



Safety over  
**EtherCAT**®

Digitized Automation for a Changing World

# Delta ACS3-SF Safety Functions Module User Manual

# Introduction

Thank you for your purchase of the Safety Function Extension module ACS3-SF used for ASDA-A3 series 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 Function Extension module.

This product is an optional module exclusively for ASDA-A3 series AC servo drives with the identification code "EP". 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 Function Extension module.

Please 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 to improve quality, function, reliability or otherwise.  
The latest version is available for download from our Website ([www.deltaww.com](http://www.deltaww.com)).
- 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 ASDA-A3 series AC Servo Drives. To set the parameters, you can use the Parameter Setting Tool (Delta Drive Safety).

This document does not provide details on servo drives, servo motors, or the use of the Parameter Setting Tool. Please also refer to the following documents.

Name	Document No.
ASDA-A3-EP AC Servo Drives User Manual	DELTA_IA-ASD_ASDA-A3-EP_UM_##_XXXXXXXX
Parameter Setting Tool Delta Drive Safety 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 date of issue of the document.




## Update Information

Product update information will be automatically distributed from our product information site (Delta IA Academy: [iabg-academy.deltaww.com](http://iabg-academy.deltaww.com)) or notified by your distributors.

# Safety Precautions



For safe and proper use of the ACS3-SF Safety Function Extension module, please read this document and the "Safety Precautions" carefully and make yourself fully acquainted with the safety devices before use.

## Warning Labels

 <b>DANGER</b>	Mishandling of the product may lead to an extremely hazardous situation, resulting in death or serious injury.
 <b>WARNING</b>	Mishandling of the product may lead to a hazardous situation, resulting in death or serious injury.
 <b>CAUTION</b>	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

 <b>DANGER</b>
<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• Use a power supply with double or reinforced insulation for the external interface of the servo drive (24 VDC power supply) and for the electromagnetic brake. Failure to do so may result in electric shock.</li> </ul>
 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>• When an alarm goes off, eliminate the cause of the alarm to ensure safety, then reset the alarm or reconnect the power to resume operation. Failure to do so may result in personal injury or damage.</li> </ul>

**Prohibition**

- Do not use the product in a location exposed to water, in a corrosive atmosphere, in an atmosphere containing flammable gases, or near flammable materials. Otherwise, it may cause 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 parts of it is missing. Unexpected operation or burnout may occur.

■ **Transportation and Storage****Prohibition**

- Do not store in areas exposed to rain or dripping water, areas containing harmful gases or liquids, areas containing metal fragments or dust, or areas where there is a risk of exposure to radioactivity. Otherwise, it may result in product malfunction.
- Store out of direct sunlight between -20°C and +65°C within the specified humidity range of 0 to 90%RH. Do not store 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 cause 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 incomplete 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 instructions for use, the wiring diagram or other technical data. Wiring errors, applying different voltages, etc. may cause 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 document. Incorrect wiring of the electromagnetic brake or applying different voltages may cause the servo drive or the servo motor to malfunction, resulting in damage to the machine 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, 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, including this product, may become hot during operation. Maintenance and inspection should be performed after sufficient time has elapsed since stopping operation. 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 insulation resistance or dielectric strength tests. 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, please be sure to provide notification and labeling on the final product, if required.

# Safety Equipment Handling

## Safety Equipment 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 document.
- (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 for the electromagnetic brake.
- (4) Keep the safety wiring separate from the other signal wiring. 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) Once this product is installed, the built-in Safe Torque Off (STO) function of the servo drive cannot be used. When using the STO function, execute it from the Safety Function Extension module.
- (8) When using the Safety-Limited Position (SLP) function, safety origin diagnosis must be performed to verify that the Safety origin sensor mounting position has not shifted at startup.
- (9) For peripheral devices used to monitor safety, including switches, relays, and sensors, it is recommended to use devices that comply with the safety standards. Safety certification should be implemented when using 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 (servo drives and servo motors equipped with this product) has the residual risks listed below, 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 the inertia of the motor, even when the Safe Torque Off (STO) function is activated. The safety system should be designed so 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 parameters. Set within the range that ensures system safety.
- (4) Position and speed are monitored in 1ms cycle. Errors within 1ms 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 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 "safe position actual value" is 0. Whenever the safety origin is reset, be sure to check the validity of the SLP monitoring level.
- (8) The servo motor may move within a very small range, on the condition that the safety monitoring function is being activated and that the servo motor is stopped. This is due to the fault diagnosis function of the encoder.
- (9) An off-pulse of shorter than 1ms 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 ISO13849-2.

### **Comply with Laws and Regulations**

For your equipment/facility to comply with the European Machinery Directive, the entire system must meet 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

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We provide warranties and assume liabilities as follows for our products. Please contact our branch or 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 us during the above warranty period, we shall provide a replacement product or repair such failed or malfunctioned product free of charge.

If such 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 catalogs, manuals, or specifications separately provided by us.
- In the case that the product is modified or repaired by anyone other than us.
- 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 products, 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 railroad cars, or medical equipment. Please contact our branch or 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, applied 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, or for any loss of opportunities or loss of profits suffered by you, resulting 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.

# Product Specifications

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# 1

This chapter describes product specifications.

1.1	Product Overview	2
1.2	Product Check	2
1.3	Product Model Number	3
1.4	Product Specifications	4
1.4.1	General Specifications	4
1.4.2	Safety Specifications	5
1.5	Part Names	7
1.6	Dimensions	8
1.7	System Block Diagram	9

## 1.1 Product Overview

The Safety Function Extension module ACS3-SF can be introduced to the AC servo drive ASDA-A3 series with the identification code “EP” to enable the following safety functions.

- Safety Functions
  - Safe Torque Off (STO) function
  - Safe Stop1 (SS1) function (time controlled / ramp monitored)
  - Safe Stop2 (SS2) function (time controlled / ramp monitored)
  - Safe Operating Stop (SOS) function
  - Safely-Limited Speed (SLS) function
  - Safe Maximum Speed (SMS) function
  - Safe Speed Monitor (SSM) output
  - Safely-Limited Increment (SLI) function
  - Safe Direction (SDI) function
  - Safely-Limited Position (SLP) function
  - Safe Brake Control (SBC) function

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

- ✓ Once the Safety Function Extension 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

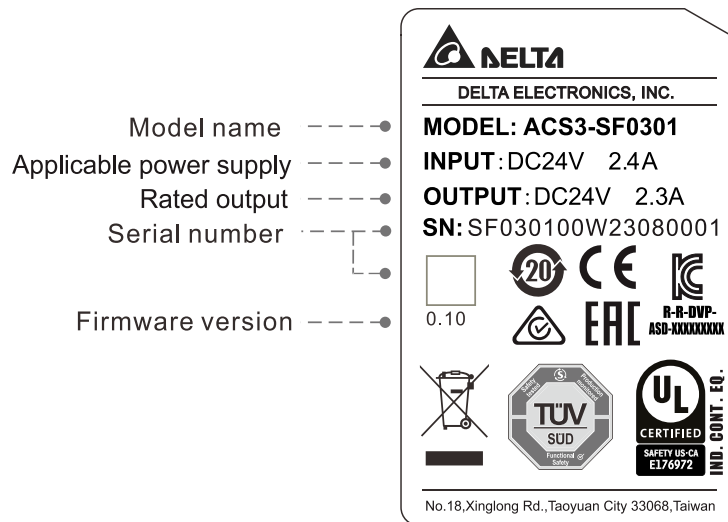
After unpacking, check the following items.

- (1) The package must include:
  - Main body of the Safety Function Extension module
  - Safety input/output connector
  - Electromagnetic brake power connector
  - Fixing screws (M3 × 5mm, 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, please contact the distributor or sales representatives from whom you purchased the product or our regional sales office.

### 1.3 Product Model Number

#### Nameplate



■ Serial number

- |                 |          |           |           |             |     |  |
|-----------------|----------|-----------|-----------|-------------|-----|--|
| <u>SF030100</u> | <u>W</u> | <u>23</u> | <u>08</u> | <u>0001</u> | (1) | Model name                                       |
| (1)             | (2)      | (3)       | (4)       | (5)         | (2) | Manufacturing plant (W: Wujiang Plant)           |
|                 |          |           |           |             | (3) | Year of manufacture (23: 2023)                   |
|                 |          |           |           |             | (4) | Week of manufacture (1 to 52)                    |
|                 |          |           |           |             | (5) | Serial number (starting from 0001 for each week) |

- ✓ Products that have received certification will be marked with the corresponding certification mark on the nameplate. Products without the mark mean that they have not yet met the relevant specifications. Please download the safety certificate from Delta's official website download center or contact Delta. Servo drives, servo motors and their accessories are not subject to the China Compulsory Product Certification System (CCC).

#### 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 Function Extension module

(3) External Interface



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

(4) Classification

Symbol	Classification
01	General-purpose type

## 1.4 Product Specifications

### 1.4.1 General Specifications

Item		Specifications
Installable servo drive model number <sup>*1</sup>		ASD-A3-XXXX-EP Firmware version 1.01 or more
Installable servo motor model number <sup>*2</sup>		ECM-B3 Series
Installable linear encoder model number <sup>*6</sup>		MSR-LEH-SDA4N3D5F1
Power supply for safety input <sup>*3</sup>		DC24V (Internal impedance 6.2 kohm)
Power supply for safety output / electromagnetic brake output <sup>*3</sup>		DC24V (max. current 2.4 A)
Electromagnetic brake power output		min. DC22.75V (max. output current 2 A)
Environmental standard <sup>*4</sup>	Place of installation	Indoor site (no direct sunlight), no corrosive or flammable gases, no oil mist, no dust
	Altitude	2000 m or less above sea level
	Atmospheric pressure	86kPa - 106kPa
	Operating temperature range	0°C to 55°C
	Storage temperature range	-20°C to +65°C
	Humidity	0 - 90% RH or less (non-condensing)
	Vibration	10 Hz - 57Hz: 0.075mm Amplitude 58Hz - 150Hz: 1G
	Ingress Protection rating (IP)	IP20
	Certified standards	IEC/EN/UL 61800-5-1  

※1: For more information on ASDA-A3-EP AC servo drives, refer to the servo drive user manual.

※2: The table below shows the servo motors that can be combined. If other motors are combined, AL575 will be displayed in the servo drive.

Servo motor frame size		Model name	Encoder type
400mm -100mm		ECM-B3□-□2□□□□□□□□ ECM-B3□-□A□□□□□□□□ ECM-B3□-□B□□□□□□□□	2, A, B
130mm		ECM-B3□-□2□□□□□□□□ ECM-B3□-□A□□□□□□□□ ECM-B3□-□B□□□□□□□□	2 <sup>*5</sup> , A, B
180mm	Rated power output 2 - 5.5 kW	ECM-B3□-□2□□□□□□□□ ECM-B3□-□A□□□□□□□□ ECM-B3□-□B□□□□□□□□	2 <sup>*5</sup> , A, B
	Rated power output 7.5 kW	ECM-B3□-□A□□□□□□□□	A
220mm		ECM-B3□-□A□□□□□□□□	A


※3: Use a safety extra-low voltage (SELV) power supply that can provide sufficient maximum current.

※4: The environmental standard conforms to the servo drive.

※5: Support will be available starting in Week 20 of 2025; an AL575 (Abnormal combination motor) will occur in servo drive , and the safety function extension module will trigger an AL5A1.2.

※6: This is a linear encoder that can be combined with a linear motor.

## 1.4.2 Safety Specifications

Standard		Certification Body
Functional Safety	IEC / EN 61508: 2010	
Machinery Directive	EN IEC 62061: 2021	
	EN 61800-5-2: 2017	
	EN ISO 13849-1: 2023	
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 Standards	I/O type		Communication Type	
HFT	Hardware Fault Tolerance	IEC/EN61508	1		1	
Type	Subsystem type	IEC/EN61508	Type B		Type B	
SIL	Safety integrity level	IEC/EN61508	SIL3 SIL2*		SIL3 SIL2*	
		EN IEC62061	maximum SIL3 maximum SIL2*		maximum SIL3 maximum SIL2*	
PFH	Risk failure rate	EN IEC62061	See the table below			
Response time	Response time	IEC/EN61508	STO, SBC	10ms	STO, SBC	15ms
			Others	25ms	Others	25ms
Fault reaction time	Failure reaction time	EN 61800-5-2	STO stop	10ms	STO stop	10ms
			SS1 stop	25ms	SS1 stop	25ms
Category	Category	EN ISO13849-1	Category 3 Category 2*		Category 3 Category 2*	
PL	Performance level	EN ISO13849-1	PL e PL d*		PL e PL d*	
MTTFd	Mean dangerous failure time	EN ISO13849-1	High (≥ 100 [years])		High (≥ 100 [years])	
DC	Diagnostic range	EN ISO13849-1	DC ≥ 98 [%] (medium)		DC ≥ 98 [%] (medium)	
Mission time	Mission time	EN ISO13849-1	20 [years]		20 [years]	

※ When the SLP function is used and the safety origin sensor is not used to determine the safety origin.

### Risk failure rate (PFH)

PFH varies depending on the input type and safety function.

Safety Functions	I/O type [1/h]	Communication type [1/h]	Note
STO	$< 1.4 \times 10^{-8}$	$< 1.5 \times 10^{-8}$	
SS1 / SS2 / SOS / SLS / SLI / SDI	$< 1.7 \times 10^{-8}$	$< 1.7 \times 10^{-8}$	
SLP	$< 1.9 \times 10^{-8}$	$< 1.9 \times 10^{-8}$	When safety sensor is used
SLP	$< 1.9 \times 10^{-8}$	$< 1.9 \times 10^{-8}$	When safety sensor is not used
SMS	$< 1.6 \times 10^{-8}$	$< 1.6 \times 10^{-8}$	
SSM	$< 1.9 \times 10^{-8}$	$< 1.7 \times 10^{-8}$	
SBC	$< 1.6 \times 10^{-8}$	$< 1.6 \times 10^{-8}$	

If multiple safety functions are induced 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.
- ✓ For details on how to determine the safety origin, see chapter 3.7.

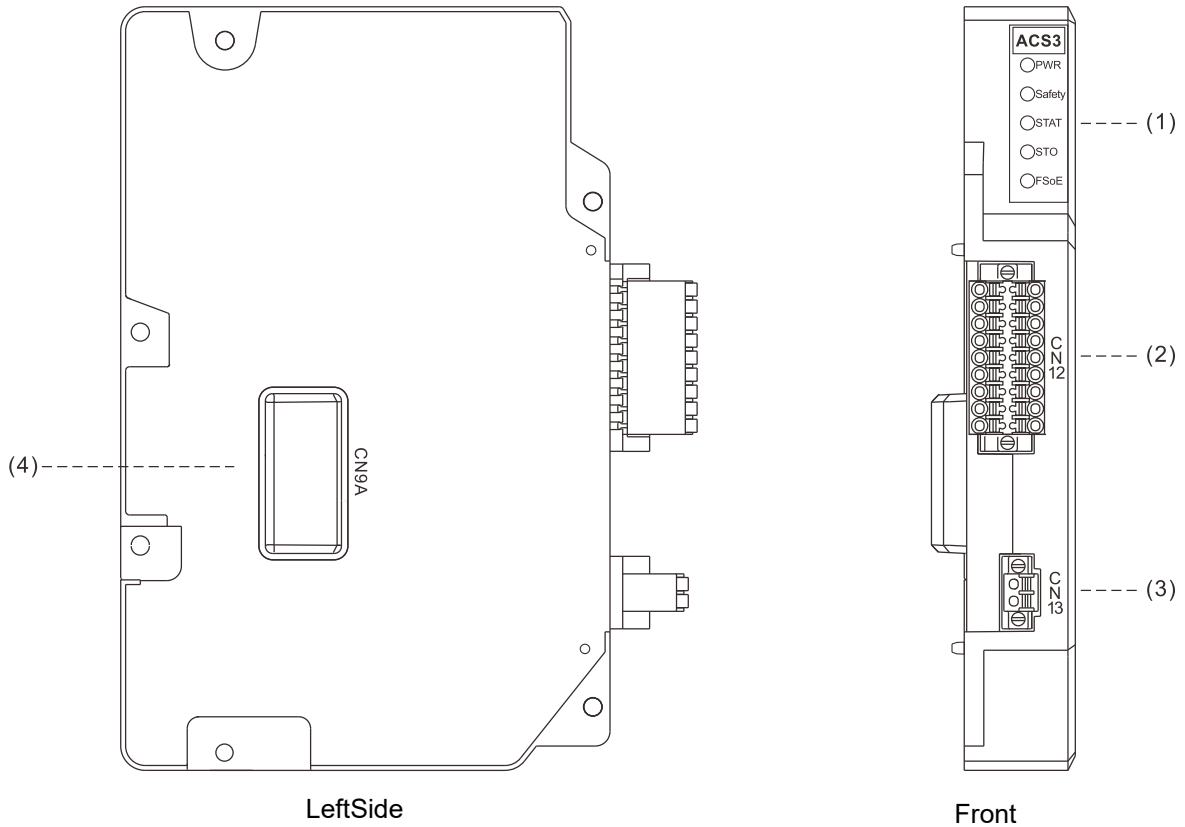
**Safety over EtherCAT (FSoE)**

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

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

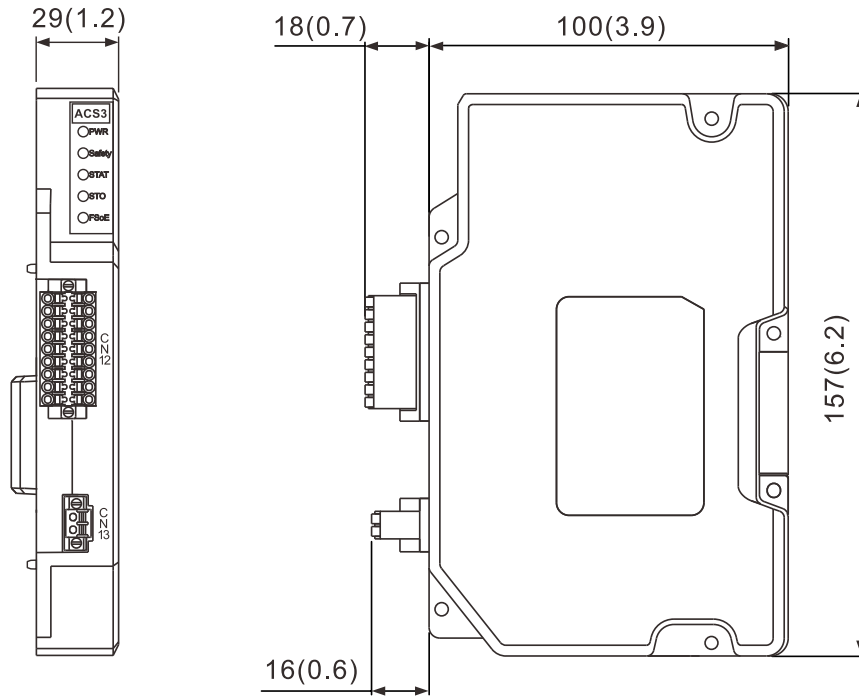
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**EtherCAT®** 


### 1.5 Part Names



Number	Name	Description	
(1)	LED	PWR	Power indicator for Safety Function Extension module
		Safety	Safety function execution status indicator
		STAT	Safety Function Extension 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 connector	
(4)	CN9A	Connector between servo drives	

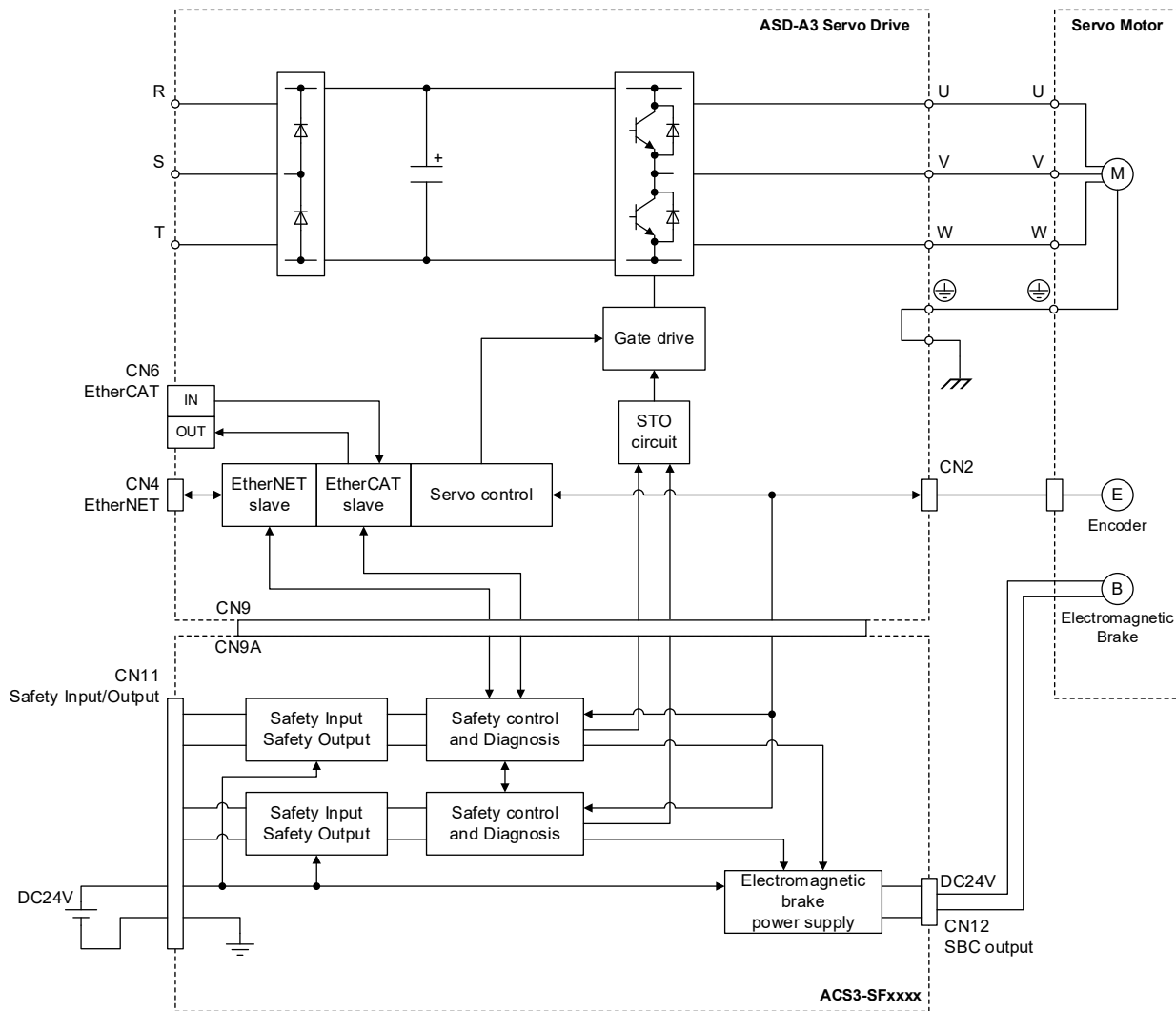
### 1.6 Dimensions



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

<b>Weight</b>	<b>0.16 kg (5.64 oz)</b>
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### 1.7 System Block Diagram



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# Installation and Wiring

# 2

This chapter describes how to install the ASDA-A3 Series AC Servo Drive and wire the connectors.

2.1	Installation and Removal	2
2.1.1	Installation	3
2.1.2	Removal	4
2.2	Wiring	6
2.2.1	Example of Peripheral Device Connection	6
2.2.2	CN12 Safety Input/Output Signals	7
2.2.2.1	Pin Assignment	7
2.2.2.2	Wiring for Safety Inputs	8
2.2.2.3	Wiring for Safety Outputs	9
2.2.2.4	Wiring for Safety Origin Sensor	10
2.2.2.4.1	Safety limit switch	10
2.2.2.5	Wiring Procedure	11
2.2.3	CN13 Electromagnetic Brake Power Supply	12
2.2.3.1	Pin Assignment	12
2.2.3.2	Wiring	13
2.2.3.3	Wiring Procedure	13

## 2.1 Installation and Removal

Make sure to obey the following precautions when you install or remove the Safety Function Extension module.

<b>DANGER</b>
Wait at least 5 minutes after turning off the power, and then check that the servo drive's "CHARGE" light is OFF before starting work. If not, it may result in electric shock.

<b>CAUTION</b>
Do not 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 the cabinet with a rating of IP54 or higher.

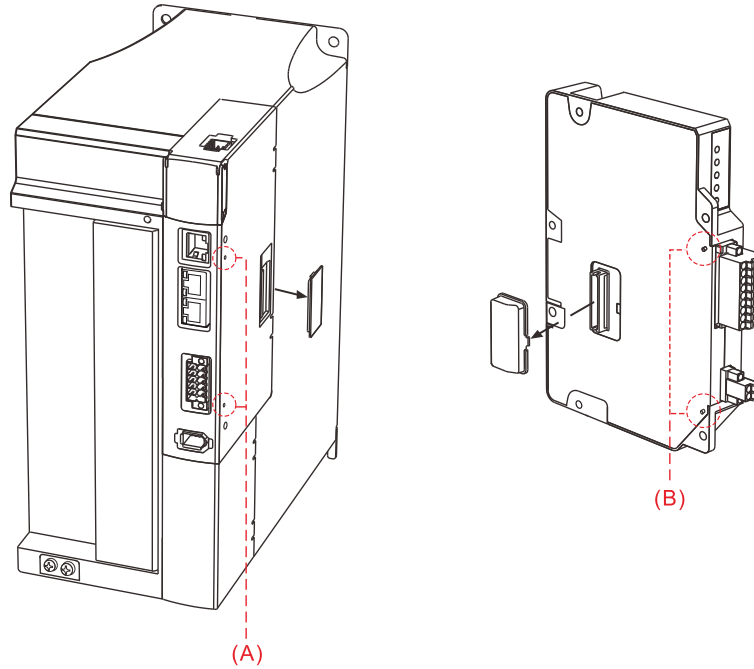
<b>Mandatory</b>																					
<p>Before installing the module in the servo drive, check the firmware version of the servo drive. Servo drive with firmware versions 1.01 or earlier does not support the Safety Function Extension module. Prepare a compatible servo drive for use.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"></td> <td style="text-align: right;">DELTA ELECTRONICS, INC</td> </tr> <tr> <td colspan="2"><b>MODEL:</b> ASD-A3-3043-EP</td> </tr> <tr> <td colspan="2"><b>INPUT:</b> 380-480V 3PH 50/60Hz 6.3A</td> </tr> <tr> <td colspan="2"><b>OUTPUT:</b> 220V 0-500Hz 9.11A</td> </tr> <tr> <td colspan="2"><b>POWER:</b> 3kW</td> </tr> <tr> <td style="text-align: center;">MAC ADDRESS XXXXXXXXXXXX</td> <td style="text-align: right;">UK CA </td> </tr> <tr> <td style="text-align: center;"></td> <td style="text-align: right;"></td> </tr> <tr> <td style="text-align: center;">1.01 A33043EPW22450003</td> <td style="text-align: right;"></td> </tr> <tr> <td colspan="2">No.18, Xinglong Rd., Taoyuan City 330477</td> </tr> <tr> <td style="vertical-align: top;"> <p> <b>WARNING</b> DISCONNECT ALL POWER AND WAIT 10 MINUTES BEFORE SERVICING RISK OF ELECTRIC SHOCK.</p> <p> <b>CAUTION</b> DO NOT TOUCH HEATSINK WHEN POWER IS ON. MAY CAUSE BURN.</p> <p> <b>CAUTION</b> READ THE USER MANUAL BEFORE OPERATION.</p> <p> USE PROPER GROUNDING TECHNIQUES</p> </td> <td style="vertical-align: top; text-align: right;"> <p>R-R-DVP-ASD-XXXXXXXX</p> <p>IND. CONT. EQ. E176972</p> <p>SERVICE.DELTAWW.COM</p> </td> </tr> </table>		DELTA ELECTRONICS, INC	<b>MODEL:</b> ASD-A3-3043-EP		<b>INPUT:</b> 380-480V 3PH 50/60Hz 6.3A		<b>OUTPUT:</b> 220V 0-500Hz 9.11A		<b>POWER:</b> 3kW		MAC ADDRESS XXXXXXXXXXXX	UK CA			1.01 A33043EPW22450003		No.18, Xinglong Rd., Taoyuan City 330477		<p> <b>WARNING</b> DISCONNECT ALL POWER AND WAIT 10 MINUTES BEFORE SERVICING RISK OF ELECTRIC SHOCK.</p> <p> <b>CAUTION</b> DO NOT TOUCH HEATSINK WHEN POWER IS ON. MAY CAUSE BURN.</p> <p> <b>CAUTION</b> READ THE USER MANUAL BEFORE OPERATION.</p> <p> USE PROPER GROUNDING TECHNIQUES</p>	<p>R-R-DVP-ASD-XXXXXXXX</p> <p>IND. CONT. EQ. E176972</p> <p>SERVICE.DELTAWW.COM</p>
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Firmware version -----●

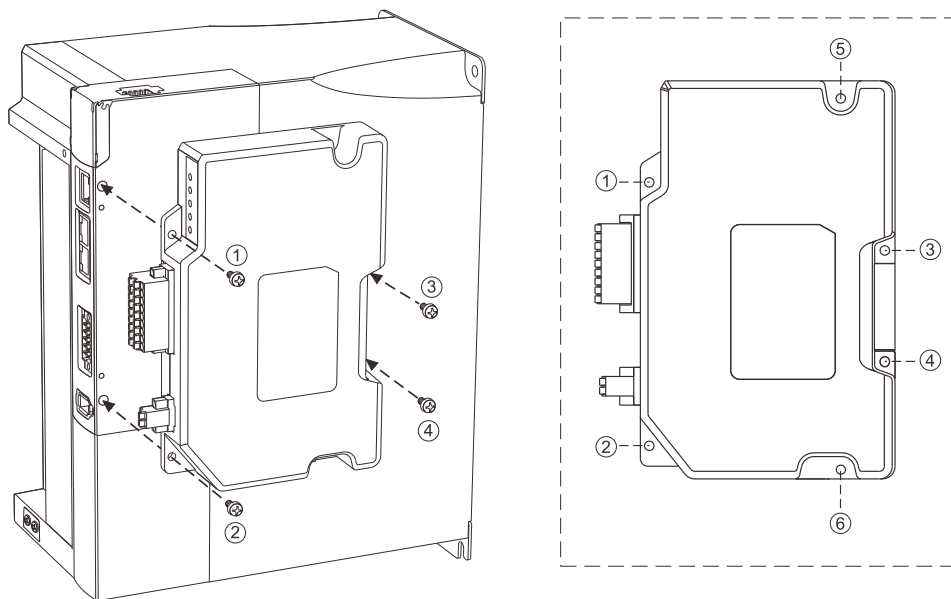
### 2.1.1 Installation

To install the Safety Function Extension module on the servo drive, follow the steps below.

- (1) Remove the connector cover on the right side of the servo drive main unit and the connector cover on the left side of the Safety Function Extension module. When combining, Make sure the alignment pin(B) of Safety Function Extension module into alignment hole(A) of servo drive.



- (2) Mount the Safety Function Extension module on the right side of the body of the servo drive and tighten the screws in the holes numbered in the diagrams below.  
Tightening torque: 6 to 8 kgf-cm

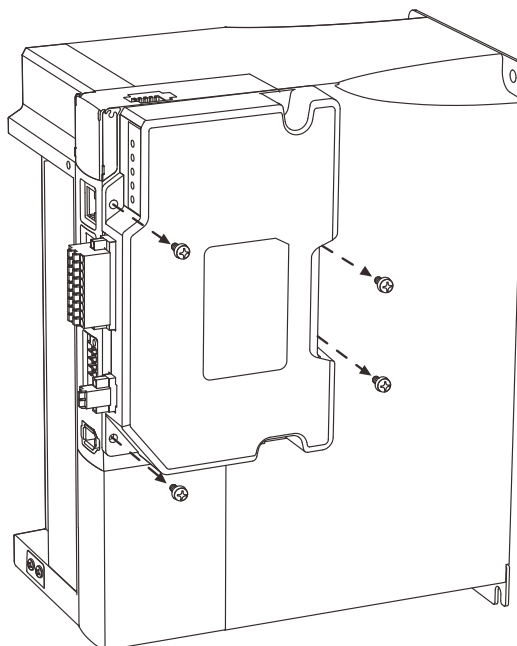


Model number of the servo drive	Screw hole
ASD-A3-0443, ASD-A3-0743, ASD-A3-1043, ASD-A3-1543, ASD-A3-4543, ASD-A3-5543, ASD-A3-7543, ASD-A3-1B43, ASD-A3-1F43	①, ②, ③, ④

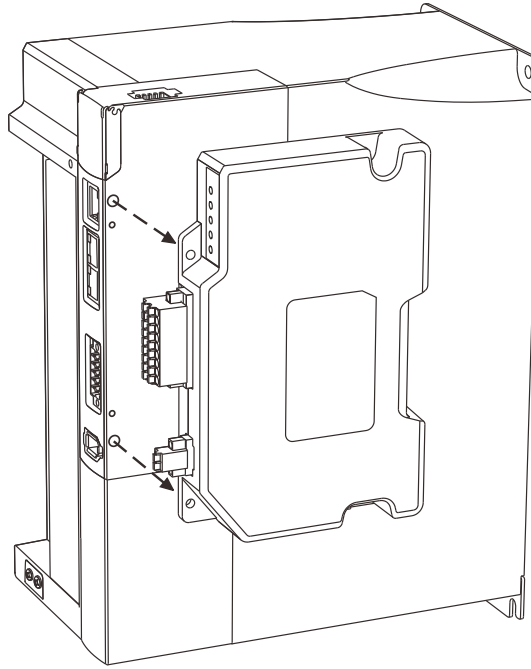
### 2.1.2 Removal

This section describes how to remove the Safety Function Extension module from the servo drive.

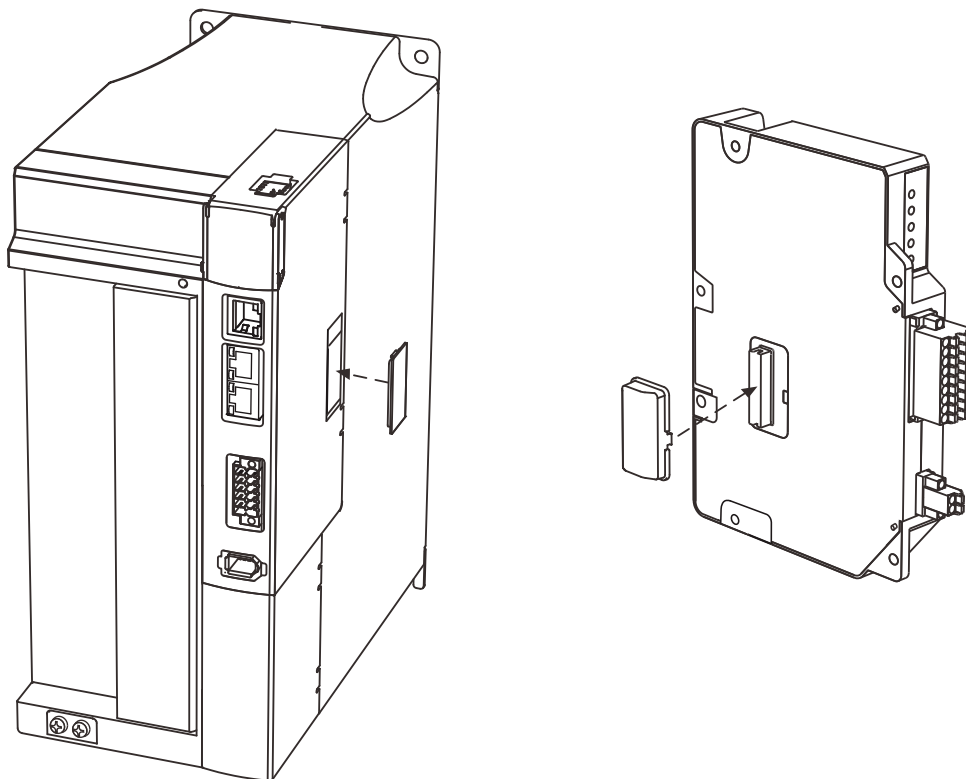
- (1) Remove all the screws securing the Safety Function Extension module.



- (2) Remove the Safety Function Extension module from the right side of the main unit of the servo drive.

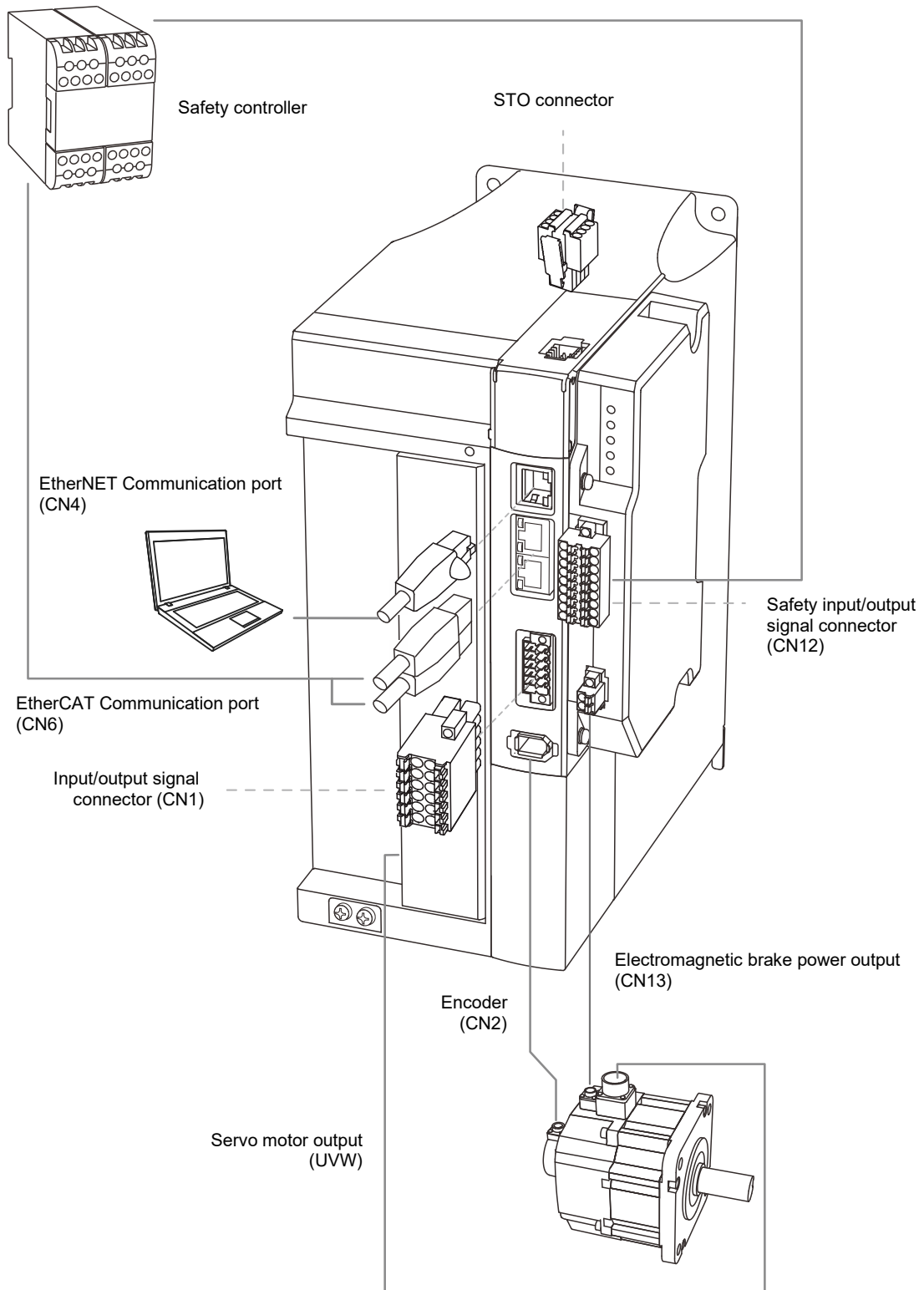


- (3) To replace the Safety Function Extension module, install another module in accordance with Section 2.1.1.  
 If the Safety Function Extension module is not installed, attach the cover to the connector on the right side of the main unit of the drive.



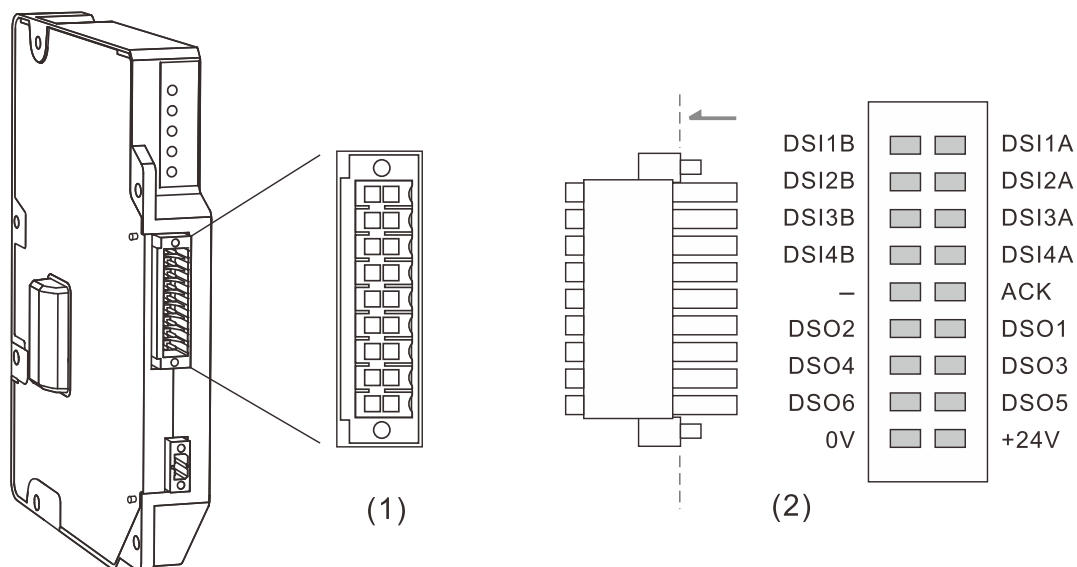
## 2.2 Wiring

### 2.2.1 Example of Peripheral Device Connection



## 2.2.2 CN12 Safety Input/Output Signals

### 2.2.2.1 Pin Assignment



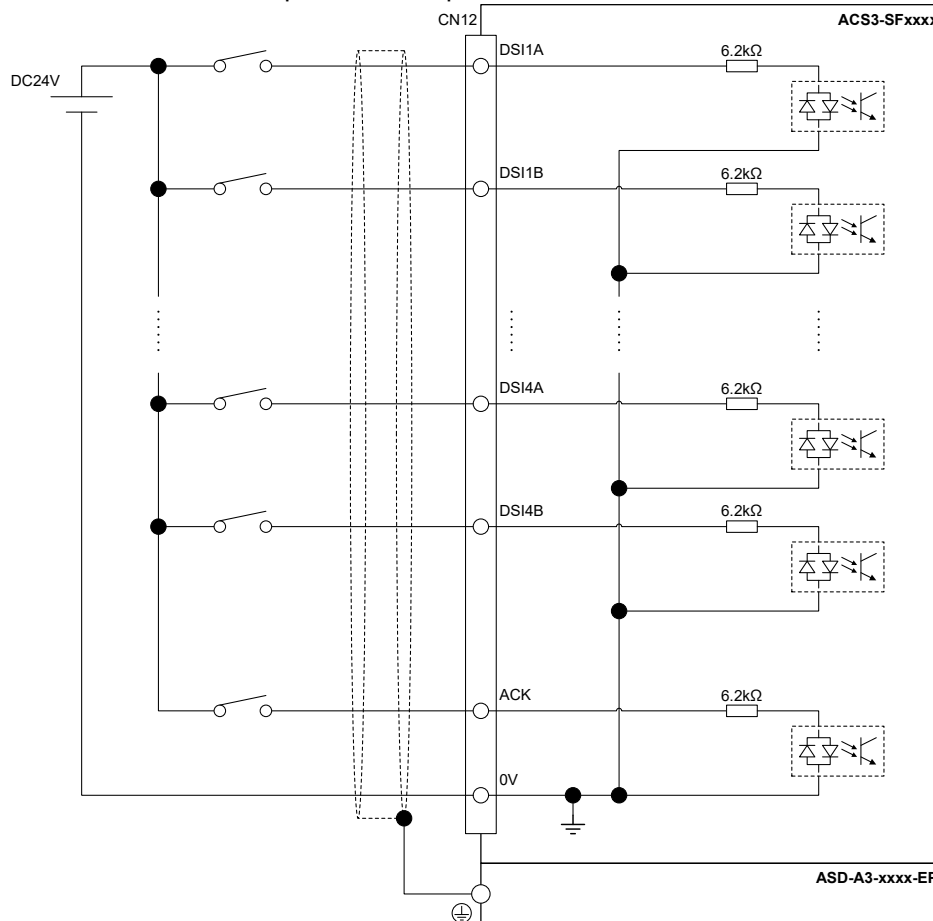
Connector	Specification
Model Number	0156-2A18-BK
Manufacturers	DINKEL
Applicable wire size	AWG16 - AWG22
Tightening torque	1.6~2.0kgf-cm
Cable length	20m or less

Pin	Signal	Name	Description
1	DSI1A	Safety Input 1A	Four-channel redundant safety inputs. Use in pairs of two channels (DSI1A and DSI1B, ..., DSI4A and DSI4B). When the input is turned OFF, the safety function determined by the user-selected parameter is activated.  <b>【Electrical Specifications】</b> Input voltage : DC24V Internal impedance : 6.2kohm Circuit configuration : Source type ON voltage : 11V or more OFF voltage : 5V or below
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 deactivated and alarm reset input	Inputs for deactivating safe stop functions (STO, SS1, SS2) and resetting alarm. Electrical specifications are identical to DSI.
10	NC	Undefined	Do not connect.
11	DSO1	Safety Output 1	Six-channel safety outputs. For outputting the status signal determined by the user-selected parameter. To output Safe Speed Monitor (SSM), use it in pairs (DSO1 and DSO2, DSO3 and DSO4, or DSO5 and DSO6).  <b>【Electrical Specifications】</b> Maximum output current : 50mA Maximum surge current : 100mA Maximum output voltage : DC24V Circuit configuration : Source type
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	
17	+24V	Power Terminal for Output	Power supply input for the safety output and for the electromagnetic brake power output.  <b>【Electrical Specifications】</b> Supply voltage : DC24V Maximum current : 2.4A
18	0V	Ground	Connect to ground.

- ✓ To power the safety inputs/outputs and the electromagnetic brake power output, use a safety extra-low voltage (SELV) power supply that can provide sufficient maximum current.
- ✓ Cable faults should be detected on the customer's side of the machine or apply the fault exclusions in ISO 13849-2 TableD.4.

2.2.2.2 Wiring for Safety Inputs

Here is an example Safety Input Wiring Diagram. Wire the safety inputs to be used as shown below. ACK input and Alarm Reset share the same pin as ACK input.



- ✓ Safety input supports OSSD type signals.

Parameter	Specification
Type	C
Class	0
Test pulse filter	3ms ~ 4ms

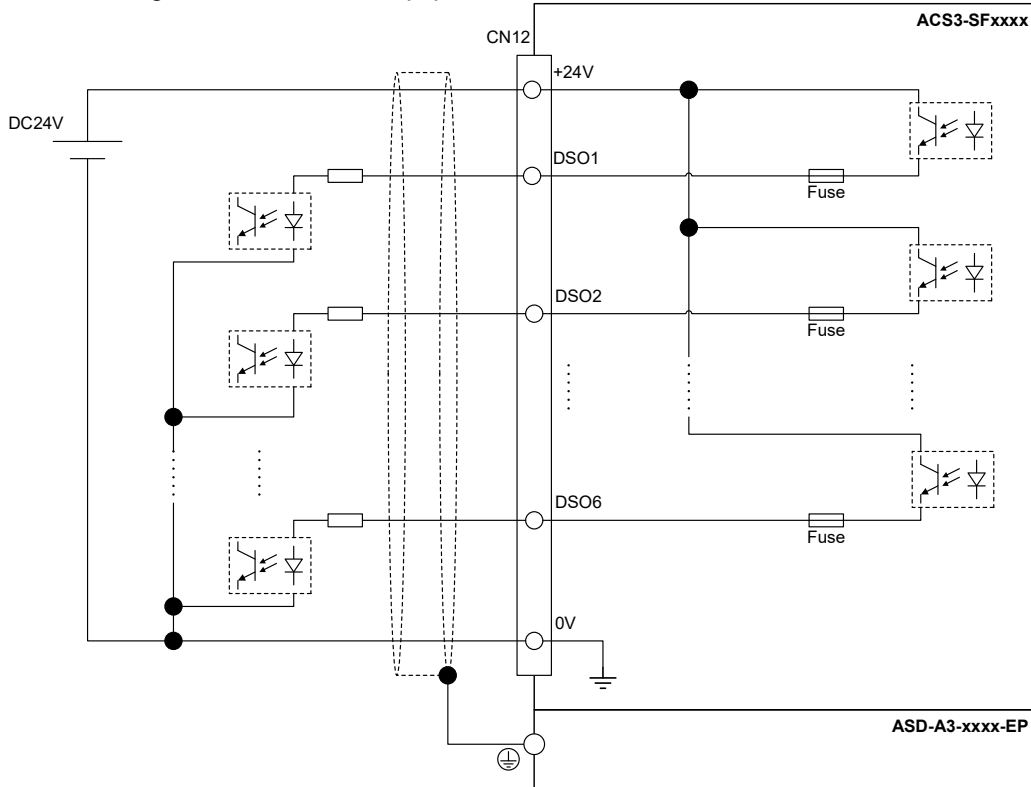
When activating the safety functions, maintain the OFF state for a period of time (approx. 5ms or more) that allows the filter to pass. (The same applies to ACK input).

- ✓ If the ACK is not wired, reset the alarm by rebooting the system (For the I/O type only).
- ✓ Normally, only the I/O type requires wiring for the safety input. However, when using the Safely Limited Position (SLP) function, wiring is also required for the communication type. Refer to the Section 2.2.2.4 for details.
- ✓ Connect the shield to the ground terminal (⊕) of the servo drive. Please select the appropriate cable length and standards based on the distance.

2.2.2.3 Wiring for Safety Outputs

An example of wiring the safety output is shown below. There is a usage difference of the safety output between outputting by the Safe Speed Monitor (SSM) and outputting by the others.

- (1) Safe Speed Monitor (SSM) outputs  
Use in pairs of two channels (DSO1 and DSO2, DSO3 and DSO4, or DSO5 and DSO6).
- (2) Outputs for the enabled status of each safety function  
It can be used with one channel. Note that these are status monitor outputs, and do not work as safety functions.  
Do not use these signals to control the equipment machine.



✓ Safety outputs are OSSD type outputs.

Parameter	Specification
Type	C
Class	1
Test pulse duration	750us.max
Test pulse interval	10min.

Connect OSSD Type C, Class 0 (not affected by test pulses) devices.

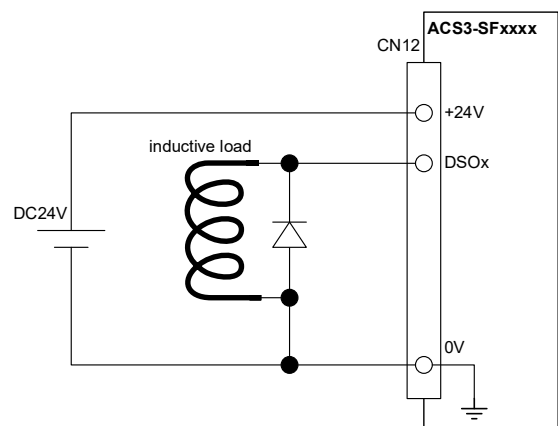
✓ Normally, only the I/O type requires wiring for the safety output. However, when using the Safely Limited Position (SLP) function, wiring is also required for the communication type. Refer to the Section 2.2.2.4 for details.

✓ In case of 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 Safety Function Extension module. Furthermore, please select a diode with a voltage rating of 48V or higher and a rated current greater than or equal to the maximum current of the inductive load.

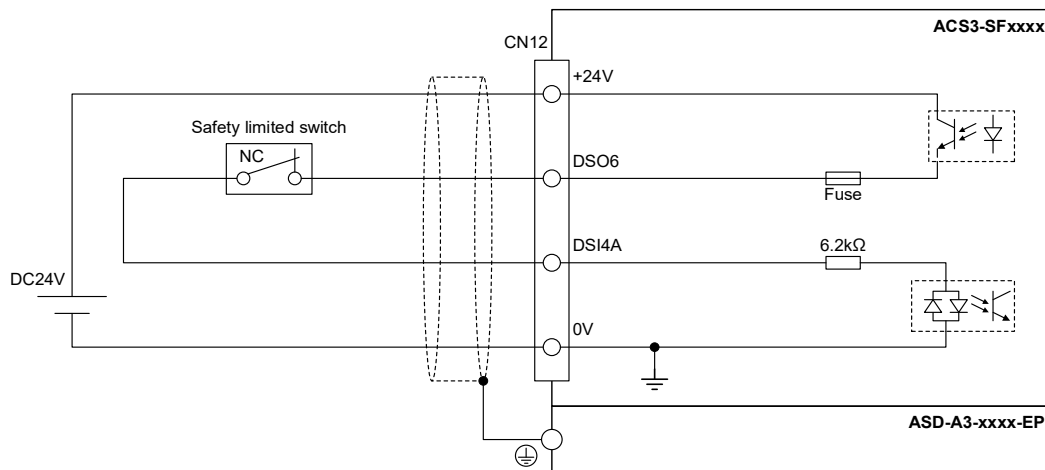


### 2.2.2.4 Wiring for Safety Origin Sensor

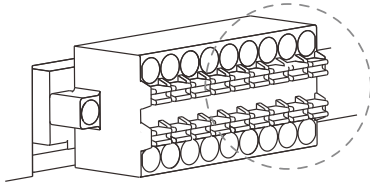
When using the Safely-Limited Position (SLP) function, the following input devices should be used to detect the safety origin.

#### 2.2.2.4.1 Safety limit switch

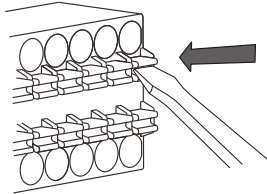
When using a safety limit switch, wire the safety input (DSI4A) and safety output (DSO6) as shown below.



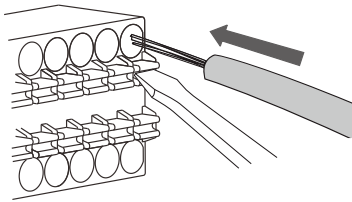
- ✓ Set the "Test Pulse Diagnostics" setting to "Enable".  
DSO6 periodically outputs an off-pulse of less than 1ms to detect input device failure or wiring error.
- ✓ Do not use terminals other than DSI4A and DSO6 to connect safety limit switches.
- ✓ Use B contact type (NC contact) for safety limit switches.
- ✓ Connect the shield to the ground terminal ⊕ of the servo drive.

2.2.2.5 Wiring Procedure

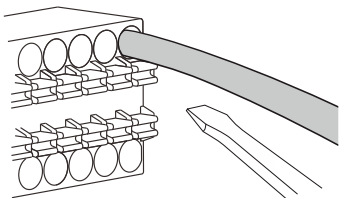
- (1) The CN12 connector has multiple terminals and a spring plate. Select the terminal to be wired.



- (2) To open the terminal port, use a flat-blade screwdriver to push up on the spring plate of the selected terminal.



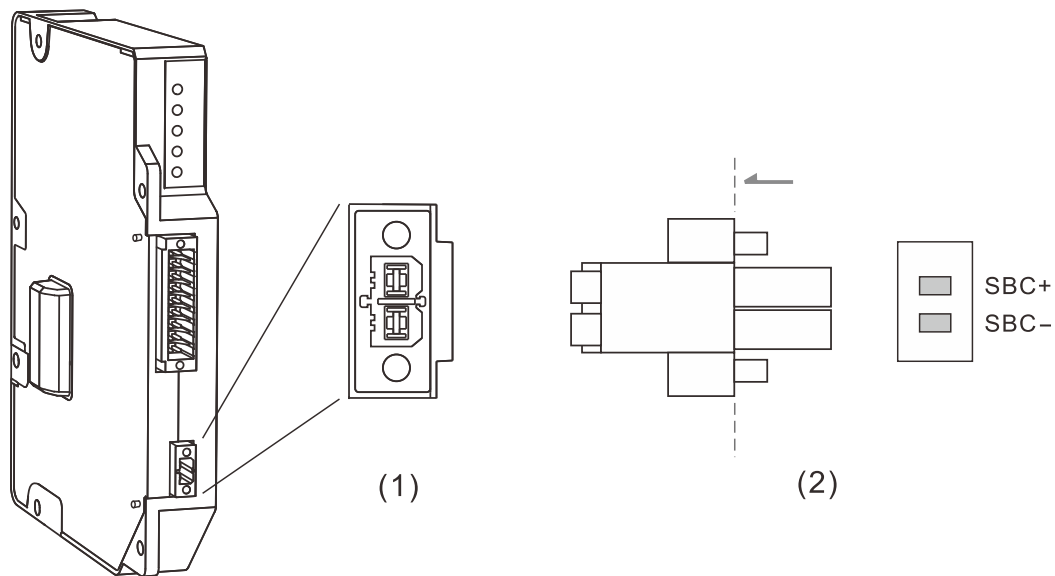
- (3) Insert the stripped wire end into the open terminal.



- (4) Release the flat-blade screwdriver to complete the wiring.

### 2.2.3 CN13 Electromagnetic Brake Power Supply

#### 2.2.3.1 Pin Assignment



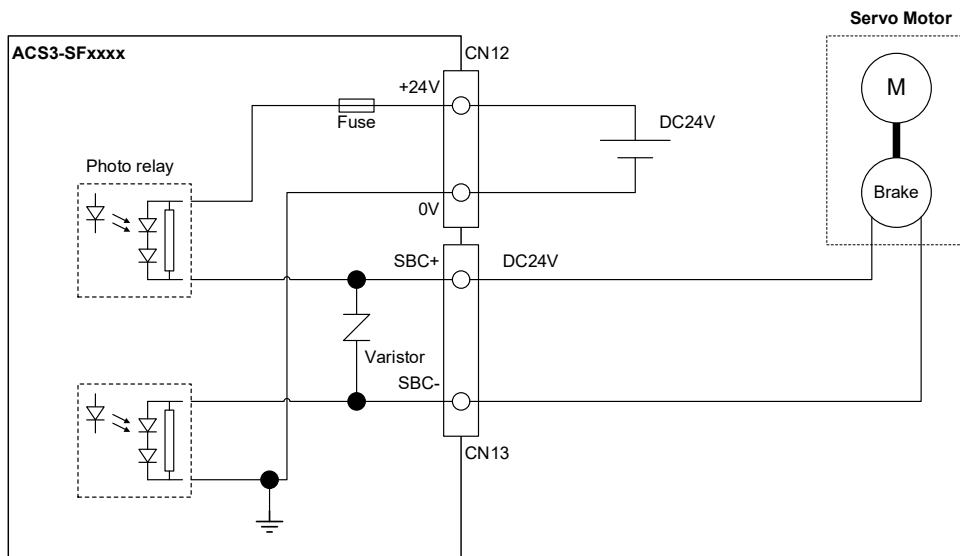
Connector	Specification
Model number	0225-0602
Manufacturers	DINKEL
Applicable wire size	AWG16 - AWG22
Tightening torque	1.6~2.0kgf-cm
Cable length	20m or less

Pin	Signal	Name	Description
1	SBC+	Electromagnetic brake power output	For outputting power supply to control electromagnetic brake  【Electrical Specifications】 Output voltage : min. DC22.75V Maximum output current : 2.0A
2	SBC-		

✓ Use an electromagnetic brake with a built-in motor. External brakes cannot be used.

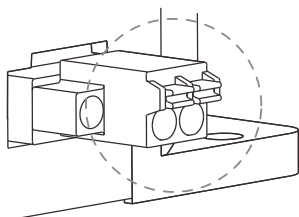
2.2.3.2 Wiring

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

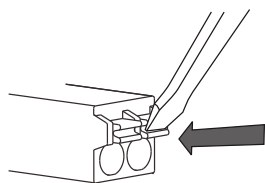


✓ In case of failure, SBC output is turned off.

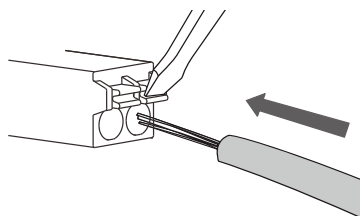
2.2.3.3 Wiring Procedure



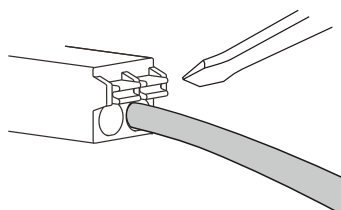
(1) The CN13 connector has two terminals and a spring plate.



(2) To open the terminal port, use a flat-blade screwdriver to push up on the spring plate.



(3) Insert the stripped wire end into the open terminal.



(4) Release the flat-blade screwdriver to complete the wiring.

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# Operation

# 3

This chapter describes how to operate the system.

3.1	System Startup	3
3.2	Installation and Wiring	3
3.3	LED Indicator	3
3.4	Initial Setting and Confirmation	7
3.5	Setting Parameters	9
3.5.1	Setting I/O type	9
3.5.1.1	Setting Password	9
3.5.1.2	Setting Motor type	9
3.5.1.3	Setting Safety Input (DSI)	10
3.5.1.4	Setting Safety Output (DSO)	11
3.5.1.5	Setting Safety Parameters	12
3.5.1.6	Setting Diagnosis Parameter	12
3.5.2	Setting the EtherCAT Communication (FSoE) Type	13
3.5.2.1	PDO Assignment Object	13
3.5.2.2	Safety PDO Mapping Object	13
3.5.2.3	Setting Motor type	16
3.5.2.4	Setting Safety Parameters	16
3.5.2.5	Setting Diagnosis Parameters	17
3.5.2.6	Parameter download	17
3.5.3	Notes	17
3.6	Test Run	18
3.6.1	I/O Type	18
3.6.2	EtherCAT Communication (FSoE) Type	20
3.6.2.1	FSoE communication setting	20
3.6.2.2	Communication sequence	20
3.6.2.3	FSoE state machine	21
3.6.2.4	Test Run	22
3.7	Safe Position Setting	23
3.7.1	Selecting the safe position homing method	23
3.7.2	Method 1: Using safety origin sensor	24

3.7.2.1	System Configuration .....	24
3.7.2.2	How to set the Safety Origin .....	25
3.7.2.3	Detection Error of Safety Origin .....	28
3.7.3	Method 2: Set the current position as safety origin .....	29
3.7.4	Safe Position Clear .....	31
3.7.4.1	Safe Position Clear Functions .....	31
3.8	Periodic Inspection .....	32
3.8.1	Safe Position Diagnosis .....	32
3.8.1.1	When the safety origin is set using Method 1 .....	32
3.8.1.2	When the safety origin is set using Method 2 .....	33
3.8.1.3	Diagnostic cycle .....	34
3.8.2	Diagnosis for Electromagnetic Brakes .....	35
3.8.3	Diagnosis Records .....	35

### 3.1 System Startup

To ensure proper use of the Safety Function Extension module and the servo drive, please follow the procedure below to set up your system when you first turn on the power or if you are replacing this product.



- ✓ When starting up the system, it is recommended that the parameters set and the results confirmed by a test run be recorded for reference during replacement and inspection.

### 3.2 Installation and Wiring

Install the Safety Function Extension module, the servo drive and the servo motors according to your 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 AC Servo Drive User Manual for information on how to use the servo drive and servo motor.

### 3.3 LED Indicator

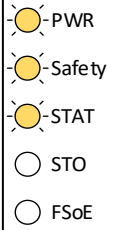

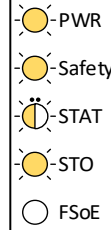
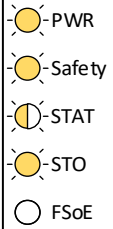

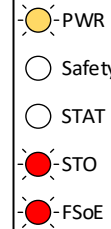
The safety function extension module has five LEDs for status indication. The main roles of each LED are as follows

LED	Role
PWR	Indicates power supply status. Lights up orange when power is being supplied.
Safety	Indicates the safety function enabled status.
STAT	Indicates the internal status.
STO	Indicates STO status.
FSoE	Indicates the FSoE (Safety Over EtherCAT) status or system restart request.

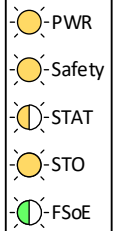

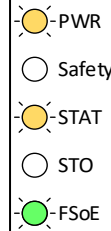
The four LEDs, except PWR, indicate various states by combination, light color, and light state.

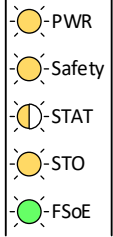
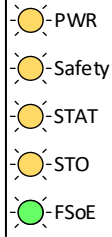
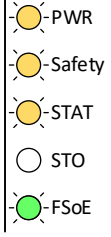
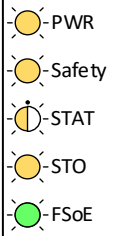
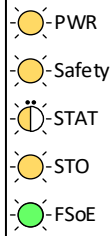
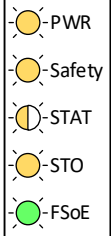


■ I/O type

Drive status	Preparing for Run	Normal State (Ready to operate)	Safe Torque Off (STO)
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Flashing slowly "STO" Orange: Steady ✓ This state also occurs when downloading parameters using Delta Drive Safety.	"STAT" Orange: Steady	"Safety" Orange: Steady "STAT" Orange: Steady "STO" Orange: Steady

Drive status	Safety function enable	Position monitoring error	Speed monitoring error
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Steady	"Safety" Orange: Steady "STAT" Orange: Single flash "STO" Orange: Steady	"Safety" Orange: Steady "STAT" Orange: Double flash "STO" Orange: Steady
Drive status	Resettable errors (Excluding position and speed monitoring errors)	Parameter reset	Non-resettable errors
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Flashing flash "STO" Orange: Steady	"Safety" Orange: Steady "STAT" Orange: Flashing quickly "STO" Orange: Steady "FSoE" Red: Steady	"STO" Red: Steady "FSoE" Red: Steady

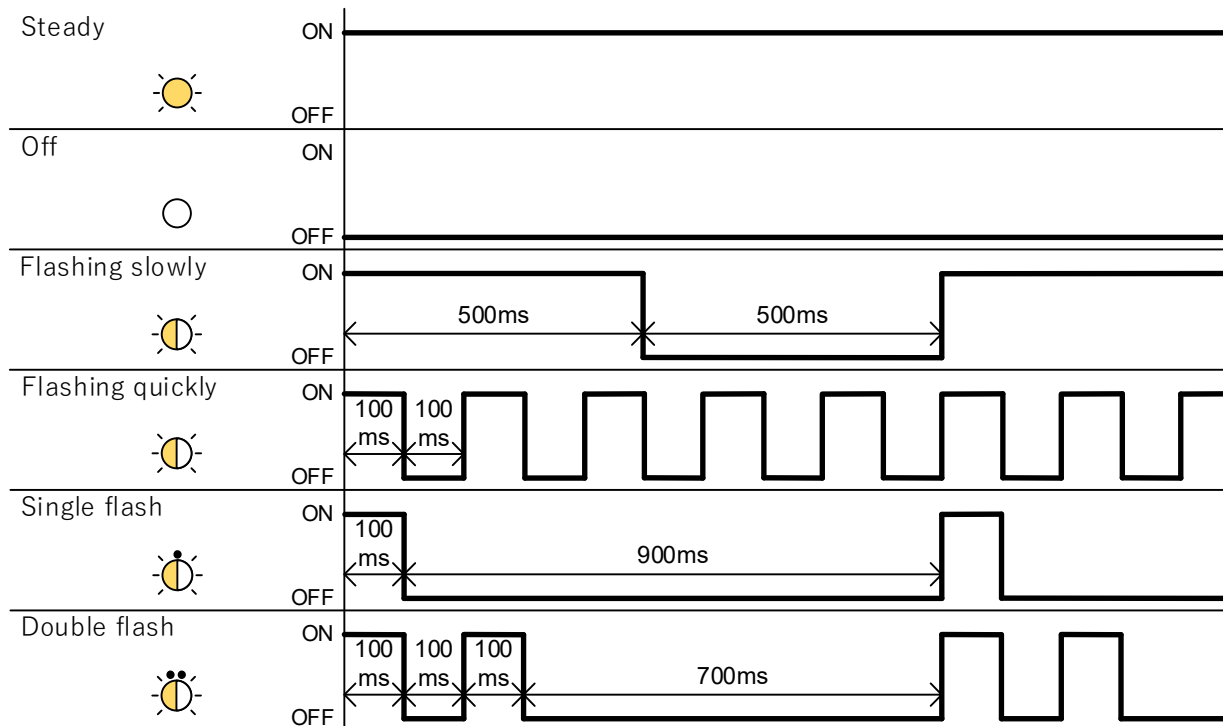
■ Communication (FSoE) type

FSoE status	Reset ~ Session ~ Connection state	Parameter state	Data State (Process Data)
Drive status	STO	STO	Ready to operate
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Flashing slowly "STO" Orange: Steady "FSoE" Green: Flashing slowly	"Safety" Orange: Steady "STAT" Orange: Flashing slowly "STO" Orange: Steady "FSoE" Orange: Flashing quickly	"STAT" Orange: Steady "FSoE" Green: Steady

FSoE status	Data State (Fail Safe Data)	Data State (Process Data)	Data State (Process Data)
Drive status	STO	STO	Safety function enable
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Flashing slowly "STO" Orange: Steady "FSoE" Green: Steady	"Safety" Orange: Steady "STAT" Orange: Steady "STO" Orange: Steady "FSoE" Green: Steady	"Safety" Orange: Steady "STAT" Orange: Steady "FSoE" Green: Steady
FSoE status	Data State (Process Data)	Data State (Process Data)	Data State (Process Data)
Drive status	Position monitoring error	Speed monitoring error	Resettable errors (Excluding position and speed monitoring errors)
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Single flash "STO" Orange: Steady "FSoE" Green: Steady	"Safety" Orange: Steady "STAT" Orange: Double flash "STO" Orange: Steady "FSoE" Green: Steady	"Safety" Orange: Steady "STAT" Orange: Flashing quickly "STO" Orange: Steady "FSoE" Green: Follow FSoE state  ✓ May be in a flashing state.
FSoE status	Data State (Process Data)	Data State (Process Data)	
Drive status	Parameter reset	Non-resettable errors	
LED indicator			
	"Safety" Orange: Steady "STAT" Orange: Flashing quickly "STO" Orange: Steady "FSoE" Red: Steady	"STO" Red: Steady "FSoE" Red: Steady	

✓ For more information about FSoE states, see Chapter 3.6.2.3.

LEDs are issued in the following forms.



The status of the safety function extension module can also be checked from the panel display of the servo drive.

State	display
STO state ✓ The STO status is also displayed for parameter update status and FSoE communication not established status.	-Sto-
SBT is being executed	-Sbt-

When you switch to the status display of the safety function expansion module using the MODE key on the front panel of the servo drive, the following status is displayed.

State	display
Initial state of the safety function expansion module	S Init
State of completion of initialization of safety function expansion module	SN-OH
Parameter update state of the safety function expansion module	PAR.Ud
Safe position not set state of the safety function expansion module	SP0SU
Diagnosing the safe position of the safety function expansion module in progress	SP0Sd

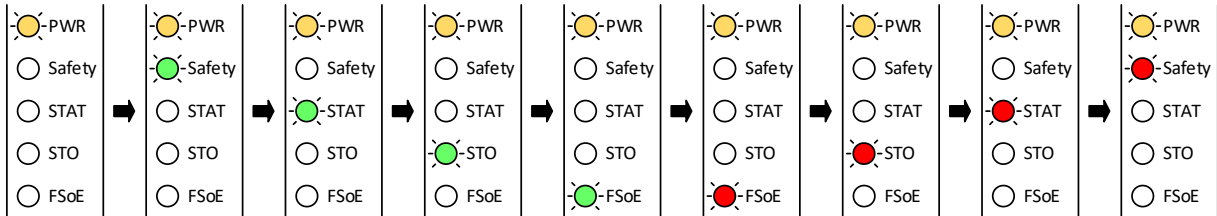
- ✓ The parameter update status display is only displayed when you switch the display with the MODE key while the write confirmation pop-up is displayed when parameters are updated using Delta Drive safety.
- ✓ If an STO state occurs while the status of the safety function expansion module is being displayed, the display will switch to the STO state display.

### 3.4 Initial Setting and Confirmation

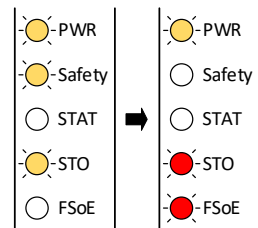
Follow the steps below to check the initial operation.

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

When the Safety Function Extension module is activated, the five LEDs on the front panel light in the sequence shown in the diagram below.



After that, "Safety" and "STO" will light up for a while, and an alarm AL500 will occur ("STO" and "FSoE" will light up red).



- (2) Set the following parameters of the servo drive.

Parameter	Explanation
P1.100 (Object : 2164h)	<p>This parameter sets the connection of the Safety Function Extension module and the external interface.</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p style="font-size: 24px; margin: 0;">0000</p> <p style="margin: 0;">U Z Y X</p> </div> <p>X : Connection of the Safety Function Extension module                      1 : With Safety Function Extension module &amp; I/O type                      2 : With Safety Function Extension module &amp; Communication (FSoE) type                      3 : With Safety Function Extension module &amp; Communication (FSoE) type (DSI usage1)</p> <p>Please select one of the above.</p>
P3.029 (Object : 231Dh)	<p>Set the FSoE address for use in the communication (FSoE) type.                      The setting range is 0x0000 to 0xFFFF.</p>

- ✓ If these parameters cannot be set or AL.576 is not detected, the servo drive is not compatible with the Safety Function Extension module. Prepare a servo drive with firmware version 1.01 or later.
- ✓ For instructions on how to use P1.100=3, refer to the ASDA-A3-EP AC Servo Drive User Manual.

- (3) Change the servo drive parameter P1.120 (Object: 2178h) to 2.  
 The method of releasing the STO state differs depending on the value set in P1.120.

P1.120 (Object: 2178h)	The method of releasing the STO state
0	<ol style="list-style-type: none"> <li>1. Perform the method of releasing the STO state of the Safety Function Extension Module</li> <li>2. Send Servo Off command to the servo drive</li> </ol>
1	<ol style="list-style-type: none"> <li>1. Perform the method of releasing the STO state of the Safety Function Extension Module</li> <li>2. Reset servo drive alarm</li> <li>3. Send Servo Off command to the servo drive</li> </ol>
2 (recommendation)	<ol style="list-style-type: none"> <li>1. Perform the method of releasing the STO state of the Safety Function Extension Module                      (When the STO condition is released, the system automatically returns to a state in which operation can be resumed.)</li> </ol>
3 (default)	<ol style="list-style-type: none"> <li>1. Perform the method of releasing the STO state of the Safety Function Extension Module</li> <li>2. Reset servo drive alarm</li> </ol>

- ✓ For more information on how to release the STO state of the Safety Function Extension module, refer to Section 4.2.
- ✓ If an alarm (AL.5C0 to AL.5CF) occurs in the Safety Function Extension module, perform an alarm reset of the Safety Function Extension module before releasing the STO state. 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 AC Servo Drive User Manual.

- (4) Restart the servo drive.  
 If both the servo drive and the Safety Function Extension module are operating properly, the LEDs are lit in sequence, then “STAT” will change from “flashing slowly” to “steady”.



If an alarm goes off on the Safety Function Extension module that causes the “STO” and “FSoE” indicators to light red, perform the following actions in accordance with the alarm code displayed on the front panel of the servo drive:

Front panel	Action
“AL.584” “AL.5A0” “AL.5A1”	Re-install and rewire. There could be a poor connection between the servo drive and the Safety Function Extension module.
“AL.576”	Check if the servo drive parameter P1.100 is set to 1 or 2.
“AL.580”	There is possible to have a malfunction in the servo drive and/or in the Safety Function Extension module. Replace either or both of them.
“AL.56A”	Wire the encoder cable to the servo drive.
Other than above	Refer to Chapter 7 and take action properly in accordance with the alarm code.

- ✓ Since P1.100.X (Connection of the Safety Function Extension module) is selected 0 (Without Safety Function Extension module) at the factory setting, the Safety Function Extension module cannot respond to the FSoE communication from the host controller (FSoE MInstance) when the first time power is on.  
 For FSoE communication, select “2 : With Safety Function Extension module & Communication (FSoE type)” and reboot the module before starting communication.

### 3.5 Setting Parameters

#### 3.5.1 Setting I/O type

When using the I/O type, set parameters by 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 User Manual.

##### 3.5.1.1 Setting Password

To prevent unintentional modification to parameters, the Delta Drive Safety classifies its access to parameters into three levels and restricts access by means of a password.

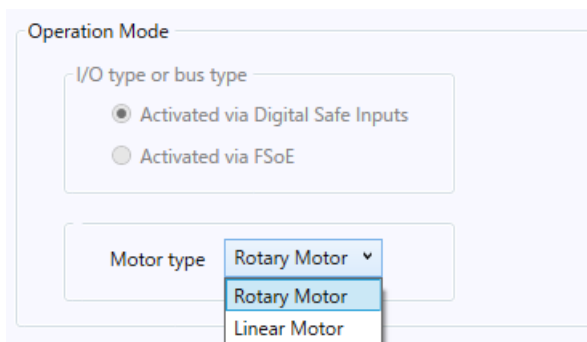
Access Levels	Uploading Parameters	Downloading Parameters Safe position clear	Changing Passwords Parameter reset
1	<input type="radio"/>	-	-
2	<input type="radio"/>	<input type="radio"/>	-
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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

- ✓ Each access level must have a different password.
- ✓ 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 Motor type

This product supports rotary and linear motors. Select the motor to be used.

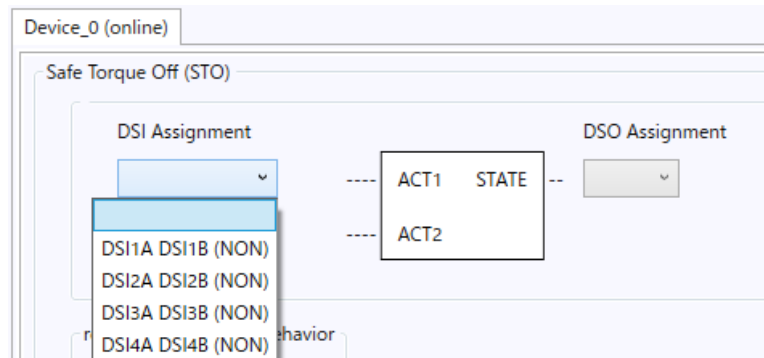


- ✓ If the setting does not match the servo drive setting, alarm AL.5C1 will be generated.

### 3.5.1.3 Setting Safety Input (DSI)

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

Select your safety inputs from the “DI Assignment” drop-down menu on the parameter setting screen for each safety function in Delta Drive Safety (The STO is shown as an example).

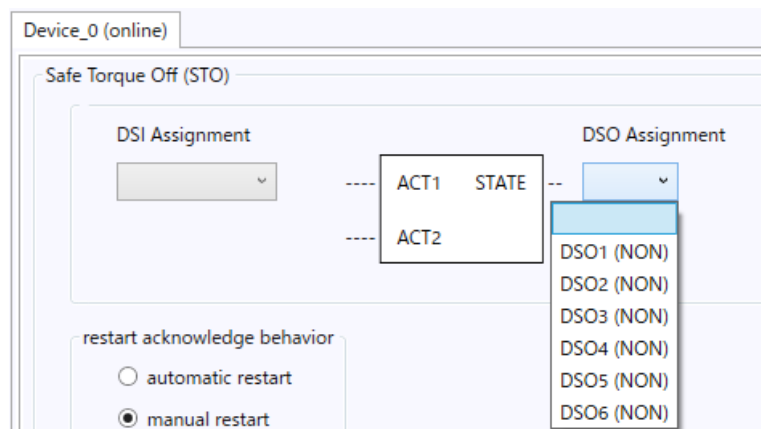


- ✓ Up to 4 safety functions can be used simultaneously.
- ✓ Multiple safety functions cannot be assigned to the same safety input.
- ✓ When the “Safely-Limited Position (SLP)” function is used and the safety origin sensor is used to set the safe position, DSI4# cannot be used.  
If you have assigned a different safety function to the DSI4#, reassign it to another safety input.

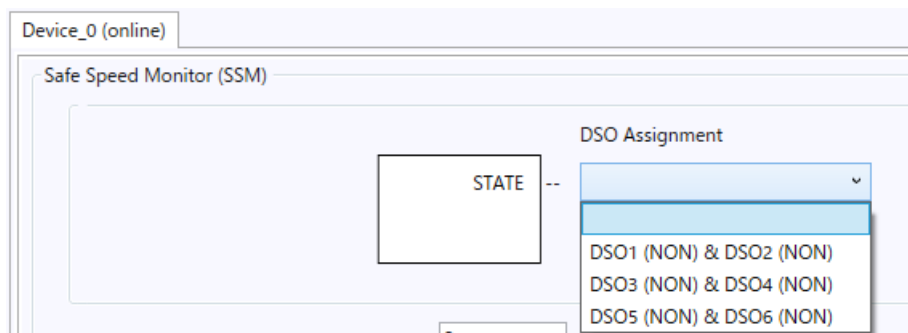
### 3.5.1.4 Setting Safety Output (DSO)

This product has 6 channels of safety outputs (DSO1 to DSO6). Assign the signal to be monitored to a safety output.

Select your safety output from the “Output Status” drop-down menu on the parameter setting screen for each safety function in Delta Drive Safety (The STO is shown as an example).



The Safe Speed Monitor (SSM) output is in pairs 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 channels if the Safe Speed Monitor (SSM) is selected).
- ✓ Multiple output signals cannot be assigned to the same safety output.
- ✓ The status monitor for each safety function (except the Safe Speed Monitor (SSM)) is not included in the safety function. Do not use these signals for safety related applications.
- ✓ When the “Safely-Limited Position (SLP)” function is used and the safety origin sensor is used to set the safe position, the DSO6 cannot be used. If other signals are assigned to DSO6, change to another safety output.

### 3.5.1.5 Setting Safety Parameters

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

- ✓ For more information on the parameters of each of the safety functions, refer to Chapter 4.
- ✓ The device will be in STO state while the parameters are being updated.
- ✓ The parameters should be set while the servo is off. They cannot be changed while the servo is on.
- ✓ Do not disconnect power while updating parameters. Or, it may cause parameter setting error (AL.5C0) to be detected at the next time the system is started.
- ✓ If the parameter update does not complete successfully, set the parameters again according to the display on the Delta Drive Safety screen.
- ✓ If an anomaly is detected during start-up or parameter update, AL.5C0 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 Delta Drive Safety y password restrictions before updating parameters.

### 3.5.1.6 Setting Diagnosis Parameter

The product constantly diagnoses encoder failures, and the sensitivity of the diagnosis can be adjusted by parameters. Set the "Diagnostic Parameter (setting range: 0 to 1000 (0: diagnostic function disabled))" on the Delta Drive Safety Device Overview screen. The default value is set to 100 (recommended value). The higher the value, the higher the sensitivity (easier to detect anomalies). Set a lower value before adjusting the servo gain of the servo drive, and return the value to the original value after adjustment.

In the following cases, reduce the value in advance.

- Large load fluctuation (disturbance) during operation
  - Low rigidity
  - Operate with speed proportional control.
- ✓ Set to 0 to stop diagnosis. Use this setting when the alarm AL.5C2 occurs during adjustment. However, after adjustment, please return to the original setting.

### 3.5.2 Setting the EtherCAT Communication (FSoE) Type

To control safety functions via EtherCAT communication (FSoE), add the following safety PDOs to the PDO assignment mapping (RxPDO assign: 1C12h / TxPDO assign: 1C13h) of the EtherCAT communication object of 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 object.

##### ■ 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 1600h to 1603h
	02	Safety PDO mapping object	1604h

##### ■ 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 1A00h to 1A03h
	02	Safety PDO mapping object	1A04h

- ✓ For more information on the PDO mapping object (Sub-index1), please refer to the ASDA-A3-EP AC servo drives user manual.

#### 3.5.2.2 Safety PDO Mapping Object

PDO mapping objects can be set from 1600h to 1604h for receive PDO (RxPDO) and from 1A00h to 1A04h for transmit PDO (TxPDO). The objects for the safety function extension module are 1604h and 1A04h.

- ✓ 1600h to 1603h for receive PDO and 1A00h to 1A03h for transmit PDO are dedicated to servo drives.

RxPDO			TxPDO		
Index (Hex)	Name	Sub-index (Hex)	Index (Hex)	Name	Sub-index (Hex)
1600	1 <sup>st</sup> PDO mapping	0 - 8	1A00	1 <sup>st</sup> PDO mapping	0 - 8
1601	2 <sup>nd</sup> PDO mapping	0 - 8	1A01	2 <sup>nd</sup> PDO mapping	0 - 8
1602	3 <sup>rd</sup> PDO mapping	0 - 8	1A02	3 <sup>rd</sup> PDO mapping	0 - 8
1603	4 <sup>th</sup> PDO mapping	0 - 8	1A03	4 <sup>th</sup> 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 mapping.

- ✓ The following table shows the mapping for the factory setting. Sub-index 02 through 11 can be changed to any value.

■ Receive Safety PDO

- Sub-indexes 02 - 11 are safety control word areas. Up to 14 safety functions can be set, and together with the safety function release (ACK) command and alarm reset command, up to 16 functions can be set.  
Dummy data (0000 00 01h) must be set for unused Sub-indexes.
- Dummy data (0000 00 10h) must be set for Sub-indexes 13, 15, and 17.

Index (Hex)	Sub-index (Hex)	Safety Functions	ESI file settings
1604	00	Number of Sub-indexes	19h (fixed)
	01	FSoE M Commands	6770 01 08h (fixed)
	02	STO Commands	6640 00 01h
	03	SS1_1 Commands	6650 01 01h
	04	SS2_1 Commands	6670 01 01h
	05	SOS_1 Commands	6668 01 01h
	06	---	0000 00 01h
	07	SDIp (positive) Command	66D0 00 01h
	08	SDIn (negative) Command	66D1 00 01h
	09	Alarm Reset Commands	6632 00 01h
	0A	Restart acknowledge command	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	6770 03 10h (fixed)
	13	---	0000 00 10h (fixed)
14	FSoE CRC_1 word	6770 04 10h (fixed)	
15		0000 00 10h (fixed)	
16	FSoE CRC_2 word	6770 05 10h (fixed)	
17		0000 00 10h (fixed)	
18	FSoE CRC_3 word	6770 06 10h (fixed)	
19	FSoE Connection ID	6770 02 10h (fixed)	

- ✓ The data length of each sub-index is fixed.

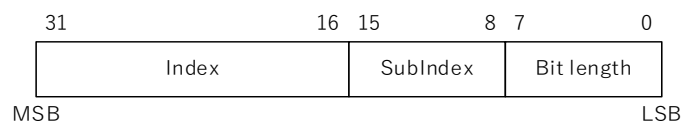
■ Transmit Safety PDO

- Sub-indexes 02 - 11 are safety status word areas. Up to 16 safety functions, alarms, restartable, and safety input statuses can be set. Dummy data (0000 00 01h) must be set for unused Sub-indexes.
- Set safety monitor data to Sub-index 13, 15, and 17. If unused, dummy data (0000 00 10h) must be set for unused Sub-indexes.

Index (Hex)	Sub-index (Hex)	Safety Functions	ESI file settings
1A04	00	Number of Sub-indexes	19h (fixed)
	01	FSoE Sub Commands	6760 01 08h (fixed)
	02	STO Status	6640 00 01h
	03	SSM_1 State	66E0 01 01h
	04	SSM_2 State	66E0 02 01h
	05	SOS_1 State	6668 01 01h
	06	---	0000 00 01h
	07	SDIp (positive) State	66D0 00 01h
	08	SDIn (negative) State	66D1 00 01h
	09	Alarm State	6632 00 01h
	0A	Restartable 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	---	0000 00 10h
14	FSoE CRC_1 word	6760 04 10h (fixed)	
15		0000 00 10h	
16	FSoE CRC_2 word	6760 05 10h (fixed)	
17		0000 00 10h	
18	FSoE CRC_3 word	6760 06 10h (fixed)	
19	FSoE Connection ID	6760 02 10h (fixed)	

✓ The data length of each sub-index is fixed.

To assign a PDO, set the index and sub-index as follows.



- Bits 31-16 : Index of the safety function or safety monitor object to be used
- Bits 15-8 : Sub-index of the safety function or safety monitor object to be used
- Bit 7-0 : Bit length

Instances assigned to Safety PDO are as follows

Safety Functions	Assignable Safety Functions	Setting	PDO
Restart Acknowledge	Safety Function Release (ACK) Command/State	6630 00 01h	Rx/Tx
Error Acknowledge	Alarm Reset Commands / Alarm State	6632 00 01h	Rx/Tx
Safe Torque Off (STO)	STO Commands	6640 00 01h	Rx/Tx
Safe Stop1 (SS1)	SS1 Command 1 - 4	6650 01 01 - 6650 04 01h	Rx/Tx
Safe Brake Control2 (SBC)	SBC Command	6660 01 01h	Rx/Tx
Safe Operating Stop (SOS)	SOS Command 1 - 4	6668 01 01 - 6668 04 01h	Rx/Tx
Safe Stop2 (SS2)	SS2 Command 1 - 4	6670 01 01 - 6670 04 01h	Rx/Tx
Safely-Limited Speed (SLS)	SLS Command 1 - 4	6690 01 01 - 6690 04 01h	Rx/Tx
Safely-Limited Position (SLP)	SLP Commands 1 - 4	66A0 01 01 - 66A0 04 01h	Rx/Tx
Safe Maximum Speed (SMS)	SMS Status Monitor	66A8 00 01h	Tx
Safely-Limited Increment (SLI)	SLI Commands 1 - 4	66B8 01 01 - 66B8 04 01h	Rx/Tx
Safe Direction Positive (SDIp)	SDIp Command	66D0 00 01h	Rx/Tx
Safe Direction Negative (SDIn)	SDIn Command	66D1 00 01h	Rx/Tx
Safe Speed Monitor (SSM)	SSM Status Monitor	66E0 00 01h	Tx
Safe Brake Test (SBT)	SBT Command	38F0 00 01h	Rx/Tx

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

Safety monitor data	Setting	PDO
Safe position actual value	6611 00 10h	Tx
Safe velocity actual value	6612 00 10h	Tx
Safe acceleration actual value	6615 00 10h	Tx

✓ To monitor the safe position actual value and safe acceleration actual value, set Sub-index 13 or 15, and set dummy data (0000 00 10h) to the next safety monitor Sub-index (15 or 17).

✓ Safe position actual value and safety acceleration actual value may overflow due to 32-bit data. If there is a possibility of overflow, set the scale factor in advance.

Object index 380Ah : safe position monitor scale factor

Object index 380Ch : safe acceleration monitor scale factor

If the scale factor is not set, data exceeding 32 bits will be discarded.

### 3.5.2.3 Setting Motor type

This product supports rotary and linear motor. Set the motor to be used in Sub-index 2 of Object index 3810h (motor type setting).

✓ If it does not match the setting of servo drive, alarm AL.5C1 will be generated.

### 3.5.2.4 Setting Safety Parameters

Set each parameter of the safety function to which the command is 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 Function Extension module.

✓ When using Safely-Limited Position (SLP) function, DSI4A and DSO6 will be used for the safety origin sensor. Set 0x000D to Sub-index 4 of Object index 3800h (DSI setting) and to Sub-index 6 of Object index 3801h (DSO setting). If not set or if a value other than the above is set, the safety home determination operation will not be completed successfully and AL.014 or AL.015 will occur.

### 3.5.2.5 Setting Diagnosis Parameters

This product do diagnostic test for encoder failure constantly, and the diagnostic sensitivity can be adjusted by using parameters. Please 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, which is recommended. A higher value indicates a higher sensitivity (easier to detect anomalies). Set a lower value before adjusting the servo gain of the servo drive, and return the value to the original value after adjustment.

In the following cases, reduce the value in advance.

- Large load fluctuation (disturbance) during operation
  - Low rigidity
  - Operate with speed proportional control.
- ✓ Set to 0 to stop diagnosis. Use this setting when the alarm AL.5C2 occurs during adjustment. However, after adjustment, please return to the original setting.
  - ✓ For more information on EtherCAT communication objects, refer to section 6.1.3.

### 3.5.2.6 Parameter download

For EtherCAT communication (FSoE) types, parameters can not be set by Delta Drive Safety. Please follow the rules of ETG.5120 and download parameters via EtherCAT MDevice and FSoE MInstance. For more information, please refer to ETG.5120 FSoE protocol Enhancements.


### 3.5.3 Notes

- ✓ Parameters cannot be changed while the servo is on.
- ✓ For IO types, the system will forcibly transition to STO state while parameters are being changed. After the change, before resuming operation, cancel the STO state according to the setting of the restart acknowledge behavior parameter.
- ✓ For FSoE types, FSoE communication must be stopped before changing parameters. (The system will transition to STO state while FSoE communication is stopped.) After the change, before resuming operation, restart FSoE communication and cancel the STO state according to the setting of the restart acknowledge behavior parameter.

### 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 your system are working properly. To activate the safety functions, the servo should be turned on during the test run.

- ✓ 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 24VDC power supply before applying the power supply to the servo drive. If the drive is started with the 24VDC power supply off, the self-diagnostic function detects a circuit fault, AL.586 or AL.587.













 <b>WARNING</b>
<ul style="list-style-type: none"> <li>■ 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.</li> </ul>

#### 3.6.1 I/O Type

To perform a test run, follow the steps below.

(1) Check the Status

Turn on the power to the drive and verify that the LEDs are lit as shown in "Normal" in the table below.

Status		LED Indicator	
Power-on		"Safety", "STAT", "STO", and "FSOE" are lit in this sequence	
Normal	Preparing for Run	 -STAT  -STO  FSoE	"STAT" Orange: Flashing slowly "STO" Orange: Steady
	Normal State (Ready to operate)	 -STAT  STO  FSoE	"STAT" Orange: Steady
Anomaly	Resettable errors (Excluding position and speed monitoring errors)	 -STAT  -STO  FSoE	"STAT" Orange: Flashing quickly "STO" Orange: Steady
	Non-resettable errors	 -STAT  -STO  -FSOE	"STAT" Off "STO" Red: Steady "FSOE" Red: Steady




































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

(2) Check the Operation of the Electromagnetic Brake Power Output (SBC)

Make sure the servo 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 Limiting Function of the servo drive. For information on how to use the Torque Limiting Function, refer to the ASDA-A3-EP AC Servo Drive User Manual.

- (3) Check the Operation of Safety Input  
Power up the servo, switch the safety input assigned to the safety function from ON to OFF starting with DSI1A/B, and check the LED indicators.

Safety Functions	Safe Torque Off (STO)	Safe Stop 1 (SS1)	Other Safety Functions	Safety Monitoring Alarms	Other Alarms		
LED Indicator	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> -STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> -STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> -STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> -Safety</li> <li> -STAT</li> <li> -STO</li> <li> FSoE</li> </ul>	<ul style="list-style-type: none"> <li> -PWR</li> <li> Safety</li> <li> STAT</li> <li> -STO</li> <li> -FSoE</li> </ul>

- ✓ 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 behaviour”), 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 goes off, there may be a logical mismatch (AL.585) between channels A and B. Check the wiring and controller settings.
- ✓ If you are using the safety input for the safety origin sensor, refer to Section 3.7.
- ✓ If the safety monitoring function detects an anomaly in position or speed, “STAT” flashes one or two times repeatedly.
  - Position monitoring anomaly : Single flash
  - Speed monitoring anomaly : Double flash

(4) Check the Operation of Safety Output

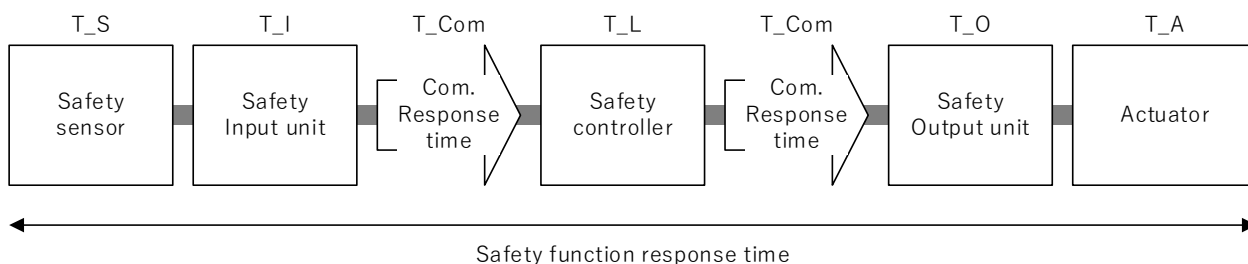
Condition	How to check	Remarks
To output the status monitor of safety devices	With the servo turned on, turn off the safety input assigned to the safety function you want to check. At this time, make sure that the safety output is turned on. Example) When the STO function is assigned to DSI1A / B and STO monitor to DSO1, make sure that DSO1 is turned on when DSI1A / B is turned off.	The servo motor should be turned off its rotation before starting the check.
To output Safe Speed Monitor (SSM)	Verify that the 2-channel safety outputs turns 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 to use a safe speed.

- ✓ If you are using the safety output for the safety origin sensor, refer to Section 3.7.

### 3.6.2 EtherCAT Communication (FSoE) Type

#### 3.6.2.1 FSoE communication setting

In ETG.5100, the FSoE communication path is configured as shown in the figure below, 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

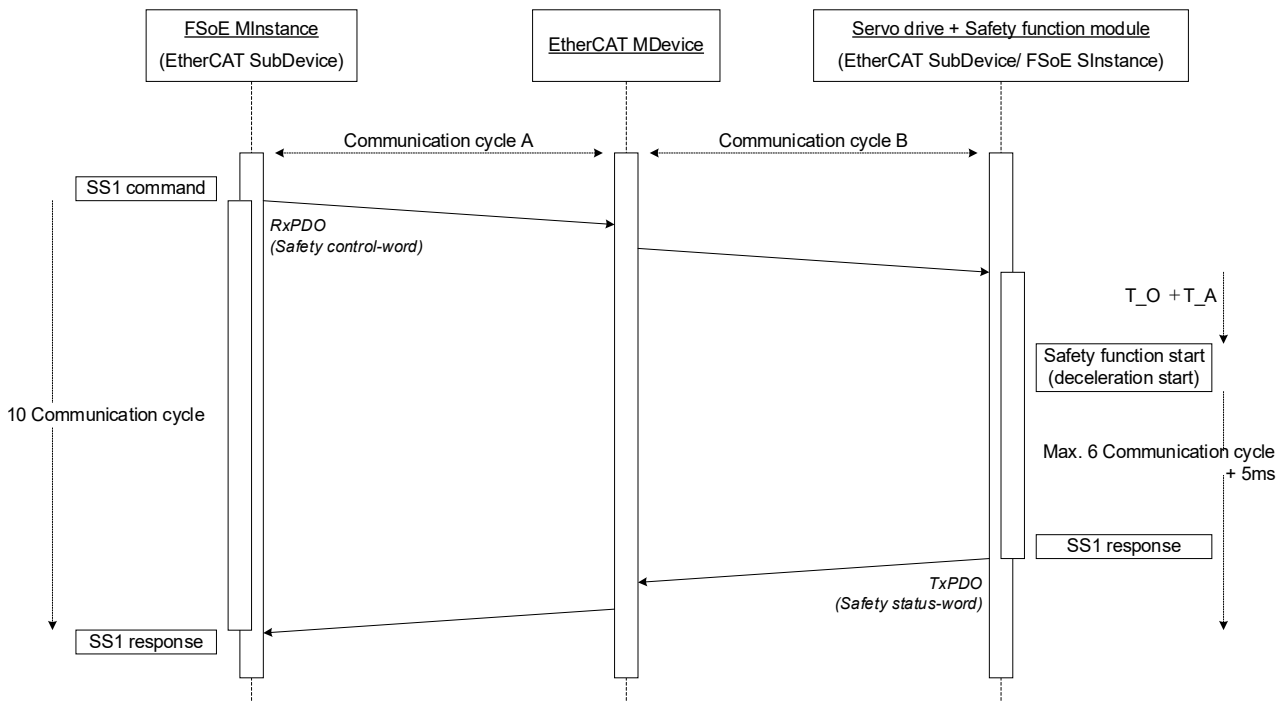
Time	Explanation
$T_O + T_A$	Response time for servo drive and safety function extension modules. The response time for each function is as follows SS1, SS2 : 25ms Other than above : 15 ms
$T_{Com}$	Watchdog time for FSoE communication. The watchdog time of the safety controller must be set to 8ms or longer.  ✓ If the processing cycle of the safety function of the safety controller is 8ms or longer, match it to the processing cycle. ✓ The response cycle for FSoE communication of the product is 2ms.
$T_S$ $T_I$ $T_L$	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 of each component above and configure your system to meet the required specifications.

- ✓ The above is a basic configuration.  
Please calculate the safety function response time according to your system.

#### 3.6.2.2 Communication sequence

The figure below shows an example of the sequence from when the FSoE Minstance issues a safety function command to when the response is received. The time from the start of the safety function to the reception of the SS1 response is a maximum of 6 communication cycles + 5 ms.

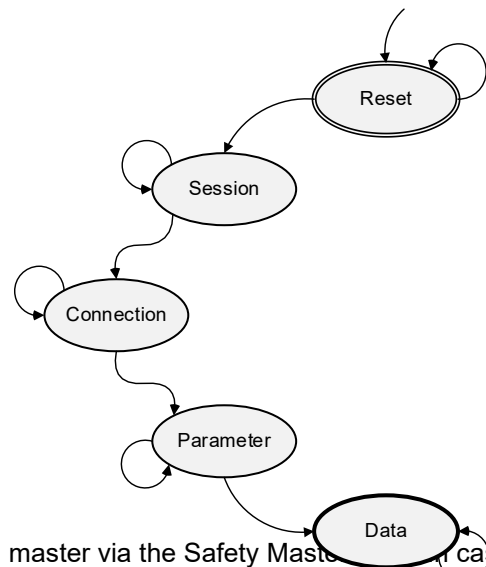


- ✓ The above figure shows the case where the EtherCAT MDevice and the FSoE MInstance are separate units and where communication cycles A and B are common. If they are the same unit or one of them has a shorter communication cycle, the total time will be reduced.
- ✓ When communication cycles A and B are less than 2 ms each, the time from issuing a safety function command to receiving a response is about 15 ms.

### 3.6.2.3 FSoE state machine

The state of FSoE is managed using the five states shown in the diagram on the right.

State	Description
Reset	State after power-on or detection of a communication error
Session	The same command is sent and received between the master and slave to confirm the connection.
Connection	The master sets the slave address to identify each individual slave.
Parameter	Set safety-related parameters.
Data (process data)	Normal state (safety state released, ready for operation)
Data (fail safe data)	Forcibly transition to the safety state



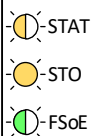
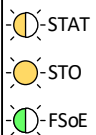

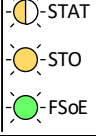
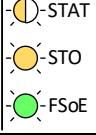
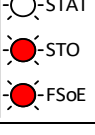
The state transitions according to the commands from the FSoE master via the Safety Master. In case of a communication error, it returns to the Reset state. For details on the FSoE state machine, please refer to ETG5100 SafetyOverEtherCAT.

3.6.2.4 Test Run

To perform a test run, follow the steps below.

(1) Check the Status

After turning on the power to the servo drive, start EtherCAT (FSoE) communication and confirm that the LEDs are lit as shown in the table below.

Status	LED Indicator						
Power-on	"STAT" - "FSoE" are lit in this sequence						
Reset - Session - Connection State	 <table border="0"> <tr> <td>"STAT"</td> <td>Orange: Flashing slowly</td> </tr> <tr> <td>"STO"</td> <td>Orange: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Green: Flashing slowly</td> </tr> </table>	"STAT"	Orange: Flashing slowly	"STO"	Orange: Steady	"FSoE"	Green: Flashing slowly
"STAT"	Orange: Flashing slowly						
"STO"	Orange: Steady						
"FSoE"	Green: Flashing slowly						
Parameter State	 <table border="0"> <tr> <td>"STAT"</td> <td>Orange: Flashing slowly</td> </tr> <tr> <td>"STO"</td> <td>Orange: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Green: Flashing quickly</td> </tr> </table>	"STAT"	Orange: Flashing slowly	"STO"	Orange: Steady	"FSoE"	Green: Flashing quickly
"STAT"	Orange: Flashing slowly						
"STO"	Orange: Steady						
"FSoE"	Green: Flashing quickly						
Data State (Process Data : Ready to operate)	 <table border="0"> <tr> <td>"STAT"</td> <td>Orange: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Green: Steady</td> </tr> </table>	"STAT"	Orange: Steady	"FSoE"	Green: Steady		
"STAT"	Orange: Steady						
"FSoE"	Green: Steady						
Data State (Fail Safe Data : Not Ready to operate)	 <table border="0"> <tr> <td>"STAT"</td> <td>Orange: Flashing slowly</td> </tr> <tr> <td>"STO"</td> <td>Orange: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Green: Steady</td> </tr> </table>	"STAT"	Orange: Flashing slowly	"STO"	Orange: Steady	"FSoE"	Green: Steady
"STAT"	Orange: Flashing slowly						
"STO"	Orange: Steady						
"FSoE"	Green: Steady						
Resettable errors (Excluding position and speed monitoring errors)	 <table border="0"> <tr> <td>"STAT"</td> <td>Orange: Flashing quickly</td> </tr> <tr> <td>"STO"</td> <td>Orange: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Green: Follow FSoE state</td> </tr> </table>	"STAT"	Orange: Flashing quickly	"STO"	Orange: Steady	"FSoE"	Green: Follow FSoE state
"STAT"	Orange: Flashing quickly						
"STO"	Orange: Steady						
"FSoE"	Green: Follow FSoE state						
Non-resettable errors	 <table border="0"> <tr> <td>"STAT"</td> <td>Off</td> </tr> <tr> <td>"STO"</td> <td>Red: Steady</td> </tr> <tr> <td>"FSoE"</td> <td>Red: Steady</td> </tr> </table>	"STAT"	Off	"STO"	Red: Steady	"FSoE"	Red: Steady
"STAT"	Off						
"STO"	Red: Steady						
"FSoE"	Red: Steady						

After successful initialization via FSoE communication, it enters the "Data" state. If not, check the communication data from the host controller.

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

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

(2) Check the Operation of the Electromagnetic Brake Power Output (SBC)

Make sure the servo 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 Limiting Function of the servo drive. For information on how to use the Torque Limiting Function, refer to the ASDA-A3-EP AC Servo Drive User Manual.

(3) Check the Operation of Safety Input

If you are using the safety input for the safety origin sensor, refer to Section 3.7.

(4) Check the Operation of Safety Output

If you are using the safety output for the safety origin sensor, refer to Section 3.7.

### 3.7 Safe Position Setting

Position monitoring is based on the safety origin (safety coordinate 0) with the Safely-Limited Position (SLP) function. Therefore, when using the SLP function, make sure to perform the safe position setting operation to set the safe position.

#### 3.7.1 Selecting the safe position homing method

This system supports two types of the safe position setting method.

- **Method 1: Using safety origin sensor**  
 Install a safety origin sensor, search by the safe position setting operation, and use the detected position as the safety origin.  
 For details on the system configuration and detection method, refer to section 3.7.2.
- **Method 2: Set the current position as safety origin**  
 Set the stopped position to the safety origin. Before setting the safety origin, move the system to the position where the safety origin is set by the host controller.  
 For details on the setting method, refer to section 3.7.3.

The safe position homing method should be selected by means of this parameter.

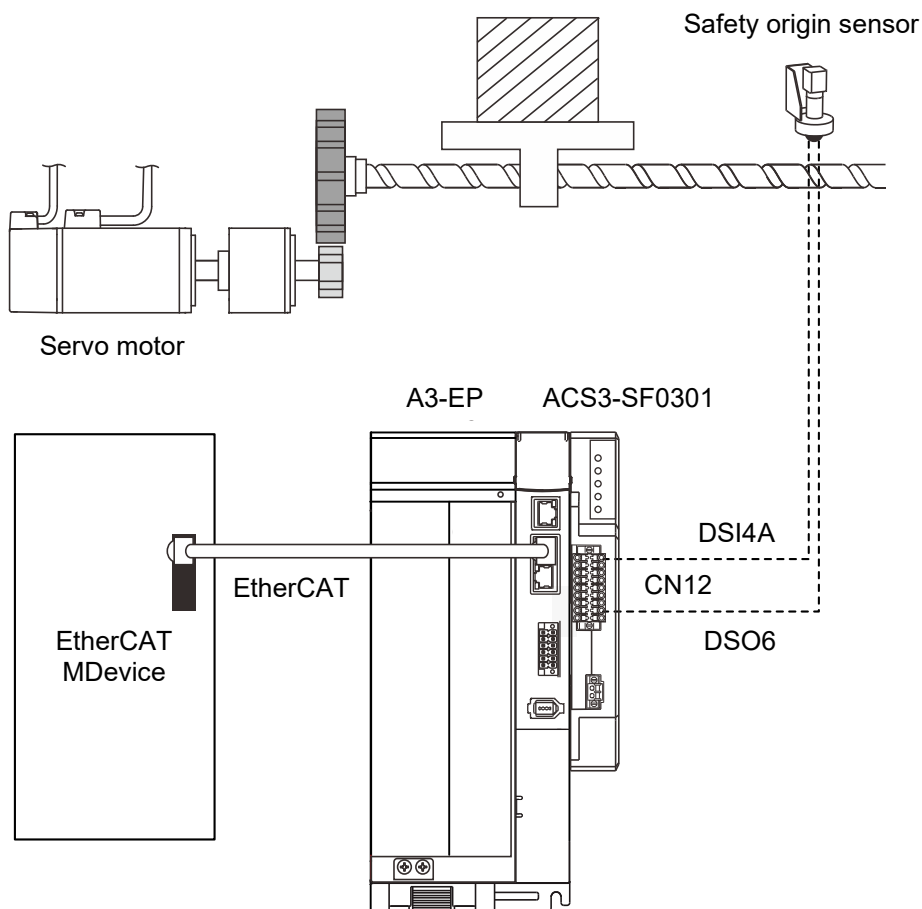
Name	Abbreviation	Description	Unit	Factory Setting	
safe position homing method	-	For selecting the safe position homing method.	-	Method 1	
		Option			Description
		method1			Using safety origin sensor
		method2	Set the current position as safety origin		

- ✓ The SLP function cannot be used until the safe position setting or the safe position diagnosis at restart is completed.
- ✓ The safety level is SIL2, PL e, Cat.3 if Safe Position Homing Method 2 is selected.

### 3.7.2 Method 1: Using safety origin sensor

#### 3.7.2.1 System Configuration

Wire the safety origin sensor to the Safety Function Extension module. For wiring instructions, refer to Section 2.2.2.4.



- ✓ The safety origin sensor is intended not for the management of the system coordinates, but for the determination of the safety coordinates of the Safety Function Extension module. To generate the servo coordinates, prepare a separate origin sensor for the servo and perform a homing operation when generating the servo coordinates. For details on the homing operation, refer to the ASDA-A3-EP AC Servo Drive User Manual.
- ✓ If a safety origin sensor is used, set the following parameters.

Index	sub-index	Parameters	Settings
3800h	4	Safety origin sensor setting1	000D: Connecting the safety home sensor to DSI4
3801h	6	Safety origin sensor setting2	000D: Connecting the safety home sensor to DSO6

For I/O types, these parameters are set automatically when parameters are set from Delta Drive Safety.

3.7.2.2 How to set the Safety Origin

If the safety origin has not been set, the servo drive informs the host controller (EtherCAT MDevice) that "Safety origin setting incomplete (Object Index: 382Ch bit0=0)". The front panel of the servo drive displays "S.POS.U".

The parameters related to the safety origin setting are as follows

Index	Sub-index	Parameters	Setting
6060h	-	Operation mode	06: Homing mode
6098h	-	Homing mode	-5: Safety origin diagnosis method -6: Safety origin diagnosis method -7: Safety origin search method -8: Safety origin search method
6099h	1	Homing speed (Speed during switch search)	Set it to 200 rpm (5 mm/s) or lower.
609Ah	-	Homing acceleration	Unrestricted
382Ch	-	Safe position homing status	Bit 0: Safety origin setting complete (1:Complete) Bit 4: Safety origin diagnosis complete (1:Complete)
38A5h	-	Safe position offset	-2147483648 to +2147483647

- ✓ Homing Method -5 and -6 are for safe position diagnosis. If this method is used before setting the safe position, the homing error (Object Index: 6041h bit13=1) will occur.
- ✓ If the homing speed is too fast, a signal from the safety origin sensor may not be detected.

After setting the homing speed, homing acceleration, and safe position offset, follow the procedure below to determine the safety origin.

- (1) Set the control word (Object Index: 6040h bit4-0) in the following order and set the servo drive state machine to Enable operation (servo-ON).

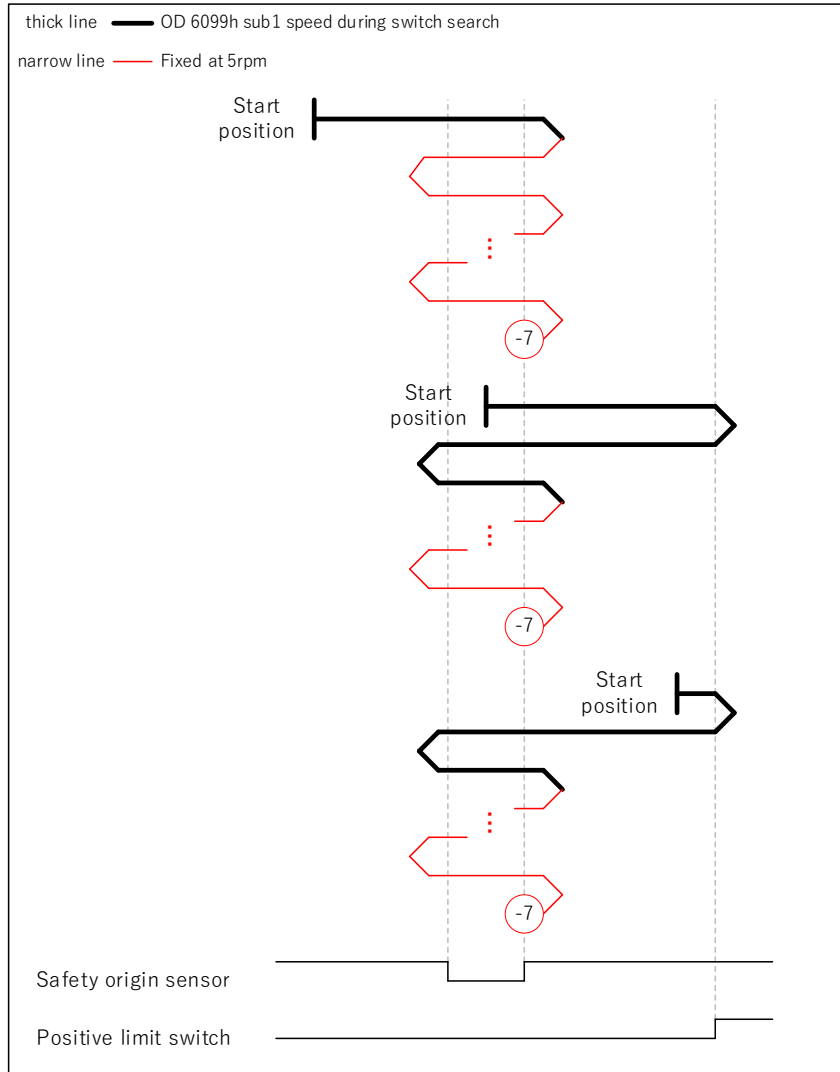
Step	Bit4	Bit3	Bit2	Bit1	Bit0	State
1	0	0	1	1	0	Shutdown
2	0	0	1	1	1	Switch on (Servo On preparation)
3	0	1	1	1	1	Enable operation (Servo On)

- (2) Set 06 (homing mode) in Operation Mode (Object Index: 6060h) and -7 or -8 in Homing Method (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)

■ Method: -7

After moving in the forward direction and passing the safety origin sensor, it runs back and forth between the two ends of the sensor several times and stops near the edge shown in the figure below.

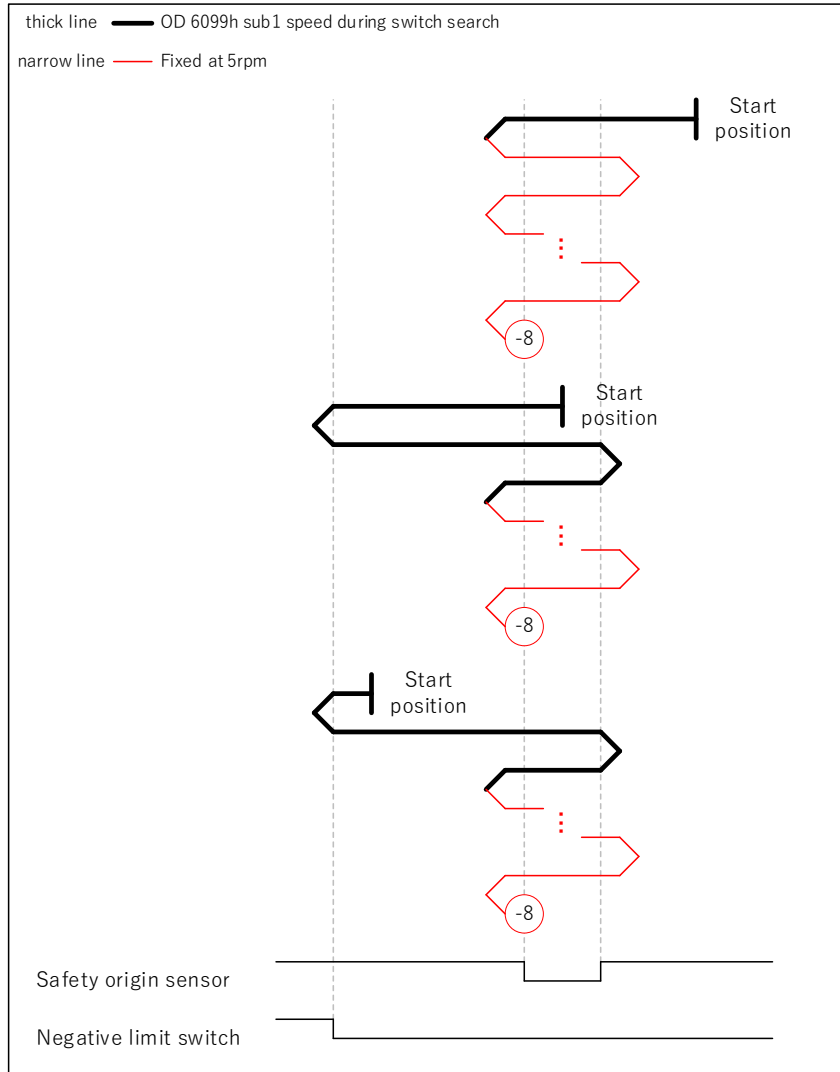
If a forward inhibit limit is detected while it is moving, it folds back to search for the safety origin sensor signal.



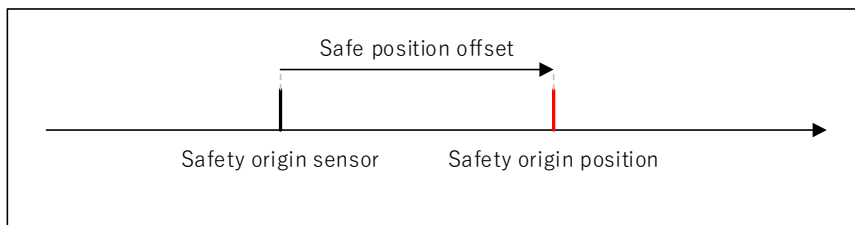
■ Method: -8

After moving in the backward direction and passing the safety origin sensor, it runs back and forth between the two ends of the sensor several times and stops near the edge shown in the figure below.

If a reverse inhibit limit is detected while it is moving, it folds back to search for the safety origin sensor signal.



The position where the safety origin sensor is detected plus the safe position offset is set to the safety origin.



- (3) Set 01111 to the control word (Object Index: 6040h bit4-0) after being notified of "Safety origin setting complete (Object Index: 382Ch bit0=1)" and "Homing complete (Object Index: 6041h bit12=1)".

If "Safety origin setting incomplete (Object Index: 382Ch bit0=0)" or "Homing is abnormal (Object Index: 6041h bit13=1)", start over from (2).

- ✓ After the safety origin setting is completed, the front panel of the servo drive switches to the monitor data display set in P0.002.
- ✓ When a homing error occurs, monitor Object index : 382D to confirm the error contents.

### 3.7.2.3 Detection Error of Safety Origin

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

The SLP monitoring level ("position upper limit" / "position lower limit") should be set based on the position where "safe position actual value" of Object index 6611h is 0.

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



The screenshot shows a configuration interface with a light blue background. At the top left, there is a checked checkbox labeled "Auto refresh". Below it, the text "Safe Position Actual Value" is followed by a text input field containing the number "0".

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

### 3.7.3 Method 2: Set the current position as safety origin

If the safety origin has not been set, the servo drive informs the host controller (EtherCAT MDevice) that "Safety origin setting incomplete (Object Index: 382Ch bit0=0)". The front panel of the servo drive displays "S.POS.U".

The parameters related to setting the safety origin are as follows

Index	Sub-index	Parameters	Setting
6060h	-	Operation mode	06: Homing mode 08: Cyclic Synchronous Position Mode
6098h	-	Homing mode	-9: Safe position setting -10: Upper limit setting -11: Lower limit setting -12: Safety origin diagnosis -13: Upper limit diagnosis -14: Lower limit diagnosis
382Ch	-	Safe position homing status	Bit 0: Safety origin setting complete (1:Complete) Bit 1: Upper limit setting complete (1:Complete) Bit 2: Lower limit setting complete (1:Complete) Bit 4: Safety origin diagnosis complete (1:Complete) Bit 5: Upper limit diagnosis complete (1:Complete) Bit 6: Lower limit diagnosis complete (1:Complete)
38A5h	-	Safe position offset	-2147483648 to +2147483647

- ✓ Homing Method -12, -13 and -14 are for diagnosis. If this method is used before setting the safety origin, the homing error (Object Index: 6041h bit13=1) will occur.

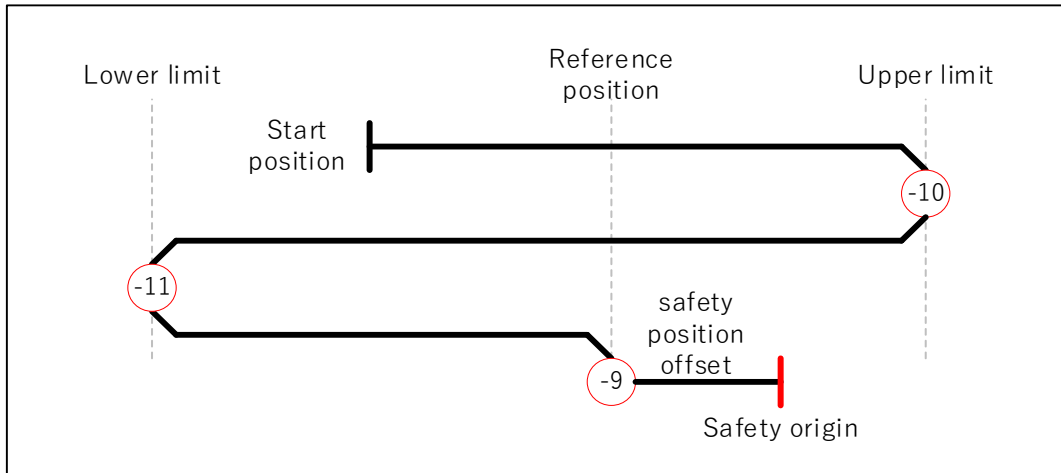
After setting the safe position offset, follow the procedure below to determine the safety origin.

- (1) Set the control word (Object Index: 6040h bit4-0) in the following order and set the servo drive state machine to Enable operation (servo-ON).

Step	Bit4	Bit3	Bit2	Bit1	Bit0	State
1	0	0	1	1	0	Shutdown
2	0	0	1	1	1	Switch on (Servo On preparation)
3	0	1	1	1	1	Enable operation (Servo On)

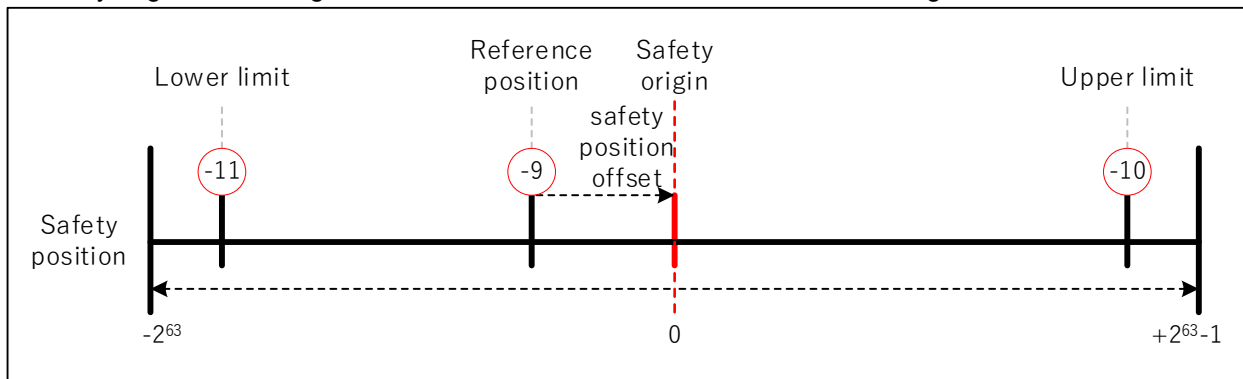
- (2) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the upper limit of the operating range.
- (3) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -10 (upper limit setting) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)
- (4) Set 01111 to the control word (Object Index: 6040h bit4-0) after "Upper limit setting complete (Object Index: 382Ch bit1=1)" and "Homing complete (Object Index: 6041h bit12=1)" are notified. If "Upper limit setting incomplete (Object Index: 382Ch bit1=0)" or "Homing is abnormal (Object Index: 6041h bit13=1)", start over from (2).
- (5) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the lower limit of the operating range.
- (6) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -11 (lower limit setting) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)

- (7) Set 01111 to the control word (Object Index: 6040h bit4-0) after “Lower limit setting complete (Object Index: 382Ch bit2=1)” and “Homing complete (Object Index: 6041h bit12=1)” are notified.  
If “Lower limit setting incomplete (Object Index: 382Ch bit2=0)” or “Homing is abnormal (Object Index: 6041h bit13=1)”, start over from (5).
- (8) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the safety origin.
- (9) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -9 (safe position setting) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)



- (10) Set 01111 to the control word (Object Index: 6040h bit4-0) after “Safety origin setting complete (Object Index: 382Ch bit0=1)” and “Homing complete (Object Index: 6041h bit12=1)” are notified.  
If “Safety origin setting incomplete (Object Index: 382Ch bit0=0)” or “Homing is abnormal (Object Index: 6041h bit13=1)”, start over from (8).

- ✓ After the safety origin setting is completed, the front panel of the servo drive switches to the monitor data display set in P0.002.
- ✓ When a homing error occurs, monitor Object index : 382D to confirm the error contents.
- ✓ The upper / lower limit position of the operating range should be  $\pm 63$  bits in encoder pulse units from the safety origin. If that range is exceeded, alarms AL5C4.1 or AL5C4.2 will be generated.



### 3.7.4 Safe Position Clear

After setting the safe position, clear the safe position if any of the following applies:

- (a) The absolute position reset function for the servo drive has been performed.
  - (b) The safety origin sensor has been replaced.
  - (c) The mounting position of the safety origin sensor has been changed.
  - (d) The servo motor has been replaced.
  - (e) The encoder battery has been replaced.
  - (f) “safe position homing method” or “Homing mode” has been changed.
  - (g) A misalignment is detected by the safe position diagnosis.
- ✓ After clearing the safe position, the Safety Function Extension module enters “Safety origin setting incomplete (Object Index: 382Ch bit0=0)”, which restricts the use of the Safely-Limited Position (SLP) function. Follow Section 3.7.2 or 3.7.3 to reconfigure the safe position and remove the restriction.
  - ✓ Check the sensor mounting position before resetting the safe position.

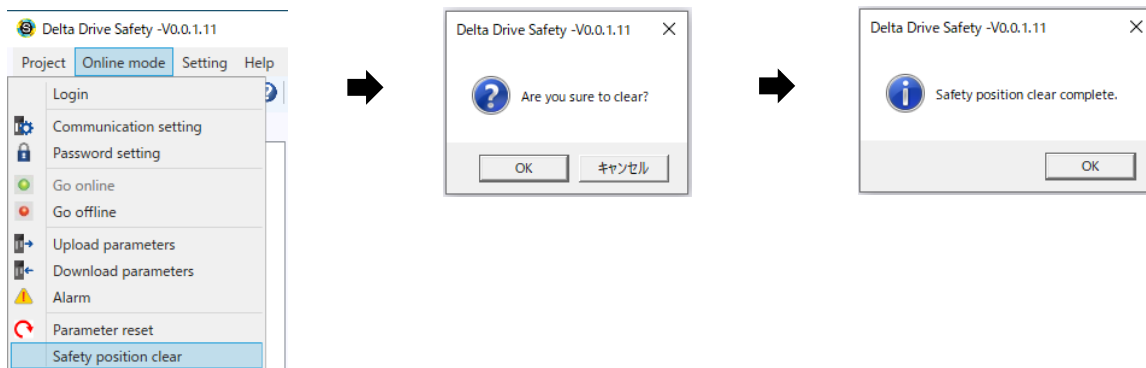
#### 3.7.4.1 Safe Position Clear Functions

In case of replacing safety origin sensor or changing its mounting position, changing servo motor, or replacing batteries, clear the safe position according to the following methods:

(1) Clear by Delta Drive Safety

Click on “Safe position clear” in online mode on the menu bar.

(2) A confirmation screen will appear, and after execution, a completion screen will appear.



(3) Clear via EtherCAT communication  
Set Object index 3811h to 1.

### 3.8 Periodic Inspection

#### 3.8.1 Safe Position Diagnosis

##### 3.8.1.1 When the safety origin is set using Method 1

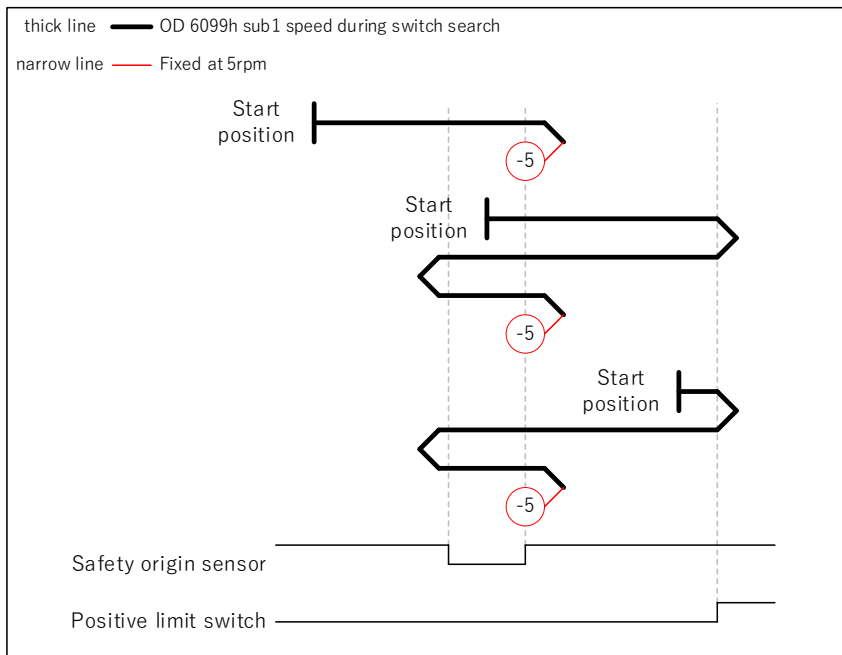
Follow the procedure below to diagnose the position of the safe home sensor.

- (1) When the servo drive is restarted, the servo drive informs the host controller (EtherCAT MDevice) that "Safety origin diagnosis incomplete (Object Index: 382Ch bit4=0)". At this point, the front panel of the servo drive displays "S.POS.d".
- (2) Perform safety origin diagnostic operation (homing method: -5 or -6).

- Method: -5

Move the moving parts of servo forward and set the safety origin to the position near the falling edge of the safety origin sensor signal.

If a forward inhibit limit is detected while it is moving, it folds back to search for the safety origin sensor signal.



- Method: -6

Move the moving parts of the servo backward and set the safety origin to the position near the rising edge of the safety origin sensor signal.

If a reverse inhibit limit is detected while it is moving, it folds back to search for the safety origin sensor signal.

- (3) Exit homing mode when you are notified that “Safety origin diagnosis complete (Object Index: 382Ch bit4=1)” and the “Homing is complete (Object Index: 6041h bit12=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 origin sensor is detected, “Safety origin diagnosis incomplete (Object Index: 382Ch bit4=0)” is retained. Clear the safety origin and then reset it. See chapter 3.7.4 for details on how to clear the safety origin.

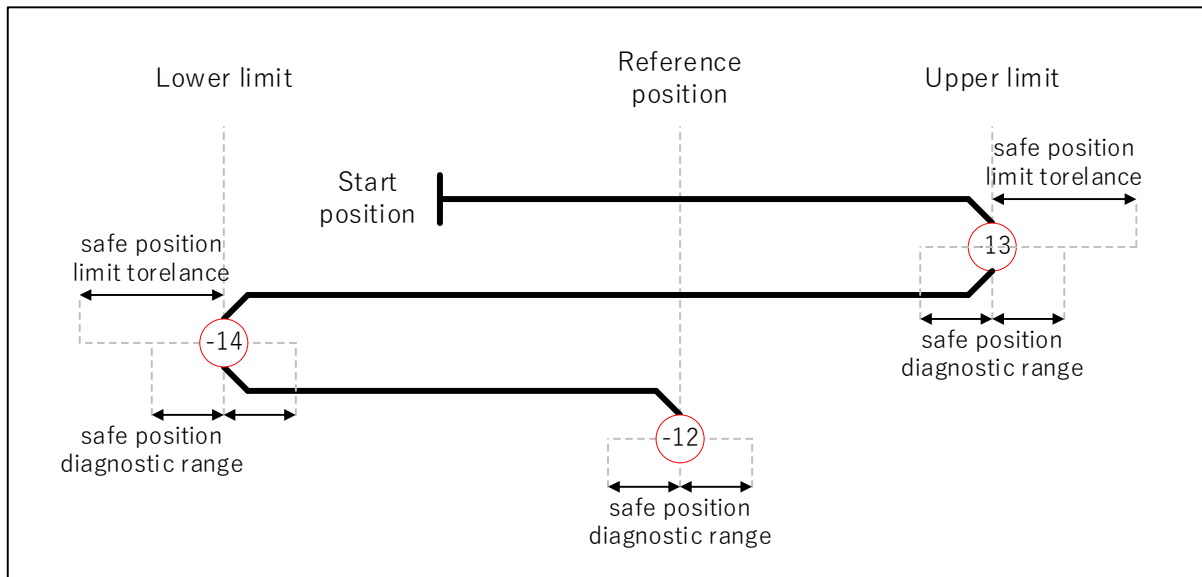
### 3.8.1.2 When the safety origin is set using Method 2

Follow the procedure below to diagnose the validity of the safe position. When performing this diagnosis, visual confirmation of each location should be performed at the same time.

- (1) Set the control word (Object Index: 6040h bit4-0) in the following order and set the servo drive state machine to Enable operation (servo-ON).

Step	Bit4	Bit3	Bit2	Bit1	Bit0	State
1	0	0	1	1	0	Shutdown
2	0	0	1	1	1	Switch on (Servo On preparation)
3	0	1	1	1	1	Enable operation (Servo On)

- (2) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the upper limit of the operating range.
- (3) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -13 (upper limit diagnosis) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)
- (4) Set 01111 to the control word (Object Index: 6040h bit4-0) after “Upper limit diagnosis complete (Object Index: 382Ch bit5=1)” and “Homing complete (Object Index: 6041h bit12=1)” are notified. If “Upper limit diagnosis incomplete (Object Index: 382Ch bit5=0)” or “homing is abnormal (Object Index: 6041h bit13=1)”, start over from (2).
- (5) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the lower limit of the operating range.
- (6) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -14 (lower limit setting) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)
- (7) Set 01111 to the control word (Object Index: 6040h bit4-0) after “Lower limit diagnosis complete (Object Index: 382Ch bit6=1)” and “Homing complete (Object Index: 6041h bit12=1)” are notified. If “Lower limit diagnosis incomplete (Object Index: 382Ch bit6=0) or “Homing is abnormal (Object Index: 6041h bit13=1)”, start over from (5).
- (8) Set 08 (cyclic position mode) in the operation mode (Object Index: 6060h) and move to the safety origin.
- (9) Set 06 (homing mode) for operation mode (Object Index: 6060h) and -12 (safe position setting) for homing mode (Object Index: 6098h) to perform homing. (Set Object Index 6040h bit4-0=11111)
- (10) Set 01111 to the control word (Object Index: 6040h bit4-0) after “Safety origin diagnosis complete (Object Index: 382Ch bit4=1)” and “Homing complete (Object Index: 6041h bit12=1)” are notified. If “Safety origin diagnosis incomplete (Object Index: 382Ch bit4=0) or “Homing is abnormal (Object Index: 6041h bit13=1)”, start over from (8).



- ✓ When a homing error occurs, monitor Object index : 382D to confirm the error contents.
- ✓ The pass range of the diagnosis can be changed by parameters. Please set the range within which system safety can be ensured.

Name	Abbreviation	Description	Unit	Factory Setting		
safe position diagnostic range	-	Set the pass range for self-diagnosis of the safe position. <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">range</td> <td style="width: 90%;">0.0 ~ 30.0</td> </tr> </table>	range	0.0 ~ 30.0	0.1degree 0.1mm	0.1
range	0.0 ~ 30.0					

### 3.8.1.3 Diagnostic cycle

Diagnose the safety origin when starting up the servo drive, when changing the safe position offset parameter, and once every three months. When operating continuously for more than 3 months, AL.5A4 occurs and operation cannot be continued after 3 months have elapsed since the last time the safety origin was set or diagnosed. Be sure to perform safety origin diagnosis within 3 months.

If the 3-month period is exceeded and an alarm occurs, restart the machine and perform the safety origin diagnosis.

The expiration date of the safe position should be monitored from Object index 382Eh.

To check from Delta Drive Safety, refer to "Safe position remaining valid time" of safe position on the SLP parameter setting page.

Auto refresh

safe position remaining valid time  hour(s)

- ✓ If AL.5C4 occurs during diagnostics, increase the safe position tolerance.

Name	Abbreviation	Description	Unit	Factory Setting		
safe position limit tolerance	-	Set the allowable range of movement beyond the positive/negative limit positions. <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">range</td> <td style="width: 90%;">0.0 ~ 30.0</td> </tr> </table>	range	0.0 ~ 30.0	0.1degree 0.1mm	0.1
range	0.0 ~ 30.0					

### 3.8.2 Diagnosis for Electromagnetic Brakes

The electromagnetic brake holding torque should be diagnosed with the Safe Brake Test (SBT) function upon servomotor replacement and once in every 3 months. If AL.5C8 or AL.5CC occurs, the holding force of the electromagnetic brake may be low. Replace the servo motor.

- ✓ See chapter 4.13 for details on SBT function and chapter 7 for details on alarms.

### 3.8.3 Diagnosis Records

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

#### ■ Checklist Examples

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?		
Safety origin	Has the safety origin diagnosis been successfully completed?		
...			
Password	Is a password set for Delta Drive Safety?		
Parameters	Are the parameter settings correct? Are the parameters recorded and stored?		

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# Safety Functions

# 4

This chapter describes how to use each safety function.

4.1	Overview of Safety Functions	4
4.1.1	Safety Functions	4
4.1.2	Order of Priority	5
4.2	Safe Torque Off (STO)	6
4.2.1	I/O Type	6
4.2.1.1	How to deactivate	6
4.2.2	EtherCAT Communication (FSoE) Type	8
4.2.2.1	How to deactivate	8
4.2.3	Parameters	10
4.3	Safe Stop1 (SS1)	11
4.3.1	Selecting Functions	11
4.3.2	Deceleration Method	11
4.3.3	I/O Type	12
4.3.3.1	Safe Stop 1 with time monitoring (SS1-t)	12
4.3.3.2	Safe Stop 1 with deceleration monitoring (SS1-r)	13
4.3.3.3	How to Deactivate	14
4.3.4	EtherCAT Communication (FSoE) Type	16
4.3.4.1	Safe Stop 1 with time monitoring (SS1-t)	16
4.3.4.2	Safe Stop 1 with deceleration monitoring (SS1-r)	17
4.3.4.3	How to Deactivate	18
4.3.5	Parameters	20
4.4	Safe Stop2 (SS2)	22
4.4.1	Selecting Functions	22
4.4.2	Deceleration Method	22
4.4.3	I/O Type	23
4.4.3.1	Safe Stop 2 with time monitoring (SS2-t)	23
4.4.3.2	Safe Stop 2 with deceleration monitoring (SS2-r)	24
4.4.3.3	How to Deactivate	25
4.4.4	EtherCAT Communication (FSoE) Type	26
4.4.4.1	Safe Stop 2 with time monitoring (SS2-t)	26

4.4.4.2	Safe Stop 2 with deceleration monitoring (SS2-r)	27
4.4.4.3	Deactivation Procedure	28
4.4.5	Parameters	30
4.5	Safe Operation Stop (SOS)	32
4.5.1	I/O Type	32
4.5.2	EtherCAT Communication (FSoE) Type	33
4.5.3	Parameters	34
4.6	Safely-Limited Speed (SLS)	35
4.6.1	Selecting Functions	35
4.6.2	I/O Type	36
4.6.2.1	Safely-Limited Speed with time monitoring (SLS)	36
4.6.2.2	Safely-Limited Speed with deceleration monitoring (SLS-r)	37
4.6.3	EtherCAT Communication (FSoE) Type	38
4.6.3.1	Safely-Limited Speed with time monitoring (SLS)	38
4.6.3.2	Safely-Limited Speed with deceleration monitoring (SLS-r)	39
4.6.4	Parameters	40
4.7	Safe Maximum Speed (SMS)	41
4.7.1	Parameters	41
4.8	Safe Speed Monitor (SSM)	42
4.8.1	SSM Output	42
4.8.2	Parameters	42
4.9	Safely-Limited Increment (SLI)	43
4.9.1	I/O Type	43
4.9.2	EtherCAT Communication (FSoE) Type	44
4.9.3	Parameters	45
4.10	Safe Direction (SDI)	46
4.10.1	I/O Type	46
4.10.2	EtherCAT Communication (FSoE) Type	47
4.10.3	Notes	48
4.10.4	Parameters	48
4.11	Safely-Limited Position (SLP)	49
4.11.1	I/O Type	49
4.11.2	EtherCAT Communication (FSoE) Type	50
4.11.3	Parameters	51
4.12	Safe Brake Control (SBC)	52
4.12.1	SBC Output Operation	52
4.12.1.1	Servo On/Off operation	52
4.12.1.2	Operation when STO is executed (Set “without SBC” in “activate SBC” for STO)	52
4.12.1.3	Operation when STO is executed (Set “with SBC” in “activate SBC” for STO)	53
4.12.1.4	Operation when SS1 is executed (Set “without SBC” in “activate SBC” for SS1)	53
4.12.1.5	Operation when SS1 is executed (Set “with SBC” in “activate SBC” for SS1)	54

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4.12.1.6 Operation at SBC request .....	55
4.12.2 Parameters .....	56
4.13 Safe Brake Test (SBT) .....	57
4.13.1 I/O Type .....	57
4.13.2 EtherCAT Communication (FSoE) Type .....	58
4.13.3 Parameters .....	59

## 4.1 Overview of Safety Functions

### 4.1.1 Safety Functions

This system is equipped with the following safety functions.

Classification	Feature	Description
Safety Stop Function	Safe Torque OFF (STO)	For shutting off power supply to the servo motor.
	Safe Stop1 time controlled (SS1-t)	For starting the STO function after a predetermined amount of time elapses. * It means Safe Stop1 with time monitoring.
	Safe Stop1 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 Stop1 with deceleration monitoring.
	Safe Stop2 time controlled (SS2-t)	For starting the SOS function after a predetermined amount of time elapses. * It means Safe Stop2 with time monitoring.
	Safe Stop2 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 Stop2 with deceleration monitoring.
Safety Monitoring Function	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 at the time 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 at the time 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 at the time 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.
Safety Output Function	Safe Brake Control (SBC)	For power supply output for electromagnetic brake of servo motors
Auxiliary Functions	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 safety stop function (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) Safety Stop Function

- The order of priority for the features of safety stop functions is STO (highest) > SS1 > SS2 (lowest).
- For the EtherCAT Communication (FSoE) type, up to four SS1 (and SS2) commands can be mapped to the Receive Safety PDO. If multiple commands are enabled simultaneously, the order of priority is as follows:  
The 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.  
Example) If the SS1 Command 1 is additionally executed while the SS1 Command 3 is being executed, the system continues the operation to stop the motor according to the parameters for the SS1 Command 3.

#### (2) Safety Monitoring Function

- The features of safety monitoring functions are not given prioritized order. All the features can be used simultaneously.
- For the EtherCAT Communication (FSoE) type, up to four identical commands can be mapped to receive PDOs (RxPDOs) and they can be used at the same time. If multiple commands run simultaneously, the system monitors the operation under the most strict conditions.  
Example) If both SLS Command 1 and SLS Command 2 are enabled while SLS velocities limit1 and limit2 are set differently to 500 rpm (500 mm/s) and to 100 rpm (100 mm/s), respectively, the speed is monitored with SLS velocity limit2.  
\* The same applies when using SLS1 and SLS2 for the I/O type.
- Once the STO function is executed, all the safety monitoring functions are deactivated.

#### (3) Safety Output Function

- The features of safety output function are not given prioritized order if the system outputs in conjunction with the STO function and the servo off/on status of the drive.
- 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 the EtherCAT communication (FSOE).

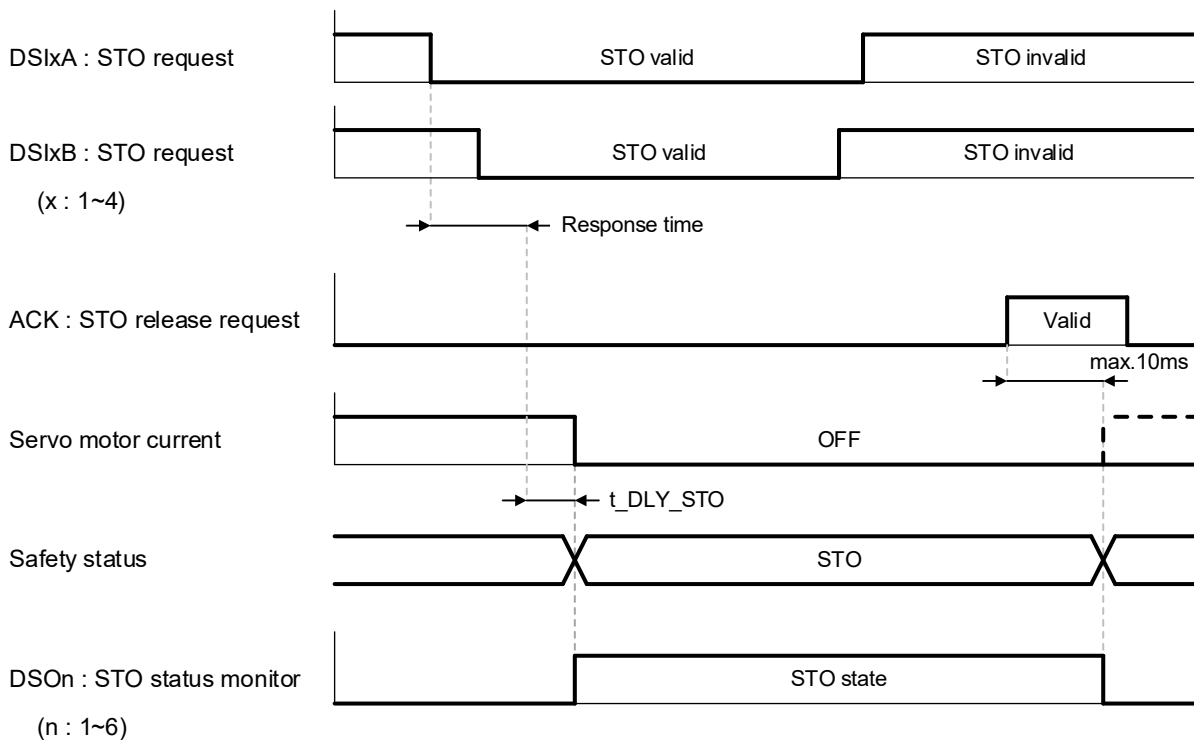
### 4.2.1 I/O Type

By turning off DSIxA / B, the system triggers the STO function, 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 the ACK input after turning on the DSIxA / B. The method of deactivating the STO state can be selected by the STO parameter “restart acknowledge behavior”.

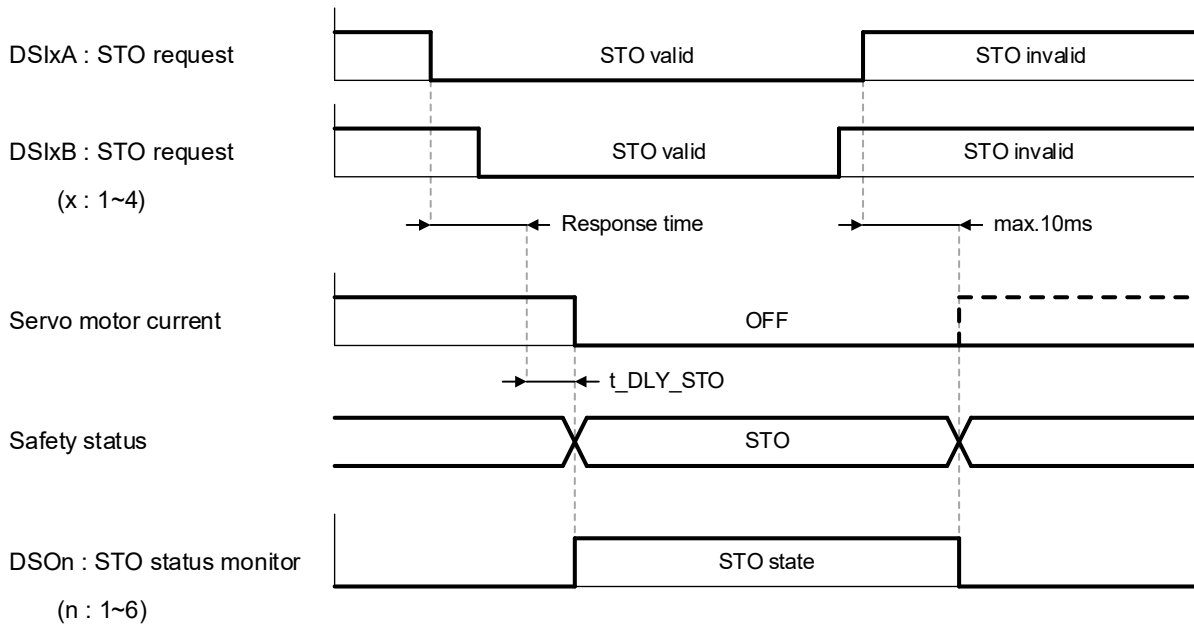
#### 4.2.1.1 How to deactivate

##### 4.2.1.1.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK input should be enabled after the STO request is deactivated by DSIxA / B. For enabling the ACK input prior to deactivating the STO request, the system will not allow to deactivate the STO state.
- ✓ If the servo-on command remains enabled at the time when the STO state is deactivated, a current may flow to the servo motor at the same time as the STO is deactivated (dotted line), the servo motor may suddenly start rotation. 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. It should not be used for safety-related applications.

4.2.1.1.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)



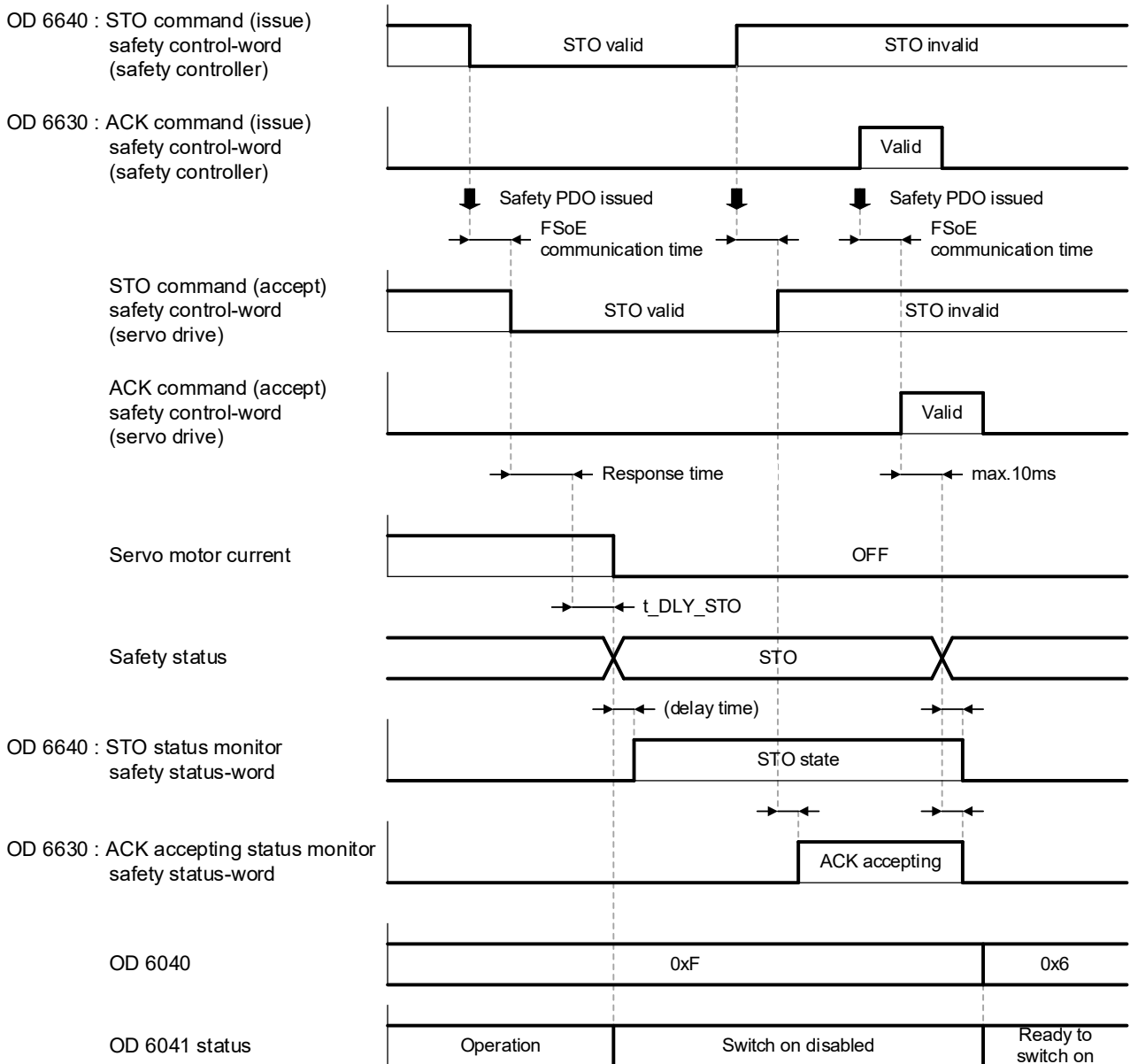
- ✓ If the servo-on command remains enabled at the time when the STO state is deactivated, a current may flow to the servo motor at the same time as the STO is deactivated (dotted line), the servo motor may suddenly start rotation. Before using this setting, perform a risk assessment and take safety precautions to ensure that no hazardous movement is created when DS1xA / B is turned on.

### 4.2.2 EtherCAT Communication (FSoE) Type

By setting the STO command assigned to the safety PDO to “0: STO enabled”, the system triggers the STO function, and then the system goes into the STO state after the response time plus  $t\_DLY\_STO$  elapses. To deactivate the STO state, change the STO command to “1: STO disabled” and the ACK command to “1: restart” together. The method of deactivating the STO state can be selected by the STO parameter “restart acknowledge behavior”.

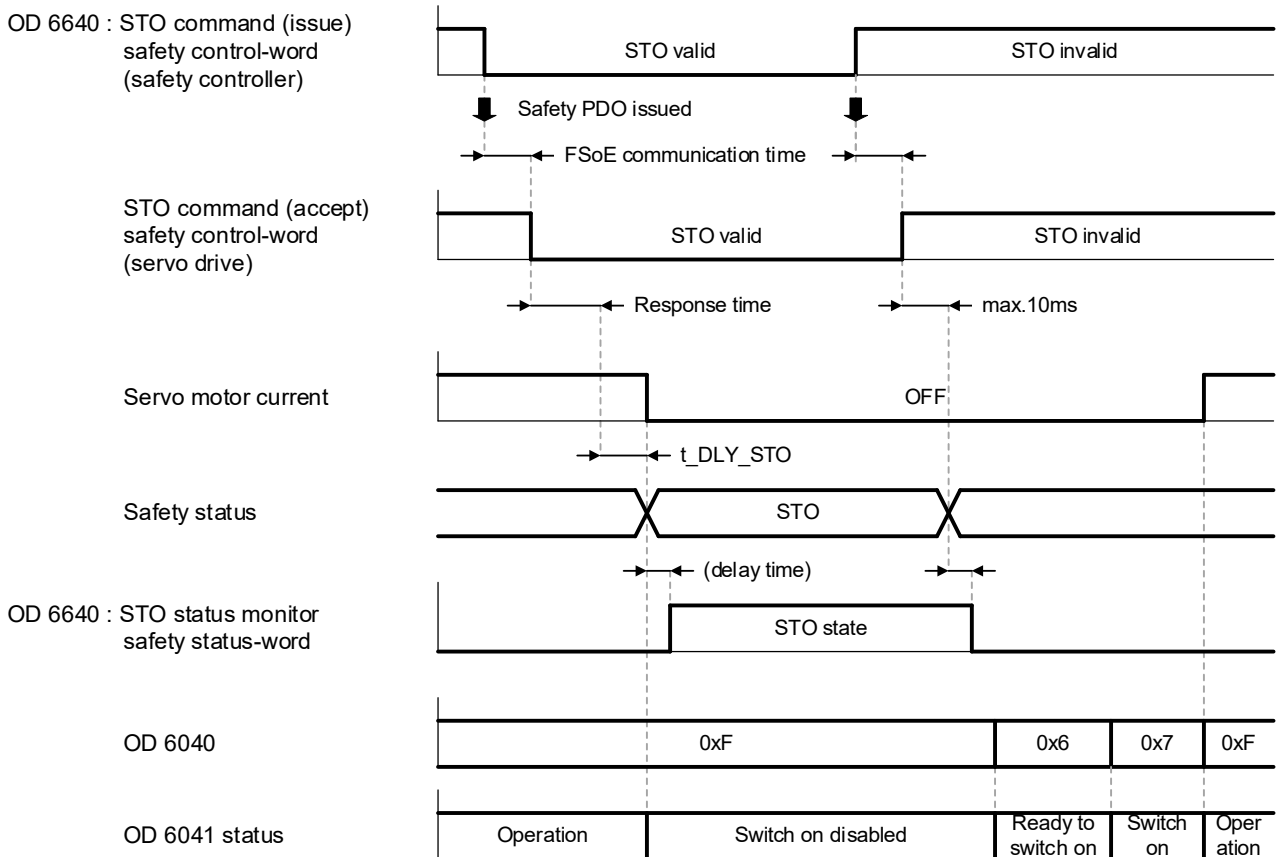
#### 4.2.2.1 How to deactivate

##### 4.2.2.1.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK command should be enabled after the STO request is deactivated by the STO command (ACK accepting status). For enabling the ACK command prior to deactivating the STO request, the system will not allow to deactivate the STO state. (If the command and the request are given simultaneously, the STO state is deactivated.)
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

4.2.2.1.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)



- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

4.2.3 Parameters

Name	Abbreviation	Description	Unit	Factory Setting						
restart acknowledge behavior	-	For selecting the method to deactivate the STO state. <table border="1" data-bbox="571 300 1155 479"> <thead> <tr> <th data-bbox="571 300 699 327">Option</th> <th data-bbox="699 300 1155 327">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="571 327 699 383">automatic restart</td> <td data-bbox="699 327 1155 383">When the STO request is deactivated, the STO state is automatically deactivated.</td> </tr> <tr> <td data-bbox="571 383 699 479">manual restart</td> <td data-bbox="699 383 1155 479">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> </tbody> </table>	Option	Description	automatic restart	When the STO request is deactivated, the STO state is automatically deactivated.	manual restart	After the STO request is deactivated, turn on the ACK input (changing the “restart acknowledge” command to 1) to deactivate the STO state.	-	manual restart
Option	Description									
automatic restart	When the STO request is deactivated, the STO state is automatically deactivated.									
manual restart	After the STO request is deactivated, turn on the ACK input (changing the “restart acknowledge” command to 1) to deactivate the STO state.									
activate SBC	-	For selecting SBC output operation. <table border="1" data-bbox="571 551 1155 680"> <thead> <tr> <th data-bbox="571 551 699 577">Option</th> <th data-bbox="699 551 1155 577">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="571 577 699 633">without SBC</td> <td data-bbox="699 577 1155 633">SBC outputs are not linked to STO operation.</td> </tr> <tr> <td data-bbox="571 633 699 680">with SBC</td> <td data-bbox="699 633 1155 680">SBC outputs are linked to STO operation.</td> </tr> </tbody> </table> ✓ Refer to Section 4.12 for more information on SBC outputs.	Option	Description	without SBC	SBC outputs are not linked to STO operation.	with SBC	SBC outputs are linked to STO operation.	-	without SBC
Option	Description									
without SBC	SBC outputs are not linked to STO operation.									
with SBC	SBC outputs are linked to STO operation.									
time to STO	t_DLY_STO	For setting the duration from the end of the response time to the time when the STO function is enabled. <table border="1" data-bbox="571 824 1155 869"> <thead> <tr> <th data-bbox="571 824 699 869">Setting range</th> <th data-bbox="699 824 1155 869"></th> </tr> </thead> <tbody> <tr> <td data-bbox="571 869 699 869"></td> <td data-bbox="699 869 1155 869">0 - 65535</td> </tr> </tbody> </table>	Setting range			0 - 65535	ms	0		
Setting range										
	0 - 65535									

### 4.3 Safe Stop1 (SS1)

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

#### 4.3.1 Selecting Functions

This system supports two types of the Safe Stop1 functions.

- SS1-t: Safe Stop 1 with time monitoring (Safe stop 1 time controlled)  
The system starts STO function after a preset 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 set value or a preset time elapses.

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

Name	Abbreviation	Description	Unit	Factory Setting	
monitoring type	-	For selecting the function of SS1.		-	SS1 with time monitoring (SS1-t)
		Option	Description		
		SS1 with time monitoring	time controlled (SS1-t)		
		SS1 with deceleration monitoring	ramp monitoring (SS1-r)		

#### 4.3.2 Deceleration Method

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

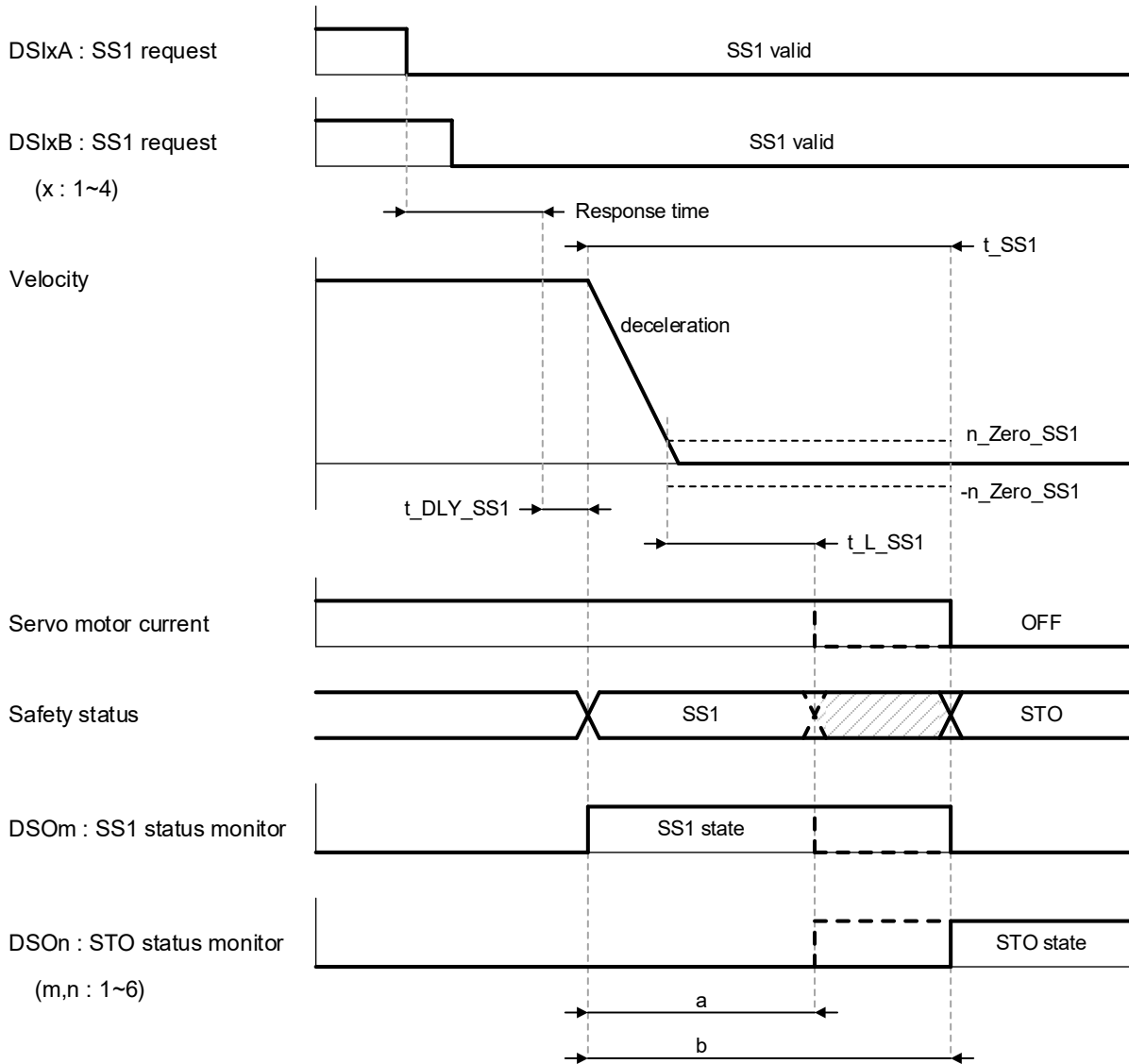
Name	Abbreviation	Description	Unit	Factory Setting	
deceleration method	-	For selecting the deceleration method.		-	by drive
		Option	Description		
		by drive	The servo drive automatically slows down.		
		by controller	The servo drive follows the commands from the controller.		

- ✓ If “by drive” is selected, position or velocity commands received during deceleration will be discarded. When using Servo Drive in the position control, update the target position of the controller with the current position acquired from Servo Drive before restarting operation.
- ✓ If “by controller” is selected, decelerate so that the motor stops before the " t\_SS1" elapses.

### 4.3.3 I/O Type

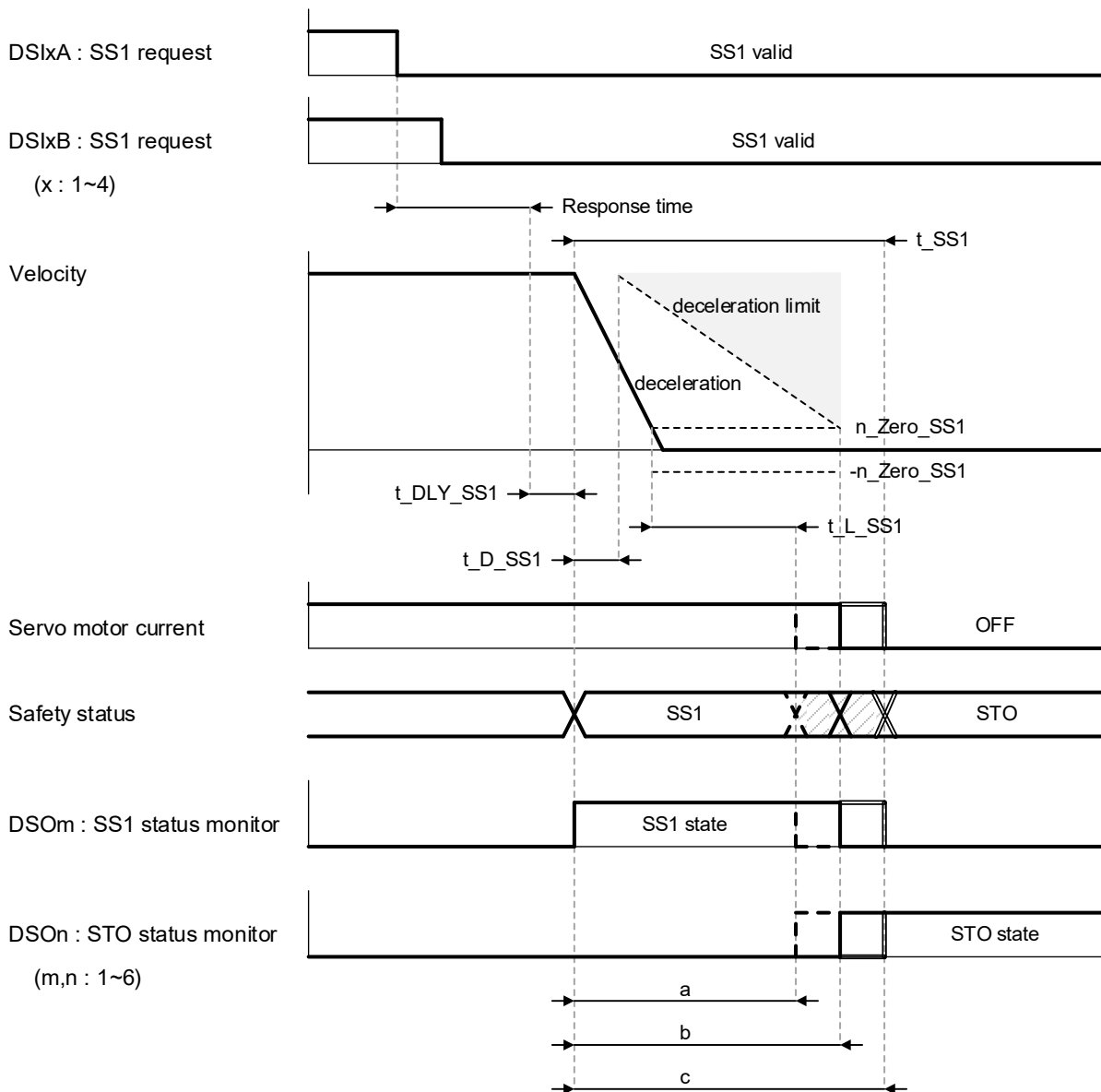
By turning off DS1xA / B, the system triggers the SS1 function, and then the system goes into the SS1 state (i.e., starts decelerating) after the response time plus  $t_{DLY\_SS1}$  elapses. To deactivate the STO state, turn on the ACK input after turning on the DS1xA / B. The method of deactivating the STO state can be selected by the STO parameter “restart acknowledge behavior”.

#### 4.3.3.1 Safe Stop 1 with time monitoring (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.
- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.
  - 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 (DS0m). The SS1 status monitor does not work as a safety function. It 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.

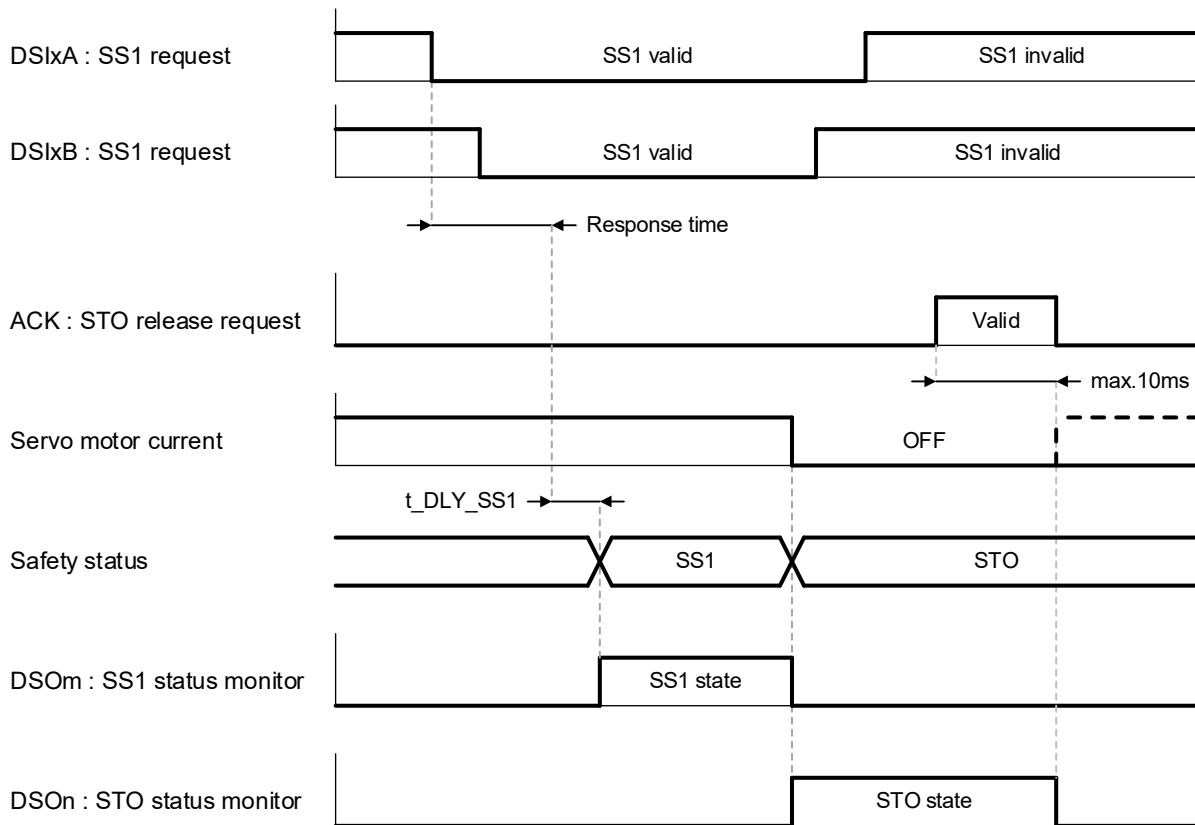
4.3.3.2 Safe Stop 1 with deceleration monitoring (SS1-r)



- ✓ 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.
- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the double line (==) in the timing chart.
  - a: deceleration time +  $t\_L\_SS1$
  - b: 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. It 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.

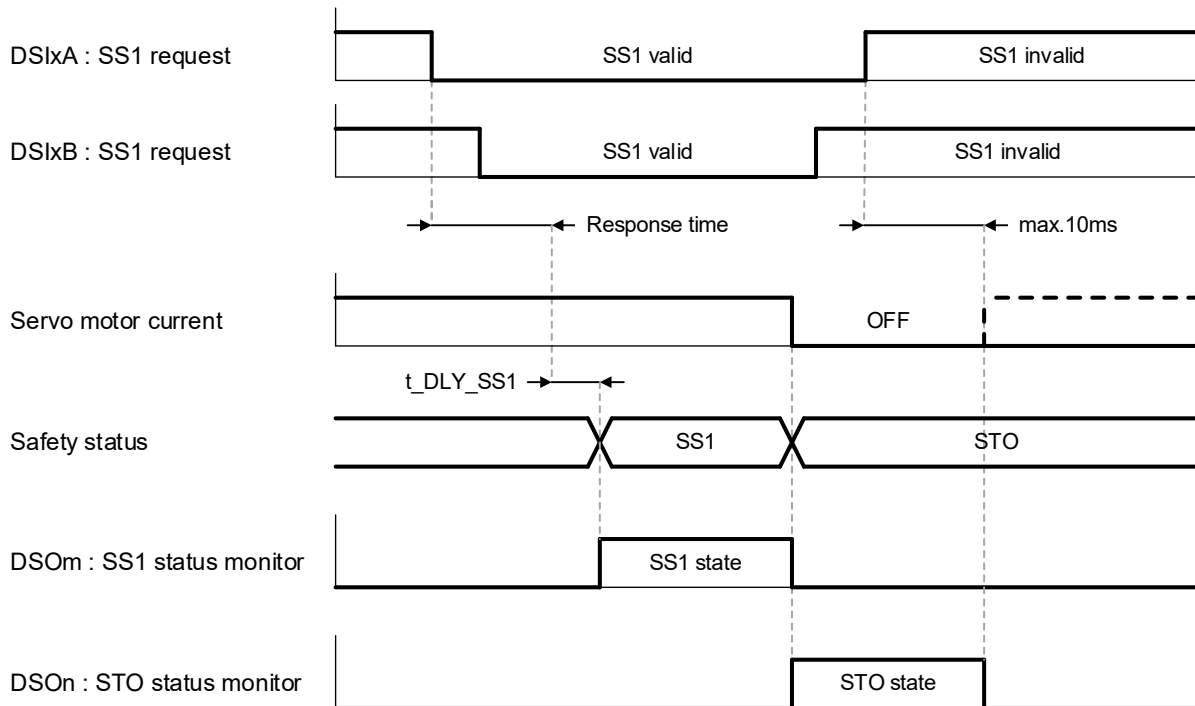
4.3.3.3 How to Deactivate

4.3.3.3.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK input should be enabled after the SS1 request is deactivated by DS1xA / B. For enabling the ACK input prior to deactivating the SS1 request, the system will not allow to deactivate the STO state.
- ✓ If the servo-on command remains enabled at the time when the STO state is deactivated, a current may flow to the servo motor at the same time as the STO is deactivated (dotted line), the servo motor may suddenly start rotation. Pay close attention to the safety of your surroundings when deactivating the STO.

4.3.3.3.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)



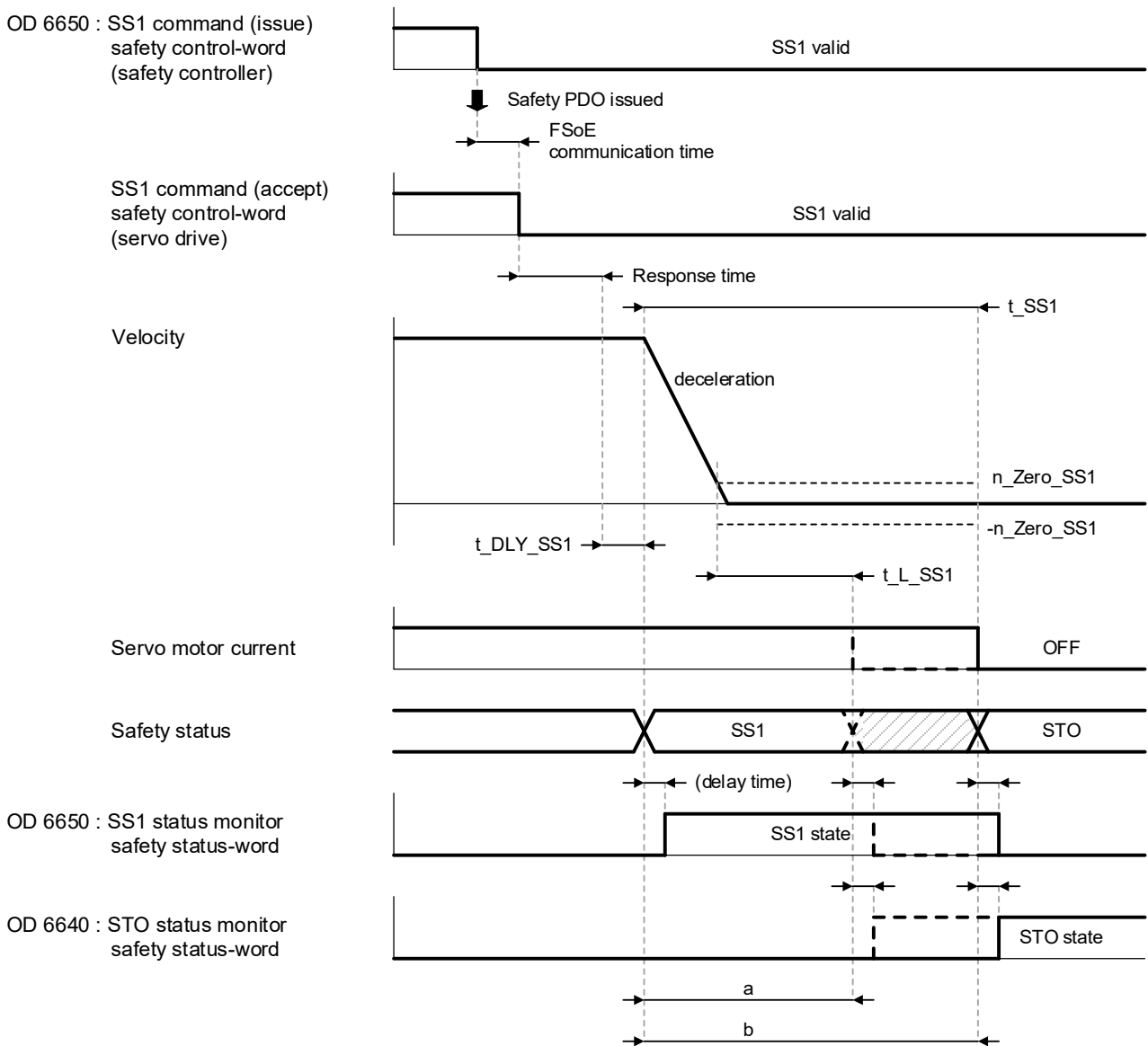
- ✓ If the servo-on command remains enabled at the time when the STO state is deactivated, a current may flow to the servo motor at the same time as the STO is deactivated (dotted line), the servo motor may suddenly start rotation. Before using this setting, perform a risk assessment and take safety precautions to ensure that no hazardous movement is created when DSIxA / B is turned on.

### 4.3.4 EtherCAT Communication (FSoE) Type

By setting the SS1 command assigned to the safety PDO to “0: SS1 enabled”, the system triggers the SS1 function and then the system goes into the SS1 state (i.e., starts decelerating) after the response time plus  $t_{DLY\_SS1}$  elapses.

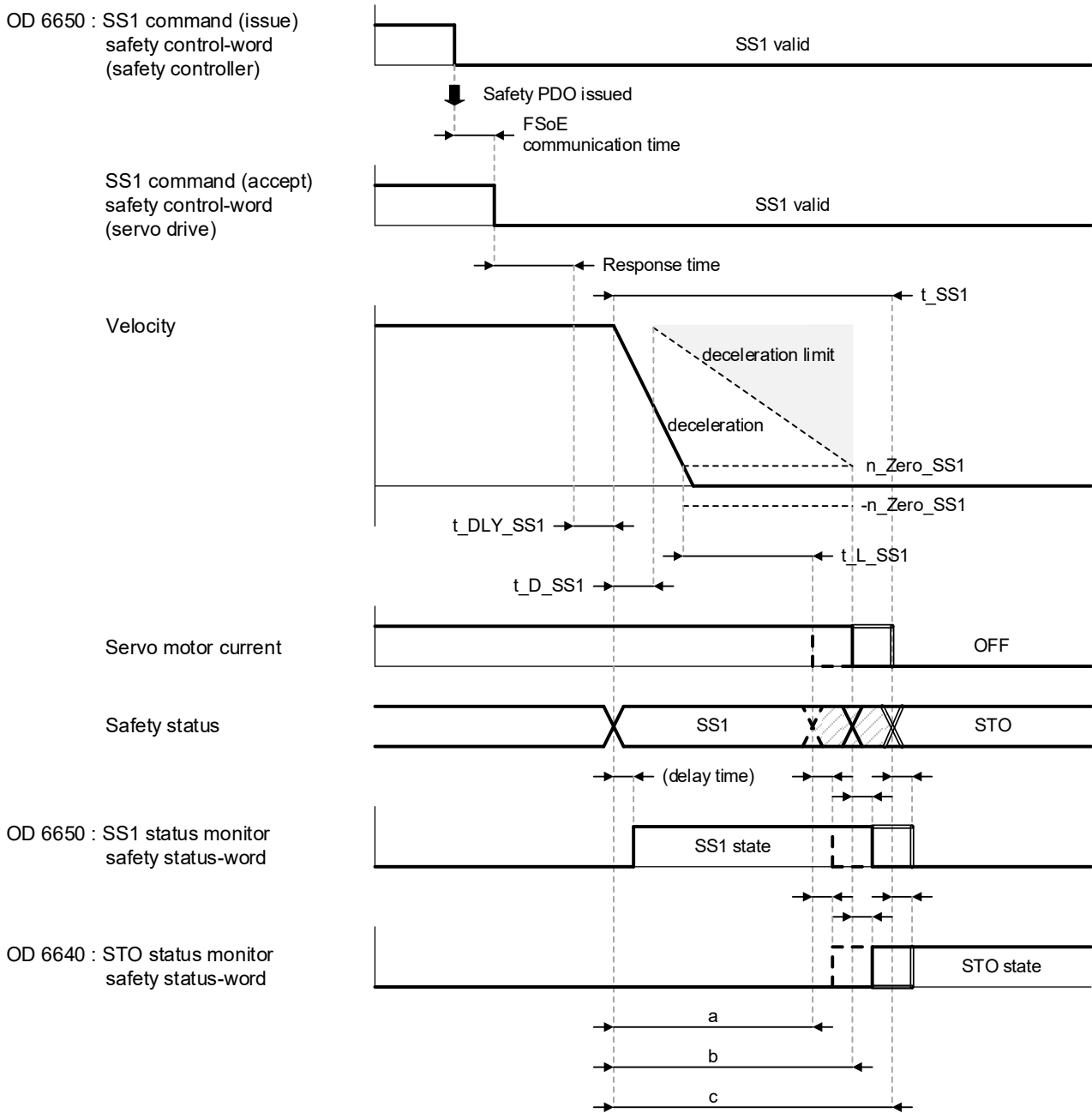
To deactivate the STO state, change the SS1 command to “1: SS1 disabled” and the ACK command to “1: restart” together. The method of deactivating the STO state can be selected by the STO parameter “restart acknowledge behavior”.

#### 4.3.4.1 Safe Stop 1 with time monitoring (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.
- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.
  - 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.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

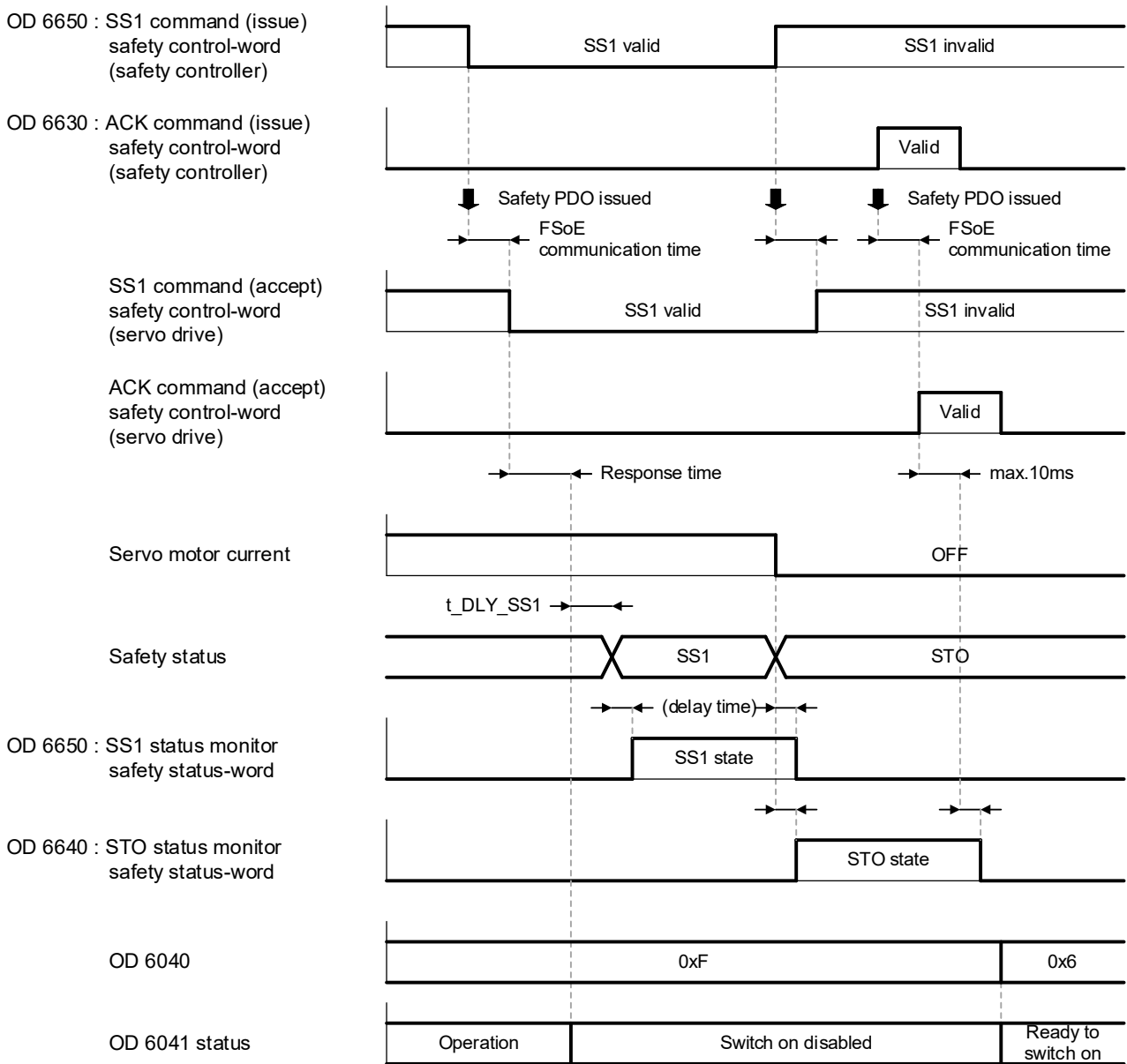
4.3.4.2 Safe Stop 1 with deceleration monitoring (SS1-r)



- ✓ 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.
- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the double line (==) in the timing chart.
  - a: deceleration time +  $t\_L\_SS1$
  - b: 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.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

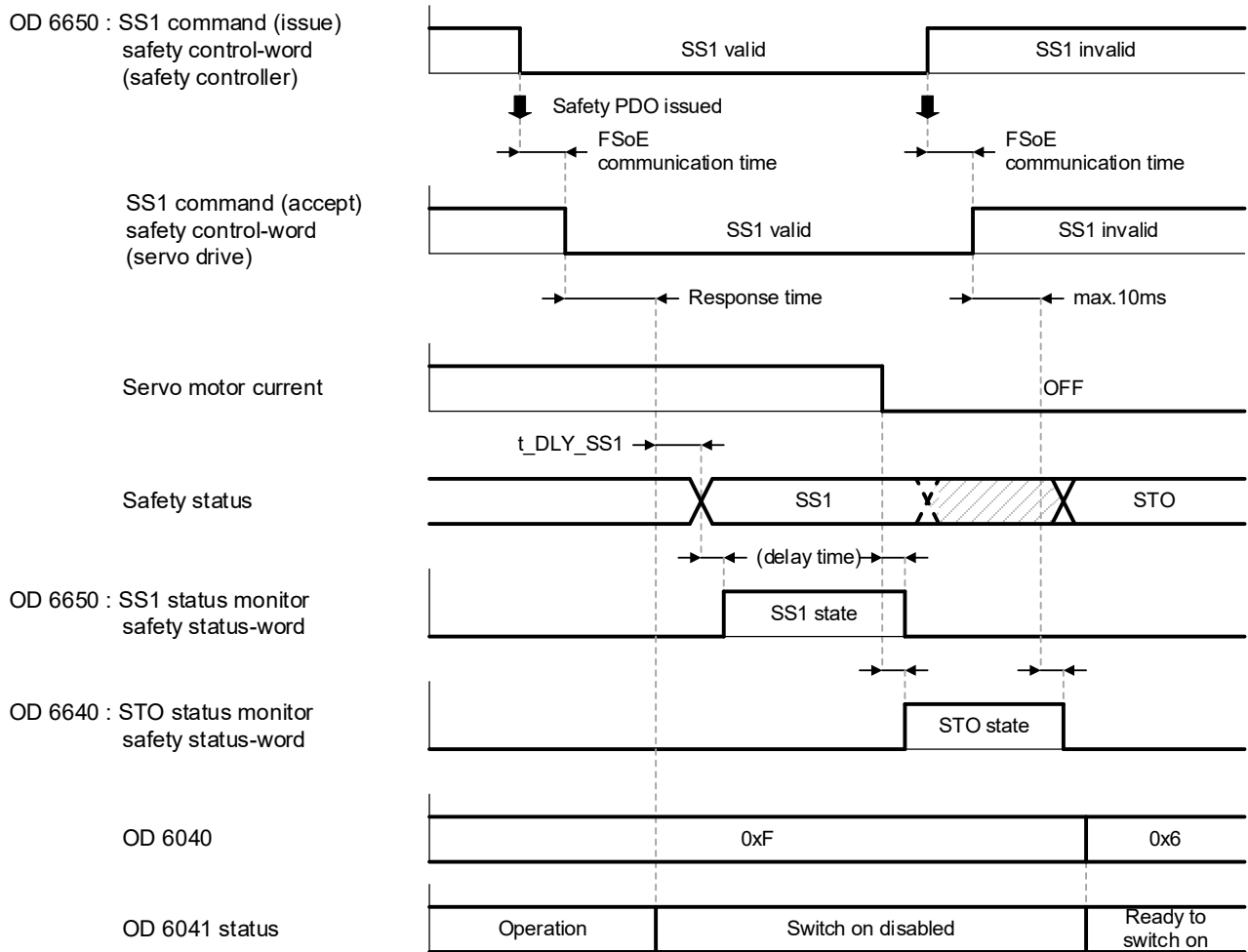
4.3.4.3 How to Deactivate

4.3.4.3.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK command should be enabled after the SS1 request is deactivated by the SS1 command. For enabling the ACK command prior to deactivating the SS1 request, the system will not allow to deactivate the STO state. (If the command and the request are given simultaneously, the STO state is deactivated.)
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

4.3.4.3.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)



- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.3.5 Parameters

Name	Abbreviation	Description	Unit	Factory 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 (rotary) mm/s (linear)	0
deceleration	-	For setting the deceleration rate. Setting range   0 - 4294967295*2 <ul style="list-style-type: none"> <li>✓ The servo drive specifications limit the deceleration rate at approximately 46 rpm/s (76 mm/s<sup>2</sup>). Therefore, if the set value corresponds to less than the deceleration limit, the deceleration is limited to this value.</li> <li>A setpoint that corresponds to less than the deceleration limit is approximately less than 12,863,000 pulse/s<sup>2</sup> for rotary motors and approximately 19,000,000 pulse/s<sup>2</sup> for linear motors (with an encoder resolution of 4 nm).</li> <li>✓ This parameter can also be set using "Ramp time for deceleration" and "Ramp speed for deceleration". For detailed switching methods, refer to the Delta Drive Safety User Manual.</li> </ul>	pulse/s <sup>2</sup>	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 <ul style="list-style-type: none"> <li>✓ The value of Deceleration limit can also be set using "Ramp time for deceleration limit" and "Ramp speed for deceleration limit". For detailed switching methods, refer to the Delta Drive Safety User Manual.</li> </ul>	pulse/s <sup>2</sup>	0
deceleration scale factor*1	-	For setting coefficients to extend the deceleration and deceleration limit. They are extended by the following formula. $\text{Actual deceleration} = \text{deceleration setting value} \times 10^{\text{scale factor}}$ Setting range   0 - 4	-	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

Name	Abbreviation	Description	Unit	Factory Setting						
activate SBC	-	For selecting SBC output operation. <table border="1" data-bbox="571 248 1155 394"> <thead> <tr> <th data-bbox="571 248 740 282">Option</th> <th data-bbox="740 248 1155 282">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="571 282 740 338">without SBC</td> <td data-bbox="740 282 1155 338">SBC outputs are not linked to SS1 operation.</td> </tr> <tr> <td data-bbox="571 338 740 394">with SBC</td> <td data-bbox="740 338 1155 394">SBC outputs are linked to SS1 operation.</td> </tr> </tbody> </table> ✓ Refer to Section 4.12 for more information on the SBC outputs.	Option	Description	without SBC	SBC outputs are not linked to SS1 operation.	with SBC	SBC outputs are linked to SS1 operation.	-	without SBC
Option	Description									
without SBC	SBC outputs are not linked to SS1 operation.									
with SBC	SBC outputs are linked to SS1 operation.									

※1: This parameter is for Safe Stop 1 with deceleration monitoring (SS1-r) only.

※2: Resolution follows the position command resolution of the servo drive.

## 4.4 Safe Stop2 (SS2)

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

### 4.4.1 Selecting Functions

This system supports two types of the Safe Stop2 functions.

- SS2-t: Safe Stop 2 with time monitoring (Safe stop 2 time controlled)  
The system starts the SOS function after a preset 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 set value or a preset time elapses.

The Safe Stop2 function should be selected by means of this parameter.

Name	Abbreviation	Description	Unit	Factory Setting	
monitoring type	-	For selecting the function of SS2.		-	SS1 with time monitoring (SS2-t)
		Option	Description		
		SS2 with time monitoring	time controlled (SS2-t)		
		SS2 with deceleration monitoring	ramp monitoring (SS2-r)		

### 4.4.2 Deceleration Method

For this system, the deceleration method can be selected after the Safe Stop2 function is activated.

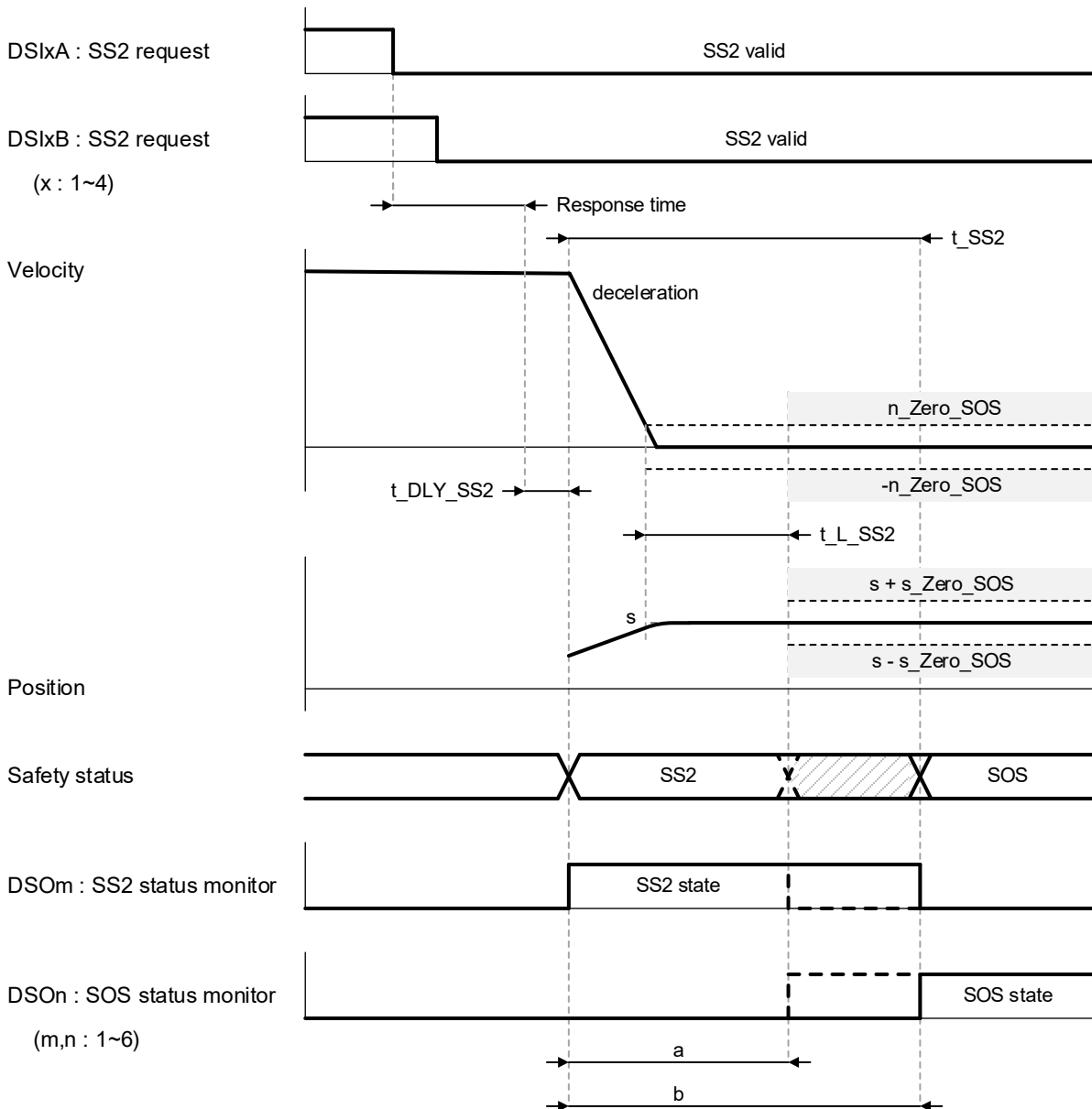
Name	Abbreviation	Description	Unit	Factory Setting	
deceleration method	-	For selecting the deceleration method.		-	by drive
		Option	Description		
		by drive	The servo drive automatically slows down.		
		by controller	The servo drive follows the commands from the controller.		

- ✓ If "by drive" is selected, position or velocity 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 to stop the position/speed command before the SOS function starts.  
When using Servo Drive in the position control, update the target position of the controller with the current position acquired from Servo Drive before restarting operation.
- ✓ If "by controller" is selected, decelerate so that the motor stops before the " t\_SS2" elapses.

### 4.4.3 I/O Type

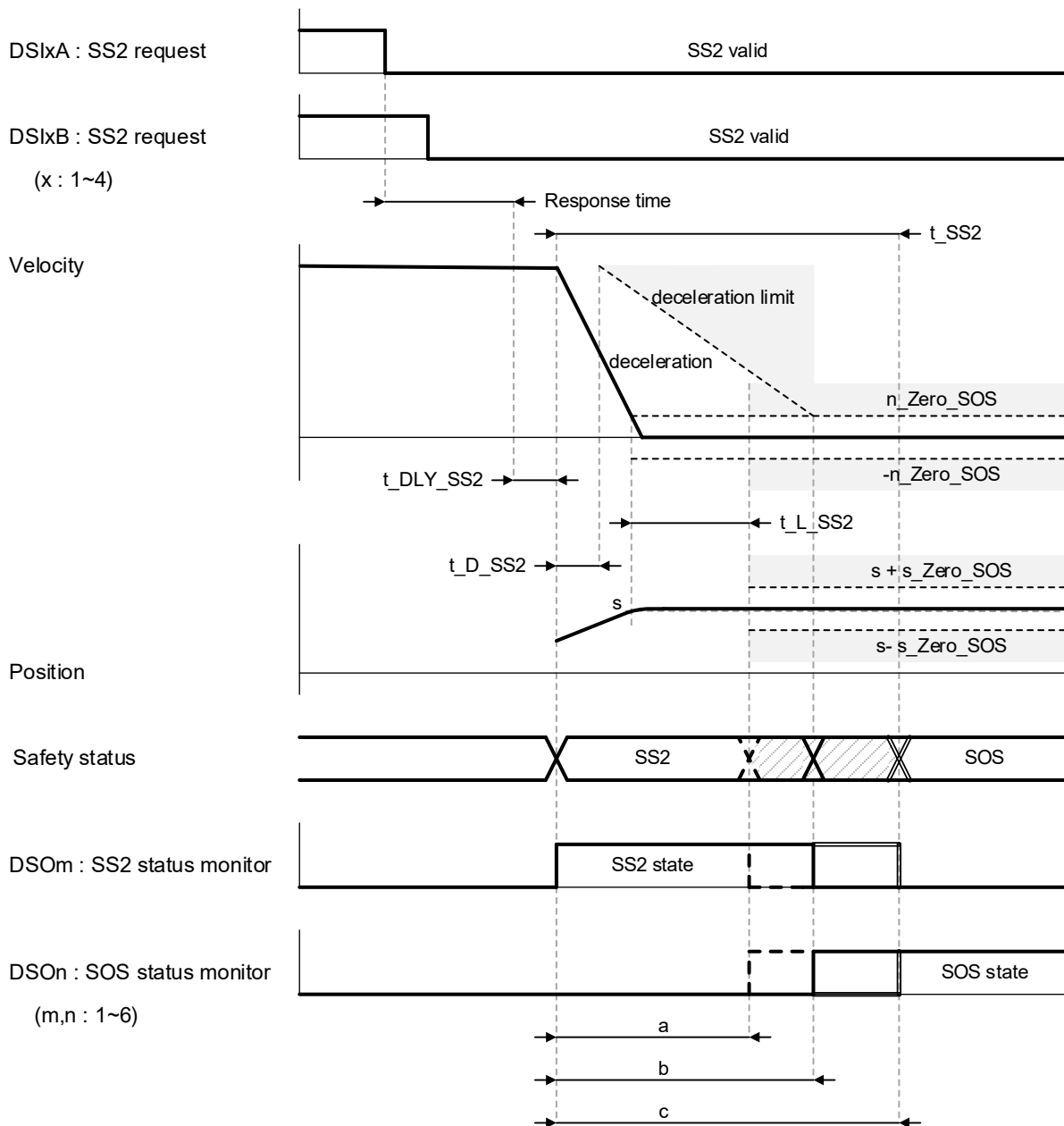
By turning off DS1xA / B, the system triggers the SS2 function, and then the system goes into the SS2 state (i.e., starts decelerating) after the response time plus  $t\_DLY\_SS2$  elapses. To deactivate the SOS state, turn on the ACK input after turning on the DS1xA / B. The method of deactivating the SS2 state can be selected by the SS2 parameter “restart acknowledge behavior”.

#### 4.4.3.1 Safe Stop 2 with time monitoring (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.
- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.
  - a : deceleration time +  $t\_L\_SS2$
  - b :  $t\_SS2$
- ✓ For more information on  $n\_Zero\_SOS$  and  $s\_Zero\_SOS$ , refer to Section 4.5.3.
- ✓ 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. It should not be used for safety-related applications.
- ✓ If the SS1 function is “enabled” while the SS2 function is running, the system will switch SS2 to SS1 operation (STO state) after the servo motor stops.

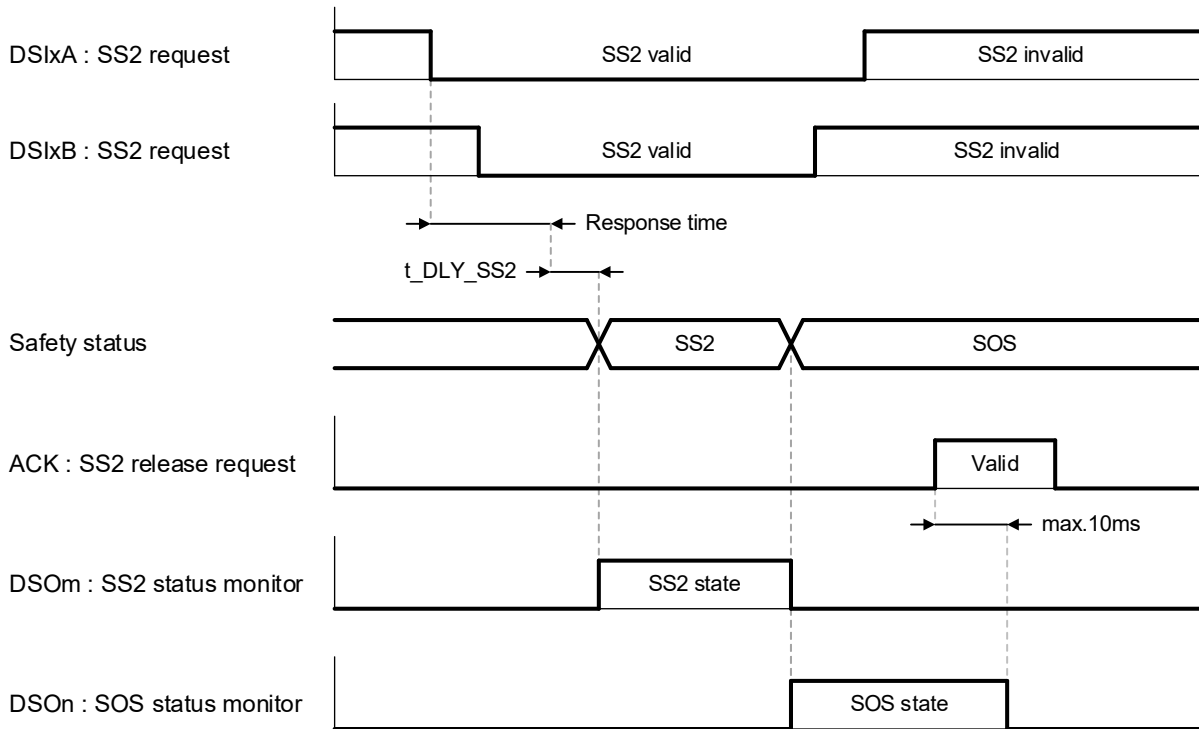
4.4.3.2 Safe Stop 2 with deceleration monitoring (SS2-r)



- ✓ 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.
- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the double line (==) in the timing chart.
  - a : deceleration time +  $t_{L\_SS2}$
  - b : 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 4.5.3.
- ✓ 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. It should not be used for safety-related applications.
- ✓ If the SS1 function is "enabled" while the SS2 function is running, the system will switch SS2 to SS1 operation (STO state) after the servo motor stops.

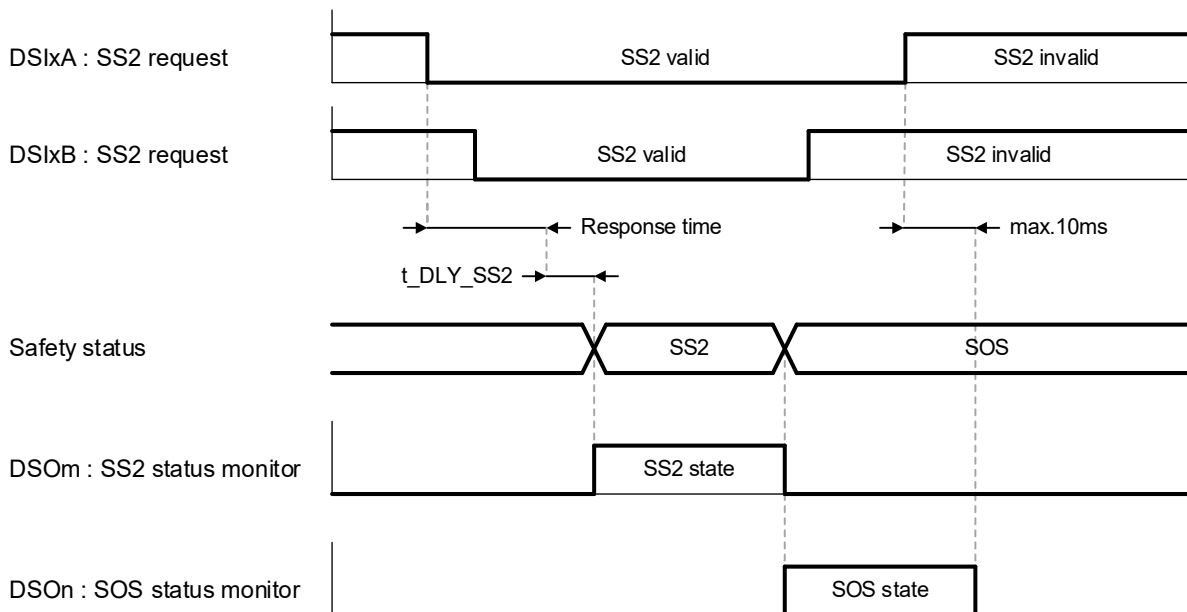
4.4.3.3 How to Deactivate

4.4.3.3.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK input should be enabled after the SS2 request is deactivated by DSIxA / B. For enabling the ACK input prior to deactivating the SS2 request, the system will not allow to deactivate the SOS state.

4.4.3.3.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)

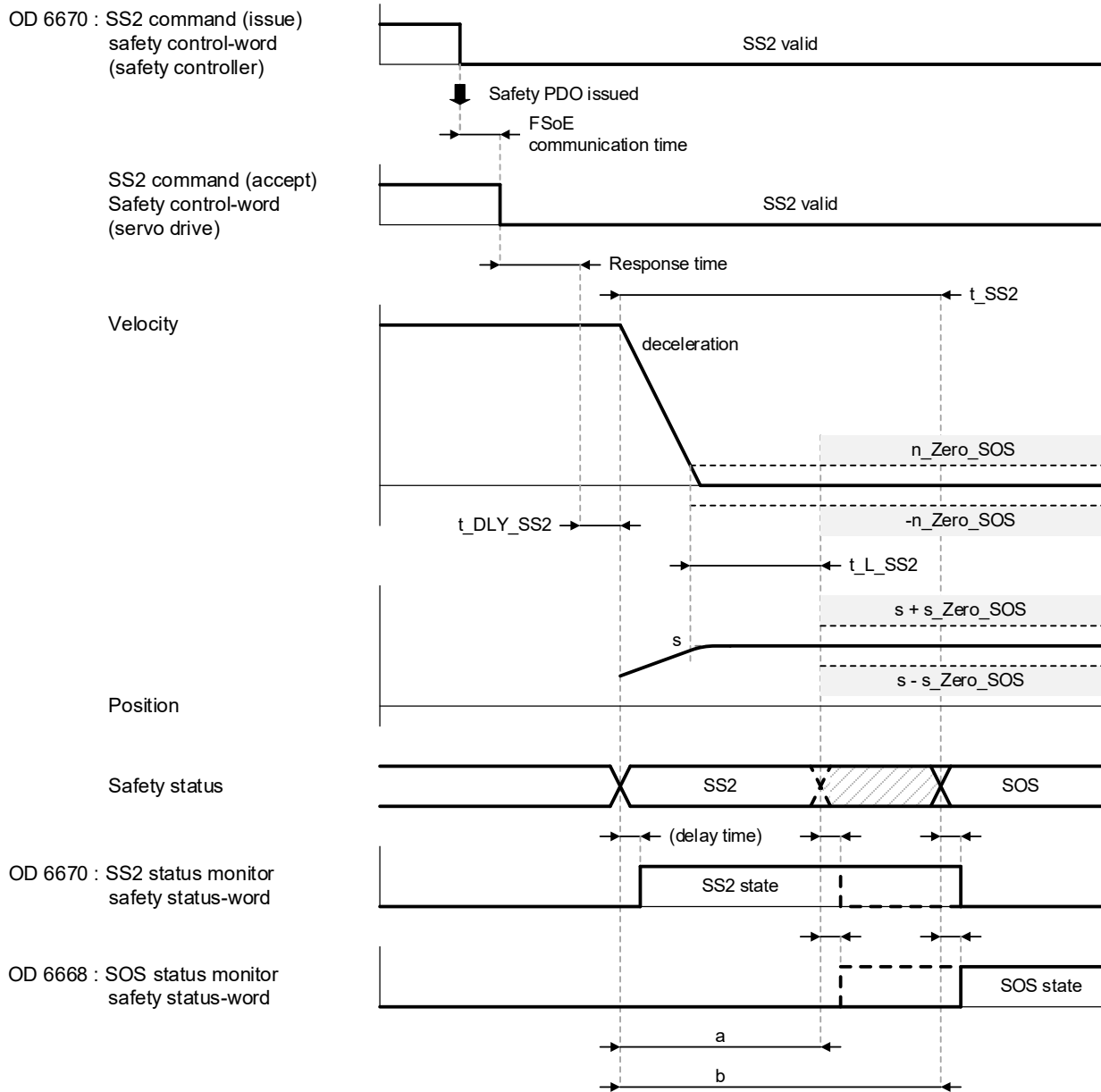


### 4.4.4 EtherCAT Communication (FSoE) Type

By setting the SS2 command assigned to the safety PDO to “0: SS2 enabled”, the system triggers the SS2 function and then the system goes into the SS2 state (i.e., starts decelerating) after the response time plus  $t\_DLY\_SS2$  elapses.

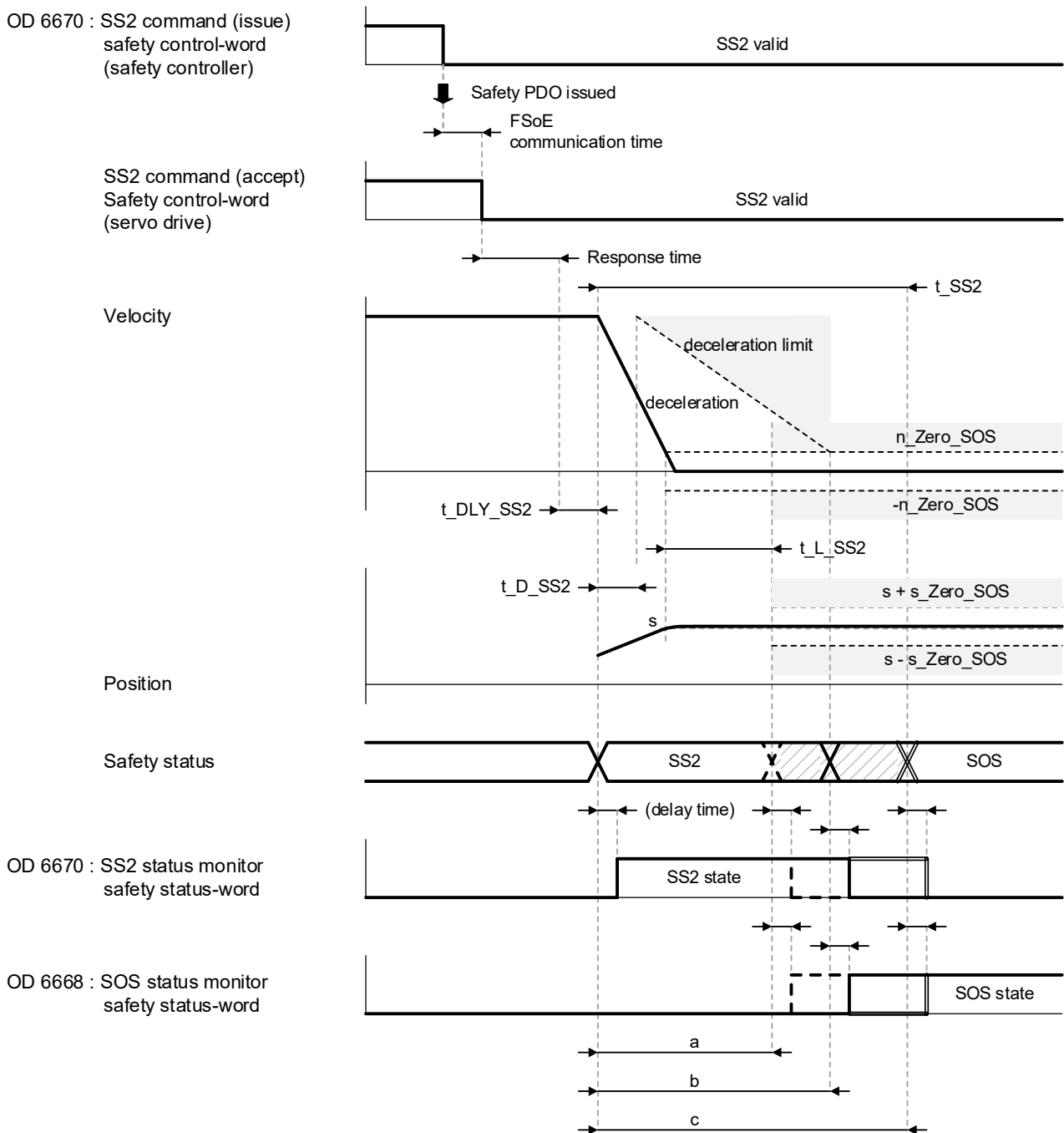
To deactivate the SOS state, change the SS2 command to “1: SS2 disabled” and the ACK command to “1: restart” together. The method of deactivating the SS2 state can be selected by the SS2 parameter “restart acknowledge behavior”.

#### 4.4.4.1 Safe Stop 2 with time monitoring (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.
- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.
  - a : deceleration time +  $t\_L\_SS2$
  - b :  $t\_SS2$
- ✓ For more information on  $n\_Zero\_SOS$  and  $s\_Zero\_SOS$ , refer to Section 4.5.3.
- ✓ If the SS1 function is “enabled” while the SS2 function is running, the system will switch SS2 to SS1 operation (STO state) after the servo motor stops.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

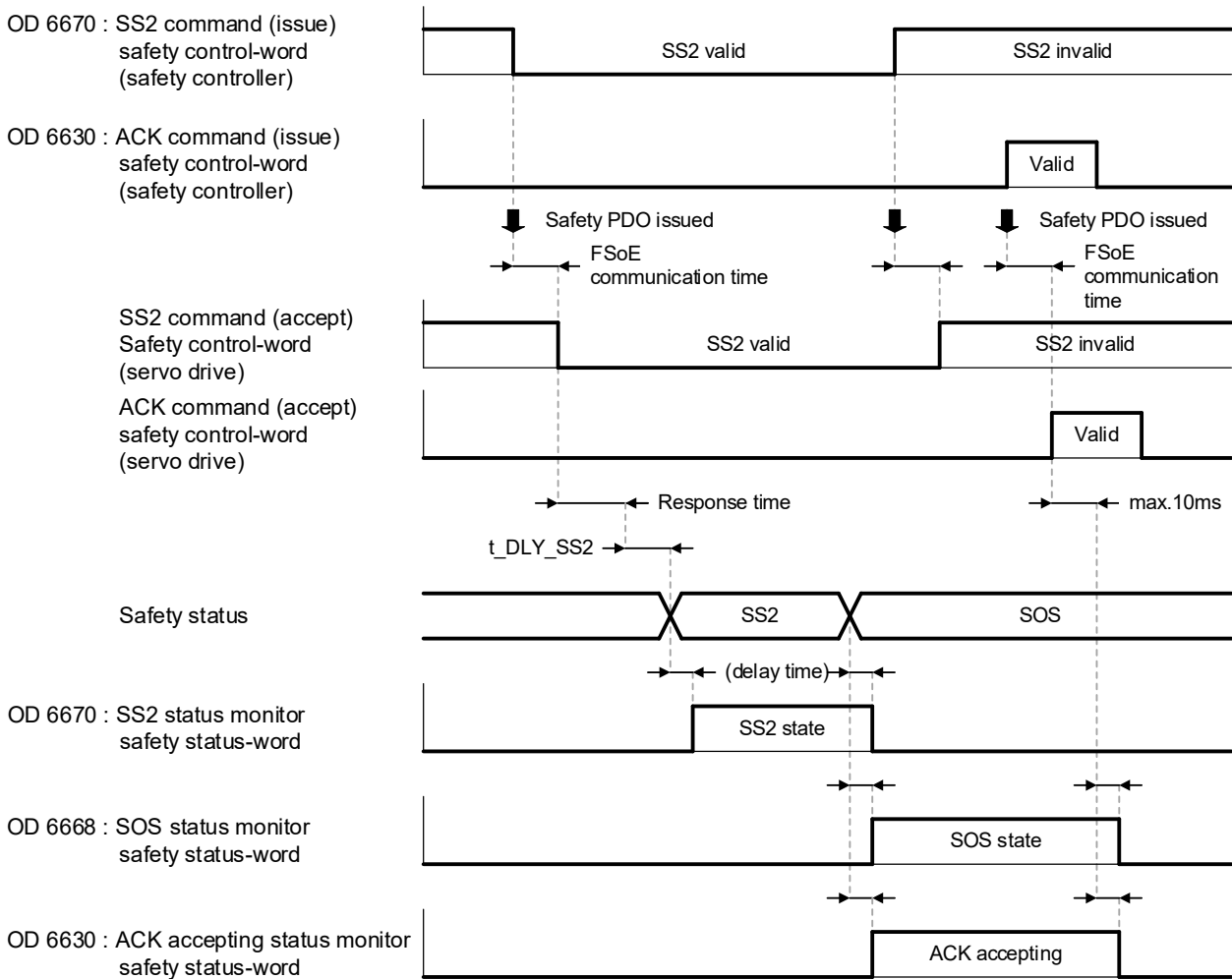
4.4.4.2 Safe Stop 2 with deceleration monitoring (SS2-r)



- ✓ 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.
- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the double line (==) in the timing chart.
  - a : deceleration time +  $t_{L\_SS2}$
  - b : 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 4.5.3.
- ✓ If the SS1 function is "enabled" while the SS2 function is running, the system will switch SS2 to SS1 operation (STO state) after the servo motor stops.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

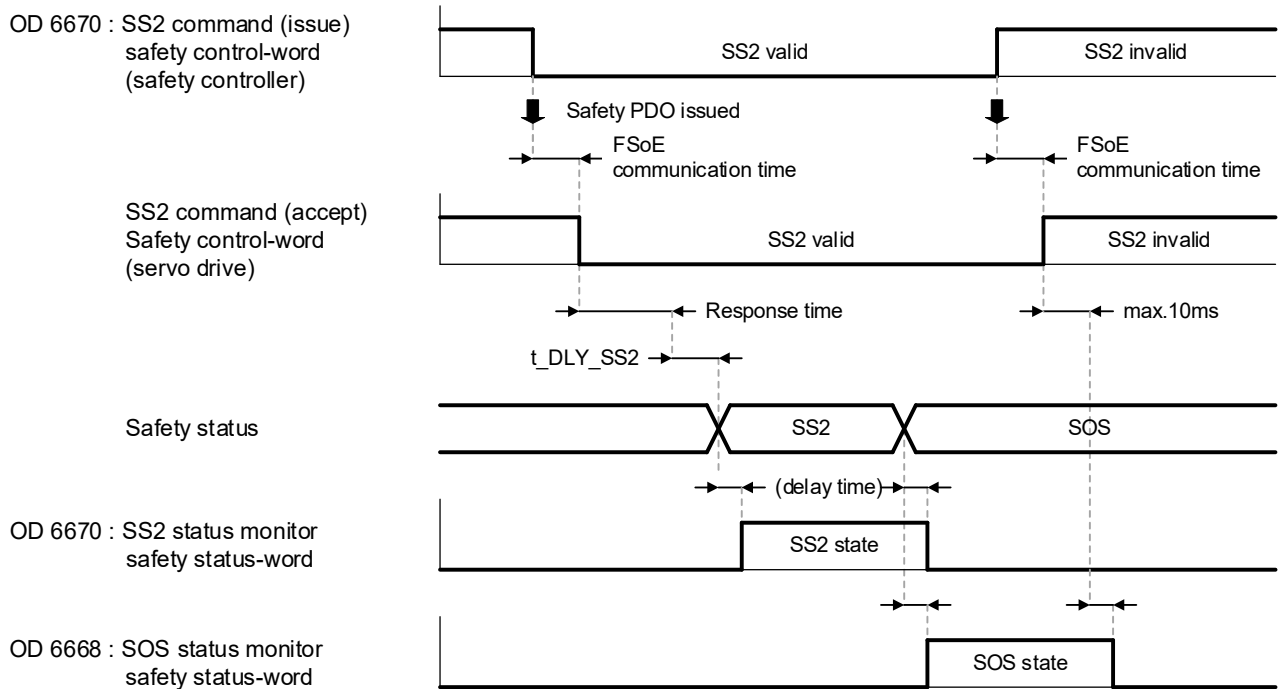
4.4.4.3 Deactivation Procedure

4.4.4.3.1 In case of “manual restart” (“restart acknowledge behavior” setpoint: 1 (default))



- ✓ The ACK command should be enabled after the SS2 request is deactivated by the SS2 command. For enabling the ACK command prior to deactivating the SS2 request, the system will not allow to deactivate the SOS state. (If the command and the request are given simultaneously, the SOS state is deactivated.)
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

4.4.4.3.2 In case of “automatic restart” (“restart acknowledge behavior” setpoint: 0)



- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.4.5 Parameters

Name	Abbreviation	Description	Unit	Factory 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* <sup>2</sup> <ul style="list-style-type: none"> <li>✓ The servo drive specifications limit the deceleration rate at approximately 46 rpm/s (76 mm/s<sup>2</sup>). Therefore, if the set value corresponds to less than the deceleration limit, the deceleration is limited to this value. A setpoint that corresponds to less than the deceleration limit is approximately less than 12,863,000 pulse/s<sup>2</sup> for rotary motors and approximately 19,000,000 pulse/s<sup>2</sup> for linear motors (with an encoder resolution of 4 nm).</li> <li>✓ The value of Deceleration can also be set using "Ramp time for deceleration" and "Ramp speed for deceleration". For detailed switching methods, refer to the Delta Drive Safety User Manual.</li> </ul>	pulse/s <sup>2</sup>	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* <sup>1</sup>	-	For setting the level of monitoring of the deceleration rate. Setting range 0 - 4294967295* <sup>2</sup> <ul style="list-style-type: none"> <li>✓ The value of Deceleration limit can also be set using "Ramp time for deceleration limit" and "Ramp speed for deceleration limit". For detailed switching methods, refer to the Delta Drive Safety User Manual.</li> </ul>	pulse/s <sup>2</sup>	0
deceleration scale factor* <sup>1</sup>	-	For setting coefficients to extend the deceleration and deceleration limit. They are extended by the following formula. $\text{Actual deceleration} = \frac{\text{deceleration setting value} \times 10^{\text{scale factor}}}{\text{Setting range}}$ Setting range 0 - 4	-	0
time delay deceleration monitoring* <sup>1</sup>	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

Name	Abbreviation	Description	Unit	Factory Setting	
restart acknowledge behavior	-	For selecting the method to deactivate the SS2 state.	-	manual restart	
		Option			Description
		automatic restart			When the SS2 request is deactivated, the SOS state is automatically activated.
manual restart	After the SS2 request is deactivated, turn on the ACK input (changing the ACK command to 1) to deactivate the SOS state.				
error reaction	-	For selecting action to take at the time when abnormality is detected.	-	STO	
		Option			Description
		STO			Starts STO operation.
		SS1			Starts SS1 operation.

※1: This parameter is for Safe Stop 2 with deceleration monitoring (SS2-r) only.

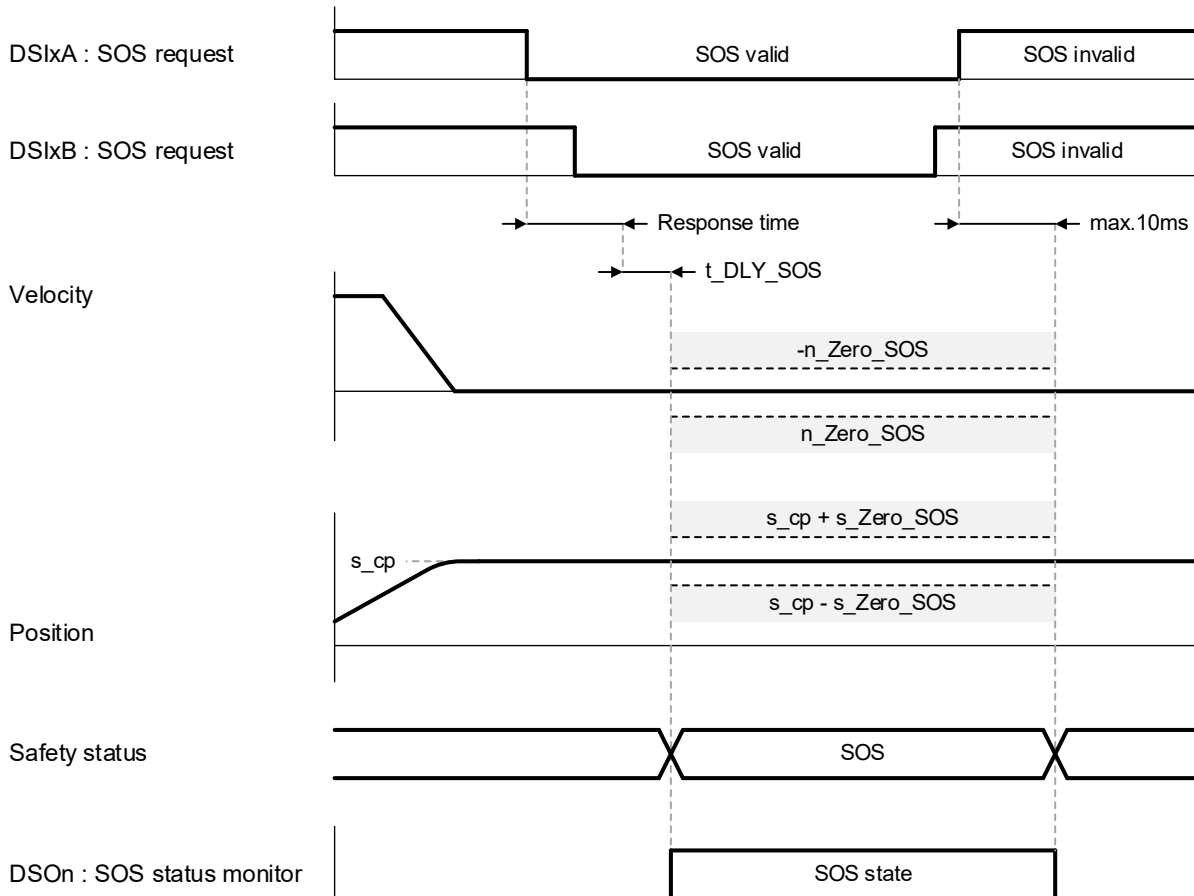
※2: Resolution follows the position command resolution of the servo drive.

### 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 the EtherCAT communication (FSoE).

#### 4.5.1 I/O Type

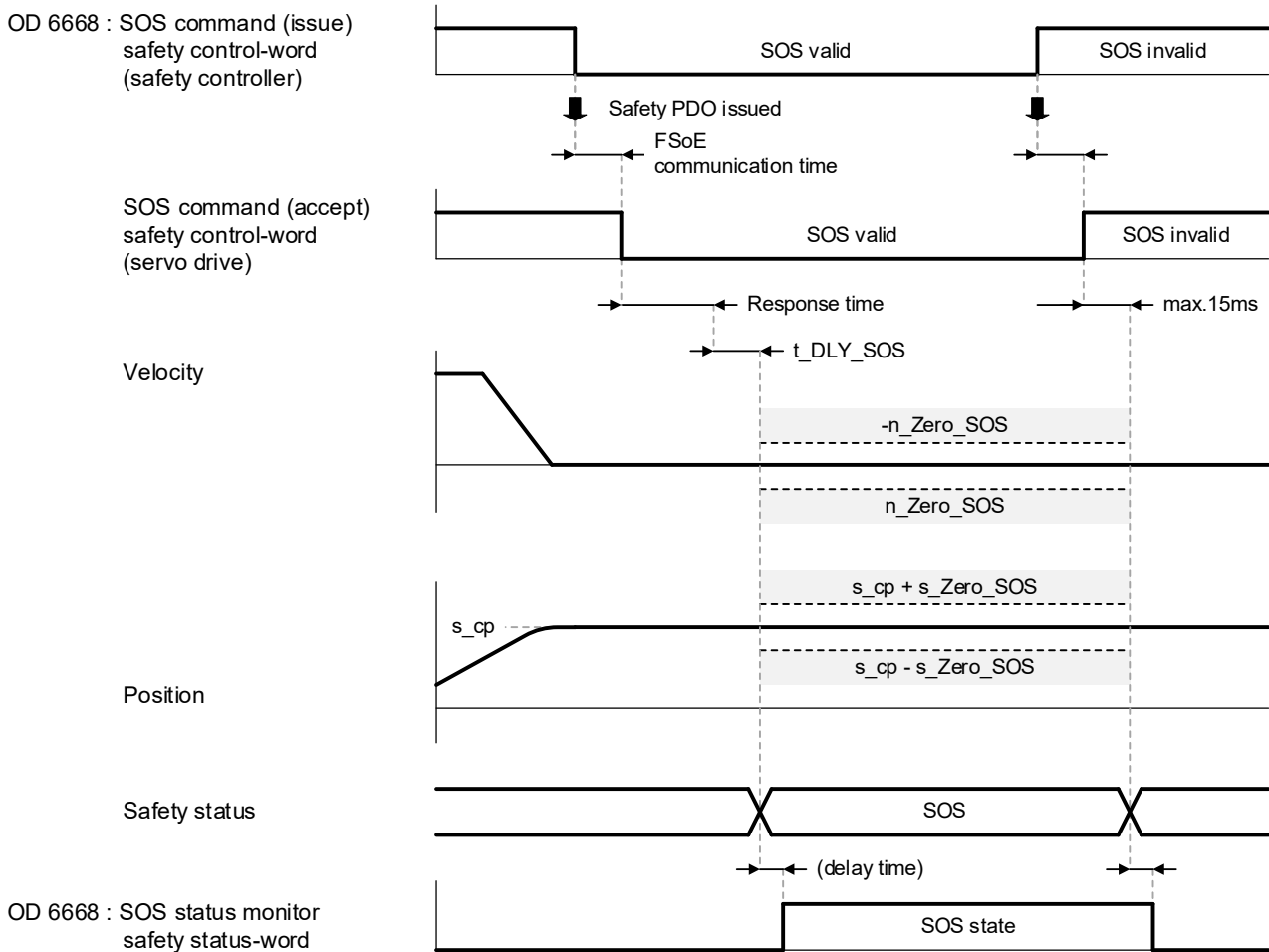
By turning off DSIxA / B, the system triggers the SOS function, and then the system starts monitoring the position of the position of the moving part of the equipment and speed of the servo motor after the response time plus  $t_{DLY\_SOS}$  elapses. Monitoring is performed using the relative position to the start position monitored ( $s_{cp}$  in the figure below).



- ✓ If the SOS function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts shift to the expected 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. It 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 enabled”, the system triggers the SOS function, 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 figure below).



- ✓ If the SOS function starts while the servo motor is in motion, an abnormality may be detected before the moving parts shift to the expected position.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.5.3 Parameters

Name	Abbreviation	Description	Unit	Factory 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 (rotary) mm/s (linear)	0
position scale factor		For setting coefficients to extend the position zero window. The position zero monitoring width is extended by the following formula. $\text{position zero monitoring width} = \frac{\text{position zero window} \times 10^{\text{scale factor}}}{\text{Setting range}}$ Setting range   0 - 4	-	0

※1: 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 the EtherCAT communication (FSOE).

### 4.6.1 Selecting Functions

This system supports two types of the Safely-Limited Speed functions.

- SLS : Safely-Limited Speed with time monitoring  
The system starts the speed monitoring after a preset time has elapsed since the acceptance of the SLS request.
- SLS-r : Safely-Limited Speed with deceleration monitoring  
When the SLS request is accepted, the system monitors the deceleration rate of the servo motor and starts the speed monitoring when the speed falls below a set value or a preset time elapses.

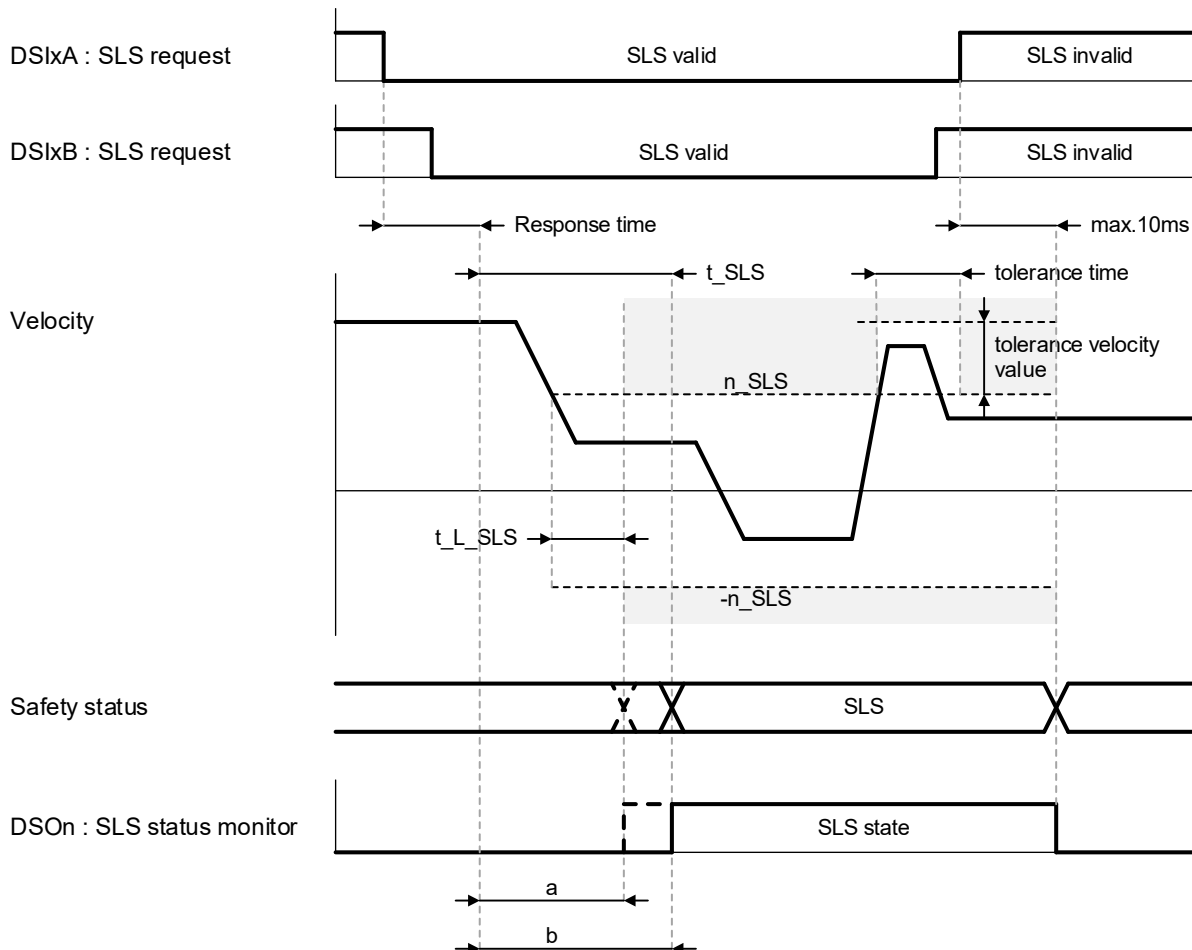
The Safely-Limited Speed function should be selected by means of this parameter.

Name	Abbreviation	Description	Unit	Factory Setting	
monitoring type	-	For selecting the function of SLS.		-	SLS with time monitoring (SLS)
		Option	Description		
		SLS with time monitoring	time controlled (SLS)		
		SLS with deceleration monitoring	ramp monitoring (SLS-r)		

### 4.6.2 I/O Type

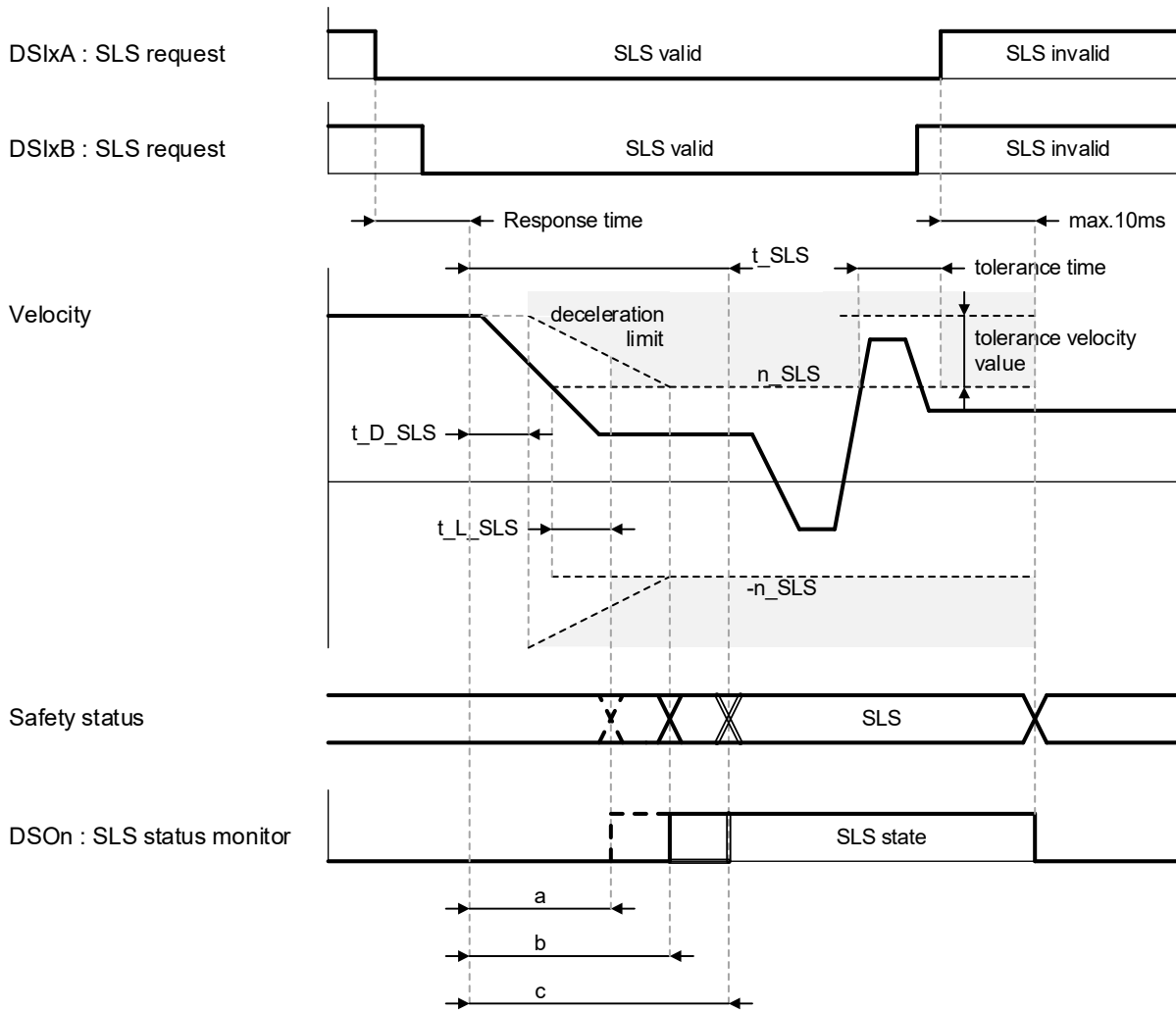
By turning off DS1xA / B, the system triggers the SLS function, and then the system starts monitoring the speed of the servo motor after the response time plus  $t_{SLS}$  elapses or after the speed reaches the monitoring level and  $t_{L\_SLS}$  elapses.

#### 4.6.2.1 Safely-Limited Speed with time monitoring (SLS)



- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.  
 $a$  : Velocity  $\leq$  Time to  $n_{SLS}$  +  $t_{L\_SLS}$   
 $b$  :  $t_{SLS}$
- ✓ Even if the velocity is higher than  $n_{SLS}$ , the alarm will not be detected until the velocity actually exceeds the "tolerance velocity value" during the "tolerance time". (It is invalid if "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. It should not be used for safety-related applications.

4.6.2.2 Safely-Limited Speed with deceleration monitoring (SLS-r)

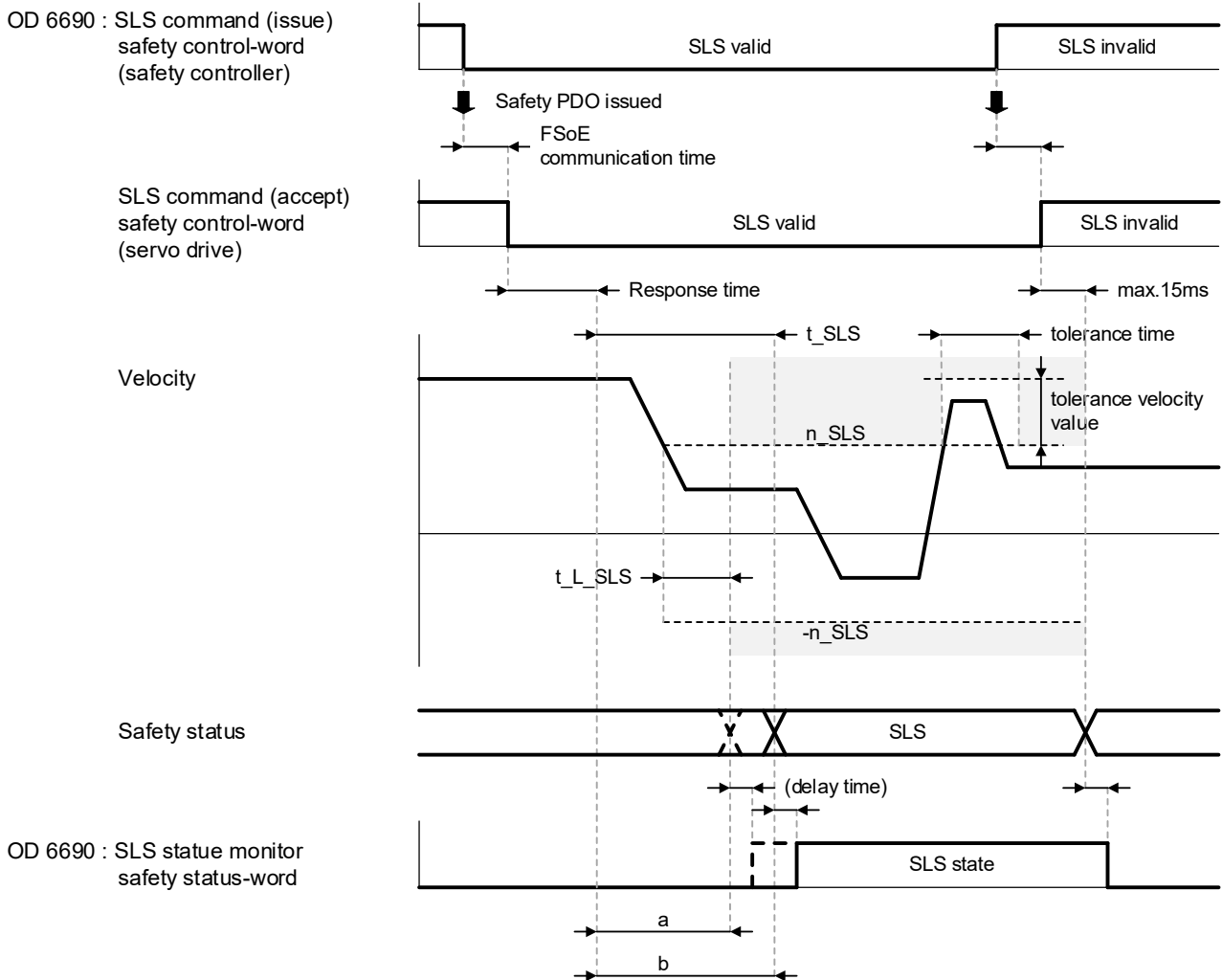


- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the solid line (==) in the timing chart.
  - a : Velocity  $\leq$  Time to  $n\_SLS$  +  $t\_L\_SLS$
  - b : Time taken for " $t\_D\_SLS$  + deceleration limit" to reach  $n\_SLS$
  - c :  $t\_SLS$
- ✓ Even if the velocity is higher than  $n\_SLS$ , the alarm will not be detected until the velocity actually exceeds the "tolerance velocity value" during the "tolerance time". (It is invalid if "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. It should not be used for safety-related applications.

### 4.6.3 EtherCAT Communication (FSoE) Type

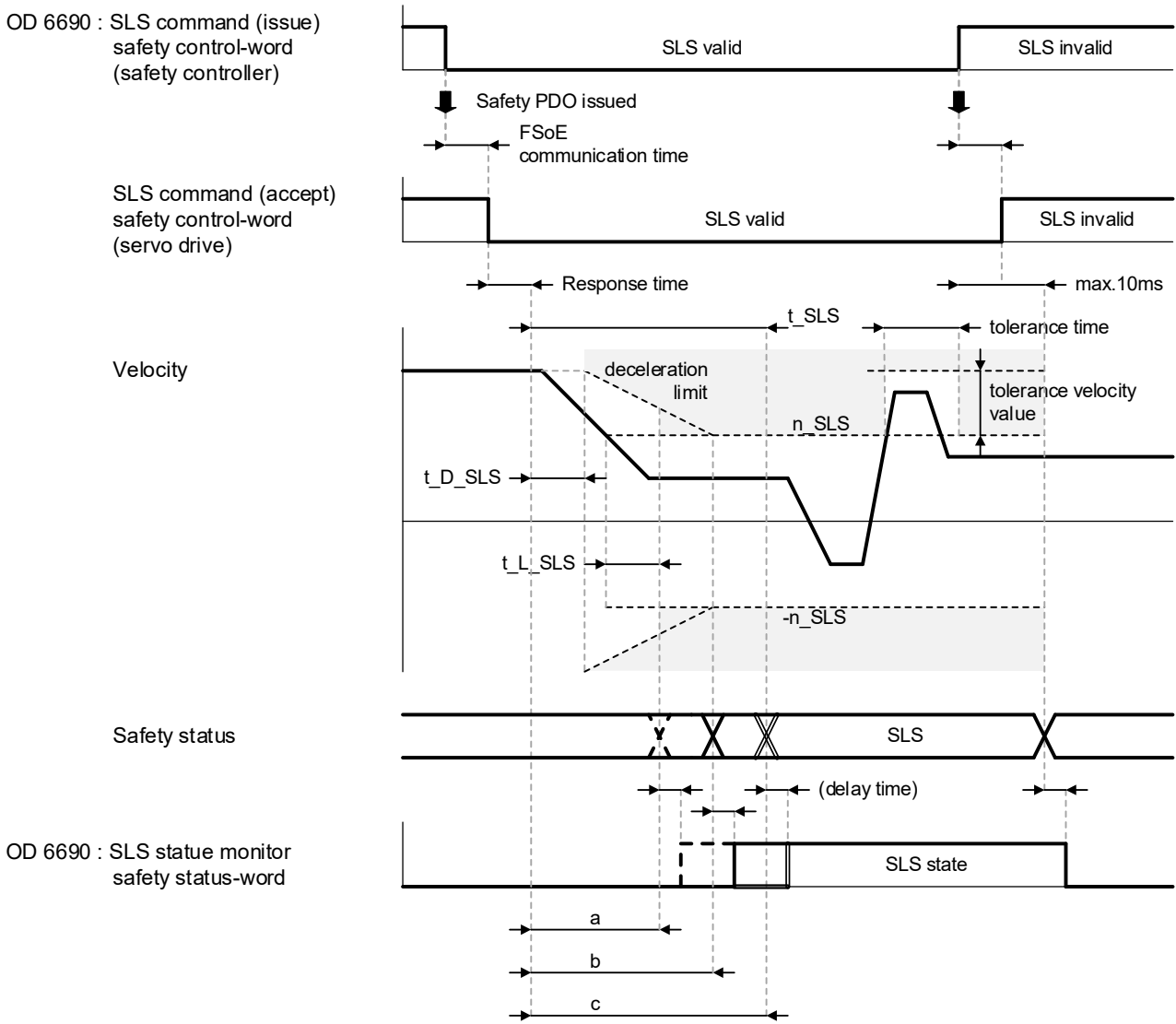
By setting the SLS command assigned to safety PDO to “0: SLS enabled”, the system triggers the SLS function, and then the system starts monitoring the speed of the servo motor after the response time plus  $t\_SLS$  elapses or after the speed reaches the monitoring level and  $t\_L\_SLS$  elapses.

#### 4.6.3.1 Safely-Limited Speed with time monitoring (SLS)



- ✓ If the relationship  $a \leq b$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a$  holds, the state is indicated as the solid line (—) in the timing chart.  
 $a$  : Velocity  $\leq$  Time to  $n\_SLS$  +  $t\_L\_SLS$   
 $b$  :  $t\_SLS$
- ✓ Even if the velocity is higher than  $n\_SLS$ , the alarm will not be detected until the velocity actually exceeds the “tolerance of velocity” during the “tolerance time”. (It is invalid if “tolerance velocity value” or “tolerance time” is set to 0.)
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

4.6.3.2 Safely-Limited Speed with deceleration monitoring (SLS-r)



- ✓ If the relationship  $a \leq b, c$  holds, the state is indicated as the dotted line (---) in the timing chart. If the relationship  $b < a, c$  holds, the state is indicated as the solid line (—) in the timing chart. If the relationship  $c < a, b$  holds, the state is indicated as the solid line (≡) in the timing chart.
  - a :  $\text{Velocity} \leq \text{Time to } n_{\text{SLS}} + t_{\text{L\_SLS}}$
  - b : Time taken for “ $t_{\text{D\_SLS}} + \text{deceleration limit}$ ” to reach  $n_{\text{SLS}}$
  - c :  $t_{\text{SLS}}$
- ✓ Even if the velocity is higher than  $n_{\text{SLS}}$ , the alarm will not be detected until the velocity actually exceeds the “tolerance velocity value” during the “tolerance time”. (It is invalid if “tolerance velocity value” or “tolerance time” is set to 0.)
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.6.4 Parameters

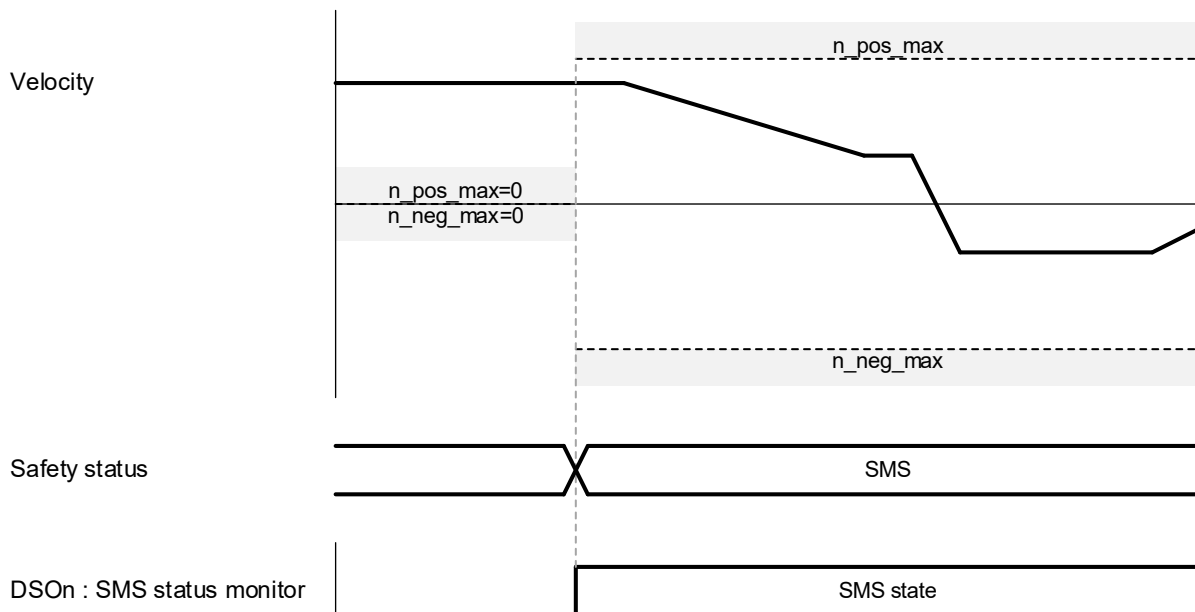
Name	Abbreviation	Description	Unit	Factory Setting						
velocity limit	n_SLS	For setting the level of monitoring of the speed. Setting range   0 - 4294967295	rpm (rotary) mm/s (linear)	0						
time to velocity monitoring	t_SLS	For setting the duration from the end of the response time to the time when 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 (rotary) mm/s (linear)	0						
deceleration limit <sup>※1</sup>	-	For setting the level of monitoring of the deceleration rate. Setting range   0 - 4294967295 <sup>※2</sup> ✓ The value of Deceleration limit can also be set using "Ramp time for deceleration limit" and "Ramp speed for deceleration limit". For detailed switching methods, refer to the Delta Drive Safety User Manual.	pulse/s <sup>2</sup>	0						
time delay deceleration monitoring <sup>※1</sup>	t_D_SLS	For setting the duration from the time when the SLS function is enabled to the time when the system starts monitoring the deceleration rate. Setting range   0 - 65535	ms	0						
deceleration scale factor <sup>※1</sup>	-	For setting coefficients to extend the deceleration limit. They are extended by the following formula. $deceleration\ limit = deceleration\ limi\ setting\ value \times 10^{scale\ factor}$ Setting range   0 - 4	-	0						
error reaction	-	For selecting action to take at the time when abnormality is detected. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>STO</td> <td>Starts STO operation.</td> </tr> <tr> <td>SS1</td> <td>Starts SS1 operation.</td> </tr> </tbody> </table>	Option	Description	STO	Starts STO operation.	SS1	Starts SS1 operation.	-	STO
Option	Description									
STO	Starts STO operation.									
SS1	Starts SS1 operation.									

※1: This parameter is for Safely-limited Speed with deceleration monitoring (SLS-r) only.

※2: Resolution follows the position command resolution of the servo drive.

### 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. It should not be used for safety-related applications.

#### 4.7.1 Parameters

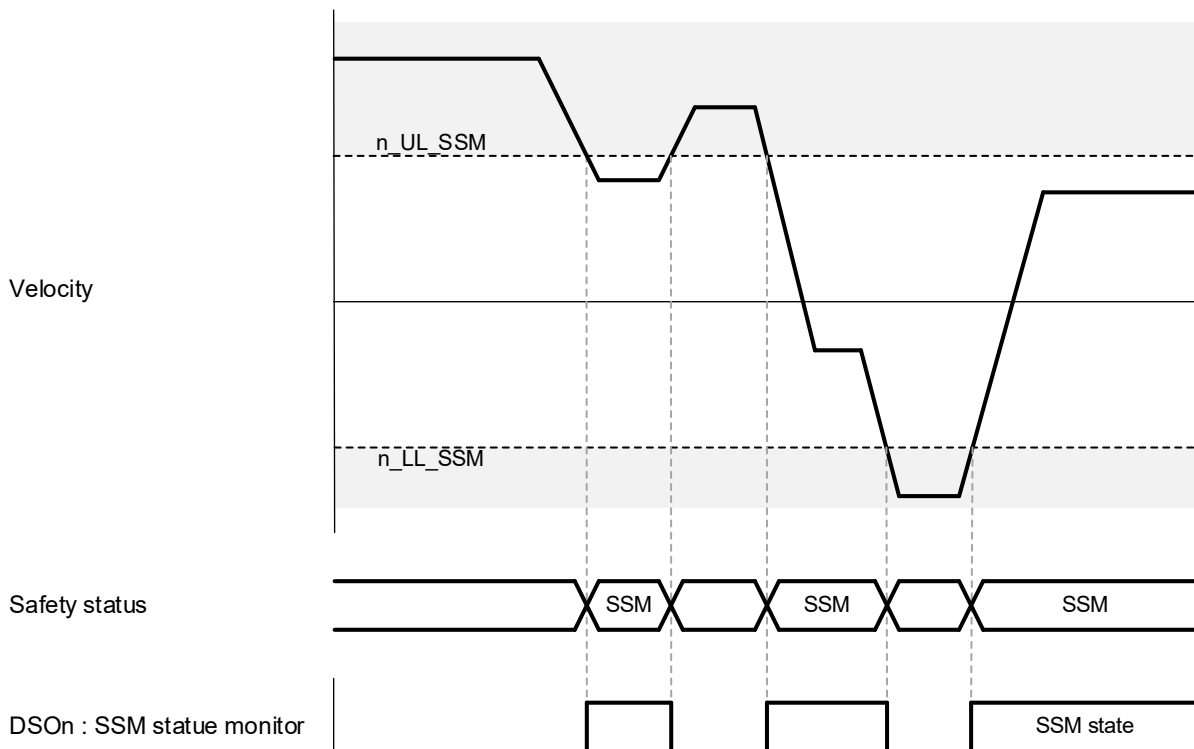
Name	Abbreviation	Description	Unit	Factory Setting
velocity maximum positive	n_pos_max	For setting the level of monitoring of the positive velocity. Setting range   -2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0
velocity maximum negative	n_neg_max	For setting the level of monitoring of the negative velocity. Setting range   -2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0
error reaction	-	For selecting action to take at the time when abnormality is detected. Option   Description STO   Starts STO operation. 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.

### 4.8.1 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

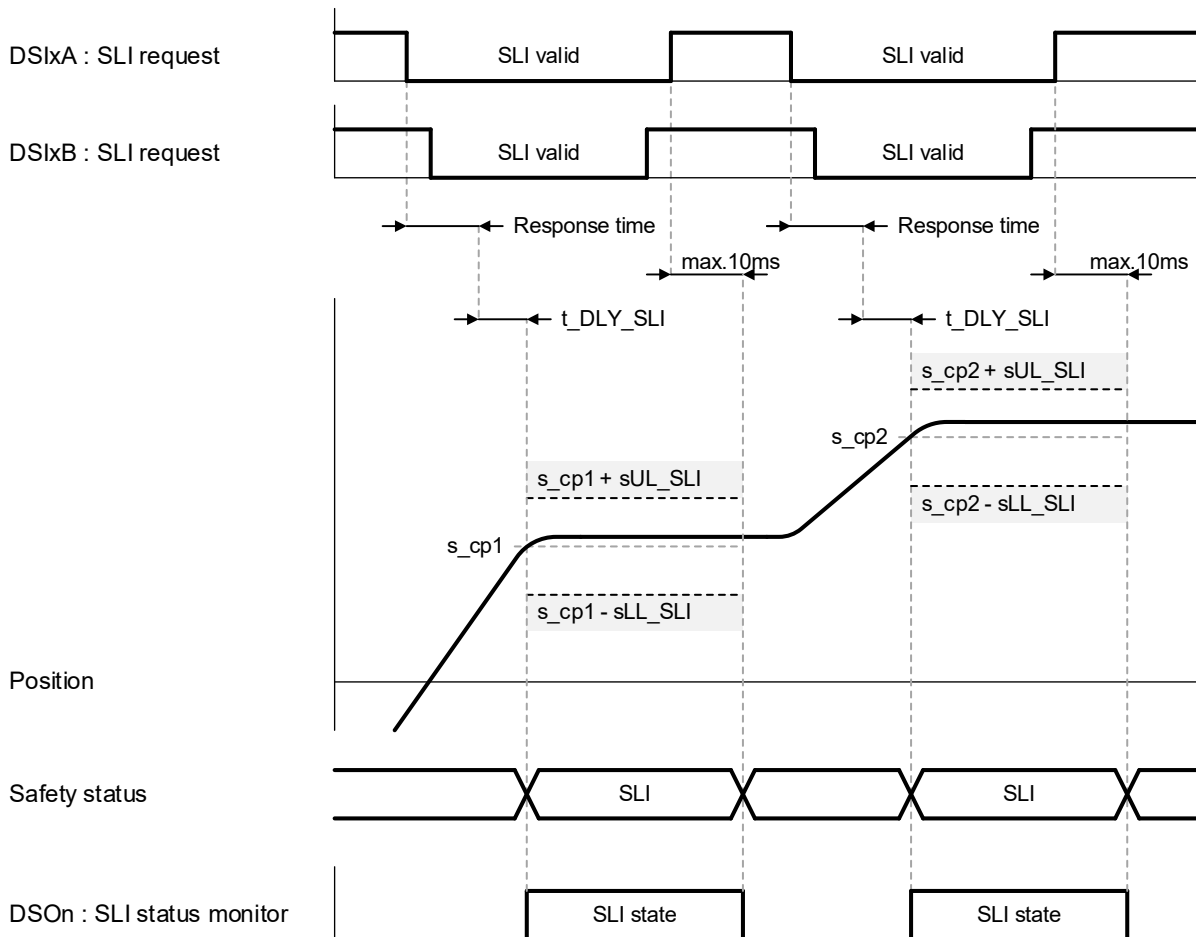
Name	Abbreviation	Description	Unit	Factory Setting
velocity upper limit	n_UL_SSM	For setting the upper limit of the velocity monitoring level Setting range   -2147483648 - 2147483647	rpm (rotary) mm/s (linear)	0
velocity lower limit	n_LL_SSM	For setting the lower limit of the velocity monitoring level Setting range   -2147483648 - 2147483647	rpm (rotary) mm/s (linear)	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 the EtherCAT communication (FSOE).

### 4.9.1 I/O Type

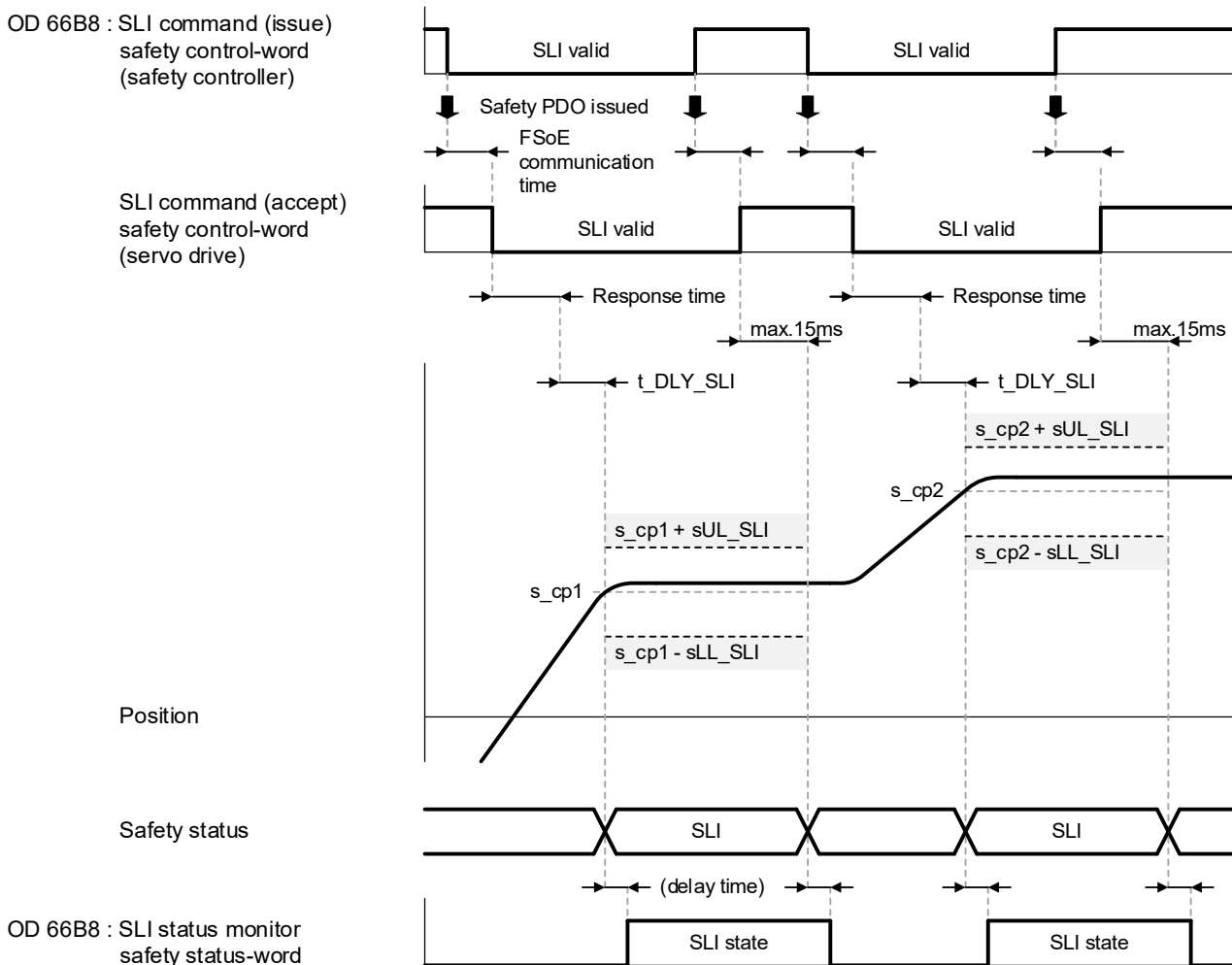
By turning off DSIxA / B, the system triggers the SLI function, and then the system starts monitoring the position of the moving part of the equipment after the response time plus  $t_{DLY\_SLI}$  elapses. Monitoring is performed using the relative position to the start position monitored ( $s_{cp1}$  and 2 in the figure below).



- ✓ If the SLI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts shift to the expected 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. It 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 enabled”, the system triggers the SLI function, 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 2 in the figure below).



- ✓ If the SLI function starts while the moving part of the equipment are in motion, an abnormality may be detected before the moving parts shift to the expected position.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.9.3 Parameters

Name	Abbreviation	Description	Unit	Factory 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	sUL_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	sLL_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 action to take at the time when abnormality is detected. <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>STO</td> <td>Starts STO operation.</td> </tr> <tr> <td>SS1</td> <td>Starts SS1 operation.</td> </tr> </tbody> </table>	Option	Description	STO	Starts STO operation.	SS1	Starts SS1 operation.	-	STO
Option	Description									
STO	Starts STO operation.									
SS1	Starts SS1 operation.									
position scale factor		For setting coefficients to extend the position relative upper/lower limit. The position relative limit is extended by the following formula. $position\ limit = position\ relative\ upper/lower\ limit \times 10^{scale\ factor}$ Setting range   0 - 4	-	0						

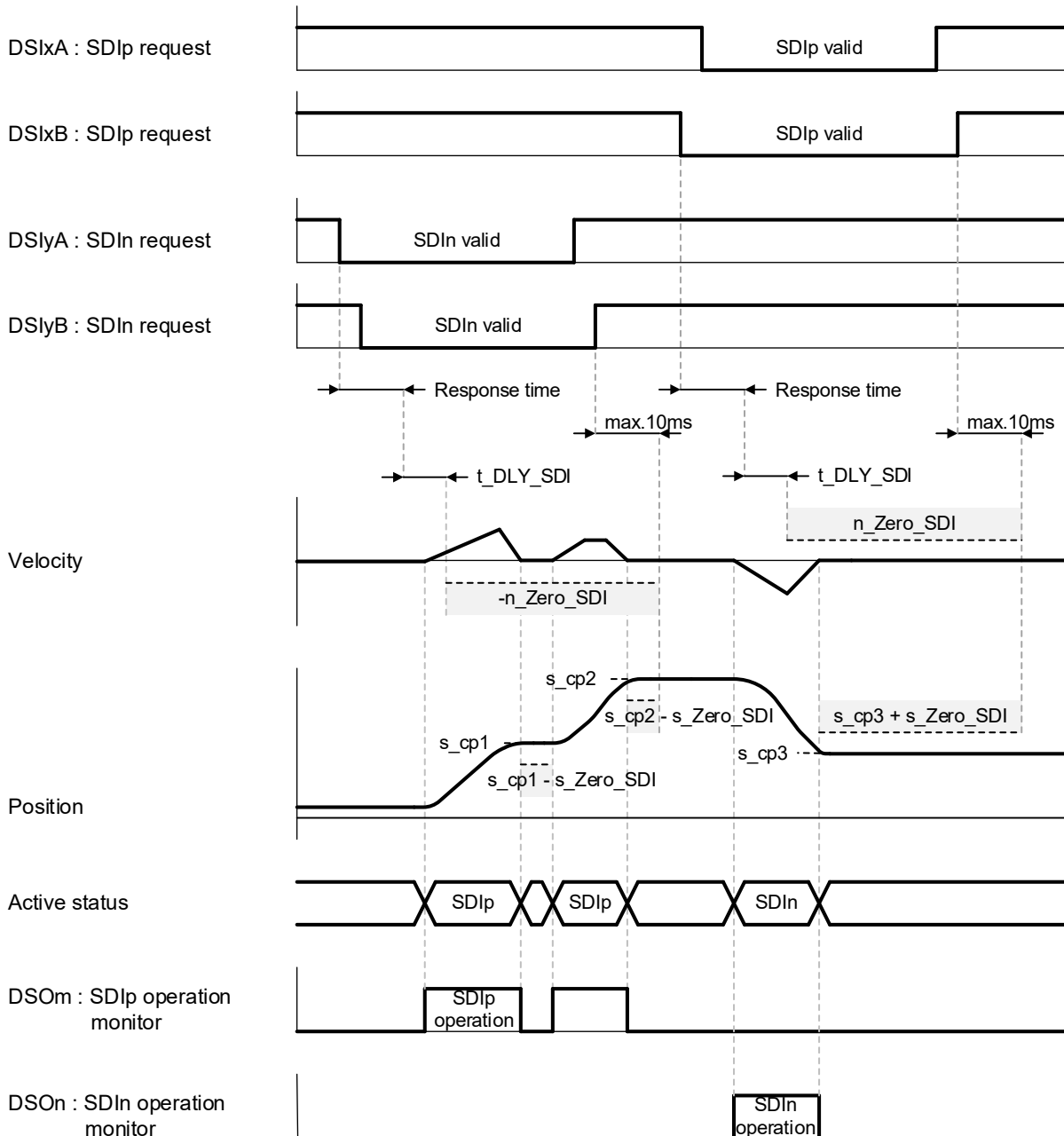
※1: Resolution follows the position command resolution of the servo drive.

### 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 the EtherCAT communication (FSOE).

#### 4.10.1 I/O Type

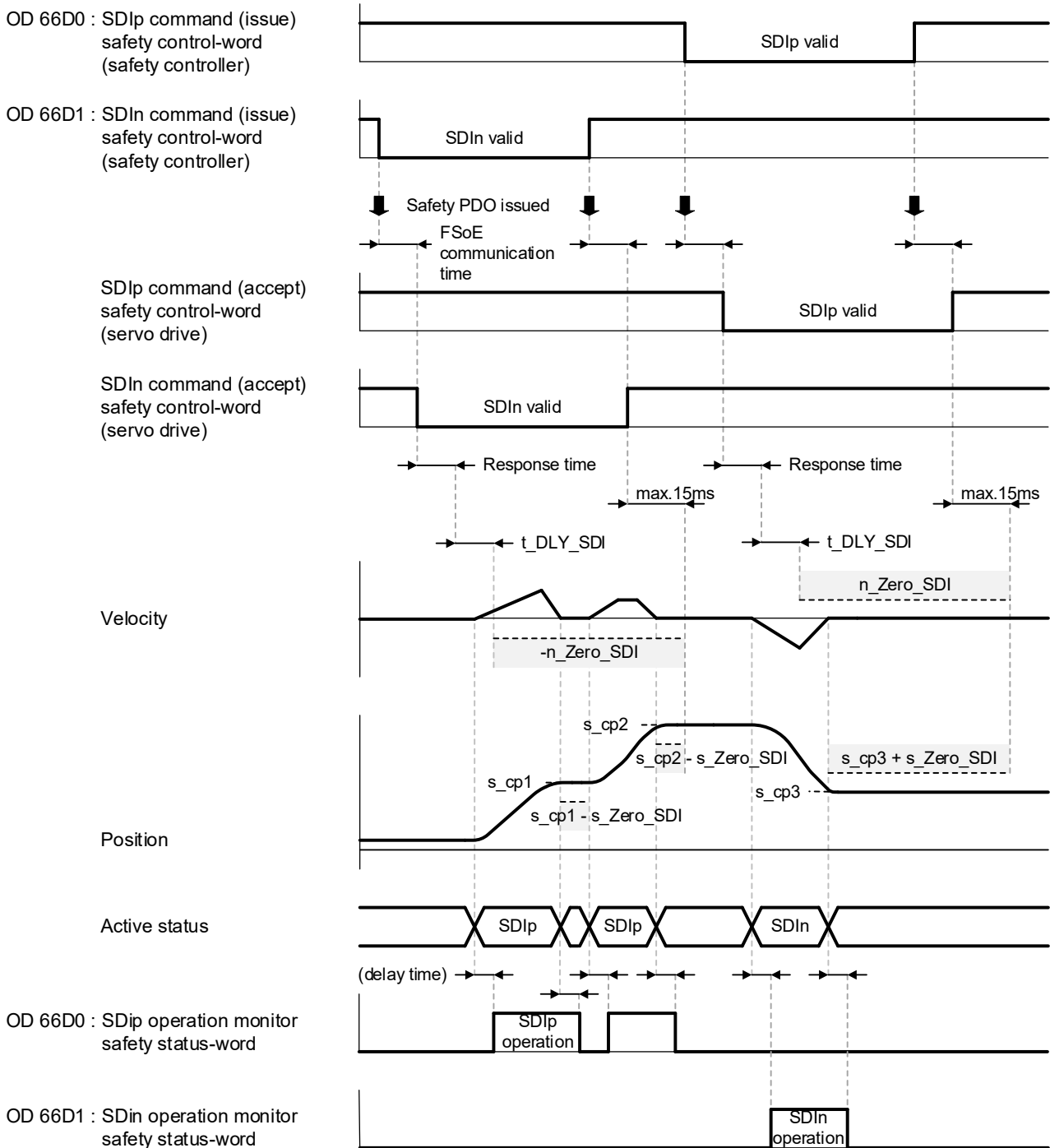
By turning off DSIxA / B, the system triggers the SDI function, and then the system starts monitoring the position of the moving parts of the equipment and speed of the servo motor after the response time plus  $t_{DLY\_SDI}$  elapses. Monitoring is performed using the relative position to the start position monitored ( $s_{cp1} - 3$  in the figure below).



- ✓ If the SDI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts shift to the expected 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. They should not be used for safety-related applications.

### 4.10.2 EtherCAT Communication (FSoE) Type

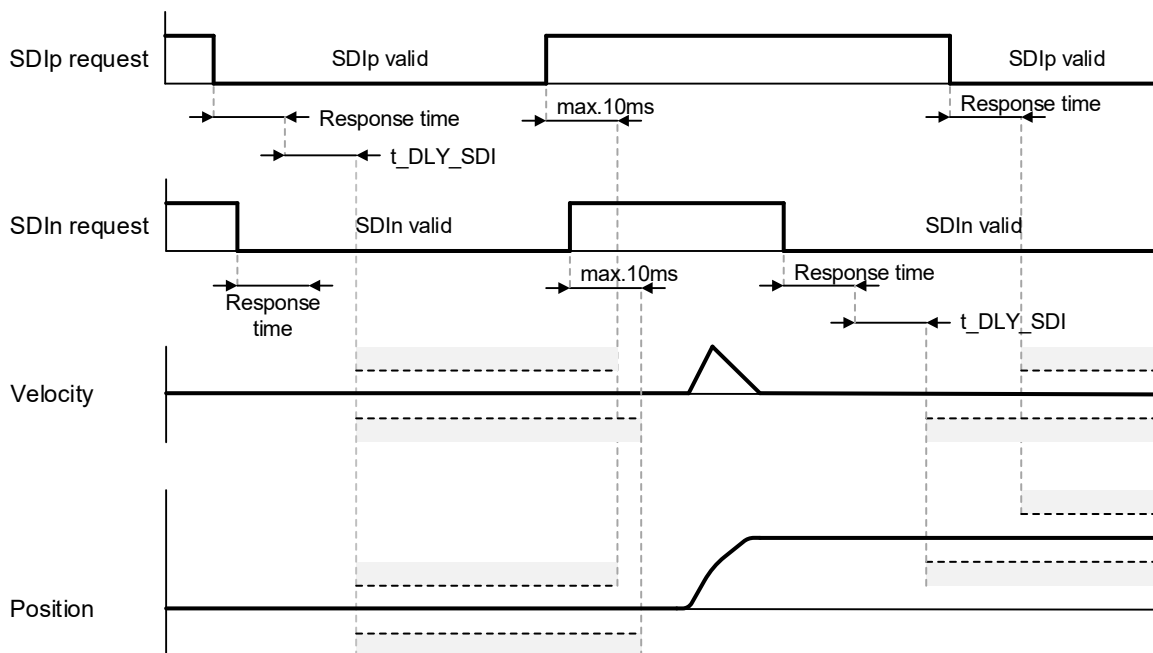
By setting the SDIp or SDIn commands assigned to the safety PDO to “0: SDI enabled”, the system triggers the SDI function, and then the system starts monitoring the position and speed of the moving parts of the equipment (or the servo motor) after the response time plus  $t\_DLY\_SDI$  elapses. Monitoring is performed using the relative position to the start position monitored ( $s\_cp1 - 3$  in the figure below).



- ✓ If the SDI function starts while the moving part of the equipment is in motion, an abnormality may be detected before the moving parts shift to the expected position.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

### 4.10.3 Notes

The SDI function normally starts monitoring after the response time plus  $t\_DLY\_SDI$  elapses after enabling it, but if one is enabled while the other is enabled, it will start monitoring without waiting for  $t\_DLY\_SDI$ .



### 4.10.4 Parameters

Name	Abbreviation	Description	Unit	Factory 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 <sup>※1</sup>	pulse	0
velocity zero window	$n\_Zero\_SDI$	For setting the level of monitoring of the speed. Setting range 0 - 4294967295	rpm (rotary) mm/s (linear)	0
position scale factor		For setting coefficients to extend the position zero window. The position zero monitoring range is extended by the following formula. $position\ zero\ monitoring\ range = position\ zero\ window \times 10^{scale\ factor}$ Setting range 0 - 4	-	0

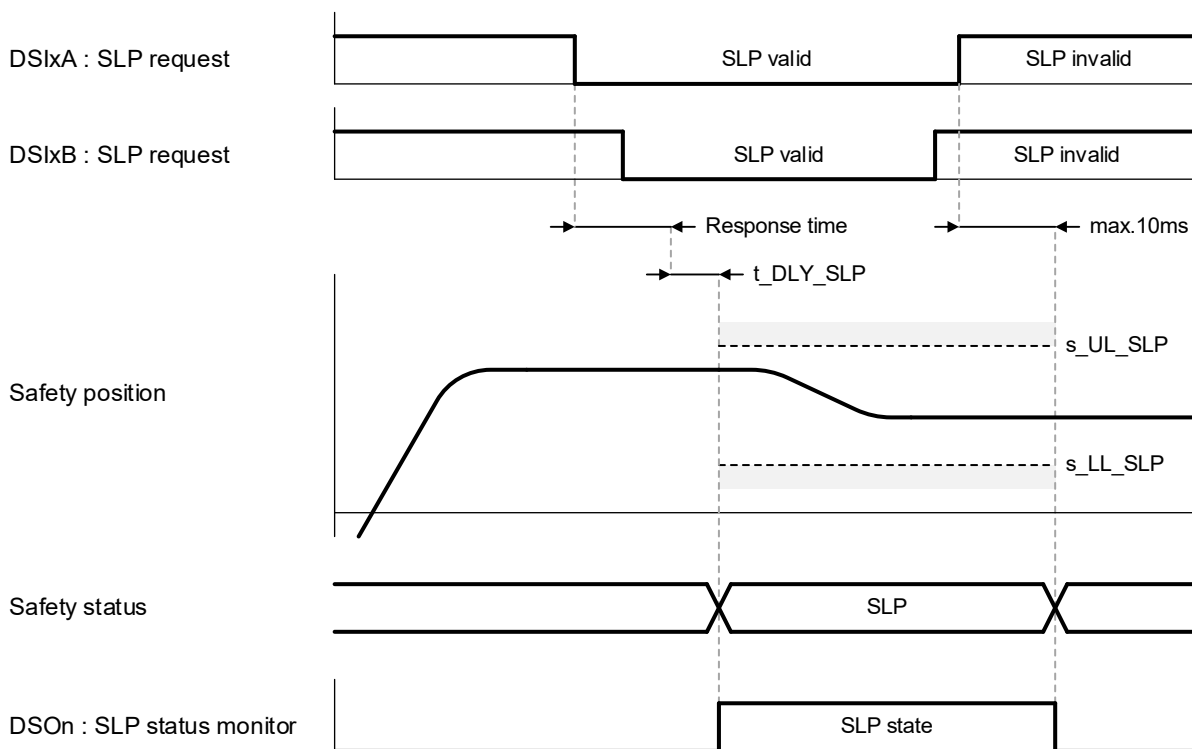
※1: Resolution follows the position command resolution of the servo drive.

### 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 the EtherCAT communication (FSOE).

#### 4.11.1 I/O Type

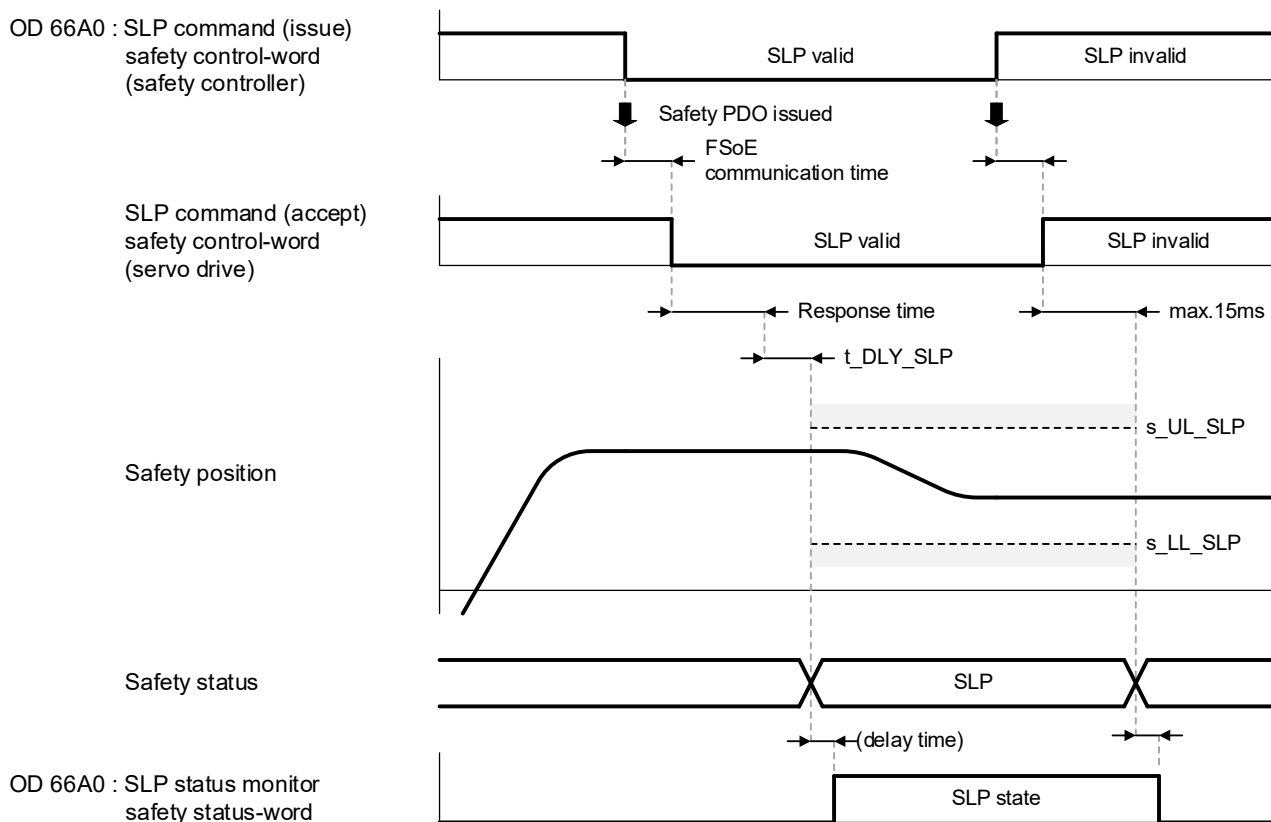
By turning off DSIxA / B, the system triggers the SLP function, and then the system starts monitoring the position of the moving part of the equipment after the response time plus  $t_{DLY\_SLP}$  elapses. Monitoring is performed using the absolute position to the safety origin.



- ✓ If the SLP function is used, use servo drive homing function to determine safety origin. For more information about the safety coordinates, refer to Section 3.7. If the safety origin is not set, "S.POS.U" appears on the drive front panel. 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 enabled”, the system triggers the SLP function, 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.



- ✓ If the SLP function is used, use servo drive homing function to determine safety origin. For more information about the safety coordinates, refer to Section 3.7. If the safety origin is not set, “S.POS.U” appears on the drive front panel. In this case, the SLP function is not available.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.11.3 Parameters

Name	Abbreviation	Description	Unit	Factory 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 upper limit	s_UL_SLP	For setting the monitoring level for the location. Determine the absolute position to the safety origin. Setting range   -2147483648 - 2147483647*1	pulse	0						
position lower limit	s_LL_SLP	For setting the monitoring level for the location. Determine the absolute position to the safety origin. Setting range   -2147483648 - 2147483647*1	pulse	0						
error reaction	-	For selecting action to take at the time when abnormality is detected. <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>STO</td> <td>Starts STO operation.</td> </tr> <tr> <td>SS1</td> <td>Starts SS1 operation.</td> </tr> </tbody> </table>	Option	Description	STO	Starts STO operation.	SS1	Starts SS1 operation.	-	STO
Option	Description									
STO	Starts STO operation.									
SS1	Starts SS1 operation.									
position scale factor	-	For setting coefficients to extend the position relative upper/lower limit. The position relative limit is extended by the following formula. $position\ limit = position\ relative\ upper/lower\ limit \times 10^{scale\ factor}$ Setting range   0 - 4	-	0						
test pulse diagnostics	-	For selecting whether or not test pulse diagnosis is required for safety origin sensor. If a safety limit switch is used, select Enable. <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>disable</td> <td>Test Pulse Diagnostics Disabled</td> </tr> <tr> <td>enable</td> <td>Test Pulse Diagnostics Enabled</td> </tr> </tbody> </table>	Option	Description	disable	Test Pulse Diagnostics Disabled	enable	Test Pulse Diagnostics Enabled	-	disable
Option	Description									
disable	Test Pulse Diagnostics Disabled									
enable	Test Pulse Diagnostics Enabled									
safe position homing method	-	For selecting the safe position homing method. <table border="1"> <thead> <tr> <th>Option</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>method1</td> <td>Using safety origin sensor</td> </tr> <tr> <td>method2</td> <td>Set the current position as safety origin</td> </tr> </tbody> </table> ✓ Refer to Section 3.7 for more information on how to set the safety origin	Option	Description	method1	Using safety origin sensor	method2	Set the current position as safety origin	-	method1
Option	Description									
method1	Using safety origin sensor									
method2	Set the current position as safety origin									
safe position diagnostic range	-	Set the pass range for self-diagnosis of the safe position. Setting range   0.0 - 30.0 ✓ Valid only when using the safety origin setting method 2.	0.1 degree (rotary) 0.1mm (linear)	0.1						
safe position offset	-	Sets the offset position from the safety origin reference position to the safety origin. Setting range   -2147483648 - 2147483647	pulse	0						
safe position limit tolerance	-	Set the allowable range of movement beyond the positive/negative limit positions. Setting range   0.0 - 30.0 ✓ Valid only when using the safety origin setting method 2.	0.1 degree (rotary) 0.1mm (linear)	0.1						

\*1: Resolution follows the position command resolution of the servo drive.

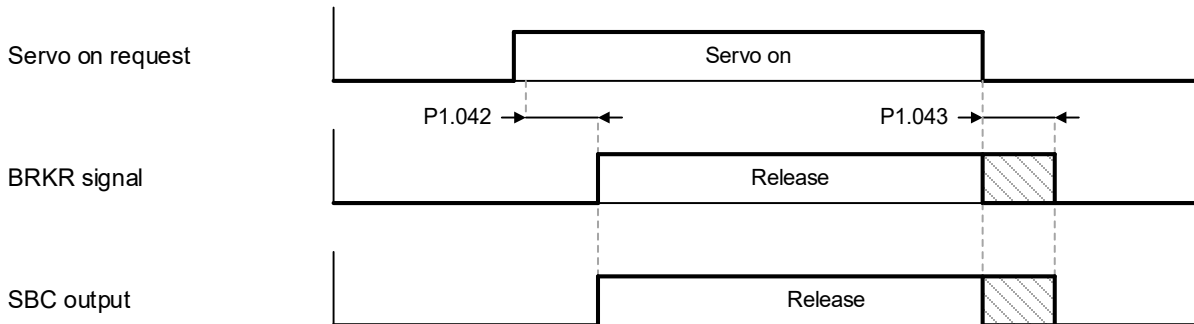
## 4.12 Safe Brake Control (SBC)

The power supply for the electromagnetic brake of the servo motor is output. The SBC output is normally linked to the servo drive's electromagnetic brake control timing (BRKR). 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

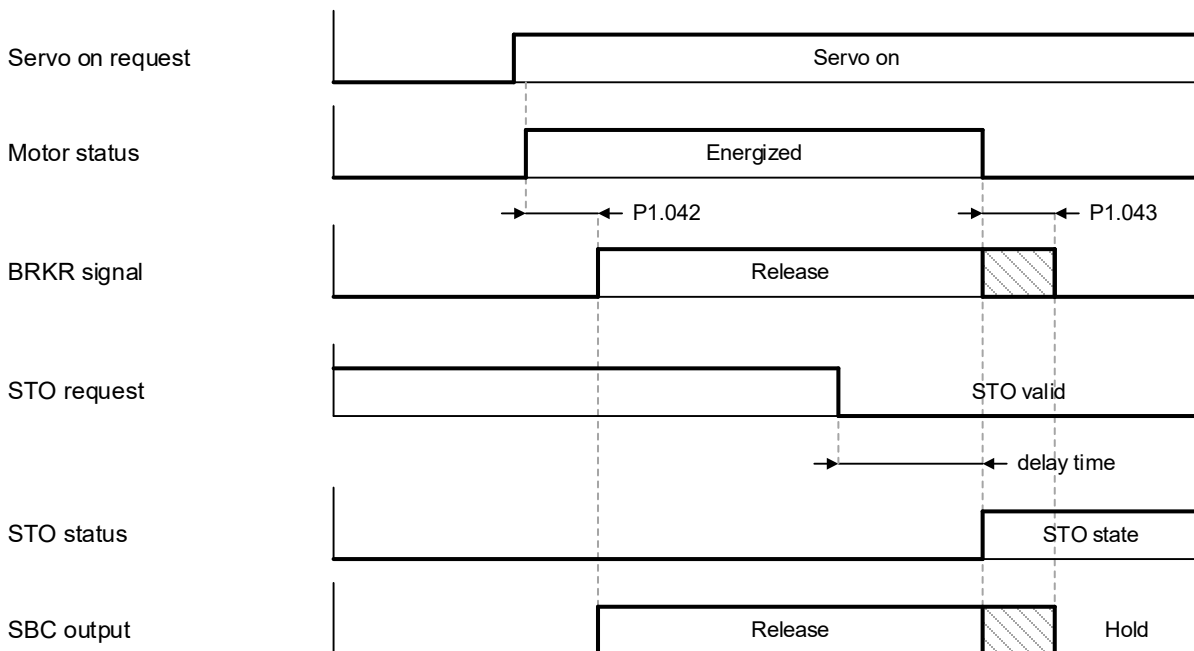
When both the STO and SS1 functions are deactivate, the SBC output is linked to the BRKR signal.



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

#### 4.12.1.2 Operation when STO is executed (Set "without SBC" in "activate SBC" for STO)

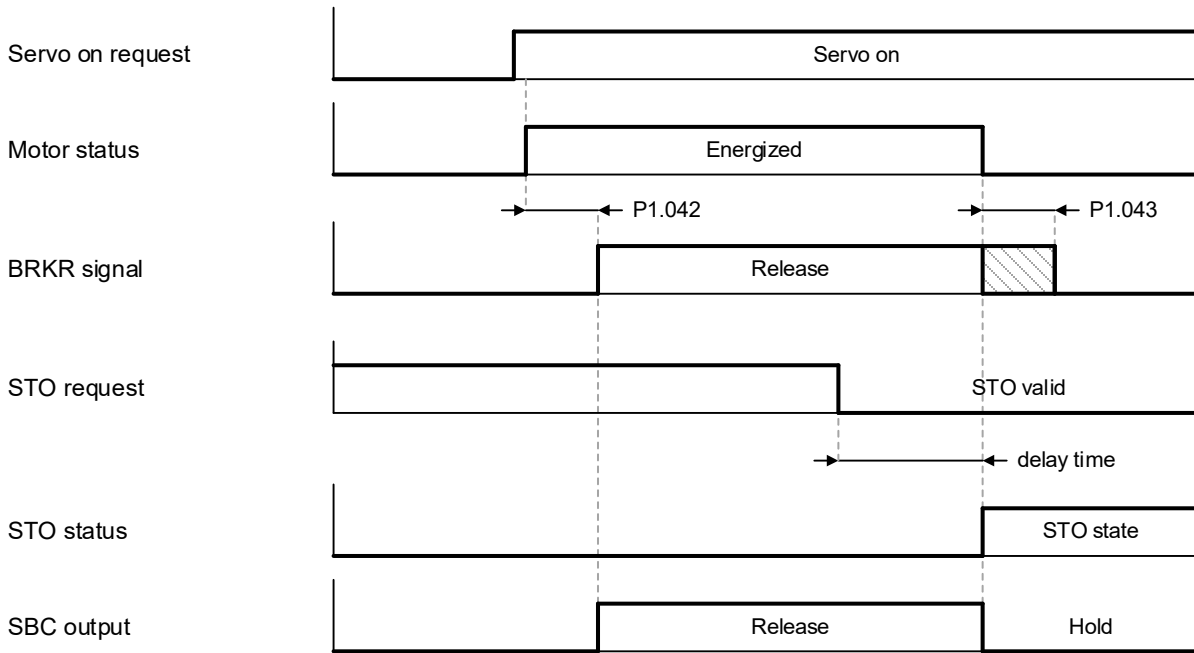
The SBC output will be linked to the BRKR signal.



- ✓ 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 “with SBC” in “activate SBC” for STO)

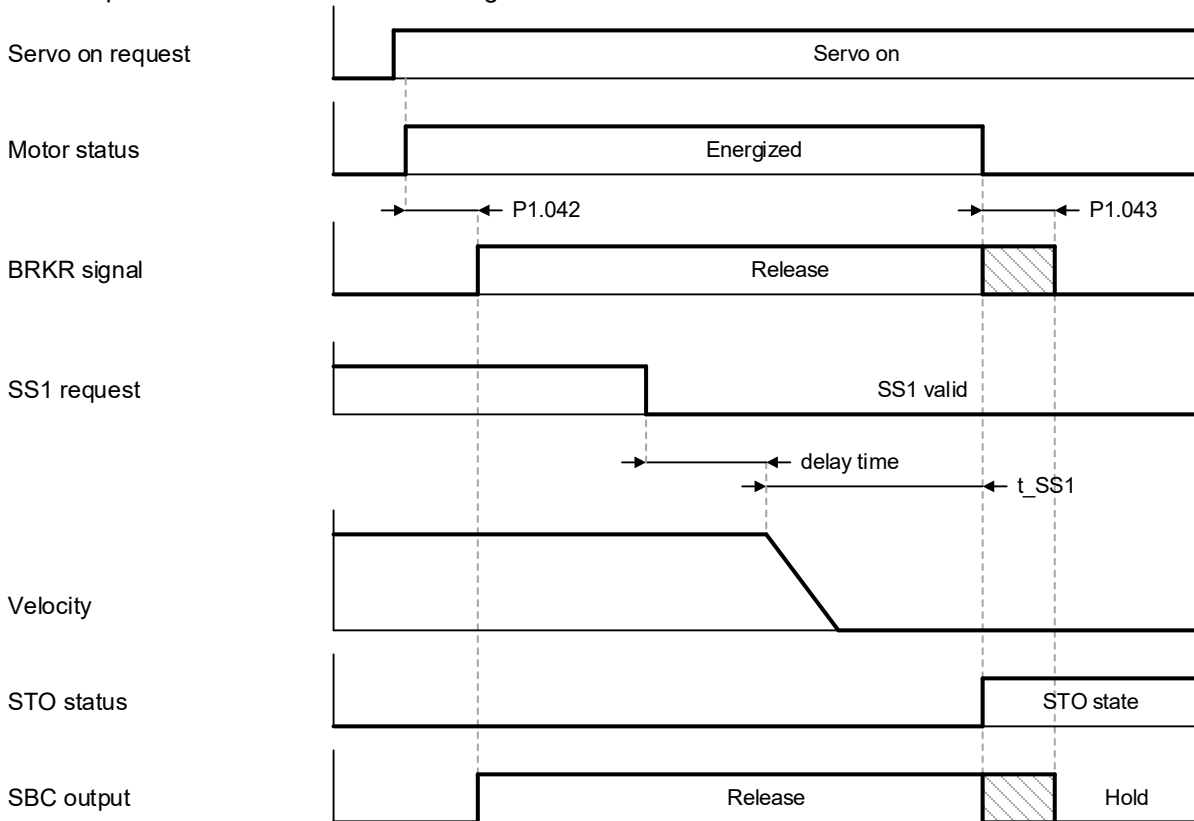
The SBC output will be linked to the STO signal.



- ✓ I/O type : delay time = Response time + t\_DLY\_STO
- Communication type : delay time = Response time + t\_DLY\_STO + FSoE communication time
- time

4.12.1.4 Operation when SS1 is executed (Set “without SBC” in “activate SBC” for SS1)

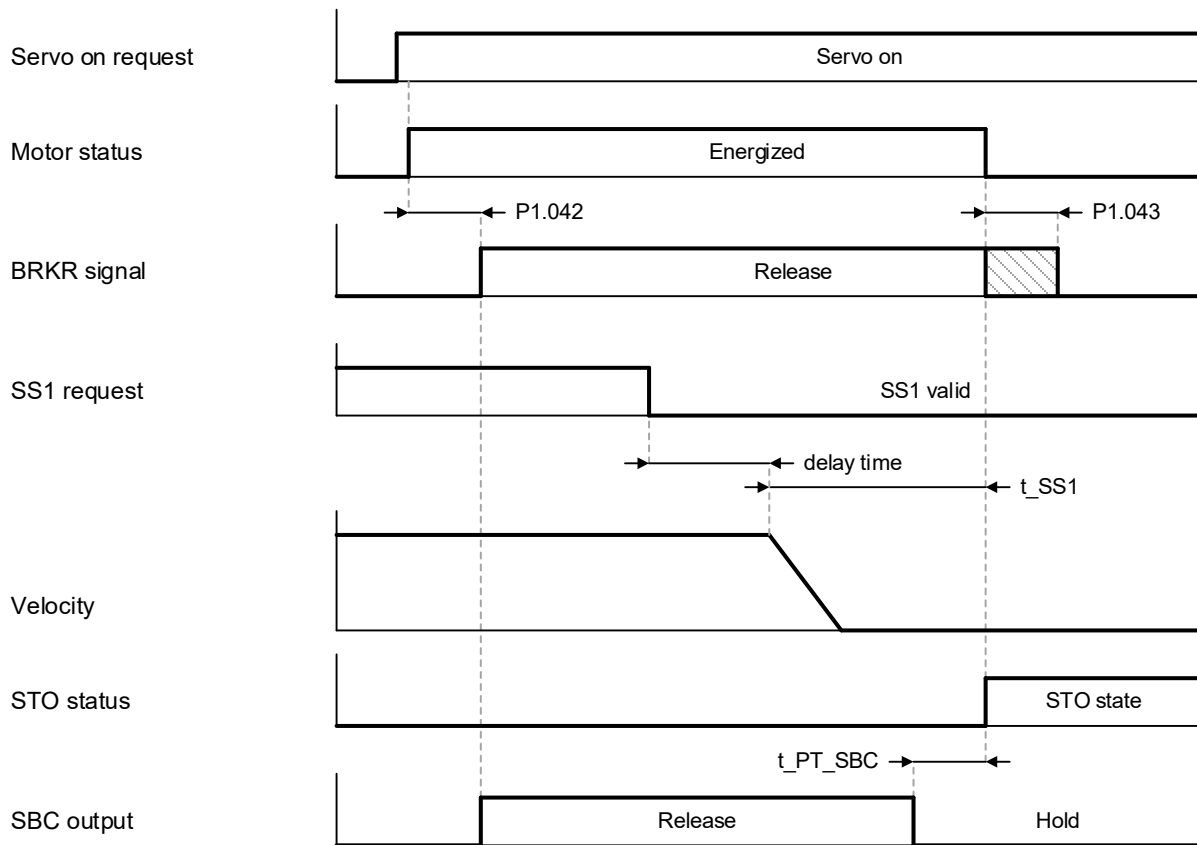
The SBC output will be linked to the BRKR signal.



- ✓ 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 “with SBC” in “activate SBC” for SS1)

The SBC output will be linked to the SS1 signal.

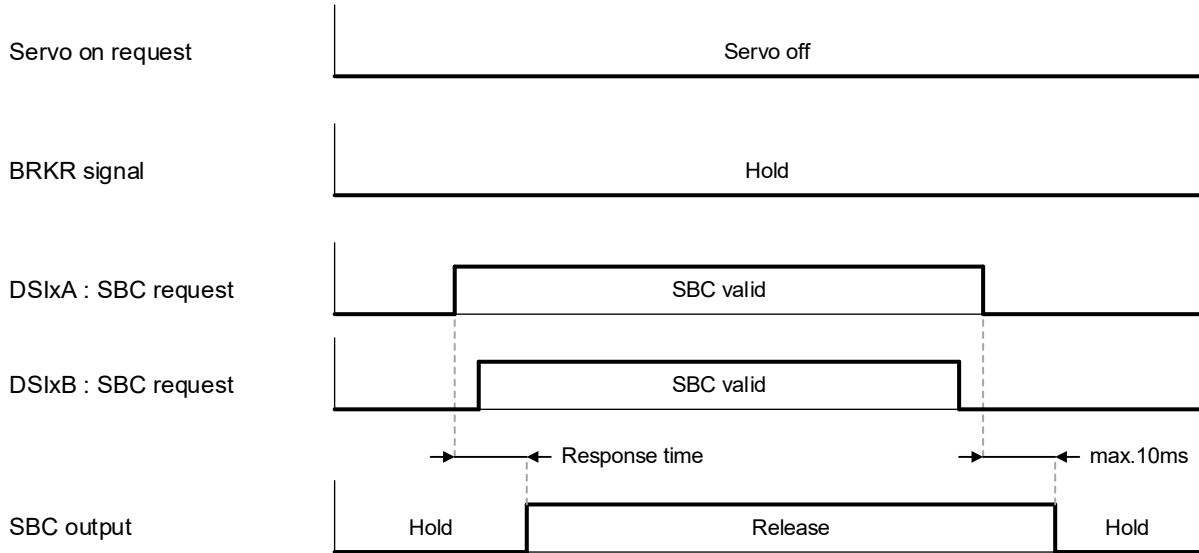


- ✓ I/O type : delay time = Response time +  $t_{DLY\_SS1}$
- Communication type : delay time = Response time +  $t_{DLY\_SS1}$  + FSoE communication time

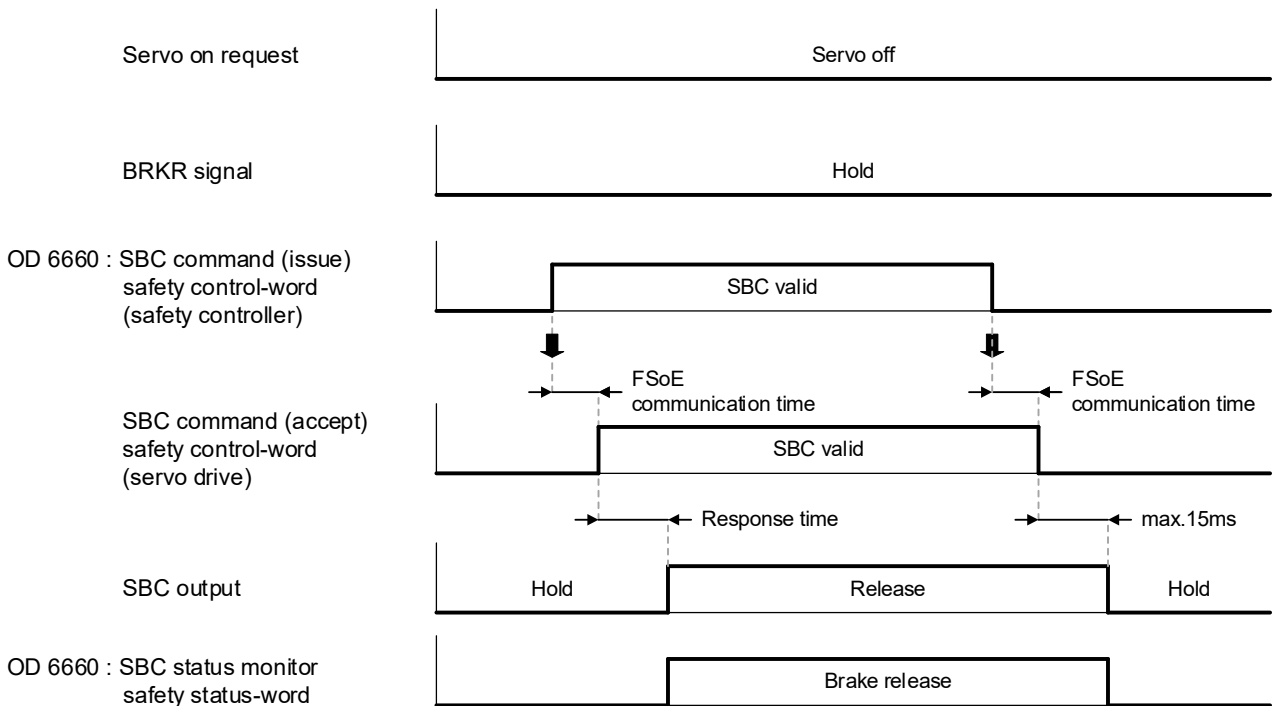
4.12.1.6 Operation at SBC request

By turning on the DS1xA / B or setting the SBC commands assigned to the safety PDO to “0: SBC enabled” 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.

■ I/O Type



■ EtherCAT Communication (FSoE) Type



- ✓ While the servo is ON, the SBC request cannot be used to control the SBC output.
- ✓ This function puts the moving parts into motion during machine maintenance. When using this function on a gravity axis, ensure that the surrounding area is sufficiently safe, since there is a risk that moving parts may fall.

4.12.2 Parameters

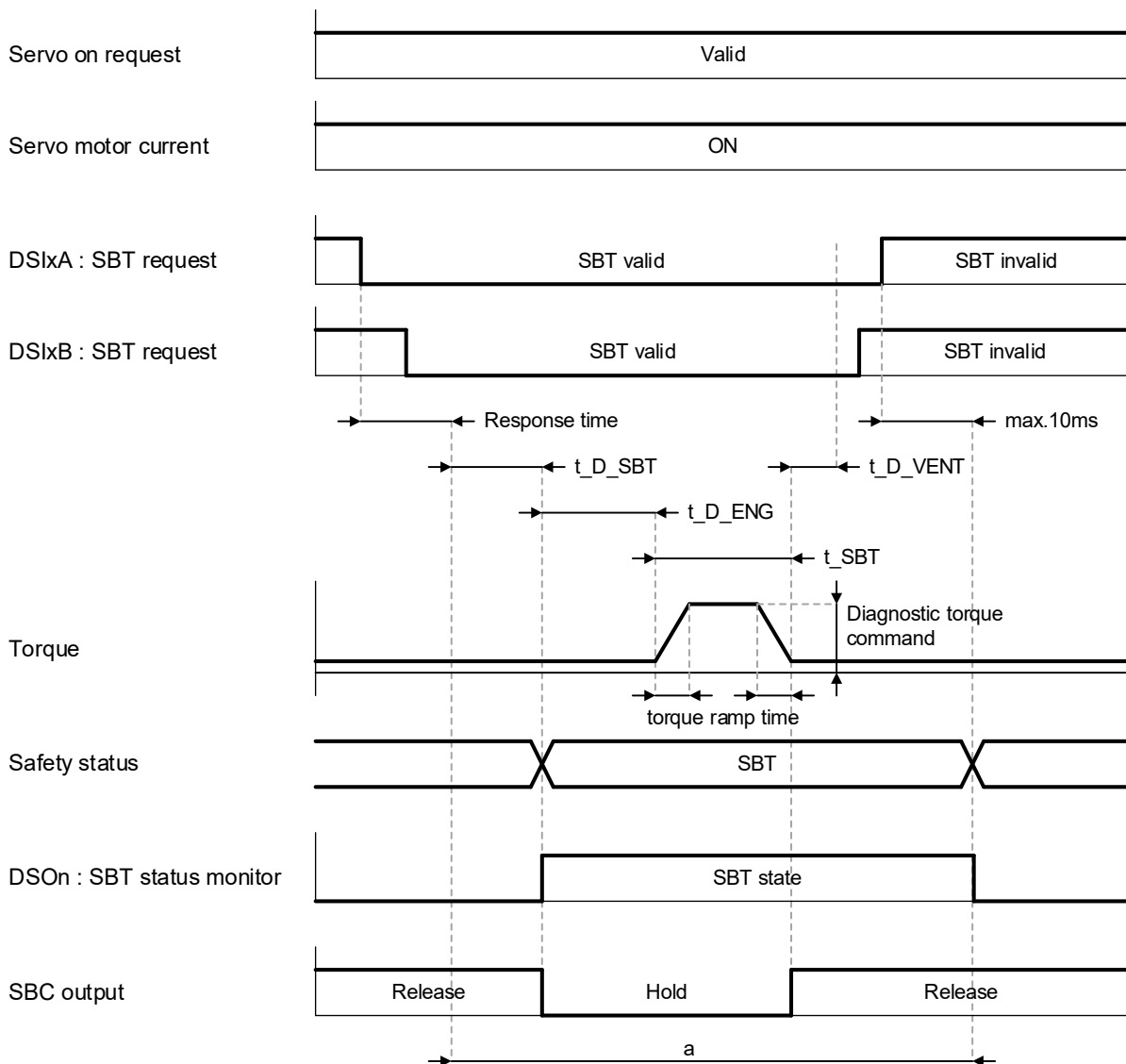
Name	Abbreviation	Description	Unit	Factory Setting						
brake time delay	t_PT_SBC	For setting the timing for output of the SBC signal at the time when the SS1 function is executed. <table border="1"> <tr> <td>Setting range</td> <td>0 - 65535</td> </tr> </table>	Setting range	0 - 65535	ms	0				
Setting range	0 - 65535									
activate SBC (for STO)	-	For selecting the SBC output operation at the time when the STO function is executed. <table border="1"> <tr> <th>Option</th> <th>Description</th> </tr> <tr> <td>with SBC</td> <td>SBC outputs are linked to STO operation.</td> </tr> <tr> <td>without SBC</td> <td>SBC outputs are not linked to STO operation.</td> </tr> </table>	Option	Description	with SBC	SBC outputs are linked to STO operation.	without SBC	SBC outputs are not linked to STO operation.	-	without SBC
Option	Description									
with SBC	SBC outputs are linked to STO operation.									
without SBC	SBC outputs are not linked to STO operation.									
activate SBC (for SS1)	-	For selecting the SBC output operation at the time when the SS1 function is executed. <table border="1"> <tr> <th>Option</th> <th>Description</th> </tr> <tr> <td>with SBC</td> <td>SBC outputs are linked to STO operation.</td> </tr> <tr> <td>without SBC</td> <td>SBC outputs are not linked to STO operation.</td> </tr> </table>	Option	Description	with SBC	SBC outputs are linked to STO operation.	without SBC	SBC outputs are not linked to STO operation.	-	without SBC
Option	Description									
with SBC	SBC outputs are linked to STO operation.									
without SBC	SBC outputs are not linked to STO operation.									
enable SBC	-	For selecting SBC output enable/disable. <table border="1"> <tr> <th>Option</th> <th>Description</th> </tr> <tr> <td>disable</td> <td>Disable SBC output</td> </tr> <tr> <td>enable</td> <td>Enable SBC output</td> </tr> </table>	Option	Description	disable	Disable SBC output	enable	Enable SBC output	-	enable
Option	Description									
disable	Disable SBC output									
enable	Enable SBC output									

### 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 the EtherCAT communication (FSoE).

#### 4.13.1 I/O Type

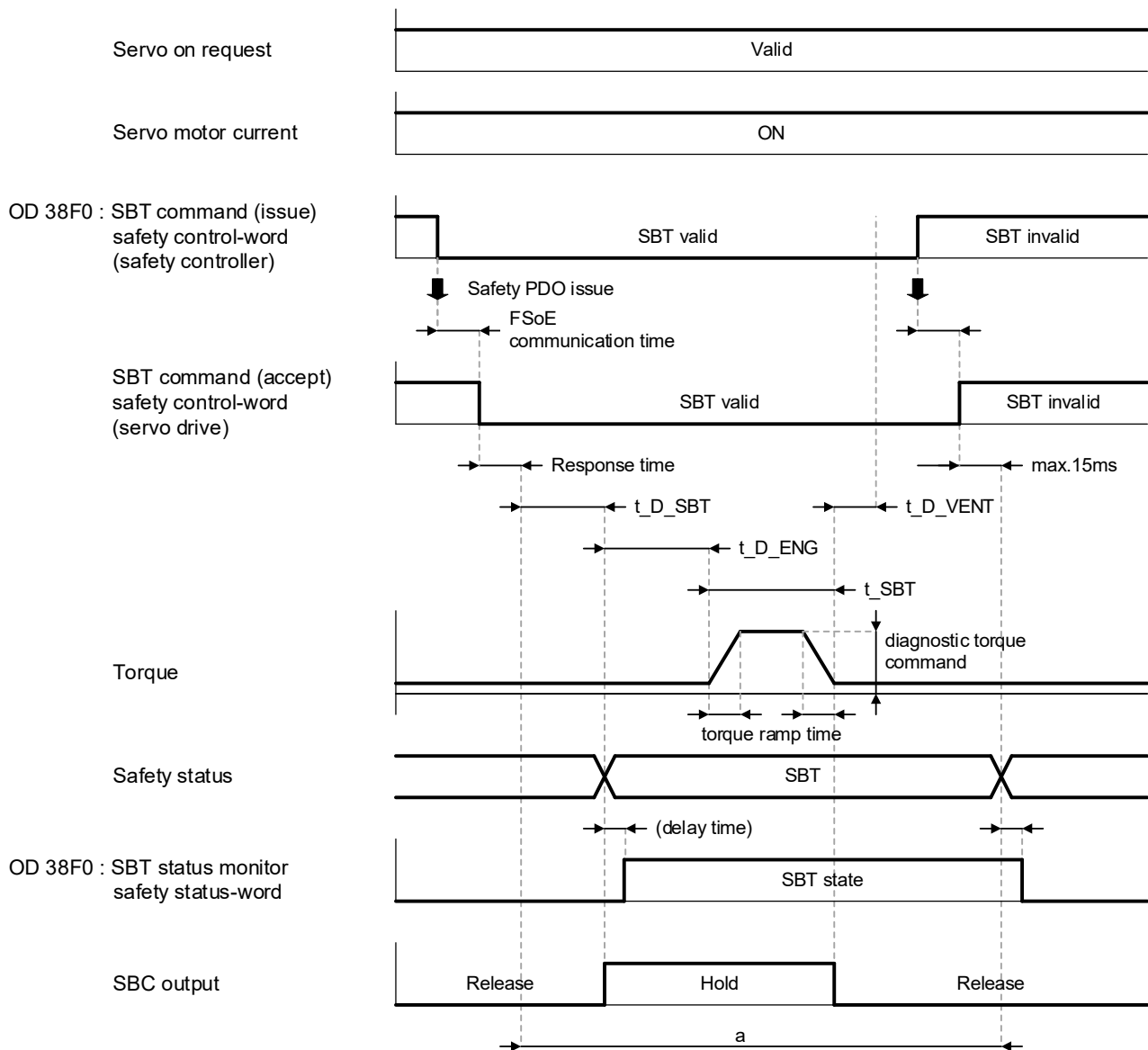
By turning off DSIxA / B, the system triggers the SBT function, and then the system starts diagnosing the holding torque of the electromagnetic brake after the response time elapses.



- ✓ This may cause the servo motor to rotate if the brake has deteriorated. When performing diagnosis assessment, ensure that the surrounding area is safe.
- ✓ By performing this function, the system forces the electromagnetic brake to hold. Therefore, do not use this function while the servo motor is rotating.
- ✓ This function should be carried out while the servo is ON.
- ✓ During the time indicated by "a" in the diagram, operation by external position/velocity 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 the 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 enabled”, the system triggers the SBT function, 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 assessment, ensure that the surrounding area is safe.
- ✓ By performing this function, the system forces the electromagnetic brake to hold. Therefore, do not use this function while the servo motor is rotating.
- ✓ This function should be carried out while the servo is ON.
- ✓ During the time indicated by “a” in the diagram, operation by external position/velocity 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 the 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.
- ✓ The response of the safety status word is subject to delays due to internal processing and communications. See chapter 3.6.2.2 for details on delay time.

## 4.13.3 Parameters

Name	Abbreviation	Description	Unit	Factory 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	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. Setting range   0 - 65535	ms	0
brake holding waiting time	t_D_ENG	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. 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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## Parameter List

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This chapter lists the parameters for I/O type.

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5.1	Parameter list .....	2
5.1.1	Parameter list format .....	2
5.1.2	Parameter list .....	2

## 5.1 Parameter list

### 5.1.1 Parameter list format

items	Contents
Classification	Related function
Name	Parameter name
Setting range	Parameter setting range
Unit	Physical unit
Default setting	Factory set value
Remarks	Special note

### 5.1.2 Parameter list

Classification	Name	Setting range	Unit	Default setting	Remarks
Setting	Motor type	0 ~ 1	-	Rotary (0)	If the setting is different from that of the drive, an alarm (AL.5C1) will be issued.
Diagnostic	encoder diagnostic sensitivity	0 ~ 1000 (0: Diagnostic function disabled)	-	100	
STO	restart acknowledge behavior	automatic restart (0) manual restart (1)	-	manual restart (1)	
	activate SBC	with SBC (0x66600001) without SBC (0x00000000)	-	without SBC (0x00000000)	
	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 (rotary) mm/s (linear)	0	
	deceleration	0 ~ 4294967295	pulse/s <sup>2</sup>	0	
	time for velocity zero	0 ~ 65535	ms	0	
	deceleration limit	0 ~ 4294967295	pulse/s <sup>2</sup>	0	
	deceleration scale factor	0 ~ 4	-	0	
	time delay deceleration monitoring	0 ~ 65535	ms	0	
	monitoring type	SS1 with time monitoring (0) SS1 with deceleration monitoring (1)	-	SS1 with time monitoring (0)	
	deceleration method	by drive (0) by controller (1)	-	by drive (0)	

Classification	Name	Setting range	Unit	Default setting	Remarks
SS1	activate SBC	with SBC (0x66600001) without SBC (0x00000000)	-	without SBC (0x00000000)	
SS2	time to SOS	0 ~ 65535	ms	0	
	time to SS2	0 ~ 65535	ms	0	
	deceleration	0 ~ 4294967295	pulse/s <sup>2</sup>	0	
	time for velocity zero	0 ~ 65535	ms	0	
	deceleration limit	0 ~ 4294967295	pulse/s <sup>2</sup>	0	
	deceleration scale factor	0 ~ 4	-	0	
	time delay deceleration monitoring	0 ~ 65535	ms	0	
	restart acknowledge behavior	automatic restart (0) manual restart (1)	-	manual restart (1)	
	error reaction	STO (0x66400001) SS1 (0x66500101)	-	STO (0x66400001)	
	monitoring type	SS2 with time monitoring (0) SS2 with deceleration monitoring (1)	-	SS2 with time monitoring (0)	
deceleration method	by drive (0) by controller (1)	-	by drive (0)		
SOS	time to SOS	0 ~ 65535	ms	0	
	position zero window	0 ~ 4294967295	pulse	0	
	velocity zero window	0 ~ 4294967295	rpm (rotary) mm/s (linear)	0	
	position scale factor	0 ~ 4	-	0	
SLS	velocity limit	0 ~ 4294967295	rpm (rotary) mm/s (linear)	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 (rotary) mm/s (linear)	0	
	time delay deceleration monitoring	0 ~ 65535	ms	0	
	deceleration limit	0 ~ 4294967295	pulse/s <sup>2</sup>	0	
	deceleration scale factor	0 ~ 4	-	0	

Classification	Name	Setting range	Unit	Default setting	Remarks
SLS	monitoring type	SLS with time monitoring (0) SLS with deceleration monitoring (1)	-	SLS with time monitoring (0)	
	error reaction	STO (0x66400001) SS1 (0x66500101)	-	STO (0x66400001)	
SMS	velocity maximum positive	-2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0	
	velocity maximum negative	-2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0	
	error reaction	STO (0x66400001) SS1 (0x66500101)	-	STO (0x66400001)	
SSM	velocity upper limit	-2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0	
	velocity lower limit	-2147483648 ~ 2147483647	rpm (rotary) mm/s (linear)	0	
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	STO (0x66400001) SS1 (0x66500101)	-	STO (0x66400001)	
	position 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 (rotary) mm/s (linear)	0	
	position scale factor	0 ~ 4	-	0	

Classification	Name	Setting range	Unit	Default setting	Remarks
SLP	time to SLP	0 ~ 65535	ms	0	
	position related upper limit	-2147483648 ~ 2147483647	pulse	0	
	position related lower limit	-2147483648 ~ 2147483647	pulse	0	
	error reaction	STO (0x66400001) SS1 (0x66500101)	-	STO (0x66400001)	
	position scale factor	0 ~ 4	-	0	
	test pulse diagnostics	disable (0) enable (1)	-	disable (0)	
	safe position homing method	method1 (0) method2 (1)	-	method1 (0)	
	safe position diagnostic range	0.0 ~ 30.0	0.1 degree (rotary) 0.1mm (linear)	0.1	
	safe position offset	-2147483648 ~ 2147483647	pulse	0	
	safe position limit tolerance	0.0 ~ 30.0	0.1 degree (rotary) 0.1mm (linear)	0.1	
SBC	brake time delay	0 ~ 65535	ms	0	
	enable SBC	disable (0) enable (1)	-	enable (1)	
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	
Monitor	Safe position monitor scale factor	0 ~ 4	-	0	
	Safe acceleration monitor scale factor	0 ~ 4	-	0	

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# **EtherCAT Communication Objects** **6**

This chapter describes the EtherCAT communication objects.  
The object (device profile area) of this product complies with ETG.6100.2 S (R) V1.3.0.

6.1	Object dictionary .....	2
6.1.1	Object Specification .....	2
6.1.1.1	Object index .....	2
6.1.1.2	Object code .....	2
6.1.1.3	Data type .....	2
6.1.1.4	Object list format .....	2
6.1.2	Object list .....	3
6.1.3	Details .....	6
6.1.3.1	OD 1XXXh: Communication area .....	6
6.1.3.2	OD 6XXXh: Drive profile area .....	7
6.1.3.3	OD 3XXXh: Manufacturer specific area2 .....	38

## 6.1 Object dictionary

### 6.1.1 Object Specification

#### 6.1.1.1 Object index

Index(Hex)	Area	Description
6000 ~ DFFF	Device profile area	Objects defined in CiA402 Drive Profile
3800 ~ 38FF	Manufacturer specific area2	Objects defined in ACS3-SF
1604, 1A04	Communication area	PDO mapping

#### 6.1.1.2 Object code

Object code	Description
VAR	Single value
ARRAY	Array consisting of multiple variables of the same data type
RECORD	An object of multiple data fields consisting of multiple variables of different data types

#### 6.1.1.3 Data type

Data type	Symbol	Size	Range
Boolean	BOOL	1bit	0 ~ 1
Integer8	I8	1byte	-128 ~ 127
Unsigned8	U8	1byte	0 ~ 255
Unsigned16	U16	2byte	0 ~ 65535
Unsigned32	U32	4byte	0 ~ 4294967295
Signed32	S32	4byte	-2147483648 ~ 2147483647
STRING*	STRING	-	Specify byte size for each variable
ENUMERATION*	ENUM	-	Specify bit length for each variable

\* The ( ) at the end indicates the data size. If there are no ( ), the size is undefined.

#### 6.1.1.4 Object list format

Items	Description
Class	Parameter classification
Index	Object index
Code	Object code (See Section 6.1.1.2)
OB	Object name
Type	See Section 6.1.1.3
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 availability Rx : Can be mapped to receive PDO Tx : Can be mapped to transmit PDO
SRA	SRA parameter N : Not included in SRA parameters Y : Included in SRA parameters

## 6.1.2 Object list

## Communication area

Class	Index	Code	OB	Type	SDO	PDO	SRA
	1604h	RECORD	5th Receive PDO mapping	U32	RW	-	N
	1A04h	RECORD	5th Transmit PDO mapping	U32	RW	-	N

## Drive profile area

Class	Index	Code	OB	Type	SDO	PDO	SRA
	6060h	VAR	Mode of operation	I8	RW	-	N
	6098h	VAR	Homing method	I8	RW	-	N
	6099h	ARRAY	Homing speed	U32	RW	-	N
	609Ah	VAR	Homing acceleration	U32	RW	-	N
	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
	6611h	VAR	Safe position actual value	S32	RO	Tx	N
	6612h	VAR	Safe velocity actual value	S16	RO	Tx	N
	6615h	VAR	Safe acceleration actual value	S32	RO	Tx	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	STO restart acknowledge behavior	BOOL	RW	-	Y
	6643h	VAR	STO activate SBC	U32	RW	-	Y
SS1	6650h	ARRAY	SS1 command	BOOL	RO	Rx / Tx	N
	6651h	ARRAY	SS1 time to STO	U16	RW	-	Y
	6653h	ARRAY	SS1 velocity zero window	U32	RW	-	Y
	6654h	ARRAY	SS1 time for velocity zero	U16	RW	-	Y
	6656h	ARRAY	SS1 deceleration limit	U32	RW	-	Y
	6657h	ARRAY	SS1 time delay deceleration monitoring	U16	RW	-	Y
	6658h	ARRAY	SS1 activate SBC	U32	RW	-	Y
SBC	6660h	VAR	SBC command	BOOL	RO	Rx / Tx	N
	6661h	VAR	SBC brake time delay	U16	RW	-	Y
SOS	6668h	ARRAY	SOS command	BOOL	RO	Rx / Tx	N
	666Ah	ARRAY	SOS position zero window	U32	RW	-	Y
	666Ch	ARRAY	SOS velocity zero window	U32	RW	-	Y
SS2	6670h	ARRAY	SS2 command	BOOL	RO	Rx / Tx	N
	6671h	ARRAY	SS2 time to SOS	U16	RW	-	Y
	6672h	ARRAY	SS2 time for velocity zero	U16	RW	-	Y
	6674h	ARRAY	SS2 deceleration limit	U32	RW	-	Y
	6675h	ARRAY	SS2 time delay deceleration monitoring	U16	RW	-	Y
	6676h	ARRAY	SS2 restart acknowledge behavior	BOOL	RW	-	Y
	6677h	ARRAY	SS2 error reaction	U32	RW	-	Y
SLS	6690h	ARRAY	SLS command	BOOL	RO	Rx / Tx	N
	6691h	ARRAY	SLS time to velocity monitoring	U16	RW	-	Y
	6693h	ARRAY	SLS velocity limit	U32	RW	-	Y
	6694h	ARRAY	SLS time for velocity in limit	U16	RW	-	Y
	6695h	ARRAY	SLS time delay deceleration monitoring	U16	RW	-	Y

Class	Index	Code	OB	Type	SDO	PDO	SRA
	6060h	VAR	Mode of operation	I8	RW	-	N
	6098h	VAR	Homing method	I8	RW	-	N
	6099h	ARRAY	Homing speed	U32	RW	-	N
	609Ah	VAR	Homing acceleration	U32	RW	-	N
	6697h	ARRAY	SLS deceleration limit	U32	RW	-	Y
	6698h	ARRAY	SLS error reaction	U32	RW	-	Y
SLP	66A0h	ARRAY	SLP command	BOOL	RO	Rx / Tx	N
	66A2h	ARRAY	SLP position upper limit	S32	RW	-	Y
	66A4h	ARRAY	SLP position lower limit	S32	RW	-	Y
	66A5h	ARRAY	SLP error reaction	U32	RW	-	Y
SMS	66A8h	VAR	SMS status	BOOL	RO	Tx	N
	66AAh	VAR	SMS velocity maximum positive	S32	RW	-	Y
	66ACh	VAR	SMS velocity maximum negative	S32	RW	-	Y
	66ADh	VAR	SMS error reaction	U32	RW	-	Y
SLI	66B8h	ARRAY	SLI command	BOOL	RO	Rx / Tx	N
	66BAh	ARRAY	SLI position relative upper limit	U32	RW	-	Y
	66BCh	ARRAY	SLI position relative lower limit	U32	RW	-	Y
	66BDh	ARRAY	SLI error reaction	U32	RW	-	Y
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	SDI position zero window	U32	RW	-	Y
	66D5h	VAR	SDI velocity zero window	U32	RW	-	Y
SSM	66E0h	ARRAY	SSM status	BOOL	RO	Tx	N
	66E2h	ARRAY	SSM velocity upper limit	S32	RW	-	Y
	66E4h	ARRAY	SSM velocity lower limit	S32	RW	-	Y
	6760h	ARRAY	FSoE slave frame elements	*	RO	-	N
	6770h	ARRAY	FSoE master frame elements	*	RO	-	N
	6791h	ARRAY	FSoE Drive Connection communication Parameter	*	RO	-	N
	67A0h	ARRAY	FSoE Drive Connection Diagnosis	*	RO	-	N

\* See chapter 6.1.3 for the Type for each sub-index.

#### Manufacturer Specific Area 2

Class	Index	Code	OB	Type	SDO	PDO	SRA
	3800h	ARRAY	DSI Function	U16	RW	-	Y
	3801h	ARRAY	DSO Function	U16	RW	-	Y
	380Ah	VAR	Safe position monitor scale factor	U32	RW	-	Y
	380Ch	VAR	Safe acceleration monitor scale factor	U32	RW	-	Y
	3810h	ARRAY	Module setting	U16	RWS	-	Y
	3811h	VAR	Safe position clear	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
	3822h	ARRAY	Fault information	U16	RO	-	N

Class	Index	Code	OB	Type	SDO	PDO	SRA
	3823h	ARRAY	encoder information	U16	RO	-	N
	3824h	-	maker-specific parameter	-	-	-	N
	382Ah	-	maker-specific parameter	-	-	-	N
	382Bh	VAR	Safe position status	BOOL	RO	Tx	N
	382Ch	VAR	Safe position homing status	U16	RO	-	N
	382Dh	VAR	Safe position homing error id	U16	RO	-	N
	382Eh	VAR	Safe position remaining valid time	U16	RO	-	N
STO	3842h	VAR	STO, time to STO	U16	RW	-	Y
SS1	3850h	ARRAY	SS1, time to SS1	U16	RW	-	Y
	3851h	ARRAY	SS1 deceleration	U32	RW	-	Y
	3852h	ARRAY	SS1 monitoring type	U16	RW	-	Y
	3853h	ARRAY	SS1 deceleration method	U16	RW	-	Y
	3854h	ARRAY	SS1 deceleration scale factor	U32	RW	-	Y
SBC	3860h	VAR	enable SBC	U16	RW	-	Y
SOS	3868h	ARRAY	SOS, time to SOS	U16	RW	-	Y
	3869h	ARRAY	SOS scale factor	U32	RW	-	Y
SS2	3870h	ARRAY	SS2 monitoring type	U16	RW	-	Y
	3871h	ARRAY	SS2 deceleration	U32	RW	-	Y
	3872h	ARRAY	time to SS2	U16	RW	-	Y
	3873h	ARRAY	SS2 deceleration method	U16	RW	-	Y
	3874h	ARRAY	SS2 deceleration scale factor	U32	RW	-	Y
SLS	3890h	ARRAY	SLS tolerance time	U16	RW	-	Y
	3891h	ARRAY	SLS tolerance of velocity	U16	RW	-	Y
	3892h	ARRAY	SLS monitoring type	U16	RW	-	Y
	3893h	ARRAY	SLS deceleration scale factor	U32	RW	-	Y
SLP	38A0h	ARRAY	SLP, time to SLP	U16	RW	-	Y
	38A1h	ARRAY	SLP scale factor	U32	RW	-	Y
	38A2h	VAR	SLP test pulse diagnostics	U16	RW	-	Y
	38A3h	VAR	SLP safety homing method	U16	RW	-	Y
	38A4h	VAR	SLP safe position diagnostic range	U16	RW	-	Y
	38A5h	VAR	SLP safe position offset	S32	RW	-	Y
	38A6h	VAR	SLP safe position limit tolerance	U16	RW	-	Y
SLI	38B0h	ARRAY	SLI, time to SLI	U16	RW	-	Y
	38B1h	ARRAY	SLI scale factor	U32	RW	-	Y
SDI	38D0h	VAR	SDI, time to SDI	U16	RW	-	Y
	38D1h	VAR	SDI 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	SBT diagnosis time	U16	RW	-	Y
	38F3h	VAR	SBT brake release waiting time	U16	RW	-	Y
	38F4h	VAR	SBT brake holding waiting time	U16	RW	-	Y
	38F5h	VAR	SBT diagnostic torque command	U16	RW	-	Y
	38F6h	VAR	SBT target torque attainment time	U16	RW	-	Y

### 6.1.3 Details

#### 6.1.3.1 OD 1XXXh: Communication area

Index	Name	Specification	
1604h	5th Receive PDO mapping	Object code	RECORD
		Data type	PDO mapping
		SDO access	RW
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Description	Number of entries
Value	19h (fixed value)

Sub-index	1 - 19h
Description	See chapter 3.5.2 for details.

Index	Name	Specification	
1A04h	5th Transmit PDO mapping	Object code	RECORD
		Data type	PDO mapping
		SDO access	RW
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Description	Number of entries
Value	19h (fixed value)

Sub-index	1 - 19h
Description	See chapter 3.5.2 for details.

## 6.1.3.2 OD 6XXXh: Drive profile area

Index	Name	Specification	
6060h	Mode of operation	Object code	VAR
		Data type	I8
		SDO access	RW
		PDO mapping	-
		SRA parameter	N
		Description	When setting the safety origin, set 06. See chapter 3.7 for details.

Index	Name	Specification	
6098h	Homing method	Object code	VAR
		Data type	I8
		SDO access	RW
		PDO mapping	-
		SRA parameter	N
		Description	Select the safety origin search method and safety origin diagnosis method. See chapter 3.7 for details.

Index	Name	Specification	
6099h	Homing speed	Object code	ARRAY
		Data type	U32
		SDO access	RW
		PDO mapping	-
		SRA parameter	N

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

Sub-index	1
Setting range	0 - 2000
Description	Sets the homing speed during a safety origin search. Set it to 200 rpm (5 mm/s) or lower. See chapter 3.7 for details.
Default	100
Unit	0.1 rpm (rotary motor) 1 um/s (linear motor)

Sub-index	2
Setting range	0 – 500
Description	Not used in safe position homing.
Default	20
Unit	0.1 rpm (rotary motor) 1 um/s (linear motor)

Index	Name	Specification		
609Ah	Homing acceleration	Object code	VAR	
		Data type	U32	
		SDO access	RW	
		PDO mapping	-	
		SRA parameter	N	
		Description	Sets the acceleration rate during a safety home search. Sets the acceleration time from 0 to 3000 rpm and the deceleration time from 3000 rpm to 0 rpm. See Chapter 3.7 for details.	
		Default	100	
		Unit	ms	

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 (rotary : fixed value) FD010300h : mm/s (linear : 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 <sup>2</sup> = pulse/s <sup>2</sup> (fixed value)

Index	Name	Specification		
6611h	safe position actual value	Object code	VAR	
		Data type	S32	
		SDO access	RO	
		PDO mapping	Tx	
		SRA parameter	N	
		Description	<p>Current actual position monitor.</p> $\text{Safety position actual value} = \frac{\text{Safety position}}{10^{\text{Object index } 380Ah}}$ <p>If no safe position is set, it is fixed at 0. It should be assigned to the transmit (Tx) safety PDO. See chapter 3.5.2 for details.</p>	
		Unit	pulse	

Index	Name	Specification		
6612h	safe velocity actual value	Object code	VAR	
		Data type	S16	
		SDO access	RO	
		PDO mapping	Tx	
		SRA parameter	N	
		Description	<p>Current actual velocity monitor. It should be assigned to the transmit (Tx) safety PDO. See chapter 3.5.2 for details.</p>	
		Unit	rpm (rotary) mm/s (linear)	

Index	Name	Specification	
6615h	safe acceleration actual value	Object code	VAR
		Data type	S32
		SDO access	RO
		PDO mapping	Tx
		SRA parameter	N
		Description	Current actual acceleration monitor. $\text{Safety acceleration actual value} = \frac{\text{Safety acceleration}}{10^{\text{Object index } 380Ch}}$ It should be assigned to the transmit (Tx) safety PDO. See chapter 3.5.2 for details.
Unit	pulse/s <sup>2</sup>		

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 chapter 3.5.2 for details. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>invalid</td> <td>Non-restartable</td> </tr> <tr> <td>1</td> <td>valid</td> <td>Restartable</td> </tr> </tbody> </table> ✓ The safety state is released by "0 → 1" edge.			value	Rx	Tx	0	invalid	Non-restartable	1	valid	Restartable
		value	Rx	Tx										
0	invalid	Non-restartable												
1	valid	Restartable												
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 chapter 3.5.2 for details. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>invalid</td> <td>no alarm</td> </tr> <tr> <td>1</td> <td>valid</td> <td>alarm</td> </tr> </tbody> </table> ✓ The alarm is reset by "0 → 1" edge.			value	Rx	Tx	0	invalid	no alarm	1	valid	alarm
		value	Rx	Tx										
0	invalid	no alarm												
1	valid	alarm												
Default	0 (Rx)													

Index	Name	Specification			
6640h	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 chapter 3.5.2 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 behaviour	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 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 chapter 3.5.2 for details.									
	<table border="1"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SS1 valid</td> <td>not SS1 state</td> </tr> <tr> <td>1</td> <td>SS1 invalid</td> <td>SS1 state</td> </tr> </tbody> </table>	value	Rx	Tx	0	SS1 valid	not SS1 state	1	SS1 invalid	SS1 state
	value	Rx	Tx							
	0	SS1 valid	not SS1 state							
1	SS1 invalid	SS1 state								
Default	1 (Rx)									

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

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 (rotary) mm/s (linear)

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 <sup>2</sup>

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

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.						
	<table border="1"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>00000000h</td> <td>without SBC</td> </tr> <tr> <td>66600001h</td> <td>with SBC</td> </tr> </tbody> </table>	value	description	00000000h	without SBC	66600001h	with SBC
	value	description					
00000000h	without SBC						
66600001h	with SBC						
Default	00000000h						

Index	Name	Specification									
6660h	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 chapter 3.5.2 for details.								
			<table border="1"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SBC valid</td> <td>not SBC state</td> </tr> <tr> <td>1</td> <td>SBC invalid</td> <td>SBC state</td> </tr> </tbody> </table>	value	Rx	Tx	0	SBC valid	not SBC state	1	SBC invalid
value	Rx	Tx									
0	SBC valid	not SBC state									
1	SBC invalid	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 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 chapter 3.5.2 for details.		
	value	Rx	Tx
	0	SOS valid	not SOS state
	1	SOS invalid	SOS state
Default	1 (Rx)		

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 (rotary) mm/s (linear)

Index	Name	Specification	
6670h	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 chapter 3.5.2 for details.									
	<table border="1"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SS2 valid</td> <td>not SS2 state</td> </tr> <tr> <td>1</td> <td>SS2 invalid</td> <td>SS2 state</td> </tr> </tbody> </table>	value	Rx	Tx	0	SS2 valid	not SS2 state	1	SS2 invalid	SS2 state
	value	Rx	Tx							
	0	SS2 valid	not SS2 state							
1	SS2 invalid	SS2 state								
Default	1 (Rx)									

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

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 <sup>2</sup>

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	description
	0	automatic restart
	1	manual restart
Default	1	

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	66400001h / 66500*01h (* : 1~4)	
Description	For selecting action to take at the time when abnormality is detected.	
	value	description
	66400001h	Starts STO operation
	66500*01h	Starts SS1 operation
	* : Specify the sub-index of the parameter for SS1.	
Default	66400001h	

Index	Name	Specification	
6690h	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 chapter 3.5.2 for details.		
	value	Rx	Tx
	0	SLS valid	not SLS state
	1	SLS invalid	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 (rotary) mm/s (linear)

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	
6695h	SLS 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 SLS function is enabled to the time when the system starts monitoring the deceleration rate.
Default	0
Unit	ms

Index	Name	Specification	
6697h	SLS 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 <sup>2</sup>

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	66400001h / 66500*01h (* : 1~4)	
Description	For selecting action to take at the time when abnormality is detected.	
	value	description
	66400001h	Starts STO operation
	66500*01h	Starts SS1 operation
	* : Specify the sub-index of the parameter for SS1.	
Default	66400001h	

Index	Name	Specification	
66A0h	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 chapter 3.5.2 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 - 2147483647
Description	For setting the monitoring level for the location. Determine the absolute position to the safety origin.
Default	0
Unit	pulse

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 - 2147483647
Description	For setting the monitoring level for the location. Determine the absolute position to the safety origin.
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	66400001h / 66500*01h (* : 1~4)	
Description	For selecting action to take at the time when abnormality is detected.	
	value	description
	66400001h	Starts STO operation
	66500*01h	Starts SS1 operation
	* : Specify the sub-index of the parameter for SS1.	
Default	66400001h	

Index	Name	Specification	
66A8h	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 chapter 3.5.2 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 - 2147483647	
		Description	For setting the level of monitoring of the positive velocity.	
		Default	0	
		Unit	rpm (rotary) mm/s (linear)	

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 - 2147483647	
		Description	For setting the level of monitoring of the negative velocity	
		Default	0	
		Unit	rpm (rotary) mm/s (linear)	

Index	Name	Specification								
66ADh	SMS error reaction	Object code	VAR							
		Data type	U32							
		SDO access	RW							
		PDO mapping	-							
		SRA parameter	Y							
		Setting range	66400001h / 66500*01h (* : 1~4)							
		Description	For selecting action to take at the time when abnormality is detected. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>66400001h</td> <td>Starts STO operation</td> </tr> <tr> <td>66500*01h</td> <td>Starts SS1 operation</td> </tr> </tbody> </table> * : Specify the sub-index of the parameter for SS1.		value	description	66400001h	Starts STO operation	66500*01h	Starts SS1 operation
		value	description							
66400001h	Starts STO operation									
66500*01h	Starts SS1 operation									
Default	66400001h									

Index	Name	Specification	
66B8h	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 chapter 3.5.2 for details. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SLI valid</td> <td>not SLI state</td> </tr> <tr> <td>1</td> <td>SLI invalid</td> <td>SLI state</td> </tr> </tbody> </table>	value	Rx	Tx	0	SLI valid	not SLI state	1	SLI invalid	SLI state
value	Rx	Tx								
0	SLI valid	not SLI state								
1	SLI invalid	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

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	66400001h / 66500*01h (* : 1~4)						
Description	For selecting action to take at the time when abnormality is detected.						
	<table border="1"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>66400001h</td> <td>Starts STO operation</td> </tr> <tr> <td>66500*01h</td> <td>Starts SS1 operation</td> </tr> </tbody> </table>	value	description	66400001h	Starts STO operation	66500*01h	Starts SS1 operation
	value	description					
	66400001h	Starts STO operation					
66500*01h	Starts SS1 operation						
* : Specify the sub-index of the parameter for SS1.							
Default	66400001h						

Index	Name	Specification												
66D0h	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 chapter 3.5.2 for details.											
			<table border="1"> <thead> <tr> <th>value</th> <th>Rx</th> <th>Tx</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SDIp valid</td> <td>positive dir. inactive</td> </tr> <tr> <td>1</td> <td>SDIp invalid</td> <td>positive dir. active</td> </tr> </tbody> </table>	value	Rx	Tx	0	SDIp valid	positive dir. inactive	1	SDIp invalid	positive dir. active		
			value	Rx	Tx									
0	SDIp valid	positive dir. inactive												
1	SDIp invalid	positive dir. active												
Default	1 (Rx)													

Index	Name	Specification			
66D1h	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 chapter 3.5.2 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 (rotary) mm/s (linear)				

Index	Name	Specification	
66E0h	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 chapter 3.5.2 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 - 2147483647
Description	For setting the upper limit of the velocity monitoring level
Default	1000
Unit	rpm (rotary) mm/s (linear)

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 - 2147483647
Description	For setting the lower limit of the velocity monitoring level
Default	0
Unit	rpm (rotary) mm/s (linear)

Index	Name	Specification	
6760h	FSoE slave frame elements	Object code	ARRAY
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	254
Description	Number of entries
Note	See ETG.6100.3 and ETG5001.4 for details

Sub-index	1
Data type	U8
Name	FSoE slave command
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	2
Data type	U16
Name	FSoE slave connection ID
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	3 - 254
Data type	U16
Name	FSoE slaveCRC 0 - 251
Description	See ETG.6100.3 and ETG5001.4 for details

Index	Name	Specification	
6770h	FSoE master frame elements	Object code	ARRAY
		SDO access	RO
		PDO mapping	-
		SRA parameter	N

Sub-index	0
Setting range	254
Description	Number of entries
Note	See ETG.6100.3 and ETG5001.4 for details

Sub-index	1
Data type	U8
Name	FSoE master command
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	2
Data type	U16
Name	FSoE master connection ID
Description	See ETG.6100.3 and ETG5001.4 for details

Sub-index	3 - 254
Data type	U16
Name	FSoE slaveCRC 0 - 251
Description	See ETG.6100.3 and ETG5001.4 for details

Index	Name	Specification	
6791h	FSoE Drive Connection Communication Parameter	Object code	ARRAY
		SDO access	RO
		PDO mapping	-
		SRA parameter	Y

Sub-index	0
Setting range	13
Description	Number of entries
Default	13

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

Sub-index	2
Data type	U16
Name	Safety 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

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

Sub-index	6
Data type	U16
Name	Connection Type
Value	1 (SubInstance 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

Sub-index	10
Data type	U32
Name	SW version
Description	Software version See ETG.6100.3 and ETG5001.4 for details

Sub-index	13
Data type	U32
Name	HW version
Description	Hardware version See ETG.6100.3 and ETG5001.4 for details

Index	Name	Specification	
67A0h	FSoE Drive Connection Diagnosis	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	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	connection diagnosis																										
Description	<table border="1"> <thead> <tr> <th>Bit</th> <th></th> </tr> </thead> <tbody> <tr> <td rowspan="13">3..0</td> <td>0 : no error</td> </tr> <tr> <td>1 : Wrong command</td> </tr> <tr> <td>2 : Unknown command</td> </tr> <tr> <td>3 : Wrong connection ID</td> </tr> <tr> <td>4 : Wrong CRC</td> </tr> <tr> <td>5 : Watchdog expired</td> </tr> <tr> <td>6 : Wrong FSoE Address</td> </tr> <tr> <td>7 : Wrong data</td> </tr> <tr> <td>8 : Wrong communication parameter length</td> </tr> <tr> <td>9 : Wrong communication parameter</td> </tr> <tr> <td>10 : Wrong application parameter length</td> </tr> <tr> <td>11 : Wrong application parameter</td> </tr> <tr> <td>12 : Unexpected Session command</td> </tr> <tr> <td>13 : If Failsafe data are communication error : Failsafe data receive</td> </tr> <tr> <td rowspan="2">4</td> <td>0 : Error in FSoE MInstance detected</td> </tr> <tr> <td>1 : Error in FSoE SubInstance detected</td> </tr> <tr> <td>5</td> <td>1 : FSoE SubInstance sends no Process Data (FSoE SubInstance in Failsafe)</td> </tr> <tr> <td>6</td> <td>1 : Connection in Startup</td> </tr> <tr> <td>7</td> <td>1 : FSoE MInstance sends no Process Data (FSoE MInstance in Failsafe)</td> </tr> </tbody> </table>	Bit		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 MInstance detected	1 : Error in FSoE SubInstance detected	5	1 : FSoE SubInstance sends no Process Data (FSoE SubInstance in Failsafe)	6	1 : Connection in Startup	7	1 : FSoE MInstance sends no Process Data (FSoE MInstance in Failsafe)
	Bit																										
	3..0	0 : no error																									
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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 MInstance detected																										
	1 : Error in FSoE SubInstance detected																										
5	1 : FSoE SubInstance sends no Process Data (FSoE SubInstance in Failsafe)																										
6	1 : Connection in Startup																										
7	1 : FSoE MInstance sends no Process Data (FSoE MInstance in Failsafe)																										
See ETG5001.4 for details																											

6.1.3.3 OD 3XXXh: Manufacturer specific area2

Index	Name	Specification	
3800h	DSI Function	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	No connecting the safety home sensor to DSI4
	000Dh	Connecting the safety home sensor to DSI4

Index	Name	Specification	
3801h	DSO Function	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	No connecting the safety home sensor to DSO6
	000Dh	Connecting the safety home sensor to DSO6

Index	Name	Specification		
380Ah	safe position monitor scale factor	Object code	VAR	
		Data type	U32	
		SDO access	RW	
		PDO mapping	-	
		SRA parameter	Y	
		Setting range	0 - 4	
		Description	For setting the scale factor for the safe position actual value (Object index 6611h). The result of the following equation is monitored. $\text{Monitor value} = \text{safety position} \times \frac{1}{10^{\text{scale factor}}}$	
		Default	0	

Index	Name	Specification		
380Ch	safe acceleration monitor scale factor	Object code	VAR	
		Data type	U32	
		SDO access	RW	
		PDO mapping	-	
		SRA parameter	Y	
		Setting range	0 - 4	
		Description	For setting the scale factor for the safe acceleration actual value (Object index 6615h). The result of the following equation is monitored. $\text{Monitor value} = \text{safety acceleration} \times \frac{1}{10^{\text{scale factor}}}$	
		Default	0	

Index	Name	Specification	
3810h	Module 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 chapter 3.5.1.5 for details.
Default	100

Sub-index	2						
Name	motor type						
Description	Selects the motor type						
	<table border="1"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Rotary motor</td> </tr> <tr> <td>1</td> <td>Linear motor</td> </tr> </tbody> </table>	value	description	0	Rotary motor	1	Linear motor
	value	description					
	0	Rotary motor					
1	Linear motor						
Default	0						
Note	If the setting is different from that of the drive, an alarm (5C13) will be issued.						

Index	Name	Specification								
3811h	Safe position clear	Object code	VAR							
		Data type	U16							
		SDO access	RW							
		PDO mapping	-							
		SRA parameter	N							
		Setting range	0 - 1							
		Description	The safe position is reset by "0 → 1" edge. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>invalid</td> </tr> <tr> <td>1</td> <td>valid</td> </tr> </tbody> </table>		value	description	0	invalid	1	valid
		value	description							
0	invalid									
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	
3822h	Fault information	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	Fault Current
Description	Show the alarm code currently occurring

Sub-index	2 - 6
Name	Fault Record
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	Single turn bit for encoder
Description	Show the encoder resolution (bit length) per motor revolution.

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

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

Index	Name	Specification	
382Ah	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.

Index	Name	Specification		
382Bh	Safe position status	Object code	VAR	
		Data type	BOOL	
		SDO access	RO	
		PDO mapping	Tx	
		SRA parameter	N	
		Description	Effective status monitor for safe position. It should be assigned to the transmit (Tx) safety PDO. See chapter 3.5.2. for details.	
			Value	Tx
	0	Safe position invalid		
	1	Safe position valid		

Index	Name	Specification			
382Ch	Safe position homing status	Object code	VAR		
		Data type	U16		
		SDO access	RO		
		PDO mapping	-		
		SRA parameter	N		
		Description	Bit	Description	
			0	Safe position setting complete (1:Complete)	
			1	Upper limit setting complete (1:Complete)	
			2	Lower limit setting complete (1:Complete)	
			3..7	Not used	
8	Diagnosis of safe position complete (1:complete)				
	9	Diagnosis of upper limit complete (1:complete)			
	10	Diagnosis of lower limit complete (1:complete)			
	11..15	Not used			

Index	Name	Specification			
382Dh	Safe position homing error id	Object code	VAR		
		Data type	U16		
		SDO access	RO		
		PDO mapping	-		
		SRA parameter	N		
		Description	ID	description	
			0000	No error	
			0001	An encoder that cannot use the SLP function is connected.	
			0002	SLP function not assigned to Safety Control word. Or the safety position is not set.	
			0003	The combination of Object dictionary : 6098 and 38A3 is not correct.	
1000	Incorrect safety origin setting procedure.				
1001	Safety origin diagnosis detected misalignment.				
1002	Safety origin is out of range.				

Index	Name	Specification		
382Eh	Safe position remaining valid time	Object code	VAR	
		Data type	U16	
		SDO access	RO	
		PDO mapping	-	
		SRA parameter	N	
		Description	Displays the time remaining after implementing safe position homing and safety origin diagnostics. When the remaining time reaches 0, STO is activated and operation is disabled.	
		Unit	hour	
		Note	FFFF is displayed when the SLP function is not used.	

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 <sup>2</sup>
Note	The servo drive specifications limit the deceleration rate at approximately 46 rpm/s (76 mm/s <sup>2</sup> ). Therefore, if the set value corresponds to less than the deceleration limit, the deceleration is limited to this value. A setpoint that corresponds to less than the deceleration limit is approximately less than 12,863,000 pulse/s <sup>2</sup> for rotary motors and approximately 19,000,000 pulse/s <sup>2</sup> for linear motors (with an encoder resolution of 4 nm).

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	description
	0	SS1 with time monitoring
	1	SS1 with deceleration monitoring
Default	0	

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	description
	0	by drive
	1	by controller
Default	0	

Index	Name	Specification	
3854h	SS1 deceleration 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 deceleration and deceleration limit. They are extended by the following formula. <i>Actual deceleration = deceleration (OD 3851h)setting value × 10<sup>scale factor</sup></i>
Default	0

Index	Name	Specification							
3860h	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. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SBC disable</td> </tr> <tr> <td>1</td> <td>SBC enable</td> </tr> </tbody> </table>	value	description	0	SBC disable	1	SBC enable
		value	description						
		0	SBC disable						
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. $position\ zero\ monitoring\ width = position\ zero\ window \times 10^{scale\ factor}$
Default	0

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.						
	<table border="1"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>SS2 with time monitoring</td> </tr> <tr> <td>1</td> <td>SS2 with deceleration monitoring</td> </tr> </tbody> </table>	value	description	0	SS2 with time monitoring	1	SS2 with deceleration monitoring
	value	description					
0	SS2 with time monitoring						
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 <sup>2</sup>
Note	<p>The servo drive specifications limit the deceleration rate at approximately 46 rpm/s (76 mm/s<sup>2</sup>). Therefore, if the set value corresponds to less than the deceleration limit, the deceleration is limited to this value.</p> <p>A setpoint that corresponds to less than the deceleration limit is approximately less than 12,863,000 pulse/s<sup>2</sup> for rotary motors and approximately 19,000,000 pulse/s<sup>2</sup> for linear motors (with an encoder resolution of 4 nm).</p>

Index	Name	Specification	
3872h	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	description
	0	by drive
	1	by controller
Default	0	

Index	Name	Specification	
3874h	SS2 deceleration 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 deceleration and deceleration limit. They are extended by the following formula. $Actual\ deceleration = deceleration(OD\ 3871h)\ setting\ value \times 10^{scale\ factor}$
Default	0

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 (rotary) mm/s (linear)

Index	Name	Specification	
3892h	SLS 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 SLS.	
	value	description
	0	SLS with time monitoring
	1	SLS with deceleration monitoring
Default	0	

Index	Name	Specification	
3893h	SLS deceleration 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 deceleration limit. They are extended by the following formula. <i>Actual deceleration limit</i> $= \text{deceleration limit}(OD\ 6697h)\ \text{setting value} \times 10^{\text{scale factor}}$
Default	0

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. $position\ limit = position\ upper/lower\ limit \times 10^{scale\ factor}$
Default	0

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 origin sensor. If a safety limit switch is used, select Enable. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>value</th> <th>description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>disable</td> </tr> <tr> <td>1</td> <td>enable</td> </tr> </tbody> </table>	value	description	0	disable	1	enable
		value	description						
0	disable								
1	enable								
Default	0								

Index	Name	Specification							
38A3h	SLP safety homing method	Object code	VAR						
		Data type	U16						
		SDO access	RW						
		PDO mapping	-						
		SRA parameter	Y						
		Setting range	0 - 1						
		Description	For selecting the safe position homing method. <table border="1"> <thead> <tr> <th>value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>method1</td> <td>Using safety origin sensor</td> </tr> <tr> <td>method2</td> <td>Set the current position as safety origin</td> </tr> </tbody> </table>	value	Description	method1	Using safety origin sensor	method2	Set the current position as safety origin
		value	Description						
		method1	Using safety origin sensor						
method2	Set the current position as safety origin								
Default	0								

Index	Name	Specification	
38A4h	SLP safe position diagnostic range	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 300 (0.0 - 30.0degree) (rotary) 0 - 300 (0.0 - 30.0 mm) (linear)
		Description	Set the pass range for self-diagnosis of the safe position.
		Default	1 (0.1degree) (rotary) 1 (0.1mm) (linear)
		Unit	0.1degree (rotary) 0.1mm (linear)

Index	Name	Specification	
38A5h	SLP safe position offset	Object code	VAR
		Data type	S32
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	-2147483648 - 2147483647
		Description	Sets the offset position from the safety origin reference position to the safety origin.
		Default	0
		Unit	pulse

Index	Name	Specification	
38A6h	SLP safe position limit tolerance	Object code	VAR
		Data type	U16
		SDO access	RW
		PDO mapping	-
		SRA parameter	Y
		Setting range	0 - 300 (0.0 - 30.0degree) (rotary) 0 - 300 (0.0 - 30.0 mm) (linear)
		Description	Set the allowable range of movement beyond the positive/negative limit positions.
		Default	1 (0.1degree) (rotary) 1 (0.1mm) (linear)
		Unit	0.1degree (rotary) 0.1mm (linear)
		Note	Valid only when using the safety origin setting method 2.

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. $position\ limit = position\ relative\ upper/lower\ limit \times 10^{scale\ factor}$
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. $position\ zero\ monitoring\ range = position\ zero\ window \times 10^{scale\ factor}$
		Default	0

Index	Name	Specification			
38F0h	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 chapter 3.5.2 for details.		
			value	Rx	Tx
			0	SBT valid	not SBT state
	1	SBT invalid	SBT state		
	Default	1 (Rx)			

Index	Name	Specification			
38F1h	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 - 100
		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	%

Index	Name	Specification	
38F6h	SBT target torque attainment 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

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This chapter explains details on alarms and how to address and clear them. If an alarm sets off, refer to this chapter to identify the cause and take action properly.

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7.1	Alarm Operation .....	2
7.1.1	Setting Operation to Stop .....	2
7.1.2	Operation to Stop .....	3
7.2	Alarm Indication .....	4
7.3	Resetting Alarms .....	5
7.4	Alarm List .....	6
7.5	Troubleshooting .....	8

## 7.1 Alarm Operation

In the event of an alarm, the Safe Torque Off (STO) action will normally cut off power to the servo motor. However, if a position, speed, or deceleration rate monitoring alarm is detected while the Safe Stop or the Safety Monitoring functions are in effect, the servo motor will be stopped using the selected stop action. (After the servo motor stops, the system will be in the STO state.)

### 7.1.1 Setting Operation to Stop

1) I/O Type

Start Delta Drive Safety and refer to the page for the safety function that you want to use. Select either the STO or the SS1 stop method from the drop-down menu for setting of “error reaction”.

2) EtherCAT communication (FSoE) Type

Select the “error reaction object” of the safety function to be used from the host controller.

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

- To select the STO stop  
Set “0x6640-0001” to “object index 6698-02”.
- To select the SS1 stop  
Set “0x6650-##01” to “object index 6698-02”.  
## is set to the “sub-index” of the SS1 object to be used in the operation to stop the servo motor.

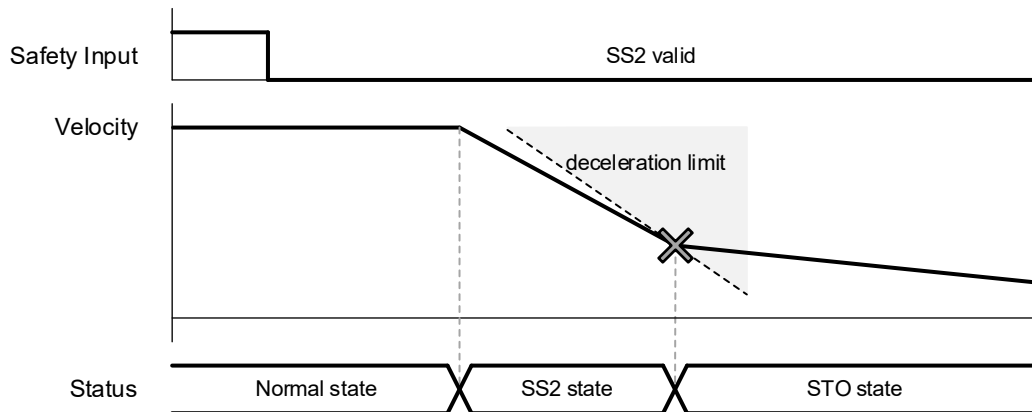
Refer to Section 6.1.3 for the “object index” of the “error reaction” for each safety function.

- ✓ Refer to Section 7.4 for a list of alarms for which you can choose how to stop.

### 7.1.2 Operation to Stop

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

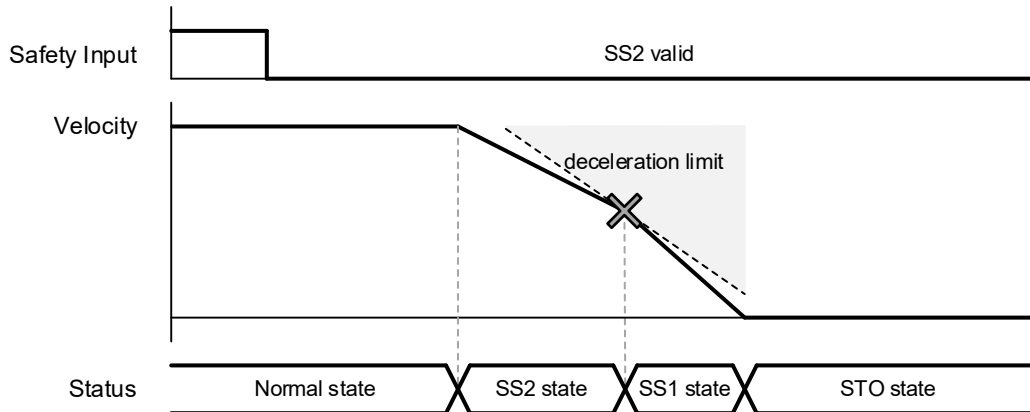
The Safe Torque Off (STO) function is activated when an alarm is detected. The diagram below shows the operation when the deceleration rate exceeds the “deceleration limit” during use of the Safe Stop 2 (SS2-r) function.



When Safe Torque Off (STO) is activated, the servo motor enters a free-run state.

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

The Safe Stop 1 (SS1) function is activated when an alarm is detected. The diagram below shows the operation when the deceleration rate exceeds the “deceleration limit” during use 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 for the SS1. In this case, the servo drive controls the deceleration rate regardless of the “deceleration by drive or controller” setting. When setting the SS1 for “error reaction”, the SS1 parameters should also be set. For the EtherCAT communication (FSoE) type, use the SS1 parameter of the “sub-index” for the “error reaction object”.

## 7.2 Alarm Indication

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, see “Alarm Information” in Delta Drive Safety.

The LEDs on the safety function extension module also indicate alarm conditions.

Pattern	1	2	3
Error	Position monitoring error	Speed monitoring error	Parameter setting error
LED display			
Safety	Orange: Steady	Orange: Steady	Orange: Steady
STAT	Orange: Single flash	Orange: Double flash	Orange: Flashing quickly
STO	Orange: Steady	Orange: Steady	Orange: Steady
FSoE (I/O)	Off	Off	Off
FSoE (Comm)	Green: Steady	Green: Steady	Green: Flashing quickly or Steady
Pattern	4	5	
Error	Other errors	Parameter reset	
LED display			
Safety	Off	Off	
STAT	Off	Orange: Flashing quickly	
STO	Red : Steady	Orange: Steady	
FSoE (I/O)	Red : Steady	Red : Steady	
FSoE (Comm)			

### 7.3 Resetting Alarms

The reset procedures are different for I/O type and communication type.

1) I/O Type

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

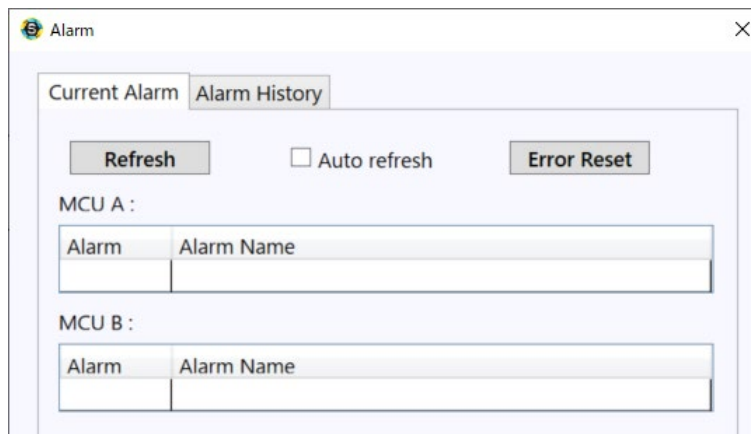
- To check the alarm conditions, monitor the DO signal of the servo drive.  
For details on DO signals, refer to the ASDA-A3-EP AC Servo Drive User Manual.
- Refer to Section 2.2.2.2 for ACK input wiring.
- If the ACK inputs are not wired, turn on the servo drive power back.

2) EtherCAT communication (FSoE) Type

After eliminating the cause of the alarm, change the error reset command (Index: 0x6632) in the safety control word to “1”.

- To check the alarm conditions, monitor the error status of the safety status word.
- For determining the safety control word and the safety status word, refer to Section 3.5.2.

✓ In both cases, the alarm can be reset using the Error Reset button on the Delta Drive Safety Alarm Information screen.



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

## 7.4 Alarm List

Alarm Indication		LED pattern	Name	Resettable/ Non-Resettable	Operation to Stop
Main Code	Subcode				
560	0	4	Processor error	Non-Resettable	STO
561	0	4	Processor error	Non-Resettable	STO
562	0 - 4	4	Memory error	Non-Resettable	STO
563	0 - 8	4	System error	Non-Resettable	STO
565	0	4	System error	Non-Resettable	STO
566	0	4	System error	Non-Resettable	STO
567	0	4	System error	Non-Resettable	STO
568	0	4	System error	Non-Resettable	STO
569	0 - 3	4	System error	Non-Resettable	STO
56A	0,1	4	System error	Non-Resettable	STO
56B	0	4	System error	Non-Resettable	STO
56C	0	4	System error	Non-Resettable	STO
-	-	4	(Reserve)	-	-
570	-	4	Internal communication error	Non-Resettable	STO
571	-	4	Internal communication error	Non-Resettable	STO
572	-	4	Internal communication error	Non-Resettable	STO
573	-	4	Internal communication error	Non-Resettable	STO
574	-	4	Internal communication error	Non-Resettable	STO
575	-	4	Abnormal combination motor	Non-Resettable	STO
576	-	4	Abnormal parameter setting	Non-Resettable	STO
577	-	4	Combination error	Non-Resettable	STO
-	-	4	(Reserve)	-	-
580	-	4	Installation error	Non-Resettable	STO
	1	4	Installation error	Non-Resettable	STO
581	0, 1	4	Clock error	Non-Resettable	STO
582	0	4	Internal power supply over-voltage	Non-Resettable	STO
	1	4	Internal power supply under-voltage	Non-Resettable	STO
583	0, 1	4	FPGA error	Non-Resettable	STO
584	0	4	STO circuit failure	Non-Resettable	STO
585	0	4	Safety input circuit failure	Non-Resettable	STO
	1	4	Safety input mismatch	Non-Resettable	STO
586	0	4	Safety output circuit failure	Non-Resettable	STO
	1	4	Safety output mismatch	Non-Resettable	STO
587	0	4	SBC circuit failure	Non-Resettable	STO
	1	4	SBC output mismatch	Non-Resettable	STO
588	0	4	System overheating	Non-Resettable	STO
589	0, 1	4	Nonvolatile memory error	Non-Resettable	STO
58A	0	4	Safety origin sensor failure	Non-Resettable	STO
-	-	-	(Reserve)	-	-
5A0	0 - 5	4	Internal communication error	Non-Resettable	STO
5A1	0 - 5	4	Internal communication error	Non-Resettable	STO
5A2	0 - 2	4	Internal communication error	Non-Resettable	STO
5A3	0, 1	4	Encoder communication error	Non-Resettable	STO
	2, 3	4	Encoder data error	Non-Resettable	STO
	5	4	Encoder data error	Non-Resettable	STO
5A4	0	4	Safe Position expired error	Non-Resettable	STO
-	-	-	(Reserve)	-	-
5B0	0	4	Combination error	Non-Resettable	STO
-	-	-	(Reserve)	-	-
5BF	0	5	Parameter reset	Non-Resettable	-
5C0	0 - 3	3	Parameter setting error	Resettable	-
5C1	0 - 2	3	Parameter error	Resettable	-
	3	3	Motor type mismatch	Resettable	-
5C2	0	3	Encoder data error	Resettable	STO
-	-	-	(Reserve)	-	-

Alarm Indication		LED pattern	Name	Resettable/ Non-Resettable	Operation to Stop
Main Code	Subcode				
5C4	1 - 2	3	Safe position error	Resettable	STO
-	-	-	(Reserve)	-	-
5C6	1 - 4	2	SS1 deceleration monitoring error	Resettable	STO
5C7	1 - 4	2	SS2 deceleration monitoring error	Resettable	STO/SS1 <sup>※</sup>
5C8	1 - 4	2	SOS speed monitoring error	Resettable	STO
5C9	1 - 4	2	SLS speed monitoring error	Resettable	STO/SS1 <sup>※</sup>
5CA	1, 2	2	SMS speed monitoring error	Resettable	STO/SS1 <sup>※</sup>
5CB	1	2	SDIp speed monitoring error	Resettable	STO
	2	2	SDIn speed monitoring error		
5CC	1 - 4	1	SOS position monitoring error	Resettable	STO
5CD	1	1	SDIp position monitoring error	Resettable	STO
	2	1	SDIn position monitoring error		
5CE	1 - 4	1	SLI position monitoring error	Resettable	STO/SS1 <sup>※</sup>
5CF	1 - 4	1	SLP position monitoring error	Resettable	STO/SS1 <sup>※</sup>

※ The stop method can be selected using parameters. Select the stop method according to the “error reaction” setting for each function.

Alarm Indication		LED pattern	Name	Resettable/ Non-resettable	Operation to stop
Main code	Subcode				
014	-	Normal state	Negative limit error	Resettable	※
015	-	Normal state	Positive limit error	Resettable	※

※ These alarms are detected by the servo drive, so for resetting methods and stopping operations, refer to the ASDA-A3-EP AC Servo Drive User Manual.

## 7.5 Troubleshooting

Alarm code	<b>AL014</b>	
Name	<b>Negative limit error</b>	
Description	When setting the safe position using safe position homing method 1, the safety origin sensor could not be detected and the limit in the negative direction was reached.	
Test and Action	Causes of occurrence (estimated)	Action
	Safety origin sensor not set	The safety origin sensor is not set for DSI4A and DSO6. Please set the parameters according to Chapter 3.7.2.
	Improper installation of safety origin sensor	The safety origin sensor may not be connected correctly. Wire the safety home sensor according to Chapter 2.2.2.4.
	Hardware failure	If the alarm occurs repeatedly, the safety origin sensor or the Safety Function Extension module may be faulty. Replace the safety origin sensor or this product.
Remarks	If this occurs when the safety position is not set using Safe Position Homing Method 1, refer to the ASDA-A3-EP AC Servo Drive User Manual. This alarm is detected by the servo drive.	

Alarm code	<b>AL015</b>	
Name	<b>Positive limit error</b>	
Description	When setting the safe position using safe position homing method 1, the safety origin sensor could not be detected and the limit in the negative direction was reached.	
Test and Action	Causes of occurrence (estimated)	Action
	Safety origin sensor not set	The safety origin sensor is not set for DSI4A and DSO6. Please set the parameters according to Chapter 3.7.2.
	Improper installation of safety origin sensor	The safety origin sensor may not be connected correctly. Wire the safety home sensor according to Chapter 2.2.2.4.
	Hardware failure	If the alarm occurs repeatedly, the safety origin sensor or the Safety Function Extension module may be faulty. Replace the safety origin sensor or this product.
Remarks	If this occurs when the safety position is not set using Safe Position Homing Method 1, refer to the ASDA-A3-EP AC Servo Drive User Manual. This alarm is detected by the servo drive.	

Alarm code	<b>AL560.0 / AL561.0</b>	
Name	<b>Processor error</b>	
Description	For detecting abnormal processor operation	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL562.0 - 4</b>	
Name	<b>Memory error</b>	
Description	For detecting abnormal operation of the built-in memory of the processor	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL563.0 - 8 / AL565.0 / AL566.0 / AL567.0 / AL568.0 / AL569.0 - 3 / AL56A.0 / AL56B.0 / AL56C.0</b>	
Name	<b>System error</b>	
Description	For detecting abnormal program behavior	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL56A.1</b>	
Name	<b>Encoder communication error</b>	
Description	For detecting communication errors with the encoder	
Test and Action	Cause of occurrence (estimated)	Action
	Combination error	Check the encoder type code of the motor model number and replace the servo motor if the encoder is not compatible. Refer to Chapter 1.4 for the compatibility of encoder type codes.
	Abnormal encoder connector setting	The encoder selected in PM.003 does not match the connector to which the encoder is connected.
	Disconnect/miswiring	Check connectors for poor contact, broken wires, and wiring errors. Repair or replace cables if problems are found.
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 above applies, replace the servo motor.	

Alarm code	<b>AL570 / AL571 / AL572 / AL573 / AL574</b>	
Name	<b>Internal communication error</b>	
Description	For detecting internal communication errors	
Test and Action	Cause of occurrence (estimated)	Action
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 by the servo drive, but at the same time there may be other alarms in the safety function extension module, so please check the alarm codes in Delta Drive Safety.	

Alarm code	<b>AL575</b>	
Name	<b>Abnormal combination motor</b>	
Description	A servo motor that cannot be combined is connected.	
Test and Action	Cause of occurrence (estimated)	Action
	A servo motor that cannot be combined is connected	Refer to chapter 1.4 of this manual and replace the servo motor with one that can be combined.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Servo motor failure	Replace the servo motor.
Remarks	This alarm is detected by the servo drive, but at the same time there may be other alarms in the safety function extension module, so please check the alarm codes in Delta Drive Safety.	

Alarm code	<b>AL576</b>	
Name	<b>Abnormal parameter setting</b>	
Description	Mismatch between servo drive parameter P1.100 setting and system configuration	
Test and Action	Cause of occurrence (estimated)	Action
	Abnormal setting of parameter P1.100	When using the safety function extension module, set 1 or 2 to parameter P1.100 of the servo drive. If the safety function extension module is not used, set 0 to P1.100.
	Poor contact between the servo drive and the safety function extension module	Remove the safety function expansion module, clean the contact area with air, etc., and reinstall it.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Servo motor failure	Replace the servo motor.
Remarks	This alarm is detected by the servo drive, but at the same time there may be other alarms in the safety function extension module, so please check the alarm codes in Delta Drive Safety.	

Alarm code	<b>AL577</b>	
Name	<b>Combination error</b>	
Description	Firmware version mismatch between safety function extension module and servo drive	
Test and Action	Cause of occurrence (estimated)	Action
	Outdated firmware version of the safety function extension module	It is necessary to replace the servo drive with a safety function extension module that is compatible with the servo drive firmware or to update the firmware of the safety function extension module. Please contact our customer service.
Remarks	This alarm is detected by the servo drive, but at the same time there may be other alarms in the safety function extension module, so please check the alarm codes in Delta Drive Safety.	

Alarm code	<b>AL580</b>	
Name	<b>Installation error</b>	
Description	For detecting abnormal connections between the Safety Function Extension module and the servo drive	
Test and Action	Cause of occurrence (estimated)	Action
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 Function Extension module and therefore does not appear in Delta Drive Safety.	

Alarm code	<b>AL580.1</b>	
Name	<b>Installation error</b>	
Description	For detecting abnormal connections between the Safety Function Extension module and the servo drive	
Test and Action	Cause of occurrence (estimated)	Action
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL581.0 - 1</b>	
Name	<b>Clock error</b>	
Description	For detecting abnormal operation of the program or the oscillation circuit	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL582.0 / AL582.1</b>	
Name	<b>Internal power supply over-voltage / under-voltage</b>	
Description	For detecting over-voltage and under-voltage of the power supply generated within the Safety Function Extension module	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product and/or servo drive.

Alarm code	<b>AL583.0 - 1</b>	
Name	<b>FPGA error</b>	
Description	For detecting abnormal operation in the FPGA's peripheral circuit or internal devices	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL584.0</b>	
Name	<b>STO circuit failure</b>	
Description	For detecting abnormal operation of STO circuit	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product or Servo drive.

Alarm code	<b>AL585.0</b>	
Name	<b>Safety input circuit failure</b>	
Description	For detecting abnormal operation of safety input circuit	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL585.1</b>	
Name	<b>Safety input mismatch</b>	
Description	For detecting logical mismatch between two safety input channels used in pairs	
Test and Action	Cause of occurrence (estimated)	Action
	Disconnect/miswiring	Check connectors for poor contact, broken wires, and wiring errors. Repair or replace cables if problems are found.
	Mismatch in control timing between the two channels	The timing of the operation of the two channels that are paired together may be shifted by 1 second 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	<b>AL586.0</b>	
Name	<b>Safety output circuit failure</b>	
Description	For detecting abnormal operation of safety output circuit	
Test and Action	Cause of occurrence (estimated)	Action
	Disconnect/miswiring	Check connectors for poor contact, broken wires, and wiring errors. Repair or replace cables if problems are found. If +24V for safety output is not supplied, connect an external power supply.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL586.1</b>	
Name	<b>Safety output mismatch</b>	
Description	For detecting logic mismatch between two channels of safety output signals used in pairs	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 if the safety output has a Safe Speed Monitor (SSM) assignment.	

Alarm code	<b>AL587.0</b>	
Name	<b>SBC circuit failure</b>	
Description	For detecting abnormal operation of SBC circuit	
Test and Action	Cause of occurrence (estimated)	Action
	Disconnect/miswiring	Check connectors for poor contact, broken wires, and wiring errors. Repair or replace cables if problems are found. If +24V for SBC output is not supplied, connect an external power supply.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL587.1</b>	
Name	<b>SBC output mismatch</b>	
Description	For detecting the logical mismatch of the SBC output signals	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL588.0</b>	
Name	<b>System overheating</b>	
Description	For detection of over-temperature inside the safety function extension module	
Test and Action	Cause of occurrence (estimated)	Action
	High ambient temperature	The ambient temperature of the system may exceed the allowable temperature. In this case, review the installation environment or install a cooling system to improve the room temperature.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL589.0 - 1</b>	
Name	<b>Nonvolatile memory error</b>	
Description	For detecting abnormal operation in nonvolatile memory	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL58A.0</b>	
Name	<b>Safety origin sensor failure</b>	
Description	For detecting unsuitable connection of safety origin sensor (not connected, broken wire, or failed)	
Test and Action	Cause of occurrence (estimated)	Action
	Safety origin sensor not connected or disconnected	If the safety origin sensor is not connected, wire the safety origin sensor according to Section 2.2.2.4.
	Safety origin sensor failure	There may be a safety origin sensor failure. In this case, replace with a new sensor
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL5A0.0 - 5 / AL5A1.0 - 5 / AL5A2.0 - 2</b>	
Name	<b>Internal communication error</b>	
Description	For detecting internal communication errors	
Test and Action	Cause of occurrence (estimated)	Action
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.
	Check Servo drive alarm	This alarm may have been triggered by other exiting alarms in the servo drive. Please check whether any additional alarms are active on the servo drive.

Alarm code	<b>AL5A3.0 - 1</b>	
Name	<b>Encoder communication error</b>	
Description	For detecting communication errors with the encoder	
Test and Action	Cause of occurrence (estimated)	Action
	Disconnect	Check connectors for poor contact and broken wires. Repair or replace cables if problems are found.
	Defective installation	Poor contact between the connector and the servo drive (e.g. due to foreign matter) may have occurred during installation of the Safety Function Extension module on the servo drive. In this case, remove the Safety Function Extension module as described in Section 2.1, after that clean the contacts on the connector, and then reassemble them in the correct order.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 above applies, replace the servo motor.

Alarm code	<b>AL5A3.2 - 3</b>	
Name	<b>Encoder data error</b>	
Description	For detecting encoder data anomalies	
Test and Action	Cause of occurrence (estimated)	Action
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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	<b>AL5A3.5</b>	
Name	<b>Encoder data error</b>	
Description	Encoder data does not change	
Test and Action	Cause of occurrence (estimated)	Action
	Encoder failure	There may be an encoder failure. In this case, replace the servo motor.

Alarm code	<b>AL5A4.0</b>	
Name	<b>Safety position expired error</b>	
Description	Safety position diagnostic interval exceeds required deadline	
Test and Action	Cause of occurrence (estimated)	Action
	Three months have passed since the last safety origin diagnosis	Reboot and perform safety origin diagnostics.
Remarks	Perform the safety origin diagnosis again within 3 months after the last safety origin diagnosis.	

Alarm code	<b>AL5B0</b>	
Name	<b>Combination error</b>	
Description	Firmware version mismatch between safety function extension module and servo drive	
Test and Action	Cause of occurrence (estimated)	Action
	Outdated firmware version of the servo drive	It is necessary to replace the safety function extension module with a servo drive that is compatible with the safety function extension module firmware or to update the firmware of the servo drive. Please contact our customer service.

Alarm code	<b>AL5BF.0</b>	
Name	<b>Parameter reset</b>	
Description	Parameter reset is executed.	
Test and Action	Cause of occurrence (estimated)	Action
	Parameter reset is executed	Reconnect the power.

Alarm code	<b>AL5C0.0 - 3 / AL5C1.0 - 1</b>	
Name	<b>Parameter setting error / Parameter error</b>	
Description	For detecting abnormal operation during parameter setting from Delta Drive Safety	
Test and Action	Cause of occurrence (estimated)	Action
	Communication errors with PC	If a communication error occurs between PC and the Safety Function Extension module while the parameters are being updated, the parameters may not be updated correctly. In this case, reset the parameters from Delta Drive Safety again.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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 restored before the alarm is cleared, AL589.0 or AL5C1.2 may occur. In this case, check each treatment.	

Alarm code	<b>AL5C1.2</b>	
Name	<b>Parameter error</b>	
Description	For detecting abnormal operation during parameter setting from Delta Drive Safety	
Test and Action	Cause of occurrence (estimated)	Action
	System power off during parameter update	There may have been a power failure during parameter update process and the parameters are not updated correctly. In this case, turn the power back on and perform a Delta Drive Safety parameter reset, then reconfigure the parameters.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing noise control measures.
	Hardware failure	If the alarm occurs repeatedly, there may be a hardware failure. In this case, replace the product.

Alarm code	<b>AL5C1.3</b>	
Name	<b>Motor type mismatch</b>	
Description	For detecting motor type setting error	
Test and Action	Cause of occurrence (estimated)	Action
	Does not match the servo drive motor type setting.	The motor type settings of the servo drive and safety function extension module do not match. Correct the incorrect one.

Alarm code	<b>AL5C2.0</b>	
Name	<b>Encoder data error</b>	
Description	For detecting encoder data anomalies	
Test and Action	Cause of occurrence (estimated)	Action
	“Encoder diagnostic sensitivity” is too high.	If the “encoder diagnostic sensitivity” setpoint is too high, a false alarm may be detected. Decrease the set value to an appropriate value.
	Servo parameters of the servo drive are improperly set.	The servo loop gain is too low, and the machine motion may not follow the position/speed command. Adjust the servo parameters to improve response or reduce the “encoder diagnostic sensitivity” setting value.
	Forced motor stop by emergency stop operation during operation	This alarm occurs when the motor is stopped suddenly. This is a normal condition, so reset the alarm and use the product as it is.
	Malfunctions due to noise	If the alarm does not recur after reconnecting power, there may be excessive noise around the servo drive. In this case, continue to use the product after implementing 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	<b>AL5C4.1</b>	
Name	<b>Safe position error</b>	
Description	Upper limit of operating range exceeded. (detected only when safe position homing method 2 is selected)	
Test and Action	Cause of occurrence (estimated)	Action
	Overshoots and exceeds the upper limit when stopped near the upper limit of the operating range	Review the operation pattern or adjust to an appropriate gain to suppress overshoot.
	During normal operation after setting the safety origin or safety origin diagnosis, the upper limit of the operating position exceeds the safe position range.	Change the reference position of the safety origin, the safety position offset or the upper limit position of the operating range. (Only when safety position homing method 2 is selected)
	Occurs during safety origin diagnosis	Expand the allowable range with the safe position tolerance range parameter.
Remarks	Passing through the upper limit position of the operating range during operation	Limit the operating range to within the range of the safety position. Alternatively, if the safety origin has been set using the safety position homing method 2, follow the procedure for setting the safety origin and re-set the upper limit position to the appropriate location.
	<ul style="list-style-type: none"> <li>Safety Position Range</li> </ul> The safe position is a range of ±63 bits in encoder pulse units from the safe home position (after adding the safe position offset).	

Alarm code	<b>AL5C4.2</b>	
Name	<b>Safe position error</b>	
Description	Lower limit of operating range exceeded. (detected only when safe position homing method 2 is selected)	
Test and Action	Cause of occurrence (estimated)	Action
	Overshoots and exceeds the lower limit when stopped near the lower limit of the operating range	Review the operation pattern or adjust to an appropriate gain to suppress overshoot.
	As a result of setting the safety origin, the lower operating limit position exceeds the range of the safety position.	Change the reference position of the safety origin, the safety position offset or the lower limit position of the operating range. (Only when safety position homing method 2 is selected)
	Occurs during safety origin diagnosis	Expand the allowable range with the safe position tolerance range parameter.
	Passing through the lower limit position of the operating range during operation	Limit the operating range to within the range of the safety position. Alternatively, if the safety origin has been set using the safety position homing method 2, follow the procedure for setting the safety origin and re-set the lower limit position to the appropriate location.
Remarks	<ul style="list-style-type: none"> <li>• Safety Position Range The safe position is a range of <math>\pm 63</math> bits in encoder pulse units from the safe home position (after adding the safe position offset).</li> <li>• Definition of Lower Limit of Operating Range When the safety origin is set by the safety position homing method 1, it is the position -63 bits from the safety origin in encoder pulse units. When the safety position homing method 2 is used, it is the position set as the lower limit of the operating range.</li> </ul>	

Alarm code	<b>AL5C6.1 - 4</b>	
Name	<b>SS1 deceleration monitoring error</b>	
Description	The deceleration rate exceeds the "deceleration limit" setpoint during deceleration by the Safe Stop 1 (SS1-r) function.	
Test and Action	Cause of occurrence (estimated)	Action
	The "deceleration" setpoint is too small or the "deceleration limit" setpoint is too large.	If the deceleration is controlled by the controller, adjust the deceleration action of the controller for faster deceleration or reduce the "deceleration limit" setpoint. If the deceleration is controlled by the servo drive, the "deceleration" setting should be greater than the "deceleration limit" setting.
	Start monitoring deceleration too early.	In this case, increase the "time delay deceleration monitoring" setpoint to delay the timing of the 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 according to the "deceleration" setpoint. In this case, determine the "deceleration" and the "deceleration limit" according to the load conditions. Also adjust the servo drive parameters (e.g., inertia ratio and servo gain).
Remarks	<ul style="list-style-type: none"> <li>• When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SS1 command. When used with I/O type, the subcode is fixed at 1.</li> <li>• Refer to Section 4.3 for details on each parameter of the SS1 function.</li> </ul>	

Alarm code	<b>AL5C7.1 - 4</b>	
Name	<b>SS2 deceleration monitoring error</b>	
Description	The deceleration rate exceeds the "deceleration limit" setpoint during deceleration by the Safe Stop 2 (SS2-r) function.	
Test and Action	Cause of occurrence (estimated)	Action
	The "deceleration" setpoint is too small or the "deceleration limit" setpoint is too large.	If the deceleration is controlled by the controller, adjust the deceleration action of the controller for faster deceleration or reduce the "deceleration limit" setpoint. If the deceleration is controlled by the servo drive, the "deceleration" setting should be greater than the "deceleration limit" setting.
	Start monitoring deceleration too early.	In this case, increase the "time delay deceleration monitoring" setpoint to delay the timing of the 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 according to the "deceleration" setpoint. In this case, determine the "deceleration" and the "deceleration limit" according to the load conditions. Also adjust the servo drive parameters (e.g., inertia ratio and servo gain).
Remarks	<ul style="list-style-type: none"> <li>When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SS2 command. When used with I/O type, the subcode is fixed at 1.</li> <li>Refer to Section 4.4 for details on each parameter of the SS2 function.</li> </ul>	

Alarm code	<b>AL5C8.1 - 4</b>	
Name	<b>SOS speed monitoring error</b>	
Description	The servo motor speed exceeds the velocity zero window setting during use of the Safe Operation Stop (SOS) function.	
Test and Action	Cause of occurrence (estimated)	Action
	The function is activated while the servo motor is running.	If the alarm sets off immediately after the SOS function is activated, reduce the servo motor speed below the "velocity zero window" setpoint before activating the function, or increase the "time to SOS" setpoint to delay the timing of the speed monitoring.
	The "velocity zero window" setpoint does not match the operating pattern.	When operating with the SOS function enabled, modify the operating pattern so that the servo motor speed does not exceed the "velocity zero window" setpoint, or increase the "velocity zero window" setpoint.
	Occurred during SBT function execution.	The holding force of the electromagnetic brake may have decreased. Replace the servo motor.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SOS command. When used with I/O type, the subcode is fixed at 1.</li> <li>Refer to Section 4.5 for details on each parameter of the SOS function.</li> </ul>	

Alarm code	<b>AL5C9.1 - 4</b>	
Name	<b>SLS speed monitoring error</b>	
Description	The servo motor speed exceeds the “velocity limit” setpoint while the Safely-Limited Speed (SLS) function is being executed.	
Test and Action	Cause of occurrence (estimated)	Action
	Start monitoring the speed too early.	If the alarm sets off immediately after the SLS function is activated, review the operation pattern to ensure that the servo motor speed reaches the velocity limit setpoint before starting velocity monitoring, or increase the “time to velocity monitoring” setpoint and “time for velocity in limit” setpoint to delay the timing of the velocity monitor.
	The “velocity limit” setpoint does not match the operating pattern.	When the SLS function is enabled, check the operating pattern so that the servo motor speed does not exceed the “velocity limit” setpoint, or increase the “velocity limit” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SLS command. When used with I/O type, the subcode is fixed at 1.</li> <li>Refer to Section 4.6 for details on each parameter of the SLS function.</li> </ul>	

Alarm code	<b>AL5CA.1</b>	
Name	<b>SMS speed monitoring error</b>	
Description	The servo motor speed exceeds the “velocity maximum positive” setpoints.	
Test and Action	Cause of occurrence (estimated)	Action
	The “velocity maximum positive” setpoints do not match the operating pattern.	Modify the operating pattern so that the servo motor speed does not exceed the “velocity maximum positive” setpoint, or increase the “velocity maximum positive” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>Refer to Section 4.7 for details on each parameter of the SMS function.</li> </ul>	

Alarm code	<b>AL5CA.2</b>	
Name	<b>SMS speed monitoring error</b>	
Description	The servo motor speed exceeds the “velocity maximum negative” setpoints.	
Test and Action	Cause of occurrence (estimated)	Action
	The “velocity maximum negative” setpoints do not match the operating pattern.	Modify the operating pattern so that the servo motor speed does not exceed the “velocity maximum negative” setpoint, or increase the “velocity maximum negative” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>Refer to Section 4.7 for details on each parameter of the SMS function.</li> </ul>	

Alarm code	<b>AL5CB.1 / AL5CB.2</b>	
Name	<b>SDIp speed monitoring error / SDIn speed monitoring error</b>	
Description	The servo motor speed exceeds the “velocity zero window” setpoints during use of the Safe Direction (SDIp or SDIn) function.	
Test and Action	Cause of occurrence (estimated)	Action
	Start monitoring the speed too early.	If the alarm sets off immediately after the SDIp or SDIn function is activated, reduce the servo motor speed below the “velocity zero window” setpoint before activating the function, or increase the “time to SDI” setpoint to delay the timing of the speed monitoring.
	The “velocity zero window” setpoint does not match the operating pattern.	When operating with the SDIp and SDIn functions enabled, modify the operating pattern so that the servo motor speed in the direction of rotation with the SDI function enabled does not exceed the “velocity zero window” setpoint, or increase the “velocity zero window” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>Refer to Section 4.10 for details on each parameter of the SDIp / SDIn function.</li> </ul>	

Alarm code	<b>AL5CC.1 - 4</b>	
Name	<b>SOS position monitoring error</b>	
Description	The servo motor position exceeds the position zero window setpoint during use of the Safe Operation Stop (SOS) function.	
Test and Action	Cause of occurrence (estimated)	Action
	The function is activated while the servo motor is running.	If an alarm occurs immediately after the SOS function is enabled, enable the function while the servo motor is stopped or increase the “time to SOS” setpoint to allow time for the servo motor to stabilize.
	The “position zero window” setpoint does not match the operating pattern.	When operating with the SOS function enabled, modify the operating pattern so that the servo motor position does not exceed the “position zero window” setpoint, or increase the “position zero window” setpoint.
	Occurred during SBT function execution.	The holding force of the electromagnetic brake may have decreased. Replace the servo motor.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SOS command. When used with I/O type, the subcode is fixed at 1.</li> <li>Refer to Section 4.5 for details on each parameter of the SOS function.</li> </ul>	

Alarm code	<b>AL5CD.1 / AL5CD.2</b>	
Name	<b>SDIp position monitoring error / SDIn position monitoring error</b>	
Description	The servo motor position exceeds the “position zero window” setpoints during use of the Safe Direction (SDIp or SDIn) function.	
Test and Action	Cause of occurrence (estimated)	Action
	Early start of position monitoring	If an alarm occurs immediately after the SDI function is enabled, enable the function while the servo motor is stopped or increase the “time to SDI” setpoint to allow time for the servo motor to stabilize.
	The “position zero window” setpoint does not match the operating pattern.	When operating with both the SDIp and SDIn functions enabled, modify the operation pattern so that the servo motor position in the direction where the functions are activated does not exceed the “position zero window” setpoint, or increase the “position zero window” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>Refer to Section 4.10 for details on each parameter of the SDIp / SDIn function.</li> </ul>	

Alarm code	<b>AL5CE.1 - 4</b>	
Name	<b>SLI position monitoring error</b>	
Description	The servo motor position exceeds “position related upper/lower limit” setpoints during use of the Safely-Limited Increment (SLI) function.	
Test and Action	Cause of occurrence (estimated)	Action
	Early start of position monitoring	If an alarm occurs immediately after the SLI function is enabled, enable the function while the servo motor is stopped or increase the “time to SLI” setpoint to allow time for the servo motor to stabilize.
	The “position related upper / lower limit” setpoints do not match the operating pattern.	When operating with the SLI function enabled, modify the operating pattern so that the servo motor position does not exceed the “position related upper / lower limit” setpoint, or increase the “position related upper / lower limit” setpoint.
Remarks	<ul style="list-style-type: none"> <li>Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SLI command. When used with I/O type, the subcode is fixed at 1.</li> <li>Refer to Section 4.9 for details on each parameter of the SLI function.</li> </ul>	

Alarm code	<b>AL5CF.1 - 4</b>	
Name	<b>SLP position monitoring error</b>	
Description	The servo motor position exceeds the “position related upper/lower limit” setpoints during use of the Safely-Limited Position (SLP) function.	
Test and Action	Cause of occurrence (estimated)	Action
	Early start of position monitoring	If an alarm occurs immediately after the SLP function is enabled, enable the function while the servo motor is stopped or increase the “time to SLP” setpoint to allow time for the servo motor to stabilize.
	The “position related upper / lower limit” setpoints do not match the operating pattern.	When operating with the SLP function enabled, modify the operating pattern so that the servo motor position does not exceed the “position related upper / lower limit” setpoint, or increase the “position related upper / lower limit” setpoint.
Remarks	<ul style="list-style-type: none"> <li>· Parameter changes should be made within the limits of safety that are adequately guaranteed by the risk assessment.</li> <li>· When used with the EtherCAT communication (FSoE) type, the subcode in the error display indicates the sub-index number of the SLP command. When used with I/O type, the subcode is fixed at 1.</li> <li>· Refer to Section 4.11 for details on each parameter of the SLP function.</li> </ul>	



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