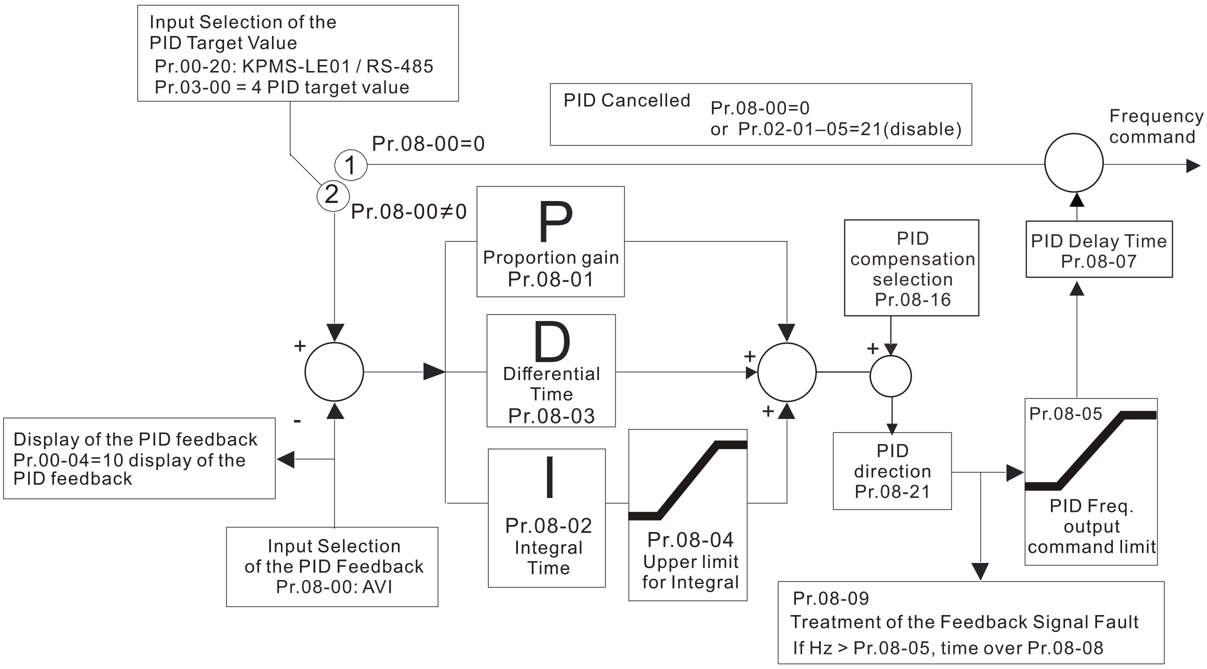
- 0: Use conventional PID control structure.
  1: The proportional gain, integral gain and differential gain are independent. You can customize the P, I and D value to fit your application.

- Pr.08-07 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the drive's response rate.
- PID control output frequency is filtered with a primary low pass function. This function can filter a mix of frequencies. A long primary low pass time means the filter degree is high and a short primary low pass time means the filter degree is low.
- Inappropriate delay time setting may cause system error.
- PI Control:
  Controlled only by the P action, so the deviation cannot be entirely eliminated. In general, to eliminate residual deviations, use the P + I control. When you use the PI control, it eliminates the deviation caused by the targeted value changes and the constant external interferences. However, if the I action is too powerful, it delays the response when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.
- PD Control:
  When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain the deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may vibrate. In this case, use the PD control to reduce the P action's vibration and stabilize the system. In other words, this control is useful with no brake function's loading over the processes.
- PID Control:
  Use the I action to eliminate the deviation and the D action to reduce vibration; then combine this with the P action for the PID control. Use the PID method for a control process with no deviations, high accuracy, and a stable system.

Serial connection



Parallel connection



08-08 Feedback Signal Detection Time

Default: 0.0

Settings 0.0–3600.0 sec.

- Pr.08-08 is valid only for ACI 4–20 mA.
- This parameter sets the detection time for abnormal PID signal feedback. Setting the detection time to 0.0 disables the detection function.

08-09 Feedback Signal Fault Treatment

Default: 0

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency

- This parameter is valid only for ACI 4–20 mA.
- The AC motor drive acts when the analog PID feedback is abnormal.

08-10 Sleep Level

Default: 0.00

Settings 0.00–599.00 Hz / 0.00~200.00%

08-11 Wake-up Level

Default: 0.00

Settings 0.00–599.00 Hz / 0.00~200.00%

- Determines the sleep frequency, and if the sleep time and the wake-up frequency are enabled or disabled.
  Pr.08-10 = 0: Disabled
  Pr.08-10 = ≠ 0: Enabled

- When Pr.08-18 = 0, the unit for Pr.08-10 and that for Pr.08-11 switch to frequency. The settings are between 0–599.00 Hz.
- When Pr.08-18 = 1, the unit for Pr.08-10 and that for Pr.08-11 switch to percentage. The settings then are between 0–200.00%.
- The percentage is based on the current command value, not the maximum value. For example, if the maximum value is 100 kg, and the current value is 30 kg, then if Pr.08-11 = 40%, the value is 12 kg.

08-12 Sleep Delay Time

Default: 0.0

Settings 0.0–6000.0 sec.

- When the Frequency command is smaller than the sleep frequency and less than the sleep time, the Frequency command is equal to the sleep frequency. However, the Frequency command remains at 0.00 Hz until the Frequency command becomes equal to or larger than the wake-up frequency.

08-13 PID Feedback Signal Error Deviation Level

Default: 10.0

Settings 1.0–50.0%

08-14 PID Feedback Signal Error Deviation Time

Default: 5.0

Settings 0.1–300.0 sec.

08-15 PID Feedback Signal Filter Time

Default: 5.0

Settings 0.1–300.0 sec.

- When the PID control function is normal, it should calculate the value within a period of time that is close to the target value.
  Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value – detection value| > Pr.08-13 PID Deviation Level and exceeds Pr.08-14 setting, it is judged as a PID control fault, and the multi-function output MO = 15 (PID feedback error) activates.

08-16 PID Compensation Selection

Default: 0

Settings 0: Parameter setting
1: Analog input

- 0: The setting for Pr.08-17 gives the PID compensation value.

08-17 PID Compensation

Default: 0

Settings -100.0–100.0%

- The PID compensation value = maximum PID target value × Pr.08-17. For example, if the maximum operation frequency Pr.01-00 = 60 Hz, and Pr.08-17 = 10.0%, the PID compensation value increases the output frequency 6.00 Hz. 60.00 Hz × 100.00% × 10.0% = 6.00 Hz

08-18 Sleep Mode Function Setting

Default: 0

Settings 0: Refer to PID output command
1: Refer to PID feedback signal

- 0: The unit for Pr.08-10 and that for Pr.08-11 switch to frequency. The settings then are between 0.00–599.00 Hz.
- 1: The unit for Pr.08-10 and that for Pr.08-11 switch to percentage. The settings then are between 0.00–200.00%.

08-19 Wake-up Integral Limit

Default: 50.0

Settings 0.0–200.0%

- Reduces the reaction time from sleep to wake-up.
- The wake-up integral limit for the drive prevents suddenly running at high speed when the drive wakes up. The wake-up integral frequency limit = (Pr.01-00 × Pr.08-19%)

08-21 Enable PID to Change the Operation Direction

Default: 0

Settings 0: Operation direction can be changed
1: Operation direction cannot be changed

08-22 Wake-up Delay Time

Default: 0.00

Settings 0.00–600.00 sec.

- Refer to Pr.08-18 for more information.

08-23 PID Control Flag

Default: 2

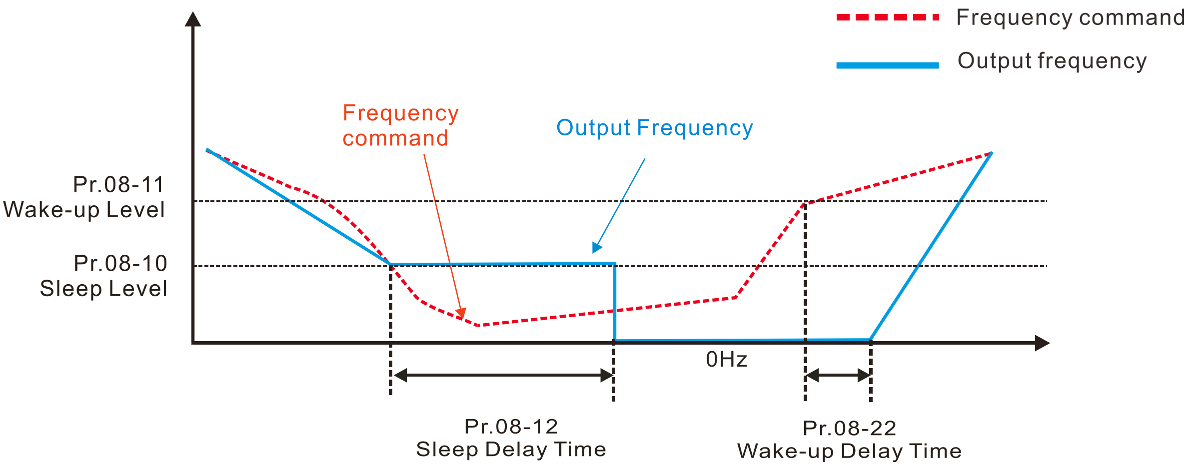
Settings bit 0 = 1, PID running in reverse follows the setting for Pr.00-23.
bit 0 = 0, PID running in reverse refers to PID’s calculated value.
bit 1 = 1, two decimal place of PID Kp
bit 1 = 0, one decimal place of PID Kp

- bit 0 = 1: Enable PID running in reverse.
- bit 0 = 0: If the PID calculated value is positive, the direction is forward. If the PID calculated value is negative, the direction is reverse.
- When the setting of bit 1 changes, the Kp gain does not change. For example: Kp = 6, when Pr.08-23 bit 1 = 0, Kp = 6.0; when Pr.08-23 bit 1 = 1, Kp = 6.00.

There are three scenarios for sleep and wake-up frequency.

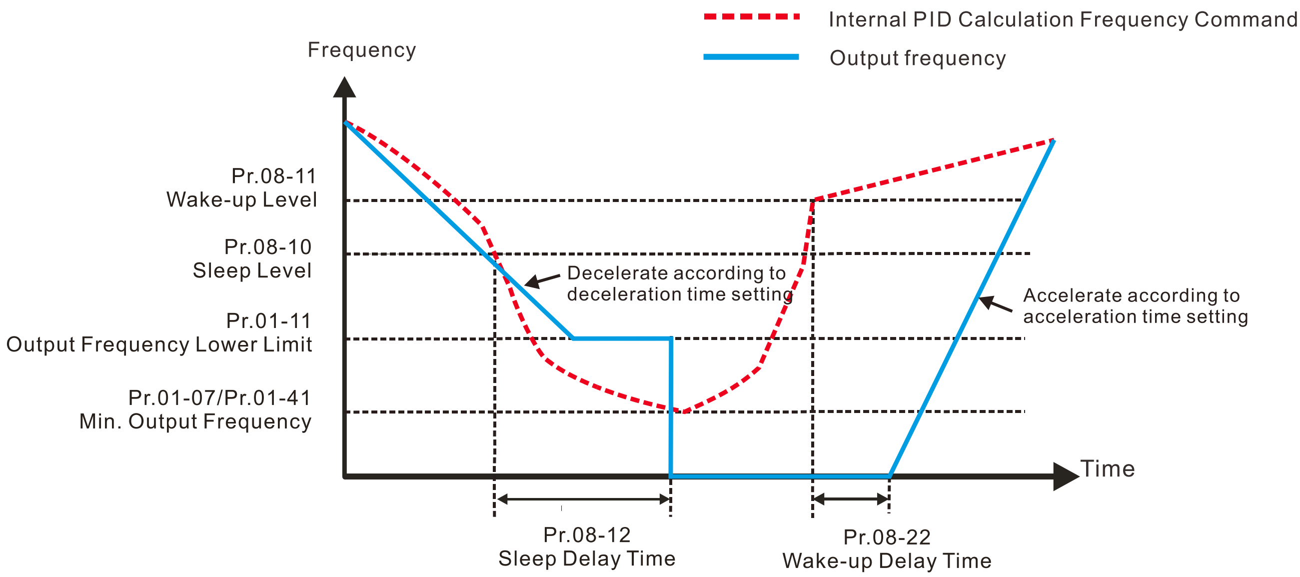
1) Frequency Command (PID is not in use, Pr.08-00 = 0, only works in VF mode)

When the output frequency ≤ the sleep frequency, and the drive reaches the preset sleep time, then the the drive is in sleep mode (0 Hz). When the frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. When the drive reaches the wake-up delay time, it starts to catch up to reach the frequency command value by the acceleration time.



2) Frequency Command Calculation of the Internal PID (Use PID, Pr.08-00 ≠ 0 and Pr.08-18 = 0)

When the PID calculation Frequency command reaches the sleep frequency, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset lower limit.), or it remains at the minimum output frequency set at Pr.01-07 and waits until it reaches the sleep time before it going into sleep mode (0Hz). When the PID calculated Frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.



3) PID Feedback Rate Percentage (Use PID, Pr.08-00 ≠ 0 and Pr.08-18 = 1)

When the PID feedback value reaches the sleep level percentage, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0 Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset of lower limit.), or it remains at the minimum output frequency set for Pr.01-07 and waits until it reaches the sleep time before going into sleep mode (0 Hz).

When the PID feedback value reaches the wake-up percentage, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.

Example 01: PID negative feedback

- Pr.08-10 must > Pr.08-11
- 30kg is the reference
- Set the parameter:

  Pr.03-00 = 5 (AVI is PID feedback)

  Pr.08-00 = 1 (PID negative feedback: AVI simulation input function select)

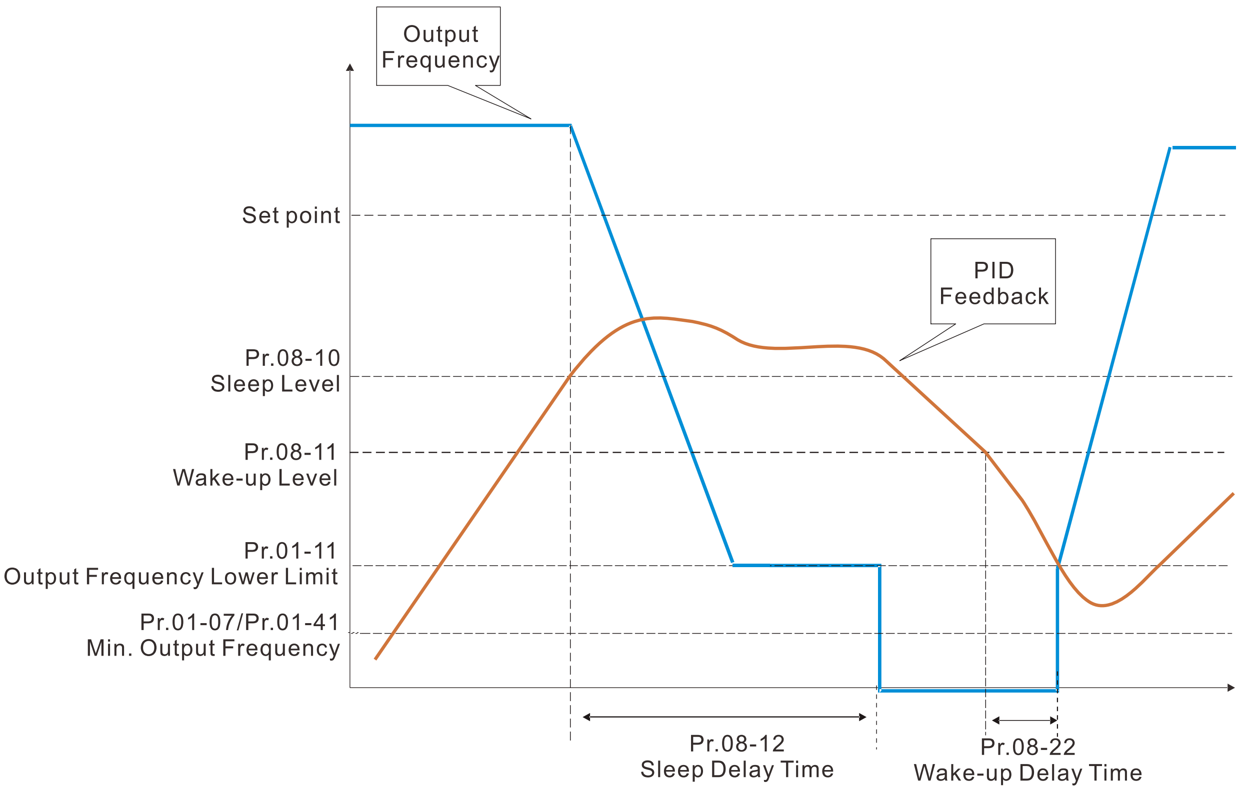
  Pr.08-10 = 40% (Sleep reference: 12kg = 40%*30kg)

  Pr.08-11 = 20% (Wake-up reference: 6kg = 20%*30kg)

  Case 01: If feedback >12kg, frequency decreases.

  Case 02: If feedback <6kg, frequency increases.

Area	**PID Physical quantity**
Sleep area	> 12 kg, the drive goes into sleep, the motor goes into sleep
Excessive area	between 6 kg and 12 kg, the drive remains in current state
Wake-up area	< 6 kg, the drive wakes-up, the motor wakes-up



Example 02: PID positive feedback

- Pr.08-10 must < Pr.08-11
- 30kg is the reference
- Set the parameter:

  Pr.03-00 = 5 (AVI is PID feedback)

  Pr.08-00 = 4 (PID positive feedback: AVI simulation input function select)

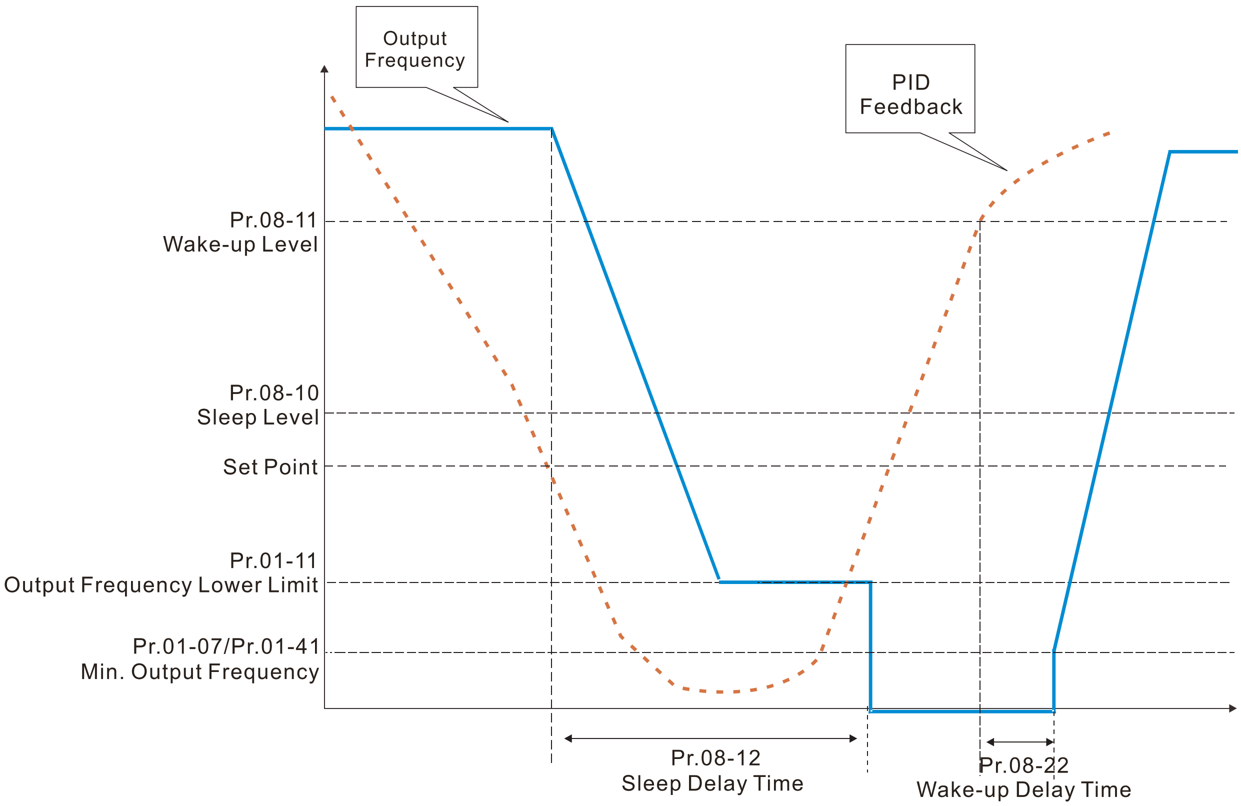
  Pr.08-10 = 110% (Sleep reference: 33kg = 110%*30kg)

  Pr.08-11 = 120% (Wake-up reference: 36kg = 120%*30kg)

  Case 01: If feedback <33kg, frequency decreases.

  Case 02: If feedback >36kg, frequency increases.

Area	PID Physical quantity
Sleep area	> 36 kg, the drive goes into sleep, the motor goes into sleep
Excessive area	between 33 kg and 36 kg, the drive remains in the current state
Wake-up area	< 33 kg, the drive wakes-up



08-26 PID Output Command Limit (Reverse Limit)

Default: 100.0

Settings 0.0–100.0%

📖 When PID enables the reverse direction, the PID output amount is a negative value, and the PID output value is limited by the setting for Pr.08-26. Use this function with Pr.08-21.

08-27 PID Command Acceleration / Deceleration Time

Default: 0.00

Settings 0.00–655.35 sec.

📖 0.00 seconds: Disables the PID acceleration/deceleration command, and the target value is equal to the PID command.

Not equal to 0.00 seconds: Enables the PID acceleration / deceleration command. For PID acceleration and deceleration, when the PID target value changes, the command value increment / decrement is executed according to this parameter.

08-29 Frequency Base Corresponding to 100.00% PID

Default: 0.00

Settings 0: PID control output 100.00%, corresponding to maximum operation frequency (Pr.01-00)

1: PID control output 100.00%, corresponding to the input value of the auxiliary frequency

- Valid when you enable the auxiliary and master frequency functions.
- When Pr.08-29 = 0, PID control output 100.00% corresponding to the maximum output frequency; When Pr.08-29 = 1, PID control output 100.00% corresponding to the input value of the auxiliary frequency. If the auxiliary frequency changes, the PID output frequency also changes.

08-31 Proportional gain 2

Default: 1.00

Settings 0.0–5000.0 (when Pr.08-23 setting bit1 = 0)

0.00–500.00 (when Pr.08-23 setting bit1 = 1)

08-32 Integral time 2

Default: 1.00

Settings 0.00–100.00 sec.

08-33 Differential time 2

Default: 0.00

Settings 0.00–1.00 sec.

08-65 Source of PID Target Value

Default: 0

Settings 0: From frequency command (Pr.00-20, 00-30)

1: From Pr.08-66

2: From RS-485

3: From external analog (refer to Pr.03-00, 03-01)

4: From CANopen

6: From communication cards (CANopen card not included)

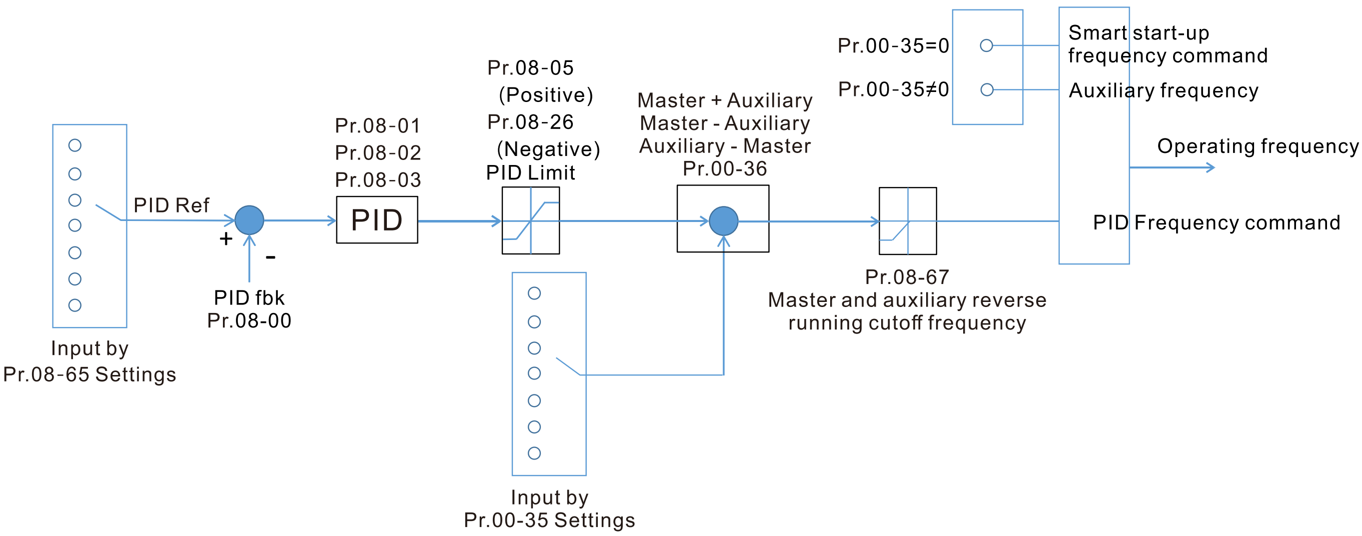
7: By the digital dial on the keypad

- Selects the target value source for PID controller.
- When Pr.08-65 = 0, the maximum operating frequency 01-00 is 60Hz, the error is 100%, and Pr.08-01 = 1.00, the output frequency is "“1” times of the Pr.01-00 maximum operating frequency, therefore, the output frequency = 60 × 100% × 1 = 60 Hz.

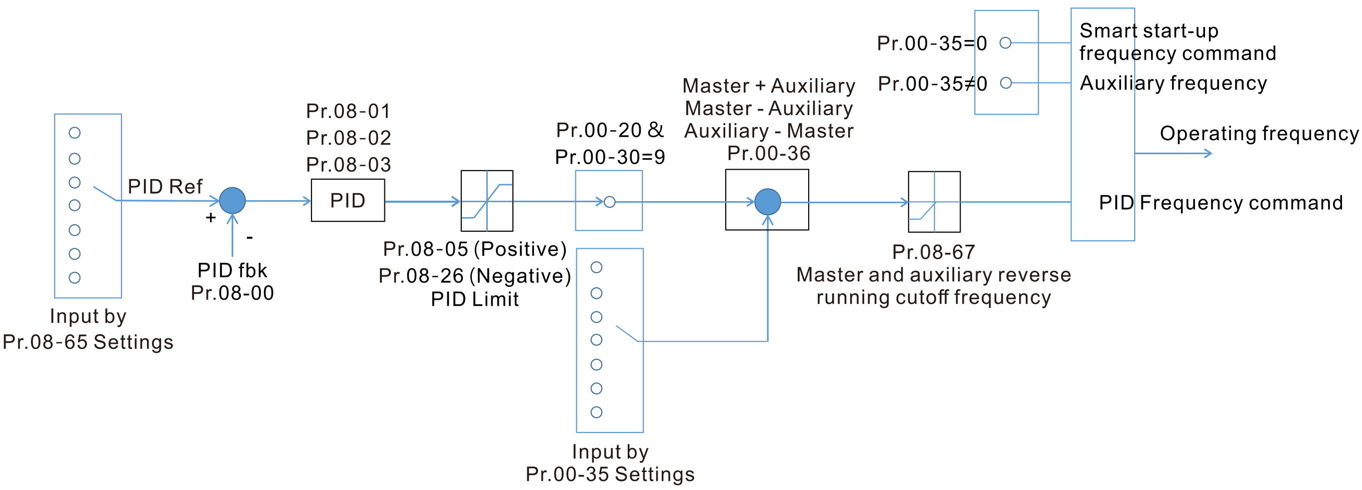
  Calculation formula:

  Output frequency = Fmax (Pr.01-00) × error% ((PID reference value (Pr.00-20 / Pr.00-30) - PID feedback (Pr.08-00)) × Pr.08-01.

- When Pr.08-65 ≠ 0, the internal calculation of Proportional gain will be reduced by 100 times, that is, when Pr.01-00 Fmax = 60Hz, error = 100%, Pr.08-01 = 1.00, the output frequency is Pr.01-00 Fmax "0.01" times, therefore, the output frequency = 60 × 100% × 0.01 = 0.6Hz.
  Calculation formula:
  Output frequency = Fmax (Pr.01-00) × error% ((PID reference value (Pr.08-66) - PID feedback value (Pr.08-00)) × Pr.08-01 × 0.01.
- When Pr.08-65=0, the PID controller architecture shows as the diagram below:



- When Pr.08-65≠0, the PID controller architecture shows as the diagram below:



- When Pr.08-65 is not set to 0, Pr.00-20 is automatically set to 9.
- When Pr.08-65 is set to 1, set the PID command through Pr.08-66; when Pr.08-65 is not set to 1, Pr.08-66 displays the PID command.
- When Pr.08-65 is set to 2, 4, and 6, the corresponding communication address is C2003H.

✓ 08-66 PID Target Value Setting

Default: 50.00

Settings -100.00–100.00%

- The target value setting of PID controller (Pr.08-66) is a relative value

08-67 Master and Auxiliary Reverse Running Cutoff Frequency

Default: 10.0

Settings 0.0–100.0%

- 100% corresponds to Pr.01-00 the Maximum operation frequency
- In some cases, it is only possible for the PID to control the value setting and the feedback in the same situation when the PID output frequency is negative (the motor is reversed). However, an excessively high reversal frequency is not allowed in some cases, and Pr.08-67 is used to determine the upper limit of the reversal frequency

08-68 PID Deviation Limit

Default: 0.00

Settings 0.00–100.00%

- When Pr.08-68 is not set to 0, the PID deviation limit function is enabled.
- When PID deviation ≤ PID deviation limit, PID stops adjusting action. It means the PID output frequency maintains the previous value and this function is effective for some closed-loop control applications.

08-69 Integral Separation Level

Default: 0.00

Settings 0.00–100.00%

- Reduces overshoot when overshoot occurs in the PID feedback at start-up.
- When Pr.08-69 is not set to 0, the integral separation function is enabled.
- The benchmark for the integral separation level is the PID error%.
- The integral separation function activates only once at start-up.
- When PID deviation ≥ Pr.08-69, the integral effect is cancelled to avoid the increasing system overshoot due to the integral effect. When PID deviation is smaller than Pr.08-69, the integral effect is activated to eliminate the steady-state error.

08-70 Smart Start-up Level

Default: 5.00

Settings 0.00–100.00%

08-71 Smart Start-up Frequency Command

Default: 0.00

Settings 0.00–599.00 Hz

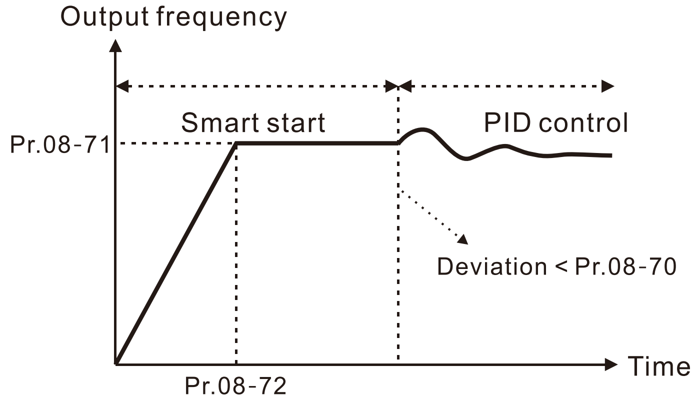
08-72 Smart Start-up Acceleration Time

Default: 3.00

Settings 0.00–600.00 sec.

- When Pr.08-71 is not set to 0, the smart start function is enabled.
- The benchmark for the smart start level is the percentage of PID deviation.
- Use the smart start-up function to reduce overshoot when overshoot occurs in the PID feedback at start-up. The smart start-up activates only once at start-up.
- When the smart start-up function is enabled, it starts with the Pr.08-71 frequency and Pr.08-72 acceleration time (Pr.08-72 acceleration time is the time that it accelerates to Pr.08-71).

When the PID deviation is smaller than Pr.08-70, it switches to the normal PID control (the smart start-up frequency is filled into the PID integral when switching to PID control to avoid discontinuous frequency).



08-75 PID2 Parameter Switch Condition

Default: 0

Settings 0: No switching (refer to Pr.08-01–Pr.08-03)
1: Auto-switch is based on the output frequency
2: Auto-switch is based on the deviation

08-76 PID2 Parameter Switch Deviation 1

Default: 10.00

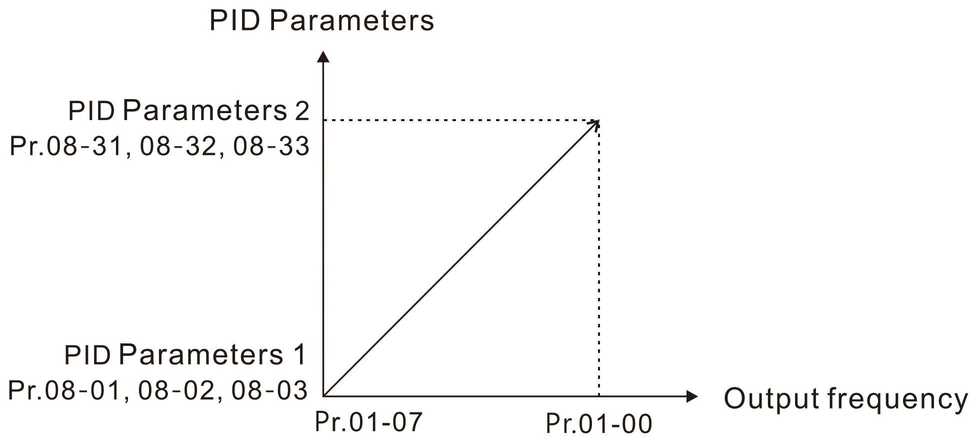
Settings 0.00–Pr.08-77%

08-77 PID2 Parameter Switch Deviation 2

Default: 40.00

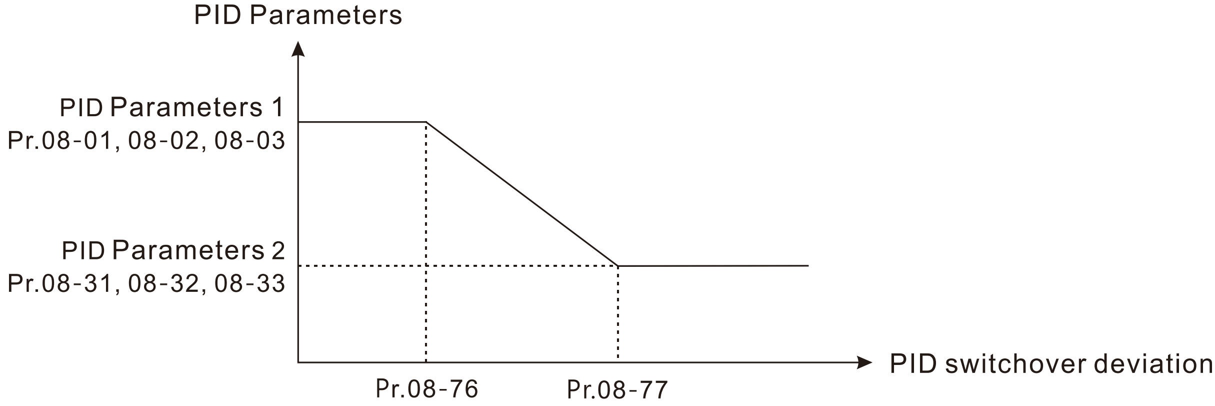
Settings Pr.08-76–100.00%

- A set of PID parameters cannot meet the requirements of the entire running process in some applications. Use Pr.08-75 to switch to the second group of PID parameter Pr.08-31–Pr.08-33. The setting method for Pr.08-31–08-33 is the same as that for Pr.08-01–08-03.
- The two sets of PID parameters switch automatically according to the frequency and deviation. Switch according to the output frequency:
  - When the output frequency is between Pr.01-07 and Pr.01-00, the PID parameter is the linear interpolation value between the two PID parameter groups.



Switch according to the deviation:

- When the deviation absolute value between the set point and feedback is smaller than Pr.08-76 (PID2 Parameter Switch Deviation 1), the first group PID parameters are used.
- When the deviation absolute value between the set point and feedback is larger than Pr.08-77 (PID2 Parameter Switch Deviation 2), the second group PID parameters are used.
- When the deviation absolute value between the set point and feedback is between Pr.08-76 and Pr.08-77, the PID parameter is the linear interpolation value between the two PID parameter groups.



08-78 Allowed reverse running time after start-up

Default: 0.0

Settings 0.0–6553.5 sec.

- When Pr.08-78 is not set to 0, allowed reverse running time after start-up is enabled.
- When it set to 1 second, the PID control is not allowed to change the running direction within 0–1 seconds of starting time (Pr.08-21 = 0), and is allowed to change after 1 second of starting time (Pr.08-21 = 1).

08-79 WireBreak detected upper level

Default: 0

Settings 0–100%

08-80 WireBreak detected lower level

Default: 0

Settings 0–100%

08-81 WireBreak detected Time

Default: 0.000

Settings 0.000–65.535 sec.

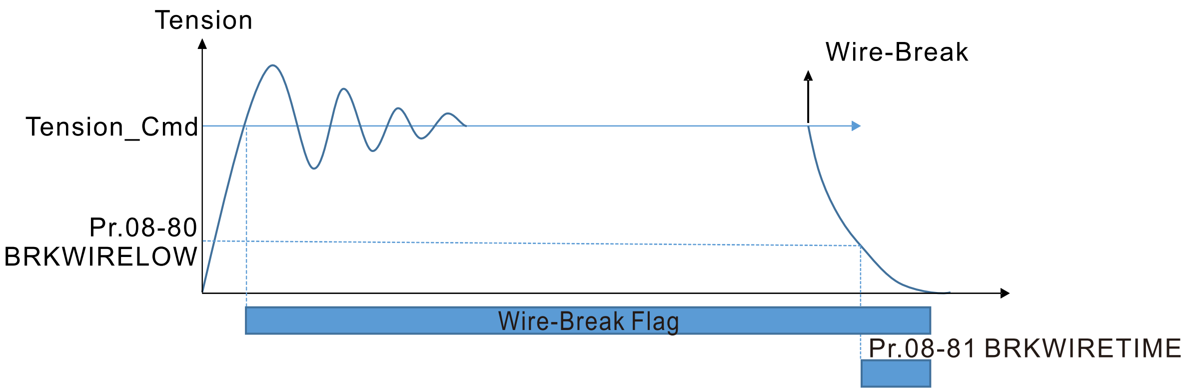
08-82 WireBreak treatment

Default: 0

Settings 0: Warn and do not stop
1: ramp to stop
2: coast to stop
3: Warn, PID hold

- Since the tension control may be activated during unwinding, there must be a mechanism to determine the material cutoff after rewind.

📖 As shown in the figure, the breaking section is set at the lower level. When WireBreak starting, the pendulum is at the lower level that the winding condition is not established. When the pendulum is greater than the command value, the WireBreak condition is established. When the pendulum reaches the lower level and the count value reaches the setting, the drive stopped according to Pr.00-22.



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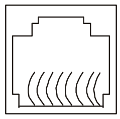
09 Communication Parameters

When using the communication interface, the diagram on the right shows the communication port pin definitions. We recommend that you connect the AC motor drive to your PC by using Delta IFD6530 or IFD6500 as a communication converter.

8←1



RS-485

Modbus RS-485
PIN 1: CAN_H
PIN 2: CAN_L
PIN 3, 7: SGND
PIN 4: SG-
PIN 5: SG+
PIN 6: Reserved
PIN 8: +10VS

✓ You can set this parameter during operation.

✓ 09-00 Communication Address

Default: 1

Settings 1–254

- If RS-485 serial communication controls the AC motor drive, you must set the communication address for this drive in this parameter. Each AC motor drive's communication address must be different.

✓ 09-01 COM1 Transmission Speed

Default: 9.6

Settings 4.8–115.2 Kbps

- Sets the transmission speed of the computer and the drive.
- Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps, or 115.2 Kbps; otherwise, the transmission speed is set to the default 9.6 Kbps.

✓ 09-02 COM1 Transmission Fault Treatment

Default: 3

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning, no fault, and continue operation

- Sets the response for Modbus communication errors in with the host. Set the detection time in Pr.09-03.
- When a transmission error occurs (for example, the error code CE10 is displayed), the error remains even if the transmission status returns to normal, and does not clear automatically. In this case, set a reset command (Reset) to clear the error.

✓ 09-03 COM1 Time-out Detection

Default: 0.0

Settings 0.0–100.0 sec.

- Sets the communication time-out.

09-04 COM1 Communication Protocol

Default: 1

Settings
1: 7, N, 2 (ASCII)
2: 7, E, 1 (ASCII)
3: 7, O, 1 (ASCII)
4: 7, E, 2 (ASCII)
5: 7, O, 2 (ASCII)
6: 8, N, 1 (ASCII)
7: 8, N, 2 (ASCII)
8: 8, E, 1 (ASCII)
9: 8, O, 1 (ASCII)
10: 8, E, 2 (ASCII)
11: 8, O, 2 (ASCII)
12: 8, N, 1 (RTU)
13: 8, N, 2 (RTU)
14: 8, E, 1 (RTU)
15: 8, O, 1 (RTU)
16: 8, E, 2 (RTU)
17: 8, O, 2 (RTU)

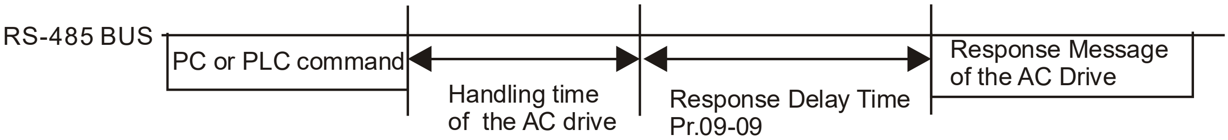
- Control by PC (Computer Link)
  When using the RS-485 serial communication interface, you must specify each drive's communication address in Pr.09-00. The computer then implements control using the drives' individual addresses.
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters.

09-09 Communication Response Delay Time

Default: 2.0

Settings 0.0–200.0 ms

- Sets the response delay time after the AC motor drive receives a communication command as shown in the following.



09-10 Communication Main Frequency

Default: 60.00

Settings 0.00–599.00 Hz

- When you set Pr.00-20 to 1 (RS-485 serial communication), the AC motor drive saves the last Frequency command into Pr.09-10 when there is abnormal power off or momentary power loss. After the drive reboots when power is restored, it checks the frequency in Pr.09-10 if no new Frequency command is input. When a Frequency command of 485 changes (the Frequency command source must be set as Modbus), this parameter also changes.

✎ 09-11 Block Transfer 1
✎ 09-12 Block Transfer 2
✎ 09-13 Block Transfer 3
✎ 09-14 Block Transfer 4
✎ 09-15 Block Transfer 5
✎ 09-16 Block Transfer 6
✎ 09-17 Block Transfer 7
✎ 09-18 Block Transfer 8
✎ 09-19 Block Transfer 9
✎ 09-20 Block Transfer 10
✎ 09-21 Block Transfer 11
✎ 09-22 Block Transfer 12
✎ 09-23 Block Transfer 13
✎ 09-24 Block Transfer 14
✎ 09-25 Block Transfer 15
✎ 09-26 Block Transfer 16

Default: 0

Settings 0–65535

- There is a group of block transfer parameters available in the AC motor drive (Pr.09-11–Pr.09-26). Using communication code 03H, you can store the parameters (Pr.09-11–Pr.09-26) that you want to read.
- For example: according to the Address List (as shown in the table below), Pr.01-42 is shown as 012A. Set Pr.09-11 to 012Ah (the minimum voltage of Pr.01-42 M2 is 2.0 V), and use Pr.09-11 (communication address 090B) to read the communication parameter, the read value is 2.0.

AC motor drive parameters	GGnnH	GG is the parameter group, nn is the parameter number; for example, the address of Pr.04-10 is 040AH.

- Mind if the block transfer parameters are read only. If the data is written to read-only parameters from the upper unit, a communication error may occur.

09-30 Communication Decoding Method

Default: 1

Settings 0: Decoding method 1 (20xx)

1: Decoding method 2 (60xx)

- EtherCAT card only supports decoding method 2 (60xx).

Decoding Method		Decoding Method 1	Decoding Method 2
Source of Operation Control	Digital Keypad	Digital keypad controls the drive action regardless of decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless of decoding method 1 or 2.	
	RS-485	RS-485 controls the drive referring to index 2000h – 20FFh	
	CANopen	Refer to index: 2020-01h–2020-FFh	Refer to index:2060-01h–2060-FFh
	Communication Card	Refer to address: 2000h–20FFh	Refer to address: 6000h–60FFh
	PLC	PLC command controls the drive action regardless of decoding method 1 or 2.	

NOTE: Refer to section 15-4 CANopen Supported Index for the definition of 6000H.

09-31 Internal Communication Protocol

Default: 0

Settings 0: Modbus 485
-1: Internal communication slave 1
-2: Internal communication slave 2
-3: Internal communication slave 3
-4: Internal communication slave 4
-5: Internal communication slave 5
-6: Internal communication slave 6
-7: Internal communication slave 7
-8: Internal communication slave 8
-10: Internal communication master
-12: Internal PLC control

📖 When it is defined as internal communication, refer to Section 16-10 for Main Control Terminal of Internal Communication.

📖 When it is defined as internal PLC control, refer to Section 16-11 for Remote IO control application (using MODRW).

✓ 09-33 PLC Command Force to 0

Default: 0

Settings 0–65535

📖 Defines whether the Frequency command or the Speed command must be cleared to zero or not before the PLC starts the next scan.

bit	Explanation
bit 0	Before PLC scan, set the PLC target frequency = 0
bit 1	Before PLC scan, set the PLC target torque = 0
bit 2	Before PLC scan, set the speed limit of torque control mode = 0

09-35 PLC Address

Default: 2

Settings 1–254

09-36 CANopen Slave Address

Default: 2

Settings 0: Disable
1–127

09-37 CANopen Speed

Default: 0

Settings 0: 1 Mbps
1: 500 kbps
2: 250 kbps
3: 125 kbps
4: 100 kbps (Delta only)
5: 50 kbps

09-39 CANopen Warning Record

Default: 0

Settings bit 0: CANopen software disconnection 1 (CANopen Guarding Time-out)
bit 1: CANopen software disconnection 2 (CANopen Heartbeat Time-out)
bit 3: CANopen SDO time-out
bit 4: CANopen SDO buffer overflow
bit 5: CANopen hardware disconnection warning (Can Bus OFF)
bit 6: Error protocol for CANopen

09-40 CANopen Decoding Method

Default: 1

Settings 0: Use Delta-defined decoding method
1: Use CANopen Standard DS402 protocol

09-41 CANopen Communication Status

Default: Read Only

Settings 0: Node Reset State
1: Com Reset State
2: Boot up State
3: Pre-operation State
4: Operation State
5: Stop State

09-42 CANopen Control Status

Default: Read Only

Settings 0: Not ready for use state
1: Inhibit start state
2: Ready to switch on state
3: Switched on state
4: Enable operation state
7: Quick stop active state
13: Error reaction activation state
14: Error state

09-43 CANopen Reset Index

Default: 65535

Settings bit 0: CANopen reset, the internal address 20XX is 0
bit 1: CANopen reset, the internal address 264X is 0
bit 2: CANopen reset, the internal address 26AX is 0
bit 3: CANopen reset, the internal address 60XX is 0

09-60 Communication Card Identifications

Default: Read Only

Settings 0: No communication card
1: DeviceNet Slave
2: PROFIBUS-DP Slave
3: CANopen Slave / Master
5: EtherNet/IP Slave
6: EtherCAT
10: Backup Power Supply
12: PROFINET

09-61 Firmware Version of Communication Card
09-62 Product Code
09-63 Error Code

Default: Read Only

Settings Read only

09-70 Communication Card Address (for DeviceNet or PROFIBUS)

Default: 1

Settings DeviceNet: 0–63
PROFIBUS-DP: 1–125

09-71 DeviceNet Speed Setting (for DeviceNet)

Default: 2

Settings Standard DeviceNet:
0: 125 Kbps
1: 250 Kbps
2: 500 Kbps
3: 1 Mbps (Delta Only)
Non-standard DeviceNet (Delta only) :
0: 10 Kbps
1: 20 Kbps
2: 50 Kbps
3: 100 Kbps
4: 125 Kbps
5: 250 Kbps
6: 500 Kbps
7: 800 Kbps

09-72 Other DeviceNet Speed Settings (for DeviceNet)

Default: 0

Settings 0: Disable:
In this mode, baud rate must be 125 Kbps, 250 Kbps, 500 Kbps, or 1 Mbps in the standard DeviceNet speed.
1: Enable:
In this mode, DeviceNet baud rate must be same as that for CANopen baud rate (0–8).

- Use this parameter with Pr.09-71.
- 0: The baud rate can only be set to 125 Kbps, 250 Kbps and 500 Kbps as a standard DeviceNet speed.
- 1: The DeviceNet communication rate can be the same as that for CANopen (setting 0–8).

09-75 Communication Card IP Configuration (for EtherNet)

Default: 0

Settings 0: Static IP
1: Dynamic IP (DHCP)

- 0: Set the IP address manually.
- 1: IP address is automatically set by the host controller.

09-76 Communication Card IP Address 1 (for EtherNet)
09-77 Communication Card IP Address 2 (for EtherNet)
09-78 Communication Card IP Address 3 (for EtherNet)
09-79 Communication Card IP Address 4 (for EtherNet)

Default: 0

Settings 0–255

- Use Pr.09-76–09-79 with a communication card.

09-80 Communication Card Address Mask 1 (for EtherNet)
09-81 Communication Card Address Mask 2 (for EtherNet)
09-82 Communication Card Address Mask 3 (for EtherNet)
09-83 Communication Card Address Mask 4 (for EtherNet)

Default: 0

Settings 0–255

09-84 Communication Card Gateway Address 1 (for EtherNet)
09-85 Communication Card Gateway Address 2 (for EtherNet)
09-86 Communication Card Gateway Address 3 (for EtherNet)
09-87 Communication Card Gateway Address 4 (for EtherNet)

Default: 0

Settings 0–255

✎ 09-88 Communication Card Password (low word) (for EtherNet)
✎ 09-89 Communication Card Password (high word) (for EtherNet)

Default: 0

Settings 0–99

✎ 09-90 Reset Communication Card (for EtherNet)

Default: 0

Settings 0: Disable

1: Reset, return to default

✎ 09-91 Additional Settings for the Communication Card (for EtherNet)

Default: 0

Settings bit 0: Enable IP filter

bit 1: Enable Internet parameters (1 bit)

When the IP address is set, this bit is enabled. After updating the parameters for the communication card, this bit changes to be disabled.

bit 2: Enable login password (1 bit)

When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to be disabled.

✎ 09-92 Communication Card Status (for EtherNet)

Default: 0

Settings bit 0: Enable password

When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.

10 Speed Feedback Control Parameters

You can set this parameter during operation.

10-00 Encoder Type Selection

Default: 0

Settings 0: Disabled
1: ABZ
3: Resolver 1x PM encoder
5. Pulse input (MI7)

- When you use the MI7 single-phase pulse input function, you must use it with Pr.00-20 = 4, Pr.10-00 = 5 and Pr.10-16 = 5
- When you use the MI6 and MI7 two-phase pulse input function, you must use them with Pr.00-20 = 4, Pr.10-00 = 0, Pr.10-16 = 1–4
- When you use MI7 single-phase pulse input as speed feedback, you must use it with Pr.10-00 =5 and Pr.10-02 = 5. The drive calculates the MI7 single-phase pulse input speed when the control modes are VF, VFPG, SVC, IM / PM FOC Sensorless, or IM / PM TQC.
- When you use MI6 and MI7 two-phase pulse input as speed feedback, you must use them with Pr.10-00 = 5 and Pr.10-02 = 1–4. The drive calculates the MI6 and MI7 two-phase pulse input speed when the control modes are VF, VFPG, SVC, IM / PM FOC Sensorless, or IM / PM TQC.

10-01 Encoder Pulses per Revolution

Default: 600

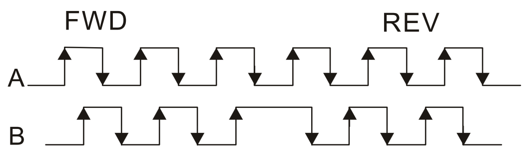
Settings 1–20000

- This parameter sets the encoder pulses per revolution (ppr). It is a feedback control signal source when using PG. The encoder sets the number of pulses for the motor rotating through one rotation. The A / B phase cycle generates the pulse number.
- This setting is also the encoder resolution. The speed control is more accurate with higher resolution.
- If you set this parameter incorrectly, it may cause motor stall, drive over-current, or a magnetic pole origin detection error for the PM motor in closed-loop control. When using the PM motor, you must perform the magnetic pole origin point detection (Pr.05-00 = 4) again if you modify the content of this parameter.

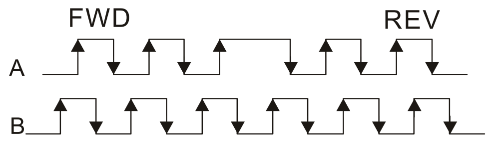
10-02 Encoder Input Type Setting

Default: 0

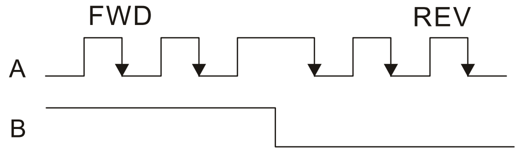
Settings 0: Disable
1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.



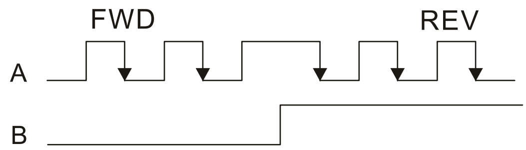
2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees.



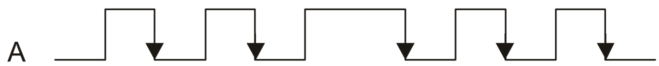
3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction).



4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction).



5: Single-phase input (MI7)



NOTE:

1: When the MH300 inputs the A / B phase pulse, you must connect the MI6 terminal to the A-phase pulse, and the MI7 terminal to the B-phase pulse.

2: When the MH300 uses single-phase input, it disables the MI6 function and prohibits any signal connection.

📖 Velocity control: PG2 acts according to the setting for Pr.10-01 (PG1 ppr), and will not be affected by PG1 pulse (single-phase pulse or A / B phase pulse). When the setting for Pr.10-00, Pr.10-01 and Pr.10-02 are changed, cycle the power of the motor drive.

1. The speed formula is (input ppr) / (PG1 ppr), when PG1 ppt = 2500, PG2 is single-phase pulse, and the input pps is 1000 (1000 pulse per second), the speed should be (1000 / 2500) = 0.40 Hz.
2. The same pps inputs of A / B phase pulse or single-phase pulse input should get the same frequency command.

✎ 10-03 Frequency Division Output Setting (Denominator)

Default: 1

Settings 1–255

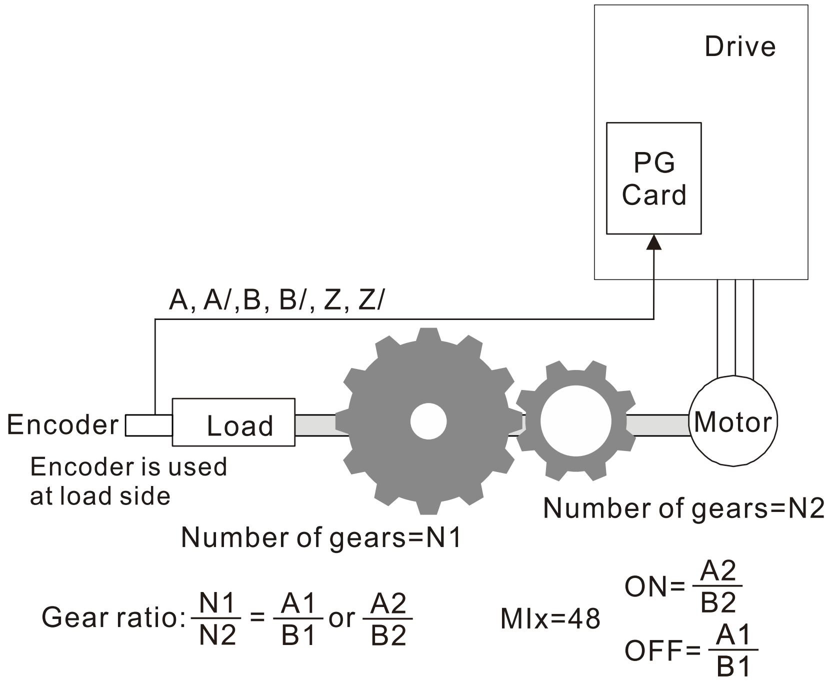
📖 Sets the denominator for the frequency division of the PG card feedback and output. When you set it to 2 with feedback 1024 ppr, PG OUT (pulse output) of PG card is 1024 / 2 = 512 ppr.

10-04 Electrical Gear at Load Side A1
10-05 Electrical Gear at Motor Side B1
10-06 Electrical Gear at Load Side A2
10-07 Electrical Gear at Motor Side B2

Default: 100

Settings 1–65535

- Use Pr.10-04–10-07 with the multi-function input terminal setting 48 to switch to Pr.10-04–10-05 or Pr.10-06–10-07, as shown in the diagram below.



A1 = Mechanical Gear A1 at Load Side (Pr.10-04)
B1 = Mechanical Gear B1 at Motor Side (Pr.10-05)
A2 = Mechanical Gear A2 at Load Side (Pr.10-06)
B2 = Mechanical Gear B2 at Motor Side (Pr.10-07)

10-08 Encoder Feedback Fault Treatment

Default: 2

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

10-09 Encoder Feedback Fault Detection Time

Default: 1.0

Settings 0.0–10.0 sec. (0: disabled)

- When there is an encoder loss, an encoder signal error, a pulse signal setting error or a signal error, if the duration exceeds the detection time for the encoder feedback fault (Pr.10-09), the encoder signal error occurs. Refer to Pr.10-08 for encoder feedback fault treatment.
- When the speed controller signal is abnormal, if time exceeds the detection time for the encoder feedback fault (Pr.10-09), the feedback fault occurs. Refer to Pr.10-08 for the encoder feedback fault treatment.

10-10 Encoder Stall Level

Default: 115

Settings 0–120% (0: No function)

This parameter determines the maximum encoder feedback signal allowed before a fault occurs. The maximum operation frequency for Pr.01-00 = 100%

10-11 Encoder Stall Detection Time

Default: 0.1

Settings 0.0–2.0 sec.

10-12 Encoder Stall Action

Default: 2

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

When the drive output frequency exceeds the encoder stall level (Pr.10-10), the drive starts to count the time. When the error time exceeds the encoder stall detection time (Pr.10-11), the drive implements the encoder stall treatment.

10-13 Encoder Slip Range

Default: 50

Settings 0–50% (0: No function)

10-14 Encoder Slip Detection Time

Default: 0.5

Settings 0.0–10.0 sec

10-15 Encoder Stall and Slip Error Action

Default: 2

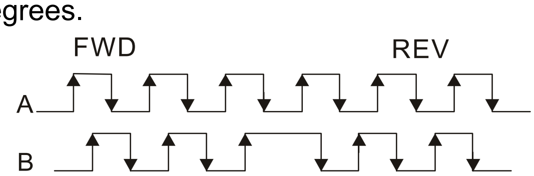
Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

This parameter acts on the settings for Pr.10-13–Pr.10-15:
When the value of (rotation speed – motor frequency) exceeds the Pr.10-13 setting, and the detection time exceeds Pr.10-14; the drive starts to count the time. If the detection time exceeds Pr.10-14, the encoder feedback signal error occurs.

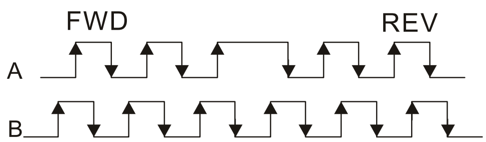
10-16 Pulse Input Type Setting

Default: 0

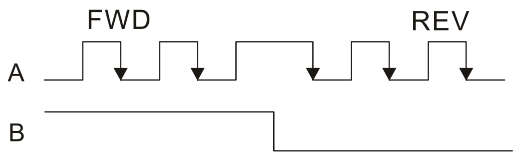
Settings 0: Disable
1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.



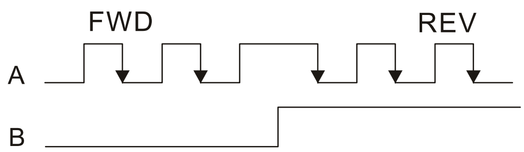
2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees.



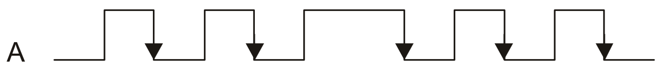
3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction).



4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction).



5: Single-phase input (MI7)



- When this setting is different from the Pr.10-02 setting and the source of the Frequency command is pulse input (Pr.00-20 set to 5), it causes a four-times frequency problem.
  Example:
  Assume that Pr.10-01 = 1024, Pr.10-02 = 1, Pr.10-16 = 3, Pr.00-20 = 5, MI = 37 and ON, then the pulse needed to rotate the motor one revolution is 4096 (1024*4), with a four-times frequency problem.
- Assume that Pr.10-01 = 1024, Pr.10-02 = 1, Pr.10-16 = 1, Pr.00-20 = 5, MI = 37 and ON, the pulse needed to rotate the motor one revolution is 1024 (1024*1), without four-times frequency problem.
- When using two-phase pulse input, you must set pulse direction to MI6, and enter the pulses to MI7.
- When using single-phase pulse input, MI6 is invalid, you must enter the pulses to MI7 and forbid connecting to any signals.
- When Pr.10-16 = 5, you cannot set Pr.10-02 as 5 (single-phase input, MI7) to execute closed-loop control.
- The setting steps when using the MI7 single-phase pulse input as the frequency command:
  1. Set Pr.00-20 = 4: Pulse inputs without direction command
  2. Set Pr.10-00 = 0: Disabled
  3. Set Pr.10-01 for motor pulse per revolution (ppr)
  4. Set Pr.10-16 =5: Single-phase pulse input
  5. Set Pr.00-04 = 22 to check if the pulse input frequency is right.

10-17 Electrical Gear A
10-18 Electrical Gear B

Default: 100

Settings 1–65535

- Rotation speed = pulse frequency / encoder pulses (Pr.10-01) * Electrical Gear A / Electrical Gear B.

10-19 Positioning for Encoder Position

Default: 0

Settings -32767–32767 pulses

- Determines the internal position in the position mode.
- Use this with the multi-function input terminal setting = 35 (enable single-point position control).
- When set to 0, it is the Z-phase position of the encoder.

10-20 Error Range for Encoder Position Reached

Default: 10

Settings 0–65535 pulses

- This parameter determines the range for the internal positioning position reached.
  Example:
  When you set the position for Pr.10-19 (Positioning for Encoder Position) and Pr.10-20 to 1000, it reaches the position if the position is between 990-1010 after positioning.

10-21 Filter Time (PG2)

Default: 0.100

Settings 0.000–65.535 sec.

- When you set Pr.00-20 to 4, the system treats the pulse command as a Frequency command. Use this parameter to suppress the speed command jump.

10-24 FOC & TQC Function Control

Default: 0

Settings 0–65535

- Only bit = 0 is used for closed-loop, other bits are used for open-loop.

bit	Description
0	ASR controller under torque control. 0: use PI as ASR; 1: use P as ASR
1–10	NA
11	Activates DC brake when executing the zero torque command. 0: ON; 1: OFF
12	FOC Sensorless mode, crossing zero means the speed goes from negative to positive or positive to negative (forward to reverse direction or reverse to forward direction). 0: determined by stator frequency; 1: determined by speed command
13	NA
14	NA
15	Direction control in open-loop status. 0: Switch ON direction control; 1: Switch OFF direction control

✎ 10-25 FOC Bandwidth for Speed Observer

Default: 40.0

Settings 20.0–100.0 Hz.

- Setting the speed observer to a higher bandwidth could shorten the speed response time but creates greater noise interference during the speed observation.

✎ 10-26 FOC Minimum Stator Frequency

Default: 2.0

Settings FOC Minimum Stator Frequency

- Sets the stator frequency lower limit in operation status. This setting ensures the stability and accuracy of observer and avoids interferences from voltage, current and motor parameter. fN is the motor rated frequency.

✎ 10-27 FOC Low-pass Filter Time Constant

Default: 50

Settings 1–1000 ms

- Sets the low-pass filter time constant of a flux observer at start-up. If you cannot activate the motor during high speed operation, lower the setting for this parameter.

✎ 10-28 FOC Gain for Excitation Current Rise Time

Default: 100

Settings 33–100% Tr

- Sets the drive's excitation current rise time when it activates in sensorless torque mode. When the drive's activation time is too long in torque mode, adjust this parameter to a shorter time value. Tr is the rotor time constant.

✎ 10-29 Top Limit of Frequency Deviation

Default: 20.00

Settings 0.00–100.00 Hz

- Limits the maximum frequency deviation.
- If you set this parameter too high, an abnormal feedback malfunction occurs.
- If the application needs a higher setting for Pr.10-29, note that a higher setting results in larger motor slip, which causes a PG Error (PGF3, PGF4). In this case, you can set Pr.10-10 and Pr.10-13 to 0 to disable PGF3 and PGF4 detection, but you must make sure the MI7 wiring and application are correct; otherwise it may lose the instant PG protection. Pr.10-29 setting too high is not commonly done.

10-30 Resolver Pole Pair

Default: 1

Settings 1–50

- To use the Pr.10-30 function, you must set Pr.10-00 = 3 (Resolver Encoder) first.

10-31 I/F Mode, Current Command

Default: 40

Settings 0–150% rated current of the motor

- Sets the current command for the drive in the low speed area (low speed area: Frequency command < Pr.10-39). When the motor stalls on heavy duty start-up or forward/reverse with load, increase the parameter value. If the inrush current is too high and causes oc stall, then decrease the parameter value.

10-32 PM FOC Sensorless Speed Estimator Bandwidth

Default: 5.00

Settings 0.00–600.0 Hz

- Sets the speed estimator bandwidth. Adjust the parameter to change the stability and the accuracy of the motor speed.
- If there is low frequency vibration (the waveform is similar to sine wave) during the process, then increase the bandwidth. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the bandwidth.

10-34 PM Sensorless Speed Estimator Low-pass Filter Gain

Default: 1.00

Settings 0.00–655.35

- Changes the response speed of the speed estimator.
- If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the gain. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

10-35 ARM (Kp)

Default: 1.00

Settings 0.00–3.00

10-36 ARM (Ki)

Default: 0.20

Settings 0.00–3.00

10-39 Frequency Point to Switch from I/F Mode to PM Sensorless Mode

Default: 20.00

Settings 0.00–599.00 Hz

- Sets the frequency for the switch point from low frequency to high frequency.
- Due to the weak back-EMF in the low frequency area, PM sensorless mode cannot estimate the accurate speed and position of the rotor. Thus, using I/F mode control is more suitable. In the medium-to-high frequency area, PM sensorless can accurately estimate the back-EMF, stabilizes and control the motor with lower current.
- If the switch point is too low and PM sensorless mode operates at a too low frequency, the motor does not generate enough back-EMF to let the speed estimator measure the rotor right position and speed, and causes stall and oc when running at the switch point frequency.

- If the switch point is too high, the drive easily runs in the frequency area of the I/F mode for a long time, which generates a larger current and cannot save energy. (If the current value for Pr.10-31 is too high, the high switch point makes the drive continue to output with the setting value for Pr.10-31).

10-40 Frequency Point to Switch from PM Sensorless Mode to I/F Mode

Default: 20.00

Settings 0.00–599.00 Hz

- Sets the switch point from high frequency to low frequency.
- Due to the weak back-EMF in the low frequency area, PM sensorless mode cannot estimate the accurate speed and position of the rotor. Thus, using I/F mode control is more suitable. In the medium-to-high frequency area, PM sensorless can accurately estimate the back-EMF, stabilizes and control the motor with lower current.
- If the switch point is too low and PM sensorless mode operates at a too low frequency, the motor does not generate enough back-EMF to let the speed estimator measure the rotor right position and speed, and causes stall and oc when running at the switch point frequency.
- If the switch point is too high, the drive easily runs in the frequency area of the I/F mode for a long time, which generates a larger current and cannot save energy. (If the current value for Pr.10-31 is too high, the high switch point makes the drive continue to output with the setting value for Pr.10-31).

10-42 Initial Angle Detection Pulse Value

Default: 1.0

Settings 0.0–3.0

- The angle detection is fixed to 3: Use the pulse injection method to start. The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotor's position. A larger pulse might cause oc.
- Increase the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.
- Refer to Section 12-2 Adjustment & Application for detailed motor adjustment procedure.

10-43 PG Card Version

Default: Read only

Settings 0.00–655.35

- Corresponding version reference:

PG02U	21.XX
PG01U	31.XX
PG01O / PG01L	11.XX
PG02O / PG02L	14.XX
PG01R	41.XX

10-49 Zero Voltage Time During Start-up

Default: 00.000

Settings 00.000–60.000 sec.

- This parameter is valid only when the setting of Pr.07-12 (Speed Tracking during Start-up) = 0.
- When the motor is in static state at start-up, this increases the accuracy when estimating angles. In order to put the motor in static state, set the three-phase drive output to 0 V to the motor. The Pr.10-49 setting time is the length of time for three-phase output at 0 V.
- It is possible that even when you apply this parameter, the motor cannot go in to the static state because of inertia or some external force. If the motor does not go into the static state in 0.2 seconds, increase this setting value appropriately.
- If Pr.10-49 is too high, the start-up time is longer. If it is too low, then the braking performance is weak.

10-51 Injection Frequency

Default: 500

Settings 0–1200 Hz

- This parameter is a high frequency injection command in PM SVC control mode, and usually you do not need to adjust it. But if a motor's rated frequency (for example, 400 Hz) is too close to the frequency setting for this parameter (that is, the Default of 500 Hz), it affects the accuracy of the angle detection. Refer to the setting for Pr.01-01 before you adjust this parameter.
- If the setting value for Pr.00-17 is lower than Pr.10-51*10, then increase the frequency of the carrier wave.
- Pr.10-51 is valid only when Pr.10-53 = 2.

10-52 Injection Magnitude

Default: 15.0 / 30.0

Settings 0.0–200.0 V

- The parameter is the magnitude command for the high frequency injection signal in PM SVC control mode.
- Increasing the parameter can increase the accuracy of the angle estimation, but the electromagnetic noise might be louder if the setting value is too high.
- The system uses this parameter when the motor's parameter is "Auto". This parameter influences the angle estimation accuracy.
- When the ratio of the salient pole (Lq/Ld) is lower, increase Pr.10-52 to make the angle detection more accurate.
- Pr.10-52 is valid only when Pr.10-53 = 2.

10-53 Angle Detection Method

Default: 0

Settings 0: Disabled
1: Force attracting the rotor to zero degrees
2: High frequency injection
3: Pulse injection

- Set to 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to 1.

11 Advanced Parameters

In this parameter group, ASR stands for Adjust Speed Regulator.

✓ You can set this parameter during operation.

11-00 System Control

Default: 0

Settings bit 0: Auto-tuning for ASR

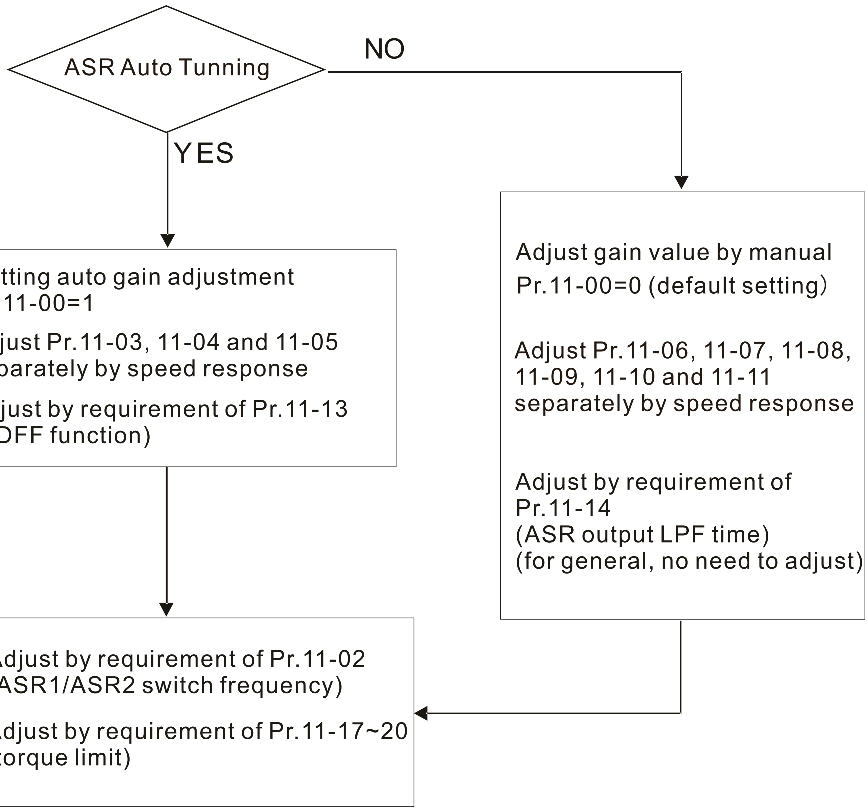
bit 1: Inertia estimate (only in FOCPG mode)

bit 2: Zero servo

bit 3: Dead time compensation closed

bit 7: Save or do not save the frequency

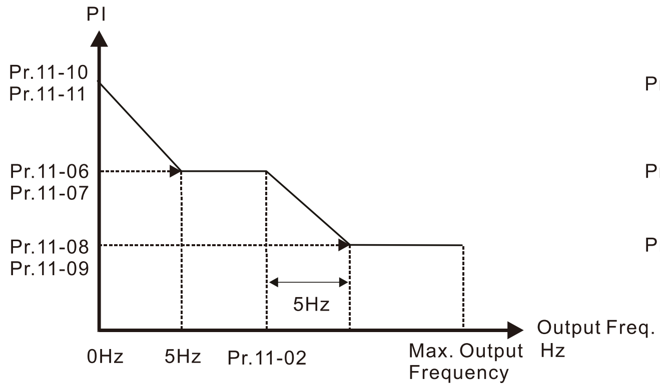
- bit 0 = 0: Manual adjustment for ASR gain, Pr.11-06–Pr.11-11 are valid and Pr.11-03–Pr.11-05 are invalid.
- bit 0 = 1: Auto-adjustment for ASR gain, the system automatically generates an ASR setting, Pr.11-06–Pr.11-11 are invalid and Pr.11-03–Pr.11-05 are valid.



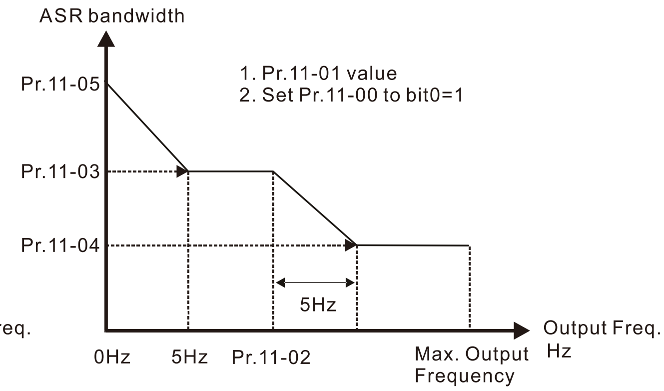
- When the drive needs to keep a certain torque at zero-speed, or it needs a steady frequency output at extreme low speed, increase Pr.11-05 zero-speed bandwidth appropriately. When the speed is in high-speed area, if the output current trembles seriously and makes the drive vibrate, then decrease the high-speed bandwidth.

For example:

Manual gain	Response: [Pr.11-10, Pr.11-11] > [Pr.11-06, Pr.11-07] > [Pr.11-08, Pr.11-09]
Auto gain	Pr.11-05 = 15 Hz, Pr.11-03 = 10 Hz, Pr.11-04 = 8 Hz



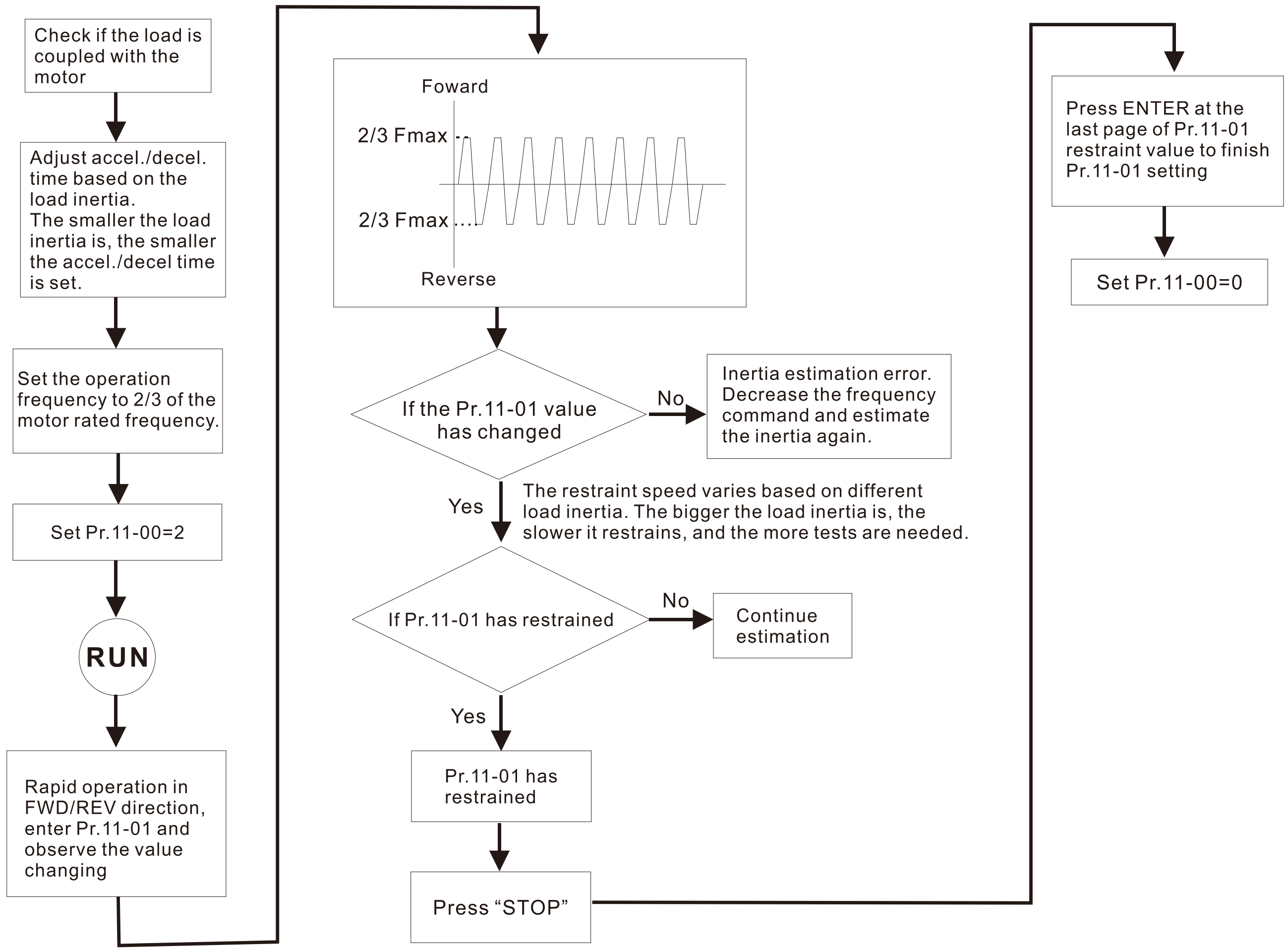
ASR adjustment- manual gain



ASR adjustment- auto gain

📖 bit1=0: no function.

bit1=1: Inertia estimation function is enabled. bit1 setting would not activate the estimation process, set Pr.05-00=12 to begin FOC / TQC Sensorless inertia estimating.



📖 bit2 = 0: no function.

bit2 = 1: when frequency command is less than Fmin (Pr.01-07), it will use the zero-servo function as position control.

📖 bit 7 = 0: Save the frequency before power is OFF. When power is ON again, the save frequency is displayed.

📖 bit 7 = 1: Do not save the frequency before power is OFF. When power is ON again, 0.00 Hz is the displayed frequency.

11-01 Per Unit of System Inertia

Default: 256

Settings 1–65535 (256 = 1 PU)

- To get the system inertia per unit from Pr.11-01, you need to set Pr.11-00 to bit1 = 1 and execute continuous forward/reverse running.
- When Pr.11-01 = 256, it is 1PU. So if you use a 2 HP motor, the 2HP motor inertia is 4.3 kg-cm^2 according to the table below. If Pr.11-01 = 10000 after tuning, the system inertia is (10000 / 256) x 4.3 kg-cm^2.
- Perform the operation test with load based on the inertia after tuning. Run the motor in acceleration, deceleration, and steady speed and observe the values. If values between speed feedback and speed command are close, steady-state error is small and overshoot is less, then this inertia is a better one.
- If the Iq current command from ASR has high-frequency glitch, then decrease the setting. If the response time of sudden loading is too slow, then increase the setting.
- When using torque mode as the control mode, perform the tuning with speed mode first to see if the tuned inertia can work normally. After verifying with speed mode, change the control mode to torque mode.

Unit of induction motor system inertia is kg-cm^2:

Power	Setting
1 HP	0.00023
2 HP	0.00043
3 HP	0.00083
5 HP	0.00148
7.5 HP	0.0026

Power	Setting
10 HP	0.00358
15 HP	0.00743
20 HP	0.00953
25 HP	0.01428
30 HP	0.01765

11-02 ASR1 / ASR2 Switch Frequency

Default: 7.00

Settings 5.00–599.00 Hz

- Sets the low-speed and high-speed ASR switching point in the FOC area.
- Provides flexibility to meet two needs: in the high-speed region of the estimator switch point it has a high response, and in the low-speed region of the estimator switch point it has a lower response.
- The recommended switching point is higher than Pr.10-39.
- A low setting does not cover Pr.10-39. If the setting is too high, high-speed range is too narrow.

11-03 ASR1 Low-speed Bandwidth

Default: 10

Settings 1–40 Hz (IM) / 1–100 Hz (PM)

11-04 ASR2 High-speed Bandwidth

Default: 10

Settings 1–40 Hz (IM) / 1–100 Hz (PM)

11-05 Zero-speed Bandwidth

Default: 10

Settings 1–40 Hz (IM) / 1–100 Hz (PM)

- After estimating the inertia and setting Pr.11-00 bit 0 = 1 (auto-tuning), you can adjust Pr.11-03, 11-04 and 11-05 separately according to the speed response. The larger the setting value, the faster the response. Pr.11-02 is the switch frequency for the low-speed/high-speed bandwidth.

11-06 ASR1 Gain

Default: 10

Settings 0–40 Hz (IM) / 1–100 Hz (PM)

11-07 ASR1 Integral Time

Default: 0.100

Settings 0.000–10.000 sec.

11-08 ASR2 Gain

Default: 10

Settings 0–40 Hz (IM) / 0–100 Hz (PM

11-09 ASR2 Integral Time

Default: 0.100

Settings 0.000–10.000 sec.

11-10 ASR Zero Speed Gain

Default: 10

Settings 0–40 Hz (IM) / 0–100 Hz (PM)

11-11 ASR Zero Speed Integral Time

Default: 0.100

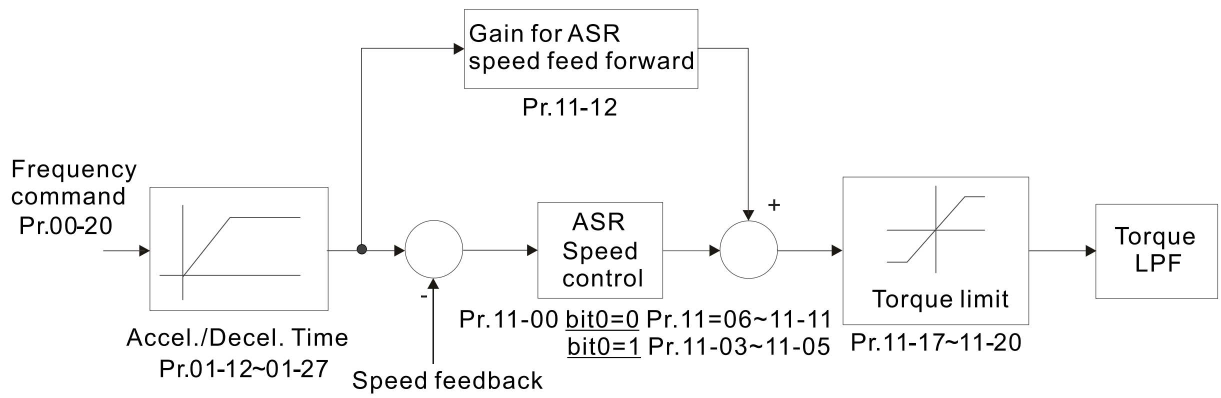
Settings 0.000–10.000 sec.

11-12 Gain for ASR Speed Feed Forward

Default: 0

Settings 0–200%

- This function enables when Pr.11-00 bit0 = 1.
- Increase the setting for Pr.11-12 to reduce the command tracking difference, and improve the speed response. Use this function for speed tracking applications.
- Set Pr.11-01 correctly to get excellent improvement of the speed response.

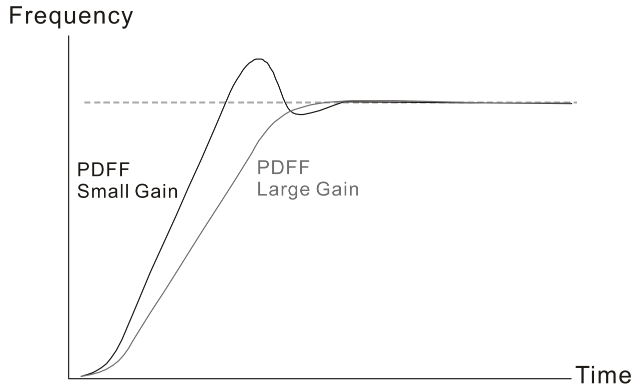


11-13 PDFF Gain Value

Default: 30

Settings 0–200%

- This parameter is invalid when Pr.05-24 = 1.
- This parameter is valid only when Pr.11-00 bit0 = 1.
- After you estimate and set Pr.11-00 bit0=1 (auto-tuning), use Pr.11-13 to reduce overshoot. However, a shift of the curve may occur earlier. In this case, you can set Pr.11-13 = 0 first, and then increase the setting value to "a condition with best acceleration and without overshoot" when the acceleration time meets your application but overshoot occurs.
- Increasing Pr.11-13 improves the overshoot of speed tracking, but an excessive value may reduce the transient response.
- Increasing Pr.11-13 enhances the system stiffness in high-speed steady state, and reduce the speed transient fluctuation at a sudden loading.
- Ensure that you set Pr.11-01 system inertia correctly to get excellent improvement of the speed response.



11-14 ASR Output Low-pass Filter Time

Default: 0.008

Settings 0.000–0.350 sec.

- Sets the ASR command filter time.

11-15 Notch Filter Depth

Default: 0

Settings 0–20 dB

11-16 Notch Filter Frequency

Default: 0.0

Settings 0.00–200.00 Hz

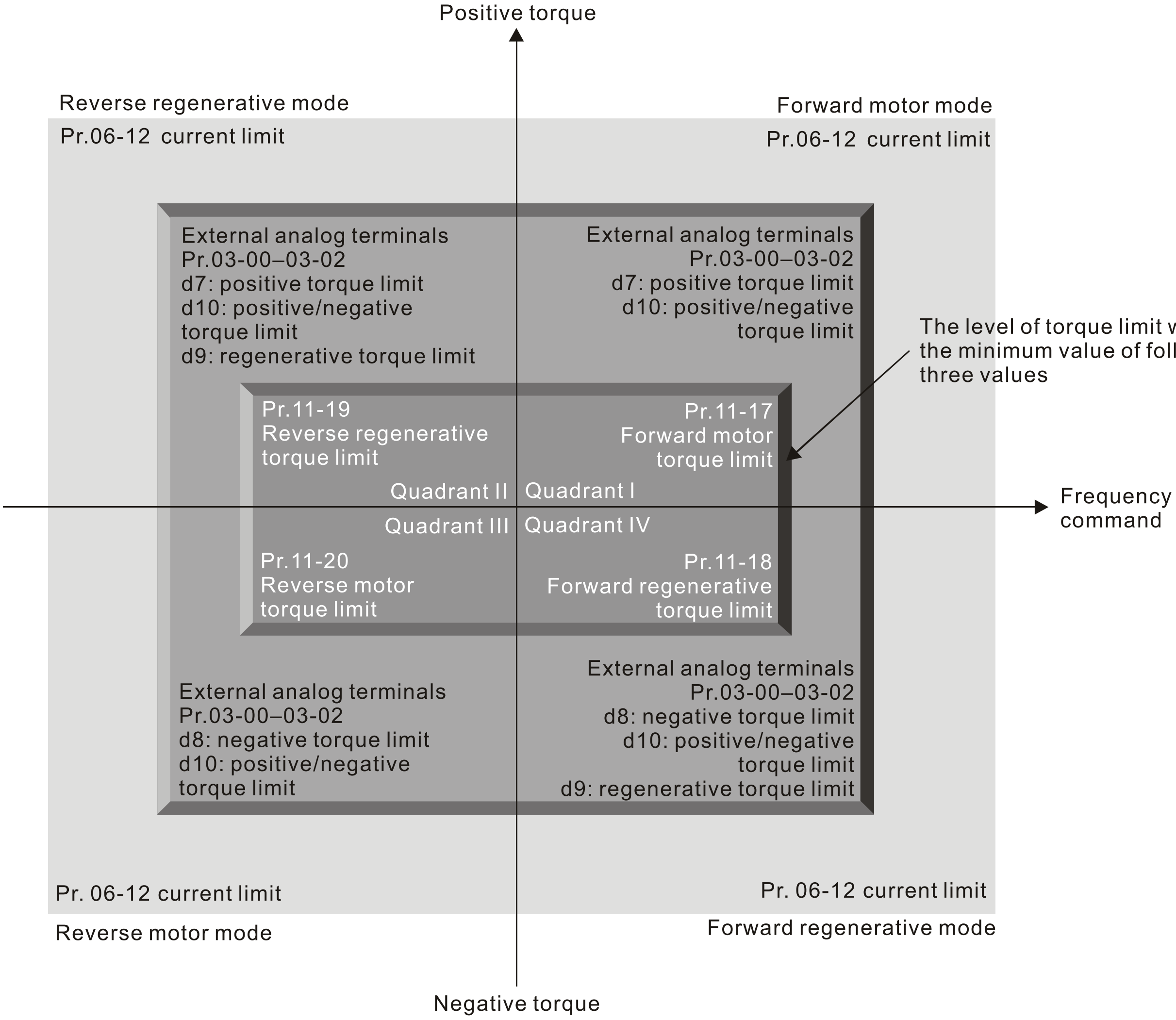
- Sets the resonance frequency of the mechanical system. Adjust it to a smaller value to suppress the mechanical system resonance.
- A larger value improves resonance suppression function.
- The notch filter frequency is the mechanical frequency resonance.

11-17 Forward Motor Torque Limit
11-18 Forward Regenerative Torque Limit
11-19 Reverse Motor Torque Limit
11-20 Reverse Regenerative Torque Limit

Default: 500

Settings 0–500%

- FOCPG & FOC Sensorless mode:
  The motor rated current = 100%. The settings value for Pr.11-17–11-20 is compare with Pr.03-00 = 7, 8, 9, 10. The minimum value of the comparison result is the torque limit. The diagram below illustrates the torque limit.
- TQCPG and TQC Sensorless mode:
  The function of Pr.11-17–11-20 is the same as FOC; however, in this case, the torque limit and the torque command executes the output torque limit at the same time. Therefore, the minimum value between Pr.11-17–11-20 and Pr.06-12 becomes the current output torque limit.
- Refer to Pr.11-34 for calculation equation for the motor rated torque.



- All control modes are based on 100% of the motor rated current except:
  IM: VF, VFPG, SVC
  PM: PMSVC

11-21 Flux Weakening Curve for Motor 1 Gain Value

Default: 90

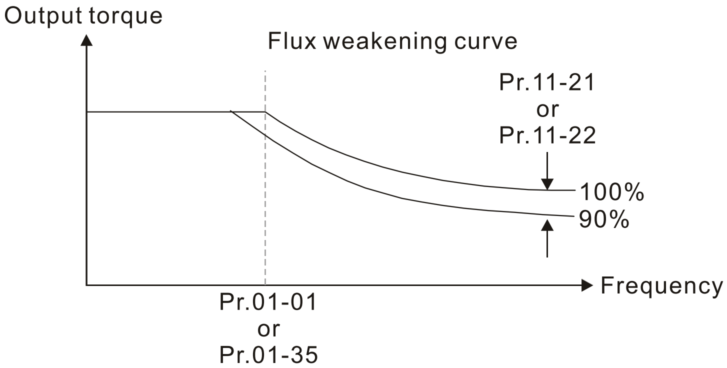
Settings 0–200%

11-22 Flux Weakening Curve for Motor 2 Gain Value

Default: 90

Settings 0–200%

- Adjusts the output voltage for the flux weakening curve.
- For the spindle application, use this adjustment method:
  1. Run the motor to the highest frequency.
  2. Observe the output voltage.
  3. Adjust the Pr.11-21 (motor 1) or Pr.11-22 (motor 2) setting to make the output voltage reach the motor rated voltage.
  4. The larger the setting value, the greater the output voltage.



11-23 Flux Weakening Area Speed Response

Default: 65

Settings 0–150%

- Controls the speed in the flux weakening area. The larger the value set for Pr.11-23, the faster the acceleration/deceleration. In general, you do not need to adjust this parameter.

11-24 APR Gain

Default: 10.00

Settings 0.00–40.00 Hz (IM) / 0.00–100.00 Hz (PM)

- Sets the Kip gain of the internal position (MIx = 35).
- The pulse-train position command (MIx = 37) controls Kp gain, and this can adjust the value of Pr.11-05 directly. The larger the setting value of Pr.11-05, the smaller the static error.

11-25 Gain Value for the APR Feed Forward

Default: 30

Settings 0–100

- This parameter is valid to the internal position (MIx = 35) and position control pulse command (MIx = 37). A larger value set can shorten the pulse-train tracking error, but it may easily to cause overshoot.

11-26 APR Curve Time

Default: 3.00

Settings 0.00–655.35 sec.

- This is valid when the multi-function input terminal is set to 35 (ON). The larger the setting value, the longer the positioning time.

11-27 Maximum Torque Command

Default: 100

Settings 0–500%

- Determines the upper limit of the torque command (motor rated torque is 100%).
- Refer to Pr.11-34 for calculation equation for the motor rated torque.

11-28 Torque Offset Source

Default: 0

Settings 0: Disable
1: Analog signal input
2: RS-485 communication (Pr.11-29)
3: Controlled by external terminal (by Pr.11-30–Pr.11-32)

- Determines the source for the torque offset.
- When it is set to 3 (external terminal control), the torque offset source follows Pr.11-30, Pr.11-31 or Pr.11-32 as the combination of MI setting as 31, 32 or 33 commands. Refer to the following chart:

Normally open (N.O.) contact: ON = contact closed, OFF = contact open

Pr.11-32	Pr.11-31	Pr.11-30	Torque Offset
MI = 33 (Low)	MI = 32 (Mid)	MI = 31 (High)	
OFF	OFF	OFF	None
OFF	OFF	ON	Pr.11-30
OFF	ON	OFF	Pr.11-31
OFF	ON	ON	Pr.11-30 + Pr.11-31
ON	OFF	OFF	Pr.11-32
ON	OFF	ON	Pr.11-30 + Pr.11-32
ON	ON	OFF	Pr.11-31 + Pr.11-32
ON	ON	ON	Pr.11-30 + Pr.11-31 + Pr.11-32

11-29 Torque Offset Setting

Default: 0.0

Settings -100.0–100.0%

- Determines the torque offset command. The motor rated torque is 100%.
- Refer to Pr.11-34 for calculation equation for the motor rated torque.

11-30 High Torque Command Compensation

Default: 30.0

Settings -100.0–100.0%

11-31 Middle Torque Command Compensation

Default: 20.0

Settings -100.0–100.0%

11-32 Low Torque Command Compensation

Default: 10.0

Settings -100.0–100.0%

- When Pr.11-28 is set to 3, the torque offset source uses Pr.11-30, Pr.11-31 or Pr.11-32 determined by the multi-function input terminals setting (31, 32 or 33). The motor rated torque is 100%.
- Refer to Pr.11-34 for calculation equation for the motor rated torque.

11-33 Torque Command Source

Default: 0

Settings 0: Digital Keypad

1: RS-485 communication (Pr.11-34)

2: Analog signal input (Pr.03-00)

3: CANopen

- When you set Pr.11-33 to 0 or 1, set the torque command in Pr.11-34.
- When you set Pr.11-33 to 2, 3, or 5, Pr.11-34 only displays the torque command.

11-34 Torque Command

Default: 0.0

Settings -100.0–100.0% (Pr.11-27 setting value = 100%)

- This parameter is for the torque command. When you set Pr.11-27 to 250% and Pr.11-34 to 100%, the actual torque command = 250 × 100% = 250% motor rated torque.
- The drive saves the setting before power is OFF.
- The calculation equation for the motor rated torque:

Motor rated torque: $T(N.M) = \dfrac{P(W)}{\omega(rad/s)}$; P(W) value = Pr.05-02 (Pr.05-14);

ω(rad/s) value = Pr.05-03 (Pr.05-15); $\dfrac{RPM \times 2\pi}{60} = rad/s$

11-35 Torque Command Filter Time

Default: 0.000

Settings 0.000–1.000 sec.

- When the setting is too long, the control is stable but the control response is delayed. When the setting is too short, the response is quick but the control may be unstable. Adjust the setting according to your control and response situation.

11-36 Speed Limit Selection

Default: 0

Settings 0: Pr.11-37 (forward speed limit) and Pr.11-38 (reverse speed limit)

1: Speed limit source is Pr.00-20 (master frequency command source), and Pr.11-37 / Pr.11-38

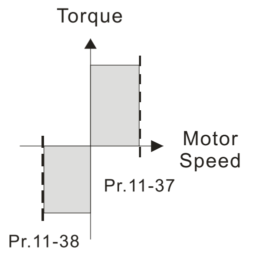
2: Pr.00-20 (master frequency command source)

3: Speed limit source is the linear speed of tension control

- Speed limit function: when you use the torque control mode, if the torque command is greater than the load, the motor accelerates until the motor speed equals the speed limit. At this time, it switches to speed control mode to stop acceleration.
- Pr.11-36 = 1:
  - When the torque command is positive, the forward speed limit is Pr.00-20 and the reverse speed limit is Pr.11-38.
  - When the torque command is negative, the forward speed limit is Pr.11-37 and the reverse speed limit is Pr.00-20.
  - For example:
    In an unwind application, the torque command direction is different from the motor operating direction, and this indicates that the load drives the motor. The speed limit must be Pr.11-37 or Pr.11-38. In normal applications, when the motor drives the load and the torque command is in the same direction as the speed limit, only then you can set the speed limit according to Pr.00-20.
- For details on the keypad display, refer to the LED Function Description in Chapter10 “Digital Keypad”. In torque control mode, the F page of keypad displays the present speed limit value.

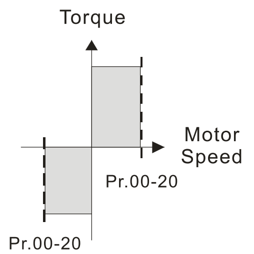
Pr.11-36=0

Forward/reverse running speed are limited by Pr.11-37 and Pr.11-38



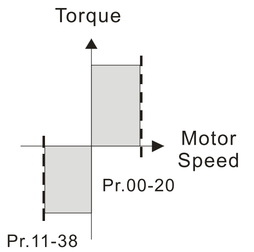
Pr.11-36=2

Forward/reverse running speed are limited by Pr.00-20



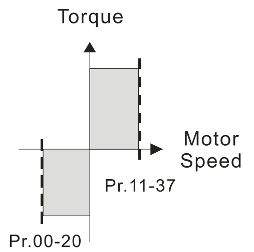
Pr.11-36=1

When torque is positive, forward running speed is limited by Pr.00-20; reverse running speed is limited by Pr.11-38



Pr.11-36=1

When torque is negative, forward running speed is limited by Pr.11-37; reverse running speed is limited by Pr.00-20



✎ 11-37 Forward Speed Limit (Torque Mode)

Default: 10

Settings 0–120%

✎ 11-38 Reverse Speed Limit (Torque Mode)

Default: 10

Settings 0–120%

- Limits the speed for forward and reverse running in torque mode (Pr.01-00 maximum operation frequency = 100%).

11-39 Zero Torque Command Mode Selection

Default: 0

Settings 0: Torque mode
1: Speed mode

- This parameter is only valid in TQCPG IM and TQCPG PM, and it defines the mode when the speed limit is 0% or 0 Hz.
- When you set Pr.11-39 to 0, and speed limit is 0% or 0 Hz, the motor generates an excitation current, and the torque command Pr.11-34 limits the torque.
- When you set Pr.11-39 to 1, and speed limit is 0% or 0 Hz, the AC motor drive can generate output torque through the speed controller (the torque limit is Pr.06-12), and the control mode changes from TQC + PG to FOC + PG mode. The motor has a holding torque. If the speed command is not 0, the drive automatically changes it to 0.

✎ 11-40 Position Control Command Source

Default: 0

Settings 0: Input from internal register
2: Input from external pulse
3: RS-485
5: Communication card

11-41 PWM Mode Selection

Default: 2

Settings 0: Two-phase
2: Space vector

- Two-phase mode: effectively reduces the drive power components losses and provides better performance in long wire applications.
- Space vector mode: effectively reduces the power loss and electromagnetic noise of the motor.

✎ 11-42 System Control Flag

Default: 0000

Settings 0000–FFFFh

bit No.	Function	Description
0	Reserved	
1	FWD / REV action control	0: FWD / REV cannot be controlled by Pr.02-12 bit 0 & 1. 1: FWD / REV can be controlled by Pr.02-12 bit 0 & 1.

✎ 11-43 Position Control Maximum Frequency

Default: 60.00

Settings 0.00–599.00 Hz

- Set the maximum operating frequency when the drive is in position control mode.
- Also sets the speed limit for pulse-train positioning position control. If the output frequency reaches the maximum frequency for position control, the system uses the maximum frequency for position control as the operating frequency and slowly executes the remaining pulse-train commands.
- If the multi-function input terminal MIx = 35 (enable single-point positioning) is enabled under the speed mode, the drive executes single-point positioning according to Pr.11-43 setting. Refer to the diagram below when Pr.11-43 is set to 40 Hz and 10 Hz respectively.
- If the multi-function input terminal MIx = 89 (position / speed mode switch) is enabled under the speed mode, the drive executes pulse-train positioning according to Pr.11-43 setting, as shown in the diagram below.
- When setting bit8 = 0 (point-to-point position control) to Pr.11-00, the speed of movement among every position is based on this parameter.

✎ 11-44 Position Control Acceleration Time
✎ 11-45 Position Control Deceleration Time

Default: 1.00

Settings 0.00–655.35 sec.

- Pr.11-44 sets the required time when the drive accelerates from 0.00Hz to Pr.11-43 (Maximum Frequency for Position Control). Pr.11-45 sets the required time when the drive decelerates from Pr.11-43 (Maximum Frequency for Position Control) to 0.00 Hz
- The acceleration and deceleration time for position control is invalid for pulse-train position command.
- The acceleration and deceleration time for multi-step positioning position control is equal to Pr.11-44 and Pr.11-45.

✎ 11-46 Torque Output Filter Gain (applied to 230V / 460V models)

Default: 0.050

Settings 0.000–65.535 sec.

- Set the filter gain of the torque output display (keypad display and communication read), including Pr.00-04 = 8 displays the output torque (%) that the drive calculates, the output torque (XXX.X %) of communication address 210B and the positive / negative output torque (%) that 2208 drive calculates (XXX.X %).

11-50 APR S-curve Time

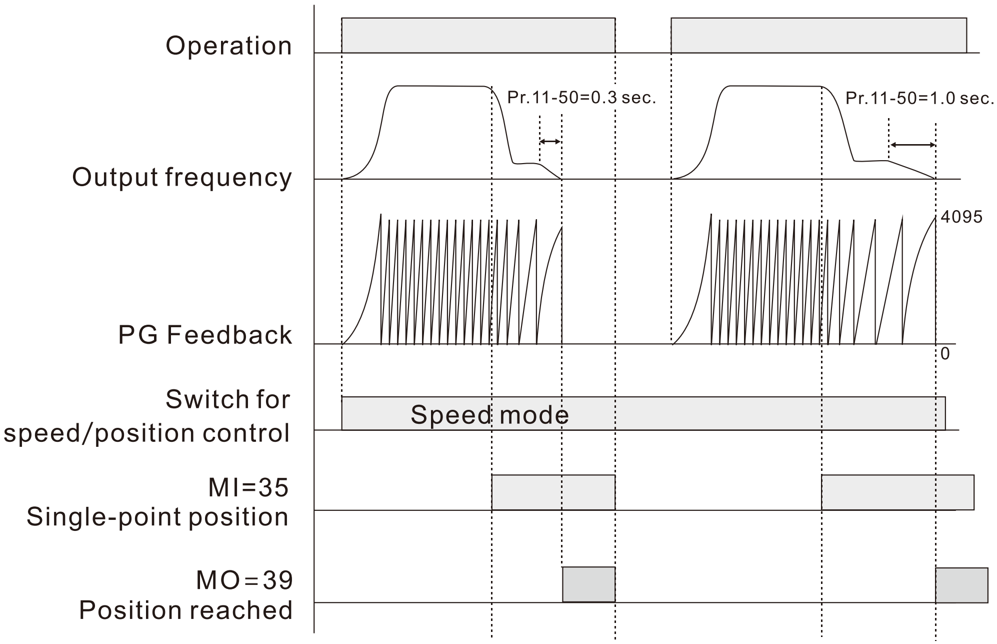
Default: 0.300

Settings 0.000–1.000

- Only valid when single-point positioning (MIx = 35) or point-to-point positioning confirmation (MIx = 88) is enabled The longer the Pr.11-50 time, the longer the positioning takes.

📖 This parameter smooths the position command for single-point positioning and point-to-point positioning control mode, especially the application for the operation of mechanical structure. When the load inertia increases, the inertia of motor generated during the stop also increases, further worsens the smoothness of the operation. In this case, increase Pr.11-50 to the elevate smoothness.

📖 If the multi-function input terminal MIx = 35 (enable single-point positioning) is enabled under the speed mode, the drive executes single-point positioning according to Pr.11-50 setting. Refer to the diagram below when Pr.11-50 is set to 1 and 0.3 second respectively.



11-51 Maximum Allowable Position Error

Default: 1000

Settings 0–65535

📖 Define the maximum error between the allowed position command and the actual position feedback when the drive is in the position control mode.

11-52 Allowable Position Error Range

Default: 10

Settings 0–65535 pulse

11-53 Allowable Position Error Cumulative Time

Default: 0.500

Settings 0.000–65.535 sec.

📖 When the position error is smaller than or equal to the allowed position error tolerance, and exceeds Pr.11-53 setting time, MOx = 39 (position reached) outputs.

📖 If the position error is larger than the allowed position error tolerance, the drive waits until the position error is smaller than or equal to the allowed tolerance and until Pr.11-53 setting time arrives, MOx = 39 outputs.

11-54 Treatment to the Large Position Error

Default: 0

Settings 0: Warn and continue operation (display oPE on keypad)
1: Fault and ramp to stop (display oPEE on keypad)
2: Fault and coast to stop (display oPEE on keypad)

- If the position error is larger than the maximum allowed position error, the drive acts according to Pr.11-54 settings.

11-56 Software Positive Limit (High Word)

Default: 30000

Settings -32768–32767

11-57 Software Positive Limit (Low Word)

Default: 0

Settings 0–65535

11-58 Software Negative Limit (High Word)

Default: -30000

Settings -32768–32767

11-59 Software Negative Limit (Low Word)

Default: 0

Settings 0–65535

- When in position control mode, if the motor moves in the forward direction and the position command exceeds Pr.11-56 and Pr.11-57 setting values, the drive stops quickly and the warning code SPL occurs.
- When in position control mode, if the motor moves in the reverse direction and the position command exceeds Pr.11-58 and Pr.11-59 setting values, the drive stops quickly and the warning code SnL occurs.
- This function is valid when Pr.11-60 bit2 = 1 under position control mode.

11-60 Position Control Bit

Default: 000Ah

Settings bit0: Position memory function is enabled
bit1: Single revolution at the load side is calculated by PPR
bit2: Software limit switch function is enabled

bit No.	Setting	Description
0	Position memory function is enabled	bit0 = 0: Position memory function is disabled bit0 = 1: Position memory function is enabled
1	Single revolution at the load side is calculated by PPR	bit1 = 0: Calculate the single revolution at the load is by the Z-phase signal. bit1 = 1: Calculate the single revolution at the load side by PPR.
2	Software limit switch function is enabled	bit2 = 0: Software limit switch function is disabled when the drive is in multi-step positioning and pulse-train positioning position control modes

bit No.	Setting	Description
		bit2 = 1: Software limit switch function is enabled when the drive is in multi-step positioning and pulse-train positioning position control modes

📖 The action of software / hardware switches and control modes:

Setting \ Control Mode	IM						
	VF	VFPG	SVC	FOCPG	FOC	TQCPG	TQC
bit2: SW limit switch function enabled	N/A	N/A	N/A	Warning displays	N/A	Warning displays	N/A
bit3: HW limit switch function enabled	Error displays	Error displays	Error displays	Warning displays	Error displays	Warning displays	Error displays

Setting \ Control Mode	PM					SynRM
	PMSVC	FOCPGPM	PMFOC	HFI	PMTQCPG	
bit2: SW limit switch function enabled	N/A	Warning displays	N/A	N/A	Warning displays	N/A
bit3: HW limit switch function enabled	Error displays	Warning displays	Error displays	Error displays	Warning displays	Error displays

Setting \ Positioning Method	Single-point	Pulse-train	Homing	P2P
bit2: SW limit switch function enabled	N/A	Warning displays	N/A	Warning displays
bit3: HW limit switch function enabled	Warning displays	Warning displays	Warning displays	Warning displays

📖 The position memory function is available for coordinate system that remains at the mechanical origin after the drive's power-off when using incremental encoder.
For example:
For example, if the motor stops at the absolute position 100000 before power-off, then the motor's initial position remains at 100000 and homing has been completed after the drive is powered on again. With the position memory function, you do not need to do the homing again. It is time-saving and more efficient.

📖 The position memory function is valid only when the homing has been completed. Any incomplete homing cannot work with this function.

📖 The position memory function only works with motor that has braking mechanism. If you move the motor by hands or by other methods when the drive is powered off, the saved origin will be different from the actual origin after power resumes because the drive cannot realize the moving distance during power-off, further causing a risk of collision when executing position commands.

📖 When Pr.11-60 bit1 = 0, the single-turn pulse number refers to encoder's Z-phase signal. But the communication type encoder does not have Z-phase signal, which makes the setting bit1 = 0 unable to position.

- When using a communication absolute encoder, force Pr.11-60 bit1 = 1 to calculate the single-turn revolution at the load side by PPR, and to ensure the single-point positioning function is normal.
- If you need to use the hardware limitation function, enable the MIx = 44 (Negative limit switch) or MIx = 45 (Positive limit switch).
- Conditions to use Pr.11-60 bit8 (Operation direction definition):
  1. The position, speed and torque command source are all from CANopen.
  2. The position, speed and torque command source are communication card, and the communication decoding method is CiA402 or Delta defines 60xx.
- Pr.11-60 bit 8 (Operation direction definition) is valid after powering ON again.

11-62 Encoder at Load Side ppr Number (High byte)

Default: 0

Settings 0–65535

11-63 Encoder at Load Side ppr Number (Low byte)

Default: 2400

Settings 0–65535

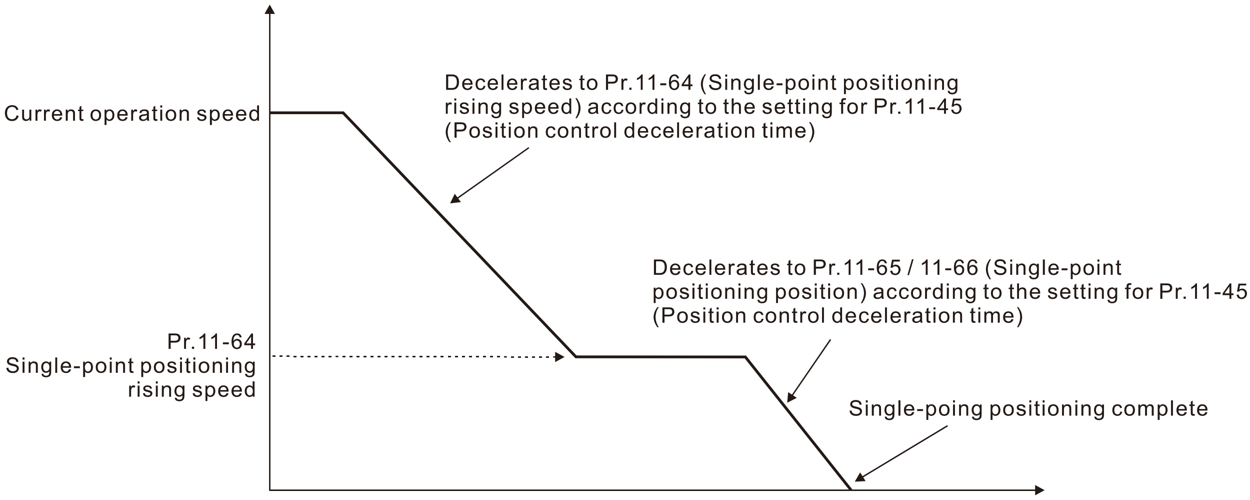
- When the encoder is installed at the motor side and the Z-phase is installed at the load side, you must set the PPR number at the load side to ensure the actual number of pulses per revolution because the pulse number for single revolution relates to the mechanical gear ratio and encoder PPR.
  For example:
  Assume that the mechanical gear ratio of the motor side to the load side is 10:1 (motor's 10 revolutions = load's 1 revolution) and Pr.10-01 = 1024:
  - If the position is at zero degree of the load side, you should set Pr.11-62 = 0, Pr.11-63 = 10240 (=1024 x 10).
  - If the position is at 270 degrees of the load side, you should set Pr.11-65 = 0, Pr.11-68 = 7680 (=1024 x 3/4).
- Change the setting of Pr.10-01, the value of Pr.11-63 will be changed, and this may also affect the setting range of Pr.11-66 at the same time.
  For example:
  In the beginning, Pr.10-01 = 600, Pr.11-63 = 2400, the setting range of Pr.11-66 = 0–2399. If Pr.10-01 changes to 1024, then Pr.11-63 changes to 4096 automatically, and the setting range of Pr.11-66 becomes 0–4095.

11-64 Single-point Positioning Rising Speed

Default: 10.00

Settings 0.10–according to the settings for Pr.11-43 and Pr.11-45

- When you perform a single-point positioning function, decelerate the system to Pr.11-64 setting speed before positioning.
- The setting range for single-point positioning rising speed is calculated according to the setting of Pr.11-43 (Position control maximum frequency) and Pr.11-45 (Position control deceleration time).



11-68 Homing Method

Default: 0008h

Settings 0000h–0128h

- Used for establishing the coordinate system that uses accumulated multiple revolution for the motor encoder.
- How to set Pr.11-68:

  For example:
  - Set Pr.11-68 = 012h when using homing method 4
  - Set Pr.11-68 = 116h when using homing method 10.
- Setting and description of homing parameter design (XYZ):

<table>
<tr><th>Z</th><th>Y</th><th>X</th></tr>
<tr><td>Home Limit</td><td>Z-phase Signal Setting</td><td>Homing Mode</td></tr>
<tr><td>0–1</td><td>0–2</td><td>0–8</td></tr>
<tr><td rowspan="2">X</td><td rowspan="4">● Y = 0: Reverse the direction to locate the Z-phase signal
● Y = 1: Continue to locate the Z-phase signal in the same direction
● Y = 2: Do not locate the Z-phase signal</td><td>0: Execute homing position control in the forward direction. Use the positive limit switch as the homing reference point.</td></tr>
<tr><td>1: Execute homing position control in the reverse direction. Use the negative limit switch as the homing reference point.</td></tr>
<tr><td rowspan="6">When reaching home limit:
● Z=0: error is displayed
● Z=1: the direction is reversed</td><td>2: Execute homing position control in the forward direction. Use the ORG switch (from 0 to 1) as the homing reference point.</td></tr>
<tr><td>3: Execute homing position control in the reverse direction. Use the ORG switch (from 0 to 1) as the homing reference point.</td></tr>
<tr><td rowspan="2">X</td><td>4: Locate the Z-phase signal in the forward direction and use the Z-phase signal as homing.</td></tr>
<tr><td>5: Locate the Z-phase signal in the reverse direction and use the Z-phase signal as homing.</td></tr>
<tr><td rowspan="2">● Y = 0: Reverse the direction to locate the Z-phase signal
● Y = 1: Continue to locate the Z-phase signal in the same direction
● Y = 2: Do not locate the Z-phase signal</td><td>6: Execute homing position control in the forward direction. Use the ORG switch (from 1 to 0) as the homing reference point.</td></tr>
<tr><td>7: Execute homing position control in the reverse direction. Use the ORG switch (from 1 to 0) as the homing reference point.</td></tr>
<tr><td>X</td><td>X</td><td>8: Use the current position as the origin.</td></tr>
</table>

NOTE: Forward direction means running in the clockwise (CW) direction; reverse direction means running in the counterclockwise (CCW) direction.

- 🕮 You can use Pr.11-68–Pr.11-74 and MIx = 47 (enable the homing function) to execute homing position control.
- 🕮 The correspondence between XYZ and CiA402 for homing mode selection:

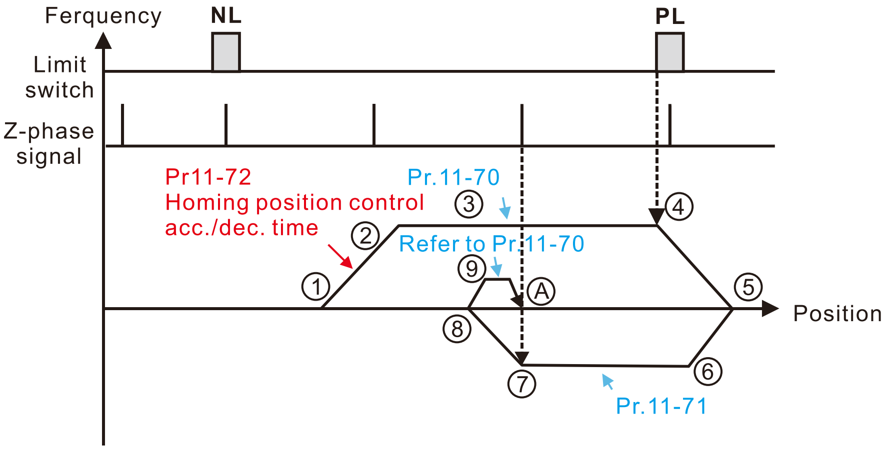
CiA402 物件 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
1	X	0	1	Execute homing position control in the reverse direction until encountering the negative limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.
2	X	0	0	Execute homing position control in the forward direction until encountering the positive limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.
3	0	0	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. Stops when encountering the positive limit switch.
4	0	1	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. Stops when encountering the positive limit switch.
5	0	0	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. Stops when encountering the negative limit switch.
6	0	1	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. Stops when encountering the negative limit switch.
7	1	0	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.
8	1	1	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

CiA402 物件 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
9	1	0	6	Execute homing position control in the forward direction until encountering the ORG switch (from 1 to 0). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.
10	1	1	6	Execute homing position control in the forward direction until encountering the ORG switch (from 1 to 0). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.
11	1	0	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
12	1	1	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
13	1	0	7	Execute homing position control in the reverse direction until encountering the ORG switch (from 1 to 0). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
14	1	1	7	Execute homing position control in the reverse direction until encountering the ORG switch (from 1 to 0). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
15	Reserved			Reserved
16	Reserved			Reserved
17	X	2	1	Execute homing position control in the reverse direction and use the negative limit switch as the origin.
18	X	2	0	Execute homing position control in the forward direction and use the positive limit switch as the origin.
19	No correspondence			See the diagram for homing method 19

CiA402 物件 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
20	0	2	2	Execute homing position control in the forward direction and use the ORG switch (from 0 to 1) as the origin. Stops when encountering the positive limit switch.
21	No correspondence			See the diagram for homing method 21
23	No correspondence			See the diagram for homing method 23
24	1	2	2	Execute homing position control in the forward direction and use the ORG switch (from 0 to 1) as the origin. When encountering the positive limit switch, the direction is reversed to the locate the origin.
25	No correspondence			See the diagram for homing method 25
26	1	2	6	Execute homing position control in the forward direction and use the ORG switch (from 1 to 0) as the origin. When encountering the positive limit switch, the direction is reversed to the locate the origin.
27	No correspondence			See the diagram for homing method 27
28	1	2	3	Execute homing position control in the reverse direction and use the ORG switch (from 0 to 1) as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
29	No correspondence			See the diagram for homing method 29
30	1	2	7	Execute homing position control in the reverse direction and use the ORG switch (from 1 to 0) as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.
31	Reserved			Reserved
32	Reserved			Reserved
33	0	X	5	Locate the Z-phase signal in the reverse direction and use the Z-phase signal as the origin. Stops when encountering the negative limit switch.
34	0	X	4	Locate the Z-phase signal in the forward direction and use the Z-phase signal as the origin. Stops when encountering the positive limit switch.
35	X	X	8	Use the current position as the origin.

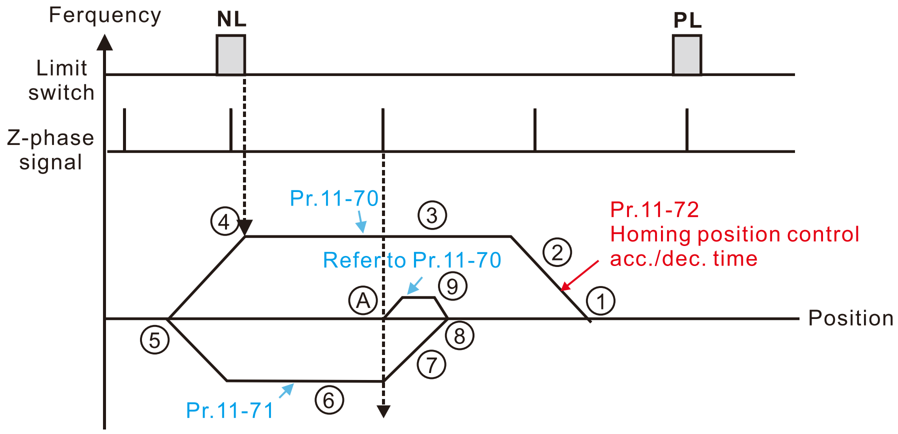
📖 Homing methods 19, 21, 23, 25, 27, and 29 cannot be set through the digital keypad KPC-CC01. Set them through communications.

- Execute homing position control in the forward direction until encountering the positive limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.



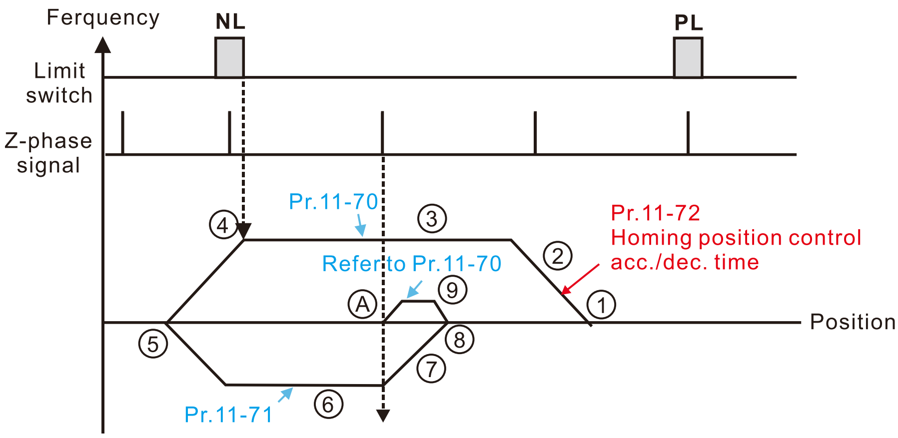
① FWD Run for execute Homing position control function.
② Accelerate to Pr.11-70 Homing position control 1st step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1st step speed.
④ Deceleration according to Pr.11-72 after encountering the rising edge of the PL.
⑤ Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2nd step speed according to Pr.11-72.
⑥ Operating with Pr.11-71 Homing control 2nd step speed.
⑦ Deceleration according to Pr.11-72 after encountering the Z-phase signal.
⑧ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑨ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
Ⓐ Positioning in Z-phase signal completed.

- Execute homing position control in the reverse direction until encountering the negative limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.



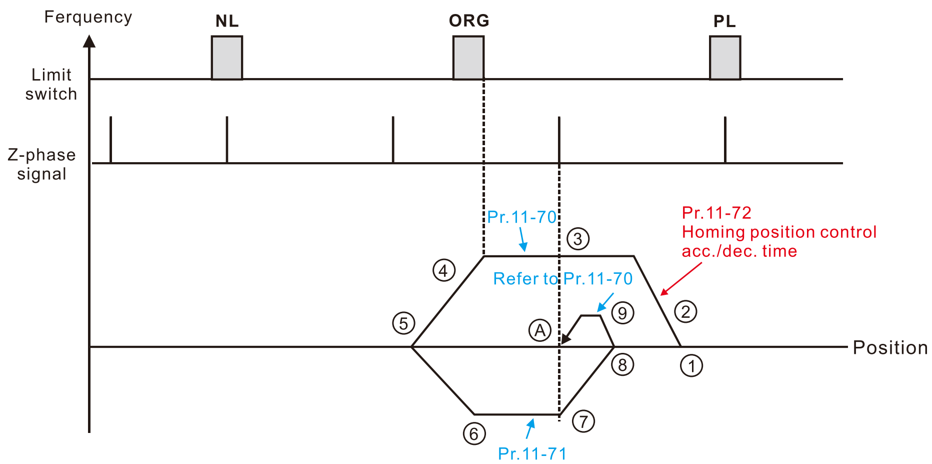
① REV Run for execute Homing position control function
② Accelerate to Pr.11-70 Homing position control 1st step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1st step speed
④ Deceleration according to Pr.11-72 after encountering the rising edge of the NL
⑤ Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2nd step speed according to Pr.11-72.
⑥ Operating with Pr.11-71 Homing control 2nd step speed
⑦ Deceleration according to Pr.11-72 after encountering the Z-phase signal
⑧ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑨ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
Ⓐ Positioning in Z-phase signal completed

- Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin.



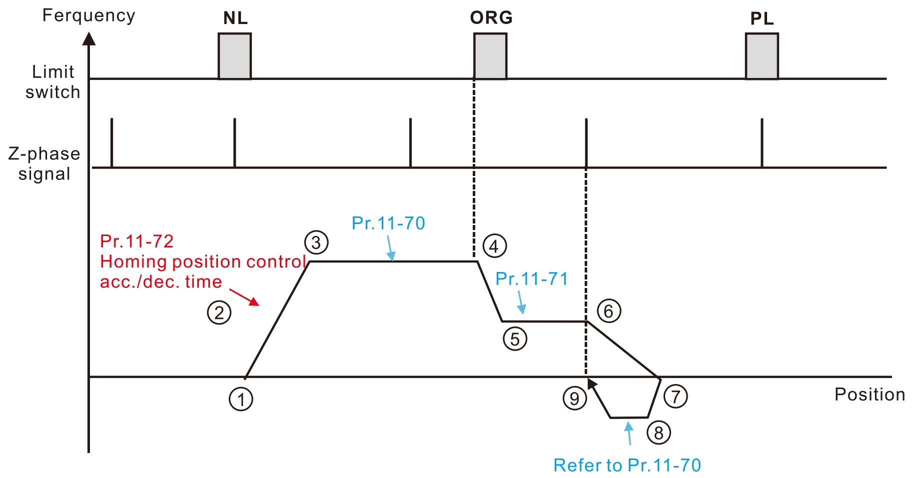
① REV Run for execute Homing position control function
② Accelerate to Pr.11-70 Homing position control 1st step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1st step speed
④ Deceleration according to Pr.11-72 after encountering the rising edge of the NL
⑤ Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2nd step speed according to Pr.11-72.
⑥ Operating with Pr.11-71 Homing control 2nd step speed
⑦ Deceleration according to Pr.11-72 after encountering the Z-phase signal
⑧ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑨ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
Ⓐ Positioning in Z-phase signal completed

- Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin.



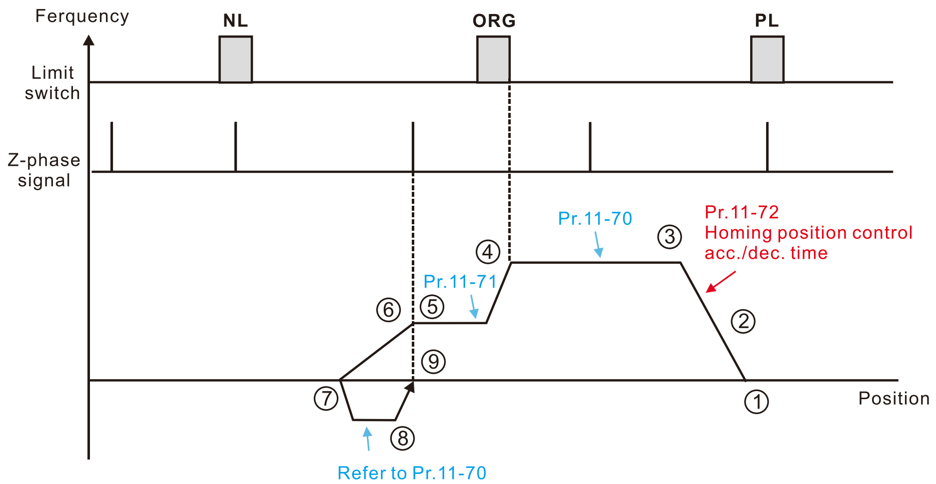
① REV Run for execute Homing position control function.
② Accelerate to Pr.11-70 Homing position control 1^{st} step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1^{st} step speed.
④ Deceleration according to Pr.11-72 after encountering the ORG.
⑤ Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2^{nd} step speed according to Pr.11-72.
⑥ Operating with Pr.11-71 Homing control 2^{nd} step speed.
⑦ Deceleration according to Pr.11-72 after encountering the Z-phase signal.
⑧ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑨ Refer to Pr.11-70 Homing position control 1^{st} step speed and start to execute creep speed.
Ⓐ Positioning in Z-phase signal completed.

- Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin.



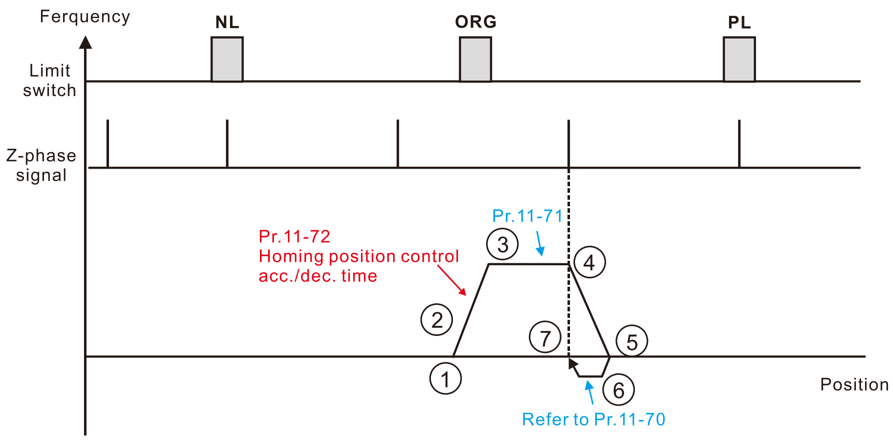
① FWD Run for execute Homing position control function.
② Accelerate to Pr.11-70 Homing position control 1^{st} step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1^{st} step speed.
④ Deceleration according to Pr.11-72 after encountering the rising edge of the ORG.
⑤ Decelerate to Pr.11-71 Homing control 2^{nd} step speed.
⑥ Deceleration according to Pr.11-72 after encountering the Z-phase signal.
⑦ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑧ Refer to Pr.11-70 Homing position control 1^{st} step speed and start to execute creep speed.
⑨ Positioning in Z-phase signal completed.

- Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin.



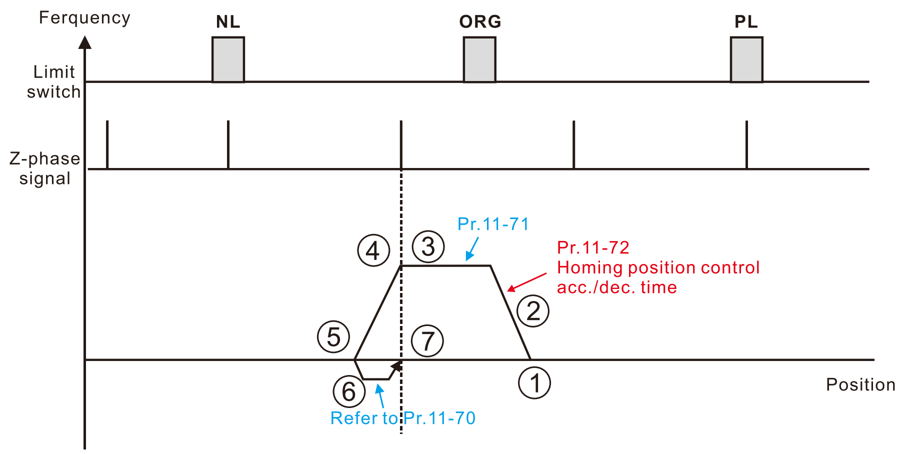
① REV Run for execute Homing position control function
② Accelerate to Pr.11-70 Homing position control 1^{st} step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-70 Homing position control 1^{st} step speed
④ Deceleration according to Pr.11-72 after encountering the rising edge of the ORG
⑤ Decelerate to Pr.11-71 Homing control 2^{nd} step speed.
⑥ Deceleration according to Pr.11-72 after encountering the Z-phase signal
⑦ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑧ Refer to Pr.11-70 Homing position control 1^{st} step speed and start to execute creep speed.
⑨ Positioning in Z-phase signal completed

- Locate the Z-phase signal in the forward direction and use the Z-phase signal as the origin.



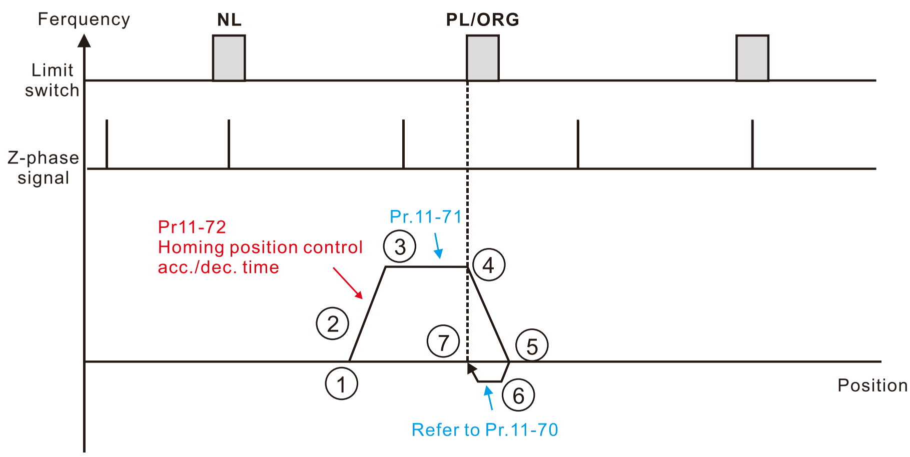
① FWD Run for execute Homing position control function.
② Accelerate to Pr.11-71 Homing position control 2^{ndt} step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-71 Homing position control 2nd step speed.
④ Deceleration according to Pr.11-72 after encountering the Z-phase signal.
⑤ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑥ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
⑦ Positioning in Z-phase signal completed.

- Locate the Z-phase signal in the reverse direction and use the Z-phase signal as the origin.



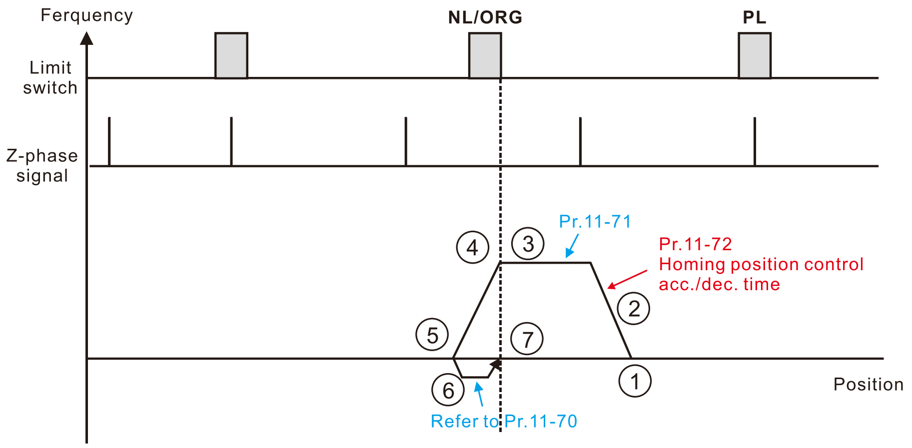
① REV Run for execute Homing position control function.
② Accelerate to Pr.11-71 Homing position control 2nd step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-71 Homing position control 2nd step speed.
④ Deceleration according to Pr.11-72 after encountering the Z-phase signal.
⑤ Decelerate to 0Hz and change operating directions for search Z-phase signal.
⑥ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
⑦ Positioning in Z-phase signal completed.

- Execute homing position control in the forward direction and use the positive limit switch or the ORG switch as the origin.



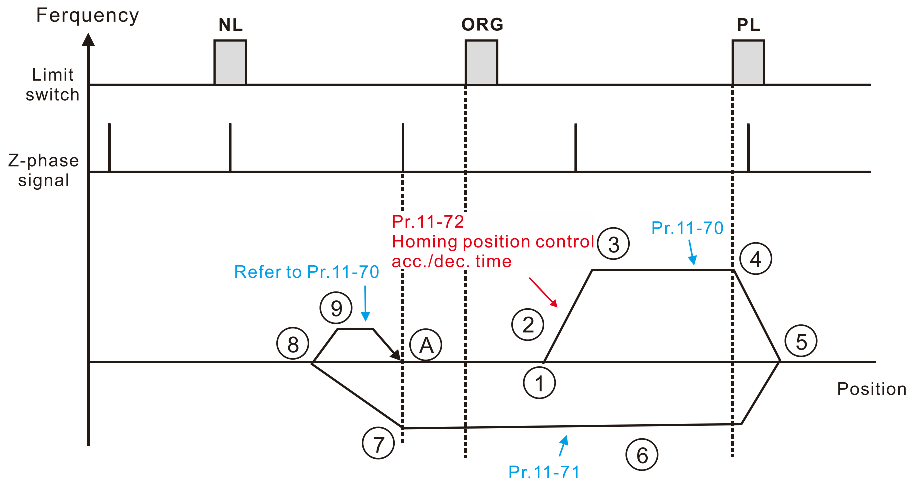
① FWD Run for execute Homing position control function.
② Accelerate to Pr.11-71 Homing position control 2nd step speed according to Pr.11-72 Homing control acc./dec. time.
③ Operating with Pr.11-71 Homing position control 2nd step speed.
④ Deceleration according to Pr.11-72 after encountering the rising edge of the PL/ORG.
⑤ Decelerate to 0Hz and change operating directions for search PL/ORGI.
⑥ Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
⑦ Positioning in PL/ORG completed.

- Execute homing position control in the reverse direction and use the negative limit switch or the ORG switch as the origin.



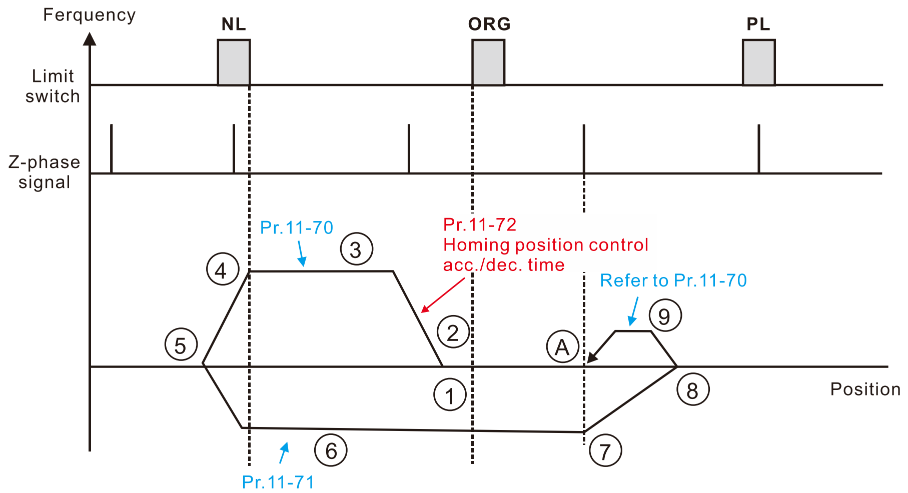
1 REV Run for execute Homing position control function.
2 Accelerate to Pr.11-71 Homing position control 2nd step speed according to Pr.11-72 Homing control acc./dec. time.
3 Operating with Pr.11-71 Homing position control 2nd step speed.
4 Deceleration according to Pr.11-72 after encountering the rising edge of the NL/ORG.
5 Decelerate to 0Hz and change operating directions for search NL/ORGI.
6 Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
7 Positioning in NL/ORG completed.

- Execute homing position control in the forward direction until encountering the positive limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.



1 FWD Run for execute Homing position control function.
2 Accelerate to Pr.11-70 Homing position control 1st step speed according to Pr.11-72 Homing control acc./dec. time.
3 Operating with Pr.11-70 Homing position control 1st step speed.
4 Deceleration according to Pr.11-72 after encountering the PL.
5 Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2nd step speed according to Pr.11-72.
6 Operating with Pr.11-71 Homing control 2nd step speed.
7 Deceleration according to Pr.11-72 after encountering the Z-phase signal.
8 Decelerate to 0Hz and change operating directions for search Z-phase signal.
9 Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
A Positioning in Z-phase signal completed.

- Execute homing position control in the reverse direction until encountering the negative limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.

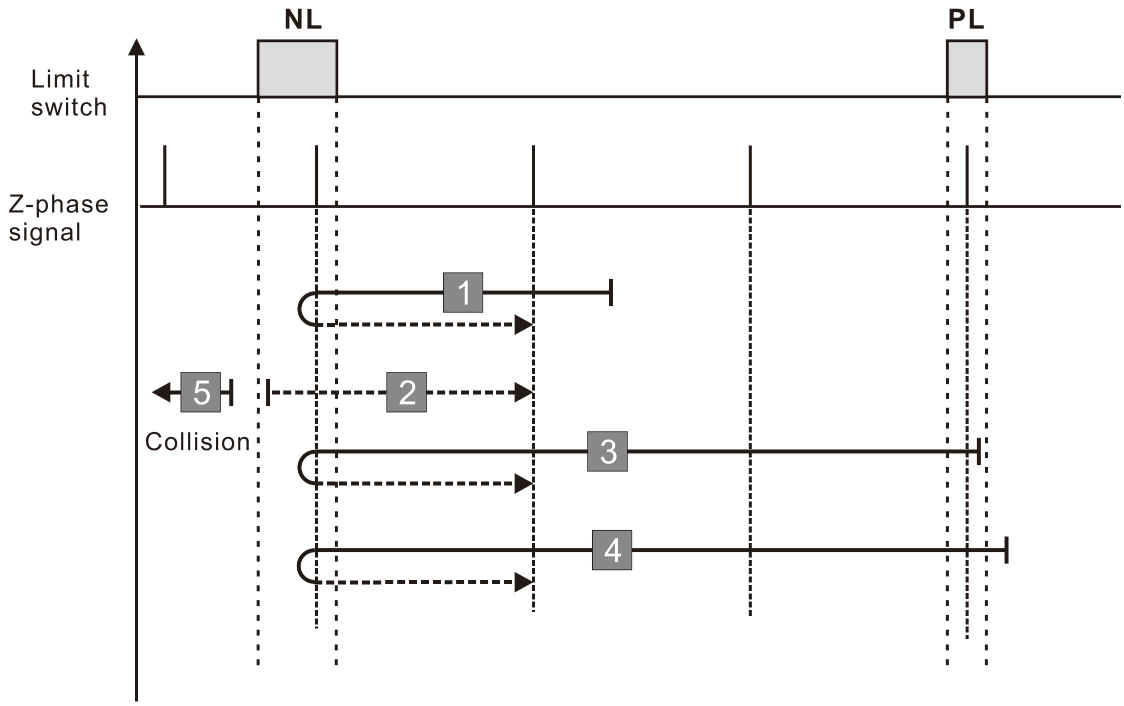


1 REV Run for execute Homing position control function.
2 Accelerate to Pr.11-70 Homing position control 1st step speed according to Pr.11-72 Homing control acc./dec. time.
3 Operating with Pr.11-70 Homing position control 1st step speed.
4 Deceleration according to Pr.11-72 after encountering the NL.
5 Decelerate to 0Hz and change operating direction. After, accelerate to Pr.11-71 Homing control 2nd step speed according to Pr.11-72.
6 Operating with Pr.11-71 Homing control 2nd step speed.
7 Deceleration according to Pr.11-72 after encountering the Z-phase signal.
8 Decelerate to 0Hz and change operating directions for search Z-phase signal.
9 Refer to Pr.11-70 Homing position control 1st step speed and start to execute creep speed.
A Positioning in Z-phase signal completed.

Diagram 1

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
1	-	0	1	Execute homing position control in the reverse direction until encountering the negative limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.

1. The initial movement is in the reverse direction.
2. When encountering the rising edge of the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



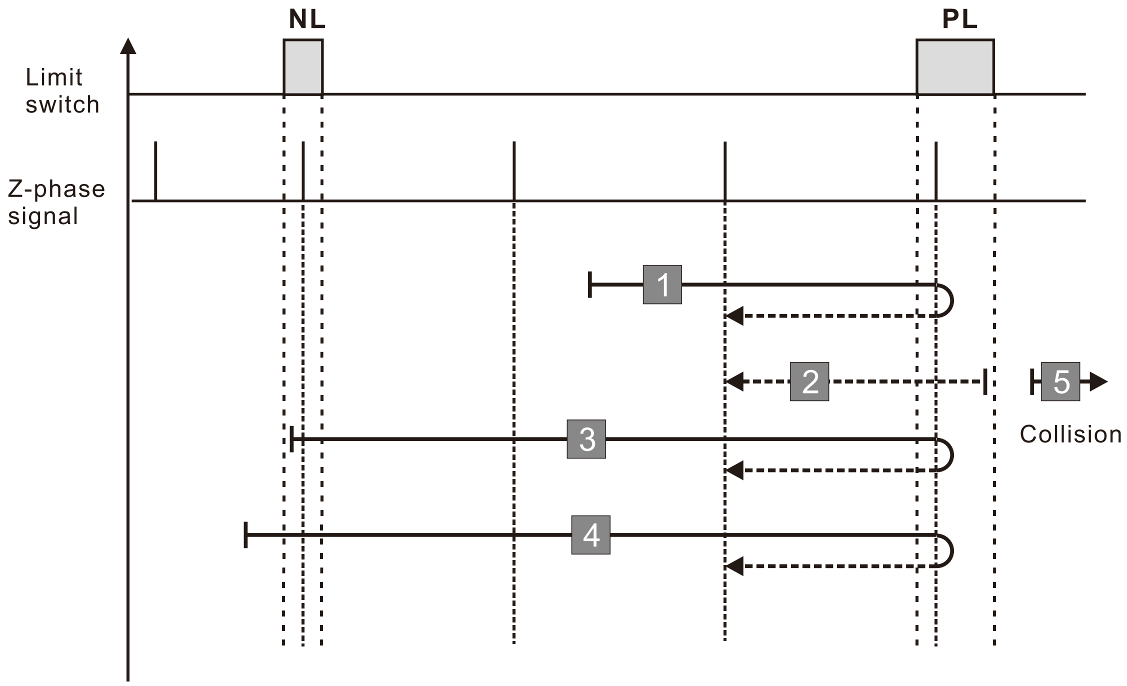
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 2

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
2	x	0	0	Execute homing position control in the forward direction until encountering the positive limit switch. Then, the direction is reversed to locate the Z-phase signal as the origin.

1. The initial movement is in the forward direction.
2. When encountering the rising edge of the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



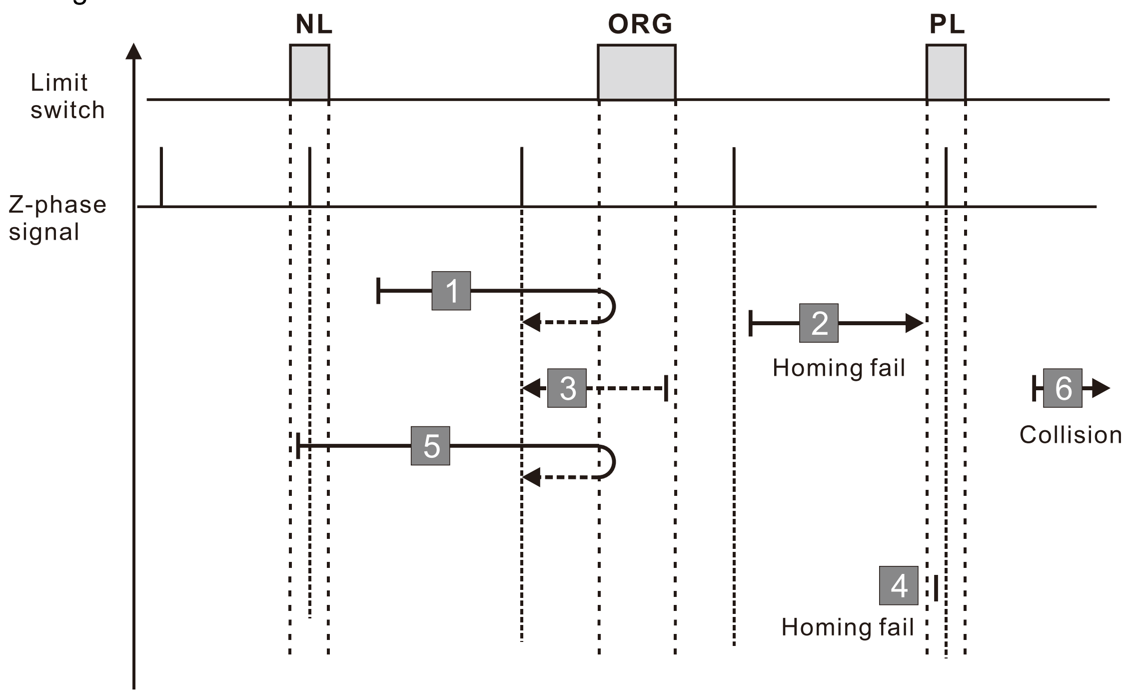
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 3

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
3	0	0	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. Stops when encountering the positive limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
3. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



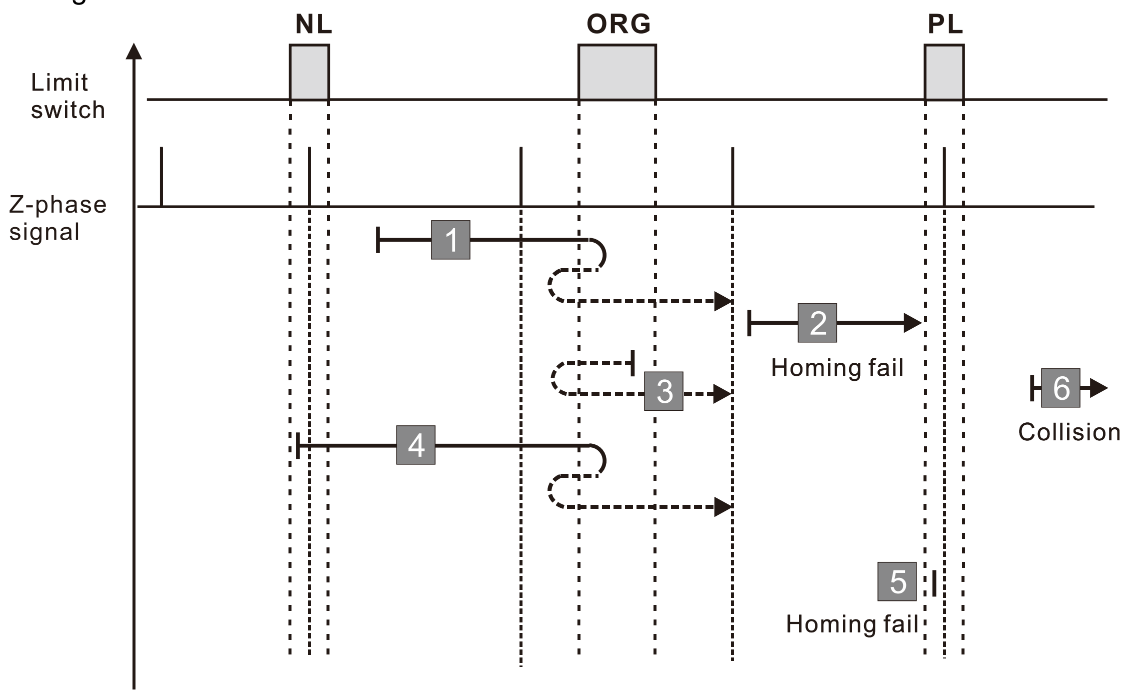
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the forward direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 4

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
4	0	1	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. Stops when encountering the positive limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed and waits for the rising-edge trigger of the ORG switch.
3. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



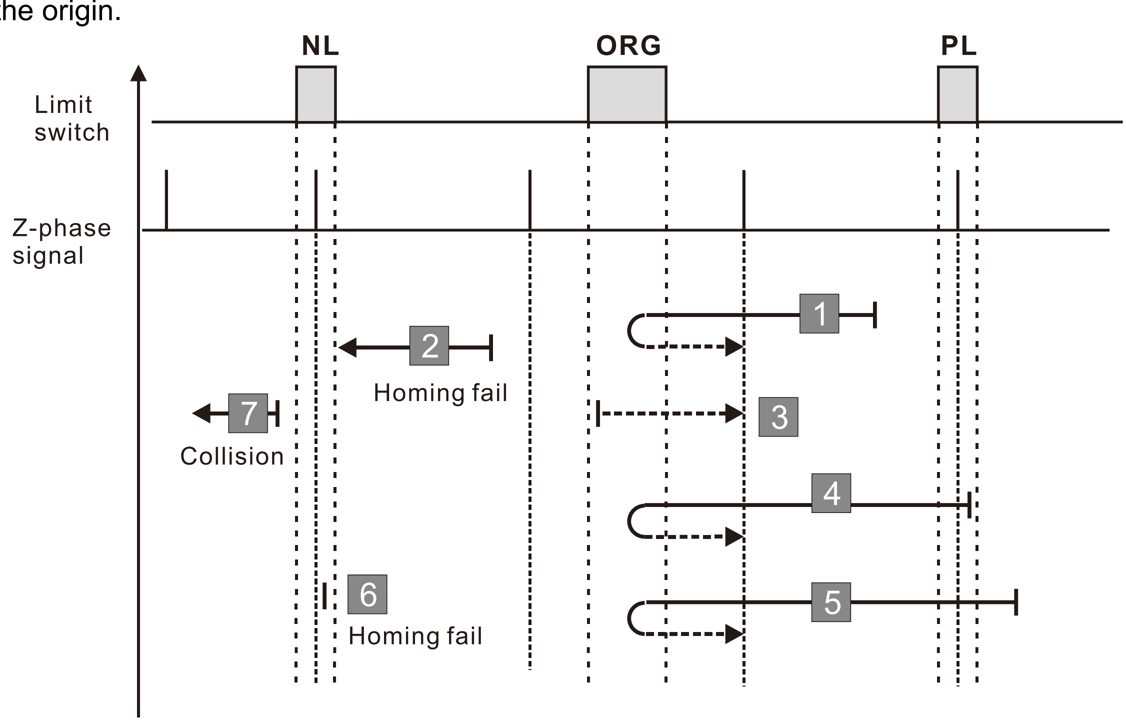
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the reverse direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 5

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
5	0	0	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. Stops when encountering the negative limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed and waits for the falling-edge trigger of the ORG switch.
3. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



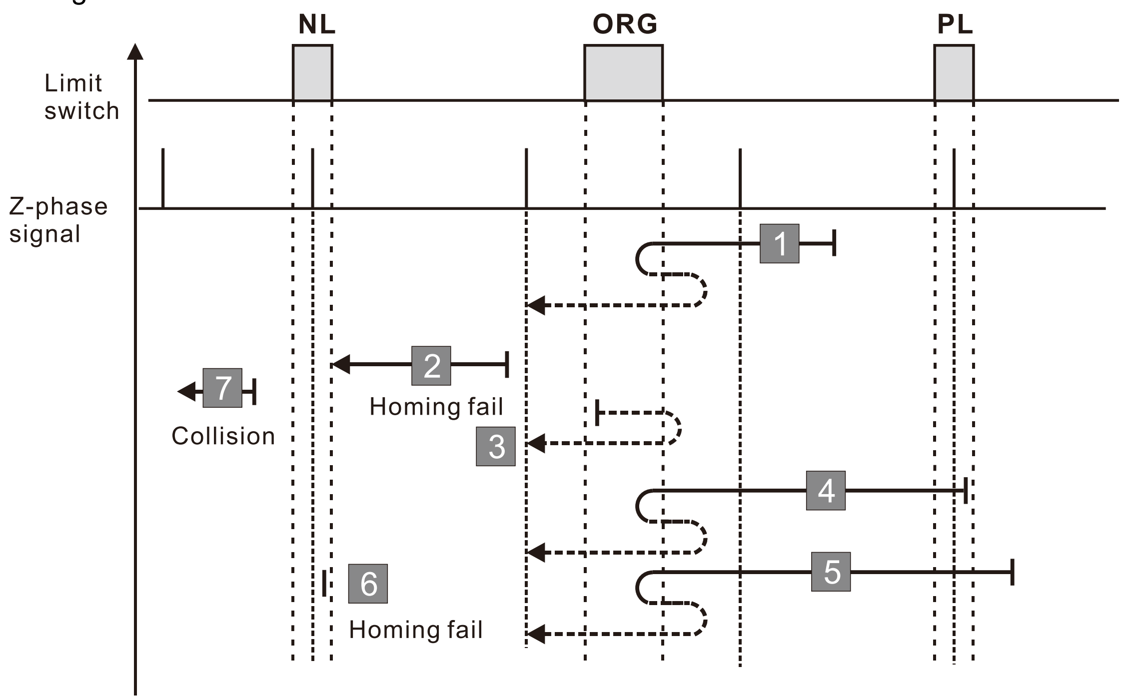
A homing failure occurs when the following condition happen:

1. If the motor starts the movement in the reverse direction and no rising edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 6

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
6	0	1	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. Stops when encountering the negative limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the falling-edge of the ORG switch, the movement direction is reversed and waits for the rising-edge trigger of the ORG switch.
3. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



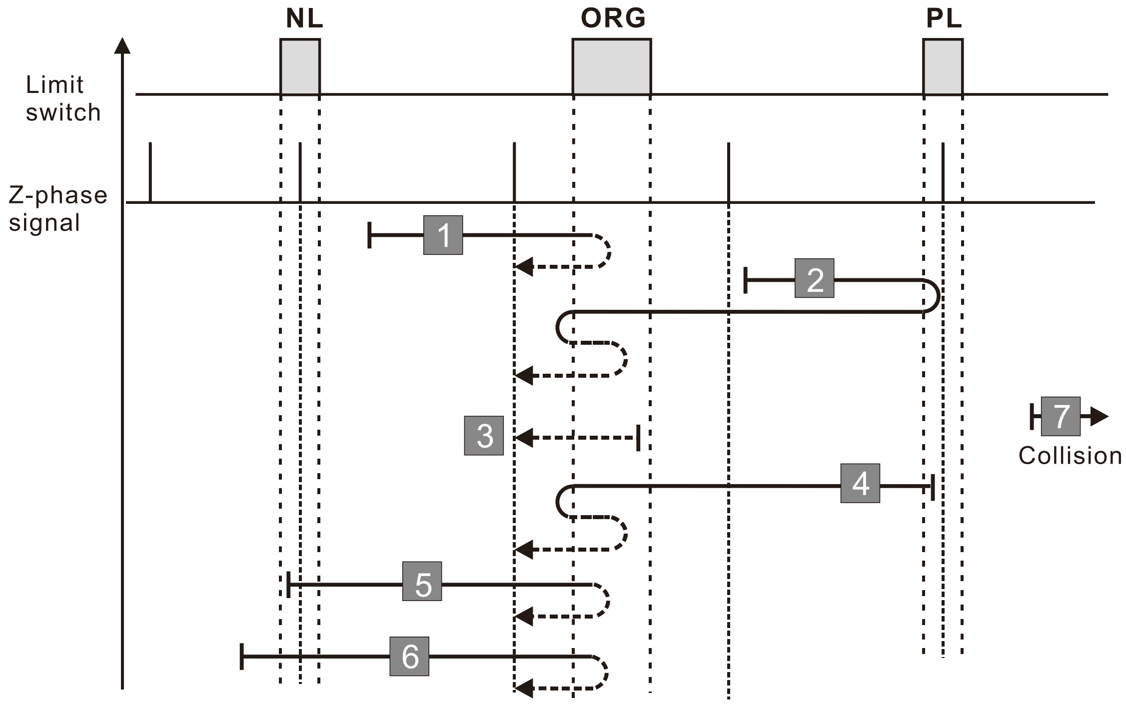
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the forward direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 7

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
7	1	0	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



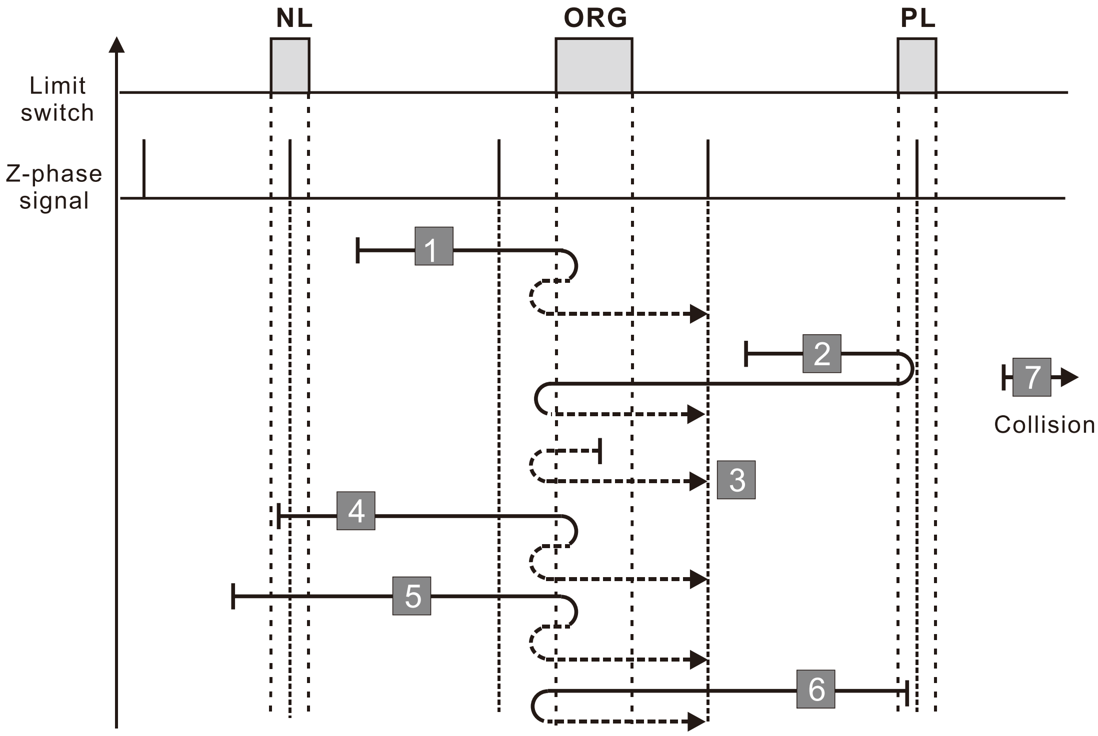
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 8

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
8	1	1	2	Execute homing position control in the forward direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin



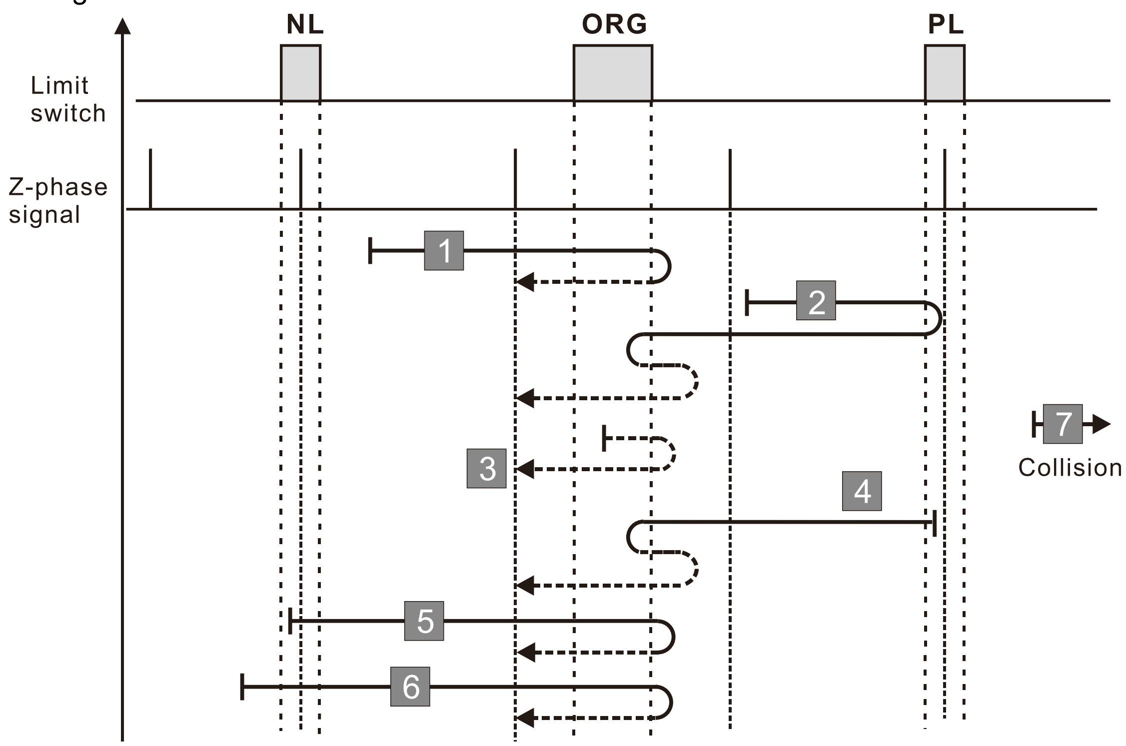
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 9

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
9	1	0	6	Execute homing position control in the forward direction until encountering the ORG switch (from 1 to 0). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the forward direction.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the forward direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



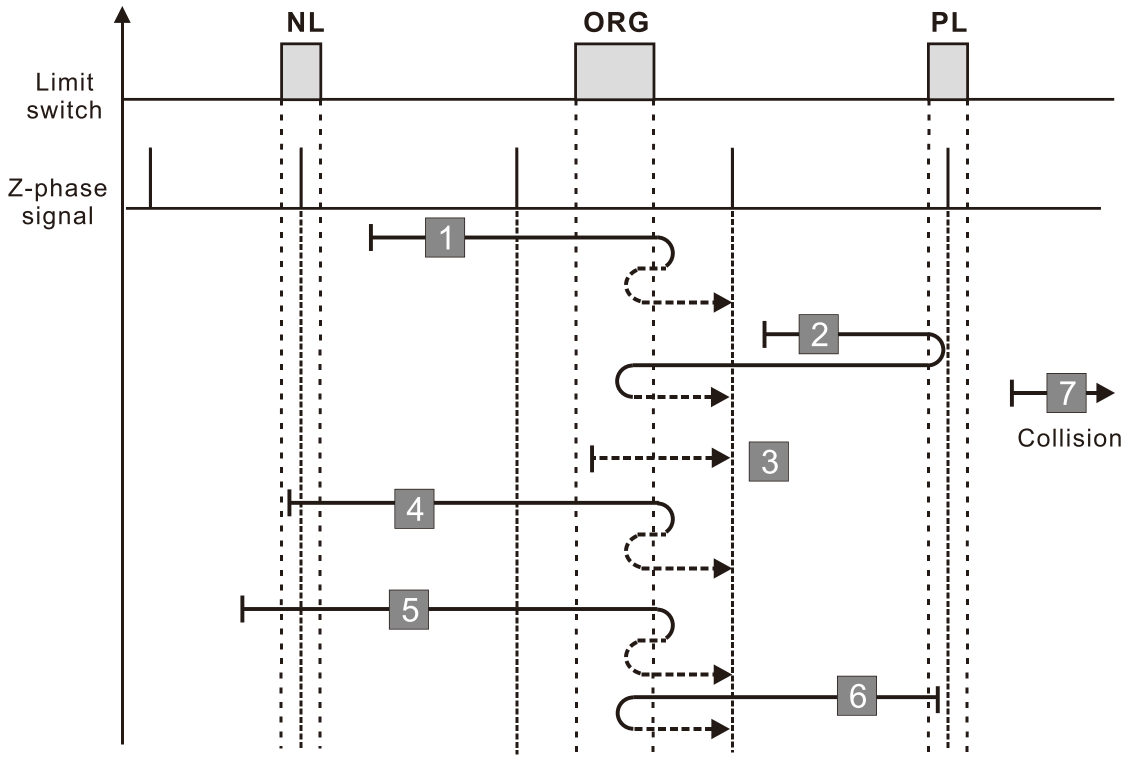
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 10

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
10	1	1	6	Execute homing position control in the forward direction until encountering the ORG switch (from 1 to 0). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the forward direction.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



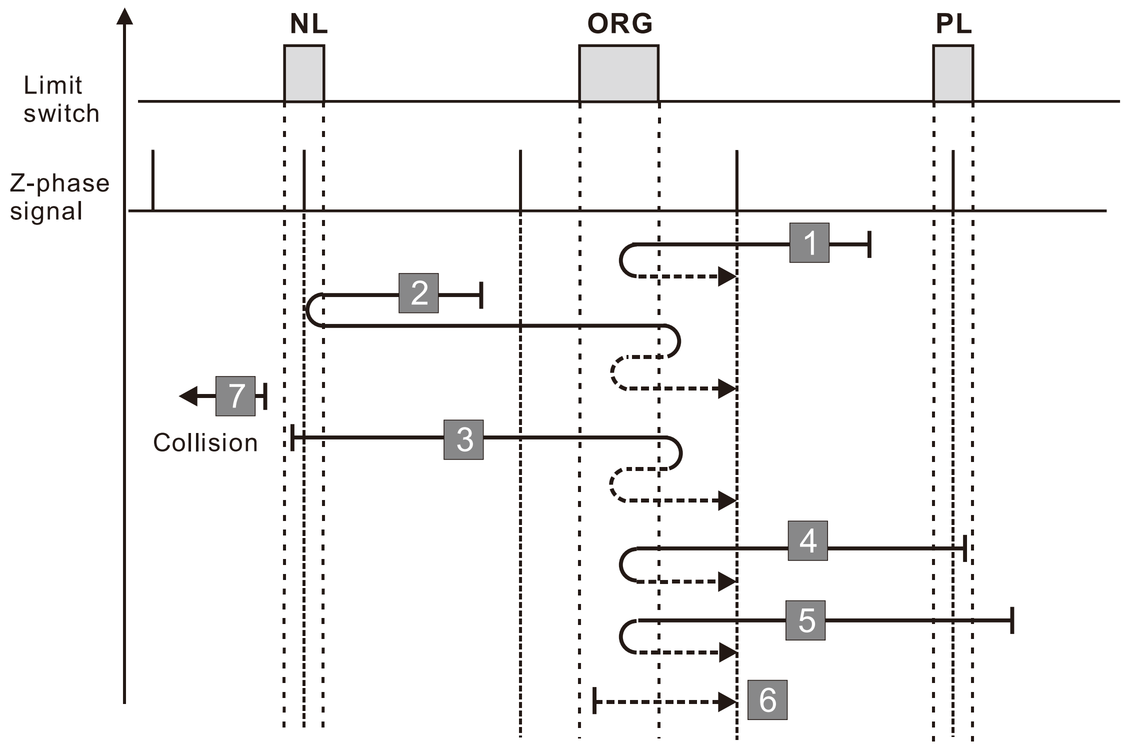
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 11

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
11	1	0	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



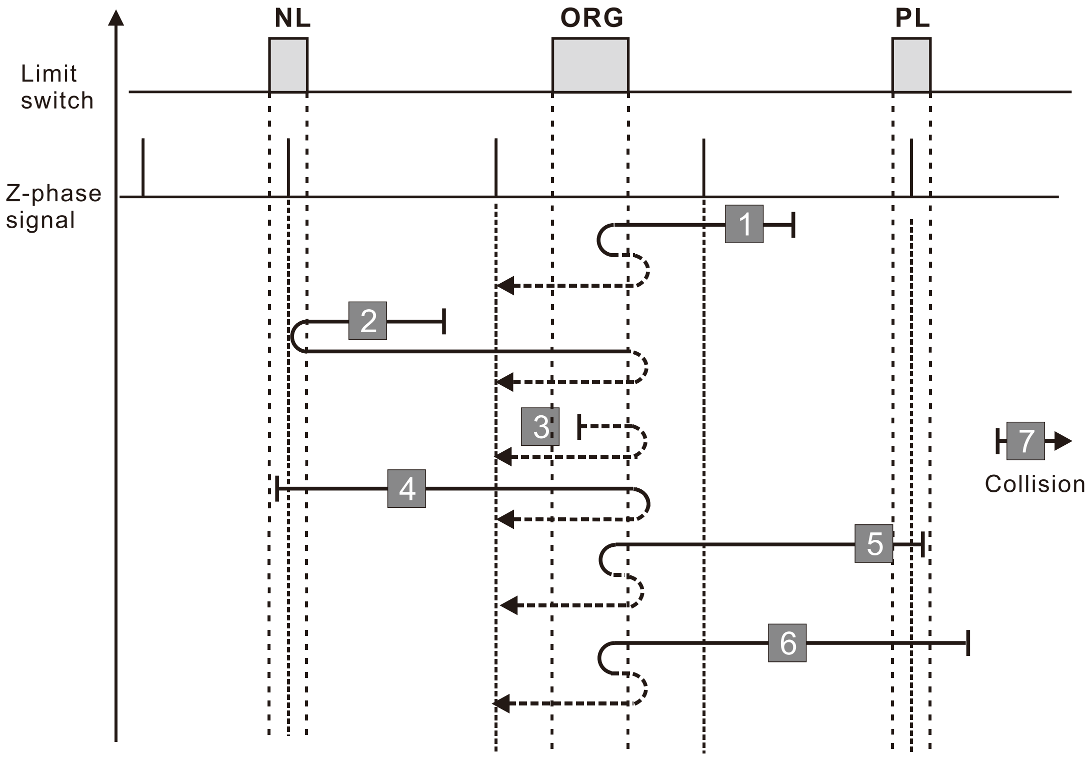
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 12

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
12	1	1	3	Execute homing position control in the reverse direction until encountering the ORG switch (from 0 to 1). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the forward direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



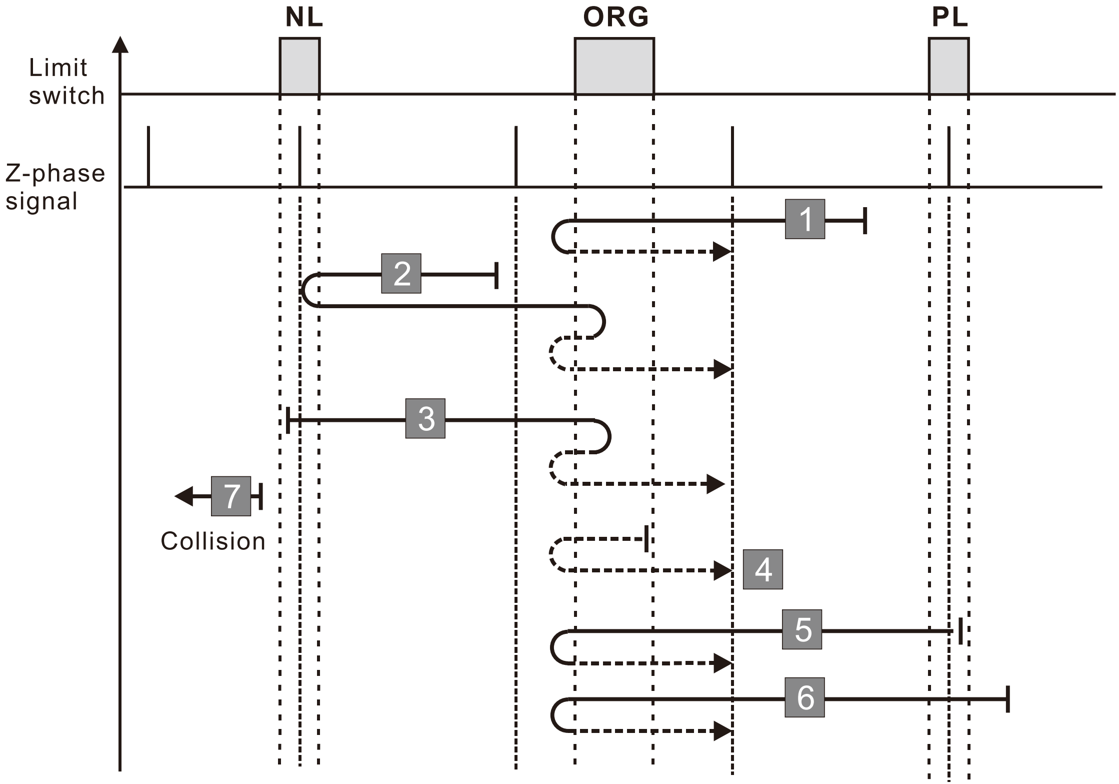
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 13

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
13	1	0	7	Execute homing position control in the reverse direction until encountering the ORG switch (from 1 to 0). Then, the direction is reversed to locate the Z-phase signal as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the reverse direction.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin



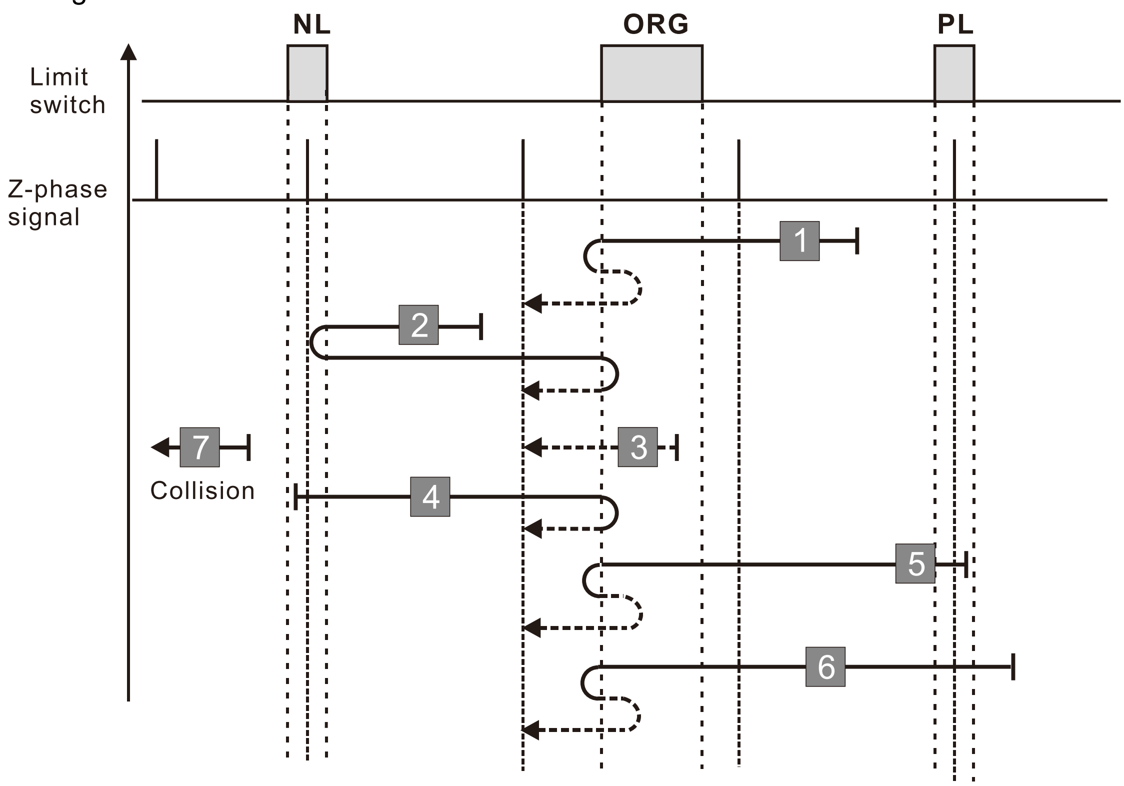
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 14

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
14	1	1	7	Execute homing position control in the reverse direction until encountering the ORG switch (from 1 to 0). Then, continue locating the Z-phase signal in the same direction as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the reverse direction.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



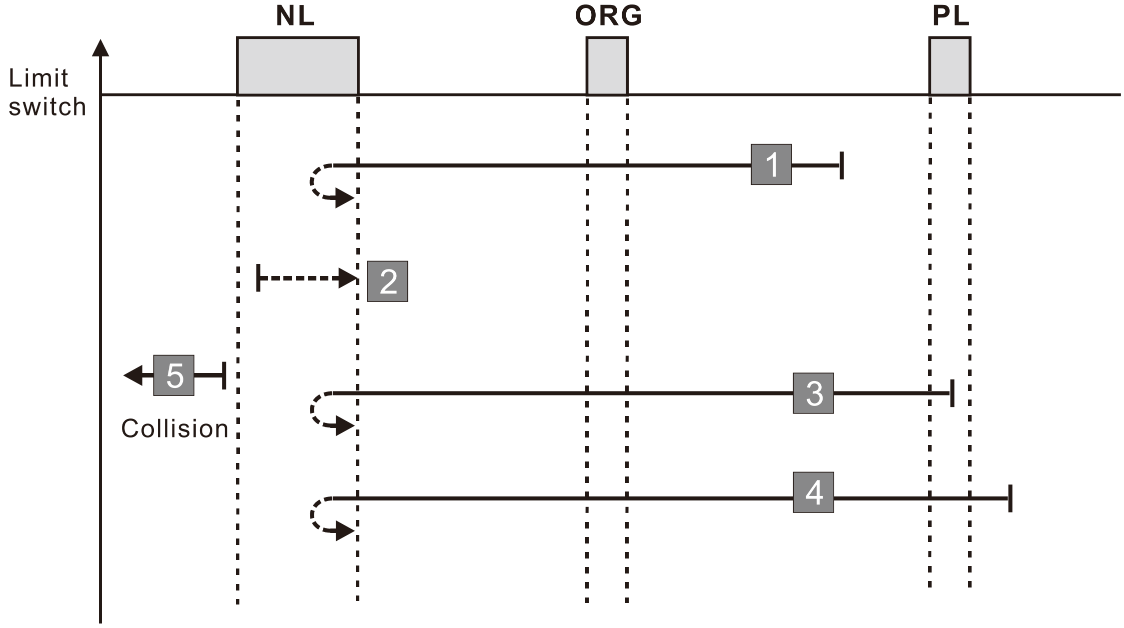
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch or Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 15

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
17	-	2	1	Execute homing position control in the reverse direction and use the negative limit switch as the origin.

1. The initial movement is in the reverse direction.
2. When encountering the rising edge of the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch as the origin.



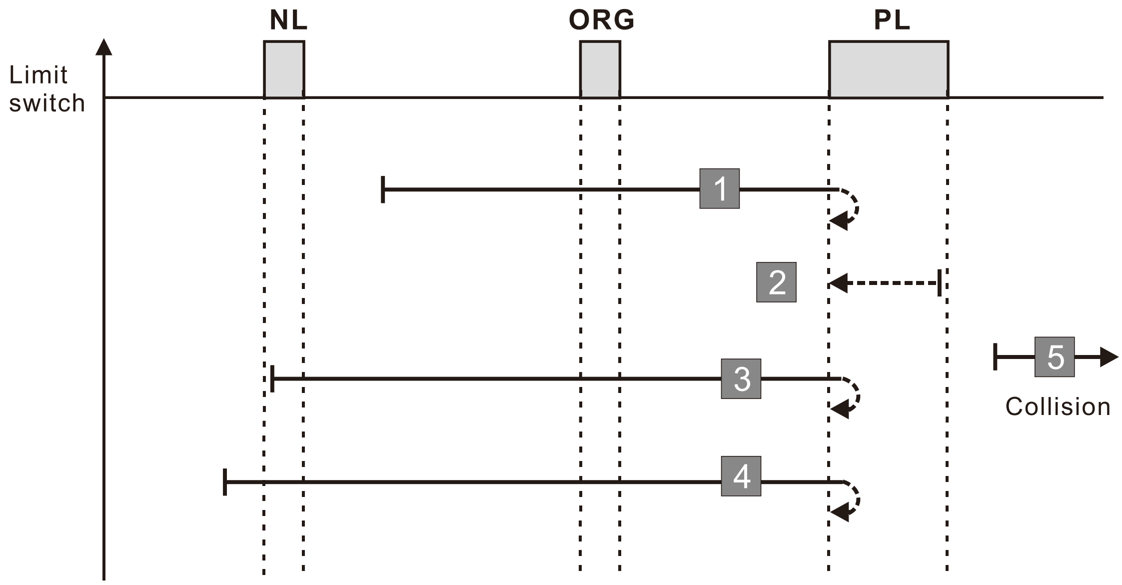
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 16

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
18	-	2	0	Execute homing position control in the forward direction and use the positive limit switch as the origin.

1. The initial movement is in the forward direction.
2. When encountering the rising edge of the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch as the origin.



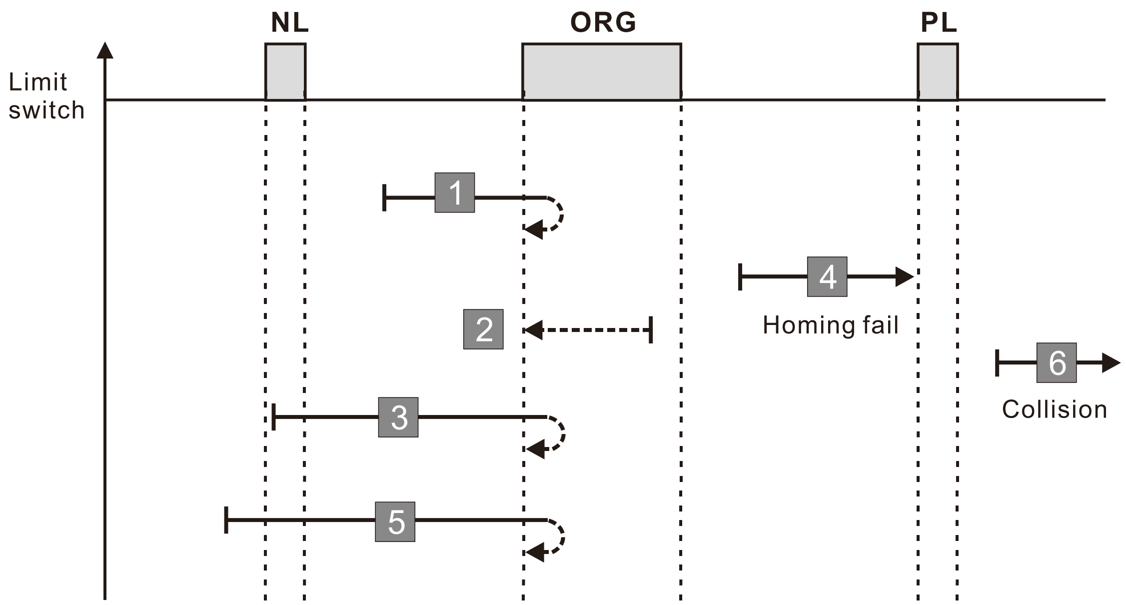
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 17

<table>
<tr><td>CiA402 object 0x6098H</td><td>Z</td><td>Y</td><td>X</td><td rowspan="2">Function Description</td></tr>
<tr><td>Homing Method</td><td>Home Limit</td><td>Z-phase Signal Setting</td><td>Homing Mode</td></tr>
<tr><td>19</td><td colspan="3">No correspondence</td><td>See the diagram for homing method 19</td></tr>
</table>

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
3. Then, wait for the falling-edge trigger of the ORG switch as the origin.



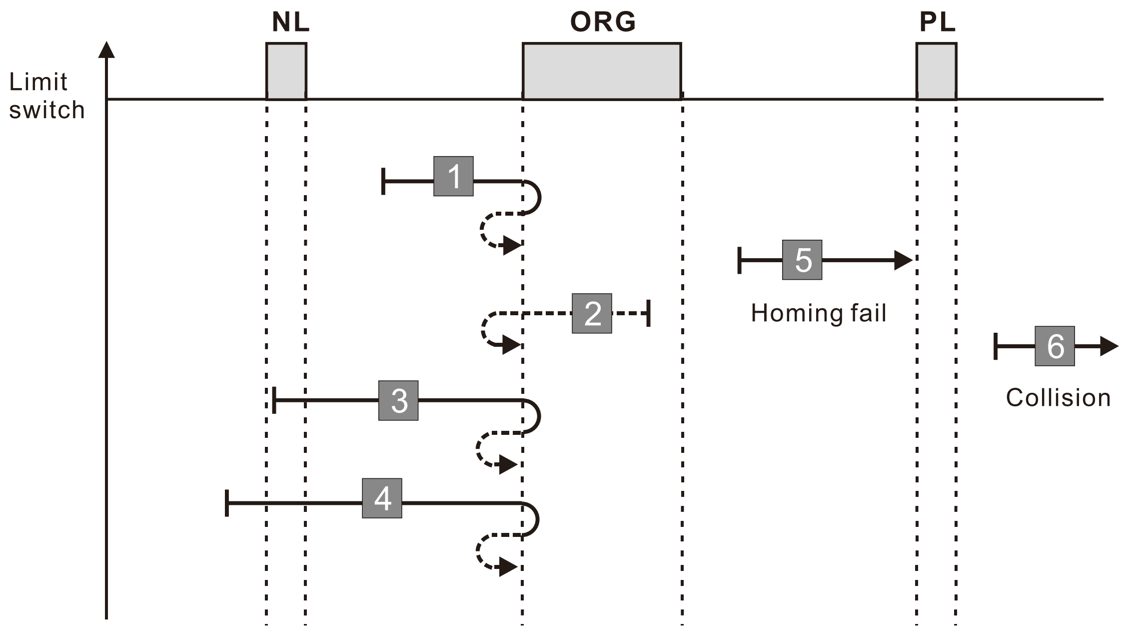
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the forward direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 18

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
20	0	2	2	Execute homing position control in the forward direction and use the ORG switch (from 0 to 1) as the origin. Stops when encountering the positive limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed and waits for the rising-edge trigger of the ORG switch.
3. Then, wait for the rising-edge trigger of the ORG switch as the origin.



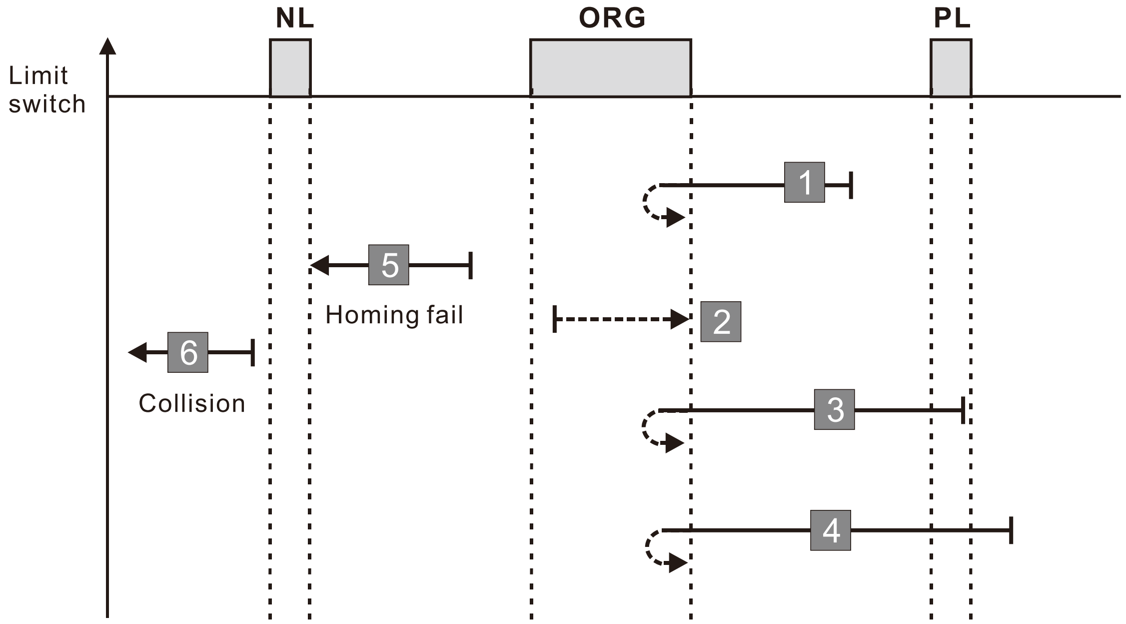
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the reverse direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 19

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
21	No correspondence			See the diagram for homing method 21

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed and waits for the falling-edge trigger of the ORG switch.
3. Then, wait for the falling-edge trigger of the ORG switch as the origin.



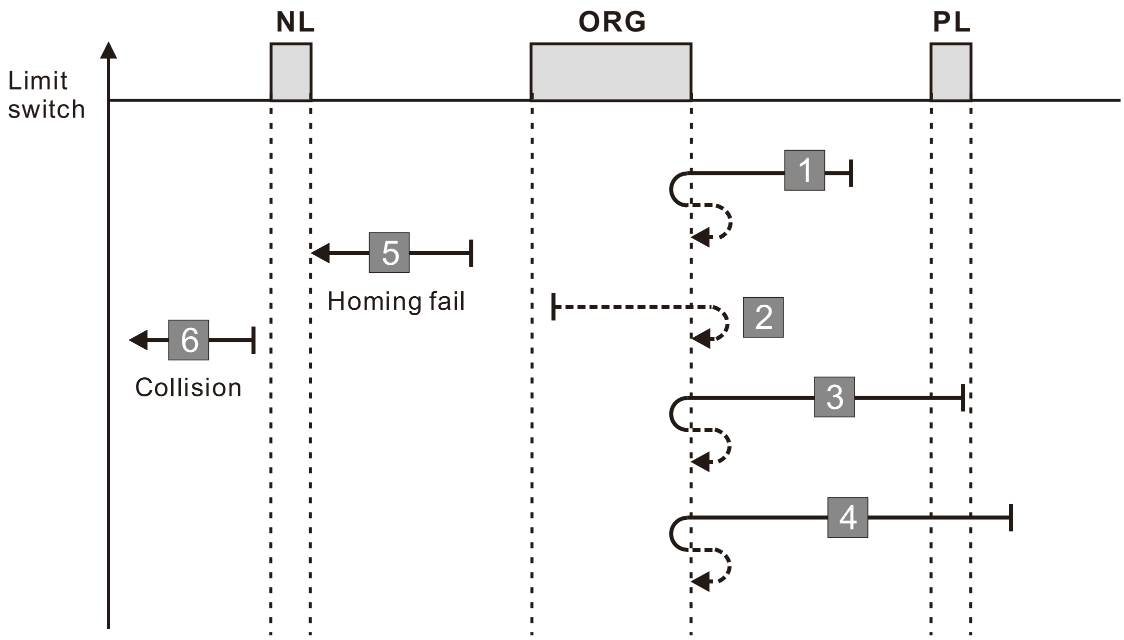
A homing failure occurs when the following condition happen:

1. If the motor starts the movement in the reverse direction and no rising edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 20

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
22	0	2	3	Execute homing position control in the reverse direction and use the ORG switch (from 0 to 1) as the origin. Stops when encountering the negative limit switch.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the falling-edge of the ORG switch, the movement direction is reversed and waits for the rising-edge trigger of the ORG switch.
3. Then, wait for the rising-edge trigger of the ORG switch as the origin.



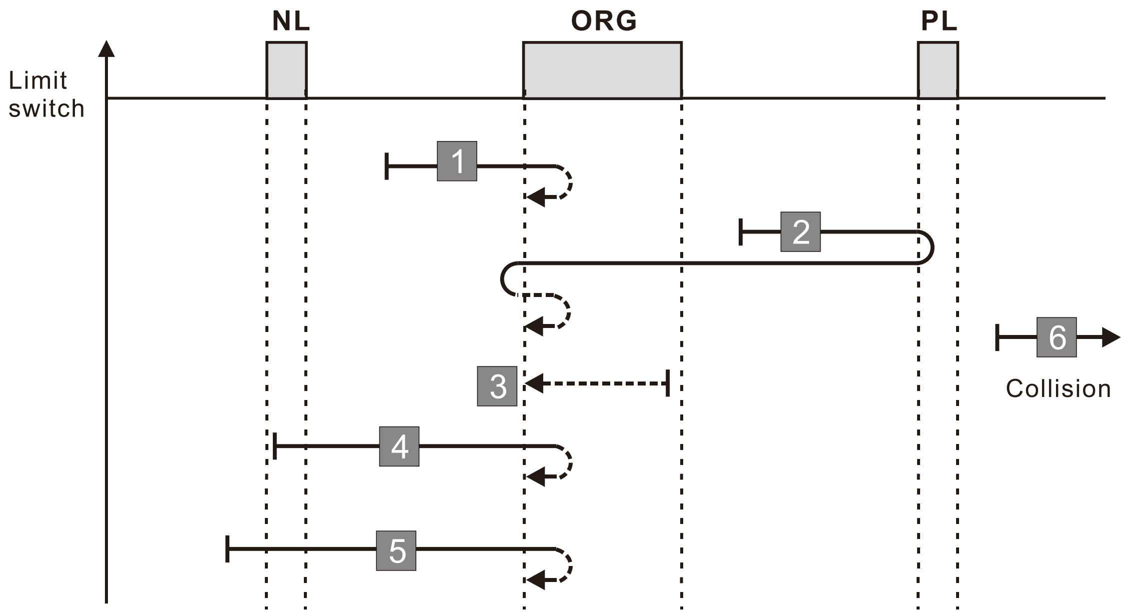
A homing failure occurs when the following condition happen:

1. If the initial motor movement is in the forward direction and no falling edge of the ORG switch is encountered, a homing failure occurs.
2. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
3. If no ORG switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 21

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
23	No correspondence			See the diagram for homing method 23

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the falling-edge trigger of the ORG switch as the origin.



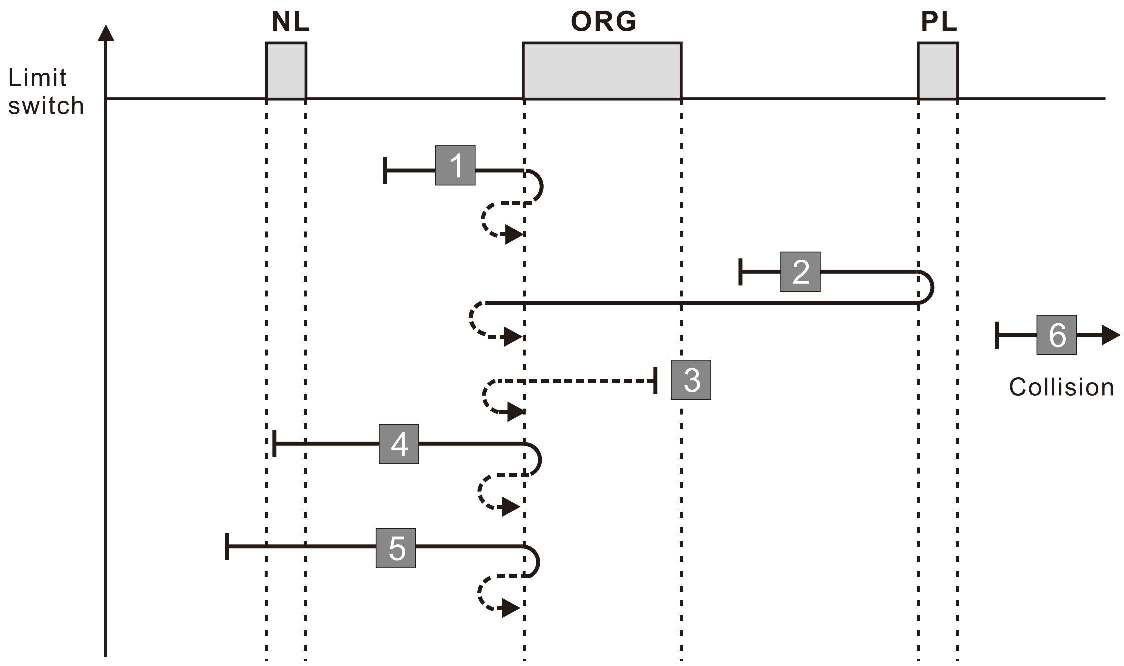
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 22

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
24	1	2	2	Execute homing position control in the forward direction and use the ORG switch (from 0 to 1) as the origin. When encountering the positive limit switch, the direction is reversed to the locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the reverse direction if the ORG switch is active; the initial movement is in the forward direction if the ORG switch is inactive.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the rising-edge trigger of the ORG switch as the origin.



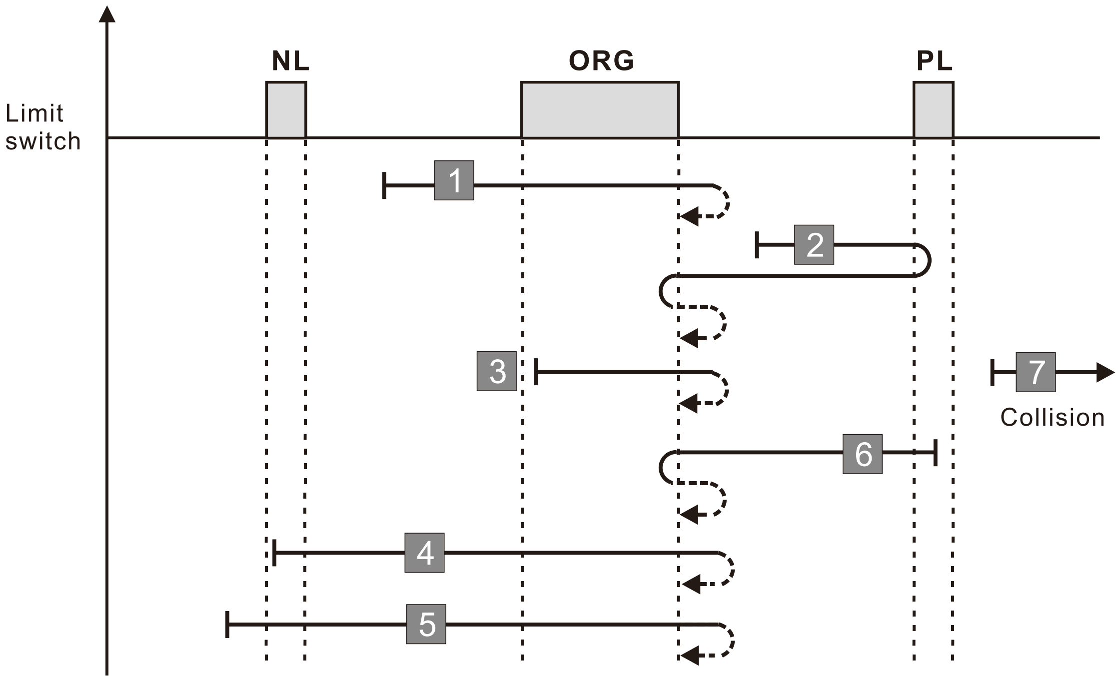
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 23

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
25	No correspondence			See the diagram for homing method 25

1. The initial movement is in the forward direction.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the forward direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the rising-edge trigger of the ORG switch as the origin.



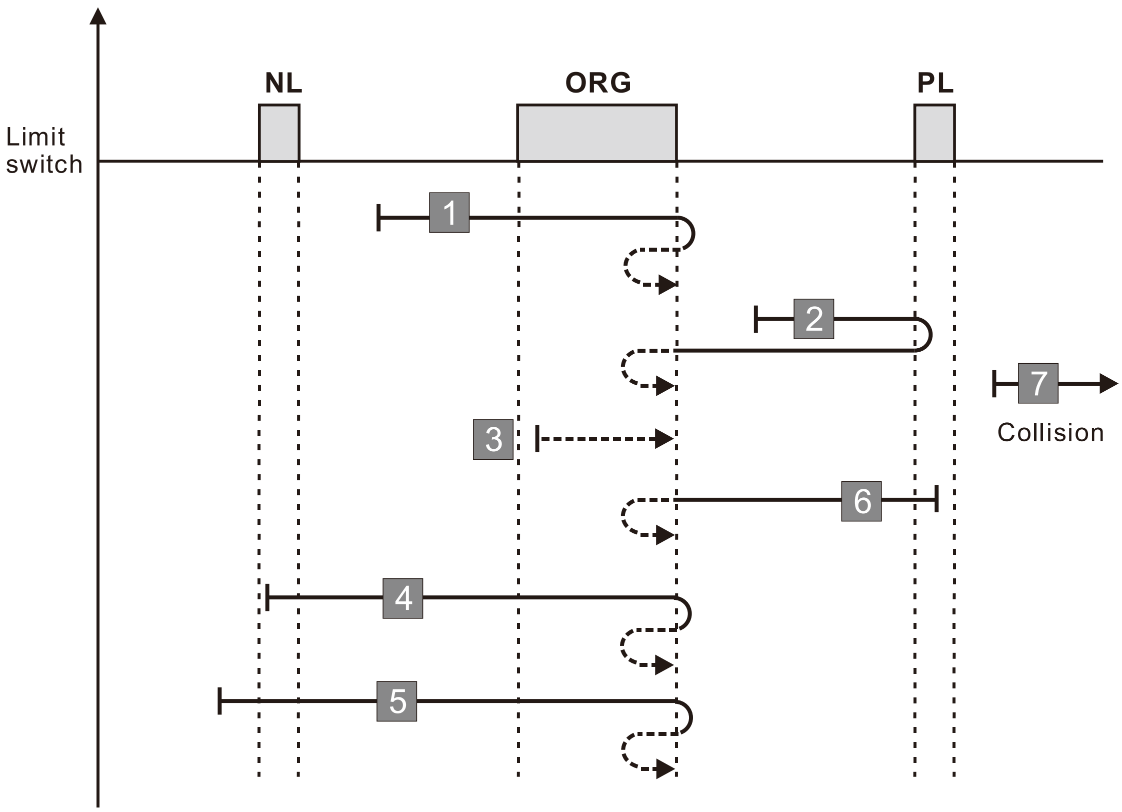
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 24

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
26	1	2	6	Execute homing position control in the forward direction and use the ORG switch (from 1 to 0) as the origin. When encountering the positive limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the forward direction.
2. When moving in the forward direction and encountering the positive limit switch, the movement direction is reversed and waits for the falling-edge trigger of the positive limit switch.
3. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the falling-edge trigger of the ORG switch as the origin.



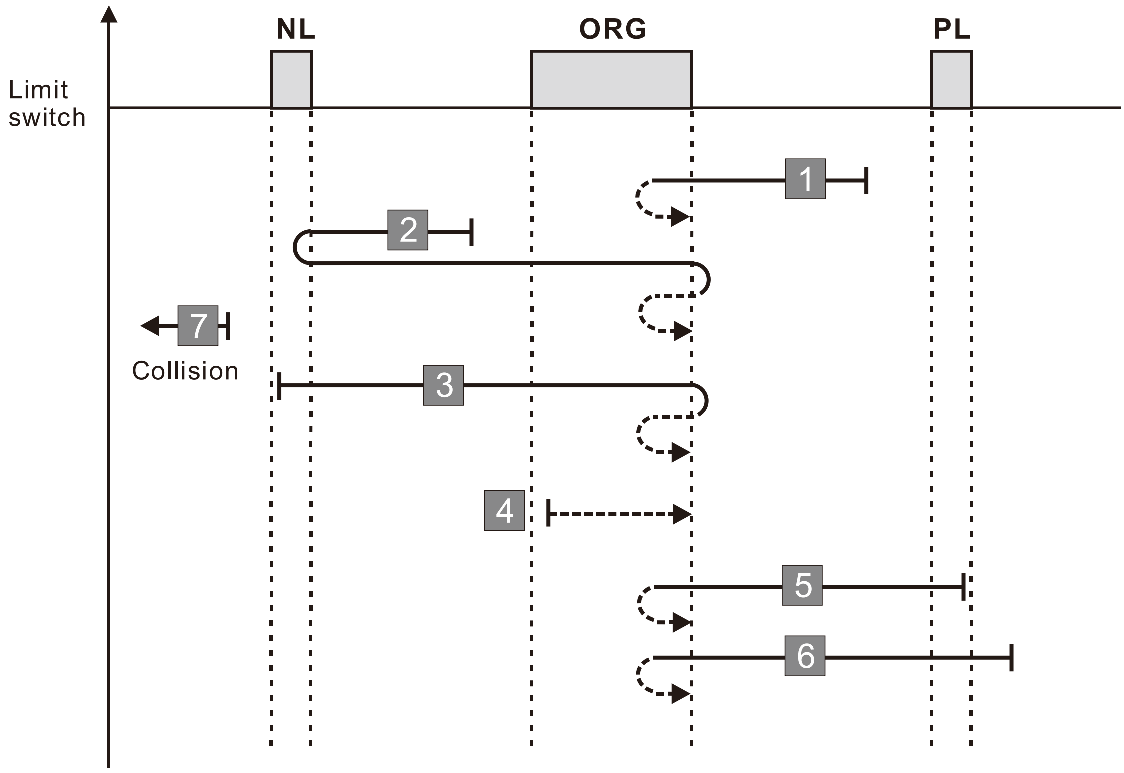
A homing failure occurs when the following condition happen:

1. If a negative limit switch signal is encountered when the motor moves in the reverse direction, a homing failure occurs.
2. If no positive limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 25

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
27	No correspondence			See the diagram for homing method 27

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the reverse direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the falling-edge trigger of the ORG switch as the origin.



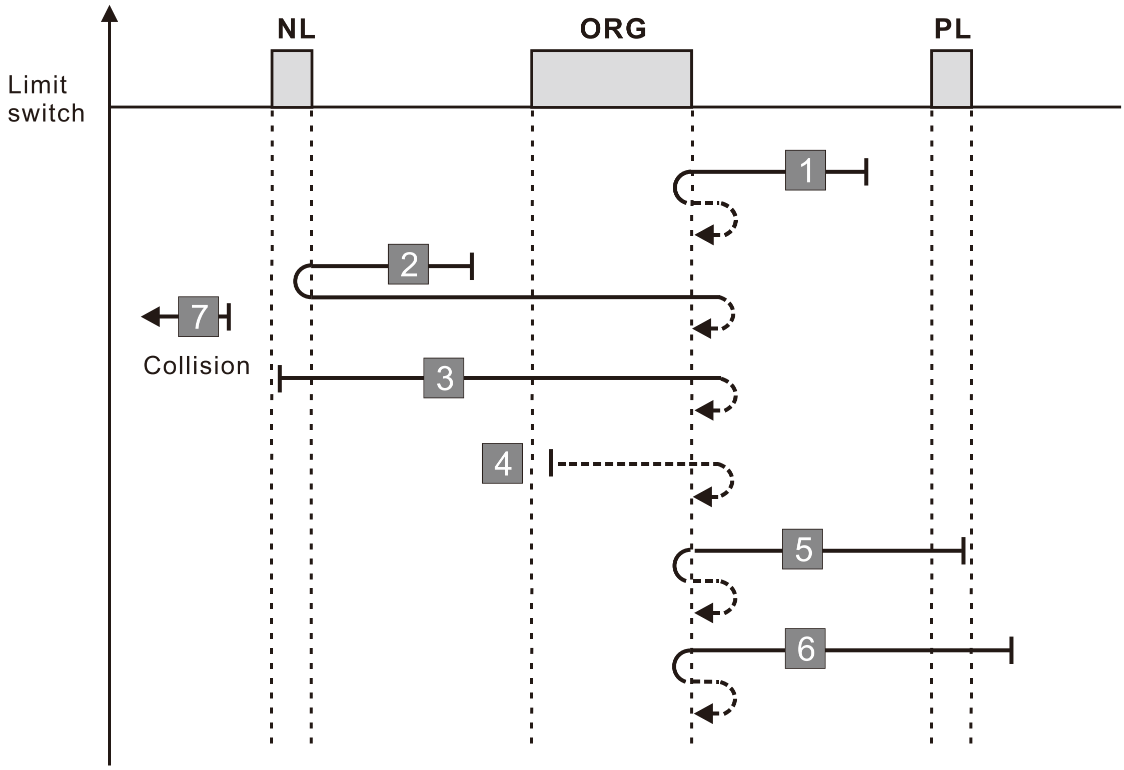
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 26

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
28	1	2	3	Execute homing position control in the reverse direction and use the ORG switch (from 0 to 1) as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement direction depends on the ORG switch status. The initial movement is in the forward direction if the ORG switch is active; the initial movement is in the reverse direction if the ORG switch is inactive.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the forward direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the rising-edge trigger of the ORG switch as the origin.



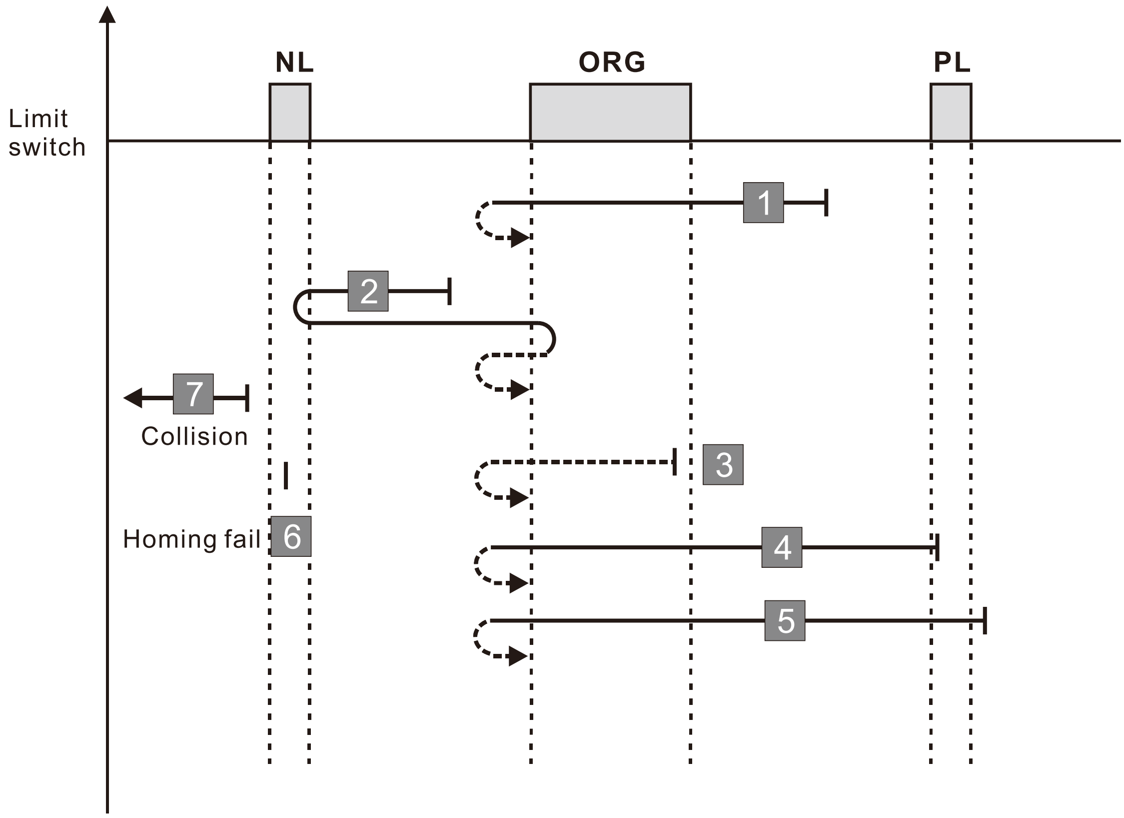
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 27

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
29	No correspondence			See the diagram for homing method 29

1. The initial movement is in the reverse direction.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the reverse direction and encountering the falling edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the rising-edge trigger of the ORG switch as the origin.



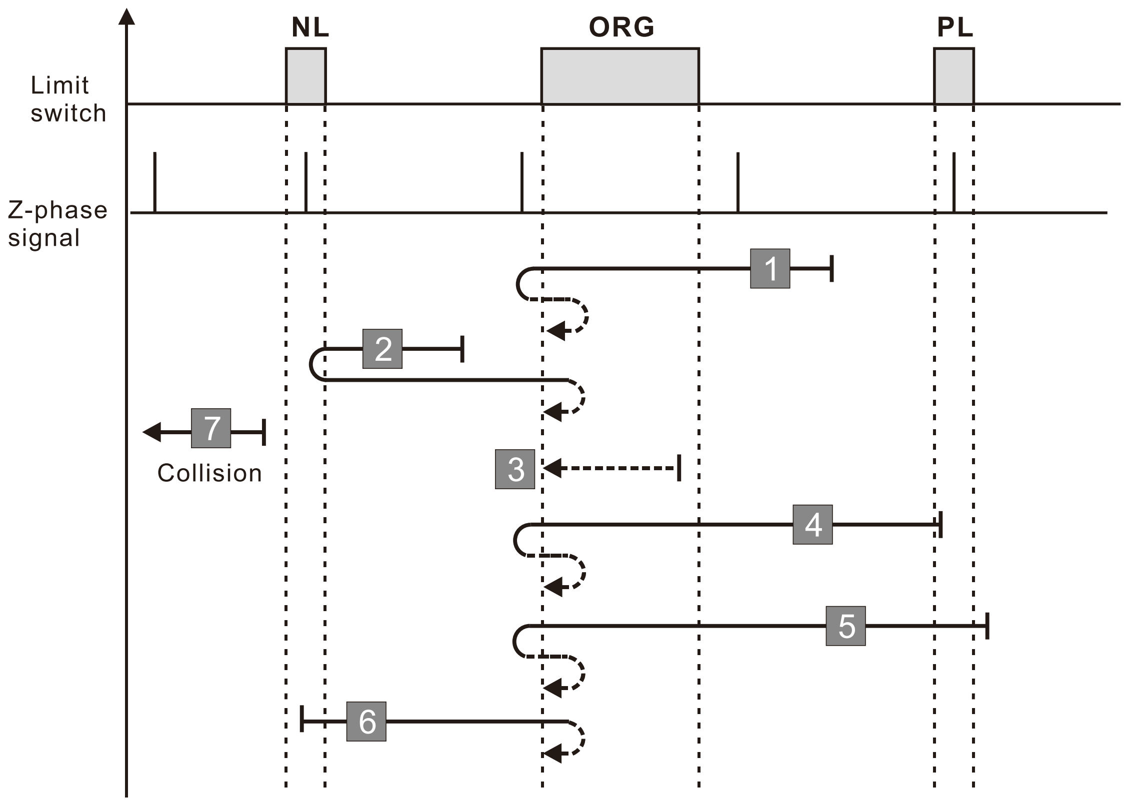
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 28

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
30	1	2	7	Execute homing position control in the reverse direction and use the ORG switch (from 1 to 0) as the origin. When encountering the negative limit switch, the direction is reversed to locate the origin.

1. The initial movement is in the reverse direction.
2. When moving in the reverse direction and encountering the negative limit switch, the movement direction is reversed and waits for the falling-edge trigger of the negative limit switch.
3. When moving in the forward direction and encountering the rising edge of the ORG switch, the movement direction is reversed.
4. Then, wait for the falling-edge trigger of the ORG switch as the origin.



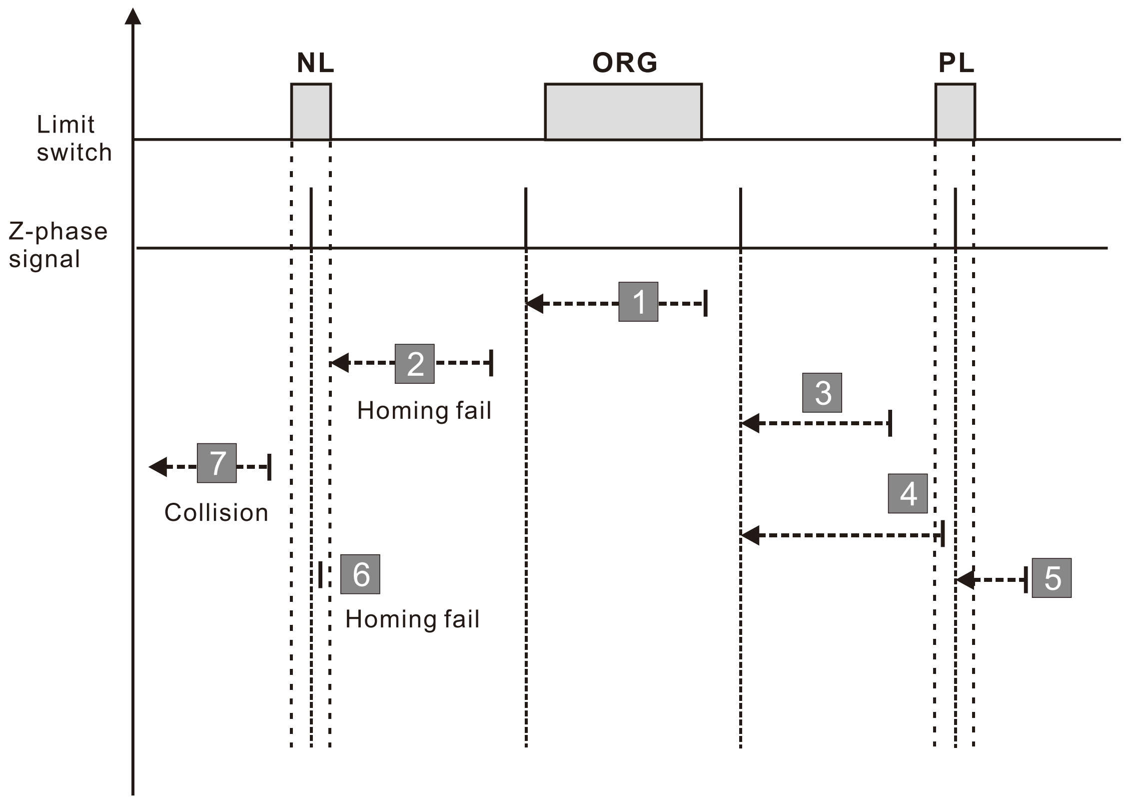
A homing failure occurs when the following condition happen:

1. If a positive limit switch signal is encountered when the motor moves in the forward direction, a homing failure occurs.
2. If no negative limit switch signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 29

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
33	0	-	5	Locate the Z-phase signal in the reverse direction and use the Z-phase signal as the origin. Stops when encountering the negative limit switch.

1. The initial movement is in the reverse direction.
2. Then, the movement locates the Z-phase signal in the reverse direction and uses the Z-phase signal as the origin.



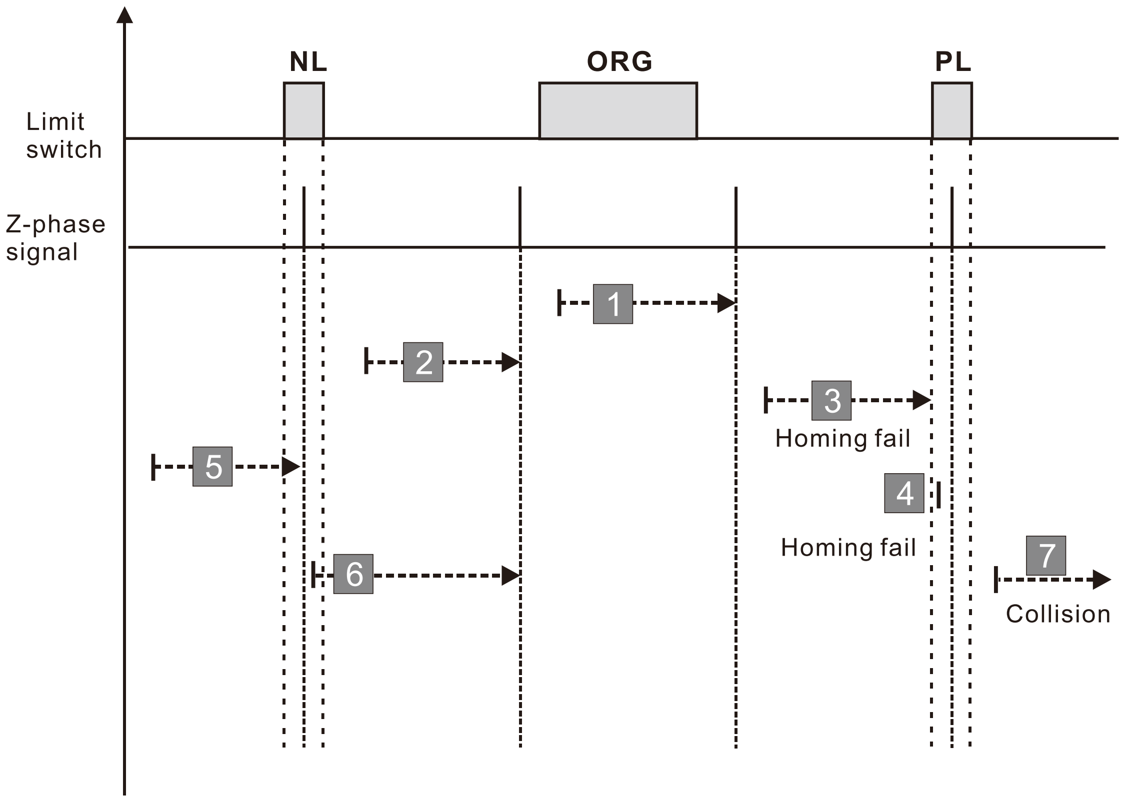
A homing failure occurs when the following condition happen:

1. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
2. If no Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 30

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
34	0	-	4	Locate the Z-phase signal in the forward direction and use the Z-phase signal as the origin. Stops when encountering the positive limit switch.

1. The initial movement is in the forward direction.
2. Then, the movement locates the Z-phase signal in the forward direction and uses the Z-phase signal as the origin.



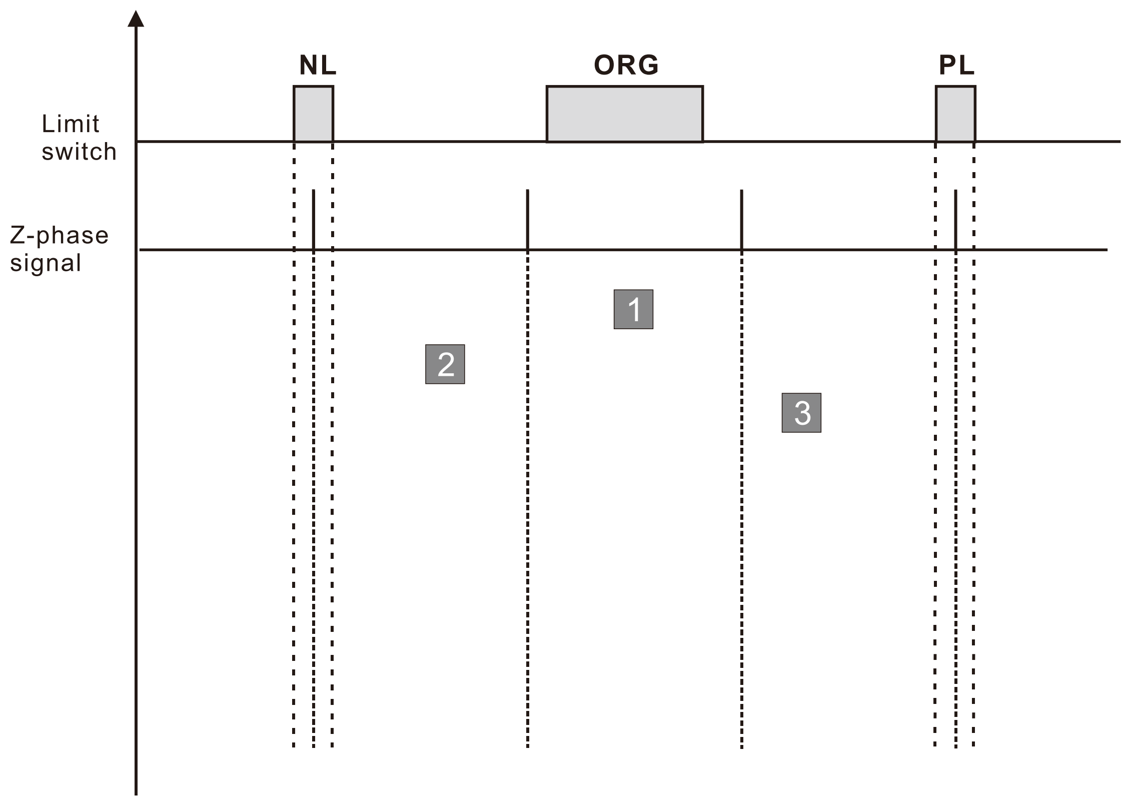
A homing failure occurs when the following condition happen:

1. If a positive or negative limit switch signal is encountered in the process of motor movement, a homing failure occurs.
2. If no Z-phase signal is encountered in the homing process mentioned above, and time-out is triggered, then a homing failure occurs.

Diagram 31

CiA402 object 0x6098H	Z	Y	X	Function Description
Homing Method	Home Limit	Z-phase Signal Setting	Homing Mode	
35	-	-	8	Use the current position as the origin.

1. The current position is used as the origin (this function is available even when the drive is in stop status).



A homing failure occurs when the following condition happen:

1. No homing failure condition occurs.

11-69 Homing Control Time Out

Default: 60.0

Settings 0.0–6000.0 sec.

- Set the time limit for completing the homing process. When executing homing position control, a fault occurs for the drive if positioning time exceeds Pr.11-69.

11-70 Homing Control First Step Speed

Default: 8.00

Settings 0.00–599.00 Hz

11-71 Homing Control Second Step Speed

Default: 2.00

Settings 0.00–599.00 Hz

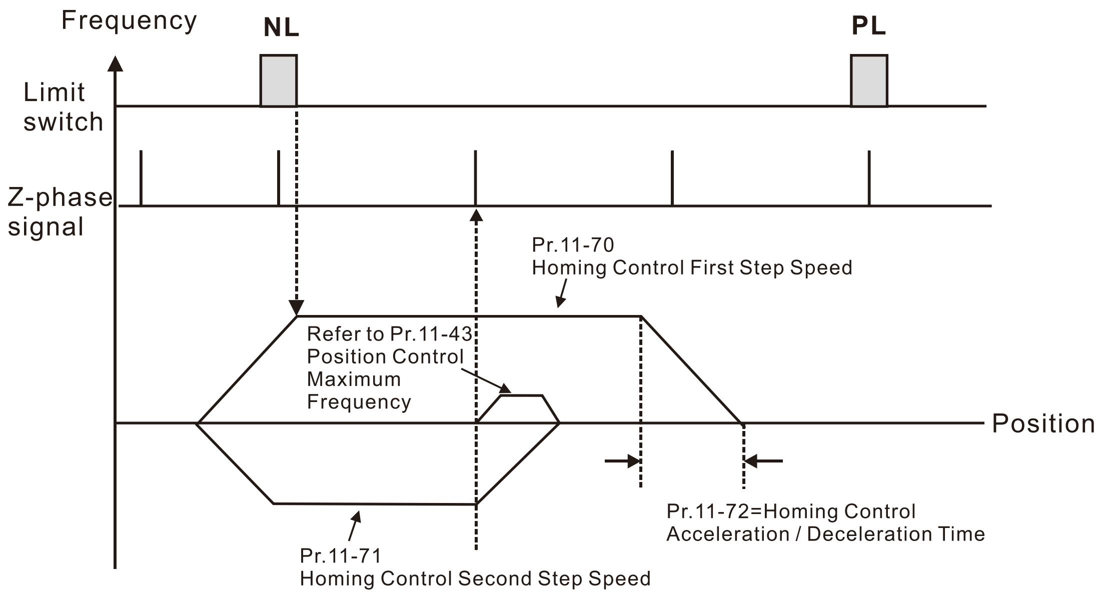
- There are two steps of speed for the homing process:
  CiA402 defines:
  - The first-step speed is used to locate the switch signals (positive limit switch, negative limit switch and ORG switch)
  - The second-step speed is used to locate the reference point (Z-phase signal, the rising / falling edge of the ORG switch signal)
- Considering the braking distance when the motor encounters the switch signal, do not use a too fast first-step speed.
- To ensure the high repeatability of the reference point, use a low second-step speed.
- When executing homing control, the last rising speed refers to the setting of Pr.11-70.

11-72 Homing Control Acceleration / Deceleration Time (0–Homing Control 1st Step Speed)

Default: 10.00

Settings 0.00–600.00 sec.

- This parameter is the first-step of acceleration / deceleration time from 0 Hz to Pr.11-70 when the homing position control function is enabled.
- Acceleration / deceleration time in the process of homing refers to Pr.11-72 setting value.



11-73 Homing Control Offset (Revolution)

Default: 0

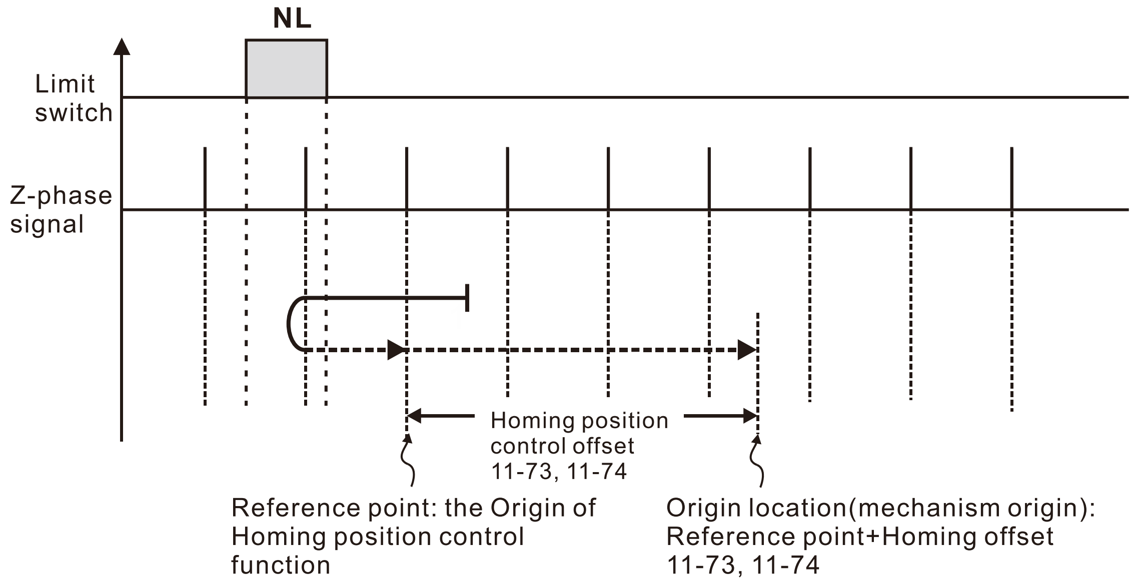
Settings -30000–30000 resolutions

11-74 Homing Control Offset (Pulse)

Default: 0

Settings Refer to Pr.10-01 setting

- Pr.11-73 and Pr.11-74 are the offset number of revolutions and pulses required for the coordinate system origin (mechanical origin) position determined after the homing positioning process is completed.
- When Pr.10-00 = 8, the setting range for Pr.11-73 is -16383–16383.



11-75 Position Record (Revolution)

Default: 0

Settings -30000–30000 resolutions

11-76 Position Record (Pulse)

Default: 0

Settings Refer to Pr.10-01 setting

- The position memory function enables the drive to record the motor's current position and makes the coordinate system remain at the mechanical origin even after the drive's power-off when using incremental encoder. With this function, you do not need to execute the homing positioning again.
- The position memory function is only valid when Pr.11-60 bit0 = 1 (position memory function is enabled).
- When the drive is powered off, it records the motor's current position in Pr.11-75 and Pr.11-76. After the drive is powered ON again, the motor's initial position = Pr.11-75 × PPR number + Pr.11-76, and the homing process is regarded as completed.
  If the saved position exceeds the maximum capacity of position memory (Pr.11-75 and Pr.11-76), the warning code POF (position counting overflow) is displayed after the drive is powered ON again.

11-78 HALT Revived Selection

Default: 0

Settings 0: Stopped

1: Continue according to the previous position command

When executing multi-step positioning position control through communications: If 6000h bit3 = 1, the drive stops at zero speed in a Servo ON status according to the deceleration time for position control. If 6000h bit3 = 0, the drive acts according to Pr.11-78 settings:

When Pr.11-78 = 0, the drive is in complete stop, and Servo ON remains.

When Pr.11-78 = 1, the drive resumes with previous position command.

Control Source Position	bit	Value	bit name	Profile Position Control Mode (pp)
6000h	3	0	HALT	Acts according to Pr.11-78 settings
		1		Stops according to the deceleration time for position control

12 Tension Control Parameters

✓ You can set this parameter during operation.

12-00 Tension Control Selection

Default: 0

Settings
0: Disabled
1: Closed-loop tension, speed mode
2: Closed-loop linear speed, speed mode
3: Closed-loop tension, torque mode
4: Open-loop tension, torque mode

📖 The table below shows the control modes applicable to each setting value:

Setting value \ Control mode	VF	SVC	FOC	TQC
0: Disabled				
1: Closed-loop tension, speed mode	○	○	○	
2: Closed-loop linear speed, speed mode	○	○	○	
3: Closed-loop tension, torque mode				○
4: Open-loop tension, torque mode				○

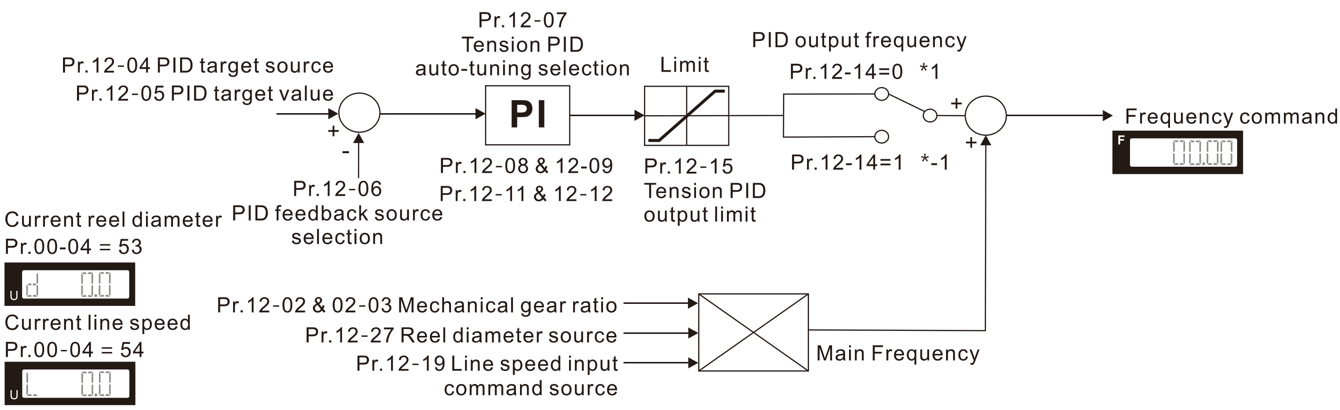
📖 See the following pages for the instructions of each setting value:

- **Setting value 1: Closed-loop tension, speed mode**

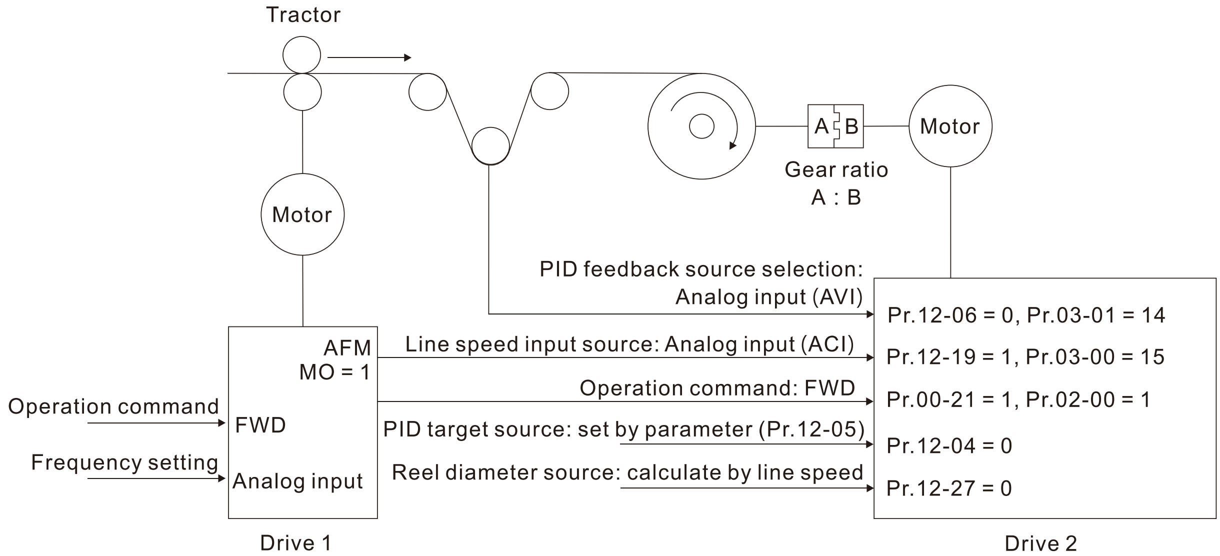
The calculation of the main frequency in tension control:

$$f(Hz) = \frac{V}{\pi D} \cdot \frac{A}{B}$$

V: Linear speed (m/min.)
D: Reel diameter (m)
A/B: Mechanical gear ratio

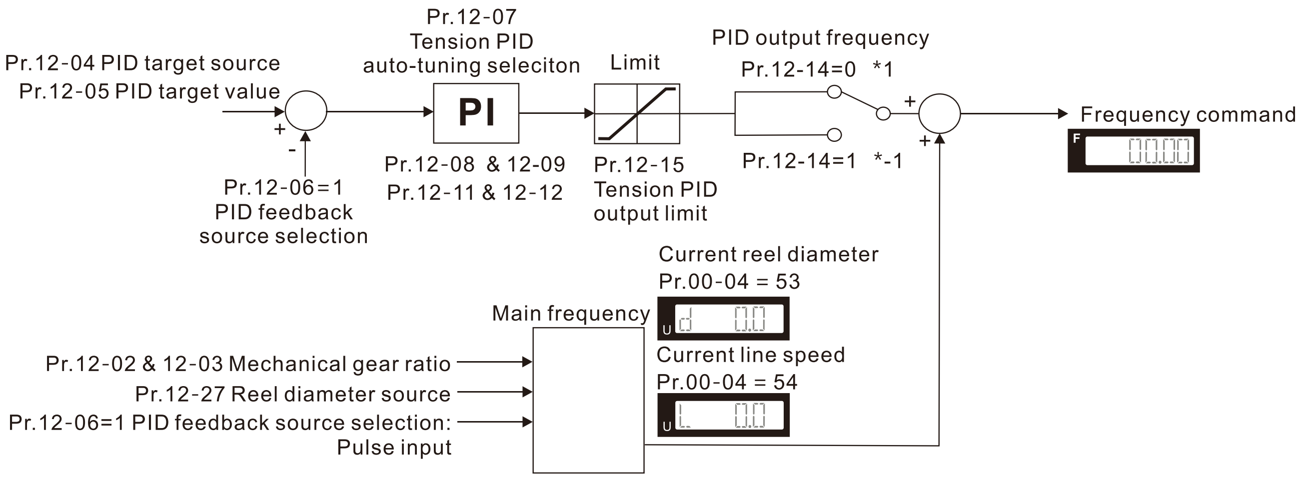


Example:

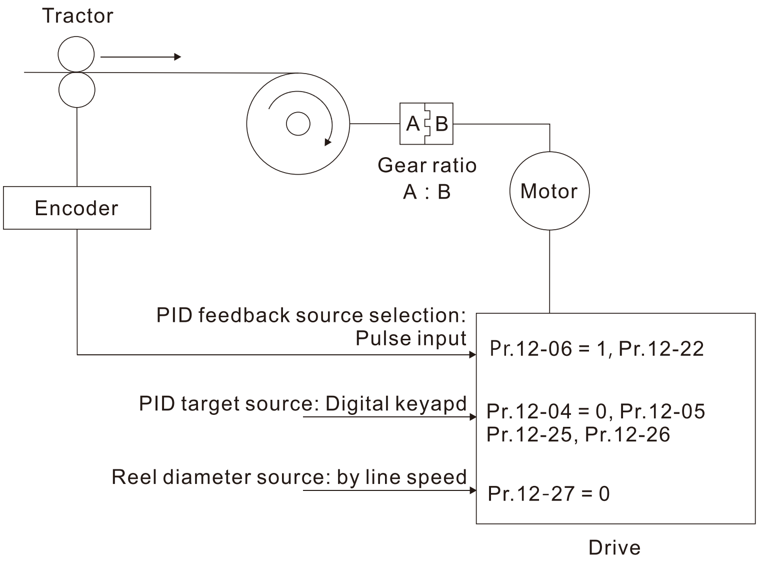


A summary of the parameters – Tension closed-loop, speed mode				
	Pr.	Parameter name	Setting	Note
Tractor (Drive 1)	00-20	Master frequency command source (AUTO, REMOTE)	2	Inputs from external analog (refer to Pr.03-00)
	00-21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
	02-16	Multi-function output 2 (MO1)	1	Indication during RUN
	03-20	AFM multi-function output	0	Output frequency (Hz)
Winder machine (Drive 2)	Pr.	Parameter name	Setting	Note
	00-21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
	03-00	AVI analog input selection	15	Linear speed
	03-01	ACI analog input selection	14	Tension PID feedback signal
	12-00	Tension control selection	1	Closed-loop tension, speed mode
	12-02	Mechanical gear A at load side	100	Depends on working condition
	12-03	Mechanical gear B at motor side	100	Depends on working condition
	12-04	PID target source	0	Set by parameter (Pr.12-05)
	12-05	PID target value	50	Depends on working condition
	12-06	PID feedback source selection	0	Analog input
	12-19	Linear speed input command source	1	Analog input
	12-27	Reel diameter source	0	Calculated via linear speed

- **Setting value 2: Closed-loop linear speed, speed mode**



Example:

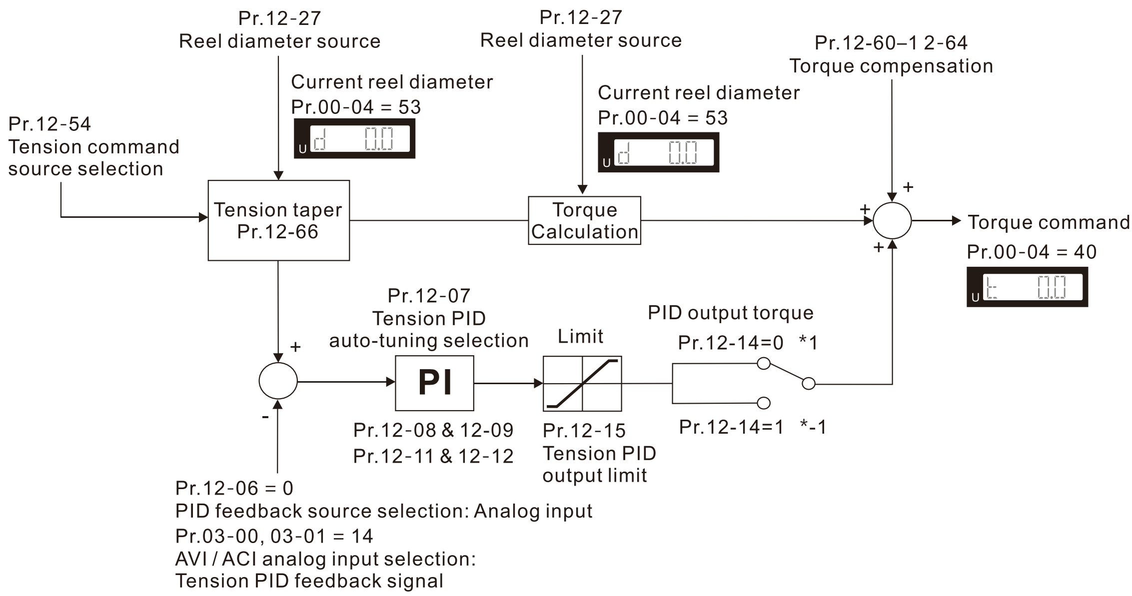


A summary of the parameters – Closed-loop linear speed, speed mode			
Pr.	Parameter name	Setting	Note
10-00	Encoder type selection	5	Pulse input
10-16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.
12-00	Tension control selection	1	Closed-loop linear speed, speed mode
12-02	Mechanical gear A at load side	100	Depends on working condition
12-03	Mechanical gear B at motor side	100	Depends on working condition
12-04	PID target source	0	Set by parameter (Pr.12-05)
12-05	PID target value	50	Depends on working condition
12-06	PID feedback source selection	1	Pulse input
12-22	Pulses per meter	500	Depends on working condition
12-25	Linear speed command acceleration time	10	Depends on working condition
12-26	Linear speed command deceleration time	10	Depends on working condition
12-27	Reel diameter source	0	Calculated via linear speed

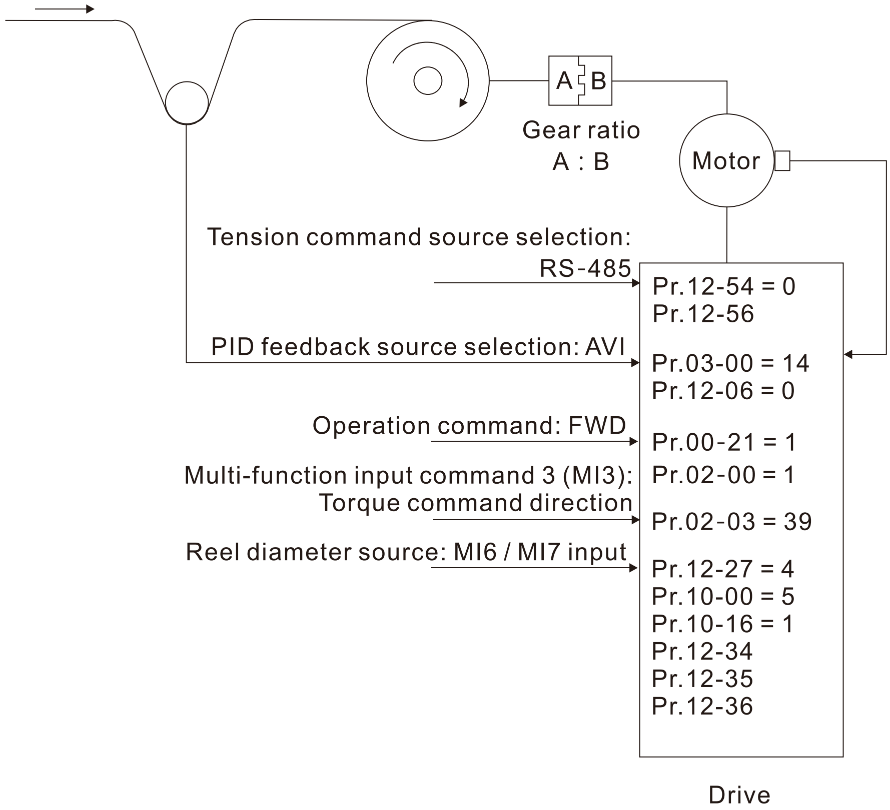
- **Setting value 3: Closed-loop tension, torque mode**

$$\text{Torque (N}-\text{m)} = \frac{F \cdot D}{2}$$

F: Tension (N)
D: Reel diameter (m)



Example:

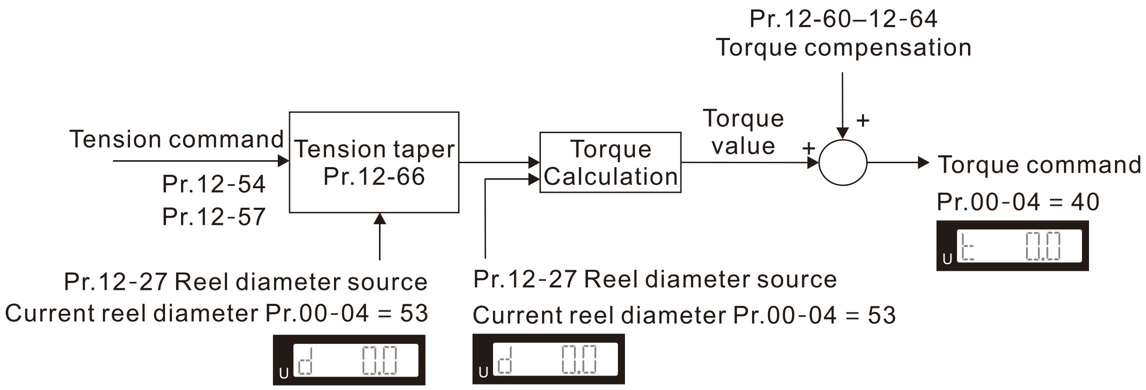


A summary of the parameters – Tension closed-loop, torque mode			
Pr.	Parameter name	Setting	Note
00-21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
02-03	Multi-function input command 3 (MI3)	39	Torque command direction
03-00	AVI analog input selection	14	Tension PID feedback signal
10-00	Encoder type selection	5	Pulse input
10-16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.
12-00	Tension control selection	3	Closed-loop tension, torque mode
12-02	Mechanical gear A at load side	100	Depends on working condition
12-03	Mechanical gear B at motor side	100	Depends on working condition
12-06	PID feedback source selection	0	Analog input
12-27	Reel diameter source	4	4: Calculated via thickness integral, the encoder installed at reel side inputs by MI6 / MI7 terminals
12-34	Pulses per revolution	1000	Depends on working condition
12-35	Revolutions per layer	10	Depends on working condition
12-36	Material thickness	0.01	Depends on working condition
12-54	Tension command source selection	0	RS-485 communication input
12-56	Tension command setting value	100	Depends on working condition

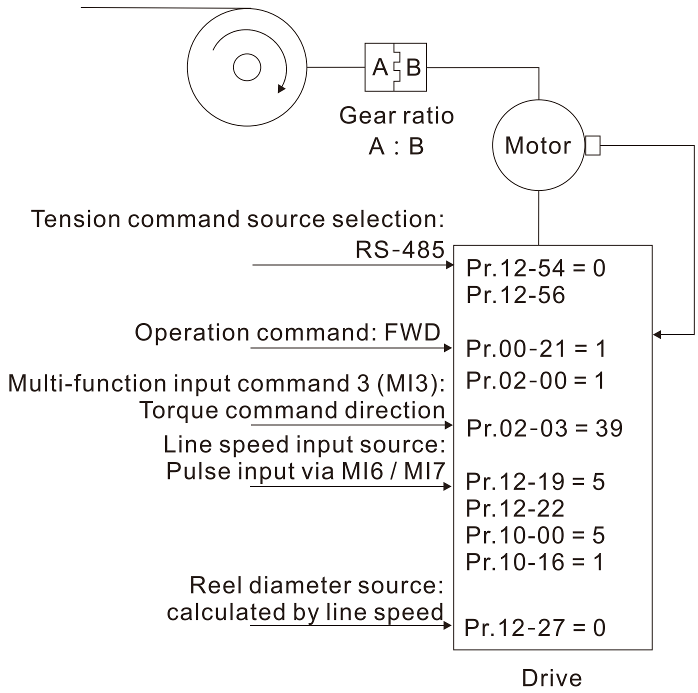
● **Setting value 4: Open-loop tension, torque mode**

$$\text{Torque}\ (N-m) = \frac{F \cdot D}{2}$$

F: Tension (N)
D: Reel diameter (m)



Example:



A summary of the parameters – Tension open-loop, torque mode			
Pr.	Parameter name	Setting	Note
00-21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
02-03	Multi-function input command 3 (MI3)	39	Torque command direction
10-00	Encoder type selection	5	Pulse input
10-16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.
12-00	Tension control selection	4	Open-loop tension, torque mode
12-02	Mechanical gear A at load side	100	Depends on working condition
12-03	Mechanical gear B at motor side	100	Depends on working condition
12-19	Linear speed input command source	5	Pulse input through MI6 / MI7 terminal
12-22	Pulses per meter	1000	Depends on working condition
12-27	Reel diameter source	0	Calculated via linear speed
12-54	Tension command source selection	0	RS-485 communication input
12-56	Tension command setting value	100	Depends on working condition

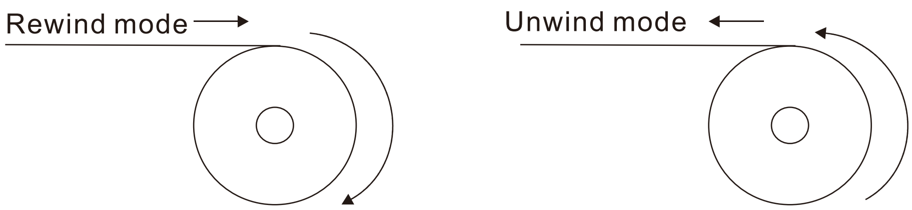
12-01 Winding Mode

Default: 0

Settings 0: Rewind

1: Unwind

- When Pr.12-01 = 1, the tension taper function is invalid.
- When using rewind mode, the reel diameter (D) increases gradually; when using unwind mode, the reel diameter (D) decreases gradually. See the figure below.



12-02 Mechanical Gear A at Load Side

Default: 100

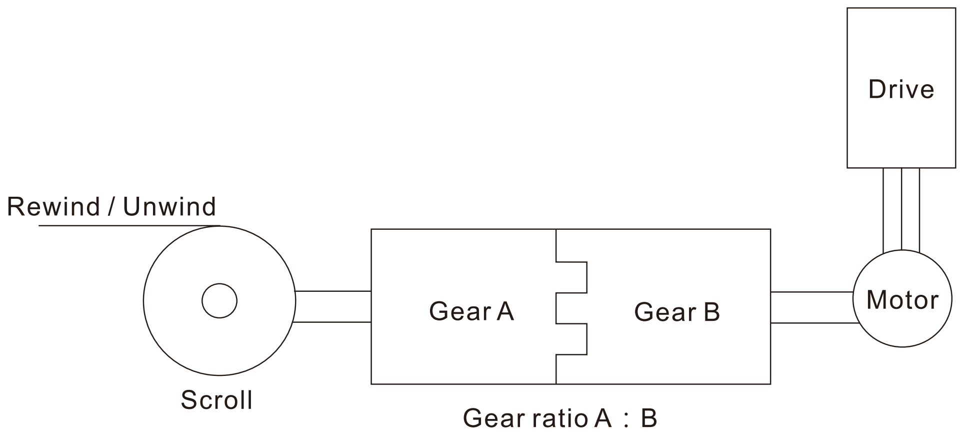
Settings 1–65535

12-03 Mechanical Gear B at Motor Side

Default: 100

Settings 1–65535

- Pr.12-02 and Pr.12-03 are only for using in tension control mode.



12-04 PID Target Source

Default: 0

Settings 0: Set by parameter (Pr.12-05)

1: Set by RS-485

2: Analog input

- This parameter is valid when Pr.12-00 =1 or 2.
- When Pr.12-04 = 0, you can adjust PID target value (Pr.12-05) via digital keypad.
- When Pr.12-04 = 1, you can adjust PID target value (Pr.12-05) via communication.
- When Pr.12-04 = 2, sets AVI / ACI analog input to be tension PID target value (Pr.03-00, Pr.03-01 = d17), and the tension target value will only display in Pr.12-05.

12-05 PID Target Value

Default: 50.0

Settings 0.0–100.0%

- This parameter is valid when Pr.12-00 = 1 or 2.
- Under the condition of closed-loop linear speed and speed mode (Pr.12-00 = 2), sets Pr.03-00, Pr.03-01 to 15 (Linear speed) as the linear speed PID command. For other tension modes, sets Pr.03-00, Pr.03-01 to 15 (linear speed) as the actual linear speed.
- The setting range 0.0–100.0% corresponds to the tension feedback 0–10 V / 0– the maximum linear speed (Pr.12-20).

  For example:
  - In tension mode, when Pr.12-00 = 1 (closed-loop tension, speed mode), the setting value 17 (tension PID target value) of Pr.03-00, Pr.03-01 corresponds to the tension feedback 0–10 V.
  - In tension mode, when Pr.12-00 = 2 (closed-loop linear speed, speed mode), the setting value 15 (linear speed) of Pr.03-00, Pr.03-01 corresponds to 0– the maximum linear speed (Pr.12-07).

12-06 PID Feedback Source Selection

Default: 0

Settings 0: Analog input

1: Pulse input

- When setting as 0, the setting for AVI / ACI analog input selection have to be tension PID feedback signal (Pr.03-00, Pr.03-01 = d14).
- When setting as 1, you have to set the pulses per meter in Pr.12-22.

12-07 Tension PID Auto-tuning Selection

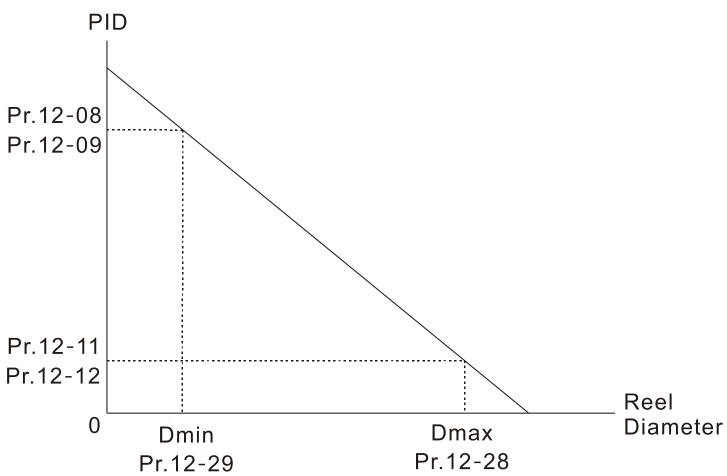
Default: 0

Settings 0: Disabled

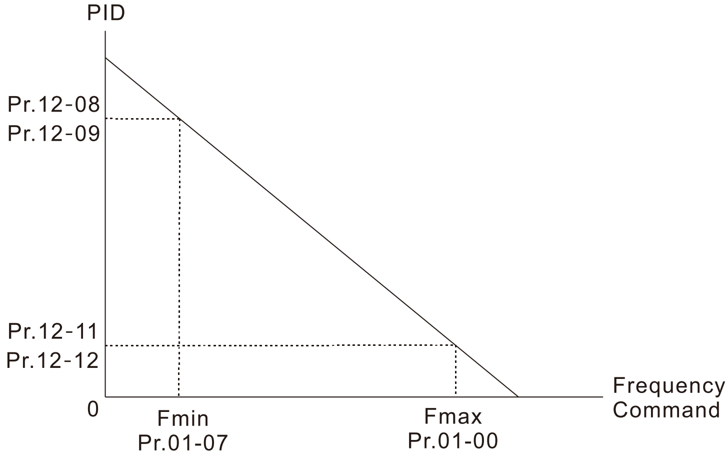
1: Reel diameter (Pr.12-08–12-09 corresponds to Pr.12-29; Pr.12-11–12-12 corresponds to Pr.12-28)

2: Frequency (Pr.12-08–12-09 corresponds to Pr. 01-07; Pr.12-11–12-12 corresponds to Pr.01-00)

- When setting as 1:



📖 When setting as 2:



12-08 Tension PID P Gain 1

Default: 50.0

Settings 0.0–1000.0

12-09 Tension PID I Integral Time 1

Default: 1.00

Settings 0.00–500.00 sec.

12-11 Tension PID P Gain 2

Default: 50.0

Settings 0.0–1000.0

12-12 Tension PID I Integral Time 2

Default: 1.00

Settings 0.00–500.00 sec.

12-14 Tension PID Output Status Selection

Default: 0

Settings 0: PID output is positive
1: PID outut is negative

📖 Select the applicable method by different requirements from the following table.
Tension feedback:

	Loose ← 0–100% → Tight	Tight ← 0–100% → Loose
Rewind	Positive output	Negative output
Unwind	Negative output	Positive output

12-15 Tension PID Output Limit

Default: 20.00

Settings 0.00–100.00%

📖 The output limit range = Pr.12-15 × Pr.01-00

12-16 Tension PID Output Command Limit (Negative Limit)

Default: 20.00

Settings 0.00–655.35%

📖 Determines the percentage of output command limit in PID control.

📖 The negative output limit range = Tension PID output command limit (negative limit) × Pr.01-00.

12-17 Tension PID Feedback Upper Limit

Default: 100.0

Settings 0.0–100.0%

📖 This parameter is valid when Pr.12-00 = 1 or 3.

12-18 Tension PID Feedback Lower Limit

Default: 0.0

Settings 0.0–100.0%

📖 This parameter is valid when Pr.12-00 = 1 or 3.

12-19 Linear Speed Input Command Source

Default: 0

Settings 0: Disabled
1: Analog input
2: RS-485 communication input
3: PG card pulse input
4: DFM-DCM pulse input
5: Pulse input through MI6 / MI7 terminal

📖 This parameter is invalid when Pr.12-00 = 2.

📖 When the setting is not 2, the current linear speed saved in Pr.12-23 by analog or pulse command. When the setting is 2, the current linear speed (Pr.12-23) can be changed by using communication.

📖 When setting as 1, sets AVI / ACI analog input to be linear speed (Pr.03-00, Pr.03-01 = d15)

📖 When setting as 2, sets the current linear speed (Pr.12-23).

📖 When setting as 3, connects pulse signals to the PG2 of the PG card (inputs pulse command), and then sets PG type through Pr.10-16.

📖 When setting as 4, sets the digital output gain (Pr.02-21) to be the same as the tractor's, and then sets the maximum linear speed (Pr.12-20).

📖 When setting as 3, 4, or 5, you have to set the pulses per meter in Pr.12-22.

12-20 Maximum Linear Speed

Default: 1000.0

Settings 0.0–3000.0 m/min.

📖 In closed-loop tension and open-loop tension modes: the maximum linear speed is the reel linear speed of the tractor that corresponds to the maximum frequency of the drive.

📖 When Pr.12-00 = 2: sets Pr.12-20 by the requirements of mechanism.

12-21 Minimum Linear Speed

Default: 0.0

Settings 0.0–3000.0 m/min

📖 If the linear speed is lower than the value set in Pr.12-21, the drive stops calculating the reel diameter and keeps the current reel diameter.

12-22 Pulses Per Meter

Default: 0.0

Settings 0.0–6000.0 pulse/m

- When Pr.12-06 = 1, you have to set this parameter.
- If the command source of the linear speed input is the pulses input from PG card or the pulses input by terminal MI6 / MI7 (Pr.12-19 =3 or 5), then you have to set this parameter.

✓ 12-23 Current Linear Speed

Default: 0.0

Settings 0.0–3000.0 m/min

- The linear speed of closed-loop linear speed and speed mode refer to Pr.12-06.
- The range to display in this parameter is based on Pr.12-20 and Pr.12-21.
- When Pr.12-19 is 1, 3, 4, or 5, the current linear speed saved in Pr.12-23 by analog or pulse command, and this parameter is read only.
- Only when Pr.12-19 is 2, the setting value of the current linear speed can be changed by using communication.

✓ 12-24 Linear Speed Low Pass Filter Time

Default: 0.10

Settings 0.00–100.00 sec.

- This parameter is valid when the command source of the linear speed input is the pulses input from PG card or the pulses input by terminal MI6 / MI7 (Pr.12-19 =3 or 5).
- Adjust this parameter to restrain the vibration of linear speed.

✓ 12-25 Linear Speed Command Acceleration Time

Default: 0.00

Settings 0.00–655.35 sec.

- This parameter is valid when closed-loop linear speed and speed mode (Pr.12-00 = 2).

✓ 12-26 Linear Speed Command Deceleration Time

Default: 0.00

Settings 0.00–655.35 sec.

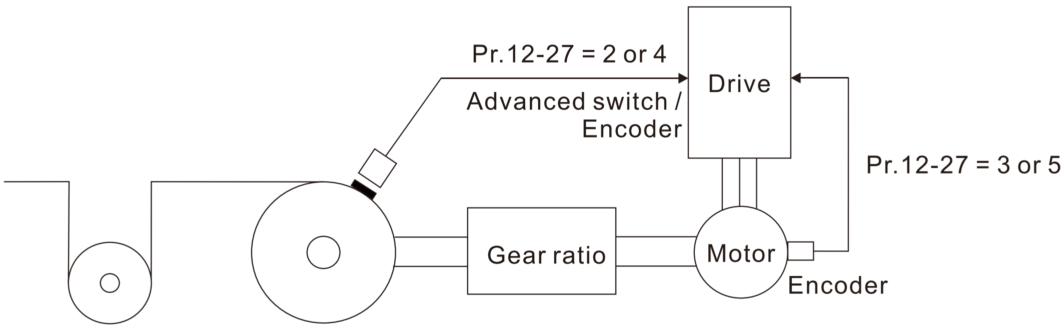
- This parameter is valid when closed-loop linear speed and speed mode (Pr.12-00 = 2).

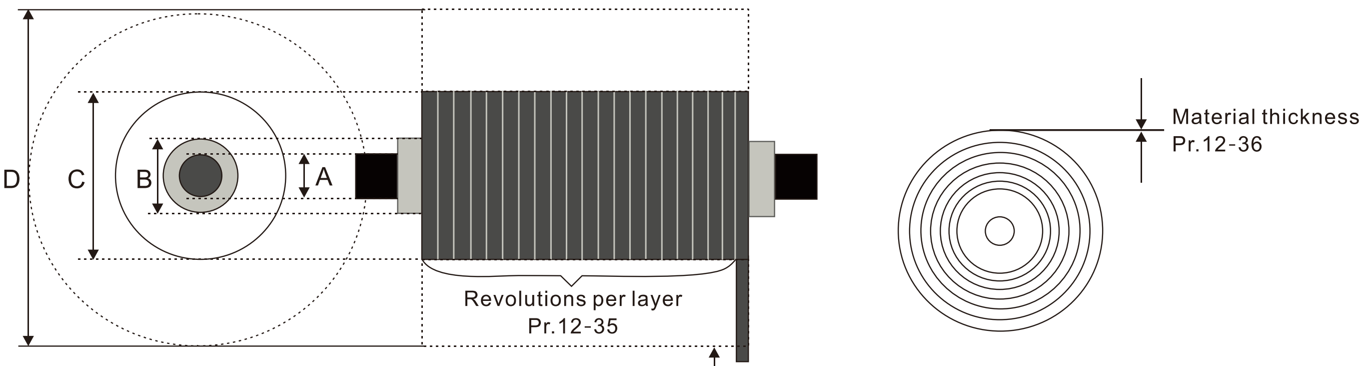
12-27 Reel Diameter Source

Default: 0

Settings
0: Calculated via linear speed
1: Calculated via analog input selection
2: Calculated via thickness integral, the encoder installed at reel side inputs by PG card
3: Calculated via thickness integral, the encoder installed at motor side inputs by PG card
4: Calculated via thickness integral, the encoder installed at reel side inputs by MI6 / MI7 terminals
5: Calculated via thickness integral, the encoder installed at motor side inputs by MI6 / MI7 terminals

- When setting as 1, sets AVI / ACI analog input to be reel diameter (Pr.03-00, Pr.03-01 = d16), 10V corresponds to the maximum reel diameter (Pr.12-28).
- When setting as 2, you can get the reel diameter from the encoder on the reel axle. At the moment, connects the pulse signals to the PG2 of the PG card (inputs pulse command), sets the encoder type (Pr.10-00), pulse input type (Pr.10-16), pulse per revolution (Pr.12-34), revolutions per layer (Pr.12-35), and material thickness (Pr.12-36) to calculate the reel diameter.
- When setting as 3, you can get the reel diameter by doing a back calculation of the motor, encoder, and gear ratio. At the moment, connects the pulse signals to the PG1 of the PG card (pulse feedback), sets the gear ratio (Pr.12-02, Pr.12-03), encoder type (Pr.10-00), encoder pulses per revolution (Pr.10-01), revolutions per layer (Pr.12-35), and material thickness (Pr.12-36) to calculate the reel diameter.
- When setting as 2, or 3, the PG card is required.
- When setting as 4, or 5, MI6 and MI7 are supported.
- When setting as 4, or 5, you have to set Pr.10-16 to 5; if rewind / unwind mode is being changed during the operation process, you should also have to set Pr.12-01.
- Refer to the table below for the related settings when the reel diameter source is calculated via thickness integral.





A: Empty reel diameter Pr.12-29
B: Initial reel diameter Pr.12-31 / 12-32 / 12-33
C: Current reel diameter Pr.12-40
D: Maximum reel diameter Pr.12-28

Position	Pulse signal	Signal interface	Parameter settings	Related parameters	Note
Motor axle	Encoder	PG1	Pr.10-00 = 1	Pr.12-27 = 3 Pr.12-02, Pr.12-03, Pr.12-35, Pr.12-36	The settings of Pr.10-01 and Pr.10-02 are depending on the working condition
		PG2	Pr.10-00 = 1 Pr.10-16 = 1, 2	Pr.12-27 = 3 Pr.12-02, 12-03, 12-34, 12-35, 12-36	N/A
		MI6 / MI7	Pr.10-00 = 5 Pr.10-16 = 1, 2	Pr.12-27 = 5 Pr.12-02, Pr.12-03, Pr.12-34, Pr.12-35, Pr.12-36	Uses two-phase input by MI6 / MI7, and considers the direction
	Advanced switch	MI7	Pr.10-00 = 5 Pr.10-16 = 5	Pr.12-27 = 5 Pr.12-02, Pr.12-03, Pr.12-34, Pr.12-35, Pr.12-36	N/A
Rewind axle	Encoder	PG2	Pr.10-00 = 1	Pr.12-27 = 2 Pr.12-34, Pr.12-35, Pr.12-36	The setting of Pr.10-16 is depending on the working condition
		MI6 / MI7	Pr.10-00 = 5 Pr.10-16 = 1, 2	Pr.12-27 = 4 Pr.12-34, Pr.12-35, Pr.12-36	Uses two-phase input by MI6 / MI7, and considers the direction
	Advanced switch	MI7	Pr.10-00 = 5 Pr.10-16 = 5	Pr.12-27 = 4 Pr.12-34, Pr.12-35, Pr.12-36	N/A

12-28 Maximum Reel Diameter

Default: 6000.0

Settings 1.0–6000.0 mm

12-29 Empty Reel Diameter

Default: 1.0

Settings 1.0–6000.0 mm

12-30 Initial Reel Diameter Source

Default: 1

Settings 0: RS-485 communication input (Pr.12-31)

1: Analog input (Pr.03-00–03-01 = d16)

📖 When setting as 1, 10 V corresponds to the maximum reel diameter (Pr.12-28).

✔ 12-31 Initial Reel Diameter

Default: 1.0

Settings 1.0–6000.0 mm

📖 The initial reel diameter means the reel diameter at the startup. For the rewind zone, it's the diameter of the reel axle; for the unwind zone, it's the diameter of the reel.

📖 When Pr.12-30 = 1, this parameter is read only.

12-32 Initial Reel Diameter 1

Default: 1.0

Settings 1.0–6000.0 mm

12-33 Initial Reel Diameter 2

Default: 1.0

Settings 1.0–6000.0 mm

- If user chooses more than one type of reel diameter, you can set Pr.12-30 as 0 (using RS-485 communication input).
  For example: To plan HMI pages or use text panel (TP series of PLC products), you can change the setting value of Pr.12-31 by using communication.
- When the drive is stop and in tension control mode,
- When the AC motor drive is at a standstill and in tension control mode, you can set three sections of initial reel diameter (Pr.12-31–Pr.12-33) by using multi-function terminal 87 and 88.
  After finishing the setting of MI =87 and MI = 88, executes the function of MI = 86. See the table below:

MIx = 88	MIx = 87	MIx = 86
OFF	OFF	ON: the setting value of Pr.12-31 will be wrote into Pr.12-40.
OFF	ON	ON: the setting value of Pr.12-32 will be wrote into Pr.12-40.
ON	OFF	ON: the setting value of Pr.12-33 will be wrote into Pr.12-40.
ON	ON	ON: the setting value of Pr.12-40 will be back to the default.

12-34 Pulses Per Revolution

Default: 1

Settings 1–60000 ppr

- When Pr.12-27 = 2 or 4, you have to set this parameter for setting the pulses per revolution of the reel.

12-35 Revolutions Per Layer

Default: 1

Settings 1–10000

12-36 Material Thickness

Default: 0.001

Settings 0.001–65.000 mm

- Sets the thickness of the material to wind.

12-37 Reel Diameter Filter Time

Default: 1.00

Settings 0.00–100.00 sec.

- This parameter improves the instability of the reel diameter source (Pr.12-27).

12-38 Automatic Reel Diameter Compensation

Default: 0

Settings 0: Disabled

1: Enabled

- This parameter is valid only when Pr.12-00 = 1 and Pr.12-19 ≠ 0. If the mechanical gear ratio or the linear speed is not accurate enough, you can use this parameter to compensate the reel diameter.

12-39 Reel Diameter Calculation Delay Time

Default: 0.0

Settings 0.0–6553.5 sec.

- Starts to calculate the reel diameter after canceling the pre-startup and delaying time set in this parameter.
- Sets this parameter to delay the time to calculate the reel diameter, and prevents from causing inaccurate reel diameter or instability condition in a short time after the pre-startup stops.

12-40 Current Reel Diameter

Default: 1.0

Settings 1.0–6000.0 mm

- When the drive is not at STOP status, this parameter is read only.

12-41 Minimum Output Frequency for Reel Diameter Calculation

Default: 1.00

Settings 0.00~599.00 Hz

12-42 Pre-startup Mode Selection

Default: 0

Settings 0: Disabled

1: Pre-startup of rewind mode

2: Pre-startup of unwind mode

- When Pr.12-42 = 2, the output frequency limit is Pr.08-67.

12-43 Switching Level for Pre-startup and PID Enablement

Default: 15.0

Settings 0.0–100.0% (according to Pr.12-05)

- Example:

The tension feedback value is 0–100% that the lower value has loose tension and the larger value has more tight tension. If Pr.12-05 = 50%, Pr.12-43 = 10%, then the range to pre-startup is 0–40%.

12-44 Pre-startup Frequency

Default: 2.00

Settings 0.00–599.00 Hz

12-45 Pre-startup Acceleration Time

Default: 3.00

Settings 0.01–600.00 sec.

- You can set Pr.12-42 = 1 when activating the tension function, by doing this to prevent the loose rewinding / unwinding material or the value exceeds the setting range of Pr.12-45 from causing the tension convergent time to be too long.
  Example: Adjusts the value of Pr.12-44 and Pr.12-45 to make the tension feedback be in the setting range of Pr.12-43, and PID control is effective at this moment.
- When Pr.12-42 = 2, in unwind mode, it's allowable that the motor runs reversely to tightly roll the material automatically.

12-46 Broken Belt Detection Function

Default: 0

Settings 0: Disabled
1: Enabled

12-47 Minimum Linear Speed of Broken Belt Detection

Default: 0.0

Settings 0.0–3000.0 m/min

12-48 Reel Diameter Error of Broken Belt Detection

Default: 100.0

Settings 1.0–6000.0 mm

12-49 Broken Belt Detection Time

Default: 1.00

Settings 0.00–100.00 sec.

- When Pr.12-21 ≠ 0 and Pr.12-27 = 0, Pr.12-46 is valid.
- The broken belt occurs when the linear speed is higher than Pr.12-47, the change of the reel diameter exceeds Pr.12-48, and over the time setting in Pr.12-49. When broken belt detection is enabled, if broken belt occurs, the drive shows "dEb" and ramp to stop. At the same time, you can also set MO to be 46 as the indication of broken belt.

12-50 Tension PID Feedback Error Level

Default: 100

Settings 0–100%

12-51 Tension PID Feedback Error Detection Time

Default: 0.5

Settings 0.0–10.0 sec.

12-52 Tension PID Feedback Error Treatment

Default: 0

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

- If the difference between the tension PID target value and tension PID feedback value exceeds the tension PID feedback error level (Pr.12-50), and the error time exceeds the tension PID feedback error detection time (Pr.12-51), then the PID feedback error is abnormal. "tdEv" displays on keypad at this moment, the treatment refers to the setting in Pr.12-52.

12-54 Tension Command Source Selection

Default: 0

Settings 0: RS-485 communication input
1: Analog input

- This parameter is valid when Pr.12-00 = 3 or 4.
- When Pr.12-54 = 0, you can use digital keypad, HMI page planning, or text panel (TP series of PLC products) to change the tension command setting value of Pr.12-56 by using communication.
- When Pr.12-54 = 1, the setting for AVI / ACI analog input selection have to be tension setting value (Pr.03-00, Pr.03-01 = d18), and Pr.12-56 only can display the value (read only).

12-55 Maximum Tension Value

Default: 0

Settings 0–65535 N

- This parameter is valid when Pr.12-00 = 3 or 4.

✓ 12-56 Tension Command Setting Value

Default: 0

Settings 0–65535 N

- This parameter is valid when Pr.12-00 = 3 or 4.
- When Pr.12-54 = 1, Pr.12-56 is read only. Analog input 10V corresponds to Pr.12-55.

12-57 Zero-speed Tension Setting Source

Default: 0

Settings 0: Disabled
1: RS-485 communication input
2: Analog input

- This parameter is valid when Pr.12-00 = 3 or 4.
- When Pr.12-57 = 1, you can use digital keypad, HMI page planning, or text panel (TP series of PLC products) to change the zero-speed tension setting value (Pr.12-58) by using communication.
- When Pr.12-57 = 2, the setting for AVI / ACI analog input selection have to be zero-speed tension (Pr.03-00, Pr.03-01 = d19), and Pr.12-58 only can display the value (read only).
- Zero-speed parameters are using for overcoming static friction.

✓ 12-58 Zero-speed Tension Setting Value

Default: 0

Settings 0–65535 N

- This parameter is valid when Pr.12-00 = 3 or 4.
- When Pr.12-57 =2, Pr.12-58 is read only. Analog input 10V corresponds to Pr.12-55.

12-59 Zero-speed Tension Threshold (Linear Speed)

Default: 0

Settings 0–100.00%

- This parameter is valid when Pr.12-00 = 3 or 4.
- When linear speed is lower than the value set in Pr.12-59, then the tension value is Pr.12-58 and reaches the static friction tension compensation.

12-60 Dynamic Friction Torque Compensation

Default: 0.0

Settings 0.0–100.0%

- This parameter is valid when Pr.12-00 = 3 or 4.
- 100% corresponds to the motor rated torque. This is mainly to be the compensation of dynamic friction.
- Executes inertia estimation in speed mode to get the compensation coefficient of the friction torque. Users can adjust the value by different control effects.
- This parameter is using for overcoming dynamic friction.

12-61 Material Inertia Compensation Coefficient

Default: 0

Settings 0–30000

- This parameter is valid when Pr.12-00 = 3 or 4.
- Compensation coefficient of material inertia = material density x material width (unit of density: kg/m^3; unit of width: m). The material inertia of reel changes along with the reel diameter.

12-62 Acceleration Inertia Compensation Gain

Default: 0.0

Settings 0.0–1000.0%

- This parameter is valid when Pr.12-00 = 3 or 4.
- This parameter is using for compensating extra torque of the moment of inertia of mechanism when the system is accelerative.

12-63 Inertia Compensation Filter Time

Default: 5.00

Settings 0.00–100.00

- This parameter is valid when Pr.12-00 = 3 or 4.

12-64 Deceleration Inertia Compensation Gain

Default: 0.0

Settings 0.0–1000.0%

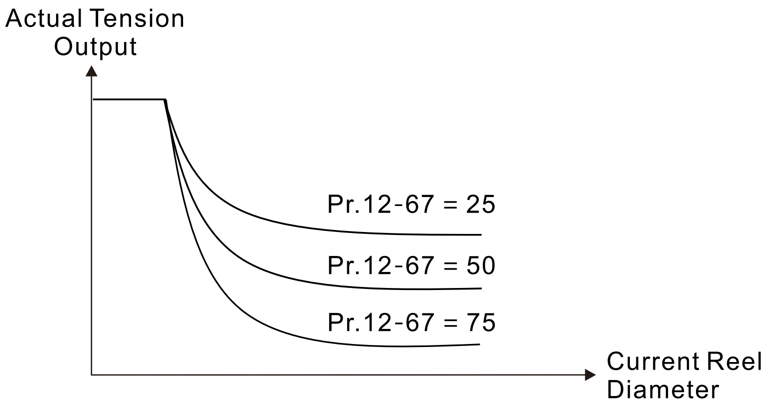
- This parameter is valid when Pr.12-00 = 3 or 4.
- This parameter is using for compensating extra torque of the moment of inertia of mechanism when the system is decelerative.

12-65 Tension Taper Curve Selection

Default: 0

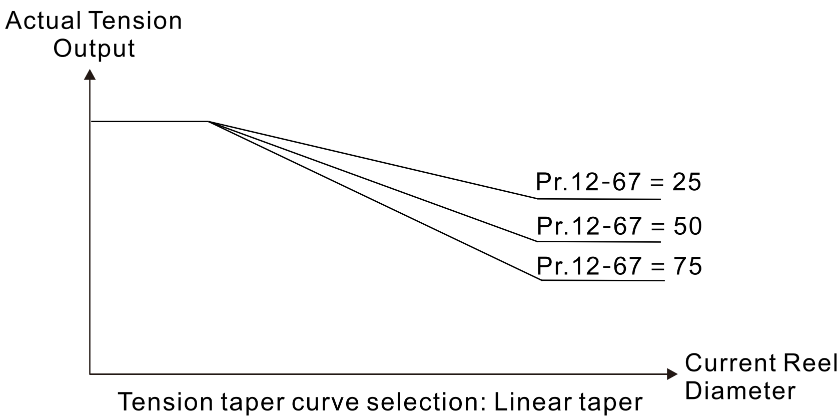
Settings 0: No taper
1: Curve taper
2: Linear taper
3: Multi-step curve taper
4: Multi-step linear taper

- When Pr.12-01 = 1, this function is invalid.
- In some situations, users request the tension decreases along with the increasing reel diameter to ensure that the material is smoothly rewinded. To meet the goal, you can set the tension taper related parameters.
- When Pr.12-65 = 1, the curve is generated by Pr.12-67, and the curve can be fine-tuning by Pr.12-68.



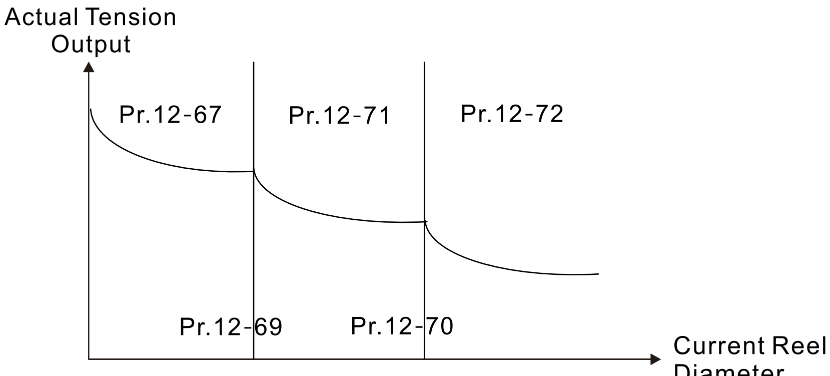
Tension taper curve selection: Curve taper
Pr.12-65 = 1

- When Pr.12-65 = 2, the linear taper is generated by Pr.12-67.



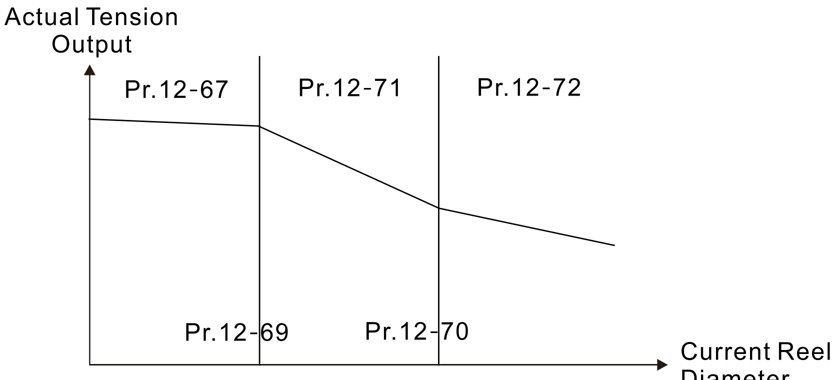
Tension taper curve selection: Linear taper
Pr.12-65 = 2

- When Pr.12-65 = 3, determines the taper of multi-curves by Pr.12-67, Pr.12-71 and Pr.12-72; and determines the turning points by Pr.12-69 and Pr.12-70.



Tension taper curve selection:
Multi-step curve taper
Pr.12-65 = 3

- When Pr.12-65 = 4, determines the multi-step linear taper by Pr.12-67, Pr.12-71 and Pr.12-72; and determines the turning points by Pr.12-69 and Pr.12-70.



Tension taper curve selection:
Multi-step linear taper
Pr.12-65 = 4

12-66 Tension Taper Setting Source

Default: 0

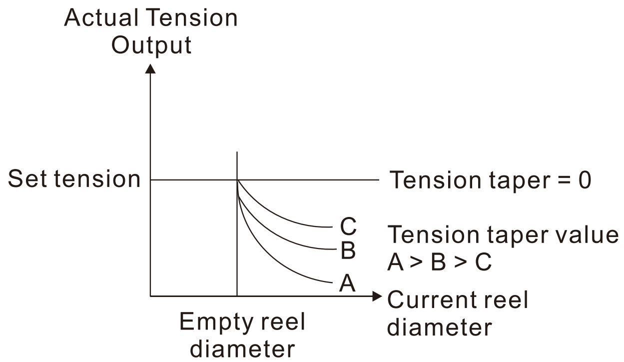
Settings 0: RS-485 communication input
1: Analog input

12-67 Tension Taper Value

Default: 0

Settings 0–100%

- When Pr.12-66 = 0, you can use digital keypad, HMI page planning, or text panel (TP series of PLC products) to change the tension taper value (Pr.12-67) by using communication.
- When Pr.12-66 = 1, Pr.03-00 and Pr.03-01 = d20 (tension taper), and Pr.12-67 only can display the value (read only).
- During the process of rewind, sometimes the tension needs to decrease along with the increasing reel diameter to ensure that the material is rewinded successfully.
- The diagram below shows the unwind control



12-68 Tension Taper Curve Compensation Value

Default: 0

Settings 0–60000

12-69 Multi-step Taper Reel Diameter 1

Default: 6000.0

Settings 10.0–6000.0

12-70 Multi-step Taper Reel Diameter 2

Default: 6000.0

Settings 10.0–6000.0

✎ 12-71 Multi-step Taper Value 1

Default: 0

Settings 0–100

✎ 12-72 Multi-step Taper Value 2

Default: 0

Settings 0–100

✎ 12-73 Pre-drive Frequency Gain

Default: 0

Settings -50.0–50.0%

📖 When switching the reel during the operation, the pre-drive function is to rotate the rewind axle / unwind axle in advance, and make the linear speed of the rotation and the material are the same to prevent from a huge impact. When pre-drive terminal is valid, the drive automatically calculates output frequency according to the linear speed and the reel diameter have been detected to match their linear speed.

✎ 12-74 Pre-drive Acceleration Time

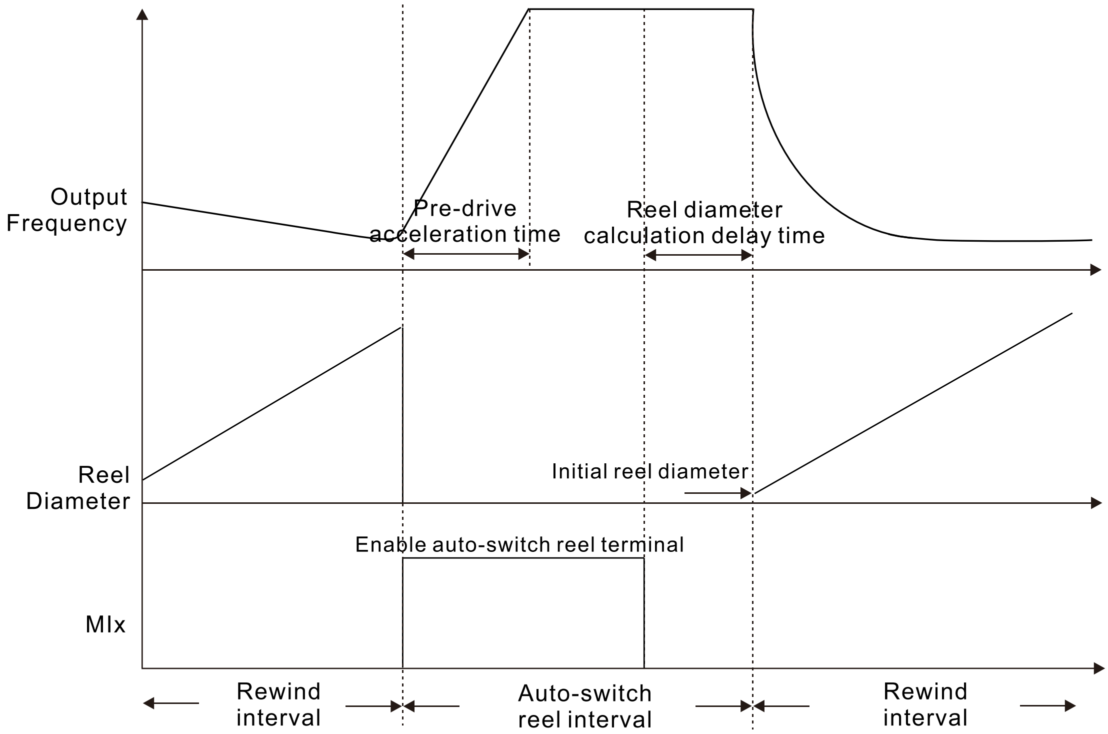
Default: 0

Settings 0–65535 sec.

✎ 12-75 Pre-drive Deceleration Time

Default: 0

Settings 0–65535 sec.



12-76 Speed Limit Gain

Default: 0

Settings 0–65535 sec.

In tension mode, when using the analog quantity of linear speed signal as the speed limit (sets Pr.11-36 = 3), you can use this parameter to adjust the value of the speed limit.

12-77 Tension Control Flag

Default: 0

Settings bit 0: Tension closed loop speed mode, allowed changing operation direction

bit 1: Start-up compensation (switching between zero-speed tension command and normal tension command)

bit 2: Acceleration and deceleration compensation (Pr.12-62 Acceleration inertia compensation gain; Pr.12-64 Deceleration inertia compensation gain)

bit 3: Reel diameter calculation by moving average method

bit 5: PID output reverse limit selection

bit 6: Material thickness range selection

Tension related analog input functions		
	Setting value	Function name
Pr.03-00 Pr.03-01	14	Tension PID feedback signal
	15	Line speed
	16	Reel diameter
	17	Tension PID target value
	18	Tension setting value
	19	Zero-speed tension
	20	Tension taper

Tension related multi-function display (user-defined)		
Pr.00-04	Setting value	Function name
	53	Display the current reel diameter under the tension control (d) (unit: mm)
	54	Display the current line speed under the tension control (L) (unit: m / minute)
	55	Display the current tension setting value under the tension control (T) (unit: N)

13 Macro (User-defined)

✔ You can set this parameter during operation.

13-00 Application Selection

Default: 00

Settings 00: Disabled
01: User-defined parameter
02: Compressor
03: Fan
04: Pump
05: Conveyor
06: Machine tool
07: Packing
08: Textiles
10: Logistics
11: Tension PID function
12: Tension PID and master / auxiliary frequency function

📖 Note: after you select the macro, some of the default values adjust automatically according to the application selection.

📖 Group setting 02: Compressor

The following table lists the compressor application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-16	Duty selection	0 (Normal duty)
00-17	Carrier frequency	Default setting
00-20	Master frequency command source (AUTO, REMOTE)	2 (Inputs from external analog)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
00-22	Stop method	0 (Ramp to stop)
00-23	Control of motor direction	1 (Disable reverse)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 rated / base frequency	Default setting
01-02	Motor 1 rated / base voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-11	Lower frequency limit	20 (Hz)
01-12	Acceleration time 1	20 (s)

Pr.	Parameter Name	Settings
01-13	Deceleration time 1	20 (s)
03-00	AVI analog input selection	0 (No function)
03-01	ACI analog input selection	1 (Frequency command)
05-01	Full-load current for induction motor 1 (A)	Default setting
05-03	Rated speed for induction motor 1 (rpm)	Default setting
05-04	Number of poles for induction motor 1	Default setting

📖 Group setting 03: Fan

The following table lists the fan setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-16	Duty selection	0 (Normal duty)
00-17	Carrier frequency	Default setting
00-20	Master frequency command source (AUTO, REMOTE)	2 (Inputs from external analog)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
00-22	Stop method	1 (Coast to stop)
00-23	Control of motor direction	1 (Disable reverse)
00-30	Master frequency command source (HAND, LOCAL)	0 (Digital keypad)
00-31	Operation command source (HAND, LOCAL)	0 (Digital keypad)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 rated / base frequency	Default setting
01-02	Motor 1 rated / base voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-10	Upper frequency limit	50 (Hz)
01-11	Lower frequency limit	35 (Hz)
01-12	Acceleration time 1	15 (s)
01-13	Deceleration time 1	15 (s)
01-43	V/F curve selection	2 (Second V/F curve)
02-05	Multi-function input command 5 (MI5)	16 (Rotating speed command from ACI)
02-16	Multi-function output 2 (MO1)	11 (Malfunction indication)
02-17	Multi-function output 3 (MO2)	1 (Indication during RUN)
03-00	AVI analog input selection	1 (Frequency command)

Pr.	Parameter Name	Settings
03-01	ACI analog input selection	1 (Frequency command)
03-28	AVI terminal input selection	0 (0–10 V)
03-29	ACI terminal input selection	1 (0–10 V)
03-31	AFM output selection	0 (0–10 V)
03-50	Analog input curve selection	1 (three-point curve of AVI)
07-06	Restart after momentary power loss	2 (Speed tracking by minimum output frequency)
07-11	Number of times of auto-restart after fault	5 (times)
07-33	Auto-restart interval of fault	60 (s)

Group setting 04: Pump

The following table lists the pump setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-16	Duty selection	0 (Normal duty)
00-20	Master frequency command source (AUTO, REMOTE)	2 (Inputs from external analog)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
00-23	Control of motor direction	1 (Disable reverse)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 output frequency	Default setting
01-02	Motor 1 output voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-10	Upper frequency limit	50 (Hz)
01-11	Lower frequency limit	35 (Hz)
01-12	Acceleration time 1	15 (s)
01-13	Deceleration time 1	15 (s)
01-43	V/F curve selection	2 (Second V/F curve)
07-06	Restart after momentary power loss	2 (Speed tracking by minimum output frequency)
07-11	Number of times of auto-restart after fault	5 (times)
07-33	Auto-restart interval of fault	60 (s)

📖 Group setting 05: Conveyor

The following table lists the conveyor setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-16	Duty selection	0 (Normal duty)
00-20	Master frequency command source (AUTO, REMOTE)	2 (Inputs from external analog)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 output frequency	Default setting
01-02	Motor 1 output voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage of motor 1	Default setting
01-12	Acceleration time 1	10 (s)
01-13	Deceleration time 1	10 (s)

📖 Group setting 06: Machine tool

The following table lists the machine tool setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-17	Carrier frequency	Default setting
00-20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 output frequency	Default setting
01-02	Motor 1 output voltage	Default setting
01-03	Motor 1 mid-point frequency 1	0
01-04	Motor 1 mid-point voltage 1	0
01-05	Motor 1 mid-point frequency 2	0
01-06	Motor 1 mid-point voltage 2	0
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-12	Acceleration time 1	5 (s)
01-13	Deceleration time 1	5 (s)
01-24	S-curve acceleration begin time 1	0
01-25	S-curve acceleration arrival time 2	0

Pr.	Parameter Name	Settings
01-26	S-curve deceleration begin time 1	0
01-27	S-curve deceleration arrival time 2	0
02-03	Multi-function input command 3 (MI3)	1 (Multi-step speed command 1)
02-04	Multi-function input command 4 (MI4)	2 (Multi-step speed command 2)
02-13	Multi-function output 1 RY1	11 (Malfunction indication)
02-16	Multi-function output 2 (MO1)	1 (Indication during RUN)
02-17	Multi-function output 3 (MO2)	2 (Operation speed reached)
03-00	AVI analog input selection	1 (Frequency command)
06-01	Over-voltage stall prevention	0 (Disabled)
06-03	Over-current stall prevention during acceleration	0 (Disabled)
06-04	Over-current stall prevention during operation	0 (Disabled)
06-05	Acceleration / deceleration time selection for stall prevention at constant speed	0 (By current acceleration/deceleration time)
07-01	DC brake current level	20 (%)
07-03	DC brake time at stop	0.3 (s)
07-04	DC brake frequency at stop	0 (Hz)
07-23	Auto voltage regulation (AVR) function	1 (Disable AVR)

📖 Group setting 07: Packing

The following table lists the packing setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-20	Master frequency command source (AUTO, REMOTE)	0 (Digital keypad)
00-21	Operation command source (AUTO, REMOTE)	2 (RS-485 Communication input)
02-00	Two-wire / three-wire operation control	1 (two-wire mode 1, power on for operation control (M1: FWD / STOP, M2: REV / STOP))
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 output frequency	Default setting
01-02	Motor 1 output voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-12	Acceleration time 1	10 (s)
01-13	Deceleration time 1	10 (s)

Pr.	Parameter Name	Settings
01-24	S-curve acceleration begin time 1	Default setting
01-25	S-curve acceleration arrival time 2	Default setting
01-26	S-curve deceleration begin time 1	Default setting
01-27	S-curve deceleration arrival time 2	Default setting
03-00	AVI analog input selection	1 (Frequency command)
03-28	AVI terminal input selection	Default setting

📖 Group setting 08: Textiles

The following table lists the textile setting application related parameters.

Pr.	Parameter Name	Settings
00-11	Speed control mode	0 (IMV/F control mode)
00-20	Master frequency command source (AUTO, REMOTE)	1 (RS-485 Communication)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Motor 1 output frequency	Default setting
01-02	Motor 1 output voltage	Default setting
01-03	Motor 1 mid-point frequency 1	Default setting
01-04	Motor 1 mid-point voltage 1	Default setting
01-05	Motor 1 mid-point frequency 2	Default setting
01-06	Motor 1 mid-point voltage 2	Default setting
01-07	Motor 1 minimum output frequency	Default setting
01-08	Motor 1 minimum output voltage	Default setting
01-12	Acceleration time 1	10 (s)
01-13	Deceleration time 1	10 (s)
01-24	S-curve acceleration begin time 1	0.2 (s)
01-25	S-curve acceleration arrival time 2	0.2 (s)
01-26	S-curve deceleration begin time 1	0.2 (s)
01-27	S-curve deceleration arrival time 2	0.2 (s)
06-03	Over-current stall prevention during acceleration	180 (%)
06-04	Over-current stall prevention during operation	180 (%)
06-07	Over-torque detection level (motor 1)	200 (%)
07-19	Fan cooling control	2 (When the AC motor drive runs, the fan is ON. When the AC motor drive stops, the fan is OFF)

Setting 10: Logistics

The following table lists the relevant logistics setting application parameters.

Pr.	Parameter Name	Settings
00-20	Master frequency command source (AUTO, REMOTE)	7 (Digital keypad potentiometer knob)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-01	Rated / base frequency of motor 1	Default setting
01-02	Rated / base voltage of motor 1	400.0
01-04	Mid-point voltage 1 of motor 1	20.0
01-06	Mid-point voltage 2 of motor 1	20.0
01-08	Minimum output voltage of motor 1	20.0
01-03	Mid-point frequency 1 of motor 1	1.50
01-07	Minimum output frequency of motor 1	1.50
01-12	Acceleration time 1	3 (sec.)
01-13	Deceleration time 1	3 (sec.)
01-24	S-curve for acceleration begin time 1	0.00
01-25	S-curve for acceleration arrival time 2	0.00
01-26	S-curve for deceleration begin time 1	0.00
01-27	S-curve for deceleration arrival time 2	0.00
06-03	Over-current stall prevention during acceleration	200
06-04	Over-current stall prevention during operation	200
06-05	Acceleration / deceleration time selection for stall prevention at constant speed	2 (By the second acceleration / deceleration time)
07-23	Automatic voltage regulation (AVR) function	1 (Disable AVR)
07-26	Torque compensation gain	0

Group setting 11: Tension PID function

The following table lists the tension PID function setting application related parameters.

Pr.	Parameter Name	Settings
00-20	Master frequency command source (AUTO, REMOTE)	9 (PID function)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-12	Acceleration time 1	3 (s)
01-13	Deceleration time 1	3 (s)
03-00	AVI analog input selection	5 (PID feedback signal)
03-50	Analog input curve selection	1 (Three-point curve of AVI)
03-63	AVI voltage lowest point	0.00

Pr.	Parameter Name	Settings
03-65	AVI voltage mid-point	9.99
03-66	AVI voltage proportional mid-point	100%
08-00	Terminal selection of PID feedback	1 (Negative PID feedback: by analog input (Pr.03-00))
08-01	Terminal selection of PID feedback	10
08-02	Integral time (I)	1
08-20	PID mode selection	1 (Parallel connection)
08-21	Enable PID to change the operation direction	0 (Operating direction can be changed)
08-65	Source of PID target value	1 (From Pr.08-66)
08-66	PID target value setting	50%

📖 Group setting 12: Tension PID and master / auxiliary frequency function

The following table lists the tension PID and master / auxiliary frequency function setting application related parameters.

Pr.	Parameter Name	Settings
00-20	Master frequency command source (AUTO, REMOTE)	9 (PID function)
00-21	Operation command source (AUTO, REMOTE)	1 (External terminals)
01-00	Motor 1 maximum operation frequency	Default setting
01-12	Acceleration time 1	3 (s)
01-13	Deceleration time 1	3 (s)
00-35	Auxiliary frequency source	3 (Inputs from analog input)
03-00	AVI analog input selection	5 (PID feedback signal)
03-01	ACI analog input selection	12 (Auxiliary frequency input)
03-10	Reverse setting when analog signal input is negative frequency	0 (Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.)
03-12	ACI analog input gain	100.0%
03-29	ACI terminal input selection	1 (0–10 V)
03-50	Analog input curve selection	1 (Three-point curve of AVI)
03-63	AVI voltage lowest point	0.00
03-65	AVI voltage mid-point	9.99
03-66	AVI voltage proportional mid-point	100%
08-00	Terminal selection of PID feedback	1 (Negative PID feedback: by analog input (Pr.03-00))
08-01	Terminal selection of PID feedback	10
08-02	Integral time (I)	1
08-20	PID mode selection	1 (Parallel connection)
08-21	Enable PID to change the operation direction	0 (Operating direction can be changed)

Pr.	Parameter Name	Settings
08-65	Source of PID target value	1 (From Pr.08-66)
08-66	PID target value setting	50%
08-67	Master and auxiliary reverse running cutoff frequency	10%

13-00 – 13-50 Application Parameters (User-defined)

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14 Protection Parameters (2)

✎You can set this parameter during operation.

✎ **14-00**	Extension Card Input Terminal Selection (AI10)
✎ **14-01**	Extension Card Input Terminal Selection (AI11)

Default: 0

Settings

0: No function

1: Frequency command

(in MH300 series, this function can be the torque limit in torque control mode)

2: Torque command (torque limit in speed mode)

3: Torque compensation command

4: PID target value

5: PID feedback signal

6: PTC thermistor input value

7: Positive torque limit

8: Negative torque limit

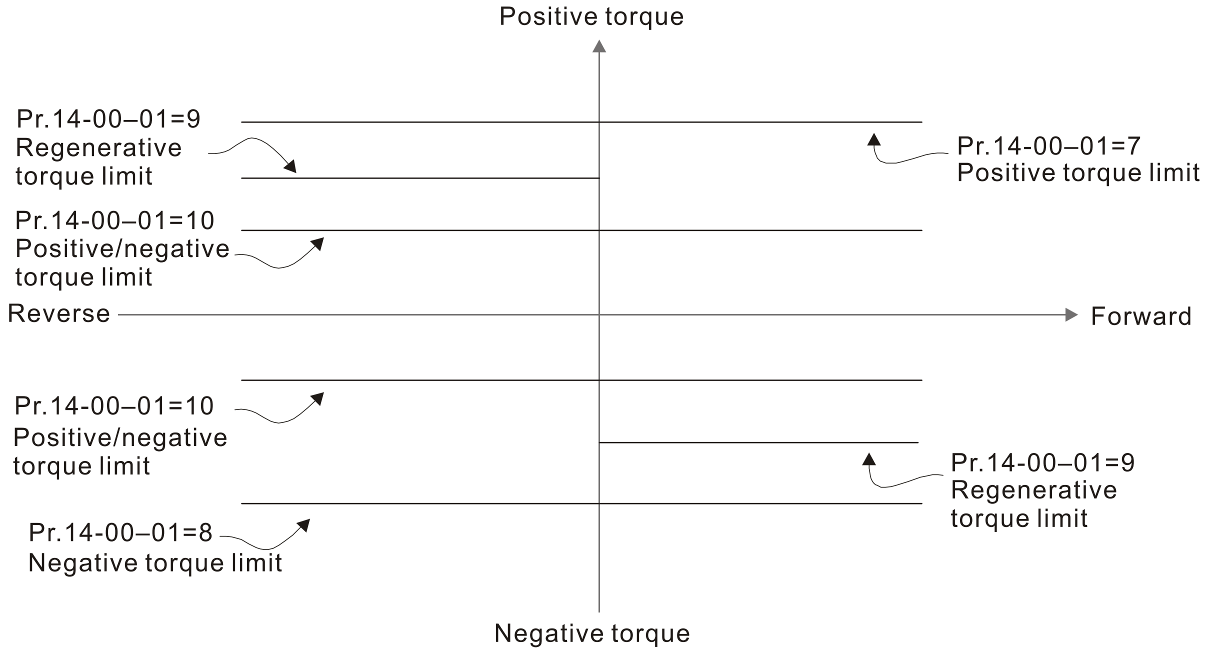
9: Regenerative torque limit

10: Positive / negative torque limit

11: PT100 thermistor input value

13: PID compensation value

- 1: This function can be the torque limit in torque control mode.
- When you use analog input as PID reference target input, you must set Pr.00-20 to 2 (external analog input).
  Setting method 1: Pr.14-00–14-01 set 1 as frequency command.
  Setting method 2: Pr.14-00–14-01 set 4 as PID reference target input.
  If the setting value 1 and setting value 4 exist at the same time, AI10 input has highest priority to become the PID reference target input value.
- When you use analog input as the PID compensation value, you must set Pr.08-16 to 1 (Source of PID compensation value is analog input). You can see the compensation value with Pr.08-17.
- When you use the frequency command, the corresponding value for 0– ± 10 V / 4–20 mA is 0–maximum operation frequency (Pr.01-00).
- When you use the torque command, the corresponding value for 0– ± 10 V / 4–20 mA is 0–maximum output torque (Pr.11-27).
- When you use torque compensation, the corresponding value for 0– ± 10 V / 4–20 mA is 0–rated torque.
- When the settings for Pr.14-00 and Pr.14-01 are the same, the AI10 is selected first.



14-02 AI10 Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AI10 voltage for the external analog input 0.

14-03 AI11 Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AI11 current for the external analog input 0.

14-04 AI10 Analog input bias
14-05 AI11 Analog input bias

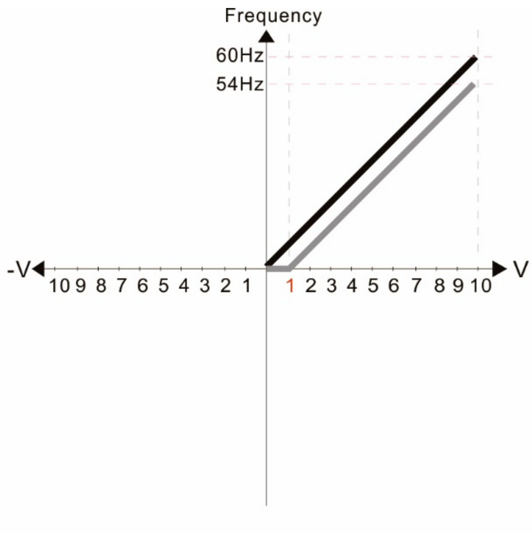
Default: 0

Settings
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

- In a noisy environment, use negative bias to provide a noise margin. Do NOT use less than 1 V to set the operation frequency.

In the diagrams below, black line is voltage-frequency curve with no bias; gray line is voltage-frequency curve with bias.

Diagram 01



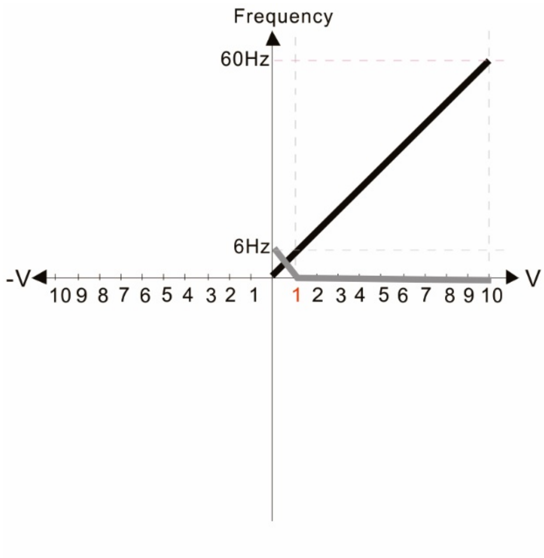
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 02



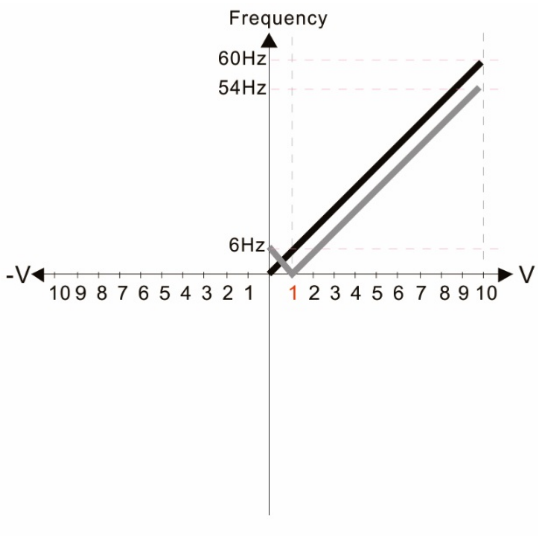
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 03



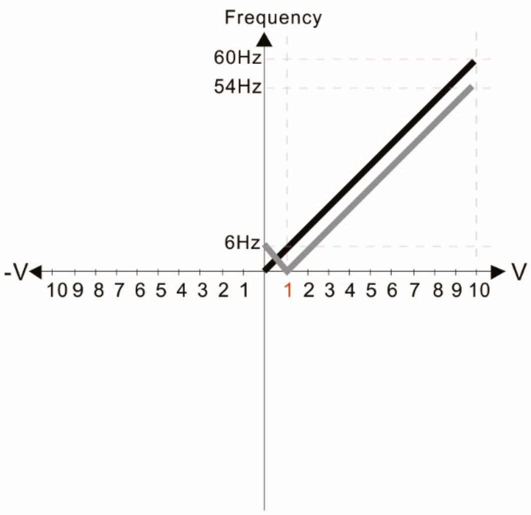
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 04



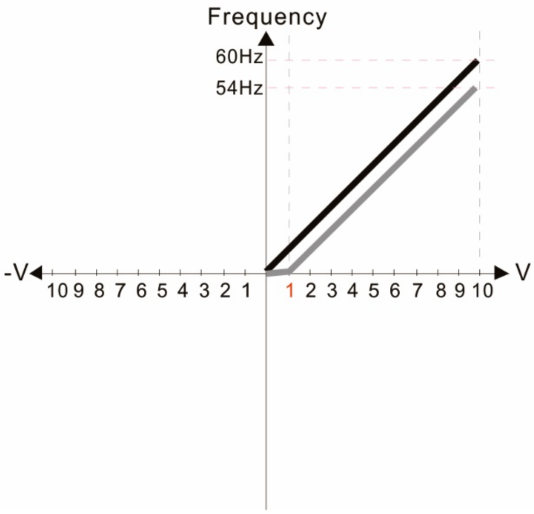
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 05



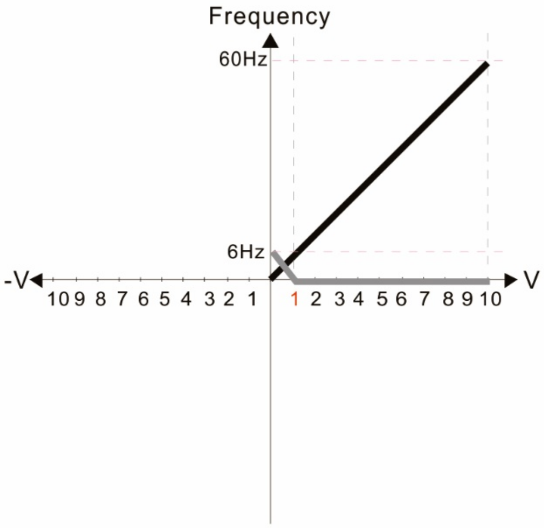
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 06



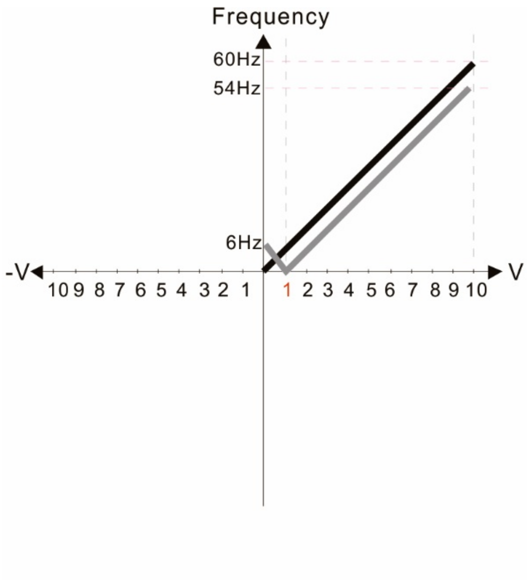
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 07



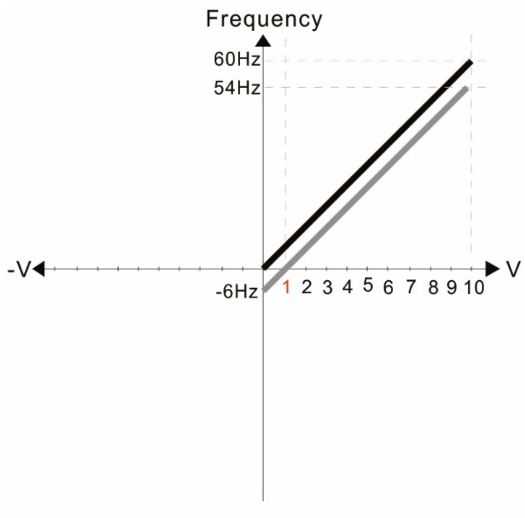
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 08



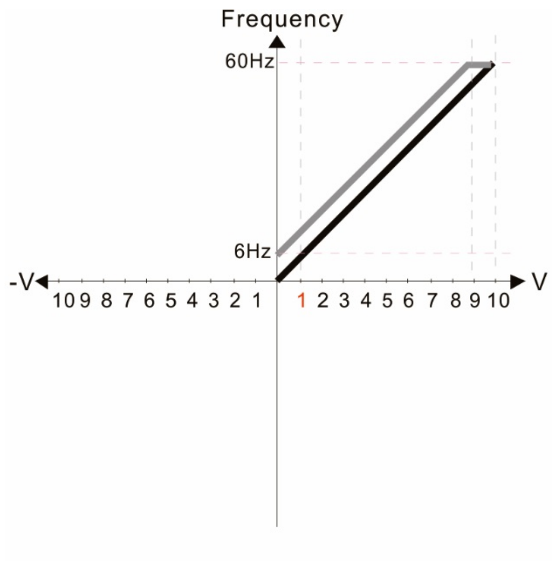
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 09



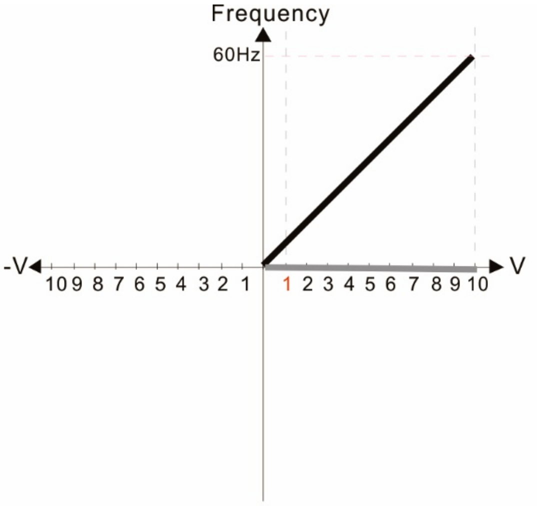
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 10



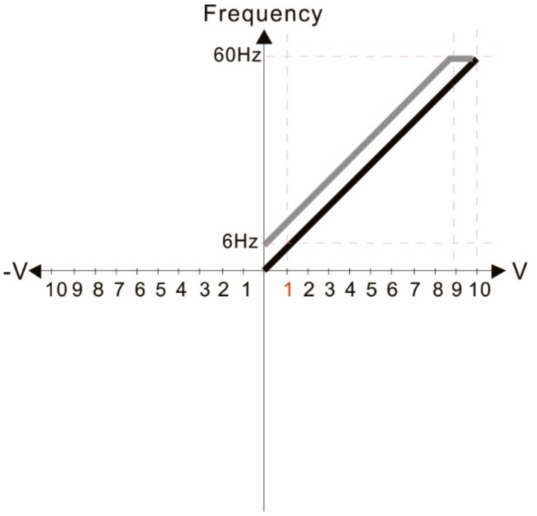
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 11



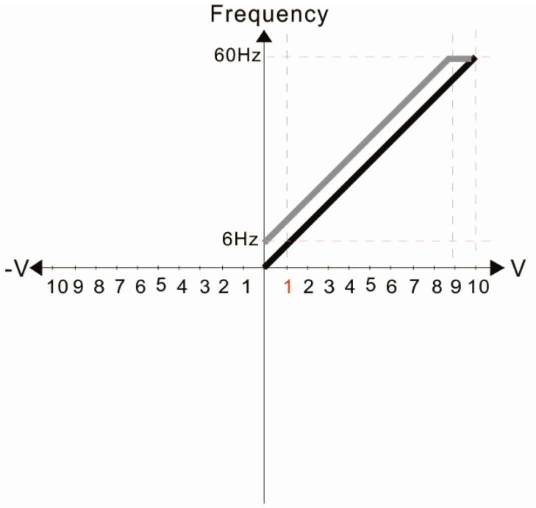
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 12



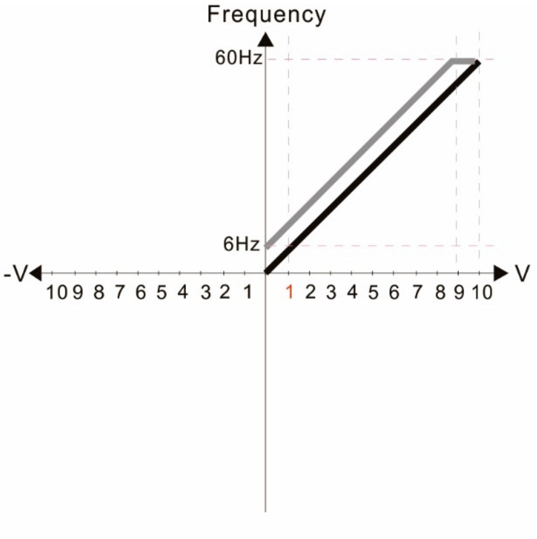
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 13



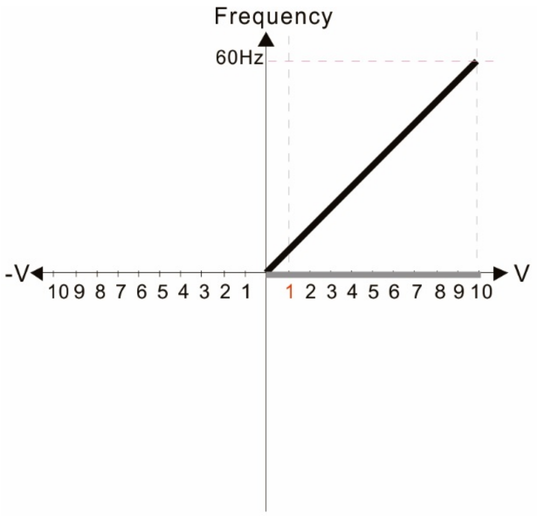
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 14



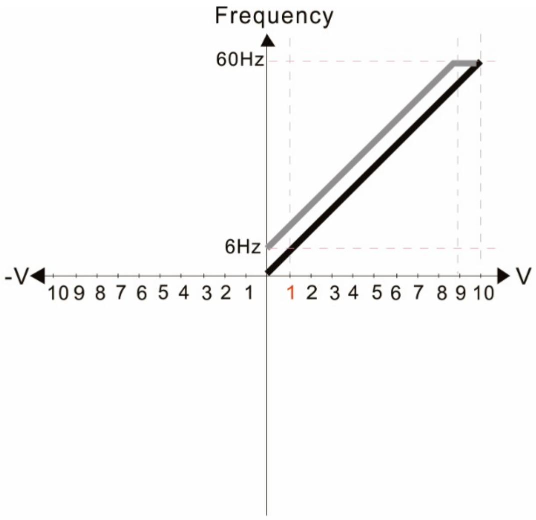
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 15



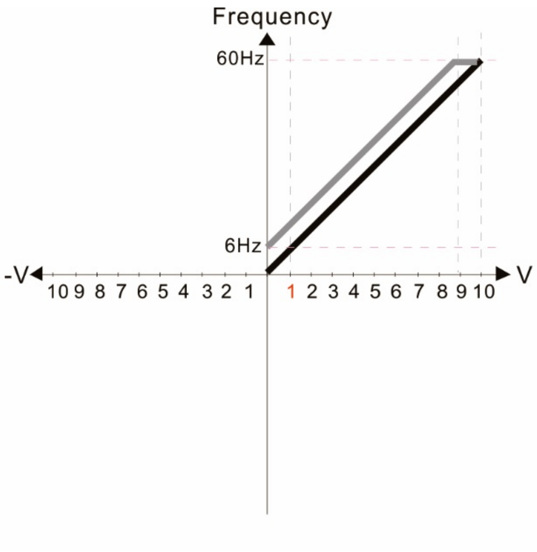
Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 16



Pr.14-02 = -10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

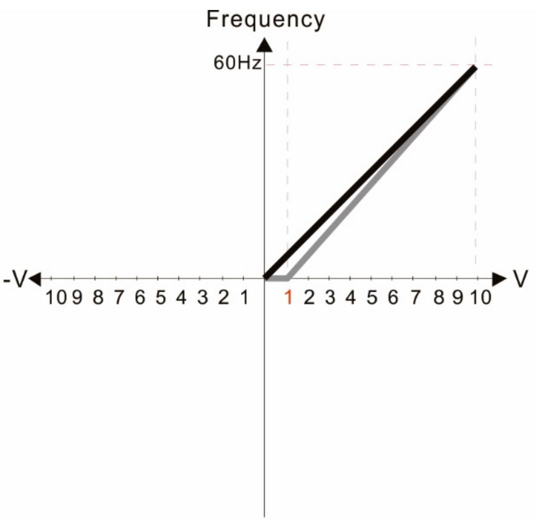
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 100%

Diagram 17



Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

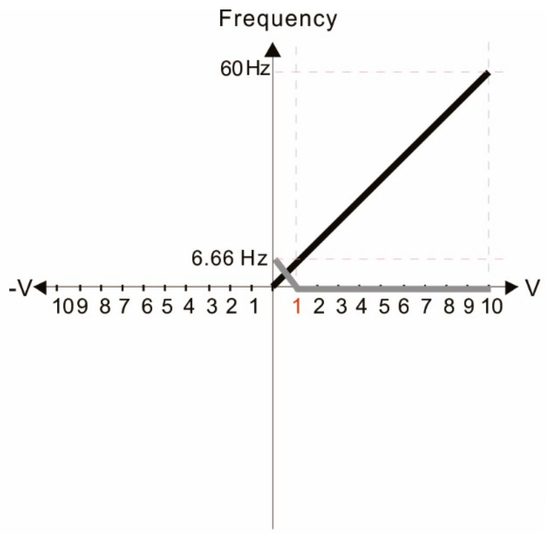
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 18



Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

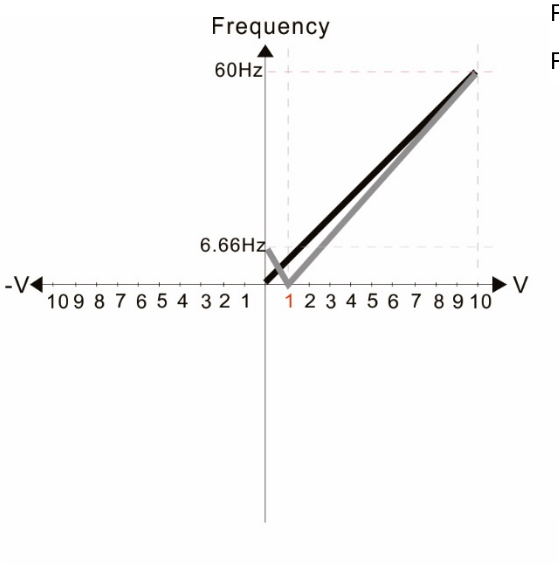
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 19



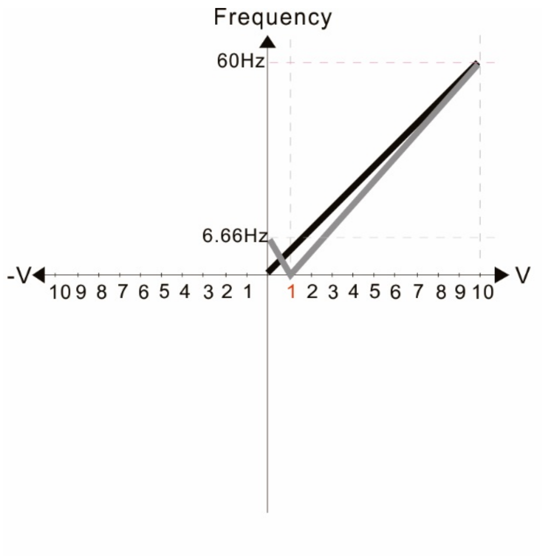
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 20



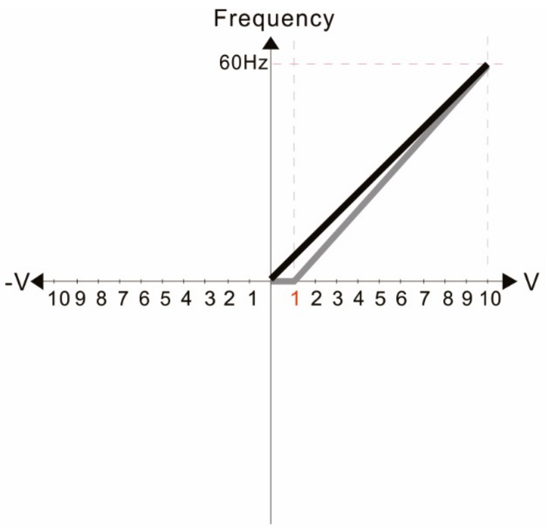
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 21



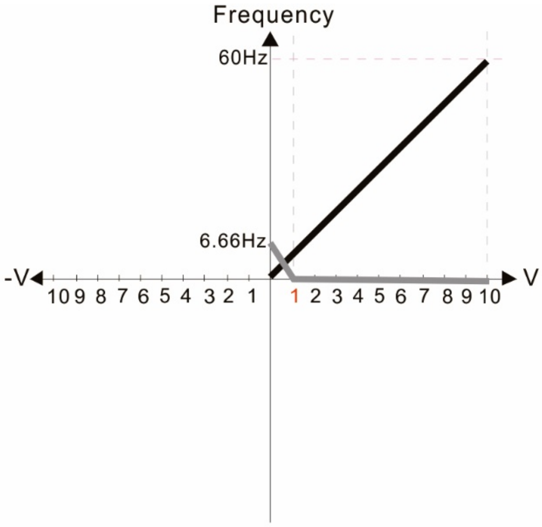
Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 22



Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

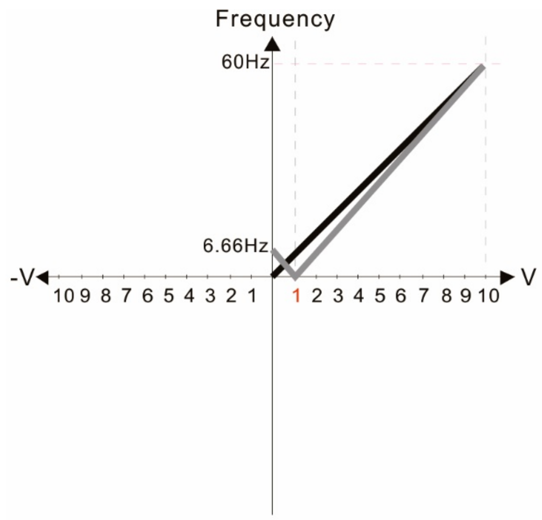
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 23



Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

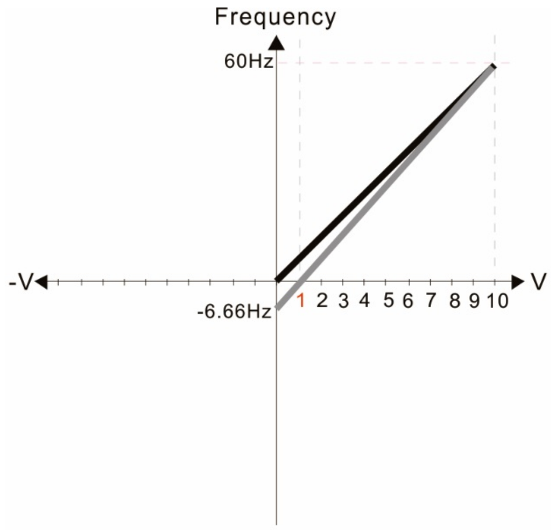
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 24



Pr.14-02 = 10%

Pr.14-04–14-05 (Positive/Negative Bias Mode)

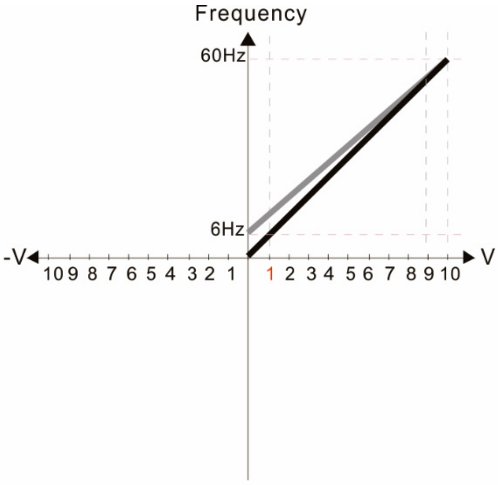
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.14-06 Analog Input Gain (AI10) = 111.1%
10/9 = 111.1%

Diagram 25



Pr.03-07~03-08 (Positive/Negative Bias Mode)
Pr.14-04–14-05

1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

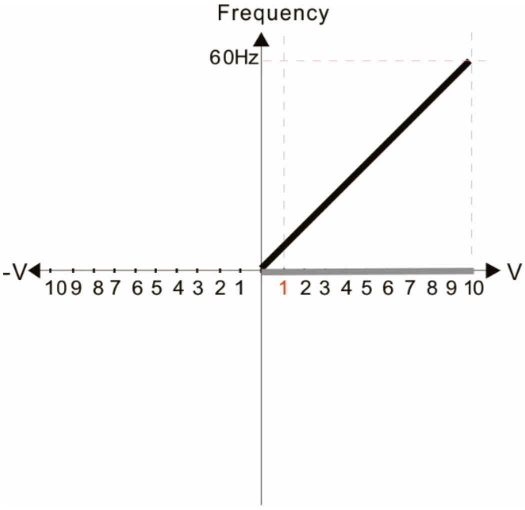
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Calculate the bias: $\frac{60\text{-}6Hz}{10V} = \frac{6\text{-}0Hz}{(0\text{-}XV)}$ $XV = \frac{10}{-9} = -1.11V$

Pr.03-03= Pr.14-02= $\frac{-1.11}{10} \times 100\% = -11.1\%$

Calculate the gain: Pr.14-06= $\frac{10V}{11.1V} \times 100\% = 90.0\%$

Diagram 26



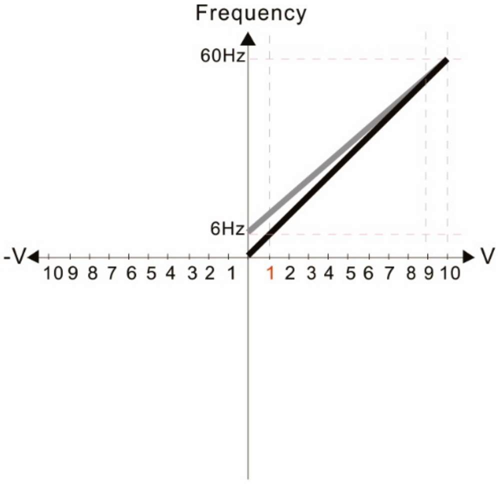
Pr.14-04–14-05 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Diagram 27



Pr.03-07~03-08 (Positive/Negative Bias Mode)
Pr.14-04–14-05

1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Calculate the bias: $\frac{60\text{-}6Hz}{10V} = \frac{6\text{-}0Hz}{(0\text{-}XV)}$ $XV = \frac{10}{-9} = -1.11V$

Pr.03-03= Pr.14-02= $\frac{-1.11}{10} \times 100\% = -11.1\%$

Calculate the gain: Pr.03-11= Pr.14-06= $\frac{10V}{11.1V} \times 100\% = 90.0\%$

Diagram 28

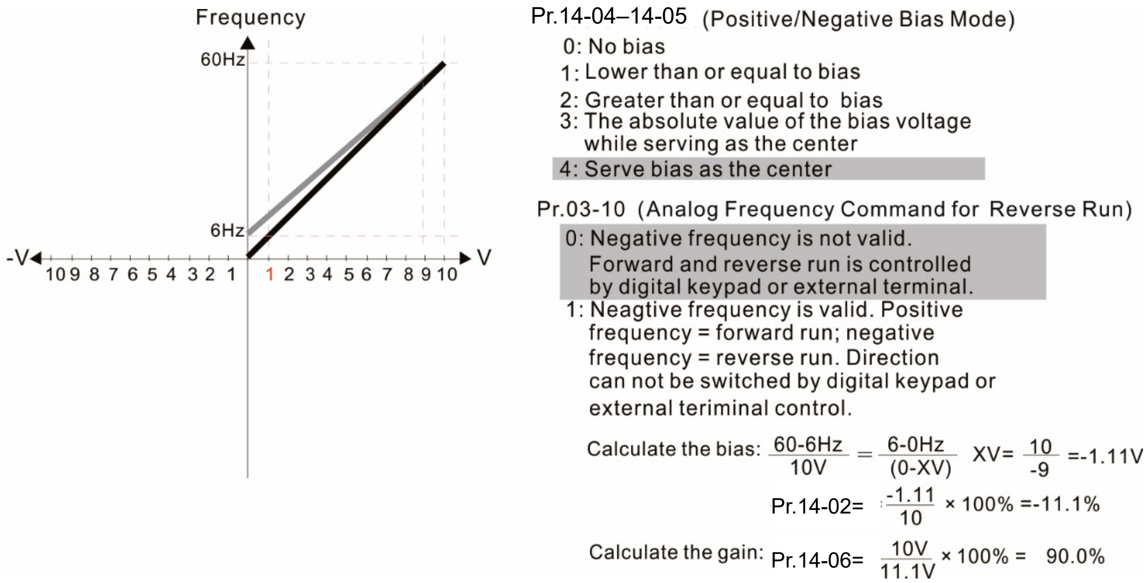


Diagram 29

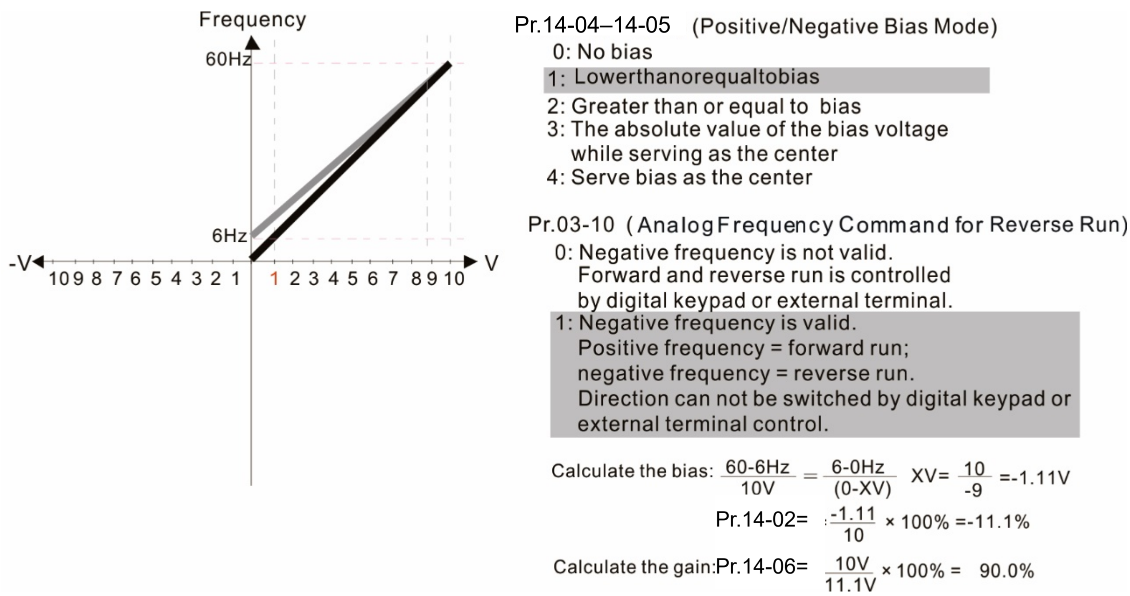


Diagram 30

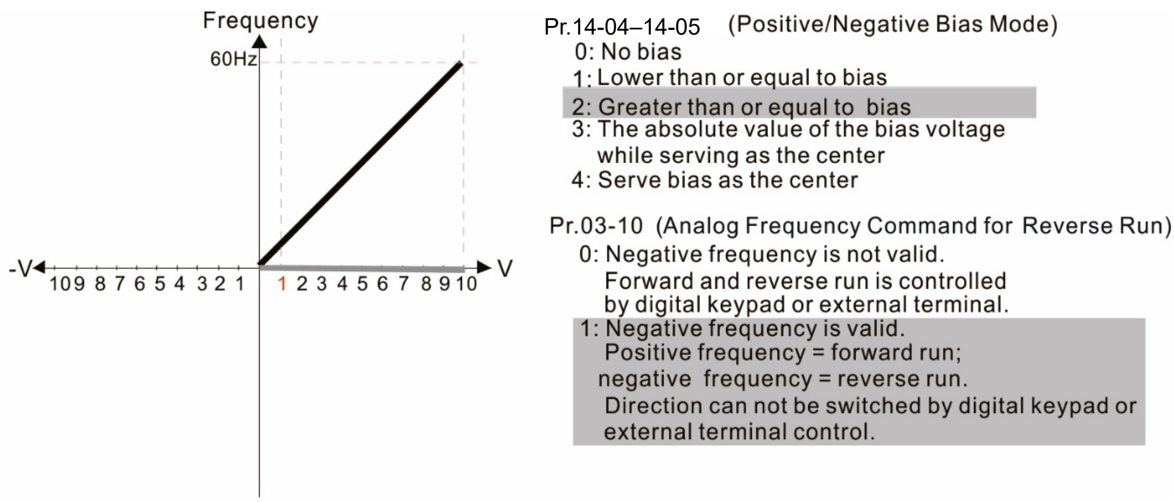


Diagram 31

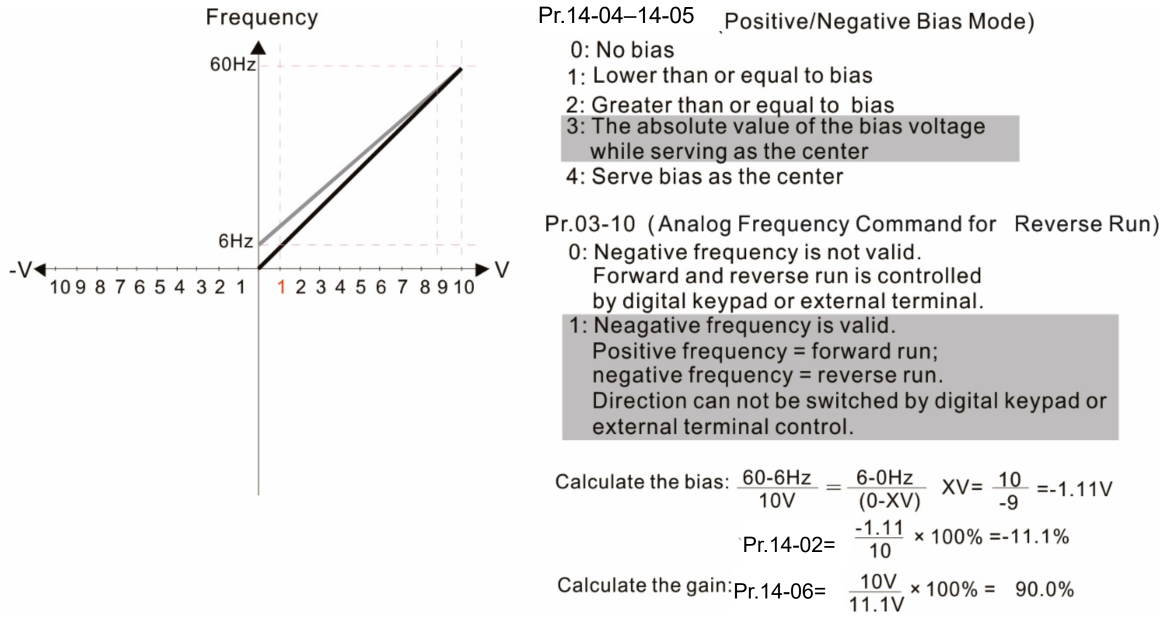
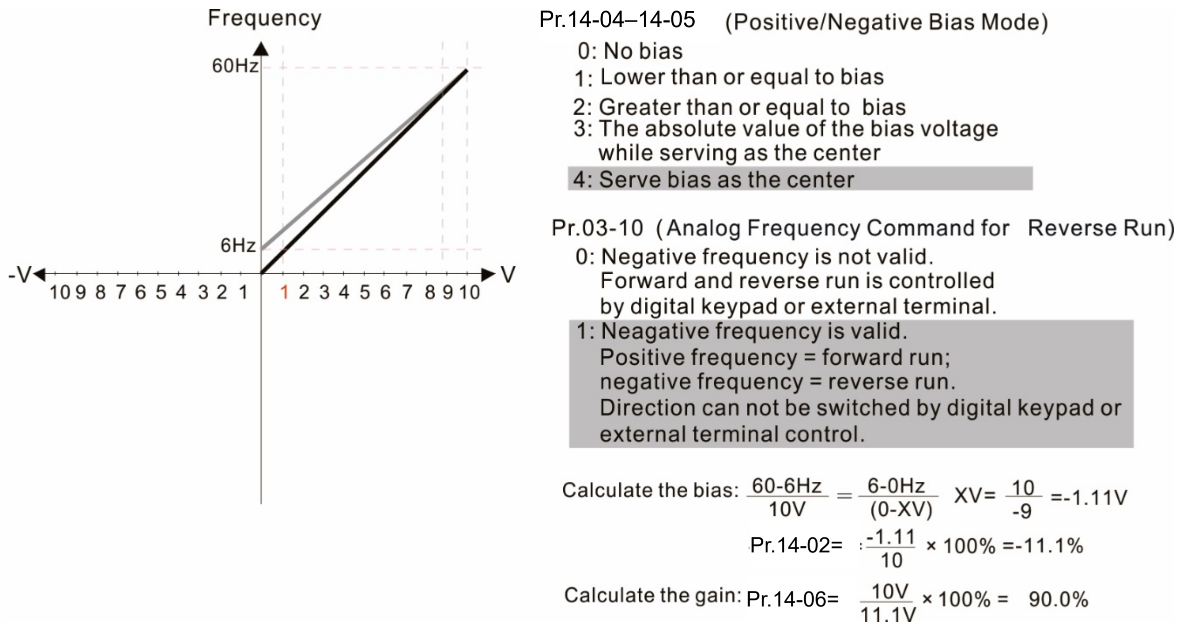


Diagram 32



14-06 AI10 Analog Input Gain
14-07 AI11 Analog Input Gain

Default: 100.0

Settings -500.0–500.0%

- Use Pr.14-06–14-07 when the source of the frequency command is the analog voltage / current signal.

14-08 AI10 Analog Input Filter Time
14-09 AI11 Analog Input Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

- The analog signals enter via the control terminals AI1 and AI2 commonly cause interference. This might affect the stability of the analog control, use these input delays to filter a noisy analog signal.
- When the setting for the time constant is too large, the control is stable but the control response is slow. When the setting for time constant is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting according to the control stability or the control response.

14-10 ACI10 Analog Input 4–20 mA Signal Loss Selection
14-11 ACI11 Analog Input 4–20 mA Signal Loss Selection

Default: 0

Settings 0: Disable
1: Continue operation at the last frequency
2: Decelerate to 0 Hz
3: Stop immediately and display “ACE”

- Determines the treatment when the 4–20 mA signal is lost (Pr.14-18 =2, Pr.14-19 = 2).
- When Pr.14-18 or Pr.14-19 = 0, the voltage input is 0–10 V; when Pr.14-18 or Pr.14-19 = 0, the voltage input is 0–20 mA. At this moment, Pr.14-10 and 14-11 are invalid.
- 1 or 2: Displays the warning code “ANL” on the keypad. It continues blinking until the lost ACI signal is recovered.
- When the drive stops, the warning condition does not continue to exist, so the warning disappears.

14-12 AO10 Extension Card Output Terminal Selection
14-13 AO11 Extension Card Output Terminal Selection

Default: 0

Settings 0–23

Function Chart

Settings	Functions	Descriptions
0	Output frequency (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
1	Frequency command (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
2	Motor speed (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
3	Output current (rms)	(2.5 x rated current) is processed as 100%.
4	Output voltage	(2 x rated voltage) is processed as 100%.
5	DC bus voltage	450 V (900 V) = 100%
6	Power factor	-1.000–1.000 = 100%
7	Power	(2 x rated power) is processed as 100%.
8	Output torque	Full load torque = 100%
9	AVI	0–10 V = 0–100%
10	ACI	4–20 mA = 0–100%
12	Iq current command	(2.5 x rated current) is processed as 100%.
13	Iq feedback value	(2.5 x rated current) is processed as 100%.
14	Id current command	(2.5 x rated current) is processed as 100%.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>15</td><td>Id feedback value</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>16</td><td>Vq-axis voltage command</td><td>250 V (500 V) = 100%</td></tr>
<tr><td>17</td><td>Vd-axis voltage command</td><td>250 V (500 V) = 100%</td></tr>
<tr><td>18</td><td>Torque command</td><td>Rated current of motor = 100%</td></tr>
<tr><td>19</td><td>PG2 frequency command</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>20</td><td>CANopen analog output</td><td>For CANopen communication analog output
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>2026-A1</td></tr>
<tr><td>AO10</td><td>2026-AB</td></tr>
<tr><td>AO11</td><td>2026-AC</td></tr>
</table></td></tr>
<tr><td>21</td><td>RS-485 analog output</td><td>For RS-485 (Modbus) analog output
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>22</td><td>Communication card analog output</td><td>For Communication analog output
(CMM-EIP02, CMM-PD02, CMM-DN02)
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>23</td><td>Constant voltage output</td><td>Pr.03-32 controls the voltage output level.
0–100% of Pr.03-32 corresponds to 0–10 V of AFM.</td></tr>
</table>

14-14 AO10 Analog Output 1 Gain
14-15 AO11 Analog Output 1 Gain

Default: 100.0

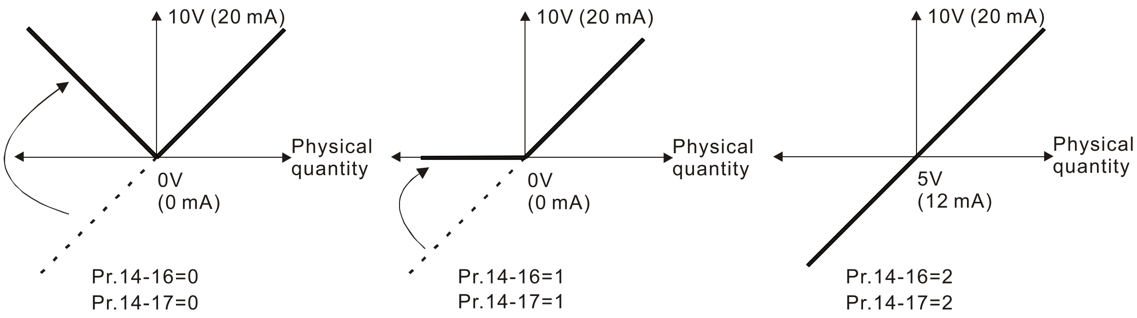
Settings 0.0–500.0%

Adjusts the voltage level outputted to the analog meter from the analog signal (Pr.14-12, 14-13) output terminal AFM of the drive.

14-16 AVO10 Analog Output 1 in REV Direction
14-17 AVO11 Analog Output 1 in REV Direction

Default: 0

Settings
0: Absolute value of output voltage
1: Reverse output 0 V; forward output 0–10 V
2: Reverse output 5–0 V; forward output 5–10 V



Selections for the analog output direction

14-18 Extension Card (AI10) Input Selection

Default: 0

Settings 0: 0–10 V (AVI10)
1: 0–20 mA (ACI10)
2: 4–20 mA (ACI10)

14-19 Extension Card (AI11) Input Selection

Default: 0

Settings 0: 0–10 V (AVI11)
1: 0–20 mA (ACI11)
2: 4–20 mA (ACI11)

📖 When you change the input mode, verify that the switch position of external terminal (AI10, AI1) is correct.

14-20 AVO10 DC Output Setting Level
14-21 AVO11 DC Output Setting Level

Default: 0.00

Settings 0.00–100.00%

14-22 AVO10 Filter Output Time
14-23 AVO11 Filter Output Time

Default: 0.01

Settings 0.00–20.00 sec.

14-24 AI10 Extension Card Lowest Point

Default: 0.00

Settings Pr.14-18 = 0, 0.00–10.00 V
Pr.14-18 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-25 AI10 Extension Card Proportional Lowest Point

Default: 0.00

Settings 0.00–100.00%

14-26 AI10 Extension Card Mid-point

Default: 5.00

Settings Pr.14-18 = 0, 0.00–10.00 V
Pr.14-18 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-27 AI10 Extension Card Proportional Mid-point

Default: 50.00

Settings 0.00–100.00%

14-28 AI10 Extension Card Highest Point

Default: 10.00

Settings Pr.14-18 = 0, 0.00–10.00 V
Pr.14-18 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-29 AI10 Extension Card Proportional Highest Point

Default: 100.00

Settings 0.00–100.00%

- When Pr.14-18 = 0, the voltage type is 0–10 V analog input and the unit is in voltage (V). When Pr.14-18≠0, the current type is 0–20 mA or 4–20 mA and the unit is in current (mA).
- When you set the analog input AI10 to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- The requirement for these three parameters (Pr.14-24, Pr.14-26 and Pr.14-28) is Pr.14-24 < Pr.14-26 < Pr.14-28. The corresponding percentage is unlimited. There is a linear calculation between two points.
- The output % becomes 0% when the AI10 input value is lower than lowest point setting.
  For example:
  If Pr.14-24 = 2 mA and Pr.14-25 = 10%, then the output becomes 0% when the value is ≤ 2 mA.
  If the AI10 input swings between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

14-30 AI10 Extension Card Lowest Point

Default: 0.00

Settings Pr.14-19 = 0, 0.00–10.00 V
Pr.14-19 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-31 AI10 Extension Card Proportional Lowest Point

Default: 0.00

Settings 0.00–100.00%

14-32 AI10 Extension Card Mid-point

Default: 5.00

Settings Pr.14-19 = 0, 0.00–10.00 V
Pr.14-19 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-33 AI10 Extension Card Proportional Mid-point

Default: 50.00

Settings 0.00–100.00%

14-34 AI10 Extension Card Highest Point

Default: 10.00

Settings Pr.14-19 = 0, 0.00–10.00 V
Pr.14-19 ≠ 0, 0.00–20.00 mA or 4–20 mA

14-35 AI10 Extension Card Proportional Highest Point

Default: 100.00

Settings 0.00–100.00%

- When Pr.14-19 = 0, the voltage type is 0–10 V analog input and the unit is in voltage (V). When Pr.14-19 ≠ 0, the current type is 0–20 mA or 4–20 mA and the unit is in current (mA).
- When you set the analog input AI11 to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- The requirement for these three parameters (Pr.14-30, Pr.14-32 and Pr.14-34) is Pr.14-30 < Pr.14-32 < 14-34. The corresponding percentage is unlimited. There is a linear calculation between two points.
- The output % becomes 0% when the AI11 input value is lower than lowest point setting.
  For example:
  If Pr.14-30 = 2 mA and Pr.14-31 = 10%, then the output becomes 0% when the value is ≤ 2 mA. If the AI11 input swings between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

14-36 AO10 Terminal Analog Signal Mode

Default: 0

Settings 0: AVO10 (analog voltage signal 0.00–10.00 V)
1: ACO10 (analog current signal 0.0–20.0 mA)
2: ACO10 (analog current signal 4.0–20.0 mA)

14-37 AO11 Terminal Analog Signal Mode

Default: 0

Settings 0: AVO11 (analog voltage signal 0.00–10.00 V)
1: ACO11 (analog current signal 0.0–20.0 mA)
2: ACO11 (analog current signal 4.0–20.0 mA)

14-50 Output Frequency at Malfunction 2
14-54 Output Frequency at Malfunction 3
14-58 Output Frequency at Malfunction 4
14-62 Output Frequency at Malfunction 5
14-66 Output Frequency at Malfunction 6

Default: Read only

Settings 0.00–599.00 Hz

- When an error occurs, you can check the output frequency for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-51	DC bus Voltage at Malfunction 2
14-55	DC bus Voltage at Malfunction 3
14-59	DC bus Voltage at Malfunction 4
14-63	DC bus Voltage at Malfunction 5
14-67	DC bus Voltage at Malfunction 6

Default: Read only

Settings 0.0–6553.5 V

📖 When an error occurs, you can check the DC voltage for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-52	Output Current at Malfunction 2
14-56	Output Current at Malfunction 3
14-60	Output Current at Malfunction 4
14-64	Output Current at Malfunction 5
14-68	Output Current at Malfunction 6

Default: Read only

Settings 0.00–655.35 Amps

📖 When an error occurs, you can check the output current for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-53	IGBT Temperature at Malfunction 2
14-57	IGBT Temperature at Malfunction 3
14-61	IGBT Temperature at Malfunction 4
14-65	IGBT Temperature at Malfunction 5
14-69	IGBT Temperature at Malfunction 6

Default: Read only

Settings -3276.7–3276.7°C

📖 When an error occurs, you can check the IGBT temperature for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-70	Fault Record 7
14-71	Fault Record 8
14-72	Fault Record 9
14-73	Fault Record 10

Default: 0

Display 0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
5: IGBT short circuit between upper bridge and lower bridge (occ)
6: Over-current at stop (ocS)

7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage at constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage at constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
17: Heatsink overheating (oH2)
18: IGBT temperature detection failure (tH1o)
19: Capacitor hardware error (tH2o)
21: Drive over-load (oL)
22: Electronic thermal relay protection 1 (EoL1)
23: Electronic thermal relay protection 2 (EoL2)
24: Motor overheating (PTC / PT100) (oH3)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Under current (uC)
29: Limit error (LiT)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware failure (Hd0)
37: oc (over-current) hardware failure (Hd1)
40: Auto-tuning error (AUE)
41: PID loss ACI (AFE)
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)
44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
. 48: ACI loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External base block (bb)
52: Enter wrong password three times and locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)

58: Modbus transmission time-out (CE10)
61: Y-connection / Δ-connection switch error (ydc)
62: Deceleration energy backup error (dEb)
63: Over-slip (oSL)
65: Hardware error of PG card (PGF5)
72: STO loss (STL1)
76: Safe torque off (STo)
77: STO loss 2 (STL2)
78: STO loss 3 (STL3)
79: U-phase Over-current before run (Aoc)
80: V-phase Over-current before run (boc)
81: W-phase Over-current before run (coc)
82: U-phase output phase loss (oPL1)
83: V-phase output phase loss (oPL2)
84: W-phase output phase loss (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
101: CANopen guarding error (CGdE)
102: CANopen heartbeat error (CHbE)
104: CANopen bus off error (CbFE)
105: CANopen index error (CidE)
106: CANopen slave station setting error (CAdE)
107: CANopen memory error(CFrE)
111: InrCOM time-out error (ictE)
121: Internal communication error (CP20)
123: Internal communication error (CP22)
124: Internal communication error (CP30)
126: Internal communication error (CP32)
127: Firmware version error (CP33)
128: Over-torque 3 (ot3)
129: Over-torque 4 (ot4)
134: Electronic thermal relay 3 protection (EoL3)
135: Electronic thermal relay 4 protection (EoL4)
140: oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tuning error 1 (DC test stage) (AUE1)
143: Auto-tuning error 2 (High frequency test stage) (AUE2)
144: Auto-tuning error 3 (Rotary test stage) (AUE3)

- The system records the fault as long as the fault is forced to stop.
- Low voltage (Lv) when stopped (LvS warning, no record); low voltage (Lv) when operating (LvA, Lvd, Lvn error, recorded by the system).

- When the dEb function is effective and enabled, the drive starts the dEb function and also records the fault code 62 to Pr.06-17–06-22, Pr.14-70–14-73 at the same time.

⌿ 14-74 Over-torque Detection Action (Motor 3)
⌿ 14-77 Over-torque Detection Action (Motor 4)

Default: 0

Settings 0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

- When Pr.14-74 and Pr.14-77 setting are 1 or 3, there is a warning message but no error record.
- When Pr.14-74 and Pr.14-77 setting are 2 or 4, there is an error message and an error record.

⌿ 14-75 Over-torque Detection Level (Motor 3)
⌿ 14-78 Over-torque Detection Level (Motor 4)

Default: 120

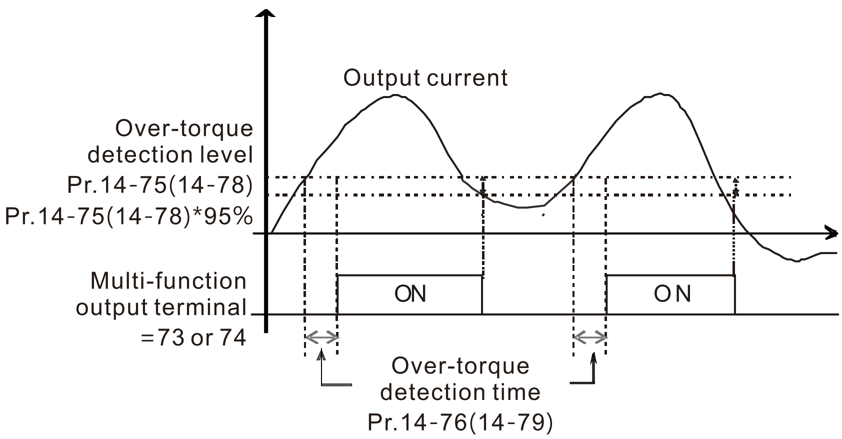
Settings 10–250% (100% corresponds to the rated current of the drive)

⌿ 14-76 Over-torque Detection Time (Motor 3)
⌿ 14-79 Over-torque Detection Time (Motor 4)

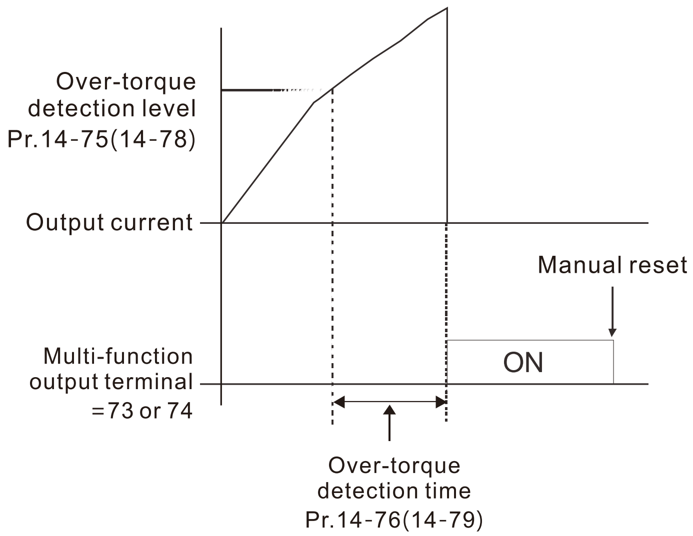
Default: 0.1

Settings 0.0–60.0 sec.

- When the output current exceeds the over-torque detection level (Pr.14-75 or Pr.14-78) and the over-torque detection time (Pr.14-76 or Pr.14-79), the over-torque detection follows the setting of Pr.14-74 or Pr.14-77.
- When Pr.14-74 or Pr.14-77 setting is 1 or 3, the drive displays an ot3/ot4 warning when the system detects over-torque. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



- When Pr.14-74 or Pr.14-77 setting is 2 or 4, the drive displays an ot3/ot4 error when the system detects over-torque. The drive stops operating until you manually reset it.



14-80	Electronic Thermal Relay Selection 3 (Motor 3)
14-82	Electronic Thermal Relay Selection 4 (Motor 4)

Default: 2

Settings 0: Inverter motor (with external forced cooling)

1: Standard motor (motor with the fan on the shaft)

2: Disable

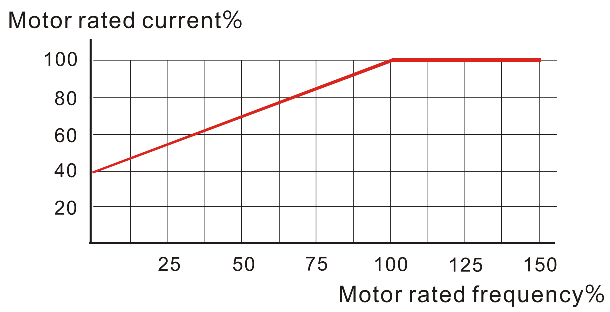
- To prevent a self-cooling motor from overheating during low speed operation, you can set the electronic thermal relay to limit the drive output power.
- 0: Suitable for an inverter motor with external forced cooling. There is no obvious correlation between the heat dissipation capability and the motor speed; therefore, the low speed electronic thermal relay remains fixed to ensure the motor load capacity at low speed.
- 1: Suitable for a standard motor with the fan on the shaft. The motor cooling capacity is poor at low speed; therefore, the electronic thermal relay action time is reduced appropriately to ensure the life of the motor.
- When you cycle the power ON / OFF frequently, the thermal relay protection resets when the power is OFF; therefore, even the setting is 0 or 1, the motor may not be protected. If several motors are connected to a drive, install an electronic thermal relay in each of the motors.

14-81	Electronic Thermal Relay Action Time 3 (Motor 3)
14-83	Electronic Thermal Relay Action Time 4 (Motor 4)

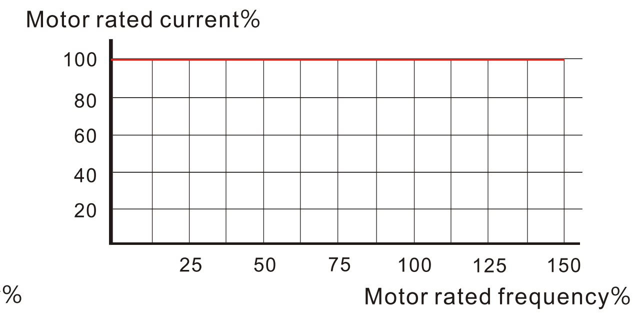
Default: 60.0

Settings 30.0–600.0 sec.

- The electronic thermal relay is rated for 150% of the motor rated current value and with Pr.14-81 settings, the settings of Pr.14-83 protects the motor to avoid burnout due to motor overheating. When it reaches the setting time, the drive displays "EoL3 / EoL4", and the motor free runs to stop.
- This parameter sets the action time of the electronic thermal relay, and the function is based on the operating characteristic curve of electronic thermal relay I2t, the drive output frequency, current, and operation time to prevent overheating of the motor.



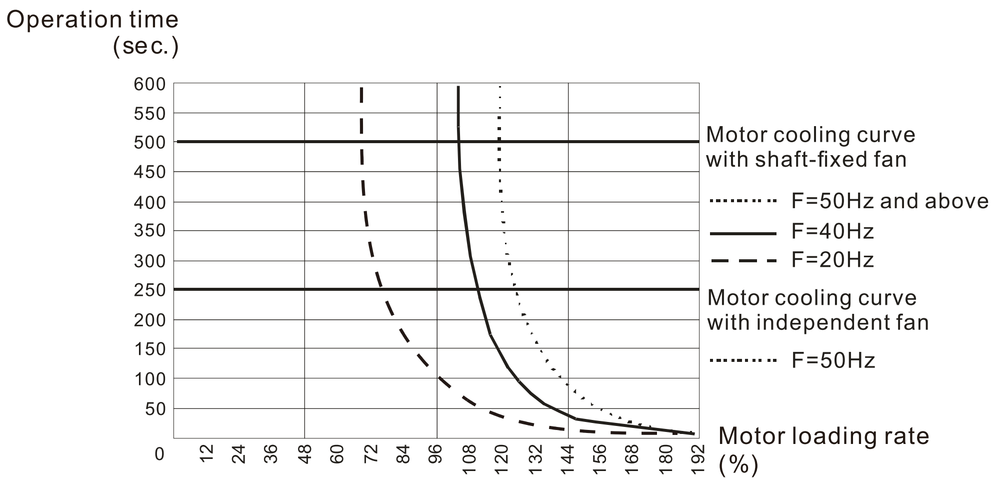
Motor cooling curve with shaft-fixed fan



Motor cooling curve with independent fan

📖 The electronic thermal relay action condition follows the settings for Pr.14-80 /Pr.14-82:

1. Pr.14-80 / Pr.14-82 set to 0 (inverter motor with external forced cooling):
   When the drive output current is higher than 150% of the rated current for the motor (refer to the motor independent cooling curve figure above), the drive starts to count the time. If the time exceeds the settings for Pr.14-81 / Pr.14-83, the electronic thermal relay is activated.
2. Pr.14-80 / Pr.14-82 set to 1 (standard motor with fan on the shaft):
   When the drive output current is higher than 150% of the rated current of the motor (refer to the motor coaxial cooling curve figure above), the drive starts to count the time. If the time exceeds the settings for Pr.14-81 / Pr.14-83, the electronic thermal relay activates. The electronic thermal relay action time depends on the drive output current (motor loading rate in %) to make appropriate adjustments: short action time when the current is high, long action time when the current is low. See the figure below:



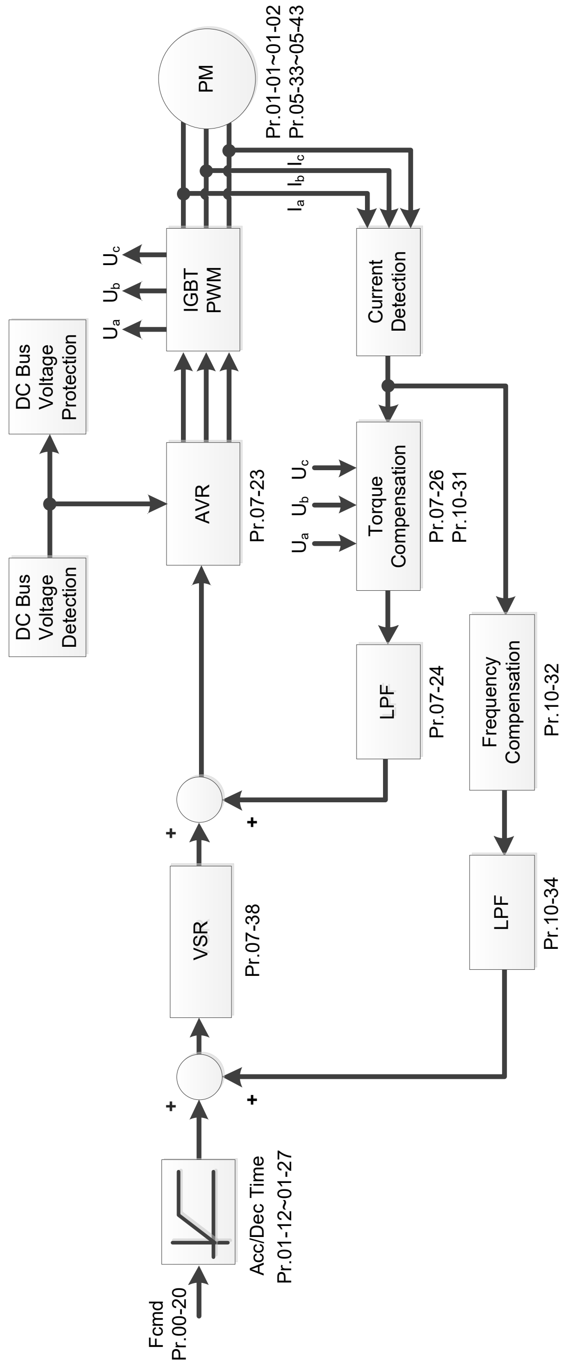
12-2 Adjustment & Application

The followings are abbreviations for different types of motors:

- IM: Induction motor
- PM: Permanent magnet synchronous AC motor
- IPM: Interior permanent magnet synchronous AC motor
- SPM: Surface permanent magnet synchronous AC motor

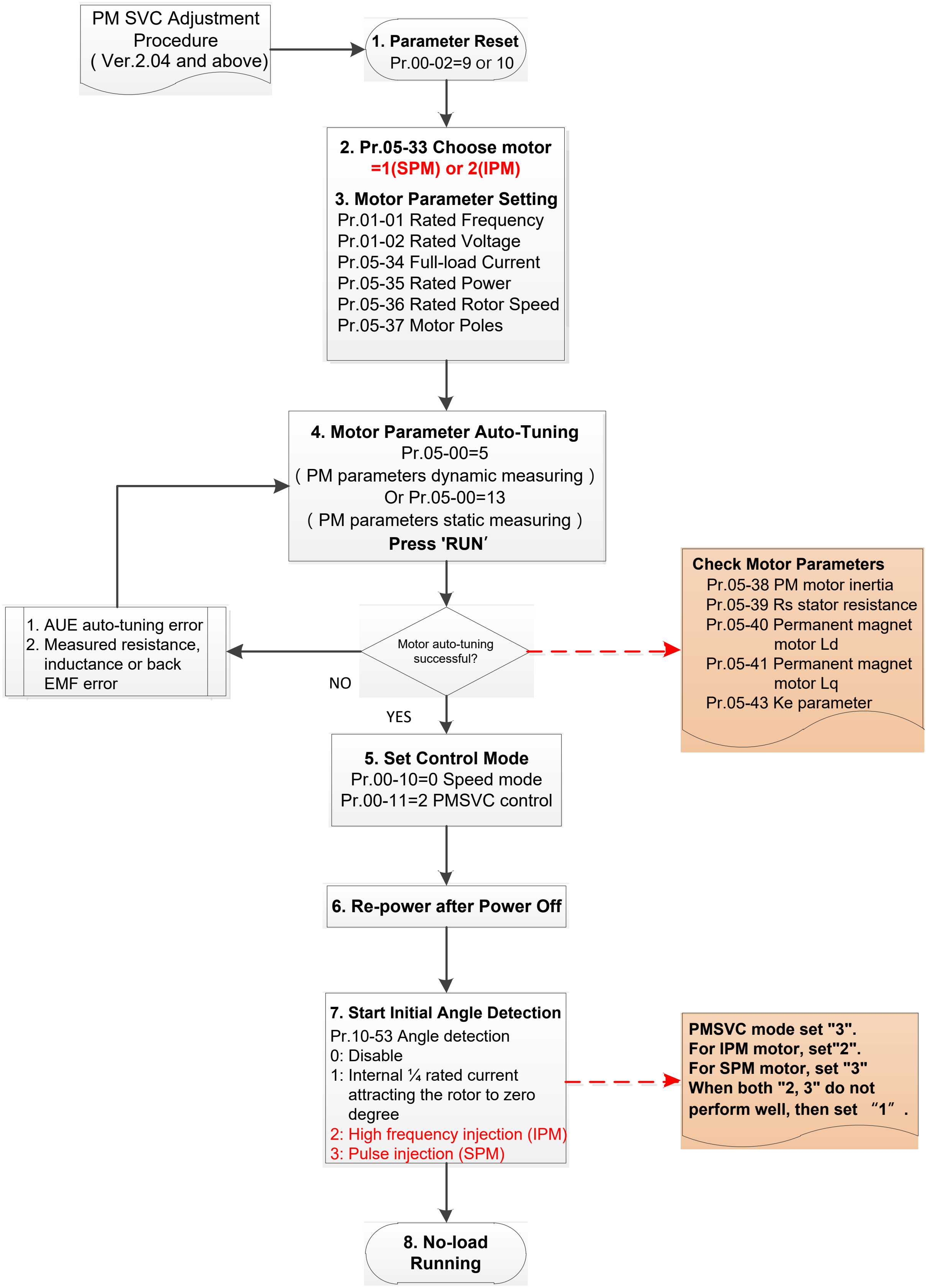
12-2-1 Permanent-Magnet Synchronous Motor, Space Vector Control Adjustment Procedure (PM SVC, Pr.00-11=2)

- Control diagram



- PM SVC adjustment procedure
  (The number marked on the procedure corresponds to the number of following adjustment explanations)

I. PM SVC motor parameters adjustment flowchart



📖 Basic motor parameters adjustment

1. Parameter reset:
   Reset Pr.00-02 = 9 (50 Hz) or 10 (60 Hz) to the default value.
2. Select PM motor type:
   Pr.05-33 = 1 (SPM) or 2 (IPM)
3. Motor nameplate parameter setting:

Parameter	Description
Pr.01-01	Rated frequency (Hz)
Pr.01-02	Rated voltage (V_{AC})
Pr.05-34	Rated current (A)
Pr.05-35	Rated power (kW)
Pr.05-36	Rated rotor speed (rpm)
Pr.05-37	Number of poles for the motor (poles)

4. PM parameter auto-tuning:
   Set Pr.05-00 = 5 (rolling auto-tuning for PM, with no load) or 13 (static auto-tuning for PM) and press RUN key to finish motor auto-tuning, then you will get the following parameters:

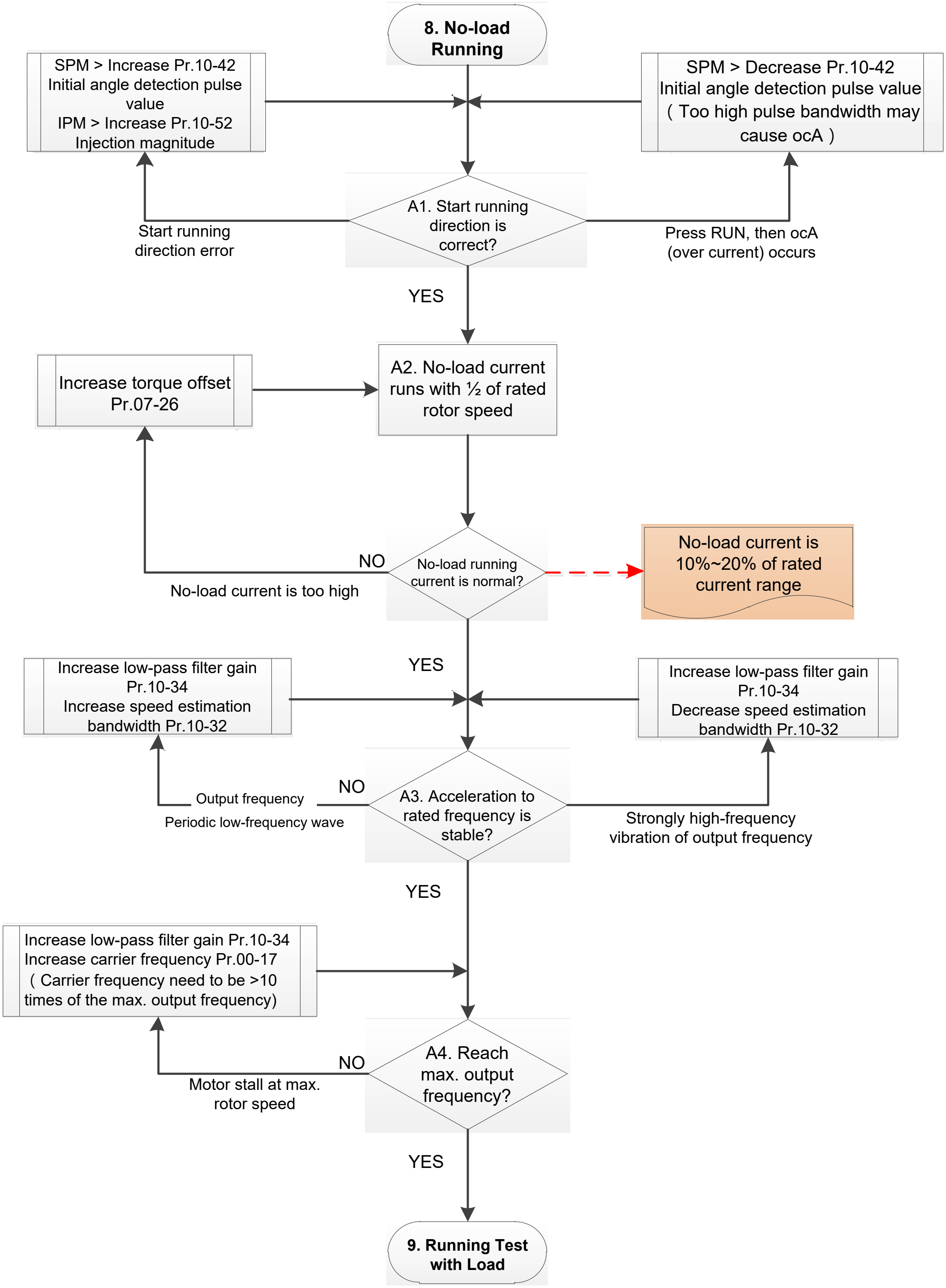
Parameter	Description
Pr.05-39	Stator resistance for a permanent magnet motor (Ω)
Pr.05-40	Permanent magnet motor Ld (mH)
Pr.05-41	Permanent magnet motor Lq (mH)
Pr.05-43	Ke parameter of a permanent magnet motor ($V_{phase\text{,}rms}$ / krpm) (When Pr.05-00 = 5, the Ke parameter is measured based on the actual motor rotation.) (When Pr.05-00 = 13, the Ke parameter is automatically calculated based on the motor power, current and rotor speed.)

   If an auto-tuning error (AUE) occurs, refer to Chapter 14 "Fault Codes and Descriptions" for further treatment.

AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (Motor phase loss error)

5. Set control mode
   Control mode for the drive: Pr. 00-10 = 0: Speed mode
   Control mode for the motor: Pr. 00-11 = 2: PM SVC mode
6. Re-power on after power off.
7. Measure the initial magnetic pole angle of PM
   Set Pr.10-53 PM initial rotor position detection method
   0: Disabled
   1: Using I/F current command (Pr.10-31) to attract the rotor to zero degrees
   2: High frequency injection
   3: Pulse injection
   * For IPM, the setting value is suggested to be 2; for SPM, the setting value is suggested to be 3. You can choose the setting 1 if the result is not good of setting as 2 or 3.

II. PM SVC adjustment flowchart for operation with no load / light load



📖 Adjustment for operation with light load

8. Start the motor without load / with light load and operate to 1/2 of the rated rotor speed
   A1. Start operation direction:
   a. If the start operation direction is wrong
      SPM: increase the current proportion for Pr.10-42 (initial angle detection pulse value) to improve the accuracy of the angle detection.
      IPM: Increase the voltage for Pr.10-52 (injection magnitude) to improve the accuracy of the angle detection.
   b. If an ocA error occurs when pressing RUN to start the motor, decrease the current proportion for Pr.10-42 (initial angle detection pulse value).

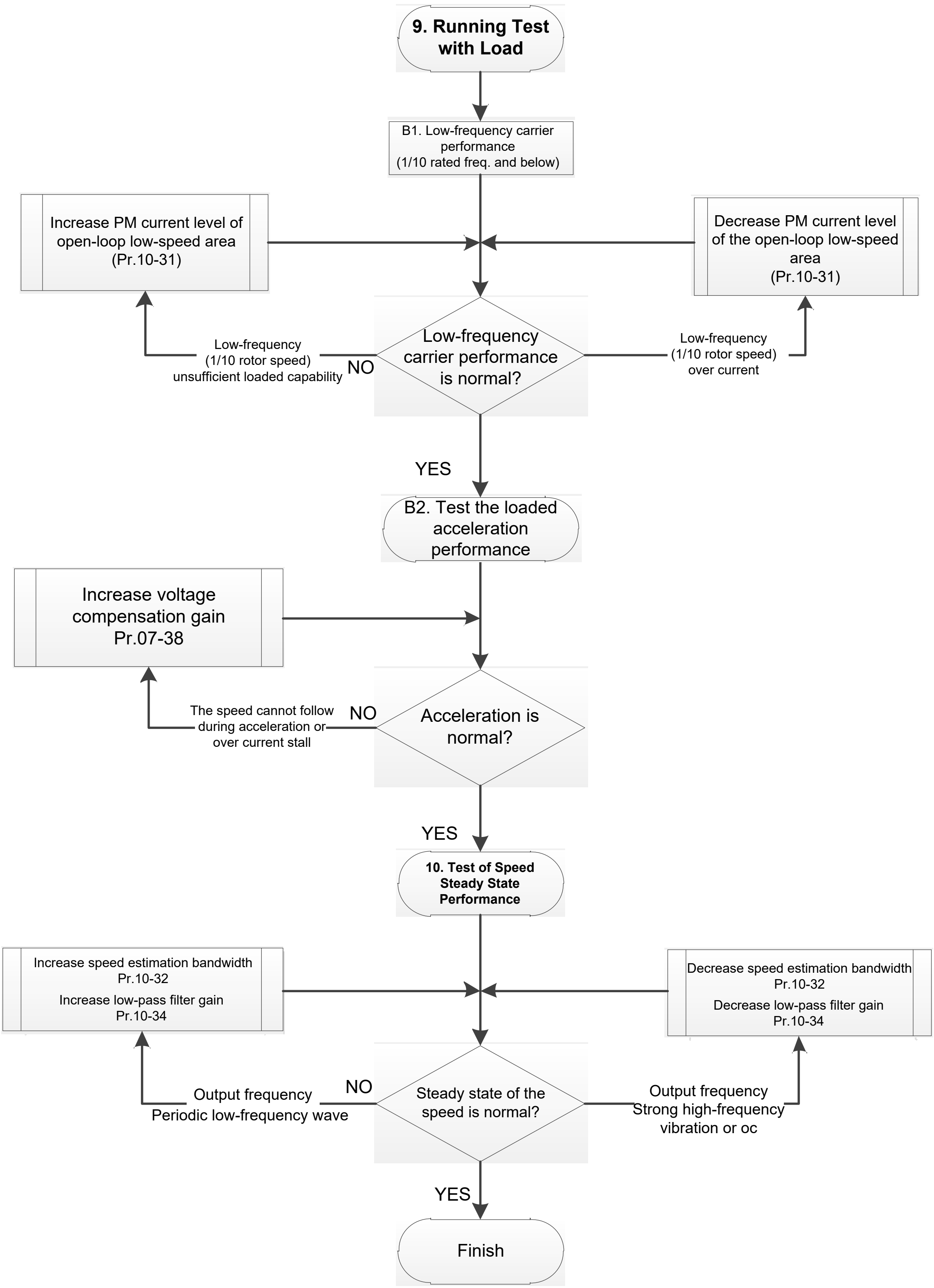
A2. Operates the motor in 1/2 of the rated rotor speed, adjust the no-load operating current
If the no-load operating current exceeds 20% of the rated current, increase Pr.07-26 (torque compensation gain) and observe the no-load operating current.

A3. Accelerate to the rated frequency and observe if the motor operates stably.

a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr.10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr.10-32 (PM FOC sensorless speed estimator bandwidth).
b. If the output frequency reflects high frequency vibration, decrease Pr.10-34 or decrease Pr.10-32.

A4. Accelerate the motor to the maximum rotor speed, and observe if it operates stably.
If the motor stalls when accelerating to the maximum rotor speed, then increase Pr.10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr.00-17 (carrier frequency, you must set the carrier frequency larger than 10 times of the maximum output frequency)

III. PM SVC adjustment flowchart for operation starts with load



Adjustment for operation with heavy load

9. Load operating test

B1. Low-frequency loading performance is below 1/10 of rated frequency:

a. If the low-frequency loading performance is insufficient, or the rotor speed is not smooth, increase Pr.10-31 (current command of I/F mode).

b. If the low-frequency current is large, decrease Pr.10-31 (current command of I/F mode).

B2. Test the with-load accelerating performance:

When the motor operates in 1/10 of rotor speed and above, if the speed cannot follow the acceleration time during accelerating, or the current stalls, increase Pr.07-38 (PMSVC voltage feedback forward gain).

10. Stability test at constant speed operation: the motor operates stably at constant speed

a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr.10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr.10-32 (PM FOC sensorless speed estimator bandwidth).

b. If the output frequency reflects high frequency vibration, decrease Pr.10-34 or decrease Pr.10-32.

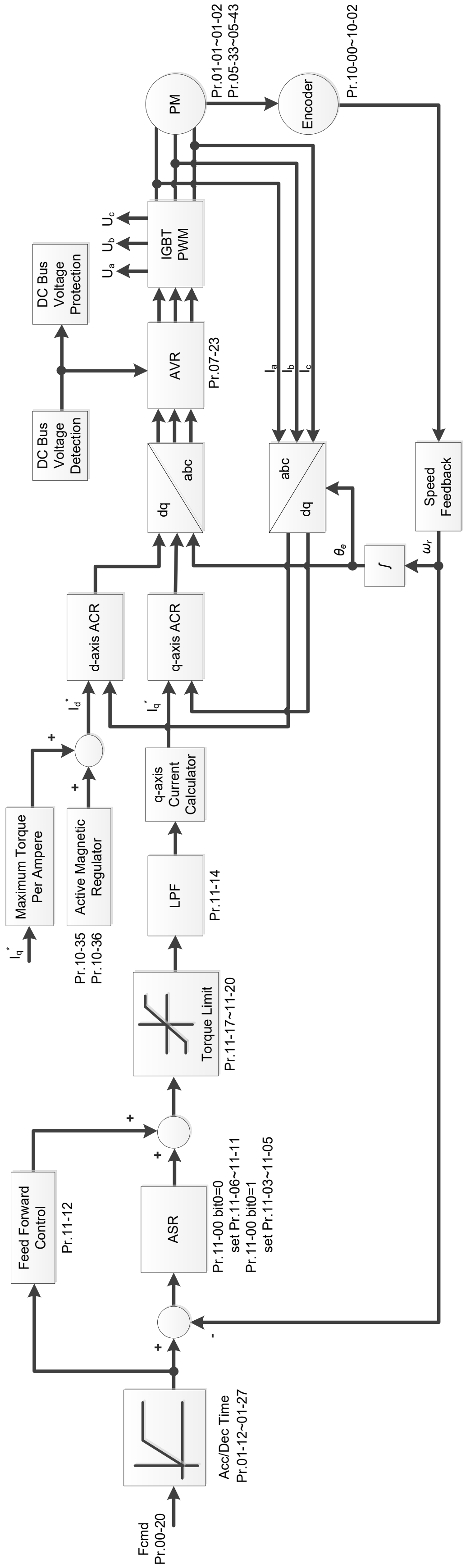
- PM SVC related parameters

Refer to Section 12-1 Description of Parameter Settings for more details.

Parameter	Description	Unit	Default	Setting Range
Pr.07-24	Torque command filter time	sec.	0.500	0.001–10.000
Pr.07-26	Torque compensation gain	NA	0	0–5000
Pr.07-38	PMSVC voltage feedback forward gain	NA	1.0	0.00–2.00
Pr.10-31	I/F mode, current command	%	40	0–150
Pr.10-32	PM FOC sensorless speed estimator bandwidth	Hz	5.00	0.00–600.00
Pr.10-34	PM sensorless speed estimator low-pass filter gain	NA	1.00	0.00–655.35
Pr.10-39	Frequency point to switch from I/F mode to PM sensorless mode	Hz	20.00	0.00–599.00
Pr.10-40	Frequency point to switch from PM sensorless mode to V/F mode	Hz	20.00	0.00–599.00
Initial Angle Estimating Parameters				
Pr.10-42	Initial angle detection pulse value	NA	1.0	0.0–3.0
Pr.10-51	Injection frequency	Hz	500	0–1200
Pr.10-52	Injection magnitude	V	15.0 / 30.0	0.0–200.0
Pr.10-53	PM initial rotor position detection method 0: Disable 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	NA	0	0–3

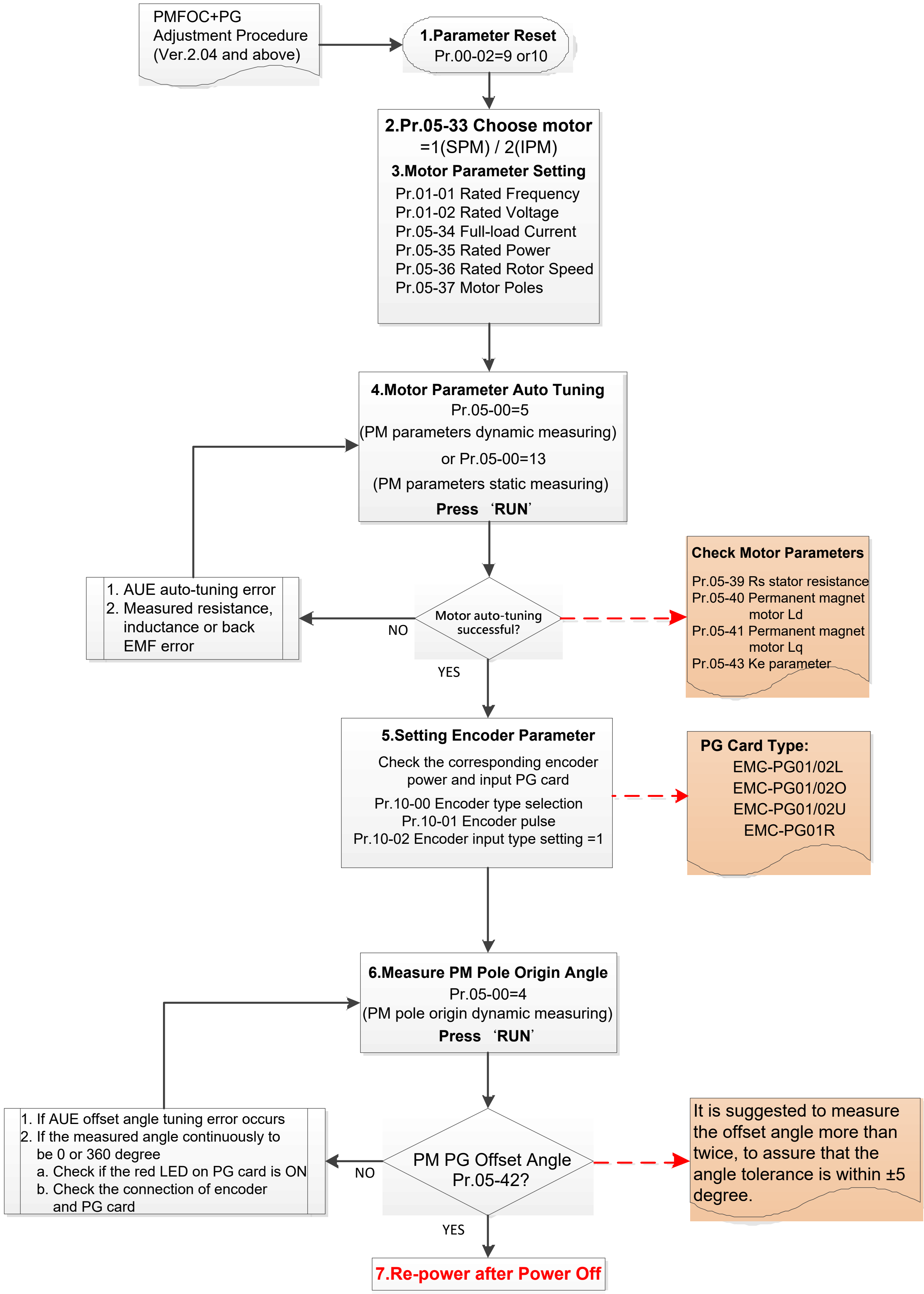
12-2-2 Permanent-Magnet Synchronuous Motor, Field-Oriented Control and with Encoder Adjustment Procedure (PM FOCPG, Pr,00-11=4)

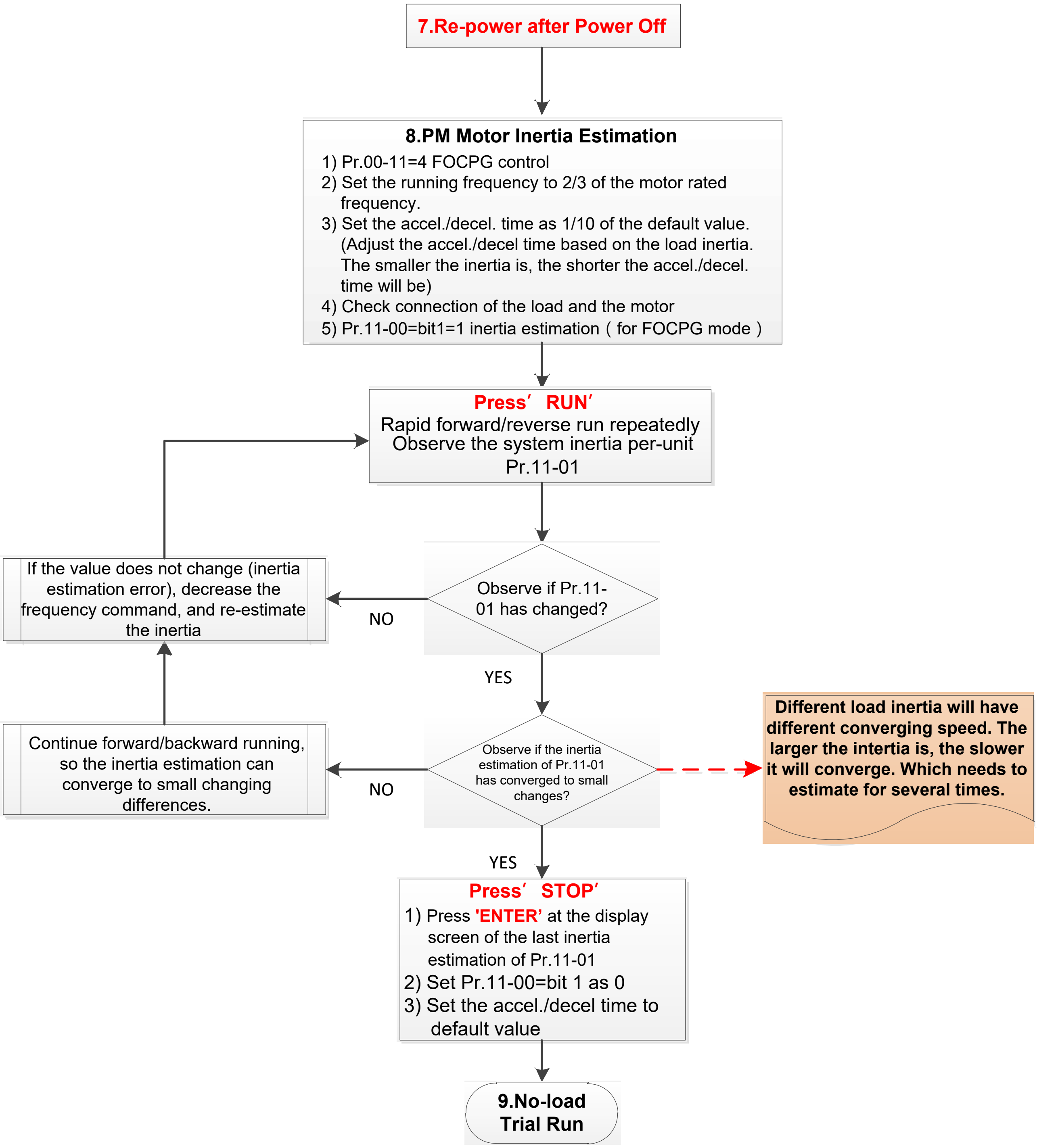
- PM FOCPG Control diagram



- PM FOCPG adjustment procedure
  (The number marked on the procedure corresponds to the number of following adjustment explanations)

  I. PM FOCPG motor parameters adjustment flowchart





📖 basic motor parameters adjustment

1. Parameter reset:
   Reset Pr.00-02=9 (50Hz) or 10 (60Hz) to the default value.
2. Select IPM motor type:
   Pr.05-33=1 (SPM) or 2 (IPM)
3. Motor nameplate parameter setting:

Parameter	Description
Pr.01-01	Rated frequency (Hz)
Pr.01-02	Rated voltage (V_{AC})
Pr.05-34	Rated current (A)
Pr.05-35	Rated power (kW)

Parameter	Description
Pr.05-36	Rated rotor speed (RPM)
Pr.05-37	Number of poles for the motor (poles)

4. PM parameter auto-tuning:
   Set Pr.05-00 = 5 (rolling auto-tuning for PM, with no load) or 13 (static auto-tuning for PM) and press RUN key to finish motor auto-tuning, then you will get the following parameters:

Parameter	Description
Pr.05-39	Stator resistance for a permanent magnet motor (Ω)
Pr.05-40	Permanent magnet motor Ld (mH)
Pr.05-41	Permanent magnet motor Lq (mH)
Pr.05-43	Ke parameter of a permanent magnet motor ($V_{phase\cdot rms}$ / krpm) (When Pr.05-00=5, the Ke parameter is measured based on the actual motor rotation.) (When Pr.05-00=13, the Ke parameter is automatically calculated based on the motor power, current and rotor speed.)

   If an auto-tuning error (AUE) occurs, refer to Chapter 14 “Error Codes and Descriptions” for further treatment.

AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (Motor phase loss error)
AUE3 (144)	Auto-tuning error 3 (No-load current I_0 measuring error)
AUE4 (148)	Auto-tuning error 4 (Leakage inductance Lsigma measuring error)

5. Set encoder parameter
   Check the encoder power and input type, make sure it is used with correct PG card.

PG Card Type		
EMC-PG01L	EMC-PG01O	EMC-PG01R

   Related parameters:
   (1) Pr. 10-00: Encoder type selection
   (2) Pr. 10-01: Encoder pulses per revolution
   (3) Pr. 10-02: Encoder input type setting = 1 (A-phase and B-phase are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees)
6. Measure the initial magnetic pole angle of PM
   (1) Set Pr.05-00=4 (dynamic test for PM magnetic pole)
   (2) Press RUN key to proceed the PM magnetic pole measurement, and to get the offset angle.
   Note 1: It is suggested to measure the offset angle more than twice, to make sure the angle tolerance is within ±5 degree.
   Note 2: Verify the encoder and PG card are connected in the right order.
7. Re-power on after power off.
8. Execute inertia estimation for PM
   (1) Set Pr. 00-11 = 4, PM FOCPG control.
   (2) Set the operation frequency command to 2/3 of the motor’s rated frequency.
   (3) Set the acceleration / deceleration time (Pr. 01-12, Pr. 01-13) to 1/10 of the default time.

(adjust the acceleration / deceleration time according to the load inertia. The smaller the load inertia, the shorter the acceleration / deceleration time is set).

(4) Check if the load and the motor is connected.

(5) Set Pr. 11-00 bit1 = 1, inertia estimate (only in FOCPG mode).

(6) Press RUN key to proceed the inertia

Quickly run the motor in forward and reverse direction repeatedly, and observe the inertia estimated value of Pr. 11-01 for the keypad.

a. If the system inertial estimated value of Pr. 11-01 does not change (= default 256), it means the inertia estimation is wrong. Reduce the frequency command and estimate the inertia again.

b. If the system inertia estimated value of Pr. 11-01 is still a lot different from the estimated value of FWD/REV operation, continue the estimation in forward / reverse operating direction to restraint the estimated inertia to small difference.

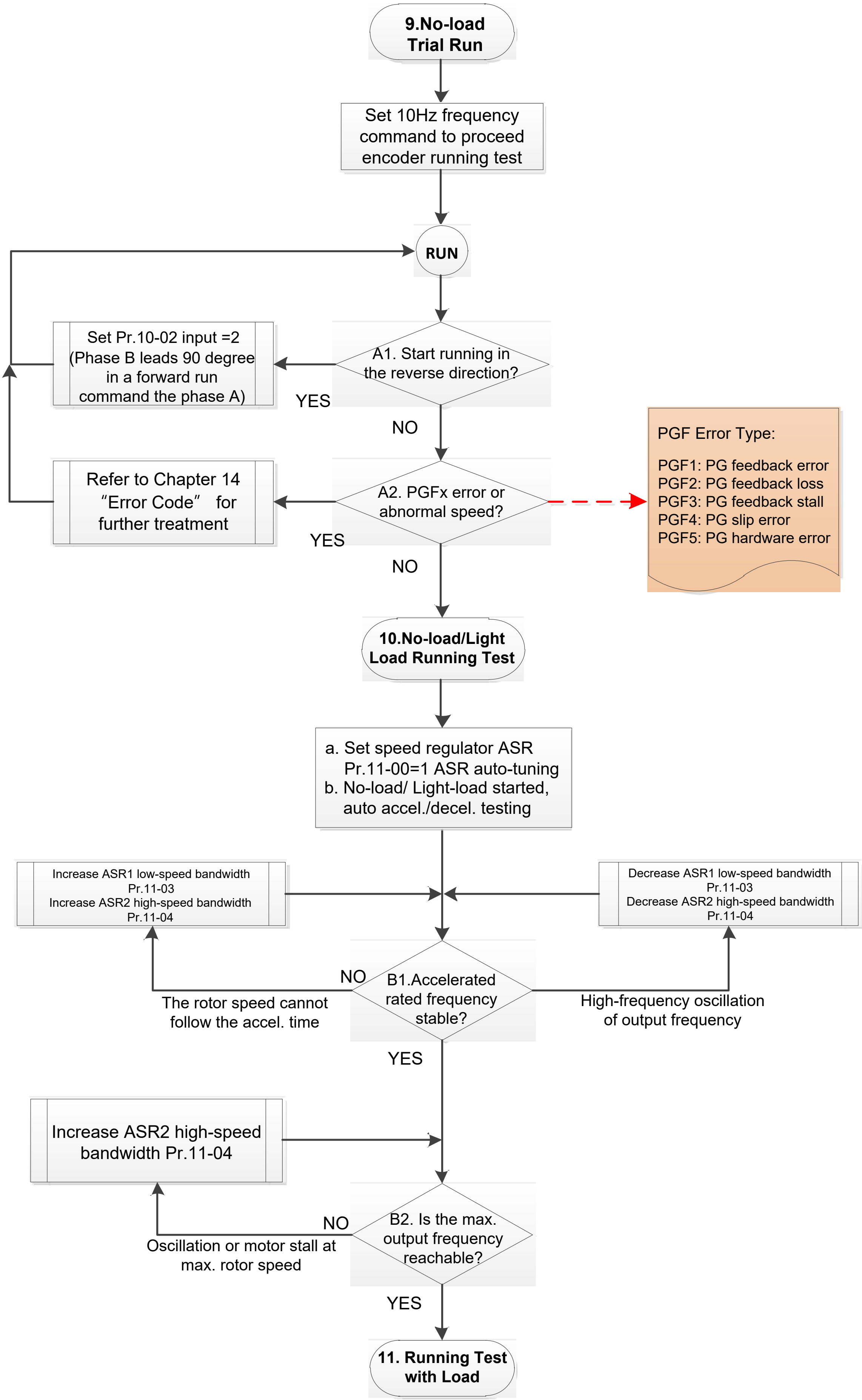
(7) Press STOP key to obtain the estimated inertia value:

a. Press ENTER to confirm the input value at the displayed page of the last estimated inertia value of Pr. 11-01.

b. Set Pr.11-01 bit1 = 0, return the control mode to speed mode.

c. Set the acceleration / deceleration time (Pr.01-12, 01-13) back to the default value.

II. PM FOC+PG adjustment flowchart for operation without load / with light load



📖 Adjustment for operation with no load / light load

9. No-load trial run
   Set the frequency command to 10 Hz to proceed the encoder running test:
   A1. If the motor starts in a reverse direction.
   If the motor starts in a reverse direction, set the encoder input type Pr. 10-02 = 2 (A-phase and B-phase are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees.)
   A2. Observe if a PGFx error is displayed on the keypad, or the motor runs in an abnormal speed.
   If the PGFx error is displayed or the motor runs in an abnormal speed, refer to Chapter 14 "Fault Codes and Descriptions" or the following table for PGFx error type and further treatment.

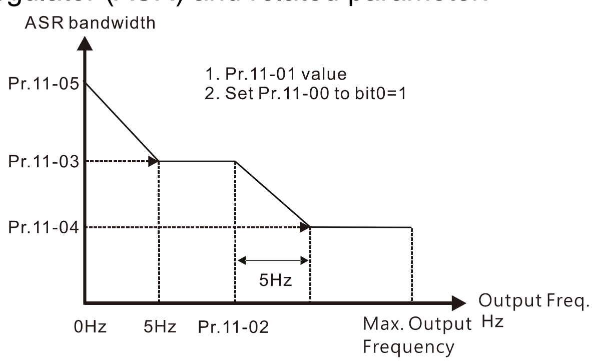
PGF Error (code)	Description	Solution
PGF1 (42)	PG feedback error	Check parameter setting of Pr.10-00–10-02
PGF2 (43)	PG feedback loss	Check the wiring of encoder and PG card
PGF3 (44)	PG feedback stall	Check the wiring of encoder and PG card
PGF4 (45)	PG slip error	Check the pulse setting of Pr.10-01 Check the wiring of encoder and PG card
PGF5 (65)	PG hardware error	Check if the PG card is installed on the correct slot position Check the setting parameter of the encoder

10. No-load / light load running test
   a. Set the speed regulator (ASR) as Pr.11-00=1, and set the ASR gain as auto-tuning.
   b. Start the motor with no load / light load and proceed acceleration / deceleration test.

   B1. Accelerate to the rated frequency and observe if the motor runs stably.
   - If the output rotor speed cannot follow the acceleration time, increase Pr.11-04 (ASR2 high-speed bandwidth) or Pr.11-03 (ASR1 low-speed bandwidth).
   - If a high-frequency oscillation occurs in the output frequency, decrease Pr.11-04 (ASR2 high-speed bandwidth) or Pr.11-03 (ASR1 low-speed bandwidth).

   B2. Accelerate the motor to the maximum frequency and observe if it runs stably.
   If an oscillation occurs or motor stalls at maximum rotor speed during operation, increase Pr.11-04 (ASR2 high-speed bandwidth).

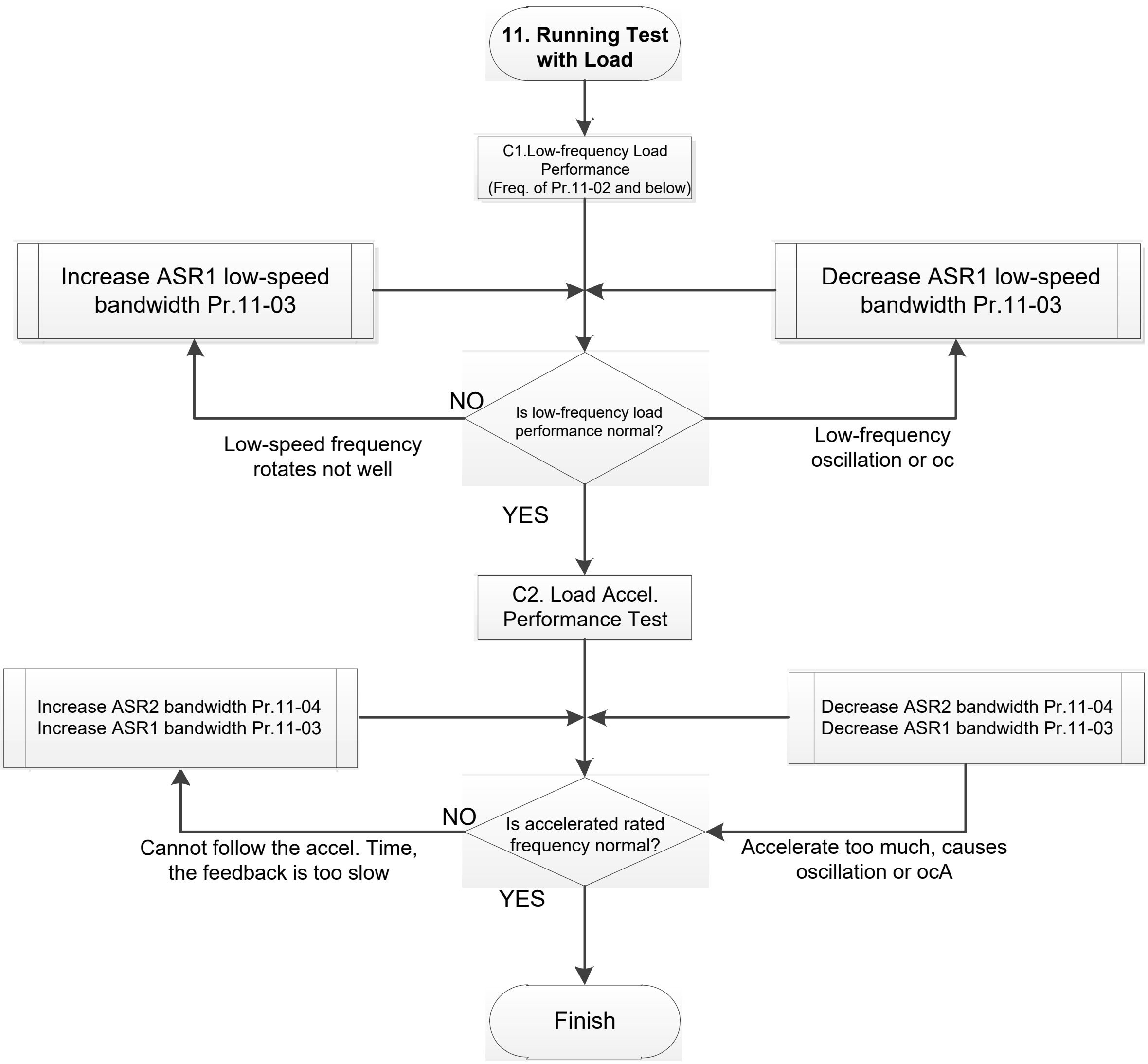
Setting curve of speed regulator (ASR) and related parameter:



ASR adjustment- auto gain

Parameter	Description	Default
Pr.11-00	System control	0
Pr.11-01	Per unit of system inertia	256
Pr.11-02	ASR1/ASR2 switch frequency (it is suggested to set the switch frequency higher than Pr.10-39)	7.00 Hz
Pr.11-03	ASR1 low-speed bandwidth	10 Hz
Pr.11-04	ASR2 high-speed bandwidth	10 Hz
Pr.11-05	ASR zero-speed bandwidth	10 Hz

III. PM FOCPG adjustment flowchart for operation starts with load



📖 Adjustment for operation with load

C1. Low-frequency load performance, when the drive operates under ASR1 / ASR2 switch frequency (Pr.11-02):

a. If the low-speed frequency cannot start-up with load or the rotor speed is not smooth, increase Pr.11-03 (ASR1 low-speed bandwidth), or increase Pr.11-01 (Per-unit system inertia).

b. If an oscillation or over current (oc) error occurs at low-speed frequency, decrease Pr.11-(ASR1 low-speed bandwidth) or decrease Pr.11-01 (Per-unit system inertia).

C2. With-load accelerating performance testing in heavy-load status, accelerate the motor to the rated rotor speed according to the acceleration time.

- If the motor rotor speed cannot follow the acceleration time, and the response is too slow, increase Pr.11-04 (ASR2 high-speed bandwidth) and Pr.11-03 (ASR1 low-speed bandwidth); if the response speed is still not enough, increase 10% of the per-unit system inertia for Pr.11-01 each time.
- If an excessive acceleration causes an oscillation or ocA error, decrease Pr.11-04 (ASR2 high-speed bandwidth) and Pr.11-03 (ASR1 low-speed bandwidth).

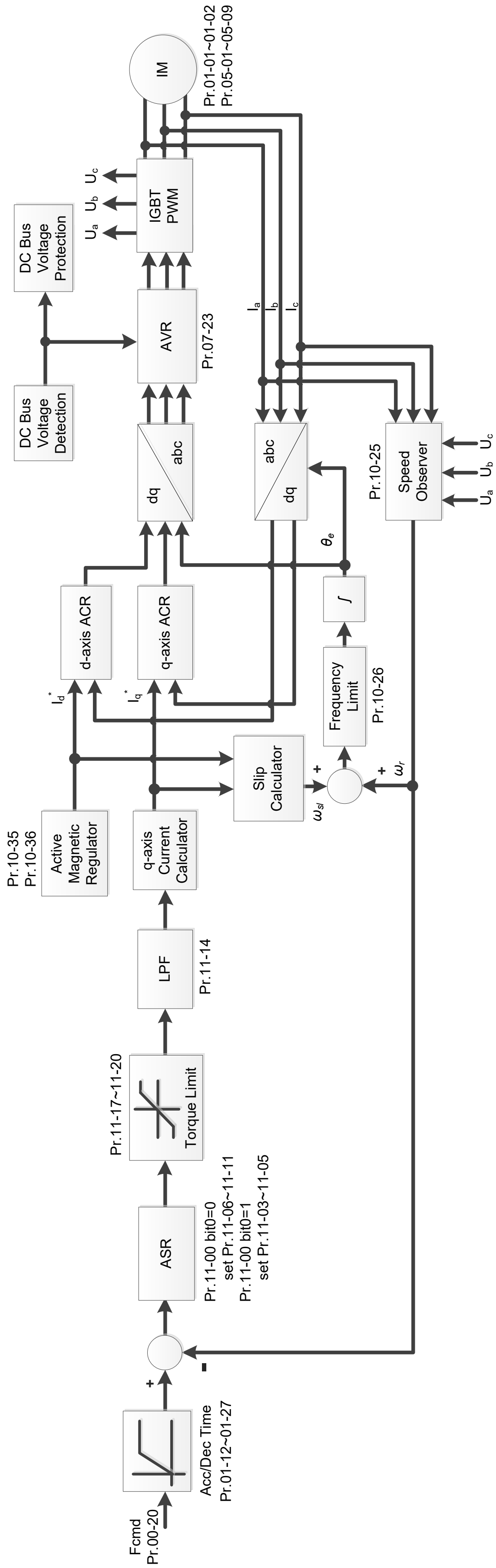
● PM FOCPG adjustment parameters

Refer to Section 12-1 "Description of Parameter Settings" for detailed information.

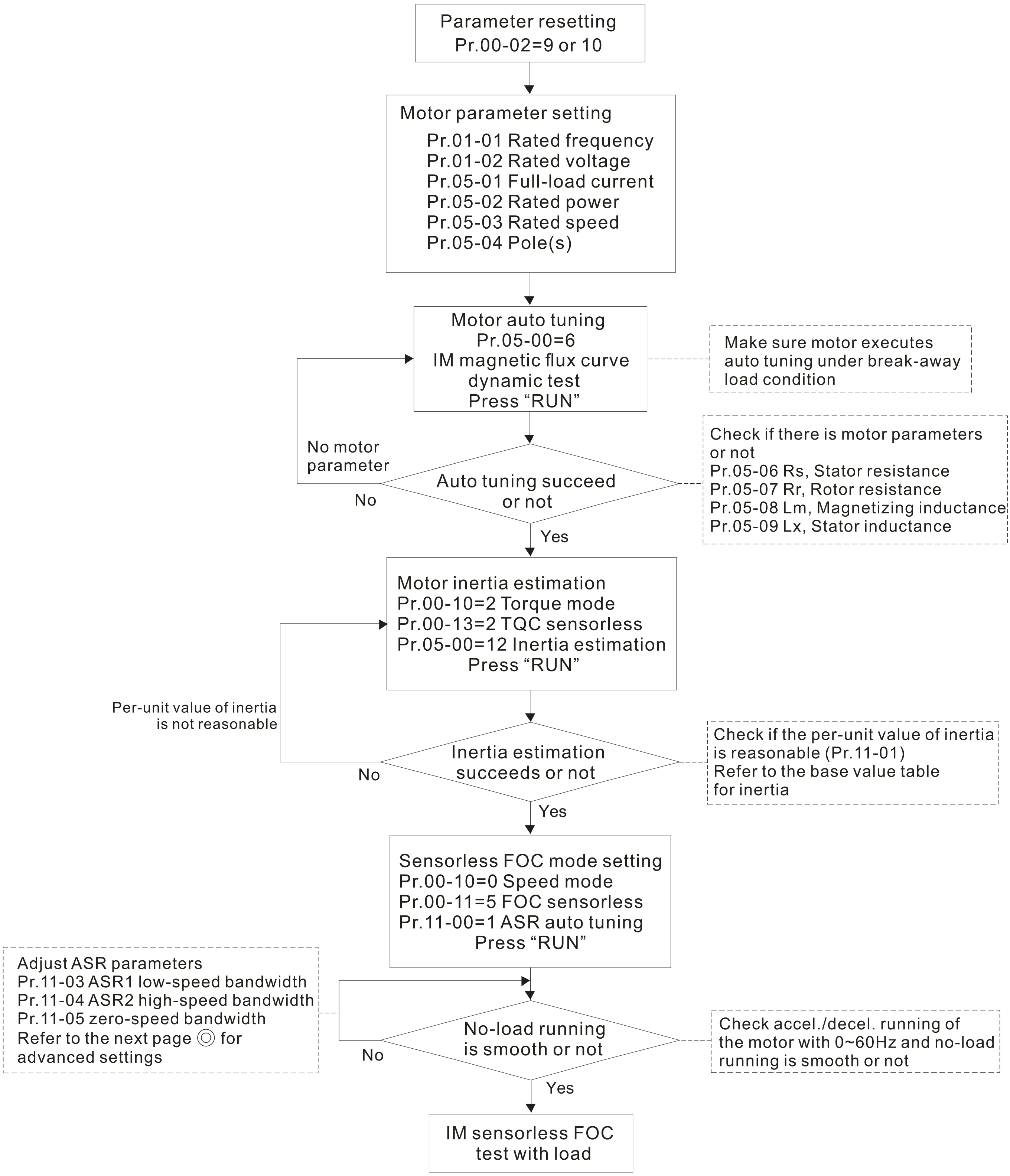
Parameter	Description	Unit	Default	Setting Range
Encoder Setting Parameters				
Pr.10-00	Encoder type selection	N/A	0	0–5
Pr.10-01	Encoder pulses per revolution	ppr	600	1–20000
Pr.10-02	Encoder input type setting	N/A	0	0–5
Motor Performance Control Parameters				
Pr.11-00	System control	bit	0	0–8
Pr.11-01	Per-unit of system inertia	N/A	256	1–65535
Pr.11-02	ASR1 / ASR2 switch frequency	Hz	7	5.00–599
Pr.11-03	ASR1 low-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
Pr.11-04	ASR2 high-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
Pr.11-05	Zero-speed bandwidth	Hz	10	1–100 (PM) 1–40 (iM)

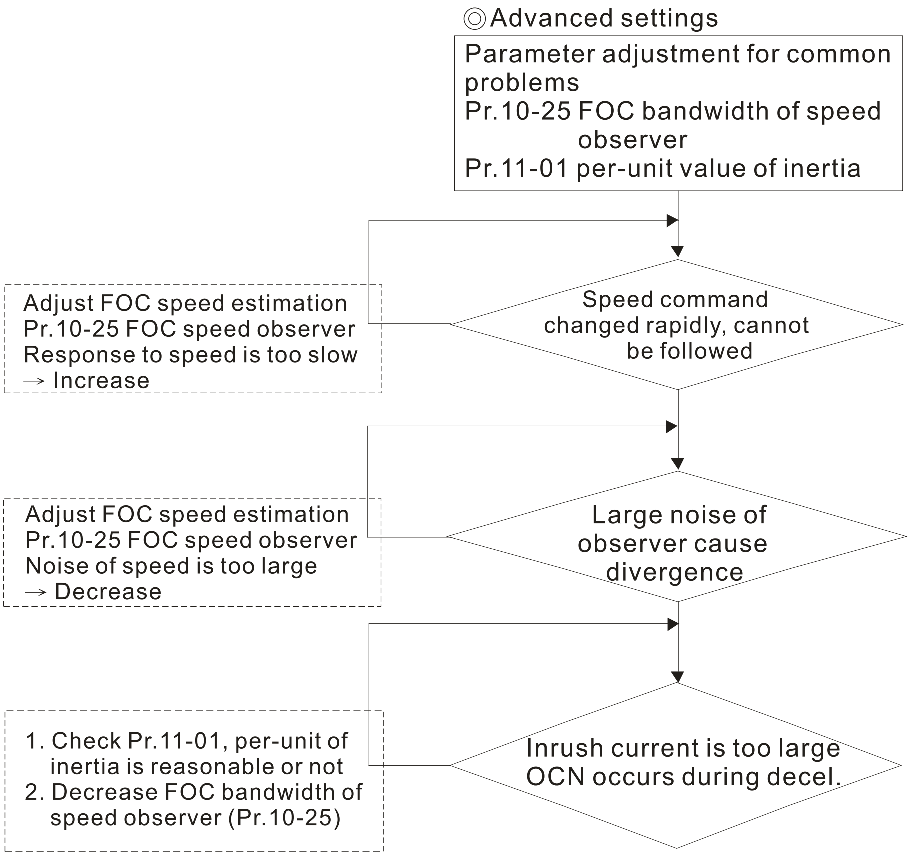
12-2-3 Induction Motor, Sensorless Field-Oriented Control Adjustment Procedure (IMFOC Sensorless, Pr.00-11=5)

- Control diagram



- Adjustment procedure





📖 Basic motor parameters adjustment

1. Parameter reset:
   Reset Pr.00-02 = 9 (50 Hz) or 10 (60 Hz) to the default value.
2. Select PM motor type:
   Pr.05-33 = 0 (IM)
3. Motor nameplate parameter setting:

Parameter	Description
Pr.01-01	Rated frequency (Hz)
Pr.01-02	Rated voltage (V_{AC})
Pr.05-01	Full-load current for induction motor 1 (A)
Pr.05-02	Rated power for induction motor 1 (kW)
Pr.05-03	Rated speed for induction motor 1 (rpm)
Pr.05-04	Number of poles for induction motor 1 (poles)

4. Press RUN to start auto-tuning of IM magnetic flux curve dynamic test for Pr.05-00 = 1 or 6 (motor is running). Make sure the motor executes auto-tuning under break-away load condition. Check if there are motor parameters after auto-tuning.

Parameter	Description
Pr.05-06	Stator resistance (Rs) for induction motor 1 (Ω)
Pr.05-07	Rotor resistance (Rr) for induction motor 1 (Ω)
Pr.05-08	Magnetizing inductance (Lm) for induction motor 1 (mH)
Pr.05-09	Stator inductance (Lx) for induction motor 1 (mH)

If an auto-tuning error (AUE) occurs, refer to Chapter 14 "Fault Codes and Descriptions" for further treatment.

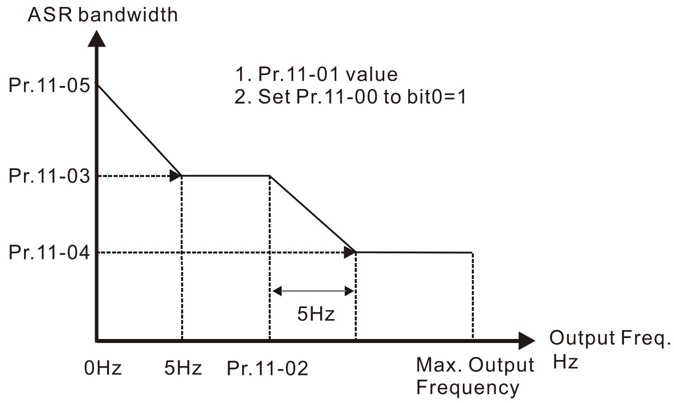
AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (Motor phase loss error)
AUE3 (144)	Auto-tuning error 3 (No-load current I_0 measuring error)
AUE4 (148)	Auto-tuning error 4 (Leakage inductance Lsigma measuring error)

5. Execute inertia estimation for IM (optional), press RUN key to start the process.
   Set Pr.00-10=2, torque mode
   Set Pr.00-13=2, IM TQC sensorless
   Set Pr.05-00=12, FOC sensorless inertia estimation
   Check if the estimated value for Pr.11-01 is reasonable (refer to the explanation of Pr.11-00) when the inertia estimation process is finished, the base value table of inertia is as below (unit: kg-cm^2).

HP	Inertia
1	0.00023
2	0.00043
3	0.00083
5	0.00148
7.5	0.0026

HP	Inertia
10	0.00358
15	0.00743
20	0.00953
25	0.01428
30	0.01765

6. Execute IMFOC Sensorless mode, set up the following parameters:
   Set Pr.00-10=0, speed mode
   Set Pr.00-11=5, IMFOC Sensorless
   Set Pr.11-00 bit0 =1, use ASR gain auto-tuning
   Press RUN key and start the no load test. Accelerate the motor to the rated speed, and then decelerate to stop, check if the motor runs smoothly.
   - If the motor runs smoothly, then the setting for IMFOC Sensorless is completed.
   - If the motor does not run smoothly or fails to start at low frequency, then refer to the following steps for adjustment.
7. Select auto-tuning gain (Pr.11-00 bit0=1), adjust ASR parameters according to the speed response.
   Set Pr.11-00 bit0 =1, use auto-tuning for ASR
   Set Pr.11-03 ASR1 low-speed bandwidth (When the acceleration of low-speed cannot follow the acceleration command, increase the low-speed bandwidth)
   Set Pr.11-04 ASR2 high-speed bandwidth (When the acceleration in high speed causes vibration or cannot follow the acceleration command, increase high-speed bandwidth)
   Set Pr.11-05 Zero-speed bandwidth (If the response of start-up is slow or incapable, increase zero-speed bandwidth)
   - The bigger the setting value for ASR bandwidth, the faster the response.
   - The low-speed bandwidth cannot be set too high, or the observer will diverge.



8. Adjust the setting of FOC speed observer and per-unit value of inertia (common problems)
   - ➢ Pr.10-25: Set up FOC bandwidth of speed observer

     Situation 1. Speed command changes rapidly, but speed response cannot follow.

     (Speed response is too slow→Increase the setting value)

     Situation 2. The noise of the observer is too large, and causes the operation diverged.

     (Speed noise is too large→Decrease)
   - ➢ Pr.11-01: Set up per unit of system inertia

     Situation 1. The inrush current is too high at start-up, and causes an oc error.

     Situation 2. An ocn error occurs during RUN or STOP, and the motor runs randomly.

     a. Check Pr.11-01 whether the JM per-unit of system inertia is too large.

     b. Decrease Pr.10-25 FOC bandwidth for speed observer or Pr.11-05 zero-speed bandwidth.

- IMFOC Sensorless adjustment parameters

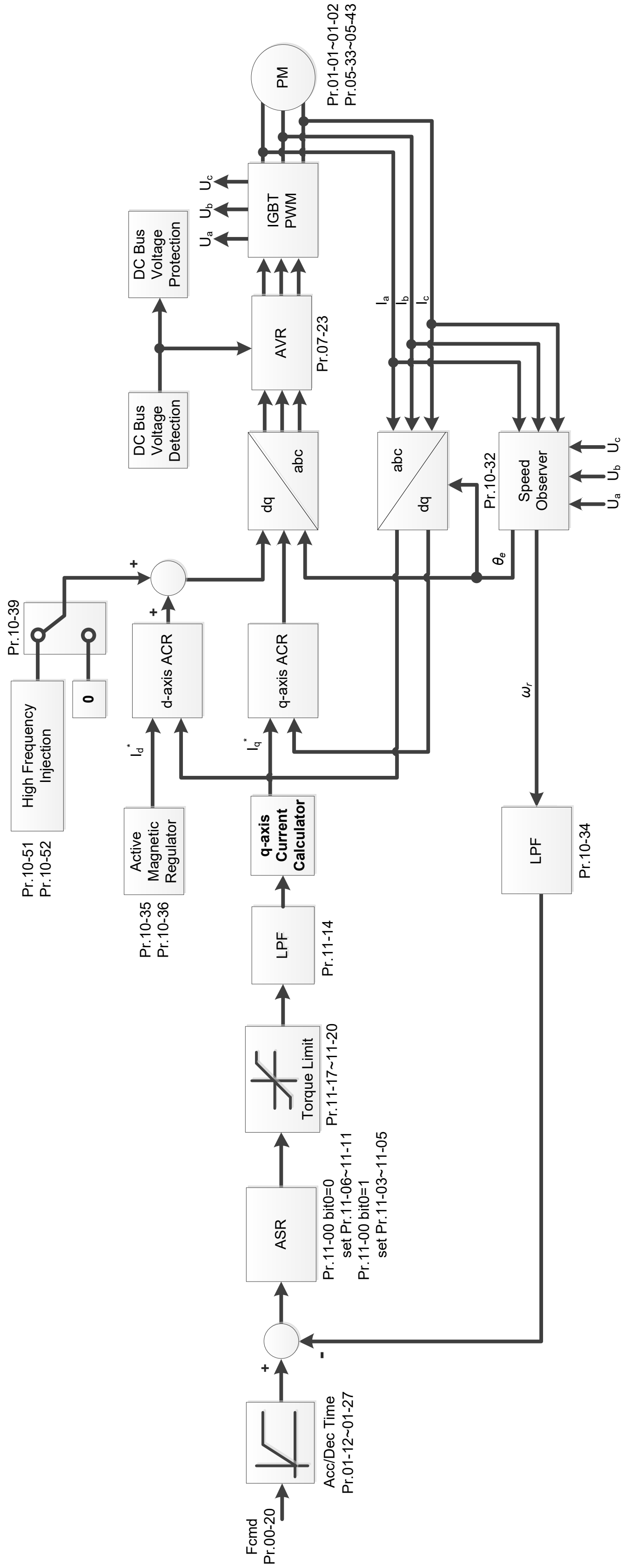
  Refer to Section 12-1 Description of Parameter Settings for more details

Parameter	Description	Unit	Default	Settings
00-11	Speed control mode		0	0–7
01-01	Rated frequency (Hz)	Hz	60.00 / 50.00	0.00–599.00
01-02	Rated voltage (V_{AC})	V	Depending on the model power	Depending on the model power
05-00	Motor parameter auto-tuning		0	0–13
05-02	Rated power for induction motor 1 (kW)	kW	Depending on the model power	0.00–655.35
05-03	Rated speed for induction motor 1 (rpm)	rpm	Depending on the motor's number of poles	0–xxxx (Depending on the motor's number of poles)
05-04	Number of poles for induction motor 1 (poles)		4	2–64
05-05	No-load current for induction motor 1 (A)		Depending on the model power	0.00–Pr.05-01 default
05-06	Stator resistance (Rs) for induction motor 1 (Ω)	Ω	Depending on the model power	0.000–65.535

Parameter	Description	Unit	Default	Settings
05-07	Rotor resistance (Rr) for induction motor 1 (Ω)	Ω	0.000	0.000–65.535
05-08	Magnetizing inductance (Lm) for induction motor 1 (mH)	mH	0.0	0.0–6553.5
05-09	Stator inductance (Lx) for induction motor 1 (mH)	mH	0.0	0.0–6553.5
10-25	FOC bandwidth for speed observer	Hz	40.0	20.0–100.0
11-00	System control		513	0–65535
11-01	Per unit of system inertia	pu	256	1–65535
11-02	ASR1 / ASR2 switch frequency	Hz	7.00	5.00–599.00
11-03	ASR1 low-speed bandwidth	Hz	10	1–40 Hz (IM) / 1–100 Hz (PM)
11-04	ASR2 high-speed bandwidth	Hz	10	1–40 Hz (IM) / 1–100 Hz (PM)
11-05	Zero-speed bandwidth	Hz	10	1–40 Hz (IM) / 1–100 Hz (PM)

12-2-4 Interior Permanent-Magnet Synchrounous, Sensorless Fieled-Oriented Control Adjustment Procedure (IPM Sensorless, Pr.00-11=7)

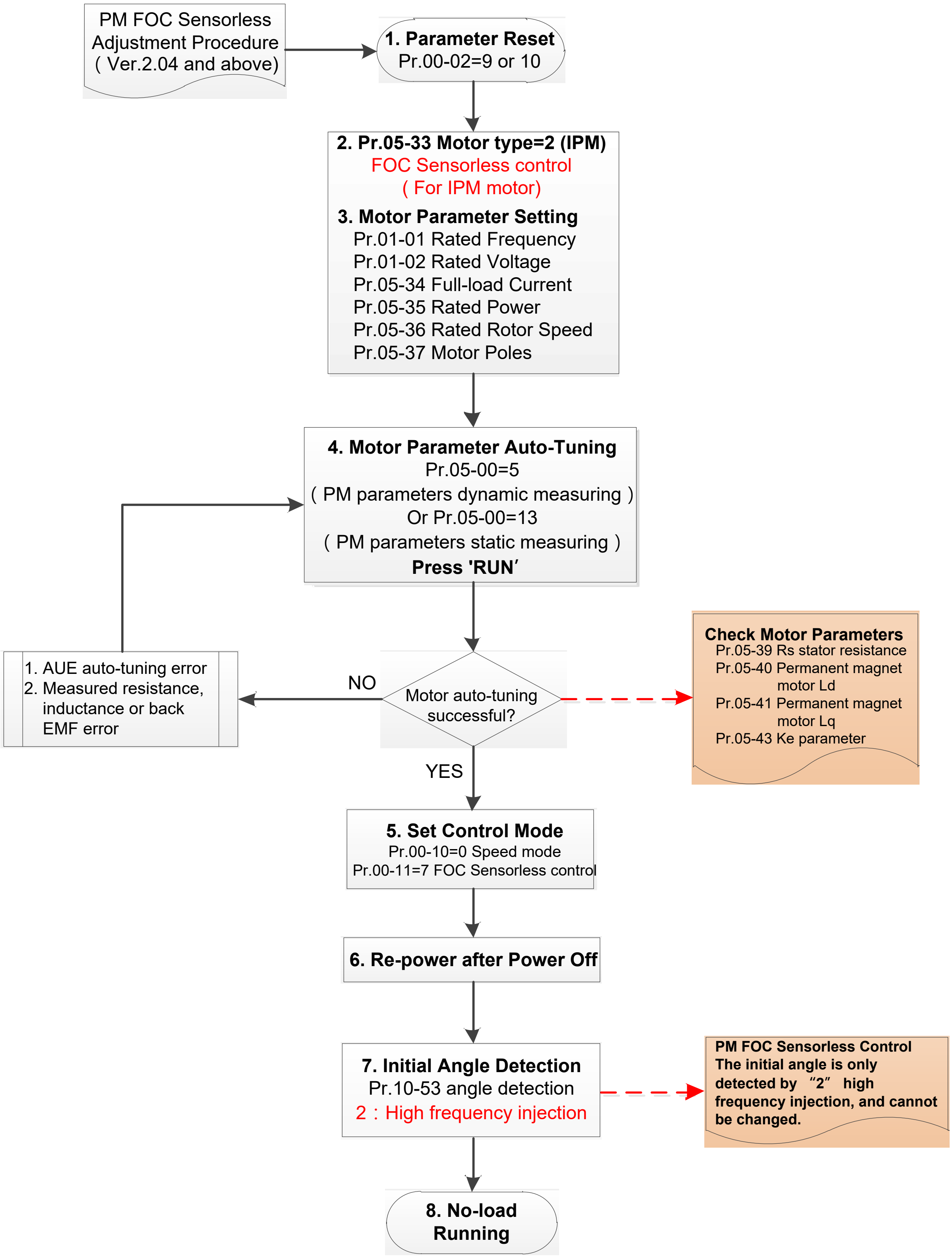
- Control diagram



* IPM Sensorless FOC control is the control method dedicated for IPM, it uses the high salient pole characteristic (Lq > Ld) of IPM to detect the positions of NS magnetic poles. By doing this, it calculates the motor’s rotor position at low-speed frequency.

- IPM Sensorless adjustment procedure
  (The number marked on the procedure corresponds to the number of following adjustment explanations)

  I. IPM Sensorless adjustment flowchart



📖 Basic motor parameters adjustment

1. Parameter reset:

   Reset Pr.00-02=9 (50Hz) or 10 (60Hz) to the default value.

2. Select IPM motor type:

   Pr.05-33=2 (IPM)

3. Motor nameplate parameter setting:

Parameter	Description
Pr.01-01	Rated frequency (Hz)
Pr.01-02	Rated voltage (V_{AC})
Pr.05-33	PM motor type (IPM or SPM)
Pr.05-34	Rated current (A)
Pr.05-35	Rated power (kW)
Pr.05-36	Rated rotor speed (RPM)
Pr.05-37	Number of poles for the motor (poles)

4. PM parameter auto-tuning:

   Set Pr.05-00 = 5 (rolling auto-tuning for PM, with no load) or 13 (static auto-tuning for PM) and press RUN key to finish motor auto-tuning, then you will get the following parameters:

Parameter	Description
Pr.05-39	Stator resistance for a permanent magnet motor (Ω)
Pr.05-40	Permanent magnet motor Ld (mH)
Pr.05-41	Permanent magnet motor Lq (mH)
Pr.05-43	Ke parameter of a permanent magnet motor ($V_{phase\cdot rms}$ / krpm) (When Pr.05-00=5, the Ke parameter is measured based on the actual motor rotation.) (When Pr.05-00=13, the Ke parameter is automatically calculated based on the motor power, current and rotor speed.)

   If an auto-tuning error (AUE) occurs, refer to Chapter 14 “Error Codes and Descriptions” for further treatment.

AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (Motor phase loss error)
AUE3 (144)	Auto-tuning error 3 (No-load current I_0 measuring error)
AUE4 (148)	Auto-tuning error 4 (Leakage inductance Lsigma measuring error)

5. Set control mode

   Control mode for the drive: Pr. 00-10 = 0: Speed mode

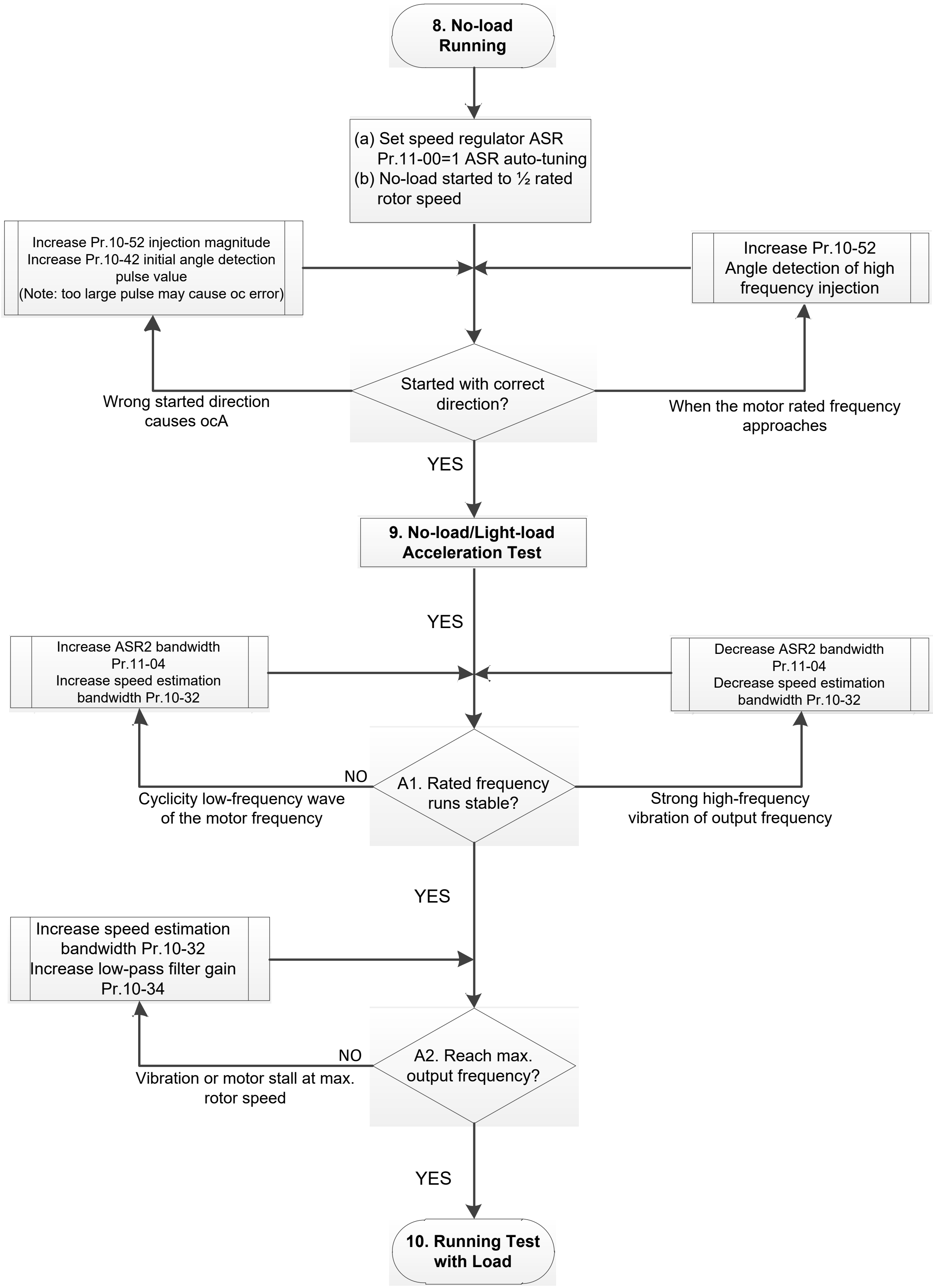
   Control mode for the motor: Pr. 00-11 = 7: Interior PM FOC Sensorless

6. After auto-tuning, cycle the power.

7. Measure the initial magnetic pole angle of PM

   When Pr.00-11=7 PM FOC Sensoreless mode, the initial magnetic pole angle detection method is high frequency injection.

II. IPM Sensorless adjustment flowchart for operation without load / with light load



📖 No-load / light-load operation adjustment

8. Start the motor with no-load

(a) Set Pr.11-00 = 1 Auto-tuning for ASR and APR

(b) Start the motor without load, and operates the motor to 1/2 of rated rotor speed

a. If the start direction is wrong, starting rotation is not smooth (ocA) or the motor salient ratio (Lq / Ld) is low, increase Pr. 10-52 (injection magnitude) and Pr. 10-42 (initial angel detection pulse value) to improve the accuracy of the angle detection.

b. If Pr. 10-51 (injection frequency) is close to the rated motor frequency (Pr. 01-01), then increase Pr.10-51 to avoid the angle detection difference caused by motor rated frequency.

9. Acceleration test with no load / light load

A1. Accelerate to rated frequency and observe if the motor operates stably.

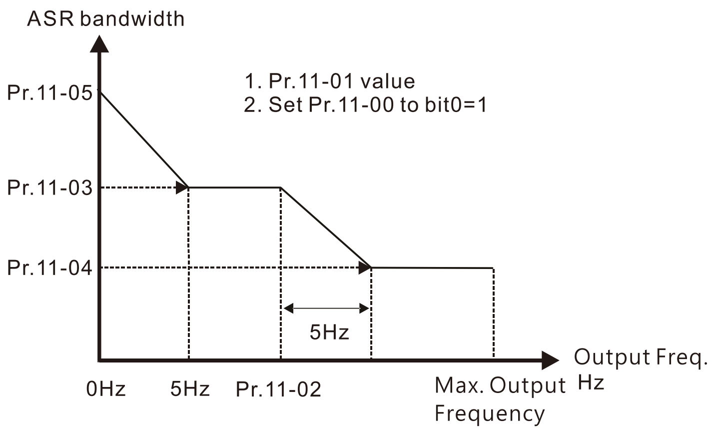
a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr. 11-04 (ASR2 high-speed bandwidth), or increase Pr. 10-32 (PM FOC sensorless speed estimator bandwidth).

b. If the output frequency reflects high-frequency vibration, decrease Pr.11-04 or decrease Pr.10-32.

A2. Accelerate the motor to the maximum frequency, and observe if it operates stably.

If the motor stalls when accelerating to the maximum rotor speed, increase Pr.10-32 (PM FOC sensoress speed estimator bandwidth) and Pr.10-34 (PM sensorless speed estimator low-pass filter gain).

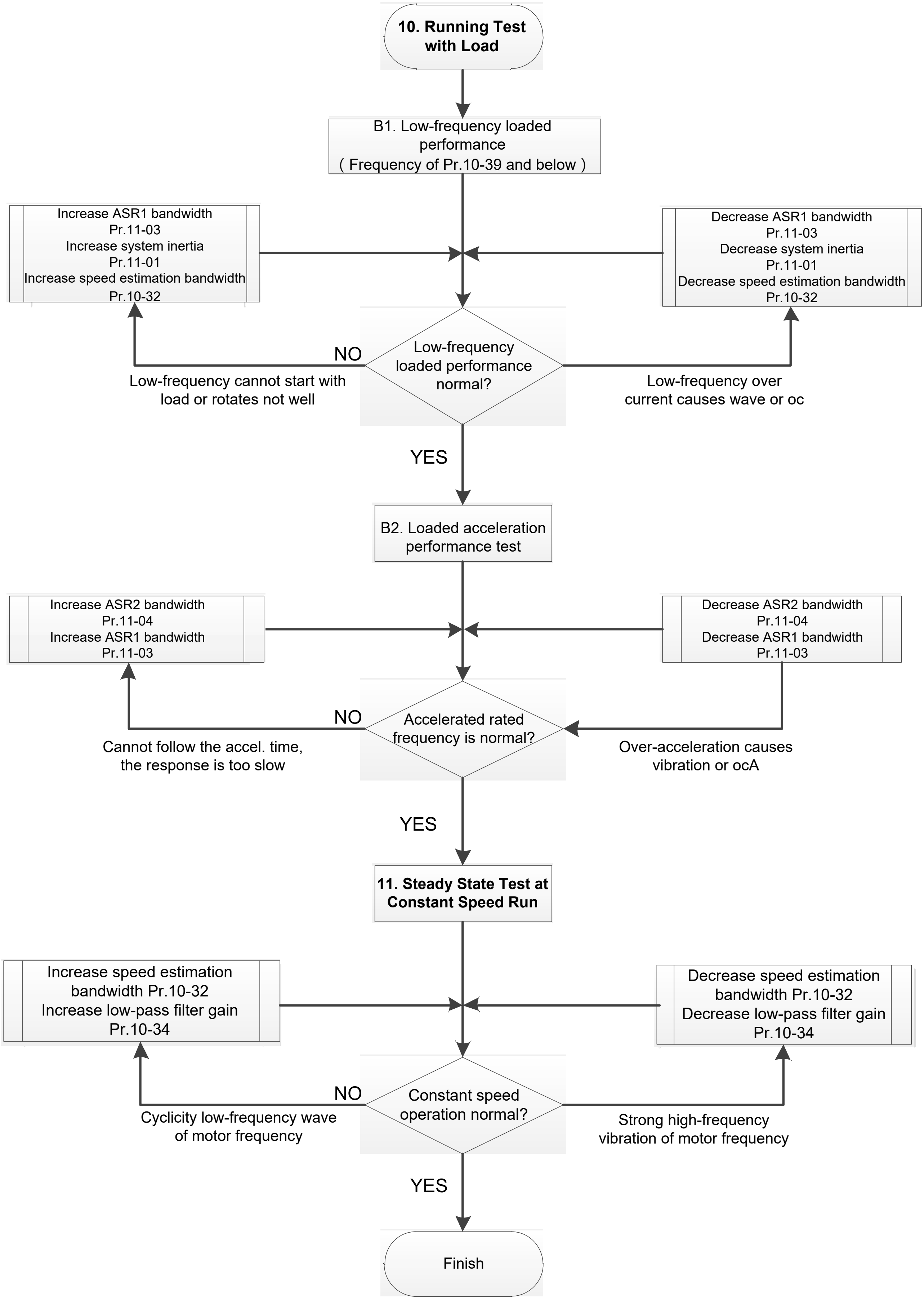
Setting curve for speed regulator (ASR) and related parameters:



ASR adjustment- auto gain

Parameter	Description	Default
Pr.11-00	System control	0
Pr.11-01	Per unit of system inertia	256
Pr.11-02	ASR1 / ASR2 switch frequency (it is suggested to set the switch frequency higher than Pr.10-39)	7 Hz
Pr.11-03	ASR1 low-speed bandwidth	10 Hz
Pr.11-04	ASR2 high-speed bandwidth	10 Hz
Pr.11-05	Zero-speed bandwidth	10 Hz

III. IPM Sensorless adjustment flowchart for operation starts with load



📖 Load operation adjustment

1. Load operating test

B1. Low-frequency loading performance, when the switch frequency is below Pr.10-39:

a. When the low-frequency cannot start the motor with load, or the rotor speed is not smooth, increase Pr.11-03 (ASR1 low-speed bandwidth) or Pr.11-01 (per-unit of system inertia); if the above adjustment cannot meet the requirement, then increase Pr.10-32 (PM FOC sensorless speed estimator bandwidth).

b. When frequency outputs, low-frequency operating current is large or an oc error occurs, decrease Pr.11-03 and Pr.11-01; or decrease Pr.10-32.

B2. Acceleration performance test under heavy-load status, accelerate the motor to rated rotor speed according to the acceleration time:

a. If the motor cannot follow the acceleration time, and the response is too slow, increase Pr.11-04 (ASR2 high-speed bandwidth) and Pr.11-03 (ASR1 low-speed bandwidth).

b. If an excessive acceleration causes vibration or ocA error, decrease Pr.11-04 and Pr.11-03.

2. Stability test at constant speed operation: if the motor operates stably at constant speed

a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr. 10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr. 10-32 (PM FOC sensorless speed estimator bandwidth).

b. If the output frequency reflects high-frequency vibration, decrease Pr. 10-34 or decrease Pr. 10-32.

- IPM Sensorless adjustment parameters

Refer to Section 12-1 Description of Parameter Settings for more details.

Parameter	Description	Unit	Default	Setting Range
Pr.10-32	PM FOC sensorless speed estimator bandwidth	Hz	5.00	0.00–600
Pr.10-34	PM sensorless speed estimator bandwidth	N/A	1.00	0.00–655.35
Pr.10-35	AMR (Kp) gain	N/A	1.00	0.00–3.00
Pr.10-36	AMR (Ki) gain	N/A	0.20	0.00–3.00
Pr.10-39	Frequency point to switch from I/F mode to PM sensorless mode	Hz	20.00	0.00–599
Pr.10-40	Frequency point to switch from PM sensorless mode to V/F mode	Hz	20.00	0.00–599
Pr.10-42	Initial angle detection pulse value	N/A	1.0	0.0–3.0
Initial Angle Estimating Parameters				
Pr.10-51	Injection frequency (for IPM)	Hz	500	0–1200
Pr.10-52	Injection magnitude (for IPM)	V	15.0 / 30.0	0.0–200.0
Pr.10-53	PM initial rotor position detection method	N/A	0	0–3
Motor Performance Control Parameters				
Pr.11-00	System control	bit	0	0–7
Pr.11-02	ASR1 / ASR2 switch frequency	Hz	7	5.00–599
Pr.11-03	ASR1 low-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
Pr.11-04	ASR2 high-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
Pr.11-05	Zero-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)

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Chapter 13 Warning Codes

Summary of Warning Codes

ID No.	Warning Name	ID No.	Warning Name
0	No record	46	CANopen format error (CPtn)
1	Communication error 1 (CE1)	50	PLC opposite defect (PLod)
2	Communication error 2 (CE2)	51	PLC save memory error (PLSv)
3	Communication error 3 (CE3)	52	Data defect (PLdA)
4	Communication error 4 (CE4)	53	Function defect (PLFn)
5	Communication error 10 (CE10)	54	PLC buffer overflow (PLor)
7	Save error 1 (SE1)	55	Function defect (PLFF)
8	Save error 2 (SE2)	56	Checksum error (PLSn)
9	IGBT overheating warning (oH1)	57	No end command (PLEd)
11	PID feedback error (PID)	58	PLC MCR error (PLCr)
12	ACI analog signal loss (AnL)	59	PLC download fail (PLdF)
13	Under current (uC)	60	PLC scan time fail (PLSF)
15	PG feedback warning (PGFb)	70	ExCom ID fail (ECid)
17	Over speed warning (oSPd)	71	ExCom power loss (ECLv)
18	Speed deviation warning (dAvE)	72	ExCom test mode (ECtt)
19	Phase loss (PHL)	73	ExCom BUS off (ECbF)
20	Over-torque 1 (ot1)	74	ExCom no power (ECnP)
21	Over-torque 2 (ot2)	75	ExCom factory defect (ECFF)
22	Motor overheating (oH3) PTC / PT100	76	ExCom inner error (ECiF)
24	Over slip warning (oSL)	78	ExCom Parameter data error (ECPP)
25	Auto tuning (tUn)	79	ExCom configuration data error (ECPi)
28	Output phase loss (OPHL)	80	Ethernet link fail (ECEF)
30	Copy model error (SE3)	81	Communication time-out (ECto)
31	Over-torque 3 (ot3)	82	Checksum error (ECCS)
32	Over-torque 4 (ot4)	83	Return defect (ECrF)
36	CANopen guarding time-out (CGdn)	84	Modbus TCP over (Eco0)
37	CANopen heartbeat error (CHbn)	85	EtherNet/IP over (ECo1)
39	CANopen BUS off error (CbFn)	86	IP fail (ECiP)
40	CANopen index error (CIdn)	87	Mail fail (EC3F)
41	CANopen station address error (CAdn)	88	ExCom busy (ECbY)
42	CANopen memory error (CFrn)	89	ExCom card break (ECCb)
43	CANopen SDO time-out (CSdn)	90	Copy PLC: password error (CPLP)
44	CANopen SDO receives register overflow (CSbn)	91	Copy PLC: Read mode error (CPL0)
45	CANopen start-up error warning (Cbtn)	92	Copy PLC: Write mode (CPL1)

ID No.	Warning Name	ID No.	Warning Name
93	Copy PLC: version error (CPLv)	96	Copy PLC: time-out (CPLt)
94	Copy PLC: size error (CPLS)	101	InrCOM time-out (ictn)
95	Copy PLC: PLC function (CPLF)		

ID No.	Display	Warning Name	Description
1	CE1	Communication error 1 (CE1)	RS-485 Modbus illegal function code
Action and Reset			
Action condition		When the function code is not 03, 06, 10 and 63.	
Action time		Immediately	
Warning treatment parameter		N/A	
Reset method		"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct function code.	
Reset condition		Immediately reset	
Record		N/A	
Cause		Corrective Actions	
Incorrect communication command from the upper unit		Check if the communication command is correct.	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from the upper unit		Check if the setting for Pr.09-04 is the same as the setting for the upper unit.	
Disconnection or bad connection of the cable		Check the cable and replace it if necessary.	

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>2</td><td></td><td>Communication error 2 (CE2)</td><td>RS-485 Modbus illegal data address (00–254 H)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">When the input data address is incorrect.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately</td></tr>
<tr><td colspan="2">Warning treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">“Warning” occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct data address.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect communication command from the upper unit</td><td colspan="2">Check if the communication command is correct.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.</td></tr>
<tr><td colspan="2">Different communication setting from the upper unit</td><td colspan="2">Check if the setting for Pr.09-04 is the same as the setting for the upper unit.</td></tr>
<tr><td colspan="2">Disconnection or bad connection of the cable</td><td colspan="2">Check the cable and replace it if necessary.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>3</td><td>CE3</td><td>Communication error 3 (CE3)</td><td>RS-485 Modbus illegal data value</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">When the length of communication data is too long.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately</td></tr>
<tr><td colspan="2">Warning treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">“Warning” occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct communication data value.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect communication command from the upper unit</td><td colspan="2">Check if the communication command is correct.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.</td></tr>
<tr><td colspan="2">Different communication setting from the upper unit</td><td colspan="2">Check if the setting for Pr.09-04 is the same as the setting for the upper unit.</td></tr>
<tr><td colspan="2">Disconnection or bad connection of the cable</td><td colspan="2">Check the cable and replace it if necessary.</td></tr>
</table>

ID No.	Display	Warning Name	Description
4	CE4	Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address.
Action and Reset			
Action condition	When the data is written to read-only address.		
Action time	Immediately		
Warning treatment parameter	N/A		
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct written address of communication data.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
5	CE10	Communication error 10 (CE10)	RS-485 Modbus transmission time-out

Action and Reset	
Action condition	When the communication time exceeds the detection time for Pr.09-33 communication time-out.
Action time	Settings for Pr.09-03
Warning treatment parameter	N/A
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
The upper unit does not transmit the communication command within Pr.09-03 setting time.	Check if the upper unit transmits the communication command within the setting time for Pr.09-03.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>7</td><td>SE1</td><td>Save error 1
(SE1)</td><td>Keypad COPY error 1: Keypad copy time-out</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">“SE1” warning occurs when the keypad does not transmit the COPY command to the drive, and does not transmit any data to the drive again in 10 ms at the time you copy the parameters to the drive.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">10 ms</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Communication connection error</td><td colspan="2" rowspan="3">SE1: The causes of error are mostly communication problems between the keypad and control board. Potential causes include communication signal interference and the unacceptable communication command to the Slave.
Check if the error occurs randomly, or only occurs when copying certain parameters (the error displays on the upper right corner of the copy page). If you cannot clear the error, please contact Delta.</td></tr>
<tr><td colspan="2">Keypad error</td></tr>
<tr><td colspan="2">Control board error</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>8</td><td>SE2</td><td>Save error 2
(SE2)</td><td>Keypad COPY error 2: parameter writing error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">“SE2” warning occurs when writing the parameters incorrectly at the time you copy parameters to the drive. For example, you copy the new firmware version with added parameters to the drive with old firmware version.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Add new parameters to the new firmware version.</td><td colspan="2">SE2: In this stage, the copied data has been transmitted to the Slave. The Slave compares and processes the copied data, and then saves the data to the Data ROM. During the process, the data error (should be attribution error) may occur, or the data cannot be saved to EEPROM. At this time, the warning occurs.
It is suggested to check the status of Data ROM and remove the error causes first.
If you cannot clear the error, please contact Delta.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring and grounding of the main circuit, control circuit and the encoder for effective anti-interference performance.</td></tr>
</table>

ID No.	Display	Warning Name	Description
9	oH1	IGBT over-heating warning (oH1)	The AC motor drive detects over-heating of IGBT, and over the protection level of oH1 warning. (When Pr.06-15 is higher than the IGBT over-heating level, the drive shows oH1 error without displaying oH1 warning.)

Action and Reset	
Action condition	Pr.06-15
Action time	"oH1" warning occurs when IGBT temperature is higher than Pr.06-15 setting value.
Warning treatment parameter	N/A
Reset method	Auto-reset
Reset condition	The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C.
Record	N/A

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading.	1. Decrease the loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.
The drive has run 100% or more than 100% of the rated output for a long time.	Replace with a drive with larger capacity.

oH1 warning level

Voltage	Model (**NOTE:** x = A or E)	oH1 (ºC)	oH warning oH1 warning = Pr.06-15 (ºC)
Single-phase _115V	VFD1A6MH11x□□A□	95	oH1 warning = oH1 – 5
	VFD2A5MH11x□□A□	100	
	VFD5A0MH11x□□A□	100	
Single-phase _230V	VFD1A6MH21x□□A□	110	
	VFD2A8MH21x□□A□	110	
	VFD5A0MH21x□□A□	110	
	VFD7A5MH21x□□A□	110	
	VFD11AMH21x□□A□	110	

Voltage	Model (**NOTE:** x = A or E)	oH1 (ºC)	oH warning oH1 warning = Pr.06-15 (ºC)
Three-phase _230V	VFD1A6MH23x□□A□	95	oH1 warning = oH1 – 5
	VFD2A8MH23x□□A□	100	
	VFD5A0MH23x□□A□	105	
	VFD7A5MH23x□□A□	110	
	VFD11AMH23x□□A□	100	
	VFD17AMH23x□□A□	105	
	VFD25AMH23x□□A□	105	
	VFD33AMH23x□□A□	115	
	VFD49AMH23x□□A□	115	
	VFD65AMH23x□□A□	115	
	VFD75AMH23x□□A□	95	
	VFD90AMH23x□□A□	95	
	VFD120MH23x□□A□	95	
	VFD146MH23x□□A□	95	
Three-phase _460V	VFD1A5MH43x□□A□	105	
	VFD3A0MH43x□□A□	110	
	VFD4A2MH43x□□A□	110	
	VFD5A7MH43x□□A□	95	
	VFD7A3MH43x□□A□	100	
	VFD9A0MH43x□□A□	115	
	VFD13AMH43x□□A□	105	
	VFD17AMH43x□□A□	110	
	VFD25AMH43x□□A□	115	
	VFD32AMH43x□□A□	115	
	VFD38AMH43x□□A□	110	
	VFD45AMH43x□□A□	115	
	VFD60AMH43x□□A□	95	
	VFD75AMH43x□□A□	95	
	VFD91AMH43x□□A□	95	
	VFD112MH43x□□A□	95	
	VFD150MH43x□□A□	95	

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Warning Name</th><th>Description</th></tr>
<tr><td>11</td><td>PID</td><td colspan="2">PID feedback error (PID)</td><td>PID feedback loss (warning for analog feedback signal; works only when PID enables)</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">When the analog input is lower than 4 mA (only detects analog input 4–20 mA).</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.08-08</td></tr>
<tr><td colspan="2">Warning treatment parameter</td><td colspan="3">Pr.08-09
0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">“Warning” occurs when Pr.08-09=0 or 3. The “Warning” automatically clears when the feedback signal is larger than 4 mA.</td></tr>
<tr><td>Manual</td><td colspan="2">“Error” occurs when Pr.08-09=1 or 2. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Records when Pr.08-09=1 or 2 (“Error”).
Does not record when Pr.08-09=0 or 3 (“Warning”).</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Loose or broken PID feedback wiring</td><td colspan="3">Tighten the terminals again.
Replace with a new cable.</td></tr>
<tr><td colspan="2">Feedback device malfunction</td><td colspan="3">Replace with a new feedback device.</td></tr>
<tr><td colspan="2">Hardware error</td><td colspan="3">If the PID error still occurs after checking all the wiring, send the drive back to the factory for repair.</td></tr>
</table>

ID No.	Display	Warning Name	Description
12	AnL	ACI analog signal loss (AnL)	Analog input current loss (including all analog 4–20 mA signals)

Action and Reset		
Action condition	When the analog input is lower than 4 mA (only detects analog input 4–20 mA)	
Action time	Immediately act	
Warning treatment parameter	Pr.03-19 0: Disable 1: Continue operation at the last frequency (warning, the keypad displays "AnL") 2: Decelerate to 0 Hz (warning, the keypad displays "AnL") 3: Stop immediately and display "ACE"	
Reset method	Auto	"Warning" occurs when Pr.03-19=1 or 2. The "Warning automatically clears when the analog input signal is larger than 4 mA.
	Manual	"Error" occurs when Pr.03-19=3. You must reset manually.
Reset condition	Immediately reset	
Record	Does not record when Pr.03-19=1 or 2 ("Warning").	

Cause	Corrective Actions
Loose or broken ACI wiring	Tighten the terminals again. Replace with a new cable.
External device error	Replace with a new device.
Hardware error	If the AnL error still occurs after checking all the wiring, send the drive back to the factory for repair.

ID No.	Display	Warning Name	Description
13	uC	Under current (uC)	Low current
Action and Reset			
Action condition	Pr.06-71		
Action time	Pr.06-72		
Warning treatment parameter	Pr.06-73 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by 2nd deceleration time 3: Warn and continue operation		
Reset method	Auto	"Warning" occurs when Pr.06-73 = 3. The "Warning" automatically clears when the output current is > (Pr.06-71+0.1 A).	
	Manual	"Error" occurs when Pr.06-73 = 1 and 2. You must reset manually.	
Reset condition	Immediately reset		
Record	Does not record when Pr.06-73 = 3 and uC displays "Warning".		
Cause	Corrective Actions		
Broken motor cable	Exclude the connection issue of the motor and its load.		
Improper setting for the low current protection	Set the proper settings for Pr.06-71, Pr.06-72 and Pr.06-73.		
Low load	Check the loading status. Make sure the loading matches the motor capacity.		

ID No.	Display	Warning Name	Description
15	PGFb	PG feedback warning (PGFb)	PG feedback error warning

Action and Reset	
Action level	Motor runs in a reverse direction to the direction of frequency command
Action time	Pr.10-09
Warning setting parameter	Pr.10-08=0 0: Warn and operation continue 1: Fault and ramp to stop 2: Fault and coast to stop
Reset method	Auto-reset
Reset condition	“Warning” automatically clears when the drive stops
Record	N/A

Cause	Corrective Actions
Incorrect encoder parameter setting	Reset encoder parameter (Pr.10-02).
Check if the connection of encoder is loss	Wiring again.
Broken PG card or PG encoder	Replace with a new PG card or encoder.
Malfunction caused by interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Warning Name	Description
17	oSPd	Over speed warning (oSPd)	Over speed warning

Action and Reset	
Action level	The encoder feedback speed > Pr.10-10
Action time	Pr.10-11
Warning setting parameter	Pr.10-12=0 0: Warn and keep operation
Reset method	“Warning” automatically clears when the drive stops
Reset condition	“Warning” automatically clears when the drive stops
Record	N/A

Cause	Corrective Actions
Improper setting for Pr.10-25 FOC bandwidth of speed observer	Decrease setting value for Pr.10-25.
Improper bandwidth setting for ASR speed controller	Increase the bandwidth setting for ASR speed controller.
Incorrect motor parameter setting	Reset motor parameter and run parameter tuning.
Malfunction caused by interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Warning Name	Description
18		Speed deviation warning (dAvE)	Over speed deviation warning
Action and Reset			
Action level		Pr.10-13	
Action time		Pr.10-14	
Warning setting parameter		Pr.10-15=0 0: Warn and keep operation	
Reset method		“Warning” automatically clears when the drive stops	
Reset condition		After the drive stops	
Record		N/A	
Cause		Corrective Actions	
Improper parameter setting for the slip error		Reset proper value for Pr.10-13 and Pr.10-14.	
Improper setting for ASR parameter and acceleration/ deceleration		Reset ASR parameters. Set proper accel./ decel. time.	
Accel./ Decel. time is too short		Reset proper accel./ decel. time.	
Motor locked		Remove the causes of motor locked.	
Mechanical brake is not released		Check the active timing of the system.	
Incorrect parameter setting of torque limit (Pr.06-12, Pr.11-17–20)		Adjust to proper setting value.	
Malfunction caused by interference		Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.	

ID No.	Display	Warning Name	Description
19	PHL	Phase loss (PHL)	Input phase loss warning
Action and Reset			
Action level		One of the phases outputs less than Pr.06-47	
Action time		Pr.06-46	
Warning setting parameter		Pr.06-45 Output Phase Loss Detection Action (OPHL) =0 0: Warn and continue operation	
Reset method		“Warning” automatically clears when the drive stops	
Reset condition		After the drive stops	
Record		N/A	
Cause		Corrective Actions	
Phase loss of the input power		Verify the wiring of the main circuit.	
Single phase power input on a three-phase model		Use the model with voltage that matches the power.	
The power voltage has changed		If the power of main circuit works well, check if the MC of the main circuit is broken. Cycle the power after verifying the power is normal. If PHL still occurs, return to the factory for repair.	
Loose wiring terminal of input power		Tighten the terminal screws with the torque listed in the user manual.	
Check if the input cable of three-phase power is broken		Make sure the wiring is correct. Replace the broken part of the cable.	
Unbalanced three-phase of the input power		Check the status of three-phase power.	

ID No.	Display	Warning Name	Description
20	ot1	Over-torque 1 (ot1)	Over-torque 1 warning

Action and Reset	
Action condition	Pr.06-07
Action time	Pr.06-08
Warning treatment parameter	Pr.06-06=1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When input current < (Pr.06-07 – 5%), the ot1 warning automatically clears.
Reset condition	When input current < (Pr.06-07 – 5%), the ot1 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-07 and 06-08 again.
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large.	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short.	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high.	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small.	Replace with a motor with larger capacity.
Over-load during low-speed operation.	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large.	Readjust the torque compensation value (Pr.07-26 torque compensation gain) till the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Warning Name	Description
21		Over-torque (ot2)	Over-torque 2 warning

Action and Reset	
Action level	Pr.06-10
Action time	Pr.06-11
Warning setting parameter	Pr.06-09 Over-torque Detection Selection (Motor 2) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When the output current < Pr.06-10, the Ot2 warning automatically clears
Reset condition	When the output current < Pr.06-10, the Ot2 warning automatically clears
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-10 and Pr.06-11
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time)
V/F voltage is too high	Adjust the V/F curve (Motor 2, Pr.01-35–01-42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small	Replace with a motor with larger capacity.
Overload during low-speed operation	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large	Adjust the torque compensation value (Pr.07-71 torque compensation gain) until the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Warning Name	Description
22_1	oH3	Motor over-heating (oH3) PTC	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high

Action and Reset	
Action level	Pr.03-00=6 (PTC), PTC input level > Pr.06-30 PTC level (default=50%)
Action time	Immediately act
Warning setting parameter	Error treatment: Pr.06-29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When Pr.06-29=0 and when the temperature is 『Pr.06-30 level, the oH3 warning automatically clears. When Pr.06-29=0 (“Warning”), it automatically resets.
Reset method	When Pr.06-29=0, oH3 displays as “Warning”. When the temperature is 『Pr.06-30 level, the oH3 warning automatically clears.
Reset condition	When the temperature is 『Pr.06-30 level, the oH3 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Ambien temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low-speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity.
Accel./ Decel. time and working cycle is too short	Increase setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PTC is properly set and wired	Check the connection between PTC thermistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Display	Warning Name	Description
22_2	oH3	Motor over-heating (oH3) PT100	Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high.

Action and Reset	
Action level	Pr.03-00=11 (PT100), PT100 input level > Pr.06-57 (default=7 V)
Action time	Immediately act
Warning setting parameter	Error treatment: Pr.06-29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When Pr.06-29=0 and when the temperature is > Pr.06-56 level, the oH3 warning automatically clears. If the temperature is between Pr.06-56 and Pr.06-57, the frequency outputs according to the operating frequency setting for Pr.06-58.
Reset method	When Pr.06-29=0, oH3 displays as "Warning". When the temperature is > Pr.06-56 level, the oH3 warning automatically clears.
Reset condition	When the temperature is > Pr.06-56 level, the oH3 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Decrease loading. Replace with a motor with larger capacity.
Ambien temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low-speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time).

V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PT100 is properly set and wired	Check the connection between PT100 thermistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Display	Warning Name	Description
24		Over slip warning (oSL)	Over slip warning. By using the maximum slip (Pr.10-29) as the base, when the drive outputs at constant speed, and the F>H or F<H exceeds Pr.07-29 level and Pr.07-30 setting time, 100% Pr.07-29 = Pr.10-29.

Action and Reset	
Action level	When the drive outputs at constant speed, and F>H or F<H exceeds the Pr.07-29 level
Action time	Pr.07-30
Warning setting parameter	Pr.07-31=0 Warning 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.07-31=0 and when the drive outputs at constant speed, and F>H or F<H no longer exceeds the Pr.07-29 level, the oSL warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Check if the motor parameter is correct	Check the motor parameter.
The load is too large	Decrease the loading.
Check if the settings for Pr.07-29, Pr.07-30 and Pr.10-29 are properly set	Check the parameter settings for oSL protection.

ID No.	Display	Warning Name	Description
25		Auto-tuning (tUn)	Parameter auto-tuning is processing. When running auto-tuning, the keypad displays "tUn".
Action and Reset			
Action condition	When running Pr.05-00 motor parameter auto-tuning, the keypad displays "tUn".		
Action time	N/A		
Warning treatment parameter	N/A		
Reset method	When auto-tuning is finished and no error occurs, the warning automatically clears.		
Reset condition	When auto-tuning is finished and no error occurs.		
Record	N/A		
Cause	Corrective Actions		
The motor parameter is running auto-tuning.	When the auto-tuning is finished, the warning automatically clears.		

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>28</td><td>OPHL</td><td>Output phase loss (OPHL)</td><td>Output phase loss</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Pr.06-47</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Warning treatment parameter</td><td colspan="2">Pr.06-45
0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">If Pr.06-45 is set to 0, the OPHL warning automatically clears after the drive stops.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Unbalanced three-phase impedance of the motor</td><td colspan="2">Replace the motor.</td></tr>
<tr><td colspan="2">Check if the wiring is incorrect.</td><td colspan="2">Check the cable.
Replace the cable.</td></tr>
<tr><td colspan="2">Check if the motor is a single-phase motor.</td><td colspan="2">Choose a three-phase motor.</td></tr>
<tr><td colspan="2">Check if the current sensor is broken.</td><td colspan="2">Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test.
If the error still occurs, send the drive back to the factory for repair.
Check if the three-phase current is balanced with a current clamp meter.
If the current is balanced and the OPHL error still shows on the display, send the drive back to the factory for repair.</td></tr>
<tr><td colspan="2">Check if the drive capacity is larger than the motor capacity.</td><td colspan="2">Choose the drive that matches the motor capacity.</td></tr>
</table>

ID No.	Display	Warning Name	Description
30	SE3	Copy model error 3 (SE3)	Keypad COPY error 3: copy model error
Action and Reset			
Action level	“SE3” warning occurs when different drive identity codes are found during copying parameters.		
Action time	Immediately act when the error is detected		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Keypad copy between different power range drives	It is mainly to prevent parameter copies between different HP/models.		

ID No.	Display	Warning Name	Description
31	ot3	Over-torque (ot3)	Over-torque 3 warning
Action and Reset			
Action level		Pr.14-75	
Action time		Pr.14-76	
Warning setting parameter		Pr.14-74 Over-torque Detection Selection (Motor 3) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
Reset method		When the output current < Pr.14-75, the Ot3 warning automatically clears	
Reset condition		When the output current < Pr.14-75, the Ot3 warning automatically clears	
Record		N/A	
Cause		Corrective Actions	
Incorrect parameter setting		Configure the settings for Pr.14-75 and Pr.14-76 again.	
Mechanical error (e.g. mechanical lock due to over-torque)		Remove the causes of malfunction.	
The load is too large		Decrease the loading. Replace with a motor with larger capacity.	
Accel./ Decel. time and working cycle is too short		Increase the setting values for Pr.01-12–01-19 (accel./ decel. time)	
V/F voltage is too high		Adjust the V/F curve (Motor 3, Pr.01-54–01-61), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).	
The motor capacity is too small		Replace with a motor with larger capacity.	
Overload during low-speed operation		Decrease the loading during low-speed operation. Increase the motor capacity.	
The torque compensation is too large		Adjust the torque compensation value (Pr.07-73 torque compensation gain) until the output current decreases and the motor does not stall.	
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)		Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.	

ID No.	Display	Warning Name	Description
32	ot4	Over-torque (ot4)	Over-torque 4 warning

Action and Reset	
Action level	Pr.14-78
Action time	Pr.14-79
Warning setting parameter	Pr.14-77 Over-torque Detection Selection (Motor 4) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When the output current < Pr.14-78, the Ot4 warning automatically clears
Reset condition	When the output current < Pr.14-79, the Ot4 warning automatically clears
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.14-78 and Pr.14-79 again.
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time)
V/F voltage is too high	Adjust the V/F curve (Motor 4, Pr.01-63–01-70), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small	Replace with a motor with larger capacity.
Overload during low-speed operation	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large	Adjust the torque compensation value (Pr.07-75 torque compensation gain) until the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>36</td><td>CGdn</td><td>CANopen guarding time-out (CGdn)</td><td>CANopen guarding time-out 1</td></tr>
<tr><td colspan="4">Action and Reset</td></tr>
<tr><td colspan="2">Action level</td><td colspan="2">When CANopen Node Guarding detects that one of the slaves does not respond, the CGdn error displays.
The upper unit sets the factor and time during configuration.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">The time that upper unit sets during configuration</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">The upper unit sends a reset package to clear this warning.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Cause</td><td colspan="2">Corrective Actions</td></tr>
<tr><td colspan="2">The guarding time is too short, or less detection times</td><td colspan="2">Increase the guarding time (Index 100C) and detection times.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
2. Make sure the communication circuit is wired in series.
3. Use CANopen cable or add terminating resistance.</td></tr>
</table>

ID No.	Display	Warning Name	Description
37	CHbn	CANopen heartbeat error (CHbn)	CANopen heartbeat error

Action and Reset	
Action level	When CANopen Heartbeat detects that one of the slaves does not response, the CHbn error shows. The upper unit sets the confirming time of producer and consumer during configuration.
Action time	The upper unit sets the confirming time of producer and consumer during configuration.
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this warning.
Record	When Pr.00-21 CHbn is a “Warning”, and the warning is not recorded.

Cause	Corrective Actions
The heartbeat time is too short	Increase heartbeat time (Index 1016)
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Warning Name</th><th>Description</th></tr>
<tr><td>39</td><td>CbFn</td><td colspan="2">CANopen bus off error (CbFn)</td><td>CANopen BUS off error</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2" rowspan="2">Action level</td><td>Hardware</td><td colspan="2">When CANopen card is not installed, the CbFn warning occurs.</td></tr>
<tr><td>Software</td><td colspan="2">When the master receives wrong communication package, the CbFn warning occurs.
Too much interference on BUS
The master receives wrong package when the CAN_H and CAN_L communication cables are short, CbFn warning occurs.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual Reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Cycle the power</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.00-21 CbFn is a “Warning”, and the warning is not recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Check if the CANopen card is installed</td><td colspan="3">Make sure the CANopen card is installed.</td></tr>
<tr><td colspan="2">Check if the CANopen speed is correct</td><td colspan="3">Reset CANopen speed (Pr.09-37)</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="3">1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
2. Make sure the communication circuit is wired in series.
3. Use CANopen cable or add terminating resistance.</td></tr>
<tr><td colspan="2">Communication cable is broken or bad connected</td><td colspan="3">Check or replace the communication cable.</td></tr>
</table>

ID No.	Display	Warning Name	Description
40	CIdn	CANopen index error (Cidn)	CANopen index error

Action and Reset	
Action level	CANopen communication Index error
Action time	Immediately act when the fault is detected
Warning setting parameter	N/A
Reset method	Manual Reset
Reset condition	The upper unit sends a reset package to clear this warning
Record	When Pr.00-21 Cidn is a “Warning”, and the warning is not recorded.

Cause	Corrective Actions
Incorrect setting of CANopen index	Reset CANopen index (Pr.00-02=7)

ID No.	Display	Warning Name	Description
41	CAdn	CANopen station address error (CAdn)	CANopen station address error (only supports 1–127)
Action and Reset			
Action level	CANopen station address error		
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	Manual Reset		
Reset condition	Pr.00-02=7		
Record	When Pr.00-21 CAdn is a “Warning”, and the warning is not recorded.		
Cause	Corrective Actions		
Incorrect setting of CANopen station address	1. Disable CANopen (Pr.09-36=0) 2. Reset CANopen (Pr.00-02=7) 3. Reset CANopen station address (Pr.09-36)		

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>42</td><td>CFrn</td><td>CANopen memory error (CFrn)</td><td>CANopen memory error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">When you update the firmware version of the control board, the FRAM internal data does not change, then CFrn warning occurs.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual Reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Pr.00-02=7</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">When Pr.00-21 CFrn is a “Warning”, and the warning is not recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">CANopen internal memory error</td><td colspan="2">1. Disable CANopen (Pr.09-36=0)
2. Reset CANopen (Pr.00-20=7)
3. Reset CANopen station address (Pr.09-36)</td></tr>
</table>

ID No.	Display	Warning Name	Description
43	CSdn	CANopen SDO time-out (CSdn)	SDO transmission time-out (only shows on master station)

Action and Reset	
Action level	When the CANopen master transmits a SDO command, and the slave response “times-out”, CSdn warning occurs.
Action time	Immediately act when the fault is detected
Warning setting parameter	N/A
Reset method	When the master resends a SDO command and receives the response, the warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Slave is not connected	Connect the slave and CANopen BUS.
The synchronous cycle is set too short	Increase the synchronous time (Index 1006)
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Disconnection or bad connection of the communication cable	Check the status of the cable, or replace the cable.

ID No.	Display	Warning Name	Description
44	CSbn	CANopen SDO receives register overflow (CSbn)	CANopen SDO receives register overflow
Action and Reset			
Action level	The upper unit sends too much SDO at one time and causes buffer overflow		
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	The upper unit sends a reset package to clear the warning.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Too much SDO from the upper unit at one time	Check if the master sends too much SDO command. Make sure the master sends the SDO command according to the command format.		

ID No.	Display	Warning Name	Description
45	Cbtn	CANopen start-up error warning (Cbtn)	CANopen start-up error warning
Action and Reset			
Action level		When the amount of sent error messages reach 255	
Action time		N/A	
Warning setting parameter		Index 6007	
Reset method		Disable CANopen, and cycle the power after power-off	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
Serious interference on hardware		Verify if the grounding, terminating resistance and bus line are properly installed.	
Incorrect setting for communication speed		Verify the setting for communication speed.	
The communication card is not connected, or the card is loose		Make sure the communication card is connected to the drive.	

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>46</td><td>CPtn</td><td>CANopen format error (CPtn)</td><td>CANopen protocol format error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">The slave detects that communication data from the upper unit cannot be recognized, and then CPtn warning occurs.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">The upper unit sends a reset packet to clear the warning</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">The upper unit sends incorrect communication packet</td><td colspan="2">Make sure the master sends the packet based on CANopen DS301 standard command format.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>50</td><td>PLod</td><td>PLC opposite defect (PLod)</td><td>PLC download error warning</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">During PLC downloading, the program source code detects incorrect address (e.g. the address exceeds the range), then the PLod warning shows.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect component number is found when downloading the PLC program</td><td colspan="2">Use the correct component number.</td></tr>
</table>

ID No.	Display	Warning Name	Description
51	PLSv	PLC save memory error (PLSv)	Data error during PLC operation

Action and Reset	
Action condition	The program detects incorrect written address (e.g. the address has exceeded the range) during PLC operation, then the PLSv warning shows.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
An incorrect written address is detected during PLC operation	Make sure the write-in address is correct and re-download the program.

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th colspan="2">Description</th></tr>
<tr><td>52</td><td>PLdA</td><td>Data defect (PLdA)</td><td colspan="2">Data error during PLC operation</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">T. The program detects incorrect write-in address when decoding the program source code and downloading the PLC program (e.g. the address has exceeded the range), then PLdA warning acts.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">During PLC operation, the external Modbus has written/read incorrect data to internal PLC program</td><td colspan="3">Check if the upper unit transmits the correct command</td></tr>
<tr><td colspan="2">The built-in PLC function is ON, there is station address of Modbus which is duplicate of the built-in PLC station address (Pr.09-35) been set in the Modbus system of the equipment</td><td colspan="3">Set the station addresses of Modbus and built-in PLC to be different</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>53</td><td>PLFn</td><td>Function defect
(PLFn)</td><td>PLC download function code error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">The program detects incorrect command (unsupported command) during PLC downloading, then PLFn warning acts.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Unsupported command has used while downloading the program</td><td colspan="2">Check if the firmware of the drive is the old version. If yes, contact Delta.</td></tr>
</table>

ID No.	Display	Warning Name	Description
54	PLor	PLC buffer overflow (PLor)	PLC register overflow

Action and Reset	
Action condition	When PLC runs the last command and the command exceeds the maximum capacity of the program, the PLor warning shows.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
The program detects source code error during PLC operation	1. Disable PLC 2. Delete PLC program (Pr.00-02 = 6) 3. Enable PLC 4. Re-download PLC program

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th colspan="2">Description</th></tr>
<tr><td>55</td><td>PLFF</td><td>Function defect (PLFF)</td><td colspan="2">Function code error during PLC operation</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="3">Action condition</td><td colspan="2">The program detects incorrect command (unsupported command) during PLC operation, then PLFF warning shows.</td></tr>
<tr><td colspan="3">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="3">Warning setting parameter</td><td colspan="2">NA</td></tr>
<tr><td colspan="3">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="3">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="3">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="3">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="3">The PLC runs an incorrect command during operation</td><td colspan="2">When starting the PLC function and there is no program in the PLC, the PLFF warning shows. This is a normal warning, please download the program.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Warning Name</th><th>Description</th></tr>
<tr><td>56</td><td>PLSn</td><td colspan="2">Checksum error (PLSn)</td><td>PLC checksum error</td></tr>
<tr><td colspan="5">Action and Reset</td></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">PLC checksum error is detected after power on, then PLSn warning shows</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="3">NA</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Cause</td><td colspan="3">Corrective Actions</td></tr>
<tr><td colspan="2">The program detects checksum error during PLC operation</td><td colspan="3">1. Disable PLC
2. Remove PLC program (Pr.00-02 = 6)
3. Enable PLC
4. Re-download PLC program</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>57</td><td>PLEd</td><td>No end command (PLEd)</td><td>PLC end command is missing</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">The “End” command is missing until the last command is executed, the PLEd warning shows</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">NA</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">There is no “END” command during PLC operation</td><td colspan="2">1. Disable PLC
2. Remove PLC program (Pr.00-02 = 6)
3. Enable PLC
4. Re-download PLC program</td></tr>
</table>

ID No.	Display	Warning Name	Description
58	PLCr	PLC MCR error (PLCr)	PLC MCR command error
Action and Reset			
Action condition	The MC command is detected during PLC operation, but there is no corresponded MCR command, then the PLCr warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The MC command is continuously used for more than 9 times	The MC command cannot be used continuously for 9 times. Check and reset the program, then re-download the program.		

ID No.	Display	Warning Name	Description
59		PLC download fail (PLdF)	PLC download fail
Action and Reset			
Action condition		PLC download fail due to momentary power loss during the downloading, when power is ON again, PLdF warning shows.	
Action time		Immediately displays when the fault is detected	
Warning setting parameter		NA	
Reset method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
PLC download is forced to stop, so the program write-in is incomplete		Check if there is any error in the program and re-download the PLC program	

ID No.	Display	Warning Name	Description
60	PLSF	PLC scan time fail (PLSF)	PLC scan time exceeds the maximum allowable time
Action and Reset			
Action condition	When the PLC scan time exceeds the maximum allowable time (400 ms), PLSF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The PLC scan time exceeds the maximum allowable time (400ms)	Check if the source code is correct and re-download the program		

ID No.	Display	Warning Name	Description
70	ECid	ExCom ID fail (ECid)	Duplicate MAC ID error Node address setting error

Action and Reset	
Action condition	Duplicate setting of MAC ID Node address setting error
Action time	N/A
Warning setting parameter	N/A
Reset method	Correct the setting and cycle the power
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
The setting address exceeds the range (0–63)	Check the address setting of the communication card (Pr.09-70)
The speed setting exceeds the range	Standard: 0–2, non-standard: 0–7
The address is duplicated with other nodes on the BUS	Reset the address

ID No.	Display	Warning Name	Description
71	ECLv	ExCom power loss (ECLv)	Low voltage of communication card

Action and Reset	
Action condition	The 5V power that drive provides to communication card is to low
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Re-power
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
The 5V power that drive provides to communication card is to low	1. Switch the communication card to other drives and observe if there is ECLv warning shown. If yes, replace with a new communication card; if not, replace the drive. 2. Use another communication card to test if the ECLv warning has shown as well. If not, replace the card; if yes, replace the drive.
The card is loose	Make sure the communication card is well inserted.

ID No.	Display	Warning Name	Description
72	ECtt	ExCom test mode (ECtt)	Communication card is in the test mode
Action and Reset			
Action condition	Communication card is in the test mode		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power and enter the normal mode		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Communication command error	Cycle the power		

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>73</td><td>ECbF</td><td>ExCom Bus off
(ECbF)</td><td>The communication card detects too much errors in the BUS, then enters the bus-off status and stop communicating</td></tr>
<tr><td colspan="4">Action and Reset</td></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">When the drive detects bus-off (for DeviceNet)</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately acts</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Cycle the power</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Cause</td><td colspan="2">Corrective Actions</td></tr>
<tr><td colspan="2">Poor connection of the cable</td><td colspan="2">Re-connect the cable</td></tr>
<tr><td colspan="2">Bad quality of the cable</td><td colspan="2">Replace the cable</td></tr>
</table>

ID No.	Display	Warning Name	Description
74	ECnP	ExCom no power (ECnP)	There is no power supply on the DeviceNet
Action and Reset			
Action condition	There is no power supply on the DeviceNet		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Re-power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The drive detects that DeviceNet has no power	Check if the cable and power is normal. If yes, return to the factory for repair.		

ID No.	Display	Warning Name	Description
75	ECFF	ExCom factory defect (ECFF)	Factory default setting error

Action and Reset	
Action condition	Factory default setting error
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Cycle the power
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Factory default setting error	Use DCISoft to reset to the default value.

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>76</td><td>ECiF</td><td>ExCom inner error (ECiF)</td><td>Serious internal error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Internal memory saving error</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately acts</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Cycle the power</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Noise interference</td><td colspan="2">Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.
Cycle the power.</td></tr>
<tr><td colspan="2">The memory is broken</td><td colspan="2">Reset to the default value and check if the error still exists. If yes, replace the communication card.</td></tr>
</table>

ID No.	Display	Warning Name	Description
78	ECPP	ExCom Parameter data error (ECPP)	Profibus parameter data error
Action and Reset			
Action condition	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The GSD file is incorrect	Get the correct GSD file from the software		

ID No.	Display	Warning Name	Description
79		ExCom configuration data error (ECPi)	Profibus configuration data error

Action and Reset	
Action condition	N/A
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	N/A

Cause	Corrective Actions
The GSD file is incorrect	Get the correct GSD file from the software

ID No.	Display	Warning Name	Description
80	ECEF	Ethernet link fail (ECEF)	Ethernet cable is not connected

Action and Reset	
Action condition	Hardware detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Ethernet cable is loose	Re-connect the cable
Bad quality of Ethernet cable	Replace the cable

ID No.	Display	Warning Name	Description
81	ECto	Communication time-out (ECto)	Communication time-out for communication card and the upper unit

Action and Reset	
Action condition	N/A
Action time	N/A
Warning setting parameter	N/A
Reset method	N/A
Reset condition	CMC-EC01: auto resets when the communication with the upper unit is back to normal
Record	N/A

Cause	Corrective Actions
Communication card is not connected with the upper unit	Check if the connection of the communication cable is correct
Communication error of the upper unit	Check if the communication of the upper unit is normal

ID No.	Display	Warning Name	Description
82	ECCS	Checksum error (ECCS)	Checksum error for communication card and the drive
Action and Reset			
Action condition		Software detection	
Action time		N/A	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately resets	
Record		N/A	
Cause		Corrective Actions	
Noise interference		Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.	

ID No.	Display	Warning Name	Description
83	ECrF	Return defect (ECrF)	Communication card returns to the default setting

Action and Reset	
Action condition	Communication card returns to the default setting
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
Communication card is returning to default setting	No actions.

ID No.	Display	Warning Name	Description
84	ECo0	Modbus TCP over (Eco0)	Modbus TCP exceeds maximum communication value

Action and Reset	
Action condition	Hardware detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card

ID No.	Display	Warning Name	Description
85	ECo1	EtherNet/IP over (ECo1)	Ethernet/IP exceeds maximum communication value

Action and Reset	
Action condition	Hardware detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card

ID No.	Display	Warning Name	Description
86	ECiP	IP fail (ECiP)	IP setting error
Action and Reset			
Action condition		Software detection	
Action time		Immediately acts	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediate reset	
Record		N/A	
Cause		Corrective Actions	
IP conflict		Reset IP	
DHCP IP configuration error		MIS check if DHCP Server works normally	

ID No.	Display	Warning Name	Description
87	EC3F	Mail fail (EC3F)	Mail warning: Alarm mail will be sent when the communication card establishes alarm conditions

Action and Reset	
Action condition	Communication card establishes alarm conditions
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
Communication card establishes alarm conditions	No actions

ID No.	Display	Warning Name	Description
88		ExCom busy (ECbY)	Communication card busy: too much packets are received

Action and Reset	
Action condition	Software detection
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Communication packets are too much for the communication card to process	Reduce communication packets

ID No.	Display	Warning Name	Description
89	Eccb	ExCom card break (ECCb)	Communication card break off warning
Action and Reset			
Action condition	Communication card break off		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Auto resets after communication card is re-installed		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
Communication card break off	Re-install communication card		

ID No.	Display	Warning Name	Description
90	CPLP	Copy PLC: password error (CPLP)	Copy PLC password error. When KPMS-LE01 is processing PLC copy and the PLC password is incorrect, the CPLP warning occurs.
Action and Reset			
Action level		PLC password is incorrect	
Action time		Immediately act	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Directly reset	
Record		N/A	
Cause		Corrective Actions	
PLC password is incorrect		Reset and enter the correct PLC password	

ID No.	Display	Warning Name	Description
91	CPL0	Copy PLC: Read mode error (CPL0)	Copy PLC Read mode error

Action and Reset	
Action condition	When copy PLC read mode with incorrect process
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A
Cause	**Corrective Actions**
When copy PLC read mode and the process is incorrect	Cycle the power and copy PLC read mode again

ID No.	Display	Warning Name	Description
92	CPL1	Copy PLC: Write mode (CPL1)	Copy PLC write mode error

Action and Reset	
Action condition	Copy PLC write mode with incorrect process
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A

Cause	Corrective Actions
When copy PLC write mode and the process is incorrect	Cycle the power and copy PLC read mode again

ID No.	Display	Warning Name	Description
93		Copy PLC: version error (CPLv)	Copy PLC version error. When a non-MS300 built-in PLC is copied to the MH300 drive, the CPLv warning occurs.
Action and Reset			
Action level		Software detection	
Action time		Immediately act	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Directly reset	
Record		N/A	
Cause		Corrective Actions	
A non-MH300 PLC program is copied to MH300		Check if the copied PLC program is for MH300. Use the correct MS300 PLC program.	

ID No.	Display	Warning Name	Description
94	CPLS	Copy PLC: size error (CPLS)	Copy PLC capacity error
Action and Reset			
Action level		Software detection	
Action time		Immediately act	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Directly reset	
Record		N/A	
Cause		Corrective Actions	
The PLC program copied to MH300 exceeds the allowable capacity		Check if the copied PLC program is for MH300 Use the correct capacity for the MH300 PLC program	

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>95</td><td>CPLF</td><td>Copy PLC: PLC function (CPLF)</td><td>KPMH-LC01 Copy PLC function must be executed when PLC is disabled.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Directly reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">PLC function is enabled when KPMH-LC01 is running PLC copy</td><td colspan="2">Disable the PLC function first, and then run the PLC copy function again.</td></tr>
</table>

ID No.	Display	Warning Name	Description
96	CPLt	Copy PLC: time-out (CPLt)	Copy PLC time-out

Action and Reset	
Action level	Software detection
Action time	Immediately act
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly reset
Record	N/A
Cause	**Corrective Actions**
KPMH-LC01 is removed while copying the PLC program	The KPMH-LC01 cannot be removed during the PLC copy process

ID No.	Display	Warning Name	Description
101	ictn	InrCOM time-out (ictn)	Internal communication time-out
Action and Reset			
Action condition	When Pr.09-31= -1 to -8, or -10, and the internal communication between Master and Slave is abnormal, the ictn warning shows.		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Auto-reset		
Reset condition	The warning automatically clears when the communication is back to normal condition		
Record	N/A		
Cause	Corrective Actions		
Malfunction caused by interference	Verify wiring / grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication conditions with the upper unit	Check if the setting for Pr.09-04 is the same as the setting for upper unit		
Communication cable break off or not connected well	Check the cable status or replace the cable		

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Chapter 14 Fault Codes

Summary of Fault Codes

ID No.	Fault Name	ID No.	Fault Name
0	No fault record	36	cc hardware failure (Hd0)
1	Over-current during acceleration (ocA)	37	oc hardware error (Hd1)
2	Over-current during deceleration (ocd)	40	Auto-tuning error (AUE)
3	Over-current during steady operation (ocn)	41	PID loss ACI (AFE)
4	Ground fault (GFF)	42	PG feedback error (PGF1)
5	IGBT short circuit between upper bridge and lower bridge (occ)	43	PG feedback loss (PGF2)
6	Over-current at stop (ocS)	44	PG feedback stall (PGF3)
7	Over-voltage during acceleration (ovA)	45	PG slip error (PGF4)
8	Over-voltage during deceleration (ovd)	48	ACI loss (ACE)
9	Over-voltage at constant speed (ovn)	49	External fault (EF)
10	Over-voltage at stop (ovS)	50	Emergency stop (EF1)
11	Low-voltage during acceleration (LvA)	51	External base block (bb)
12	Low-voltage during deceleration (Lvd)	52	Password is locked (Pcod)
13	Low-voltage at constant speed (Lvn)	54	Illegal command (CE1)
14	Low-voltage at stop (LvS)	55	Illegal data address (CE2)
15	Phase loss protection (OrP)	56	Illegal data value (CE3)
16	IGBT overheating (oH1)	57	Data is written to read-only address (CE4)
17	Internal key parts overheating (oH2)	58	Modbus transmission time-out (CE10)
18	IGBT temperature detection failure (tH1o)	61	Y-connection / Δ-connection switch fault (ydc)
19	Capacitor hardware error (tH2o)	62	Deceleration energy backup fault (dEb)
21	Over load (oL)	63	Over slip error (oSL)
22	Electronic thermal relay 1 protection (EoL1)	65	Hardware error of PG card (PGF5)
23	Electric thermal relay 2 protection (EoL2)	72	STO loss 1 (STL1)
24	Motor overheating (oH3) PTC / PT100	76	STO (STO)
26	Over torque 1 (ot1)	77	STO loss 2 (STL2)
27	Over torque 2 (ot2)	78	STO loss 3 (STL3)
28	Under current (uC)	79	U-phase over-current before run (Aoc)
29	Limit error (LiT)	80	V-phase over-current before run (boc)
31	EEPROM read error (cF2)	81	W-phase over-current before run (coc)
33	U-phase error (cd1)	82	Output phase loss U phase (OPHL)
34	V-phase error (cd2)	83	Output phase loss V phase (OPHL)
35	W-phase error (cd3)	84	Output phase loss W phase (OPHL)

ID No.	Fault Name	ID No.	Fault Name
87	Overload protection at low frequency (oL3)	126	Internal communication error (CP32)
89	Rotor position detection error (RoPd)	127	Internal communicatino error (CP33)
101	CANopen guarding fault (CGdE)	128	Over-torque 3 (ot3)
102	CANopen heartbeat fault (CHbE)	129	Over-torque 4 (ot4)
104	CANopen bus off fault (CbFE)	134	Internal communicatino error (EoL3)
105	CANopen index error (CIdE)	135	Internal communication error (EoL4)
106	CANopen station address error (CAdE)	140	oc hardware error (Hd6)
107	CANopen memory error (CFrE)	141	GFF occurs before run (b4GFF)
111	InrCOM time-out error (ictE)	142	Auto-tune error 1 (AUE1)
121	Internal communication error (CP20)	143	Auto-tune error 2 (AUE2)
123	Internal communication error (CP22)	144	Auto-tune error 3 (AUE3)
124	Internal communication error (CP30)		

ID No.	Display	Fault Name	Description
1	ocA	Over-current during acceleration (ocA)	Output current exceeds 3 times of the rated current during acceleration. When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.

Action and Reset	
Action condition	300% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Acceleration time is too short.	1. Increase the acceleration time 2. Increase the acceleration time of S-curve 3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44) 4. Set over-current stall prevention function (Pr.06-03) 5. Replace the drive with a larger capacity model
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large.	Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The motor starts when in free run.	Enable the speed tracking during start-up of Pr.07-12.

Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.
Incorrect combination of control mode and used motor	Check the settings for Pr.00-11 control mode: 1. For IM motor, Pr.00-11 = 0, 1, 2, 3, 5 2. For PM motor, Pr.00-11 = 4, 6, 7
The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

ID No.	Display	Fault Name	Description
2	ocd	Over-current during deceleration (ocd)	Output current exceeds 3 times of the rated current during deceleration. When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.

Action and Reset	
Action condition	300% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Deceleration time is too short.	1. Increase the deceleration time 2. Increase the deceleration time of S-curve 3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44) 4. Set over-current stall prevention function (Pr.06-03) 5. Replace the drive with a larger capacity model
Check if the mechanical brake of the motor activates too early	Check the action timing of the mechanical brake
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large.	Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocd occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

ID No.	Display	Fault Name	Description
3	ocn	Over-current during steady operation (ocn)	Output current exceeds 3 times of the rated current during constant speed. When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.

Action and Reset	
Action condition	300% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible shaft lock, burnout or aging insulation of the motor	Troubleshoot the motor shaft lock. Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive).
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocn occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.

ID No.	Display	Fault Name	Description
4	GFF	Ground fault (GFF)	When the drive detects grounding short circuit on the output terminals (U/V/W), the drive closes the gate of the output immediately, the motor runs freely, and the display shows a GFF error.

Action and Reset	
Action condition	N/A
Action time	N/A
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in five seconds after the fault is cleared
Record	Yes

Cause	Corrective Actions
Motor burnout or aging insulation occurred	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Short circuit due to broken cable	Troubleshoot the short circuit. Replace the cable.
Larger stray capacitance of the cable and terminal ⏚	If the motor cable length exceeds 100 m, decrease the setting value for the carrier frequency. Take remedies to reduce stray capacitance.
Malfunction caused by interference	Verify the grounding and wiring of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Hardware failure	Cycle the power after checking the status of motor, cable and cable length. If GFF still exists, return to the factory for repair.
Over-current at constant speed	Refer to the corrective actions for ocn.
Over-current during acceleration	Refer to the corrective actions for ocA.
Over-current during deceleration	Refer to the corrective actions for ocd.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>5</td><td>ocC</td><td>IGBT short circuit between upper bridge and lower bridge (occ)</td><td>Short-circuit is detected between upper bridge and lower bridge of the IGBT module</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Hardware protection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">IGBT fault</td><td colspan="2" rowspan="2">Check the motor wiring.
Cycle the power, if occ still occurs, return to the factory for repair.</td></tr>
<tr><td colspan="2">Short-circuit detecting circuit fault</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>6</td><td>ocS</td><td>Over-current at stop (ocS)</td><td>Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">240% of the rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
7		Over-voltage during acceleration (ovA)	DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.
Action and Reset			
Action condition		230V series: 410 V_{DC} 460V series: 820 V_{DC}	
Action time		Immediately act when DC bus voltage is higher than the level.	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset only when DC bus voltage is lower than 90% of the over-voltage level.	
Record		Yes	
Cause		Corrective Actions	
Acceleration is too slow (e.g. when elevator is going down)		Decrease the acceleration time. Use brake unit or DC bus. Replace the drive with a larger capacity model.	
The setting for stall prevention level is smaller than no-load current.		The setting for stall prevention level should be larger than no-load current.	
Power voltage is too high.		Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.	
ON/OFF switch action of phase-in capacitor in the same power system		If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.	
Regenerative voltage of motor inertia		Use over-voltage stall prevention function (Pr.06-01) Use auto-acceleration and auto-deceleration setting (Pr.01-44) Use a brake unit or DC bus	
Acceleration time is too short.		Check if the over-voltage warning occurs after acceleration stops. When the warning occurs, do the following: 1. Increase the acceleration time 2. Set Pr.06-01 over-voltage stall prevention 3. Increase the setting value for Pr.01-25 S-curve acceleration arrival time 2	
Motor ground fault		The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.	
Incorrect wiring of brake resistor or brake unit		Check the wiring of brake resistor or brake unit.	
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.	

ID No.	Display	Fault Name	Description
8	ovd	Over-voltage during deceleration (ovd)	DC bus over-voltage during deceleration. When ovd occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovd error.

Action and Reset	
Action condition	230V series: 410 V_{DC} 460V series: 820 V_{DC}
Action time	Immediately act when DC bus voltage is higher than the level.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when DC bus voltage is lower than 90% of the over-voltage level.
Record	Yes

Cause	Corrective Actions
Deceleration time is too short, causing too large regenerative energy of the load.	1. Increase the setting value for Pr.01-13, Pr.01-15, Pr.01-17 and Pr.01-19 (deceleration time). 2. Connect brake resistor, brake unit or DC bus to the drive. 3. Reduce the brake frequency. 4. Replace the drive with a larger capacity model. 5. Use S-curve acceleration/deceleration. 6. Use over-voltage stall prevention (Pr.06-01). 7. Use auto-acceleration and auto-deceleration (Pr.01-44). Adjust braking level (Pr.07-01 or the bolt position of the brake unit).
The setting for stall prevention level is smaller than no-load current.	The setting for stall prevention level should be larger than no-load current.
Power voltage is too high.	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor or brake unit.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Fault Name	Description
9	ovn	Over-voltage at constant speed (ovn)	DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output, motor runs freely, and the display shows an ovn error.
Action and Reset			
Action condition		230V series: 410 V_{DC} 460V series: 820 V_{DC}	
Action time		Immediately act when DC bus voltage is higher than the level.	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset only when DC bus voltage is lower than 90% of the over-voltage level.	
Record		Yes	
Cause		Corrective Actions	
Impulsive change of the load		1. Connect brake resistor, brake unit or DC bus to the drive. 2. Reduce the load. 3. Replace the drive with a larger capacity model. 4. Adjust braking level (Pr.07-01 or the bolt position of the brake unit).	
The setting for stall prevention level is smaller than no-load current.		The setting for stall prevention level should be larger than no-load current.	
Regenerative voltage of motor inertia		Use over-voltage stall prevention function (Pr.06-01) Use a brake unit or DC bus	
Power voltage is too high.		Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.	
ON/OFF switch action of phase-in capacitor in the same power system		If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.	
Motor ground fault		The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.	
Incorrect wiring of brake resistor or brake unit		Check the wiring of brake resistor or brake unit.	
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.	

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>10</td><td>ovS</td><td>Over-voltage at stop (ovS)</td><td>Over-voltage at stop</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">230V series: 410 V_{DC}
460V series: 820 V_{DC}</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act when DC bus voltage is higher than the level.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset only when DC bus voltage is lower than 90% of the over-voltage level.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Power voltage is too high.</td><td colspan="2">Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.</td></tr>
<tr><td colspan="2">ON/OFF switch action of phase-in capacitor in the same power system</td><td colspan="2">If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.</td></tr>
<tr><td colspan="2">Incorrect wiring of brake resistor or brake unit</td><td colspan="2">Check the wiring of brake resistor or brake unit.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">Hardware failure in voltage detection</td><td colspan="2">Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.</td></tr>
<tr><td colspan="2">Motor ground fault</td><td colspan="2">The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals.
Troubleshoot the ground fault.</td></tr>
</table>

ID No.	Display	Fault Name	Description
11	LvA	Low-voltage during acceleration (LvA)	DC bus voltage is lower than Pr.06-00 setting value during acceleration.

Action and Reset	
Action condition	Pr.06-00 (Default = depending on the model)
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.
The load is too large.	Reduce the load. Increase the drive capacity. Increase the acceleration time.
DC bus	Install DC reactor(s).
Check if there is short circuit plate or any DC reactor installed between terminal +1 and +2.	Connect short circuit plate or DC reactor between terminal +1 and +2. If the error still exists, return to the factory for repair.

ID No.	Display	Fault Name	Description
12	Lvd	Low-voltage during deceleration (Lvd)	DC bus voltage is lower than Pr.06-00 setting value during deceleration.

Action and Reset	
Action condition	Pr.06-00 (Default = depending on the model)
Action time	Immediate activate when DC bus voltage is lower than Pr.06-00.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.
Sudden load	Reduce the load. Increase the drive capacity.
DC bus	Install DC reactor(s).

ID No.	Display	Fault Name	Description
13	Lvn	Low-voltage at constant speed (Lvn)	DC bus voltage is lower than Pr.06-00 setting value at constant speed.

Action and Reset	
Action condition	Pr.06-00 (Default = depending on the model)
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Power voltage changes	Adjust voltage to the power range of the drive.
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.
Sudden load	Reduce the load. Increase the drive capacity.
DC bus	Install DC reactor(s).

ID No.	Display	Fault Name	Description
14		Low-voltage at stop (LvS)	1. DC bus voltage is lower than Pr.06-00 setting value at stop. 2. Hardware failure in voltage detection.

Action and Reset	
Action condition	Pr.06-00 (Default = depending on the model)
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.
Fault treatment parameter	N/A
Reset method	Manual / Auto 230V series: Lv level + 30 V_{DC} + 500 ms 460V series: Lv level + 60 V_{DC} + 500 ms
Reset condition	500 ms
Record	Yes

Cause	Corrective Actions
Power-off	Improve power supply condition.
Incorrect drive models	Check if the power specification matches the drive.
Power voltage changes	Adjust voltage to the power range of the drive. Cycle the power after checking the power. If LvS error still exists, return to the factory for repair.
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.
DC bus	Install DC reactor(s).

ID No.	Display	Fault Name	Description
15	orP	Phase loss protection (orP)	Phase loss of power input

Action and Reset	
Action condition	When DC bus ripple is higher than the protection level, and the output current exceeds 50% of the rated current, the drive starts counting. When the counting value reaches the upper limit, an orP error occurs.
Action time	The action time varies with different output current.
Fault treatment parameter	Pr.06-53
Reset method	Manual reset
Reset condition	Immediately reset when DC bus is higher than Pr.07-00
Record	Yes

Cause	Corrective Actions
Phase loss of input power	Correctly install the wiring of the main circuit power.
Single phase power input to three-phase model	Choose the model whose power matches the voltage.
Power voltage changes	If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power, if orP error still exists, return to the factory for repair.
Loose wiring terminal of input power	Tighten the terminal screws according to the torque described in the user manual.
The input cable of three-phase power is cut off	Wire correctly. Replace the cut off cable.
Unbalanced three-phase of input power	Check the power three-phase status.

ID No.	Display	Fault Name	Description
16	oH1	IGBT overheating (oH1)	IGBT temperature exceeds the protection level.

Action and Reset	
Action condition	Depending on the model power, refer to Table 1 below. When the setting for Pr.06-15 is higher than the oH1 level, oH1 error occurs instead of oH1 warning. An IGBT overheating error occurs, and the drive stops.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when IGBT temperature is lower than oH1 error level minus (-) 10°C
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as brake resistors, in the surroundings. 4. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponding load	1. Reduce the load 2. Reduce the carrier wave 3. Replace the drive with a larger capacity model.
The drive has run 100% or more than 100% of the rated output for a long time	Replace the drive with a larger capacity model.

ID No.	Display	Fault Name	Description
17	oH2	Over-heat key components (oH2)	The drive has detected the key components are over heat

Action and Reset	
Action condition	Refer to the table below for oH2 level of each models
Action time	The oH2 fault occurs when the temperature sensor of key components detects the temperature is higher than the protection level for 100ms.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	The drive auto-resets when the temperature sensor of key components detects the temperature is lower than oH2 error level minus (–) 10°C
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install / add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponding load	1. Reduce the load 2. Reduce the carrier 3. Replace the drive with a larger capacity model.
The drive has run 100% or more than 100% of the rated output for a long time	Replace the drive with a larger capacity model.
Unstable power	Install reactor(s)
Load changes frequently	Reduce load changes

Voltage	Model (**NOTE:** x = A orE)	oH1 (ºC)	oH2 (ºC)	oH warning oH1 warning = Pr.06-15 (ºC)
Single-phase _115V	VFD1A6MH11x□□A□	95	-	oH1 warning = oH1 – 5 oH2warning = oH2 – 5
	VFD2A5MH11x□□A□	100	-	
	VFD5A0MH11x□□A□	100	-	
Single-phase _230V	VFD1A6MH21x□□A□	110	-	
	VFD2A8MH21x□□A□	110	-	
	VFD5A0MH21x□□A□	110	-	
	VFD7A5MH21x□□A□	110	-	
	VFD11AMH21x□□A□	110	-	

Voltage	Model (**NOTE:** x = A orE)	oH1 (ºC)	oH2 (ºC)	oH warning oH1 warning = Pr.06-15 (ºC)
Three-phase _230V	VFD1A6MH23x□□A□	95	-	oH1 warning = oH1 – 5 oH2 warning = oH2 – 5
	VFD2A8MH23x□□A□	100	-	
	VFD5A0MH23x□□A□	105	-	
	VFD7A5MH23x□□A□	110	-	
	VFD11AMH23x□□A□	100	-	
	VFD17AMH23x□□A□	105	-	
	VFD25AMH23x□□A□	105	-	
	VFD33AMH23x□□A□	115	-	
	VFD49AMH23x□□A□	115	-	
	VFD65AMH23x□□A□	115	-	
	VFD75AMH23x□□A□	95	65	
	VFD90AMH23x□□A□	95	65	
	VFD120MH23x□□A□	95	65	
	VFD146MH23x□□A□	95	65	
Three-phase _460V	VFD1A5MH43x□□A□	105	-	
	VFD3A0MH43x□□A□	110	-	
	VFD4A2MH43x□□A□	110	-	
	VFD5A7MH43x□□A□	95	-	
	VFD7A3MH43x□□A□	100	-	
	VFD9A0MH43x□□A□	115	-	
	VFD13AMH43x□□A□	105	-	
	VFD17AMH43x□□A□	110	-	
	VFD25AMH43x□□A□	115	-	
	VFD32AMH43x□□A□	115	-	
	VFD38AMH43x□□A□	110	-	
	VFD45AMH43x□□A□	115	-	
	VFD60AMH43x□□A□	95	65	
	VFD75AMH43x□□A□	95	65	
	VFD91AMH43x□□A□	95	65	
	VFD112MH43x□□A□	95	65	
	VFD150MH43x□□A□	95	65	

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>18</td><td>tH1o</td><td>IGBT temperature detection failure (tH1o)</td><td>IGBT hardware failure in temperature detection</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">NTC broken or wiring failure</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH1o protection activates.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>19</td><td>tH2o</td><td>Capacitor hardware fault
(tH2o)</td><td>Hardware failure in capacitor temperature detection</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">NTC broken or wiring failure</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">When the IGBT temperature is higher than the protection level, and detection time exceeds 100ms, the tH2o protection occurs.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset immediately</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">Wait for 10 minutes, and then cycle the power. Check if tH2o protection still occurs. If yes, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
21	oL	Overload (oL)	The AC motor drive detects excessive drive output current. Overload capacity: • Normal duty: Sustains for one minute when the drive outputs 120% of the drive's rated output current. Sustains for three seconds when the drive outputs 150% of the drive's rated output current. • Heavy duty: Sustains for one minute when the drive outputs 150% of the drive's rated output current. Sustains for three seconds when the drive outputs 200% of the drive's rated output current.

Action and Reset	
Action condition	Based on overload curve and derating curve (refer to the section 9-6)
Action time	When the load is higher than the protection level and exceeds allowable time, the oL protection activates.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
The load is too large.	Reduce the load.
Accel. / Decel. time and the working cycle are too short.	Increase the setting values for Pr.01-12–01-19 (accel. / decel. time).
V/F voltage is too high.	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
The capacity of the drive is too small.	Replace the drive with a larger capacity model.
Overload during low-speed operation.	Reduce the load during low-speed operation. Increase the drive capacity. Decrease the carrier frequency of Pr.00-17.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Output phase loss	Check the status of three-phase motor. Check if the cable is broken or the screws are loose.

Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Fault Name	Description
22	EoL1	Electronic thermal relay 1 protection (EoL1)	Electronic thermal relay 1 protection. The drive coasts to stop once it activates.

Action and Reset	
Action condition	Start counting when output current > 150% of motor 1 rated current.
Action time	Pr.06-14 (if the output current is larger than 105% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr.06-14.)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
The load is too large.	Reduce the load.
Accel./Decel. time and the working cycle are too short.	Increase the setting values for Pr.01-12–01-19 (accel. / decel. time)
V/F voltage is too high.	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
Overload during low-speed operation. When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motors, Pr.06-13=0 (electronic thermal relay selection motor 1 = 0 inverter motor)	Pr.06-13=1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low.	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.06-13=2 electronic thermal relay selection motor 1 = disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID No.	Display	Fault Name	Description
23	EoL2	Electronic thermal relay 2 protection (EoL2)	Electronic thermal relay 2 protection. The drive coasts to stop once it activates.

Action and Reset	
Action condition	Start counting when the output current > 150% of the motor 2 rated current
Action time	Pr.06-28 (If the output current is larger than 105% of the motor 2 rated current again within 60 sec., the counting time reduces and is less than Pr.06-28)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in five seconds after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load
Accel. / Decel. time or the working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel. / decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-35–01-42 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection setting of Pr.01-43.
Overload during low-speed operation. When using general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motors, Pr.06-27=0 (electronic thermal relay selection motor 2 = 0 inverter motor)	Pr.06-27=1 Electronic thermal relay selection motor 2 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.06-27=2 Electronic thermal relay selection motor 2 = disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-71 torque compensation gain) until the current reduces and the motor does no stall.
Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID No.	Display	Fault Name	Description
24_1	oH3	Motor overheating (oH3) PTC	Motor overheating (PTC) (Pr.03-00–Pr.03-01=6 PTC), when PTC input > Pr.06-30, the fault treatment acts according to Pr.06-29.

Action and Reset	
Action condition	PTC input value > Pr.06-30 setting (Default = 50%)
Action time	Immediately act
Fault treatment parameter	Pr.06-29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.06-29=0, oH3 is a “Warning”. The “Warning” is automatically cleared. When Pr.06-29=1 or 2, oH3 is a “Fault”. You must reset manually.
Reset condition	Immediately reset
Record	When Pr.06-29=1 or 2, oH3 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Motor shaft lock	Remove the shaft lock.
The load is too large	Reduce the load. Increase the motor capacity.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operate at low-speed too long.	Decrease low-speed operation time. Replace the motor with a dedicated to VFD model. Increase the motor capacity.
Accel. / Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel. / decel. time)
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate.	Reset to the correct motor rated current.
Check if the PTC is properly set and wired.	Check the connection between PTC thermistor and the heat protection.

Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high.	Use remedies to reduce harmonics.

ID No.	Display	Fault Name	Description
24_2	oH3	Motor overheating (oH3) PT100	Motor overheating (PT100) (Pr.03-00–Pr.03-01=11 PT100). When PT100 input > Pr.06-57 (default = 7 V), the fault treatment acts according to Pr.06-29.

Action and Reset	
Action condition	PT100 input value > Pr.06-57 setting (default = 7 V)
Action time	Immediately act
Fault treatment parameter	Pr.06-29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.06-29=0 and the temperature < Pr.06-56, oH3 is automatically cleared. When Pr.06-29=1 or 2, oH3 is a “Fault”. You must reset manually.
Reset condition	Immediately reset
Record	When Pr.06-29=1 or 2, oH3 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Motor shaft lock	Remove the shaft lock.
The load is too large	Reduce the load. Increase the motor capacity.
Ambient temperature is too high	Change the installed place If there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operate at low-speed too long	Decrease low-speed operation time. Replace the motor with a dedicated to VFD model. Increase the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–Pr.01-19 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate.	Reset to the correct motor rated current.
Check if the PT100 is properly set and wired.	Check connection of PT100 thermistor.

Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high	Use remedies to reduce harmonics.

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Fault Name</th><th>Description</th></tr>
<tr><td>26</td><td>ot 1</td><td colspan="2">Over-torque 1
(ot1)</td><td>When output current exceeds the over-torque detection level (Pr.06-07) and exceeds over-torque detection time (Pr.06-08), and when Pr.06-06 or Pr.06-09 is set to 2 or 4, the ot1 error displays.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Pr.06-07</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.06-08</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.06-06
0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.06-06=1 or 3, ot1 is a “Warning”. The warning is automatically cleared when the output current < (Pr.06-07 – 5%).</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.06-06=2 or 4, ot1 is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.06-06=2 or 4, ot1 is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect parameter setting</td><td colspan="3">Reset Pr.06-07 and 06-08.</td></tr>
<tr><td colspan="2">Mechanical error (e.g. over-torque, mechanical lock)</td><td colspan="3">Remove the causes of malfunction.</td></tr>
<tr><td colspan="2">The load is too large.</td><td colspan="3">Reduce the load.
Replace the motor with a larger capacity model.</td></tr>
<tr><td colspan="2">Accel. / Decel. time and working cycle are too short.</td><td colspan="3">Increase the setting values for Pr.01-12–01-19 (accel. / decel. time).</td></tr>
<tr><td colspan="2">V/F voltage is too high.</td><td colspan="3">Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Refer to the V/F curve selection of Pr.01-43.</td></tr>
<tr><td colspan="2">The motor capacity is too small.</td><td colspan="3">Replace the motor with a larger capacity model.</td></tr>
<tr><td colspan="2">Overload during low-speed operation.</td><td colspan="3">Decrease low-speed operation time.
Increase the motor capacity.</td></tr>
<tr><td colspan="2">Torque compensation is too large.</td><td colspan="3">Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.</td></tr>
</table>

Improper parameter settings for speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Fault Name	Description
27	ot2	Over torque 2 (ot2)	When the output current exceeds the over-torque detection level (Pr.06-10) and exceeds over-torque detection time (Pr.06-11), and when Pr.06-09 is set to 2 or 4, the ot2 error displays.

Action and Reset		
Action condition	Pr.06-10	
Action time	Pr.06-11	
Fault treatment parameter	Pr.06-09 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
Reset method Reset condition	Auto	When Pr.06-09=1 or 3, ot2 is a “Warning”. The warning is automatically cleared when the output current < (Pr.06-10 – 5%).
	Manual	When Pr.06-09=2 or 4, ot2 is a “Fault”. You must reset manually.
Record	Immediately reset	
Active level	When Pr.06-09=2 or 4, ot2 is a “Fault”, and the fault is recorded.	

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-10 and Pr.06-11 again.
Mechanical failure (e.g. over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large.	Reduce the load. Replace the motor with a larger capacity model.
Accel. / Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel. / decel. time).
V/F voltage is too high	Adjust the V/F curve (Motor 2, Pr.01-35–01-42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Increase the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-71 torque compensation gain) until the current reduces and the motor does no stall.

Improper parameter settings for speed tracking function (including restart at momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Fault Name	Description
28	uC	Under current (uC)	Low current detection
Action and Reset			
Action condition	Pr.06-71		
Action time	Pr.06-72		
Fault treatment parameter	Pr.06-73 0: No function 1: warn and coast to stop 2: warn and ramp to stop by the 2nd deceleration time 3: warn and continue operation		
Reset method	Auto	When Pr.06-73=3, uC is a “Warning”. The warning is automatically cleared when the output current > (Pr.06-71 + 0.1 A).	
	Manual	When Pr.06-73=1 or 2, uC is a “Fault”. You must reset manually.	
Reset condition	Immediately reset		
Record	When Pr.06-73=1 or 2, uC is a “Fault”, and the fault is recorded.		
Cause	Corrective Actions		
Motor cable disconnection	Troubleshoot the connection between the motor and the load.		
Improper setting of low-current protection	Reset Pr.06-71, Pr.06-72 and Pr.06-73 to proper settings.		
The load is too low.	Check the load status. Check if the motor capacity matches the load.		

ID No.	Display	Fault Name	Description
29	LiT	Limit Error (LiT)	This code occurs when the motor drive is running under speed mode (not IMFOCPG / PMFOCPG) and the negative running limit or the positive running limit of the MI terminals is enabled.

Action and Reset	
Action condition	When under the speed mode (not FOCPG), negative running limit or positive running limit is enabled.
Action time	Act immediately
Fault treatment parameter	N/A
Reset method	Move the motor away from the limit position, press the STOP/ RESET button on the keypad (Manual reset).
Reset condition	Reset immediately
Record	Yes

Cause	Corrective Actions
The limit ON/OFF switch may be on the wrong position	Install the limit ON/OFF switch to correct position.
MI terminal may not be working properly.	Set Pr00-04=16 to verify if the MI terminals work properly. 16: The digital input status (ON / OFF) (i)
Deceleration time may be too long, causing the motor cannot stop at limit position	Reduce deceleration time. Adjust setting value of DC brake current level (Pr.07-01 or the insert position on the brake unit).

ID No.	Display	Fault Name	Description
31		EEPROM read error (cF2)	Internal EEPROM cannot be read.

Action and Reset	
Action condition	Firmware internal detection
Action time	cF2 acts immediately when the drive detects the fault.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Internal EEPROM cannot be read.	Press RESET key. If cF2 error still displays on the keypad, return to the factory for repair. Reset the parameter to the default setting. If cF2 error still displays on the keypad, return to the factory for repair. Cycle the power. If cF2 error still exists, return to the factory for repair.

ID No.	Display	Fault Name	Description
33	cd1	U-phase error (cd1)	U-phase current detection error when power is ON.

Action and Reset	
Action condition	Hardware detection
Action time	cd1 acts immediately when the drive detects the fault.
Fault treatment parameter	N/A
Reset method	Power-off
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.

ID No.	Display	Fault Name	Description
34	cd2	V-phase error (cd2)	V-phase current detection error when power is ON.
Action and Reset			
Action condition		Hardware detection	
Action time		cd2 acts immediately when the drive detects the fault.	
Fault treatment parameter		N/A	
Reset method		Power-off	
Reset condition		N/A	
Record		Yes	
Cause		Corrective Actions	
Hardware failure		Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.	

ID No.	Display	Fault Name	Description
35	cd3	W-phase error (cd3)	W-phase current detection error when power is ON.

Action and Reset	
Action condition	Hardware detection
Action time	cd3 acts immediately when the drive detects the fault.
Fault treatment parameter	N/A
Reset method	Power-off
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.

ID No.	Display	Fault Name	Description
36	Hd0	cc Hardware failure (Hd0)	cc (current clamp) hardware protection error when power is ON.
Action and Reset			
Action condition	Hardware detection		
Action time	Hd0 acts immediately when the drive detects the fault.		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.		

ID No.	Display	Fault Name	Description
37	Hd1	Oc Hardware failure (Hd1)	oc hardware protection error when power is ON.

Action and Reset	
Action condition	Hardware detection
Action time	Hd1 acts immediately when the drive detects the fault.
Fault treatment parameter	N/A
Reset method	Power-off
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.

ID No.	Display	Fault Name	Description
40	AUE	Auto-tuning error (AUE)	Motor auto-tuning error

Action and Reset	
Action condition	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Press STOP key during auto-tuning.	Re-execute auto-tuning.
Incorrect motor capacity (too large or too small) and parameter setting	Check motor capacity and related parameters. Set the correct parameters, that is Pr.01-01–01-02. Set Pr.01-00 larger than motor rated frequency.
Incorrect motor wiring	Check the wiring.
Motor shaft lock	Remove the cause of motor shaft lock.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.
The load is too large.	Reduce the load. Replace the motor with a larger capacity model.
Accel. / Decel. time is too short.	Increase the setting values for Pr.01-12–01-19 (Accel. / Decel. time).

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th colspan="2">Description</th></tr>
<tr><td>41</td><td>AFE</td><td>PID loss ACI (AFE)</td><td colspan="2">PID feedback loss (analog feedback signal is only valid when the PID function is enabled.)</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">When the analog input < 4 mA (only detects 4–20 mA analog input)</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.08-08</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.08-09
0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.08-09=3 or 4, AFE is a “Warning”. When the feedback signal is > 4 mA, the ”Warning” is automatically cleared.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.08-09=1 or 2, AFE is a “Fault”. You must rest manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.08-09=1 or 2, AFE is a “Fault”, and the fault is recorded; when Pr.08-09=3 or 4, AFE is a “Warning”, and the warning is not recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">PID feedback cable is loose or cut off.</td><td colspan="3">Tighten the terminal.
Replace the cable with a new one.</td></tr>
<tr><td colspan="2">Feedback device failure</td><td colspan="3">Replace the device with a new one.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">Check all the wiring. If the AFE fault still displays on the keypad, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
42	PGF1	PG feedback error (PGF1)	The motor runs in a reverse direction to the frequency command direction.
Action and Reset			
Action condition		Software detection	
Action time		Pr. 10-09	
Fault treatment parameter		Pr. 10-08 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop	
Reset method		Manual reset	
Reset condition		Reset immediately	
Record		Yes	
Cause		Corrective Actions	
Incorrect parameter setting of encoder		Reset encoder parameter (Pr. 10-02).	
Check wiring of the encoder		Re-wire the encoder.	
PG card or PG encoder failure		Replace PG card or encoder with a new one.	
Malfunction caused by interference		Verify wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.	

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>43</td><td>PGF2</td><td>PG feedback loss (PGF2)</td><td>Pr. 10-00 and Pr. 10-02 is not set in the PG control mode. When press “RUN” key, PGF2 fault occurs.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset immediately</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect setting of encoder parameter</td><td colspan="2">Reset encoder parameters (Pr. 10-00 and Pr. 10-02)</td></tr>
<tr><td colspan="2">Incorrect selection of the control mode</td><td colspan="2">Choose the correct control mode.</td></tr>
</table>

ID No.	Display	Fault Name	Description
44	PGF3	PG feedback stall (GF3)	Under PG mode, when the motor frequency exceeds the encoder observer stall level (Pr. 10-10) and starts to count, the fault time is longer than the detection time of encoder observer stall (Pr. 10-11), then PGF3 fault occurs.

Action and Reset	
Action condition	Pr. 10-10
Action time	Pr. 10-11
Fault treatment parameter	Pr. 10-12 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop
Reset method	Manual reset
Reset condition	Reset immediately
Record	Yes

Cause	Corrective Actions
Incorrect setting of encoder parameter	Reset encoder parameter (Pr. 10-01)
Pr. 01-00 is set too small	Set proper value for Pr. 01-00.
Incorrect setting for ASR parameters and accel. / decel. time	Reset ASR parameters. Set correct accel. / decel. time.
Incorrect setting for PG feedback stall	Reset proper values for Pr. 10-10 and Pr. 10-11

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th colspan="2">Description</th></tr>
<tr><td>45</td><td>PGF4</td><td>PG slip error
(PGF4)</td><td colspan="2">Under PG mode, when the motor frequency exceeds encoder observer slip range (Pr. 10-13) and starts to count, the fault time is longer than the detection time of encoder observer slip (Pr. 10-14), PGF4 fault occurs.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Pr. 10-13</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr. 10-14</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr. 10-15
0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr. 10-15=0, PGF4 is a “Warning”, when the deviation between output frequency and motor frequency is smaller than the encoder observer slip range, the warning is automatically cleared.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr. 10-15=1 or 2, PGF4 is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Reset immediately</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr. 10-15=1 or 2, PGF4 is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect settings for PG feedback parameters</td><td colspan="3">Reset correct values for Pr. 10-13 and Pr. 10-14.</td></tr>
<tr><td colspan="2">Incorrect settings for ASR parameters and accel. / decel. time</td><td colspan="3">Reset ASR parameters.
Set correct accel. / decel time.</td></tr>
<tr><td colspan="2">Incorrect settings of encoder parameters</td><td colspan="3">Reset encoder parameters (Pr. 10-01).</td></tr>
<tr><td colspan="2">Accel. / Decel. time is too short</td><td colspan="3">Reset proper accel. / decel. time.</td></tr>
<tr><td colspan="2">Incorrect settings of torque limit parameters (Pr. 06-12, Pr. 11-17–20)</td><td colspan="3">Reset proper setting values for Pr. 06-12 and Pr. 11-17–Pr. 17-20.</td></tr>
<tr><td colspan="2">Motor shaft lock</td><td colspan="3">Remove causes of motor shaft lock.</td></tr>
<tr><td colspan="2">Mechanical brake is not released</td><td colspan="3">Check the action sequence of the system.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Fault Name</th><th>Description</th></tr>
<tr><td>48</td><td>ACE</td><td colspan="2">ACI loss
(ACE)</td><td>Analog input loss (including all the 4–20 mA analog signal)</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">When the analog input is < 4 mA (only detects 4–20 mA analog input)</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.03-19
0: Disable
1: Continue operation at the last frequency (warning, ANL displays on the keypad)
2: Decelerate to 0 Hz (warning, ANL displays on the keypad)
3: Stop immediately and display “ACE”</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.03-19=1 or 2, ACE is a “Warning”. When analog input signal is > 4 mA, the “Warning” is automatically cleared.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.03-19=3, ACE is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.03-19=3, ACE is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">ACI cable is loose or cut off.</td><td colspan="3">Tighten the terminal.
Replace the cable with a new one.</td></tr>
<tr><td colspan="2">External device failure</td><td colspan="3">Replace the device with a new one.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">Check all the wiring. If the ACE fault still displays on the keypad, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>49</td><td>EF</td><td>External fault
(EF)</td><td>External fault. When the drive decelerates based on the setting of Pr.07-20, the EF fault displays on the keypad</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">MI=EF and the MI terminal is ON.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">Pr.07-20
0: Coast to stop
1: Stop by 1st deceleration time
2: Stop by 2nd deceleration time
3: Stop by 3rd deceleration time
4: Stop by 4th deceleration time
5: System deceleration
6: Automatic deceleration</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Manual reset only after the external fault is cleared (terminal status is recovered).</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">External fault</td><td colspan="2">Press RESET key after the fault is cleared.</td></tr>
</table>

ID No.	Display	Fault Name	Description
50	EF1	Emergency stop (EF1)	When the contact of MIx = EF1 is ON, the output stops immediately and displays EF1 on the keypad. The motor is in free running.

Action and Reset	
Action condition	MIx=EF1 and the MI terminal is ON
Action time	Act immediately
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
Record	Yes

Cause	Corrective Actions
When Mix = EF1 activates	Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.

ID No.	Display	Fault Name	Description
51	bb	External base block (bb)	When the contact of MI=bb is ON, the output stops immediately and displays bb on the keypad. The motor is in free running.

Action and Reset	
Action condition	MI=bb and the MI terminal is ON.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	The display “bb” is automatically cleared after the fault is cleared.
Reset condition	N/A
Record	No

Cause	Corrective Actions
MI=bb activates	Verify if the system is back to normal condition, and then press RESET key to return to the default.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>52</td><td>Pcod</td><td>Password is locked (Pcod)</td><td>Entering the wrong password three consecutive times</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Entering the wrong password three consecutive times</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Power-off</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect password input through Pr.00-07</td><td colspan="2">1. Input the correct password after rebooting the motor drive.
2. If you forget the password, enter 9999.
3. Press ENTER, and then enter 9999 again.
4. You must finish pressing ENTER within 10 seconds. If not, you must repeat the entering. After you successfully unlock the password, the parameter settings return to the default.</td></tr>
</table>

ID No.	Display	Fault Name	Description
54	CE1	Illegal command (CE1)	Communication command is illegal

Action and Reset	
Action condition	When the function code is not 03, 06, 10, or 63.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Display	Fault Name	Description
55	CE2	Illegal data address (CE2)	Data address is illegal.

Action and Reset	
Action condition	When the data address is correct.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Display	Fault Name	Description
56	CE3	Illegal data value (CE3)	Data value is illegal.
Action and Reset			
Action condition	When the data length is too long.		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	No		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Fault Name	Description
57	CE4	Data is written to read-only address (CE4)	Data is written to read-only address.

Action and Reset	
Action condition	When the data is written to read-only address.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-04 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Display	Fault Name	Description
58	CE10	Modbus transmission time-out (CE10)	Modbus transmission time-out occurs.
Action and Reset			
Action condition		When the communication time exceeds the detection time for Pr.09-03 time-out.	
Action time		Pr.09-03	
Fault treatment parameter		Pr.09-02 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue operation	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		Yes	
Cause		Corrective Actions	
The upper unit does not transmit the communication command within Pr.09-03 setting time.		Check if the upper unit transmits the communication command within the setting time for Pr.09-03.	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from the upper unit		Check if the setting for Pr.09-04 is the same as the setting for the upper unit.	
Disconnection or bad connection of the cable		Check the cable and replace it if necessary.	

ID No.	Display	Fault Name	Description
61	ydc	Y-connection / Δ-connection switch fault (ydc)	A fault occurs when Y-Δ switches

Action and Reset	
Action condition	1. ydc occurs when the confirmation signals of Y-connection and Δ-connection are conducted at the same time. 2. If any of confirmation signals is not conducted within Pr. 05-25, ydc occurs.
Action time	Pr. 05-25
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Can be reset only when the confirmation signal of Y-connection is conducted if it is Y-connection, or when the confirmation signal of Δ-connection is conducted if it is Δ-connection.
Record	Yes

Cause	Corrective Actions
The electromagnetic valve operates incorrectly during Y-Δ switch.	Check if the electromagnetic valve works normally. If not, replace it.
Incorrect parameter setting	Check if related parameters are all set up and set correctly.
The wiring of Y-Δ switch function is incorrect	Check the wiring.

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Fault Name</th><th>Description</th></tr>
<tr><td>62</td><td>dEb</td><td colspan="2">Deceleration energy backup fault (dEb)</td><td>When Pr. 07-13 is not 0, and the power is suddenly off, causing the DC bus voltage lower than the dEb action level, the dEb function acts and the motor ramps to stop. Then dEb displays on the keypad.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">When Pr. 07-13 is not 0, and the DC bus voltage is lower than the level of dEb.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr. 07-13=2 (dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored): dEb is automatically cleared.</td></tr>
<tr><td>Hand</td><td colspan="2">When Pr. 07-13=1 (dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored): The drive stops when dEb acts and the rotation speed becomes 0 Hz, then the drive can be reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Auto: The fault is automatically cleared.
Hand: When the drive decelerates to 0 Hz.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Unstable power source or the power is off</td><td colspan="3">Check the power system.</td></tr>
<tr><td colspan="2">There is any other large load operates in the power system</td><td colspan="3">1. Replace power system with a larger capacity.
2. Use a different power system from the large load system.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Fault Name</th><th>Description</th></tr>
<tr><td>63</td><td>oSL</td><td colspan="2">Over slip error (oSL)</td><td>On the basis of the maximum slip limit set via Pr. 10-29, the speed deviation is abnormal. When the motor drive outputs at constant speed, F>H or F<H exceeds the level set via Pr. 07-29, and it exceeds the time set via Pr. 07-30, oSL shows. oSL occurs in induction motors only.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Pr. 07-29
100% of Pr. 07-29 = the maximum limit of the slip frequency (Pr. 10-29)</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr. 07-30</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr. 07-31
0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">Pr. 07-31=0 is a warning.
When the motor drive outputs at constant speed, and F>H or F<H does not exceed the level set via Pr. 07-29 anymore, oSL warning will be cleared automatically.</td></tr>
<tr><td>Hand</td><td colspan="2">When Pr. 07-31=1 or 2, oSL is an error, and it needs to reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Reset immediately</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Pr. 07-31=1 or 2, oSL is “Fault”, and will be recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Any of the motor parameters in parameter group 5 may be incorrect</td><td colspan="3">Check the motor parameters</td></tr>
<tr><td colspan="2">Overload</td><td colspan="3">Decrease the load</td></tr>
<tr><td colspan="2">Any of the setting value of Pr. 07-29, 07-30, and 10-29 is improper</td><td colspan="3">Check the setting of oSL protection function related parameters</td></tr>
</table>

ID No.	Display	Fault Name	Description
65	PGF5	Hardware error of PG card (PGF5)	Hardware error of PG card

Action and Reset	
Action condition	1. The PG card (PG01U/PG02U) can only be used with the permanent magnetic motor. When the power is ON and Pr. 00-04=29 pole section shows 0 or 7 (wiring error or no U/V/W signal input), the PGF5 error will be activated. 2. The drive receives the operation command right after the power is ON, meanwhile, the PG card is not ready yet.
Action time	Act immediately
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset after cycle the power.
Record	Yes

Cause	Corrective Actions
Wiring error or there is no U/V/W signal input	Re-connect the cables correctly
Encoder failure	Verify if it is the UVW encoder
The setting of encoder parameter is incorrect	Choose the correct setting of Pr. 10-00
If the motor selection switch of PG card on the correct position	Check if it is the UVW encoder or Delta encoder
PG card selection is incorrect	Install the correct PG card

ID No.	Display	Fault Name	Description
72	STL1	STO Loss 1 (STL1)	S1–DCM internal loop detection error

Action and Reset	
Action condition	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Hardware failure, and cannot reset. Cycle the power.
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
S1 and DCM short circuit lines are not connected	Re-connect the short circuit line
Hardware failure	After you make sure all the wiring is correct, if STL1 fault still exists after cycling the power, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th colspan="2">Description</th></tr>
<tr><td>76</td><td>STo</td><td>STO
(STo)</td><td colspan="2">Safety Torque Off function active</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.06-44=1 and after STo error is cleared, it automatically resets.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.06-44=0 and after STo error is cleared, reset it manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Reset only after STo error is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">The switch action of STO1/SCM1 and STO2/SCM2 (OPEN)</td><td colspan="3">Reset the switch (ON) and cycle the power</td></tr>
</table>

ID No.	Display	Fault Name	Description
77	STL2	STO Loss 2 (STL2)	S2–DCM internal loop detection error

Action and Reset	
Action condition	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Hardware failure, and cannot reset. Cycle the power.
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
STO2 and SCM2 short circuit lines are not connected	Re-connect the short circuit lines
Hardware failure	After you make sure all the wiring is correct, if STL2 fault still exists after cycling the power, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>78</td><td>STL3</td><td>STO Loss 3
(STL3)</td><td>S1–DCM and S2–DCM internal loop detection error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Hardware failure, and cannot reset. Cycle the power.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">STO1 and SCM1, or STO2 and SCM2 short circuit lines are not connected</td><td colspan="2">Re-connect the short circuit lines</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">After you make sure all the wiring is correct, if STL3 fault still exists after cycling the power, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
79	Aoc	U-phase short circuit (Aoc)	U-phase short circuit detected when output wiring detection is performed before the drive runs.
Action and Reset			
Action condition		300% of the rated current	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset in 5 sec. after the fault is cleared.	
Record		Yes	
Cause		Corrective Actions	
Incorrect motor wiring		Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct.	
Short-circuit at motor output due to poor insulation wiring.		Without considering the short circuits, check the motor cable or replace the cable before turning on the power.	
Check for possible burnout or aging insulation of the motor.		Check the motor insulation value with megger. Replace the motor if the insulation is poor.	
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.	
The length of motor cable is too long.		Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).	
Hardware failure		The Aoc occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.	

ID No.	Display	Fault Name	Description
80	boc	V-phase short circuit (Boc)	V-phase short circuit detected when output wiring detection is performed before the drive runs.

Action and Reset	
Action condition	300% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Incorrect motor wiring	Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct.
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor.	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The Boc occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>81</td><td>CoC</td><td>W-phase short circuit (Coc)</td><td>W-phase short circuit detected when output wiring detection is performed before the drive runs.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">300% of the rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect motor wiring</td><td colspan="2">Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.</td></tr>
<tr><td colspan="2">Short-circuit at motor output due to poor insulation wiring.</td><td colspan="2">Without considering the short circuits, check the motor cable or replace the cable before turning on the power.</td></tr>
<tr><td colspan="2">Check for possible burnout or aging insulation of the motor.</td><td colspan="2">Check the motor insulation value with megger. Replace the motor if the insulation is poor.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">The length of motor cable is too long.</td><td colspan="2">Increase the AC motor drive’s capacity.
Install AC reactor(s) on the output side (U/V/W).</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">The Coc occurs due to short circuit or ground fault at the output side of the drive.
Check for possible short circuits between terminals with the electric meter:
B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W.
If short circuits occur, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
82	oPL 1	Output phase loss U phase (oPL1)	U phase output phase loss

Action and Reset	
Action condition	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.
Fault treatment parameter	Pr.06-45 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.06-45=1 or 2, OPL1 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect.	Check the cable and replace it if necessary. Check the motor’s internal wiring. If the fault still exists, replace the motor.
Check if the motor is a single-phase motor.	Choose a three-phase motor.
Check if the current sensor is broken.	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the oPL1 fault still exists, return to the factory for repair.
Check if the drive capacity is larger than the motor capacity.	Choose the drive that matches the motor capacity.

ID No.	Display	Fault Name	Description
83	oPL2	Output phase loss V phase (oPL2)	V phase output phase loss

Action and Reset	
Action condition	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.
Fault treatment parameter	Pr.06-45 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.06-45=1 or 2, OPL2 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect.	Check the cable and replace it if necessary. Check the motor’s internal wiring. If the fault still exists, replace the motor.
Check if the motor is a single-phase motor.	Choose a three-phase motor.
Check if the current sensor is broken.	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the oPL2 fault still exists, return to the factory for repair.
Check if the drive capacity is larger than the motor capacity.	Choose the drive that matches the motor capacity.

ID No.	Display	Fault Name	Description
84	oPL3	Output phase loss W phase (oPL3)	W phase output phase loss

Action and Reset	
Action condition	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46..
Fault treatment parameter	Pr.06-45 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.06-45=1 or 2, OPL3 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect.	Check the cable and replace it if necessary. Check the motor’s internal wiring. If the fault still exists, replace the motor.
Check if the motor is a single-phase motor.	Choose a three-phase motor.
Check if the current sensor is broken.	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the oPL3 fault still exists, return to the factory for repair.
Check if the drive capacity is larger than the motor capacity.	Choose the drive that matches the motor capacity.

ID No.	Display	Fault Name	Description
87	oL3	Overload protection at low frequency (oL3)	Low frequency and high current protection
Action and Reset			
Action condition	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
The drive operates at a frequency below 15 Hz, and output current is too large.	1. Enhance the heat dissipation capacity for the cabinet. 2. Lower the carrier frequency (Pr.00-17). 3. Decrease the voltage settings that correspond to frequency below 15 Hz in the V/F curve. 4. Change Pr.00-11 to general control mode. 5. Replace the drive with a larger power model.		

ID No.	Display	Fault Name	Description
89	roPd	Rotor position detection error (roPd)	Rotor position detection error protection

Action and Reset	
Action condition	Reset the software.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Check if the motor cable is abnormal or broken.	Check or replace the cable.
Motor coil error	Replace the motor.
Hardware failure	IGBT broken. Return to the factory for repair.
Drive’s current feedback line error	Cycle the power. If roPd still occurs during operation, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>101</td><td>CGdE</td><td>CANopen guarding fault (CGdE)</td><td>CANopen guarding fault</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="3">Action condition</td><td>When CANopen Node Guarding detects that one of the slaves is not responding, the CGdE fault occurs.
The upper unit sets factor and time during configuration.</td></tr>
<tr><td colspan="3">Action time</td><td>The time that upper unit sets during configuration</td></tr>
<tr><td colspan="3">Fault treatment parameter</td><td>N/A</td></tr>
<tr><td colspan="3">Reset method</td><td>Manual reset</td></tr>
<tr><td colspan="3">Reset condition</td><td>The upper unit sends a reset package to clear this fault</td></tr>
<tr><td colspan="3">Record</td><td>Yes</td></tr>
<tr><th colspan="3">Cause</th><th>Corrective Actions</th></tr>
<tr><td colspan="3">The guarding time is too short, or less detection times</td><td>Increase the guarding time (Index 100C) and detection times</td></tr>
<tr><td colspan="3">Malfunction caused by interference</td><td>1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
2. Make sure the communication circuit is wired in series.
3. Use CANopen cable or add terminating resistance.</td></tr>
<tr><td colspan="3">Communication cable is broken or bad connected</td><td>Check or replace the communication cable.</td></tr>
</table>

ID No.	Display	Fault Name	Description
102	CHbE	CANopen heartbeat fault (CHbE)	CANopen heartbeat fault

Action and Reset	
Action condition	When CANopen Heartbeat detects that one of the slaves is not responding, the CHbE fault occurs. The upper unit sets the confirming time of producer and consumer during configuration.
Action time	The confirming time that upper unit sets for producer and consumer during configuration.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this fault
Record	Yes

Cause	Corrective Actions
The heartbeat time is too short	Increase heartbeat time (Index 100C)
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th colspan="2">Description</th></tr>
<tr><td>104</td><td>CbFE</td><td>CANopen bus off fault (CbFE)</td><td colspan="2">CANopen bus off fault</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2" rowspan="2">Action condition</td><td>Hardware</td><td colspan="2">When CANopen card is not installed, CbFE fault occurs.</td></tr>
<tr><td>Software</td><td colspan="2">When the master received wrong communication package, CbFE fault occurs.
Too much interference on BUS
When the CAN_H and CAN_L communication cable is short, the master will receive wrong package, and CbFE fault occurs.</td></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Cycle the power</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Check if the CANopen card is installed</td><td colspan="3">Make sure the CANopen card is installed.</td></tr>
<tr><td colspan="2">Check if the CANopen speed is correct</td><td colspan="3">Reset CANopen speed (Pr. 09-37)</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="3">1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
2. Make sure the communication circuit is wired in series.
3. Use CANopen cable or add terminating resistance.</td></tr>
<tr><td colspan="2">Communication cable is broken or bad connected</td><td colspan="3">Check or replace the communication cable.</td></tr>
</table>

ID No.	Display	Fault Name	Description
105	CIdE	CANopen index error (CIdE)	CANopen index error
Action and Reset			
Action condition		Software detection	
Action time		Act immediately	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Upper unit sends a reset package to clear this fault	
Record		Yes	
Cause		Corrective Actions	
Incorrect setting of CANopen index		Reset CANopen Index (Pr. 00-02=7)	

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>106</td><td>CAdE</td><td>CANopen station address error (CAdE)</td><td>CANopen station address error (only supports 1 – 127)</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset (Pr.00-02=7)</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect setting of CANopen station address</td><td colspan="2">1. Disable CANopen (Pr.09-36=0)
2. Reset CANopen (Pr.00-02=7)
3. Reset CANopen station address (Pr.09-36)</td></tr>
</table>

ID No.	Display	Fault Name	Description
107	CFrE	CANopen memory error (CFrE)	CANopen memory error
Action and Reset			
Action condition	When the user update firmware version of the control board, but the FRAM internal data remains the same, then CFrE fault occurs.		
Action time	Act immediately		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Pr. 00-02=7		
Record	Pr. 00-21=3, the fault is recorded		
Cause	Corrective Actions		
CANopen internal memory error	1. Disable CANopen (Pr. 09-36=0) 2. Reset CANopen (Pr. 00-02=7) 3. Reset CANopen station address (Pr. 09-36)		

ID No.	Display	Fault Name	Description
111	ictE	InrCOM time-out error (ictE)	Internal communication time-out

Action and Reset	
Action condition	Pr.09-31=-1 ~ -10 (there is no -9), when the internal communication between Slave and Master is abnormal, IctE fault occurs.
Action time	Act immediately
Fault treatment parameter	N/A
Reset method	Automatically reset after the internal communication is normal
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degrees for effective anti-interference performance.
The communication condition is different with the upper unit	Verify the setting of Pr. 09-04 is the same as the setting of upper unit.
Communication cable is broken or bad connected	Check or replace the communication cable.

ID No.	Display	Fault Name	Description
121	CP20	Internal communication error (CP20)	Internal communication time-out
Action and Reset			
Action condition	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	N/A		
Record	Yes		
Cause	Corrective Actions		
Internal communication error	Contact your local distributor or Delta.		

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>123</td><td>CP22</td><td>Internal communication error (CP22)</td><td>Abnormal internal communication</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Internal communication error</td><td colspan="2">Contact your local distributor or Delta.</td></tr>
</table>

ID No.	Display	Fault Name	Description
124	CP30	Internal communication error (CP30)	Abnormal internal communication
Action and Reset			
Action condition		Software detection	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		N/A	
Record		Yes	
Cause		Corrective Actions	
Internal communication error		Contact your local distributor or Delta.	

ID No.	Display	Fault Name	Description
126	CP32	Internal communication error (CP32)	Abnormal internal communication

Action and Reset	
Action condition	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	N/A
Record	Yes
Cause	**Corrective Actions**
Internal communication error	Contact your local distributor or Delta.

ID No.	Display	Fault Name	Description
127	CP33	Internal communication error (CP33)	Abnormal internal communication
Action and Reset			
Action condition	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	N/A		
Record	Yes		
Cause	Corrective Actions		
Internal communication error	Contact your local distributor or Delta.		

ID No.	Display	Fault Name	Description
128	ot3	Over-torque 3 (ot3)	When the output current exceeds the over-torque detection level (Pr.14-75) and exceeds over-torque detection time (Pr.14-76), and when Pr.14-74 is set to 2 or 4, the ot3 error displays.

Action and Reset		
Action condition	Pr.14-75	
Action time	Pr.14-76	
Fault treatment parameter	Pr.14-74 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
Reset method	Auto	When Pr.14-74=1 or 3, ot3 is a “Warning”. The warning is automatically cleared when the output current < Pr.14-75.
	Manual	When Pr.14-74=2 or 4, ot3 is a “Fault”. You must reset manually.
Reset condition	Immediately reset	
Record	Pr.14-74=2 or 4, ot3 is a “Fault”, and the fault is recorded.	

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr.14-75 and Pr.14-76
Mechanical failure (e.g. over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Accel./ Decel. time and working cycle are too short	Increase the setting for Pr.01-12–Pr.01-19 (accel. / decel. time)
V/F voltage is too high	Adjust the V/F curve (Motor 3, Pr.01-54–01-61), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Increase the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-73 torque compensation gain) until the current reduces and the motor does not stall.
Improper parameter settings for speed tracking function (including restart after momentary power loss and restart after fault)	1. Correct the parameter settings for speed tracking. 2. Start the speed tracking function. 3. Adjust the maximum current for Pr.07-09 speed tracking.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th colspan="2">Description</th></tr>
<tr><td>129</td><td>ot4</td><td>Over-torque 4
(ot4)</td><td colspan="2">When the output current exceeds the over-torque detection level (Pr.14-78) and exceeds over-torque detection time (Pr.14-79), and when Pr.14-77 is set to 2 or 4, the ot4 error displays.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="3">Pr.14-78</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.14-79</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.14-77
0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.14-77=1 or 3, ot4 is a “Warning”. The warning is automatically cleared when the output current < Pr.14-78.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.14-77=2 or 4, ot4 is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Pr.14-77=2 or 4, ot4 is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect parameter setting</td><td colspan="3">Configure the settings for Pr.14-78 and Pr.14-79 again.</td></tr>
<tr><td colspan="2">Mechanical failure (e.g. over-torque, mechanical lock)</td><td colspan="3">Remove the causes of malfunction.</td></tr>
<tr><td colspan="2">The load is too large</td><td colspan="3">Reduce the load.
Replace the motor with a larger capacity model.</td></tr>
<tr><td colspan="2">Accel./ Decel. time and working cycle are too short</td><td colspan="3">Increase the setting values for Pr.01-12–Pr.01-19 (accel. / decel. time)</td></tr>
<tr><td colspan="2">V/F voltage is too high</td><td colspan="3">Adjust the V/F curve (Motor 4, Pr.01-63–01-70), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).</td></tr>
<tr><td colspan="2">The motor capacity is too small</td><td colspan="3">Replace the motor with a larger capacity model.</td></tr>
<tr><td colspan="2">Overload during low-speed operation</td><td colspan="3">Decrease low-speed operation time.
Increase the motor capacity.</td></tr>
<tr><td colspan="2">Torque compensation is too large</td><td colspan="3">Adjust the torque compensation (refer to Pr.07-75 torque compensation gain) until the current reduces and the motor does not stall.</td></tr>
</table>

Improper parameter settings for speed tracking function (including restart after momentary power loss and restart after fault)	1. Correct the parameter settings for speed tracking. 2. Start the speed tracking function. 3. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Fault Name	Description
134	EoL3	Internal communication error (EoL3)	Electronic thermal relay 3 protection. The drive coasts to stop once it activates.

Action and Reset	
Action condition	Start counting when output current > 105% of the motor 3 rated current.
Action time	Pr.14-81 (If the output current is larger than 105% of the motor 3 rated current again within 60 sec., the counting time reduces and is less than Pr.14-81)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in five seconds after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel. / Decel. time or the working cycle are too short	Increase the setting value for Pr.01-12–01-19 (accel. / decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-54–01-61 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Overload during low-speed operation. When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motor, Pr.06-13=0 (electronic thermal relay selection motor 1 = inverter motor)	Pr.14-80 = 1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.14-80 electronic thermal relay 3 selection = 2 disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-73 torque compensation gain) until the current reduces and the motor does not stall.

Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID No.	Display	Fault Name	Description
135	EoL4	Internal communication error (EoL4)	Electronic thermal relay 4 protection. The drive coasts to stop once it activates.

Action and Reset	
Action condition	Start counting when the output current > 105% of the motor 4 rated current.
Action time	Pr.14-83 (If the output current is larger than 105% of motor 4 rated current again within 60 sec., the counting time reduces and is less than Pr.14-83)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in five seconds after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel. / Decel. time or the working cycle are too short	Increase the setting value for Pr.01-12–01-19 (accel. / decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-62–01-70 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Overload during low-speed operation. When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motor, Pr.06-13=0 (electronic thermal relay selection motor 1 = inverter motor)	Pr.14-82 = 1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.14-82 electronic thermal relay 4 selection = 2 disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-75 torque compensation gain) until the current reduces and the motor does not stall.

Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID No.	Display	Fault Name	Description
140	Hd6	GFF detected when power is on (Hd6)	The ground current short circuit detected when power is on.
Action and Reset			
Action condition	Reset the software.		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
The length of motor cable is too long.	Use a shorter cable or install an output reactor.		
Check if the motor cable is abnormal or broken.	Check or replace the cable.		
Hardware failure	IGBT broken. Return to the factory for repair.		
Drive’s current feedback line error	Cycle the power. If Hd6 still occurs during operation, return to the factory for repair.		

ID No.	Display	Fault Name	Description
141	b4GFF	GFF occurs before running (b4GFF)	The ground short circuit detected when output wiring detection is performed before the drive runs.
Action and Reset			
Action condition	250% of the rated current		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset in 5 sec. after the fault is cleared.		
Record	Yes		
Cause	Corrective Actions		
Incorrect motor wiring	Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct.		
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.		
Check for possible burnout or aging insulation of the motor.	Check the motor insulation value with megger. Replace the motor if the insulation is poor.		

ID No.	Display	Fault Name	Description
142	AuE1	Auto-tune error 1 (AUE1)	No feedback current error when motor parameter automatically detects.
Action and Reset			
Action condition	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
Motor is not wired.	Wire the motor correctly.		
The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).	Verify that the electromagnetic valve is closed.		

ID No.	Display	Fault Name	Description
143	AUE2	Auto-tune error 2 (AUE2)	Motor phase loss error when motor parameter automatically detects.

Action and Reset	
Action condition	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Incorrect motor wiring	Wire the motor correctly.
Motor error	Check if the motor works normally.
The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).	Verify that the three-phases of the electromagnetic valve are all closed.
Motor U/V/W wire error	Check if the wires are broken.

ID No.	Display	Fault Name	Description
144		Auto-tune error 3 (AUE3)	No load current I_0 measurement error when motor parameter automatically detects.
Action and Reset			
Action condition	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
Incorrect settings for the motor parameter (rated current)	Check the settings for Pr.05-01 / Pr.05-13 / Pr.05-34.		
Motor error	Check if the motor works normally.		

Chapter 15 CANopen Overview

15-1 CANopen Overview

15-2 Wiring for CANopen

15-3 CANopen Communication Interface Descreptions

15-4 CANopen Supporting Index

15-5 CANopen Fault Codes

15-6 CANopen LED Functions

The built-in CANopen function is a kind of remote control. You can control the AC motor drive using the CANopen protocol. CANopen is a CAN-based higher layer protocol that provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO), and special functions (Time Stamp, Sync message, and Emergency message). It also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to the CiA website http://www.can-cia.org/ for details. The content of this instruction sheet may be revised without prior notice. Consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation.

Delta CANopen supported functions:

- Supports CAN2.0A Protocol
- Supports CANopen DS301 V4.02
- Supports DSP-402 V2.0

Delta CANopen supported services:

- PDO (Process Data Objects): PDO1–PDO4
- SDO (Service Data Objects):

Initiate SDO Download;

Initiate SDO Upload;

Abort SDO;

You can use the SDO message to configure the slave node and access the Object Dictionary in every node.

- SOP (Special Object Protocol):

Supports default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;

Supports SYNC service;

Supports Emergency service.

- NMT (Network Management):

Supports NMT module control;

Supports NMT Error control;

Supports Boot-up.

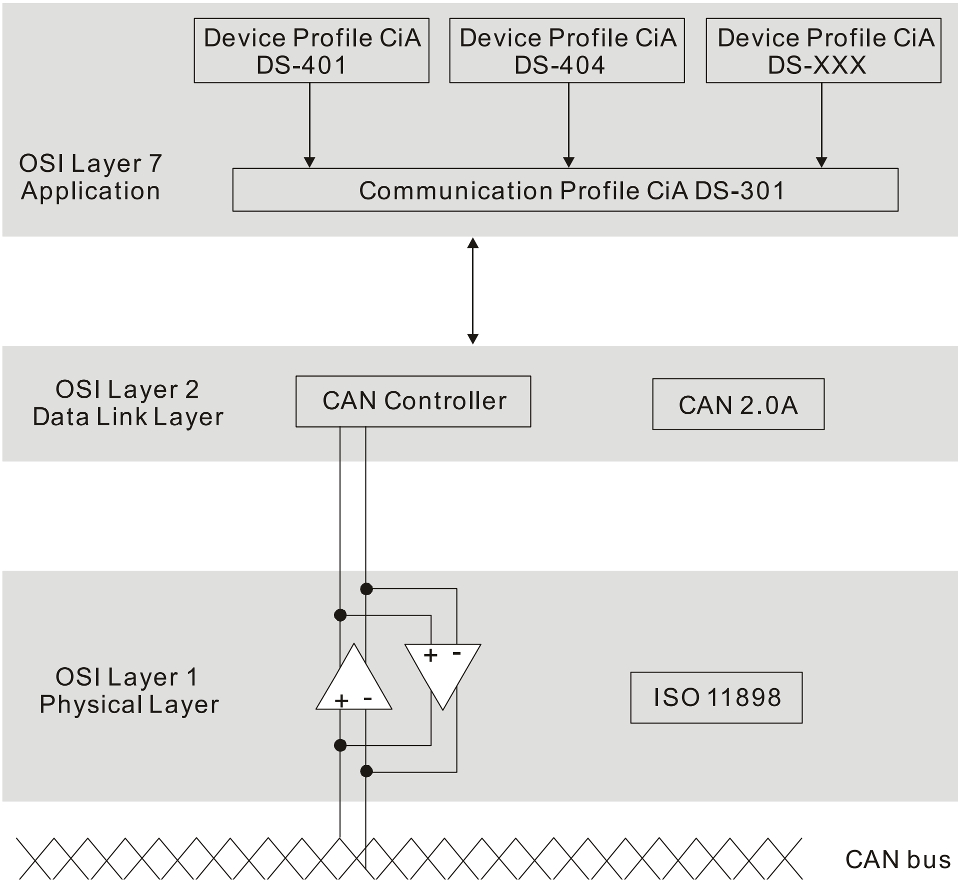
Delta CANopen does not support this service:

- Time Stamp service

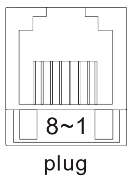
15-1 CANopen Overview

CANopen Protocol

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover the application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).



RJ45 Pin Definition



PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_SGND	Ground / 0 V / V-
6	CAN_SGND	Ground / 0 V / V-

CANopen Communication Protocol contains the following services:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Objects)
- EMCY (Emergency Object)

NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. A network has only one NMT master, and the other nodes are slaves. All CANopen nodes have a present NMT state, and the NMT master can control the state of the slave nodes. The following shows the state diagram of a node:

(1) After power is applied, start in the auto-initialization state
(2) Automatically enter the pre-operational state
(3) (6) Start remote node
(4) (7) Enter the pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Automatically enter reset application state
(16) Automatically enter reset communication state

A: NMT
B: Node Guard
C: SDO
D: Emergency
E: PDO
F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○

SDO (Service Data Objects)

Use SDO to access the Object Dictionary in every CANopen node using the Client / Server model. One SDO has two COB-IDs (request SDO and response SDO) to upload or download data between two nodes. There is no data limit for SDOs to transfer data, but it must transfer data by segment when the data exceeds four bytes with an end signal in the last segment. MH300 series does not support segmented transmission at the moment.

The Object Dictionary (OD) is a group of objects in a CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path in the OD is the index and sub-index; each object has a unique index in the OD, and has a sub-index if necessary. The following shows the request and response frame structure of SDO communication:

Type		Data 0								Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7
		7	6	5	4	3	2	1	0	Index	Index	Index	Data	Data	Data	Data
		command								L	H	Sub	LL	LH	HL	HH
Segmented download	Client	0	0	1	-	N		E	S							
	Server	0	1	1	-	-	-	-	-							
Segmented upload	Client	0	1	0	-	-	-	-	-							
	Server	0	1	0	-	N		E	S							
Pause segment transmission	Client	1	0	0	-	-	-	-	-							
	Server	1	0	0	-	-	-	-	-							

N: No bytes used; E: General (0) / Transferred (1); S: Data size

PDO (Process Data Objects)

PDO communication can be described by the producer / consumer model. Each node of the network listens to the messages of the transmission node and distinguishes whether the message has to be processed or not after receiving the message. A PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and an RxPDO. PDOs are transmitted in a non-confirmed mode. All transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1–240	○		○		
241–251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

Type number 0 indicates the synchronous aperiodic message between two PDO transmissions.
Type number 1–240 indicates the number of SYNC message between two PDO transmissions.
Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.

Type number 253 indicates the data is updated immediately after receiving RTR.
Type number 254: Delta CANopen does not support this transmission format.
Type number 255 indicates the data is an asynchronous aperiodic transmission.

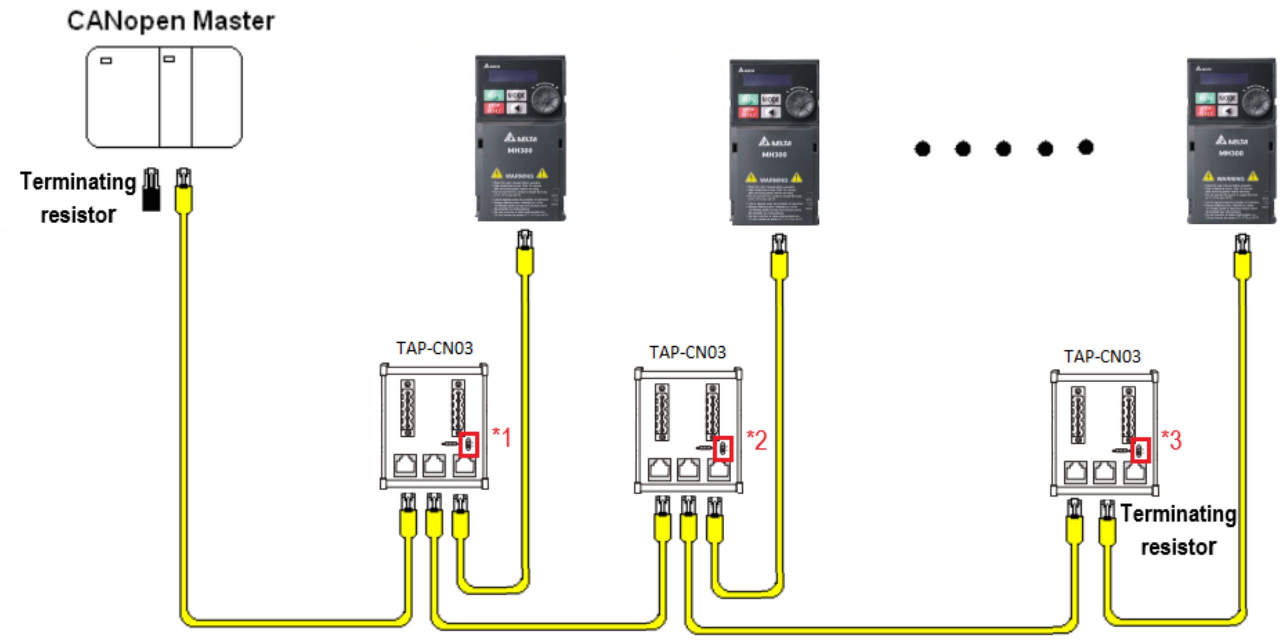
All PDO transmission data must be mapped to the index with Object Dictionary.

EMCY (Emergency Object)

When errors occur inside the hardware, an emergency object is triggered. An emergency object is only sent when an error occurs. As long as there is nothing wrong with the hardware, there is no emergency object warning of an error message.

15-2 Wiring for CANopen

Use an external CANopen communication splitter box (TAP-CN03) for built-in CANopen wiring to connect CANopen to an MH300. The link uses an RJ45 cable. You must terminate the two farthest ends with 120 Ω terminating resistors as shown in the picture below.



*1. Turn the terminal resistor setting switch SW to **OFF**.

*2. Turn the terminal resistor setting switch SW to **OFF**.

*3. Turn the terminal resistor setting switch SW to **ON**.

15-3 CANopen Communication Interface Descriptions

15-3-1 CANopen Control Mode Selection

There are two control modes for CANopen: the DS402 standard (Pr.09-40 set to 1) is the default, and the Delta's standard setting (Pr.09-40 set to 0). There are two control modes according to Delta's standard. One is the old control mode (Pr.09-30 = 0); this control mode can only control the motor drive under frequency control. The other mode is a new standard (Pr.09-30 = 1); this new control mode allows the motor drive to be controlled under multiple modes. The MH300 currently supports speed and torque mode. The following table shows the control mode definitions:

CANopen Control Mode Selection	Control Mode							
	Speed		Torque		Position		Home	
	Index	Description	Index	Description	Index	Description	Index	Description
DS402 Standard Pr.09-40=1	6042-00	Target Rotating Speed (RPM)	6071-00	Target Torque (%)	607A-00	Target Position	-----	-----
	-----	-----	6072-00	Max. Torque Limit (%)	-----	-----	-----	-----
Delta Standard (Old definition) Pr.09-40=1, Pr.09-30=0	2020-02	Target Rotating Speed (Hz)	-----	-----	-----	-----	-----	-----
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	2060-03	Target Rotating Speed (Hz)	2060-07	Target Torque (%)	2060-05	Target Position	-----	-----
	2060-04	Torque Limit (%)	2060-08	Speed Limit (Hz)	-----	-----	-----	-----

CANopen Control Mode Selection	Operation Control	
	Index	Description
DS402 Standard Pr.09-40=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) Pr.09-40=1, Pr.09-30=0	2020-01	Operation Command
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	2060-01	Operation Command
	-----	-----

CANopen Control Mode Selection	Others	
	Index	Description
DS402 Standard Pr.09-40=1	605A-00	Quick stop processing mode
	605C-00	Disable operation processing mode
Delta Standard (Old definition) Pr.09-40=1, Pr.09-30=0	-----	-----
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	-----	-----
	-----	-----

You can use some indices in either DS402 or Delta's standard.

For example:

1. Indices that are defined as RO attributes.
2. The corresponding index of available parameter groups: (2000-00–200E-XX)
3. Accelerating / Decelerating Index: 604F 6050

15-3-2 DS402 Standard Control Mode

15-3-2-1 Related set up for an AC motor drive (following the DS402 standard)

If you want to use the DS402 standard to control the motor drive, follow these steps:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen).
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control. (RUN / STOP, forward / reverse run, etc.)
3. Set the frequency source: set Pr.00-20 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set the torque source: set Pr.11-33. Choose the source for the Torque command from the CANopen setting.
5. Set the position source: set Pr.11-40. Choose the source for the Position command from the CANopen setting.
6. Set DS402 for the control mode: Pr.09-40 = 1
7. Set the CANopen station: set the CANopen station (range 1–127, 0 is the disable CANopen slave function) with Pr.09-36.
   NOTE: set Pr.00-02 = 7 to reset if the station number error CAdE or CANopen memory error CFrE appears.
8. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps (0), 500 Kbps (1), 250 Kbps (2), 125 Kbps (3), 100 Kbps (4) or 50 Kbps (5)).
9. Set the multiple input functions to Quick Stop. You can also choose enable or disable; the default setting is disabled. If it is necessary to enable the function, set MI terminal to 53 in one of the following parameters: Pr.02-01–02-07 or Pr.02-26–02-28. Note: This function is available in DS402 only.

15-3-2-2 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 statuses as described below.

3 blocks

1. Power Disable: without PWM output
2. Power Enable: with PWM output
3. Fault: one or more errors have occurred.

9 status

1. Start: power on
2. Not Ready to Switch On: the motor drive is initiating.
3. Switch On Disable: occurs when the motor drive finishes initiating.
4. Ready to Switch On: warming up before running.
5. Switch On: the motor drive has the PWM output, but the reference command is not effective.
6. Operation Enable: able to control normally.
7. Quick Stop Active: when there is a Quick Stop request, stop running the motor drive.
8. Fault Reaction Active: the motor drive detects conditions which might trigger error(s).
9. Fault: one or more errors have occurred in the motor drive.

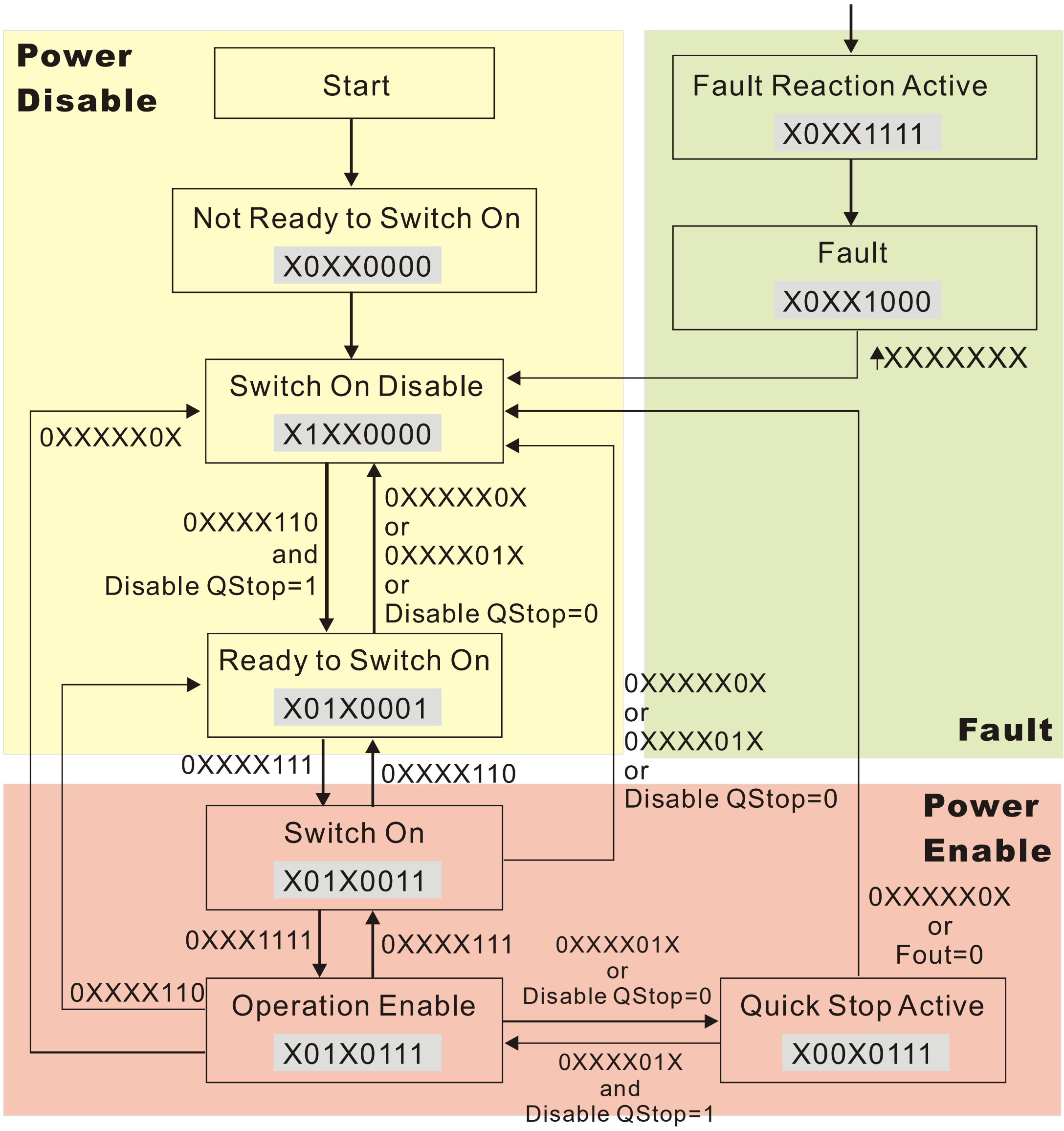
When the motor drive turns on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operation Enable status. To do this, set the control word's bit0–bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described below:

Index 6040

15–9	8	7	6–4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15–14	13–12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on



Set command 6040 = 0xE, and then set another command 6040 = 0xF. Then you can switch the motor drive to Operation Enable. The Index 605A determines the direction of the lines from Operation Enable when the control mode changes from Quick Stop Active. When the setting value is 5–7, both direction lines are active, but when the setting value of 605A is not 5–7, once the motor drive is switched to Quick Stop Active, it is not able to switch back to Operation Enable.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function 1: Slow down on slow down ramp 2: Slow down on quick stop ramp 5: Slow down on slow down ramp and stay in Quick Stop 6: Slow down on quick stop ramp and stay in Quick Stop 7: Slow down on the current limit and stay in Quick Stop

When the control section switches from Power Enable to Power Disable, use 605C to define the stop method.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function.

15-3-2-3 Various mode control method (by following DS402 standard)

Speed mode:

1. Set MH300 to speed control mode: set Index6060 to 2.
2. Switch to Operation Enable mode: set 6040 = 0xE, and then set 6040 = 0xF.
3. Set the target frequency: set target frequency for 6042, since the operation unit of 6042 is rpm, a transform is required:

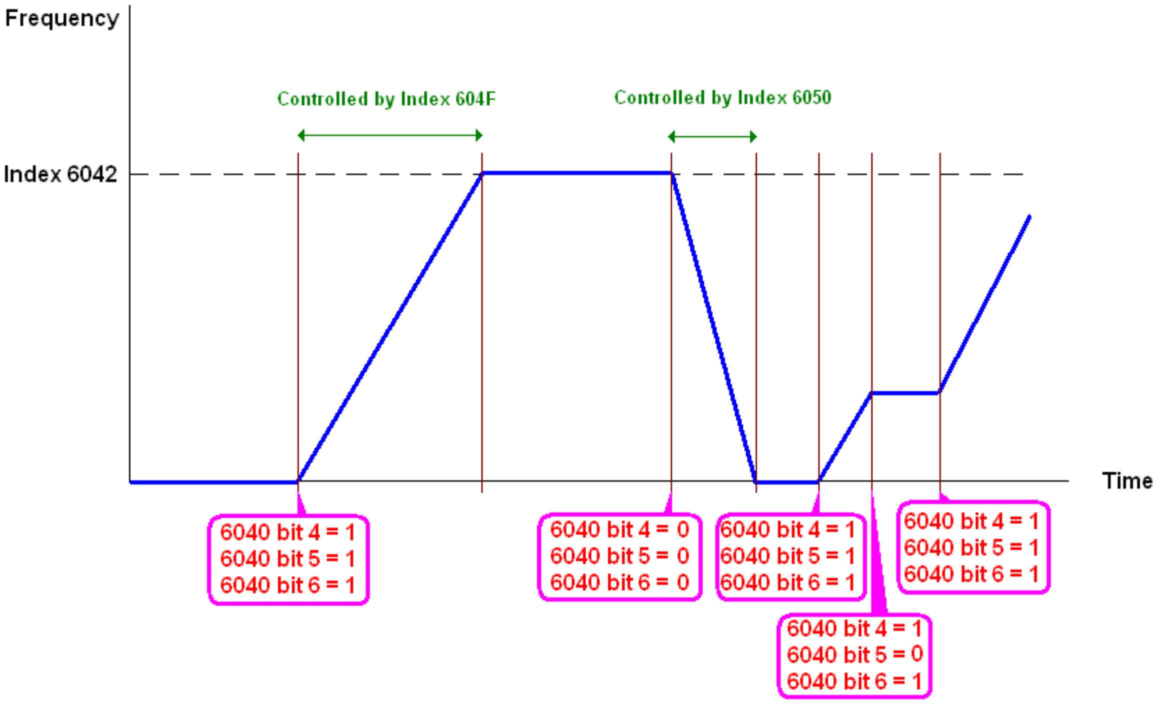
   $$n = f \times \frac{120}{p}$$

   n: rotation speed (rpm) (rounds/minute)
   p: number of poles in the motor (Pole)
   f: rotation frequency (Hz)

   For example:

   Set 6042H = 1500 (rpm), if the number of poles is 4 (Pr.05-04, Pr.05-16, Pr.05-67, or Pr.05-73), then the motor drive's operation frequency is 1500 (120/4) = 50 Hz. The 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter-clockwise.
4. To set acceleration and deceleration: use 604F (Acceleration) and 6050 (Deceleration).
5. Trigger an ACK signal: in the speed control mode, the bit 6–4 of Index 6040 needs to be controlled. It is defined below:

	Index 6040			SUM
	bit 6	bit 5	bit 4	
Speed mode (Index 6060 = 2)	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0 Hz.



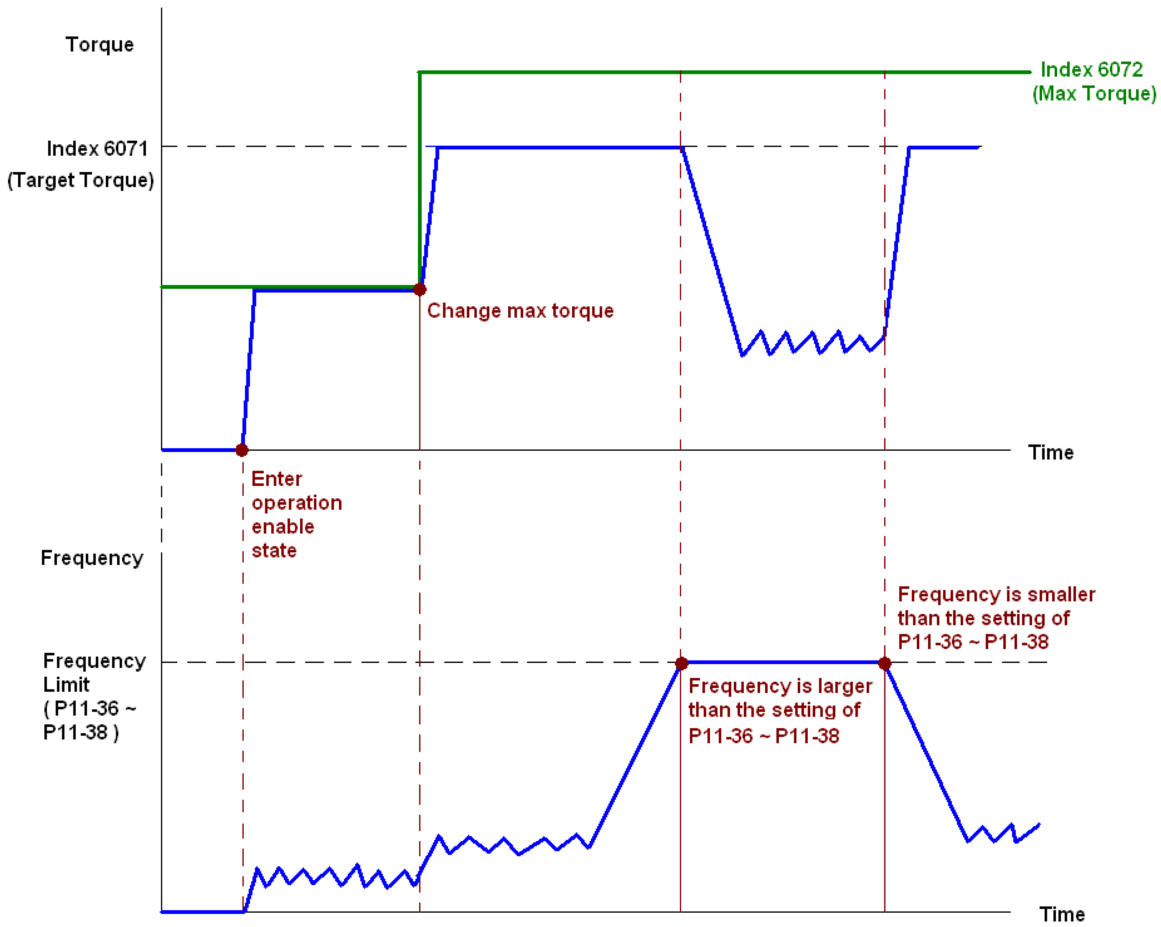
NOTE:

1. Read 6043 to get the current rotation speed (unit: rpm).
2. Read bit 10 of 6041 to find if the rotation speed has reached the targeting value (0: Not reached; 1: Reached).

Torque mode:

1. Set AC motor drive to the torque mode: set index 6060 = 4. (index 6042 is available for speed limit under the torque control mode)
2. Switch to Operation Enable mode: set 6040 = 0xE, and then set 6040 = 0xF.
3. To set targeting torque: set 6071 as targeting torque and 6072 as the largest output torque.

Torque mode (Index 6060 = 4)	Index 6040			SUM
	bit 6	bit 5	bit 4	
	X	X	X	RUN to reach the targeting torque.

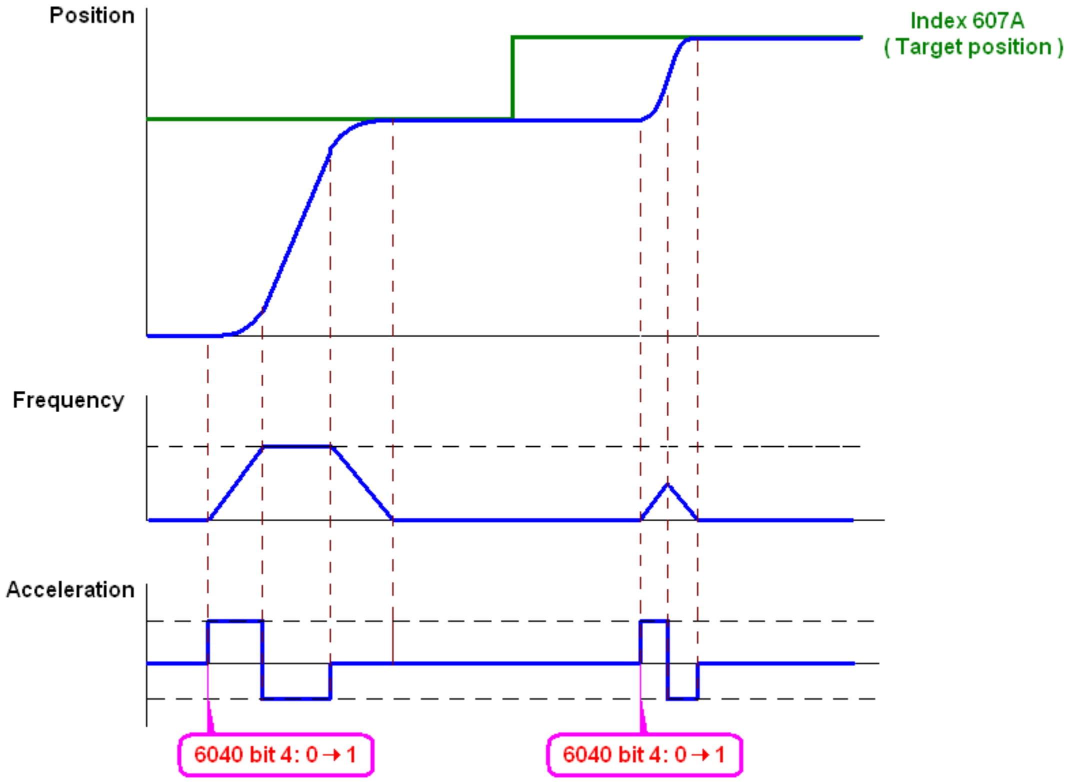


NOTE:

1. There is no maximum speed limit in standard DS402. Therefore, if the drive is using DS402 as the control method, then the maximum speed limit follows the settings of Pr.11-36–11-38.
2. Read 6077 to know the present current. (Unit: 0.1%)
3. Determine that the torque reaches the setting value or not by bit10 of 6041. (0: not reached; 1: reached)

Position mode

1. Set the parameter of a trapezium curve to define position control (Pr.11-43 Max. Frequency of Point-to-Point Position Control, Pr.11-44 Accel. Time of Point-to-Point Position Control and Pr.11-45 Decel. Time of Point-to-Point Position Control)
2. Set MH300 to position control mode: set Index 6060 = 1.
3. Switch to Operation Enable mode: set 6040 = 0xE, and then set 6040 = 0xF.
4. Set targeting position: set 607A as the targeting position.
5. Trigger an ACK signal: set 6040 = 0x0F, and then set 6040 = 0x1F. (Pulse On).



NOTE:

1. Read 6064 to get the current position.
2. Read bit10 of 6041 to find if the position reaches the targeting position. (0: Not reached, 1: reached)
3. Read bit11 of 6041 to find if the position is over the limited area. (0: in the limit, 1: over the limit)

Home mode

1. Set 6098 = 1–35 to choose a home method.
2. Set the left and right limits correspond to the position of MI terminal.
3. Switch to Home mode: set Index 6060 = 6.
4. Switch to Operation Enable mode: set 6040 = 0xE, and then set 6040 = 0xF.
5. To trigger an ACK signal: set 6040 = 0x0F, and then set 6040 = 0x1F (Pulse On, and the motor drive will be back to home.)

NOTE: Read bit12 of 6041 to find if the home mode is completed. (0: Not reached, 1: reached)

15-3-3 Using the Delta Standard (Old Definition)

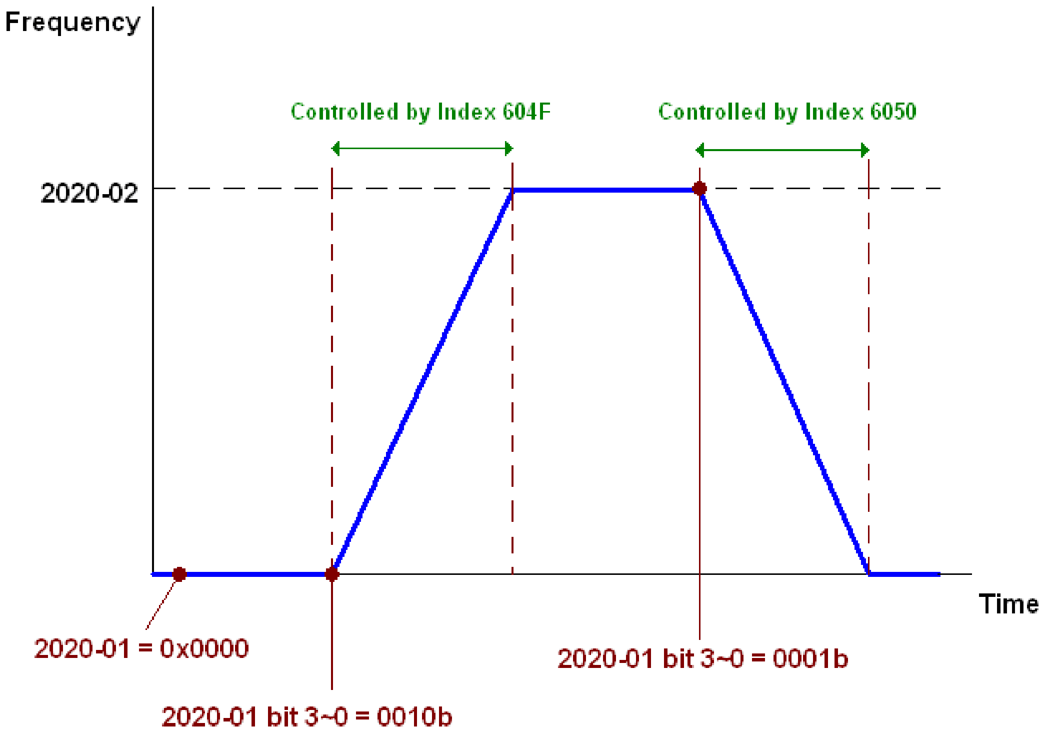
15-3-3-1 Various Mode Control Method (Delta Old Standard)

Follow the steps below:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen).
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control. (RUN / STOP, forward / reverse run, etc.)
3. Set the frequency source: set Pr.00-20 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set Delta Standard (Old definition, only supports speed mode) as the control mode: Pr.09-40 = 0 and Pr.09-30 = 0.
5. Set the CANopen station: set Pr.09-36; the range is between 1–127. When Pr.09-36 = 0, the CANopen slave function is disabled. Note: if an error appears (CAdE or CANopen memory error) as you complete the station setting, set Pr.00-02 = 7 to reset.
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps (0), 500 Kbps (1), 250 Kbps (2), 125 Kbps (3), 100 Kbps (4) and 50 Kbps (5)).

15-3-3-2 Controls Under the Speed Mode

1. Set the target frequency: set 2020-02, the unit is Hz, with 2 decimal places. For example: 1000 is 10.00 Hz.
2. Operation control: set 2020-01 = 0002H for running, and set 2020-01 = 0001H for stopping.



15-3-4 By Using Delta Standard (New Definition)

15-3-4-1 Related Set Up for an AC Motor Drive (Delta New Standard)

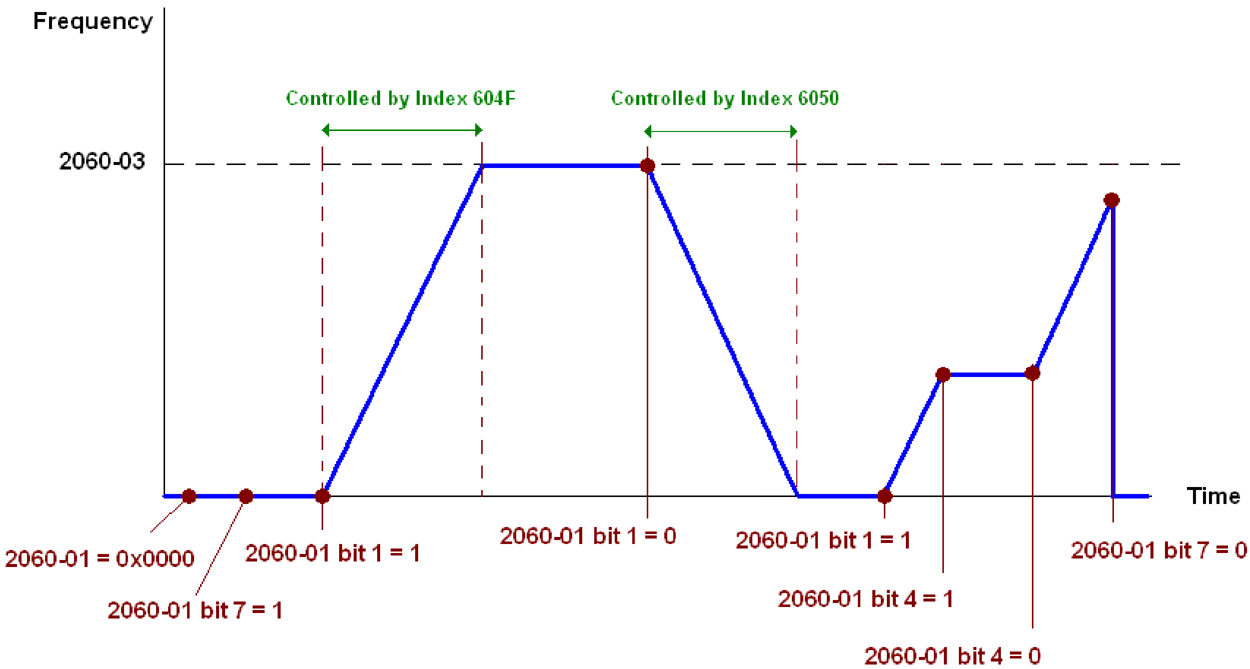
Follow the steps below:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen).
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.00-20 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set the torque source: set Pr.11-33. Choose the source of the Torque Command from CANopen setting.)
5. Set the position source: set Pr.11-40 = 3. Choose the source of the Position Command from CANopen setting.)
6. Set Delta Standard (New definition) as the control mode: Pr.09-40 = 0 and 09-30 = 1.
7. Set the CANopen station: set Pr.09-36; the range is between 1–127. When Pr.09-36 = 0, the CANopen slave function is disabled. Note: if an error appears (CAdE or CANopen memory error) as you complete the station setting, set Pr.00-02 = 7 to reset.
8. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps (0), 500 Kbps (1), 250 Kbps (2), 125 Kbps (3), 100 Kbps (4) and 50 Kbps (5)).

15-3-4-2 Controls Under Various Modes (Delta New Standard)

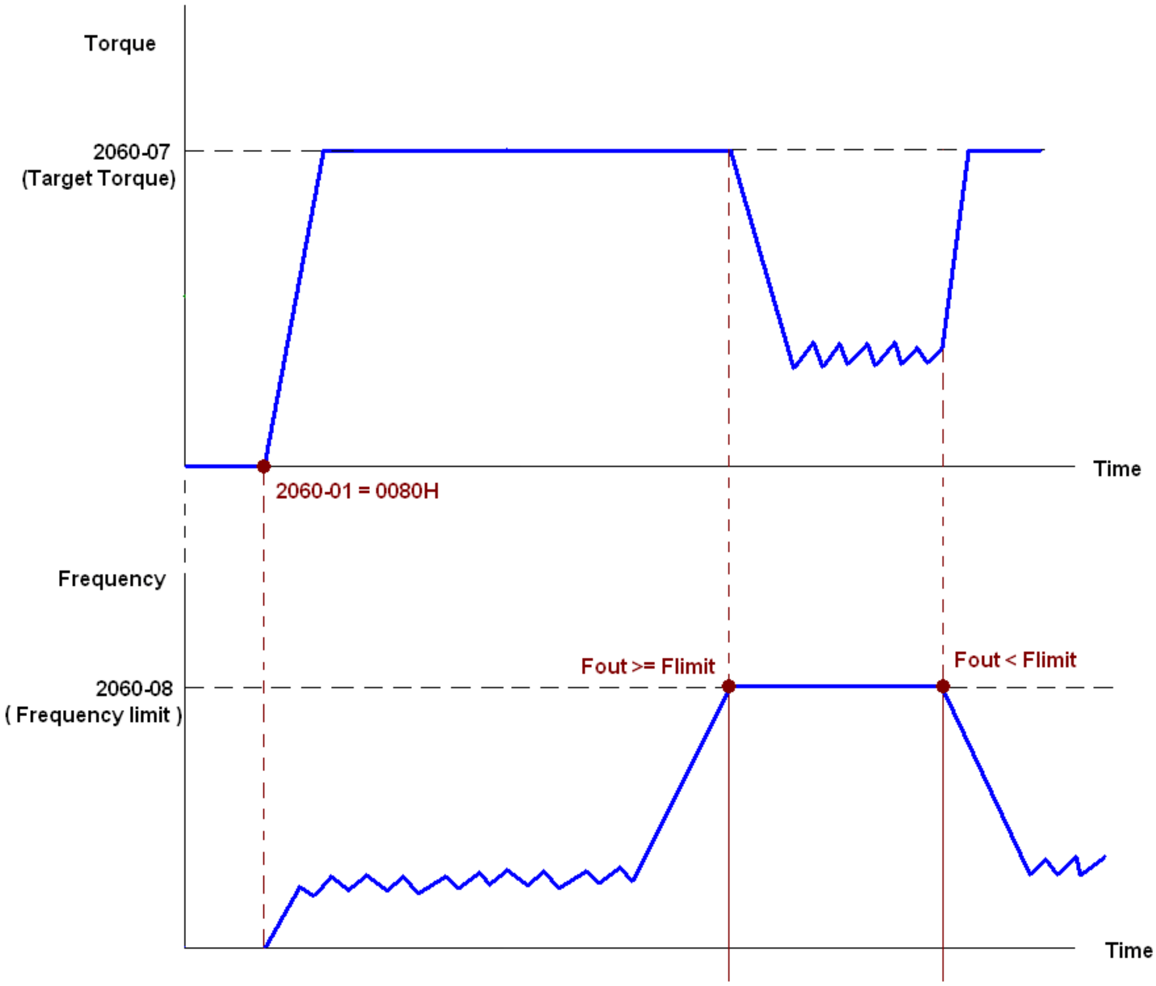
Speed Mode:

1. Set MH300 to speed control mode: set index 6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with 2 decimal places.
   For example: 1000 is 10.00 Hz.
3. Operation control: set 2060-01 = 008H for server on, and set 2060-01 = 0081H for running.



Torque mode:

1. Set MH300 to speed control mode: set index 6060 to 4.
2. Set the target torque: set 2060-07 unit as %, and the value is one decimal place. 100 represents 10.0%.
3. Operation: set 2060-01 = 0080H starts excitation, and the drive immediately runs at the target torque.

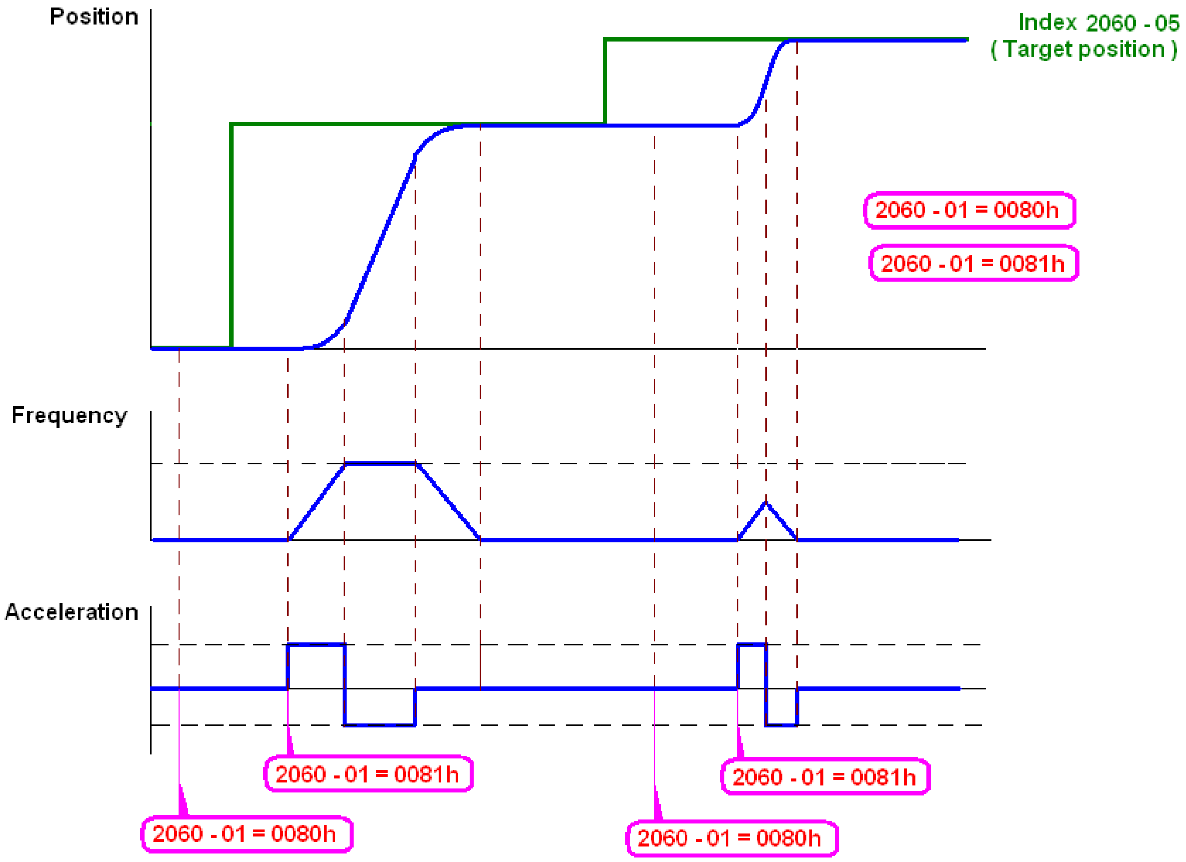


NOTE:

1. Read 2061-07 to know the present current. (Unit: 0.1%)
2. Determine that the torque reaches the setting value or not by bit10 of 2061-01. (0: not reached; 1: reached)
3. If the speed of the drive reaches the speed limit when torque outputs, the output torque may decrease to ensure that the speed stays within the limits.

Position Mode

1. Set the parameter of a trapezium curve to define position control (Pr.11-43 Max. Position Control Frequency), Pr.11-44 Accel. Time of Position Control, Pr.11-45 Decel. Time of Position Control)
2. Set MH300 to position control mode, set Index 6060 = 1.
3. Set 2060-01 = 0080h, then motor drive starts excitation.
4. Set target position: set 2060-05 = target position.
5. Set 2060-01 =0081h to trigger the motor drive runs to the target position.
6. Repeat step 3 to step 5 to move to another position.



NOTE:

1. Read 2061-05 to get the current position.
2. Read bit0 of 2061 to find if the position has reached to the target position. (0: Not reached, 1: Reached).

Home Mode

1. Set 6098 = 1–35 to choose a home method.
2. Set the left and right limits correspond to the position of MI terminal.
3. Switch to home mode: set Index 6060 = 6.
4. Set 2060-01 = 0080h, then the motor drive starts excitation.
5. Set the ACK signal: set 2060-01 = 0081h, then the motor drive starts to go back home.

NOTE: Read bit12 of 6041 to find if returning home is completed. (0: Not reached, 1: Reached).

15-3-5 DI / DO / AI / AO are Controlled through CANopen

To control the DO AO of the motor drive through CANopen, follow these steps:

1. Define the DO to be controlled by CANopen. For example, set Pr.02-13 = 50 to control RY1.
2. Define the AO to be controlled by CANopen. For example, set Pr.03-20 = 20 to control AFM.
3. To control DO, use control Index 2026-41. To control AO, use control 2026-A1. To set RY1 as ON, set bit 0 of Index 2026-41 = 1, then RY1 outputs 1. To control AFM output = 50.00%, set Index 2026-A1 = 5000, then AFM outputs 50%.

The following table shows the mapping of CANopen DI DO AI AO:

DI:

Terminal	Related Parameters	R/W	Mapping Index
MI 1	Pr.02-01	RO	2026-01 bit 2
MI 2	Pr.02-02	RO	2026-01 bit 3
MI 3	Pr.02-03	RO	2026-01 bit 4
MI 4	Pr.02-04	RO	2026-01 bit 5
MI 5	Pr.02-05	RO	2026-01 bit 6
MI 6	Pr.02-06	RO	2026-01 bit 7
MI 7	Pr.02-07	RO	2026-01 bit 8
MI 10	Pr.02-26	RO	2026-01 bit 10
MI 11	Pr.02-27	RO	2026-01 bit 11
MI 12	Pr.02-28	RO	2026-01 bit 12

DO:

Terminal	Related Parameters	R/W	Mapping Index
RY1	Pr.02-13 = 50	RW	2026-41 bit 0
MO1	Pr.02-16 = 50	RW	2026-41 bit 3
MO2	Pr.02-17 = 50	RW	2026-41 bit 4
MO10 (RY10)	Pr.02-36 = 50	RW	2026-41 bit 5
MO11 (RY11)	Pr.02-37 = 50	RW	2026-41 bit 6
MO12 (RY12)	Pr.02-38 = 50	RW	2026-41 bit 7

AI:

Terminal	Related Parameters	R/W	Mapping Index
AVI	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62
AI10	==	RO	Value of 2026-64
AI11	==	RO	Value of 2026-65

AO:

Terminal	Related Parameters	R/W	Mapping Index
AFM	Pr.03-20 = 20	RW	Value of 2026-A1
AO10	Pr.14-12 = 20	RW	Value of 2026-A3
AO11	Pr.14-13 = 20	RW	Value of 2026-A4

15-4 CANopen Supporting Index

MH300 Index:

The parameter index corresponds as shown in this example:

Index	**sub-Index**
2000H + Group	Pr. Number + 1

For example:

Pr.10-15 (Encoder Slip Error Treatment)

Group		**Pr. Number**
10 (0AH)	-	15 (0FH)

Index = 2000H + 0AH = 200A

Sub Index = 0FH + 1H = 10H

MH300 Control Index:

Delta Standard Mode (Old Definition)

<table>
<tr><th>Index</th><th>Sub</th><th>Definition</th><th>Default</th><th>R/W</th><th>Size</th><th colspan="2">Note</th></tr>
<tr><td rowspan="29">2020H</td><td>0</td><td>Number</td><td>3</td><td>R</td><td>U8</td><td></td><td></td></tr>
<tr><td rowspan="28">1</td><td rowspan="28">Control word</td><td rowspan="28">0</td><td rowspan="28">RW</td><td rowspan="28">U16</td><td rowspan="4">bit 1–0</td><td>00B: Disable</td></tr>
<tr><td>01B: Stop</td></tr>
<tr><td>10B: Disable</td></tr>
<tr><td>11B: JOG Enable</td></tr>
<tr><td>bit 3–2</td><td>Reserved</td></tr>
<tr><td rowspan="4">bit 5–4</td><td>00B: Disable</td></tr>
<tr><td>01B: Direction forward</td></tr>
<tr><td>10B: Direction reverse</td></tr>
<tr><td>11B: Switch direction</td></tr>
<tr><td rowspan="4">bit 7–6</td><td>00B: 1st step accel. /decel.</td></tr>
<tr><td>01B: 2nd step accel. /decel.</td></tr>
<tr><td>10B: 3rd step accel. /decel.</td></tr>
<tr><td>11B: 4th step accel. /decel.</td></tr>
<tr><td rowspan="16">bit 11–8</td><td>0000B: Master speed</td></tr>
<tr><td>0001B: 1st step speed</td></tr>
<tr><td>0010B: 2nd step speed</td></tr>
<tr><td>0011B: 3rd step speed</td></tr>
<tr><td>0100B: 4th step speed</td></tr>
<tr><td>0101B: 5th step speed</td></tr>
<tr><td>0110B: 6th step speed</td></tr>
<tr><td>0111B: 7th step speed</td></tr>
<tr><td>1000B: 8th step speed</td></tr>
<tr><td>1001B: 9th step speed</td></tr>
<tr><td>1010B: 10th step speed</td></tr>
<tr><td>1011B: 11th step speed</td></tr>
<tr><td>1100B: 12th step speed</td></tr>
<tr><td>1101B: 13th step speed</td></tr>
<tr><td>1110B: 14th step speed</td></tr>
<tr><td>1111B: 15th step speed</td></tr>
</table>

Index	Sub	Definition	Default	R/W	Size	Note	
2020H						bit 12	1: Enable the function of bit 6-11
						bit 14–13	00B: No function
							01B: Operation command by the digital keypad
							10B: Operation command according to Pr.00-21 setting
							11B: Switch the source of operation command
						bit 15	Reserved
	2	Freq. command (XXX.XX Hz)	0	RW	U16		
	3	Other trigger	0	RW	U16	bit 0	1: E.F. ON
						bit 1	1: Reset
						bit 15–3	Reserved
2021H	0	Number	DH	R	U8		
	1	Error code	0	R	U16		High byte: Warn Code Low Byte: Error Code
	2	AC motor drive status	0	R	U16	bit 1–0	00B: Stop
							01B: Decelerate to stop
							10B: Waiting for operation command
							11B: In operation
						bit 2	1: JOG command
						bit 4–3	00B: Run forward
							01B: Switch from run in reverse to run forward
							10B: Switch from run forward to run in reverse
							11B: Run in reverse
						bit 7–5	Reserved
						bit 8	1: Master Frequency command controlled by communication interface
						bit 9	1: Master Frequency command controlled by analog / external terminal signal input
						bit 10	1: Operation command controlled by communication interface
						bit 11	1: Parameter lock
						bit 12	1: Enable the digital keypad copy parameter function
						bit 15–13	Reserved
	3	Frequency command (XXX.XXHz)	0	R	U16		
	4	Output freq. (XXX.XX Hz)	0	R	U16		

Index	Sub	Definition	Default	R/W	Size	Note
2021H	5	Output current (XXX.XX A)	0	R	U16	When the current is greater than 655.35, it automatically uses a decimal point (XXX.X A). Decimal places can refer to the high byte of 2021-20.
	6	DC BUS voltage (XXX.X V)	0	R	U16	
	7	Output voltage (XXX.X V)	0	R	U16	
	8	The current segment is run by the multi-segment speed command	0	R	U16	
	9	Reserved	0	R	U16	
	A	Display counter value (c)	0	R	U16	
	B	Display output power angle (XXX.X°)	0	R	U16	
	C	Display output torque (XXX.X%)	0	R	U16	
	D	Display motor speed (XXXXX rpm)	0	R	U16	
	E	Number of PG feedback pulses (0–65535)	0	R	U16	
	F	Number of PG2 pulse commands (0–65535)	0	R	U16	
	10	power output (XX.XXX kW)	0	R	U16	
	17	Multi-function display (Pr.00-04)	0	R	U16	
	20	High byte: current number of digits (display)	0	R	U16	
2022H	0	Reserved	0	R	U16	
	1	Display output current (XX.XX A)	0	R	U16	When the current is greater than 655.35, it automatically uses a decimal point (XXX.XA). Decimal places can refer to the high byte of 211F.
	2	Display counter value	0	R	U16	
	3	Display actual output frequency (XXX.XX Hz)	0	R	U16	
	4	Display DC bus voltage (XXX.X V)	0	R	U16	
	5	Display output voltage (XXX.X V)	0	R	U16	
	6	Display output power angle (XXX.X°)	0	R	U16	
	7	Display output power in kW (XX.XXX kW)	0	R	U16	
	8	Display actual motor speed (XXXXX rpm)	0	R	U16	
	9	Display estimate output torque (XXX.X%)	0	R	U16	
	A	Display PG feedback	0	R	U16	

Index	Sub	Definition	Default	R/W	Size	Note	
2022H	B	Display PID feedback value after enabling the PID function in % (XXX.XX%)	0	R	U16		
	C	Display signal for AVI analog input terminal, 0–10 V corresponds to 0–100% (to two decimal places)	0	R	U16		
	D	Display signal of ACI analog input terminal, 4–20 mA/0–10 V corresponds to 0-100% (to two decimal places)	0	R	U16		
	F	Display the IGBT temperature of drive power module (XXX.X ºC)	0	R	U16		
	11	The status of digital input (ON/OFF), refer to Pr.02-12	0	R	U16		
	12	The status of digital output (ON/OFF), refer to Pr.02-18	0	R	U16		
	13	Display the multi-step speed that is executing	0	R	U16		
	14	The corresponding CPU pin status of digital input	0	R	U16		
	15	The corresponding CPU pin status of digital output	0	R	U16		
	16	Number of actual motor revolutions (PG1 of PG card). Starts from 9 when the actual operation direction is changed, or the keypad display at stop is 0. Maximum is 65535.	0	R	U16		
	17	Pulse input frequency (PG2 of PG card) (XXX.XX Hz)	0	R	U16		
	18	Pulse input position (PG card PG2), maximum setting is 65535.	0	R	U16		
	1A	Display times of counter overload (0.00–100.00%)	0	R	U16		
	1B	Display GFF in % (XXX.XX%)	0	R	U16		
	1C	Display DC bus voltage ripples (XXX.X V_{DC}) (r.)	0	R	U16		
	1D	Display PLC register D1043 data	0	R	U16		
	1E	Display number of poles of permanent magnet motor	0	R	U16		
	1F	User page displays the value in physical measure	0	R	U16		

Index	Sub	Definition	Default	R/W	Size	Note	
2022H	20	Output the value of Pr.00-05	0	R	U16		
	21	Number of motor turns when drive operates (Z-phase)	0	R	U16		
	22	Operation position of motor	0	R	U16		
	25	Carrier frequency of the drive (XX kHz)	0	R	U16		
	26	Reserved					
	27	Status of the drive bit 1–0 00b: No direction 01b: Forward 10b: Reverse bit 3–2 01b: Drive ready 10b: Error bit 4 0b: No drive output 1b: The drive with output bit 5 0b: No warning 01b: There is a warning					
	28	The estimated positive and negative output torque of the drive					
	29	Torque command (XXX.X%)					
	2A	KWH display (XXXX.X)					
	2B	PG2 pulse input in low word					
	2C	PG2 pulse input in high word					
	2D	Motor actual position in low word					
	2E	Motor actual position in high word					
	2F	PID reference target (XXX.XX%)					
	30	PID offset (XXX.XX%)					
	31	PID output frequency (XXX.XX Hz)					

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to different input terminals.
	02h	R	Each bit corresponds to different input terminals.
	03h–40h	R	Reserved
	41h	RW	Each bit corresponds to different output terminals.
	42h–60h	R	Reserved
	61h	R	AVI (%)
	62h	R	ACI (%)
	63h	R	Reserved
	64h		AI10 (%)
	65h		AI11 (%)
	66h–A0h	R	Reserved
	A1h	RW	AFM (%)
	A3h	RW	AO10 (%)
	A4h	RW	AO11 (%)

Index 2026-01	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	MI1	MI2	MI3	MI4	MI5	MI6	MI7									
2											MI10	MI11	MI12	MI13	MI14	MI15

1: Control broad I/O

2: Add external card, EMM-D33A (D1022 = 10)

Index 2026-41	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	RY1			MO1	MO2											
2						MO10	MO11	MO12								
3						RY10	RY11									
4						RY10	RY11	RY12								

1: Control broad I/O

2: Add external card, EMM-D33A (D1022 = 10)

3: Add external card, EMM-R2CA (D1022 = 12)

4: Add external card, EMM-R3AA (D1022 = 13)

Delta Standard Mode (New Definition)

Index	sub	R/W	Size	Descriptions bit	Definition	Priority	Speed Mode	Position Mode	Home Mode	Torque Mode
2060h	00h	R	U8						0: Stop Homing	
	01h	RW	U16	0	Ack	4	0: fcmd =0 1: fcmd = Fset(Fpid)	Pulse 1: Position control	Pulse 1: Return to home	
				1	Dir	4	0: FWD run command 1: REV run command			
				2				0: Relative move 1: Absolute move		
				3	Halt	3	0: drive run till target speed is attained 1: drive stop by deceleration setting			The torque target of internal decoding is set as 0, but the display of outside torque target will remain its outside setting.
				4	Hold	4	0: drive run till target speed is attained 1: frequency stop at current frequency			
				5	JOG	4	0: JOG OFF Pulse 1: JOG RUN			
				6	Qstop	2	Quick Stop	Quick Stop	Quick Stop	Quick Stop
				7	Power	1	0: Power OFF 1: Power ON	0: Power OFF 1: Power ON	0: Power OFF 1: Power ON	0: Power OFF 1: Power ON
				8	Ext Cmd2	4	0→1: Absolute position cleared	0→1: Absolute position cleared	0→1: Absolute position cleared	0→1: Absolute position cleared
				14–9	Reserved					
				15	RST		Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared
	02h	RW	U16		Mode Cmd		0: Speed mode	1: P2P position mode	3: Home mode	2: Torque mode
	03h	RW	U16				Speed command (unsigned decimal)			
	04h	RW	U16							
	05h	RW	S32					Position command		
	06h	RW								
	07h	RW	U16							Torque command (signed decimal)
	08h	RW	U16							Speed limit (unsigned decimal)
2061h	01h	R	U16	0	Arrive		Frequency command reached	Position attained	Homing complete	Torque attained
				1	Dir		0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run
				2	Warn		Warning occurs	Warning	Warning	Warning
				3	Error		Error detected	Error detected	Error detected	Error detected
				4						
				5	JOG		JOG	JOG	JOG	JOG
				6	Qstop		Quick stop	Quick stop	Quick stop	Quick stop
				7	Power On		Switch ON	Switch ON	Switch ON	Switch ON
				15–8						
	02h	R								
	03h	R	U16				Actual output frequency	Actual output frequency	Actual output frequency	Actual output frequency
	04h	R								

Index	sub	R/W	Size	Descriptions			Speed Mode	Position Mode	Home Mode	Torque Mode
				bit	Definition	Priority				
2061h	05h	R	S32				Actual position (absolute)	Actual position (absolute)	Actual position (absolute)	Actual position (absolute)
	06h	R								
	07h	R	S16				Actual torque	Actual torque	Actual torque	Actual torque

DS402 Standard

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action 2: Disable voltage 3: Quick Stop
603Fh	0	Error code	0	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be 100 ms, and check if the setting is 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function 1: Slow down on slow down ramp 2: Slow down on quick stop ramp 5: Slow down on slow down ramp and stay in QUICK STOP 6: Slow down on quick stop ramp and stay in QUICK STOP
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function
6060h	0	Mode of operation	2	RW	S8		Yes		1: Profile Position mode 2: Velocity mode 4: Torque Profile mode 6: Homing mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above
6062H	0	Position demand value	0	RO	S32	pulse	Yes		
6064H	0	Position actual value	0	RO	S32	pulse	Yes		
6071H	0	Target torque	0	RW	S16	0.1%	Yes	tq	Valid unit: 1%
6072H	0	Max torque	1500	RW	U16	0.1%	Yes	tq	Valid unit: 1%
6075H	0	Motor rated current	0	RO	U32	mA	No	tq	
6077H	0	Torque actual value	0	RO	S16	0.1%	Yes	tq	
6078H	0	Current actual value	0	RO	S16	0.1%	Yes	tq	
6079H	0	DC link circuit voltage	0	RO	U32	mV	No	tq	
607AH	0	Target position	0	RW	S32	pulse	Yes		

15-5 CANopen Fault Codes

- The settings are based on Pr.06-17–Pr.06–22 and Pr.14-70–Pr.14-73.
- Refer to Chapter 14 for details about the fault codes.

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
1	ocA	0001H	Over-current during acceleration (ocA)	1	2213H
2	ocd	0002H	Over-current during deceleration (ocd)	1	2213H
3	ocn	0003H	Over-current during steady operation (ocn)	1	2214H
4	GFF	0004H	Ground fault (GFF)	1	2240H
5	occ	0005H	IGBT short circuit between upper bridge and lower bridge (occ)	1	2250H
6	ocS	0006H	Over-current at stop (ocS)	1	2214H
7	ovA	0007H	Over-voltage during acceleration (ovA)	2	3210H
8	ovd	0008H	Over-voltage during deceleration (ovd)	2	3210H
9	ovn	009H	Over-voltage at constant speed (ovn)	2	3210H
10	ovS	000AH	Over-voltage at stop (ovS)	2	3210H
11	LvA	000BH	Low-voltage during acceleration (LvA)	2	3220H
12	Lvd	000CH	Low-voltage during deceleration (Lvd)	2	3220H
13	Lvn	000DH	Low-voltage at constant speed (Lvn)	2	3220H
14	LvS	000EH	Low-voltage at stop (LvS)	2	3220H
15	orP	000FH	Phase loss protection (orP)	2	3130H
16	oH1	0010H	IGBT overheating (oH1)	3	4310H
17	oH2	0011H	Over-heat key components (oH2)	3	4310H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
18	tH1o	0012H	IGBT temperature detection failure (tH1o)	3	FF00H
19	tH2o	0013H	Capacitor hardware fault (tH2o)	3	FF01H
21	oL	0015H	Overload (oL)	1	2310H
22	EoL1	0016H	Electronic thermal relay 1 protection (EoL1)	1	2310H
23	EoL2	0017H	Electronic thermal relay 2 protection (EoL2)	1	2310H
24	oH3	0018H	Motor overheating (oH3)	3	FF20H
26	ot1	001AH	Over-torque 1 (ot1)	3	8311H
27	ot2	001BH	Over-torque 2 (ot1)	3	8311H
28	uC	001CH	Under current (uC)	1	8321H
29	LiT	001DH	Limit Error (LiT)	1	7320H
31	cF2	001FH	EEPROM read error (cF2).	5	5530H
33	cd1	0021H	U-phase error (cd1)	1	FF04H
34	cd2	0022H	V-phase error (cd2)	1	FF05H
35	cd3	0023H	W-phase error (cd3)	1	FF06H
36	Hd0	0024H	CC (current clamp) hardware failure (Hd0)	5	FF07H
37	Hd1	0025H	OC hardware failure (Hd1)	5	FF08H
40	AUE	0028H	Auto-tuning error (AUE)	1	FF21H
41	AFE	0029H	PID loss ACI (AFE)	7	FF22H
42	PGF1	002AH	PG feedback error (PGF1)	7	7301H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
43	PGF2	002BH	PG feedback loss (PGF2)	7	7301H
44	PGF3	002CH	PG feedback stall (GF3)	7	7301H
45	PGF4	002DH	PG slip error (PGF4)	7	7301H
48	ACE	0030H	ACI loss (ACE)	1	FF25H
49	EF	0031H	External fault (EF)	5	9000H
50	EF1	0032H	Emergency stop (EF1)	5	9000H
51	bb	0033H	External base block (bb)	5	9000H
52	Pcod	0034H	Password is locked (Pcod)	5	FF26H
54	CE1	0036H	Illegal command (CE1)	4	7500H
55	CE2	0037H	Illegal data address (CE2)	4	7500H
56	CE3	0038H	Illegal data value (CE3)	4	7500H
57	CE4	0039H	Data is written to read-only address (CE4)	4	7500H
58	CE10	003AH	Modbus transmission time-out (CE10)	4	7500H
61	ydc	003DH	Y-connection / Δ-connection switch fault (ydc)	2	3330H
62	dEb	003EH	Deceleration energy backup fault (dEb)	2	FF27H
63	oSL	003FH	Over slip error (oSL)	7	FF28H
65	PGF5	0041H	Hardware error of PG card (PGF5)	5	FF29H
72	STL1	0048H	STO Loss 1 (STL1)	5	FF30H
76	STo	004CH	STO (STo)	5	FF31H

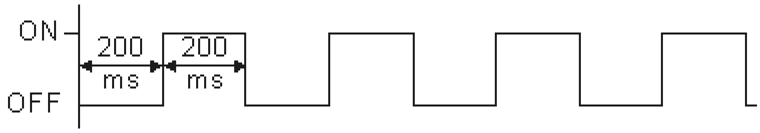
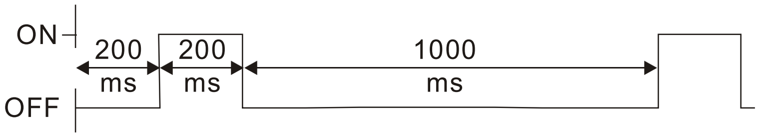
Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
77	STL2	004DH	STO Loss 2 (STL2)	5	FF32H
78	STL3	004EH	STO Loss 3 (STL3)	5	FF33H
79	Aoc	0050H	U-phase short circuit (Aoc)	1	FF2BH
80	boc	0051H	V-phase short circuit (Boc)	1	FF2CH
81	coc	0050H	W-phase short circuit (Coc)	1	FF2DH
82	oPL1	0052H	Output phase loss U phase (oPL1)	2	2331H
83	oPL2	0053H	Output phase loss V phase (oPL2)	2	2332H
84	oPL3	0054H	Output phase loss W phase (oPL3)	2	2333H
87	oL3	0057H	Overload protection at low frequency (oL3)	0	8A00H
89	roPd	0059H	Rotor position detection error (roPd)	0	8A00H
101	CGdE	0065H	CANopen guarding fault (CGdE)	4	8130H
102	CHbE	0066H	CANopen heartbeat fault (CHbE)	4	8130H
104	CbFE	0068H	CANopen bus off fault (CbFE)	4	8140H
105	CidE	0069H	CANopen index error (CIdE)	4	8100H
106	CAdE	006AH	CANopen station address error (CAdE)	4	8100H
107	CFrE	006BH	CANopen memory error (CFrE)	4	8100H
111	ictE	006FH	InrCOM time-out error (ictE)	4	7500H
121	CP20	007AH	Internal communication error (CP20)	7	FF36H
123	CP22	007CH	Internal communication error (CP22)	7	FF38H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
124	CP30	007DH	Internal communication error (CP30)	7	FF39H
126	CP32	0080H	Internal communication error (CP32)	7	FF3BH
127	CP33	0081H	Internal communication error (CP33)	7	FF3CH
128	ot3	0082H	Over-torque 3 (ot3)	1	2310H
129	ot4	0083H	Over-torque 4 (ot4)	1	2310H
134	EoL3	0088H	Internal communication error (EoL3)	1	2310H
135	EoL4	0089H	Internal communication error (EoL4)	1	2310H
140	Hd6	008EH	GFF detected when power is on (Hd6)	1	2240H
141	b4GFF	0090H	GFF occurs before running (b4GFF)	1	2240H
142	AuE1	0091H	Auto-tune error 1 (AUE1)	1	FF3DH
143	AuE2	0092H	Auto-tune error 2 (AUE2)	1	FF3EH
144	AuE3	0093H	Auto-tune error 3 (AUE3)	1	FF3FH

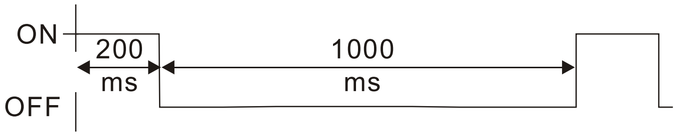
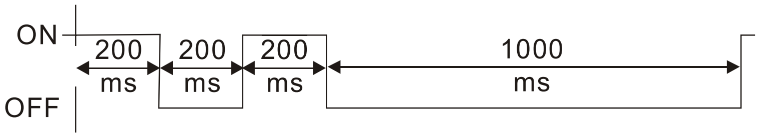
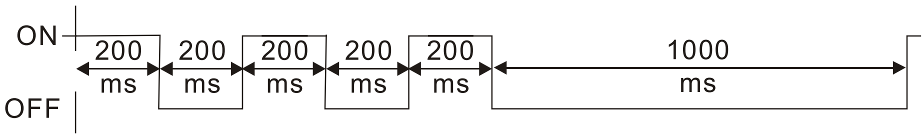
15-6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

RUN LED:

LED status	Condition	CANopen Status
OFF	Keep lighting off	Initial
Blinking		Pre-operation
Single flash		Stopped
ON	Keep lighting on	Operation

ERR LED:

LED status	Condition / Status
OFF	No Error
Single flash	At least one CANopen packet failure 
Double flash	Guarding failure or heartbeat failure 
Triple flash	SYNC failure 
ON	Bus off

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Chapter 16 PLC Function Applications

16-1 PLC Summary

16-2 Notes Before Using a PLC

16-3 Turn On

16-4 Basic Principles of PLC Ladder Diagrams

16-5 Various PLC Device Functions

16-6 Introduction to the Command Window

16-7 Display and Treatment of PLC Related Faults and Codes

16-8 Explanation of Each PLC Mode Control (Speed, Torque)

16-9 Count Function Using Pulse Input

16-10 CANopen Master Control Applications

16-11 Modbus Remote IO Control Applications (Use MODRW)

16-1 PLC Summary

16-1-1 Introduction

The commands provided by the MH300's built-in PLC functions, including the ladder diagram editing tool WPLSoft, as well as the use of basic commands and application commands, follow the operating methods of Delta's PLC DVP series.

16-1-2 WPLSoft ladder diagram editing tool

WPLSoft is Delta's software program for the DVP and MH300 programmable controllers in Windows operating system environment. In addition to general PLC program design and general Windows editing functions (such as cut, paste, copy, and multiple windows), WPLSoft also provides many features such as Chinese/English annotation editing, registry editing, settings, file reading, saving, and contact graphic monitoring and settings.

Table 16-1 lists the basic requirements for installing the WPLSoft editing software:

Item	System requirements
Operating system	Windows 95 / 98 / 2000 / NT / ME / XP / 7 / 10
CPU	At least Pentium 90
Memory	At least 16 MB (it is recommend at least 32 MB)
Hard drive	Hard drive capacity: at least 100 MB of free space One optical drive (to install this software)
Display	Resolution: 640×480, at least 16 colors; it is recommended that the screen area be set at 800×600 pixels.
Mouse	Ordinary mouse or Windows-compatible pointing device
Printer	Printer with Windows driver software
RS-485 port	Must have at least an RS-485 port to link to the PLC
USB port	The USB port on the drive can be connected to the PLC

Table 16-1

16-2 Notes Before Using a PLC

1. The MH300 provides two communication serial ports that you can use to download programs to the PLC (see Figure 16-1 below).
   - Channel 1 (USB port) communication format is the same as channel 2.
   - Channel 2 has a preset communication format of 7, N, 2, 9600; you can change to ASCII in Pr.09-01 (transmission speed) and Pr.09-04 (communication protocol).
2. The PLC preset is node 2; you can change the PLC node in Pr.09-35 (PLC address), but this address may not be the same as the drive's address setting in Pr.09-00 (communication address).

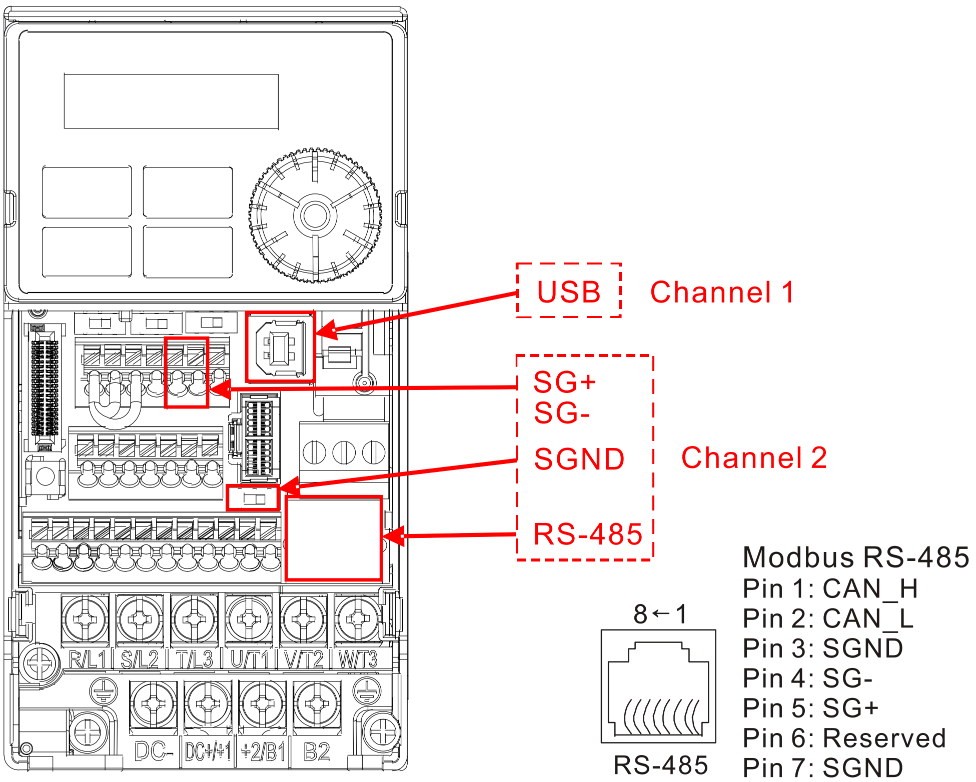


Figure 16-1

3. The host controller can simultaneously access data from the drive and the internal PLC, using the identifier for the node. For instance, if the drive node is 1 and the internal PLC node is 2, then the host controller command depends on the node address:
   - 01 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in drive Pr.04-00.
   - 02 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in internal PLC X0.
4. The PLC program is disabled when uploading/downloading programs.
5. Note that when using WPR commands to write parameters, you may modify values up to a maximum of 10^9 times; otherwise, a memory write error occurs. The number of modifications depends on whether the parameter value has changed. If you do not change the value, it does not change the number of modifications; however, if the entered value is different from before, the number of modifications increases by one.

6. When you set Pr.00-04 to 28, the displayed value is the value of PLC register D1043, as shown below.

Figure 16-2
Digital Keypad KPC-CC01 (optional)
Can display 0–65535

7. In the PLC Run and PLC Stop mode, you cannot set Pr.00-02 to the values 9 or 10, and cannot be reset to the default value.
8. You can reset the PLC to the default value when you set Pr.00-02 to 6.
9. The corresponding MI function is disabled when the PLC writes to input contact X.
10. When the PLC controls the drive operation, the control commands are entirely controlled by the PLC and are not affected by the setting for Pr.00-21.
11. When the PLC controls the drive's Frequency commands (FREQ commands), the Frequency commands are entirely controlled by the PLC, and are not affected by the setting for Pr.00-20 or the HAND ON / OFF configuration.
12. When the PLC controls the drive operation, if the keypad STOP setting is valid, this triggers an FStP error and causes the drive to stop.

16-3 Turn On

16-3-1 Connect the Drive to the PC

You start operating the PLC functions with the following steps:

After pressing the MENU key and choosing 4: PLC on the KPC-CC01 digital keypad (optional), press the ENTER key (see Figure 16-3 below).

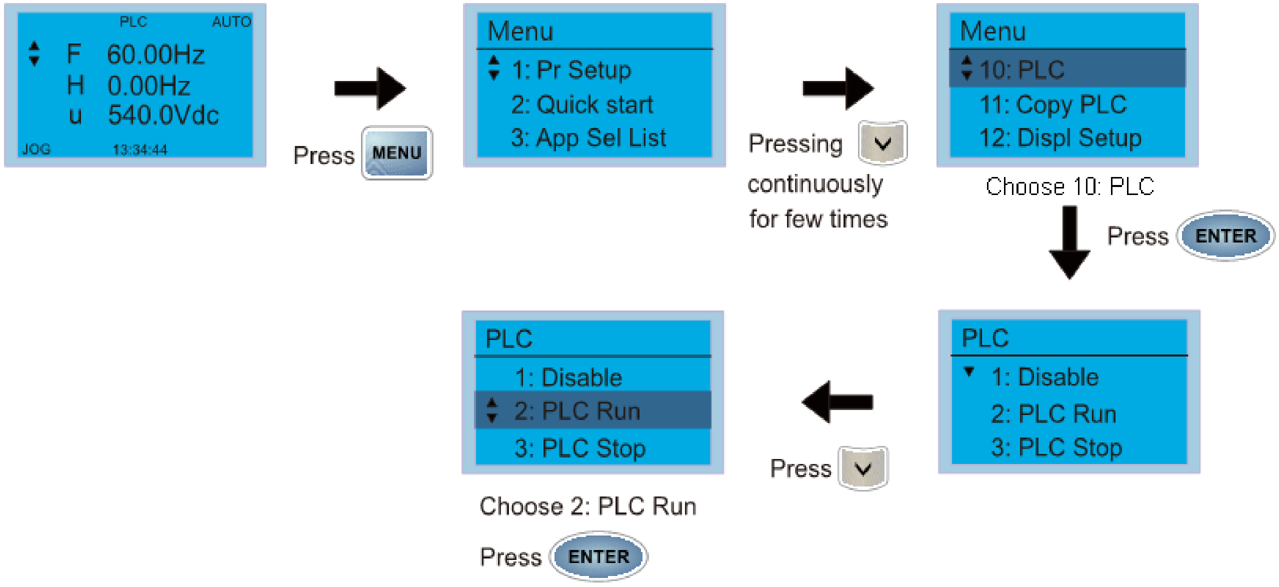


Figure 16-3

1. Wiring: Connect the drive's RJ45 communication interface to a PC through the RS-485 cable.

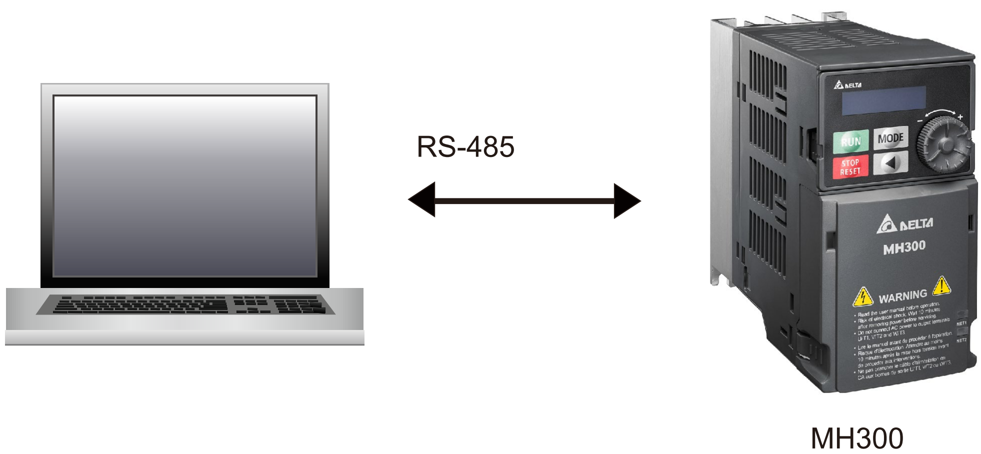


Figure 16-4

2. PLC function usage

   Digital keypad KPC-CC01 (optional)

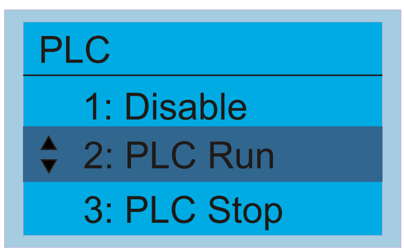


Figure 16-5

PLC functions are as shown in Figure 16-5 on the left; select item 2 PLC Run to enable the PLC functions.

1: No function (Disable)

2: Enable PLC (PLC Run)

3: Stop PLC functions (PLC Stop)

Digital keypad (KPMH-LC01)

Enter PLC mode setting, and select PLC1
PLC 0: Do not implement PLC functions
PLC 1: Initiate PLC Run
PLC 2: Initiate PLC Stop

Figure 16-6

The MH300 automatically switches to PLC mode when the external multifunctional input terminals (MI1–MI7) are in PLC Mode selection bit 0 (51) or PLC Mode selection bit1 (52), and the terminal contact is closed or open. In this case, keypad switching is ineffective. The corresponding actions are listed in the following table.

PLC mode		PLC Mode selection bit1 (52)	PLC Mode selection bit0 (51)
Using KPC-CC01 (optional)	Using KPMH-LC01		
Disable	PLC 0	OFF	OFF
PLC Run	PLC 1	OFF	ON
PLC Stop	PLC 2	ON	OFF
Maintain previous state	Maintain previous state	ON	ON

Table 16-2

Using the MH300 digital keypad to implement the PLC functions

☑ When the PLC screen switches to the PLC1 screen, this triggers one PLC action, and you control the PLC program start/stop by communications with WPLSoft.

☑ When the PLC screen switches to the PLC2 screen, this triggers one PLC stop, and you control the PLC program start/stop by communications with WPLSoft.

☑ The external terminal control method is the same as shown in Table 16-2 above.

NOTE:

- When the input / output terminals (MI1–MI7 Relay MO) are included in the PLC program, these input / output terminals are used only by the PLC. For example, when the PLC program controls Y0 during PLC operation (PLC1 or PLC2), the corresponding output terminal relay (RA / RB / RC) operates according to the program. At this time, the multifunctional input / output terminal setting has no effect. Because these terminal functions are already being used by the PLC, you can determine the DI / DO / AO in use by the PLC by looking at Pr.02-52, 02-53, and 03-30.
- When the PLC's procedures use special register D1040, the corresponding AO contact AFM is occupied.
- Pr.03-30 monitors the state of action of the PLC function analog output terminals; bit 1 corresponds to the AFM action state.

16-3-2 I/O device explanation

Input devices:

Serial No.	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
1	MI1	MI2	MI3	MI4	MI5	MI6	MI7									
2											MI10	MI11	MI12			

1: Control I/O

2: Expansion card EMM-D33A (D1022=10)

Output devices:

Serial No.	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
1	RY1			MO1	MO2											
2						MO10	MO11	MO12								
3						RY10	RY11									
4						RY10	RY11	RY12								

1: Control I/O |

2: Expansion card EMM-D33A (D1022=10)

3: Expansion card EMM-R2CA (D1022=12)

4: Expansion card EMM-R3AA (D1022=13)

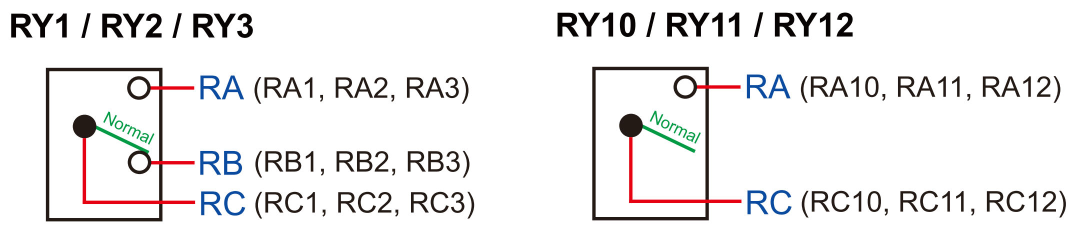


Figure 16-7

16-3-3 Installing WPLSoft

See Delta's website where you can download the WPLSoft editing software:

After you install WPLSoft, the WPLSoft program is located in the folder "C:\Program Files\Delta Industrial Automation\WPLSoft x.xx".

16-3-4 Writing programs in WPLSoft

STEP 1:

You can run the editing software by double-clicking the WPL icon.

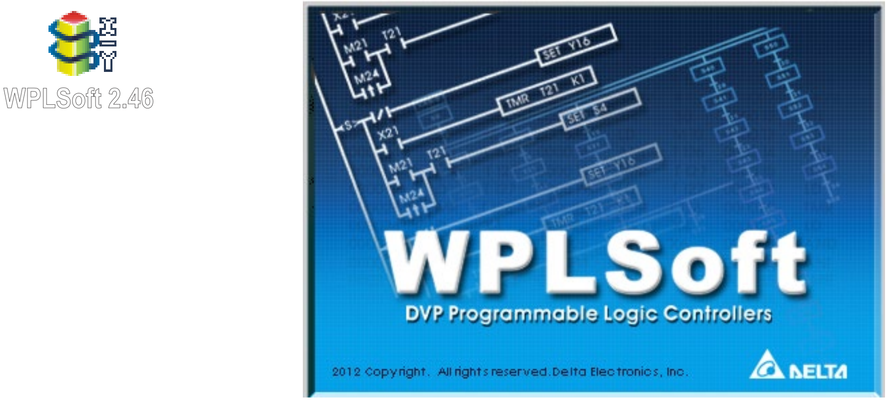


Figure 16-8

STEP 2:

The WPL editing window appears after three seconds. When running WPLSoft for the first time, before you create a new project file, the menu bar shows only **File**, **View**, **Communication, Options**, and **Help** menus.

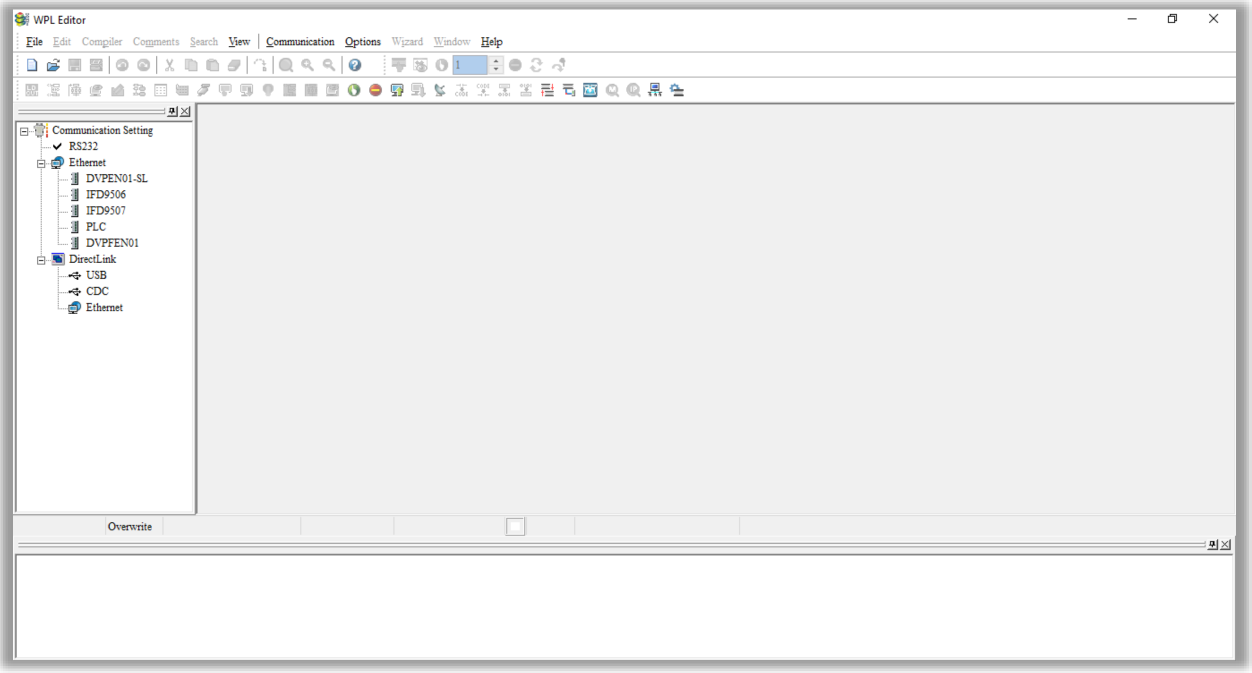


Figure 16-9

NOTE:

The next time you run WPLSoft, the program opens the last project file you edited. Figure 16-10 describes the main parts of the WPLSoft editing window.

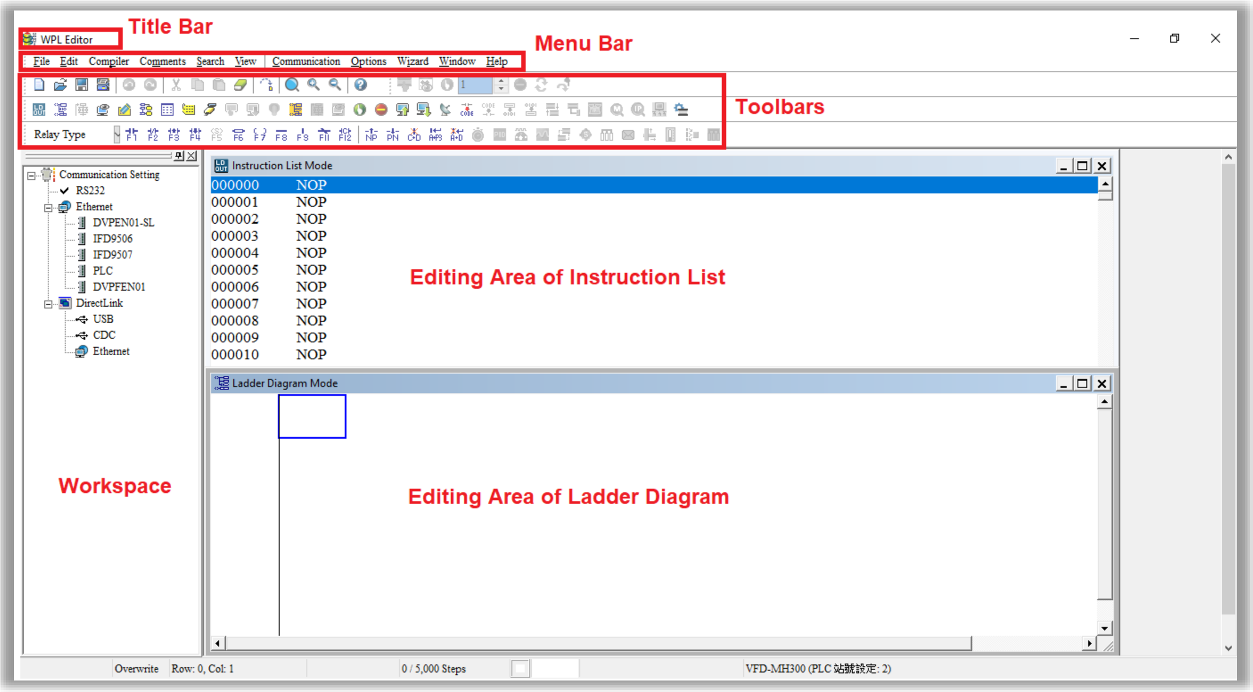


Figure 16-10

STEP 3:

To open a new project file, on the Toolbar, click the New  button (or press Ctrl+N).

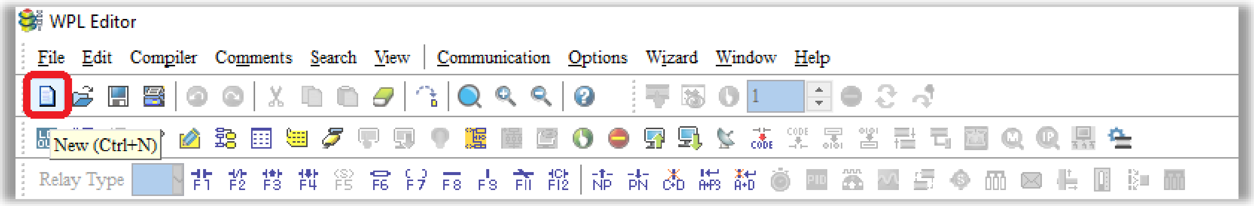


Figure 16-11

NOTE:

Alternatively, on the **File** menu, click **New** (Ctrl+N).

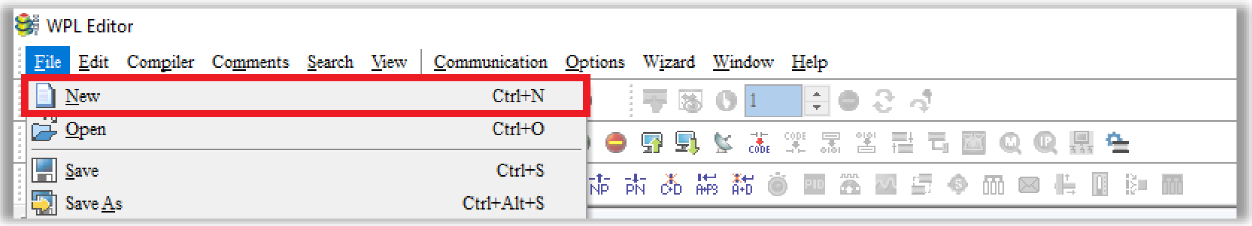


Figure 16-12

STEP 4:

This displays the **Select a PLC Model** dialog box where you can enter the **Program Title**, **File Name**, and select the device and communication settings.

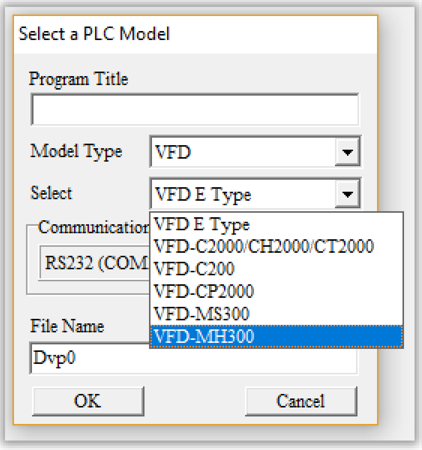


Figure 16-13

In the **Communication Setting** dialog box, define the communication settings and then click **OK**.

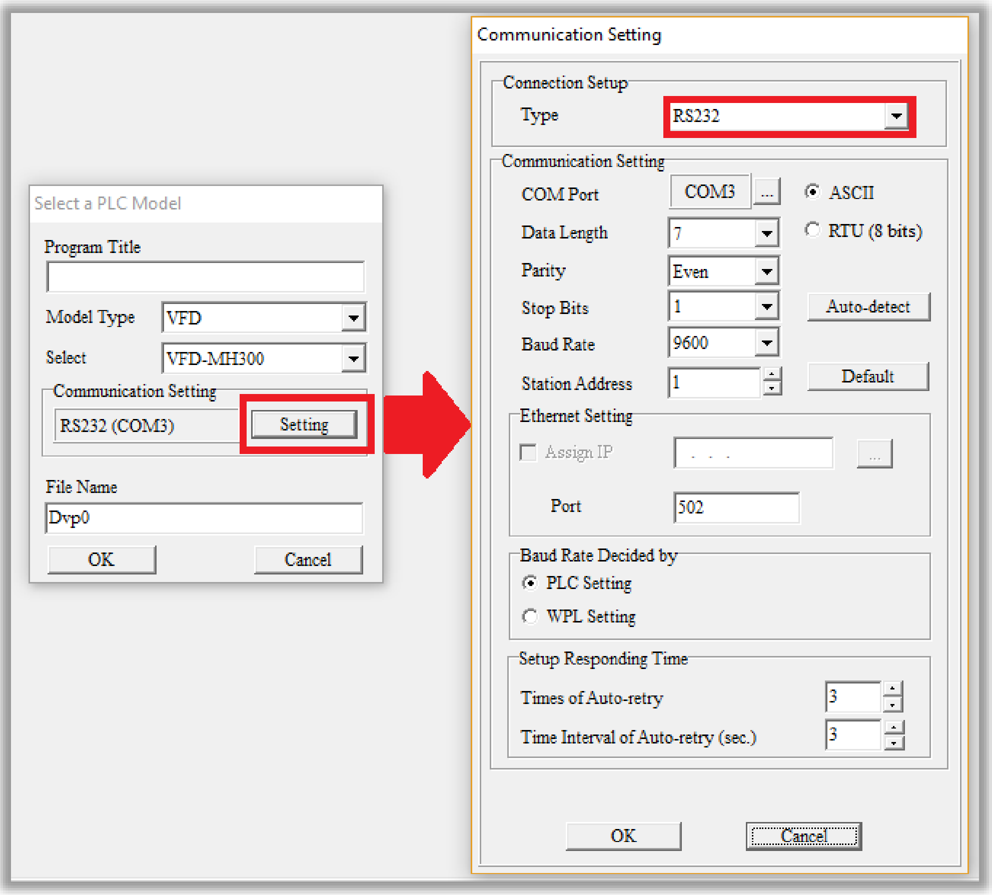


Figure 16-14

NOTE:

You must select RS232 for the type of connection setup in the **Communication Setting** dialog box when using USB to connect the motor drive (MS300 / MH300 series).

STEP 5:

You can then begin editing the program. There are two program editing methods: you can edit in the command mode, or edit in the ladder diagram mode.

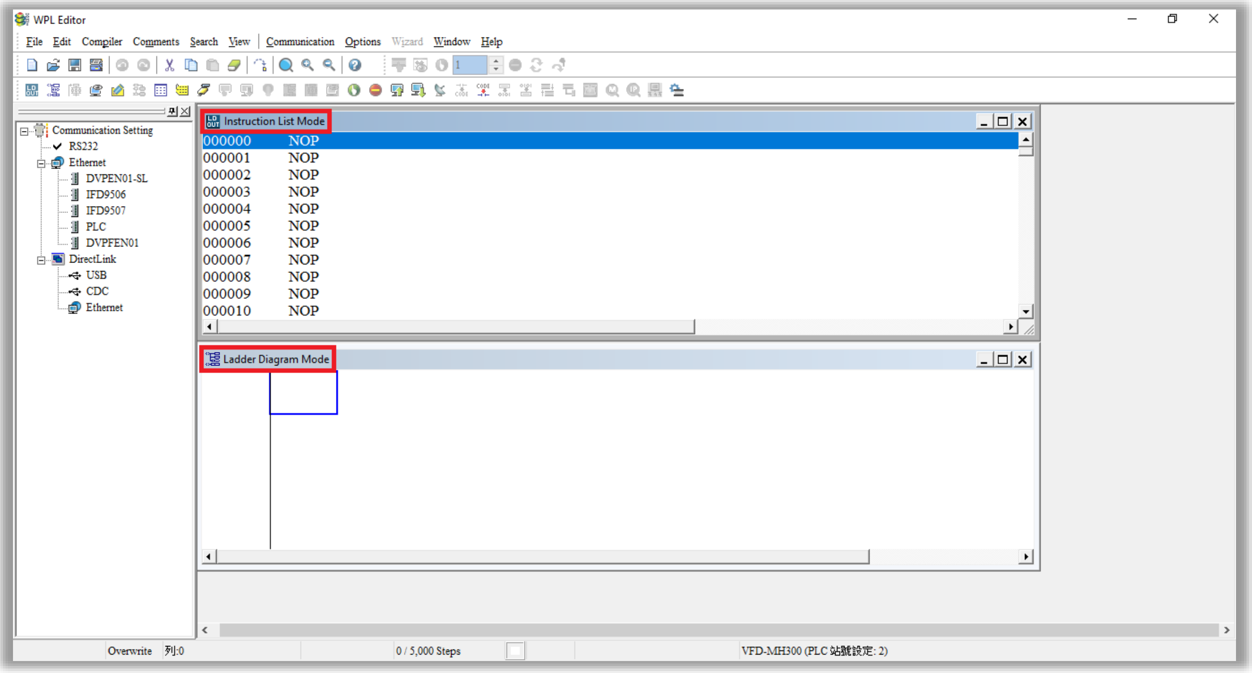


Figure 16-15

NOTE:

In the ladder diagram mode, you use the buttons on the function icon row on the toolbar.

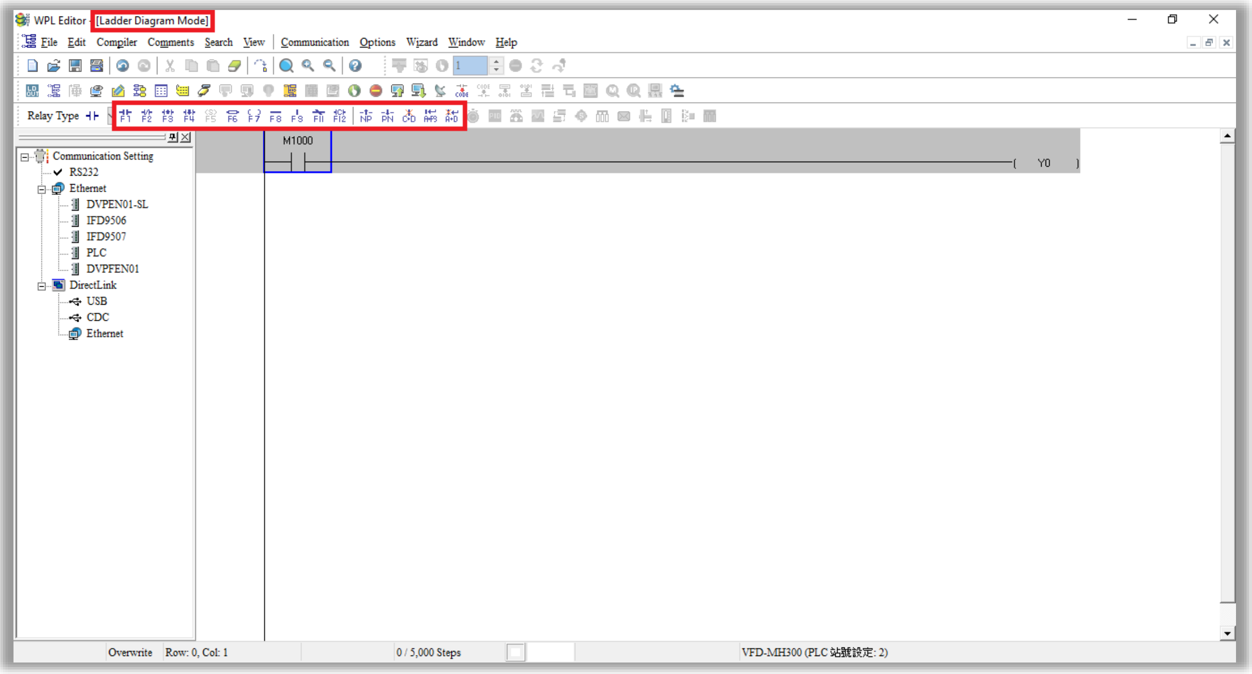


Figure 16-16

Basic Operation

Example: Create the ladder diagram in the following picture.

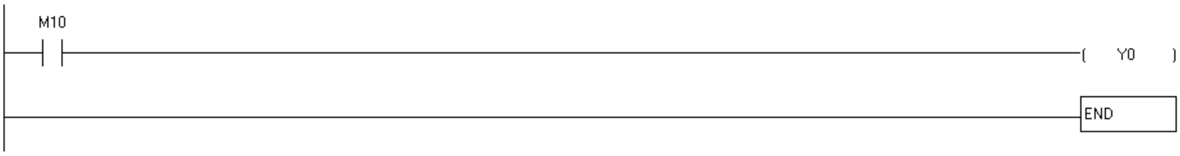


Figure 16-17

Use the following steps to create the ladder diagram. These steps show you how to use both the mouse and the keyboard (F1–F12) to add functions.

1. The following picture shows the WPLSoft program after you create a new project file.

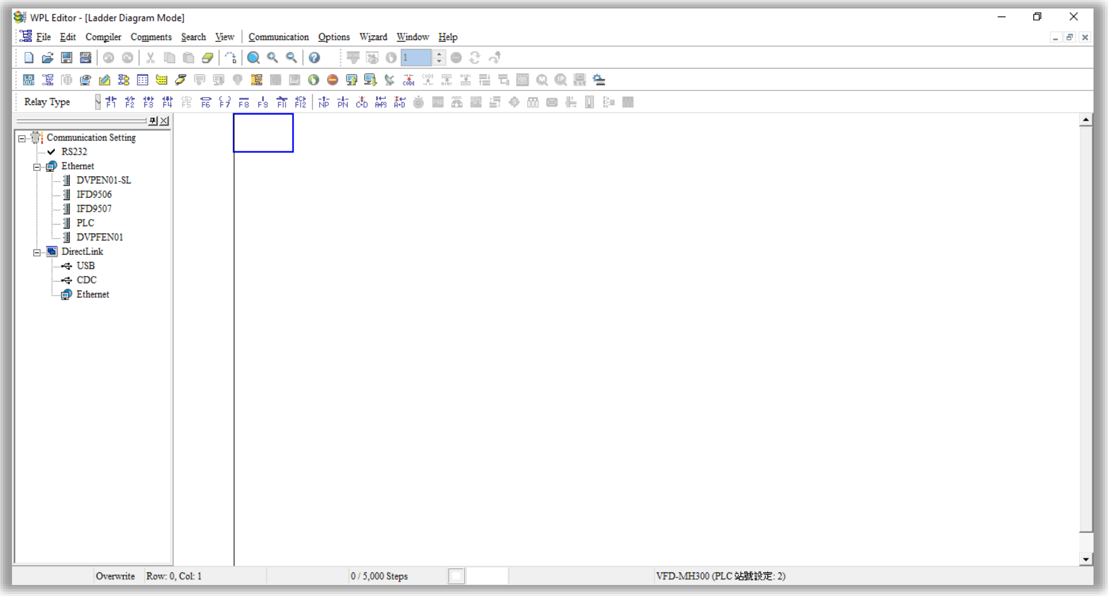


Figure 16-18

2. Add an always-open switch. On the toolbar click the always-open switch button  or press F1.

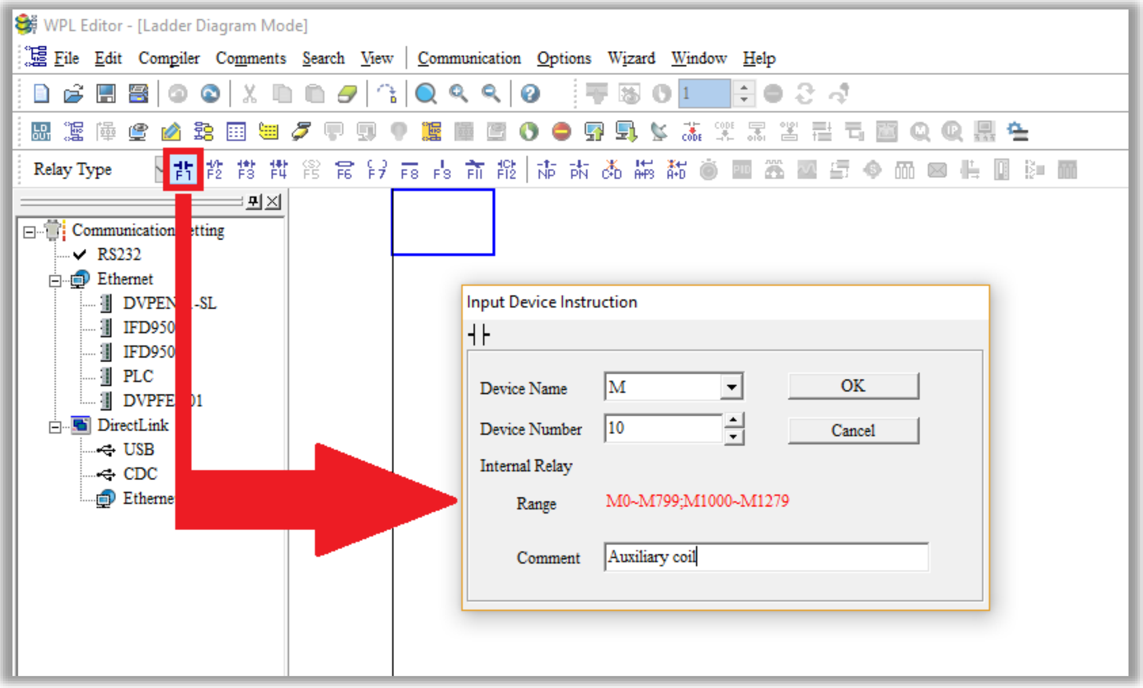


Figure 16-19

In the **Input Device Instruction** dialog box, select the device name (such as **M**), device number (such as **10**) and enter comments (such as **auxiliary coil**). Click **OK** when finished.

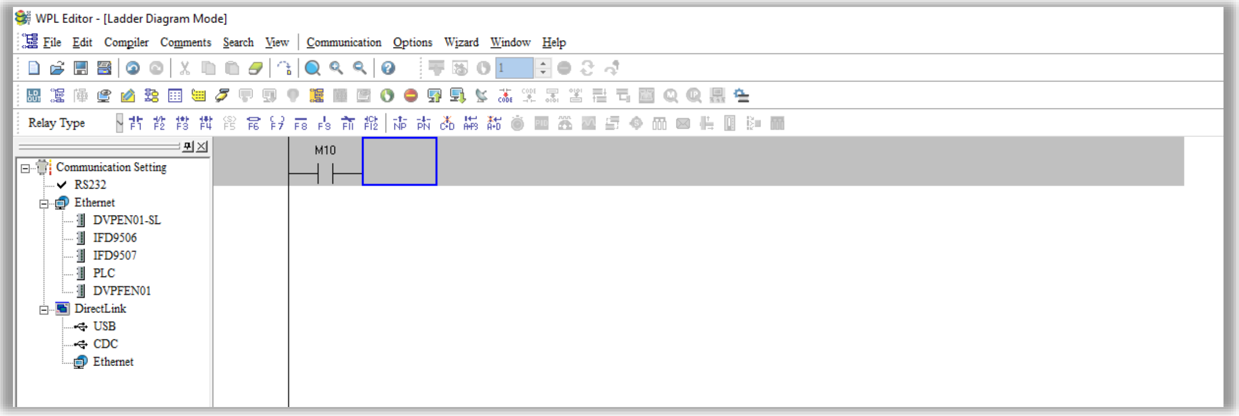


Figure 16-20

3. Add an output coil. Click the output coil button  or press F7.

   In the **Input Device Instruction** dialog box, select the device name (such as **Y**), the device number (such as **0**) and enter comments (such as **output coil**). Click **OK** when finished.

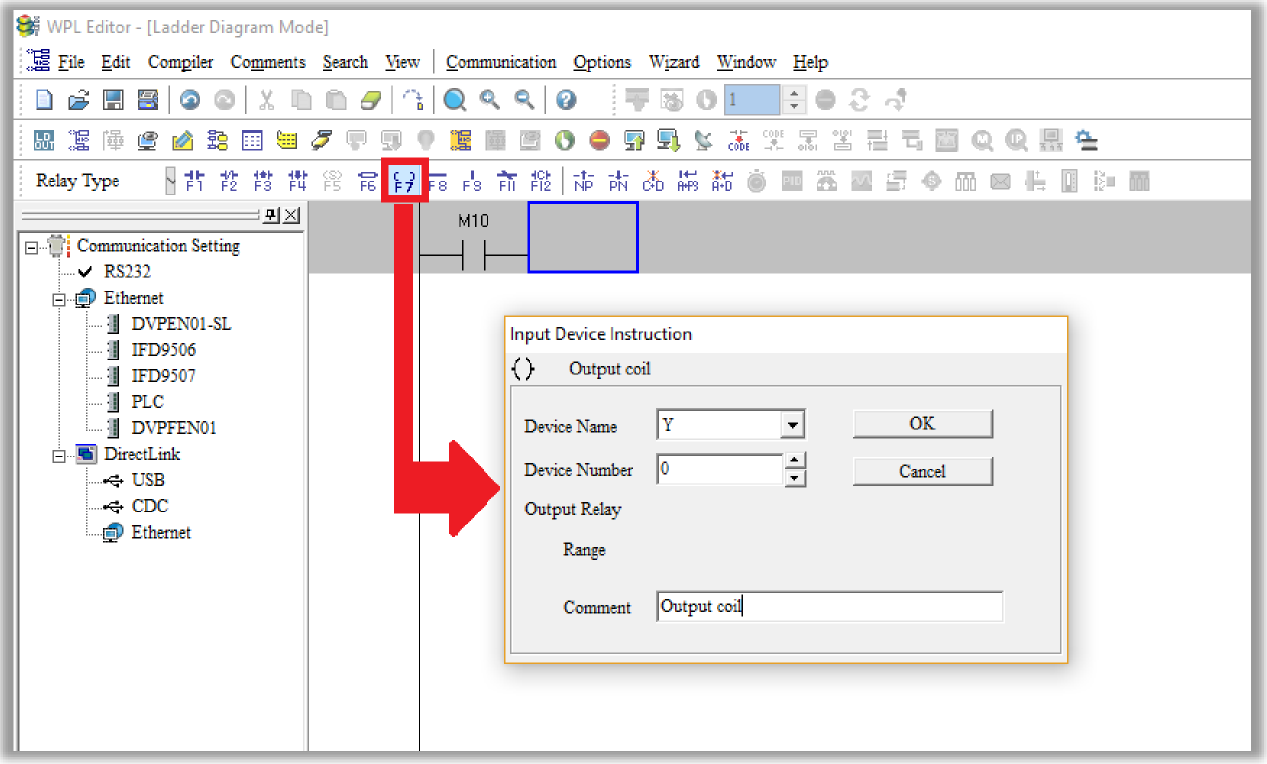


Figure 16-21

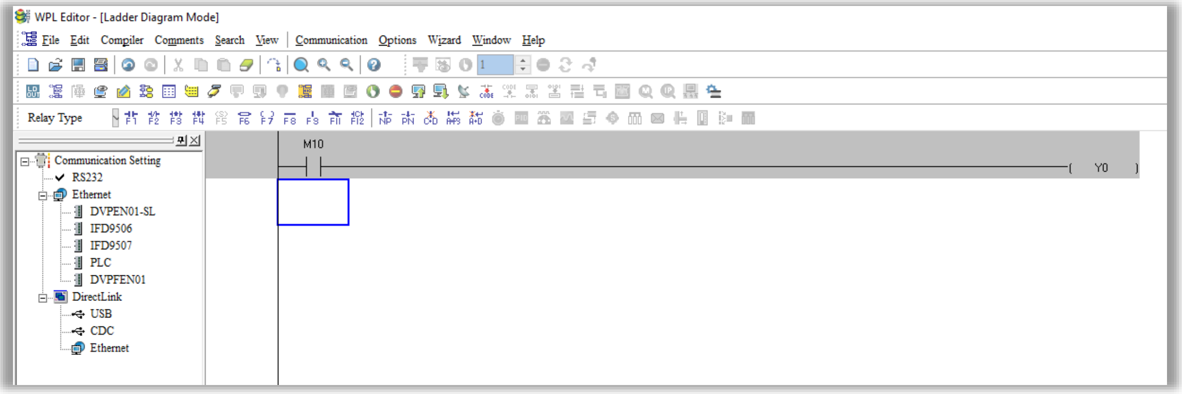


Figure 16-22

4. Press Enter, and **Input Instruction** box appears. In the **Input Instruction** box, select **END**, or use the keyboard to type "END", and then click **OK**, as shown in Figure 16-23 and Figure 16-24.

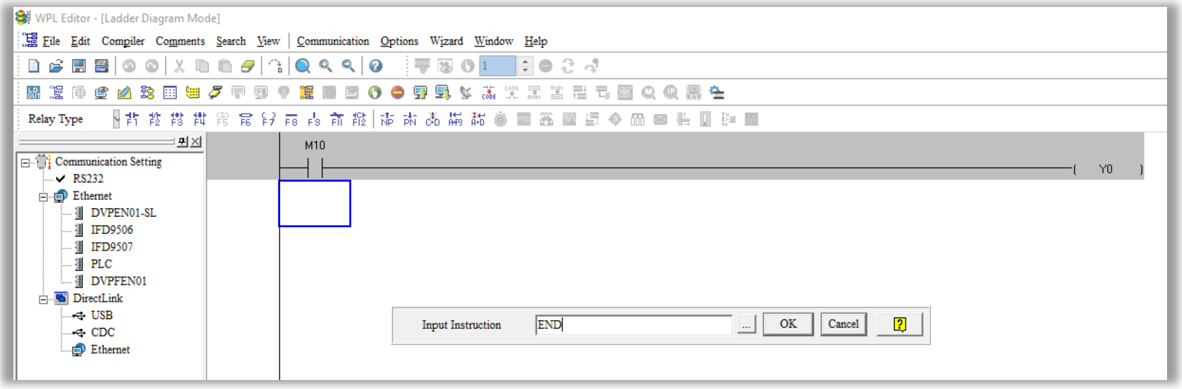


Figure 16-23

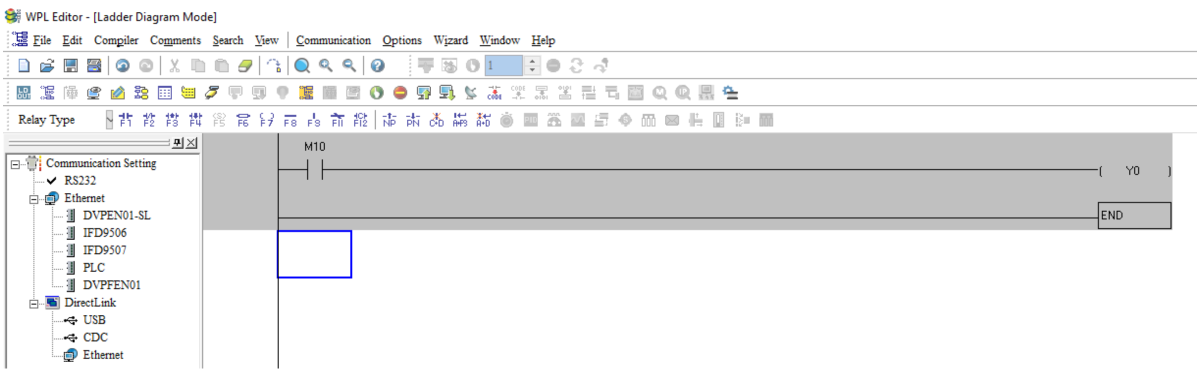


Figure 16-24

5. Compile the program. On the toolbar, click the Compile button  to compile the edited ladder diagram into a command program. After compiling, the number of rungs appear on the left side of the busbar.

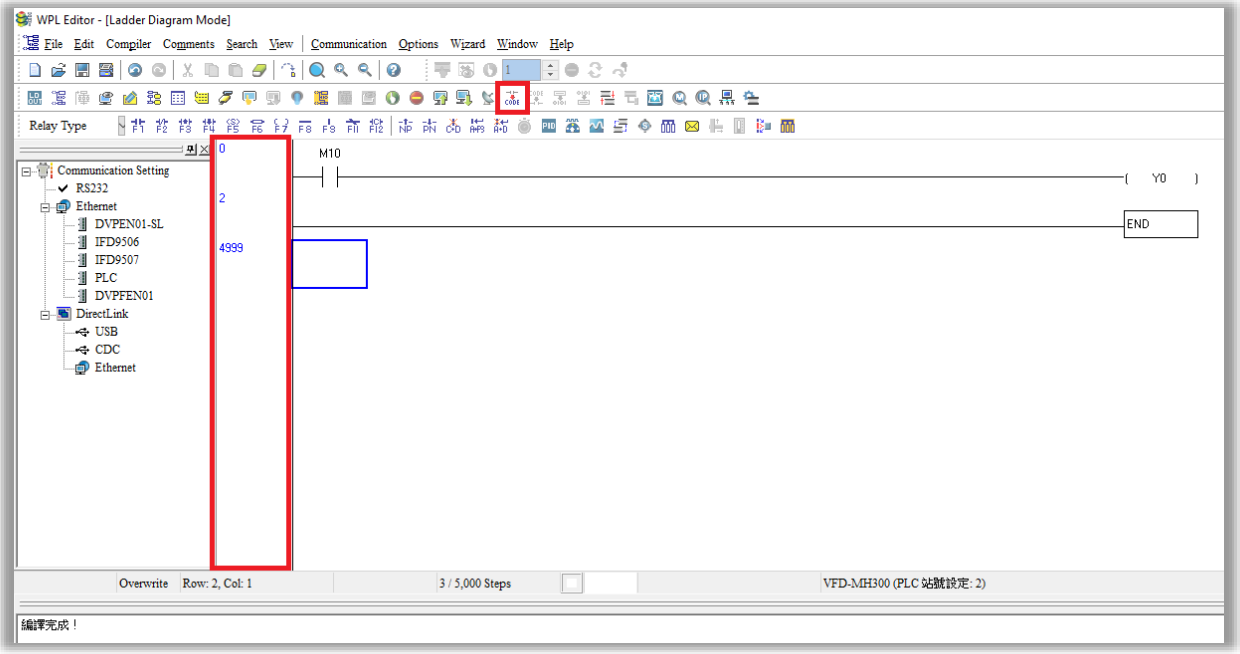


Figure 16-25

16-3-5 Program download

After you compile your program, download it to the device. Click the Download button . WPLSoft downloads the program to the online PLC in the communication format that you specified for the communication settings.

16-3-6 Program monitoring

After you download the program, confirm that the PLC is in Run mode. On the Communication menu, click Online Mode , and then click **Start Ladder Diagram Control** (as shown in Figure 16-26). This allows you to supervise and operate the ladder diagram while online.

Figure 16-26

16-4 Basic Principles of PLC Ladder Diagrams

16-4-1 Schematic diagram for PLC ladder diagram program scanning

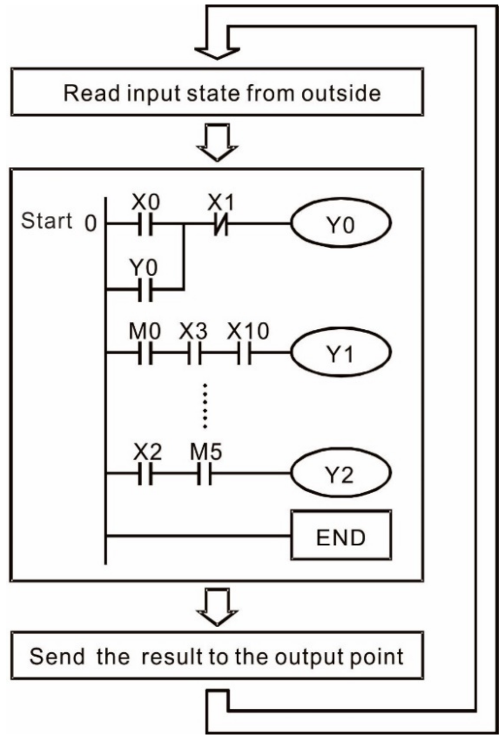


Figure 16-27

16-4-2 Introduction to ladder diagrams

Ladder diagrams use a graphic language widely applied in automatic controls. They employ common electrical control circuit symbols. After you use a ladder diagram editor to create a ladder diagram program, the PLC program design is complete. Using a graphic format to control processes is very intuitive and is readily accepted by personnel who are familiar with electrical control circuit technology. Many of the basic symbols and actions in a ladder diagram mimic common electrical devices in conventional automatic control power distribution panels, such as buttons, switches, relays, timers, and counters.

Internal PLC devices: The types and quantities of internal PLC devices vary in different brands of products. Although these internal devices use the same names as the conventional electrical control circuit elements (such as relays, coils, and contacts), a PLC does not actually contain these physical devices, and they instead correspond to basic elements in the PLC's internal memory (bits). For instance, if a bit is 1, this may indicate that a coil is electrified; and if that bit is 0, it indicates that the coil is not electrified. You can use a N.O. contact (Normally Open, or contact A) to directly read the value of the corresponding bit, and use a N.C. contact (Normally Closed, or contact B) to get the inverse of the bit's value. Multiple relays occupy multiple bits, and eight bits comprise one byte. Two bytes comprise one word, and two words comprise a double word. When multiple relays are processing at the same time (as in addition/subtraction or displacement), it can use a byte, a word, or a double word. Furthermore, a PLC contains two types of internal devices: a timer and a counter. It not only has a coil, but can count time and numerical values. Because of this, when it is necessary to process numerical values, these values are usually in the form of bytes, words, or double words (internally in the PLC).

The various internal devices in a PLC use a certain amount of memory in the PLC's storage area. When you use these devices, the content of the corresponding storage area is read in the form of bits, bytes, or words.

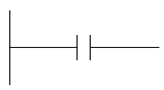
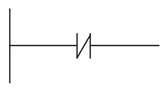
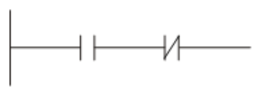
The following table describes the internal devices in a PLC

Device Type	Description of Function
Input Relay	An input relay constitutes the basic unit of storage in a PLC's internal memory, and corresponds to an external input point. It serves as a terminal connecting with an external input switch and receiving external input signals. It is driven by external input signals, to which it assigns values of 0 or 1. A program design method cannot change the input relay status, and therefore cannot rewrite the corresponding basic units of an input relay. You cannot use WPLSoft to manually perform ON/OFF actions. You can use a relay's contacts (contacts A and B) an unlimited number of times in a program. An input relay with no input signal must be left idle and cannot be used for some other purpose. ● Input devices are indicated by X0, X1, X7, X10, X11, and so on. These devices are indicated with the symbol X, and a device's order is indicated with an octal number. Input point numbers are indicated in the main PLC and in expansion devices.
Output Relay	An output relay constitutes the basic unit of storage in a PLC's internal memory, and corresponds to an external output point. It connects with an external load. It can be driven by an input relay contact, a contact on another internal device, or its own contacts. It uses one N.O. contact to connect with external loads or other contacts, and like the input contacts, you can use the output relay's contacts an unlimited number of times in a program. An output relay with no input signal is idle, but can be used by an internal relay if needed. ● Output devices are indicated by Y0, Y1, Y7, Y10, Y11, and so on. These devices are indicated with the symbol Y, and a device's order is indicated with an octal number. Output point numbers are indicated in the main PLC and in expansion devices.
Internal Relay	Internal relays have no direct connection with the outside. These relays are auxiliary relays inside a PLC. Their function is the same as that of an auxiliary (central) relay in an electrical control circuit: Each auxiliary relay corresponds to a basic unit of internal storage; they can be driven by input relay contacts, output relay contacts, and the contacts of other internal devices. You can use an internal auxiliary relay's contacts an unlimited number of times in a program. Internal relays have no outputs to the outside, and their status must output through an output point. ● Internal relay devices are indicated by: M0, M1–M799, and so on. These devices are indicated with the symbol M, and the device's order is indicated with a decimal number.

Device Type	Description of Function
Counter	Counters perform counting operations. The setting value for a counter (such as the number of pulses to be counted) must be assigned when a counter is used. A counter contains a coil, contact, and a counting storage device. When the coil goes from OFF→ ON, this indicates that the counter receives an input pulse, and adds one to its count. There are 16 bits available in the counter. ● Counter device is indicated by: C0, C1–C79, and so on. These devices are indicated by the symbol C, and the device's order is indicated with a decimal number.
Timer	Timers perform timing for operations. The timer contains a coil, contact, and a time value register. When the coil is electrified, and the setting value for the timer is reached, the contact is actuated (contact A closes, contact B opens), and the timer's fixed value is given by the setting value. A timer has a regulated clock cycle (timing units: 100 ms). As soon as power to the coil is cut off, the contact is no longer be actuated (contact A opens, contact B closes), and the original timing value returns to zero. ● Timer devices are indicated by: T0, T1–T159, and so on. These devices are indicated by the symbol T, and the device's order is indicated with a decimal number.
Data Register	Data registers are used exclusively to store data and various parameters. When you use a PLC is to perform various types of sequence control, set time values, and count value controls, the PLC performs data processing and numerical operations and stores the operands, parameters, and results in data registers. Each data register contains 16 bits of binary data (one word). Two data registers with adjacent numbers can process double words. ● Data register devices are indicated by: D0, D1–D399, and so on. These devices are indicated by the symbol D, and the device's order is indicated with a decimal number.

Ladder diagram images and explanations

See the Section 16-4-2 "Introduction to ladder diagrams" for descriptions of devices.

Ladder diagram structures	Explanation of commands	Command	Using Device
	N.O. switch, contact A	LD	X, Y, M, T, C
	N.C. switch, contact B	LDI	X, Y, M, T, C
	Series N.O.	AND	X, Y, M, T, C
	Series N.C.	ANI	X, Y, M, T, C

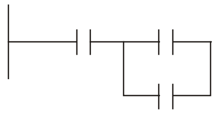
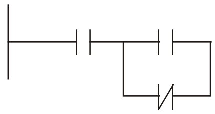
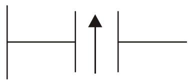
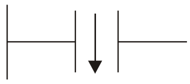
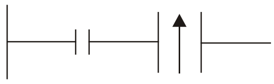
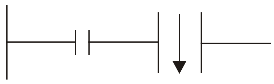
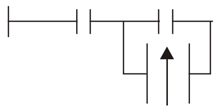
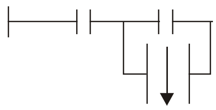
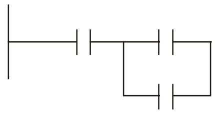
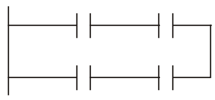
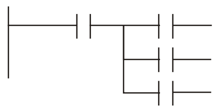
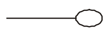
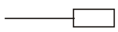
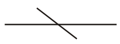
Ladder diagram structures	Explanation of commands	Command	Using Device
	Parallel N.O.	OR	X, Y, M, T, C
	Parallel N.C.	ORI	X, Y, M, T, C
	Rising edge-triggered switch	LDP	X, Y, M, T, C
	Falling edge-triggered switch	LDF	X, Y, M, T, C
	Rising edge-triggered series	ANDP	X, Y, M, T, C
	Falling edge-triggered series	ANDF	X, Y, M, T, C
	Rising edge-triggered parallel	ORP	X, Y, M, T, C
	Falling edge-triggered parallel	ORF	X, Y, M, T, C
	Block series	ANB	N/A
	Block parallel	ORB	N/A
	Multiple outputs	MPS MRD MPP	N/A
	Coil driven output commands	**OUT**	Y, M
	Some basic commands, application commands.	Some basic commands, application commands.	
	Inverted logic	**INV**	N/A

Table 16-6

16-4-3 Overview of PLC ladder diagram editing

The program editing method in WPLSoft begins from the left busbar and proceeds to the right busbar (the right busbar is not visible in WPLSoft). Continue to the next row after completing each row; there are a maximum of 11 contacts on each row. If this is not sufficient, WPLSoft generates a continuous line to indicate the continued connection, so that you can add more devices. A continuous series of numbers is generated automatically and you can use identical input points repeatedly (as shown in Figure 16-28).

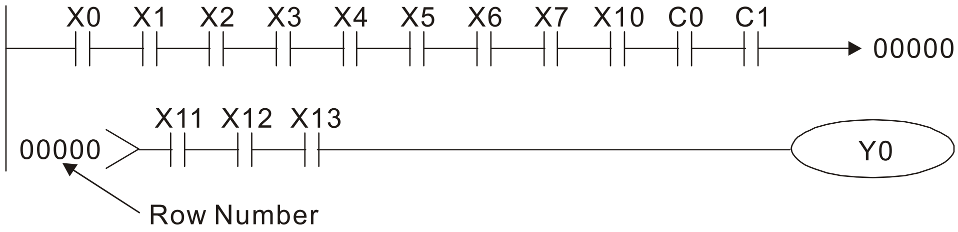


Figure 16-28

The PLC scans a ladder diagram programs from the upper left corner to the lower right corner. The coils and application command computing box are handled in the output, and in ladder diagram are placed on the farthest right of a rung. Taking Figure 16-29 below as an example, we can analyze the procedural sequence of the ladder diagram. The number in the upper right corner gives the sequential order.

Explanation of command sequence

1	LD	X0	
2	OR	M0	
3	AND	X1	
4	LD	X3	
	AND	M1	
	ORB		
5	LD	Y1	
	AND	X4	
6	LD	T0	
	AND	M3	
	ORB		
7	ANB		
8	OUT	Y1	
	TMR	T0	K10

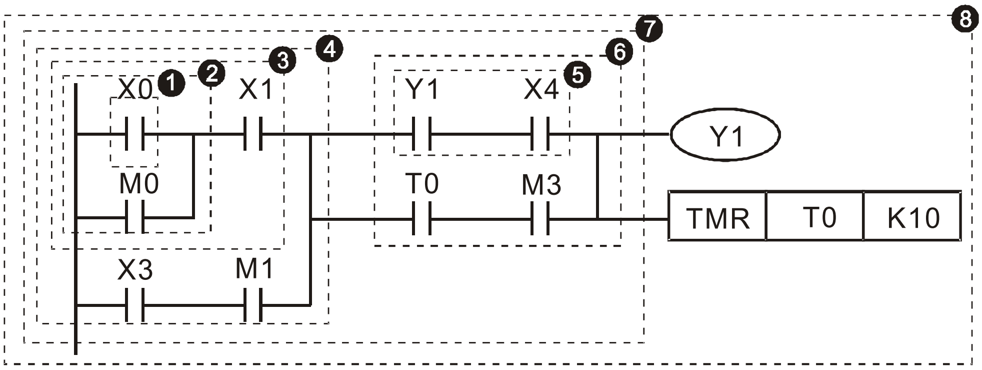


Figure 16-29

Explanation of basic structure of ladder diagrams

LD (LDI) command: an LD or LDI command appears at the start of a block. See Figure 16-30.

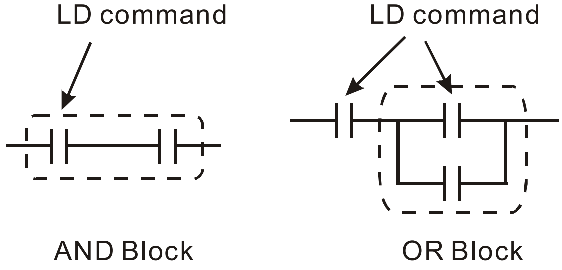


Figure 16-30

LDP and LDF use this command structure, but there are differences in their action state. LDP, LDF only act at the rising or falling edge of a conducting contact (see Figure 16-31).

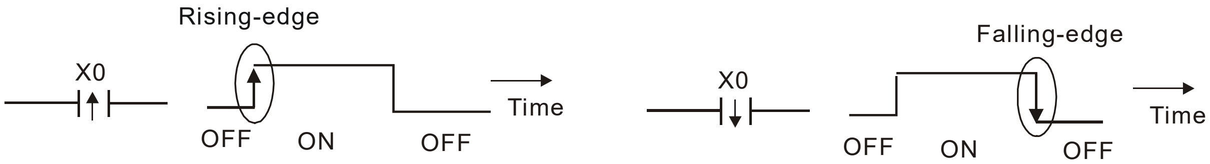


Figure 16-31

AND (ANI) command: a series configuration in which a single device is connected with one device or a block. See Figure 16-32.

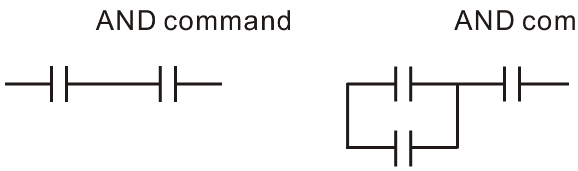


Figure 16-32

NOTE:

ANDP, ANDF use this structure, but their action occurs at the rising and falling edge of a conducting contact.

OR (ORI) command: a single device is connected with one device or a block. See Figure 16-33.

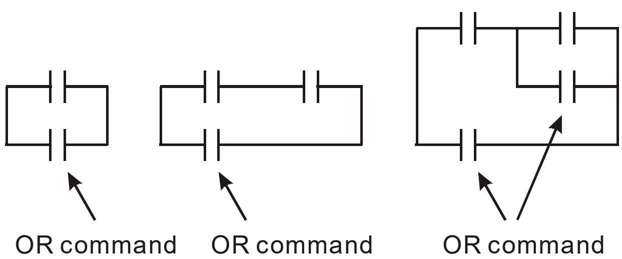


Figure 16-33

NOTE:

ORP, ORF use this structure, but their action occurs at the rising and falling edge of a conduction contact.

ANB command: a configuration in which one block is in series with one device or block. See Figure 16-34.

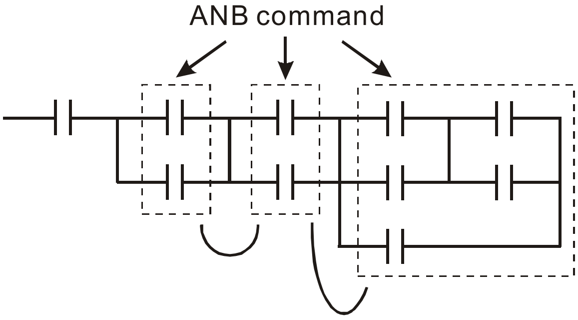


Figure 16-34

ORB command: a configuration in which one block is in parallel with one device or block. See Figure 16-35.

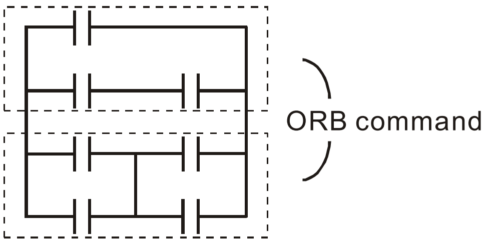


Figure 16-35

NOTE:

In the case of ANB and ORB operations that connect a number of blocks, they should be combined to form a block or network from the top down or from left to right.

MPS, MRD, MPP commands: branching point memory for multiple outputs that enable multiple different outputs. The MPS command begins at a branching point, which refers to the intersection of horizontal and vertical lines. Control relies on the contact status along a single vertical line to determine whether the next contact can give a memory command. While each contact is basically able to give memory commands, in view of convenience and the PLC's capacity restrictions, this can be omitted from some places when editing a ladder diagram. You can use the structure of the ladder diagram to judge what kinds of contact memory commands are used.

MPS is indicated by use of the ┬ symbol. You can use this command consecutively up to eight times.

The MRD command is read from branching point memory; because logic states along any one vertical line must be the same, in order to continue analysis of other parts of the ladder diagram, the original contact status must be read. MRD is indicated by the ├ symbol.

The MPP command is read from the starting state of the uppermost branching point, and it is read from the stack (pop operation); because it is the final command along a vertical line, it indicates that the state of the vertical line can be concluded. MPP is indicated by the └ symbol.

Although there should basically be no errors when using the foregoing analytical approach, the compiling program may sometimes omit identical state output, as shown in Figure 16-36.

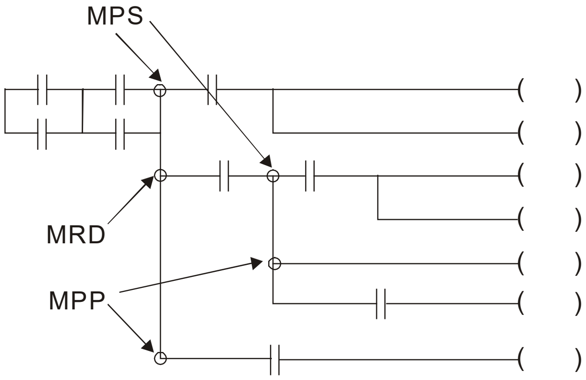


Figure 16-36

16-4-4 Common basic program design examples

Start, stop, and protection circuits

Some applications may require a brief close or brief break using a button to start and stop equipment. A protective circuit must therefore be designed to maintain continued operation in these situations. This protective circuit may employ one of the following methods.

Example 1: Priority stop protective circuit

When the start N.O. contact X1=ON, and the stop N.C. contact X2=OFF, Y1=ON. If X2 switches to ON, coil Y1 is no longer electrified, and this is therefore referred to as priority stop. See Figure 16-37.

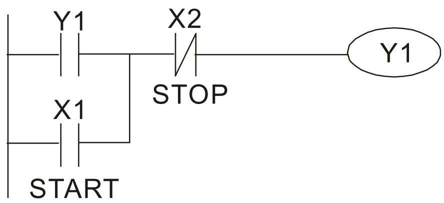


Figure 16-37

Example 2: Priority start protective circuit

When the start N.O. contact X1=ON, and the stop N.C. contact X2＝OFF, Y1=ON, and coil Y1 is electrified and protected. If X2 switches to ON, coil Y1 still protects the contact and continues to be electrified, and this is therefore referred to as priority start. See Figure 16-38.

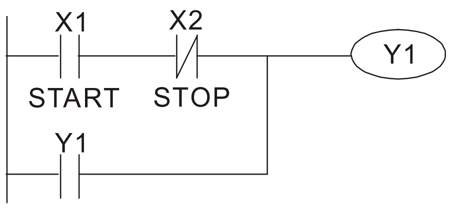


Figure 16-38

Example 3: Setting (SET) and reset (RST) command protective circuit

Figure 16-39 shows a protective circuit composed of RST and SET commands.

- **A priority stop** occurs when you place the RST command after the SET command. Because the PLC executes programs from the top down, at the end of the program the state of Y1 indicates whether coil Y1 is electrified. When X1 and X2 both actuate, Y1 loses power, and this is therefore referred to as priority stop.
- **A priority start** occurs when you place the SET command after the RST command. When X1 and X2 both actuate, Y1 electrifies, and this is therefore referred to as priority start.

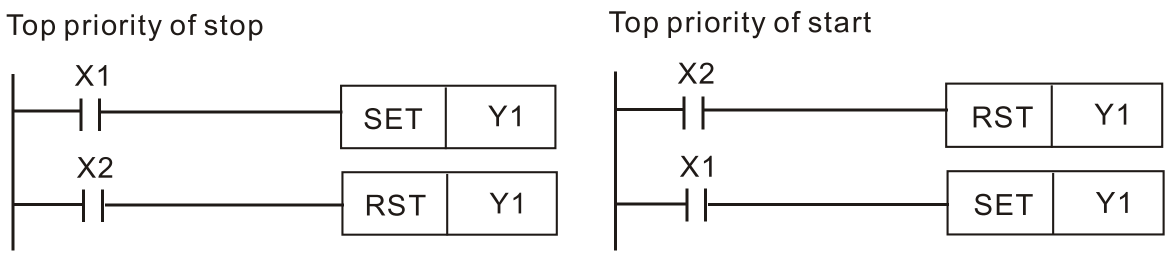


Figure 16-39

Commonly-used control circuits

Example 4: Conditional control

X1 and X3 respectively start and stop Y1; and X2 and X4 respectively start and stop Y2. All have protective circuits. Because Y1's N.O. contact is in series with Y2's circuit, it becomes an AND condition for the actuation of Y2. The action of Y1 is therefore a condition for the action of Y2, and Y1 must actuate before Y2 can actuate. See Figure 16-40.

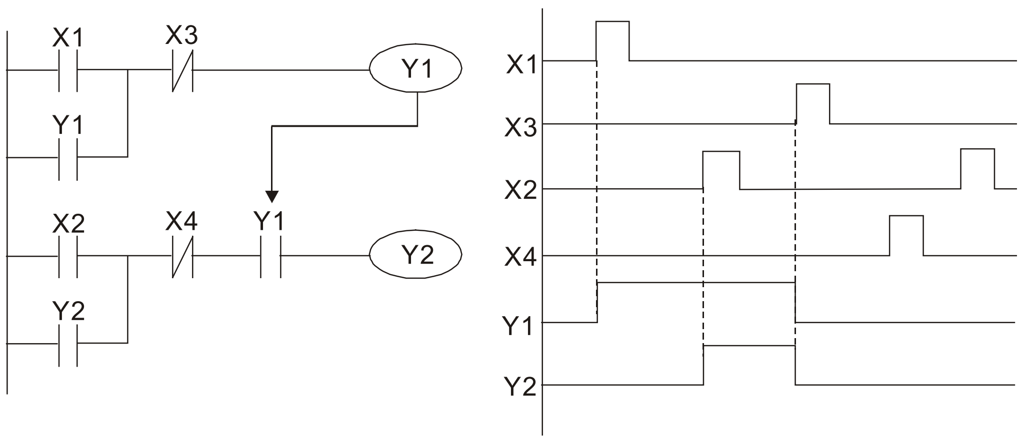


Figure 16-40

Example 5: Interlocking control

Figure 16-41 shows an interlocking control circuit. Depending on which of the start contacts X1 or X2 becomes valid first, the corresponding output Y1 or Y2 actuates, and when one actuates, the other does not actuate. Y1 and Y2 cannot actuate at the same time (interlocking effect). Even if both X1 and X2 are valid at the same time, because the ladder diagram program is scanned from the top down, it is impossible for Y1 and Y2 to actuate at same time. This ladder diagram assigns priority only to Y1.

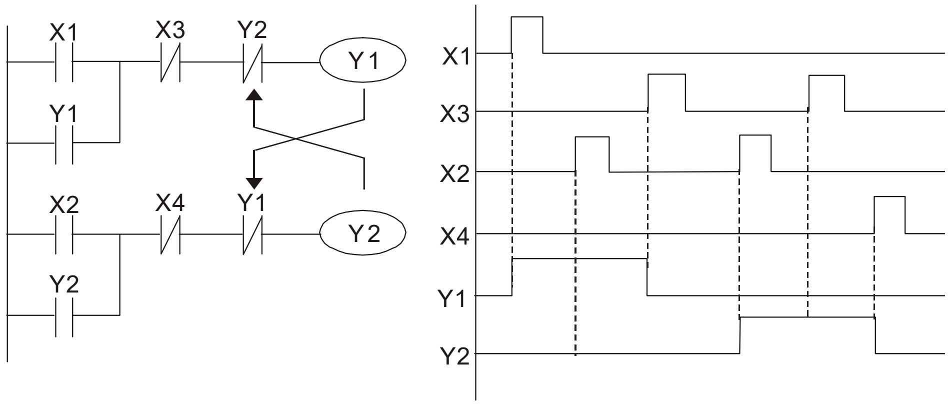


Figure 16-41

Example 6: Sequence control

If the N.C. contact of Y2 in the interlocking control configuration from example 5 is put in series with the Y1 circuit, to create an AND condition for actuation of Y1 (see Figure 16-42), not only is Y1 a condition for the actuation of Y2 in this circuit, but the actuation of Y2 also stops the actuation of Y1. This configuration confirms the actuation order of Y1 and Y2.

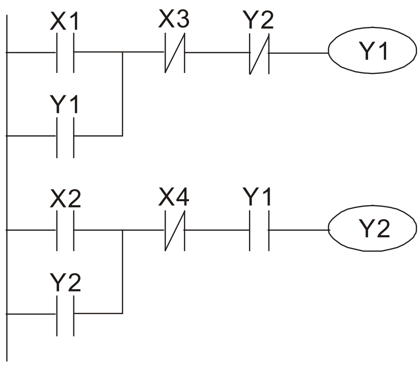


Figure 16-42

Example 7: Oscillating circuit

Oscillating circuit with a period of ΔT+ΔT

Figure 16-43 shows a very simple ladder diagram. When starting to scan the Y1 N.C. contact, because the Y1 coil has lost power, the Y1 N.C. contact is closed. When the Y1 coil is then scanned, it is electrified, and the output is 1. When the Y1 N.C. contact is scanned in the next scanning cycle, because the Y1 coil is electrified, the Y1 NC contact is open, the Y1 coil then loses power, and the output is 0. Following repeated scanning, the output of Y1 coil has an oscillating waveform with a period of ΔT(ON)+ΔT(OFF).

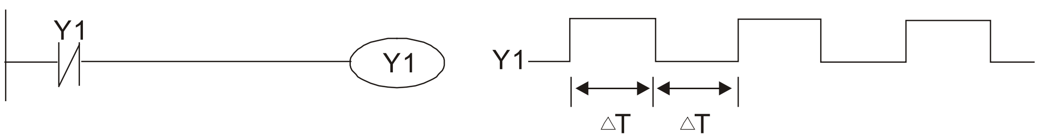


Figure 16-43

Oscillating circuit with a period of nT+ΔT

The ladder diagram (Figure 16-44) shown below uses timer T0 to control coil Y1's electrified time. After Y1 is electrified, it causes timer T0 to close during the next scanning cycle, which causes the output from Y1 to oscillate as shown in the diagram below. The constant n is the timer's decimal setting value, and T is the clock cycle of the timer.

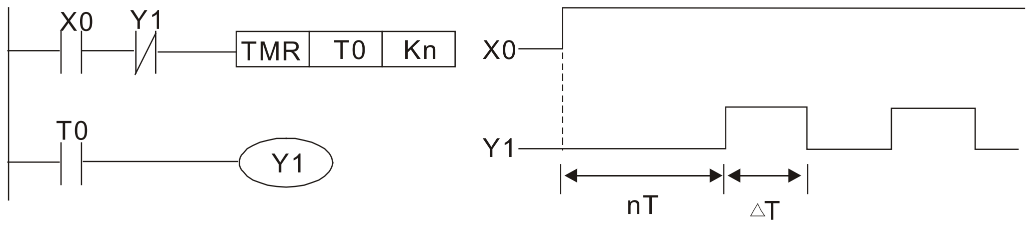


Figure 16-44

Example 8: Flashing circuit

Figure 16-45 shows an oscillating circuit of a type commonly used to cause an indicator to flash or a buzzer to buzz. It uses two timers to control the ON and OFF time of Y1 coil. Here constants n1 and n2 are the setting values of timers T1 and T2, and T is the clock cycle of the timer.

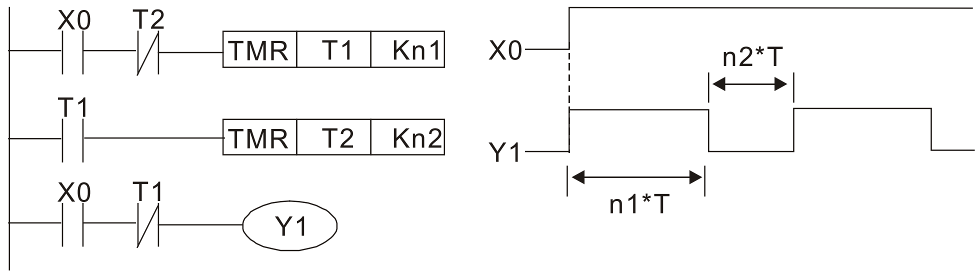


Figure 16-45

Example 9: Triggering circuit

In Figure 16-46, a rising edge in input X0 causes coil M0 to generate a single pulse for ΔT (length of one scanning cycle), and coil Y1 is electrified during this scanning cycle. Coil M0 loses power during the next scanning cycle, and N.C. contact M0 and N.C. contact Y1 are both closed. This causes coil Y1 to stay in an electrified state until there is another rising edge in input X0. This again causes the electrification of coil M0 and the start of another scanning cycle, while also causing coil Y1 to lose power, and so on. You can see the sequence of these actions in the figure below. This type of circuit is commonly used to enable one input to perform two alternating actions. You can see from the time sequence in the diagram below that when input X0 is a square wave signal with a period of T, the output of coil Y1 is a square wave signal with a period of 2T.

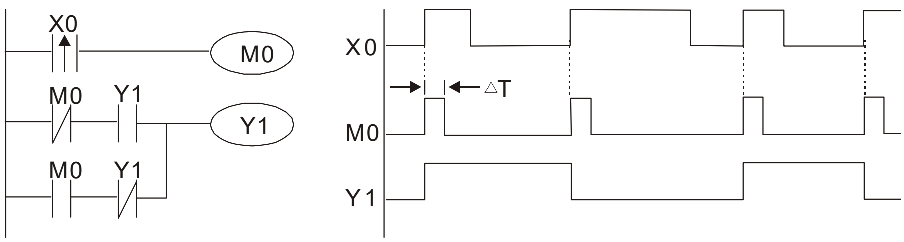


Figure 16-46

Example 10: Delay circuit

When input X0 is ON, because the corresponding NC contact is OFF, the timer T10 is in a no power state, and output coil Y1 is electrified. T10 receives power and begins to count the time only after input X0 is OFF, and output coil Y1 is delayed for 100 seconds (K1000*0.1 sec. = 100 sec.) before losing power. You can see the sequence of actions in Figure 16-47.

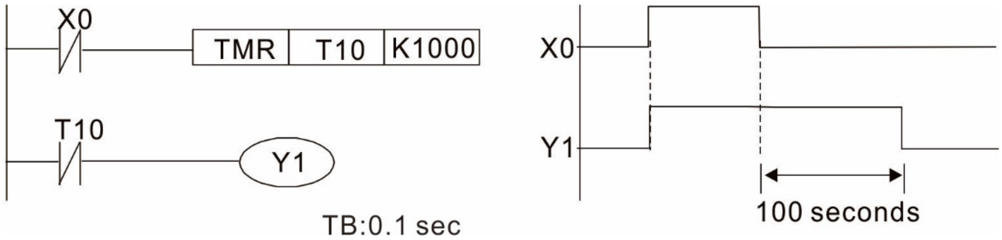


Figure 16-47

Example 11: The open/close delay circuit is composed of two timers; output Y4 has a delay no matter input X0 is ON or OFF. See Figure 16-48.

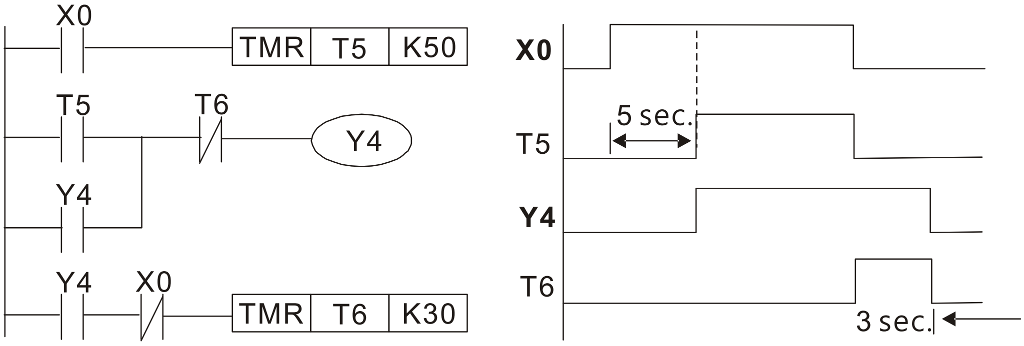


Figure 16-48

Example 12: Extended timing circuit

In the circuit in the ladder diagram (Figure 16-49) on the left, the total delay time from the moment input X0 closes to the time output Y1 is electrified is (n1+n2)*T, where T is the clock cycle. The timers are T11 and T12, and the clock cycle is T.

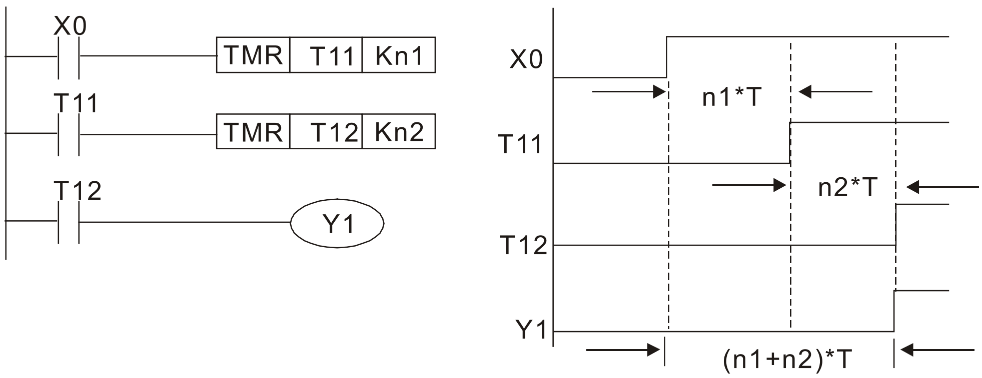


Figure 16-49

16-5 Various PLC Device Functions

Item	Specifications	Notes
Algorithmic control method	The program is stored internally, alternating back-and-forth scanning method.	
Input/output control method	When the scan starts again after ending (after execution to the END command), the input / output is immediately refreshed.	
Algorithmic processing speed	Basic commands (several μs)	Application command (1 to several tens of μs)
Programming language	Command + ladder diagram	
Program capacity	5000 steps	
Input/output terminal	Digital input (X): 7, digital output (Y): 3 Analog input AI: 2, analog output AO: 1	

Table 16-7

Type	Device	Item		Range		Function
Relay bit form	X	External input relay		X0–X17, 16 points, octal number	Total 32 points	Corresponds to external input point
	Y	External output relay		Y0–Y17, 16 points, octal number		Corresponds to external output point
	M	Auxiliary Relay	General Use	M0–M799, 800 points	Total 1080 points	Contact can switch ON/OFF within the program
			Special purpose	M1000–M1279, 280 points		
	T	Timer	100 ms timer	T0–T59, 160 points	Total 160 points	Timers referred to by the TMR command; T contact with the same number switches ON when the time is reached.
	C	Counter	16-bit counter, general use	C0–C79, 80 points	Total 80 points	Counter referred to by the CNT command; contact of the C with the same number switches ON when the count is reached.
Register word data	T	Current timer value		T0–T159, 160 points		The contact switches ON when the time is reached.
	C	Current counter value		C0–C79, 16-bit counter 80 points		The counter contact switches ON when the count is reached.
	D	Data Register	Used to maintain power OFF	D0–D99, 100 points	Total 1020 points	Used as data storage memory area
			Special purpose	D100–D399, 300 points D1000–D1619, 620 points		
Constant	K	Decimal	Single-byte	Setting Range: K-32,768–K32,767		
			Double-byte	Setting Range: K-2,147,483,648–K2,147,483,647		
	H	Hexadecimal	Single-byte	Setting Range: H0000–HFFFF		
			Double-byte	Setting Range: H00000000–HFFFFFFFF		
Serial communications port (program write/read)				RS-485/USB/keypad port		
Input/output				Two built-in analog inputs and one analog output		
High-speed counting				One built-in (MI7 or MI6+MI7) 32-bit high-speed counter		
Function expansion module			Optional Accessories	EMM-D33A; EMM-R2CA; EMM-R3AA; EMM-A22A		
Communication expansion module			Built-in	CANopen (slave)		
			Optional Accessories			

Table 16-8

16-5-1 Introduction to device functions

Input / output contact functions

Input contact X has this function: input contact X is connected with an input device, and reads input signals entering the PLC. There are no restrictions on the number of times that the input contact A or B appear in the program. The ON/OFF state of input contact X changes as the input device switches between ON and OFF; you cannot use a peripheral device (WPLSoft) to force contact X ON or OFF.

Output contact Y functions

The output contact Y sends an ON/OFF signal to drive the load connected to output contact Y. There are two types of output contacts: relays and transistors. There are no restrictions on the number of times that contact A or B of an output contact Y appear in a program, but it is recommended that you use the number of output coil Y only once in a program; otherwise the output state when the PLC performs program scanning is determined by the program's final output Y circuit.

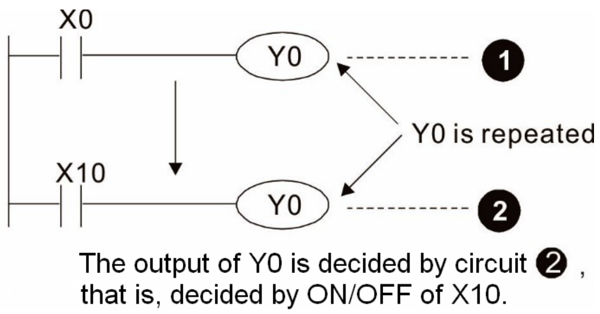


Figure 16-50

Numerical value, constant [K] / [H]

Constant	Single-byte	K	Decimal	K-32,768–K32,767
	Double-byte			K-2,147,483,648–K2,147,483,647
	Single-byte	H	Hexadecimal	H0000–HFFFF
	Double-byte			H00000000–HFFFFFFFF

Table 16-9

The PLC uses five types of numerical values to implement calculations based on its control tasks; the following topics explain the use and function of the different numerical types.

Binary Number, BIN

The PLC's numerical operations and memory employ binary numbers. Table 16-10 below explains terms related to binary numbers.

bit	Bits are the fundamental units of binary values, and have a state of either 1 or 0.
Nibble	Comprised of a series of four bits (such as b3–b0); can be used to express a one-nibble decimal number 0–9 or hexadecimal number 0–F.
Byte	Comprised of a series of two nibbles (i.e. 8 bits, b7–b0); can express a hexadecimal number: 00–FF.
Word	Comprised of a series of two bytes (i.e. 16 bits, b15–b0); can express a hexadecimal number with four nibbles: 0000–FFFF.
Double Word	Comprised of a series of two words (i.e. 32 bits, b31–b0); can express a hexadecimal number with eight nibbles: 00000000–FFFFFFFF

Table 16-10

The following diagram shows the relationship between bits, digits, nibbles, words, and double words in a binary system (see Figure 16-51).

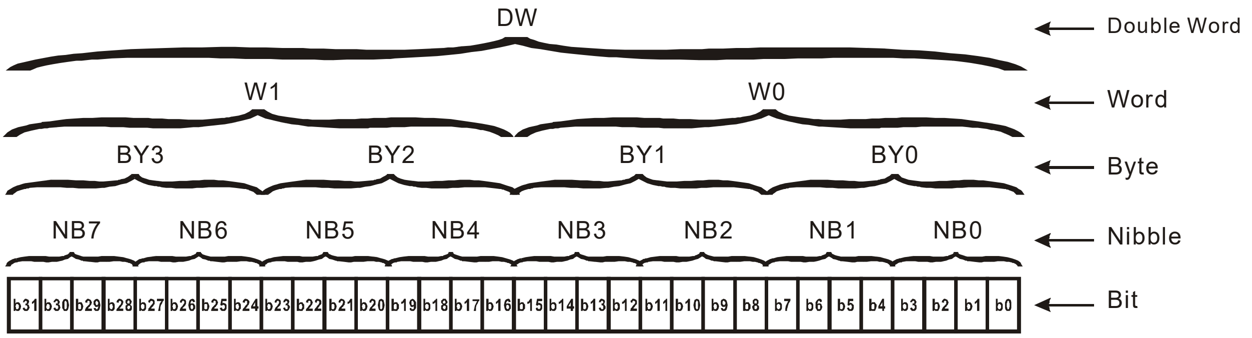


Figure 16-51

Octal Number, OCT

The external input and output terminals of a DVP-PLC are numbered using octal numbers.

Example: External input: X0–X7, X10–X17…(Device number table)

External output: Y0–Y7, Y10–Y17…(Device number table)

Decimal Number, DEC

A PLC uses decimal numbers for the following purposes:

☑ The setting values of timer T or counter C, such as TMR C0 K50 (K constant).

☑ The numbers of devices including M, T, C, or D, such as M10 or T30 (device number).

☑ An operand in an application command, such as MOV K123 D0 (K constant).

Binary Coded Decimal, BCD

Uses one nibble or four bits to express the data in a decimal number; a series of 16 bits can therefore express a decimal number with four nibbles. These are used to read the input value of a rotating numerical switch to input or output a numerical value to a seven-segment display drive.

Hexadecimal Number, HEX

A PLC uses hexadecimal numbers as operands in application commands, such as MOV H1A2B D0 (H constant).

Constant K

PLC's usually prefixed decimal numbers with K, such as K100. This indicates that it is a decimal number with a numeric value of 100.

Exceptions: You can combine K with a bit device X, Y, M, or S to produce data in the form of a nibble, byte, word, or double word, such as in the case of K2Y10 or K4M100. Here K1 represents a 4-bit combination, and K2–K4 represent 8-, 12-, and 16-bit combinations.

Constant H

PLC's usually prefixed hexadecimal numbers with H, such as in the case of H100. This indicates a hexadecimal number with a numeric value of 100.

Functions of auxiliary relays

Like an output relay Y, an auxiliary relay M has an output coil and contacts A and B, and you can use the output relay contacts any number of times in a program. You can use an auxiliary relay M to configure the control circuit, but cannot use the auxiliary relay to directly drive an external load. There are two types of auxiliary relays:

- Ordinary auxiliary relays: ordinary auxiliary relays all revert to the OFF state when a power outage occurs while the PLC is running, and remains in the OFF state when power is restored.
- Special purpose auxiliary relays: each special purpose auxiliary relay has its own specific use. Do not use any undefined special purpose auxiliary relays.

Timer functions

Timers use 100 ms as their timing unit. When the timing method is an upper time limit, and the current timer value = setting value, the timer output coil is energized. Timer setting values use decimal K values; you can also use the data register D as a setting value.

Actual timer setting time = timing units * set value

Counter features

Item	16-bit counter
Type	General Type
CT Direction:	Up
Setting	0–32,767
Designation of set value	Constant K or data register D
Change in current value	When the count reaches the setting value, it stops counting.
Output contact	When the count reaches the setting value, the contact switches ON and stays ON.
Reset	The current value reverts to 0 when an RST command is executed, and the contact reverts to OFF.
Contact actuation	All are actuated after the end of scanning.

Counter functions

When a counter's counting pulse input signal switches from OFF to ON, if the counter's current value is equal to the setting value, the output coil switches ON. The setting value can be either a decimal K or a data register D.

16-bit counter:

- ☑ 16-bit counter setting range: K0–K32,767. When K0 and K1 are identical, the output contact is immediately ON during the first count.
- ☑ The current counter value is cleared from an ordinary counter when power to the PLC turns OFF.
- ☑ If you use the MOV command or WPLSoft to transmit a value greater than the setting value to the C0 current value register, when the next X1 switches from OFF to ON, the C0 counter contact changes to ON, and the current value changes to the setting value.
- ☑ You can set a counter's setting value directly using a constant K, or indirectly using the value in register D (not including special data registers D1000–D1199 or D2000–D2799).
- ☑ If the setting value is a constant K, the value must be a positive number. If the setting value is from data register D, the value can be either a positive or negative number. If using a data register, and the current value is 32,767, incrementing the count causes the count value to roll over to -32,768 as the count continues to accumulate.

Example

LD	X0
RST	C0
LD	X1
CNT	C0 K5
LD	C0
OUT	Y0

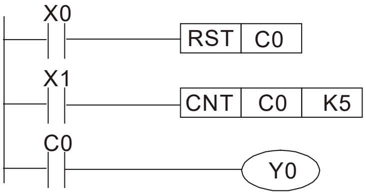


Figure 16-52

1. When X0 = ON and the RST command is executed, the current value of C0 reverts to 0, and the output contact reverts to OFF.
2. When X1 switches from OFF to ON, the current value of the counter is incremented by one (add one).
3. When the count in C0 reaches the set value K5, the contact C0 switches to ON, and the current value of C0 = setting value = K5. Afterwards, additional changes in X1 do not affect the count value, and C0 remains at K5.

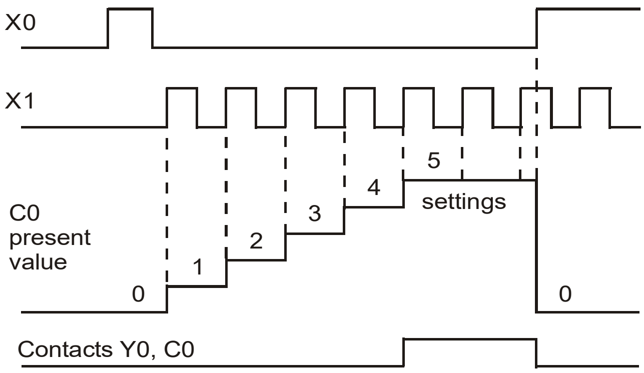


Figure 16-53

16-5-2 Introduction to special relay functions (special M)

R/W column: RO means read only; RW means read and write.

Special M	Function Descriptions	R/W
M1000	Monitors N.O. contact (contact A). N.O. while RUN, contact A. This contact is ON while in the RUN state.	RO
M1001	Monitors N.C. contact (contact B). N.C. while RUN, contact B. This contact is OFF while in the RUN state.	RO
M1002	Initiates a forward pulse (the instant RUN is ON). Initial pulse, contact A. Produces a forward pulse when RUN begins; pulse width = scan cycle.	RO
M1003	Initiates a reverse pulse (the instant RUN is OFF). Initial pulse, contact A. Produces a reverse pulse when RUN ends; pulse width = scan cycle.	RO
M1004	--	RO
M1005	Drive malfunction instructions	RO
M1006	Drive has no output	RO
M1007	Drive direction FWD (0) / REV (1)	RO
M1008 – M1010	--	--
M1011	10ms clock pulse, 5 ms ON / 5 ms OFF.	RO
M1012	100ms clock pulse, 50 ms ON / 50 ms OFF.	RO
M1013	1 sec. clock pulse, 0.5 s ON / 0.5 s OFF.	RO
M1014	1 min. clock pulse, 30 s ON / 30 s OFF.	RO
M1015	Frequency reached (when used with M1025)	RO
M1016	Parameter read/write error	RO
M1017	Parameter write successful	RO
M1018	--	--
M1019	--	--
M1020	Zero flag	RO
M1021	Borrow flag	RO
M1022	Carry flag	RO
M1023	Divisor is 0	RO
M1024	--	--
M1025	Drive frequency = set frequency (ON) Drive frequency = 0 (OFF)	RW
M1026	Drive operating direction FWD (OFF) / REV (ON)	RW
M1027	Drive Reset	RW
M1028	--	--
M1029	--	--
M1030	--	--
M1031	--	--

Special M	Function Descriptions	R/W
M1032	--	--
M1033	--	--
M1034	--	--
M1035	--	--
M1036	--	--
M1037	--	--
M1038	MI7 single-phase or MI6+MI7 AB-phase count begins	RW
M1039	Reset MI7 single-phase or MI6+MI7 AB-phase count value	RW
M1040	Hardware power (Servo On)	RW
M1041	--	--
M1042	Quick Stop	RW
M1043	--	--
M1044	Pause (Halt)	RW
M1045 – M1047	--	--
M1048	--	--
M1049	--	--
M1050	--	--
M1051	--	--
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW
M1053	--	--
M1054	--	--
M1055	--	--
M1056	Hardware already has power (Servo On Ready)	RO
M1057	--	--
M1058	On Quick Stopping	RO
M1059 – M1062	--	--
M1063	Torque reached	RO
M1064 – M1076	--	--
M1077	485 read / write completed	RO
M1078	485 read / write error	RO
M1079	485 communication time-out	RO
M1080	485 exception error	RO
M1081	485 check sum or data format is wrong	RO
M1085	485 data have been updated	RW

Special M	Function Descriptions	R/W
M1086	485 data receives a request	RW
M1090	OFF (Refer to Pr.00-29 for more information)	RO
M1091	HAND (Refer to Pr.00-29 for more information)	RO
M1092	AUTO (Refer to Pr.00-29 for more information)	RO
M1100	LOCAL (Refer to Pr.00-29 for more information)	RO
M1101	REMOTE (Refer to Pr.00-29 for more information)	RO

Table 16-11

16-5-3 Introduction to special register functions (special D)

R/W column: RO means read only; RW means read and write.

Special D	Function Descriptions	R/W
D1000	--	--
D1001	Device system program version	RO
D1002	Program capacity	RO
D1003	Total program memory content	RO
D1004 – D1009	--	--
D1010	Current scan time (units: 0.1 ms)	RO
D1011	Minimum scan time (units: 0.1 ms)	RO
D1012	Maximum scan time (units: 0.1 ms)	RO
D1013 – D1017	--	--
D1018	Current integral value	RO
D1019	Force setting for PID I integral	RW
D1020	Output frequency (0.00–599.00 Hz)	RO
D1021	Output current (####.#A)	RO
D1022	AI AO DI DO expansion card number 0: No expansion card 10: EMM-D33A 11: EMM-A22A 12: EMM-R2CA 13: EMM-R3AA	--
D1023	Communication expansion card number 0: No expansion card 1: DeviceNet Slave 2: PROFIBUS-DP Slave 3: CANopen Slave 5: EtherNet/IP Slave	RO
D1024 – D1026	--	--
D1027	PID calculation frequency command (frequency command after PID calculation)	RO
D1028	AVI value (0.00–100.00%)	RO
D1029	ACI value (0.00–100.00%)	RO
D1030	--	--
D1031	AI10 value (0.00–100.00%)	RO

Special D	Function Descriptions	R/W
D1032	AI11 value (0.00–100.00%)	RO
D1033 – D1034	--	--
D1035	--	--
D1036	Servo error bit	RO
D1037	Drive output frequency	RO
D1038	DC bus voltage	RO
D1039	Output voltage	RO
D1040	Analog output value AFM (-100.00–100.00%)	RW
D1041	Analog output value AO10 (0.00–100.00%)	RW
D1042	Analog output value AO11 (0.00–100.00%)	RW
D1043	Can be user-defined (is displayed on panel when Pr.00-04 is set to 28; display method is Cxxx)	RW
D1044	--	-
D1045	--	--
D1046 – D1049	--	--
D1050	Actual operation mode 0: Speed 2: Torque	RO
D1051	--	--
D1052	--	--
D1053	Actual torque	RO
D1054	MI7 current calculated count value (low word)	RO
D1055	MI7 current calculated count value (high word)	RO
D1056	Rotational speed corresponding to MI7	RO
D1057	MI7's rotating speed ratio	RW
D1058	MI7 refresh rate (ms) corresponding to rotating speed	RW
D1059	Number of nibbles of rotating speed corresponding to MI7 (0–3)	RW
D1060	Operation mode setting 0: Speed 2: Torque	RW
D1061	485 Modbus communication time-out time (ms)	RW
D1062	Torque command (torque limit in speed mode)	RW
D1063 – D1069	--	--
D1100	Target frequency	RO

Special D	Function Descriptions	R/W
D1101	Target frequency (must be operating)	RO
D1102	Reference frequency	RO
D1103	--	--
D1104	--	--
D1105	Target torque	RO
D1106	--	--
D1107	π (Pi) low word	RO
D1108	π (Pi) high word	RO
D1109	Random number	RO
D1111	Encoder pulse number L	RO
D1112	Encoder pulse number H	RO
D1600	The information length that the present 485 received	RO
D1601	The packet accumulation that the present 485 received	RO
D1610	The initial disk D to stack packet	RW

Table 16-12

The following is CANopen Master's special D (Allow writing only when PLC is in STOP state)
n = 0–7

Special D	Description of Function	PDO Map	Power off Memory	Default	R/W
D1070	Channel opened by CANopen initialization (bit0=Machine code0 …)	NO	NO	0	R
D1071	Error channel occurring in CANopen initialization process (bit0=Machine code0 …)	NO	NO	0	R
D1072	Reserved	-	-		-
D1073	CANopen break channel (bit0=Machine code0 …)	NO	NO		R
D1074	Error code of master error 0: No error 1: Slave station setting error 2: Synchronizing cycle setting error (too small)	NO	NO	0	R
D1075	Reserved	-	-		-
D1076	SDO error message (main index value)	NO	NO		R
D1077	SDO error message (secondary index value)	NO	NO		R
D1078	SDO error message (error code)	NO	NO		R
D1079	SDO error message (error code)	NO	NO		R
D1080	Reserved	-	-		-
D1081 – D1086	Reserved	-	-		-
D1087 – D1089	Reserved	-	-		-
D1090	Synchronizing cycle setting	NO	YES	4	RW
D1091	Sets slave station On or Off (bit 0–bit 7 correspond to slave stations number 0–7)	NO	YES	FFFFH	RW
D1092	Delay before start of initialization	NO	YES	0	RW
D1093	Break time detection	NO	YES	1000ms	RW
D1094	Break number detection	NO	YES	3	RW

Special D	Description of Function	PDO Map	Power off Memory	Default	R/W
D1095 – D1096	Reserved	-	-		-
D1097	Corresponding real-time transmission type (PDO) Setting range: 1–240	NO	YES	1	RW
D1098	Corresponding real-time receiving type (PDO) Setting range: 1–240	NO	YES	1	RW
D1099	Initialization completion delay time Setting range: 1–60000 sec.	NO	YES	15 sec.	RW
D2000+100*n	Station number n of slave station Setting range: 0–127 0: No CANopen function	NO	YES	0	RW

16-5-4 PLC Communication address

Device	Range	Type	Address (Hex)
X	00–17 (Octal)	bit	0400–040FF
Y	00–17 (Octal)	bit	0500–050F
T	00–159	bit/word	0600–069F
M	000–799	bit	0800–0B1F
M	1000–1279	bit	0BE8–0CFF
C	0–79	bit/word	0E00–0E4F
D	00–399	word	1000–118F
D	1000–1619	word	13E8–1653

Table 16-13

Command codes

Function Code	Function Descriptions	Function target
H1	Coil status read	Y, M, T, C
H2	Input status read	X, Y, M, T, C
H3	Read single unit of data	T, C, D
H5	Force single coil status change	Y, M, T, C
H6	Write single unit of data	T, C, D
HF	Force multiple coil status change	Y, M, T, C
H10	Write multiple units of data	T, C, D

Table 16-14

NOTE:

When PLC functions have been activated, the MH300 can match the PLC and drive parameters; this method uses different addresses for drives (default station number is 1; PLC sets station number as 2).

16-6 Introduction to the Command Window

16-6-1 Overview of basic commands

- Ordinary commands

Command code	Function	OPERAND	Execution speed (μs)
LD	Load contact A	X, Y, M, T, C	0.8
LDI	Load contact B	X, Y, M, T, C	0.8
AND	Connect contact A in series	X, Y, M, T, C	0.8
ANI	Connect contact B in series	X, Y, M, T, C	0.8
OR	Connect contact A in parallel	X, Y, M, T, C	0.8
ORI	Connect contact B in parallel	X, Y, M, T, C	0.8
ANB	Series circuit block	N/A	0.3
ORB	Parallel circuit block	N/A	0.3
MPS	Save to stack	N/A	0.3
MRD	Stack read (pointer does not change)	N/A	0.3
MPP	Read stack	N/A	0.3

Table 16-15

- Output command

Command code	Function	OPERAND	Execution speed (μs)
OUT	Drive coil	Y, M	1
SET	Action continues (ON)	Y, M	1
RST	Clear contact or register	Y, M, T, C, D	1.2

Table 16-16

- Timer, counter

Command code	Function	OPERAND	Execution speed (μs)
TMR	16-bit timer	T-K or T-D commands	1.1
CNT	16-bit counter	C-K or C-D (16-bit)	0.5

Table 16-17

- Main control command

Command code	Function	OPERAND	Execution speed (μs)
MC	Common series contact connection	N0–N7	0.4
MCR	Common series contact release	N0–N7	0.4

Table 16-18

- Contact rising edge / falling edge detection command

Command code	Function	OPERAND	Execution speed (μs)
LDP	Start of rising edge detection action	X, Y, M, T, C	1.1
LDF	Start of falling edge detection action	X, Y, M, T, C	1.1
ANDP	Rising edge detection series connection	X, Y, M, T, C	1.1
ANDF	Falling edge detection series connection	X, Y, M, T, C	1.1
ORP	Rising edge detection parallel connection	X, Y, M, T, C	1.1
ORF	Falling edge detection parallel connection	X, Y, M, T, C	1.1

Table 16-19

- Upper/lower differential output commands

Command code	Function	OPERAND	Execution speed (μs)
PLS	Upper differential output	Y, M	1.2
PLF	Lower differential output	Y, M	1.2

Table 16-20

- Stop command

Command code	Function	OPERAND	Execution speed (μs)
END	Program conclusion	N/A	0.2

Table 16-21

- Other commands

Command code	Function	OPERAND	Execution speed (μs)
NOP	No action	N/A	0.2
INV	Inverse of operation results	N/A	0.2
P	Index	P	0.3

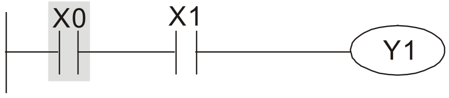
Table 16-22

16-6-2 Detailed explanation of basic commands

Command	Function					
LD	Load contact A					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: Use the LD command for contact A starting at the left busbar or contact A starting at a contact circuit block; its function is to save current content and save the acquired contact status in the cumulative register.

Example: Ladder diagram:

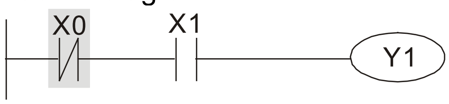


Command code:		Description:
LD	**X0**	Load Contact A of X0
AND	X1	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil

Command	Function					
LDI	Load contact B					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: Use the LDI command for contact B starting at the left busbar or contact B starting at a contact circuit block; its function is to save current content and save the acquired contact status in the cumulative register.

Example: Ladder diagram:



Command code:		Description:
LDI	**X0**	Load Contact B of X0
AND	X1	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil

Command	Function					
AND	Connect contact A in series					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: Use the AND command to create a series connection to contact A; its function is to first read the current status of the designated series contact and the logical operation results before contact in order to perform “AND” operation; saves the results in the cumulative register.

Example: Ladder diagram:

Command code:		Description:
LDI	X1	Load Contact B of X1
AND	**X0**	Create a series connection to contact A of X0
OUT	Y1	Drive Y1 coil

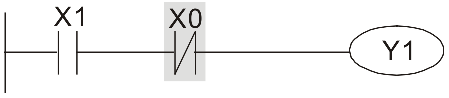
Command	Function					
ANI	Connect contact B in series					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

Use the ANI command to create a series connection to contact B; its function is to first read the current status of the designated series contact and the logical operation results before contact in order to perform “AND” operation; saves the results in the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X1	Load Contact A of X1
ANI	**X0**	Create a series connection to contact B of X0
OUT	Y1	Drive Y1 coil

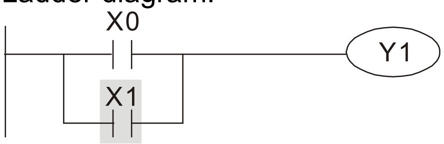
Command	Function					
OR	Connect contact A in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

Use the OR command to establish a parallel connection to contact A; its function is to first read the current status of the designated series contact and the logical operation results before contact in order to perform “OR” operation; saves the results in cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
OR	**X1**	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil

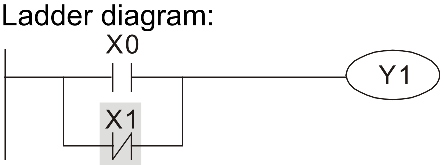
Command	Function					
ORI	Connect contact B in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

Use the ORI command to establish a parallel connection to contact B; its function is to first read the current status of the designated series contact and the logical operation results before contact in order to perform “OR” operation; saves the results in cumulative register.

Example

Ladder diagram:

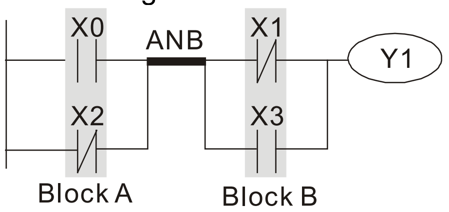


Command code:		Description:
LD	X0	Load Contact A of X0
ORI	**X1**	Create a series connection to contact B of X1
OUT	Y1	Drive Y1 coil

Command	Function
ANB	Series circuit block
Operand	N/A

Explanation ANB performs an “AND” operation on the previously saved logic results and the current cumulative register content.

Example Ladder diagram:

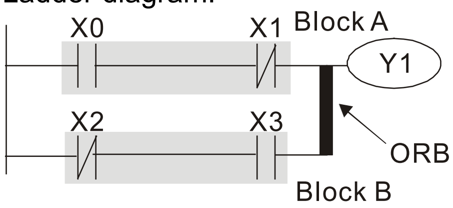


Command code:		Description:
LD	X0	Load Contact A of X0
ORI	X2	Establish a parallel connection to contact B of X2
LDI	X1	Load Contact B of X1
OR	X3	Establish a parallel connection to contact A of X3
ANB		Series circuit block
OUT	Y1	Drive Y1 coil

Command	Function
ORB	Parallel circuit block
Operand	N/A

Explanation ORB performs an “OR” operation on the previously saved logic results and the current cumulative register content.

Example Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
ANI	X1	Establish a parallel connection to contact B of X1
LDI	X2	Load Contact B of X2
AND	X3	Establish a parallel connection to contact A of X3
ORB		Parallel circuit block
OUT	Y1	Drive Y1 coil

Command	Function
MPS	Save to stack
Operand	N/A

Explanation Saves the current content of the cumulative register to the stack (add one to the stack pointer).

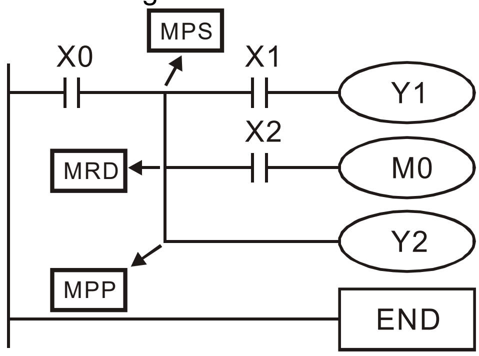
Command	Function
MRD	Read stack (pointer does not change)
Operand	N/A

Explanation Reads the stack content and saves to the cumulative register (the stack pointer does not change).

Command	Function
MPP	Read stack
Operand	N/A

Explanation Retrieves the result of the previously-saved logical operation from the stack, and saves to the cumulative register (subtract one from stack pointer).

Example Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
MPS		Save to the stack
AND	X1	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil
MRD		Read the stack (pointer does not change)
AND	X2	Create a series connection to contact A of X2
OUT	M0	Drive M0 coil
MPP		Read stack
OUT	Y2	Drive Y2 coil
END		Program conclusion

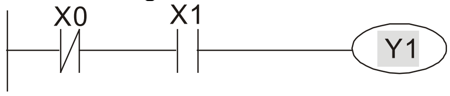
Command	Function					
OUT	Drive coil					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	–	✓	✓	–	–	–

Explanation Outputs the result of the logical operation before the OUT command to the designated element.

Coil contact action:

Result:	Out command		
	Coil	Access Point:	
		Contact A (N.O.)	Contact B (N.C.)
FALSE	OFF	Not conducting	Conducting
TRUE	ON	Conducting	Not conducting

Example Ladder diagram:

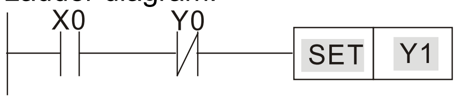


Command code:		Description:
LD	X0	Load Contact B of X0
AND	X1	Establish a parallel connection to contact A of X1
OUT	**Y1**	Drive Y1 coil

Command	Function					
SET	Action continues (ON)					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	–	✓	✓	–	–	–

Explanation Sets the designated element to ON, and maintains it in an ON state, regardless of whether the SET command is still driven. Use the RST command to set the element as OFF.

Example Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
AN	Y0	Establish a parallel connection to contact B of Y0
SET	**Y1**	Action continues (ON)

Command	Function					
RST	Clear contact or register					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	✓	✓	✓

Explanation

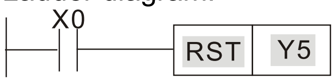
Resets the designated element as described.

Element	Mode
Y, M	Both coil and contact are set to OFF.
T, C	Sets the current timing or count value to 0 and both the coil and contact are set to OFF.
D	Sets the content value to 0.

If the RST command is not executed, the status of the designated element remains unchanged.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
RST	**Y5**	Clear the contact or register

Command	Function	
TMR	16-bit timer	
Operand	T-K	T0–T159, K0–K32,767
	T-D	T0–T159, D0–D399

Explanation

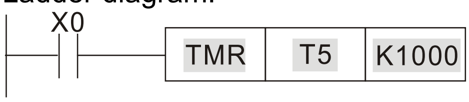
Electrifies the designated timer coil, and the timer begins timing. The contact's action is as follows when the timing value reaches the designated setting value (timing value ≥ setting value):

N.O. (Normally Open) contact	Closed
N.C. (Normally Closed) contact	Open

If the RST command is not executed, the status of the designated element remains unchanged.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
TMR	**T5 K1000**	T5 timer Set value as K1000

Command	Function	
CNT	16-bit counter	
Operand	C-K	C0–C79, K0–K32,767
	C-D	C0–C79, D0–D399

Explanation

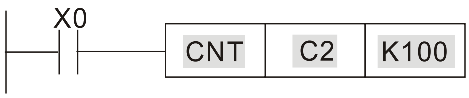
When you execute the CNT command from OFF to ON, switch the designated counter coil from no power to electrified and add one to the counter's count value. When the count reaches the designated value (count value = setting value), the contact has the following action:

N.O. (Normally Open) contact	Closed
N.C. (Normally Closed) contact	Open

After reaching the count value, the contact and count value both remain unchanged even with continued count pulse input. Use the RST command to restart or clear the count.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
CNT	**C2 K100**	C2 counter Set value as K100

Command	Function
MC / MCR	Connect / release a common series contact
Operand	N0–N7

Explanation

MC is the main control initiation command, and any command between MC and MCR is executed normally. When the MC command is OFF, any command between MC and MCR acts as follows:

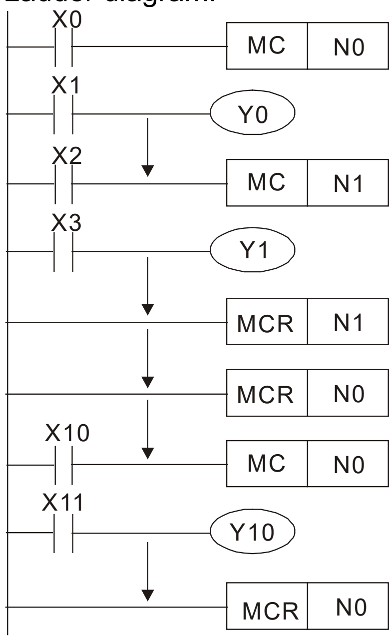
Determination of commands	Description
Ordinary timer	The timing value reverts to 0, the coil loses power, and the contact does not operate.
Counter	The coil loses power, and the count value and contact stay in their current state.
Coil driven by OUT command	None receive power.
Elements driven by SET, RST commands	They remain in their current state.
Application commands	None are actuated.

MCR is the main control stop command, and is placed at the end of the main control program. There may not be any contact command prior to the MCR command.

The MC-MCR main control program commands support a nested program structure with a maximum of only eight levels; use in the order N0–N7. Refer to the following program example:

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
MC	**N0**	Connection of N0 common series contact
LD	X1	Load Contact A of X1
OUT	Y0	Drive Y0 coil
:		
LD	X2	Load Contact A of X2
MC	**N1**	Connection of N1 common series contact
LD	X3	Load Contact A of X3
OUT	Y1	Drive Y1 coil
:		
MCR	**N1**	Release N1 common series contact
:		
MCR	**N0**	Release N0 common series contact
:		
LD	X10	Load Contact A of X10
MC	**N0**	Connection of N0 common series contact
LD	X11	Load Contact A of X11
OUT	Y10	Drive Y10 coil
:		
MCR	**N0**	Release N0 common series contact

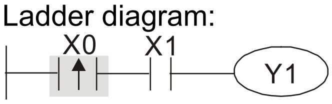
Command	Function					
LDP	Start of rising edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LDP command has the same use as LD, but its action is different. Its function is to save the current content while also saving the detected state of the rising edge of the contact to the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDP	**X0**	Start of X0 rising edge detection action
AND	X1	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil

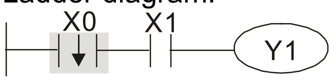
Command	Function					
LDF	Start of falling edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LDF command has the same use as LD, but its action is different. Its function is to save the current content while also saving the detected state of the falling edge of the contact to the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDF	**X0**	Start of X0 falling edge detection action
AND	X1	Create a series connection to contact A of X1
OUT	Y1	Drive Y1 coil

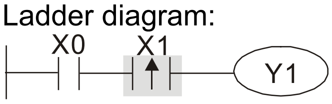
Command	Function					
ANDP	Rising edge detection series connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

Use the ANDP command for a contact rising edge detection series connection.

Example

Ladder diagram:

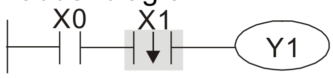


Command code:		Description:
LD	X0	Load Contact A of X0
ANDP	**X1**	X1 Rising edge detection series connection
OUT	Y1	Drive Y1 coil

Command	Function					
ANDF	Falling edge detection series connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation Use the ANDF command for a contact falling edge detection series connection.

Example Ladder diagram:

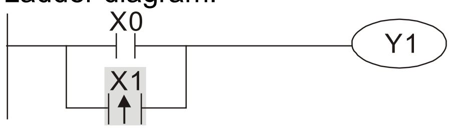


Command code:		Description:
LD	X0	Load Contact A of X0
ANDF	**X1**	X1 Falling edge detection series connection
OUT	Y1	Drive Y1 coil

Command	Function					
ORP	Rising edge detection parallel connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation Use the ORP command for a contact rising edge detection parallel connection.

Example Ladder diagram:

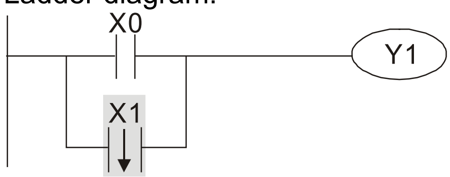


Command code:		Description:
LD	X0	Load Contact A of X0
ORP	**X1**	X1 Rising edge detection parallel connection
OUT	Y1	Drive Y1 coil

Command	Function					
ORF	Falling edge detection parallel connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation Use the ORF command for a contact falling edge detection parallel connection.

Example Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
ORF	**X1**	X1 Falling edge detection parallel connection
OUT	Y1	Drive Y1 coil

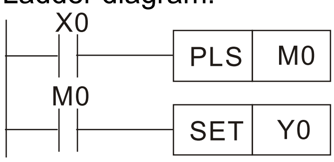
Command	Function					
PLS	Upper differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation

Upper differential output command: when X0 switches from OFF to ON (rising edge-triggered), the PLS command is executed, and M0 sends one pulse with the pulse length consisting of one scanning period.

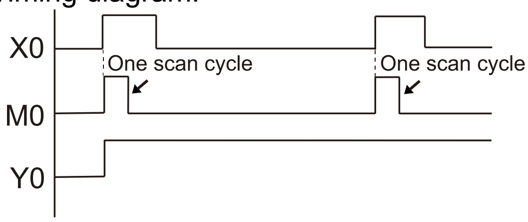
Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
PLS	**M0**	M0 Upper differential output
LD	M0	Load Contact A of M0
SET	Y0	Y0 Action continues (ON)

Timing diagram:



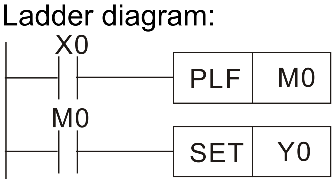
Command	Function					
PLF	Lower differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation

Lower differential output command: when X0 switches from ON to OFF (falling edge-triggered), the PLF command is executed, and M0 sends one pulse with the pulse length consisting of one scanning period.

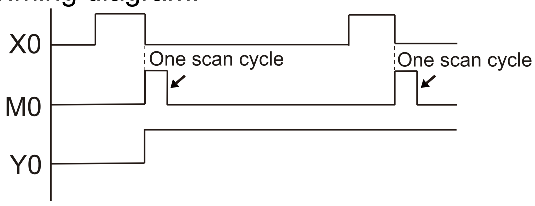
Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
PLF	**M0**	M0 Lower differential output
LD	M0	Load Contact A of M0
SET	Y0	Y0 Action continues (ON)

Timing diagram:



Command	Function
END	End of Program
Operand	N/A

Explanation

An END command must be added to the end of a ladder diagram program or command program. The PLC scans the program from address 0 to the END command, and then returns to address 0 and begins scanning again.

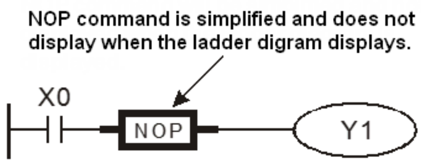
Command	Function
NOP	No action
Operand	N/A

Explanation

The NOP command does not perform any operation in the program. Because execution of this command retains the original logical operation results, you can use it in the following situation: use the NOP command instead of a command that is deleted without changing the program length.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact B of X0
NOP		No action
OUT	Y1	Drive Y1 coil

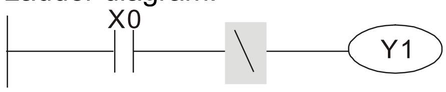
Command	Function
INV	Inverse of operation results
Operand	N/A

Explanation

Saves the result of the logic inversion operation prior to the INV command in the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
INV		Inverse of operation results
OUT	Y1	Drive Y1 coil

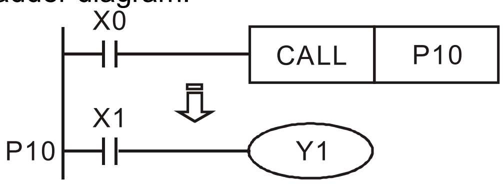
Command	Function
P	Pointer
Operand	P0–P255

Explanation

Use pointer P as the target in a subprogram call (command API 01 CALL). Using P does not require starting from zero, but the number cannot be used repeatedly; otherwise, an unpredictable error occurs.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact A of X0
CALL	P10	Call command CALL to P10
:		
P10		Pointer P10
LD	X1	Load Contact A of X1
OUT	Y1	Drive Y1 coil

16-6-3 Overview of application commands

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16 bit	32 bit
Circuit control	01	CALL	-	✓	Call a subprogram	3	-
	2	SRET	-	-	End a subprogram	1	-
	06	FEND	-	-	End a main program	1	-
Send comparison	10	CMP	DCMP	✓	Compare set output	7	13
	11	ZCP	DZCP	✓	Range comparison	9	17
	12	MOV	DMOV	✓	Move data	5	9
	15	BMOV	–	✓	Send all	7	–
Four logical operations	20	ADD	DADD	✓	BIN addition	7	13
	21	SUB	DSUB	✓	BIN subtraction	7	13
	22	MUL	DMUL	✓	BIN multiplication	7	13
	23	DIV	DDIV	✓	BIN division	7	13
	24	INC	DINC	✓	BIN add one	3	5
	25	DEC	DDEC	✓	BIN subtract one	3	5
Rotational displacement	30	ROR	DROR	✓	Right rotation	5	–
	31	ROL	DROL	✓	Left rotation	5	–
Data Process	40	ZRST	–	✓	Clear range	5	-
	49	–	DFLT	✓	Convert BIN whole number to binary floating point number	-	9
Floating point operation	110	–	DECMP	✓	Compare binary floating point numbers	–	13
	111	–	DEZCP	✓	Compare binary floating point number range	–	17
	116	–	DRAD	✓	Convert angle to diameter	–	9
	117	–	DDEG	✓	Convert diameter to angle	–	9
	120	–	DEADD	✓	Add binary floating point numbers	–	13
	121	–	DESUB	✓	Subtract binary floating point numbers	–	13
	122	–	DEMUL	✓	Multiply binary floating point numbers	–	13
	123	–	DEDIV	✓	Divide binary floating point numbers	–	13
	124	–	DEXP	✓	Find exponent of a binary floating point number	–	9
	125	–	DLN	✓	Find natural logarithm of a binary floating point number	–	9
	127	–	DESQR	✓	Find the square root of a binary floating point number	–	9
	129	–	DINT	✓	Convert binary floating point number to BIN whole number	–	9
	130	–	DSIN	✓	Find the sine of a binary floating point number	–	9
	131	–	DCOS	✓	Find the cosine of a binary floating point number	–	9
	132	–	DTAN	✓	Find the tangent of a binary floating point number	–	9
	133	–	DASIN	✓	Find the arcsine of a binary floating point number	–	9
	134	–	DACOS	✓	Find the arccosine of a binary floating point number	–	9
	135	–	DATAN	✓	Find the arctangent of a binary floating point number	–	9
	136	–	DSINH	✓	Find the hyperbolic sine of a binary floating point number	–	9
	137	–	DCOSH	✓	Find the hyperbolic cosine of a binary floating point number	–	9
	138	–	DTANH	✓	Find the hyperbolic tangent of a binary floating point number	–	9

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16 bit	32 bit
Communication	150	MODRW	–	✓	Modbus read / write	7	–
GRAY code	170	GRY	DGRY	✓	Convert BIN to GRAY code	5	9
	171	GBIN	DGBIN	✓	Convert GRAY code to BIN	5	9
Data processing	202	SCAL	DSCAL	✓	Scale value operation	5	9
Contact form logical operation	215	LD&	DLD&	-	Contact form logical operation LD#	5	9
	216	LD|	DLD|	-	Contact form logical operation LD#	5	9
	217	LD^	DLD^	-	Contact form logical operation LD#	5	9
	218	AND&	DAND&	-	Contact form logical operation AND#	5	9
	219	ANDI	DANDI	-	Contact form logical operation AND#	5	9
	220	AND^	DAND^	-	Contact form logical operation AND#	5	9
	221	OR&	DOR&	-	Contact form logical operation OR#	5	9
	222	OR|	DOR|	-	Contact form logical operation OR#	5	9
	223	OR^	DOR^	-	Contact form logical operation OR#	5	9
Contact form comparison command	224	LD＝	DLD＝	-	Contact form compare LD*	5	9
	225	LD＜	DLD＜	-	Contact form compare LD*	5	9
	226	LD＞	DLD＞	-	Contact form compare LD*	5	9
	228	LD＜＞	DLD＜＞	-	Contact form compare LD*	5	9
	229	LD＝＞	DLD＝＞	-	Contact form compare LD*	5	9
	230	LD＝＜	DLD＝＜	-	Contact form compare LD*	5	9
	232	AND＝	DAND＝	-	Contact form compare AND*	5	9
	233	AND＜	DAND＜	-	Contact form compare AND*	5	9
	234	AND＞	DAND＞	-	Contact form compare AND*	5	9
	236	AND＜＞	DAND＜＞	-	Contact form compare AND*	5	9
	237	AND＝＞	DAND＝＞	-	Contact form compare AND*	5	9
	238	AND＝＜	DAND＝＜	-	Contact form compare AND*	5	9
	240	OR＝	DOR＝	-	Contact form compare OR*	5	9
	241	OR＜	DOR＜	-	Contact form compare OR*	5	9
	242	OR＞	DOR＞	-	Contact form compare OR*	5	9
	244	OR＜＞	DOR＜＞	-	Contact form compare OR*	5	9
	245	OR＝＞	DOR＝＞	-	Contact form compare OR*	5	9
	246	OR＝＜	DOR＝＜	-	Contact form compare OR*	5	9
Floating point contact form	275	-	FLD＝	-	Floating point number contact form compare LD*	-	9
	276	-	FLD＜	-	Floating point number contact form compare LD*	-	9
	277	-	FLD＞	-	Floating point number contact form compare LD*	-	9
Comparison command	278	-	FLD＜＞	-	Floating point number contact form compare LD*	-	9
	279	-	FLD＝＞	-	Floating point number contact form compare LD*	-	9
	280	-	FLD＝＜	-	Floating point number contact form compare LD*	-	9
	281	-	FAND＝	-	Floating point number contact form compare AND*	-	9
	282	-	FAND＜	-	Floating point number contact form compare AND*	-	9
	283	-	FAND＞	-	Floating point number contact form compare AND*	-	9

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16 bit	32 bit
	284	-	FAND＜＞	-	Floating point number contact form compare AND*	-	9
	285	-	FAND＝＞	-	Floating point number contact form compare AND*	-	9
	286	-	FAND＝＜	-	Floating point number contact form compare AND*	-	9
	287	-	FOR＝	-	Floating point number contact form compare OR*	-	9
	288	-	FOR＜	-	Floating point number contact form compare OR*	-	9
	289	-	FOR＞	-	Floating point number contact form compare OR*	-	9
	290	-	FOR＜＞	-	Floating point number contact form compare OR*	-	9
	291	-	FOR＝＞	-	Floating point number contact form compare OR*	-	9
	292	-	FOR＝＜	-	Floating point number contact form compare OR*	-	9
Drive special command	139	RPR	–	✓	Read servo parameter	5	–
	140	WPR	–	✓	Write servo parameter	5	–
	141	FPID	–	✓	Drive PID control mode	9	–
	142	FREQ	–	✓	Drive torque control mode	7	–
	262	–	DPOS	✓	Set target	-	5
	263	TORQ	–	✓	Set target torque	5	-

16-6-4 Detailed explanation of application commands

API					
01		CALL	P	S	Call a subprogram

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Notes on operand usage:
The S operand can designate P.
MH300 series device: The S operand can designate P0-P63.

16-bit command (3 STEP)

CALL	Continuous execution type	CALLP	Pulse execution type

32-bit command

–	–	–	–

Flag signal: none

Explanation

- **S**: Call subprogram pointer
- Write the subprogram after the FEND command.
- The subprogram must end after the SRET command.
- Refer to the FEND command explanation and sample content for detailed command functions.

API					
02		SRET		–	End of subprogram

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Notes on operand usage:
No operand
A contact-driven command is not needed.

16-bit command (1 STEP)

FEND	Continuous execution type	–	–

32-bit command

–	–	–	–

Flag signal: none

Explanation

- A contact-driven command is not needed. Automatically returns next command after CALL command.
- Indicates end of subprogram. After end of subprogram, SRET returns to main program, and executes next command after the original call subprogram CALL command.
- Refer to the FEND command explanation and sample content for detailed command functions.

API			
06	FEND	–	End of a main program

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Notes on operand usage:
No operand
A contact-driven command is not needed.

16-bit command (1 STEP)

FEND	Continuous execution type	–	–

32-bit command

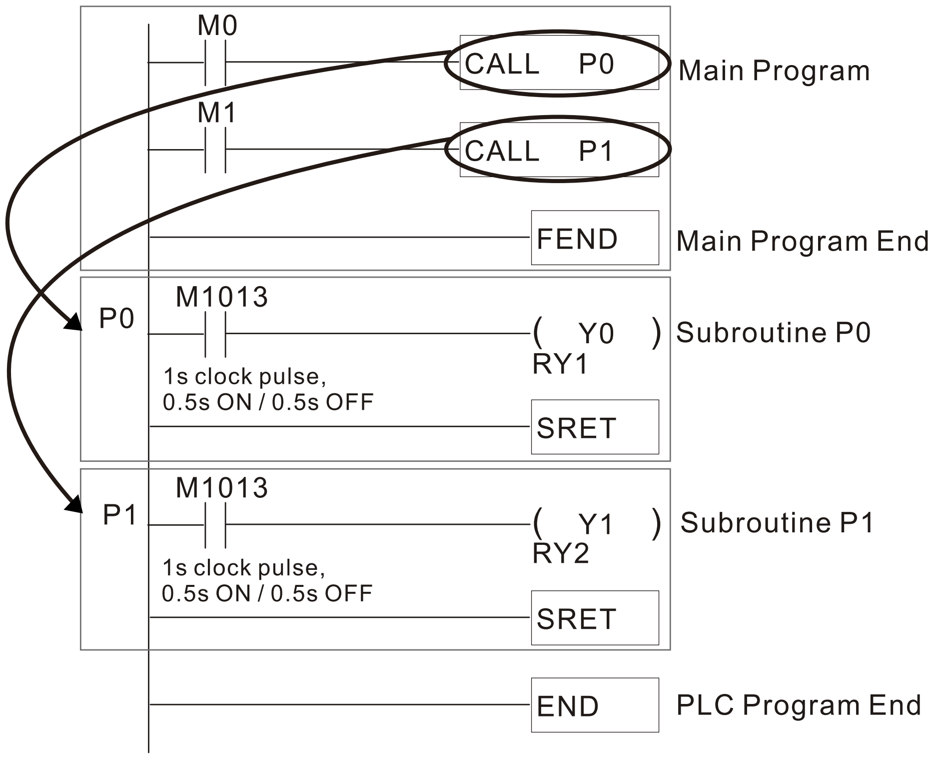
–	–	–	–

Flag signal: none

Explanation

- This command indicates the end of the main program. It is the same as the END command when the PLC executes this command.
- The CALL command program must be written after the FEND command, and the SRET command is added to the end of the subprogram.
- When using the FEND command, an END command is also needed. However, the END command must be placed at the end, after the main program and subprogram.

CALL command process



API					
10	D	CMP	P	S1 S2 D	Compare set output

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points

16-bit command (7 STEP)

CMP	Continuous execution type	CMPP	Pulse execution type

32-bit command (13 STEP)

DCMP	Continuous execution type	DCMPP	Pulse execution type

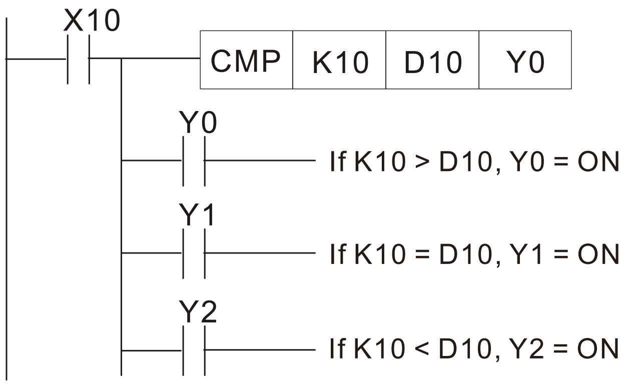
Flag signal: none

Explanation

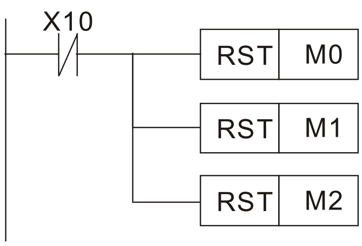
- **S1**: Compare value 1. **S2**: Compare value 2. **D**: Results of comparison.
- Compares the size of the content of operand **S1** and **S2**; stores the results of the comparison in **D**.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

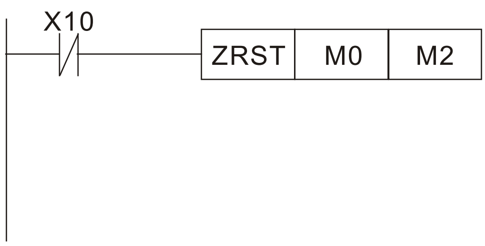
Example

- When the designated device is Y0, it automatically occupies Y0, Y1 and Y2.
- When X10 = ON, the CMP command executes, and Y0, Y1 or Y2 is ON. When X10 = OFF, the CMP command does not execute, and the state of Y0, Y1 and Y2 remain in the state prior to X10=OFF.
- For ≥, ≤, or ≠ comparison results, use series and parallel connections among Y0–Y2.



- To clear results of comparison, use the RST or ZRST command.





API				
11	D	ZCP	P	(S1) (S2) (S) (D) Range comparison

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The content value of operand S1 is less than the content value of S2 operand.
The operand D occupies three consecutive points.

16-bit command (9 STEP)			
ZCP	Continuous execution type	ZCPP	Pulse execution type

32-bit command (17 STEP)			
DZCP	Continuous execution type	DZCPP	Pulse execution type

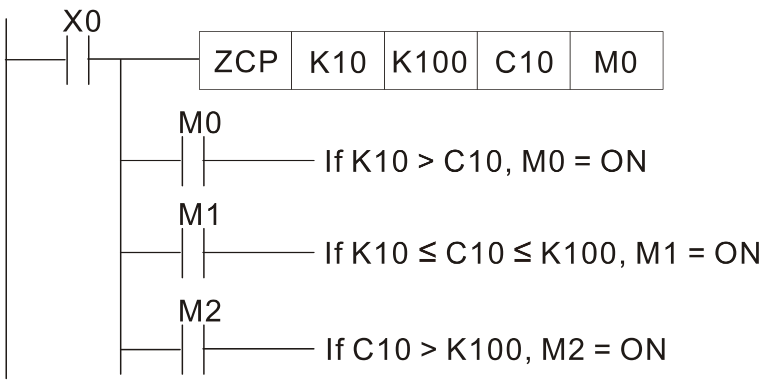
Flag signal: none

Explanation

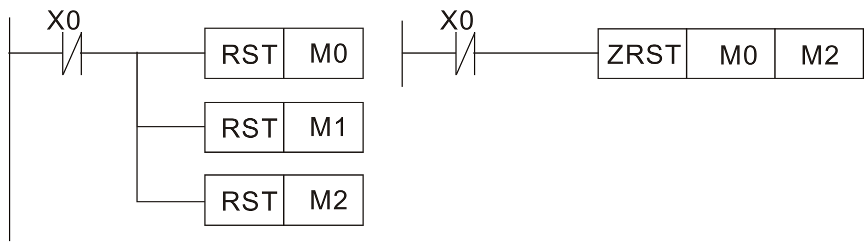
- **S1**: Lower limit of range comparison. **S2**: Upper limit of range comparison. **S**: Comparative value. **D**: Results of comparison.
- Compares value **S** with the lower limit **S1** and upper limit **S2**, and stores the results of the comparison in **D**.
- When lower limit **S1** > upper limit **S2**, the command uses the lower limit **S1** to perform the comparison with **S1** as the upper and lower limit.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

Example

- When the designated device is M0, it automatically occupies M0, M1 and M2.
- When X0 = ON, the ZCP command executes, and M0, M1 or M2 is ON. When X0 = OFF, the ZCP command does not execute, and the state of M0, M1 or M2 remains in the state prior to X0=OFF.
- For ≥, ≤, or ≠ comparison results, use series and parallel connections of M0–M2.



- To clear results of comparison, use the RST or ZRST command.



API 12	D	MOV	P	(S) (D)	Move data

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

MOV	Continuous execution type	MOVP	Pulse execution type

32-bit command (9 STEP)

DMOV	Continuous execution type	DMOVP	Pulse execution type

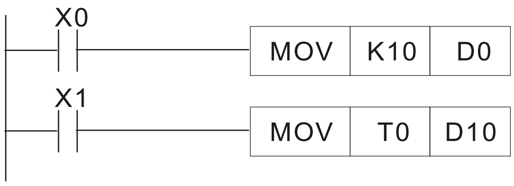
Flag signal: none

Explanation

- **S**: Data source. **D**: Destination of data movement.
- Moves the content in **S** to **D**. When the command does not execute, the content of **D** does not change.

Example

- When X0=OFF, the content of D10 does not change; if X0=ON, the value K10 is moved to data register D10.
- When X1=OFF, the content of D10 does not change; if X1=ON, the current value of T0 is moved to data register D10.



API				
15	BMOV	P	(S) (D) (n)	Send all

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*				*	*	

Notes on operand usage:
n operand scope n ＝ 1 to 512

16-bit command (7 STEP)			
BMOV	Continuous execution type	BMOVP	Pulse execution type

32-bit command			
—	—	—	—

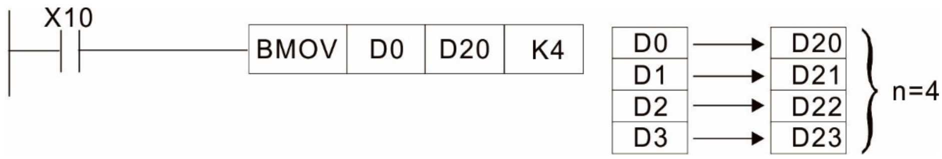
Flag signal: none

Explanation

- **S**: Initiate source device. **D**: Initiate destination device. **n**: Send block length.
- Sends the content of n registers starting from the initial number of the device designated by **S** to the n registers starting from the initial number of the device designated by **n**; if the number of points referred to by n exceeds the range used by that device, sends only points within the valid range.

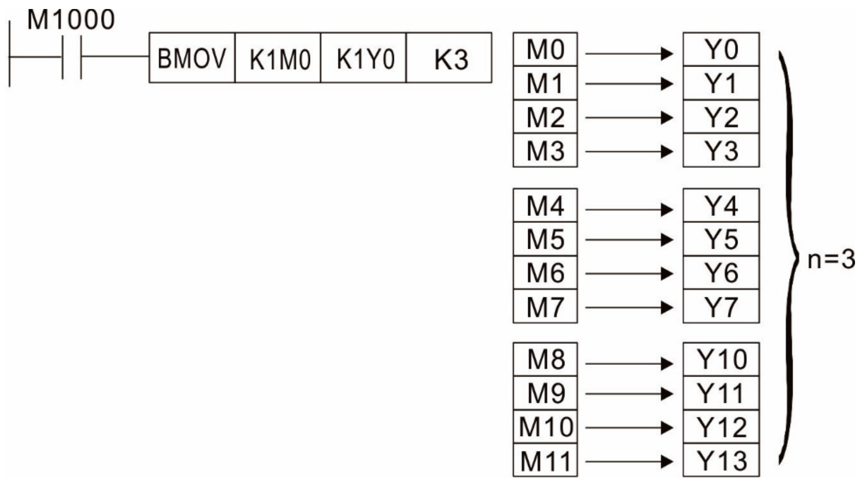
Example 1

- When X10=ON, sends the content of registers D0–D3 to the four registers D20–D23.



Example 2

- When sending from designated bit devices KnX, KnY, and KnM, **S** and **D** must have the same number of nibbles, which means n must be identical for source and destination.



API	D	ADD	P	(S1) (S2) (D)	BIN addition
20					

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (7 STEP)			
ADD	Continuous execution type	ADDP	Pulse execution type

32-bit command (13 STEP)			
DADD	Continuous execution type	DADDP	Pulse execution type

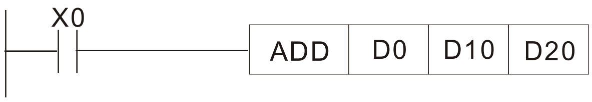
Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag
Refer to the following supplementary explanation

Explanation

- **S1**: Augend. **S2**: Addend. **D**: Sum.
- Adds **S1** and **S2** using the BIN method and stores result in **D**.
- The highest bit of any data defines the sign: bit=0 indicates (positive) bit=1 indicates (negative); enables the use of algebraic addition operations (for instance: 3+ (-9) =-6).
- Flag changes connected with the addition.
  1. When calculation results are 0, the zero flag M1020 is ON.
  2. When calculation results are less than -32,768, the borrow flag M1021 is ON.
  3. When calculation results are greater than 32,767, the carry flag M1022 is ON.

Example

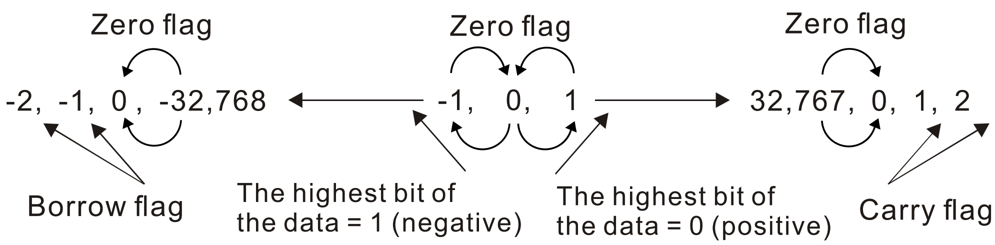
- 16-bit BIN addition: When X0=ON, saves the result of the content of addend D0 plus the content of augend D10 in the content of D20.



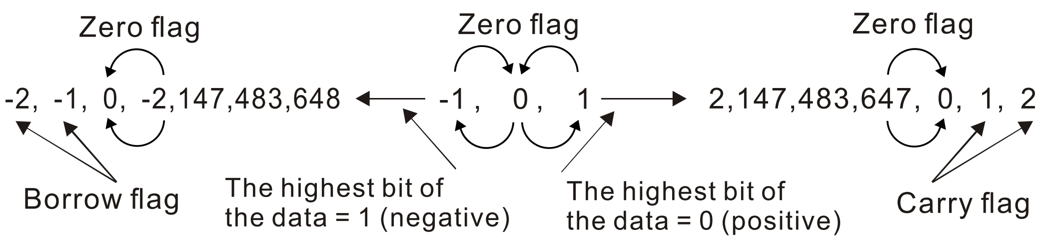
Remarks

- Relationship between flag actions and negative/positive numbers:

16-bit:



32-bit:



API					
21	D	SUB	P	S1 S2 D	BIN subtraction

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (7 STEP)

SUB	Continuous execution type	SUBP	Pulse execution type

32-bit command (13 STEP)

DSUB	Continuous execution type	DSUBP	Pulse execution type

Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag
Refer to the following supplementary explanation

Explanation

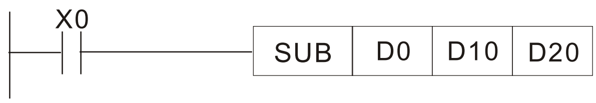
- **S1**: Minuend. **S2**: Subtrahend. **D**: Difference.
- Subtracts **S2** from **S1** using the BIN method and stores result in **D**.
- The highest bit of any data defines the sign bit=0 indicates (positive) bit=1 indicates (negative); enables the use of algebraic subtraction operations.
- Flag changes connected with subtraction.

  16-bit command:
  1. When calculation results are 0, the zero flag M1020 is ON.
  2. When calculation results are less than -32,768, the borrow flag M1021 is ON.
  3. When calculation results are greater than 32,767, the carry flag M1022 is ON.

  32-bit command:
  1. When calculation results are 0, the zero flag M1020 is ON.
  2. When calculation results are less than -2,147,483,648, the borrow flag M1021 is ON.
  3. When calculation results are greater than 2,147,483,6477, the carry flag M1022 is ON.

Example

- 16-bit BIN subtraction: When X0=ON, subtracts the content of D10 from the content of D0, and stores the difference in D20.



API				
22	D	MUL	P	S1 S2 D	BIN multiplication

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
The 16-bit command operand D occupies two consecutive points.

16-bit command (7 STEP)			
MUL	Continuous execution type	MULP	Pulse execution type

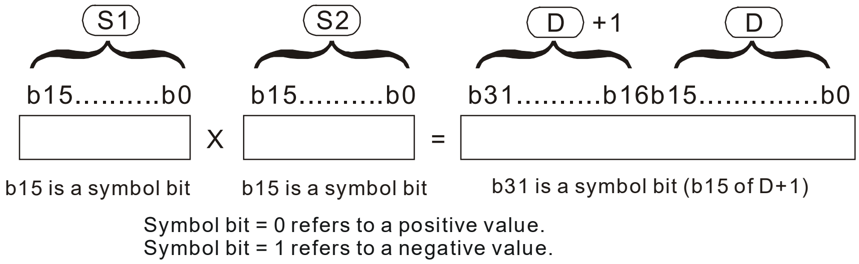
32-bit command (13 STEP)			
DMUL	Continuous execution type	DMULP	Pulse execution type

Flag signal: none

Explanation

- **S1**: Multiplicand. **S2**: Multiplier. **D**: Product.
- Multiplies **S1** and **S2** using the BIN method, and stores the product in **D**.

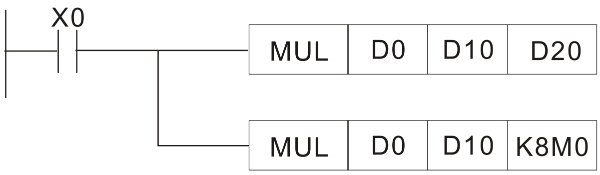
16-bit BIN multiplication operation:



When **D** is a bit device, K1–K4 can be designated as a hexadecimal number, which occupies two consecutive units.

Example

- When 16-bit DO is multiplied by 16-bit D10, the result is a 32-bit product; the upper 16 bits are stored in D21, and the lower 16 bits are stored in D20. The bit at the farthest left indicates the sign of the result.



API 23	D	DIV	P	S1 S2 D	BIN division

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
The 16-bit command operand D occupies two consecutive points.

16-bit command (7 STEP)			
DIV	Continuous execution type	DIVP	Pulse execution type

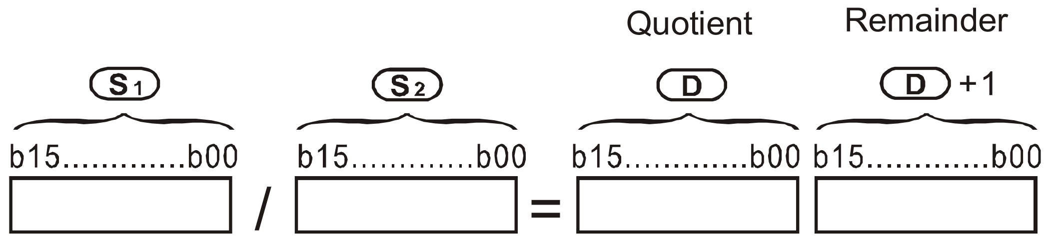
32-bit command (13 STEP)			
DDIV	Continuous execution type	DDIVP	Pulse execution type

Flag signal: none

Explanation

- **S1**: Dividend. **S2**: Divisor. **D**: Quotient and remainder.
- Divides **S1** by **S2** and stores the quotient and remainder in **D** using the BIN method. The sign bit for **S1**, **S2** and **D** must be kept in mind when performing a 16-bit operation.

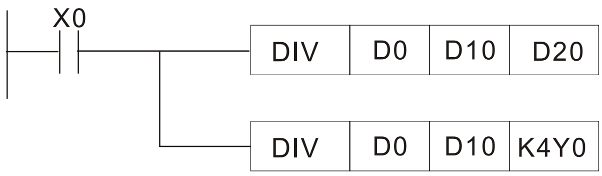
  16-bit BIN division:



  If **D** is a bit device, K1–K4 can be designated as 16 bits, which occupy two consecutive units and yield the quotient and remainder.

Example

- When X0=ON, stores the quotient resulting from division of dividend D0 by divisor D10 in D20, and the remainder in D21. The highest bit indicates the sign of the result.



API					
24	D	INC	P	(D)	BIN add one

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (3 STEP)

INC	Continuous execution type	INCP	Pulse execution type

32-bit command (5 STEP)

DINC	Continuous execution type	DINCP	Pulse execution type

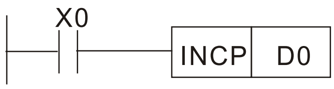
Flag signal: none

Explanation

- **D**: Destination device.
- If a command is not the pulse execution type, adds 1 to the content of device **D** during each scanning cycle.
- Generally use this command as a pulse execution type command (INCP).
- During 16-bit operation, 32,767 +1 rolls over to -32,768. During 32 bit operation, 2,147,483,647 +1 rolls over to -2,147,483,648.

Example

- When X0 switches from OFF to ON, adds 1 to the content of D0.



API					
25	D	DEC	P	(D)	BIN subtract one

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D				*	*	*	*	*			

Notes on operand usage: none

16-bit command (3 STEP)

DEC	Continuous execution type	DECP	Pulse execution type

32-bit command (5 STEP)

DDEC	Continuous execution type	DDECP	Pulse execution type

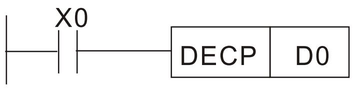
Flag signal: none

Explanation

- **D**: Destination device.
- If a command is not the pulse execution type, adds 1 to the content of device **D** during each scanning cycle.
- Generally use this command as a pulse execution type command (DECP).
- During 16-bit operation, -32,768 -1 rolls over to 32,767. During 32 bit operation, -2,147,483,648 -1 rolls over to 2,147,483,647.

Example

- When X0 switches OFF to ON, subtracts 1 from the content of D0.



API					
30	D	ROR	P	D n	Right rotation

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Notes on operand usage:
K4 (16-bit) is only valid if the operand D is designated as KnY or KnM.
n operand n=K1-K16 (16-bit)

16-bit command (5 STEP)			
ROR	Continuous execution type	RORP	Pulse execution type

32-bit command (9 STEP)			
DROR	Continuous execution type	DRORP	Pulse execution type

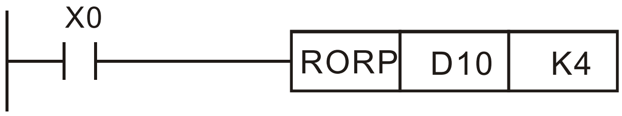
Flag signal: M1022 Carry flag

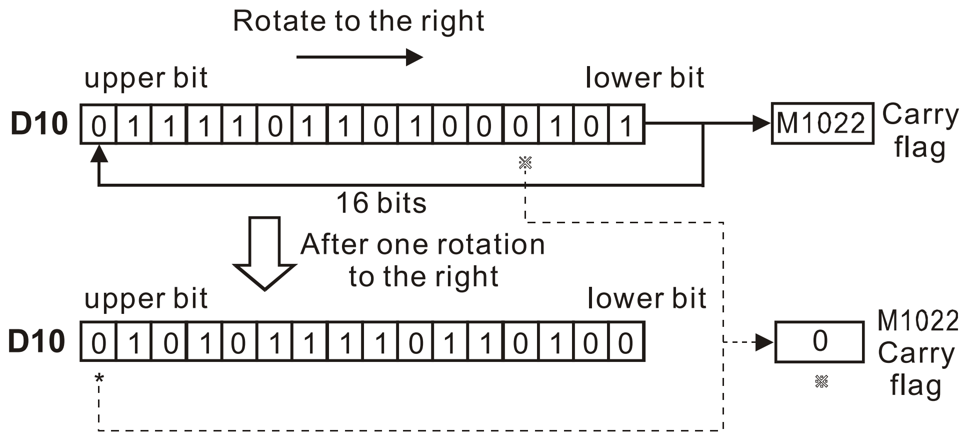
Explanation

- **D**: Device to be rotated. **n**: Number of bits for one rotation.
- Rotates the device designated by **D** to the right **n** bits.
- Generally use this command as a pulse execution type command (RORP).

Example

- When X0 switches OFF to ON, 4 of the 16 bits in D10 specify a right rotation; the content of the bit indicated with * (see figure below) is sent to the carry flag signal M1022.





API 31	D	ROL	P	D n	Left rotation

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Notes on operand usage:
K4 (16-bit) is only valid if the operand D is designated as KnY or KnM.
n operand n=1 to 16 (16-bit)

16-bit command (5 STEP)

ROL	Continuous execution type	ROLP	Pulse execution type

32-bit command (9 STEP)

DROL	Continuous execution type	DROLP	Pulse execution type

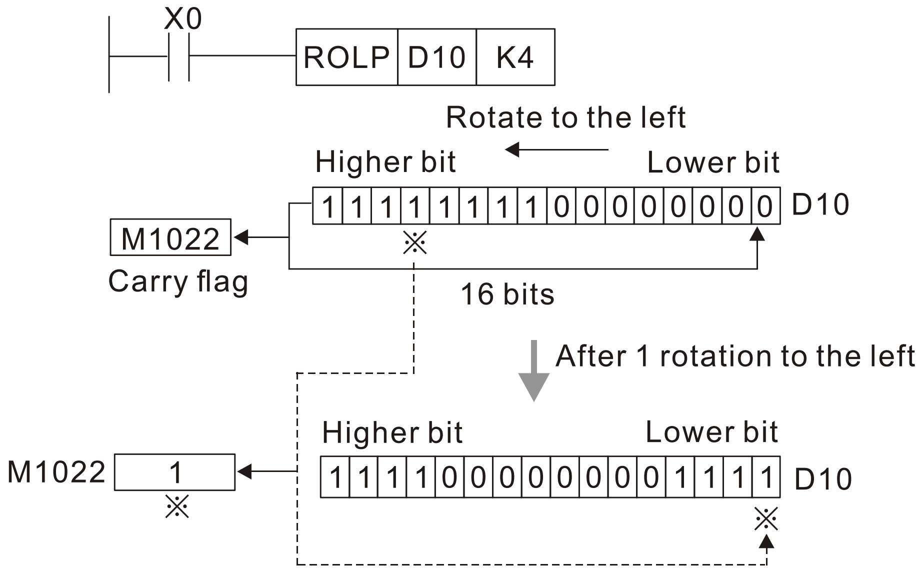
Flag signal: M1022 Carry flag

Explanation

- **D**: Device to be rotated. **n**: Number of bits for one rotation.
- Rotates the device designated by **D** to the left **n** bits.
- Generally use this command as a pulse execution type command (ROLP).

Example

- When X0 switches OFF to ON, 4 of the 16 bits in D10 specify a left rotation; the content of the bit indicated with * (see figure below) is sent to the carry flag signal M1022.



API		ZRST		(D1) (D2)	Clear range
40			P		

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D1		*	*						*	*	*
D2		*	*						*	*	*

Notes on operand usage:
Number of operand D_1 operand ≤ number of operand D_2.
Operands D_1, D_2 must designate the same type of device. Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)			
ZRST	Continuous execution type	ZRSTP	Pulse execution type

32-bit command			
—	—	—	—

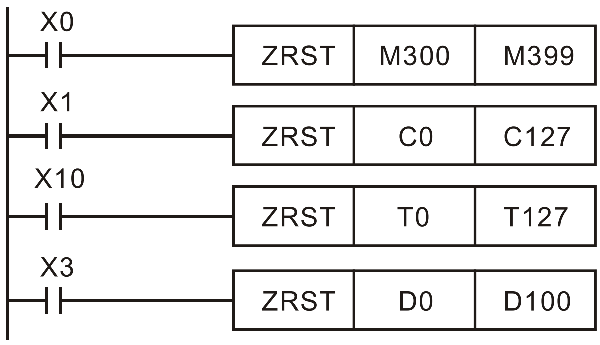
Flag signal: none

Explanation

- **D1**: Clear range's initial device. **D2**: Clear range's final device.
- When the number of operand **D1** > number of operand **D2**, only the operand designated by **D2** is cleared.

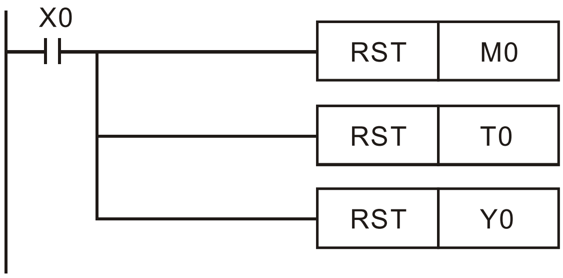
Example

- When X0 is ON, clears auxiliary relays M300–M399, changes them to OFF.
- When X1 is ON, 16-bit clears counters C0–C127 (writes 0, and clears and changes contact and coil to OFF).
- When X10 is ON, clears timer T0–T127 (writes 0, and clears and changes contact and coil to OFF).
- When X3 is ON, clears the data in data registers D0–D100 (sets to 0).



Remarks

- Devices such as bit device Y, M and word device T, C, D can independently use the clear command (RST).



API 49	D	FLT	P	S D	Convert BIN whole number to binary decimal

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S		*	*						*	*	*
D		*	*						*	*	*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.
The operand D occupies two consecutive points.

16-bit command			
–	–	–	–

32-bit command (9steps)			
DFLT	Continuous execution type	DFLTP	Pulse execution type

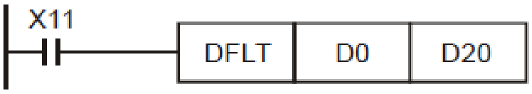
Flag signal: none

Explanation

- **S**: Source device. **D**: Result device.
- Converts a BIN whole number into a binary decimal value.

Example

- When X11 is ON, converts the whole number corresponding to D0 and D1 into floating point numbers, and stores the result in D20 and D21.



API					
110	D	ECMP	P	S1 S2 D	Compare binary floating point numbers

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Notes on operand usage:
The operand D occupies three consecutive points. Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
—	—	—	—

32-bit command (13 STEP)			
DECMP	Continuous execution type	DECMPP	Pulse execution type

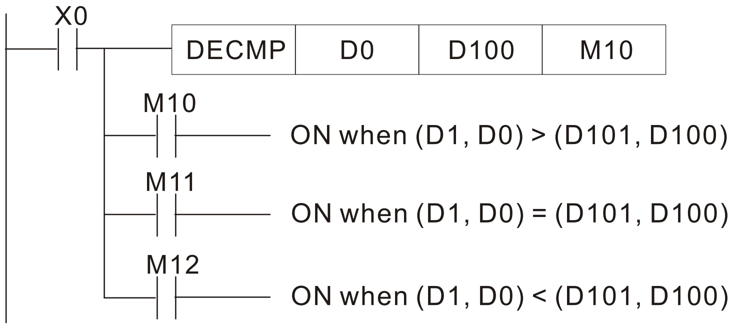
Flag signal: none

Explanation

- **S**$_1$: Binary floating point number 1. **S**$_2$: Binary floating point number 2. **D**: Results of comparison, occupies three consecutive points.
- Compares binary floating point number 1 with binary floating point number 2, and stores the result of comparison (>, =, <) in **D**.
- **If the source operand S**$_1$ or **S**$_2$ designates a constant K or H, the command converts the constant to a binary floating point number for the purpose of comparison.

Example

- When the designated device is M10, it automatically occupies M10–M12.
- When X0=ON, the DECMP command executes, and one of M10–M12 is ON. When X0=OFF, the DECMP command does not execute, and M10–M12 remains in the X0=OFF state.
- For ≥, ≤, or ≠ comparison, use series and parallel connections for M10–M12.
- Use the RST or ZRST command to clear the result.



API 111	D	EZCP	P	S1 S2 S D	Compare binary floating point number range

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S				*	*						*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points. Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

—	—	—	—

32-bit command (17 STEP)

DEZCP	Continuous execution type	DEZCPP	Pulse execution type

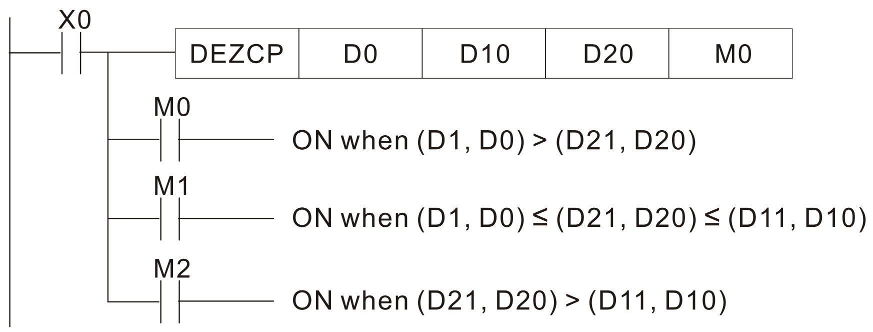
Flag signal: none

Explanation

- **S_1**: Lower limit for binary floating point number in range comparison. **S_2**: Upper limit for binary floating point number in range comparison. **S**: Comparison of binary floating point numerical values. **D**: Results of comparison, occupies three consecutive points.
- Compares binary floating point number **S** with the lower limit value **S_1** and the upper limit value **S_2**; stores the results of comparison in **D**.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command converts the constant to a binary floating point number for the purpose of comparison.
- When the lower limit **S_1** is greater than the upper limit **S_2**, a command issues to perform comparison using the lower limit value **S_1** as the upper and lower limit.

Example

- When the designated device is M0, it automatically occupies M0–M2.
- When X0=ON, the DEZCP command executes, and one of M0–M2 is ON. When X0=OFF, the EZCP command does not execute, and M0–M2 remains in the X0=OFF state.
- Use the RST or ZRST command to clear the result.



API					
116	D	RAD	P	(S) (D)	Convert angle to diameter

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

DRAD	Continuous execution type	DRADP	Pulse execution type

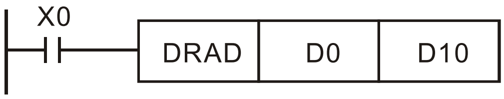
Flag signal: none

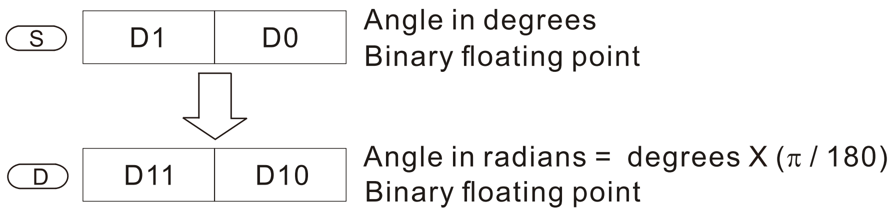
Explanation

- **S**: data source (angle). **D**: result of transformation (diameter).
- Uses the following formula to convert angles to radians.
  Diameter = Angle × (π/180)

Example

- When X0=ON, converts the angle of the designated binary floating point number (D1, D0) to radians and stores the result in (D11, D10); the result is a binary floating point number.





API					
117	D	DEG	P	(S) (D)	Convert diameter to angle

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

DDEG	Continuous execution type	DDEGP	Pulse execution type

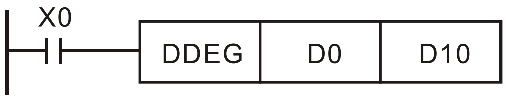
Flag signal: none

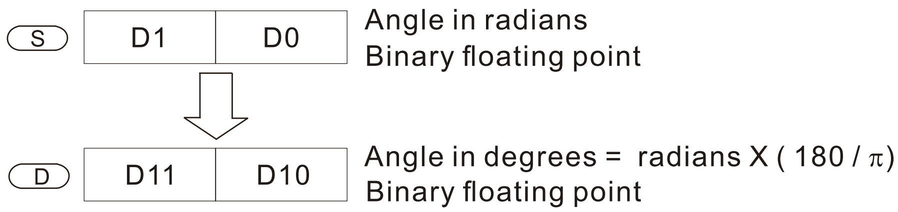
Explanation

- **S**: data source (diameter). **D**: results of transformation (angle).
- Uses the following formula to convert radians to an angle.
- Angle = Diameter × (180/π)

Example

- When X0=ON, angle of the designated binary floating point number (D1, D0) in radians is converted to an angle and stored in (D11, D10), with the content consisting of a binary floating point number.





API				
120	D	EADD	P	S1 S2 D	Add binary floating point numbers

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
—	—	—	—

32-bit command (9 STEP)			
DEADD	Continuous execution type	DEADDP	Pulse execution type

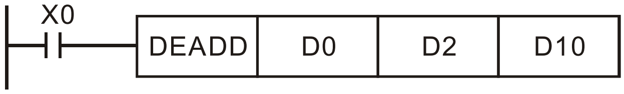
Flag signal: none

Explanation

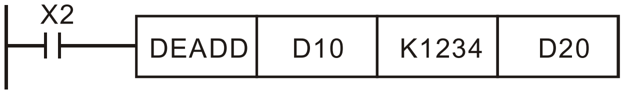
- **S_1**: addend. **S_2**: augend. **D**: sum.
- Adds the content of the register designated by **S_2** to the content of the register designated by **S_1**, and stores the result in the register designated by **D**. Addition is performed entirely using binary floating point numbers.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command converts that constant into a binary floating point number for use in addition.
- **In the situation when S_1** and **S_2** designate identical register numbers, if a "continuous execution" command is employed, when the conditional contact is ON, the register performs addition once during each scan. You generally use pulse execution type commands (DEADDP) under ordinary circumstances.

Example

- When X0=ON, adds a binary floating point number (D1, D0) to a binary floating point number (D3, D2), and stores the results in (D11, D10).



- When X2 =ON, adds a binary floating point number (D11, D10) to K1234 (which is automatically converted to a binary floating point number), and stores the results in (D21, D20).



API 121	D	ESUB	P	S1 S2 D	Subtract binary floating point numbers

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–
32-bit command (13 STEP)			
DESUB	Continuous execution type	DESUBP	Pulse execution type

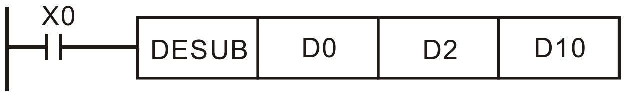
Flag signal: none

Explanation

- **S_1**: minuend. **S_2**: subtrahend. **D**: difference.
- Subtracts the content of the register designated by **S_2** from the content of the register designated by **S_1**, and stores the difference in the register designated by **D**; subtraction is performed entirely using binary floating point numbers.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command converts that constant into a binary floating point number for use in subtraction.
- **In the situation when S_1** and **S_2** designate identical register numbers, if a "continuous execution" command is employed, when conditional contact is ON, the register performs subtraction once during each scan. You generally use pulse execution type commands (DESUBP) under ordinary circumstances.

Example

- When X0=ON, subtracts a binary floating point number (D1, D0) from a binary floating point number (D3, D2), and stores the results in (D11, D10).



- When X2 =ON, subtracts the binary floating point number (D1, D0) from K1234 (which is automatically converted to a binary floating point number), and stores the results in (D11, D10).

API 122	D	EMUL	P	S1 S2 D	Multiply binary floating point numbers

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (13 STEP)			
DEMUL	Continuous execution type	DEMULP	Pulse execution type

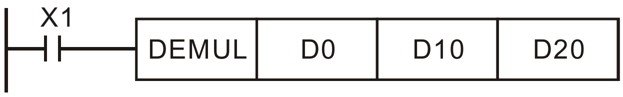
Flag signal: none

Explanation

- S_1: multiplicand. S_2: multiplier. **D**: product.
- Multiplies the content of the register designated by S_1 by the content of the register designated by S_2, and stores the product in the register designated by **D**; multiplication is performed entirely using binary floating point numbers.
- **If the source operand** S_1 or S_2 designates a constant K or H, the command converts that constant into a binary floating point number for use in multiplication.
- **In the situation when** S_1 and S_2 designate identical register numbers, if you employ a "continuous execution" command, when conditional contact is ON, the register performs multiplication once during each scan. You generally use pulse execution type commands (DEMULP) under ordinary circumstances.

Example

- When X1=ON, multiplies the binary floating point number (D1, D0) by the binary floating point number (D11, D10), and stores the product in the register designated by (D21, D20).



- When X2 =ON, multiplies the binary floating point number (D1, D0) by K1234 (which is automatically converted to a binary floating point number), and stores the results in (D11, D10).

API					
123	D	EDIV	P	S1 S2 D	Divide binary floating point numbers

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (13 STEP)			
DEDIV	Continuous execution type	DEDIVP	Pulse execution type

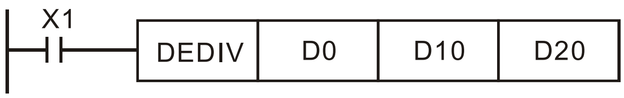
Flag signal: none

Explanation

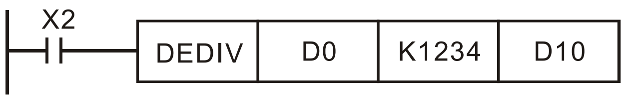
- **S₁**: dividend. **S₂**: divisor. **D**: quotient.
- Divides the content of the register designated by **S₁** by the content of the register designated by **S₂** and stores the quotient in the register designated by **D**; division is performed entirely using binary floating point numbers.
- **If the source operand S₁** or **S₂** designates a constant K or H, the command converts that constant into a binary floating point number for use in division.

Example

- When X1=ON, divides the binary floating point number (D1, D0) by the binary floating point number (D11, D10), and stores the quotient in the register designated by (D21, D20).



- When X2 =ON, divides the binary floating point number (D1, D0) by K1,234 (which is automatically converted to a binary floating point number), and stores the results in (D11, D10).



API 124	D	EXP	P	(S) (D)	Find the exponent of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (9 STEP)			
DEXP	Continuous execution type	DEXPP	Pulse execution type

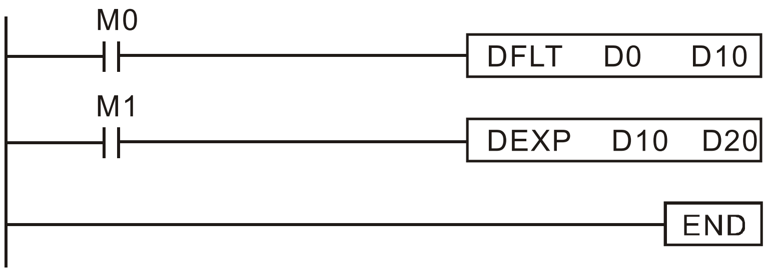
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation:
- [**D** +1, **D**]=EXP [**S** +1, **S**]
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. Performs the operation using floating point numbers, and converts **S** to a floating point number.
- Content of operand **D** =e^{S} ; e=2.71828, **S** is the designated source data.

Example

- When M0 is ON, converts the value of (D1, D0) to a binary floating point number, and stores the result in register (D11, D10).
- When M1 is ON, performs the EXP operation on the exponent of (D11, D10), converts the result to a binary floating point number and stores it in register (D21, D20).



API 125	D	LN	P	(S) (D)	Find the natural logarithm of a binary floating point

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

DLN	Continuous execution type	DLNP	Pulse execution type

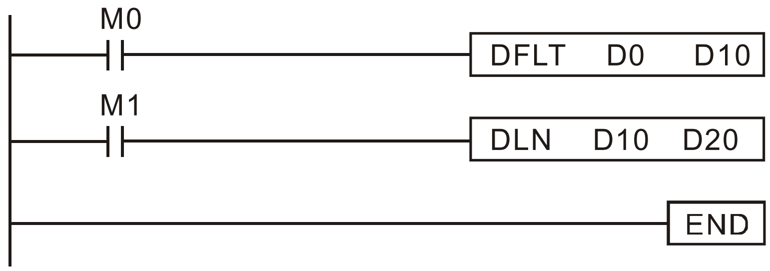
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation.
- [**D** +1, **D**]=EXP[**S** +1, **S**]
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. Performs the operation using floating point numbers, and converts **S** to a floating point number.
- Content of operand **D** =e^{S} ; e=2.71828, **S** is the designated source data.

Example

- When M0 is ON, converts the value of (D1, D0) to a binary floating point number, and stores the result in register (D11, D10).
- When M1 is ON, performs the EXP operation on the exponent of (D11, D10); converts the result to a binary floating point number and stores it in register (D21, D20).



API					
127	D	ESQR	P	S D	Find the square root of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (9 STEP)			
DESQR	Continuous execution type	DESQRP	Pulse execution type

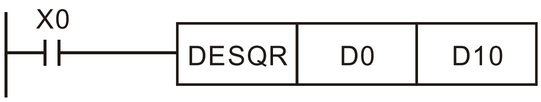
Flag signal: none

Explanation

- **S**: source device for which square root is desired. **D**: result of finding square root.
- Finds the square root of the content of the register designated by **S**, stores the result in the register designated by **D**. Square roots are performed entirely using binary floating point numbers.
- If the source operand **S** refers to a constant K or H, the command converts that constant into a binary floating point number for use in the operation.

Example

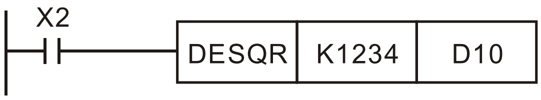
- When X0=ON, finds the square root of the binary floating point number (D1, D0), and stores the result in the register designated by (D11, D10).



$$\sqrt{(D1 \cdot D0)} \longrightarrow (D11 \cdot D10)$$

Binary floating point   Binary floating point

- When X2 =ON, finds the square root of K1,234 (which is automatically converted to a binary floating point number), and stores the result in (D11, D10).



API 129	D	INT	P	S D	Convert binary floating point number to BIN whole number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S											*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

DINT	Continuous execution type	DINTP	Pulse execution type

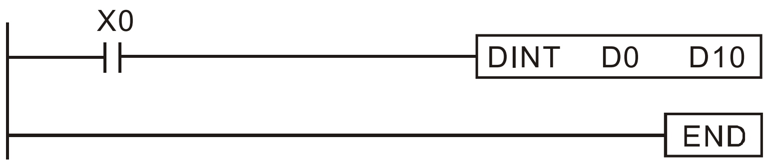
Flag signal: none

Explanation

- **S**: the source device to be converted. **D**: results of conversion.
- Converts the content of the register designated by **S** from a binary floating point number format to a BIN whole number, and stores the results in **D**. The BIN whole number floating point number is discarded.
- The action of this command is the opposite of that of command API 49 (FLT).

Example

- When X0=ON, converts the binary floating point number (D1, D0) into a BIN whole number, and stores the result in (D10); the BIN whole number floating point number is discarded.



API 130	D	SIN	P	(S) (D)	Find the sine of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

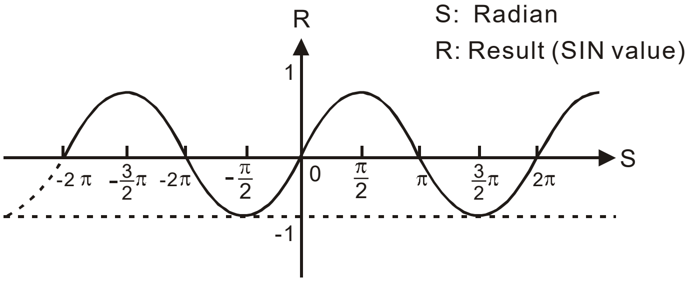
Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
—	—	—	—
32-bit command (9 STEP)			
DSIN	Continuous execution type	DSINP	Pulse execution type

Flag signal: none

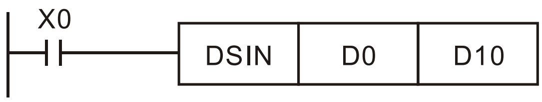
Explanation

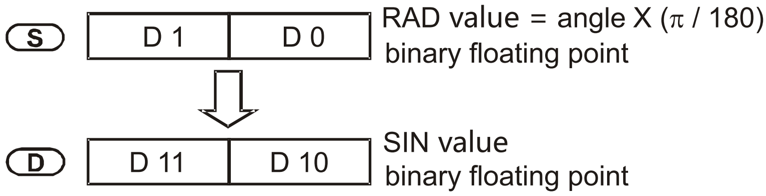
- **S**: the designated source value. **D**: the SIN value result.
- **S** is the designated source in radians.
- The value in radians (RAD) is equal to (angle × π/180).
- Finds the SIN from the source value designated by **S** and stores the result in **D**.
  The following figure displays the relationship between the arc and SIN results:



Example

- When X0=ON, finds the SIN value of the designated binary floating point number (D1, D0) in radians (RAD) and stores the result in (D11, D10), as a binary floating point number.





API 131	D	COS	P	S D	Find the cosine of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

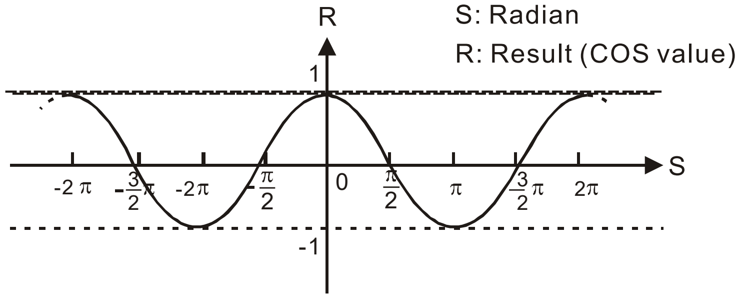
32-bit command (9 STEP)

DCOS	Continuous execution type	DCOSP	Pulse execution type

Flag signal: none

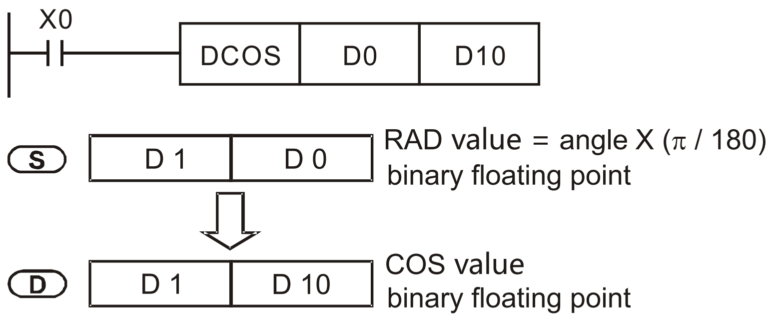
Explanation

- **S**: the designated source value. **D**: the COS value result.
- Finds the COS of the source value designated by **S** and stores it in **D**.
  The following figure displays the relationship between the arc and COS results:



Example

- When X0=ON, finds the COS value of the designated binary floating point number (D1, D0) in radians and stores the result in (D11, D10), as a binary floating point number.



API 132	D	TAN	P	S D	Find the tangent of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

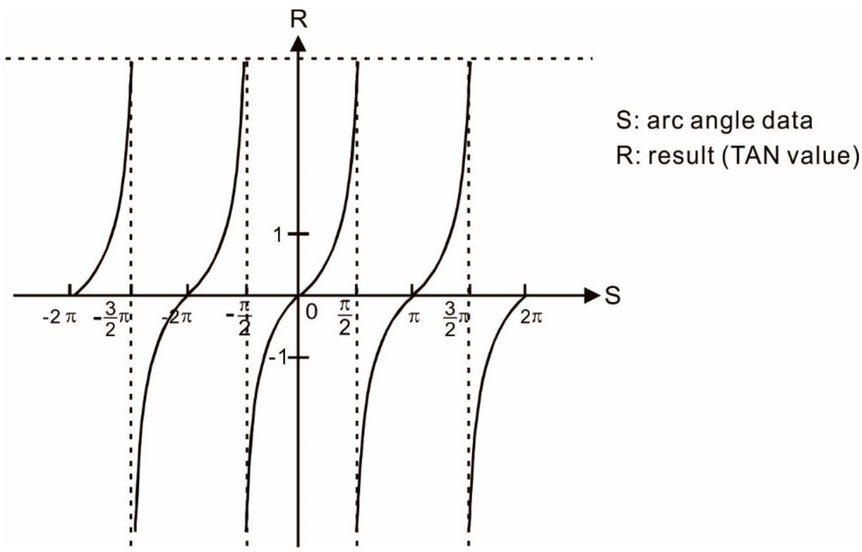
16-bit command			
–	–	–	–

32-bit command (9 STEP)			
DTAN	Continuous execution type	DTANP	Pulse execution type

Flag signal: none

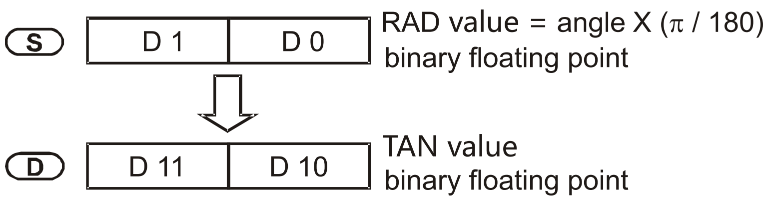
Explanation

- **S**: the designated source value. **D**: the TAN value result.
- Finds the TAN of the source value designated by **S** and stores it in **D**.
  The following figure displays the relationship between the arc and TAN results:



Example

- When X0=ON, finds the TAN value of the designated binary floating point number (D1, D0) in radians (RAD) and stores the result in (D11, D10), as a binary floating point number.



API 133	D	ASIN	P	S D	Find the arcsine of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

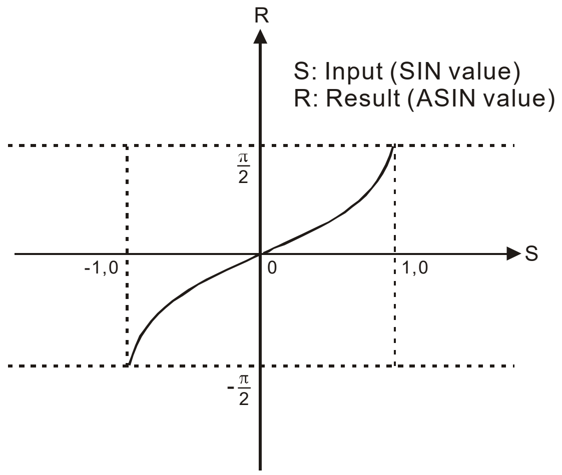
DASIN	Continuous execution type	DASINP	Pulse execution type

Flag signal: none

Explanation

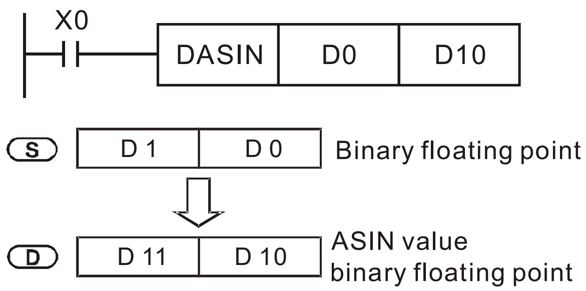
- **S**: the designated source (binary floating point number). **D**: the ASIN value result.
- ASIN value =sin^{-1}

The figure below shows the relationship between input data and result:



Example

- When X0=ON, finds the ASIN value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.



API					
134	D	ACOS	P	S D	Find the arccosine of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage

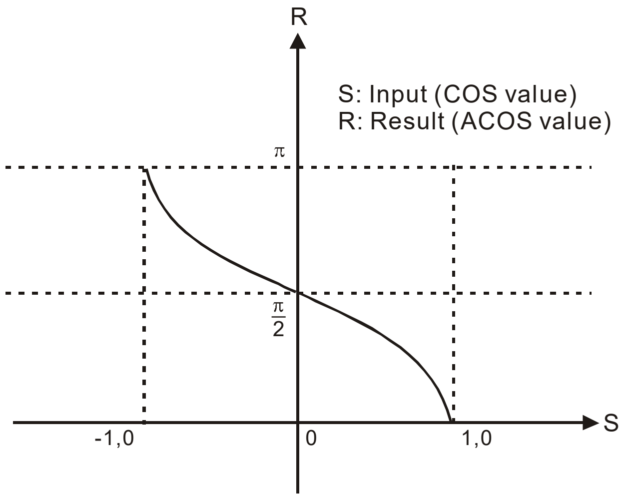
16-bit command			
–	–	–	–

32-bit command (9 STEP)			
DACOS	Continuous execution type	DACOS P	Pulse execution type

Flag signal: none

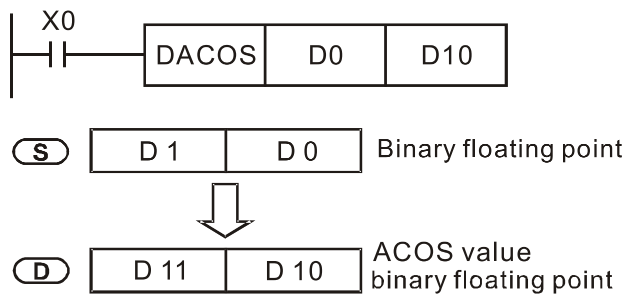
Explanation

- **S**: the designated source (binary floating point number). **D**: the ACOS value result.
- ACOS value =$\cos^{-1}$
  The figure below shows the relationship between input data and result:



Example

- When X0=ON, finds the ACOS value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.



API					
135	D	ATAN	P	S D	Find the arctangent of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

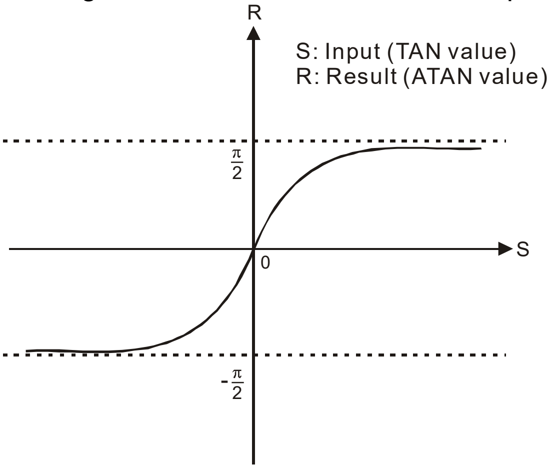
32-bit command (9 STEP)			
DATAN	Continuous execution type	DATANP	Pulse execution type

Flag signal: none

Explanation

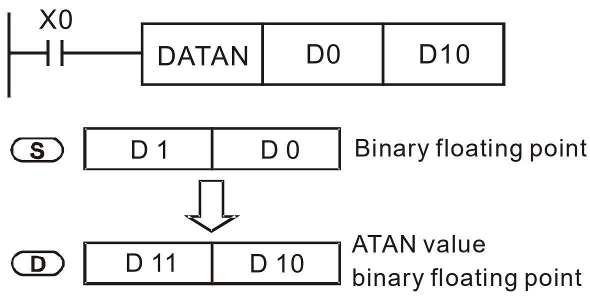
- **S**: the designated source (binary floating point number). **D**: the ATAN value result.
- ATAN value $=\tan^{-1}$

The figure below shows the relationship between input data and result:



Example

- When X0=ON, finds the ATAN value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.



API					
136	D	SINH	P	S D	Find the hyperbolic sine of at binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (9 STEP)			
DSINH	Continuous execution type	DSINHP	Pulse execution type

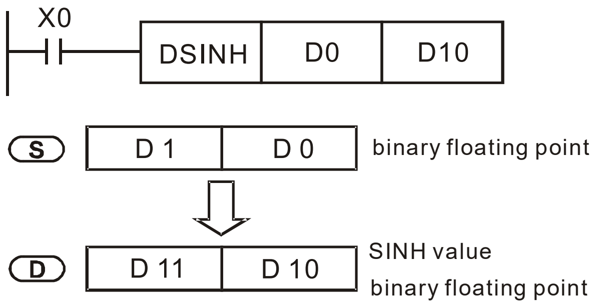
Flag signal: none

Explanation

- **S**: the designated source (binary floating point number). **D**: the SINH value result.
- SINH value $=(e^{s}-e^{-s}) \div 2$

Example

- When X0=ON, finds the SINH value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.



API					
137	D	COSH	P	S D	Find the hyperbolic cosine of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

—	—	—	—

32-bit command (9 STEP)

DCOSH	Continuous execution type	DCOSHP	Pulse execution type

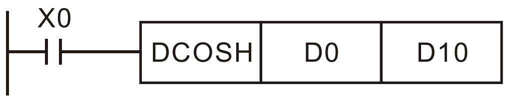
Flag signal: none

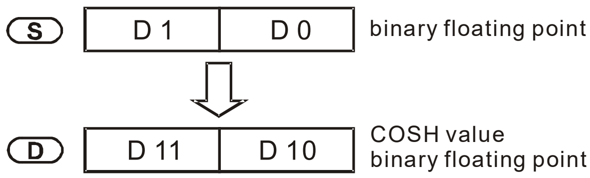
Explanation

- **S**: the designated source (binary floating point number). **D**: the COSH value result.
- COSH value $=(e^{s}+e^{-s}) \div 2$

Example

- When X0=ON, finds the COSH value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.





API					
138	D	TANH	P	S D	Find the hyperbolic tangent of a binary floating point number

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command

–	–	–	–

32-bit command (9 STEP)

DTANH	Continuous execution type	DTANHP	Pulse execution type

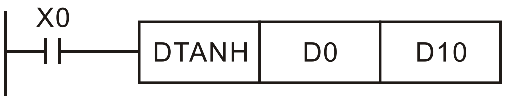
Flag signal: none

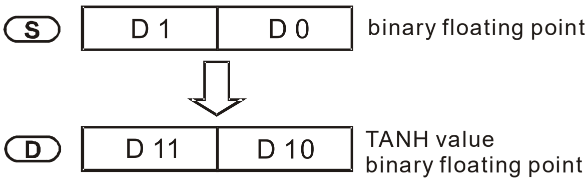
Explanation

- **S**: the designated source (binary floating point number). **D**: the TANH value result.
- TANH value $=(e^{s}-e^{-s}) \div (e^{s}+e^{-s})$

Example

- When X0=ON, finds the TANH value of the designated binary floating point number (D1, D0) and stores the result in (D11, D10), as a binary floating point number.





API 150	MODRW P	S1 S2 S3 S n	Modbus data read / write

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
S											*
n				*	*						*

16-bit command (5 STEP)

MODRW	Continuous execution type	MODRWP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: M1077 M1078 M1079

Explanation

- S1: online device address. S2: communications function code. S3: address of data to read / write. S: register for data to be read/written is stored. N: length of data to be read / written.
- COM1 must be defined as controlled by the PLC (set Pr.09-31 = -12) before using this command, and the corresponding communications speed and format must also be set (set Pr.09-01 and Pr.09-04). S2: communications function code. Currently only supports the following function code; the remaining function code cannot be executed.

Function	Description
H 02	Input read
H 03	Read word
H 06	Write single word
H 0F	Write multiple coils
H 10	Write single word

- After executing this command, M1077, M1078 and M1079 will be immediately changed to 0.
- As an example, when MH300 must control another converter and PLC, if the converter has a station number of 10 and the PLC has a station number of 20, see the following example:

Control slave device converter

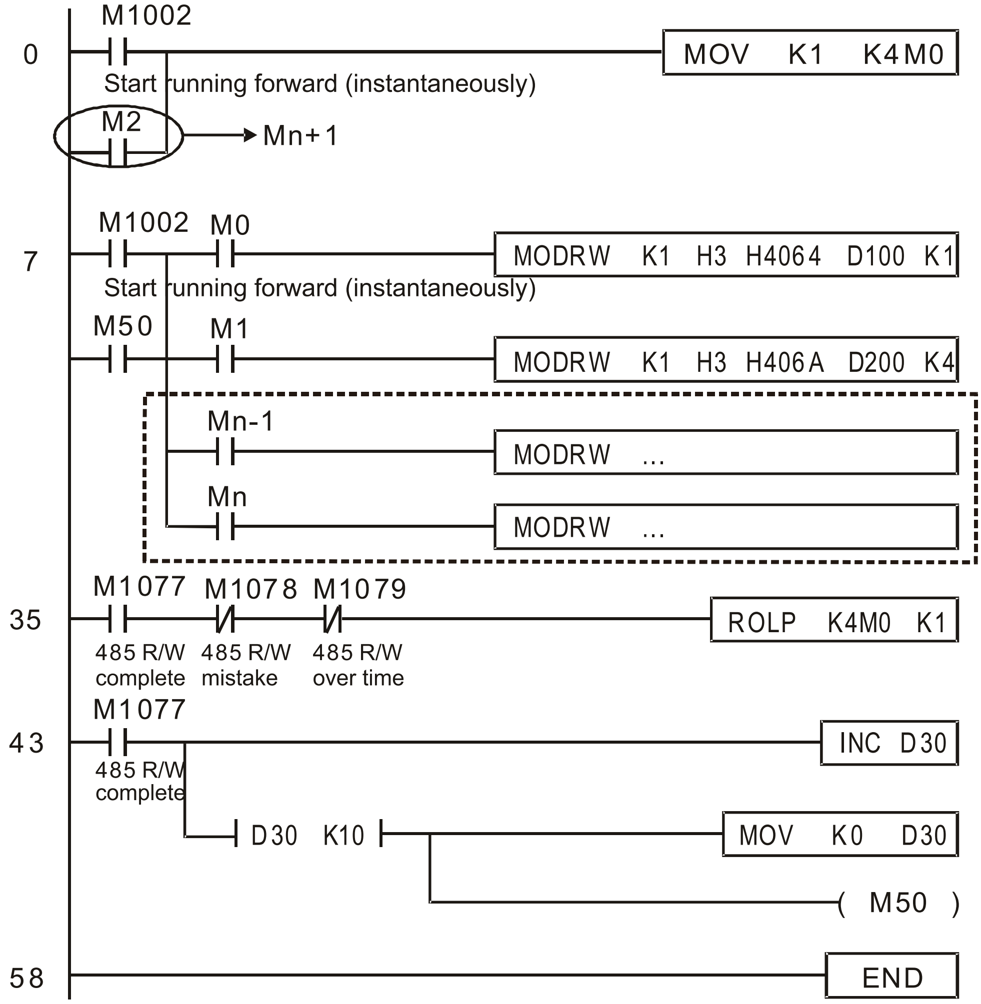
Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length
1	Reads 4 sets of data comprising the converter slave device parameters Pr.01-00 to Pr.01-03, and saves the read data in D0 to D3	K10	H3	H100	D0	K4
2	Reads 3 sets of data comprising the converter slave device addresses H2100 to H2102, and saves the read data in D5 to D7	K10	H3	H2100	D5	K3
3	Writes 3 sets of data comprising the converter slave device parameters Pr.05-00 to Pr.05-03, and writes the values as D10 to D12	K10	H10	H500	D10	K3
4	Writes 2 sets of data comprising the converter slave device addresses H2000 to H2001, and writes the values as D15 to D16	K10	H10	H2000	D15	K2

PLC controlling slave device

Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length
1	Reads 4 sets of data comprising the PLC slave device's X0 to X3 state, and saves the read data in bits 0 to 3 of D0	K20	H2	H400	D0	K4
2	Reads 4 sets of data comprising the PLC slave device's Y0 to Y3 state, and saves the read data in bits 0 to 3 of D1	K20	H2	H500	D1	K4
3	Reads 4 sets of data comprising the PLC slave device's M0 to M3 state, and saves the read data in bits 0 to 3 of D2	K20	H2	H800	D2	K4
4	Reads 4 sets of data comprising the PLC slave device's T0 to T3 state, and saves the read data in bits 0 to 3 of D3	K20	H2	H600	D3	K4
5	Reads 4 sets of data comprising the PLC slave device's C0 to C3 state, and saves the read data in bits 0 to 3 of D4	K20	H2	HE00	D4	K4
6	Reads 4 sets of data comprising the PLC slave device's T0 to T3 count value, and saves the read data of D10 to D13	K20	H3	H600	D10	K4
7	Reads 4 sets of data comprising the PLC slave device's C0 to C3 count value, and saves the read data of D20 to D23	K20	H3	HE00	D20	K4
8	Reads 4 sets of data comprising the PLC slave device's D0 to D3 count value, and saves the read data of D30 to D33	K20	H3	H1000	D30	K4
9	Writes 4 sets of the PLC slave device's Y0 to Y3 state, and writes the values as bits 0 to 3 of D1	K20	HF	H500	D1	K4
10	Writes 4 sets of the PLC slave device's M0 to M3 state, and writes the values as bits 0 to 3 of D2	K20	HF	H800	D2	K4
11	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values as bits 0 to 3 of D3	K20	HF	H600	D3	K4
12	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values as bits 0 to 3 of D4	K20	HF	HE00	D4	K4
13	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values of D10 to D13	K20	H10	H600	D10	K4
14	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values of D20 to D23	K20	H10	HE00	D20	K4
15	Writes 4 sets of the PLC slave device's D0 to D3 state, and writes the values of D30 to D33	K20	H10	H1000	D30	K4

Example

- Will trigger M0 On when the PLC begins to operate, and sends instruction to execute one MODRW command.
- After receiving the slave device's response, if the command is correct, it will execute one ROL command, which will cause M1 to be On.
- After receiving the slave device's response, will trigger M50 = 1 after a delay of 10 PLC scanning cycles, and then execute one MODRW command.
- After again receiving the slave device's response, if the command is correct, it will execute one ROL command, and M2 will change to On at this time (and M2 can be defined as a repeat of M); K4M0 will change to K1, and only M0 will remain 1. Transmission can proceed in a continuous cycle. If you wish to add a command, merely add the desired command in the empty frame, and change repeat M to Mn+1.



API				
170	D	GRY	P	S D

Convert BIN to GRAY code

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)			
GRY	Continuous execution type	GRYP	Pulse execution type

32-bit command (9 STEP)			
DGRY	Continuous execution type	DGRYP	Pulse execution type

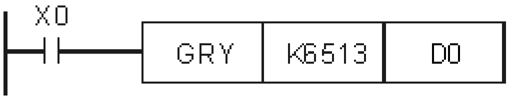
Flag signal: none

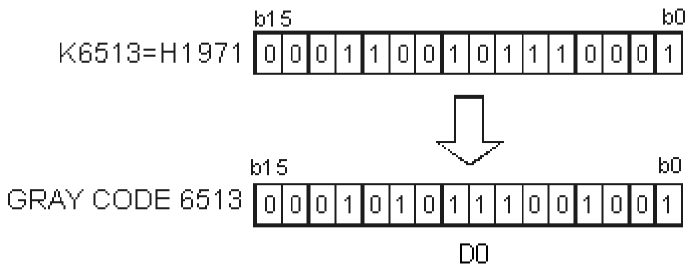
Explanation

- **S**: source device. **D**: device storing GRAY code.
- Converts the BIN value of the device designated by **S** to a GRAY code, and stores the result in the device designated by **D**.
- The valid range for **S** is as shown below; if you exceed this range, it is an error, and the command does not execute.
  16-bit command: 0–32,767
  32-bit command: 0–2,147,483,647

Example

- When X0=ON, converts the constant K6513 to a GRAY code and stores it in D0.





API				
171	D	GBIN	P	S D	Convert GRAY code to BIN

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)

GBIN	Continuous execution type	GBINP	Pulse execution type

32-bit command (9 STEP)

DGBIN	Continuous execution type	DGBINP	Pulse execution type

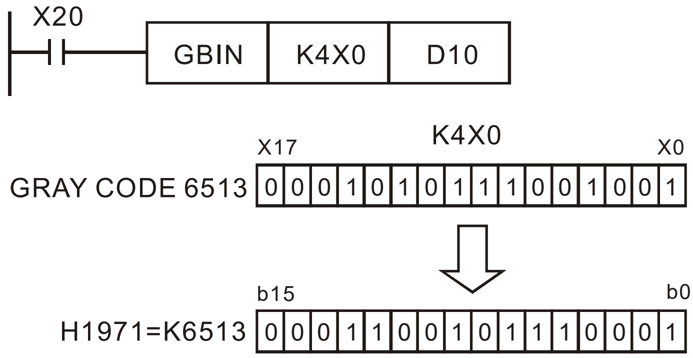
Flag signal: none

Explanation

- **S**: source device storing GRAY code. **D**: device storing BIN value after conversion.
- Converts the GRAY code corresponding to the value of the device designated by **S** that is transformed into a BIN value, and stores it in the device designated by **D**.
- This command converts the value of the absolute position encoder connected with the PLC's input (this encoder usually has an output value in the form of GRAY code) into a BIN value, and stores it in the designated register.
- The valid range of **S** is as shown below; if you exceed this range, it is an error, and the command does not execute.
  16-bit command: 0–32,767
  32-bit command: 0–2,147,483,647

Example

- When X20=ON, converts the GRAY code of the absolute position encoder connected with input points X0–X17 to a BIN value and stores it in D10.



API		Mnemonic		Operands	Function
202		SCAL	P	S1 S2 S3 D	Scale value operation

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
D											*

Notes on operand usage:
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (9 STEP)

SCAL	Continuous execution type	SCALP	Pulse execution type

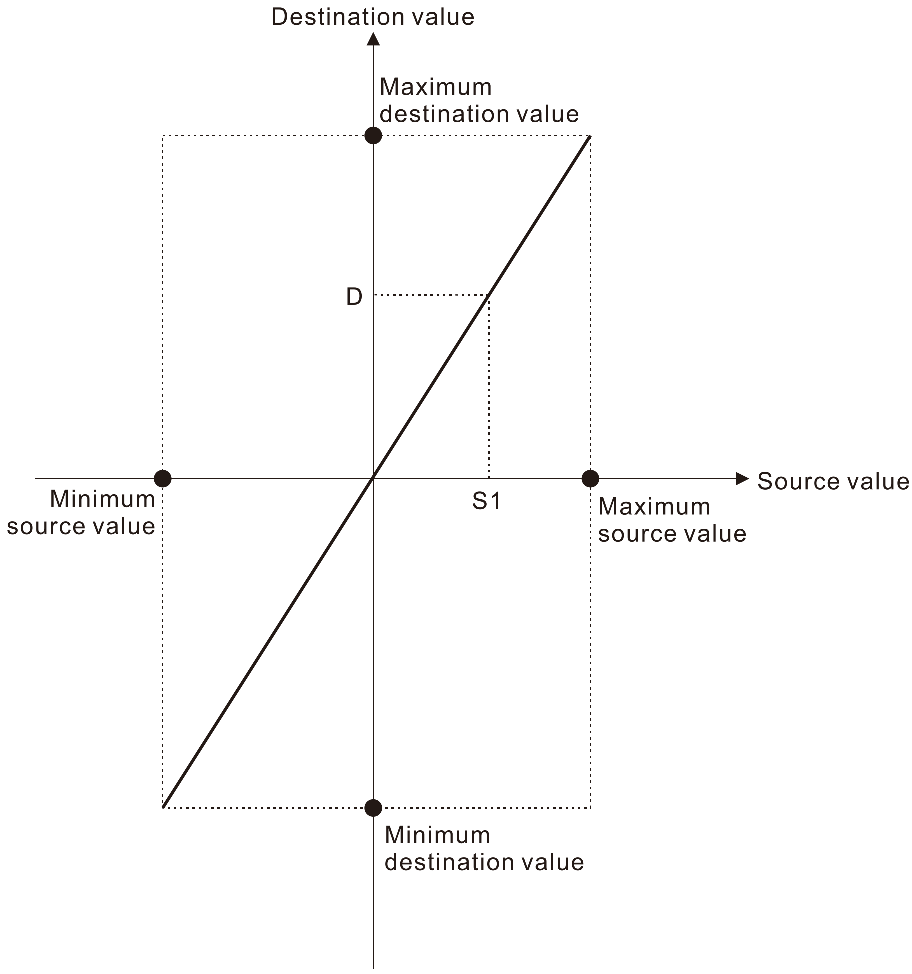
32-bit command

-	-	-	-

Flag signal: none

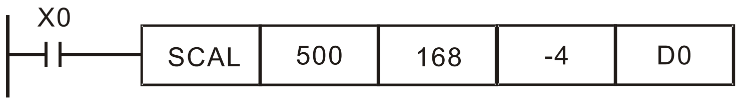
Explanation

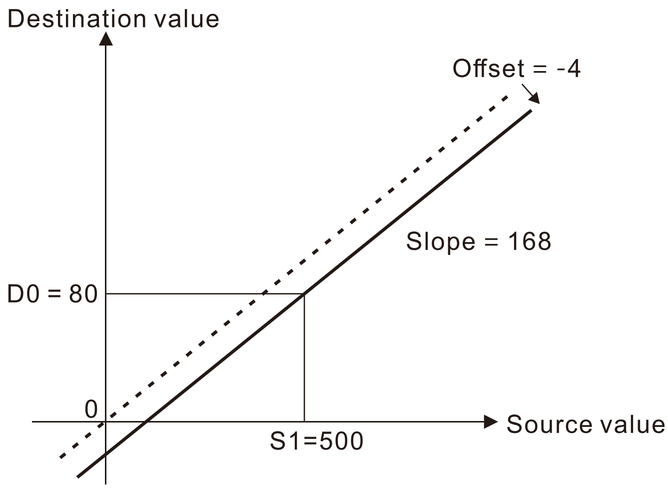
- **S1**: Data source. **S2**: Slope, unit: 0.001. **S3**: Offset. **D**: Destination device.
- The operation equation in the instruction: D = (S1 × S2) ÷ 1000 + S3
- To obtain the values in S2 and S3, users have to use the slope equation and the offset equation below first, and then round off the results to the nearest whole digit. The final 16-bit value are entered into S2 and S3.
- The slope equation: S2 = [(maximum destination value – minimum destination value) ÷ (maximum source value –maximum source value)] × 1000
- The offset equation: S3 = minimum destination value –maximum source value × S2 ÷ 1000
- The output curve is as shown below:



Example

- Suppose the values in S1, S2, and S3 are 500, 168, and -4 respectively. When X0 is ON, the instruction SCAL is executed, and the scale value is stored in D0.





API 215–217	D	LD#		S1 S2	Contact form logical operation LD#

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: #, :, &, |, ^
Refer to the function specifications table for each device in series for the range of device usage.

16-bit command (5 STEP)			
LD#	Continuous execution type	—	—

32-bit command (9 STEP)			
DLD#	Continuous execution type	—	—

Flag signal: none

Explanation

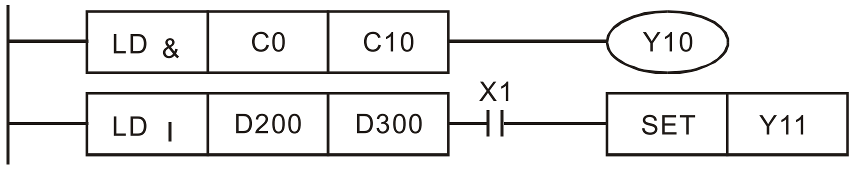
- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. When the result of comparison is not 0, this command activates; when the result of comparison is 0, this command does not activate.
- You can use the LD# command directly to connect with the busbar.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
215	LD&	**D**LD&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
216	LD|	**D**LD|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
217	LD^	**D**LD^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

&: logical AND operation.
|: logical OR operation.
^: logical XOR operation.

Example

- When you compare the contents of C0 and C10 with the logical AND operation, and the result is not equal to 0, then Y10=ON.
- When you compare the content of D200 and D300 with the logical OR operation, and the result is not equal to 0, and X1=ON, then Y11=ON and remains in that state.



API					
218–220	D	AND#		S1 S2	Contact form logical operation AND#

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: #, : , &, |, ^
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)

AND#	Continuous execution type	–	–

32-bit command (9 STEP)

DAND#	Continuous execution type	–	–

Flag signal: none

Explanation

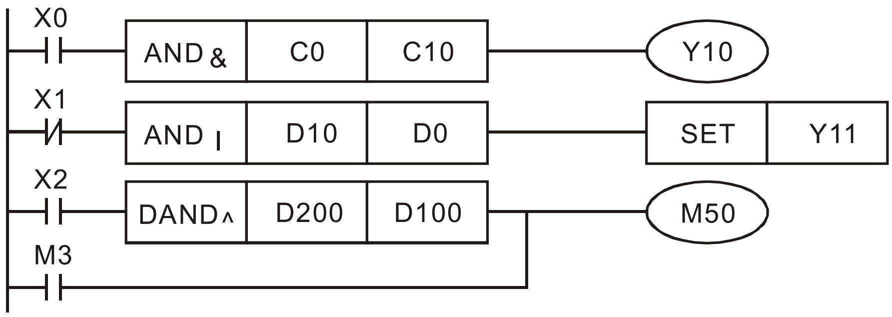
- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. When the result of comparison is not 0, this command activates; when the result of comparison is 0, this command does not activate.
- The AND# command is an operation command in series with the contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
218	AND&	DAND&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
219	AND|	DAND|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
220	AND^	DAND^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

&: logical AND operation.
|: logical OR operation.
^: logical XOR operation.

Example

- When X0=ON and you compare the contents of C0 and C10 with the logical AND operation, and the result is not equal to 0, then Y10=ON.
- When X1=OFF and you compare the contents D10 and D0 with the logical OR operation, and the result is not equal to 0, then Y11=ON and remains in that state.
- When X2 =ON and compare the contents of the 32-bit register D200 (D201) and the 32-bit register D100 (D101) with the logical XOR operation, and the result is not equal to 0 or M3=ON, then M50=ON.



API 221–223	D	OR#		S1 S2	Contact form logical operation OR#

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: #: &, |, ^

Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)			
OR#	Continuous execution type	—	—

32-bit command (9 STEP)			
DOR#	Continuous execution type	—	—

Flag signal: none

Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. When the result of comparison is not 0, this command activates; when the result of comparison is 0, this command does not activate.
- The OR# command is an operation command in series with the contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
221	OR&	DOR&	S_1 & S_2 ≠ 0	S_1 & S_2 = 0
222	OR|	DOR|	S_1 | S_2 ≠ 0	S_1 | S_2 = 0
223	OR^	DOR^	S_1 ^ S_2 ≠ 0	S_1 ^ S_2 = 0

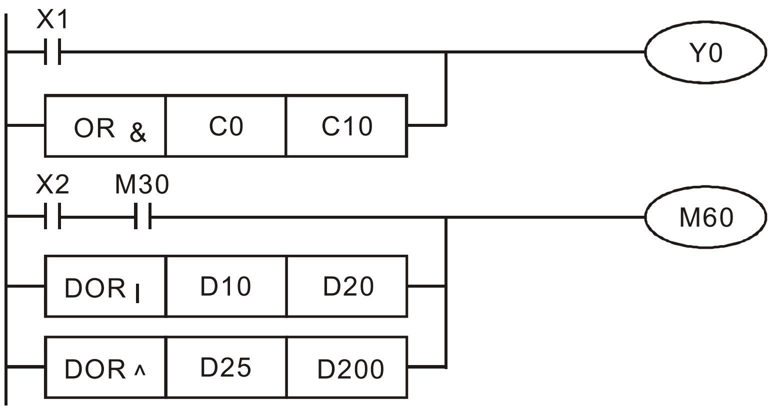
&: logical AND operation.

|: logical OR operation.

^: logical XOR operation.

Example

- When X1=ON and you compare the contents of C0 and C10 with the logical AND operation, and the result is not equal to 0, then Y0=ON.
- When X2 and M30 are both equal to ON, or you compare the contents of the 32-bit register D10 (D11) and the 32-bit register D20 (D21) with the logical OR operation, and the result is not equal to 0, or you compare the contents of the 32-bit counter C235 and the 32-bit register D200 (D201) with the logical XOR operation, and the result is not equal to 0, then M60=ON.



API 224–230	D	LD※		(S1) (S2)	Contact form compare LD*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)			
LD※	Continuous execution type	–	–

32-bit command (9 STEP)			
DLD※	Continuous execution type	–	–

Flag signal: none

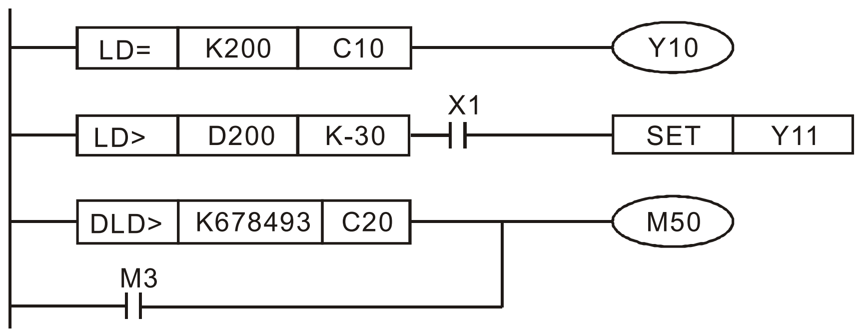
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking API 224 (LD=) as an example, this command activates when the result of comparison is “equal”, and does not activate when the result is “unequal”.
- You can use the LD* directly to connect with the busbar.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
224	LD =	**D**LD =	$S_1 = S_2$	$S_1 \neq S_2$
225	LD <	**D**LD <	$S_1 < S_2$	$S_1 \leq S_2$
226	LD >	**D**LD >	$S_1 > S_2$	$S_1 \geq S_2$
228	LD < >	**D**LD < >	$S_1 \neq S_2$	$S_1 = S_2$
229	LD = >	**D**LD = >	$S_1 \leq S_2$	$S_1 < S_2$
230	LD = <	**D**LD = <	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When the content of C10 is equal to K200, then Y10=ON.
- When the content of D200 is greater than K-30, and X1=ON, then Y11=ON and remains in that state.



API					
232–238	D	AND※		(S1) (S2)	Contact form compare AND*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)			
AND※	Continuous execution type	—	—

32-bit command (9 STEP)			
DAND※	Continuous execution type	—	—

Flag signal: none

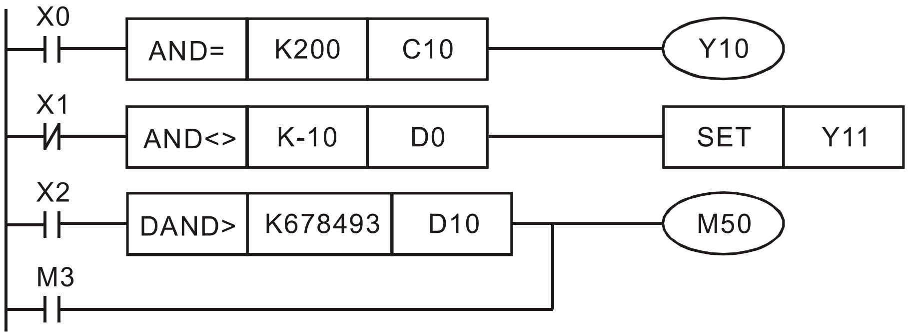
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking API 232 (AND=) as an example, when the result of comparison is "equal", this command activates; when the result of comparison is "unequal", this command does not activate.
- The AND* command is a comparison command in series with a contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
232	AND =	DAND =	$S_1 = S_2$	$S_1 \neq S_2$
233	AND <	DAND <	$S_1 < S_2$	$S_1 \leq S_2$
234	AND >	DAND >	$S_1 > S_2$	$S_1 \geq S_2$
236	AND < >	DAND < >	$S_1 \neq S_2$	$S_1 = S_2$
237	AND = >	DAND = >	$S_1 \leq S_2$	$S_1 < S_2$
238	AND = <	DAND = <	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When X0=ON and the current value of C10 is also equal to K200, then Y10=ON.
- When X1=OFF and the content of register D0 is not equal to K-10, then Y11=ON and remains in that state.
- When X2=ON and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=ON, then M50=ON.



API				
240–246	D	OR※	S1 S2	Contact form compare OR*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command (5 STEP)

OR※	Continuous execution type	—	—

32-bit command (9 STEP)

DOR※	Continuous execution type	—	—

Flag signal: none

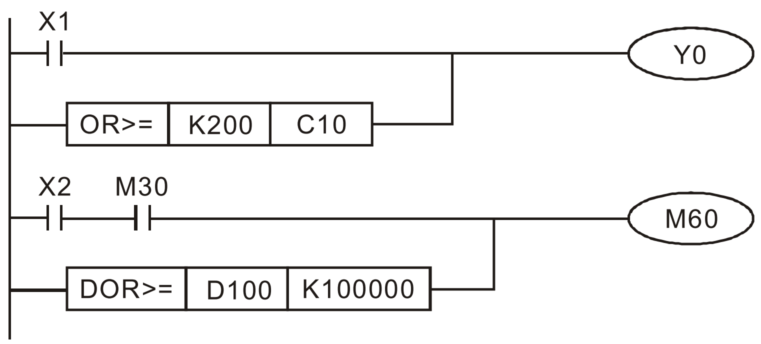
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking API 240 (OR=) as an example, when the result of comparison is “equal”, this command activates; when the result of comparison is “unequal”, this command does not activate.
- The OR* command is a comparison command in parallel with a contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
240	OR =	**D**OR =	$S_1 = S_2$	$S_1 \neq S_2$
241	OR <	**D**OR <	$S_1 < S_2$	$S_1 \leq S_2$
242	OR >	**D**OR >	$S_1 > S_2$	$S_1 \geq S_2$
244	OR < >	**D**OR < >	$S_1 \neq S_2$	$S_1 = S_2$
245	OR = >	**D**OR = >	$S_1 \leq S_2$	$S_1 < S_2$
246	OR = <	**D**OR = <	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When X0=ON and the current value of C10 is also equal to K200, then Y10=ON.
- When X1=OFF and the content of register D0 is not equal to K-10, then Y11=ON and remains in that state.
- When X2=ON and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=ON, then M50=ON.



API 275–280		**FLD※**		(S1) (S2)	Floating point number contact form compare LD*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (9 STEP)			
FLD※	Continuous execution type	–	–

Flag signal: none

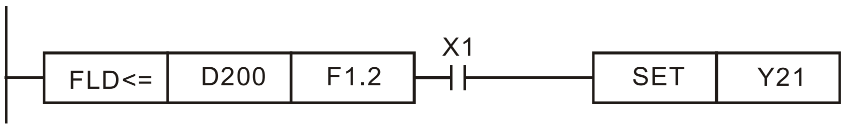
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking "FLD=" as an example, if the result of comparison is "equal", this command activates; but it does not activate when the result is "unequal".
- The FLD* command can directly input floating point numbers (for instance: F1.2) to the S_1 and S_2 operands, or store the floating point numbers in register D for use in operations.
- You can use this command directly to connect with the busbar.

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
275	FLD =	$S_1 = S_2$	$S_1 \neq S_2$
276	FLD <	$S_1 < S_2$	$S_1 \leq S_2$
277	FLD >	$S_1 > S_2$	$S_1 \geq S_2$
278	FLD < >	$S_1 \neq S_2$	$S_1 = S_2$
279	FLD = >	$S_1 \leq S_2$	$S_1 < S_2$
280	FLD = <	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When the floating point number in register D200 (D201) is less than or equal to F1.2, and X1 is activated, then contact Y21 activates and remains in that state.



API 281–286		FAND※		(S1) (S2)	Floating point number contact form compare AND*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
—	—	—	—

32-bit command (9 STEP)			
FAND※	Continuous execution type	—	—

Flag signal: none

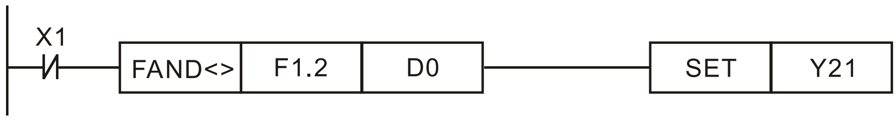
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking “FAND=” as an example, if the result of comparison is “equal”, this command activates; but it does not activate when the result is “unequal”.
- The FAND* command can directly input floating point numbers (for instance: F1.2) to the S_1 and S_2 operands, or store floating point numbers in register D for use in operations.
- You can use this command directly to connect with the busbar.

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
281	FAND =	$S_1 = S_2$	$S_1 \neq S_2$
282	FAND >	$S_1 < S_2$	$S_1 \leq S_2$
283	FAND <	$S_1 > S_2$	$S_1 \geq S_2$
284	FAND < >	$S_1 \neq S_2$	$S_1 = S_2$
285	FAND < =	$S_1 \leq S_2$	$S_1 < S_2$
286	FAND > =	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When X1=OFF, and the floating point number in register D100 (D101) is not equal to F1.2, then Y21=ON and remains in that state.



API 287–292		FOR※		(S1) (S2)	Floating point number contact form compare OR*

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ※, : , =, >, <, <>, ≤, ≥
Refer to the function specifications table for each device in series for the scope of device usage.

16-bit command			
–	–	–	–

32-bit command (9 STEP)			
FOR※	Continuous execution type	–	–

Flag signal: none

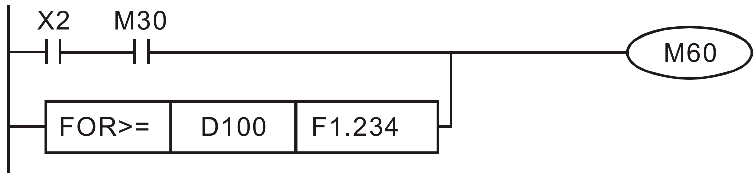
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the contents of S_1 and S_2. Taking "FOR=" as an example, if the result of comparison is "equal", this command activates; but it does not activate when the result is "unequal".
- The FOR* command can directly input floating point numbers (for instance: F1.2) to the S_1 and S_2 operands, or store floating point numbers in register D for use in operations.
- You can use this command directly to connect with the busbar.

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
287	FOR =	$S_1 = S_2$	$S_1 \neq S_2$
288	FOR <	$S_1 < S_2$	$S_1 \leq S_2$
289	FOR >	$S_1 > S_2$	$S_1 \geq S_2$
290	FOR < >	$S_1 \neq S_2$	$S_1 = S_2$
291	FOR = >	$S_1 \leq S_2$	$S_1 < S_2$
292	FOR = <	$S_1 \geq S_2$	$S_1 > S_2$

Example

- When X2 and M30 are both equal to ON, or the floating point number in register D100 (D101) is greater than or equal to F1.234, then M60=ON.



16-6-5 Detailed explanation of drive special application commands

API				
139	RPR	P	S1 S2	Read servo parameter

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2											*

Notes on operand usage: none

16-bit command (5 STEP)			
RPR	Continuous execution type	RPRP	Pulse execution type
32-bit command			
–	–	–	–

Flag signal: none

Explanation

- **S1**: Parameter address of data to be read. **S2**: Register where data that is read is stored.

API				
140	WPR	P	S1 S2	Write servo parameter

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

16-bit command (5 STEP)			
WPR	Continuous execution type	WPRP	Pulse execution type
32-bit command			
–	–	–	–

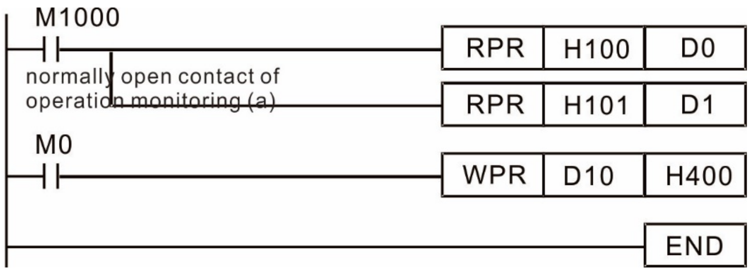
Flag signal: M1017 parameter written successfully.

Explanation

- **S1**: Data to write to specified page. **S2**: Parameter address of data to be written.

Example

- When the data in the MH300 drive's parameter H01.00 is read and written to D0, data from H01.01 is read and written to D1.
- When M0=ON, the content of D10 is written to the MH300 drive Pr.04.00 (first speed of multiple speed levels).
- When M1017=ON, the parameter has been written successfully.
- The MH300's WPR command does not support writing to the 20XX address, but the RPR command supports reading of 21XX, 22XX.



Recommendation Be cautious when using the WPR command. When writing parameters, most parameters are recorded when they are written, and these parameters may only be revised 10^9 times: a memory write error may occur if parameters are written more than (MS)10^6 or (MH)10^9 times.

The number of times a parameter is written is based on whether the written value is modified. For instance, writing the same value 100 times at the same time counts as writing only once.

The following commonly-used parameters have special treatment, so there are no limits for the number of times that they can be written.

Pr. 00-10: Control method

Pr. 00-11: Speed mode selection

Pr. 00-13: Torque mode select

Pr. 00-27: User-defined value

Pr. 01-12: Acceleration time 1

Pr. 01-13: Deceleration time 1

Pr. 01-14: Acceleration time 2

Pr. 01-15: Deceleration time 2

Pr. 01-16: Acceleration time 3

Pr. 01-17: Deceleration time 3

Pr. 01-18: Acceleration time 4

Pr. 01-19: Deceleration time 4

Pr. 02-12: Select MI Conversion Time mode:

Pr. 02-18: Select MO Conversion Time mode:

Pr. 04-50–Pr. 04-69: PLC register parameter 0–19

Pr. 08-04: Upper limit of integral

Pr. 08-05: PID output upper limit

Pr. 10-17: Electronic gear A

Pr. 10-18: Electronic gear B

Pr. 11-34: Torque command

API		Mnemonic		Operands	Function
141		FPID	P	(S1) (S2) (S3) (S4)	Drive PID control mode

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
S4				*	*						*

Notes on operand usage: none

16-bit command (9 STEP)			
FPID	Continuous execution type	FPIDP	Pulse execution type

32-bit command			
–	–	–	–

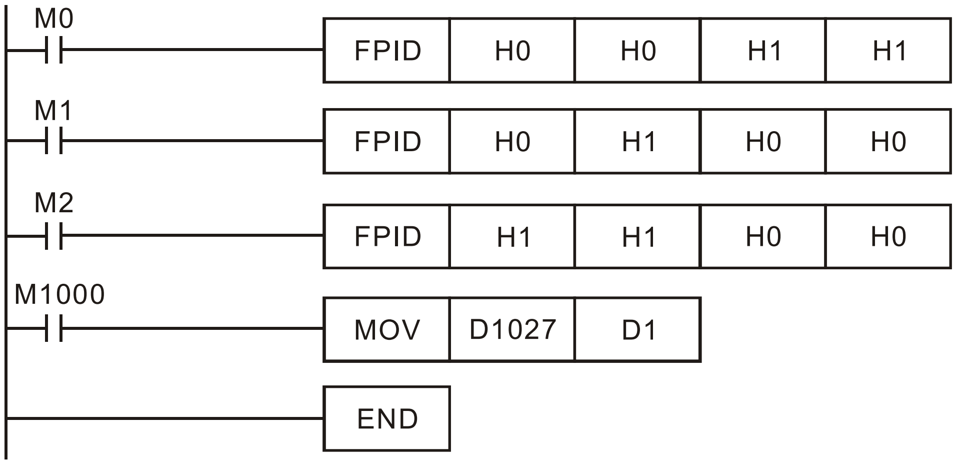
Flag signal: none

Explanation

- **S_1**: PID reference target value input terminal selection. **S_2**: PID function proportional gain P. **S_3**: PID function integral time I. **S_4**: PID function differential time D.
- The FPID command can directly control the drive's PID feedback control Pr.08-00 Terminal Selection of PID Feedback, Pr.08-01 Proportional Gain (P), Pr.08-02 Integral Time (I), and Pr.08-03 Differential Time (D).

Example

- When M0=ON, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 0, the PID function integral time I is 1 (units: 0.01 sec.), and the PID function differential time D is 1 (units: 0.01 sec.).
- When M1=ON, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- When M2=ON, the set PID reference target value input terminal selection is 1 (target frequency input is controlled through the digital keypad), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- D1027: Frequency command after PID operation.



API		FREQ	P	(S1) (S2) (S3)	Drive speed control mode
142					

	bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*

Notes on operand usage: none

16-bit command (7 STEP)

FREQ	Continuous execution type	FREQP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: M1015

Explanation

- **S1**: Frequency command. **S2**: Acceleration time. **S3**: Deceleration time.
- **S2**, **S3**: In the acceleration and deceleration time settings, the number of decimal places is determined by the definition in Pr.01-45.

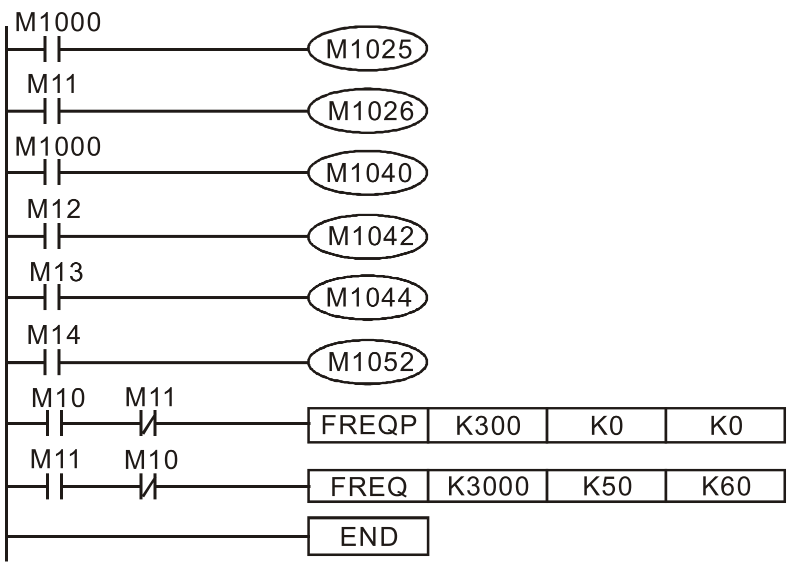
Example

When Pr.01-45=0: units of 0.01 sec.. A setting of **S2**=50 (acceleration time) in the ladder diagram below implies 0.5 sec., and the **S3** (deceleration time) setting of 60 implies 0.6 sec..

- The FREQ command can control drive Frequency commands, and acceleration and deceleration time. It also uses special register control actions, such as:
  M1025: Control drive RUN (ON)/STOP (OFF) (RUN requires Servo ON (M1040 ON) to be effective)
  M1026: Control drive operating direction FWD(OFF)/REV(ON)
  M1040: Control Servo ON/Servo OFF.
  M1042: Trigger Quick Stop (ON)/does not trigger Quick Stop (OFF).
  M1044: Pause (ON)/release pause (OFF)
  M1052: Lock frequency (ON)/release lock frequency (OFF)

Example

- M1025: Drive RUN (ON)/STOP (OFF), M1026: drive operating direction FWD (OFF)/REV (ON). M1015: frequency reached.
- When M10=ON, sets the drive frequency command K300 (3.00 Hz) with an acceleration and deceleration time of 0.
  When M11=ON, sets the drive frequency command K3000 (30.00 Hz), with an acceleration time of 50 (0.5 sec.) and deceleration time of 60 (0.6 sec.) (when Pr.01-45=0).
- When M11=OFF, the drive frequency command changes to 0.

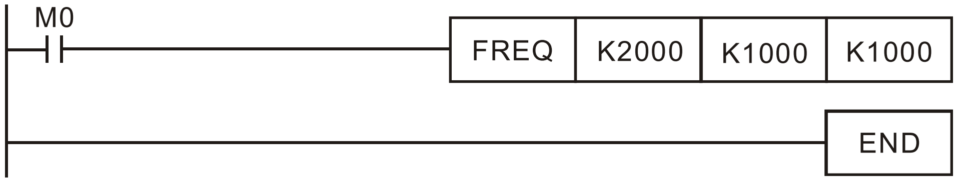


- Parameters Pr.09-33 are defined on the basis of whether reference commands have been cleared before the PLC operation.
  bit 0: Prior to PLC scanning procedures, acts on whether the target frequency has been cleared to 0. This is written to the FREQ command when the PLC is On.

bit 1: Prior to PLC scanning procedures, acts on whether the target torque has been cleared to 0. This is written to the TORQ command when the PLC is On.

bit 2: Prior to PLC scanning procedures, acts on whether speed limits in the torque mode have been cleared to 0. This is written to the TORQ command when the PLC is On.

Example: When using r to write a program,



If we force M0 to 1, the frequency command is 20.00 Hz; but when M0 is set to 0, there is a different situation.

Case 1: When the Pr.09-33 bit 0 is 0, and M0 is set as 0, then the frequency command remains at 20.00 Hz.

Case 2: When the Pr.09-33 bit 0 is 1, and M0 is set as 0, then the frequency command changes to 0.00 Hz

This is because when Pr.09-33 bit 0 is 1 prior to PLC scanning procedures, the frequency first reverts to 0. When Pr.09-33 bit 0 is 0, the frequency does not revert to 0.

API 263		TORQ P	(S1) (S2)	Drive torque control mode

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

16-bit command (5 STEP)			
TORQ	Continuous execution type	TORQ P	Pulse execution type
32-bit command			
—	—	—	—

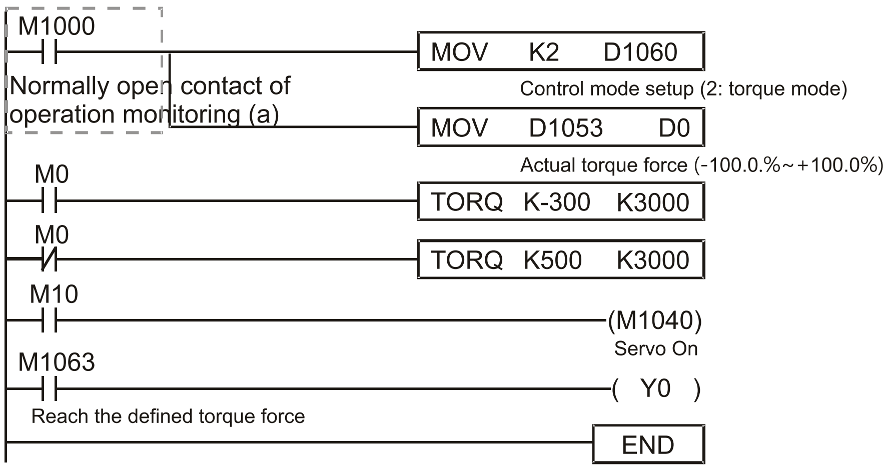
Flag signal: M1063

Explanation

- (S1): Torque command (numbered, no more than one digit). (S2): Speed limit.
- The TORQ command can control the drive torque command and speed limits; it also uses special register control actions, such as:
  M1040: Controls Servo On/Servo Off. When Servo is ON, if a TORQ command is executed, the torque will output the torque defined by the TORQ command, and the frequency restrictions will similarly be controlled by the TORQ command.

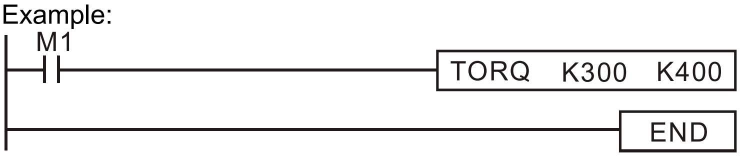
Example

- M1040: Control Servo On/Servo Off. M1063: set torque attained. D1060 is the mode controls. D1053 is the actual torque.
- When M0=Off, set the drive torque command K+500 (+50.0%), rotational speed restrictions is 3000 (30Hz).
- When M0=On, sets the drive torque command K-300 (-30.0%), rotational speed restrictions is 3000 (30Hz).
- When M10=On, drive began output torque command.
- When set torque is attained, M1063 will go On; this flag usually jumps continuously, however.



- Pr. 09-33 are defined on the basis of whether reference commands have been cleared before PLC operation.
  bit0: Prior to PLC scanning procedures, whether the target frequency has been cleared is 0. (This will be written to the FREQ command when the PLC is On)
  bit1: Prior to PLC scanning procedures, whether the target torque has been cleared is 0. (This will be written to the TORQ command when the PLC is On)
  bit2: Prior to PLC scanning procedures, whether speed limits in the torque mode have been cleared is 0. (This will be written to the TORQ command when the PLC is On)

Example:



If we now force M1 to be 1, the torque command will be K+300 (+30%), and the speed limit will be 400 (40Hz). But when M1 is set as 0, there will be a different situation.
Case 1: When bit 1 and bit 2 of Pr. 09-33 are both set as 0, and M1 is set as 0, the torque command will remain at +30%, and the speed limit will be set as 40Hz.
Case 2: When bit 2 of Pr. 09-33 are both 1, and M1 is set as 0, the torque command will revert 0%, and the speed limit will be set as 0Hz.

16-7 Display and Treatment of PLC Related Faults and Codes

Code	ID*	Description	Recommended error resolution
PLod	50	The addresses in program exceed the range during PLC downloading. For example, T only supports T0–T159, however, if you use T160, PLod warning shows during PLC downloading.	Check whether the program has an error, correct it and download the program again.
PLSv	51	The program detects incorrect written address during PLC operation, then PLSv warning occurs.	Check if the program is correct and download the program again.
PLdA	52	The program detects incorrect read / written address from Modbus during PLC operation, then PLdA warning occurs.	Check if the command that the host controller transmits is correct.
PLFn	53	When unsupported commands are found during PLC downloading, then PLFn warning shows.	Check if the firmware of the drive is the old version. If yes, please contact Delta.
PLor	54	When internal program code errors are detected during PLC operation, then PLor warning shows.	1. Disable PLC function 2. Clear PLC program (set Pr.00-02 = 6) 3. Enable PLC function 4. Download PLC program again
PLFF	55	When the corresponding command that PLC executes is unreasonable during PLC operation, then PLFF warning shows.	When PLC function is enabled and there is no program in the internal PLC program, then PLFF warning shows. This is a normal situation. You can download the program directly.
PLSn	56	Checksum error occurs during PLC operation.	1. Disable PLC function 2. Clear PLC program (set Pr.00-02 = 6) 3. Enable PLC function 4. Download PLC program again
PLEd	57	No END command during PLC operation.	1. Disable PLC function 2. Clear PLC program (set Pr.00-02 = 6) 3. Enable PLC function 4. Download PLC program again
PLCr	58	MC command has been used continuously more than nine times.	Cannot continuously use MC command more than nine times. Check whether the program has an error and download the program again.
PLdF	59	Forced to stop during PLC downloading and causes incomplete writing.	Check whether the program has an error and download again.
PLSF	60	PLC scan time excessively long	Check whether the program code has a writing error and download again.

*ID: Warning code

16-8 Explanation of Each PLC Mode Control (Speed, Torque)

Torque mode must be based on FOC vector control, and speed mode can also support FOC vector control. So for torque mode or FOC-based speed mode, you must complete the motor parameter auto-tuning in advance; otherwise, the control cannot be completed.

In addition, there are two types of motors: IM and PM. The IM motor only needs to perform motor parameter auto-tuning, while PM motor must complete auto-tuning of the motor origin offset angle after the motor parameter auto-tuning is complete. Refer to Pr.05-00 for details.

※ If the PM motor is one of the Delta ECMA series, you can directly input the motor parameters according to the servo motor catalog. There is no need to perform motor parameter auto-tuning.

Speed control:

Register table for speed mode:

Control special M

Special M	Function Description	Attributes
M1025	Drive frequency = set frequency (ON) / drive frequency = 0 (OFF)	RW
M1026	Drive operating direction FWD (OFF) / REV (ON)	RW
M1040	Hardware power (Servo On)	RW
M1042	Quick Stop	RW
M1044	Pause (Halt)	RW
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW

Status special M

Special M	Function Description	Attributes
M1015	Frequency reached (when used with M1025)	RO
M1056	Hardware already has power (Servo On Ready)	RO
M1058	On Quick Stopping	RO

Control special D

Special D	Function Description	Attributes
D1060	Operation mode setting (speed mode is 0)	RW

Status special D

Special D	Function Description	Attributes
D1037	Drive output frequency (0.00–599.00 Hz)	RO
D1050	Actual operation mode (speed mode is 0)	RO

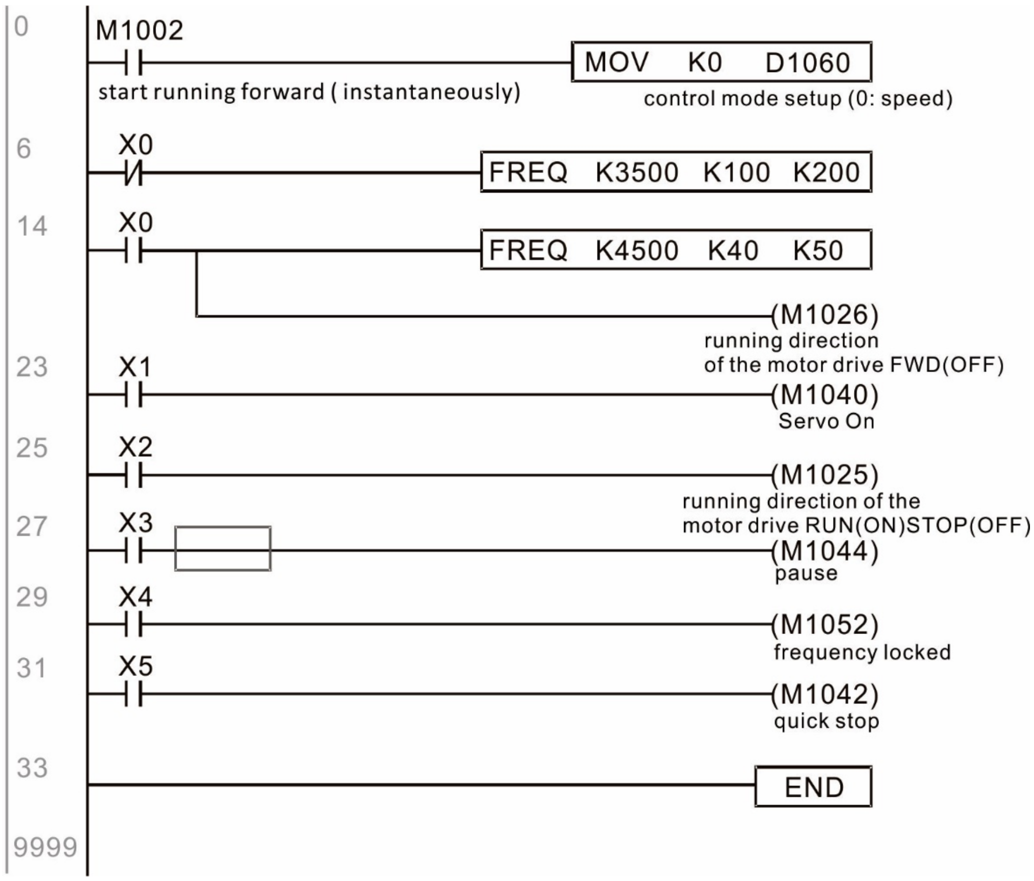
Speed mode control commands:

FREQ(P)	S1	S2	S3
	Target speed	The first acceleration time setting	The first deceleration time setting

Example of speed mode control:

Before using speed control, if you use the FOC (magnetic field orientation) control method, you must first complete the setting of the electro-mechanical parameters.

1. Setting D1060 = 0 shifts the drive to speed mode (default).
2. Use the FREQ command to control frequency, acceleration time, and deceleration time.
3. Setting M1040 = 1, the drive is now excited, but the frequency is 0.
4. Setting M1025 = 1, the drive Frequency command now jumps to the frequency designated by FREQ, and acceleration and deceleration is controlled on the basis of the acceleration time and deceleration time specified by FREQ.
5. Use M1052 to lock the current operation frequency.
6. Use M1044 to temporarily pause the operation, and the deceleration method uses the deceleration settings.
7. Use M1042 to perform Quick Stop, and deceleration is as fast as possible without causing an error. There may still be a jump error if the load is too large.
8. Control user rights: M1040 (Servo On) > M1042 (Quick Stop) > M1044 (Halt) > M1052 (LOCK)



Torque control:

Register table for torque mode:

Control special M

Special M	Function Description	Attributes
M1040	Hardware power (Servo On)	RW

Status special M

Special M	Function Description	Attributes
M1056	Hardware already has power (Servo On ready)	RO
M1063	Torque reached	RO

Control special D

Special D	Function Description	Attributes
D1060	Operation mode setting (torque mode is 2)	RW

Status special D

Special D	Function Description	Attributes
D1050	Actual operation mode (torque mode is 2)	RO
D1053	Actual torque	RO

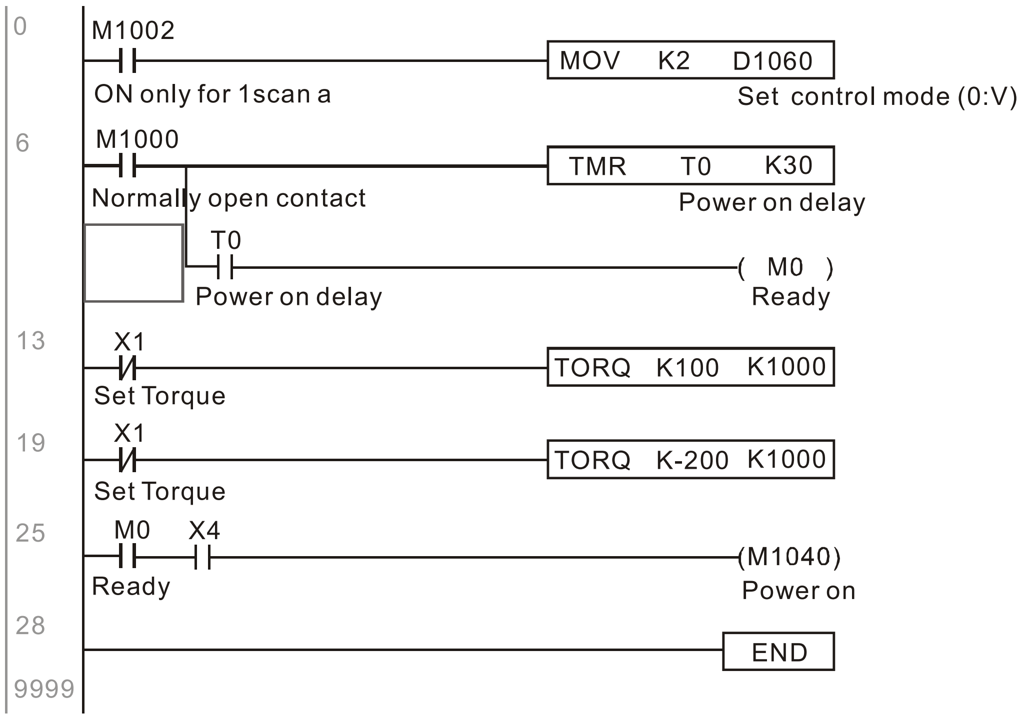
Torque mode control commands:

TORQ(P)	S1	S2
	Target torque (with numbers)	Frequency restrictions

Example of torque mode control:

You must complete the setting of the electro-mechanical parameters involved in torque control before using torque control.

1. Set D1060 = 2 to change to torque mode.
2. Use the TORQ command to implement torque control and the speed limits.
3. Set M1040 = 1; the drive is now excited, and immediately jumps to the target torque or speed limit. Use D1053 to find the current torque.

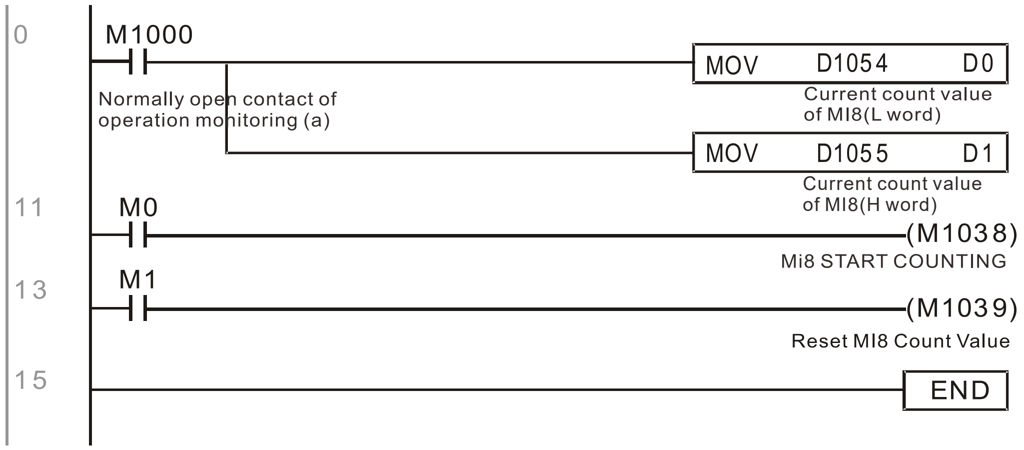


16-9 Count Function Using Pulse Input

16-9-1 High-speed count function

The MH300's MI7 supports one-way pulse counting, or you can use MI6+MI7 to support AB-phase two-way pulse counting, with a maximum speed of 33 k. The starting method is very simple, and only requires setting M1038 to begin counting. The 32 bit count value is stored in D1054 and D1055 in non-numerical form. M1039 resets the count value to 0.

Take MI7 one-way pulse input as an example:



NOTE: When the PLC program defines MI7 for use as a high-speed counter, that is when M1038 or M1039 is written in PLC procedures, the other functions of MI7 are disabled.

16-9-2 Frequency calculation function

Apart from high-speed counting, the MH300's MI7 (one-way pulse counting) or MI6+MI7 (AB-phase two-way pulse counting) can also convert a received pulse to a frequency. The following figure shows that there is no conflict between frequency conversion and count calculations, which the MH300 can perform simultaneously.

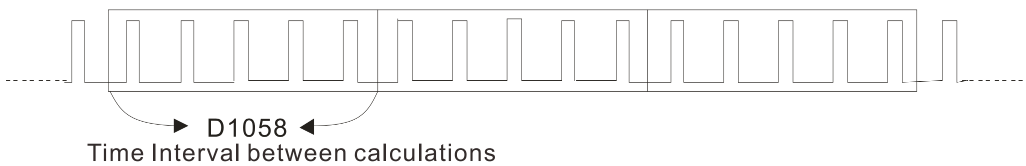
PLC speed calculation formula

D1057 Speed

D1058 Interval between calculations

D1059 Decimal places

Assume that there are five input pulses each second, (see figure below) we set D1058 = 1000 ms = 1.0 seconds as the calculation interval. This enables five pulses to be sent to the drive each second.



Assume that each five pulses correspond to 1 Hz, we set D1057 = 5.

Setting D1059 = 2 displays numbers to two decimal places, which is also 1.00 Hz. The numerical value displayed at D1056 is 100. For simplicity, the D1059 conversion formula can be expressed in the following formula:

D1056 = (Pulses per second / D1057) * (1000 / D1058) * (10^D1059)

16-10 CANopen Master control applications

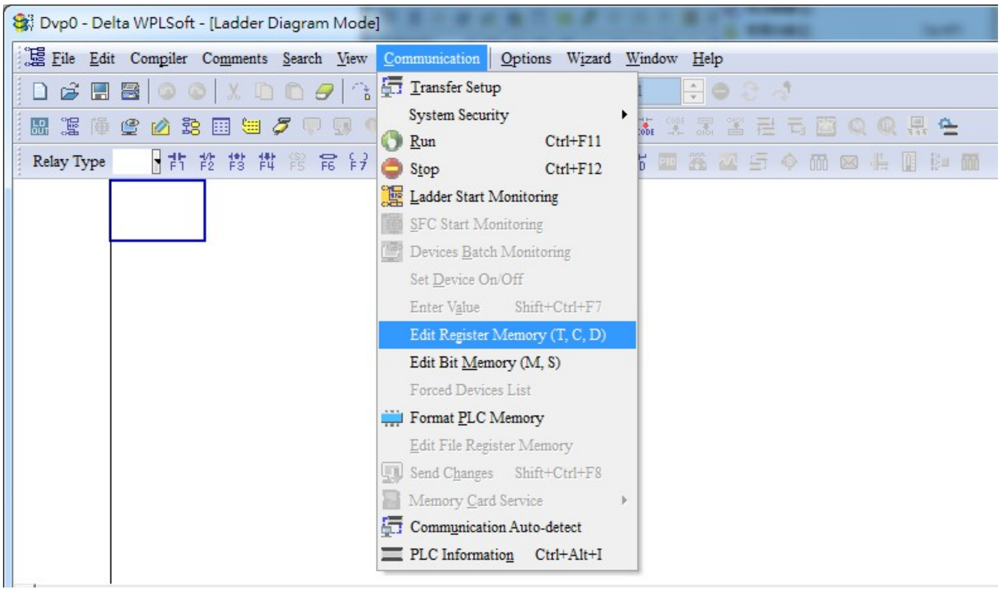
Control of a simple multi-axis application is required in certain situations. If the device supports the CANopen protocol, a MH300 can serve as the master in implementing simple control (position, speed, homing, and torque control). The setting method comprises the following seven steps:

Step 1: Activating CANopen Master functions

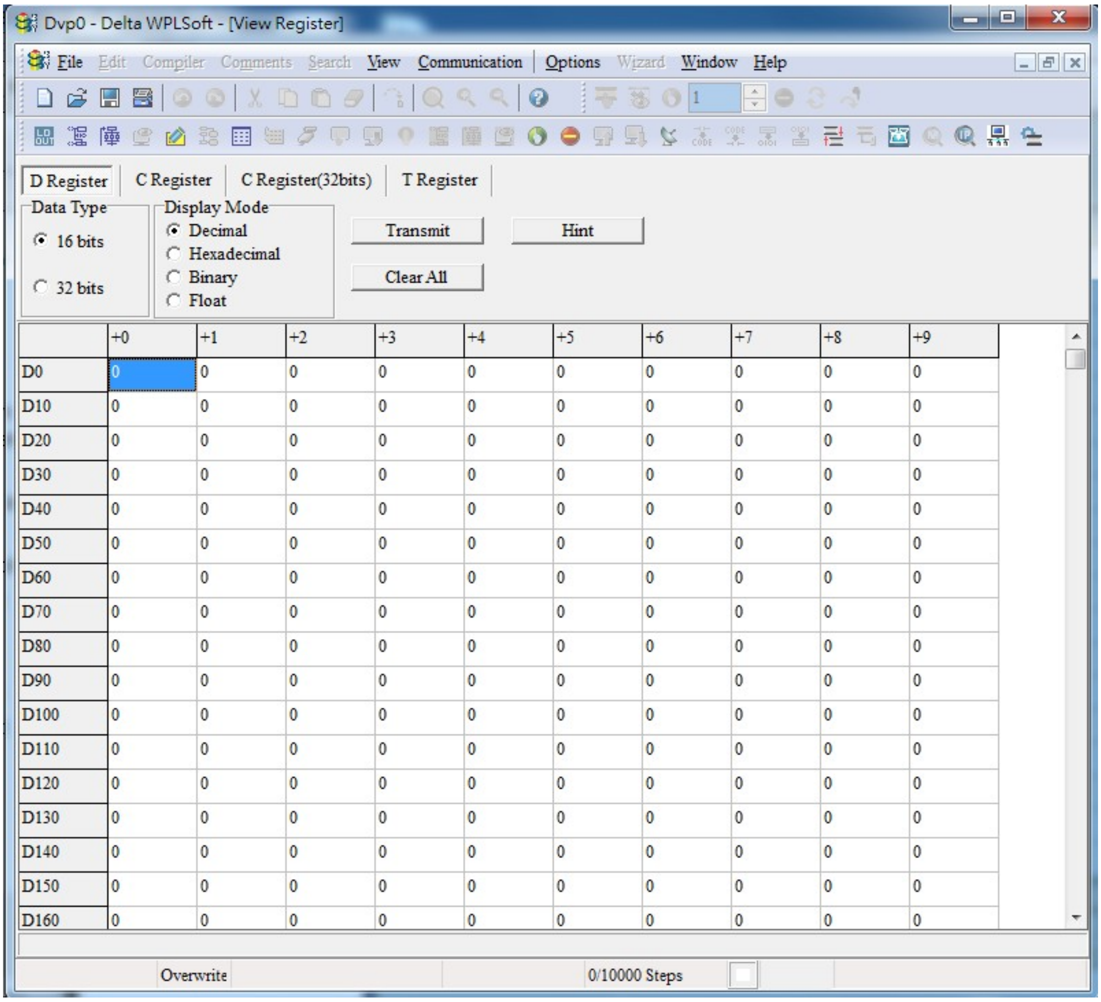
1. Pr. 09-45=1 (initiates Master functions); restart power after completing setting, the status bar on the KPC-CC01 digital keypad will display "CAN Master".
2. Pr. 00-02=6 reset PLC (please note that this action will reset the program and PLC registers to the default values)
3. Turn power off and on again.
4. Use the KPC-CC01 digital keypad to set the PLC control mode as **"PLC 2"** (if a newly-introduced drive is used, the blank internal PLC program will cause a PLFF warning code to be issued).

Step 2: Master memory settings

1. After connecting the 485 communications cable, use WPL Soft to set the PLC **status** as Stop (if the PLC mode has been switched to the **"PLC 2"** mode, the PLC **status** should already be Stop)
2. Set the address and corresponding station number of the slave station to be controlled. For instance, if it is wished to control two slave stations (a maximum of 4 stations can be controlled simultaneously), and the station numbers are 21 and 22, it is only necessary to set D2000 and D2100 as 20 and 21, and then set D2200, D2300, D2400, D2500, D2600, and D2700 as 0. The setting method involves use of the PLC's WPL editing software WPL as follows:
   - Open WPL and implement **communications > register edit (T C D)** function



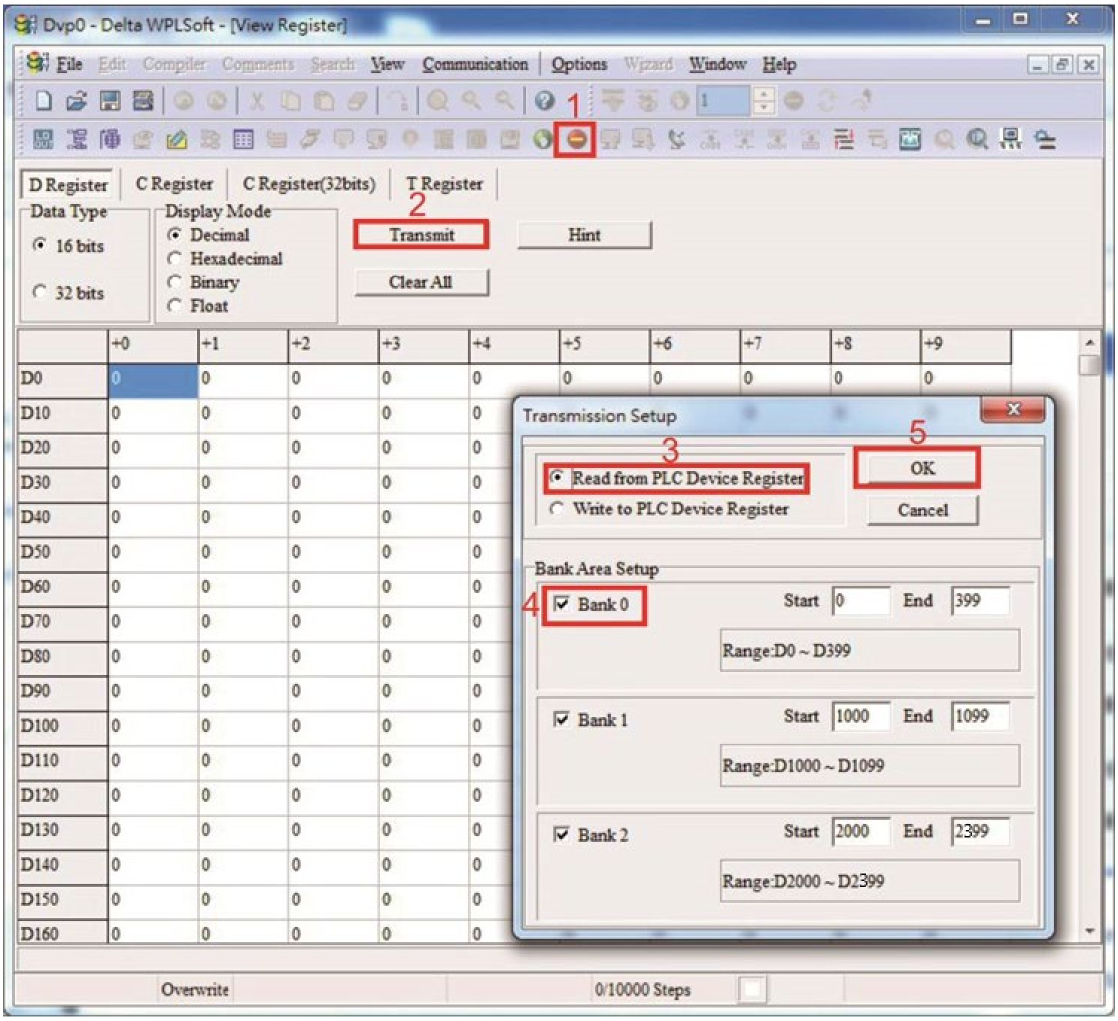
- After leaving the PLC register window, the register setting screen will appear, as shown below:



If there is a new PLC program and no settings have been made yet, you can read default data from the converter, and merely edit it to suit the current application.

If settings have already been made, however, the special D in the CANopen area will display the saved status (the CANopen D area is located at D1090 to D1099 and D2000 to D2399). Assuming it is a new program, we will first read the default data from the converter; check the communications format if there is no communications link (the default PLC station number is 2, 9600, 7N2, ASCII). Perform the following steps:

1. Switch the PLC to Stop status
2. Press the transmit button
3. Click on read memory after exiting the window
4. Ignore D0–D399
5. Click on the confirm button.



After reading the data, it is necessary to perform some special D settings. Before proceeding, we will first introduce the special D implications and setting range.

The CANopen Master's special D range is currently D1070 to D1099 and D2000 to D2399; this range is divided into 3 blocks:

- The first block is used to display CANopen's current status, and has a range of D1070–D1089
- The second block is used for CANopen's basic settings, and has a range of D1090–D1099
- The third block is the slave station mapping and control area, and has a range of D2000–D2399.

These areas are therefore introduced as follows:

The first contains the current CANopen status display:
When the master initializes a slave station, we can find out from D1070 whether configuration of the slave device has been completed; we can find out whether an error occurred in the configuration process from D1071 and whether the configuration is inappropriate from D1074. After entering normal control, we can find out whether the slave device is offline from D1073. In addition, we can check the slave device's read/write information using the CANRX, CANTX, and CANFLS commands; error information can be obtained from D1076 to D1079 if there has been a read/write failure.

Special D	Description of Function	R/W
D1070	Channel opened by CANopen initialization (bit0=Machine code0 …….)	R
D1071	Error channel occurring in CANopen initialization process (bit0=Machine code0 …….)	R
D1072	Reserved	-
D1073	CANopen break channel (bit0=Machine code0 …….)	R
D1074	Error code of master error 0: No error 1: Slave station setting error 2: Synchronizing cycle setting error (too small)	R
D1075	Reserved	-
D1076	SDO error message (main index value)	R
D1077	SDO error message (secondary index value)	R
D1078	SDO error message (error code L)	R
D1079	SDO error message (error code H)	R

The second area is for basic CANopen settings: (the PLC must have **stopped** when this area is used to make settings)

We must set the information exchange time for the master and slave station,

Special D	Description of Function	Default:	R/W
D1090	Synchronizing cycle setting	4	RW

Use D1090 to perform settings; setting time relationships include:

$$\text{Sync time} \geq \frac{1M}{\text{Rate}} * \frac{N}{4}$$

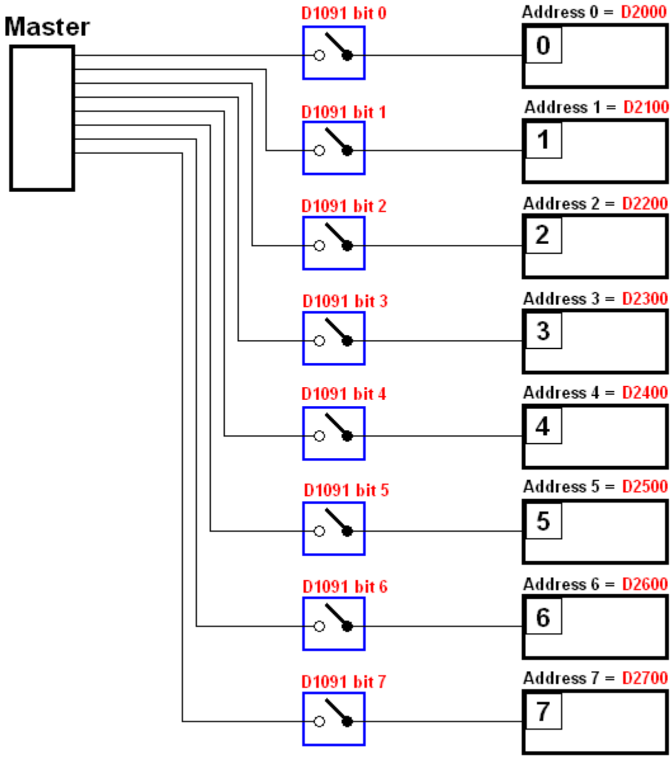
N: TXPDO + RXPDO

For instance, when communications speed is 500K, TXPDO + RXPDO have 8 sets, and synchronizing time will require more than 4 ms

We must also define how many slave stations will be opened. D1091 is the channel for defining station opening, and D2000+100*n is the station number defining this channel. See the detailed explanation below.

Slave station number **n**=0–3

Special D	Description of Function	R/W
D1091	Sets slave station On or Off (bit 0-bit 3 correspond to slave stations number 0-3)	RW
D2000+100***n**	Slave station number	RW



If slave devices have a slow start-up, the master can delay for a short time before performing slave station configuration; this time delay can be set via D1092.

Special D	Description of Function	Default	R/W
D1092	Delay before start of initialization	0	RW

With regard to slave device initialization, a delay time can be set to judge whether failure has occurred. If the communications speed is relatively slow, the delay time can be adjusted to judge whether initialization has been completed, which will ensure that there is time to perform slave device initialization.

Special D	Description of Function	Default	R/W
D1099	Initialization completion delay time Setting range: 1 to 60000 sec.	15 sec.	RW

After communication is successful, the system must detect whether there is a break in communications with the slave station. D1093 is used to set detection time, and D1094 sets the number of consecutive errors that will trigger a break error.

Special D	Description of Function	Default	R/W
D1093	Break time detection	1000ms	RW
D1094	Break number detection	3	RW

The packet type transmitted by PDO is set before establishing normal communications and generally does not require adjustment.

Special D	Description of Function	Default	R/W
D1097	Corresponding real-time transmission type (PDO) Setting range: 1–240	1	RW
D1098	Corresponding real-time receiving type (PDO) Setting range: 1–240	1	RW

The third block is the slave station mapping and control area.

CANopen provides a PDO method to perform mapping of the master and slave station memory, and enables the master to directly access read/write data in a certain memory area. The master will automatically perform data exchange with the corresponding slave device, and the read/write values can be seen directly from the special D area after real-time exchange (M1034 = 1 time) has been established. The MH300 currently supports real-time mapping of two PDOs, and there are two types of PDO RXPDO (reads slave device information) and TXPDO (writes to slave device). In addition, in order to facilitate control, the MH300 cannot perform mapping of commonly-used registers; the following is an overview of the current PDO mapping situation:

TXPDO				RXPDO			
PDO2 (Remote I/O)		PDO1 (Speed)		PDO2 (Remote I/O)		PDO1 (Speed)	
Description	Special D	Description	Special D	Description	Special D	Description	Special D
Slave device DO	D2027+100*n	Controller word	D2008+100*n	Slave device DI	D2026+100*n	Mode word	D2009+100*n
Slave device AO1	D2031+100*n	Target speed	D2012+100*n	Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
從機 AO2	D2032+100*n			從機 AI2	D2029+100*n		
Slave device AO2	D2033+100*n			Slave device AI2	D2030+100*n		

Because usage requires only simple to open the corresponding PDO, where TXPDO employs D2034+100*n settings and RXPDO employs D2067+100*n settings.

These two special D areas are defined as follows:

	PDO2		PDO1	
Default definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	En	Length	En	Length

En: indicates whether PDO is used

Length: indicates mapping of several variables

In a simple example, if we want to control a MH300 slave device and make it to operate in speed mode, we only have to make the following settings:

D2034+100*n =000Ah：

Length:	TXPDO			
	PDO2 (Remote I/O)		PDO1 (Speed)	
	Description	Special D	Description	Special D
1	Slave device DO	D2027+100*n	Controller Word	D2008+100*n
2	Slave device AO1	D2031+100*n	Target speed	D2012+100*n
3	Slave device AO2	D2032+100*n		
4	Slave device AO3	D2033+100*n		

	PDO2		PDO1	
Definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	0	0	1	2

D2067+100*n =000Ah：

Length:	TXPDO			
	PDO2 (Remote I/O)		PDO1 (Speed)	
	Description	Special D	Description	Special D
1	Slave device DI	D2026+100*n	Controller Word	D2009+100*n
2	Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
3	Slave device AI2	D2029+100*n		
4	Slave device AI3	D2030+100*n		

	PDO2		PDO1	
Definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	0	0	1	2

Switch the PLC to Run after completing settings. Now wait for successful initialization of CANopen (M1059 = 1 and M1061 = 0), and then initiate CANopen memory mapping (M1034 = 1). The control word and frequency command will now automatically refresh to the corresponding slave device (D2008+n*100 and D2012+n*100), and the slave device's status word and currently frequency will also be automatically sent back to the master station (D2009+n*100 and D2013+n*100). This also illustrates how the master can handle these tasks through read/write operations in the special D area.

Furthermore, it should be noted that the remote I/O of PDO2 can obtain the slave device's current DI and AI status, and can also control the slave device's DO and AO status. Nevertheless, after introducing a fully automatic mapping special D, the MH300 CANopen master also provides additional information refreshes. For instance, while in speed mode, acceleration/deceleration settings may have been refreshed. The special D therefore also stores some seldom-used real-time information, and these commands can be refreshed using the CANFLS command. The following is the MH300's current CANopen master data conversion area, which has a range of D2001+100*n–D2033+100*n, as shown below:

1. The range of n is 0–3
2. ●Indicates PDOTX, ▲Indicates PDORX; unmarked special D can be refreshed using the CANFLS command

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2000+100*n	Station number n of slave station Setting range: 0–127 0: No CANopen function	0			RW
D2002+100*n	Manufacturer code of slave station number n (L)	0			R
D2003+100*n	Manufacturer code of slave station number n (H)	0			R
D2004+100*n	Manufacturer's product code of slave station number n (L)	0			R
D2005+100*n	Manufacturer's product code of slave station number n (H)	0			R

Basic definitions

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2006+100*n	Communications break handling method of slave station number n	0			RW
D2007+100*n	Error code of slave station number n error	0			R
D2008+100*n	Control word of slave station number n	0	●		RW
D2009+100*n	Status word of slave station number n	0	▲		R
D2010+100*n	Control mode of slave station number n	2			RW
D2011+100*n	Actual mode of slave station number n	2			R

Velocity Control

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2001+100*n	Torque restriction on slave station number n	0			RW
D2012+100*n	Target speed of slave station number n (rpm)	0	●		RW
D2013+100*n	Actual speed of slave station number n (rpm)	0	▲		R
D2014+100*n	Error speed of slave station number n (rpm)	0			R
D2015+100*n	Acceleration time of slave station number n (ms)	1000			RW
D2016+100*n	Deceleration time of slave station number n (ms)	1000			RW

Torque control

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2017+100*n	Target torque of slave station number n (-100.0% – +100.0%)	0			RW
D2018+100*n	Actual torque of slave station number n(XX.X%)	0			R
D2019+100*n	Actual current of slave station number n(XX.XA)	0			R

Position control

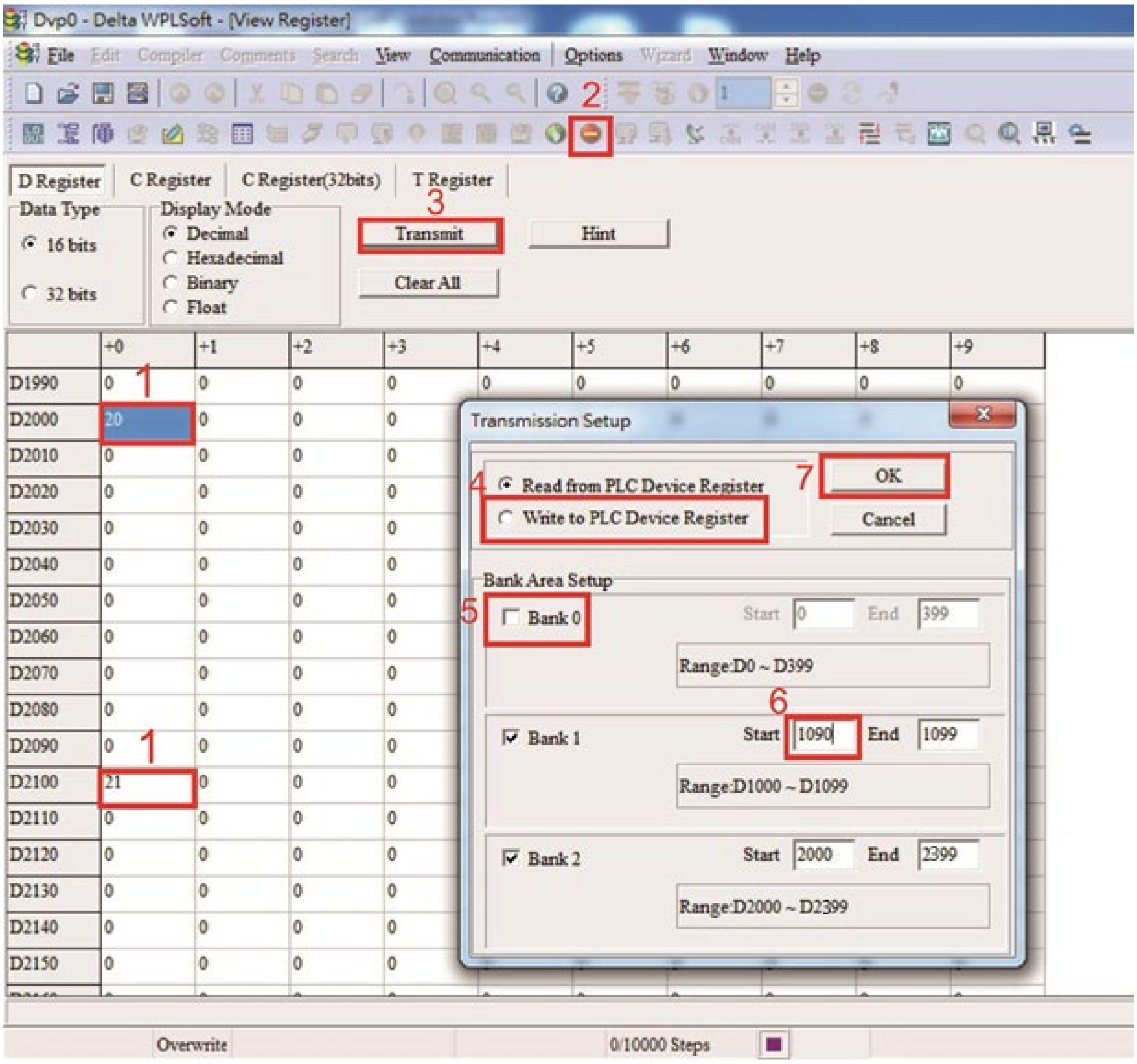
Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2020+100*n	Target of slave station number n (L)	0			RW
D2021+100*n	Target of slave station number n (H)	0	●		RW
D2022+100*n	Actual position of slave station number n (L)	0			R
D2023+100*n	Actual position of slave station number n (H)	0			R
D2024+100*n	Speed chart of slave station number n (L)	10000			RW
D2025+100*n	Speed chart of slave station number n (H)	0			RW

Remote I/O

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2026+100*n	MI status of slave station number n	0		▲	R
D2027+100*n	MO setting of slave station number n	0		●	RW
D2028+100*n	AI1 status of slave station number n	0		▲	R
D2029+100*n	AI2 status of slave station number n	0		▲	R
D2030+100*n	AI3 status of slave station number n	0		▲	R
D2031+100*n	AO1 setting of slave station number n	0		●	RW
D2032+100*n	AO2 setting of slave station number n	0		●	RW
D2033+100*n	AO3 setting of slave station number n	0		●	RW

After gaining an understanding of special D definitions, we return to setting steps. After entering the values corresponding to D1090 to D1099, D2000+100*n, D2034+100*n and D2067+100*n, we can begin to perform downloading, which is performed in accordance with the following steps:

1. D2000 and D2100 are set as 20 and 21, and D2200, D2300, D2400, D2500, D2600, and D2700 are set as 0; if a setting of 0 causes problems, D1091 can be set as 3, and slave stations 2 to 3 can be closed.
2. Switch PLC to Stop status.
3. Press the transmit button.
4. Click on write memory after exiting the window.
5. Ignore D0–D399.
6. Change the second range to D1090–D1099.
7. Click on Confirm.



■ Another method can be used to set D1091: Determine which of slave stations 0 to 3 will not be needed, and set the corresponding bits to 0. For instance, if it is not necessary to control slave stations 1 and 3, merely set D1091 = 000A, and the setting method is the same as described above: Use WPL to initiate **communications > use register edit (T C D)** function to perform settings.

Step 3: Set the master's communications station number and communications speed

- ☑ When setting the master's station number (Pr. 09-46, default is set as 100), make sure not to use the same number as a slave station.
- ☑ Set the CANopen communications speed (Pr. 09-37); regardless of whether the drive is defined as a master or slave station, the communications speed is set via this parameter.

Step 4: Write program code

Real-time access: Can directly read / write to or from the corresponding D area.

Non real-time access:

- **Read command**: Use the CANRX command for reading. M1066 will be 1 when reading is completed; M1067 will be 1 if reading is successful, and M1067 will be 0 if an error has occurred.
- **Write command**: Use the CANTX command for writing. M1066 will be 1 when writing is completed; M1067 will be 1 if writing is successful, and M1067 will be 0 if an error has occurred.
- **Refresh command:** Use CANFLS command to refresh (if there are RW attributes, the master will write to the slave station; if there are RO attributes, the slave station will return the read values to the master); M1066 will be 1 if refresh has been completed; M1067 will be 1 if refresh is successful, and M1067 will be 0 if an error has occurred.

NOTE:

When using CANRX, CANTX or CANFLS, internal implementation commands will wait until M1066 is completed before executing the next CANRX, CANTX or CANFLS.

Afterwards, download program to the drive (Please note that the PLC's default communications format is ASCII 7N2 9600, and the station number is 2. The WPL must therefore be modified, and the WPL setting pathway is **settings > communications settings**)

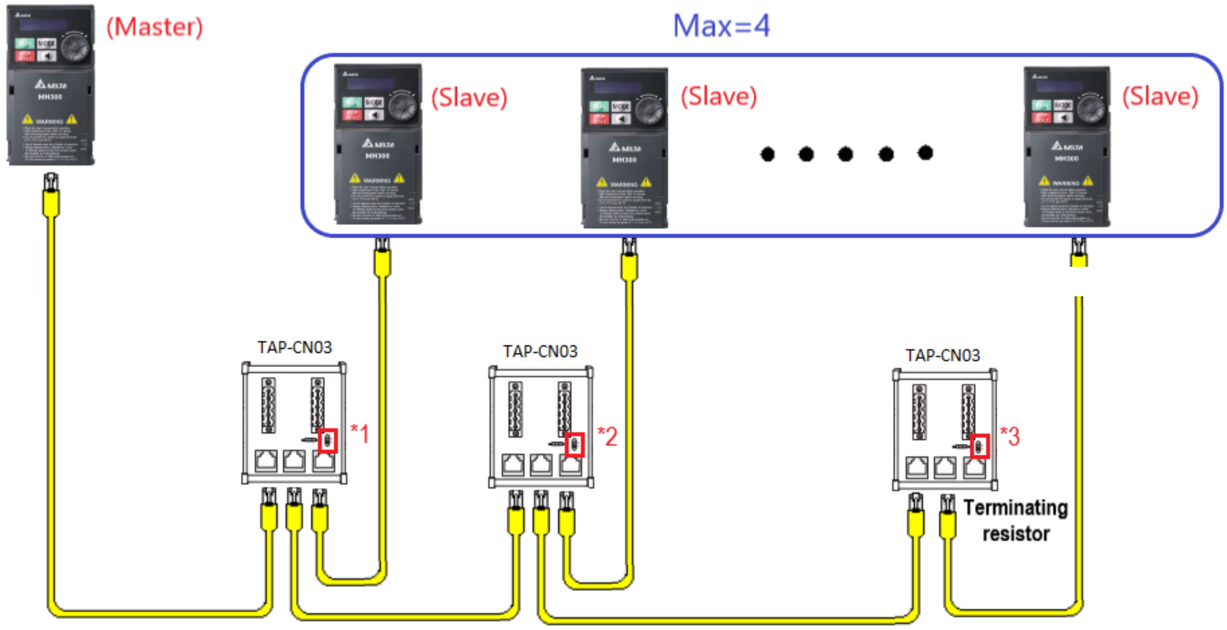
Step 5: Set the slave stations' station numbers, communications speed, control source, and command source

Delta's MH300 and MS300 series devices currently support the CANopen communications interface drive, and the corresponding slave station numbers and communications speed parameters are as follows:

	Corresponding device parameters		Value	Definition
	MH300	MS300		
Slave station address	09-36	09-36	0	Disable CANopen hardware interface
			1–127	CANopen Communication address
Communication speed	09-37	09-37	0	1Mbps
			1	500Kbps
			2	250Kbps
			3	125Kbps
			4	100Kbps
			5	50Kbps
Control source	00-21	00-21	3	
	-	-	5	
Frequency source	00-20	00-20	6	
	-	-	5	
Torque source	11-33	11-33	3	
	-	-	-	
Position source	11-40	-	3	
	-	-	-	

Step 6: Connect hardware wiring

When performing wiring, note the head and tail terminal resistance; connection methods are as follows:



*1. Turn the terminal resistor setting switch SW to **ON**.

*2. Turn the terminal resistor setting switch SW to **OFF**.

*3. Turn the terminal resistor setting switch SW to **ON**.

Step 7: Initiate control

After a program has been written and downloaded, switch the PLC mode to Run. Merely turn power to master and slave stations off and then on again.

16-11 Modbus Remote IO Control Applications (use MODRW)

The MH300's internal PLC supports 485 read/write functions, which can be realized using the MODRW command. However, the 485 serial port must be defined as available for the PLC's 485 use before writing a program, and the Pr. 09-31 must be set as -12. After completing settings, the standard functions defined by 485 can be used to implement read/write commands at other stations. Communications speed is defined by parameter 09-01, the communications format is defined by Pr. 09-04, and the PLC's current station number is defined by Pr. 09-35. The MH300 currently supports the functions read coil (0x01), read input (0x02), read register (0x03), write to single register (0x06), write to several coils (0x0F), and write to several registers (0x10). Explanations and the usage of these functions are provided as follows:

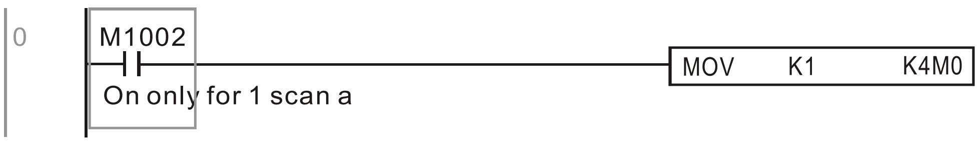
MODRW command					General meaning	Slave device is Delta's PLC meaning	Slave device is Delta's converter meaning
S1	S2	S3	S4	S5			
Node ID	Command	Address	Return: D area	Length			
K3	H01	H500	D0	K18	Read coil (bit)	Read 18 bits of data corresponding to slave station 3 PLC Y0 to Y21. This data is stored by bit 0 to 15 of the station's D0 and bit 0 to bit 3 of D1.	Does not support this function
K3	H02	H400	D10	K10	Read input (bit)	Read 10 bits of data corresponding to slave station 3 PLC X0 to X11. This data is stored by bit 0 to 9 of this station's D10.	Does not support this function
K3	H03	H600	D20	K3	Read register (word)	Read 3 words of data corresponding to slave station 3 PLC T0 to T2. This data is stored by D20 to D22.	Read 3 words of data corresponding to slave station 3 converter parameters 06-00 to 06-02. This data is stored by D20 to D22
K3	H06	H610	D30	XX	Write to single register (word)	Write slave station 3 PLC's T16 to this station's D30 value	Write slave station 3 converter 06 to 16 parameter to this station's D30 value
K3	H0F	H509	D40	K10	Write to multiple coils (Bit)	Write slave station 3 PLC's Y11 to Y22 to bit 0 to 9 of D40.	Does not support this function
K3	H10	H602	D50	K4	Write to multiple registers (word)	Write slave station 3 PLC's T2 to T5 to D50 to D53	Write slave station 3 converter 06-02 to 06-05 parameters to this station's D50 to D53

NOTE: XX means this can be ignored.

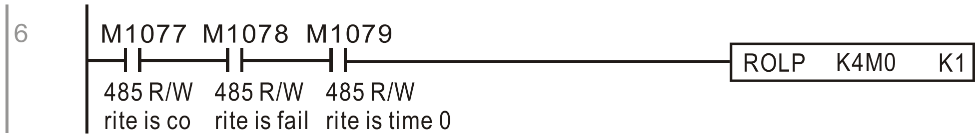
After implementing MODRW, the status will be displayed in M1077 (485 read/write complete), M1078 (485 read/write error), and M1079 (485 read/write time out). M1077 is defined so as to immediately revert to 0 after the MODRW command has been implemented. However, any of three situations—a report of no error, a data error report, or time out with no report—will cause the status of M1077 to change to On.

Example program: Testing of various functions

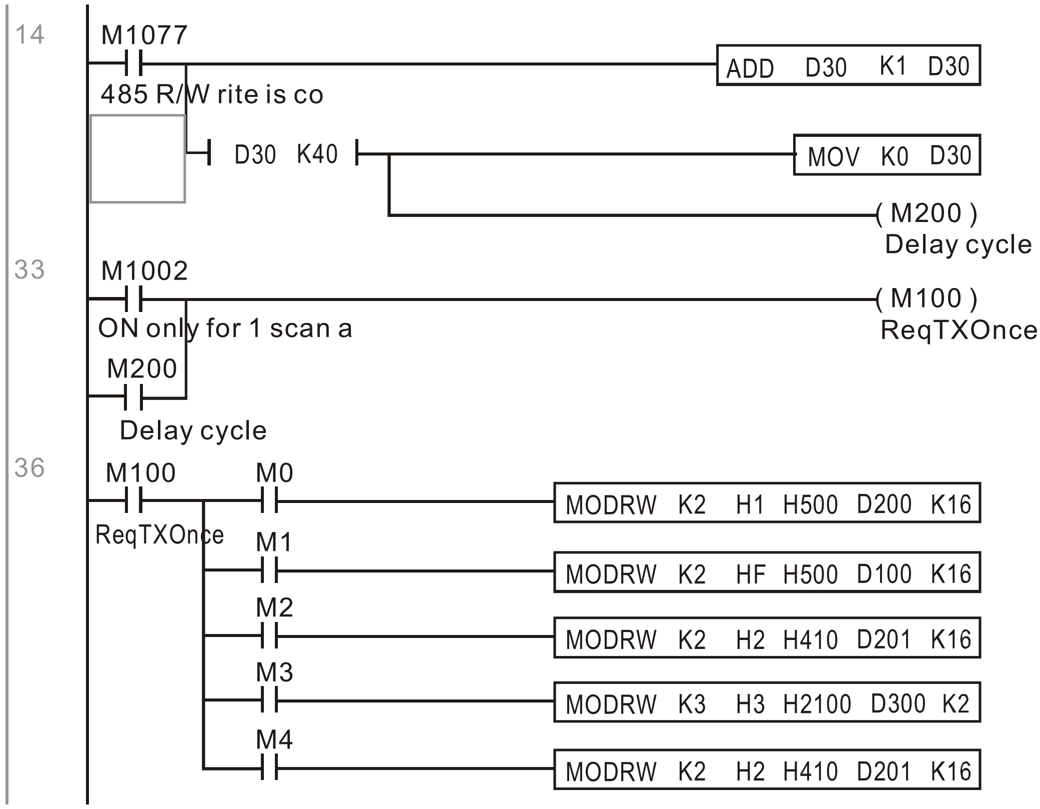
At the start, will cause the transmitted time sequence to switch to the first data unit.



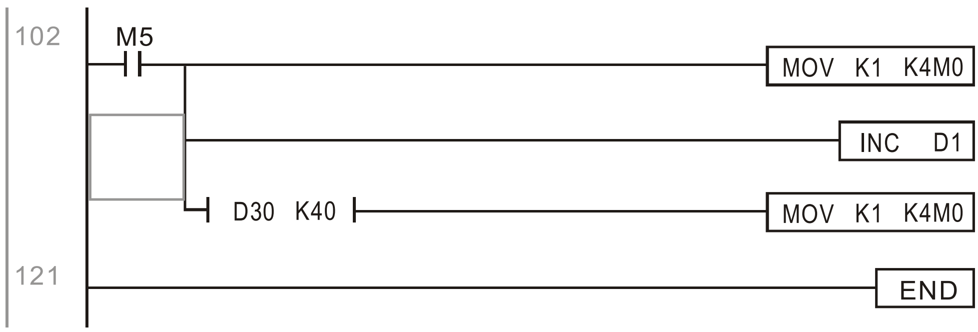
When the reported message indicates no error, it will switch to the next transmitted command



If time out occurs or an error is reported, the M1077 will change to On. At this time, after a delay of 30 scanning cycles, it will re-issue the original command once



It will repeat after sending all commands



Practical applications:

Actual use to control the RTU-485 module.

Step 1: Set the communications format. Assume that the communications format is 115200, 8,N,2, RTU

MH300：The default PLC station number is set as 2 (09-35)

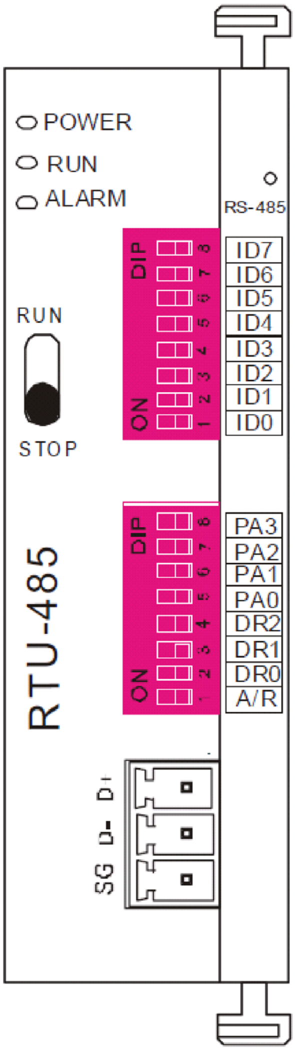
Pr. 09-31=-12 (COM1 is controlled by the PLC), Pr. 09-01=115.2 (The communications speed is 115200)

Pr. 09-04=13 (The format is 8,N,2, RTU)

RTU-485: The station number = 8 (give example)

ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
0	0	0	0	1	0	0	0

PA3	PA2	PA1	PA0	DR2	DR1	DR0	A/R
1	**0**	**0**	**0**	**1**	**1**	**1**	**0**



Communication station #:
ID0~ ID7 are defined as 2^0, 2^1, 2^2...2^6, 2^7

Communication protocol

PA3	PA2	PA1	PA0	A/R	Communication Protocol
OFF	OFF	OFF	OFF	ON	7,E,1, ASCII
OFF	OFF	OFF	ON	ON	7,O,1, ASCII
OFF	OFF	ON	OFF	ON	7,E,2, ASCII
OFF	OFF	ON	ON	ON	7,O,2, ASCII
OFF	ON	OFF	OFF	ON	7,N,2, ASCII
OFF	ON	OFF	ON	ON	8,E,1, ASCII
OFF	ON	ON	OFF	ON	8,O,1, ASCII
OFF	ON	ON	ON	ON	8,N,1, ASCII
ON	OFF	OFF	OFF	ON	8,N,2, ASCII
OFF	ON	OFF	ON	OFF	8,E,1, RTU
OFF	ON	ON	OFF	OFF	8,O,1, RTU
OFF	ON	ON	ON	OFF	8,N,1, RTU
ON	OFF	OFF	OFF	OFF	8,N,2, RTU

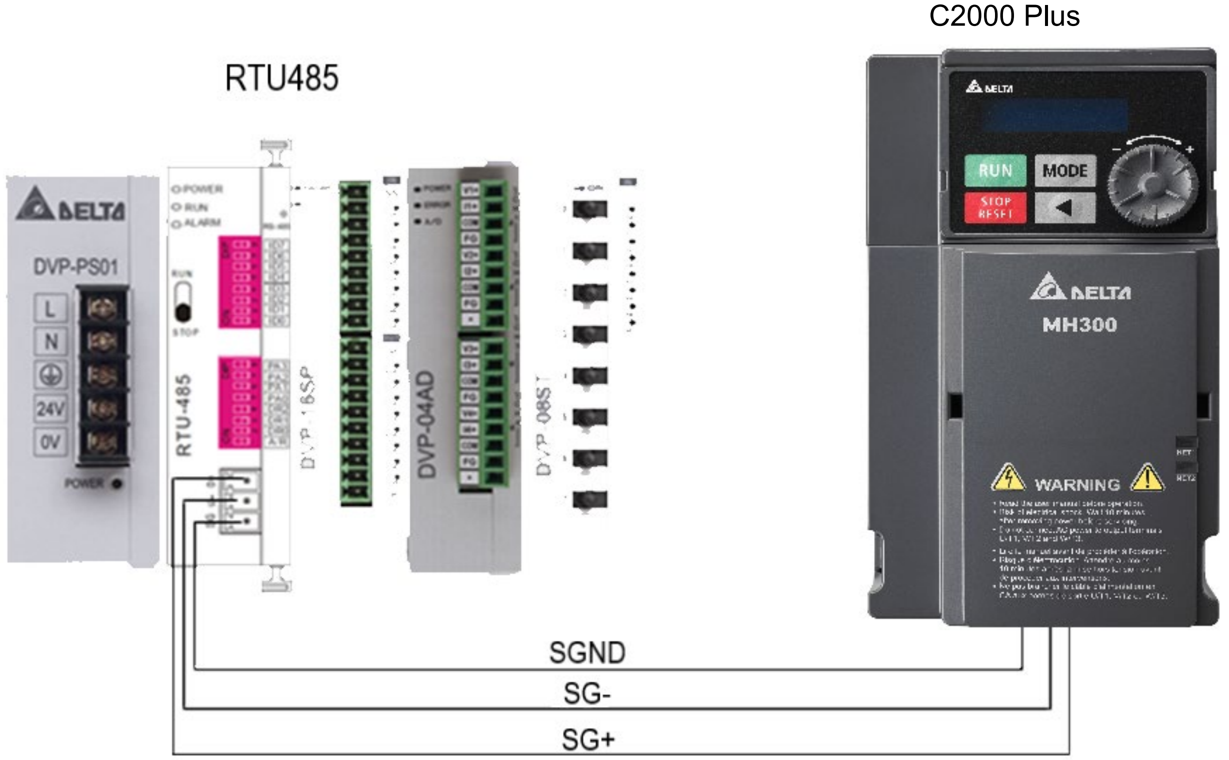
DR2	DR1	DR0	Communicaton Speed
OFF	OFF	OFF	1,200 bps
OFF	OFF	ON	2,400 bps
OFF	ON	OFF	4,800 bps
OFF	ON	ON	9,600 bps
ON	OFF	OFF	19,200 bps
ON	OFF	ON	38,400 bps
ON	ON	OFF	57,600 bps
ON	ON	ON	115,200 bps

Step 2: Install control equipment. We sequentially connect a DVP16-SP (8 IN 8 OUT), DVP-04AD (4 channels AD), DVP02DA (2 channels DA), and DVP-08ST (8 switches) to the RTU-485.

The following corresponding locations can be obtained from the RTU-485's configuration definitions:

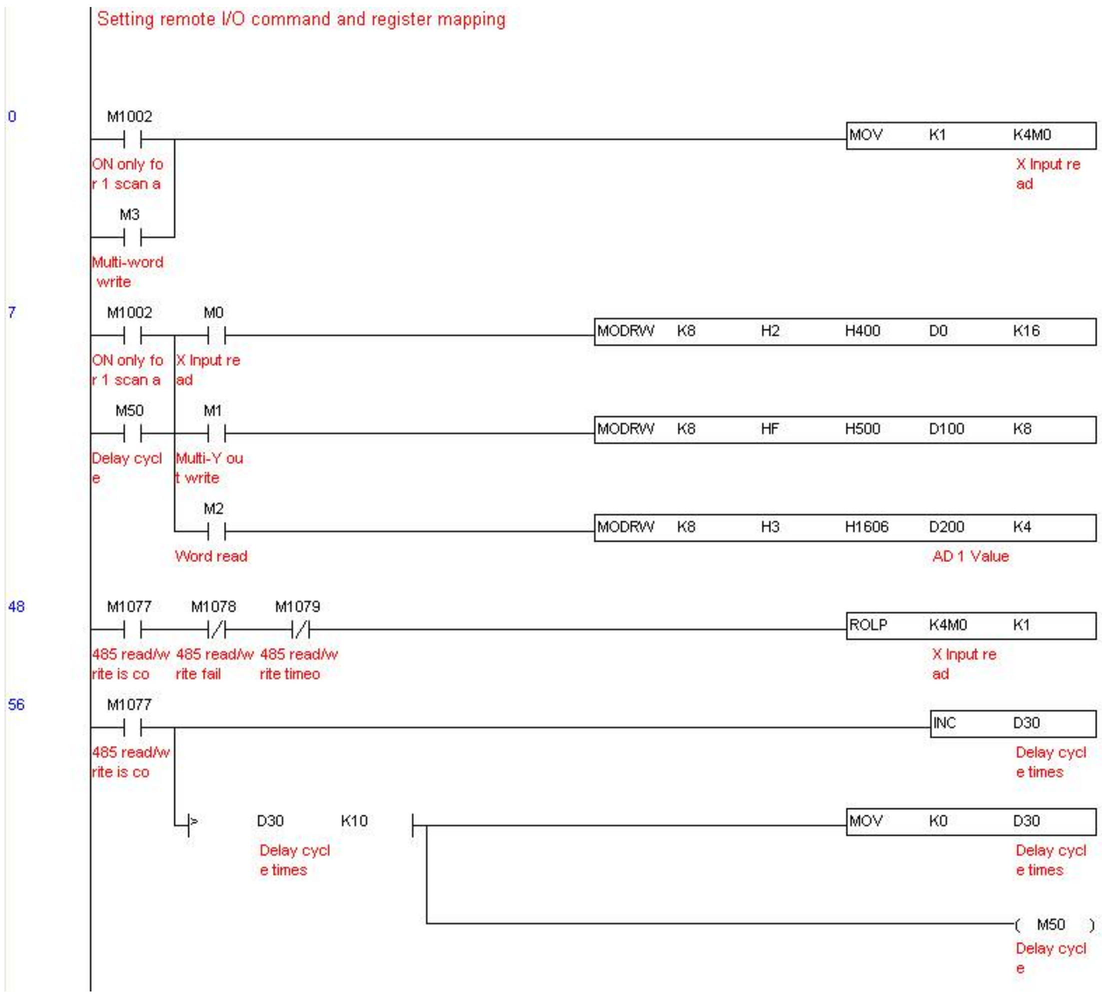
Module	Terminals	485 Address
DVP16-SP	X0–X7	0400H–0407H
	Y0–Y7	0500H–0507H
DVP-04AD	AD0–AD3	1600H–1603H
DVP02DA	DA0–DA1	1640H–1641H
DVP-08ST	Switch 0–7	0408H–040FH

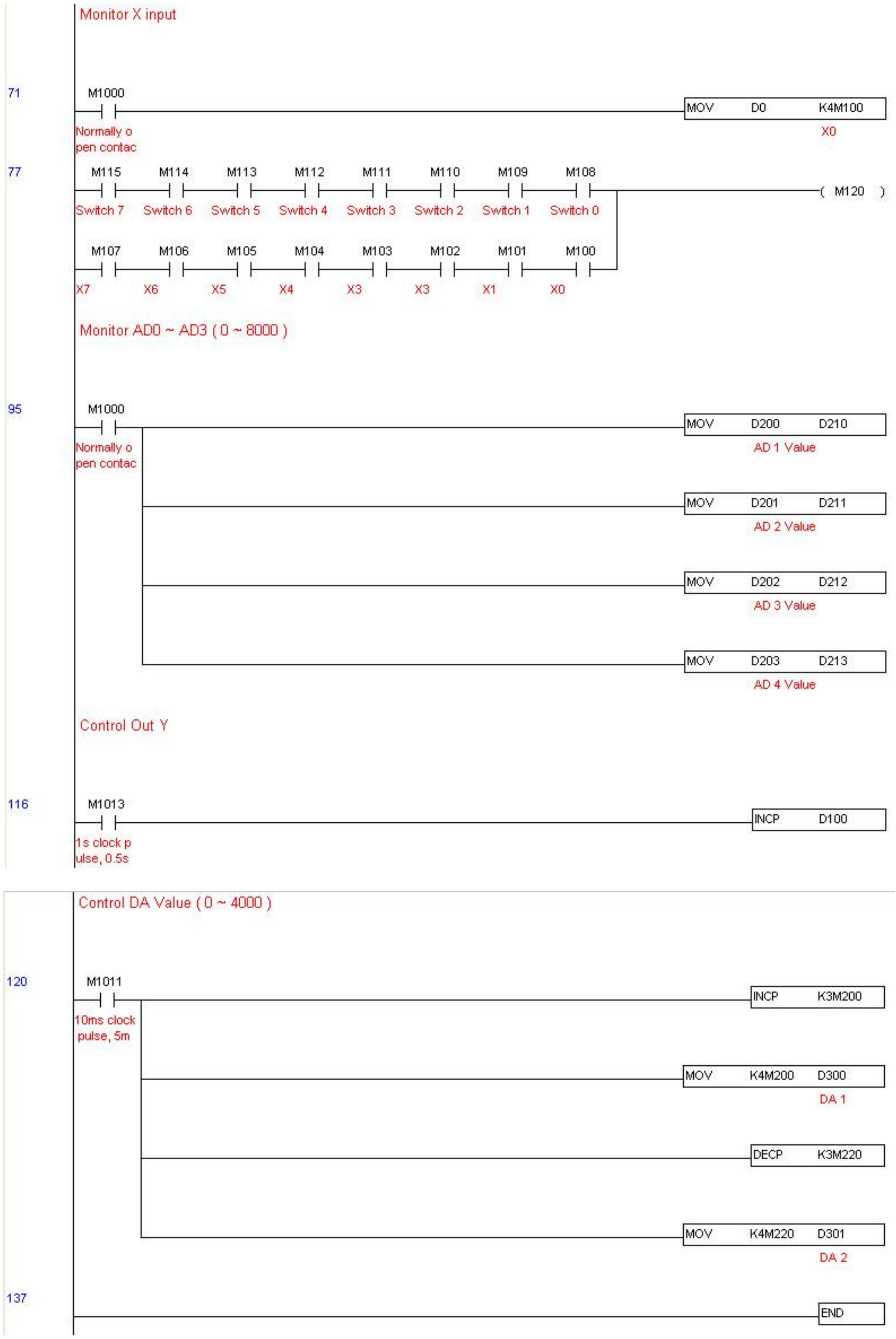
Step 3: Physical configuration



NOTE: Digital frequency signal common (Sink) can switch to SGND.

Step 4: Write to PLC program

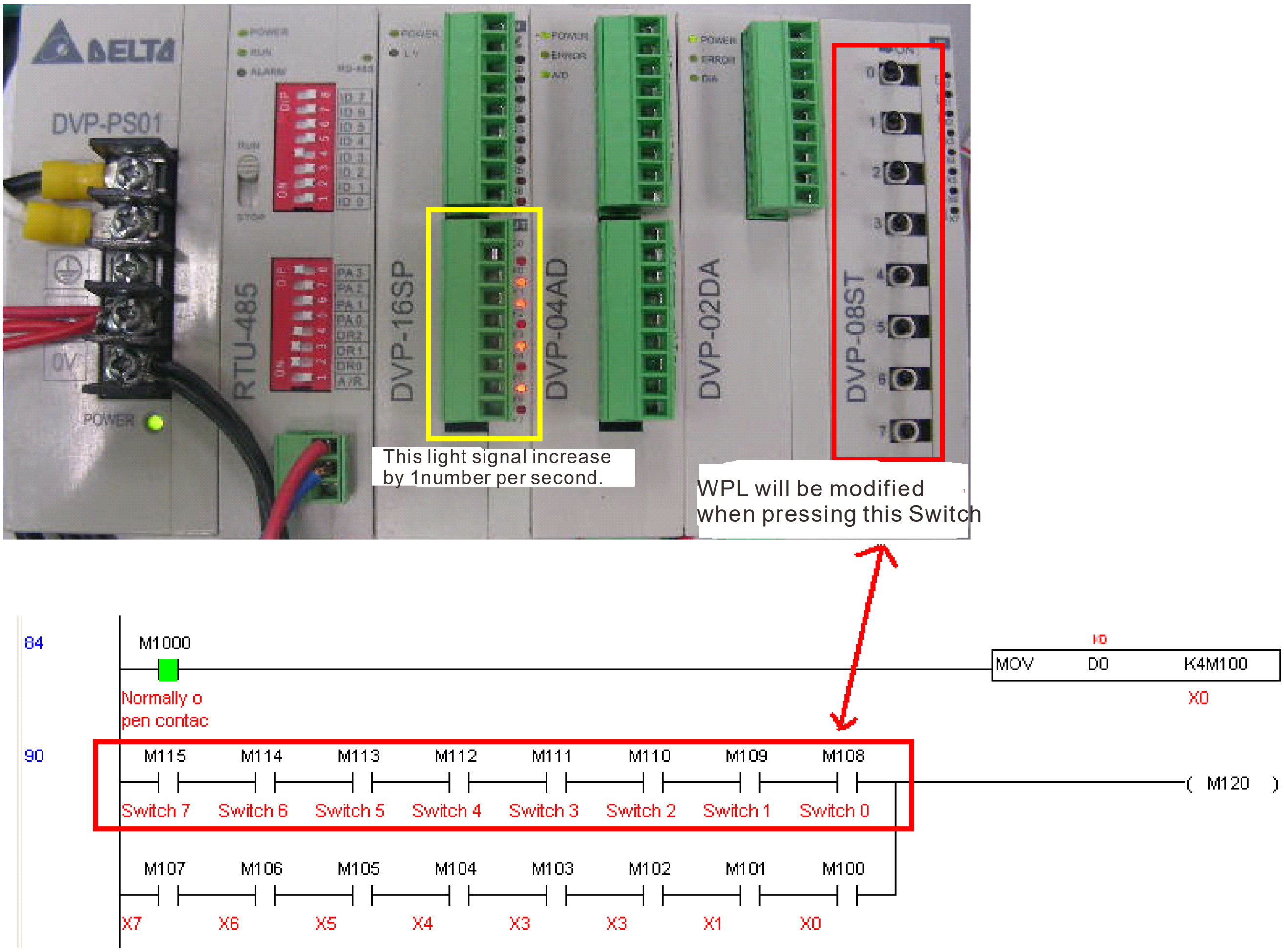




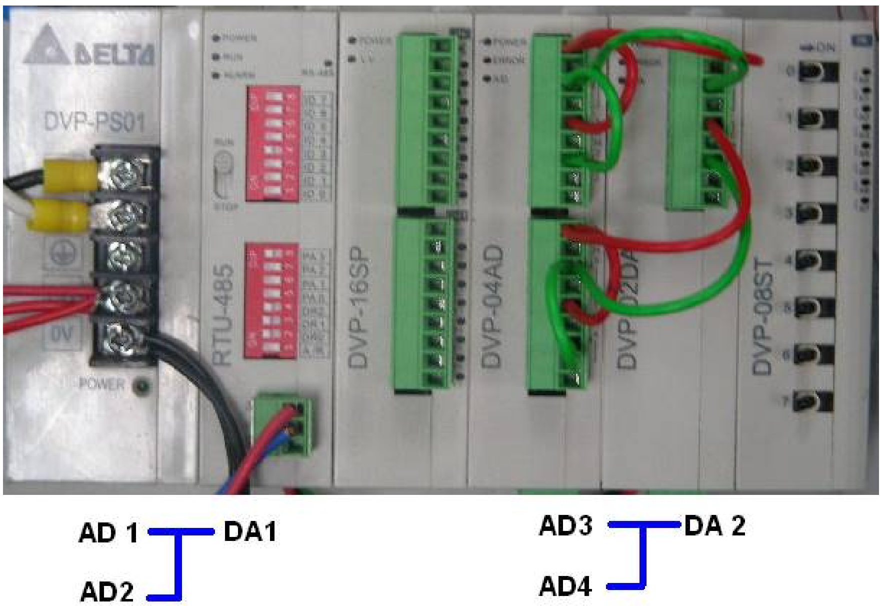
Monitor X input
71
M1000
Normally o
pen contac
MOV D0 K4M100
X0
77
M115 M114 M113 M112 M111 M110 M109 M108
Switch 7 Switch 6 Switch 5 Switch 4 Switch 3 Switch 2 Switch 1 Switch 0
M120
M107 M106 M105 M104 M103 M102 M101 M100
X7 X6 X5 X4 X3 X3 X1 X0
Monitor AD0 ~ AD3 (0 ~ 8000)
95
M1000
Normally o
pen contac
MOV D200 D210
AD 1 Value
MOV D201 D211
AD 2 Value
MOV D202 D212
AD 3 Value
MOV D203 D213
AD 4 Value
Control Out Y
116
M1013
1s clock p
ulse, 0.5s
INCP D100
Control DA Value (0 ~ 4000)
120
M1011
10ms clock
pulse, 5m
INCP K3M200
MOV K4M200 D300
DA 1
DECP K3M220
MOV K4M220 D301
DA 2
137
END

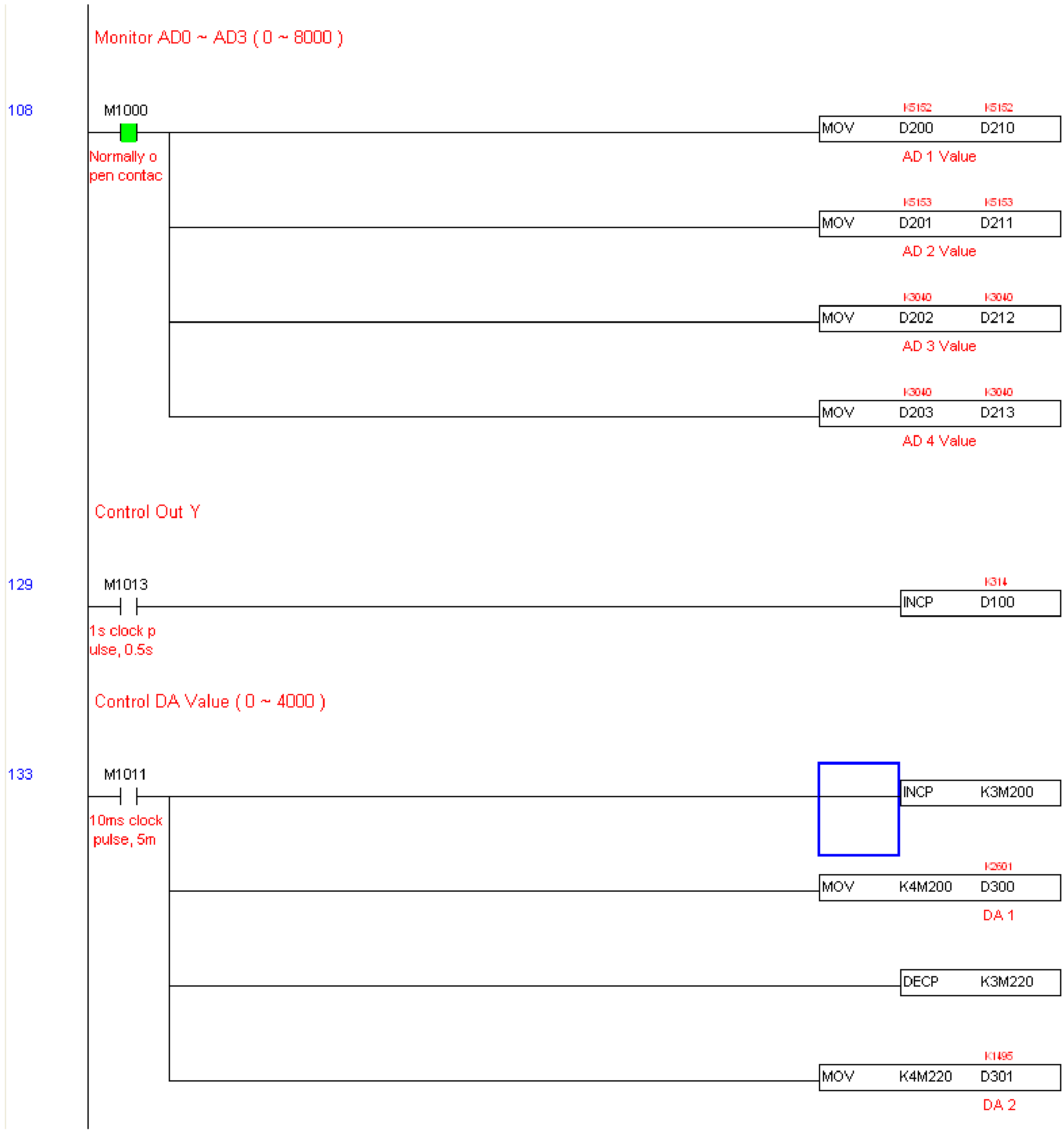
Step 5: Actual testing situation:

I/O testing: When the switch is activated, it can be discovered that the display corresponds to M115–M108. Furthermore, it can be seen that one output point light is added every 1 sec. (the display uses a binary format)



AD DA testing: It can be discovered that D200 and D201 are roughly twice the D300, and continue to increase progressively. For their part, the D202 and D203 are roughly twice the D301, and continue to decrease progressively.




Monitor AD0 ~ AD3 (0 ~ 8000)
108
M1000
Normally o
pen contac
K5152
K5152
MOV
D200
D210
AD 1 Value
K5153
K5153
MOV
D201
D211
AD 2 Value
K3040
K3040
MOV
D202
D212
AD 3 Value
K3040
K3040
MOV
D203
D213
AD 4 Value
Control Out Y
129
M1013
1s clock p
ulse, 0.5s
K314
INCP
D100
Control DA Value (0 ~ 4000)
133
M1011
10ms clock
pulse, 5m
INCP
K3M200
K2601
MOV
K4M200
D300
DA 1
DECP
K3M220
K1495
MOV
K4M220
D301
DA 2

Chapter 17 Safe Torque Off Function

17-1 Basic Function Description
17-2 Safe Torque Off Terminal Function Description
17-3 Wiring Diagram
17-4 Failure Rate of the Drive Safety Function
17-5 Reset the Parameter Settings
17-6 Timing Diagram Description
17-7 Fault Codes and Troubleshooting Instructions
17-8 Test and Fault Confirmation

17-1 Basic Function Description

The MH300 series provides a Safe Torque Off (STO) function. The MH300 series uses dual-channel S1 and S2 signal inputs to turn off IGBT switching, further preventing the generation of motor torque in order to achieve a safe stop. Refer to Figure 1 for the Safe Torque Off function circuit diagram.

The MH300 Safe Torque Off function meets the following international standards:

- ISO 13849-1: 2015 Category 3 PL d
- IEC 61508 SIL2
- EN 62061 SIL CL 2
- EN 60204-1 Category 0

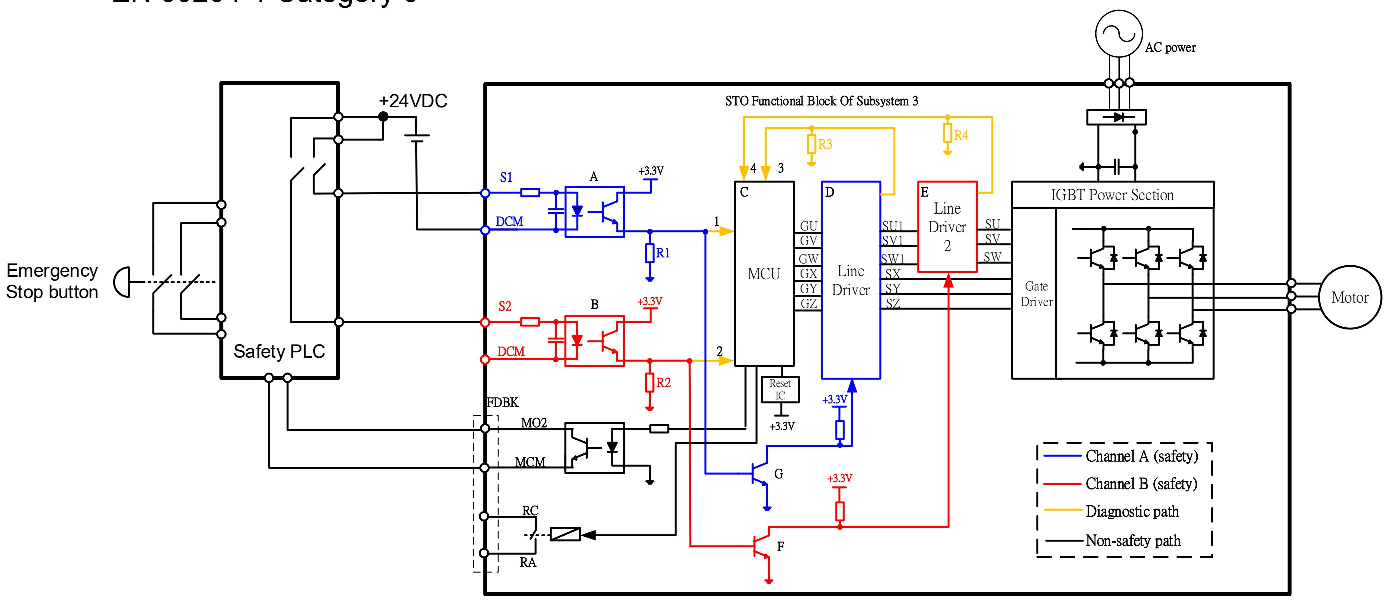


Fig.17-1 The circuit diagram for the Safe Torque Off function

17-2 Safe Torque Off Terminal Function Description

STO (Safe Torque Off) related terminal functions are shown as Table 17-1.

<table>
<tr><th>Terminals</th><th>Terminal Function</th><th>Description</th></tr>
<tr><td>+24 V</td><td>When the STO function is not used, you can disable the STO function by shorting S1 and S2 with +24 V.</td><td>Output voltage range: +24 V ±10%
Output voltage capacity: 100 mA</td></tr>
<tr><td>S1</td><td>Signal input for STO function channel 1</td><td rowspan="3"><u>S1–DCM / S2–DCM</u>
Rated input voltage: +24 V_{DC} ±10%; maximum input voltage: +30 V_{DC} ±10%
Rated input current: 6.67 mA ±10%
<u>STO activation mode</u>
Input voltage level: 0 V_{DC} < S1-DCM < 5 V_{DC} or 0 V_{DC} < S2-DCM < 5 V_{DC}
STO response time: ≤ 20 ms (time required for S1 / S2 to operate until the drive stops outputting)
<u>STO cut-off mode</u>
Input voltage level: 11 V_{DC} < S1-DCM < 30 V_{DC} and 11 V_{DC} < S2-DCM < 30 V_{DC}</td></tr>
<tr><td>S2</td><td>Signal input for STO function channel 2</td></tr>
<tr><td>DCM</td><td>Reference ground for S1 and S2 signal</td></tr>
</table>

Table 17-1 STO terminal function description

The action logic and keypad display after the S1 / S2 signal input are shown as Table 17-2.

Signal	Status			
S1–DCM	ON	ON	OFF	OFF
S2–DCM	ON	OFF	ON	OFF
Drive output	Ready to output	STL2 mode (torque output off)	STL1 mode (torque output off)	STO mode (torque output off)
Error displays on keypad	No error displays	STL2	STL1	STO

Table 17-2 Action logic and keypad display description

- STO means channel 1 and 2 operate simultaneously and enter Safe Torque Off.
- STL1 means channel 1 operates.
- STL2 means channel 2 operates.
- STL3 means there is an error detected in the internal loop of channel 1 or channel 2.
- S1–DCM / S2–DCM ON: means S1–DCM / S2–DCM inputs a power supply > 11 V_{DC}.
- S1–DCM / S2–DCM OFF: means S1–DCM / S2–DCM inputs a power supply < 5 V_{DC}.

17-3 Wiring Diagram

17-3-1. The internal circuit diagram of the safe control loop is shown as Fig.17-2.

17-3-2. The terminals of the safe control loop +24V-S1-S2 are short-circuited together with jumper wire at the factory, see the red circle marked in Fig. 17-2.

17-3-3. The safe control loop wiring diagram is as follows:

1. Remove the jumper wire from +24V-S1-S2.
2. The wiring is shown in Fig. 17-3 below. Normally, you must close the ESTOP contact switch, so the drive can output without displaying an error.
3. In STO mode, the switch ESTOP is turned on. The drive stops outputting and the keypad displays STO.

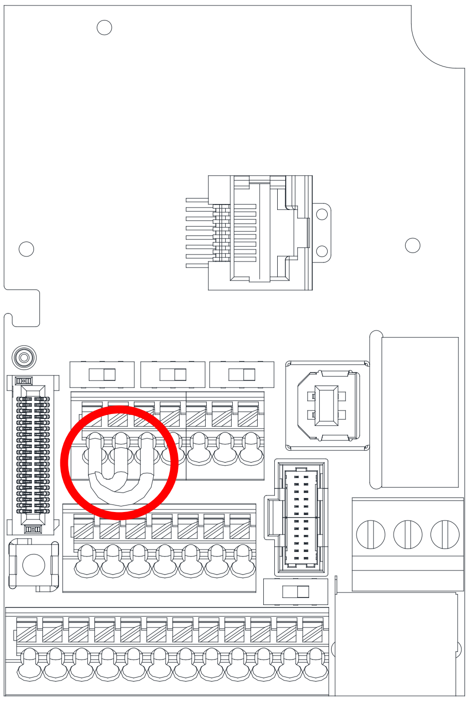


Fig.17-2

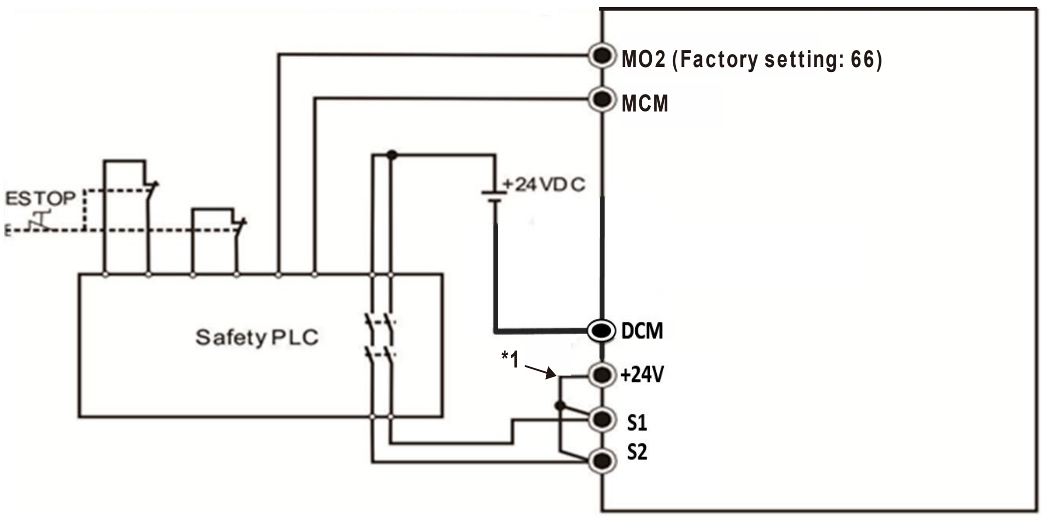


Fig.17-3

NOTE:

*1 is factory jumper wire shorting +24V-S1-S2. To use the Safety function, remove this jumper wire. To disable the Safety function, short-circuit +24V-S1-S2 with a jumper wire.

17-4 Failure Rate of the Drive Safety Function

The relevant safe loop parameters are shown as Table 17-3.

Item	Definition	Standard	Performance
SFF	Safe failure fraction	IEC61508	S1–DCM = 88.35% S2–DCM = 88.2%
HFT (Type A subsystem)	Hardware fault tolerance	IEC61508	1
SIL	Safety integrity level	IEC61508	SIL 2
		IEC62061	SILCL 2
PFH	Average frequency of dangerous failure [h-1]	IEC61508	1.36×10^{-9}
PFD_{av}	Probability of dangerous failure on demand	IEC61508	5.99×10^{-6}
PTI	Proof test interval	IEC61508	1 year
Category	Category	ISO13849-1	Category 3
PL	Performance level	ISO13849-1	d
$MTTF_d$	Mean time to dangerous failure	ISO13849-1	High
DC	Diagnostic coverage	ISO13849-1	Low

Table 17-3 Relevant safe loop parameters

17-5 Reset the Parameter Settings

Use Pr.06-44 to specify the reset method when an STO alarm occurs.

06-44 STO Latch Selection

Default: 0

Settings 0: STO Latch
1: STO no Latch

- Pr.06-44 = 0: STO Alarm Latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.
- Pr.06-44 = 1: STO Alarm no Latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.
- All of the STL1–STL3 errors are “Alarm Latch” mode (in STL1–STL3 mode, the Pr.06-44 function is not effective).

17-6 Timing Diagram Description

The following timing diagrams show the status of relevant signals under different conditions.

17-6-1 Normal operation status

As shown in Fig. 17-4, when S1–DCM and S2–DCM is ON (STO function is not required), the drive executes Operating or Output Stop according to RUN command.

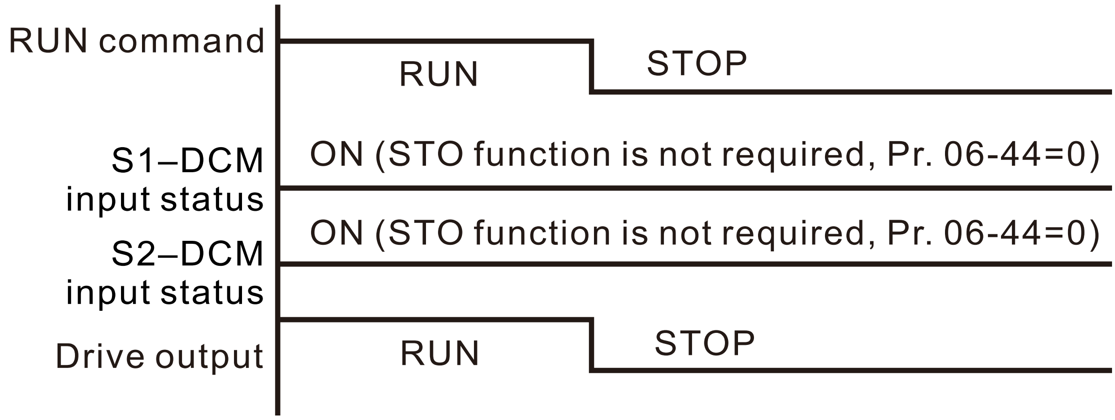


Fig.17-4

17-6-2 STO status, Pr.06-44 = 0

17-6-2-1 STO, Pr.06-44 = 0, Pr.02-35=0

(external control operation after reset / power on, 0 = not valid)

As shown in Fig. 17-5, when both S1–DCM and S2–DCM are OFF during operation (STO function is required), the drive stops outputting when it enters safe mode regardless of whether the RUN command is in ON or OFF status.

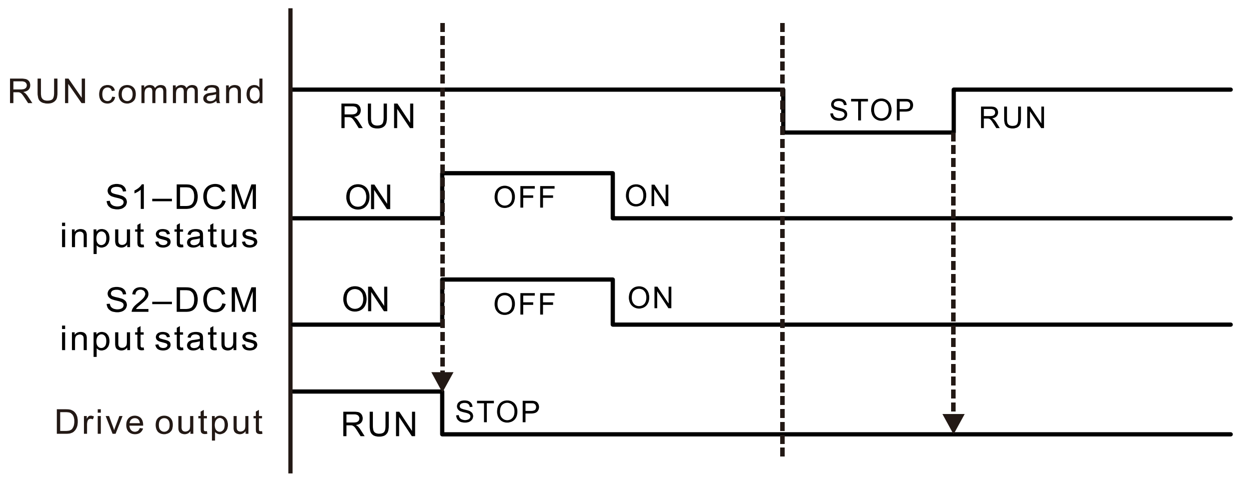


Fig.17-5

17-6-2-2 STO, Pr.06-44=0, Pr.02-35=1

(external control operation after reset / power on, 1= the drive executes RUN if the command remains after reset)

As shown in Fig. 17-6, the action is the same as in Figure 5; however, because Pr.02-35=1, if the RUN command remains after reset, the drive immediately executes the RUN command again.

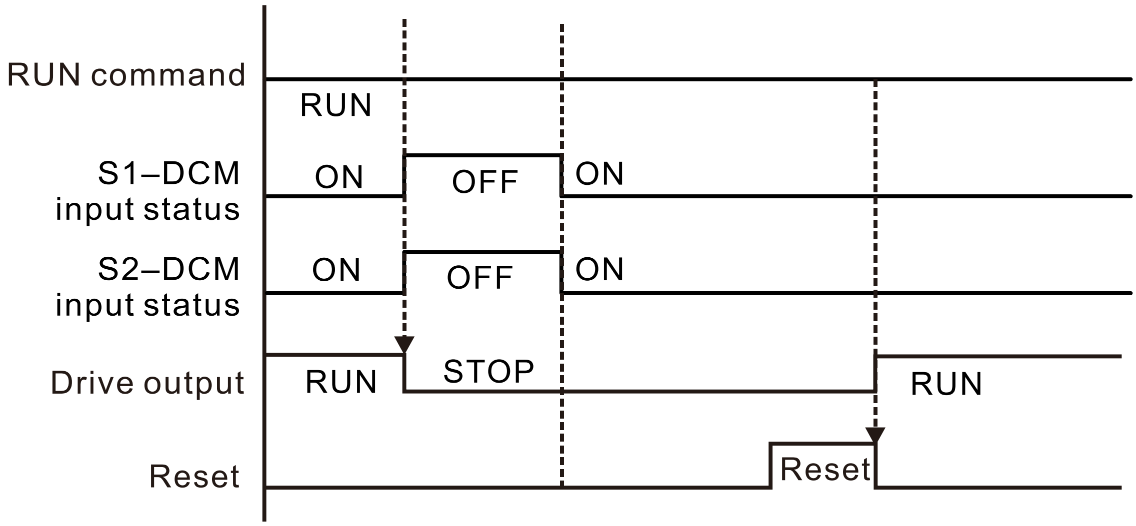


Fig.17-6

17-6-3 STO, Pr.06-44=1

As shown in Fig. 17-7, when both of S1–DCM and S2–DCM are OFF during operation (STO function is required), the drive stops outputting. When the S1 / S2 status is restored (ON), the STO alarm clears automatically. The drive outputs when the RUN command is executed again.

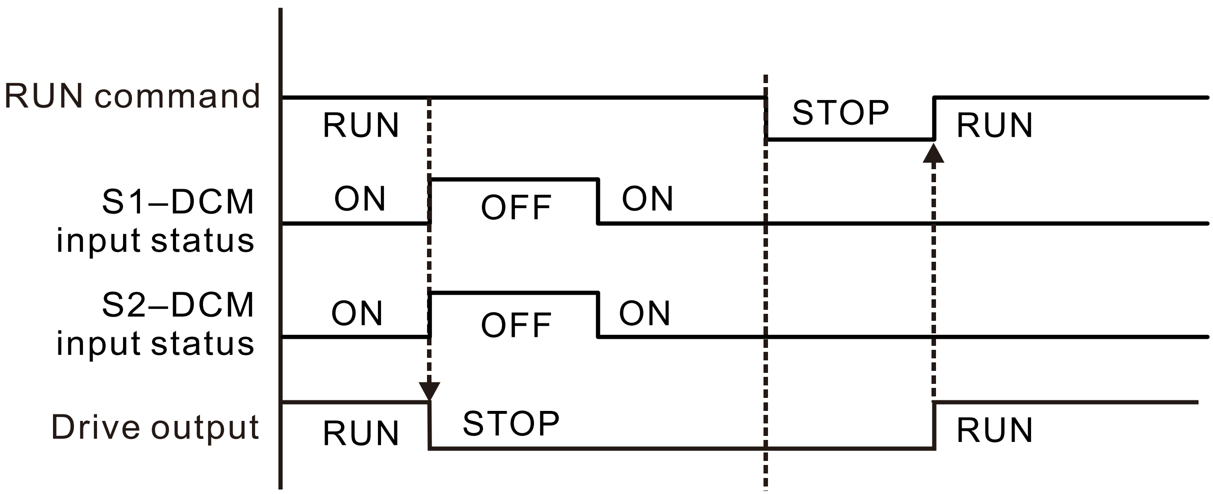


Fig.17-7

17-6-4 STL1, Pr.06-44=0 or 1

As shown in Fig. 17-8, when S1–DCM is OFF during operation (STO function is required) and S2–DCM is ON (STO function is not required), the drive stops outputting and the keypad shows the STL1 error. However, you cannot reset the STL1 error even if the S1 status is restored (ON) regardless of the parameter setting. You must cycle the power to reset and to restore the drive to the normal standby state.

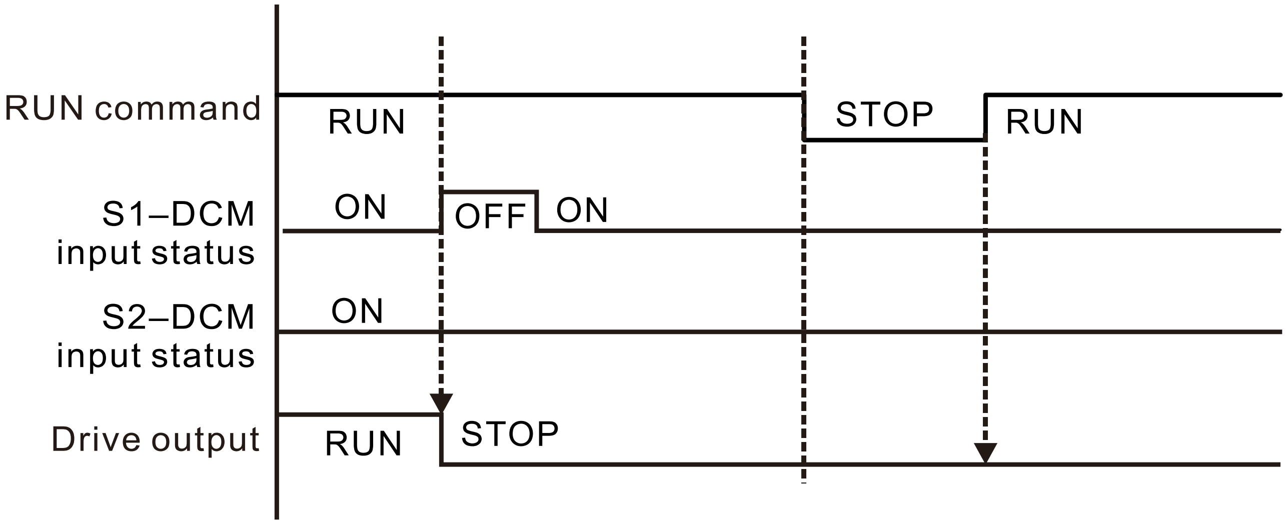


Fig.17-8

17-6-5 STL2, Pr.06-44=0 or 1

As shown in Fig. 17-9, when S1–DCM is ON during operation (STO function is not required) and S2–DCM is OFF (STO function is required), the drive stops outputting and the keypad shows the STL2 error. However, you cannot reset the STL2 error even if the S2 status is restored (ON) regardless of the parameter setting. You must cycle the power to reset and to restore the drive to the normal standby state.

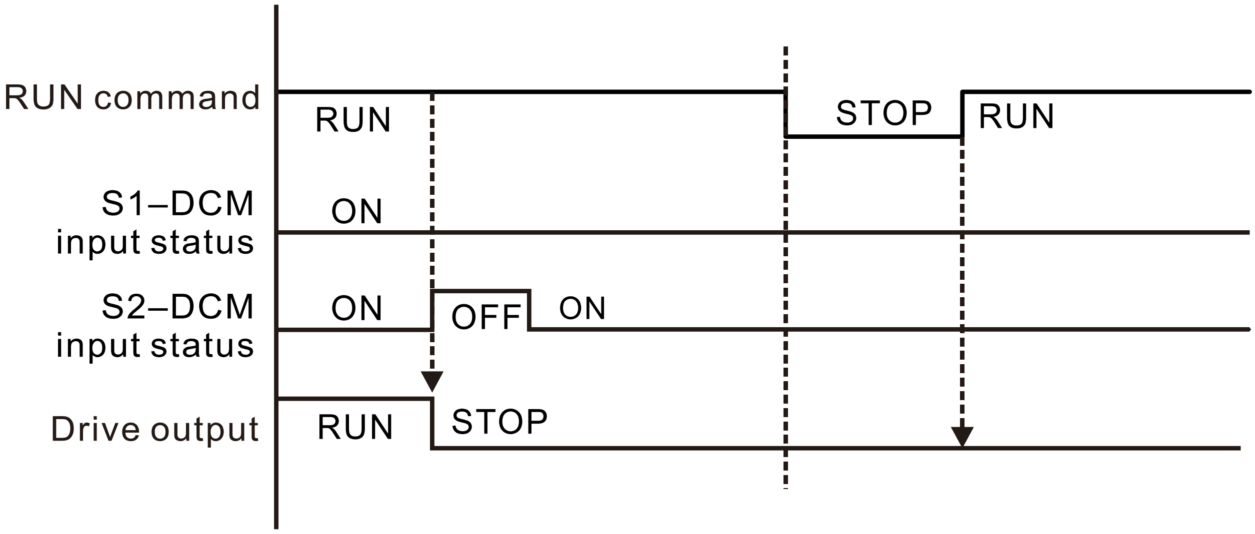


Fig.17-9

17-7 Fault Codes and Troubleshooting Instructions

17-7-1 Fault Code Description

Refer to Pr.06-17–Pr.06-22 for the fault record; the relevant STO error code is 72 / 76 / 77 / 78. The definition is as follows and in Table 4.

06-17	Fault Record 1
06-18	Fault Record 2
06-19	Fault Record 3
06-20	Fault Record 4
06-21	Fault Record 5
06-22	Fault Record 6

Display

72: Channel 1 (S1–DCM) safety loop error (STL1)
76: Safe Torque Off (STo)
77: Channel 2 (S2–DCM) safety loop error (STL2)
78: Internal loop error (STL3)

Fault code	Name	Description
76 (STo)	Safe Torque Off	Safe Torque Off function active
72 (STL1)	Channel 1 (S1–DCM) safety loop error	S1–DCM internal loop detection error
77 (STL2)	Channel 2 (S2–DCM) safety loop error	S2–DCM internal loop detection error
78 (STL3)	Internal loop error	S1–DCM and S2–DCM internal loop detection error

Table 17-4 Fault code description

17-7-2 Troubleshooting Instructions

Refer to the following instructions for troubleshooting when STO / STL1 / STL2 / STL3 appears on the keypad. Refer to Chapter 14 Fault Codes.

ID No.	KPMH-LC01 Display	Descriptions
72		S1–DCM internal loop detection error Possible cause and corrective actions ● The short-circuit wire of S1 and DCM does not connect. → Re-connect the short-circuit wire ● Hardware failure →After you make sure all the wiring is correct, if STL1 fault still exists after cycling the power, contact with Delta.
76		Safe Torque Off function active Possible cause and corrective actions ● The switch of S1 / DCM, S2 / DCM act (OPEN: open loop) → Reset the switch (ON: conducting) and cycle the power

ID No.	KPMH-LC01 Display	Descriptions
77	STL2	S2–DCM internal loop detection error Possible cause and corrective actions ● The short-circuit wire of S2 and DCM does not connect. → Re-connect the short-circuit wire ● Hardware failure →After you make sure all the wiring is correct, if STL2 fault still exists after cycling the power, contact with Delta.
78	STL3	S1–DCM & S2–DCM internal loop detection error Possible cause and corrective actions ● The short-circuit wire of S1 and DCM, or S2 and DCM does not connect. → Re-connect the short-circuit wire ● Hardware failure →After you make sure all the wiring is correct, if STL3 fault still exists after cycling the power, return to the factory for repair.

Table 17-5

17-8 Test and Fault Confirmation

After wiring the STO circuit in accordance with Section 17-3 Wiring Diagram, follow the steps below to verify that the STO and related detection functions are working normally.

1. When the drive is powered on, make sure that the S1–DCM and S2–DCM voltage falls between 11–30 V_{DC}. At this time, the drive should enter Standby mode and wait for RUN command. There is no error displayed on the keypad.
2. Press RUN on the keypad and use the emergency button or other method to make the S1–DCM and S2–DCM voltage fall between 0–5 V_{DC}. At the same time, after the output frequency is reached, the drive should enter Torque Stop mode STO and stop outputting voltage. The keypad displays the STO error, and the response time of the S1 and S2 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the S1–DCM and S2–DCM voltage to 11–30 V_{DC}, and press RESET on the keypad to clear the STO error. The drive should enter Standby mode and wait for RUN command.
3. Press RUN on the keypad and use the emergency button or other method to make the S1–DCM voltage fall between 0–5 V_{DC}, and the S2–DCM voltage remain between 11–30 V_{DC} after the output frequency is reached. At this time, the drive should enter Torque Stop mode STL1 and stop outputting voltage. The keypad displays the ST1 error, and the response time of S1 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the S1–DCM voltage to 11–30 V_{DC}. However, pressing RESET on the keypad cannot clear the STL1 error. You must cycle the power to the drive. Make sure that the S1–DCM and S2–DCM voltage falls between 11–30 V_{DC}, and then cycle the power to the drive, then the STL1 error is cleared. The drive should enter Standby mode and wait for RUN command.
4. Press RUN on the keypad and use the emergency button or other method to make the S2–DCM voltage fall between 0–5 V_{DC}, and the S1–DCM voltage remain between 11–30 V_{DC} after the output frequency is reached. At this time, the drive should enter Torque Stop mode STL2 and stop outputting voltage. The keypad displays the ST2 error, and the response time of S2 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the S2–DCM voltage to 11–30 V_{DC}. However, pressing RESET on the keypad cannot clear the STL2 error. You must cycle the power to the drive. Make sure that the S1–DCM and S2–DCM voltage falls between 11–30 V_{DC}, and then cycle the power to the drive, then the STL2 error is cleared. The drive should enter Standby mode and wait for RUN command.
5. If you can conduct these four steps normally in sequence with no other error, then the Safe Torque Off function loop is normal, as shown in Table 5 below. However, if a situation that differs from these four steps, or if STL3 occurs, then the Safe Torque Off function loop is not working normally. Please refer to Section 17-7 Error Code and Troubleshooting Instructions.

Signal	Status			
S1–DCM	ON	ON	OFF	OFF
S2–DCM	ON	OFF	ON	OFF
Drive output	Ready to output	STL2 mode (torque output off)	STL1 mode (torque output off)	STO mode (torque output off)
Error displays on keypad	No error displayed	STL2	STL1	STO
Response time	N/A	≤ 20 ms		
RESET mechanism	N/A	Cycle power to the drive	Cycle power to the drive	Press RESET directly

6.

- STO means channel 1 and 2 operate simultaneously and enter Safe Torque Off.
- STL1 means channel 1 operates.
- STL2 means channel 2 operates.
- STL3 means there is an error detected in the internal loop of channel 1 or channel 2.
- S1–DCM / S2–DCM ON: means S1–DCM / S2–DCM inputs a power supply > 11 V_{DC}.
- S1–DCM / S2–DCM OFF: means S1–DCM / S2–DCM inputs a power supply < 5 V_{DC}.

Appendix A. Modbus Protocol

A-1 Code Description

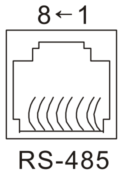
A-2 Data Format

A-3 Communication Protocol

A-4 Address List

A-5 Exception Response

- This appendix helps users to control by computers and monitor drive parameters and status through Modbus by using RS-485 serial communication interface
- When using the communication interface, the diagram on the right shows the communication port pin definitions. It is recommended that you connect the AC motor drive to your PC by using Delta IFD6530 or IFD6500 as a communication converter.



Modbus RS-485
PIN 1: CAN_H
PIN 2: CAN_L
PIN 3, 7: SGND
PIN 4: SG-
PIN 5: SG+
PIN 6: Reserved
PIN 8: +10VS

- The default communication formats for communication port:
  1. Modbus ASCII mode
  2. 9600 bps serial communication baud rates
  3. 7-bit data character
  4. No calibration
  5. 2 stop bit
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as ‘64’ in ASCII, consists of ‘6’ (36Hex) and ‘4’ (34Hex)

A-1 Code Description

The communication protocol is in hexadecimal, ASCII: “0”…“9”, “A”…“F”, every hexadecimal value represents an ASCII code. The following table shows some examples.

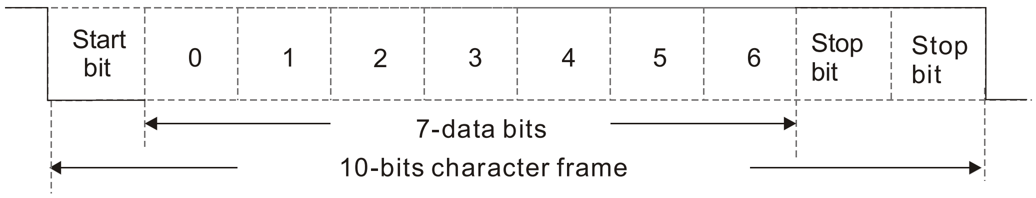
Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

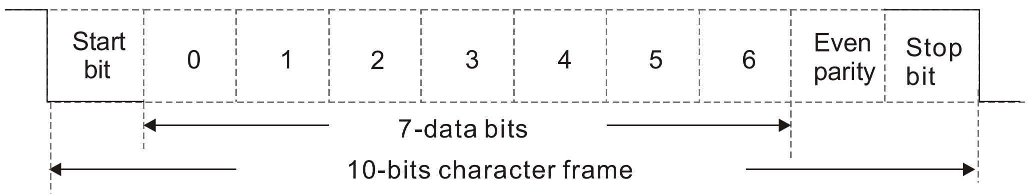
A-2 Data Format

10-bit character frame (For ASCII):

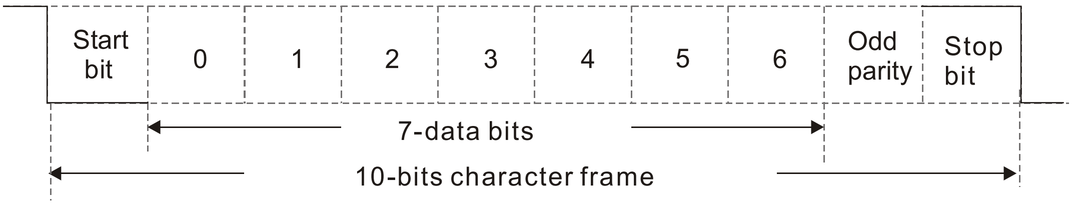
(7, N, 2)



(7, E, 1)

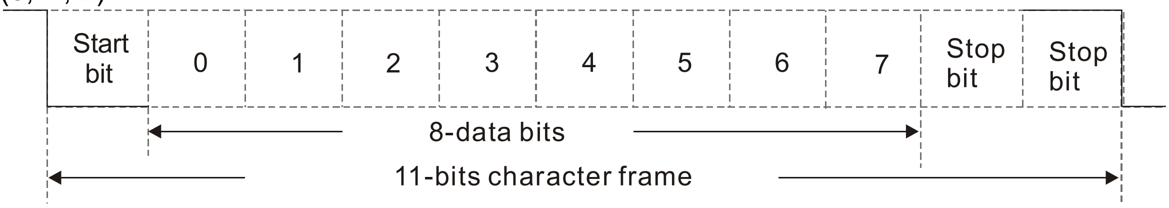


(7, O, 1)

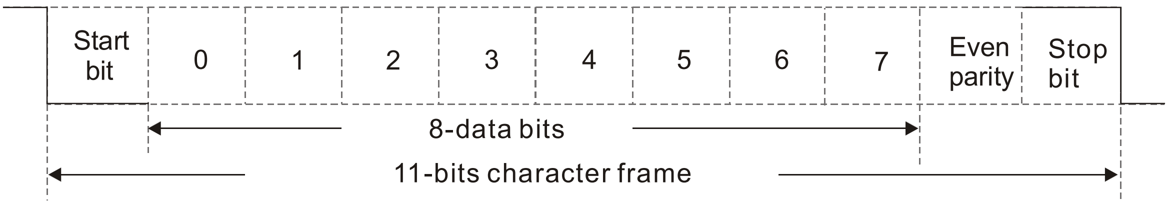


11-bit character frame (For RTU):

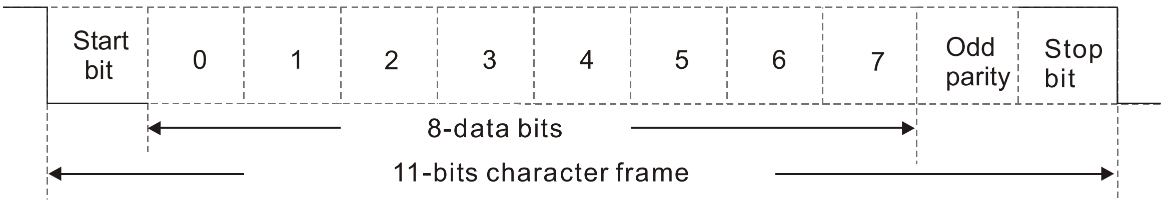
(8, N, 2)



(8, E, 1)



(8, O, 1)



A-3 Communication Protocol

1. Communication data frame

ASCII mode:

STX	Start character = ':' (3AH)
Address High	Communication address: one 8-bit address consists of 2 ASCII codes
Address Low	
Function High	Command code: one 8-bit command consists of 2 ASCII codes
Function Low	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
…….	
DATA 0	
LRC Check High	LRC checksum: one 8-bit checksum consists of 2 ASCII codes
LRC Check Low	
END High	End characters: END Hi = CR (0DH), END Lo = LF(0AH)
END Low	

RTU mode:

START	Defined by a silent interval of larger than / equal to 3.5 char
Address	Communication address: 8-bit binary address
Function	Command code: 8-bit binary command
DATA (n-1)	Contents of data: N × 8-bit data, n ≤ 16
…….	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit CRC checksum consists of 2 8-bit binary characters
CRC Check High	
END	Defined by a silent interval of larger than / equal to 3.5 char

2. Communication address (Address)

00H: broadcast to all AC motor drives

01H: AC motor drive of address 01

0FH: AC motor drive of address 15

10H: AC motor drive of address 16

:

FEH: AC motor drive of address 254

3. Function (function code) and data (data characters)

03H: read data from a register

Example: Reading two continuous data from register address 2102H, AMD address is 01H.

ASCII mode:

Command Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Starting register	‘2’
	‘1’
	‘0’
	‘2’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘D’
	‘7’
END	CR
	LF

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘3’
Number of register (count by byte)	‘0’
	‘4’
Content of starting register 2102H	‘1’
	‘7’
	‘7’
	‘0’
Content of register 2103H	‘0’
	‘0’
	‘0’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Command Message

Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by word)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message

Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

4. 06H: single write, write single data to a register.

Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Command Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

Response Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

5. 10H: write multiple registers (can write at most 20 sets of data simultaneously).
   Example: Set the multi-step speed of an AC motor drive (address is 01H),
   Pr.04-00 = 50.00 (1388H), Pr.04-01 = 40.00 (0FA0H.)

ASCII mode:

Command Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
Number of register (count by byte)	‘0’
	‘4’
The first data content	‘1’
	‘3’
	‘8’
	‘8’
The second data content	‘0’
	‘F’
	‘A’
	‘0’
LRC Check	‘9’
	‘A’
END	CR
	LF

Response Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘E’
	‘8’
END	CR
	LF

RTU mode:

Command Message

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
Quantity of data (byte)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	‘9’
CRC Check High	‘A’

Response Message

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

6. Checksum

ASCII mode (LRC Check):

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2’s-complement negation of the sum.

Example:

01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2’s-complement negation of 29H is D7H.

RTU mode (CRC Check):

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFh.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Examine the LSB of CRC register.

Step 4: If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

Step 5: Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.

Step 6: Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

7. The following is an example of CRC generation using C language.

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

unsigned int crc_chk(unsigned char* data, unsigned char length)

```
{
        int j;
        unsigned int reg_crc=0xffff;
        while(length--){
                reg_crc ^= *data++;
                for(j=0;j<8;j++){
                        if(reg_crc & 0x01){    /* LSB(b0)=1 */
                                reg_crc=(reg_crc>>1) ^ 0xa001;
                        }else{
                                reg_crc=reg_crc >>1;
                        }
                }
        }
        return reg_crc;                         // return register CRC
 }
```

A-4 Address List

1. ASCII
   (1) Reads one or more parameter values: 3Ah (start bit‘ : ’) + 30h 31h (station address 01) + 30h 33h (function code 03h) + 30h 30h xxh xxh–32h 36h xxh xxh (Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (reading length 1) + LRC (checksum) + CR/LF
   (2) Writes one parameter value: 3Ah (start bit‘ : ’) + 30h 31h (station address 01) + 30h 36h (function code 06h) + 30h 30h xxh xxh–32h 36h xxh xxh(Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (writing value) + LRC (checksum) + CR/LF
   (3) Writes 20 parameter values: 3Ah (start bit‘ : ’) + 30h 31h (station address 01) + 31h 30h (function code 10h) + 30h 30h xxh xxh–32h 36h xxh xxh (Modbus address 00xxh–26xxh) + 30h 30h 31h 34h (word data length) + 30h 30h 32h 38h(byte data length) + xxh xxh xxh xxh (the first writing value) + ... + xxh xxh xxh xxh (the 20th writing value) + LRC (checksum) + CR/LF
2. RTU
   (1) Reads one or more parameter values: 01h (station address 01) + 03h (function code 03h) + 00xxh–26xxh (Modbus address) + xxxxh (reading length) + CRC (checksum)
   (2) Writes one parameter value: 01h (station address 01) + 06h (function code 06h) + 00xxh–26xxh (Modbus address) + xxxxh (writing value) + CRC (checksum)
   (3) Writes 20 parameter values: 01h (station address 01) + 10h (function code 10h) + 00xxh–26xxh (Modbus address) + 0014h (data length, count by word) + 0028h (data length, count by byte) + xxxxh (the first writing value) + ... + xxxxh (the 20th writing value) + CRC (checksum)

3. AC motor drive parameters (GGnnH): communication station address is Pr.09-00 setting value

Modbus Address	Attribute (Function Code)	Description
GGnnH	R(03H) / W(06H, 10H)	GG means parameter group, nn means parameter number. For example, the Modbus address of Pr.04-10 is 040AH when reading by Delta VFDsoft.

4. Control command (20xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description		
Operation command	2000H	R (03H) / W (06H, 10H)	U16	bit1–0	00B: No function	1. Remains the status specified by a first command until a second command is received. 2. Valid only when operation command source is set to communication (Pr.00-03=2).
					01B: Stop	
					10B: Run	
					11B: JOG + Run	
				bit3–2	Reserved	
				bit5–4	00B: No function	
					01B: FWD	
					10B: REV	
					11B: Change direction	
				bit7–6	00B: 1st accel. / decel.	1. Valid only when 2000h bit12 is set to 1. 2. Obtain the current running speed by reading 2107h.
					01B: 2nd accel. / decel.	
					10B: 3rd accel. / decel.	
					11B: 4th accel. / decel.	
				bit11–8	0000B: zero step speed	
					0001B: 1st step speed	

Function Name	Modbus Address	Attribute (Function Code)	Size	Description		
			U16	bit11–8	0010B: 2nd step speed	
					0011B: 3rd step speed	
					0100B: 4th step speed	
					0101B: 5th step speed	
					0110B: 6th step speed	
					0111B: 7th step speed	
					1000B: 8th step speed	
					1001B: 9th step speed	
					1010B: 10th step speed	
					1011B: 11th step speed	
					1100B: 12th step speed	
					1101B: 13th step speed	
					1110B: 14th step speed	
					1111B: 15th step speed	
				bit12	1: Enable bit06–11 function	
				bit15	Reserved	
Frequency command	2001H	R (03H) / W (06H, 10H)		Frequency command (XXX.XX Hz). There are two decimal places for general-purpose drives.		
Fault / control command source	2002H	R (03H) / W (06H, 10H)		bit0	1: External Fault (E.F.) ON	To trigger an external fault to the drive to make it stop running. Drive's stop method can be set through drive parameters.
				bit1	1: Reset	To clear the fault status
				bit2	1: Base block (B.B) ON	To trigger an external base block to the drive to suspend the operation. When bit = 0 and clear BB situation, the drive returns to the previous operation.
				bit5	1: Fire mode ON	To prevent the drive from shutting down due to its own protection, and to maintain the important fan operation without controlling by any control signal or alarm.
				bit15–3	Reserved	

5. Status monitor read only (21xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description	
Fault status	2100H	R(03H)	U16	bit7–0: Fault code bit15–8: Warning code	
Drive operation status	2101H	R(03H)		bit1–0	Status of RUN / STOP 00B: Drive fully stops (RUN indicator is OFF / STOP indicator is ON) 01B: Drive is stopping (RUN indicator flashes / STOP indicator is ON) 10B: Drive is in standby status (RUN indicator is ON / STOP indicator flashes) 11B: Drive is running (RUN indicator is ON / STOP indicator is OFF)
				bit2	1: JOG command
				bit4–3	Operation direction 00B: FWD (REV indicator is OFF / FWD indicator is ON) 01B: from REV to FWD (REV indicator flashes / FWD indicator is ON) 10B: from FWD to REV (REV indicator is ON / FWD indicator flashes) 11B: REV (REV indicator is ON / FWD indicator is OFF)
				bit8	1: Master frequency controlled by communication interface
				bit9	1: Master frequency controlled by analog / external terminal signal
				bit10	1: Operation command controlled by communication interface
				bit11	1: Parameter locked
Frequency command	2102H	R(03H)		Drive’s frequency command (XXX.XX Hz) 1: Speed mode→Speed command 2: Torque mode→Speed limit	
Output frequency	2103H	R(03H)		Drive’s output frequency (XXX.XX Hz)	
Output current	2104H	R(03H)		Drive’s output current (XX.XX A). Decimal places can be referred by the high byte of 211F	
DC bus voltage	2105H	R(03H)		Drive’s DC bus voltage (XXX.X V)	
Output voltage	2106H	R(03H)		Drive’s output voltage (XXX.X V)	
Multi-step speed status	2107H	R(03H)		Drive’s current running speed step given by multi-step speed command (0 is main speed)	

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Counter value	2109H	R(03H)	U16	The present value of MI
Output power factor angle	210AH	R(03H)		Drive's output power factor angle (XXX.X°) (0.0–180.0°)
Output torque	210BH	R(03H)		Output torque (XXX.X %)
Motor actual speed	210CH	R(03H)		Actual motor speed (XXXXX rpm)
Number of PG feedback pulses	210DH	R(03H)		Number of PG feedback pulses (0~65535)
Number of pulse commands	210EH	R(03H)		Number of PG2 pulse commands (0~65535)
Power output	210FH	R(03H)		Drive's output power (X.XXX kW)
Multi-function display	2116H	R(03H)		Display the low word value (Pr.00-04) of user-defined items, the value is low 16 bits data.
Maximum user-defined value	211BH	R(03H)		Maximum Operation Frequency (Pr.01-00) or Maximum User-defined Value (Pr.00-26) ● When Pr.00-26 is 0, this value is equal to Pr.01-00 setting ● When Pr.00-26 is not 0, and the command source is keypad, this value = Pr.00-24 × Pr.00-26 / Pr.01-00 ● When Pr.00-26 is not 0, and the command source is 485, this value = Pr.09-10 × Pr.00-26 / Pr.01-00
Output current digit	211FH	R(03H)		High byte: Current digit (display)
Multi-point positioning	2157H	R(03H)		Display the position of multi-point positioning

6. Status monitor read only (22xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Output current	2200H	R(03H)	U16	Display output current (A). When current is higher than 655.35, it shifts the decimal as (XXX.X A). The decimal can refer to High byte of 211F.
Counter value	2201H	R(03H)		Display counter value (c)
Output frequency	2202H	R(03H)		Actual output frequency (XXXXX Hz)
DC bus voltage	2203H	R(03H)		DC bus voltage (XXX.X V)
Output voltage	2204H	R(03H)		Output voltage (XXX.X V)
Power factor angle	2205H	R(03H)		Power angle (XXX.X)
Power output	2206H	R(03H)		Display actual motor speed kW of U, V, W (XXXX.X kW)
Motor actual speed	2207H	R(03H)		Display motor speed in rpm estimated by the drive or encoder feedback (XXXXX rpm)
Output torque	2208H	R(03H)		Display positive/negative output torque in %, estimated by the drive (t0.0: positive torque, -0.0: negative torque) (XXX.X %)
Feedback position	2209H	R(03H)		Display PG feedback (see NOTE 1 in Pr.00-04)
PID feedback value	220AH	R(03H)		PID feedback value after enabling PID function (XXX.XX %)
AVI analog input	220BH	R(03H)		Display signal of AVI analog input terminal, 0–10 V corresponds to 0.00–100.00% (1.) (see NOTE 2 in Pr.00-04)
ACI analog input	220CH	R(03H)		Display signal of ACI analog input terminal, 4–20 mA / 0–10 V corresponds to 0.00–100.00% (2.) (see NOTE 2 in Pr.00-04)
AUI analog input	220DH	R(03H)		Display signal of AUI analog input terminal, -10 V–10 V corresponds to -100.00–100% (3.) (see NOTE 2 in Pr.00-04)
IGBT temperature	220EH	R(03H)		IGBT temperature of drive power module (XXX.XºC)
Drive capacitance temperature	220FH	R(03H)		The temperature of capacitance (XXX.XºC)
Digital input status	2210H	R(03H)		The status of digital input (ON/OFF), refer to Pr.02-12. (see NOTE 3 in Pr.00-04)
Digital output status	2211H	R(03H)		The status of digital output (ON/OFF), refer to Pr.02-18. (see NOTE 4 in Pr.00-04)
Multi-step speed	2212H	R(03H)		The multi-step speed that is executing (S)
The co-rresponding CPU pin status of digital input	2213H	R(03H)		The corresponding CPU pin status of digital input (d.) (see NOTE 3 in Pr.00-04)
The co-rresponding CPU pin status of digital output	2214H	R(03H)		The corresponding CPU pin status of digital output (O.) (see NOTE 4 in Pr.00-04)
Actual motor position	2215H	R(03H)		Number of actual motor revolution (PG1 of PG card) (P.) it starts from 9 when the actual operation direction is changed or the keypad displays at stop is 0. The maximum is 65535.
Pulse input frequency	2216H	R(03H)		Pulse input frequency (PG2 of PG card) (XXX.XX Hz)
Pulse input position	2217H	R(03H)		Pulse input position (PG card PG2), the maximum setting is 65535.

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Tracing error of pulse command in position control	2218H	R(03H)	U16	Position command tracing error
Overload counter	2219H	R(03H)		Display times of counter overload (XXX.XX %)
GFF	221AH	R(03H)		GFF (XXX.XX%)
DC bus voltage ripples	221BH	R(03H)		DCBUS voltage ripples (XXX.X V)
PLC register	221CH	R(03H)		PLC register D1043 data (C)
Magnetic pole zone	221DH	R(03H)		Number of poles of a permanent magnet motor
Display of user-defined output	221EH	R(03H)		User page displays the value in physical measure
Pr.00-05 gain value	221FH	R(03H)		Output Value of Pr.00-05 (XXX.XX Hz)
Number of motor runs	2220H	R(03H)		Number of motor runs when drive operates (saves when drive stops, and resets to zero when operating.)
Operating position of the motor	2221H	R(03H)		Operating position of the motor (saves when drive stops, and resets to zero when operating.)
Running speed of fan	2222H	R(03H)		Fan speed of the drive (XXX%)
Control mode	2223H	R(03H)		Control mode of the drive 0: speed mode 1: torque mode
Frequency of carrier wave	2224H	R(03H)		Carrier frequency of the drive (XX kHz)
Drive status	2226H	R(03H)		Drive status
				bit1~0: 00b: No direction 01b: Forward 10b: Reverse
				bit3~2: 01b: Drive ready 10b: Error
				bit4: 0b: Motor drive did not output 1b: Motor drive did output
				bit5: 0b: No alarm 1b: Alarm
Positive / negative torque	2227H	R(03H)		Drive's estimated output torque (positive or negative direction) (XXXX Nt-m)
Torque command	2228H	R(03H)		Torque command (XXX.X%)
kWh	2229H	R(03H)		kWh display (XXXX.X)
MI7 pulse input (L)	222AH	R(03H)		MI7 pulse input in Low Word
MI7 pulse input (H)	222BH	R(03H)		MI7 pulse input in High Word
Motor actual position (L)	222CH	R(03H)		Motor actual position in Low Word
Motor actual position (H)	222DH	R(03H)		Motor actual position in High Word
PID reference	222EH	R(03H)		PID reference (XXX.XX%)
PID offset	222FH	R(03H)		PID offset (XXX.XX%)
PID output frequency	2230H	R(03H)		PID output frequency (XXX.XX Hz)
Auxiliary frequency	2232H	R(03H)		Display the auxiliary frequency value
Master frequency	2233H	R(03H)		Display the master frequency value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Frequency value after addition and subtraction of master and auxiliary frequency	2234H	R(03H)	U16	Display the frequency value after addition and subtraction of master and auxiliary frequency

7. Remote IO (26xx) : communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Digital input terminal MI16–MI1 status	2600H	R(03H)	U16	Each bit corresponds to a different terminal input contact
Digital output terminal MI16–MI1 status	2640H	R(03H) / W(06H, 10H)		Each bit corresponds to a different terminal output contact
AVI proportional value	2660H	R(03H)		AVI proportional value
ACI proportional value	2661H	R(03H)		ACI proportional value
Percentage of analog input signal AI10	266AH	R(03H)		Extension card AI10, 0.0–100.0% (EMM-A22A)
Percentage of analog input signal AI11	266BH	R(03H)		Extension card AI11, 0.0–100.0% (EMM-A22A)
AFM1 output proportional value	26A0H	R(03H) / W(06H, 10H)		AFM1 output proportional value (%)
Percentage of analog output signal AI10	26AAH	R(03H) / W(06H, 10H)		Extension card AO10, 0.0–100.0% (EMM-A22A)
Percentage of analog output signal AI11	26ABH	R(03H) / W(06H, 10H)		Extension card AO11, 0.0–100.0% (EMM-A22A)

A-5 Exception Response

When the drive is using the communication connection, if an error occurs, the drive responds to the error code and sets the highest bit (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred.

If the keypad displays “CE-XX” as a warning message, “XX” is the error code at that time. Refer to the table of error codes for communication error for reference.

ASCII mode

STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘0’
	‘2’
LRC Check	‘7’
	‘7’
END	CR
	LF

RTU mode

Address	01H
Function	86H
Exception code	02H
CRC Check Low	C3H
CRC Check High	A1H

The explanation of exception codes:

Error code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

修改歷程 (不轉 PDF)

韌體版本：V2.01

手冊版本：V00

日期	頁碼	內容
2022/7/29	All	1. 從 CH12-Grp.09 的參數 09-04 擷取出來獨立成附錄 A 2. 以 C2000 Plus V3.07 檔案 “C2000 Plus_附錄 A. Modbus 通訊協定 _20220722_Snow_BK” 為基底，修改為 MS300 適用內容 (mail: RE: [MS300]問題確認_參數 09 群_Pohan_20220729)
	10	3. 2101H 新增 bit13: 點動狀態的指示位元 (Rational #272333)
2022/8/22	4	4. RTU 模式下的 START / END: 保持無輸入訊號大於等於 10 ms，改為 3.5 char (Rational #291083)
2022/11/9	10	5. 刪除原新增的 2101H bit13 (mail: RE: MS300_2101H_bit13_Pohan_20221109)

Appendix B. Revision History

New information	
Description	Related part
New parameters and functions according to firmware V2.00: ● Parameter group 00: 00-10 (setting 10), 01-43 (setting 16), 01-72–01-77 ● Parameter group 02: 02-01–02-07 + 02-26–02-28 (setting 78–80), 02-13 + 02-16 + 02-17 + 02-36–02-38 (setting 49) ● Parameter group 06: 06-02 setting 2–3 ● Parameter group 07: 07-63 ● Parameter group 08: 08-79–08-82 ● Parameter group 09: 09-31, 09-60 ● Parameter group 11: 11-40, 11-43–11-46, 11-50–11-54, 11-56–11-60, 11-62–11-64, 11-68–11-76, 11-78 ● Parameter group 13: 13-00 (setting 10)	Chapter 11, 12
Add 16-10 CANopen Master Control Applications and 16-11 Modbus Remote IO Control Applications (Use MODRW).	Chapter 16

Updated information	
Description	Related part
Update the specification of the heat shrink tube.	Chapter 5
Update the information of the control terminal specifications: +24V, S1 / S2, and DCM.	Chapter 6
Update the information of optional accessories of magnetic contactor, air circuit breaker and AC / DC reactors.	Chapter 7
Update the overload capability information of general specifications. Add the link of the information on Certifications and Declaration of Conformity (DoC).	Chapter 9
Update the keypad operation process-shifting datas.	Chapter 10
Update parameter settings and descriptions: ● Parameter group 00: 00-01, 00-02, 00-04, 00-07, 00-16, 00-20, 00-21, 00-25, 00-27, 00-30, 00-31, 00-35, 00-36, 00-47 ● Parameter group 02: 02-01–02-07 + 02-26–02-28, 02-13 + 02-16 + 02-17 + 02-36–02-38, 02-54 ● Parameter group 03: 03-19, 03-20 ● Parameter group 05: 05-26–05-30, 05-43 ● Parameter group 06: 06-01, 06-02, 06-08, 06-11 ● Parameter group 07: 07-13, 07-19, 07-23 ● Parameter group 08: 08-01, 08-15, 08-23, 08-31 ● Parameter group 09: 09-04 (Upadat Modbus Protocol information and move to Appendix A), 09-30 ● Parameter group 11: 11-26, 11-29–11-32 ● Parameter group 12: 12-15, 12-16	Chapter 11, 12

Updated information	
Description	Related part
● Parameter group 14: 14-24, 14-26, 14-28, 14-30, 14-32, 14-34, 14-36, 14-37	
Update the information of 15-2 Wiring for CANopen, 15-3 CANopen Communication Interface Descreptions and 15-4 CANopen Supporting Index.	Chapter 15
Update the operating system of the WPLSoft editing software.	Chapter 16