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Delta ACS3-SF Safety Functions Module User Manual

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Preface

Thank you for purchasing the ACS3-SF safety functions module used for the ASDA-A3-EP AC servo drives. This document provides information regarding product specifications, installing and wiring methods, operation, safety functions, parameters, and troubleshooting for the ACS3-SF safety functions module.
This product is an optional module exclusively for the ASDA-A3-EP AC servo drives. This product is not intended to be used in combination with any other products.

About this document

This document contains information necessary for the safe and proper use of the ACS3-SF safety functions module. Read this document carefully before use and keep it for future reference.

Notice

- No part of this document shall be copied, reproduced, or reprinted in any form or by any means without prior permission.
- The contents of this document are subject to change without notice, which is to improve the quality, function, reliability, or otherwise. The latest version is available for download from Delta's website.
- We have taken all possible measures to ensure the contents of this document are accurate. However, if you have any questions or find any errors, please contact our branch or sales representatives.

Related documentation

This product is used with the ASDA-A3-EP AC servo drives. To set the parameters, you can use the Parameter Setting Tool (Delta Drive Safety).
This document does not provide details on the servo drives, servo motors, or the use of the Parameter Setting Tool. Refer to the following documents for details.

Name	Document No.
Delta ASDA-A3-EP Series AC Servo Drive User Manual	DELTA_IA-ASD_ASDA-A3-EP_UM_##_XXXXXXXX
Delta Drive Safety Software User Manual	DELTA_IA-ASD_Delta Drive Safety_UM_##_XXXXXXXX

- "##" is a symbol indicating the language used for documentation. (EN: English; TC: Traditional Chinese, JP: Japanese, etc.)
- "XXXXXXXX" is the release date of the document.

Update information

Customers who have registered as users on our website (Delta IA Academy: iabg-academy.deltaww.com) will automatically receive product updates. If you are not registered, check the preceding website for updates.
For safe and proper use of the ACS3-SF safety functions module, read this manual and the "Safety Precautions" carefully and make yourself fully acquainted with the safety devices before use.

Warning labels

DANGER	Mishandling of the product may lead to an extremely hazardous situation, resulting in death or serious injury.
WARNING	Mishandling of the product may lead to a hazardous situation, resulting in death or serious injury.
CAUTION	Mishandling of the product may lead to a hazardous situation, resulting in moderate or minor injury and/or property damage.

The items listed in the “CAUTION” section must also be observed, as they may have serious consequences depending on the situation.

DO and DO NOT icons

	Indicates a prohibited action (What you must NOT DO).
	Indicates a required action (What you must DO).

Safety precautions

■ General precautions

⚠DANGER
■ Do not remove any covers, cables, connectors, or optional equipment while the power is on. Otherwise, it may result in electric shock, crashing, or burnout. ■ Do not attempt to disassemble, repair, or modify the product. Otherwise, it may cause fire or malfunction. Products that have been disassembled, repaired, or modified will not be covered by the product warranty. ■ Use a power supply with double or reinforced insulation for the servo drive's power interface (24 V_{DC} power supply) and for the electromagnetic brake. Failure to do so may result in electric shock.

⚠CAUTION
■ When an alarm occurs, eliminate the cause of the alarm to ensure safety, then reset the alarm or cycle power to resume operation. Failure to do so may result in personal injury or damage.

Prohibition
■ Do not use the product in a location exposed to water, corrosive and inflammable gases, or near inflammable materials. Otherwise, it may result in an electric shock or fire. ■ Do not handle the product with wet hands or it may result in product malfunction. ■ Do not use the product if it is damaged or if any of its parts is missing. Unexpected operation or burnout may occur.

■ Transportation and storage

Prohibition
■ Do not store the product in areas exposed to rain or dripping water, harmful gases or liquids, metal fragments or dust, or where there is a risk of exposure to radioactivity. Otherwise, it may result in product malfunction. ■ Store out of direct sunlight between -20°C (-4°F) and +65°C (+149°F) within the specified humidity range of 0 to 90% RH. Do not store the product in a location where condensation may form due to sudden temperature changes. Product malfunction may occur. ■ Do not hold the front cover or connector part of the servo drive during transportation. Doing so may result in breakage or damage. ■ This product is precision equipment. Do not drop the product or subject it to severe physical impact. Otherwise, it may result in malfunction or damage. ■ Do not apply impact to the connector parts or it may result in poor connection or malfunction.

■ Installing and wiring

⚠DANGER
■ Do not modify the wiring while the power is on. Before making any wiring changes, always make sure the power is off. Failure to do so may result in electric shock or personal injury.

⚠ WARNING
■ The wiring should be carried out by a qualified electrician. Failure to do so may result in electric shock or product malfunctions. ■ The wiring and power supply should be checked in accordance with the instruction sheet, the wiring diagram, or other technical data. Wiring errors, applying different voltages, etc. may result in short circuit failures. In the event of such a malfunction, damage to the machine may result in personal injury.

⚠ CAUTION
■ Make sure the product is installed in the specified orientation. Failure to do so may result in malfunction. ■ Do not allow any foreign objects to get into the connectors that are connected to the servo drive. Failure to do so may result in malfunction. ■ Wiring and testing must be performed in accordance with the precautions and procedures described in this manual. Incorrect wiring of the electromagnetic brake or applying incorrect voltages may cause the servo drive or the servo motor to malfunction, resulting in machine damage or personal injury. ■ Use shielded twisted-pair cables for safety input/output signal lines.

■ Operation

⚠ WARNING
■ Before starting operation, set the parameters according to the machine specifications. Failure to do so may result in unexpected operation or malfunction of the machine, or personal injury.

■ Maintenance and inspection

⚠ WARNING
■ For safety reasons, do not inspect the wiring or other components while the power is on. Otherwise, it may result in electric shock. ■ The entire servo drive set, including this product, may become heated during operation. Maintenance and inspection should be performed after sufficient time has elapsed since the operation has stopped. Failure to do so may result in burns.

Prohibition
■ Do not attempt to disassemble or repair the product yourself. Otherwise, it may result in fire or electric shock. ■ Do not perform tests on insulation resistance or dielectric strength. Otherwise, it may damage the product. ■ Do not plug or unplug connectors while the power is on (hot swapping). Otherwise, it may result in malfunction. ■ Do not remove or disassemble the nameplate.

■ Disposal

⚠ CAUTION
■ Dispose of this product in accordance with the applicable laws and regulations relating to waste, etc., in your country of residence. In addition, be sure to provide notification and labeling on the final product, if required.

Safety device handling

Safety device handling

(1) The system with safety functions should be installed, tested, and adjusted by a qualified technical engineer trained in safety standards and in accordance with the information in this manual.
(2) When shipping a mechanical device equipped with this product, the parameters at the time of shipment must be recorded and retained. Perform pre-shipment inspections using check sheets or other means.
(3) Use a safety extra-low voltage (SELV) power supply to power the safety input/output circuits and the power output circuit of the electromagnetic brake.
(4) Keep the safety wiring separate from other signal wirings. In addition, the wiring should be adequately protected.
(5) Ensure proper clearance / creepage distances in accordance with voltage rating.
(6) Safety inputs should be duplicated and wired to both A and B channels.
(7) The safety origin position may have a detection error due to the system configuration (gear ratio, ball screw lead, etc.), repetition accuracy of the safety origin sensor, detection delay time of this product, etc. When setting the SLP monitoring level, set it based on the position where the "safety position monitor" is 0. Whenever the safety origin position is reset, be sure to check the validity of the SLP monitoring level.
(8) Once this product is installed, the built-in Safe Torque Off (STO) function of the servo drive is unavailable. To use the STO function, execute it from the safety functions module.
(9) When using the Safety-limited Position (SLP) function, diagnosis must be performed to verify that the Safety Origin Detection Device mounting position has not shifted at startup.
(10) For peripheral devices, including switches, relays, and sensors, used to monitor safety, it is recommended that you use devices that comply with the safety standards. Safety certification should be implemented when you use equipment that does not meet the safety standards.

Risk assessments

To ensure the safety of your equipment and facilities, perform a risk assessment of entire machinery and equipment to determine all risks including residual risks. Customers are responsible for the installation and delegation of the safety system.

Residual risks

The servo system (including the servo drives and servo motors used with this product) has the following residual risks even when the safety functions of this product are activated. Conduct a risk assessment to make sure you are safe from these risks.

(1) Power is supplied to the servo amplifier even when the Safe Torque Off (STO) function is activated. Disconnect the power supply to the servo amplifier if there is a risk of electric shock during maintenance or inspection of the servo amplifier.

(2) The servo motor continues to rotate for a while due to inertia even when the Safe Torque Off (STO) function is activated. The design of the safety system should assure that no hazards can occur before the servo motor comes to a complete stop.

(3) The time until monitoring of position and speed is started by the safety monitoring function can be changed by setting the parameters. Set the parameters within the range that ensures system safety.

(4) Position and speed are monitored in a cycle of 1 ms. Errors within 1 ms will not be detected.

(5) The Safe Brake Control (SBC) function does not guarantee braking performance (e.g., reduced holding power due to wear). The performance of electromagnetic brakes must be diagnosed periodically.

(6) The safety monitoring level is set in units of encoder resolution. As a result, there are errors with respect to the actual safety range of the mechanical device. The level of safety monitoring should be set to a level within an acceptable margin of these errors.

(7) The safety origin position has an error of ± 0.1 degree relative to the mechanical angle of the motor. The safety monitoring should be set to a level within an acceptable margin of the errors.

(8) The servo motor may move within a very small range on the condition that the safety monitoring function is being activated and the servo motor is stopped. This is due to the fault diagnosis function of the encoder.

(9) An off-pulse of shorter than 1 ms is periodically output from the safety output pin. The mechanical equipment should be designed in such a way that it does not react to this impulse.

(10) This product cannot detect a wiring fault on CN11. Please detect it on the customer's machine equipment side or apply the fault exclusion in ISO 13849-2.

Compliance with laws and regulations

For your equipment / facility to comply with the European Machinery Directive, the entire system must meet the safety standards. We recommend using a third-party organization to obtain safety certification.
When using the product, make sure to comply with the relevant laws and standards of your country of residence.

Warranty

We provide warranties and assume liabilities as follows for our products. Contact our sales representatives if you have any questions or inquiries.

Warranty period

The warranty period shall be one year from the date when you purchase the product.

Scope of warranty

In the event of any failure or malfunction of the product due to a reason attributable to Delta during the warranty period, we shall provide a replacement product or repair such failed or malfunctioned product free of charge.

If the failure or malfunction meets any of the following cases, the warranty shall not apply even during the warranty period.

- In the case that the product is used or handled under inappropriate conditions, environments, handling methods, use cases that are out of those specified in the catalogs, manuals, or specification sheets provided by Delta.
- In the case that the product is modified or repaired by anyone other than Delta.
- In the case that the product is used for a purpose not originally intended.
- In the case that such failure or malfunction is caused by a reason that cannot be expected in the scientific and/or technical knowledge we had at the time of shipment.
- In the case that such failure or malfunction is caused by a reason beyond our control such as natural disasters and accidents.

Product application / Conditions of use

- Customers have the responsibility for checking and confirming what standards are to be met and what laws and regulations are to be complied with for the equipment.
- The product is designed for use in general industrial equipment, and not designed or manufactured for equipment or systems that are used in a situation where human lives could be at stake.
- This product is not designed for use in nuclear power control or aerospace equipment, transportation equipment such as railway vehicles, or medical equipment. Contact our sales representatives if you wish to use the product for such an application.
- It is not allowed to use the product for systems that affect people’s life or infrastructure facilities requiring 24/7 operations such as those supplying gas, water, or electricity.
- While we have made every effort to ensure the quality of the product, you may experience the unexpected operation of the product due to factors such as external noise beyond the expected range, lightning surges, application of static electricity, unstable input power supply and voltage, incorrect wiring, or troubles on parts and components. Your equipment should have a fail-safe design, redundancy, and appropriate operating range settings for safe operation.

Limitation of liabilities

- In the case that you apply the product to equipment that may cause a serious accident or loss if the product is malfunctioned or failed, you should prepare preventive measures such as the installation of safety devices and/or maintaining backup in advance to prevent such loss. We are not liable for any damages, loss of opportunities, or loss of profits you suffer from the failure of this product.
- We are not liable for any accidents or losses resulting from the parameter settings of the product. The same shall apply even if we set or assist in setting the parameters. You are required to understand the parameters and fully verify the operation of the system before the product is online.
- The information contained in the catalogs and manuals is for assisting you in purchasing an appropriate product for your specific purpose of use. Therefore, no warranty shall be made on non-infringement or grant of license to you of any intellectual property or other rights held by third parties. We shall not be liable for any infringement of such rights.

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Product Specifications 1

This chapter describes the product specifications.

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1.1 Product overview

The ACS3-SF safety functions module can be introduced to the AC servo drive ASDA-A3-EP model to enable the following safety functions.

- Safety functions
  - Safe Torque Off (STO)
  - Safe Stop 1 (SS1) (time controlled / ramp monitored)
  - Safe Stop 2 (SS2) (time controlled / ramp monitored)
  - Safe Operating Stop (SOS)
  - Safely-limited Speed (SLS)
  - Safe Maximum Speed (SMS)
  - Safe Speed Monitor (SSM)
  - Safely-limited Increment (SLI)
  - Safe Direction (SDI)
  - Safely-limited Position (SLP)
  - Safe Brake Control (SBC)

  Safe Brake Test (SBT) can also be introduced as an auxiliary function.

- Once the safety functions module is installed, the STO function cannot be carried out from the safety inputs (SF1, SF2: CN10) built into the drive.
- For more information about the safety functions, refer to Chapter 4.

1.2 Product check

After unpacking, check the following items.

(1) The package must include:
  - Main body of the safety functions module
  - Safety input / output connector
  - Electromagnetic brake power connector
  - Fixing screws (M3 × 5 mm, 5 pcs)

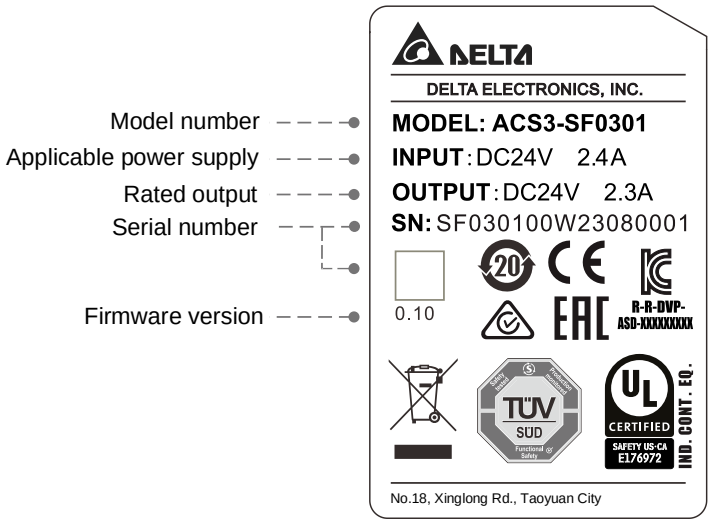
(2) The product is free from defects and damages.

(3) The product model is correct and proper.

If you have any questions or find any problems with the system, contact the distributor, sales representatives from whom you purchased the product, or our regional sales office.

1.3 Product model number

Nameplate



■ Serial number

SF030100	W	23	08	0001		
(1)	(2)	(3)	(4)	(5)	(1)	Model number
					(2)	Manufacturing plant (W: Wujiang plant)
					(3)	Year of production (23: year 2023)
					(4)	Week of production (from 1 to 52)
					(5)	Production sequence in a week (starting from 0001)

For products that have received certification, the corresponding certification mark will be printed on the nameplate. As for products without the mark, they have not yet met the relevant specifications.

Download the safety certificate from Delta website's Download Center or contact Delta.

Servo drives, servo motors, and their accessories are not subject to the China Compulsory Certificate (CCC).

1

Model number

ACS3	-	SF	-	03	-	01
(1)		(2)		(3)		(4)

(1) Product name

ACS3: accessories for ASDA-A3 series AC servo drives

(2) Product type

SF: safety functions module

(3) External interface

Code	Interface type
03	Standard type (for both I/O type and communication type)

(4) Classification

Code	Classification
01	General-purpose type

1.4 Product specifications

1.4.1 General specifications

Item		Specifications
Compatible servo drive model *1		ASD-A3-XXXX-EP Firmware version 1.01 or later
Compatible servo motor model *2		ECM-B3 series
Power supply for safety input *3		DC24V (internal impedance 6.2 kOhm)
Power supply for safety output / electromagnetic brake output *3		DC24V (max. current 2.4 A)
Electromagnetic brake power output		Min. DC22.75V (max. output current 2 A)
Environment *4	Installation site	Indoors (no direct sunlight), no corrosive or flammable gases, oil mist, and dust
	Altitude	Less than 2000 m above sea level
	Atmospheric pressure	86 kPa – 106 kPa
	Ambient temperature	0°C to 55°C (32°F to 131°F)
	Storage temperature	-20°C to +65°C (-4°F to +149°F)
	Humidity	0 - 90% RH (non-condensing)
	Vibration	10 Hz - 57 Hz: 0.075 mm amplitude 58 Hz - 150 Hz: 1G
	IP rating	IP20
	Approvals	IEC/EN/UL 61800-5-1

Note:

1. For more information on ASDA-A3-EP AC servo drives, refer to the servo drive user manual.
2. The following table lists the servo motors that can be combined. If other motors are combined, AL575 will be displayed on the servo drive.

Motor frame size		Model number	Encoder type
F40 - F100		ECM-B3□-□2□□□□□□□ ECM-B3□-□A□□□□□□□ ECM-B3□-□B□□□□□□□	2, A, B
F130		ECM-B3□-□2□□□□□□□ ECM-B3□-□A□□□□□□□ ECM-B3□-□B□□□□□□□	2*6, A, B
F180	Rated power output 2 - 5.5 kW	ECM-B3□-□2□□□□□□□ ECM-B3□-□A□□□□□□□ ECM-B3□-□B□□□□□□□	2*6, A, B
	Rated power output 7.5 kW	ECM-B3□-□A□□□□□□□	A
F220		ECM-B3□-□A□□□□□□□	A

3. Use a safety extra-low voltage (SELV) power supply that can provide sufficient maximum current.
4. The servo drive is compliant with the environmental specifications.
5. UL certification application is in progress.
6. Support for the encoder type 2 will be available starting from week 20 of year 2025; prior to that, AL575 (Motor combination error) will be displayed on the servo drive, and AL5A1.2 will be triggered on the safety functions module.

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1.4.2 Safety specifications

Standard		Certification Body
Functional Safety	IEC / EN 61508: 2010 ISO 13849-1: 2023	
Machinery Directive	EN IEC 62061: 2021	
	EN 61800-5-2: 2017	
	EN ISO 13849-1: 2015	
Low Voltage Directive	EN 61800-5-1: 2007/A11: 2021	
EMC for Functional Safety	EN 61326-3-1: 2017	
	EN 61000-6-7: 2015	

Item		Relevant standard	I/O type		Communication type	
HFT	Hardware Fault Tolerance	IEC / EN 61508	1		1	
Type	Subsystem type	IEC / EN 61508	Type B		Type B	
SIL	Safety integrity level	IEC / EN 61508	SIL3		SIL3	
		EN IEC 62061	maximum SIL 3		maximum SIL 3	
PFH	Risk failure rate	EN IEC 62061	See the following table.			
Response time	Response time	IEC / EN 61508	STO, SBC	10 ms	STO, SBC	15 ms
			Others	25 ms	Others	25 ms
Fault reaction time	Failure reaction time	EN 61800-5-2	STO stop	10 ms	STO stop	10 ms
			SS1 stop	25 ms	SS1 stop	25 ms
Category	Category	EN ISO13849-1: 2015	Category 3		Category 3	
PL	Performance level	EN ISO13849-1: 2015	PL e		PL e	
MTTFd	Mean dangerous failure time	EN ISO13849-1: 2015	High (≥ 100 [years])		High (≥ 100 [years])	
DC	Diagnostic range	EN ISO13849-1: 2015	DC ≥ 98 [%] (medium)		DC ≥ 98 [%] (medium)	
Mission time	Mission time	EN ISO13849-1: 2015	20 [years]		20 [years]	

Risk failure rate (PFH)

PFH varies depending on the input type and safety function.

Safety function	I/O type [1/h]	Communication type [1/h]
STO	$< 1.4 \times 10^{-8}$	$< 1.5 \times 10^{-8}$
SS1 / SS2 / SOS / SLS / SLI / SDI / SLP	$< 1.7 \times 10^{-8}$	$< 1.8 \times 10^{-8}$
SMS	$< 1.7 \times 10^{-8}$	$< 1.7 \times 10^{-8}$
SSM	$< 1.9 \times 10^{-8}$	$< 1.8 \times 10^{-8}$
SBC	$< 1.6 \times 10^{-8}$	$< 1.6 \times 10^{-8}$

- If multiple safety functions are used to design a systematic processing, give the maximum PFH value of the function to be used as the PFH value of the drive.
- Select the interface type using the parameters. For details, refer to Section 3.5.

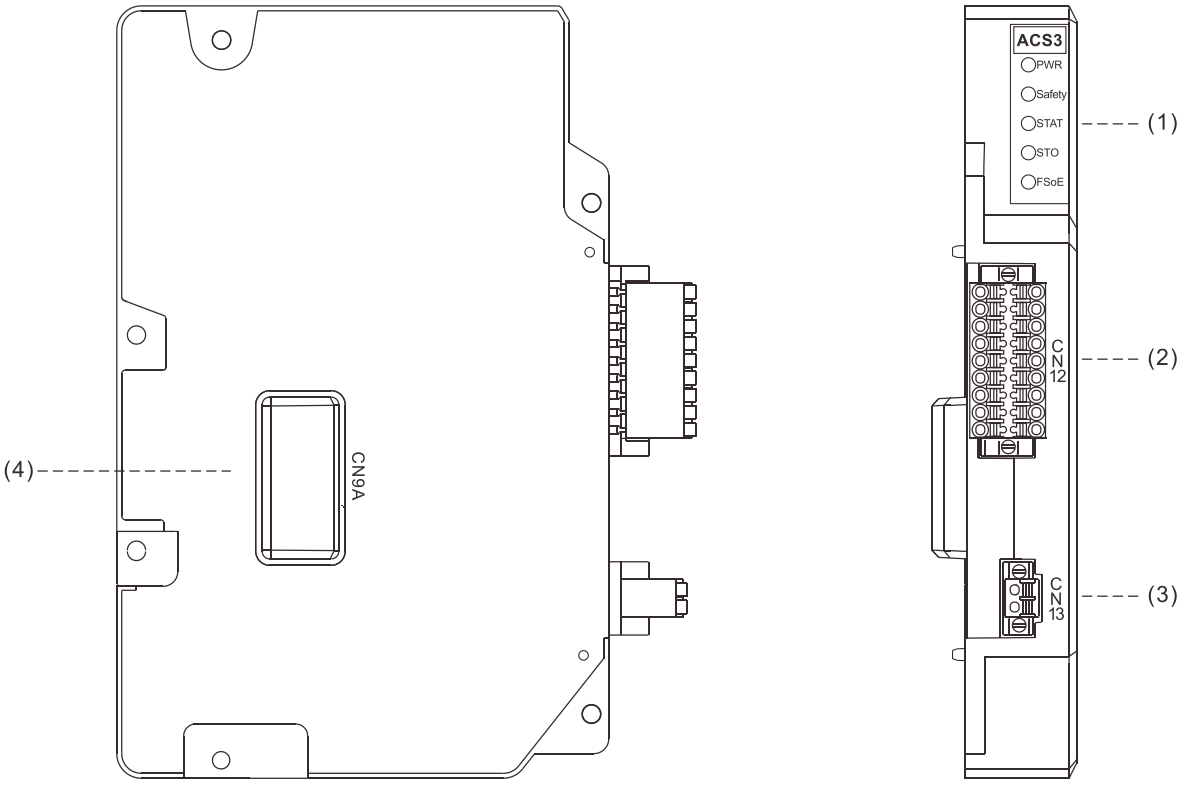
Safety over EtherCAT (FSoE)

The product supports Safety over EtherCAT (FSoE) as a safety communication, allowing the user to build a safety system by executing safety functions from an EtherCAT safety controller.

- See Sections 3.5 and 3.6 for more information about using FSoE communication.
- Safety over EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

1

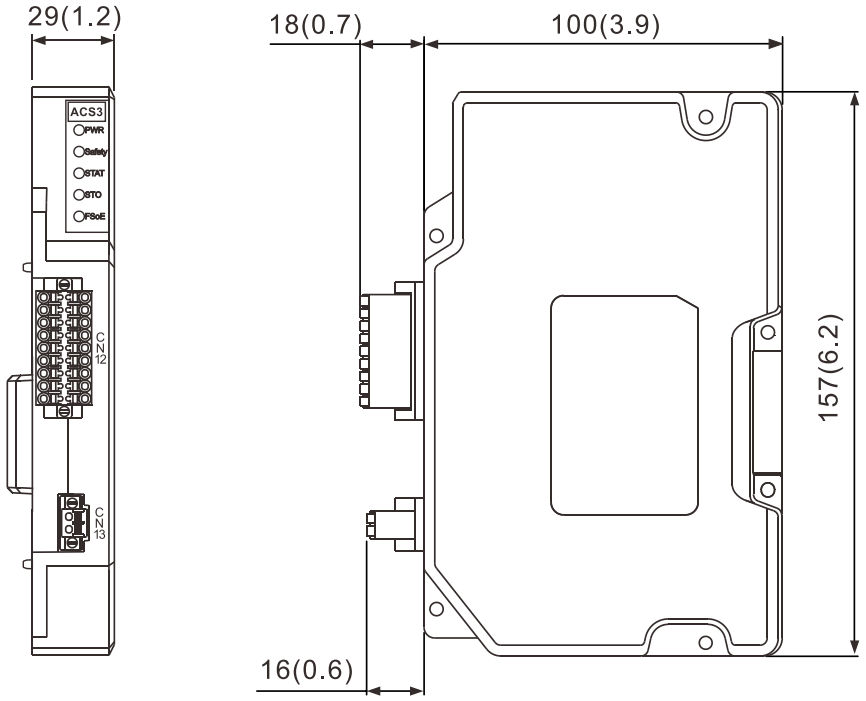
1.5 Part names



Left side view Front view

Number	Name	Description	
(1)	LED indicator	PWR	Power indicator for the safety functions module
		Safety	Safety function execution status indicator
		STAT	Safety functions module status indicator
		STO	STO status indicator
		FSoE	FSoE (Safety Over EtherCAT) status indicator
(2)	CN12	Safety input/output signal connector	
(3)	CN13	Electromagnetic brake power output	
(4)	CN9A	For connecting to the servo drive.	

1.6 Dimensions



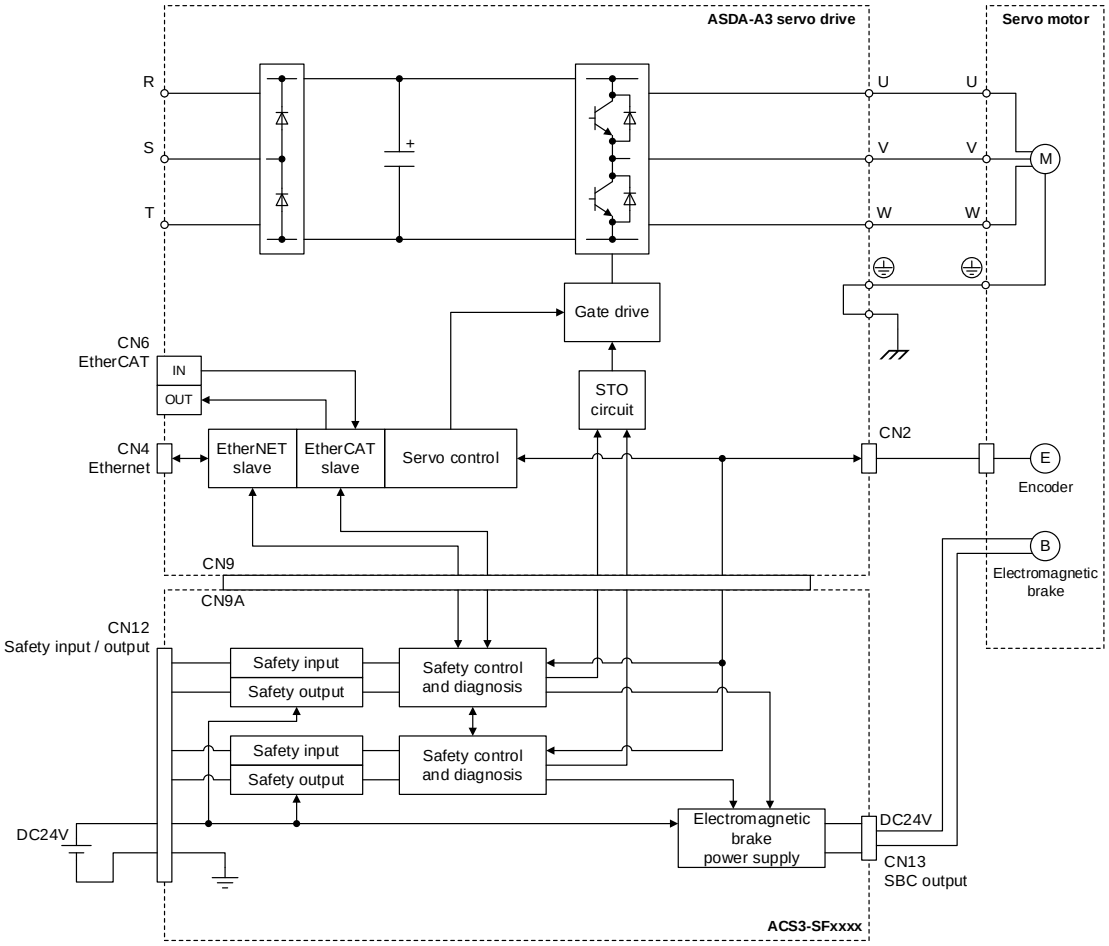
SCREW: M3x0.5
Mounting screw torque:6-8(kgf-cm)

Unit: mm(inch)

Weight	0.16 kg (5.64 oz)

1

1.7 System block diagram



Installation and Wiring 2

This chapter describes how to install the safety functions module to the ASDA-A3-EP AC servo drive and how to wire the connectors.

2.1 Installation and removal ····· 2-2
2.1.1 Installation ····· 2-3
2.1.2 Removal ····· 2-4
2.2 Wiring ····· 2-6
2.2.1 Example of peripheral device connection ····· 2-6
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2.2.2.1 Pin assignment ····· 2-7
2.2.2.2 Wiring for safety inputs ····· 2-9
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2.2.2.4 Wiring for Safety Origin Detection Device ····· 2-12
Safety limit switch ····· 2-12
Safety photoelectric sensor / proximity sensor ····· 2-13
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2.2.3.1 Pin assignment ····· 2-15
2.2.3.2 Wiring ····· 2-16
2.2.3.3 Wiring procedure ····· 2-16

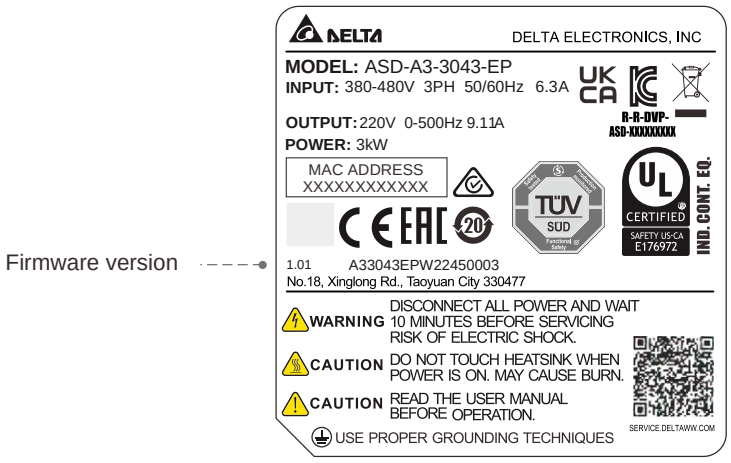
2.1 Installation and removal

Make sure to obey the following precautions when you install or remove the safety functions module.

DANGER
■ Wait at least 5 minutes after turning off the power, and then check that the servo drive's “CHARGE” indicator is off before starting work. Otherwise, it may result in electric shock.

CAUTION
■ Do not install and remove the module frequently, or it may result in loose contact between the connectors. ■ To meet the functional safety requirement, install the servo drive in a control cabinet with a rating of IP54 or higher.

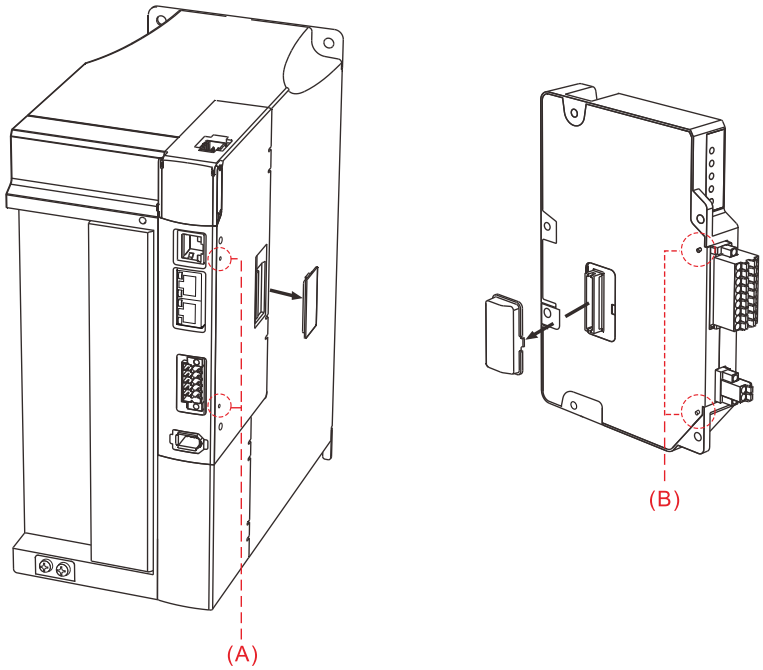
Mandatory
■ Before installing the module to the servo drive, check the firmware version of the servo drive. Servo drive with firmware versions 1.01 or earlier does not support the safety functions module; prepare a compatible servo drive for use.



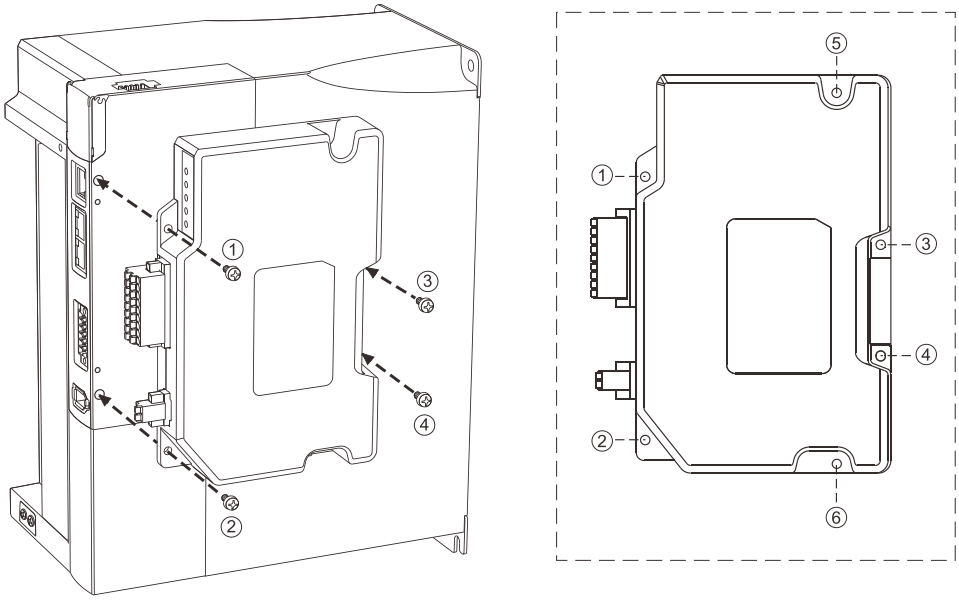
2.1.1 Installation

Install the safety functions module to the servo drive with the following steps.

(1) Remove the connector covers on the right side of the servo drive and on the left side of the safety functions module. When installing, make sure to insert the alignment pin (B) of the module into the alignment hole (A) of the servo drive.



(2) Mount the safety functions module to the right side of the servo drive, and then tighten the screws in the corresponding holes as shown in the following diagram and table.
Tightening torque: 6 to 8 kgf-cm

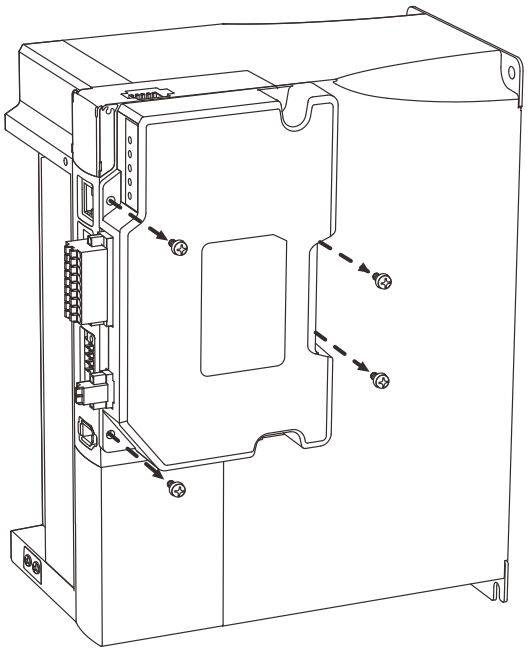


Model number of the servo drive	Screw hole
ASD-A3-0443-EP, ASD-A3-0743-EP, ASD-A3-1043-EP, ASD-A3-1543-EP, ASD-A3-4543-EP, ASD-A3-5543-EP, ASD-A3-7543-EP, ASD-A3-1B43-EP, ASD-A3-1F43-EP	①, ②, ③, ④

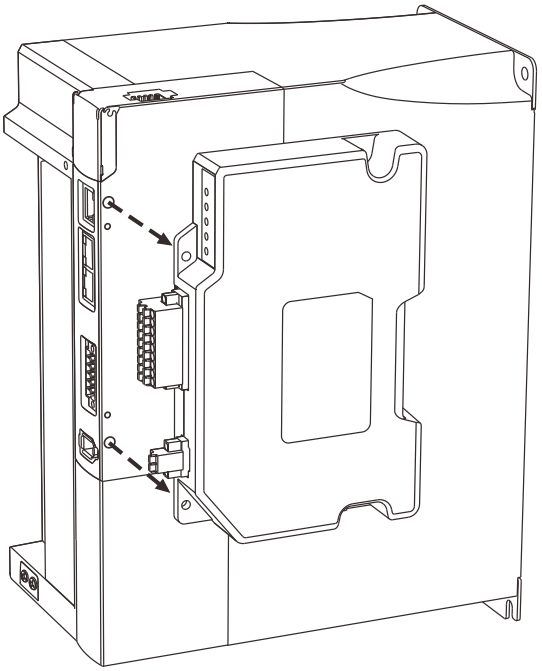
2.1.2 Removal

This section describes how to remove the safety functions module from the servo drive.

(1) Remove all the screws securing the safety functions module.

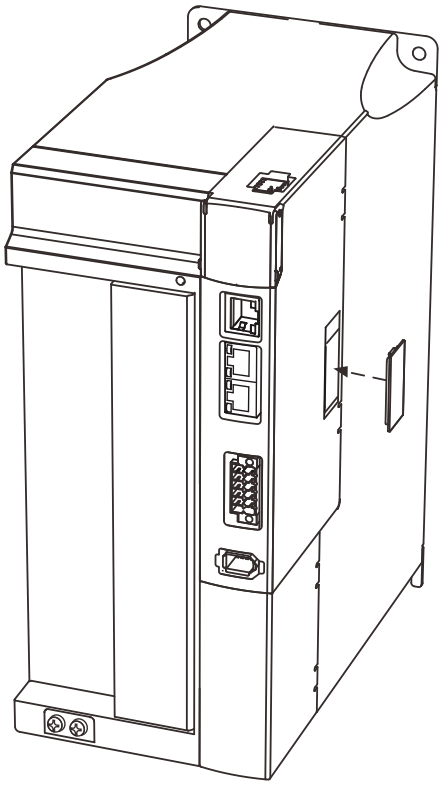


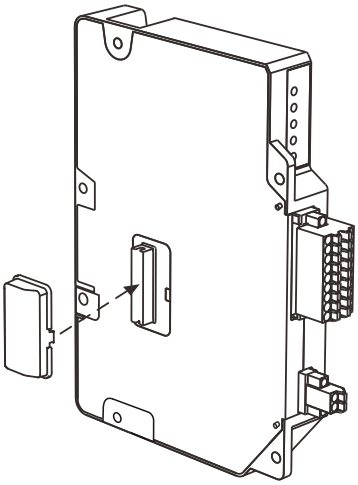
(2) Remove the safety functions module from the right side of the servo drive.



(3) If you intend to replace the safety functions module, follow Section 2.1.1 to install another module.

If you do not intend to install the safety functions module, attach the connector covers on the right side of the servo drive and on the left side of the module.

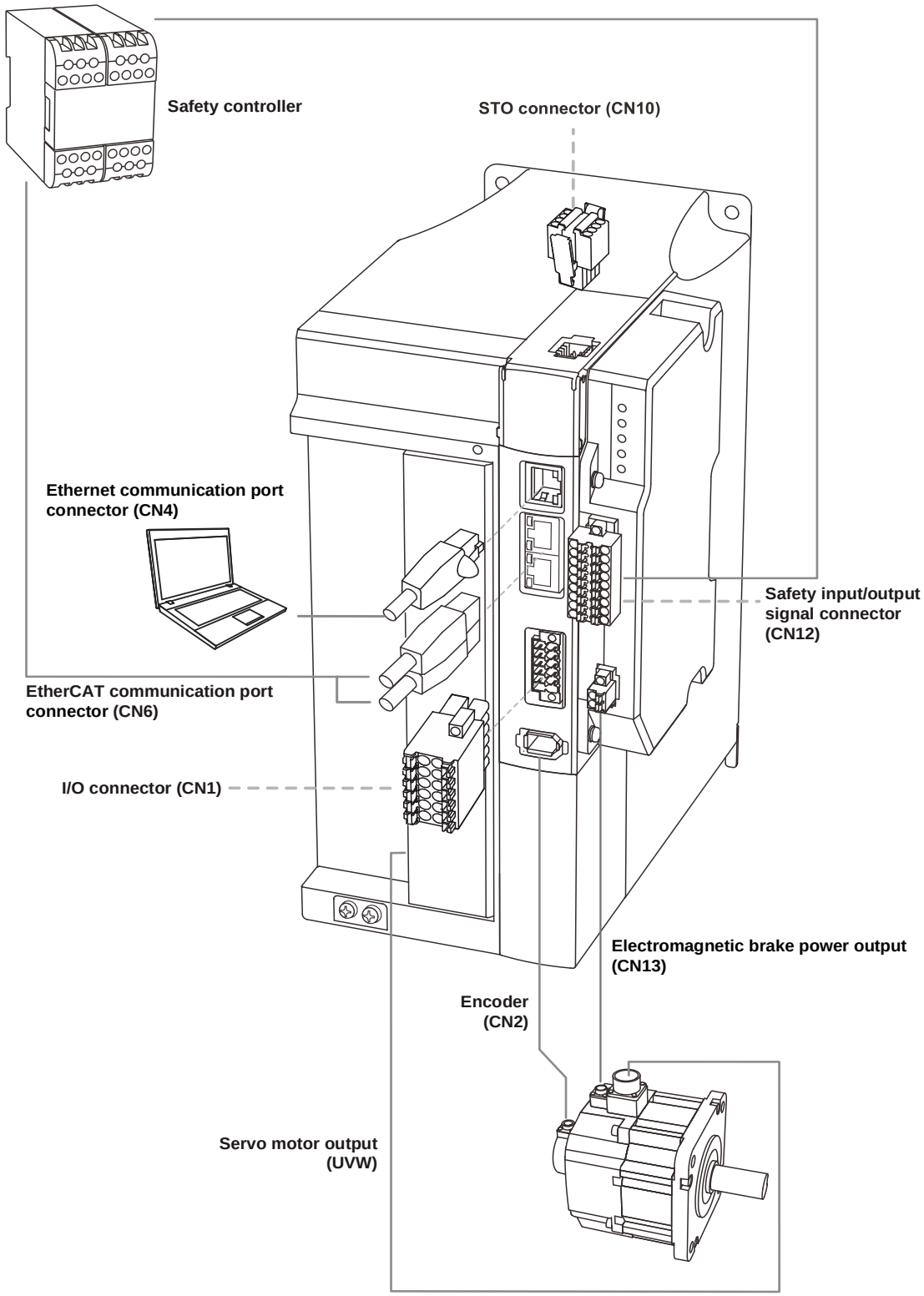




2.2 Wiring

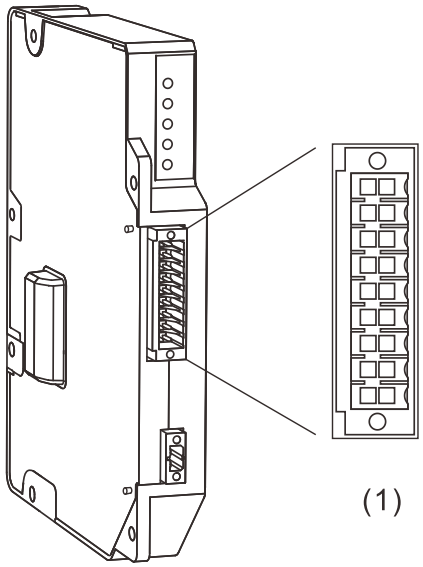
2.2.1 Example of peripheral device connection

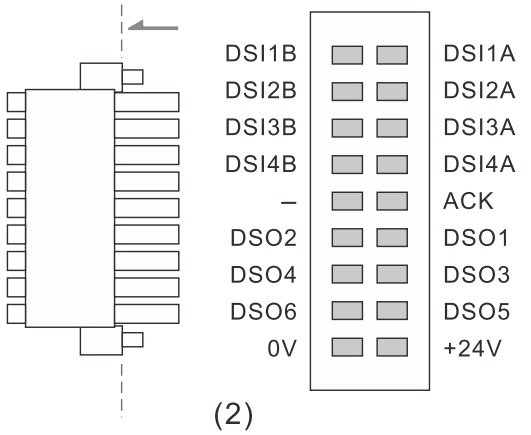
2



2.2.2 CN12 safety input/output signal connector

2.2.2.1 Pin assignment





Connector	Specification
Model number	0156-2A18-BK
Manufacturer	DINKEL
Applicable wire size	16 AWG - 22 AWG
Tightening torque	1.6 - 2.0 kgf-cm
Cable length	20 m or less

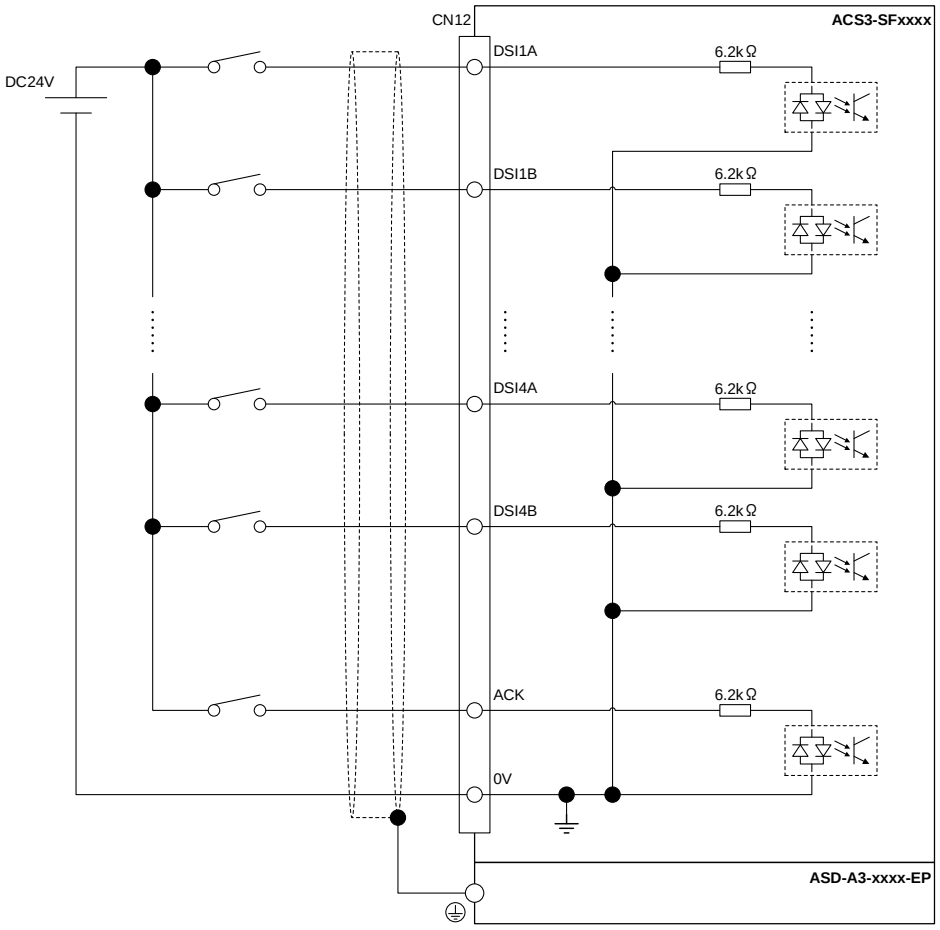
Pin	Signal	Name	Description
1	DSI1A	Safety input 1A	Four-channel redundant safety inputs; use the signals in pairs (DSI1A and DSI1B, …, DSI4A and DSI4B). When the input is OFF, the safety function determined by the corresponding parameter is activated. Electrical specifications: Input voltage: DC24V; Internal impedance: 6.2 kΩ; Circuit configuration: SOURCE mode; ON voltage: 11V or more; OFF voltage: Below 5V
2	DSI1B	Safety input 1B	
3	DSI2A	Safety input 2A	
4	DSI2B	Safety input 2B	
5	DSI3A	Safety input 3A	
6	DSI3B	Safety input 3B	
7	DSI4A	Safety input 4A	
8	DSI4B	Safety input 4B	
9	ACK	Safety state deactivation & alarm reset input	Input for deactivating the safe stop functions (STO, SS1, SS2) and resetting the alarm. The electrical specifications are identical to DSI.
10	-	NC	Do not connect.
11	DSO1	Safety output 1	Six-channel safety outputs; for outputting the status determined by the corresponding parameter. When outputting Safe Speed Monitor (SSM), use the signals in pairs (DSO1 and DSO2, DSO3 and DSO4, or DSO5 and DSO6). Electrical specifications: Maximum output current: 50 mA; Maximum surge current: 100 mA; Maximum output voltage: DC24V; Circuit configuration: SOURCE mode
12	DSO2	Safety output 2	
13	DSO3	Safety output 3	
14	DSO4	Safety output 4	
15	DSO5	Safety output 5	
16	DSO6	Safety output 6	

<table>
<tr><th>Pin</th><th>Signal</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="4">17</td><td rowspan="4">+24V</td><td rowspan="4">Power input terminal for safety output & electromagnetic brake power output</td><td colspan="2">Power input for the safety output and the electromagnetic brake power output.</td></tr>
<tr><td colspan="2">Electrical specifications</td></tr>
<tr><td>Supply voltage</td><td>DC24V</td></tr>
<tr><td>Maximum current</td><td>2.4 A</td></tr>
<tr><td>18</td><td>0V</td><td>Ground</td><td colspan="2">Connect to ground.</td></tr>
</table>

- For the power of safety inputs / outputs and electromagnetic brake power output, use a safety extra-low voltage (SELV) power supply that can provide sufficient maximum current.
- If a cable fault occurs, detect it on your machine or perform the fault exclusions as described in ISO 13849-2 Table D.4.

2.2.2.2 Wiring for safety inputs

Wire the safety inputs according to the following diagram. Note that the ACK signal input is also used for alarm reset.



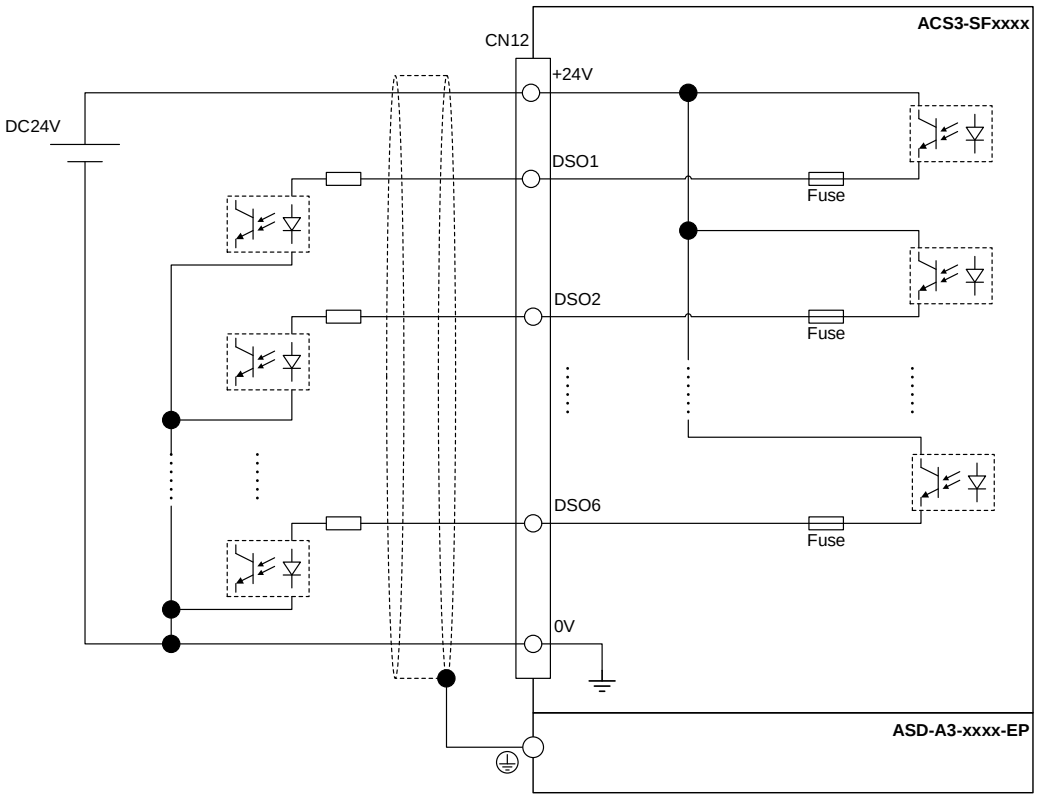
- A filter circuit is inserted at the safety input. When activating the safety functions, maintain the OFF state for a period of time (approx. 5 ms or more) that allows the filter to pass. (The same applies to ACK input).
- If the ACK signal is not wired, reset the alarm by rebooting the system (for I/O type models only).
- Normally, only the I/O type model requires wiring for the safety input. However, when using the Safely-limited Position (SLP) function, wiring is also required for the communication type model. Refer to Section 2.2.2.4 for details.
- Connect the shield to the ground terminal ⏚ of the servo drive.

2.2.2.3 Wiring for safety outputs

Wire the safety outputs according to the following diagram. Note that the output method for Safe Speed Monitor (SSM) is different from others.

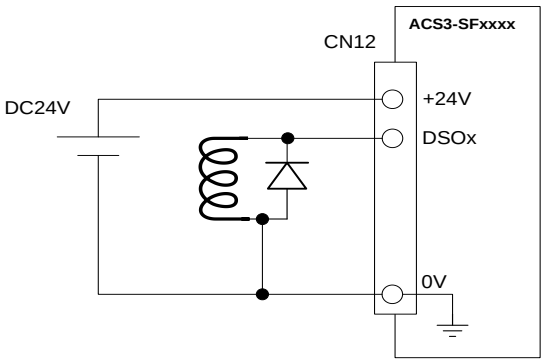
(1) Outputting for Safe Speed Monitor (SSM):
Use a pair of two channels (DSO1 and DSO2, DSO3 and DSO4, or DSO5 and DSO6).

(2) Outputting for other safety functions:
You can use one channel. However, the status monitor outputs are not safety functions. Do not use these signals to control the machine.



- To perform self-diagnosis, the safety output periodically sends an off-pulse of less than 1 ms. Connect to devices that are not affected by the off-pulse.
- Normally, only the I/O type model requires wiring for the safety output. However, when using the Safely-limited Position (SLP) function, wiring is also required for the communication type model. Refer to the Section 2.2.2.4 for details.
- In the event of a failure, all outputs are turned off.
- Connect the shield to the ground terminal ⏚ of the servo drive.

- When connecting an inductive load to the safety output, install a surge absorption diode. Make sure the polarity of the diode is correct, or it may damage the module.



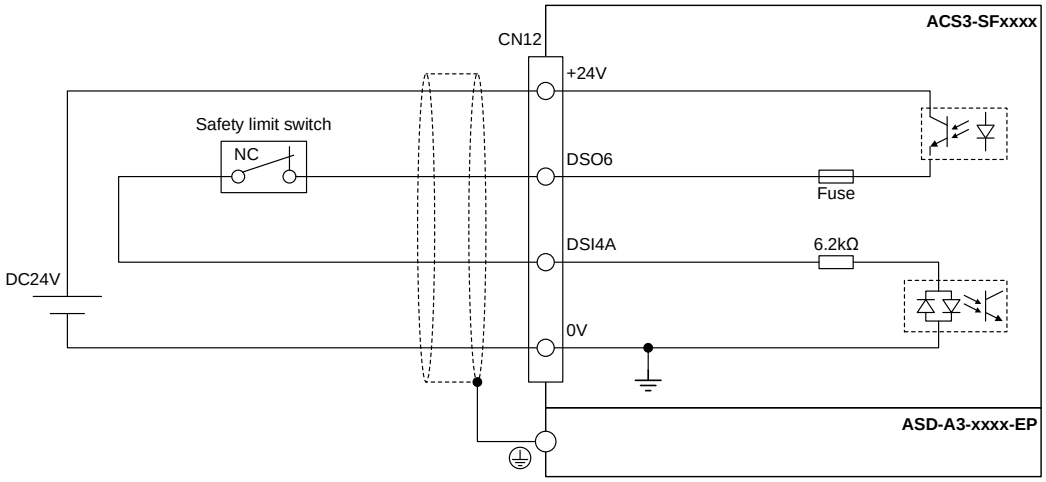
2.2.2.4 Wiring for Safety Origin Detection Device

When using the Safely-limited Position (SLP) function, the following input devices should be used to detect the safety origin.

2

Safety limit switch

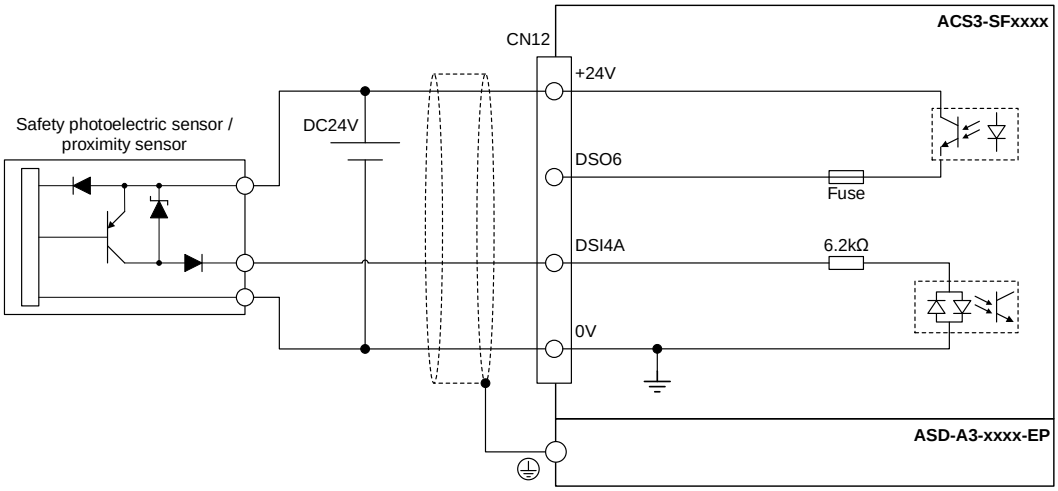
When using a safety limit switch, wire the safety input (DSI4A) and safety output (DSO6) as follows.



- Enable the "Test pulse diagnostics" setting.
  DSO6 periodically outputs an off-pulse of less than 1 ms to detect input device failures or wiring errors.
- Only use the DSI4A and DSO6 terminals for connecting the safety limit switches.
- Use B contact type (NC contact) for safety limit switches.
- Connect the shield to the ground terminal ⏚ of the servo drive.

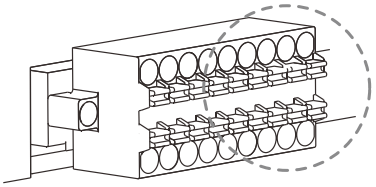
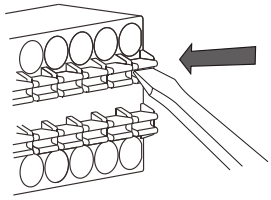
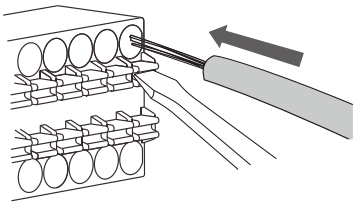
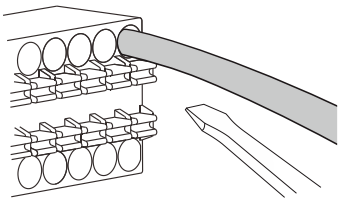
Safety photoelectric sensor / proximity sensor

When using a safety photoelectric sensor or proximity sensor, wire the output terminal of the sensor to the safety input (DSI4A) as follows.



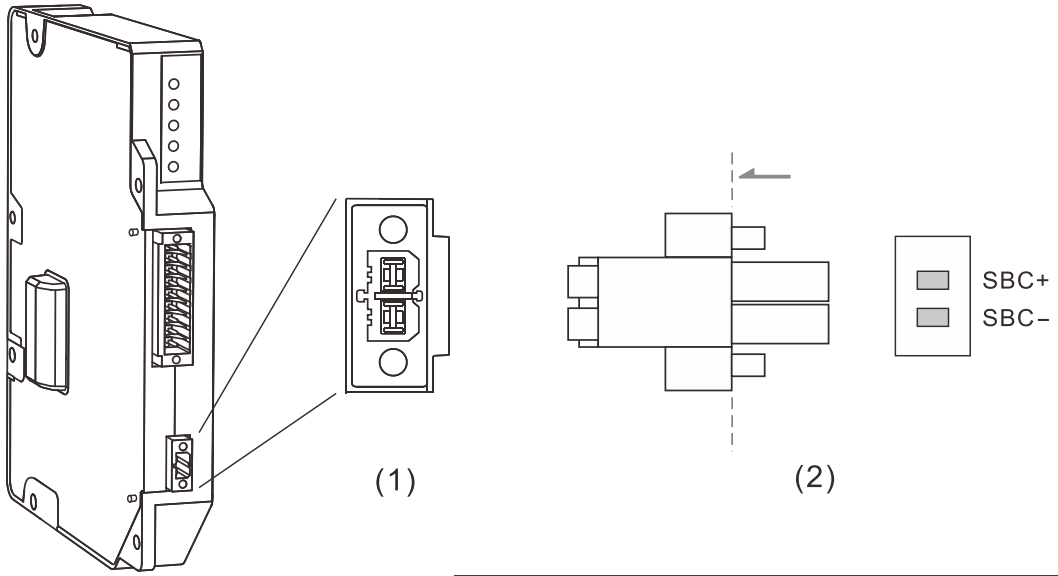
- Use the PNP output type for input devices.
- Do not use the magnetic types.
- Only use the DSI4A terminal for connecting the safety photoelectric sensors / proximity sensors.
- Connect the shield to the ground terminal ⏚ of the servo drive.

2.2.2.5 Wiring procedure

Step 1		The CN12 connector has multiple spring-loaded terminals. Determine which terminal is to be wired in advance.
Step 2		Use a flathead screwdriver to press the spring down to open the pin.
Step 3		Insert the stripped wire into the pin.
Step 4		Withdraw the flathead screwdriver to complete the wiring.

2.2.3 CN13 electromagnetic brake power output

2.2.3.1 Pin assignment



Connector	Specification
Model number	0225-0602
Manufacturer	DINKEL
Applicable wire size	16 AWG - 22 AWG
Tightening torque	1.6 - 2.0 kgf-cm
Cable length	20 m or less

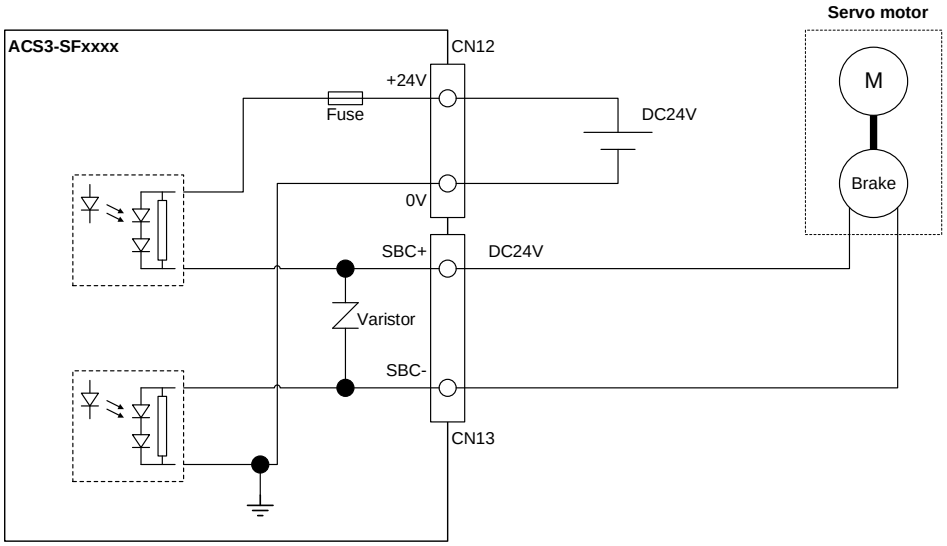
Pin	Signal	Name	Description
1	SBC+	Electromagnetic brake power output	Power outputs for the electromagnetic brake.
2	SBC-		Electrical specifications: Minimum output voltage DC22.75V; Maximum output current 2.0 A

- Use the motor with a built-in electromagnetic brake. Do not use external brakes.

2

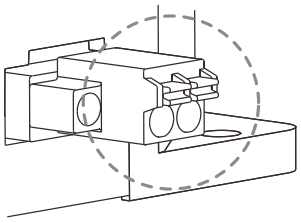
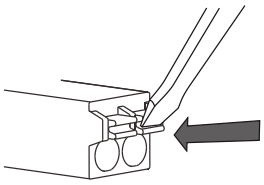
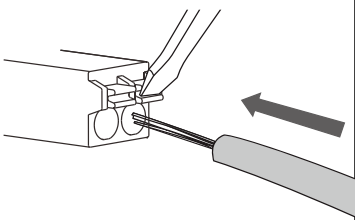
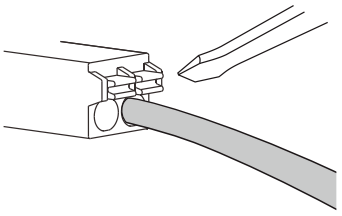
2.2.3.2 Wiring

The electromagnetic brake output circuit has a built-in relay. Wire the SBC output terminal directly to the power terminal of the electromagnetic brake.



- In the event of a failure, the SBC output is turned off.

2.2.3.3 Wiring procedure

Step 1		The CN13 connector has two spring-loaded terminals.
Step 2		Use a flathead screwdriver to press the spring down to open the pin.
Step 3		Insert the stripped wire into the pin.
Step 4		Withdraw the screwdriver to complete the wiring.

Operation 3

This chapter describes how to operate the system.

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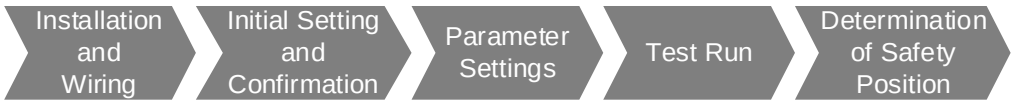
3

3.1 System startup

To ensure proper use of the safety functions module and the servo drive, follow this procedure to set up the system when you first turn on the power or if you are replacing the product.



- When starting up the system, it is recommended that you record the set parameters and the test run results for reference during replacement and inspection.

3.2 Installation and wiring

Install the safety functions module, servo drive, and servo motors to the system, and wire all necessary cables.

- Refer to Chapter 2 for instructions on how to install and wire this product.
- Refer to the ASDA-A3-EP User Manual for information on how to use the servo drive and servo motor.

3.3 LED indicators

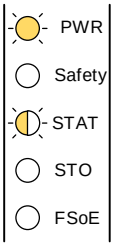
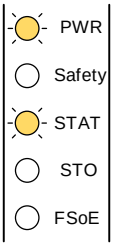
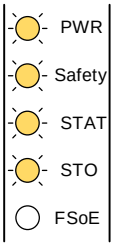
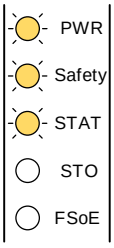
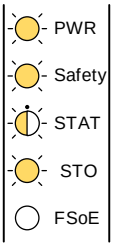
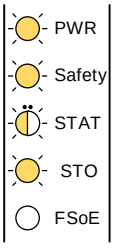
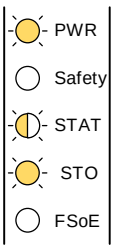
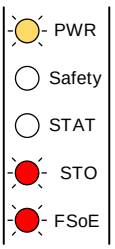
The safety functions module has five LED indicators for status display.

The main functions of each indicator are as follows

Indicator	Function
PWR	Indicates the power supply status. Lights orange when power is being supplied.
Safety	Indicates the status of the enabled safety function.
STAT	Indicates the internal status.
STO	Indicates STO status.
FSoE	Indicates the FSoE communication status.

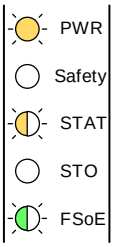
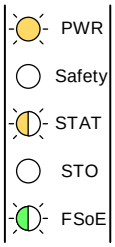
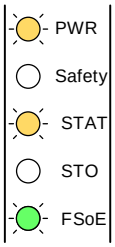
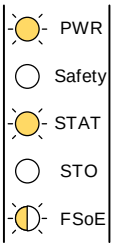
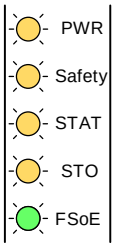
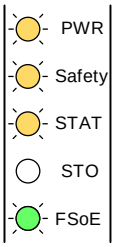
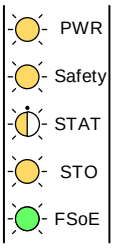
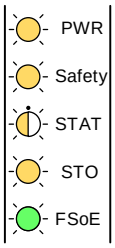
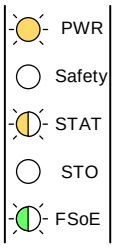
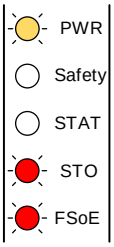
The four indicators, except PWR, indicate various states by different combinations, display colors, and display modes.

■ I/O type

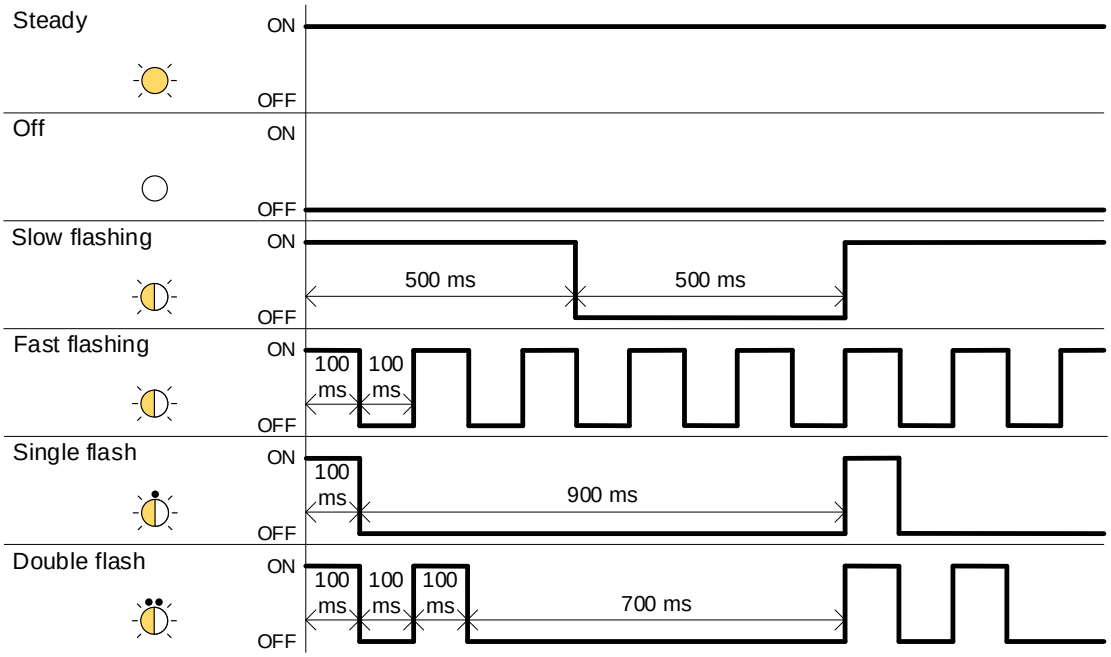
Status	Ready	Normal State (Ready to operate)	Safe Torque Off (STO)
LED indication			
	STAT: slow flashing orange	STAT: steady orange	Safety / STAT / STO: steady orange
Status	Safety function enabled (including during SS1 deceleration)	Position monitoring alarm status	Speed monitoring alarm status
LED indication			
	Safety: steady orange STAT: steady orange	Safety: steady orange STAT: single flash - orange STO: steady orange	Safety: steady orange STAT: double flash - orange STO: steady orange
Status	Parameter setting error （AL5C1）	Other alarm status	
LED indication			
	STAT: fast flashing orange STO: steady orange	STO: steady red FSoE: steady red	

3

■ Communication (FSoE) type

Status	Reset - Session - Connection state	Parameter state	Data state (Process Data: ready to operate)
LED indication			
	STAT: slow flashing orange FSoE: slow flashing green	STAT: slow flashing orange FSoE: fast flashing orange	Safety: steady orange FSoE: steady green
Status	Data state (Fail Safe Data: not ready to operate)	STO state	Safety function enabled (including during SS1 deceleration)
LED indication			
	STAT: steady orange FSoE: slow flashing orange	Safety: steady orange STAT: steady orange STO: steady orange FSoE: steady green	Safety: steady orange STAT: steady orange FSoE: steady green
Status	Position monitoring alarm state	Speed monitoring alarm state	Parameter setting error（AL5C1）
LED indication			
	Safety: steady orange STAT: single flash - orange STO: steady orange FSoE: steady green	Safety: steady orange STAT: double flash - orange STO: steady orange FSoE: steady green	STAT: fast flashing orange FSoE: fast flashing green
Status	Alarm status		
LED indication			
	STO: steady red FSoE: steady red		

The LED indicators are displayed in the following modes.

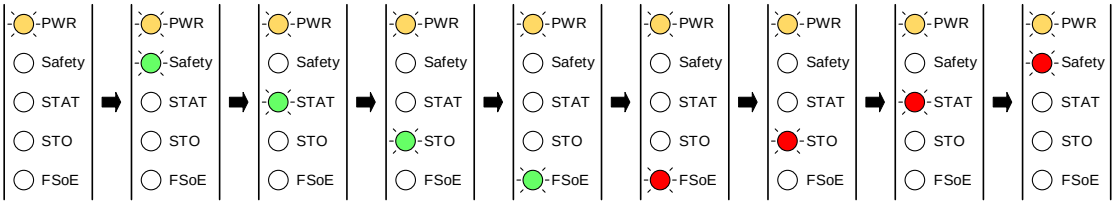


3.4 Initial setting and confirmation

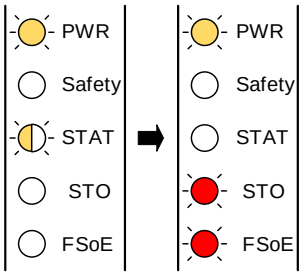
Follow these steps to check the initial operation.

(1) Turn on the control power supply to the servo drive.

When the safety functions module is activated, the five LED indicators on the front panel light in the sequence shown as follows.



Then, “STAT” “flashes slowly” and an alarm occurs (“STO” and “FSoE” light steady red).



■ When the power is On for the first time, the drive parameter P1.100 (Object index: 2164h) is set to 0x0000 (no safety functions module installed). Therefore, a system configuration error is detected and an alarm is detected in both the servo drive and the safety functions module. In this case, “AL580” occurs in the servo drive.

(2) Set the following servo drive parameters.

Parameter	Description
P1.100 (Object index: 2164h)	This parameter sets the connection of the safety functions module and the external interface.  X: connection of the safety functions module 1: use the safety functions module through I/O mode 2: use the safety functions module through communication (FSoE) mode Set X to either 1 or 2.
P3.029 (Object index: 231Dh)	Set the FSoE address when in the communication (FSoE) mode. The setting range is 0x0000 to 0xFFFF.

■ If these parameters cannot be set or “AL580” is not detected, it means the servo drive is not compatible with the safety functions module. Replace the servo drive with one with the firmware version of 1.01 or later.

(3) Set the servo drive parameter P1.120 (Object index: 2178h) to 2.

The method of deactivating STO differs depending on the setting value.

P1.120 (Object index: 2178h)	STO deactivation setting
0	1. Perform the method of deactivating STO for the safety functions module 2. Send Servo Off command to the servo drive
1	1. Perform the method of deactivating STO for the safety functions module 2. Reset servo drive alarm 3. Send Servo Off command to the servo drive
2 (recommended)	1. Perform the method of deactivating STO for the safety functions module (When the STO state is deactivated, the system automatically returns to a state in which operation can be resumed.)
3 (default)	1. Perform the method of deactivating STO for the safety functions module 2. Reset servo drive alarm

- For more information on how to deactivate STO for the safety functions module, refer to Section 4.2.
- If an alarm (AL5C0 to AL5CF) occurs in the safety functions module, perform an alarm reset before deactivating STO. For more information on how to reset alarms, refer to Section 7.3.
- For information on how to reset the servo drive alarm, refer to the ASDA-A3-EP User Manual.

(4) Restart the servo drive.

If both the servo drive and the safety functions module are operating properly, the LED indicators are lit in sequence, and then “STAT” changes from “slow flashing” to “steady”.

If an alarm occurs in the safety functions module (“STO” and “FSoE” indicators display steady red), perform the following actions in accordance with the alarm code displayed on the front panel of the servo drive:

Drive panel display	Corrective action
“AL584” “AL5A0” “AL5A1”	There could be a poor connection between the servo drive and the safety functions module. Re-install and redo the wiring.
“AL580”	Check if the servo drive parameter P1.100 is set to 1 or 2. When P1.100 is set to 1 or 2, the servo drive and/or the safety functions module may be malfunctioning. Replace either or both of them.
“AL5A3”	Wire the encoder cable to the servo drive.
Other alarms	Refer to Chapter 7 and take the corrective action properly in accordance with the alarm code.

- Since P1.100.X (Connection of the safety functions module) is set to 0 (no safety functions module installed) at the factory setting, the safety functions module cannot respond to the FSoE communication from the host controller (FSoE master) when the power is on for the first time.

  To use the FSoE communication, select “2: use the safety functions module through communication (FSoE) mode” and restart the drive before starting communication.

3.5 Parameter setting

3.5.1 Setting in I/O mode

When selecting the I/O mode, set parameters with the parameter setting tool (Delta Drive Safety). Connect a LAN cable between CN4 of the servo drive and a PC, and start Delta Drive Safety. For more information on Delta Drive Safety, refer to the Delta Drive Safety Software User Manual.

3.5.1.1 Setting password

To prevent unintentional modifications to parameters, the Delta Drive Safety sets three authority levels for parameter access and restricts the access by means of passwords.

Authority level	Upload parameters	Downloading parameters Safety position clear	Password setting Parameter reset
1	✓	×	×
2	✓	✓	×
3	✓	✓	✓

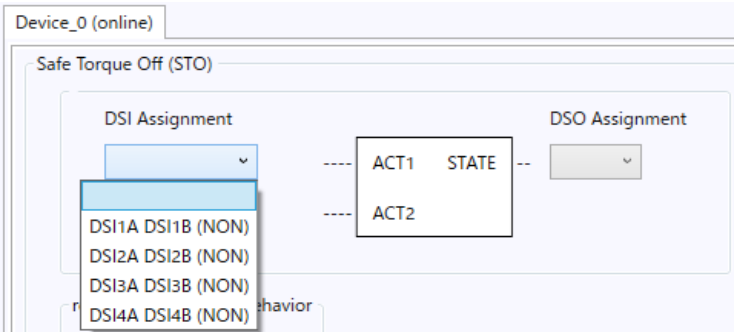
The passwords are initialized at the factory setting, so none of the levels are available. Before starting to set parameters, set a password (a maximum of 8 digits) for each authority level.

- Set different passwords for each authority level.
- The passwords should be well-maintained and kept by the person in charge. Do not share the passwords with anyone.

3.5.1.2 Setting safety input (DSI)

This product provides four sets of safety inputs (DSI1A / B to DSI4A / B). Assign a safety function to be used to one set of the safety inputs.

Select one set of the safety inputs from the “DSI Assignment” drop-down list box in the parameter setting screen for each safety function in Delta Drive Safety (the STO function is shown as an example).

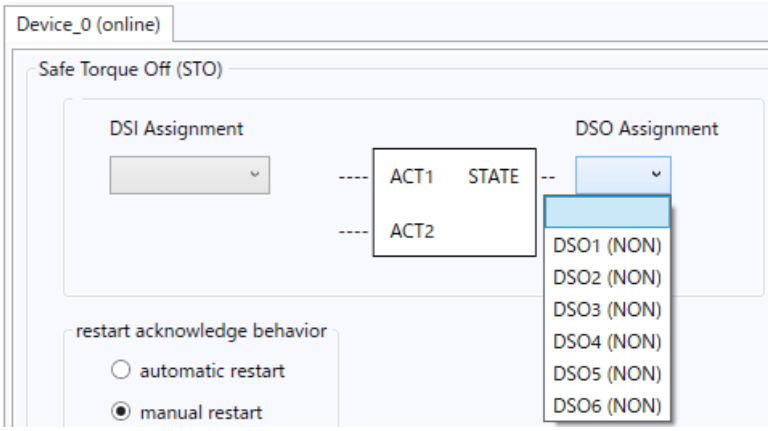


- Up to 4 safety functions can be used simultaneously.
- Assigning multiple safety functions to the same set of safety inputs is not allowed.
- When the “Safely-limited Position (SLP)” function is used, DSI4 is not available.
  If you have assigned another safety function to DSI4, reassign it to another set of safety inputs.

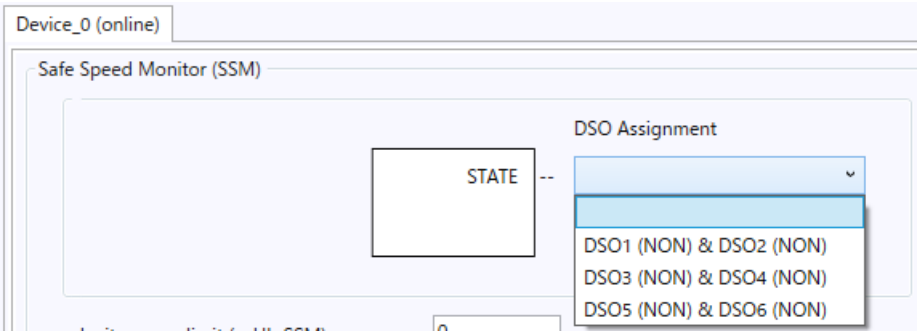
3.5.1.3 Setting safety output (DSO)

This product provides 6 channels of safety outputs (DSO1 to DSO6). Assign the monitor signal to one safety output.

Select the safety output from the “DSO Assignment” drop-down list box in the parameter setting screen for each safety function in Delta Drive Safety (the STO function is shown as an example).



The Safe Speed Monitor (SSM) signal output requires a pair of two channels. Three combinations are available: “DSO1 & DSO2”, “DSO3 & DSO4”, and “DSO5 & DSO6”.

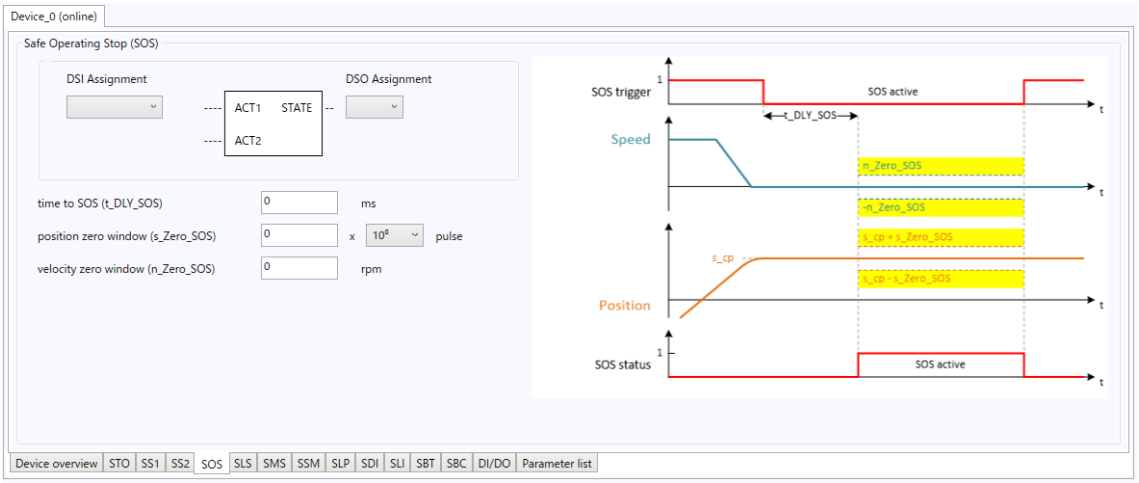


- Up to 6 status monitors can be output simultaneously. (Limited to 5 if the Safe Speed Monitor (SSM) is selected).
- Assigning multiple output signals to the same safety output is not allowed.
- The status monitor for each safety function (except the Safe Speed Monitor (SSM)) is not safety function. Do not use these signals for safety related applications.
- When the “Safely-limited Position (SLP)” function is used, DSO6 is not available.
  If you have assigned another signal to DSO6, reassign it to another safety output.

3

3.5.1.4 Setting safety parameters

For each safety function of Delta Drive Safety (Safe Operating Stop (SOS) function is shown as an example), refer to the timing diagram on the right and set each parameter on the parameter setting screen.



- For more information on the parameters of each safety function, refer to Chapter 4.
- While the parameters are being updated, “S.PAU.d” is displayed on the front panel of the drive.
- Set the parameters when the servo drive is in the Servo Off state. They cannot be changed when Servo On.
- Do not disconnect power while updating parameters. Or, it may cause parameter setting error (AL5C0) to occur the next time the system is started.
- If the parameter update is not complete successfully, set the parameters again according to the display on the Delta Drive Safety screen.
- If an error is detected during start-up or parameter update, “AL5C0” is displayed on the front panel of the drive. In this case, reset all parameters using Delta Drive Safety. Then, after the reset completes normally, clear the alarms.
- Remove the password restrictions in Delta Drive Safety before updating parameters.

3.5.1.5 Setting Diagnostic Parameter

The product constantly diagnoses encoder failures, and the diagnostic sensitivity can be adjusted by parameters. Set the "Diagnostic Parameter (setting range: 0 to 1000 (0: diagnostic function disabled))" in the **Device overview** tab of the Delta Drive Safety. The default value is set to 100 (recommended value). A higher value indicates a higher sensitivity (easier to detect errors).

Set a lower value before adjusting the servo gain of the servo drive, and reset it to the original value after adjustment.

In the following cases, set a lower value in advance.

- Large load fluctuation (disturbance) during operation
- Low rigidity
- Operation with speed proportional control.

■ Setting this parameter to 0 stops the diagnosis. Use this setting when the alarm AL5C2 occurs during adjustment. However, after adjustment, reset it to the original setting.

3.5.2 Setting in EtherCAT communication (FSoE) mode

To control the safety functions via EtherCAT communication (FSoE), add the following safety PDO mappings to the PDO assignment objects (RxPDO assign: 1C12h / TxPDO assign: 1C13h) of the EtherCAT communication for the servo drive.

- RxPDO: receive safety PDO mapping (1604h)
- TxPDO: transmit safety PDO mapping (1A04h)

3.5.2.1 PDO assignment object

Set the safety PDO mapping object to the PDO assignment objects.

■ Receive PDO assignment object

Index (Hex)	Sub-index (Hex)	Settings	ESI file settings
1C12	00	Number of sub-indexes	02h (fixed)
	01	PDO mapping object	Select from 1600 to 1603
	02	Safety PDO mapping object	1604

■ Transmit PDO assignment object

Index (Hex)	Sub-index (Hex)	Settings	ESI file settings
1C13	00	Number of sub-indexes	02h (fixed)
	01	PDO mapping object	Select from 1A00 to 1A03
	02	Safety PDO mapping object	1A04

■ For more information on the PDO mapping object (sub-index1), refer to the ASDA-A3-EP User Manual.

3.5.2.2 Safety PDO mapping object

The PDO mapping objects can be set as receive PDO (1600 to 1604) and transmit PDO (1A00 to 1A04). The objects for the safety functions module are OD 1604h and OD 1A04h.

■ RxPDO 1600 to 1603 and TxPDO 1A00 to 1A03 are dedicated to servo drives.

RxPDO			TxPDO		
Index (Hex)	Name	Sub-index (Hex)	Index (Hex)	Name	Sub-index (Hex)
1600	1st PDO mapping	0 - 8	1A00	1st PDO mapping	0 - 8
1601	2nd PDO mapping	0 - 8	1A01	2nd PDO mapping	0 - 8
1602	3rd PDO mapping	0 - 8	1A02	3rd PDO mapping	0 - 8
1603	4th PDO mapping	0 - 8	1A03	4th PDO mapping	0 - 8
1604	Safety PDO mapping	0 - 19	1A04	Safety PDO mapping	0 - 19

Configure the safety functions to be used for the safety PDO mappings.

The following table shows the mapping at the factory setting. Sub-indices 02 to 11 can be changed to any value.

■ Receive safety PDO (Safety controlword)

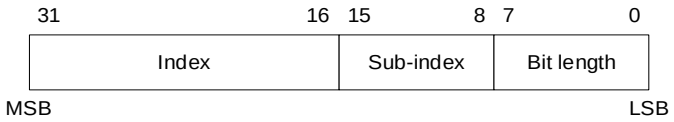
Index (Hex)	Sub-index (Hex)	Safety function	ESI file settings
1604	00	Number of sub-indices	13h (fixed)
	01	FSoE master command	6770 01 08h (fixed)
	02	STO command	6640 00 01h
	03	SS1_1 command	6650 01 01h
	04	SS2_1 command	6670 01 01h
	05	SOS_1 command	6680 01 01h
	06	-	0000 00 00h
	07	SDIp (positive) command	66D0 00 01h
	08	SDIn (negative) command	66D1 00 01h
	09	Alarm reset command	6632 00 01h
	0A	Restart acknowledge command	6630 00 01h
	0B	-	0000 00 00h
	0C	-	0000 00 00h
	0D	-	0000 00 00h
	0E	-	0000 00 00h
	0F	-	0000 00 00h
	10	-	0000 00 00h
	11	-	0000 00 00h
	12	FSoE CRC_0 word	6770 03 10h (fixed)
	13	FSoE connection ID	6770 02 10h (fixed)

■ You can set up to 14 safety functions, the safety function deactivation (ACK) command, and the alarm reset command in the receive safety PDO, so there is a maximum of 16 functions can be set.

■ Transmit Safety PDO (Safety statusword)

Index (Hex)	Sub-index (Hex)	Safety function	ESI file settings
1A04	00	Number of sub-indices	13h (fixed)
	01	FSoE slave command	6760 01 08h (fixed)
	02	STO state	6640 00 01h
	03	SSM_1 state	66E0 01 01h
	04	SSM_2 state	66E0 02 01h
	05	SOS_1 state	6680 01 01h
	06	-	0000 00 00h
	07	SDIp (positive) state	66D0 00 01h
	08	SDIn (negative) state	66D1 00 01h
	09	Alarm state	6632 00 01h
	0A	Restart acknowledge status	6630 00 01h
	0B	-	0000 00 01h
	0C	-	0000 00 01h
	0D	-	0000 00 01h
	0E	-	0000 00 01h
	0F	-	0000 00 01h
	10	-	0000 00 01h
	11	-	0000 00 01h
	12	FSoE CRC_0 word	6760 03 10h (fixed)
	13	FSoE connection ID	6760 02 10h (fixed)

To assign a PDO mapping, set the index and sub-index of the safety function to be used as follows.



Bits 31 - 16 : index of the safety function object to be used

Bits 15 - 8 : sub-index of the safety function object to be used

Bits 7 - 0 : bit length (fixed to 1)

The safety functions and instances that can be assigned are as follows.

Safety function	Assignable safety function	Setting	PDO
Restart acknowledge	Safety function deactivation (ACK) command / state	6630 00 01	Rx/Tx
Error acknowledge	Alarm reset command / Alarm state	6632 00 01	Rx/Tx
Safe Torque Off (STO)	STO command	6640 00 01	Rx/Tx
Safe Stop 1 (SS1)	SS1 commands 1 - 4	6650 01 01 - 6650 04 01	Rx/Tx
Safe Brake Control 2 (SBC)	SBC command	6660 01 01	Rx/Tx
Safe Operating Stop (SOS)	SOS commands 1 - 4	6668 01 01 - 6668 04 01	Rx/Tx
Safe Stop 2 (SS2)	SS2 commands 1 - 4	6670 01 01 - 6670 04 01	Rx/Tx
Safely-limited Speed (SLS)	SLS commands 1 - 4	6690 01 01 - 6690 04 01	Rx/Tx
Safely-limited Position (SLP)	SLP commands 1 - 4	66A0 01 01 - 66A0 04 01	Rx/Tx
Safe Maximum Speed (SMS)	SMS status monitor	66A8 00 01	Tx
Safely-limited Increment (SLI)	SLI commands 1 - 4	66B8 01 01 - 66B8 04 01	Rx/Tx
Safe Direction Positive (SDIp)	SDIp command	66D0 00 01	Rx/Tx
Safe Direction Negative (SDIn)	SDIn command	66D1 00 01	Rx/Tx
Safe Speed Monitor (SSM)	SSM status monitor	66E0 00 01	Tx
Safe Brake Test (SBT)	SBT command	3600 00 01	Rx/Tx

- The SS1, SOS, SS2, SLS, SLP, and SLI functions have four instances. Each instance runs independently.

3.5.2.3 Setting safety parameters

Set each parameter of the safety function with command assigned to the PDO mapping. For more information on the parameters of each safety function and the object index, refer to Chapters 4 and 6.

- When the system starts up, make sure to download all safety parameters from the host controller to the safety functions module.
- When the Safety-limited Position (SLP) function is used, DSI4A / B and DSO6 will be used for the safety home position detection device. Set 0x000D (Safety home position sensor) to Sub-index 4 of Object index 3800h (DSI setting) and to Sub-index 6 of Object index 3801h (DSO setting). If these two settings are set to a value other than 0x000D, AL5C0 occurs.

3.5.2.4 Setting Diagnostic Parameter

This product constantly diagnoses encoder failures, and the diagnostic sensitivity can be adjusted by parameters. Set Sub-index 1 "Encoder diagnostic sensitivity (setting range: 5 to 1000 (0: diagnostic function disabled))" of Object index 3810h (system settings). The default value is 100 (recommended value). A higher value indicates a higher sensitivity (easier to detect errors).
Set a lower value before adjusting the servo gain of the servo drive, and reset it to the original value after adjustment.

In the following cases, set a lower value in advance.

- Large load fluctuation (disturbance) during operation
- Low rigidity
- Operation with speed proportional control.

- Setting this parameter to 0 stops the diagnosis. Use this setting when the alarm AL5C2 occurs during adjustment. However, after adjustment, reset it to the original setting.
- For more information on EtherCAT communication objects, refer to Section 6.1.3.

3.5.2.5 Parameter download

In EtherCAT communication (FSoE) mode, parameters cannot be set by Delta Drive Safety. Follow the rules of ETG.5120 and download parameters via EtherCAT master and FSoE master.
For more information, refer to ETG.5120 FSoE Protocol Enhancements.

3.5.3 Precautions

During parameter setting, the servo drive is forcibly shifted to STO state, and the STO state is automatically deactivated after the setting is complete.
Also, parameters cannot be changed while the servo is on.

3.6 Test run

Once the parameters have been set, perform a test run to verify that the safety input / output and the electromagnetic brake power output used in the system are working properly. To activate the safety functions during the test run, the servo should be in the Servo On state.

- After start-up, a self-diagnosis of the safety input and output circuits and the electromagnetic brake power output circuit is performed periodically. When using the safety output and the electromagnetic brake power output circuit, apply the 24 V_{DC} power supply before applying the power supply to the servo drive. If the drive is started with the 24 V_{DC} power supply off, the self-diagnostic function detects a circuit fault, “AL586” or “AL587”.

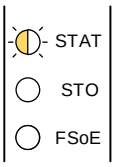
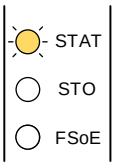
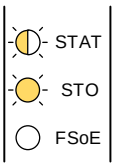
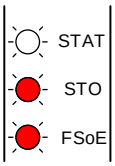
Warning
■ Do not connect the system to the user's machine during the test run. Or, it may result in unexpected machine operation, malfunction, or personal injury.

3.6.1 I/O type

To perform a test run, follow these steps.

(1) Checking status

Turn on the power to the drive and verify that the LED indicators are lit as shown in the “Normal” row in the following table.

Status		LED indication	
Power-on		“Safety”, “STAT”, “STO”, and “FSoE” are lit in sequence	
Normal	Ready		STAT: slow flashing orange
	Normal state (Ready to operate)		STAT: steady orange
Error	Parameter setting error (AL5C1)		STAT: fast flashing orange STO: steady orange
	Alarm state		STAT: off STO: steady red FSoE: steady red

If a parameter setting error occurs, refer to Section 3.5 to check the parameter settings. If other alarms occur, refer to Chapter 7 and take the corrective action properly in accordance with the alarm code.

3

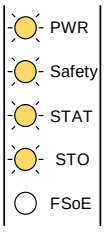
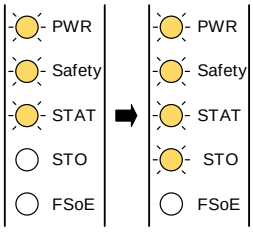
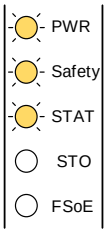
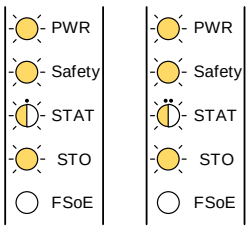
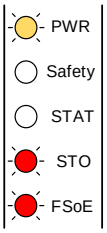
(2) Checking the operation of electromagnetic brake power output (SBC)

Make sure the motor shaft does not move while the servo is Off. Then switch the servo to On and run the servo motor at low speed to confirm that the electromagnetic brake is released.

- Run the servo motor at a safe speed.
- To prevent overcurrent to the servo motor, activate the Torque Limit Function of the servo drive. For information on how to use the Torque Limit Function, refer to the ASDA-A3-EP User Manual.

(3) Checking the operation of safety input

When the servo is on, switch the safety input assigned to the safety function from On to Off starting with DSI1A / B, and check the LED indicators.

Safety function	Safe torque off (STO)	Safe stop 1 (SS1)	Other safety function	Safety monitoring alarm	Other alarms
LED indication					

- If you are using the Safe Torque Off (STO) and the Safe Stop 1/2 (SS1, SS2) and have set “Manual restart” as the method of deactivating the safe state (“restart ACK behavior”), deactivate the safe state by ACK input before checking the operation of the next safety input. For details on how to restart, refer to Chapter 4.
- If an alarm occurs, there may be a logic mismatch (AL585) between channels A and B. Check the wiring and controller settings.
- If you are using the safety input for the safety home position detection device, refer to Section 0.
- If the safety monitoring function detects an error in position or speed, “STAT” flashes one or two times repeatedly.

  Position monitoring error : single flash

  Speed monitoring error : double flash

(4) Checking the operation of safety output

Condition	Checking method	Remarks
To output the status monitor of safety devices	With the servo switched to on, turn off the safety input assigned to the safety function you want to check. At this time, make sure that the safety output is turned on. Example: When assigning the STO function to DSI1A / B and STO monitor to DSO1, make sure that DSO1 is turned on when DSI1A / B is turned off.	The servo motor should be stopped before the check is started.
To output Safe Speed Monitor (SSM)	Verify that the 2-channel safety outputs turn off when the servo motor is running at a speed exceeding the “Velocity upper limit” (or “Velocity lower limit”)	For test runs, lower the “Velocity upper limit” (or “Velocity lower limit”) setting and run at a safe speed.

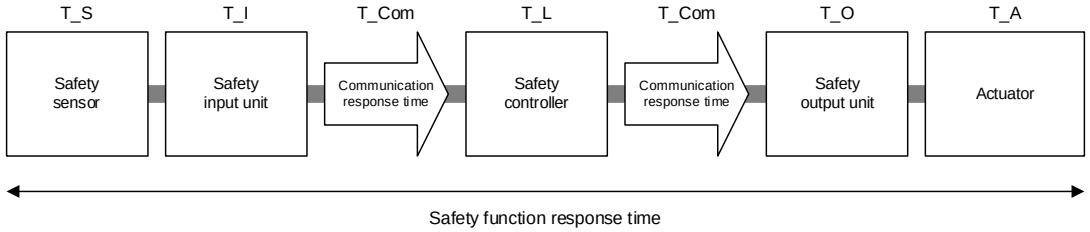
■ If you are using the safety output for the safety home position detection device, refer to Section 0.

3.6.2 EtherCAT communication (FSoE) type

3.6.2.1 FSoE communication setting

3

In ETG.5100, the FSoE communication path is configured as follows, and the safety function response time is defined as the sum of the delay and communication time of each component.



The delay time for each component is as follows.

Time	Description
T_O + T_A	Response time for the servo drive and safety functions module. The response time for each function is as follows SS1, SS2: 25 ms Others : 15 ms
T_Com	Watchdog time for FSoE communication. The watchdog time of the safety controller must be set to 8 ms or longer. ■ If the processing cycle is 8 ms or longer for the safety function of the safety controller, match the watchdog time setting to the processing cycle. ■ The response cycle is 2 ms for the FSoE communication of this product.
T_S T_I T_L	Response time of the device. Varies depending on the device used.

Calculate the safety function response time of your equipment based on the delay time for each of the preceding components and configure the system to meet the required specifications.

■ The preceding description is a basic configuration.

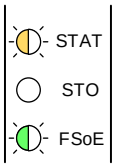
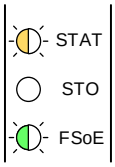
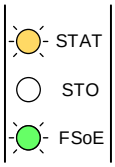
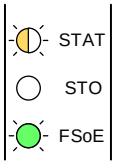
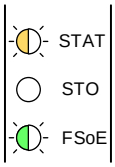
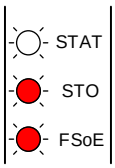
Calculate the safety function response time according to the system.

3.6.2.2 Test run

To perform a test run, follow these steps.

(1) Checking status

After applying power to the servo drive, start EtherCAT (FSoE) communication and confirm that the LED indicators are lit as shown in the following table.

Status	LED indication
Power-on	“Safety” - “FSoE” are lit in sequence
Reset - Session - Connection state	 STAT: slow flashing orange FSoE: slow flashing green
Parameter state	 STAT: slow flashing orange FSoE: fast flashing green
Data state (Process Data: ready to operate)	 STAT: steady orange FSoE: steady green
Data state (Fail Safe Data: not Ready to operate)	 STAT: slow flashing orange FSoE: steady green
Parameter setting error (AL5C0)	 STAT: fast flashing orange FSoE: fast flashing green
Alarm state	 STAT: off STO: steady red FSoE: steady red

After successful initialization via FSoE communication, the servo enters the “Data” state. If not, check the communication data from the host controller.

If a parameter setting error occurs, refer to Section 3.5 to check the parameter settings.

If other alarms occur, refer to Chapter 7 and take the corrective action properly in accordance with the alarm code.

■ If Fail safe data is received while the servo is on, the servo is forced to enter the STO state.

(2) Checking the operation of the electromagnetic brake power output (SBC)

Make sure the motor shaft does not move while the servo is off. Then turn on the servo and run the servo motor at low speed to confirm that the electromagnetic brake is released.

- Run the servo motor at a safe speed.
- To prevent overcurrent to the servo motor, activate the Torque Limit function of the servo drive. For information on how to use the Torque Limit function, refer to the ASDA-A3-EP User Manual.

(3) Checking the operation of safety input

If you are using the safety input for the safety home position detection device, refer to Section 0.

(4) Checking the operation of safety output

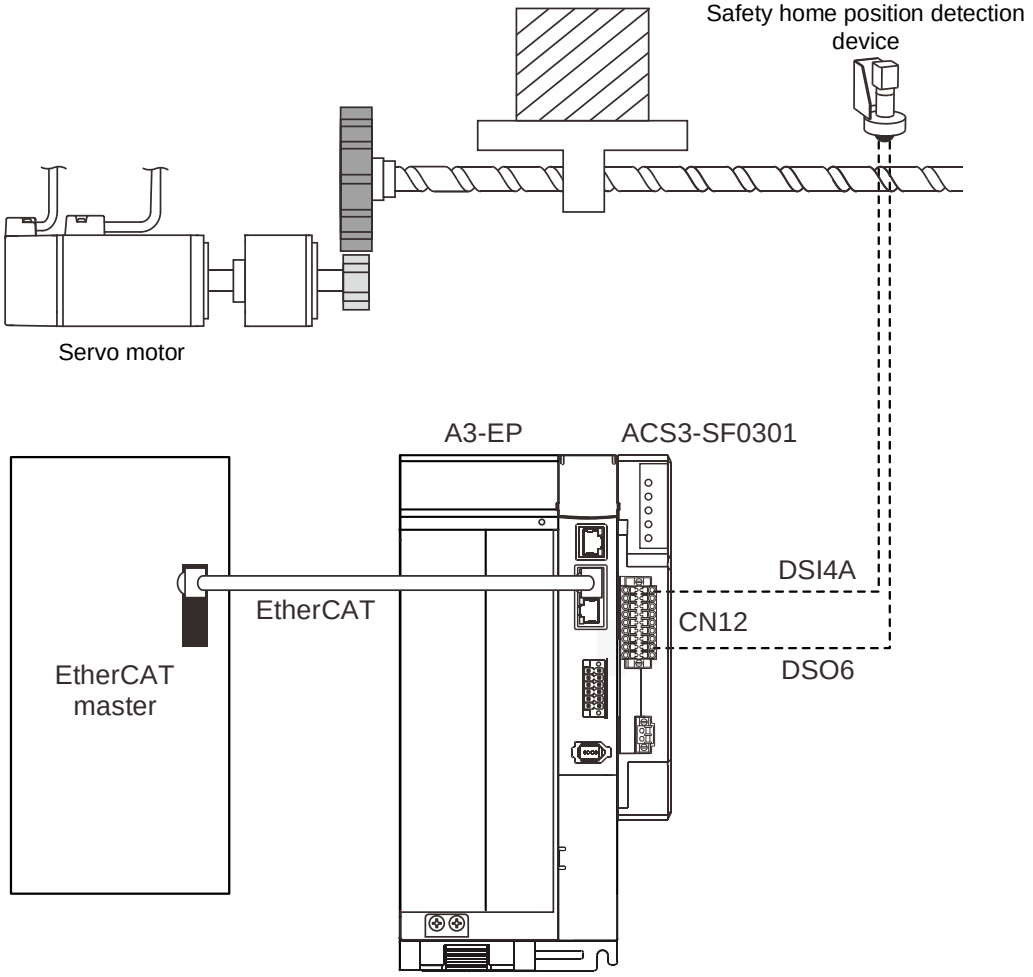
If you are using the safety output for the safety home position detection device, refer to Section 0.

3.7 Setting of safety position

Position monitoring of the Safely-limited Position (SLP) function is based on the safety home position (safety position 0). Therefore, when using the SLP function, make sure to perform the operation for determining the safety home position.

3.7.1 System configuration

Wire the safety home position detection device to the safety functions module. For wiring instructions, refer to Section 2.2.2.4.



- The safety home position detection device is not intended to manage the system position, but to determine the safety position of the safety functions module. To generate the servo position, prepare a separate home position detection device for the servo and perform the homing operation. For details on the homing operation, refer to the ASDA-A3-EP User Manual.

3.7.2 How to set the safety home position

If the safety home position has not been set, the servo drive informs the host controller (EtherCAT master) that “Safety home position is not set (Object index: 2455h = 0)”. The front panel of the servo drive displays “S.POS.U”.
Follow these steps to determine the safety home position.

(1) Set the homing-related parameters.

Index	Sub-index	Parameter	Setting
6060h	-	Operation mode	06: homing mode
6098h	-	Homing method	-5: safety home position diagnosis -6: safety home position diagnosis -7: safety home position search -8: safety home position search
6099h	1	Homing speed (Speed during switch search)	Set it to 200 rpm or lower.
609Ah	-	Homing acceleration	Unrestricted
2455h	-	Safety home position setting status	0: safety home position is not set 1: safety home position is set or SLP is not used * When the SLP function is not assigned to the safety input, 1 is always displayed.
2456h	-	Safety home position diagnosis status	0: safety home position diagnosis complete 1: safety home position diagnosis not complete

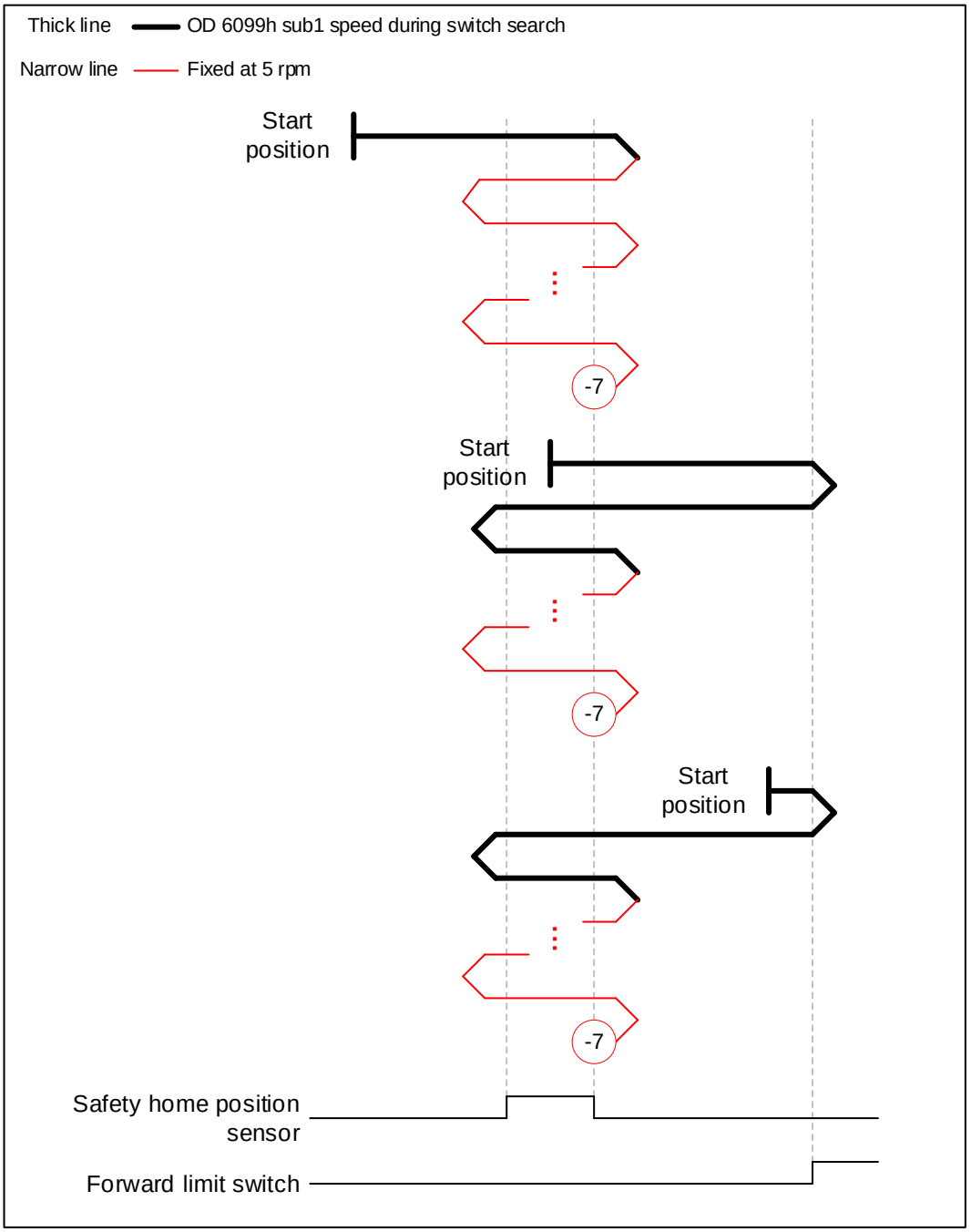
- Homing methods -5 and -6 are for diagnosing the safety home position. If either of the methods is used before the safety home position is set, the homing error (Object index: 6041h Bit 13 = 1) occurs.
- If the homing speed is too fast, signals from the safety home position detection device may not be detected.
- Object indices 2455h and 2456h should be mapped to PDO and monitored constantly or read periodically via SDO transfer.

(2) Switch the servo to On and start the homing procedure. (Set the Object index 6040h Bit 4-0 = 11111)

■ Method: -7

After moving in the forward direction and passing the safety home position sensor, the motor runs back and forth between the two ends of the sensor several times and stops near the edge shown in the following figure.

If a forward limit switch is detected while the motor is moving, it reverses to search for the safety home position.

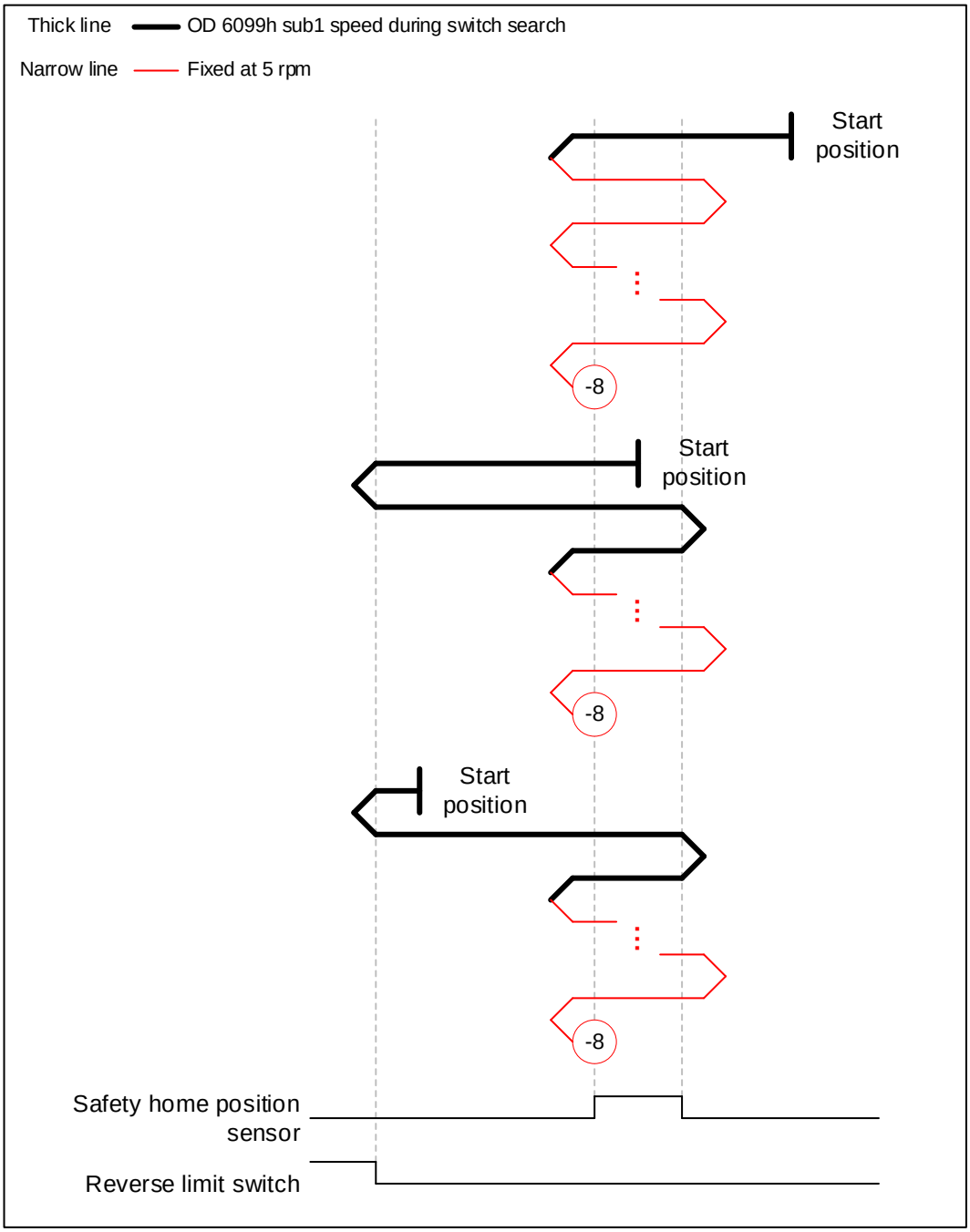


3

■ Method: -8

After moving in the reverse direction and passing the safety home position sensor, the motor runs back and forth between the two ends of the sensor several times and stops near the edge shown in the following figure.

If a reverse limit switch is detected while the motor is moving, it reverses to search for the safety home position.



(3) Exit homing mode when you are notified that “Safety home position is set (Object index: 2455h = 1)” and homing is complete (Object index: 6041h Bit 12 = 1).

At this point, the front panel of the drive switches to the monitoring display set in P0.002.

- If an error is detected during homing, the homing error (Object index 6041h Bit 13 = 1) is reported.

3.7.3 Detection error of safety home position

The safety home position is subject to detection errors due to the system configuration (such as gear ratio and ball screw lead), the repeatability of the safety home position sensor, and the detection delay time of the product.

The SLP monitoring level ("Position monitoring level upper limit" / "Position monitoring level lower limit") should be set based on the position where Sub-index 1 "Safety position monitor" of Object index 3821h (monitor data) is 0.

To check from Delta Drive Safety, refer to the Safe Position Actual Value on the SLP parameter setting page.

- When the safety home position is reset, the safety home position may shift due to a detection error of the safety home position. After resetting the safety home position, be sure to check the appropriateness of the SLP monitoring level.

3.7.4 Resetting safety home position

After determining the safety home position, reset the safety home position if any of the following conditions applies:

(a) A misalignment is detected by the safety home position diagnosis.

(b) The absolute position reset function for the servo drive has been performed.

(c) The safety home position detection device has been replaced.

(d) The mounting position of the safety home position detection device has been changed.

(e) The servo motor has been replaced.

(f) The encoder battery has been replaced.

- After the safety home position is reset, the safety functions module enters “Safety home position is not set (Object index: 2455h = 0)”, which restricts the use of the Safely-limited Position (SLP) function. Refer to Section 0 to reconfigure the safety home position and remove the restriction.
- In case of condition (a), check the detection device mounting position before resetting the safety home position.

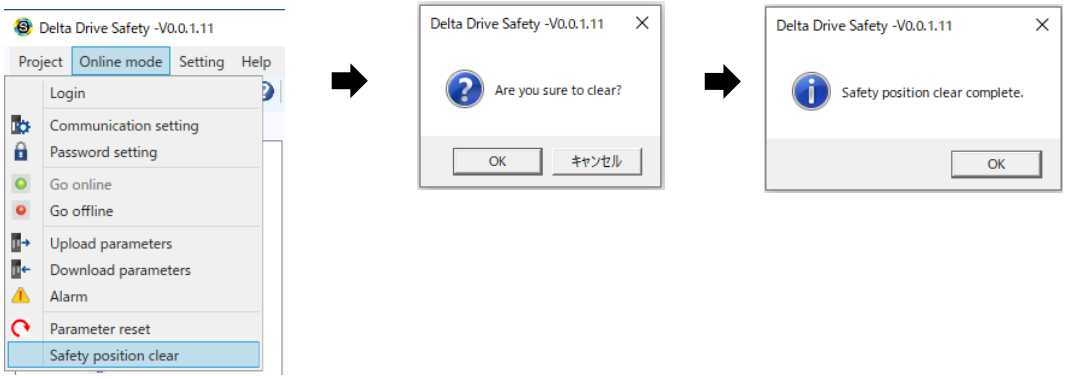
3.7.4.1 Safety home position reset function

In case of replacing the safety home position detection device or changing its mounting position, changing the servo motor, or replacing the batteries, the safety home position should be reset according to the following methods:

(1) Resetting by Delta Drive Safety

Click **Safe position clear** from Online mode in the menu bar.

A confirmation window appears, and after the execution is complete, a completion window is displayed.



(2) Resetting via EtherCAT communication

Set Object index 3811h to 1.

3.8 Periodic inspection

3.8.1 Safety home position diagnosis

3

Once the safety home position has been set, a misalignment diagnosis should be performed on the safety home position detection device when the drive is started. Follow these steps to diagnose the issues.

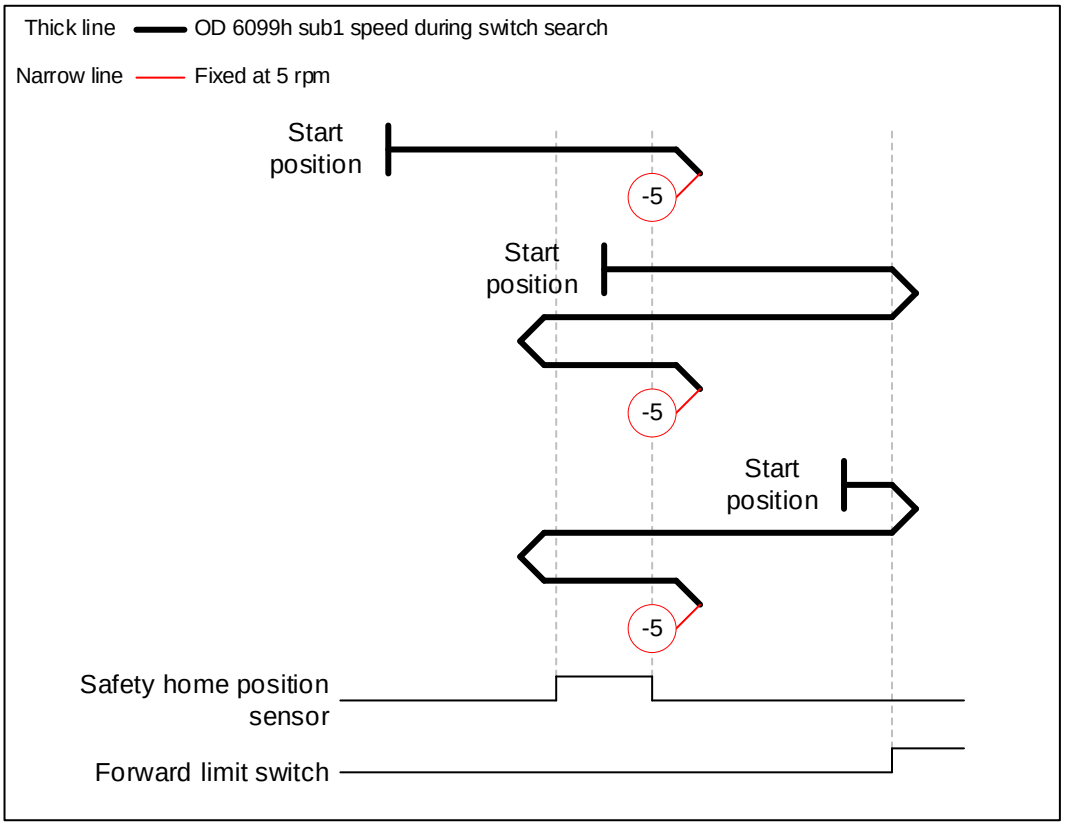
(1) When the servo drive is restarted, the servo drive informs the host controller (EtherCAT master) that “Safety home position diagnosis not complete (Object index: 2456h = 1)”. At this point, the front panel of the servo drive displays “S.POS.d”.

(2) Perform safety home position diagnostic operation (homing method: -5 or -6).

- Method: -5

  The motor moves in the forward direction and the safety home position is set near the falling edge of the safety home position detection device signal.

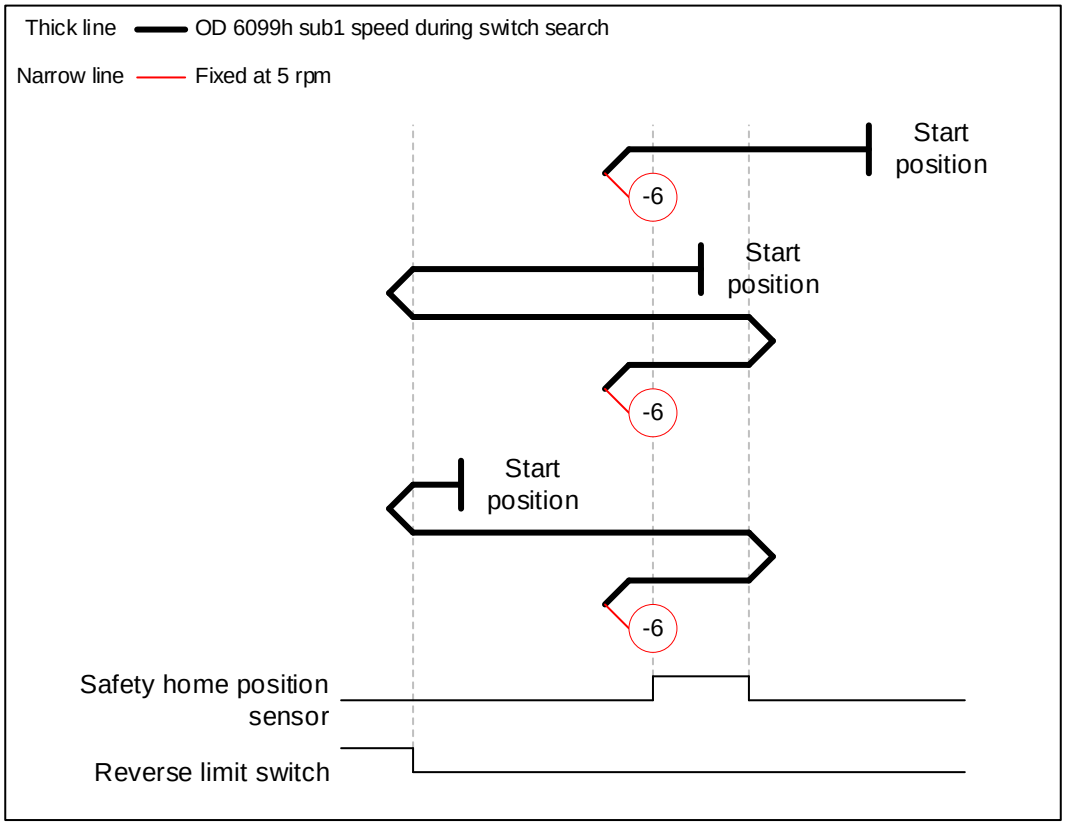
  If a forward limit switch is detected while the motor is moving, it reverses to search for the safety home position detection device signal.



■ Method: -6

The motor moves in the reverse direction and the safety home position is set near the rising edge of the safety home position detection device signal.

If a reverse limit switch is detected while the motor is moving, it reverses to search for the safety home position detection device signal.



(3) Exit homing mode when you are notified that “Safety home position diagnosis complete (Object index: 2456h = 0)” and the homing is complete (Object index: 6041h Bit 12 = 1).

■ The Safely-limited Position (SLP) function cannot be used until the diagnostic process is complete. (Other safety functions are available.)

■ If a misalignment of the safety home position detection device is detected, “Safety home position is not set (Object index: 2456h = 1)” is retained. Reset the safety home position and then set it again.

See Section 3.7.4 for details on how to reset the safety home position.

3.8.2 Diagnosis for electromagnetic brakes

The electromagnetic brake holding torque should be diagnosed with the Safe Brake Test (SBT) function upon servo motor replacement and once in every 3 months. If AL5C8 or AL5CC occurs, the holding force of the electromagnetic brake may be low. Replace the servo motor.

■ See Section 4.13 for details on SBT function and Chapter 7 for details on alarms.

3.8.3 Diagnosis records

List the check items and record the results of test runs and periodic diagnostic assessments. Save the set parameters as well.

■ Checklist example

Item	What to check	Date	Person in charge
Test run	Has a trial run been performed?		
I/O	Is the DSI/DSO operating properly?		
SBC	Is the SBC output operating properly? Is the holding torque of the electromagnetic brake sufficient?		
STO	Is the STO function operating properly?		
…	…		
Password	Is a password set for the Delta Drive Safety software?		
Parameters	Are the parameter settings correct? Are the parameters recorded and stored?		

Safety Functions 4

This chapter describes how to use each safety function.

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4.1 Overview of safety functions

4.1.1 Safety functions

4

This system is equipped with the following safety functions.

Function type	Function name	Description
Safe stop functions	Safe Torque Off (STO)	For shutting off power supply to the servo motor.
	Safe Stop 1 - time controlled (SS1-t)	For starting the STO function after a predetermined amount of time elapses. * It means Safe Stop 1 with time monitoring.
	Safe Stop 1 - ramp monitored (SS1-r)	For monitoring the deceleration rate of the servo motor and initiating the STO function when the speed falls below a given value or a predetermined time elapses. * It means Safe Stop 1 with deceleration monitoring.
	Safe Stop 2 - time controlled (SS2-t)	For starting the SOS function after a predetermined amount of time elapses. * It means Safe Stop 2 with time monitoring.
	Safe Stop 2 - ramp monitored (SS2-r)	For monitoring the deceleration rate of the servo motor and initiating the SOS function when the speed falls below a given value or a predetermined time elapses. * It means Safe Stop 2 with deceleration monitoring.
Safe monitoring functions	Safe Operating Stop (SOS)	For monitoring that the position of the moving part of the equipment stops within a specified range from the position they are in when the function starts.
	Safely-limited Speed (SLS)	For monitoring that the servo motor is operating within the specified speed limits.
	Safe Maximum Speed (SMS)	For monitoring that the servo motor is operating at or below the specified maximum speed.
	Safe Speed Monitor (SSM)	For providing a safety signal indicating that the servo motor is operating within the specified speed limits.
	Safely-limited Increment (SLI)	For monitoring that the position of the moving part of the equipment is operating within a specified range from the position they are in when the function starts.
	Safe Direction (SDI)	For monitoring that the position of the moving part of the equipment does not move beyond a specified range in an unintended direction from the position they are in when the function starts.
	Safely-limited Position (SLP)	For monitoring that the position of the moving part of the equipment is operating within the specified travel range.
Safe output functions	Safe Brake Control (SBC)	For power supply output for electromagnetic brake of servo motors
Auxiliary function	Safe Brake Test (SBT)	For checking that the electromagnetic brake of the servo motor is working properly.

In this product, the safety status is defined as follows:

- Power supply to the motor is cut off by the safe stop functions (including alarm state).
- The servomotor is held by an electromagnetic brake (when a servomotor with an electromagnetic brake is used).

4.1.2 Order of priority

This system is designed to execute multiple safety functions simultaneously. Each safety function specifies an order of priority for its features.

(1) Safe stop functions

- Order of priority: STO (highest) > SS1 > SS2 (lowest).
- For the communication type models, up to four SS1 (and SS2) commands can be mapped to the receive safety PDOs (RxPDOs). If multiple commands are enabled simultaneously, the order of priority is: SS1 command 1 (highest) > 2 > 3 > 4 (lowest). If the commands are enabled in sequential order, the system operates according to the first enabled command.
  For example, if SS1 Command 1 is executed while SS1 Command 3 is in execution, the system continues the operation to stop the motor according to the parameters of SS1 Command 3.

(2) Safe monitoring functions

- The functions are not given prioritized order. All functions can be used simultaneously.
- For the communication type models, up to four identical commands can be mapped to the receive PDOs (RxPDOs) and can be used at the same time. If multiple commands are enabled simultaneously, the system monitors the operation under the strictest conditions.
  For example, if both SLS Command 1 and SLS Command 2 are enabled while SLS velocity limit 1 and 2 are respectively set to 500 rpm and to 100 rpm, the speed is monitored with SLS velocity limit 2.
  * The same applies when using SLS1 and SLS2 for the I/O type.
- Once the STO function is executed, all the safe monitoring functions are deactivated.

(3) Safe output functions

- If the system outputs in conjunction with the STO function and the servo off / on status of the drive, the functions are not given prioritized order.
- Controlling this function with the safety inputs (I/O type) and the SBC commands (communication type) is available only when the servo is Off.

(4) Auxiliary function

- Do not use this function with other safety functions simultaneously.

4.2 Safe Torque Off (STO)

The system carries out the STO function at the time when an STO request is accepted by the safety input (DSIxA / B) or the STO command from EtherCAT communication (FSoE).

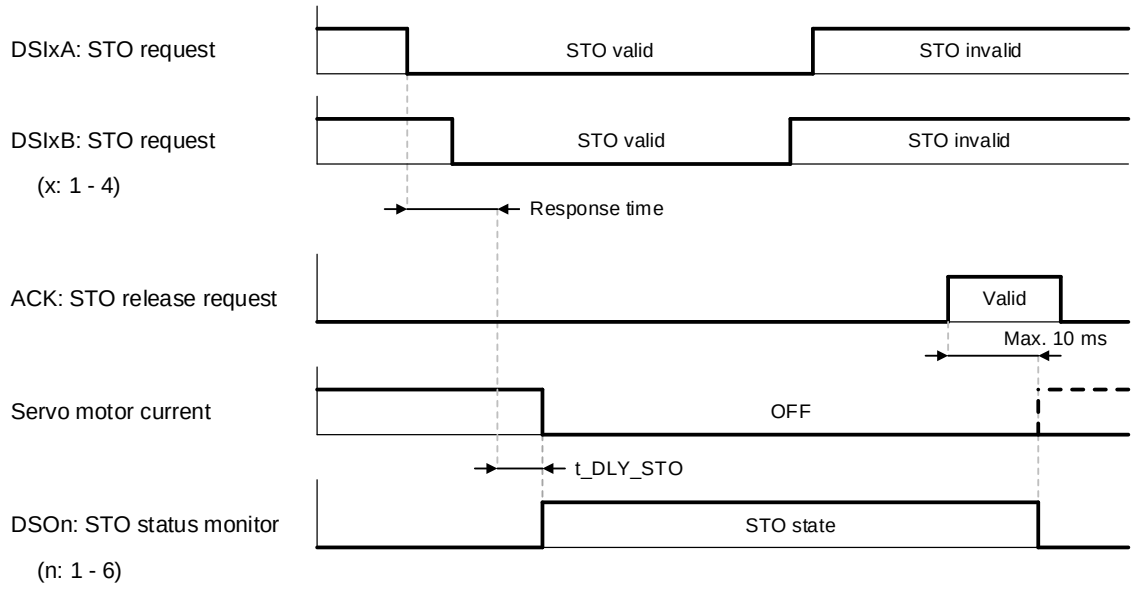
4

4.2.1 I/O type

By turning off DSIxA / B, the STO function is triggered, and then the system goes into the STO state after the response time plus t_DLY_STO elapses.
To deactivate the STO state, turn on DSIxA / B and then turn on the ACK input. The method of deactivating the STO state can be selected by the STO parameter “Restart acknowledge behavior”.

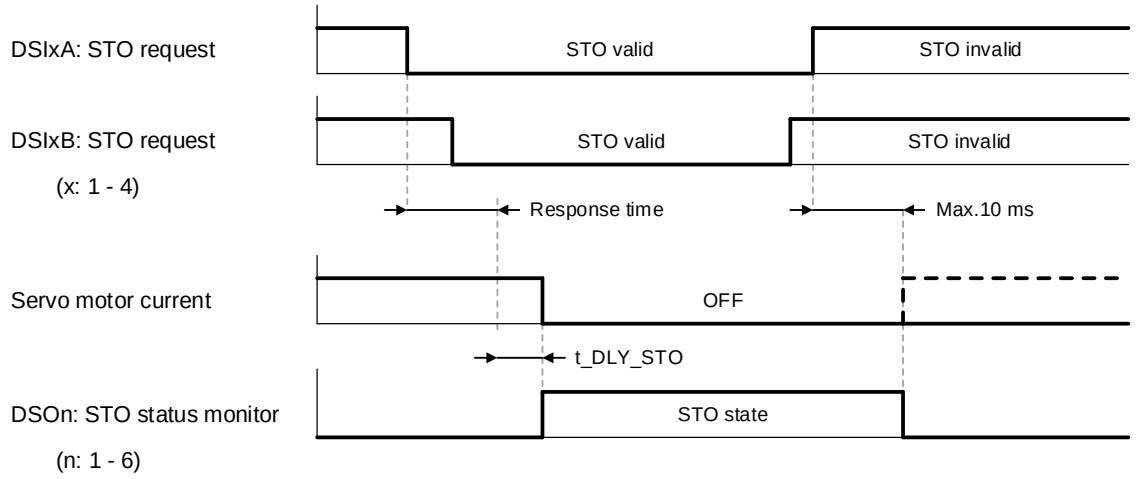
4.2.1.1 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK input should be enabled after the STO request is deactivated by DSIxA / B. If you enable the ACK input before deactivating the STO request, the STO state will not be deactivated.
- If the Servo On command remains enabled when the STO state is deactivated, a current may flow to the servo motor as the STO is deactivated (indicated as dotted lines in the preceding figure), and the servo motor may suddenly start rotating. Pay close attention to the safety of your surroundings when deactivating the STO.
- To monitor the STO state, select the STO state as the output signal from the safety output (DSOn). The STO status monitor does not work as a safety function and should not be used for safety-related applications.

When setting to Automatic restart (Restart acknowledge behavior = 0)



- If the Servo On command remains enabled when the STO state is deactivated, a current may flow to the servo motor as the STO is deactivated (indicated as dotted lines in the preceding figure), and the servo motor may suddenly start rotating.
  Before using this setting, perform risk assessment and take safety precautions to ensure that no hazardous movement is created when DSIxA / B is On.

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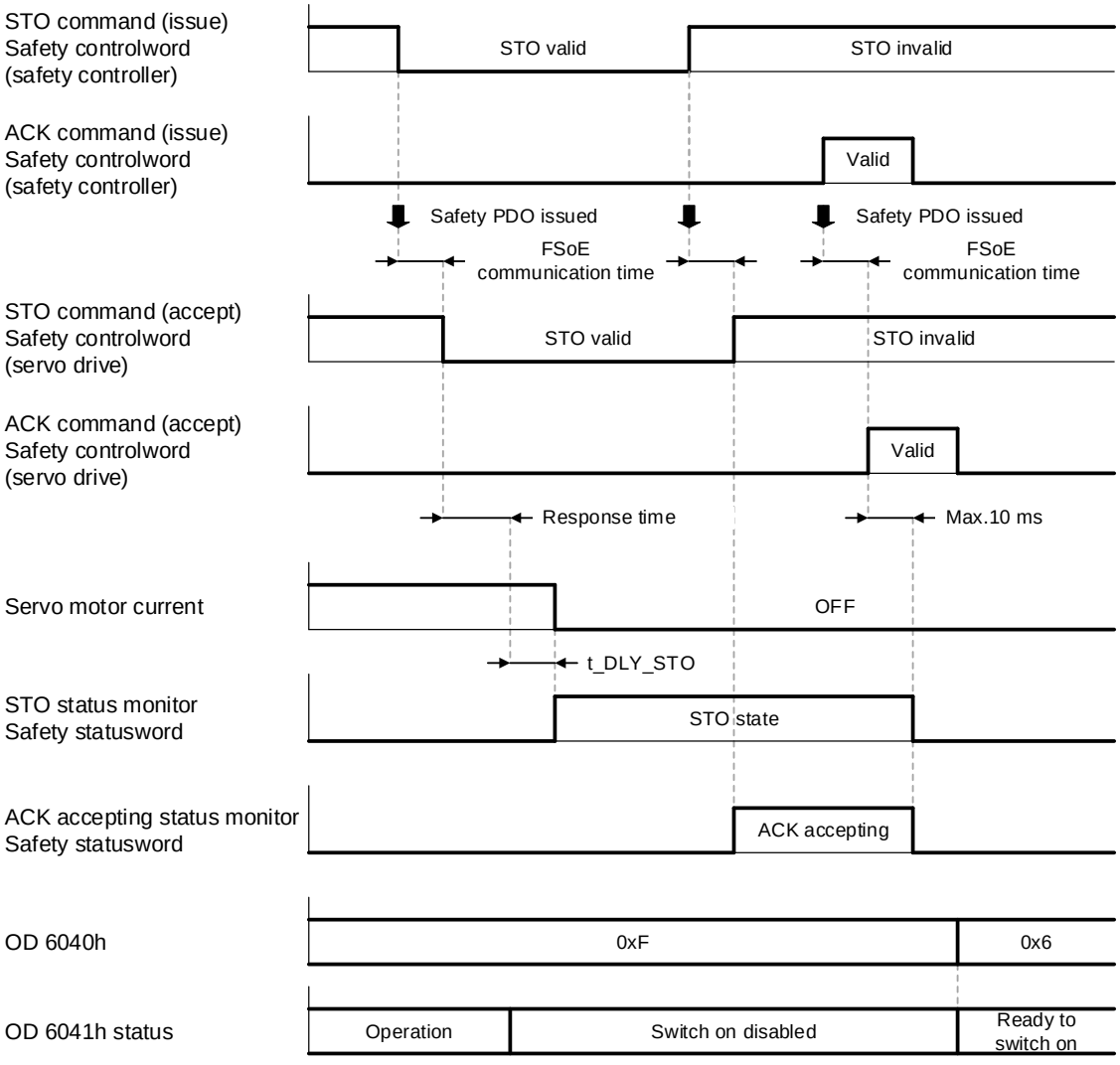
4.2.2 EtherCAT communication (FSoE) type

By setting the STO command assigned to the safety PDO to 0 (STO valid), the STO function is triggered, and then the system goes into the STO state after the response time plus t_DLY_STO elapses.

To deactivate the STO state, set the STO command to 1 (STO invalid) and then set the ACK command to 1 (restart). The method of deactivating the STO state can be selected by the STO parameter “Restart acknowledge behavior”.

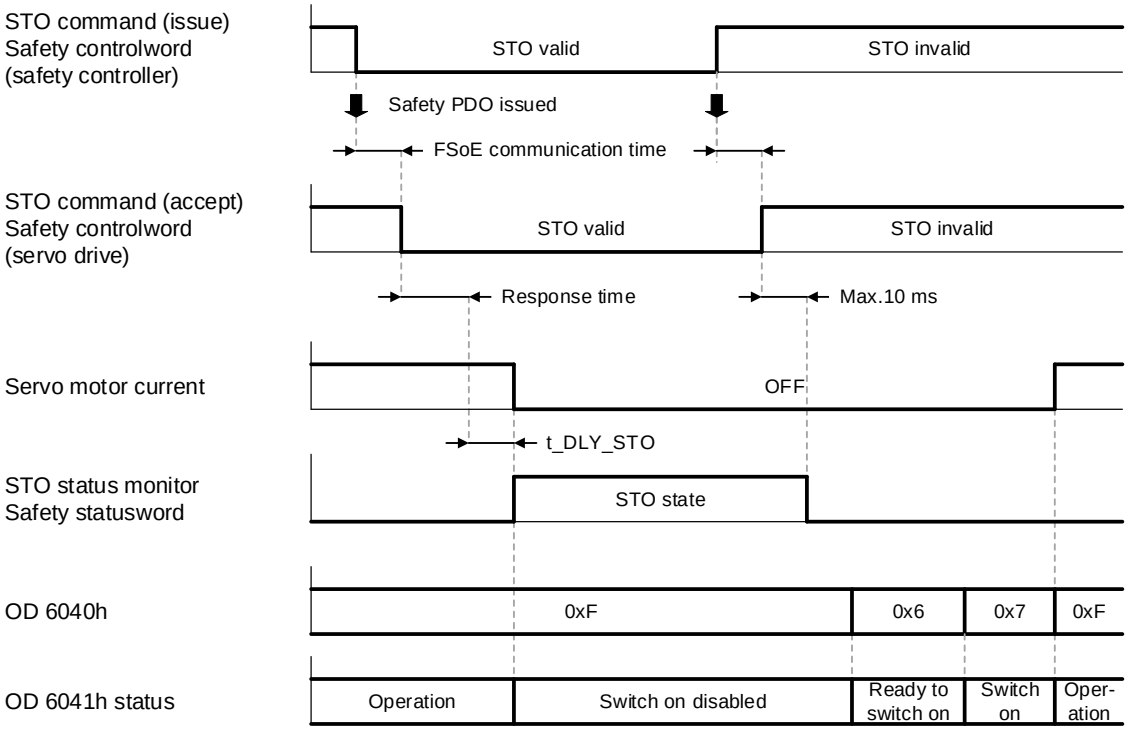
4.2.2.1 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK command should be enabled after the STO request is deactivated by the STO command (ACK accepting status). If you enable the ACK command before deactivating the STO request, the STO state will not be deactivated. (If the ACK command is enabled the same time the STO request is deactivated, the STO state is deactivated.)

When setting to Automatic restart (Restart acknowledge behavior = 0)



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4.2.3 Parameters

<table>
<tr><th>Name</th><th>Abbreviation</th><th>Description</th><th>Unit</th><th>Default setting</th></tr>
<tr><td>Restart acknowledge behavior</td><td>-</td><td>For selecting the method to deactivate the STO state.<table><tr><th>Option</th><th>Description</th></tr><tr><td>Automatic restart</td><td>When the STO request is deactivated, the STO state is automatically deactivated.</td></tr><tr><td>Manual restart</td><td>After the STO request is deactivated, turn on the ACK input (changing the “Restart acknowledge” command to 1) to deactivate the STO state.</td></tr></table></td><td>-</td><td>Manual restart</td></tr>
<tr><td>Activate SBC (for STO)</td><td>-</td><td>For selecting the SBC output operation at the time when the STO function is executed.<table><tr><th>Option</th><th>Description</th></tr><tr><td>Without SBC</td><td>SBC outputs are not linked to STO operation.</td></tr><tr><td>With SBC</td><td>SBC outputs are linked to STO operation.</td></tr></table>■ Refer to Section 0 for more information on the SBC outputs.</td><td>-</td><td>Without SBC</td></tr>
<tr><td>Time to STO</td><td>t_DLY_STO</td><td>For setting the duration from the end of the response time to the time when the STO function is enabled.<table><tr><td>Setting range</td><td>0 - 65535</td></tr></table></td><td>ms</td><td>0</td></tr>
</table>

4.3 Safe Stop 1 (SS1)

The system carries out the SS1 function at the time when an SS1 request is accepted by the safety input (DSIxA / B) or the SS1 command from EtherCAT communication (FSoE).

4.3.1 Selecting functions

This system supports two types of Safe Stop 1 functions.

- SS1-t: Safe Stop 1 with time monitoring (Safe stop 1 - time controlled)
  The system starts the STO function after a preset amount of time has elapsed since the acceptance of the SS1 request.
- SS1-r: Safe Stop 1 with deceleration monitoring (Safe stop 1 - ramp monitoring)
  When the SS1 request is accepted, the system monitors the deceleration rate of the servo motor and starts the STO function when the speed falls below a given value or when a preset time has elapsed.

The Safe Stop 1 function should be selected by this parameter.

Name	Abbreviation	Description	Unit	Default setting
Monitoring type	-	For selecting the function of SS1. Option: SS1 with time monitoring — Description: Time controlled (SS1-t) Option: SS1 with deceleration monitoring — Description: Ramp monitoring (SS1-r)	-	SS1 with time monitoring (SS1-t)

4.3.2 Deceleration method

For this product, the deceleration method can be selected after the Safe Stop 1 function is activated.

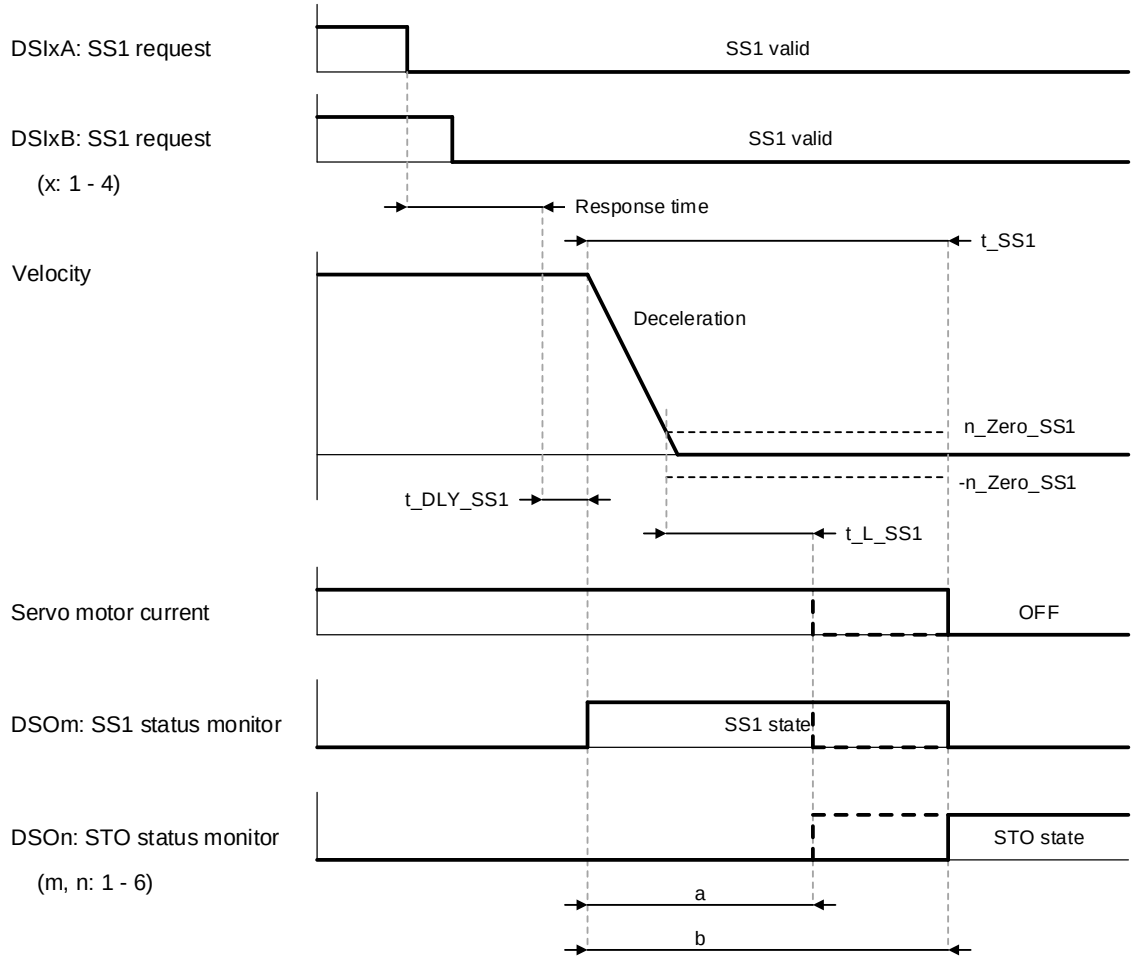
Name	Abbreviation	Description	Unit	Default setting
Deceleration method	-	For selecting the deceleration method. Option: By drive — Description: The servo drive automatically slows down. Option: By controller — Description: The servo drive follows the commands from the controller.	-	By drive

- If “By drive” is selected, the position or speed commands received during deceleration will be discarded.
  When using a servo drive in the position control, update the target position of the controller with the current position acquired from the servo drive before restarting operation.
- If “By controller” is selected, decelerate the motor so that it stops before t_SS1 elapses.

4.3.3 I/O type

By turning off DSIxA / B, the SS1 function is triggered, and then the system goes into the SS1 state (i.e., starts decelerating) after the response time plus t_DLY_SS1 elapses.
To deactivate the STO state, turn on DSIxA / B and then turn on the ACK input. The method of deactivating the STO state can be selected by the STO parameter “Restart acknowledge behavior”.

4.3.3.1 Safe Stop 1 - time controlled (SS1-t)



- For safety reasons, set both the deceleration rate and t_SS1 so that the servo motor stops before t_SS1 elapses. If t_SS1 elapses during deceleration, the servo motor will continue to rotate due to inertia, leading to an unsafe and serious situation.
- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: deceleration time + t_L_SS1
  b: t_SS1
- To monitor the SS1 state, select the SS1 state as the output signal from the safety output (DSOm). The SS1 status monitor does not work as a safety function and should not be used for safety-related applications.
- If the SS2 function is enabled while the SS1 function is running, the SS1 function will continue to run.

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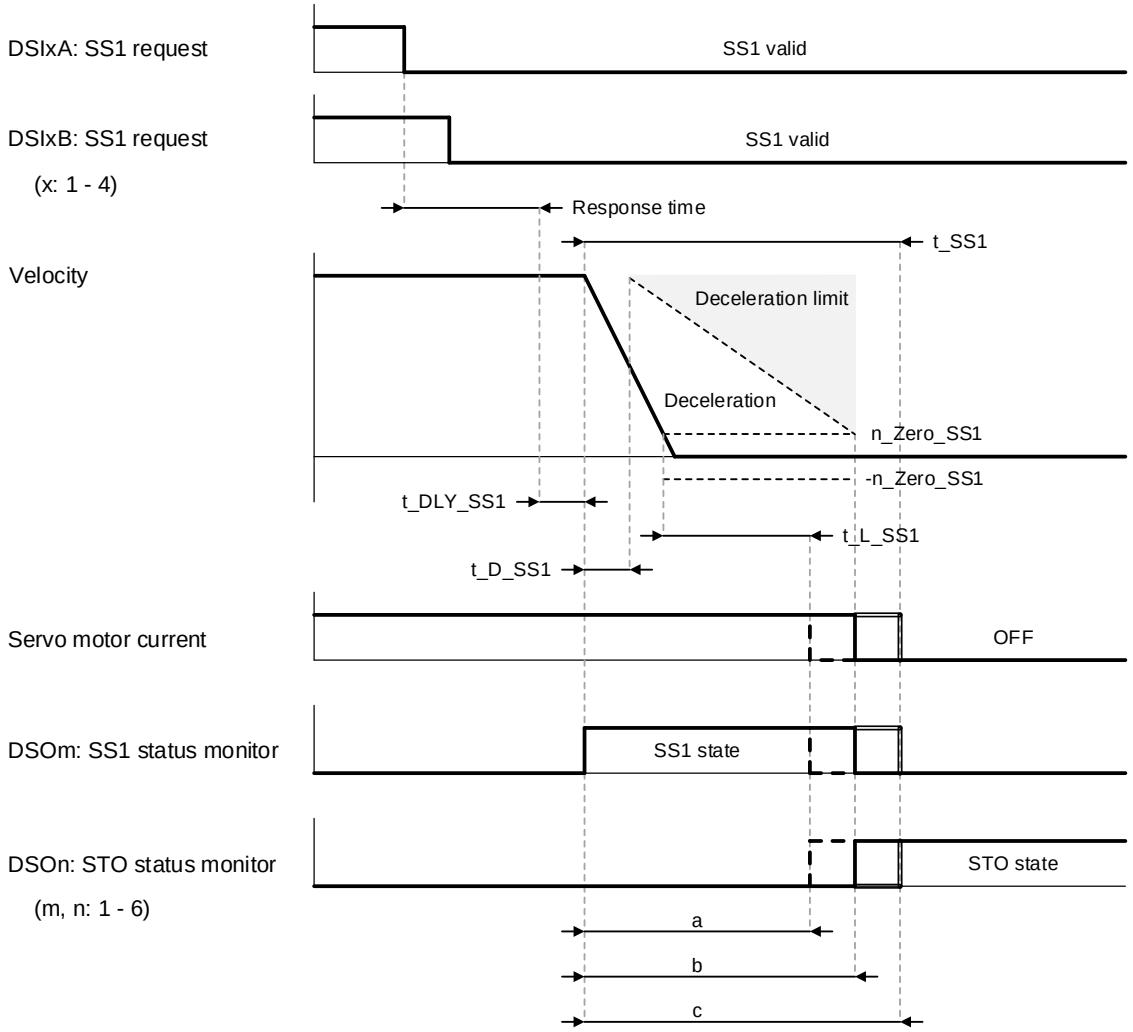
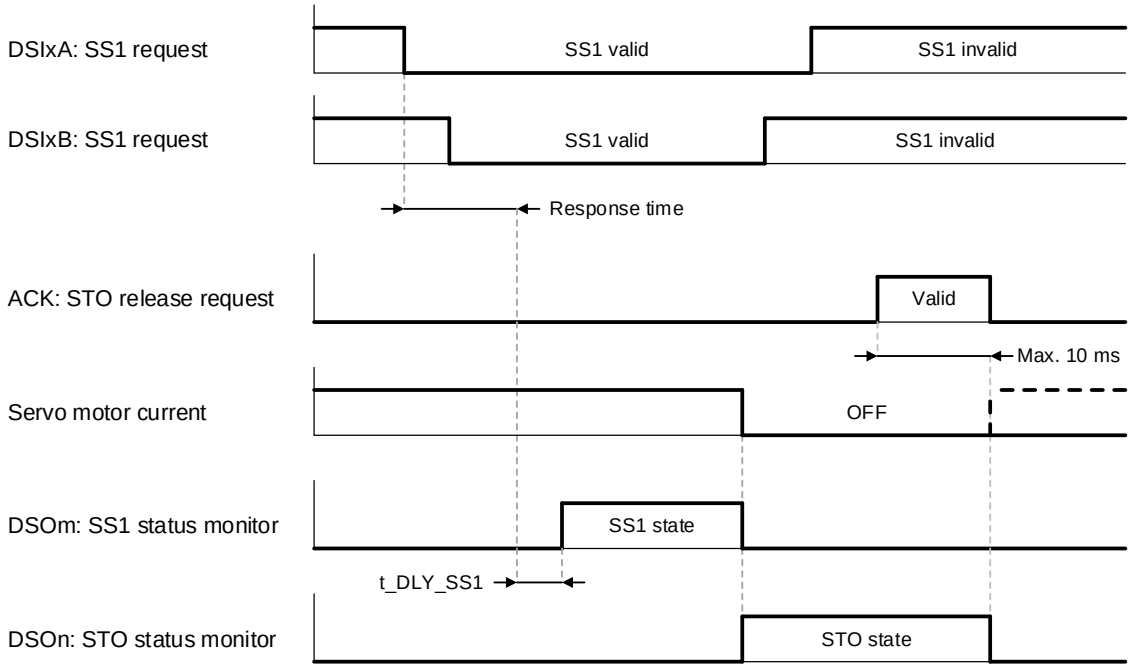
4.3.3.2 Safe Stop 1 - ramp monitoring (SS1-r)



- For safety reasons, set both the deceleration rate and t_SS1 so that the servo motor stops before t_SS1 elapses. If t_SS1 elapses during deceleration, the servo motor will continue to rotate due to inertia, leading to an unsafe and serious situation.
- When a ≤ b and c, refer to the dotted lines in the preceding figure.
  When b < a and c, refer to the solid lines in the preceding figure.
  When c < a and b, refer to the double solid lines in the preceding figure.
  a: deceleration time + t_L_SS1
  b: the time taken for “t_D_SS1 + deceleration limit” to reach n_Zero_SS1
  c: t_SS1
- To monitor the SS1 state, select the SS1 state as the output signal from the safety output (DSOm). The SS1 status monitor does not work as a safety function and should not be used for safety-related applications.
- If the SS2 function is enabled while the SS1 function is running, the SS1 function will continue to run.

4.3.3.3 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK input should be enabled after the SS1 request is deactivated by DSIxA / B. If you enable the ACK input before deactivating the SS1 request, the STO state will not be deactivated.
- If the Servo On command remains enabled when the STO state is deactivated, a current may flow to the servo motor as the STO is deactivated (indicated as dotted lines in the preceding figure), and the servo motor may suddenly start rotating. Pay close attention to the safety of your surroundings when deactivating the STO.

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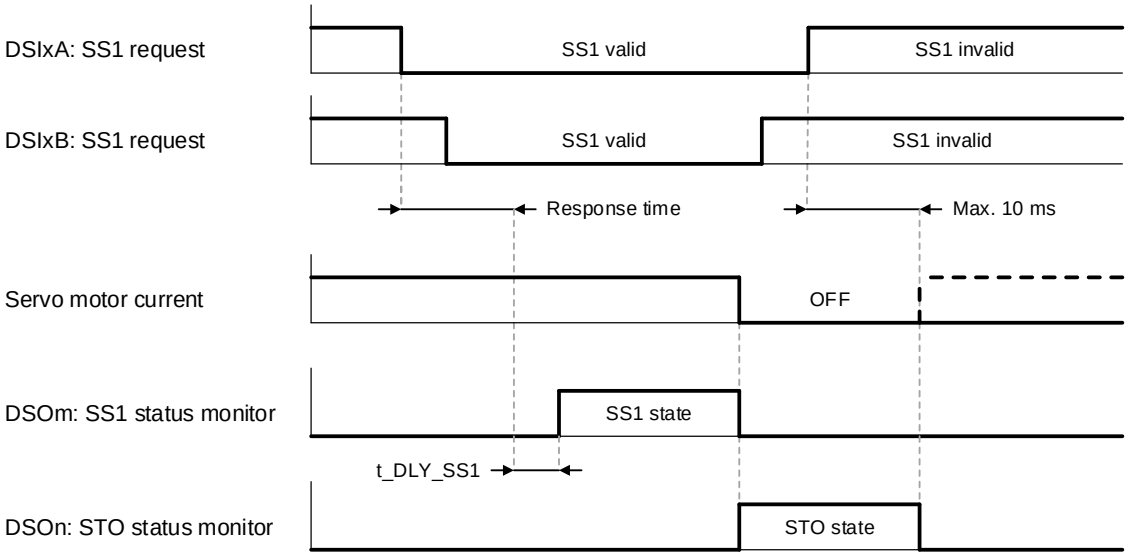
When setting to Automatic restart (Restart acknowledge behavior = 0)



- If the Servo On command remains enabled when the STO state is deactivated, a current may flow to the servo motor as the STO is deactivated (indicated as dotted lines in the preceding figure), and the servo motor may suddenly start rotating.
  Before using this setting, perform risk assessment and take safety precautions to ensure that no hazardous movement is created when DSIxA / B is On.

4.3.4 EtherCAT communication (FSoE) type

By setting the SS1 command assigned to the safety PDO to 0 (SS1 valid), the SS1 function is triggered and then the system goes into the SS1 state (i.e., starts decelerating) after the response time plus t_DLY_SS1 elapses.

To deactivate the STO state, set the SS1 command to 1 (SS1 invalid) and then set the ACK command to 1 (restart). The method of deactivating the STO state can be selected by the STO parameter “Restart acknowledge behavior”.

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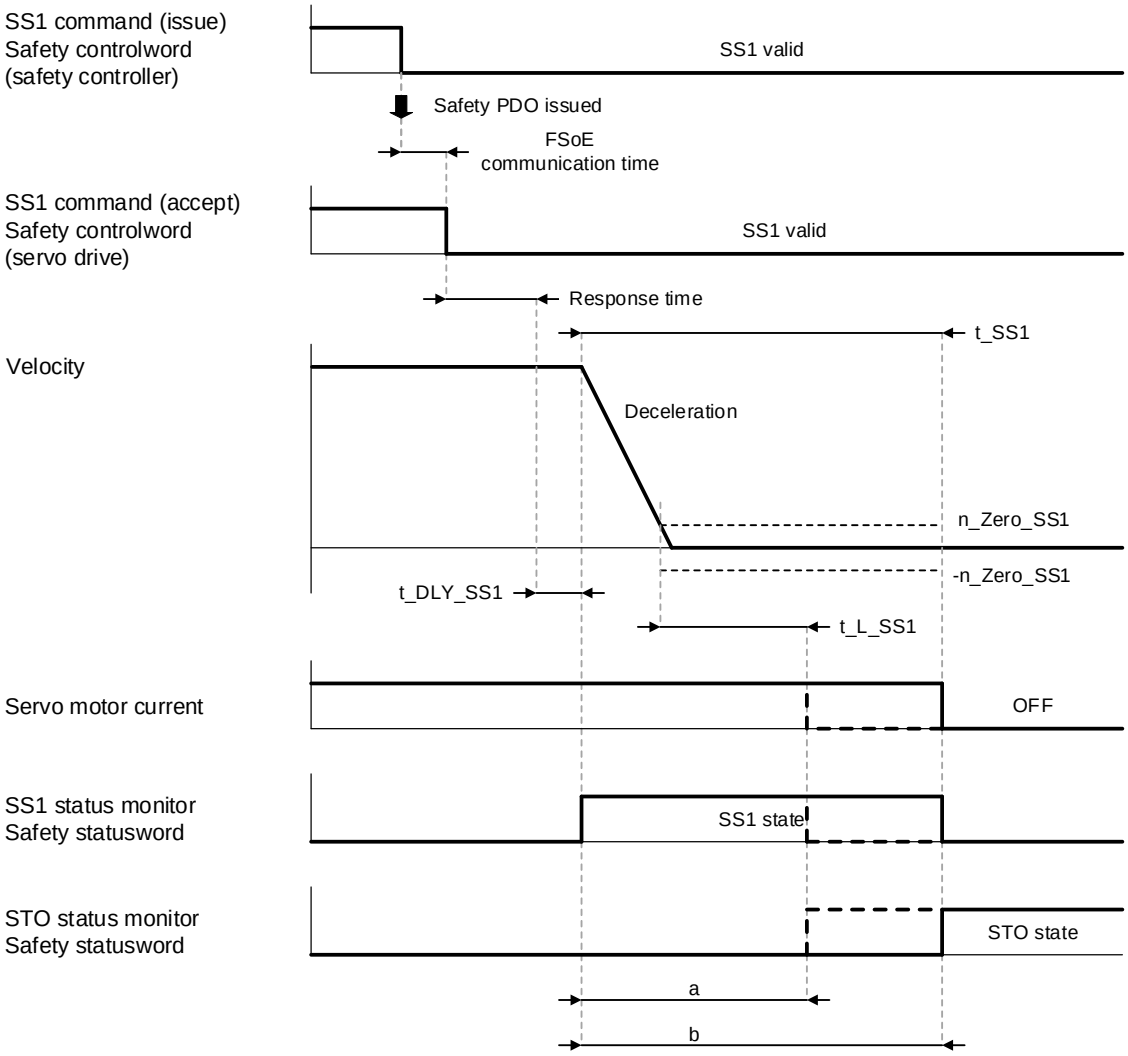
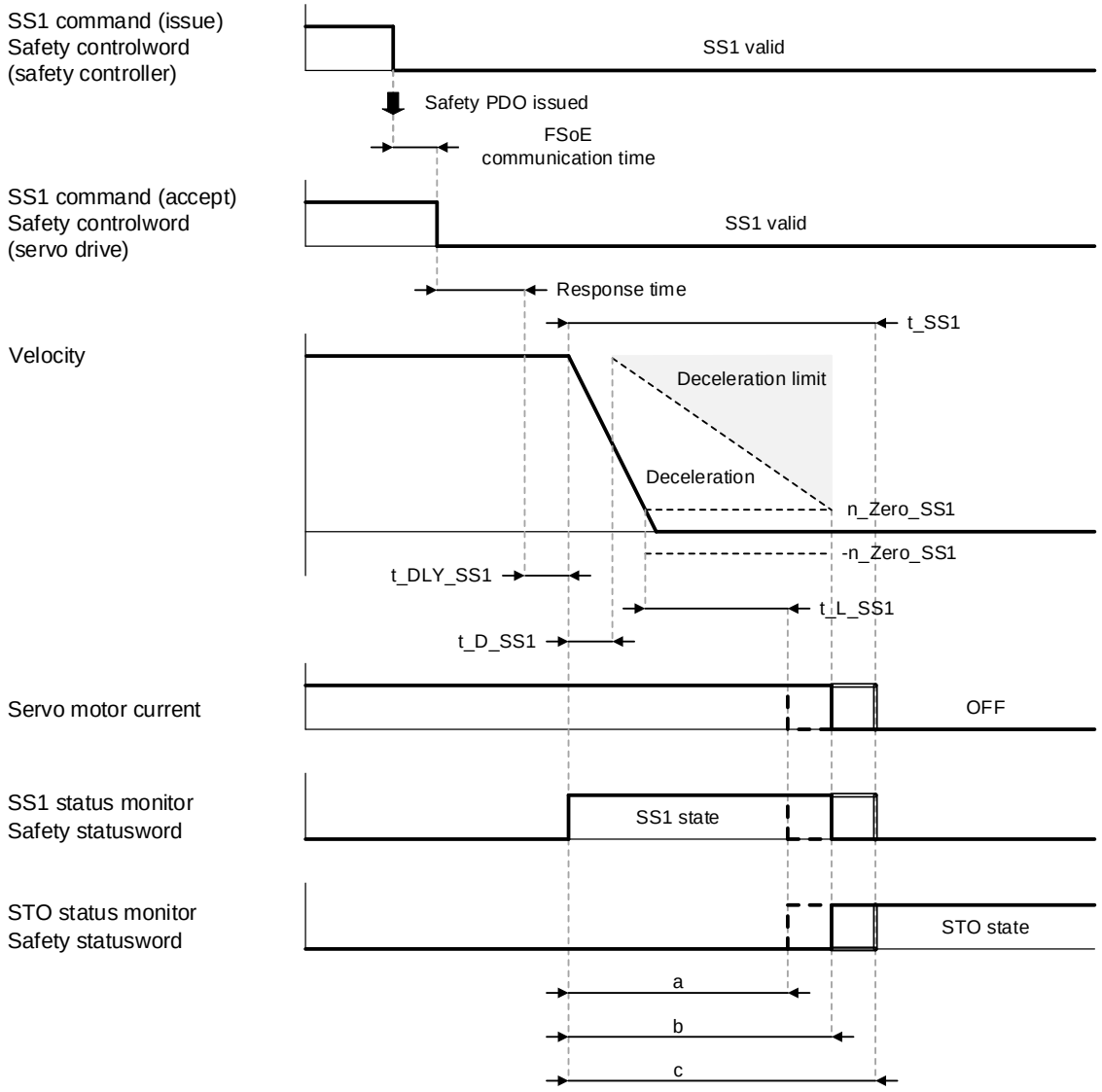
4.3.4.1 Safe Stop 1 - time controlled (SS1-t)



- For safety reasons, set both the deceleration rate and t_SS1 so that the servo motor stops before t_SS1 elapses. If t_SS1 elapses during deceleration, the servo motor will continue to rotate due to inertia, leading to an unsafe and serious situation.
- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: deceleration time + t_L_SS1
  b: t_SS1
- If the SS2 function is enabled while the SS1 function is running, the SS1 function will continue to run.

4.3.4.2 Safe Stop 1 - ramp monitoring (SS1-r)

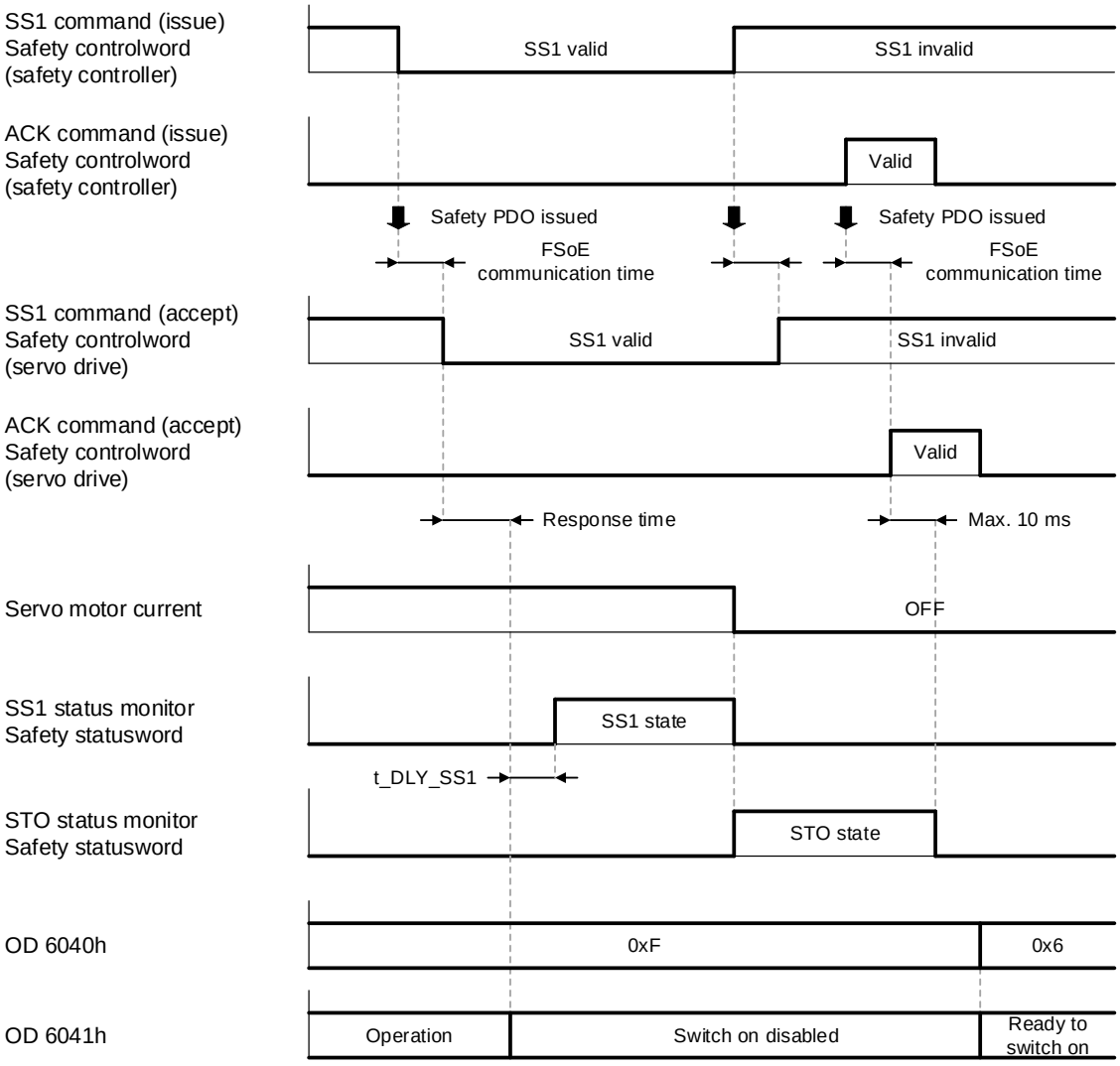


- For safety reasons, set both the deceleration rate and t_SS1 so that the servo motor stops before t_SS1 elapses. If t_SS1 elapses during deceleration, the servo motor will continue to rotate due to inertia, leading to an unsafe and serious situation.
- When a ≤ b and c, refer to the dotted lines in the preceding figure.
  When b < a and c, refer to the solid lines in the preceding figure.
  When c < a and b, refer to the double solid lines in the preceding figure.
  a: deceleration time + t_L_SS1
  b: the time taken for “t_D_SS1 + deceleration limit” to reach n_Zero_SS1
  c: t_SS1
- If the SS2 function is enabled while the SS1 function is running, the SS1 function will continue to run.

4

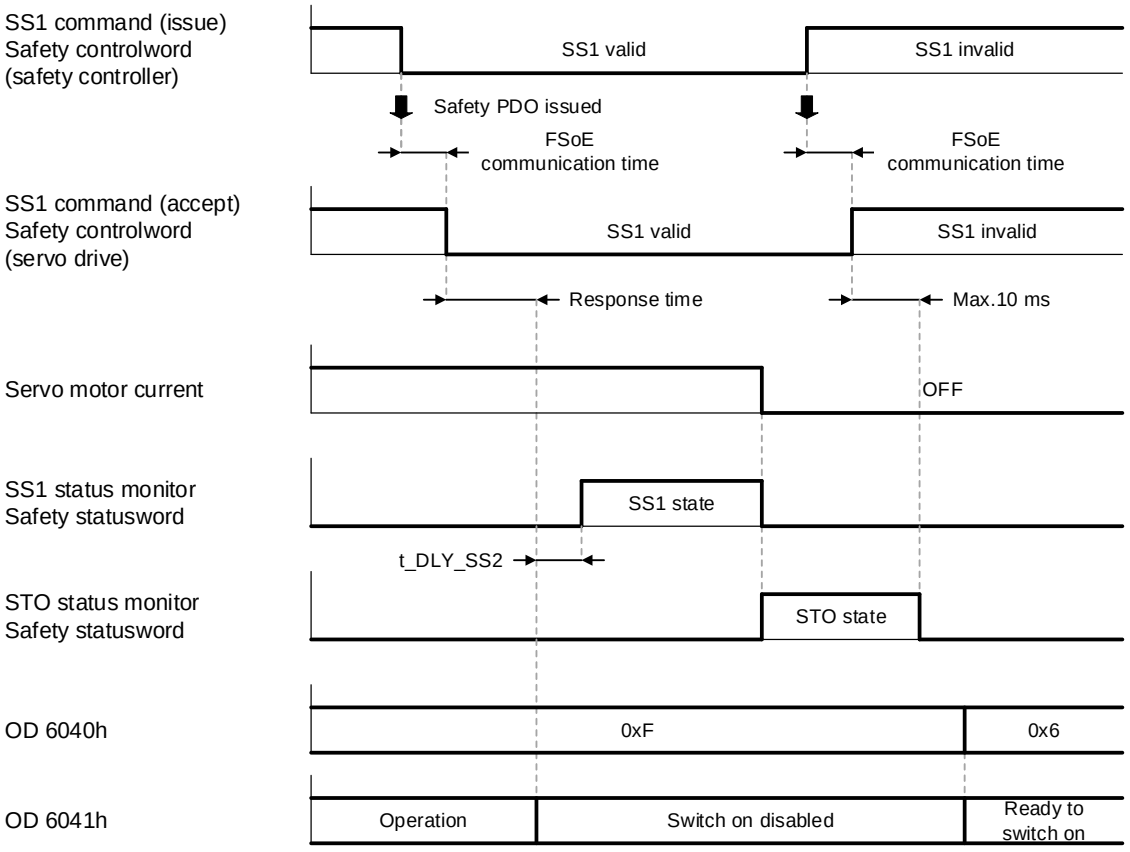
4.3.4.3 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK command should be enabled after the SS1 request is deactivated by the SS1 command. If you enable the ACK command before deactivating the SS1 request, the STO state will not be deactivated. (If the ACK command is enabled the same time the STO request is deactivated, the STO state is deactivated.)

When setting to Automatic restart (Restart acknowledge behavior = 0)



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4.3.5 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to STO	t_SS1	For setting the duration from the end of “response time + t_DLY_SS1” to the time when the STO function is enabled. Setting range: 0 - 65535	ms	0
Time to SS1	t_DLY_SS1	For setting the duration from the end of the response time to the time when the SS1 function is enabled. Setting range: 0 - 65535	ms	0
Velocity zero window	n_Zero_SS1	For setting the speed at which the end of the deceleration is detected. Setting range: 0 - 4294967295	rpm	0
Deceleration	-	For setting the deceleration rate. Setting range: 0 - 4294967295 *2	pulse/s^2	0
Time for velocity zero	t_L_SS1	For setting the duration from the time when the end of deceleration is detected to the time when the STO function is enabled. Setting range: 0 - 65535	ms	0
Deceleration limit*1	-	For setting the level of monitoring of the deceleration rate. Setting range: 0 - 4294967295 *2	pulse/s^2	0
Time delay deceleration monitoring*1	t_D_SS1	For setting the duration from the time when the SS1 function is enabled to the time when the system starts monitoring the deceleration rate. Setting range: 0 - 65535	ms	0
Activate SBC (for SS1)	-	For selecting the SBC output operation at the time when the SS1 function is executed. Without SBC: SBC outputs are not linked to SS1 operation. With SBC: SBC outputs are linked to SS1 operation. ■ Refer to Section 0 for more information on the SBC outputs.	-	Without SBC

Note:

1. This parameter is for Safe Stop 1 - ramp monitoring (SS1-r) only.
2. The resolution follows the position command resolution of the servo drive.

4.4 Safe Stop 2 (SS2)

The system carries out the SS2 function at the time when an SS2 request is accepted by the safety input (DSIxA / B) or the SS2 command from EtherCAT communication (FSoE).

4.4.1 Selecting functions

This system supports two types of Safe Stop 2 functions.

- SS2-t: Safe Stop 2 with time monitoring (Safe stop 2 time controlled)
  The system starts the SOS function after a preset amount of time has elapsed since the acceptance of the SS2 request.
- SS2-r: Safe Stop 2 with deceleration monitoring (Safe stop 2 ramp monitoring)
  When the SS2 request is accepted, the system monitors the deceleration rate of the servo motor and starts the SOS function when the speed falls below a given value or when a preset time has elapsed.

The Safe Stop 2 function should be selected by this parameter.

Name	Abbreviation	Description	Unit	Default setting
Monitoring type	-	For selecting the function of SS2. Option: SS2 with time monitoring — Description: Time controlled (SS2-t) Option: SS2 with deceleration monitoring — Description: Ramp monitoring (SS2-r)	-	SS2 with time monitoring (SS2-t)

4.4.2 Deceleration method

For this product, the deceleration method can be selected after the SS2 function is activated.

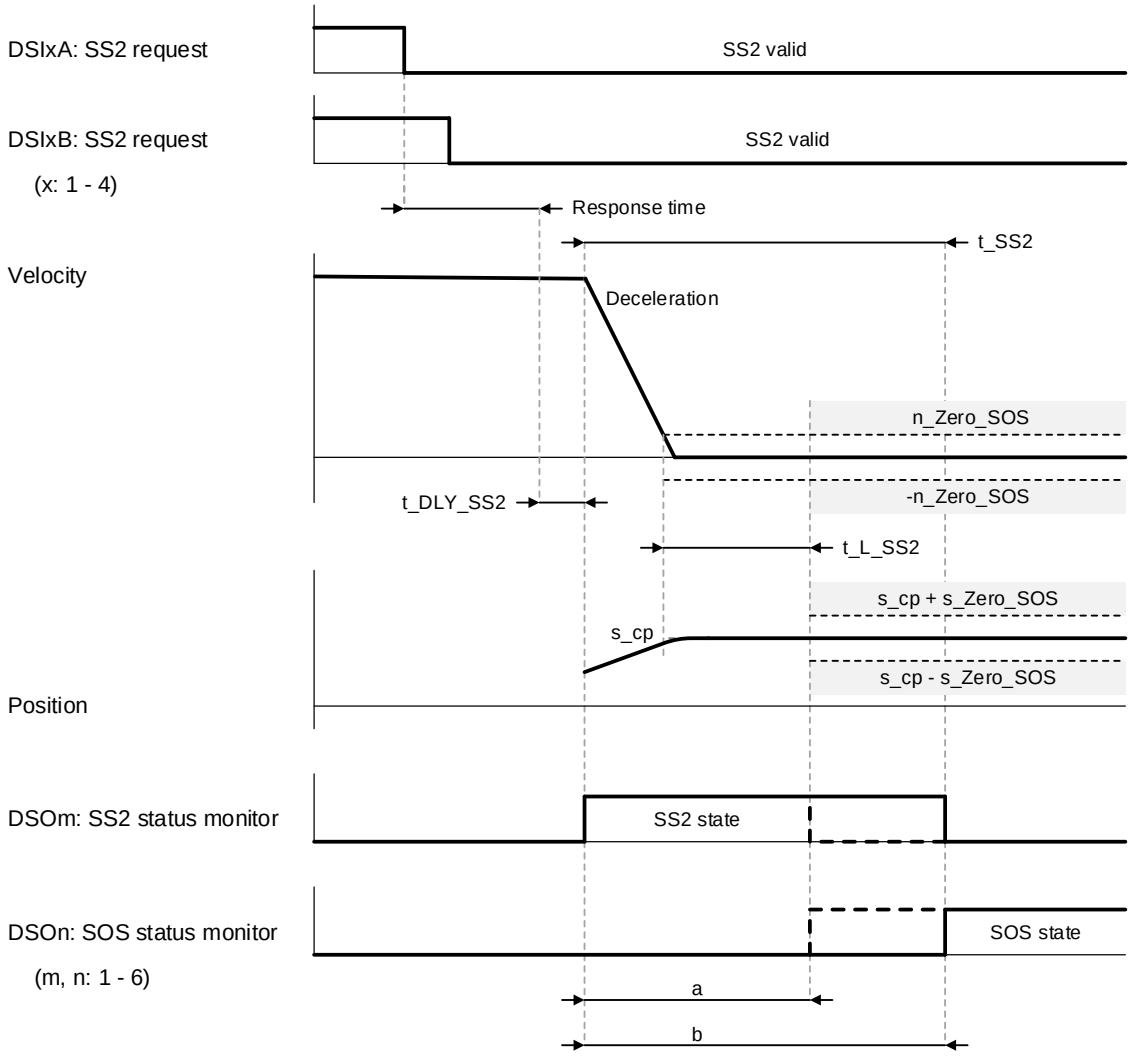
Name	Abbreviation	Description	Unit	Default setting
Deceleration method	-	For selecting the deceleration method. Option: By drive — Description: The servo drive automatically slows down. Option: By controller — Description: The servo drive follows the commands from the controller.	-	By drive

- If “By drive” is selected, the position or speed commands received during deceleration will be discarded.
- If “By drive” is selected, the motor follows the position / speed command received by the drive when the SOS function starts. To prevent unintended motion, it is recommended that you stop the position / speed command before the SOS function starts.
  When using a servo drive for position control, update the target position of the controller with the current position acquired from the servo drive before restarting operation.
- If “By controller” is selected, decelerate the motor so that it stops before t_SS2 elapses.

4.4.3 I/O type

By turning off DSIxA / B, the SS2 function is triggered, and then the system goes into the SS2 state (i.e., starts decelerating) after the response time plus t_DLY_SS2 elapses.
To deactivate the SOS state, turn on the DSIxA / B and then turn on the ACK input. The method of deactivating the SS2 state can be selected by the SS2 parameter “Restart acknowledge behavior”.

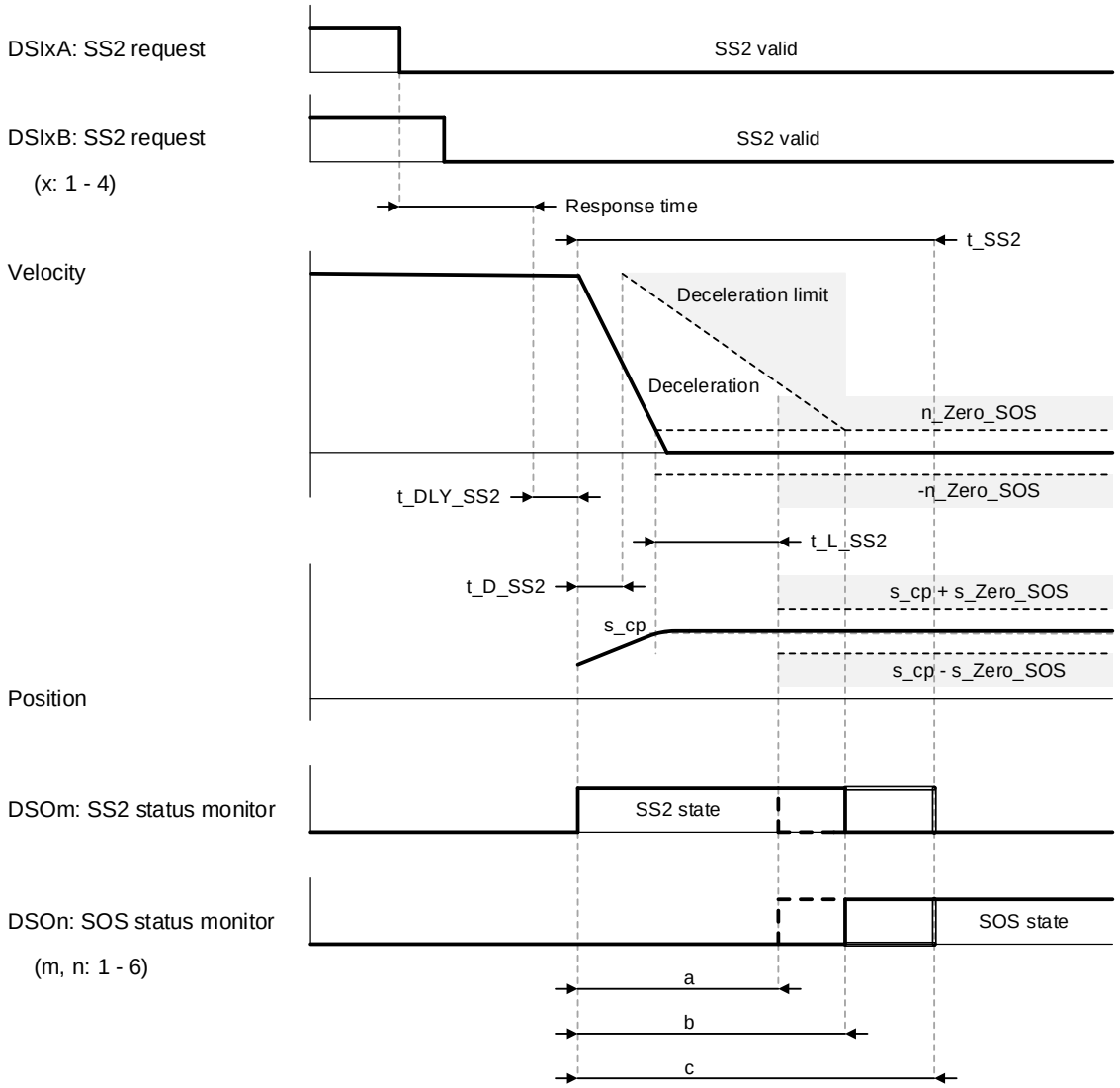
4.4.3.1 Safe Stop 2 - time controlled (SS2-t)



- For safety reasons, set both the deceleration rate and t_SS2 so that the servo motor stops before t_SS2 elapses. If t_SS2 elapses during deceleration, an anomaly may be detected by the SOS position monitor.
- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: deceleration time + t_L_SS2
  b: t_SS2
- For more information on n_Zero_SOS and s_Zero_SOS, refer to Section 0.
- To monitor the SS2 state, select the SS2 state as the output signal from the safety output (DSOm). The SS2 status monitor does not work as a safety function and should not be used for safety-related applications.
- If the SS1 function is enabled while the SS2 function is running, the system switches to the SS1 operation (STO state) after the servo motor stops.

4

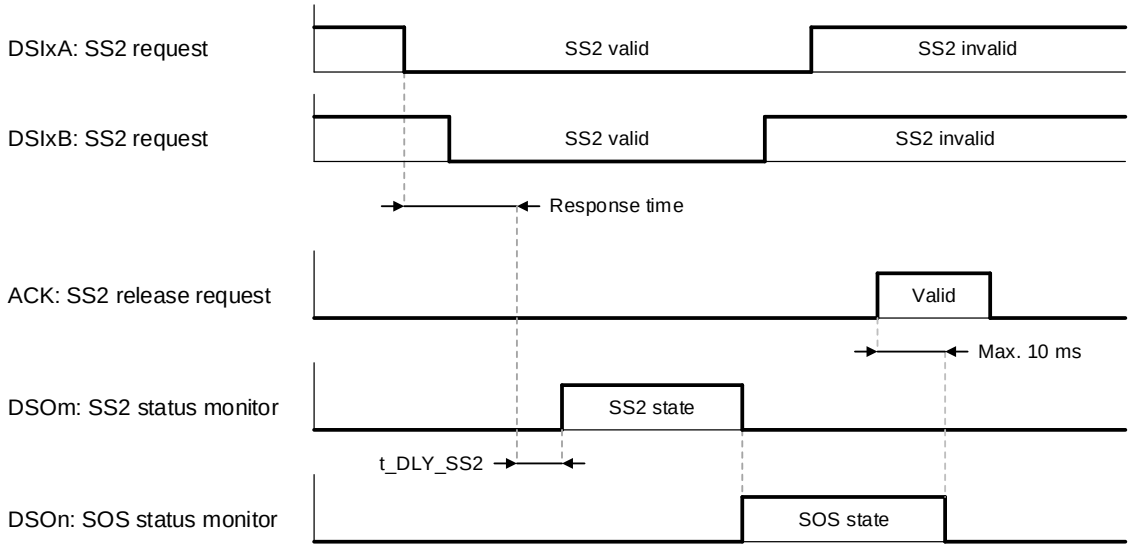
4.4.3.2 Safe Stop 2 - ramp monitoring (SS2-r)



- For safety reasons, set both the deceleration rate and t_SS2 so that the servo motor stops before t_SS2 elapses. If t_SS2 elapses during deceleration, an anomaly may be detected by the SOS position monitor.
- When a ≤ b and c, refer to the dotted lines in the preceding figure.
  When b < a and c, refer to the solid lines in the preceding figure.
  When c < a and b, refer to the double solid lines in the preceding figure.
  a: deceleration time + t_L_SS2
  b: the time taken for “t_D_SS1 + deceleration limit” to reach n_Zero_SS2
  c: t_SS2
- For more information on n_Zero_SOS and s_Zero_SOS, refer to Section 0.
- To monitor the SS2 state, select the SS2 state as the output signal from the safety output (DSOm). The SS2 status monitor does not work as a safety function and should not be used for safety-related applications.
- If the SS1 function is enabled while the SS2 function is running, the system switches to the SS1 operation (STO state) after the servo motor stops.

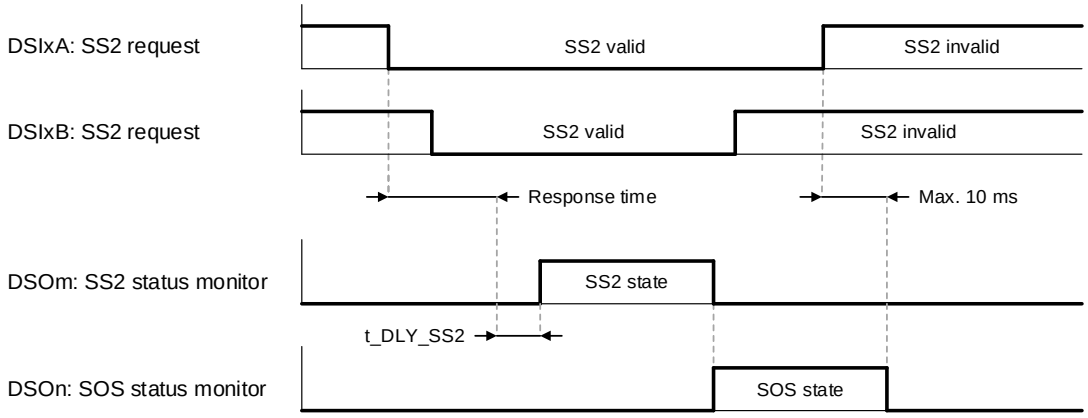
4.4.3.3 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK input should be enabled after the SS2 request is deactivated by DSIxA / B. If you enable the ACK input before deactivating the SS2 request, the SOS state will not be deactivated.

When setting to Automatic restart (Restart acknowledge behavior = 0)

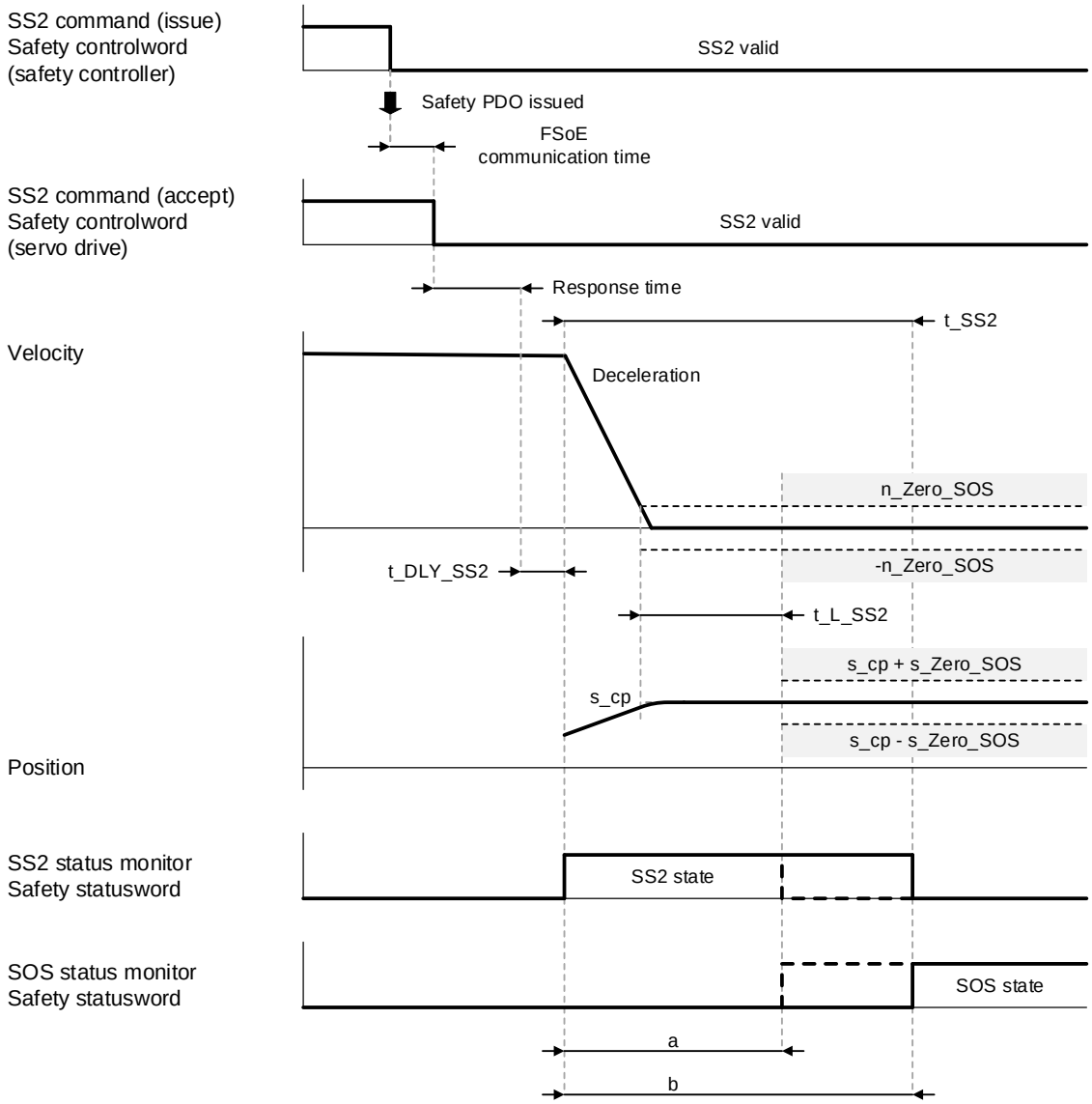


4.4.4 EtherCAT communication (FSoE) type

By setting the SS2 command assigned to the safety PDO to 0 (SS2 valid), the SS2 function is triggered, and then the system goes into the SS2 state (i.e., starts decelerating) after the response time plus t_DLY_SS2 elapses.

To deactivate the SOS state, change the SS2 command to 1 (SS2 invalid) and the ACK command to 1 (restart). The method of deactivating the SS2 state can be selected by the SS2 parameter “Restart acknowledge behavior”.

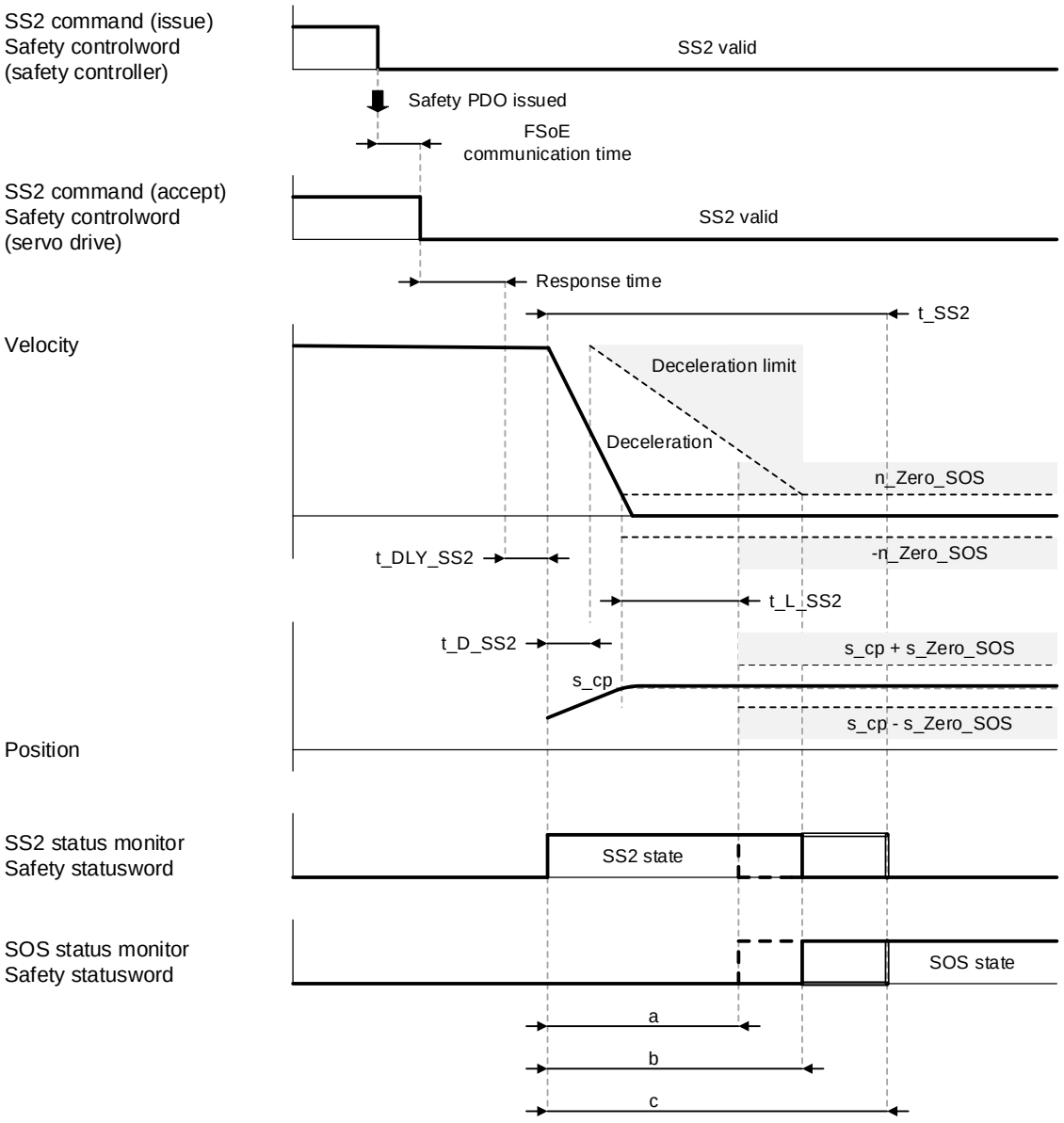
4.4.4.1 Safe Stop 2 - time controlled (SS2-t)



- For safety reasons, set both the deceleration rate and t_SS2 so that the servo motor stops before t_SS2 elapses. If t_SS2 elapses during deceleration, an anomaly may be detected by the SOS position monitor.
- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: deceleration time + t_L_SS2
  b: t_SS2
- For more information on n_Zero_SOS and s_Zero_SOS, refer to Section 0.
- If the SS1 function is enabled while the SS2 function is running, the system switches to the SS1 operation (STO state) after the servo motor stops.

4

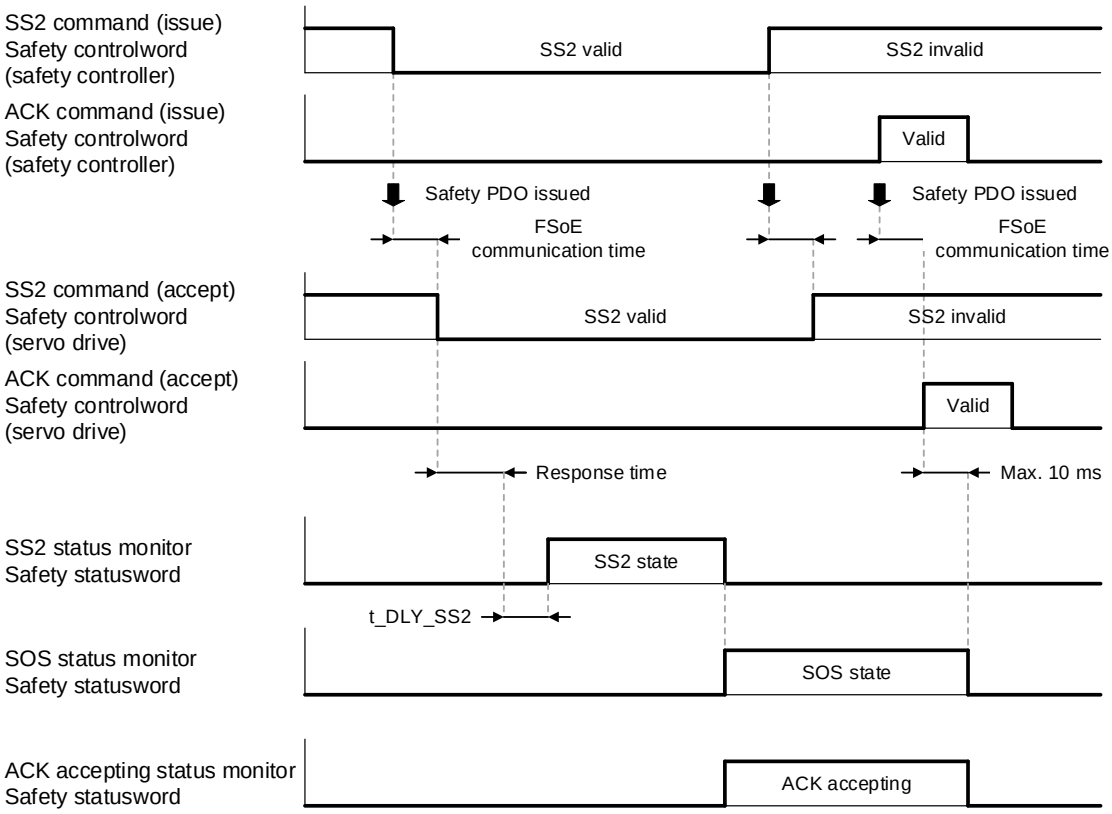
4.4.4.2 Safe Stop 2 - ramp monitoring (SS2-r)



- For safety reasons, set both the deceleration rate and t_SS2 so that the servo motor stops before t_SS2 elapses. If t_SS2 elapses during deceleration, an anomaly may be detected by the SOS position monitor.
- When a ≤ b and c, refer to the dotted lines in the preceding figure.
  When b < a and c, refer to the solid lines in the preceding figure.
  When c < a and b, refer to the double solid lines in the preceding figure.
  a: deceleration time + t_L_SS2
  b: the time taken for “t_D_SS1 + deceleration limit” to reach n_Zero_SS2
  c: t_SS2
- For more information on n_Zero_SOS and s_Zero_SOS, refer to Section 0.
- If the SS1 function is enabled while the SS2 function is running, the system switches to the SS1 operation (STO state) after the servo motor stops.

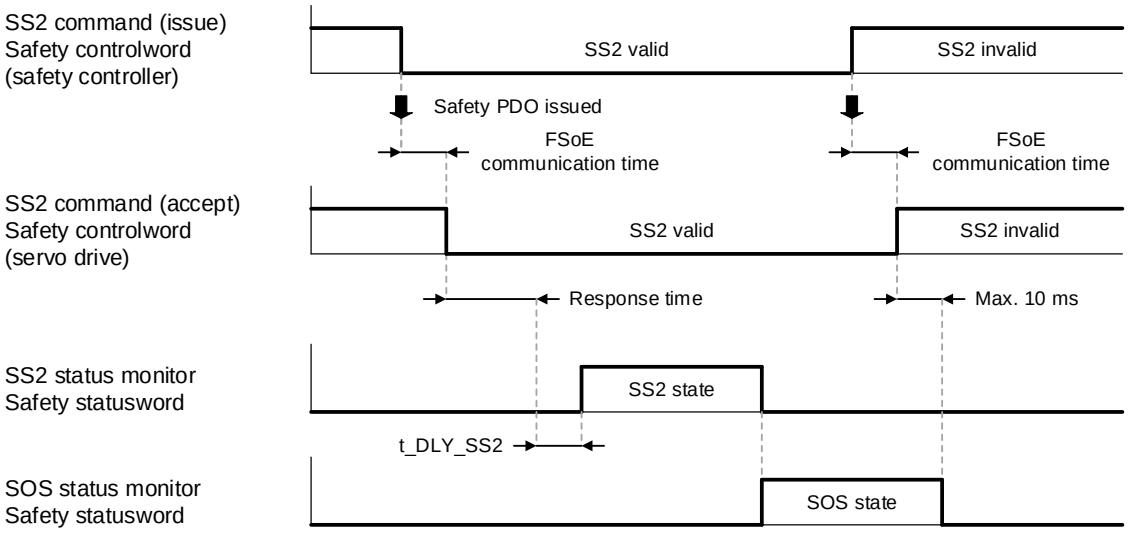
4.4.4.3 How to deactivate

When setting to Manual restart (Restart acknowledge behavior = 1 (default))



- The ACK command should be enabled after the SS2 request is deactivated by the SS2 command. If you enable the ACK command before deactivating the SS2 request, the SOS state will not be deactivated. (If the ACK command is enabled the same time the SS2 request is deactivated, the SOS state is deactivated.)

When setting to Automatic restart (Restart acknowledge behavior = 0)



4

4.4.5 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SOS	t_SS2	For setting the duration from the end of “response time + t_DLY_SS2” to the time when the SOS function is enabled. Setting range: 0 - 65535	ms	0
Time to SS2	t_DLY_SS2	For setting the duration from the end of the response time to the time when the SS2 function is enabled. Setting range: 0 - 65535	ms	0
Deceleration	-	For setting the deceleration rate. Setting range: 0 - 4294967295 *2	pulse/s^2	0
Time for velocity zero	t_L_SS2	For setting the duration from the time when the end of deceleration is detected to the time when the SOS function is enabled. Setting range: 0 - 65535	ms	0
Deceleration limit*1	-	For setting the level of monitoring of the deceleration rate. Setting range: 0 - 4294967295 *2	pulse/s^2	0
Time delay deceleration monitoring*1	t_D_SS2	For setting the duration from the time when the SS2 function is enabled to the time when the system starts monitoring the deceleration rate. Setting range: 0 - 65535	ms	0
Restart acknowledge behavior	-	For selecting the method to deactivate the SS2 state. Automatic restart: When the SS2 request is deactivated, the SOS state is automatically deactivated. Manual restart: After the SS2 request is deactivated, turn on the ACK input (changing the ACK command to 1) to deactivate the SOS state.	-	Manual restart
Error reaction	-	For selecting the action to take when an abnormality is detected. STO: Starts STO operation. SS1: Starts SS1 operation.	-	STO

Note:

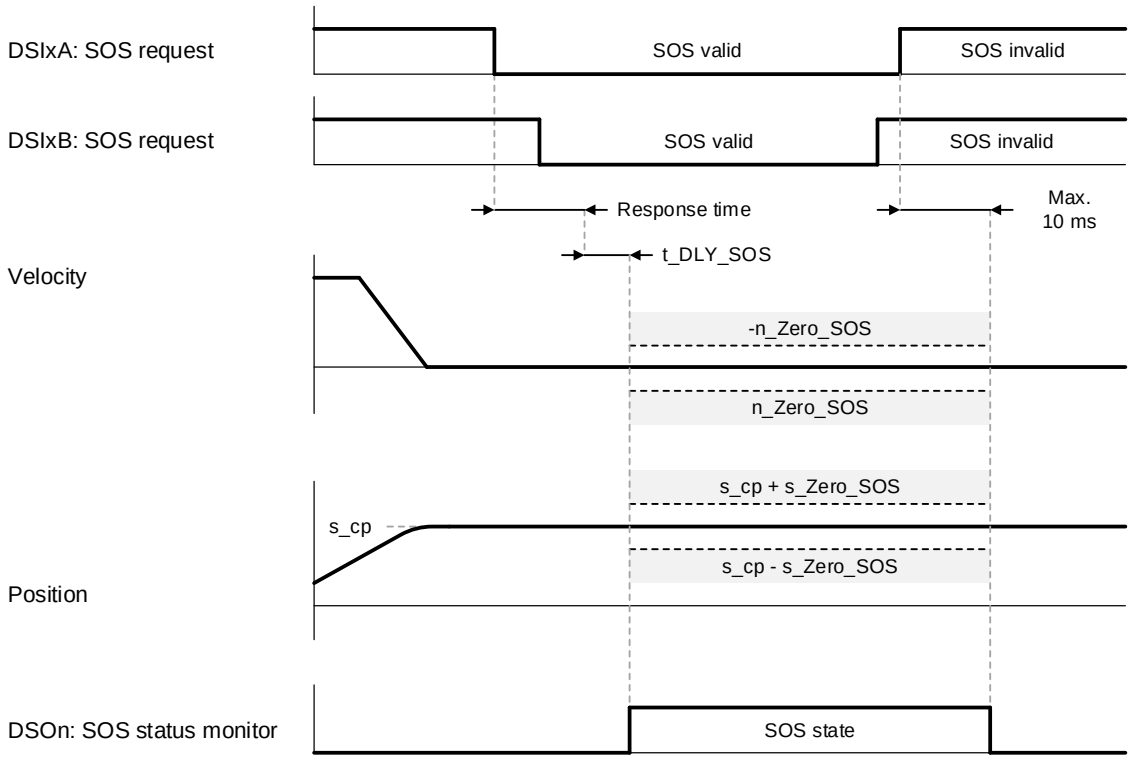
1. This parameter is for Safe Stop 2 - ramp monitoring (SS2-r) only.
2. The resolution follows the position command resolution of the servo drive.

4.5 Safe Operation Stop (SOS)

The system carries out the SOS function at the time when a SOS request is accepted by the safety input (DSIxA / B) or the SOS command from EtherCAT communication (FSoE).

4.5.1 I/O type

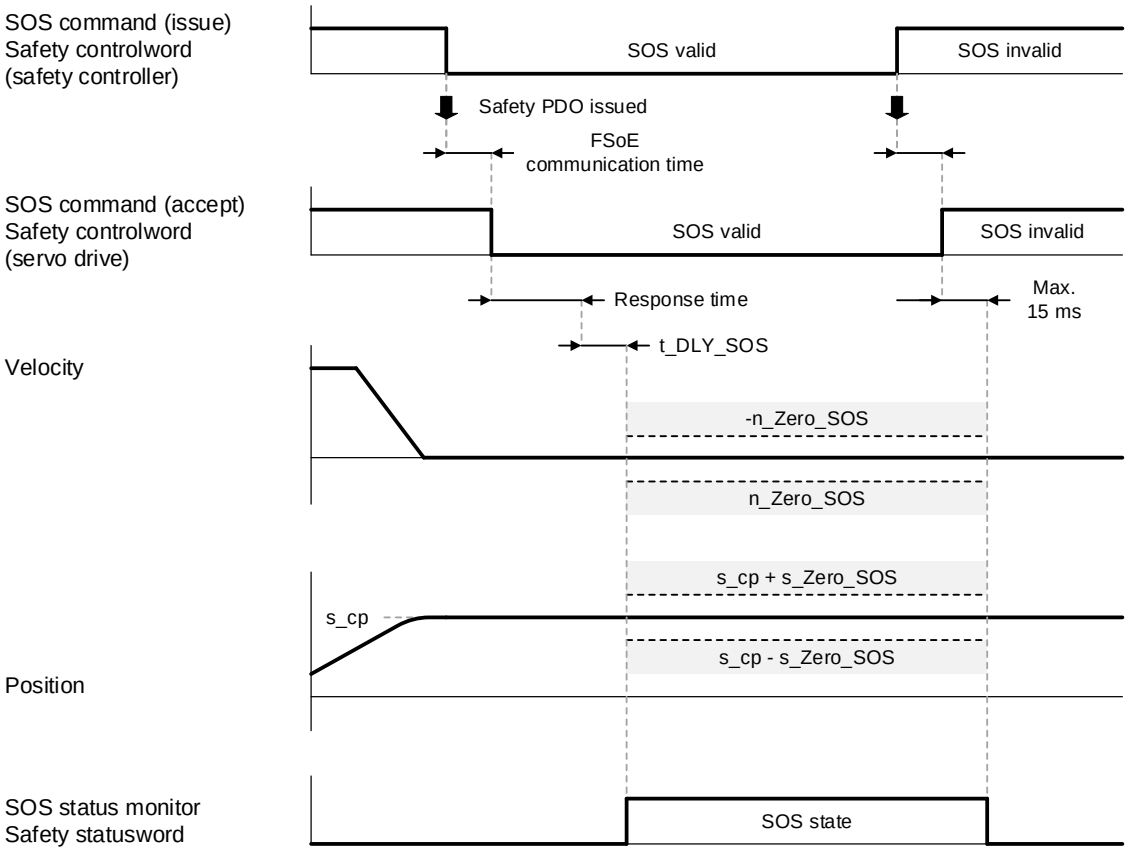
By turning off DSIxA / B, the SOS function is triggered, and then the system starts monitoring the position of the moving part for the equipment and the servo motor speed after the response time plus t_DLY_SOS elapses. Monitoring is performed using the relative position to the start position monitored (s_cp in the following figure).



- If the SOS function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts reaches the target position.
- To monitor the SOS state, select the SOS state as the output signal from the safety output (DSOn). The SOS status monitor does not work as a safety function and should not be used for safety-related applications.

4.5.2 EtherCAT communication (FSoE) type

By setting the SOS command assigned to the safety PDO to 0 (SOS valid), the SOS function is triggered, and then the system starts monitoring the position and speed of the moving parts of the servo motor after the response time plus t_DLY_SOS elapses. Monitoring is performed using the relative position to the start position monitored (s_cp in the following figure).



- If the SOS function starts while the servo motor is in motion, an abnormality may be detected before the moving parts reaches the target position.

4.5.3 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SOS	t_DLY_SOS	For setting the duration from the end of the response time to the time when the SOS function is enabled. Setting range: 0 - 65535	ms	0
Position zero window	s_Zero_SOS	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts. Setting range: 0 - 4294967295 *1	pulse	0
Velocity zero window	n_Zero_SOS	For setting the level of monitoring of the speed. Setting range: 0 - 4294967295	rpm	0
Scale factor	-	For setting coefficients to extend the position zero window. The position zero monitoring width is extended by the following formula: Position zero monitoring width = position zero window × $10^{\text{setting value}}$ Setting range: 0 - 4	-	0

Note: the resolution follows the position command resolution of the servo drive.

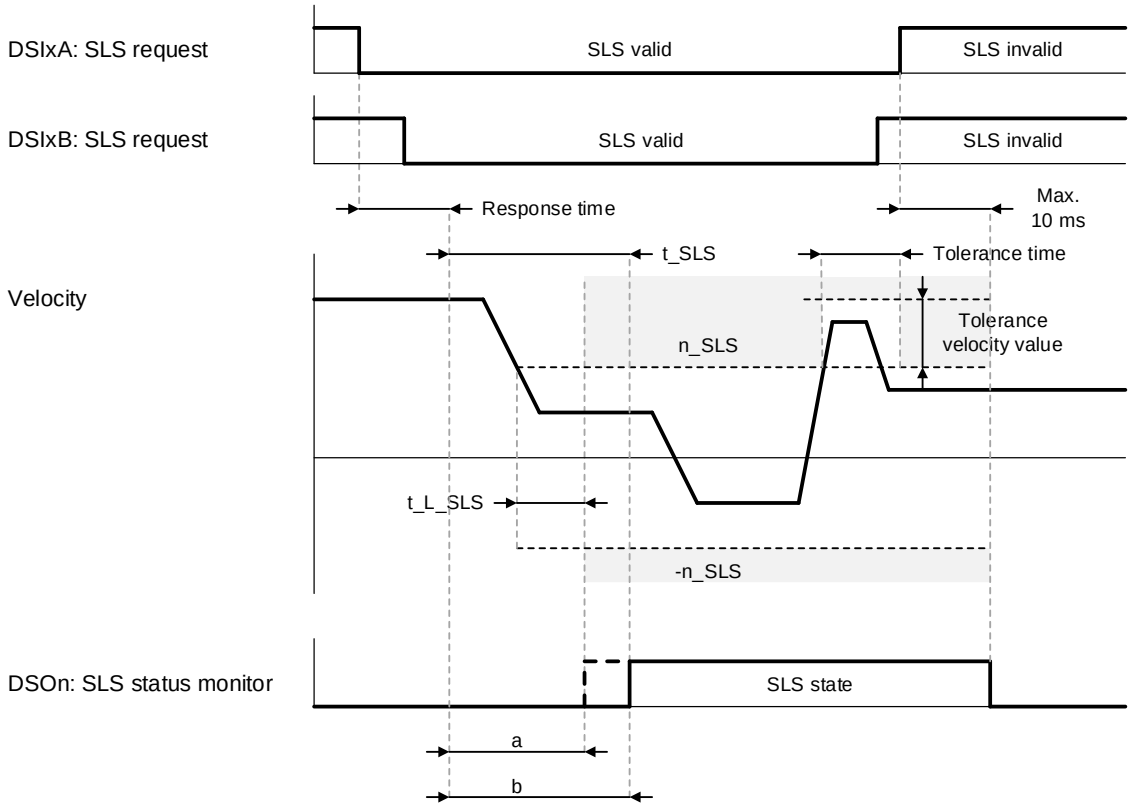
4.6 Safely-limited Speed (SLS)

The system carries out the SLS function at the time when an SLS request is accepted by the safety input (DSIxA / B) or the SLS command from EtherCAT communication (FSoE).

4

4.6.1 I/O type

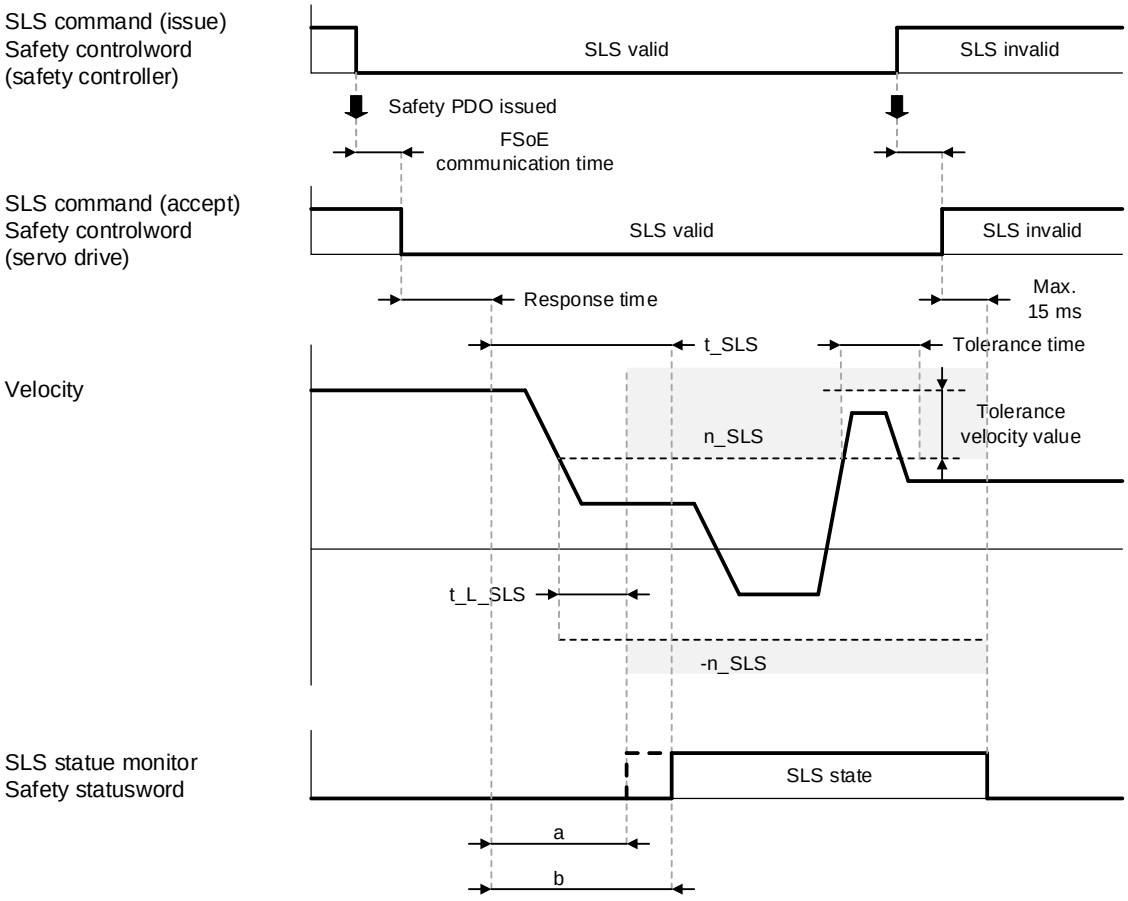
By turning off DSIxA / B, the SLS function is triggered, and then the system starts monitoring the speed of the servo motor after the response time plus t_SLS elapses or after the speed reaches the monitoring level and t_L_SLS elapses.



- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: velocity ≤ time to n_SLS + t_L_SLS
  b: t_SLS
- Even if the velocity is higher than n_SLS, the alarm will not be triggered until the velocity actually exceeds the “tolerance velocity value” during the “tolerance time”. (It is invalid when “tolerance velocity value” or “tolerance time” is set to 0.)
- To monitor the SLS state, select the SLS state as the output signal from the safety output (DSOn). The SLS status monitor does not work as a safety function and should not be used for safety-related applications.

4.6.2 EtherCAT communication (FSoE) type

By setting the SLS command assigned to safety PDO to 0 (SLS valid), the SLS function is triggered, and then the system starts monitoring the speed of the servo motor after the response time plus t_SLS elapses or after the speed reaches the monitoring level and t_L_SLS elapses.



- When a ≤ b, refer to the dotted lines in the preceding figure.
  When b < a, refer to the solid lines in the preceding figure.
  a: velocity ≤ time to n_SLS + t_L_SLS
  b: t_SLS
- Even if the velocity is higher than n_SLS, the alarm will not be triggered until the velocity actually exceeds the “tolerance of velocity” during the “tolerance time”. (It is invalid when “tolerance velocity value” or “tolerance time” is set to 0.)

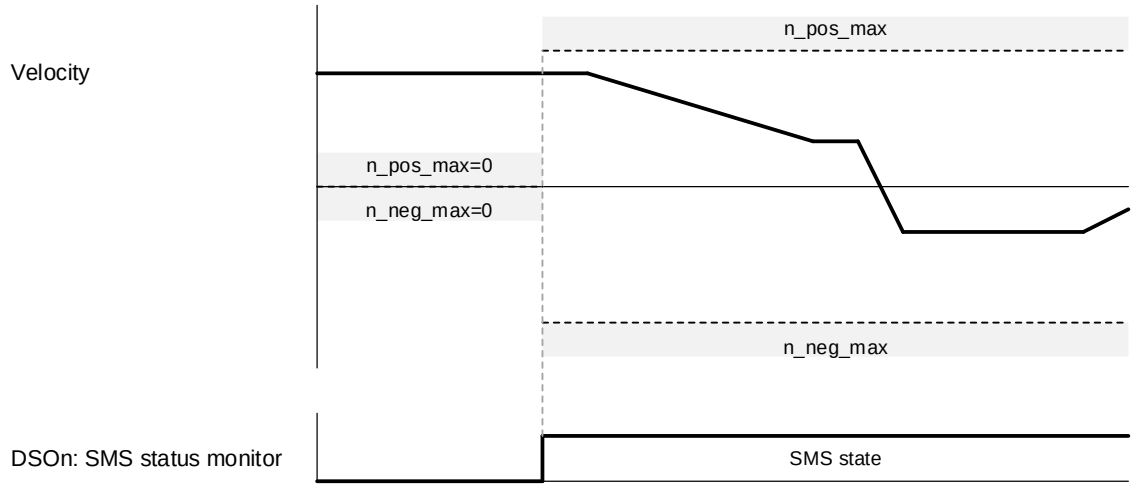
4

4.6.3 Parameters

Name	Abbreviation	Description	Unit	Default setting
Velocity limit	n_SLS	For setting the level of monitoring of the speed. Setting range: 0 - 4294967295	rpm	0
Time to velocity monitoring	t_SLS	For setting the duration from the end of the response time to the time when SLS is enabled. Setting range: 0 - 65535	ms	0
Time for velocity in limit	t_L_SLS	For setting the duration from the time when the velocity reaches n_SLS or below to the time when the SLS function is enabled. Setting range: 0 - 65535	ms	0
Tolerance time	-	For setting the allowable duration from the time when the velocity becomes greater than n_SLS to the time when an anomaly is detected. Setting range: 0 - 65535	ms	0
Tolerance of velocity	-	For setting the allowable speed from the time when the velocity becomes greater than n_SLS to the time when an anomaly is detected. Setting range: 0 - 65535	rpm	0
Error reaction	-	For selecting the action to take when an abnormality is detected. Option: STO — Starts STO operation. Option: SS1 — Starts SS1 operation.	-	STO

4.7 Safe Maximum Speed (SMS)

The system continuously monitors the speed of the servo motor.



- If both n_pos_max and n_neg_max are set to 0, this function does not work.
- To monitor the SMS state, select the SMS state as the output signal from the safety output (DSOn). The SMS status monitor does not work as a safety function and should not be used for safety-related applications.

4.7.1 Parameters

Name	Abbreviation	Description	Unit	Default setting
Velocity maximum positive	n_pos_max	For setting the level of monitoring of the positive velocity. Setting range: -2147483648 to +2147483647	rpm	0
Velocity maximum negative	n_neg_max	For setting the level of monitoring of the negative velocity. Setting range: -2147483648 to +2147483647	rpm	0
Error reaction	-	For selecting action to take when an abnormality is detected. Option: STO — Starts STO operation. Option: SS1 — Starts SS1 operation.	-	STO

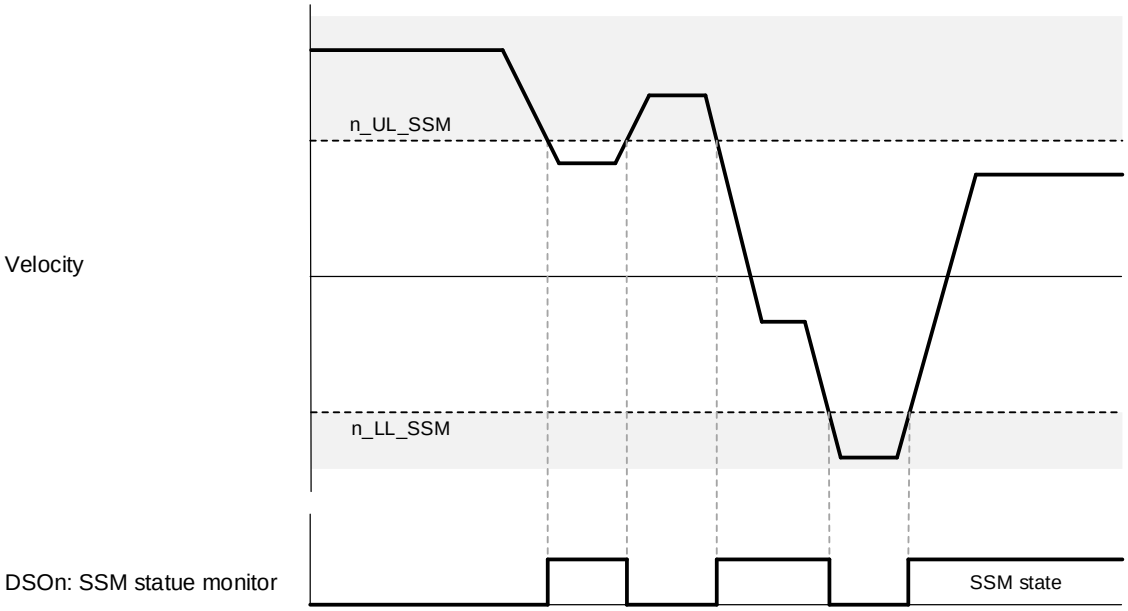
4.8 Safe Speed Monitor (SSM)

The system continuously monitors the speed of the servo motor to output safety signals.

4

4.8.1 SSM output

The system produces a safety signal while the velocity of the servo motor is operating within the limit range of preset speed.



- To monitor the SSM state, select the SSM state as the output signal from the safety output (DSOn). The SSM output is a safety signal and is produced on two channels. Connect both signals when monitoring with a host controller.

4.8.2 Parameters

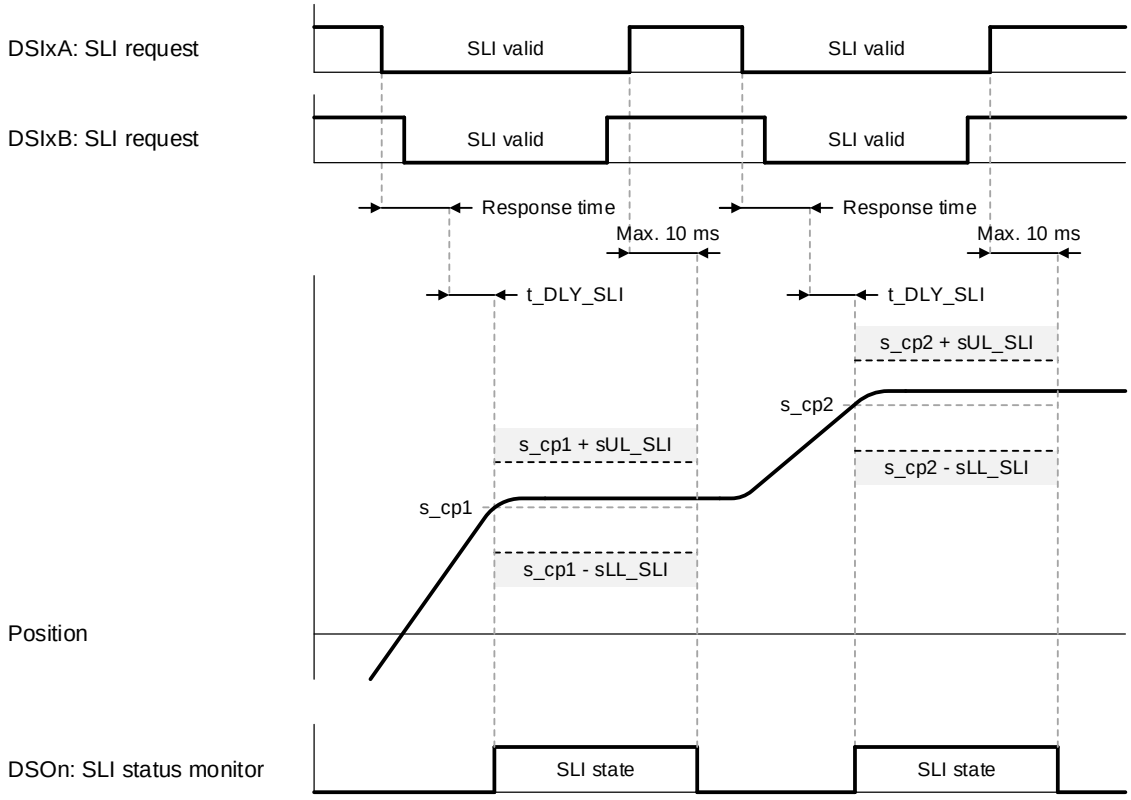
Name	Abbreviation	Description	Unit	Default setting
Velocity upper limit	n_UL_SSM	For setting the upper limit of the velocity monitoring level Setting range: -2147483648 to +2147483647	rpm	0
Velocity lower limit	n_LL_SSM	For setting the lower limit of the velocity monitoring level Setting range: -2147483648 to +2147483647	rpm	0

4.9 Safely-limited Increment (SLI)

The system carries out the SLI function at the time when an SLI request is accepted by the safety input (DSIxA / B) or the SLI command from EtherCAT communication (FSoE).

4.9.1 I/O type

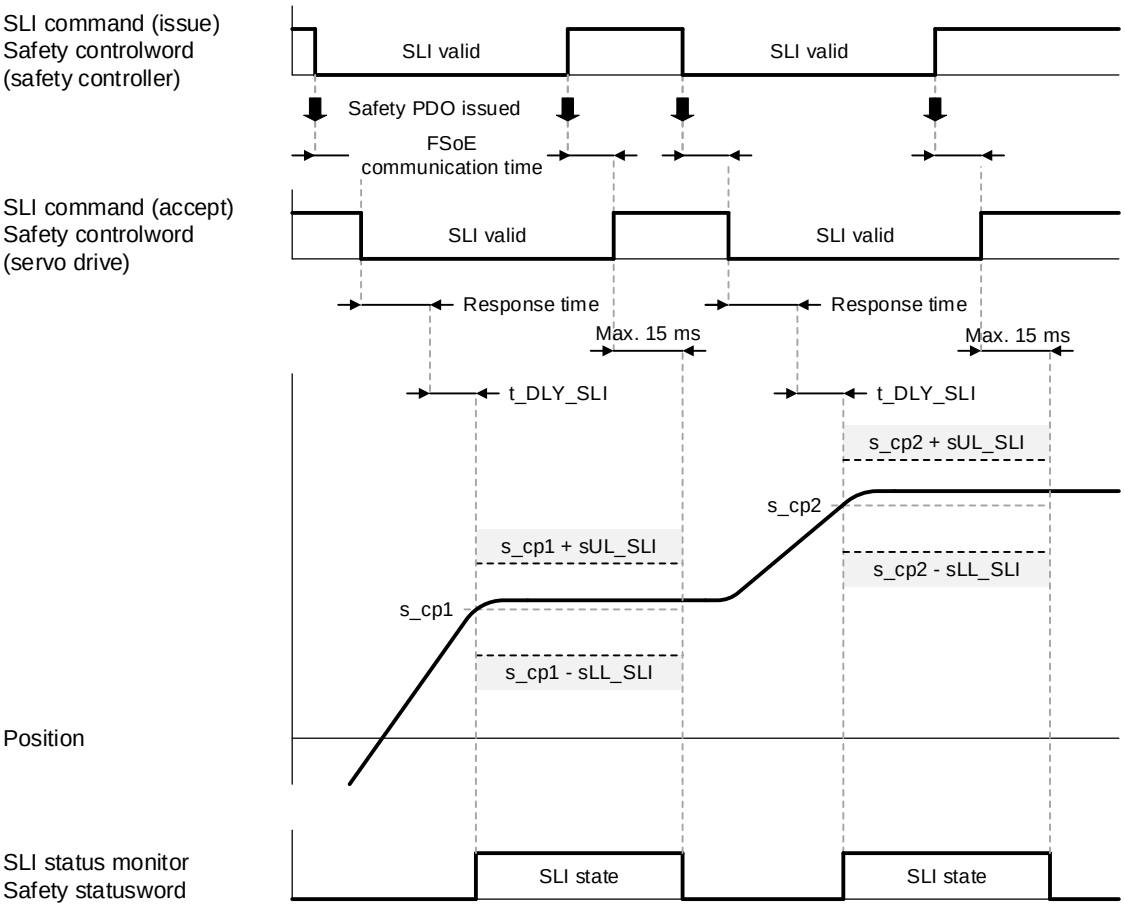
By turning off DSIxA / B, the SLI function is triggered, and then the system starts monitoring the position of the moving part of the equipment after the response time plus t_DLY_SLI elapses. Monitoring is performed using the relative position to the start position monitored (s_cp1 and s_cp2 in the following figure).



- If the SLI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts reaches the target position.
- To monitor the SLI state, select the SLI state as the output signal from the safety output (DSOn). The SLI status monitor does not work as a safety function and should not be used for safety-related applications.

4.9.2 EtherCAT communication (FSoE) type

By setting the SLI command assigned to the safety PDO to 0 (SLI valid), the SLI function is triggered, and then the system starts monitoring the position of the moving parts of the equipment after the response time plus t_DLY_SLI elapses. Monitoring is performed using the relative position to the start position monitored (s_cp1 and s_cp2 in the following figure).



- If the SLI function starts while the moving part of the equipment are in motion, an abnormality may be detected before the moving parts reaches the target position.

4.9.3 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SLI	t_DLY_SLI	For setting the duration from the end of the response time to the time when the SLI function is enabled. Setting range: 0 - 65535	ms	0
Position related upper limit	s_UL_SLI	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts. Setting range: 0 - 4294967295 *1	pulse	0
Position related lower limit	s_LL_SLI	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts. Setting range: 0 - 4294967295 *1	pulse	0
Error reaction	-	For selecting the action to take when an abnormality is detected. Option: STO — Starts STO operation. Option: SS1 — Starts SS1 operation.	-	STO
Scale factor	-	For setting coefficients to extend the position related upper / lower limit. The position related limit is extended by the following formula: Position limit = position related upper or lower limit × $10^{\text{setting value}}$ Setting range: 0 - 4	-	0

Note: the resolution follows the position command resolution of the servo drive.

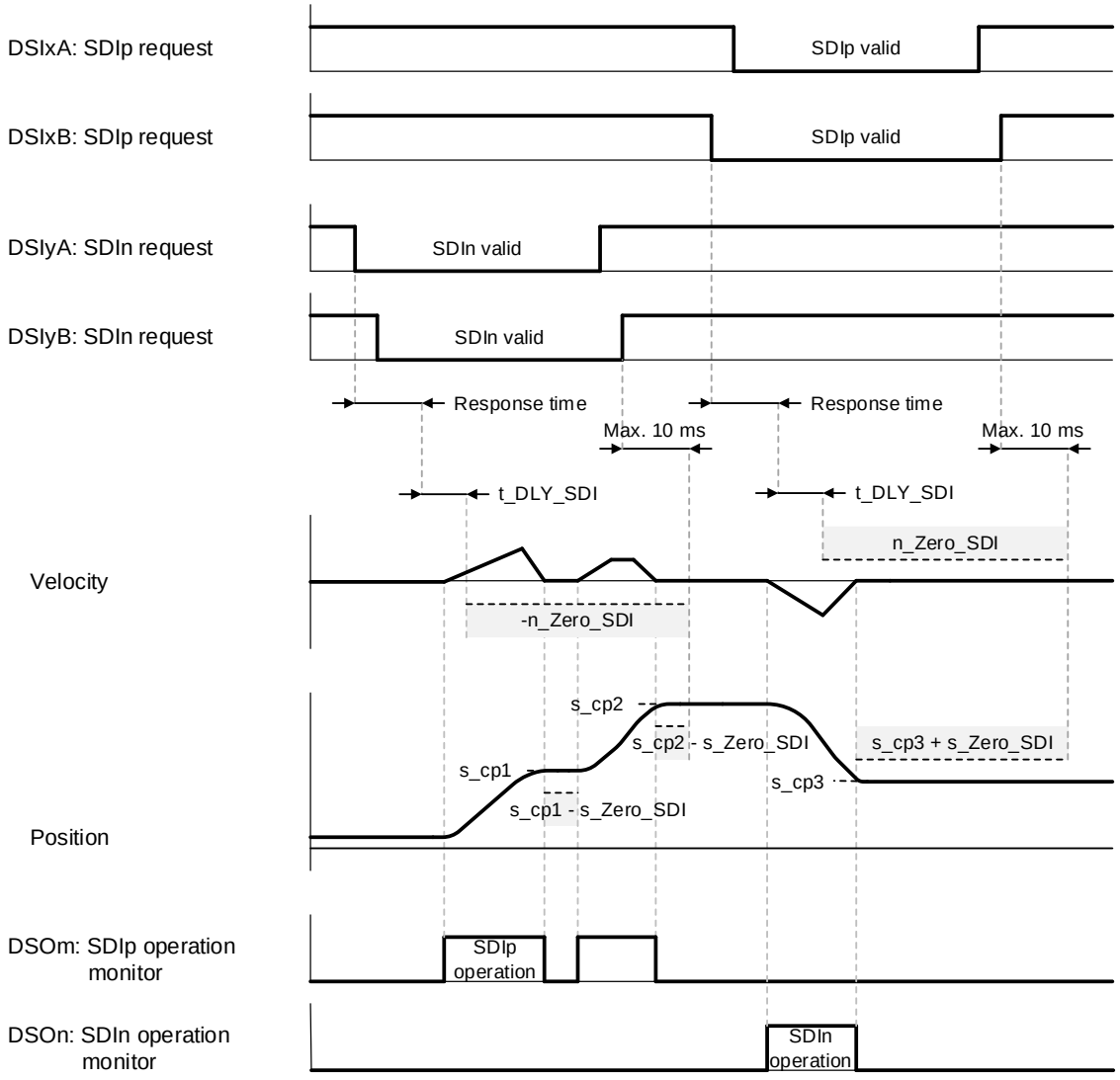
4.10 Safe Direction (SDI)

The system carries out the SDI function at the time when an SDI request is accepted by the safety input (DSIxA / B) or the SDIp or SDIn command from EtherCAT communication (FSoE).

4

4.10.1 I/O type

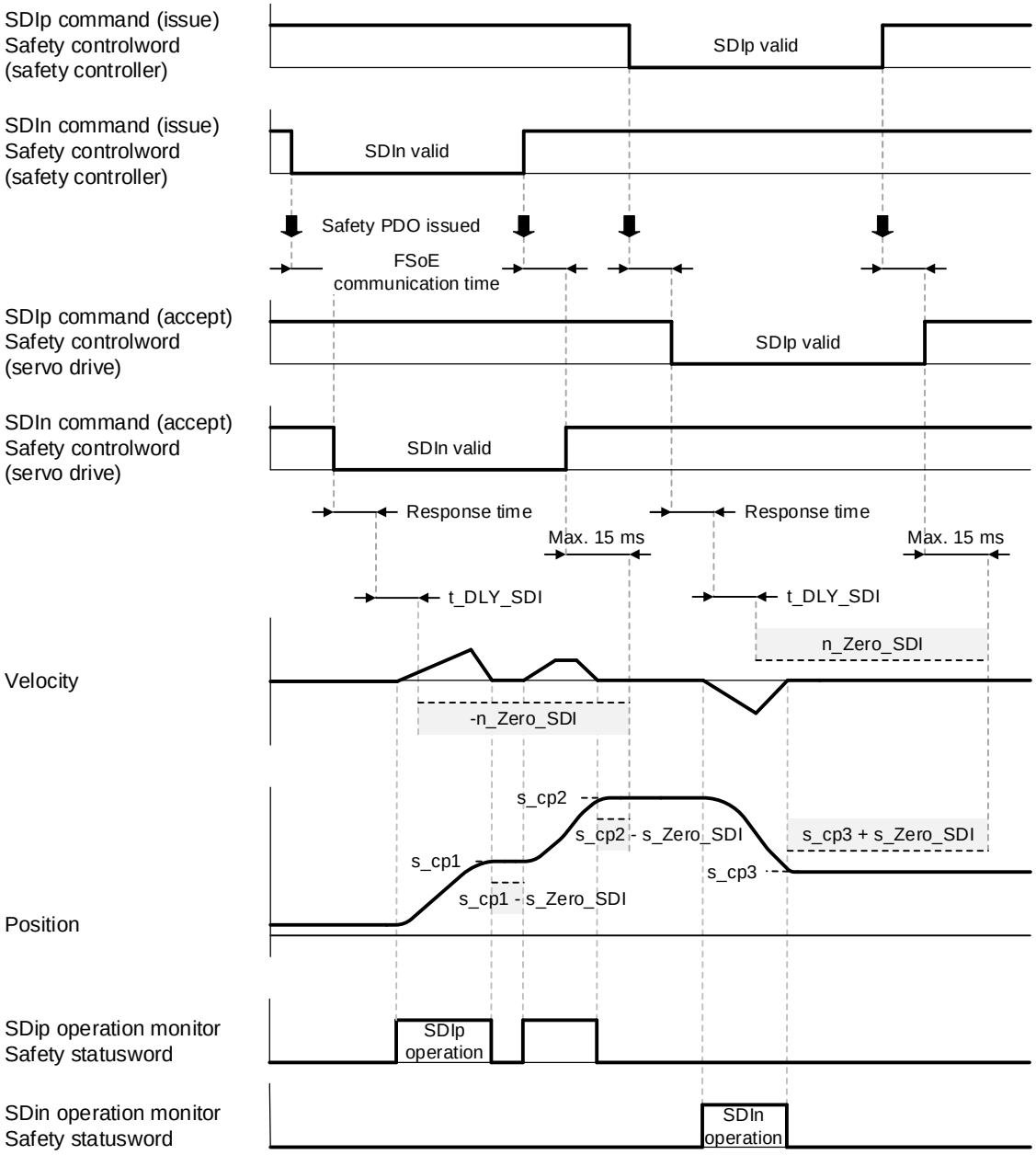
By turning off DSIxA / B, the SDI function is triggered, and then the system starts monitoring the position of the moving parts of the equipment and speed of the servo motor after the response time plus t_DLY_SDI elapses. Monitoring is performed using the relative position to the start position monitored (s_cp1 - s_cp3 in the following figure).



- If the SDI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts reaches the target position.
- To monitor the SDI active state, select the SDIp or SDIn state as the output signal from the safety output (DSOn). The SDIp or SDIn status monitor does not work as a safety function and should not be used for safety-related applications.

4.10.2 EtherCAT communication (FSoE) type

By setting the SDIp or SDIn commands assigned to the safety PDO to 0 (SDI valid), the SDI function is triggered, and then the system starts monitoring the position and speed of the moving parts of the equipment (or the servo motor) after the response time plus t_DLY_SDI elapses. Monitoring is performed using the relative position to the start position monitored (s_cp1 - s_cp3 in the following figure).

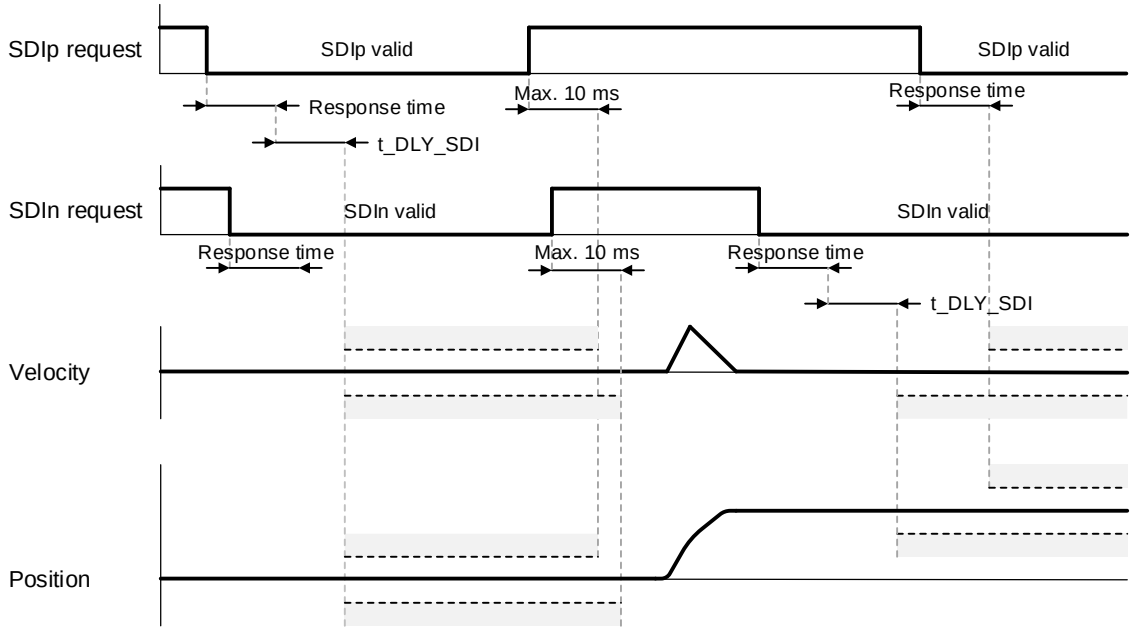


- If the SDI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts reaches the target position.

4

4.10.3 Precautions

After the SDI function is enabled, it normally starts monitoring after the response time plus t_DLY_SDI elapses, but if one is enabled while the other is enabled, the system will start monitoring without waiting for t_DLY_SDI.



4.10.4 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SDI	t_DLY_SDI	For setting the duration from the end of the response time to the time when the SDI function is enabled. Setting range: 0 - 65535	ms	0
Position zero window	s_Zero_SDI	For setting the monitoring level for the location. Determine the relative position with respect to the position where moving parts stop. Setting range: 0 - 4294967295 *1	pulse	0
Velocity zero window	n_Zero_SDI	For setting the level of monitoring of the speed. Setting range: 0 - 4294967295	rpm	0
Scale factor	-	For setting coefficients to extend the position zero window. The position zero monitoring range is extended by the following formula: Position zero monitoring range = position zero window × $10^{\text{setting value}}$ Setting range: 0 - 4	-	0

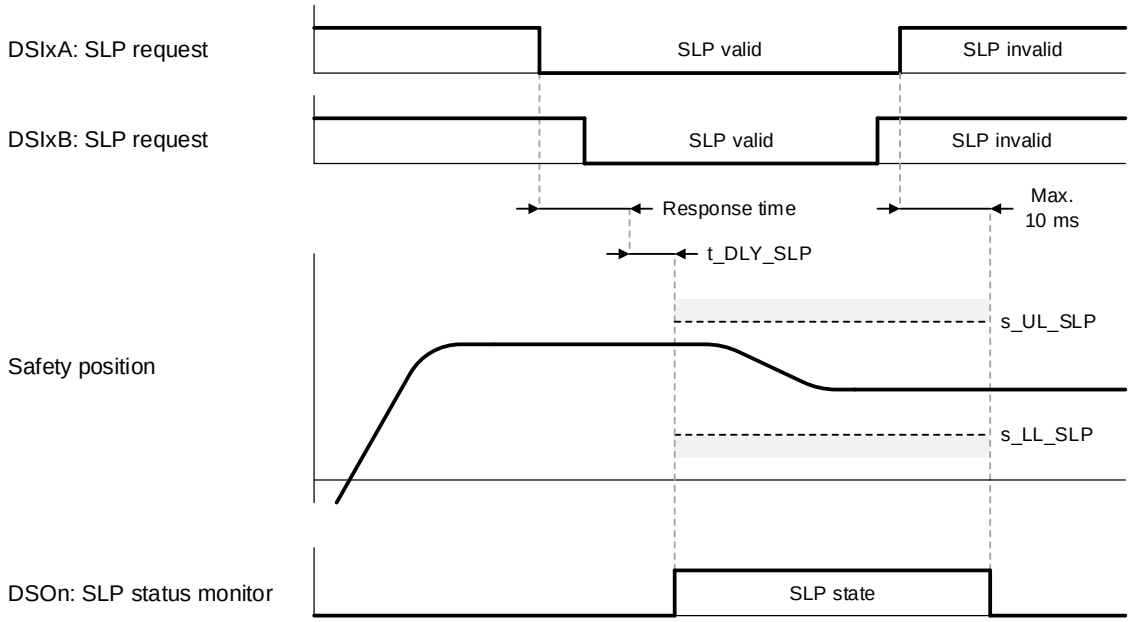
Note: the resolution follows the position command resolution of the servo drive.

4.11 Safely-limited Position (SLP)

The system carries out the SLP function at the time when an SLP request is accepted by the safety input (DSIxA / B) or the SLP command from EtherCAT communication (FSoE).

4.11.1 I/O type

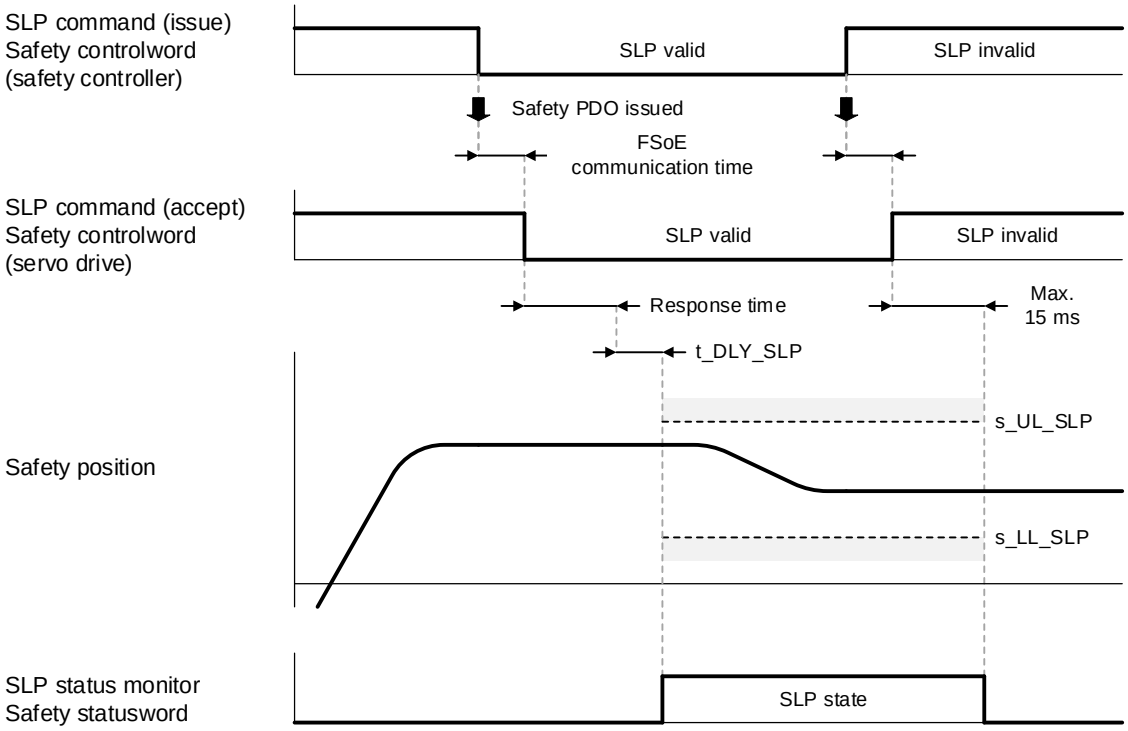
By turning off DSIxA / B, the SLP function is triggered, and then the system starts monitoring the position of the moving part of the equipment after the response time plus t_DLY_SLP elapses. Monitoring is performed using the absolute position to the safety origin position.



- If the SLP function is used, use the servo drive homing function to determine safety origin position. For more information about the safety position, refer to Section 3.7.
  If the safety origin position is not set, “S.POS.U” appears on the front panel of the servo drive. In this case, the SLP function is not available.

4.11.2 EtherCAT communication (FSoE) type

By setting the SLP command assigned to the safety PDO to 0 (SLP valid), the SLP function is triggered, and then the system starts monitoring the position of the moving part of the equipment after the response time plus t_DLY_SLP elapses. Monitoring is performed using the absolute position to the safety origin position.



- If the SLP function is used, use the servo drive homing function to determine safety origin position. For more information about the safety position, refer to Section 3.7.
  If the safety origin position is not set, “S.POS.U” appears on the front panel of the servo drive. In this case, the SLP function is not available.

4.11.3 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SLP	t_DLY_SLP	For setting the duration from the end of the response time to the time when the SLP function is enabled. Setting range: 0 - 65535	ms	0
Position related upper limit	s_UL_SLP	For setting the monitoring level for the location. Determine the absolute position to the safety origin position. Setting range: -2147483648 to +2147483647 *1	pulse	0
Position related lower limit	s_UL_SLP	For setting the monitoring level for the location. Determine the absolute position to the safety origin position. Setting range: -2147483648 to +2147483647 *1	pulse	0
Error reaction	-	For selecting the action to take when an abnormality is detected. Option: STO — Starts STO operation. Option: SS1 — Starts SS1 operation.	-	STO
Scale factor	-	For setting coefficients to extend the position related upper / lower limit. The position related limit is extended by the following formula: Position limit = position related upper or lower limit × $10^{\text{setting value}}$ Setting range: 0 - 4	-	0
Test pulse diagnostics	-	For selecting whether or not the test pulse diagnosis is required for safety home detection devices. If a safety limit switch is used, select Enable. Option: Disable — Test pulse diagnostics disabled Option: Enable — Test pulse diagnostics enabled	-	Disable

Note: the resolution follows the position command resolution of the servo drive.

4

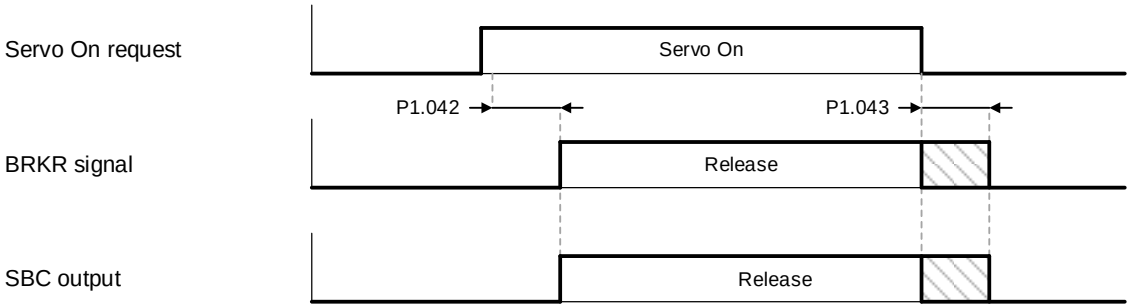
4.12 Safe Brake Control (SBC)

Outputs the power supply for the electromagnetic brake of the servo motor.
The SBC output is normally linked to the servo drive's electromagnetic brake control timing (BRKR signal). Parameters can also be used to link the output to STO and SS1. While the electromagnetic brake is operating (in the hold state), it is also possible to force release of the hold by a request signal from the safety input.

4.12.1 SBC output operation

4.12.1.1 Servo On / Off operation

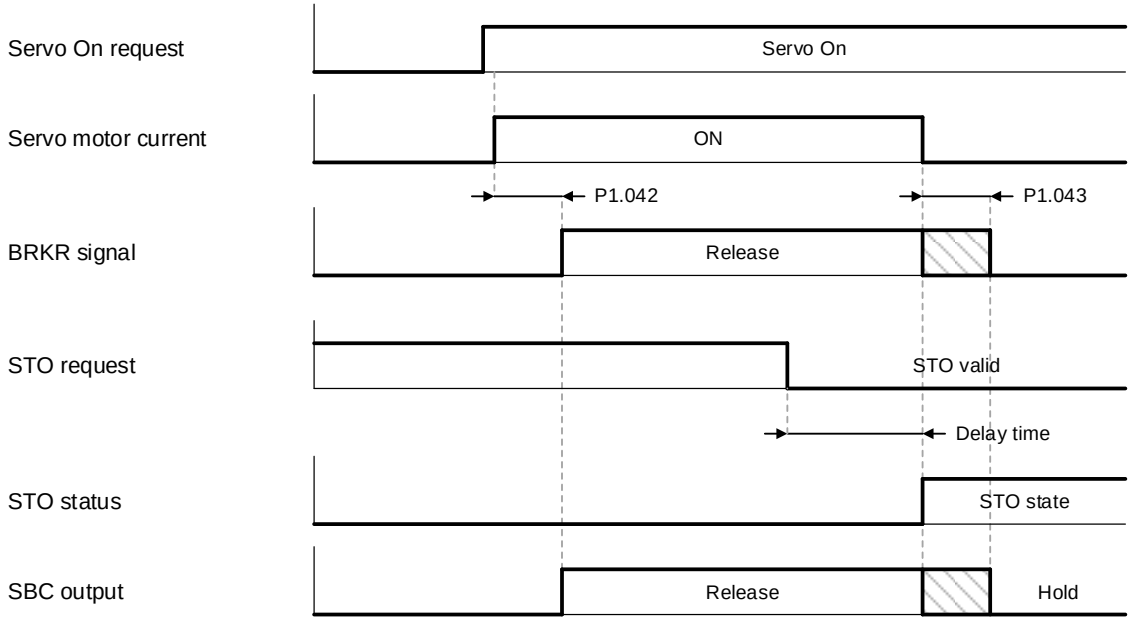
When both the STO and SS1 functions are deactivate, the SBC output is linked to the BRKR signal.



- The timing for producing the BRKR signal can be decided using the servo drive parameters P1.042 and P1.043. For details, refer to the Delta ASDA-A3-EP Series Servo Drive User Manual.

4.12.1.2 Operation when STO is executed (set “Activate SBC (for STO)” to “Without SBC”)

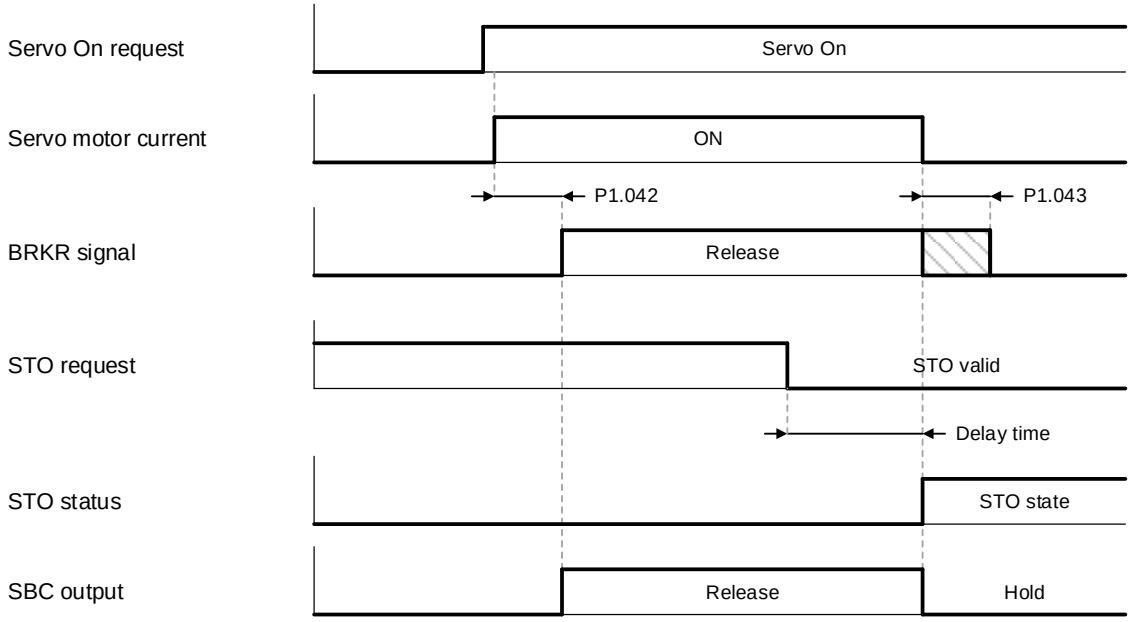
The SBC output is linked to the BRKR signal.



- I/O type: Delay time = Response time + t_DLY_STO
  Communication type: Delay time = Response time + t_DLY_STO + FSoE communication time

4.12.1.3 Operation when STO is executed (set “Activate SBC (for STO)” to “With SBC”)

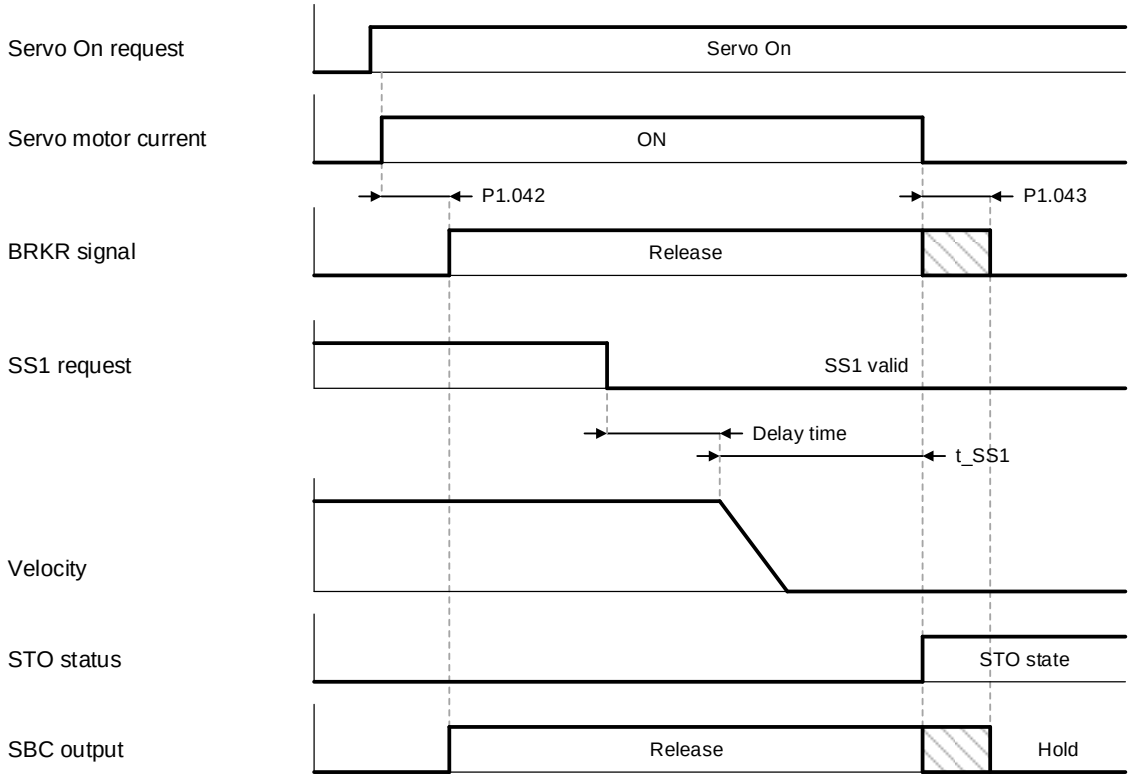
The SBC output is linked to the STO signal.



- I/O type: Delay time = Response time + t_DLY_STO
  Communication type: Delay time = Response time + t_DLY_STO + FSoE communication time

4.12.1.4 Operation when SS1 is executed (set “Activate SBC (for SS1)” to “Without SBC”)

The SBC output is linked to the BRKR signal.

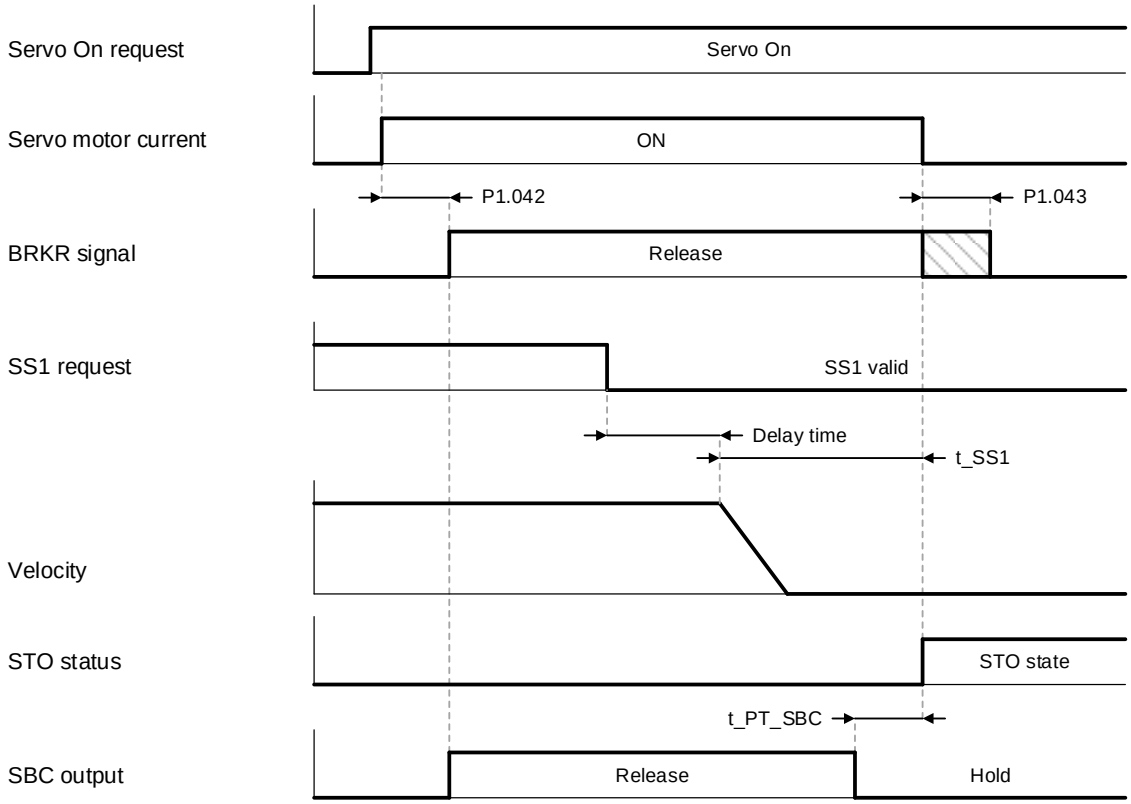


- I/O type: Delay time = Response time + t_DLY_SS1
  Communication type: Delay time = Response time + t_DLY_SS1 + FSoE communication time

4.12.1.5 Operation when SS1 is executed (set “Activate SBC (for SS1)” to “With SBC”)

4

The SBC output is linked to the SS1 signal.

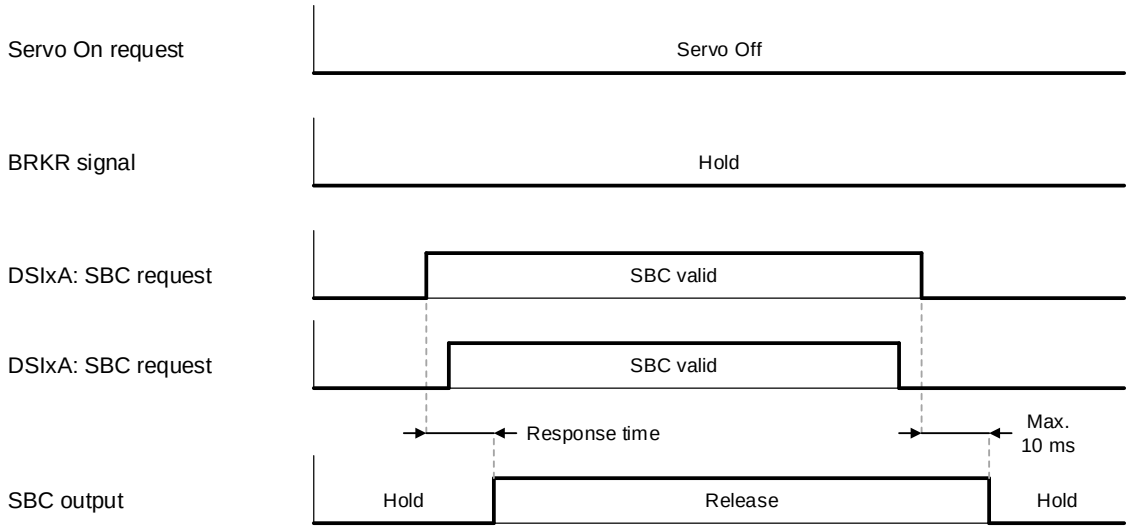


- I/O type: Delay time = Response time + t_DLY_SS1
  Communication type: Delay time = Response time + t_DLY_SS1 + FSoE communication time

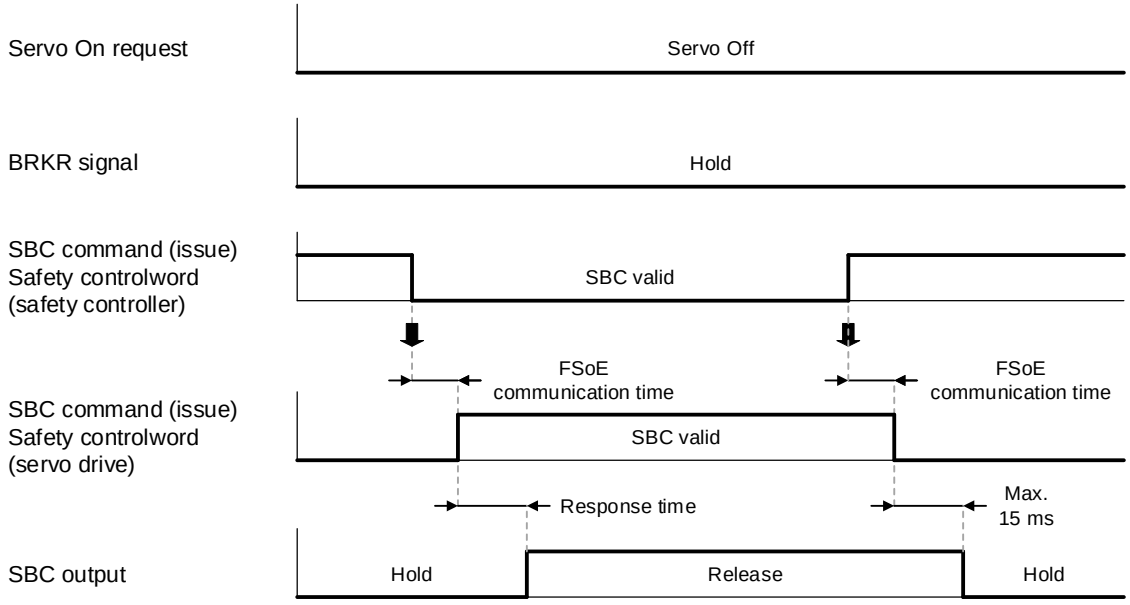
4.12.1.6 Operation at SBC request

By turning on the DSIxA / B or setting the SBC commands assigned to the safety PDO to 1 (SBC valid) (communication type) while the servo is Off (electromagnetic brake is in hold state), the system triggers the SBC function and forces the electromagnetic brake to release after a response time has elapsed.

(1) I/O type



(2) EtherCAT communication (FSoE) type



- While the servo is On, the SBC request cannot be used to control the SBC output.
- This function forces the moving parts into motion during machine maintenance. When using this function on a gravity axis, ensure that the surroundings are safe, since there is a risk that moving parts may fall.

4

4.12.2 Parameters

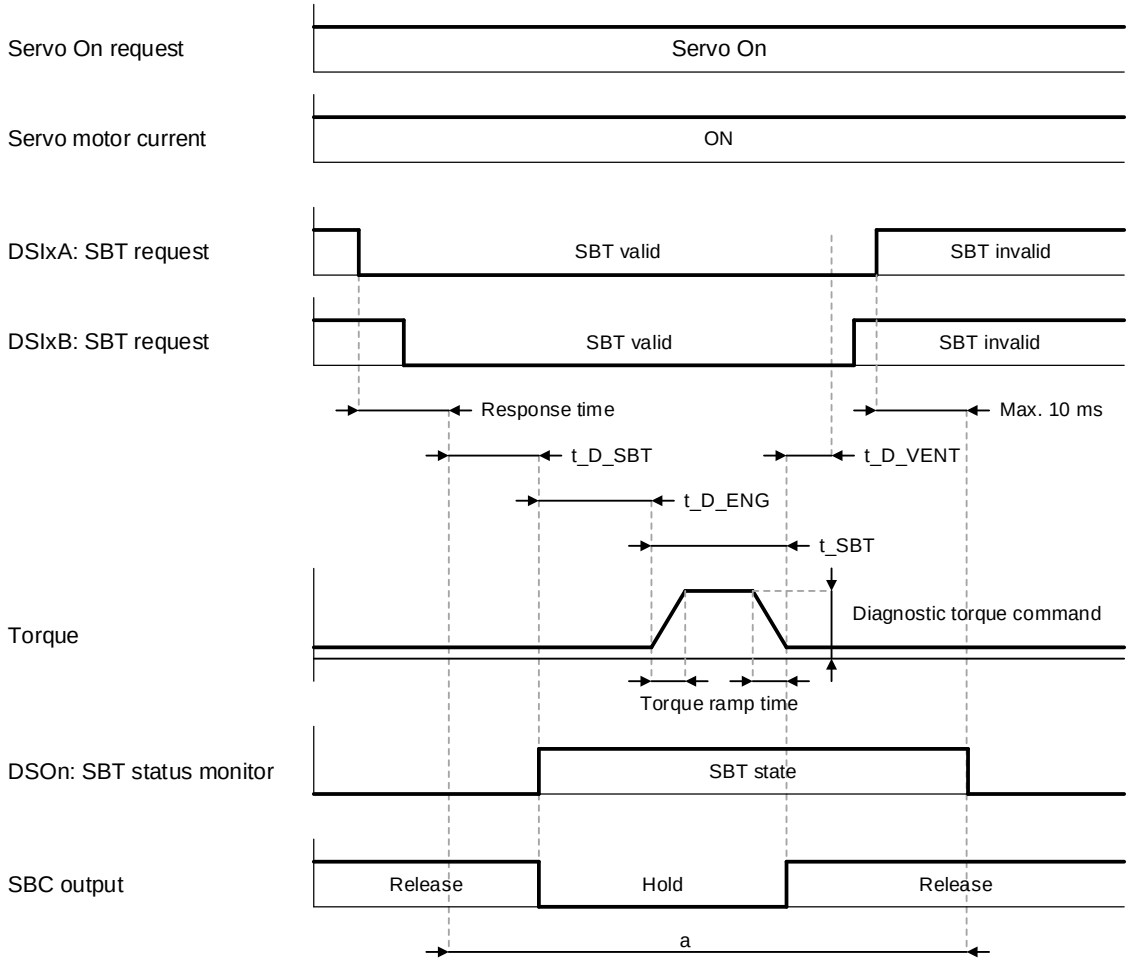
Name	Abbreviation	Description	Unit	Default setting
Brake time delay	t_PT_SBC	For setting the timing for output of the SBC signal at the time when the SS1 function is executed. Setting range: 0 - 65535	ms	0
Activate SBC (for STO)	-	For selecting the SBC output operation at the time when the STO function is executed. Option: With SBC — SBC outputs are linked to STO operation. Option: Without SBC — SBC outputs are not linked to STO operation.	-	Without SBC
Activate SBC (for SS1)	-	For selecting the SBC output operation at the time when the SS1 function is executed. Option: With SBC — SBC outputs are linked to SS1 operation. Option: Without SBC — SBC outputs are not linked to SS1 operation.	-	Without SBC
Enable SBC	-	For selecting SBC output enable / disable. Option: Disable — Disable SBC output Option: Enable — Enable SBC output	-	Enable

4.13 Safe Brake Test (SBT)

The system carries out the SBT function (diagnosing the deterioration of the electromagnetic brake holding force of a servo motor) at the time when an SBT request is accepted by the safety input (DSIxA / B) or the SBT command from EtherCAT communication (FSoE).

4.13.1 I/O type

By turning off DSIxA / B, the SBT function is triggered, and then the system starts diagnosing the holding torque of the electromagnetic brake after the response time elapses.

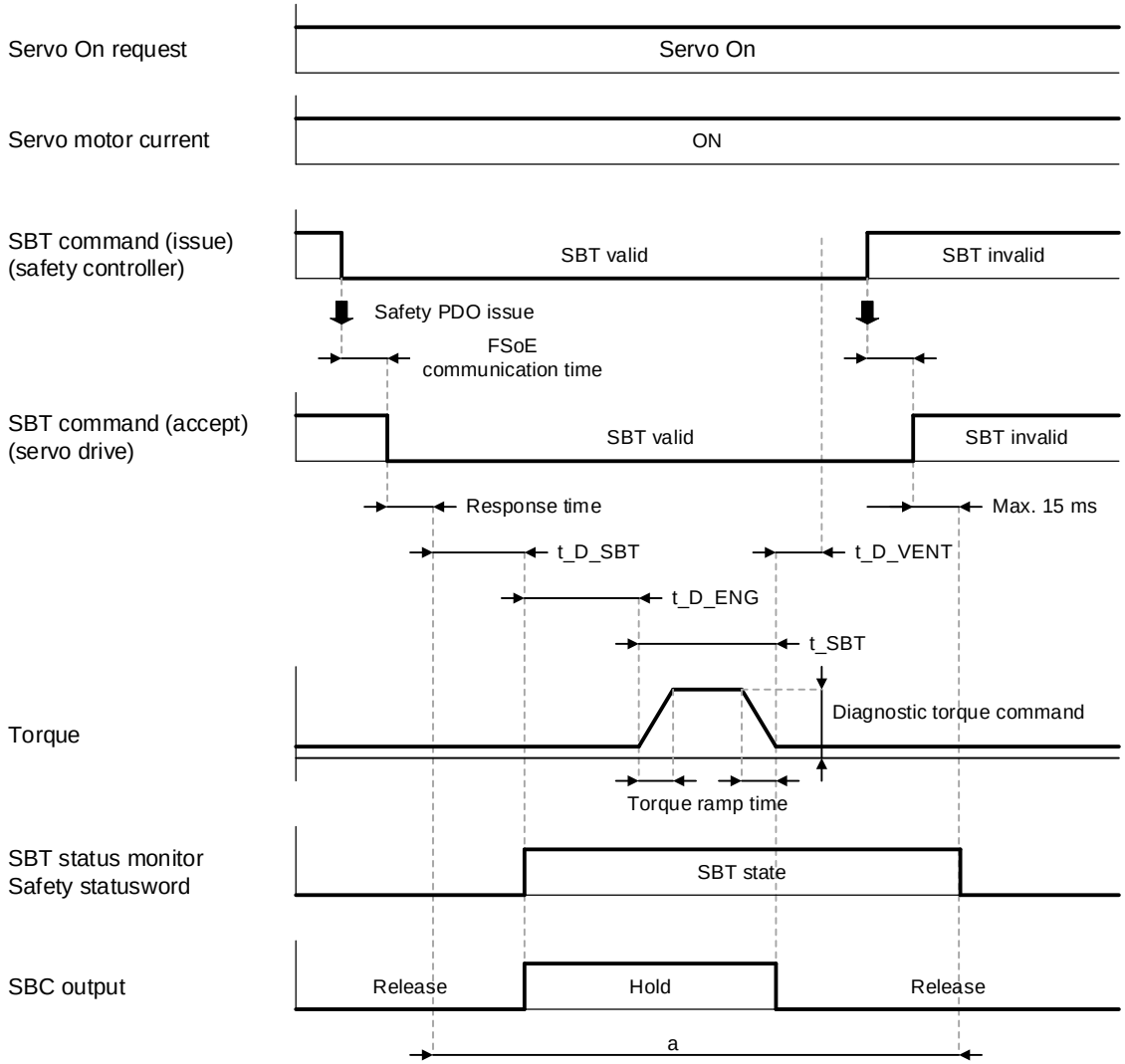


- This may cause the servo motor to rotate if the brake has deteriorated. When performing diagnosis, ensure that the surroundings are safe.
- This function forces the electromagnetic brake to hold. Therefore, do not use this function while the servo motor is rotating.
- Use this function when the servo is On.
- During the time “a” in the preceding diagram, operation by external position / speed command is not allowed.
- If the torque ramp time is longer than t_SBT, diagnostic torque will not be output. Also, set the torque ramp time to t_SBT/2 or less.

- During SBT execution, the motor may rotate due to a forced torque command. If a servo drive is used in position control, update the target position of the controller with the current position obtained from the servo drive before restarting operation.

4.13.2 EtherCAT communication (FSoE) type

By setting the SBT command assigned to the safety PDO to 0 (SBT valid), the SBT function is triggered, and then the system starts diagnosing the holding torque of the electromagnetic brake after the response time elapses.



- This may cause the servo motor to rotate if the brake has deteriorated. When performing diagnosis, ensure that the surroundings are safe.
- This function forces the electromagnetic brake to hold. Therefore, do not use this function while the servo motor is rotating.
- Use this function when the servo is On.
- During the time “a” in the preceding diagram, operation by external position / speed command is not allowed.
- If the torque ramp time is longer than t_SBT, diagnostic torque will not be output. Also, set the torque ramp time to t_SBT/2 or less.

- During SBT execution, the motor may rotate due to a forced torque command. If a servo drive is used in position control, update the target position of the controller with the current position obtained from the servo drive before restarting operation.

4.13.3 Parameters

Name	Abbreviation	Description	Unit	Default setting
Time to SBT	t_D_SBT	For setting the duration from the end of the response time to the time when the SBT function is enabled. Setting range: 0 - 65535	ms	0
Diagnosis time	t_SBT	For setting the execution time of the SBT function. Setting range: 0 - 65535	ms	0
Brake release waiting time	t_D_VENT	Sets the duration of keeping the SBT state after the diagnosis process for the brake is complete. Set a sufficient time for the electromagnetic brake to release. Setting range: 0 - 65535	ms	0
Brake holding waiting time	t_D_ENG	Sets the duration from the time the electromagnetic brake holds to the time the torque output to the servo motor starts. Set a sufficient time for the electromagnetic brake to hold. Setting range: 0 - 65535	ms	0
Diagnostic torque command	-	For setting the torque command value when diagnosing the holding torque of the electromagnetic brake. Set the ratio when the rated torque is 100%. Setting range: 0 - 100	%	0
Torque ramp time	-	For setting the time to increase or decrease the diagnostic torque command Setting range: 0 - 65535	ms	0

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I/O Parameters

5

This chapter lists the parameters for I/O type.

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5.1.1 Parameter list format ····· 5-2
5.1.2 Parameter list ····· 5-2

5.1 Parameter overview

5.1.1 Parameter list format

5

Item	Content
Classification	Related function
Name	Parameter name
Setting range	Parameter setting range
Unit	Physical unit
Default setting	Factory setting value
Remarks	Special note

5.1.2 Parameter list

Classification	Name	Setting range	Unit	Default setting	Remarks
Diagnostic	Encoder diagnostic sensitivity	0 - 1000 (0: diagnostic function disabled)	-	100	
STO	Restart acknowledge behavior	0: automatic restart 1: manual restart	-	1 (manual restart)	
	SBC activation	0x66600001: with SBC 0x00000000: without SBC	-	0x00000000 (without SBC)	
	Time to STO	0 - 65535	ms	0	
SS1	Time to STO	0 - 65535	ms	0	
	Time to SS1	0 - 65535	ms	0	
	Velocity zero window	0 - 4294967295	rpm	0	
	Deceleration	0 - 4294967295	pulse/s^2	0	
	Time for velocity zero	0 - 65535	ms	0	
	Deceleration limit	0 - 4294967295	pulse/s^2	0	
	Delay time before deceleration monitoring	0 - 65535	ms	0	
	Monitoring type	0: SS1 with time monitoring 1: SS1 with deceleration monitoring	-	0 (SS1 with time monitoring)	
	Deceleration method	0: by drive 1: by controller	-	0 (by drive)	
	SBC activation	0x66600001: with SBC 0x00000000: without SBC	-	0x00000000 (without SBC)	

Classification	Name	Setting range	Unit	Default setting	Remarks
SS2	Time to SOS	0 - 65535	ms	0	
	Time to SS2	0 - 65535	ms	0	
	Deceleration	0 - 4294967295	pulse/s^2	0	
	Time for velocity zero	0 - 65535	ms	0	
	Deceleration limit	0 - 4294967295	pulse/s^2	0	
	Delay time before deceleration monitoring	0 - 65535	ms	0	
	Restart acknowledge behavior	0: automatic restart 1: manual restart	-	1 (manual restart)	
	Error reaction	0x66400001: STO 0x66500101: SS1	-	0x66400001 (STO)	
	Monitoring type	0: SS2 with time monitoring 1: SS2 with deceleration monitoring	-	0 (SS2 with time monitoring)	
	Deceleration method	0: by drive 1: by controller	-	0 (by drive)	
SOS	Time to SOS	0 - 65535	ms	0	
	Position zero window	0 - 4294967295	pulse	0	
	Velocity zero window	0 - 4294967295	rpm	0	
	Scale factor	0 - 4	-	0	
SLS	Velocity limit	0 - 4294967295	rpm	0	
	Time to velocity monitoring	0 - 65535	ms	0	
	Time for velocity in limit	0 - 65535	ms	0	
	Tolerance time	0 - 65535	ms	0	
	Tolerance of velocity	0 - 65535	rpm	0	
	Error reaction	0x66400001: STO 0x66500101: SS1	-	0x66400001 (STO)	
SMS	Maximum positive velocity	-2147483648 to +2147483647	rpm	0	
	Maximum negative velocity	-2147483648 to +2147483647	rpm	0	
	Error reaction	0x66400001: STO 0x66500101: SS1	-	STO (0x66400001)	
SSM	Velocity upper limit	-2147483648 to +2147483647	rpm	0	
	Velocity lower limit	-2147483648 to +2147483647	rpm	0	

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Classification	Name	Setting range	Unit	Default setting	Remarks
SLI	Time to SLI	0 - 65535	ms	0	
	Position related upper limit	0 - 4294967295	pulse	0	
	Position related lower limit	0 - 4294967295	pulse	0	
	Error reaction	0x66400001: STO 0x66500101: SS1	-	0x66400001 (STO)	
	Scale factor	0 - 4	-	0	
SDI	Time to SDI	0 - 65535	ms	0	
	Position zero window	0 - 4294967295	pulse	0	
	Velocity zero window	0 - 4294967295	rpm	0	
	Scale factor	0 - 4	-	0	
SLP	Time to SLP	0 ~ 65535	ms	0	
	Position related upper limit	-2147483648 to +2147483647	pulse	0	
	Position related lower limit	-2147483648 to +2147483647	pulse	0	
	Error reaction	0x66400001: STO 0x66500101: SS1	-	0x66400001 (STO)	
	Scale factor	0 - 4	-	0	
	Test pulse diagnosis	0: disable 1: enable	-	0 (disable)	
SBC	Brake time delay	0 - 65535	ms	0	
	SBC enabling	0: disable 1: enable	-	1 (enable)	
SBT	Time to SBT	0 - 65535	ms	0	
	Diagnosis time	0 - 65535	ms	0	
	Brake release waiting time	0 - 65535	ms	0	
	Brake holding waiting time	0 - 65535	ms	0	
	Diagnostic torque command	0 - 100	%	0	
	Torque ramp time	0 - 65535	ms	0	

EtherCAT Communication Objects 6

This chapter describes the EtherCAT communication objects.
The Standardized Device Profile Area objects of this product comply with ETG.6100.2 S (R) V1.3.0.

6.1 Object dictionary ····· 6-2
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6.1.2 List of objects ····· 6-3
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6.1.3.2 OD 3XXXh: Manufacturer Specific Profile Area 2 ····· 6-32

6.1 Object dictionary

6.1.1 Specification for objects

Object index

Index	Object area	Description
6000h - DFFFh	Standardized Device Profile Area	Objects defined in CiA DS402 Drive Profile.
3800h - 38FFh	Manufacturer Specific Profile Area 2	Objects defined in ACS3-SF.

Object code

Object code	Description
VAR	A single value.
ARRAY	An object of multiple data fields consisting of multiple variables of the same data type.

Data type

Data type	Symbol	Size	Range
Boolean	BOOL	1 bit	0 - 1
Unsigned8	U8	1 byte	0 - 255
Unsigned16	U16	2 bytes	0 - 65535
Unsigned32	U32	4 bytes	0 - 4294967295
Signed32	S32	4 bytes	-2147483648 to +2147483647
String	STRING	-	Specify byte size for each variable
Enumeration	ENUM	-	Specify bit length for each variable

Header descriptions for the list of objects

Item	Description		
Class	Parameter classification.		
Index	Object index.		
Code	Object code; refer to the preceding Object codes.		
Name	Object name.		
Type	Refer to the preceding Data types.		
SDO	SDO access	RO	Read-only.
		RW	Read / Write enabled (not stored in non-volatile memory).
		RWS	Read / Write enabled (stored in non-volatile memory).
PDO	PDO mapping	Rx	Can be mapped to the receive PDOs.
		Tx	Can be mapped to the transmit PDOs.
SRA	SRA parameter	N	Not included in SRA parameters.
		Y	Included in SRA parameters.

6.1.2 List of objects

Standardized Device Profile Area

Class	Index	Code	Name	Type	SDO	PDO	SRA
-	6600h	VAR	Time unit	U32	RO	-	N
	6601h	VAR	Position unit	U32	RO	-	N
	6602h	VAR	Velocity unit	U32	RO	-	N
	6603h	VAR	Acceleration unit	U32	RO	-	N
	6630h	VAR	Restart acknowledge	BOOL	RO	Rx / Tx	N
	6632h	VAR	Error acknowledge	BOOL	RO	Rx / Tx	N
STO	6640h	VAR	STO command	BOOL	RO	Rx / Tx	N
	6641h	VAR	Restart acknowledge behavior	BOOL	RW	-	Y
	6643h	VAR	Activate SBC	U32	RW	-	Y
SS1	6650h	ARRAY	SS1 command	BOOL	RO	Rx / Tx	N
	6651h	ARRAY	Time to STO	U16	RW	-	Y
	6653h	ARRAY	Velocity zero window	U32	RW	-	Y
	6654h	ARRAY	Time for velocity zero	U16	RW	-	Y
	6656h	ARRAY	Deceleration limit	U32	RW	-	Y
	6657h	ARRAY	Time delay deceleration monitoring	U16	RW	-	Y
	6658h	ARRAY	Activate SBC	U32	RW	-	Y
SBC	6660h	VAR	SBC command	BOOL	RO	Rx / Tx	N
	6661h	VAR	Brake time delay	U16	RW	-	Y
SOS	6668h	ARRAY	SOS command	BOOL	RO	Rx / Tx	N
	666Ah	ARRAY	Position zero window	U32	RW	-	Y
	666Ch	ARRAY	Velocity zero window	U32	RW	-	Y
SS2	6670h	ARRAY	SS2 command	BOOL	RO	Rx / Tx	N
	6671h	ARRAY	Time to SOS	U16	RW	-	Y
	6672h	ARRAY	Time for velocity zero	U16	RW	-	Y
	6674h	ARRAY	Deceleration limit	U32	RW	-	Y
	6675h	ARRAY	Time delay deceleration monitoring	U16	RW	-	Y
	6676h	ARRAY	Restart acknowledge behavior	BOOL	RW	-	Y
	6677h	ARRAY	Error reaction	U32	RW	-	Y
SLS	6690h	ARRAY	SLS command	BOOL	RO	Rx / Tx	N
	6691h	ARRAY	Time to velocity monitoring	U16	RW	-	Y
	6693h	ARRAY	Velocity limit	U32	RW	-	Y
	6694h	ARRAY	Time for velocity in limit	U16	RW	-	Y
	6698h	ARRAY	Error reaction	U32	RW	-	Y
SLP	66A0h	ARRAY	SLP command	BOOL	RO	Rx / Tx	N
	66A2h	ARRAY	Position upper limit	S32	RW	-	Y
	66A4h	ARRAY	Position lower limit	S32	RW	-	Y
	66A5h	ARRAY	Error reaction	U32	RW	-	Y
SMS	66A8h	VAR	SMS status	BOOL	RO	Tx	N
	66AAh	VAR	Velocity maximum positive	S32	RW	-	Y
	66ACh	VAR	Velocity maximum negative	S32	RW	-	Y
	66ADh	VAR	Error reaction	U32	RW	-	Y
SLI	66B8h	ARRAY	SLI command	BOOL	RO	Rx / Tx	N
	66BAh	ARRAY	Position relative upper limit	U32	RW	-	Y
	66BCh	ARRAY	Position relative lower limit	U32	RW	-	Y
	66BDh	ARRAY	Error reaction	U32	RW	-	Y

Class	Index	Code	Name	Type	SDO	PDO	SRA
SDI	66D0h	VAR	SDI positive direction command	BOOL	RO	Rx / Tx	N
	66D1h	VAR	SDI negative direction command	BOOL	RO	Rx / Tx	N
	66D3h	VAR	Position zero window	U32	RW	-	Y
	66D5h	VAR	Velocity zero window	U32	RW	-	Y
SSM	66E0h	ARRAY	SSM status	BOOL	RW	Tx	N
	66E2h	ARRAY	Velocity upper limit	S32	RW	-	Y
	66E4h	ARRAY	Velocity lower limit	S32	RW	-	Y
-	6791h	ARRAY	FSoE communication setting	*	RO	-	N
	67A0h	ARRAY	FSoE state monitor	*	RO	-	N

Note: see Section 6.1.3 for the Type for each sub-index.

Manufacturer Specific Profile Area 2

Class	Index	Code	Name	Type	SDO	PDO	SRA
-	3800h	ARRAY	Safety origin sensor setting 1	U16	RW	-	Y
	3801h	ARRAY	Safety origin sensor setting 2	U16	RW	-	Y
	3810h	ARRAY	System setting	U16	RWS	-	Y
	3811h	VAR	Safety origin reset	U16	RW	-	N
	3812h	-	Maker-specific parameter	-	-	-	N
	3813h	-	Maker-specific parameter	-	-	-	N
	3814h	-	Maker-specific parameter	-	-	-	N
	3815h	-	Maker-specific parameter	-	-	-	N
	3816h	-	Maker-specific parameter	-	-	-	N
	3820h	-	Maker-specific parameter	-	-	-	N
	3821h	ARRAY	Monitor data	S32	RO	-	N
	3822h	ARRAY	Alarm history	U16	RO	-	N
	3823h	ARRAY	Encoder information	U16	RO	-	N
	3824h	-	Maker-specific parameter	-	-	-	N
STO	3842h	VAR	Time to STO	U16	RW	-	Y
SS1	3850h	ARRAY	Time to SS1	U16	RW	-	Y
	3851h	ARRAY	Deceleration	U32	RW	-	Y
	3852h	ARRAY	Monitoring type	U16	RW	-	Y
	3853h	ARRAY	Deceleration method	U16	RW	-	Y
SBC	3860h	VAR	Enable SBC	U16	RW	-	Y
SOS	3868h	ARRAY	Time to SOS	U16	RW	-	Y
	3869h	ARRAY	Scale factor	U32	RW	-	Y
SS2	3870h	ARRAY	Monitoring type	U16	RW	-	Y
	3871h	ARRAY	Deceleration	U32	RW	-	Y
	3872h	ARRAY	Time to SS2	U16	RW	-	Y
	3873h	ARRAY	Deceleration method	U16	RW	-	Y
SLS	3890h	ARRAY	Tolerance time	U16	RW	-	Y
	3891h	ARRAY	Tolerance of velocity	U16	RW	-	Y
SLP	38A0h	ARRAY	Time to SLP	U16	RW	-	Y
	38A1h	ARRAY	Scale factor	U32	RW	-	Y
	38A2h	VAR	Test pulse diagnostics	U16	RW	-	Y
SLI	38B0h	ARRAY	Time to SLI	U16	RW	-	Y
	38B1h	ARRAY	Scale factor	U32	RW	-	Y
SDI	38D0h	VAR	Time to SDI	U16	RW	-	Y
	38D1h	VAR	Scale factor	U32	RW	-	Y
SBT	38F0h	VAR	SBT command	BOOL	RO	Rx / Tx	N
	38F1h	VAR	Time to SBT	U16	RW	-	Y
	38F2h	VAR	Diagnosis time	U16	RW	-	Y
	38F3h	VAR	Brake release waiting time	U16	RW	-	Y
	38F4h	VAR	Brake holding waiting time	U16	RW	-	Y
	38F5h	VAR	Diagnostic torque command	U16	RW	-	Y
	38F6h	VAR	Torque ramp time	U16	RW	-	Y

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6.1.3 Details of objects

6.1.3.1 OD 6XXXh: Standardized Device Profile Area

Index	Name	Specification	
6600h	Time unit	Object code	VAR
		Data type	U32
		SDO access	RO
		PDO mapping	-
		SRA parameter	N
		Value	FD030000h: ms (fixed value)

Index	Name	Specification	
6601h	Position unit	Object code	VAR
		Data type	U32
		SDO access	RO
		PDO mapping	-
		SRA parameter	N
		Value	00B50000h: incremental=pulse (fixed value)

Index	Name	Specification	
6602h	Velocity unit	Object code	VAR
		Data type	U32
		SDO access	RO
		PDO mapping	-
		SRA parameter	N
		Value	00B44700h: rev/min (fixed value)

Index	Name	Specification	
6603h	Acceleration unit	Object code	VAR
		Data type	U32
		SDO access	RO
		PDO mapping	-
		SRA parameter	N
		Value	00B55700h: incremental/s^2 = pulse/s^2 (fixed value)

Index	Name	Specification	
6630h	Restart acknowledge	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Restart command and status monitor for STO and SS2 status. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.

Value	Rx	Tx
0	Invalid	Non-restartable
1	Valid	Restartable

✓ The safety state is released by "0 → 1" edge.

	Default	0 (Rx)

Index	Name	Specification	
6632h	Error acknowledge	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Alarm reset command / alarm status monitor. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.

Value	Rx	Tx
0	Invalid	No alarm
1	Valid	Alarm

✓ The alarm is reset by "0 → 1" edge.

	Default	0 (Rx)

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Index	Name	Specification	
6640h	STO STO command	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Control command and status monitor for STO function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
		Default	1 (Rx)

Value	Rx	Tx
0	STO valid	Not STO state
1	STO invalid	STO state

Index	Name	Specification	
6641h	STO Restart acknowledge behavior	Object code	VAR
		Data type	BOOL
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 1
		Description	For selecting the method to deactivate the STO state.
		Default	1

Value	Description
0	Automatic restart
1	Manual restart

Index	Name	Specification	
6643h	STO Activate SBC	Object code	VAR
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	00000000h / 66600001h
		Description	For selecting SBC output operation.
		Default	00000000h

Value	Description
00000000h	Without SBC
66600001h	With SBC

Index	Name	Specification	
6650h	SS1 SS1 command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SS1 function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
Default	1 (Rx)

Value	Rx	Tx
0	SS1 valid	Not SS1 state
1	SS1 invalid	SS1 state

Index	Name	Specification	
6651h	SS1 Time to STO	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of “response time + time to SS1” to the time when the STO function is enabled.
Default	0
Unit	ms

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Index	Name	Specification	
6653h	SS1 Velocity zero window	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the speed at which the end of the deceleration is detected.
Default	0
Unit	rpm

Index	Name	Specification	
6654h	SS1 Time for velocity zero	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the time when the end of deceleration is detected to the time when the STO function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
6656h	SS1 Deceleration limit	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the level of monitoring of the deceleration rate.
Default	0
Unit	pulse/s^2

Index	Name	Specification	
6657h	SS1 Time delay deceleration monitoring	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the time when the SS1 function is enabled to the time when the system starts monitoring the deceleration rate.
Default	0
Unit	ms

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Index	Name	Specification	
6658h	SS1 Activate SBC	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	00000000h / 66600001h
Description	For selecting SBC output operation. Value: 00000000h — Without SBC Value: 66600001h — With SBC
Default	00000000h

Index	Name	Specification	
6660h	SBC SBC command	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Control command and status monitor for SBC function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details. Value 0: Rx = SBC valid, Tx = Not SBC state Value 1: Rx = SBC invalid, Tx = SBC state
		Default	1 (Rx)

Index	Name	Specification	
6661h	SBC Brake time delay	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the timing for output of the SBC signal at the time when the SS1 function is executed.
		Default	0
		Unit	ms

Index	Name	Specification	
6668h	SOS SOS command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SOS function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
Default	1 (Rx)

Value	Rx	Tx
0	SOS valid	Not SOS state
1	SOS invalid	SOS state

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Index	Name	Specification	
666Ah	SOS Position zero window	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts.
Default	0
Unit	pulse

Index	Name	Specification	
666Ch	SOS Velocity zero window	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the level of monitoring of the speed.
Default	0
Unit	rpm

Index	Name	Specification	
6670h	SS2 SS2 command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SS2 function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
Default	1 (Rx)

Value	Rx	Tx
0	SS2 valid	Not SS2 state
1	SS2 invalid	SS2 state

Index	Name	Specification	
6671h	SS2 Time to SOS	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of “response time + time to SS2” to the time when the SOS function is enabled.
Default	0
Unit	ms

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Index	Name	Specification	
6672h	SS2 Time for velocity zero	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the time when the end of deceleration is detected to the time when the SOS function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
6674h	SS2 Deceleration limit	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the level of monitoring of the deceleration rate.
Default	0
Unit	pulse/s^2

Index	Name	Specification	
6675h	SS2 Time delay deceleration monitoring	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the time when the SS2 function is enabled to the time when the system starts monitoring the deceleration rate.
Default	0
Unit	ms

Index	Name	Specification	
6676h	SS2 Restart acknowledge behavior	Object code	ARRAY
		Data type	BOOL
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	For selecting the method to deactivate the SS2 state. Value: 0 — Automatic restart Value: 1 — Manual restart
Default	1

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Index	Name	Specification	
6677h	SS2 Error reaction	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	66400001 / 66500*01 (*: 1 - 4)
Description	For selecting action to take at the time when abnormality is detected. Value: 66400001 — Starts STO operation Value: 66500*01 — Starts SS1 operation Note: specify the sub-index of the parameter for SS1.
Default	66400001

Index	Name	Specification	
6690h	SLS SLS command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SLS function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details. Value: 0 — Rx: SLS valid — Tx: Not SLS state Value: 1 — Rx: SLS invalid — Tx: SLS state
Default	1 (Rx)

Index	Name	Specification	
6691h	SLS Time to velocity monitoring	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when SLS is enabled.
Default	0
Unit	ms

Index	Name	Specification	
6693h	SLS Velocity limit	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the level of monitoring of the speed.
Default	0
Unit	rpm

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Index	Name	Specification	
6694h	SLS Time for velocity in limit	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the time when the velocity reaches “velocity limit” or below to the time when the SLS function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
6698h	SLS Error reaction	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	66400001 / 66500*01 (*: 1 - 4)
Description	For selecting action to take at the time when abnormality is detected. Value: 66400001 — Description: Starts STO operation Value: 66500*01 — Description: Starts SS1 operation Note: specify the sub-index of the parameter for SS1.
Default	66400001

Index	Name	Specification	
66A0h	SLP SLP command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SLP function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.

Value	Rx	Tx
0	SLP valid	Not SLP state
1	SLP invalid	SLP state

Default	1 (Rx)

Index	Name	Specification	
66A2h	SLP Position upper limit	Object code	ARRAY
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	-2147483648 to +2147483647
Description	For setting the monitoring level for the location. Determine the absolute position to the safety origin position.
Default	0
Unit	pulse

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Index	Name	Specification	
66A4h	SLP Position lower limit	Object code	ARRAY
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	-2147483648 to +2147483647
Description	For setting the monitoring level for the location. Determine the absolute position to the safety origin position.
Default	0
Unit	pulse

Index	Name	Specification	
66A5h	SLP Error reaction	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	66400001 / 66500*01 (*: 1 - 4)
Description	For selecting action to take at the time when abnormality is detected. Value: 66400001 — Starts STO operation Value: 66500*01 — Starts SS1 operation Note: specify the sub-index of the parameter for SS1.
Default	66400001

Index	Name	Specification	
66A8h	SMS SMS status	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Status monitor for SMS function. It should be assigned to the transmit (Tx) safety PDO. See Section 3.5.2.1 for details.

Value	Tx
0	Not SMS state
1	SMS state

Index	Name	Specification	
66AAh	SMS Velocity maximum positive	Object code	VAR
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	-2147483648 to +2147483647
		Description	For setting the level of monitoring of the positive velocity.
		Default	0
		Unit	rpm

Index	Name	Specification	
66ACh	SMS Velocity maximum negative	Object code	VAR
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	-2147483648 to +2147483647
		Description	For setting the level of monitoring of the negative velocity
		Default	0
		Unit	rpm

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Index	Name	Specification	
66ADh	SMS Error reaction	Object code	VAR
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	66400001 / 66500*01 (*: 1 - 4)
		Description	For selecting action to take at the time when abnormality is detected. Value: 66400001 — Description: Starts STO operation Value: 66500*01 — Description: Starts SS1 operation Note: specify the sub-index of the parameter for SS1.
		Default	66400001

Index	Name	Specification	
66B8h	SLI SLI command	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Control command and status monitor for SLI function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details. Value: 0 — Rx: SLI valid — Tx: Not SLI state Value: 1 — Rx: SLI invalid — Tx: SLI state
Default	1 (Rx)

Index	Name	Specification	
66BAh	SLI Position relative upper limit	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts.
Default	0
Unit	pulse

Index	Name	Specification	
66BCh	SLI Position relative lower limit	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the monitoring level for the location. Determine the relative position with respect to the position where the function starts.
Default	0
Unit	pulse

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Index	Name	Specification	
66BDh	SLI Error reaction	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	66400001 / 66500*01 (*: 1 - 4)
Description	For selecting action to take at the time when abnormality is detected. Value: 66400001 — Description: Starts STO operation Value: 66500*01 — Description: Starts SS1 operation Note: specify the sub-index of the parameter for SS1.
Default	66400001

Index	Name	Specification	
66D0h	SDI SDI positive direction command	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Control command and status monitor for SDIp function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
		Default	1 (Rx)

Value	Rx	Tx
0	SDIp valid	Positive dir. inactive
1	SDIp invalid	Positive dir. active

Index	Name	Specification	
66D1h	SDI SDI negative direction command	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Control command and status monitor for SDIn function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
		Default	1 (Rx)

Value	Rx	Tx
0	SDIn valid	Negative dir. inactive
1	SDIn invalid	Negative dir. active

Index	Name	Specification	
66D3h	SDI Position zero window	Object code	VAR
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 4294967295
		Description	For setting the monitoring level for the location. Determine the relative position with respect to the position where moving parts stop.
		Default	0
		Unit	pulse

Index	Name	Specification	
66D5h	SDI Velocity zero window	Object code	VAR
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 4294967295
		Description	For setting the level of monitoring of the speed.
		Default	0
		Unit	rpm

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Index	Name	Specification	
66E0h	SSM SSM status	Object code	ARRAY
		Data type	BOOL
		SDO access	RO
		PDO mapping	Tx
		SRA parameter	N

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	Status monitor for SSM function. It should be assigned to the transmit (Tx) safety PDO. See Section 3.5.2.1 for details.

Value	Tx
0	Not SSM state
1	SSM state

Index	Name	Specification	
66E2h	SSM Velocity upper limit	Object code	ARRAY
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	-2147483648 to +2147483647
Description	For setting the upper limit of the velocity monitoring level
Default	1000
Unit	rpm

Index	Name	Specification	
66E4h	SSM Velocity lower limit	Object code	ARRAY
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	-2147483648 to +2147483647
Description	For setting the lower limit of the velocity monitoring level
Default	0
Unit	rpm

Index	Name	Specification	
6791h	FSoE communication setting	Object code	ARRAY
		SDO access	RO
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	9
Description	Number of entries
Default	9

Sub-index	0
Data type	STRING(2)
Name	FSoE Version
Value	01 (Supported FSoE version)
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	2
Data type	U16
Name	FSoE Address
Description	The value set in the servo drive parameter P3.029 is displayed.

Sub-index	3
Data type	U16
Name	FSoE ConnectionID
Description	See ETG.6100.3 and ETG5001.4 for details

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Sub-index	4
Data type	U16
Name	Watchdog Time
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	6
Data type	ENUM
Name	Connection Type
Value	1 (Slave connection)
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	7
Data type	U16
Name	ComParameterLength
Description	Number of bytes of the communication parameter in the parameter set See ETG.6100.3 and ETG5001.4 for details

Sub-index	8
Data type	U16
Name	ApplParameterLength
Description	Number of bytes of the application parameter in the parameter set See ETG.6100.3 and ETG5001.4 for details

Sub-index	9
Data type	U32
Name	SRA CRC
Description	CRC checksum of the safety-related application parameter set See ETG.6100.3 and ETG5001.4 for details

Index	Name	Specification	
67A0h	FSoE state monitor	Object code	ARRAY
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	2
Description	Number of entries
Default	2

Sub-index	1
Data type	ENUM (16)
Name	FSoE communication state
Value	100: Reset 101: Session 102: Connection 103: Parameter 104: Data 105: Failsafe
Description	See ETG5001.4 for details

Sub-index	2
Data type	U16
Name	FSoE connection diagnosis
Description	Bit / Description 3..0: 0: no error; 1: wrong command; 2: unknown command; 3: wrong connection ID; 4: wrong CRC; 5: watchdog expired; 6: wrong FSoE Address; 7: wrong data; 8: wrong communication parameter length; 9: wrong communication parameter; 10: wrong application parameter length; 11: wrong application parameter; 12: unexpected Session command; 13: if Failsafe data are communication error: Failsafe data receive 4: 0: error in FSoE Master detected; 1: error in FSoE Slave detected 5: 1: FSoE Slave sends no Process Data (FSoE Slave in Failsafe) 6: 1: connection in Startup 7: 1: FSoE Master sends no Process Data (FSoE Master in Failsafe) See ETG5001.4 for details

6.1.3.2 OD 3XXXh: Manufacturer Specific Profile Area 2

6

Index	Name	Specification	
3800h	Safety origin sensor setting 1	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 3
Description	Maker-specific parameters

Sub-index	4
Description	For setting the safety origin sensor To use the SLP function, set 000Dh.

Value	Description
0000h	Do not use the safety origin sensor
000Dh	Use the safety origin sensor

Index	Name	Specification	
3801h	Safety origin sensor setting 2	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	6
Description	Number of entries
Default	6

Sub-index	1 - 5
Description	Maker-specific parameters

Sub-index	6
Description	For setting the safety origin sensor To use the SLP function, set 000Dh.

Value	Description
0000h	Do not use the safety origin sensor
000Dh	Use the safety origin sensor

Index	Name	Specification	
3810h	System setting	Object code	ARRAY
		Data type	U16
		SDO access	RWS
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	2
Description	Number of entries
Default	2

Sub-index	1
Name	encoder diagnostic sensitivity
Setting range	0 - 5000
Description	Sets the detection sensitivity of the encoder diagnostic function. The larger the value, the higher the sensitivity (easier to detect errors). A setting of 0 disables the diagnostic function. See Section 3.5.1.5 for details.
Default	100

Sub-index	2
Setting range	interface type selection
Description	Selects the interface type Value: 0 — I/O type Value: 1 — EtherCAT communication (FSoE) type
Default	0

Index	Name	Specification	
3811h	Safety origin reset	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	N
		Setting range	0 - 1
		Description	The safety origin is reset by "0 → 1" edge. Value: 0 — Invalid Value: 1 — Valid
		Default	0

Index	Name	Specification	
3812h 3813h 3814h 3815h 3816h 3820h	Maker-specific parameters	Object code	-
		Data type	-
		SDO access	-
		PDO mapping	-
		SRA parameter	N
		Description	This is a manufacturer-specific parameter. Do not access this object.

Index	Name	Specification	
3821h	Monitor data	Object code	ARRAY
		Data type	S32
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	2
Description	Number of entries
Default	2

Sub-index	1
Name	Safety position monitor
Description	Show the current safety position.
Unit	pulse

Sub-index	2
Name	Velocity monitor
Description	Show the current velocity.
Unit	rpm

Index	Name	Specification	
3822h	Alarm history	Object code	ARRAY
		Data type	U16
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	6
Description	Number of entries
Default	6

Sub-index	1
Name	Current alarm
Description	Show the alarm code currently occurring

Sub-index	2 - 6
Name	Alarm history
Description	Show the alarm codes for up to 5 previous alarms.

Index	Name	Specification	
3823h	Encoder information	Object code	ARRAY
		Data type	U16
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	3
Description	Number of entries
Default	3

Sub-index	1
Name	Encoder resolution
Description	Show the encoder resolution (bit length) per motor revolution.

Sub-index	2
Name	Operation mode
Description	Show the current operation mode. Value: 0 — Incremental type Value: 1 — Absolute type

Sub-index	3
Name	Direction of safety position
Description	Show the relationship between safety position data and motor direction of rotation. Value: 0 — Safety position data is added as the motor rotates in the CCW direction Value: 1 — Safety position data is added as the motor rotates in the CW direction

Index	Name	Specification	
3824h	Maker-specific parameter	Object code	-
		Data type	-
		SDO access	-
		PDO mapping	-
		SRA parameter	N
		Description	This is a manufacturer-specific parameter. Do not access this object.

6

Index	Name	Specification	
3842h	STO Time to STO	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the duration from the end of the response time to the time when the STO function is enabled.
		Default	0
		Unit	ms

Index	Name	Specification	
3850h	SS1 Time to SS1	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when the SS1 function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
3851h	SS1 Deceleration	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the deceleration rate.
Default	0
Unit	pulse/s^2

Index	Name	Specification	
3852h	SS1 Monitoring type	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	For selecting the function of SS1. Value: 0 — SS1 with time monitoring Value: 1 — SS1 with deceleration monitoring
Default	0

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Index	Name	Specification	
3853h	SS1 Deceleration method	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	For selecting the deceleration method. Value: 0 — By drive Value: 1 — By controller
Default	0

Index	Name	Specification	
3860h	SBC Enable SBC	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 1
		Description	For selecting SBC output enable/disable. Value: 0 — SBC disable Value: 1 — SBC enable
		Default	1

Index	Name	Specification	
3868h	SOS Time to SOS	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when the SOS function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
3869h	SOS Scale factor	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4
Description	For setting coefficients to extend the position zero window. The position zero monitoring width is extended by the following formula: Position zero monitoring width = position zero window × $10^{\text{setting value}}$
Default	0

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Index	Name	Specification	
3870h	SS2 Monitoring type	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	For selecting the function of SS2. Value: 0 — SS2 with time monitoring Value: 1 — SS2 with deceleration monitoring
Default	0

Index	Name	Specification	
3871h	SS2 Deceleration	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4294967295
Description	For setting the deceleration rate.
Default	0
Unit	pulse/s^2

Index	Name	Specification	
3872h	SS2 Time to SS2	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when the SS2 function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
3873h	SS2 Deceleration method	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 1
Description	For selecting the deceleration method. Value: 0 — By drive Value: 1 — By controller
Default	0

6

Index	Name	Specification	
3890h	SLS Tolerance time	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the allowable duration from the time when the velocity becomes greater than “velocity limit” to the time when an anomaly is detected.
Default	0
Unit	ms

Index	Name	Specification	
3891h	SLS Tolerance of velocity	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the allowable speed from the time when the velocity becomes greater than “velocity limit” to the time when an anomaly is detected.
Default	0
Unit	rpm

Index	Name	Specification	
38A0h	SLP Time to SLP	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when the SLP function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
38A1h	SLP Scale factor	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4
Description	For setting coefficients to extend the position upper/lower limit. The position limit is extended by the following formula: Position limit = position related upper or lower limit × $10^{\text{setting value}}$
Default	0

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Index	Name	Specification	
38A2h	SLP Test pulse diagnostics	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 1
		Description	For selecting whether or not test pulse diagnosis is required for safety home detection devices. If a safety limit switch is used, select Enable.
		Default	0

Value	Description
0	Disable
1	Enable

Index	Name	Specification	
38B0h	SLI Time to SLI	Object code	ARRAY
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 65535
Description	For setting the duration from the end of the response time to the time when the SLI function is enabled.
Default	0
Unit	ms

Index	Name	Specification	
38B1h	SLI Scale factor	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	4
Description	Number of entries
Default	4

Sub-index	1 - 4
Setting range	0 - 4
Description	For setting coefficients to extend the position relative upper/lower limit. The position relative limit is extended by the following formula: Position limit = position related upper or lower limit × $10^{\text{setting value}}$
Default	0

Index	Name	Specification	
38D0h	SDI Time to SDI	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the duration from the end of the response time to the time when the SDI function is enabled.
		Default	0
		Unit	ms

Index	Name	Specification	
38D1h	SDI Scale factor	Object code	VAR
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 4
		Description	For setting coefficients to extend the position zero window. The position zero monitoring range is extended by the following formula: Position zero monitoring range = position zero window × $10^{\text{setting value}}$
		Default	0

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Index	Name	Specification	
38F0h	SBT SBT command	Object code	VAR
		Data type	BOOL
		SDO access	RO
		PDO mapping	Rx / Tx
		SRA parameter	N
		Setting range	0 - 1
		Description	Control command and status monitor for SBT function. It should be assigned to the receive (Rx) and transmit (Tx) safety PDO. See Section 3.5.2.1 for details.
		Default	1 (Rx)

Value	Rx	Tx
0	SBT valid	Not SBT state
1	SBT invalid	SBT state

Index	Name	Specification	
38F1h	SBT Time to SBT	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the duration from the end of the response time to the time when the SBT function is enabled.
		Default	0
		Unit	ms

Index	Name	Specification	
38F2h	SBT Diagnosis time	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the execution time of the SBT function.
		Default	0
		Unit	ms

Index	Name	Specification	
38F3h	SBT Brake release waiting time	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the duration to hold the SBT state after the diagnosis process is completed for the brake. Give a sufficient time for the electromagnetic brake to release.
		Default	0
		Unit	ms

Index	Name	Specification	
38F4h	SBT Brake hold waiting time	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the duration from the time of holding the electromagnetic brake to the time of outputting the starting torque to the servo motor. Give a sufficient time for the electromagnetic brake to hold.
		Default	0
		Unit	ms

Index	Name	Specification	
38F5h	SBT Diagnostic torque command	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the torque command value when diagnosing the holding torque of the electromagnetic brake Set the ratio when the rated torque is 100%.
		Default	0
		Unit	%

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Index	Name	Specification	
38F6h	SBT Torque ramp time	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 65535
		Description	For setting the time to increase or decrease the diagnostic torque command
		Default	0
		Unit	ms

Troubleshooting 7

This chapter provides the alarm descriptions and the corresponding corrective actions and clearing methods. If an alarm occurs, refer to this chapter to identify the cause and take the corrective action properly.

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7.1 Action upon alarm occurrence

In the event of an alarm, the Safe Torque Off (STO) normally cuts off power to the servo motor. However, if a position, speed, or deceleration rate monitoring alarm is detected while the Safe stop or Safe monitoring functions are in effect, the servo motor stops according to the designated stop action. (After the servo motor stops, the system is in the STO state.)

7.1.1 Setting the stopping behavior

(1) I/O type

Start Delta Drive Safety and go to the page of the safety function to be used. Select either STO or SS1 as the stop method from the drop-down list box of “error reaction”.

(2) EtherCAT communication (FSoE) type

Set the object for the “error reaction” setting of the safety function to be used from the controller.

The following is an example of how to select a stop method for “Safely-limited Speed” (when the “sub-index” of the SLS command is set to 2).

- “error reaction” is set to STO

  Set “0x66400001” to OD 6698h sub2.

- “error reaction” is set to SS1

  Set “0x66500#01” to OD 6698h sub2.

  # is set to the “sub-index” of the SS1 object to be used in the operation to stop the servo motor.

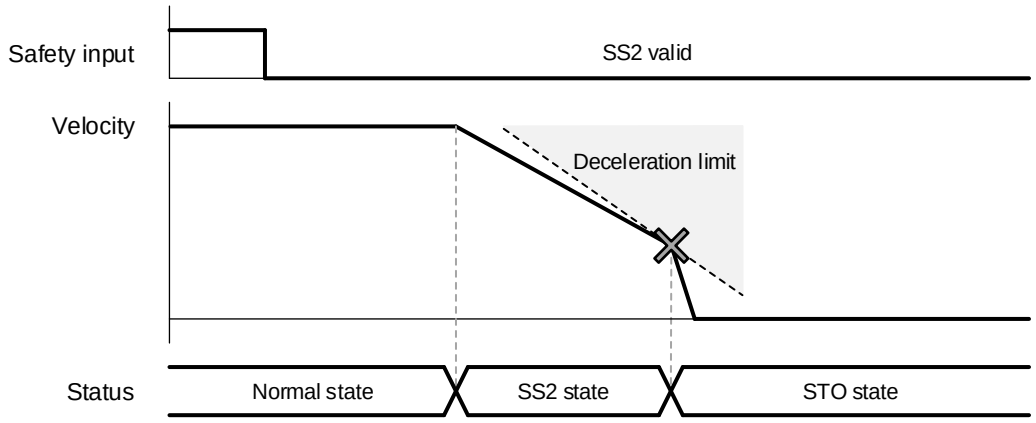
Refer to Section 6.1.3 for the object index of the “error reaction” of each safety function.

Refer to Section 7.4 for the list of alarms from which you can choose the stop method.

7.1.2 Stopping behavior

(1) When “error reaction” is set to STO

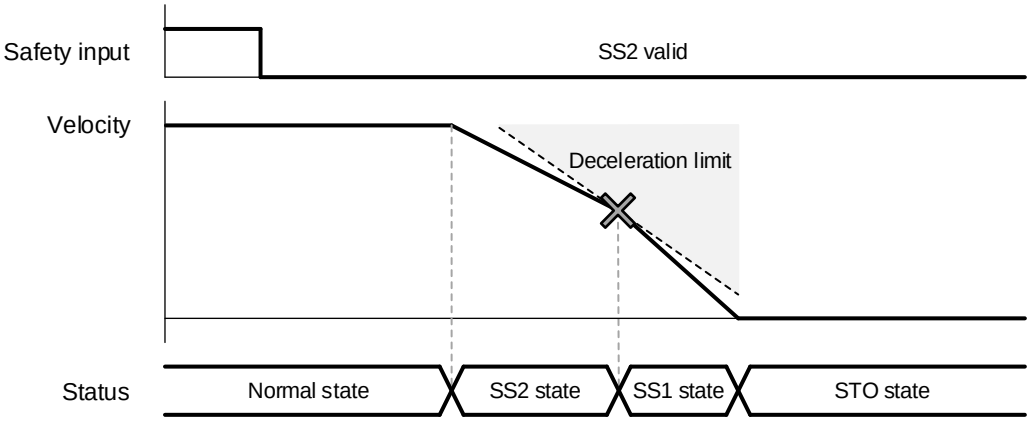
The Safe Torque Off (STO) function is activated when an alarm is detected. The following diagram shows the behavior when the deceleration rate exceeds the “deceleration limit” during the operation of the Safe Stop 2 (SS2-r) function.



When the Safe Torque Off (STO) function is activated, the servo motor is normally forced to stop by the dynamic brake. Set the way the dynamic brake is activated to stop the motor with the servo drive parameter P1.032 [Bit 5] and [Bit 4]. For more details, refer to the ASDA-A3-EP Series Servo Drive User Manual.

(2) When “error reaction” is set to SS1

The Safe Stop 1 (SS1) function is activated when an alarm is detected. The following diagram shows the behavior when the deceleration rate exceeds the “deceleration limit” during the operation of the Safe Stop 2 (SS2-r) function.



When the Safe Stop 1 (SS1) function is activated, the servo motor is stopped according to the deceleration rate and other parameters set for the SS1 function. In this case, the servo drive controls the deceleration regardless of the setting for “deceleration method”.

When setting SS1 for “error reaction”, it is necessary to set the SS1 parameters. For the EtherCAT communication (FSoE) type, set the SS1 parameter which sub-index is set for the object of “error reaction”.

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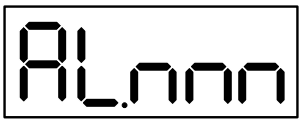
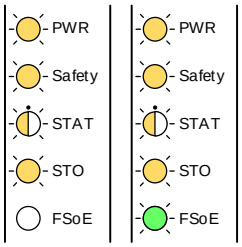
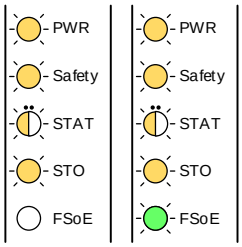
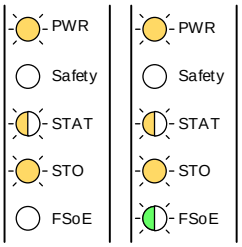
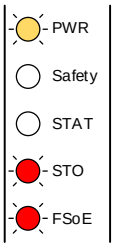
7.2 Alarm display

When an alarm is detected, a three-digit alarm code (main code) is displayed on the front panel of the servo drive.



To confirm the sub-code, go to the “Alarm” screen in Delta Drive Safety.

The LED indicators on the safety functions module also indicate alarm conditions.

Pattern	1	2	3	4
Alarm	Position monitoring	Speed monitoring	Parameter setting error	Others
LED indication				
Safety	Steady orange	Steady orange	Off	Off
STAT	Single flash - orange	Double flash - orange	Fast flashing orange	Off
STO	Steady orange	Steady orange	Steady orange	Steady red
FSoE (I/O)	Off	Off	Off	Steady red
FSoE (Comm.)	Steady green	Steady green	Fast flashing green	

7.3 Resetting alarms

The reset procedures are different for I/O type and EtherCAT communication (FSoE) type.

(1) I/O type

After eliminating the cause of the alarm, keep the ACK input On for at least 5 ms.

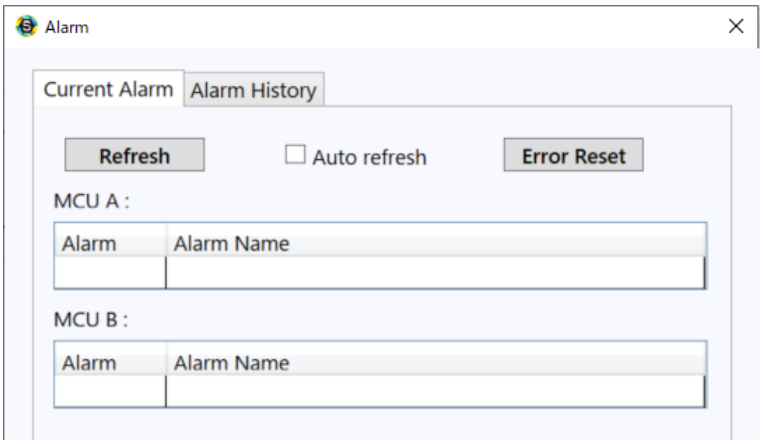
- To check the alarm conditions, monitor the DO signal of the servo drive. For details of the DO signal, refer to the ASDA-A3-EP Series Servo Drive User Manual.
- Refer to Section 2.2.2.2 for the ACK input wiring.
- If the ACK input is not wired, cycle power on the servo drive.

(2) EtherCAT communication (FSoE) type

After eliminating the cause of the alarm, set the alarm reset command (Index: 0x6632) of the Safety controlword to “1”.

- To check the alarm conditions, monitor the alarm status of the Safety statusword.
- For determining the Safety controlword and Safety statusword, refer to Section 3.5.2.

In both cases, the alarm can be reset using the **Error Reset** button in the Delta Drive Safety Alarm screen.



Refer to Section 7.4 to see if each alarm can be reset or not.

If the safety parameter is changed during the occurrence of an alarm, the STO state is maintained even if the "restart acknowledge behavior” is set to 1 (manual restart). Deactivate the STO by the ACK input.

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7.4 Alarm list

Alarm		LED pattern	Name	Can be reset or not	Stopping behavior
Main code	Subcode				
560	0	4	Processor error	No	STO
561	0	4	Processor error	No	STO
562	0 - 4	4	Memory error	No	STO
563	0 - 8	4	System error	No	STO
565	0	4	System error	No	STO
566	0	4	System error	No	STO
567	0	4	System error	No	STO
568	0	4	System error	No	STO
569	0 - 3	4	System error	No	STO
56A	0,1	4	System error	No	STO
56B	0	4	System error	No	STO
56C	0	4	System error	No	STO
-	-	4	Reserved	-	-
570	-	4	Internal communication error	No	STO
571	-	4	Internal communication error	No	STO
572	-	4	Internal communication error	No	STO
573	-	4	Internal communication error	No	STO
574	-	4	Internal communication error	No	STO
575	-	4	Motor combination error	No	STO
576		4	Parameter setting error	No	STO
-	-	4	Reserved	-	-
580	-	4	Installation error	No	STO
	1	4	Installation error	No	STO
581	0, 1	4	Clock error	No	STO
582	0	4	System power overvoltage	No	STO
	1	4	System power undervoltage	No	STO
583	0, 1	4	FPGA error	No	STO
584	0	4	STO circuit failure	No	STO
585	0	4	Safety input circuit failure	No	STO
	1	4	Safety input mismatch	No	STO
586	0	4	Safety output circuit failure	No	STO
	1	4	Safety output mismatch	No	STO
587	0	4	SBC circuit failure	No	STO
	1	4	SBC output mismatch	No	STO
588	0	4	System overheating	No	STO
589	0, 1	4	Non-volatile memory error	No	STO
58A	0	4	Safety origin sensor failure	No	STO
-	-	-	Reserved	-	-
5A0	0 - 5	4	Internal communication error	No	STO
5A1	0 - 5	4	Internal communication error	No	STO
5A2	0 - 2	4	Internal communication error	No	STO

Alarm		LED pattern	Name	Can be reset or not	Stopping behavior
Main code	Subcode				
5A3	0, 1	4	Encoder communication error	No	STO
	2, 3	4	Encoder data error	No	STO
	5	4	Encoder data error	No	STO
	6	4	Encoder setting error	No	STO
-	-	-	Reserved	-	-
5BF	0	4	Parameter reset	No	-
5C0	0 - 3	4	Parameter setting error	Yes	-
5C1	0 - 2	3	Parameter error	Yes	-
5C2	0	4	Encoder data error	Yes	STO
-	-	-	Reserved	-	-
5C6	1 - 4	2	SS1 deceleration monitoring error	Yes	STO
5C7	1 - 4	2	SS2 deceleration monitoring error	Yes	STO/SS1*
5C8	1 - 4	2	SOS speed monitoring error	Yes	STO
5C9	1 - 4	2	SLS speed monitoring error	Yes	STO/SS1*
5CA	1, 2	2	SMS speed monitoring error	Yes	STO/SS1*
5CB	1	2	SDIp speed monitoring error	Yes	STO
	2	2	SDIn speed monitoring error		
5CC	1 - 4	1	SOS position monitoring error	Yes	STO
5CD	1	1	SDIp position monitoring error	Yes	STO
	2	1	SDIn position monitoring error		
5CE	1 - 4	1	SLI position monitoring error	Yes	STO/SS1*
5CF	1 - 4	1	SLP position monitoring error	Yes	STO/SS1*

Note: you can select the stop behavior with the “error reaction” setting for each safety function.

7.5 Troubleshooting

Alarm code	**AL560.0 / AL561.0**	
Name	**Processor error**	
Description	Detected an abnormal operation of the processor.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL562.0 - 4**	
Name	**Memory error**	
Description	Detected an abnormal operation for the internal memory of the processor.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL563.0 - 8 / AL565.0 / AL566.0 / AL567.0 / AL568.0 / AL569.0 - 3 / AL56A.0 / AL56B.0 / AL56C.0**	
Name	**System error**	
Description	Detected an abnormal program behavior.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL56A.1**	
Name	**System error**	
Description	Detected an initial processing error in the encoder.	
Checking method and corrective action	Possible cause	Action
	Combination error	Check the encoder type code in the motor model number and replace the servo motor if the encoder is not compatible. Refer to Section 1.4 for the compatible encoder types.
	Encoder connection setting error	CN5 is selected for the main encoder connection. Change the setting with the servo drive parameter PM.003.
	Disconnection / miswiring	Check the connectors for poor contact, broken wires, and wiring errors. If any of the issues occurs, repair or replace the cable.
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
	Encoder failure	If none of the preceding actions can clear the error, replace the servo motor.

Alarm code	**AL570 / AL571 / AL572 / AL573 / AL574**	
Name	**Internal communication error**	
Description	Detected an internal communication error.	
Checking method and corrective action	Possible cause	Action
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
Remarks	These alarms are detected on the servo drive, but at the same time there may be other alarm occurring in the safety functions module, so check the alarm code in Delta Drive Safety.	

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Alarm code	**AL575**	
Name	**Motor combination error**	
Description	An incompatible servo motor is connected.	
Checking method and corrective action	Possible cause	Action
	Connection to an incompatible motor	Refer to Section 1.4 and replace the servo motor with a compatible one.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Servo motor failure	Replace the servo motor.
Remarks	This alarm is detected on the servo drive, but at the same time there may be other alarm occurring in the safety functions module, so check the alarm code in Delta Drive Safety.	

Alarm code	**AL576**	
Name	**Parameter setting error**	
Description	Mismatch between servo drive parameter P1.100 setting and system configuration.	
Checking method and corrective action	Possible cause	Action
	P1.100 setting error	When using the safety functions module, set the servo drive parameter P1.100 to 1 or 2. If not using the safety functions module, set P1.100 to 0.
	Poor contact between the servo drive and the safety functions module	Remove the safety functions module, clean the contact area with a stream of air, etc., and then reinstall it.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Servo motor failure	Replace the servo motor.
Remarks	This alarm is detected on the servo drive, but at the same time there may be other alarm occurring in the safety functions module, so check the alarm code in Delta Drive Safety.	

Alarm code	**AL580**	
Name	**Installation error**	
Description	Detected an abnormal connection between the safety functions module and the servo drive.	
Checking method and corrective action	Possible cause	Action
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
Remarks	This alarm is detected on the servo drive. It is not recognized by the safety functions module and therefore does not appear in Delta Drive Safety.	

Alarm code	**AL580.1**	
Name	**Installation error**	
Description	Detected an abnormal connection between the safety functions module and the servo drive.	
Checking method and corrective action	Possible cause	Action
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL581.0 - 1**	
Name	**Clock error**	
Description	Detected an abnormal operation of the program or the oscillator circuit.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL582.0 / AL582.1**	
Name	**System power overvoltage / System power undervoltage**	
Description	Detected an overvoltage or undervoltage of the power generated within the safety functions module.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL583.0 - 1**	
Name	**FPGA error**	
Description	Detected an abnormal operation in the FPGA's peripheral circuit or internal devices.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

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Alarm code	**AL584.0**	
Name	**STO circuit failure**	
Description	Detected an abnormal operation of the STO circuit.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the module or the servo drive.

Alarm code	**AL585.0**	
Name	**Safety input circuit failure**	
Description	Detected an abnormal operation of the safety input circuit.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL585.1**	
Name	**Safety input mismatch**	
Description	Detected a logic mismatch in the safety input signals of the two channels used in pairs.	
Checking method and corrective action	Possible cause	Action
	Disconnection / miswiring	Check the connector for poor contact, broken wires, and wiring errors. If any of the issues occurs, repair or replace the cable.
	Mismatch in control timing between two channels	The timing of the operation of the two channels that are paired together may be shifted by 1 seconds or more. Check the safety controller settings.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL586.0**	
Name	**Safety output circuit failure**	
Description	Detected an abnormal operation of the safety output circuit.	
Checking method and corrective action	Possible cause	Action
	Disconnection / miswiring	Check the connector for poor contact, broken wires, and wiring errors. If any of the issues occurs, repair or replace the cable. If +24V for the safety output is not supplied, connect an external power supply.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL586.1**	
Name	**Safety output mismatch**	
Description	Detected a logic mismatch in the safety output signals of the two channels used in pairs.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
Remarks	The system detects this mismatch only when the Safe Speed Monitor (SSM) signal is assigned to the safety output.	

Alarm code	**AL587.0**	
Name	**SBC circuit failure**	
Description	Detected an abnormal operation of the SBC circuit.	
Checking method and corrective action	Possible cause	Action
	Disconnection / miswiring	Check the connector for poor contact, broken wires, and wiring errors. If any of the issues occurs, repair or replace the cable. If +24V for the SBC output is not supplied, connect an external power supply.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL587.1**	
Name	**SBC output mismatch**	
Description	Detected a logic mismatch of the SBC output signals.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

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Alarm code	**AL588.0**	
Name	**System overheating**	
Description	Detected that the internal temperature of the safety functions module exceeds the allowable range.	
Checking method and corrective action	Possible cause	Action
	High ambient temperature	The ambient temperature for the system may have exceeded the allowable range. In this case, modify the installation environment or install a cooling device to lower the room temperature.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL589.0**	
Name	**Non-volatile memory error**	
Description	Detected a corruption of the safety parameters stored in the non-volatile memory.	
Checking method and corrective action	Possible cause	Action
	System power off during parameter update	There may have been a power failure during the parameter update process so the parameters are not updated correctly. In this case, set the parameters again.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL589.1**	
Name	**Non-volatile memory error**	
Description	Detected an abnormal operation of the non-volatile memory.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL58A.0**	
Name	**Safety origin sensor failure**	
Description	The safety origin detection device is not connected, disconnected, or in error.	
Checking method and corrective action	Possible cause	Action
	No connection to or disconnection of safety origin detection device	If the safety origin detection device is not connected, wire it according to Section 2.2.2.4.
	Safety origin detection device failure	There may be a safety origin detection device failure. In this case, replace the detection device with a new one.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	**AL5A0.0 - 5 / AL5A1.0 - 5 / AL5A2.0 - 2**	
Name	**Internal communication error**	
Description	Detected an internal communication error.	
Checking method and corrective action	Possible cause	Action
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
	Check servo alarms	This alarm may have been triggered by other existing alarms in the servo drive. Check if any alarms are triggered on the servo drive.

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Alarm code	**AL5A3.0 - 1**	
Name	**Encoder communication error**	
Description	Detected a communication error in the encoder.	
Checking method and corrective action	Possible cause	Action
	Combination error	Check the encoder type code in the motor model number and replace the servo motor if the encoder is not compatible. Refer to Section 1.4 for the compatible encoder type.
	Encoder connection setting error	CN5 is selected for the main encoder connection. Change the setting with the servo drive parameter PM.003.
	Disconnection / miswiring	Check the connector for poor contact, broken wires, and wiring errors. If any of the issues occurs, repair or replace cable.
	Improper installation	There may be poor contact (e.g. due to foreign matter) in the contact area between the servo drive and safety functions module during installation. In this case, remove the safety functions module as described in Section 2.1, clean the contact area, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
	Encoder failure	If none of the preceding actions can clear the error, replace the servo motor.

Alarm code	**AL5A3.2 - 3**	
Name	**Encoder data error**	
Description	Detected anomalies in the encoder data.	
Checking method and corrective action	Possible cause	Action
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Encoder failure	If the alarm occurs repeatedly, there may be an encoder failure. In this case, replace the servo motor.

Alarm code	**AL5A3.5**	
Name	**Encoder data error**	
Description	Encoder data did not change.	
Checking method and corrective action	Possible cause	Action
	Encoder failure	There may be an encoder failure. In this case, replace the servo motor.

Alarm code	**AL5A3.6**	
Name	**Encoder setting error**	
Description	The encoder information is incorrect.	
Checking method and corrective action	Possible cause	Action
	Encoder setting failure / Combination error	Incorrect encoder setting or an incorrect combination is used. In this case, replace the servo motor.

Alarm code	**AL5BF.0**	
Name	**Parameter reset**	
Description	Parameter reset is executed.	
Checking method and corrective action	Possible cause	Action
	Parameter is reset	Power cycling.

Alarm code	**AL5C0.0 - 3 / AL5C1.0 - 2**	
Name	**Parameter setting error / Parameter error**	
Description	Detected an abnormal operation during parameter setting in Delta Drive Safety.	
Checking method and corrective action	Possible cause	Action
	Communication with PC is in error	If a communication error occurs between PC and the safety functions module while the parameters are being updated, the parameters may not be updated correctly. In this case, set the parameters in Delta Drive Safety again.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
Remarks	If power is cycled before the alarm is cleared, AL589.0 may occur. In this case, check the corrective actions for AL589.0.	

Alarm code	**AL5C2.0**	
Name	**Encoder data error**	
Description	Detected anomalies in the encoder data.	
Checking method and corrective action	Possible cause	Action
	“Encoder diagnostic sensitivity” is too high	If the setting of “encoder diagnostic sensitivity” is too high, an alarm may be falsely detected. Decrease the setting to an appropriate value.
	Improper setting of servo drive parameters	The servo loop gain is too low, so the machine operation may not follow up the position / speed command. Adjust the servo parameters to improve response or decrease the setting of “encoder diagnostic sensitivity”.
	Forced stop by emergency stop during motor operation	This alarm occurs when the motor is stopped in an emergency. This is a normal condition, so reset the alarm and continue the operation.
	Occurred during SBT execution	The holding torque of the electromagnetic brake may have decreased. Replace the servo motor.
	Malfunctions due to noise	If the alarm does not recur after power cycling, there may be excessive noise around the servo drive. In this case, continue to use the product after taking noise control measures.
	Encoder failure	If the alarm occurs repeatedly, there may be an encoder failure. In this case, replace the servo motor.

Alarm code	**AL5C6.1 - 4**	
Name	**SS1 deceleration monitoring error**	
Description	The deceleration rate exceeds the “deceleration limit” setting during deceleration by the Safe Stop 1 (SS1-r) function.	
Checking method and corrective action	Possible cause	Action
	Setting of “deceleration” is too small or setting of “deceleration limit” is too large	If the deceleration is controlled by the controller, adjust the controller operation for faster deceleration or reduce the setting of “deceleration limit”. If the deceleration is controlled by the servo drive, the “deceleration” setting should be greater than the “deceleration limit” setting.
	Deceleration monitoring started too early	In this case, increase the setting of “delay time before deceleration” to delay the timing for deceleration rate monitoring.
	Load inertia is too large	If the load inertia of the servo motor is too large, it may not be able to decelerate with the setting of “deceleration”. In this case, properly set the “deceleration” and “deceleration limit” based on the load conditions. Also, adjust the servo drive parameters (such as inertia ratio and servo gain).
Remarks	・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SS1 command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.3 for details of each parameter of the SS1 function.	

Alarm code	**AL5C7.1 - 4**	
Name	**SS2 deceleration monitoring error**	
Description	The deceleration rate exceeds the “deceleration limit” setting during deceleration by the Safe Stop 2 (SS2-r) function.	
Checking method and corrective action	Possible cause	Action
	Setting of “deceleration” is too small or setting of “deceleration limit” is too large	If the deceleration is controlled by the controller, adjust the controller operation for faster deceleration or reduce the setting of “deceleration limit”. If the deceleration is controlled by the servo drive, the “deceleration” setting should be greater than the “deceleration limit” setting.
	Deceleration monitoring started too early	In this case, increase the setting of “delay time before deceleration” to delay the timing for deceleration rate monitoring.
	Load inertia is too large	If the load inertia of the servo motor is too large, it may not be able to decelerate with the setting of “deceleration”. In this case, properly set the “deceleration” and the “deceleration limit” based on the load conditions. Also, adjust the servo drive parameters (such as inertia ratio and servo gain).
Remarks	・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SS2 command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.4 for details of each parameter of the SS2 function.	

Alarm code	**AL5C8.1 - 4**	
Name	**SOS speed monitoring error**	
Description	The servo motor speed exceeds the “velocity zero window” setting during the execution Safe Operation Stop (SOS).	
Checking method and corrective action	Possible cause	Action
	Function activated during motor operation	If the alarm occurs immediately after the SOS function is activated, reduce the servo motor speed below the setting of “velocity zero window” before activating the function, or increase the setting of “time to SOS” to delay the timing for speed monitoring.
	Setting of “velocity zero window” does not match the operation pattern	When operating the motor with the SOS function activated, modify the operation pattern so that the servo motor speed does not exceed the setting of “velocity zero window”, or increase the setting of “velocity zero window”.
	Occurred during SBT execution	The holding torque of the electromagnetic brake may have decreased. Replace the servo motor.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SOS command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.5 for details of each parameter of the SOS function.	

Alarm code	**AL5C9.1 - 4**	
Name	**SLS speed monitoring error**	
Description	The servo motor speed exceeds the “velocity limit” setting during the execution of Safely-limited Speed (SLS).	
Checking method and corrective action	Possible cause	Action
	Speed monitoring started too early	If the alarm occurs immediately after the SLS function is activated, review the operation pattern to ensure that the servo motor speed reaches the setting of “velocity limit” before activating the function, or increase the setting of “time to velocity monitoring” and “time for velocity in limit” to delay the timing for velocity monitoring.
	Setting of “velocity limit” does not match the operation pattern	When the SLS function is activated, modify the operation pattern so that the servo motor speed does not exceed the setting of “velocity limit”, or increase the setting of “velocity limit”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SLS command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.6 for details of each parameter of the SLS function.	

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Alarm code	**AL5CA.1**	
Name	**SMS speed monitoring error**	
Description	The servo motor speed exceeds the “maximum positive velocity” setting.	
Checking method and corrective action	Possible cause	Action
	Setting of “maximum positive velocity” do not match the operation pattern	Modify the operation pattern so that the servo motor speed does not exceed the setting of “maximum positive velocity”, or increase the setting of “maximum positive velocity”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ Refer to Section 4.7 for details of each parameter of the SMS function.	

Alarm code	**AL5CA.2**	
Name	**SMS speed monitoring error**	
Description	The servo motor speed exceeds the “maximum negative velocity” setting.	
Checking method and corrective action	Possible cause of	Action
	Setting of “maximum negative velocity” do not match the operation pattern	Modify the operation pattern so that the servo motor speed does not exceed the setting of “maximum negative velocity”, or increase the setting of “maximum negative velocity”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ Refer to Section 4.7 for details of each parameter of the SMS function.	

Alarm code	**AL5CB.1 / AL5CB.2**	
Name	**SDIp speed monitoring error / SDIn speed monitoring error**	
Description	The servo motor speed exceeds the “velocity zero window” setting during the execution of Safe Direction (SDIp or SDIn).	
Checking method and corrective action	Possible cause	Action
	Speed monitoring started too early	If the alarm occurs immediately after the SDIp or SDIn function is activated, reduce the servo motor speed below the setting of “velocity zero window” before activating the function, or increase the setting of “time to SDI” to delay the timing for speed monitoring.
	Setting of “velocity zero window” does not match the operation pattern	When operating the motor with the SDIp and SDIn functions activated, modify the operation pattern so that the servo motor speed in the rotation direction with the SDI function activated does not exceed the setting of “velocity zero window”, or increase the setting of “velocity zero window”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ Refer to Section 4.10 for details of each parameter of the SDIp / SDIn function.	

Alarm code	**AL5CC.1 - 4**	
Name	**SOS position monitoring error**	
Description	The servo motor position exceeds the “position zero window” setting during the execution of Safe Operation Stop (SOS).	
Checking method and corrective action	Possible cause	Action
	Function activated during motor operation	If an alarm occurs immediately after the SOS function is activated, activate the function while the servo motor is stopped or increase the setting of “time to SOS” to allow time for the servo motor to stabilize.
	Setting of “position zero window” does not match the operation pattern	When operating the motor with the SOS function activated, modify the operation pattern so that the servo motor position does not exceed the setting of “position zero window”, or increase the setting of “position zero window”.
	Occurred during SBT execution	The holding torque of the electromagnetic brake may have decreased. Replace the servo motor.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SOS command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.5 for details of each parameter of the SOS function.	

Alarm code	**AL5CD.1 / AL5CD.2**	
Name	**SDIp position monitoring error / SDIn position monitoring error**	
Description	The servo motor position exceeds the “position zero window” setting during the execution of Safe Direction (SDIp or SDIn).	
Checking method and corrective action	Possible cause	Action
	Position monitoring started too early	If an alarm occurs immediately after the SDI function is activated, activate the function while the servo motor is stopped or increase the setting of “time to SDI” to allow time for the servo motor to stabilize.
	Setting of “position zero window” does not match the operation pattern	When operating the motor with both the SDIp and SDIn functions activated, modify the operation pattern so that the servo motor position in the direction where the functions are activated does not exceed the setting of “position zero window”, or increase the setting of “position zero window”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ Refer to Section 4.10 for details of each parameter of the SDIp / SDIn function.	

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Alarm code	**AL5CE.1 - 4**	
Name	**SLI position monitoring error**	
Description	The servo motor position exceeds “position related upper/lower limit” setting during the execution of Safely-limited Increment (SLI).	
Checking method and corrective action	Possible cause	Action
	Position monitoring started too early	If an alarm occurs immediately after the SLI function is activated, enable the function while the servo motor is stopped or increase the setting of “time to SLI” to allow time for the servo motor to stabilize.
	Setting of “position related upper / lower limit” do not match the operation pattern	When operating the motor with the SLI function activated, modify the operation pattern so that the servo motor position does not exceed the setting of “position related upper / lower limit”, or increase the setting of “position related upper / lower limit”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SLI command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.9 for details of each parameter of the SLI function.	

Alarm code	**AL5CF.1 - 4**	
Name	**SLP position monitoring error**	
Description	The servo motor position exceeds the “position related upper/lower limit” setting during the execution of Safely-limited Position (SLP).	
Checking method and corrective action	Possible cause	Action
	Position monitoring started too early	If an alarm occurs immediately after the SLP function is activated, activate the function while the servo motor is stopped or increase the setting of “time to SLP” to allow time for the servo motor to stabilize.
	Setting of “position related upper / lower limit” does not match the operation pattern	When operating the motor with the SLP function activated, modify the operation pattern so that the servo motor position does not exceed the setting of “position related upper / lower limit”, or increase the setting of “position related upper / lower limit”.
Remarks	・ Parameter changes should be made with the safety adequately guaranteed by risk assessments. ・ When in the EtherCAT communication (FSoE) type, the subcode in the alarm display indicates the sub-index number of the SLP command. When in the I/O type, the subcode is fixed at 1. ・ Refer to Section 4.11 for details of each parameter of the SLP function.	

Revision History

Release date	Version	Chapter	Revision Contents
May, 2025	V2.0 (Second edition)	1	Updated the table of the servo motors that can be combined: added F130 and F180 (2 - 5.5 kW) motors with the encoder type of 2.
		7	Added the checking method and corrective action for AL5A1: check servo alarms.
October, 2024	V1.0 (First edition)	-	-

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