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Classification:	☐ New ■ Change

Technical Reference

- Communication Specification -

Product Name: Servo driver

Product Series Name: MINAS A7B (EtherCAT)

Product Model Number: Rotary Motor (Standard / Multi-function / Application specialized)

Motion Control Business Unit Industrial Device Business Division
Panasonic Industry Co., Ltd.
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If you have any questions, please contact the retailer (dealer) from which you purchased the product.

Panasonic

REVISIONS

Date	Rev.	Page	Description	Signed
Jan. 7, 2025	0.0	—	NEWLY ISSUED	—
Apr. 1, 2025	0.1	1.2.4	Changed Function (Add to Unsupported Features) ● position comparison output function ● Monitor Signal Output	—
Apr. 11, 2025	1.0	1.2.2, 1.2.6	Software version upgrade ● CPU1: Ver1.04→Ver1.05 ● Manufacture Software: Ver1.00→Ver1.01	—
		1.2.4	Remove from the list of Unsupported Features ● position comparison output function ● Monitor Signal Output	
		1.2.7	Changed Not Supported to Supported ● MII Management Con-trol/Status (0510h to 0511h), PHY Address (0512h), PHY Register Address (0513h), PHY Data (0514h to 0515h) Deleted Notes ● Length SyncManager 1 (080Ah to 080Bh) Deleted restrictions ● LRW command for proc-ess data RAM area (1000h to FFFFh)	
		2.1	Added restrictions for each control mode ● Cycle time (DC, SM2 communication cycle)	
		4.2	Changed the default value ● ESC Register Byte Address: 0002h to 0003h	
		6.1.2	Changed Protection Function Details ● Err80.3.0 (Primary cause/Detected ESM state/ESM state after detection/Handling/Related objects) ● Err81.1.0 (Primary cause)	
		8.2.8	Updated Object Dictionary List ● Changed the Initial value of 3780h ● Add 37B7h	
		8.2.11	Updated Object Dictionary List ● Add 3A01h	
May 28, 2025	1.1	1.2.7	Changed function (added to the functional difference from the previous series) ● Obj.3724h:00h “Communication function extended setup 3” : bit 5 “Latch position detection delay compensation function switching”	—
		4.4	Added Description	

Date	Rev.	Page	Description	Signed
		5.5.8.4.4, 5.5.8.7, 6.2.1	Corrected typographical errors	

Table of Contents

1 Introduction

The Servo Driver MINAS A7B Series Technical Reference is comprised of two parts: Functional Specification and Communication Specification. The Functional Specification describes the trial runs, tuning and maintenance of the servo driver. The Communication Specification describes the communication specification for the network interface EtherCAT that connects the servo driver (sub device) to the main device.

1.1 EtherCAT Communication

This product is a servo driver that controls motor driving using EtherCAT communication.

EtherCAT is short for “Ethernet for Control Automation Technology”, and is an open network communication between main devices and sub devices using real-time Ethernet developed by Beckhoff Automation GmbH.

EtherCATis managed by ETG (EtherCAT Technology Group).

EtherCAT® is registered trademark and patented technology,
licensed by Beckhoff Automation GmbH, Germany.

1.2 Software Version

1.2.1 Notes Regarding Software

This product incorporates open source software (OSS), and usage is pursuant to the terms of the license (see Technical Reference Functional Specification “10 License Terms for Open Source Software (OSS)”). Your company may also have an obligation to use OSS, so please take appropriate measures at your company.

1.2.2 Applicable Software Version

The present manual applies to the following servo driver software versions.

CPU 1 (Software version 1)	Ver.1.05
CPU 2 (Software version 2)	Ver.1.02
Manufacture Software (Software version 3)	Ver.1.01

1.2.3 Software Version Confirmation Method

The above software versions can be confirmed using the following methods.

- Software version 1, Software version 2
  - EtherCAT communication command Obj.3744h:00h “Software version”
    (See *“5.2.1 Device Information”*)
  - Set-up Support Software (PANATERM ver.7)
- Software version 3
  - EtherCAT communication command Obj.100Ah:00h “Manufacturer software version”
    (See *“5.2.1 Device Information”*)
  - Set-up Support Software (PANATERM ver.7)

1.2.4 Functions Not Currently Supported

The functions listed in the table below are not currently supported in this software version.

Please note that although the following functions are described in some parts of the text, they are not supported in this software version.

Function name
Batteryless encoder
Full-closed control function (rotary scale)
Virtual full-closed control function
Deterioration diagnosis warning function
Retracting operation function
EoE (Ethernet over EtherCAT)
Touch probe function ● External scale z-phase latch function for semi-closed control
Backlash compensation function

1.2.5 Restrictions

The functions below are not compatible with this software version.

The descriptions and notes regarding the following functions in the text are subject to change without prior notice.

Item	Not currently compatible
Device profile	FoE (File Access over EtherCAT)
Modes of Operation (Control modes)	Interpolated position control/ip mode
Motion	Jerk
SDO message	Complete Access

1.2.6 Software Version History

- New software versions are upward compatible with old software versions.

  The parameters used in the old software version can be used as they are in the new software version.

  Parameter factory default values for features added in the new software version are set to values that disable the added features. For this reason, immediately after upgrading, the servo driver will operate in a manner compatible with an older software versions.
- When using the added functions, set parameters in accordance with the explanations of functions in this manual.

Software version		Class	Changed Function Details	Relevant Section	Supported Set-up Support Software (PANATERM ver.7)
CPU1	CPU2				
1.04	1.02	First version	Newly created	―	7.0.0.0 and later
1.05	1.02	Extended Version 1	Monitor Signal Output	TR_FS “3.5”	7.0.3.0 and later
			Position Comparison Output Function	TR_FS “5.3”	
			EtherCAT communication Enhancements	*“1.2.7”* , *“4.2”* , *“6.1.2”*	

1.2.7 Functional Differences from Previous Series

The main differences in communication specifications between the MINAS A7B Series and the MINAS A6B Series are shown in the table below.

For differences in specifications for basic functions, refer to Technical Reference Functional Specification “1.2.6 Functional Differences from Previous Series” .

Description	Specifications				
	A6BE Standard type	A6BF Multi-function type	A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
“1.5 EtherCAT Reference Documents”					
EtherCAT Sub Device Controller	Beckhoff EtherCAT IP Core for Altera® FPGAs		TI EtherCAT Sub Device Controller For details of ET1100 non-compatible functions, see the URL below. "2.5. Sitara TI ESC Exceptions" *https://software-dl.ti.com/processor-industrial-sw/esd/docs/indsw/EtherCAT_Slave/Sitara_TI_ESC_Exceptions.html*		

Description	Specifications				
	A6BE Standard type	A6BF Multi-function type	A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
EtherCAT Event Request (0210h to 0211h):bit 3 “AL Status event”	When main device side processing reads “AL Status” (0130h), “EtherCAT Event Request” (0210h to 0211h):bit 3 “AL Status event” returns to 0.		After confirming with main device side processing that “EtherCAT Event Request” (0210h to 0211h):bit 3 “AL Status event” is now 1, read “AL Status” (0130h). If you do not follow the steps above, “EtherCAT Event Request” (0210h to 0211h):bit 3 “AL Status event” may not return to 0 even if “AL Status” (0130h) is read. To return “EtherCAT Event Request” (0210h to 0211h):bit 3 “AL Status event” to 0 with main device side processing, read “AL Status” (0130h) repeatedly until “EtherCAT Event Request” (0210h to 0211h):bit 3 “AL Status event” returns to 0.		
Watchdog Counter Process Data (0442h) Watchdog Counter PDI (0443h)	The counter count does not increase even if 0 is written to “Watchdog Time PDI” (0410h to 0411h) or “Watchdog Time Process Data” (0420h to 0421h) and PDI/PDO Watchdog is disabled.		The counter count increases by 1 if 0 is written to “Watchdog Time PDI” (0410h to 0411h) or “Watchdog Time Process Data” (0420h to 0421h) and PDI/PDO Watchdog is disabled.		
MII Management Control/Status (0510h～0511h) PHY Address (0512h) PHY Register Address (0513h) PHY Data (0514h～0515h)	Supported		Supported *“Notes on Initial Software Versions”*		
Length SyncManager 1 (080Ah～080Bh)	The sending mailbox (SubDevice→MainDevice) maximum size can be set as an even/odd number.		Only even numbers can be set as the maximum size of the outgoing Mailbox (SubDevice→MainDevice). *“Notes on Initial Software Versions”*		
“4.1 EtherCAT Frame Configuration”					
APRW, FPRW and BRW commands for process data RAM area (1000h to FFFFh)	Supported		Not supported		
LRW command for process data RAM area (1000h to FFFFh)	No restrictions		No restrictions *“Notes on Initial Software Versions”*		
“4.8.3.2 Emergency Messages”					
Alarm cause number acquisition for Error Field	Not supported		Supported		
Data[1] and Data[2] when SyncManager3 setting is invalid	Data[1]: 22h Data[2]: 03h		Data[1]: 20h Data[2]: 00h		
“4.10 Ethernet over EtherCAT (EoE) Function”					
EoE Communication Function	Not supported		Not supported		
“5.2.4 Sync Manager 2/3 Synchronization (1C32h, 1C33h)” Obj.1C32h: “Sync manager 2 synchronization” , Obj.1C33h: “Sync manager 3 synchronization”					
Sync Manager cycle. Obj.1C32h:02h “Cycle time” Obj.1C33h:02h “Cycle time”	125 μs, 250 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 10 ms		62.5 μs, 125 μs, 250 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 10 ms		
Obj.1C33h:03h “Shift time” Setup value restriction	Numbers in increments of 125,000 (125 μs)		Numbers in increments of 62500 (62.5 μs)		

Description	Specifications				
	A6BE Standard type	A6BF Multi-function type	A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
Obj.1C32h:05h “Minimum cycle time” Obj.1C33h:05h “Minimum cycle time”	125,000 (125 μs)		62500 (62.5 μs)		
“5.2.6 Diagnosis history (Error (Alarm) History Readout Function) (10F3h)”					
Alarm history count Obj.10F3h: “Diagnosis history”	14		30		
“5.5.5.3.6 Displacement Control Function”					
Function	Not supported		Not supported		Supported
“5.5.8.1.8 Latch Position Detection Delay Compensation Function”					
Obj.3724h:00h “Communication function extended setup 3” : bit 5 “Latch position detection delay compensation function switching”	Supported		Not supported		
“5.5.8.4.2 Electronic Gear Function”					
Electronic gear ratio valid range	8000× to 1/1000× Communication cycle 125 μs is supported only for an electronic gear ratio of 1/1		128000× to 1/1000× All communication cycles are supported regardless of the electronic gear ratio		
“5.5.8.3.2 Digital outputs (60FEh)”					
Importing the reference time for timestamping into the servo driver Obj.60FEh: “Digital outputs” :bit 28 “Timestamp reference time reset”	Not supported		Supported		
“5.5.8.7 Servo Information Monitoring Object”					
Timestamp reference time setting Obj.430Eh: “Timestamp reference time”	Not supported		Supported		
Obj.4D57h:00h “Driver derating monitor”	Not supported		Supported		
Alarm supplementary information Obj.4DA0h: “Alarm accessory information”	24 types		33 types		
Add alarm occurrence time to alarm supplementary information Obj.4DA0h:25h “Alarm occurrence time on timestamp standard (Lower)” Obj.4DA0h:26h “Alarm occurrence time on timestamp standard (Higher)”	Not supported		Supported		
Alarm cause number acquisition for Obj.4F37h: “Multiple alarm/warning information”	Not supported		Supported		

Description	Specifications				
	A6BE Standard type	A6BF Multi-function type	A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
“6.1.1 List of Protection Functions” “6.1.2 Protection Function Details”					
Cause number expansion	Not supported		Supported		
Err13.2.0 Add	Not supported		Main power supply undervoltage protection (AC interrupt detection)		
Err14.0.0 Alarm name change	Overcurrent protection		Overcurrent protection 1		
Err14.1.☐ Alarm name change Add alarm	IPM error protection		☐= 0: Overcurrent protection 2 ☐= 1: Overheat protection 2 ☐= 2: Overheat protection 3		
Err15.0.0 Alarm name change Cause classification support	Overheat protection		Overheat protection 1		
Err27.5.0 Add	Not supported		Command generation error protection		
Err27.6.☐ Cause classification support Change cause and action	Operation command contention protection		☐ = 0, 1 Operation command contention protection Change cause and action		
Err31.0.☐ Cause classification support Add action	Safety function error protection 1		☐ = 0 to 2, 10 to 12, 20 to 25, 30 to 37, 40 to 43 Safety function error protection 1 Add a countermeasure for when an alarm is triggered by SSU function to the actions		
Err31.2.☐ Add Cause classification support	Safety function error protection 2		☐ = 1 to 3 Safety function error protection 2		
Err33.2.0 Add function	Input function number error 1 protection		Input function number error 1 protection Change cause		
Err33.3.0 Add function	Input function number error 2 protection		Input function number error 2 protection Change cause		
Err33.8.0 Add function	Latch input assignment error protection		Latch input assignment error protection Change cause		
Err34.0.0 Add condition	Motor movable range setup error protection		Motor movable range setup error protection Add condition Pr6.97:bit 2 = 1		
Err39.0.0 Add	Not supported		Not supported		Analog input (AIN) excess protection
Err68.0.0 Add	Not supported		Internal communication processing error protection1		
Err68.3.☐ Add	Not supported		☐ = 0 to 3 Internal communication processing error protection4		
Err68.☐.0 Add	Not supported		☐ = 5 to 11 Internal communication processing error protection6 to 12		

Description	Specifications				
	A6BE Standard type	A6BF Multi-function type	A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
Err68.☐.0 Add	Not supported		☐ = 14, 19, 21 Internal communication processing error protection15, 20, 22		
Err70.0.☐ Alarm name change Cause classification support	U-phase current detector error protection		☐ = 0, 1 U-phase current detector error protection 1, 2		
Err70.1.☐ Alarm name change Cause classification support	W-phase current detector error protection		☐ = 0, 1 W-phase current detector error protection 1, 2		
Err75.0.☐ Add	Not supported		☐ = 0, 1 External memory access error protection		
Err77.0.0 Add	Not supported		Microcomputer error protection 1		
Err77.6.☐ Add	Not supported		☐ = 0 to 3 Microcomputer error protection7		
Err80.4.0 Change	PDO watchdog error protection		PDO watchdog error protection Change primary cause		
Err81.4.0 Change	PDO watchdog setup error protection		PDO watchdog setup error protection Change cause		
Err85.3.0 Change	SII EEPROM error protection		SII EEPROM error protection Change cause		
Err95.☐.0 Alarm name change	Motor automatic recognition error protection		☐ = 0 to 5 Motor automatic recognition error protection 1 to 6		
Err96.2.0, Err96.3.0, Err96.5.0, Err96.7.0, Err96.8.0 Delete	Supported		Not supported		
Err98.2.0 Change	Communication hardware error protection 2		Communication hardware error protection 2 Change cause		
Err98.5.0 Add	Not supported		Hardware self-diagnostic error protection 1 Attribute change, cause change		
Special 7-segment display Add	Not supported		System error protection Front panel display: 71 72 73 75 76 77		
“6.1.2 Protection Function Details”					
Supported ESM state	Init, PreOP, OP, SafeOP, Bootstrap		Init, PreOP, OP, SafeOP		
“6.2.1 List of Warning Functions”					
WngE1h Add	Not supported		Driver overload warning		
WngE2h Add	Not supported		Lifetime detection warning 2		

■ Notes on Initial Software Versions

The initial software version (CPU1 Ver. 1.04, CPU2 Ver. 1.02) has the following specifications:

Description	Specifications A7BE, A7BF, A7BR
MII Management Control/Status (0510h～0511h) PHY Address (0512h) PHY Register Address (0513h) PHY Data (0514h～0515h)	Not supported **Precautions** ● Do not access these registers. If they are accessed, EtherCAT communication will not function properly, or Err77.6.☐ “Microcomputer error protection7” will occur, and it will need to be powered up again.
Length SyncManager 1 (080Ah～080Bh)	The sending mailbox (SubDevice→MainDevice) maximum size can only be set as an even number. **Notes** ● As the default size is 256 bytes, the initial settings can be used without issue. ● If the maximum size of the sending mailbox is set as an odd number, you will not be able to use the sending mailbox for communication. (You cannot respond to mailbox communication commands from a MainDevice)
LRW command for process data RAM area (1000h to FFFFh)	When using this command for process data RAM area (1000h to FFFFh), set the same address in the Logical Start Address of FMMU for both Input and Output.

1.3 Related Documents

The following are documents related to this product (including this manual). See each document as necessary for safe use of this product.

The documents can be downloaded from the following site.

https://industry.panasonic.com/global/en/

Document name	Abbreviations in this manual	Document No.	Description
Servo System Operating Instructions			
MINAS A7B Series Operating Instructions (Overall) EtherCAT Rotary Motor	OI_O	IMG07	This manual describes the selection, connection, usage, and error handling of servo drivers and servo motors to ensure correct and safe use of this product.
MINAS A7B Series Operating Instructions (Tuning) EtherCAT Rotary Motor	OI_A	IMG20	This document describes the adjustment function of the servo driver.
For MINAS Set-up Support Software (PANATERM ver.7) Operating Manual	PT_OM	IMG15	This document describes how to use PANATERM ver. 7, the setup support software for this product.
Servo Driver Standard Specification			
MINAS A7BSeries Standard Specifications Rotary Motor (Standard / Multi-function / Application specialized)	SS	SX-DSV03714	This document describes the hardware specifications of the servo driver.
Servo Driver Technical Reference			
MINAS A7B Series Technical Reference Functional Specification Rotary Motor (Standard / Multi-function / Application specialized)	TR_FS	SX-DSV03752	This document describes how to use the various functions of the servo driver.
MINAS A7B Series Technical Reference Communication Specification Rotary Motor (Standard / Multi-function / Application specialized)	TR_CS	SX-DSV03755	This document describes the interface that connects the servo driver to the host device.
Motion Controller User's Manual			
GM1 Controller User’s Manual (Operation)	GM1_UM	WUME-GM1OP	This document describes how to use the motion controller GM1.

1.4 Trademarks

- MINAS, TUNE COMPASS and PANATERM are registered trademarks or trademarks of Panasonic Holdings Corporation in Japan and other countries.
- EtherCAT is a registered trademark and patented technology licensed by Beckhoff Automation GmbH, Germany.

1.5 EtherCAT Reference Documents

This document has been created with reference to the following documents.

To the extent of any discrepancy between this document and the following reference documents, the descriptions in this document take precedence.

We do not guarantee all of the information in the reference materials that are not included in this document.

■ EtherCAT standards

Number	Document	Type	State	Version	Date
ETG.1000.2	EtherCAT Specification - Part 2 - Physical Layer service definition and protocol specification	S	R	V1.0.4	2017/09/15
ETG.1000.3	EtherCAT Specification - Part 3 - Data Link Layer service definition	S	R	V1.0.4	2017/09/15
ETG.1000.4	EtherCAT Specification - Part 4 - Data Link Layer protocol specification	S	R	V1.0.4	2017/09/15
ETG.1000.5	EtherCAT Specification - Part 5 - Application Layer service definition	S	R	V1.0.4	2017/09/15
ETG.1000.6	EtherCAT Specification - Part 6 - Application Layer protocol specification	S	R	V1.0.4	2017/09/15
ETG.1020	Protocol Enhancements	S	R	V1.2.0	2015/12/01
ETG.1300	Indicator and Labeling	S	R	V1.1.1	2015/07/03
ETG.2000	Slave Information	S	R	V1.0.8	2016/09/20
ETG.6010	Implementation Directive for CiA402 Drive Profile	D	R	V1.1.0	2014/11/19

■ CiA402 standards

Number	Document	Type	State	Version	Date
IEC 61800-7-200 (201)	Adjustable speed electrical power drives systems - Profile type 1 specification	—	—	Ed.1.0	2007/8/10
IEC 61800-7-300 (301)	Adjustable speed electrical power drives systems - Mapping of profile type 1 to network technologies	—	—	Ed.1.0	2007/8/10

■ ESC register information

- PRU ICSS EtherCAT Sub Device Controller Register List

See the URL below. If a part number is specified, see AM64x information.

https://software-dl.ti.com/processor-industrial-sw/esd/docs/indsw/EtherCAT_Slave/PRU_ICSS_EtherCAT_Slave_Controller_Register_List.html

There are ET1100 non-compatible features. For details, see the URL below.

"2.5. Sitara TI ESC Exceptions"

https://software-dl.ti.com/processor-industrial-sw/esd/docs/indsw/EtherCAT_Slave/Sitara_TI_ESC_Exceptions.html

1.6 Precautions

- Unauthorized reproduction or duplication of the contents of the present text, either in whole or in part, is strictly prohibited.
- In order to improve the product, contents of this document (specifications, software versions, etc.) are subject to change without notice.
- The factory default values of the parameters and objects for this product have changed from the previous series (MINAS A6B Series and earlier). When changing from a previous series to this product, it may be necessary to adjust parameters and objects.

  For the factory default values of the parameters for this product, see Technical Reference Functional Specification “8 List of Parameters” . For object factory default values, see *“8 Object Dictionary List”* .
- This product may not operate in complete compatibility with previous series.

  Be sure to carry out an evaluation before changing from a previous series to this product.

1.7 Information Needed to Read this Document

■ Bit expressions

In this document, the LSB is treated as bit 0.

Take this into consideration when assigning functions to parameters and objects in bit units.

■ Abbreviations

The official names for abbreviations used in this document are listed in *"9 Glossary"* .

■ Absolute encoder

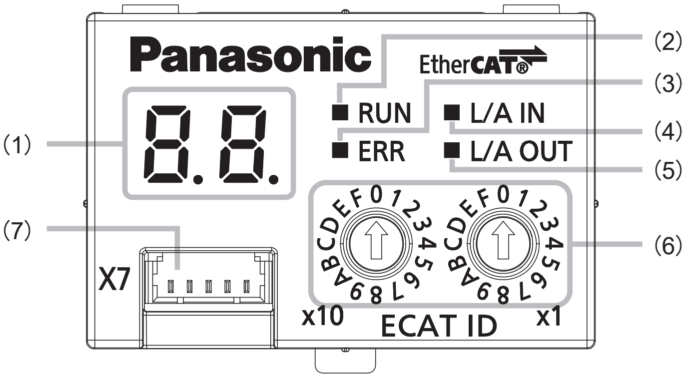
The following two types of absolute encoders exist, which differ depending on the method in which multi-turn data is backed up.

- Absolute encoder (battery backup)
  A type that requires a battery connection to back up multi-turn data
- Batteryless absolute encoder
  A type that does not require a battery connection to back up multi-turn data

Functions that are not specifically mentioned are common to both types of absolute encoders.

■ Front panel configuration

The front panel configuration for this product is shown in the figure below.



No. in image	Name	
(1)	7-segment LED for display (2-digit)	
(2)	RUN LED (Green)	EtherCAT Indicator
(3)	ERROR LED (Red)	
(4)	Link/Activity IN LED (Green)	
(5)	Link/Activity OUT LED (Green)	
(6)	Node address (Station Alias) setting rotary switch (2-digit) Setting range: 0 to FF	
(7)	Analog monitor connector (X7)	

Analog monitor connector X7

Pin No.[*1]	Symbol	Description
1	AM1	Analog monitor 1
2	AM2	Analog monitor 2
3	GND	Signal ground
4, 5	—	Reserved (connection prohibited)

*1 Going from the left, the pins are numbered in 1, 2, 3 order

■ Set-up Support Software (PANATERM ver.7)

Connecting a computer with the Set-up Support Software (PANATERM ver.7) installed with this product enables simple procedures including monitoring of parameter settings and control status, set-up support and device analysis.

Set-up Support Software (PANATERM ver.7) is compatible with the following functions.

- USB communication
- Reading and writing servo parameters
- Reading and writing objects
- Status monitoring inside the driver and of input/output terminals
- Alarm detail display, history display, and clearing
- Graphic display of motor operation waveforms
- Trial run, frequency characteristics analysis function (FFT function)

Etc.

For details on Set-up Support Software (PANATERM ver.7) , see Set-up Support Software (PANATERM ver.7) Operating Manual.

Install the Set-up Support Software (PANATERM ver.7) to the computer after downloading it from the Panasonic website. We do not have CD-ROMs or other media available for distribution.

2 List of Functions and Specifications

2.1 Basic Network Specifications

Item	Specifications
Physical Layer	100BASE-TX (IEEE 802.3)
Baud rate	100 Mbps (Full duplex)
Topology	Line (Please inquire regarding non-line connections)
Connection cable	Twisted-pair CAT5e
Cable length	Between nodes: Maximum 100 m
Number of sub devices (axes) connected	Maximum 65535
Communication ports	2 ports (RJ45 connector)
EtherCAT Indicators (LED)	[RUN] RUN indicator (Green) [ERR] ERROR indicator (Red) [L/A IN] Port 0 Link/activity indicator (Green) [L/A OUT] Port 1 Link/activity indicator (Green)
Station Alias (ID)	Setting range: 0 to 65535 Setup Method (1) Lower 8 bits: Rotary switch, 2-digit (front panel) Upper 8 bits: Object 3740h Setup Method (2) SII saved value
Explicit Device ID	Supported
Device profile	CoE (CANopen over EtherCAT)
SyncManager	4
FMMU	3
Modes of Operation (Control modes) Abbreviation: Op-mode	● Semi-closed control (S) • Position Control: Profile position control (pp), cyclic position control (csp), homing position control (hm) • Velocity Control: Profile velocity control (pv), cyclic velocity control (csv) • Torque Control: Profile torque control (tq), cyclic torque control (cst) ● Full-closed control (F) • Position Control: Profile position control (pp), cyclic position control (csp), homing position control (hm) The above semi-closed control and full-closed control are switched by parameters. Switches between the abovementioned pp, csp, hm, pv, csv, tq, cst according to the EtherCAT communication object
Touch Probe	2ch positive edge, negative edge
Synchronous mode	DC (SYNC0 event synchronization) (DC 64 bit) SM2 (SM2 event synchronization) FreeRUN (asynchronous)
Cycle time (DC, SM2 communication cycle)	62.5 μs, 125 μs, 250 μs, 500 μs, 1 ms, 2 ms, 4 ms, 8 ms, 10 ms pp, pv, tq are not compatible with 62.5 μs and 125 μs hm is not compatible with 62.5 μs
Communication object	SDO (Service Data Object) PDO (Process Data Object)
SDO message	Supported: SDO Request, SDO Response, SDO information, Emergency message Not currently supported: Complete Access
Free PDO Mapping	Supported

Item	Specifications
Maximum number of PDO assignments	RxPDO: 4 Table TxPDO: 4 Table
Maximum data length	RxPDO: 32 bytes TxPDO: 32 bytes
Diagnosis Object	Supported: Diagnosis message
Command Object	Not currently supported
Shift time	Only input (response) in 62.5 μs increments is supported
csp position command correction when there is a communication error	Supported
Object editor	Supported (object value can be monitored and changed using Set-up Support Software (PANATERM ver.7))
EtherCAT communication confirmation pending Set-up Support Software (PANATERM ver.7) operation	Supported

2.2 Supported Control Modes

The table below shows the control modes supported by the product and an overview of the control modes.

—: None

Class	Control mode		Abbreviation	Description
—	NOP	NOP	NOP	A mode for sending temporary invalid data immediately after the network is established.
Semi-closed control	Profile position control mode	Profile position mode	pp	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic synchronous position mode	csp	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.
	Homing position control mode	Homing mode	hm	This is a position control mode in which the host device designates settings such as the homing method, operating speed, etc., generates position commands inside the servo driver, and performs the homing operation.
	Profile velocity control mode	Profile velocity mode	pv	This is a velocity control mode in which the host device designates settings such as the target speed and acceleration/deceleration, and operates by generating position commands inside the servo driver.
	Cyclic velocity control mode	Cyclic synchronous velocity mode	csv	A velocity control mode in which the host device generates a speed command, and operates by updating (sending) the command speed in a communication cycle.
	Profile torque control mode	Torque profile mode	tq	This is a torque control mode in which the host device designates settings such as the target torque, and acceleration/deceleration, and operates by generating position commands inside the servo driver.
	Cyclic torque control mode	Cyclic synchronous torque mode	cst	A torque control mode in which the host device generates a torque command, and operates by updating (sending) the command torque in a communication cycle.
Full-closed control	Profile position control mode	Profile position mode	pp	A position control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and operates by generating position commands inside the servo driver.
	Cyclic position control mode	Cyclic synchronous position mode	csp	A position control mode in which the host device generates a position command, and operates by updating (sending) a command position in a command updating cycle.
	Homing position control mode	Homing mode	hm	This is a position control mode in which the host device designates settings such as the homing method, operating speed, etc., generates position commands inside the servo driver, and performs the homing operation.

2.3 Supported Functions (By Driver Type)

The table below shows the functions supported by this product by driver type.

The functions listed in gray in the table below are not supported in this software version.

○: Supported ×: Not supported

Class	Function	Driver Type		
		A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
Control mode	Semi-closed control			
	Profile position control mode (pp)	○	○	○
	Cyclic position control mode (csp)	○	○	○
	Homing position control mode (hm)	○	○	○
	Profile velocity control mode (pv)	○	○	○
	Cyclic velocity control mode (csv)	○	○	○
	Profile torque control mode (tq)	○	○	○
	Cyclic torque control mode (cst)	○	○	○
	Full-closed control			
	Profile position control mode (pp)	×	○	○
	Cyclic position control mode (csp)	×	○	○
	Homing position control mode (hm)	×	○	○
	Full-closed control (rotary scale)	×	×	×
Input/output	Analog input	×	×	○
	Analog output (analog monitor 1, analog monitor 2)	○	○	○
	External scale division/multiplication settings	○	○	○
	Positioning complete output (INP/INP2)	○	○	○
	Speed arrival output	○	○	○
	Velocity coincidence output	○	○	○
Basic	Rotational direction setting	○	○	○
	Command input processing	○	○	○
	Electronic gear function	○	○	○
	Motor working range setup function	○	○	○
	Two-degree-of-freedom control (position)	○	○	○
	Two-degree-of-freedom control (speed)	○	○	○
	Two-degree-of-freedom control (full-closed)	×	○	○
	Regenerative resistor settings	○	○	○
	Absolute settings	○	○	○
	Velocity limit function	○	○	○
	External scale selection function	×	○	○
	External scale dividing ratio settings	×	○	○
	Hybrid Deviation Excess Setup	×	○	○
	Full-closed control function (rotary scale)	×	×	×
	Batteryless absolute encoder	×	×	×
Adjustment	For details on adjustment functions, see Operating Instructions (Tuning).			

Class	Function	Driver Type		
		A7BE Standard type	A7BF Multi-function type	A7BR Application specialized type
Application	Torque limit switching function	○	○	○
	Torque saturation protection function	○	○	○
	Position comparison output function	○	○	○
	Single-turn absolute function	○	○	○
	Continuous rotating absolute encoder function	○	○	○
	Pulse regeneration function	○	○	○
	Displacement control function	×	×	○
	Virtual full-closed control function	×	×	×
	External scale position information monitor function for semi-closed control	×	○	○
	Deterioration diagnosis warning function	×	×	×
	Touch probe function (*1)	○	○	○
	Retracting operation function	×	×	×
	Deceleration to stop function	○	○	○
	Deceleration to stop function for during over-travel inhibit input (POT, NOT)	○	○	○
	Deceleration to Stop Function for Servo Off	○	○	○
	Deceleration to stop function for when main power supply is off	○	○	○
	Deceleration to stop function for when alarm is triggered	○	○	○
	Emergency stop function for when alarm is triggered	○	○	○
	Fall prevention function for when alarm is triggered	○	○	○
	Fall prevention function for servo-on	○	○	○
	Slow stop function	○	○	○
	Driver derating function	○	○	○
	EoE (Ethernet over EtherCAT)	×	×	×
Safety	Safety function	×	○	○
Protection	Protection functions	○	○	○
	Warning functions	○	○	○
	Timestamp function	○	○	○

*1 External scale z-phase latch function for semi-closed control is not currently compatible.

3 Startup

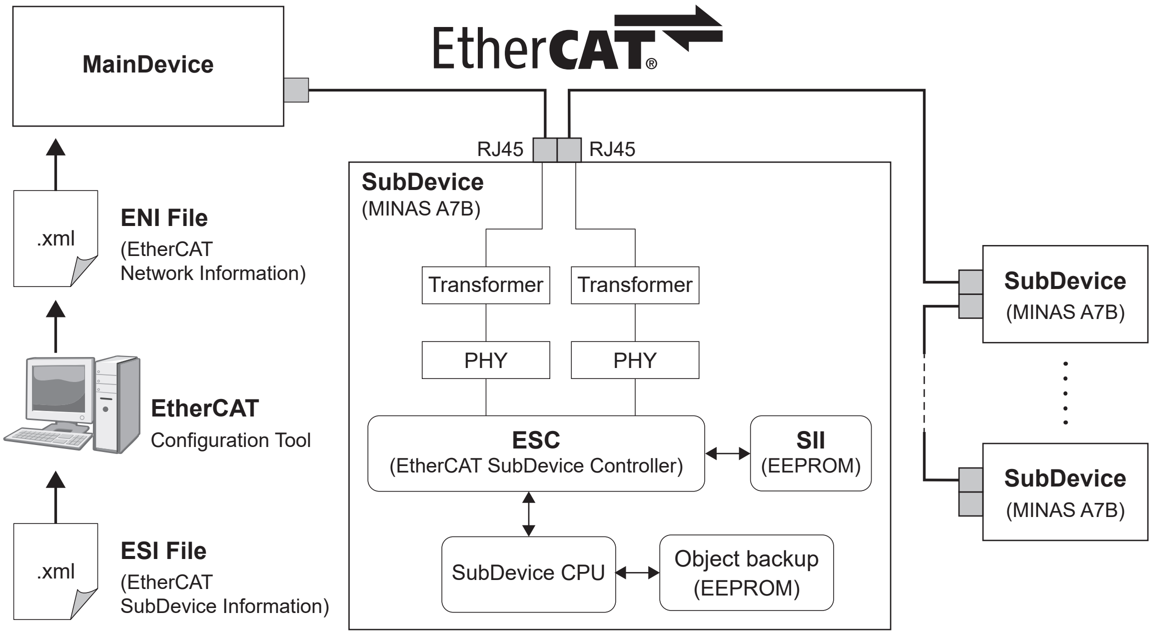
3.1 System Configuration

EtherCAT is a network system that connects a main device and multiple sub devices on a line.

Please contact us regarding non-line connections.

The number of potential node connections for a sub device depends on the processing and communication cycle of the main device, and on factors such as the number of bytes transmitted. Please also check the main device specifications.

The main device generates EtherCAT Network Information (ENI) based on EtherCAT Sub Device Information (ESI) we provide, and construct EtherCAT networks using ENI (using configuration tools).



- EtherCAT Sub Device Information (ESI)

  This is an XML-format file we provide.

  Download from our website.

  https://industry.panasonic.com/global/en/

  It lists definitions of fixed sub device information (including vendor data, product data, profile, object, process data, synchronization and SyncManager settings).

- EtherCAT Network Information (ENI)

  This is a file generated on the main device side.

  ENI contains information (such as vendor data) to identify sub devices and to initialize each sub device. The main device initializes and constructs the network based on data contained in ENI.

- Sub device Information Interface (SII)

  EEPROM containing saved SII data is connected to the ESC.

  Data such as ESC initialization information, spec values for sub device application Communication Setting (mailbox data size values) and process data mapping is contained in the EEPROM (SII).

Precautions

- The cable length between nodes should be 100 m or less.
- This product does not support communication other than EtherCAT, for example the RTEX (Realtime Express) communication type MINAS A☐N Series cannot be connected.

  However, it can be connected to the EtherCAT communication type MINAS A☐B Series.

- When this product is rebooted, initialize EtherCAT communication and re-establish communication.

3.2 General Procedure for Establishing Communication

This section describes a general procedure for using profile position control (pp) to establish communication and enable motor operation.

Notes

- This section is for reference only and does not guarantee operation.
- Because this section is for reference only, setup procedures for homing and other operations are omitted.
- Object values must be changed from their factory default values to values appropriate for the environment in which the device is used.

  For the factory default values of each object, see *“8 Object Dictionary List”* .
- For settings and operations, see from chapter *“4 Communication System”* onwards in this document as well as ETG standards.

1 Preparation and connections (see mainly *“4 Communication System”*)

1-1 Connect the servo driver (sub device) to the main device and the motor.

1-2 An ESI file (.xml format) that describes EtherCAT sub device information is required for EtherCAT communication.

Save the provided ESI file to the save destination for the ESI file as specified in the main device.

Notes

- The following two types of ESI file are provided.
  - ESI file without object dictionary:

    An ESI file that comprises only the minimum amount of information (small file size)
  - ESI file with object dictionary:

    An ESI file that includes object dictionary information (large file size)

1-3 Main devices generate ENI based on the provided ESI and construct EtherCAT networks (using configuration tools). (For details, see Servo System Operating Instructions for main devices)

1-4 Set the Station Alias.

The initial value for Station Alias is SII.0004h “Configured Station Alias” =0.

When setting the Station Alias using the rotary switch on the front of the servo driver, turn on the control power once and write Obj.3741h:00h “Station Alias selection” = 0 to EEPROM.

After turning off the control power, set the Station Alias using the rotary switch. (The Station Alias can be set between 0 and 255 using only the rotary switch. To set to 256 or higher, see *“4.6 Node Address”*)

An additional setting method is via AL Status Code. For details, see *“4.6 Node Address”* .

The main device reads the value set in ESC register 0012h “Configured Station Alias” and sets that setting value to 0010h “Configured Station Address” .

This setting sets addresses for the FPRD commands, etc., used by Mailbox.

1-5 Turn on both the servo driver main power supply and control power.

After powering on, check the 7-segment LED on the front of the servo driver to confirm that no errors have occurred.

2 Establishing communication (see mainly *“4 Communication System”* and *“5.2 CoE Communication Area (1000h to 1FFFh) Details”*)

2-1 The main device initializes and constructs communication in accordance with the ENI file.

As an example of setup, DC mode setup is shown below.

(When time until DC mode, 2 ms cycle data is latched = 0 μs)

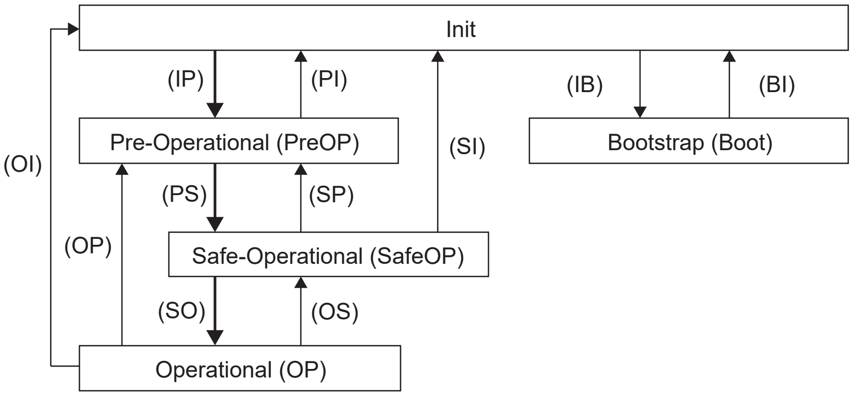
- Obj.1C32h:01h = 2 (DC), Obj.1C32h:02h = 2,000,000 ns
- Obj.1C33h:01h = 2 (DC), Obj.1C33h:03h = 0 ns

2-2 Configure the ESM (EtherCAT State Machine) register settings (SyncManager for MailBOX, etc.) to transition the ESM status from Init to PreOP.

2-3 After checking the ESM status has changed to PreOP, configure ESC Register settings (SyncManager for DC and PDO, etc.) to transition the ESM status from PreOP to SafeOP.

2-4 After confirming that the ESM status has changed to SafeOP, transition the ESM status from “SafeOP” to “OP”.

EtherCAT Application Layer Status Transition Diagram



* Bootstrap is not currently supported.

3 Object setup (see mainly *“5.5 Drive Profile Area (6000h to 6FFFh) Details”*)

3-1 This section describes an example setting for initiating the absolute positioning operation using pp control as shown in the diagram below.

3-2 Change the control mode (Obj.6060h:00h “Modes of operation”).

Set Obj.6060h = 1 (pp)

3-3 Change the target position (Obj.607Ah:00h “Target position”).

Set Obj.607Ah = 50,000,000 command units.

When the Obj.607Dh: “Software position limit” setting is enabled, the operating range is restricted. For details, see *“5.5.5.1 Position Control Common Functions”* .

3-4 Change the target speed (Obj.6081h:00h “Profile velocity”).

Set Obj.6081h = 2,000,000 command units/s.

The operation speed is restricted depending on the Obj.607Fh:00h “Max profile velocity” and Obj.6080h:00h “Max motor speed” setup values. For details, see *“5.5.5.1 Position Control Common Functions”* .

3-5 Change the acceleration (Obj.6083h:00h “Profile acceleration”).

Set Obj.6083h = 5,000,000 command units/s^2.

The operation speed is restricted depending on the Obj.60C5h:00h “Max acceleration” setup value. For details, see *“5.5.5.1 Position Control Common Functions”* .

3-6 Change the deceleration (Obj.6084h:00h “Profile deceleration”).

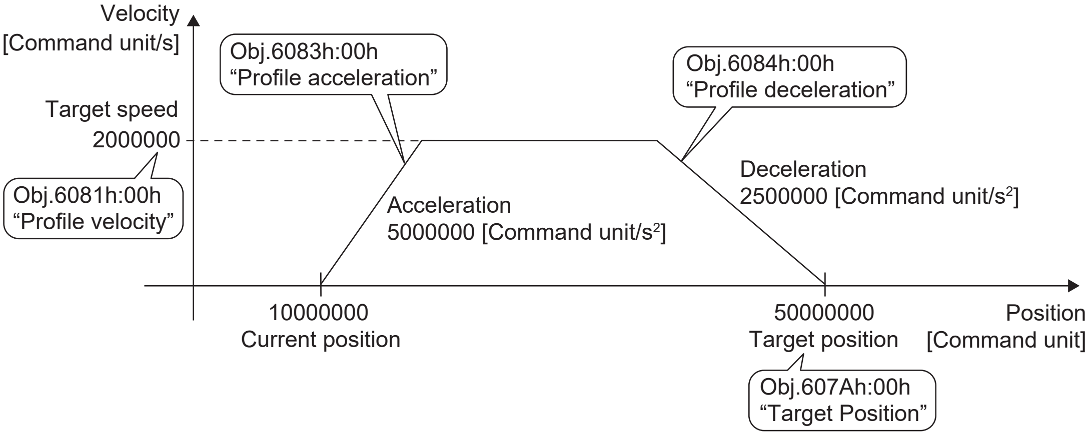
Set Obj.6084h = 2500000 command units/s^2.

The operation speed is restricted depending on the Obj.60C6h:00h “Max deceleration” setup value. For details, see *“5.5.5.1 Position Control Common Functions”* .

Notes

- The deceleration method in the event of a EtherCAT-related alarm (Err80.☐.☐, Err81.☐.☐, Err85.☐.☐, Err88.☐) is in accordance with Obj.605Eh:00h “Fault reaction option code” settings.

  In the servo driver default state, the deceleration method at over-travel inhibit input is in accordance with Obj.6085h:00h “Quick stop deceleration” settings.
- Change the settings from their factory default values to values appropriate for the environment in which the device is used.



Please contact us for further details or with any questions regarding conditions for operation and other matters.

4 Motor operation (see mainly *“5.5 Drive Profile Area (6000h to 6FFFh) Details”*)

In EtherCAT communication, the servo driver status is represented by the PDS (Power Drive Systems) status.

PDS can be changed with Obj.6040h:00h “Controlword” and the status confirmed with Obj.6041h:00h “Statusword” .

After ensuring that the status has transitioned with Obj.6041h:00h “Statusword” , send the command to transition to the next status.

When running the motor, follow the steps below to change PDS.

4-1 Transition the PDS status from “Switch on disabled” to “Ready to switch on”.

Set Obj.6040h:00h “Controlword” = 0006h (2: Shutdown) and confirm that Obj.6041h:00h “Statusword” has changed from xx40h to xx21h.

4-2 Transition the PDS status from “Ready to switch on” to “Switched on”.

Set Obj.6040h:00h “Controlword” = 0007h (3: Switch on) and confirm that Obj.6041h:00h “Statusword” has changed from xx21h to xx33h.

4-3 Transition the PDS status from “Switched on” to “Operation enabled”.

Set Obj.6040h:00h “Controlword” = 000Fh (4: Enable operation) and confirm that Obj.6041h:00h “Statusword” has changed from xx33h to xx37h.

When Obj.6041h:00h “Statusword” = xx37h, the servo driver is in servo-on state.

4-4 To start pp operation, change Obj.6040h:00h “Controlword” :bit 4 “new set-point” from 0 to 1.

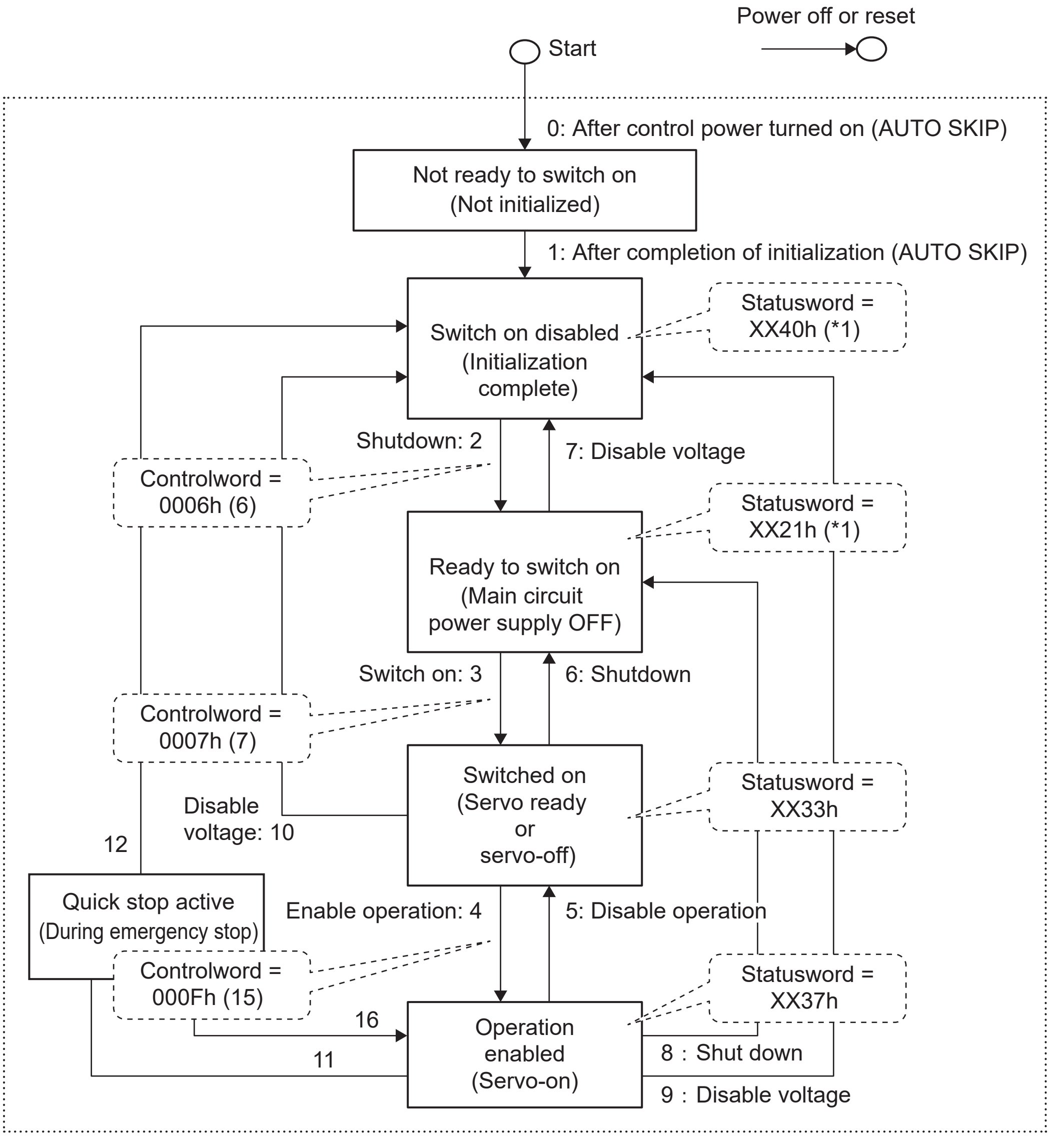
Leave bit 5 “change set immediately” , bit 6 “absolute / relative” and bit 9 “change on set-point” as 0.

Set Obj.6040h:00h “Controlword” = 001Fh.

The motor will start operating when the above settings are complete.

4-5 Transition the PDS status from “Operation enabled” to “Switched on” to turn to servo-off.

Set Obj.6040h:00h “Controlword” = 0007h (5: Disable operation) and confirm that Obj.6041h:00h “Statusword” has changed from xx37h to xx33h.



*1 When the main circuit power supply voltage is not applied to PDS, the Obj.6041h:00h “Statusword” value is entered.

When the main circuit power supply voltage is applied to PDS, Obj.6041h:00h “Statusword” :bit 4 “voltage enabled” is 1.

Precautions

If the motor is not operating, check the following.

- When not in servo-on, the main device may have sent a command to transition to the next status before the PDS status inside the driver has transitioned. Confirm that the PDS status transition is complete before sending a command to transition to the next status.
- When in servo-on but without the motor operating, there may be an error in objects settings or a setting may have been missed. Please check object setup values.

  Specifically, check that there are no restrictions in place due to objects with maximum values set such as Obj.6080h:00h “Max motor speed” and objects with an operating range set such as Obj.607Dh: “Software position limit” .

  If Obj.6041h:00h “Statusword” :bit 11 “internal limit active” is 1, internal restrictions are set.After referring to *“5.5.3 Statusword (6041h)”* , eliminate the cause of the internal restrictions.
- If an alarm occurs, see *“6 Protection Functions/Warning Functions”* or Technical Reference Functional Specification “7 Protection Function, Warning Function, Time Stamping Function” in this document and eliminate the cause of the alarm.

After eliminating the cause of the alarm, see *“6 Protection Functions/Warning Functions”* in this document and clear the alarm.

4 Communication System

4.1 EtherCAT Frame Configuration

EtherCAT is an Ethernet-based real-time controllable industrial communication protocol.

This protocol extends the IEEE 802.3 Ethernet standard and enables transmission of data within the standard Ethernet frame without any infrastructural changes.

Setting the Ethernet Header EtherType to 88A4 causes Ethernet Data to process Ethernet frames as EtherCAT frames.

EtherCAT frame consists of a EtherCAT Header and one or more EtherCAT Datagrams, with theEtherCAT Datagram being further subdivided.

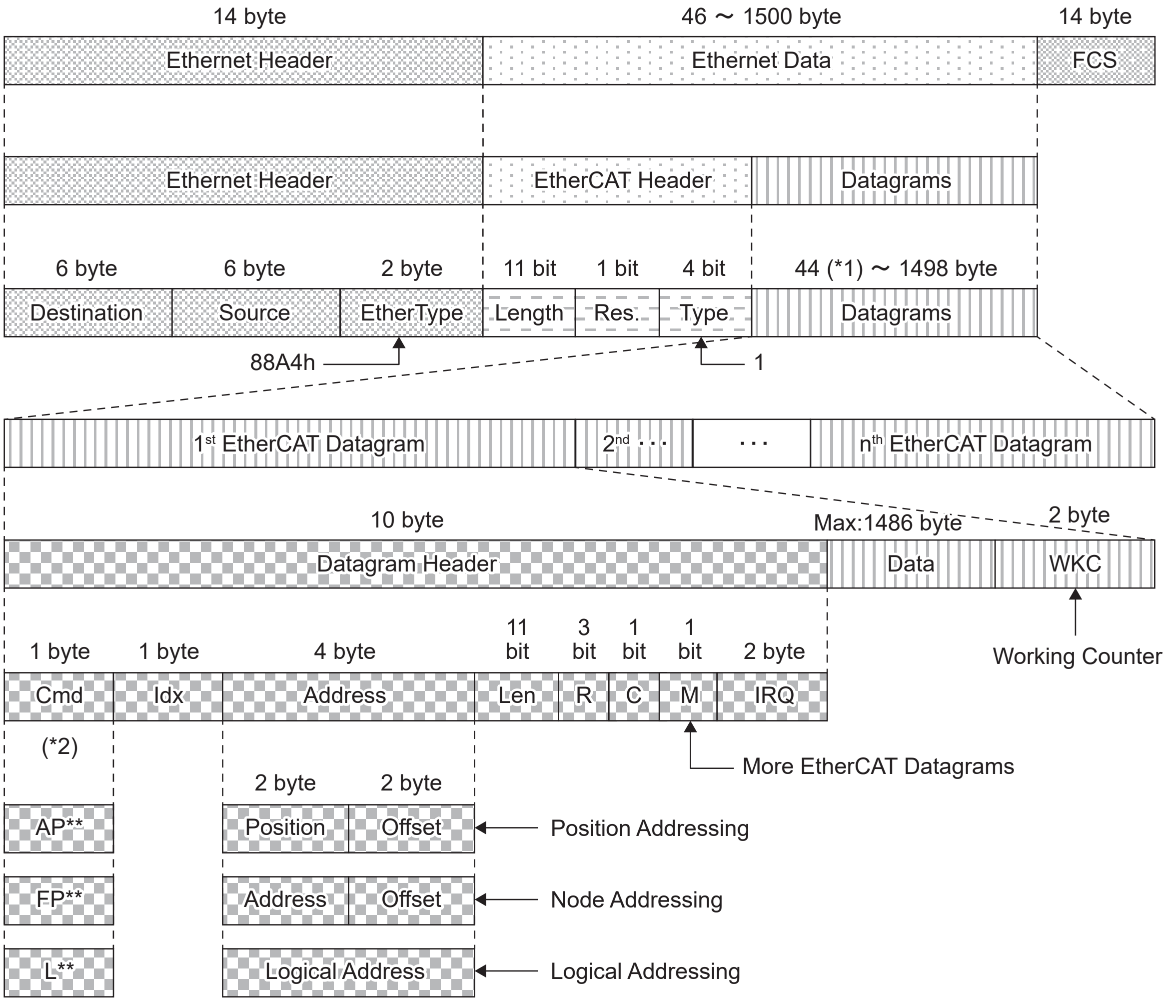
Always set EtherCAT Header Type to 1. By setting Type=1, ESC (EtherCAT Sub Device Controller) will process frames as EtherCAT frames. If Type does not = 1, ESC will not process frames as EtherCAT frames and the frames will not be processed. The way frames are handled when Type does not = 1 is set via "ESC DL Control" in the ESC register. Please see *"4.2 ESC (EtherCAT Sub Device Controller) Address Space"* for a detailed description of the ESC Register.

Precautions

- In consideration of the possibility that noise, etc., could prevent this product from properly receiving EtherCAT frames from the main device, please confirm on the main device side that this product has properly received EtherCAT frames.

  If the product fails to successfully receive EtherCAT frames, retransmit the EtherCAT frames from the main device.

Ethernet Frame Configuration and EtherCAT Frame Configuration



*1 If an Ethernet frame is shorter than 64 bytes, 1 to 32 bytes are added.
(Ethernet header + Ethernet data + FCS)

*2 The addressing mode is specified by Cmd in the datagram header of a EtherCAT datagram.
The Cmd and addressing modes supported are as indicated in the below table.

—: N/A

Cmd	Addressing modes	Abbreviation	Name	Description
00h	—	NOP	No operation	Nothing is performed.
01h	Position Addressing	APRD	Auto increment physical read	Each sub device increments the address. When a frame with the address value 0 is received, the requested read operation is performed.
02h		APWR	Auto increment physical write	Each sub device increments the address. When a frame with the address value 0 is received, the requested write operation is performed.
03h		APRW	Auto increment physical read write	Each sub device increments the address. When a frame with the address value 0 is received, the requested read and write operations are performed. This command cannot be used for the process data RAM area (1000h to FFFFh).
04h	Node Addressing	FPRD	Configured address physical read	When the address value matches the station address, each sub device executes the requested read operation.
05h		FPWR	Configured address physical write	When the address value matches the station address, each sub device executes the requested write operation.
06h		FPRW	Configured address physical read write	When the address value matches the station address, each sub device executes the requested read and write operations. This command cannot be used for the process data RAM area (1000h to FFFFh).
07h	—	BRD	Broadcast read	Each sub device executes the requested read operation.
08h		BWR	Broadcast write	Each sub device executes the requested write operation.
09h		BRW	Broadcast read write	Each sub device executes the requested read and write operations. This command cannot be used for the process data RAM area (1000h to FFFFh).
0Ah	Logical Addressing	LRD	Logical read	When the logical address value matches the logical memory zone specified in the FMMU request, each sub device executes the requested read operation.
0Bh		LWR	Logical write	When the logical address value matches the logical memory zone specified in the FMMU request, each sub device executes the requested write operation.
0Ch		LRW	Logical read write	When the logical address value matches the logical memory zone specified in the FMMU request, each sub device executes the required read and write operations. When using this command for process data RAM area (1000h to FFFFh), set the same address in the Logical Start Address of FMMU for both Input and Output.
0Dh	Position Addressing	ARMW	Positional physical read /multiple write	Each sub device increments the address. The sub device that receives a frame with the address value 0 executes the requested read operation. Another sub device executes the write operation.
0Eh	Node Addressing	FRMW	Configured address physical read /multiple write	Each sub device compares the values of the address and the station address. The sub device with the compared and matching value executes the requested read operation. Another sub device executes the write operation.
0Fh to FFh	—	—	(Reserved)	—

4.2 ESC (EtherCAT Sub Device Controller) Address Space

The product has 12 Kbytes of physical address space.

Of this, the first 4 Kbytes (0000h to 0FFFh) are used as register space, and the next 8 Kbytes are used as a process data RAM area.

Representative registers are presented in the below table. For a detailed description of registers and registers that are not in the table below, see *“ESC Register Information”* in *“1.5 EtherCAT Reference Documents”* .

—: N/A

ESC Register Byte Address	Length (byte)	Description	Initial Value (*1)
ESC Information			
0000h	1	Type	90h
0001h	1	Revision	06h
0002h to 0003h	2	Build	0530h
0004h	1	FMMUs supported	08h
0005h	1	SyncManagers supported	08h
0006h	1	RAM Size	3Bh
0007h	1	Port Descriptor	0Fh
0008h to 0009h	2	ESC Features supported	008Ch
Station Address			
0010h to 0011h	2	Configured Station Address	—
0012h to 0013h	2	Configured Station Alias	—
⋮			
DL (Data Link Layer)			
⋮			
0100h to 0103h	4	ESC DL Control	—
⋮			
0110h to 0111h	2	ESC DL Status	—
AL (Application Layer)			
0120h to 0121h	2	AL Control	—
0130h to 0131h	2	AL Status	—
0134h to 0135h	2	AL Status Code	—
⋮			
PDI (Physical Device Interface)			
0140h	1	PDI Control	80h
0141h	1	ESC Configuration	0Ch
0150h	1	PDI Configuration	E0h
0151h	1	SYNC / LATCH PDI Configuration	00h
0152h to 0153h	2	Extended PDI Configuration	—
⋮			
Watchdogs			
0400h to 0401h	2	Watchdog Divider	—
0410h to 0411h	2	Watchdog Time PDI	—
0420h to 0421h	2	Watchdog Time Process Data	—
0440h to 0441h	2	Watchdog Status Process Data	—
0442h	1	Watchdog Counter Process Data	—

ESC Register Byte Address	Length (byte)	Description	Initial Value (*1)
0443h	1	Watchdog Counter PDI	—
⋮			
FMMU (Fieldbus Memory Management Units)			
0600h to 062Fh	3x16	FMMU [2:0]	—
+0h to 3h	4	Logical Start Address	—
+4h to 5h	2	Length	—
+6h	1	Logical Start bit	—
+7h	1	Logical Stop bit	—
+8h to 9h	2	Physical Start Address	—
+Ah	1	Physical Start bit	—
+Bh	1	Type	—
+Ch	1	Activate	—
+Dh to Fh	3	Reserved	—
⋮			
Distributed Clocks (DC) - SYNC Out Unit			
0981h	1	Activation	—
⋮			
0984h	1	Activation Status	—
098Eh	1	SYNC0 Status	—
⋮			
0990h to 0993h	4	Start Time Cyclic Operation / Next SYNC0 Pulse	—
⋮			
09A0h to 09A3h	4	SYNC0 Cycle Time	—
⋮			

*1 The initial value is that at the time ESC starts up. This may be changed by CPU firmware, etc.

4.3 SII (Sub Device Information Interface) EEPROM

This product stores EtherCAT sub divide information (ESI) in the 16 Kbit EEPROM area.

The SII EEPROM structure is shown in the table below. Word addressing is used for ESI.

SII EEPROM structure

SII EEPROM Word Address	+0h	+1h	+2h	+3h	+4h	+5h	+6h	+7h
0000h	EtherCAT Sub Device Controller Configuration Area							
0008h	Vendor ID		Product Code		Revision Number		Serial Number	
0010h	Hardware Delays				Bootstrap Mailbox Config			
0018h	Mailbox Sync Man Config					Reserved		
0020h ⋮ 0030h	Reserved							
0038h	Reserved						Size	Version
0040h ⋮	Additional Information (Subdivided in Categories)							
	Category Strings							
	Category Generals							
	Category FMMU							
	Category SyncManager							
	Category TxPDO and RxPDO for each PDO							

Among SII EEPROM structures, EEPROM word addresses 0000h to 003Fh are assigned as SII areas.

In addition, 0000h to 0007h from within the SII area are allocated as the ESC configuration area.

ESC configuration area

—: N/A

SII EEPROM Word Address	Name	Description	ESC Register Word Address	Data Type	Initial Value
0000h	PDI Control	Initial value for PDI control register	0140h 0141h	Unsigned16	0C80h
0001h	PDI Configuration	Initial value for PDI configuration register	0150h 0151h	Unsigned16	00E0h
0002h	Pulse Length of SYNC Signals	Initial value for SYNC signal pulse length	0982h 0983h	Unsigned16	0064h
0003h	Extended PDI Configuration	Initial value for extended PDI configuration register	0152h 0153h	Unsigned16	0000h
0004h	Configured Station Alias	Initial value for Station Alias (ID) For details, see *“4.6 Node Address”* .	0012h 0013h	Unsigned16	0000h
0005h	Reserved	Reserved	—	BYTE [4]	—
0006h					
0007h	Checksum	ESC configuration area checksum	—	Unsigned16	—

After control power is turned on, 0004h “Configured Station Alias” is automatically read out from the ESC configuration area by the ESC.

The 0004h “Configured Station Alias” read is written to the ESC register.

If values subsequent to the SII EEPROM change are reflected in the ESC register, turn on the control power supply again.

ESC registers other than those in the table above are set to the initial values found in *"ESC Register Information"* in *"1.5 EtherCAT Reference Documents"* .

Notes

- Basically, do not change anything other than 0007h "Checksum" and 0004h "Configured Station Alias" .

  If changes are necessary, 0004h "Configured Station Alias" and 0007h "Checksum" must be changed together.

  For a details, see *"ESC Register Information"* in *"1.5 EtherCAT Reference Documents"* .

Details of the SII EEPROM connected to the ESC configuration area

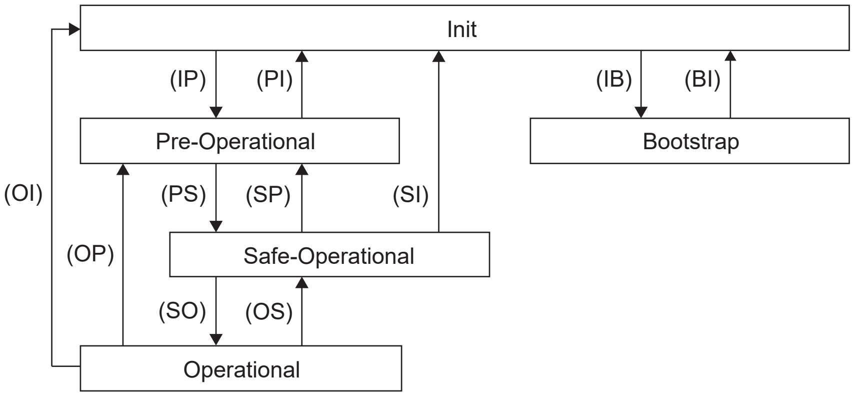
—: N/A

SII EEPROM Word Address	Name	Description	ESC Register Word Address	Data Type	Initial Value
0008h 0009h	Vendor ID	Vendor ID	—	Unsigned32	066Fh
000Ah 000Bh	Product Code	Product Code	—	Unsigned32	(Varies according to product)
000Ch 000Dh	Revision Number	Revision Number	—	Unsigned32	(Varies according to product)
000Eh 000Fh	Serial Number	Serial Number	—	Unsigned32	(Varies according to product)
0010h	Execution Delay	Execution Delay	—	Unsigned16	0000h
0011h	Port 0 Delay	Port 0 Delay	—	I16	0000h
0012h	Port 1 Delay	Port 1 Delay	—	I16	0000h
0013h	Reserved	Reserved	—	BYTE [2]	—
0014h	Bootstrap Receive Mailbox Offset	The offset for the receiving mailbox in bootstrap status (Main Device > Sub Device)	—	Unsigned16	1000h
0015h	Bootstrap Receive Mailbox Size	The size of the receiving mailbox in bootstrap status (Main Device > Sub Device)	—	Unsigned16	0100h
0016h	Bootstrap Send Mailbox Offset	The offset for the sending mailbox in bootstrap status (Sub Device > Main Device)	—	Unsigned16	1200h
0017h	Bootstrap Send Mailbox Size	The size of the sending mailbox in bootstrap status (Sub Device > Main Device)	—	Unsigned16	0100h
0018h	Standard Receive Mailbox Offset	The offset for the receiving mailbox in standard status (Main Device > Sub Device)	—	Unsigned16	1000h
0019h	Standard Receive Mailbox Size	The size of the receiving mailbox in standard status (Main Device > Sub Device)	—	Unsigned16	0100h

SII EEPROM Word Address	Name	Description	ESC Register Word Address	Data Type	Initial Value
001Ah	Standard Send Mailbox Offset	The offset for the sending mailbox in standard status (Sub Device > Main Device)	—	Unsigned16	1200h
001Bh	Standard Send Mailbox Size	The size of the sending mailbox in standard status (Sub Device > Main Device)	—	Unsigned16	0100h
001Ch	Mailbox Protocol	Supported Mailbox protocol	—	Unsigned16	000Ch
001Dh	Reserved	Reserved	—	BYTE [66]	—
⋮					
003Dh					
003Eh	Size	EEPROM size (This product features 16 Kbit EEPROM)	—	Unsigned16	000Fh
003Fh	Version	Version (Fixed as 1)	—	Unsigned16	0001h
0040h	Data by category				
⋮					

4.4 ESM (EtherCAT State Machine)

EtherCAT application layer status (ESM status) transition diagram



* Bootstrap is not currently supported.

Precautions

- In the figure above, abbreviations for state transitions such as (IP) are used only in ESM state transition figures.

  (Abbreviation example)

  (IP): Init→Pre-Operational

  (PS): Pre-Operational→Safe-Operational etc.

  Note that if the same abbreviation is used elsewhere in this document (i.e. Not in an ESM state transition figure) the meaning will differ.

ESM state list

—: N/A

ESM state	Actions that can be taken in each status	Communication operation				Trial run
		CoE			EoE	Frequency characteristics analysis function (FFT function) operation
		SDO (Mailbox) send/receive	PDO send (S to M)	PDO receive (M to S)	Ethernet (Mailbox) Set-up Support Software (PANATERM ver.7) connection	
Init	The communication section is being initialized, and SDO (Mailbox) send/receive and PDO send/receive are disabled	No	No	No	No	Yes
Pre-operational (Abbreviation: Pre-OP)	SDO (Mailbox) send/receive is enabled	Yes	No	No	Yes	Yes
Safe-operational (Abbreviation: Safe-OP)	PDO send (sub device to main device) enabled in addition to SDO (Mailbox) send/receive	Yes	Yes (*1)	No	Yes	Yes
Operational (Abbreviation: OP) (*2)	All SDO (Mailbox) send/receive and PDO send/receive are enabled	Yes	Yes (*1)	Yes	Yes	Yes

ESM state	Actions that can be taken in each status	Communication operation				Trial run
		CoE			EoE	Frequency characteristics analysis function (FFT function) operation
		SDO (Mailbox) send/ receive	PDO send (S to M)	PDO receive (M to S)	Ethernet (Mailbox)	
					Set-up Support Software (PANATERM ver.7) connection	
Bootstrap (Abbreviation: Boot) (*3)	—	—	—	—	—	—

*1 TxPDO is not updated when SYNC0, which is the cause of the error such as Err80.7.0 “Synchronization signal error protection” , or interrupt processing omission by IRQ occurs.

*2 The expression “OP” appearing in the text of this document is an abbreviation for “operational”.

Note that this is not the ESM state transition OP (Operational → Pre-Operational).

*3 Bootstrap is not currently supported.

- Regardless of the table above, the ESC register can be accessed by the main device at any time.
- A communication error may occur if command updating stops before ESM state transition is completed during transition of the ESM state from OP to another ESM state (Init, PreOP, or SafeOP), or if there is a SYNC0 or SM2 event stoppage, etc.
- If repeatedly transitioning the ESM state, confirm that the previous status transition has been completed, and then transition to the next status.
- If Obj.3799h:00h “Communication function extended setup 6” :bit 0=0, the ESM state must be set to Init when using the Set-up Support Software (PANATERM ver.7) trial run, frequency characteristics analysis function (FFT function), etc. via USB communication.

  If Obj.3799h:00h “Communication function extended setup 6” :bit 0=1, Set-up Support Software (PANATERM ver.7) operations such as trial runs and frequency characteristics analysis functions (FFT function) are enabled even when the ESM state is not Init.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3799h	00h	Communication function extended setup 6	—	-32768 to 32767	I16	rw	No	ALL	Yes	B
● bit 0: Enable/disable FFT execution while EtherCAT communication is established 0: Disabled 1: Enabled										

Please see *“5.5.1 Power Drive Systems (PDS) Status”* for a detailed description of PDS (Power Drive Systems).

The relationship between each power drive system (PDS) status and ESM state

—: N/A

PDS status	ESM state				
	Init	PreOP	SafeOP	OP	Boot (*6)
Not ready to switch on	Yes	No	No	No	—
Switch on disabled	Yes	Yes	Yes	Yes	—
Ready to switch on (*1)	No	Yes	Yes	Yes	—

PDS status	ESM state				
	Init	PreOP	SafeOP	OP	Boot (*6)
Switched on (*1)	No	Yes	Yes	Yes	—
Operation enabled (*2) (*5)	No	Yes (*4)	Yes (*4)	Yes	—
Fault reaction active	Yes	Yes	Yes	Yes	—
Fault (*3)	Yes	Yes	Yes	Yes	—

*1 When a command to transition the ESM state from PreOP, SafeOP, or OP to Init is received, the ESM state is transitioned to “Switch on disabled”.

*2 When the PDS status is “Operation enabled”, and a command to transition the ESM state to another ESM state is received, there is a Err88.2.0 “ESM requirements during operation error protection” , and the PDS status is transitioned to Fault.

*3 The ESM state is retained when the PDS status has transitioned to Fault due to an error that is unrelated to EtherCAT communication. However, in case of a EtherCAT communication-related error, the ESM state follows the specifications set forth in *“6.1.2 Protection Function Details”* .

*4 Set the PDS status to “Operation enabled” in the ESM “OP” status.

*5 Status transitions in accordance with ESM requests from the main device may take time to reach completion.

Pay careful attention to timeout settings, etc., on the main device side.

For example, if the ESM state is transitioned from OP to PreOP when the PDS state is Operation enabled, Err88.2.0 “ESM requirements during operation error protection” will occur. After that, deceleration processing is performed according to Obj.605Eh:00h “Fault reaction option code” , but the ESM state during deceleration retains OP. Therefore, the slower the deceleration slope, the longer it takes to transition to PreOP.

*6 PDS status is not supported when the ESM state is “Boot”.

Bootstrap is also not currently supported by this product.

4.5 Object Configuration

All objects are assigned a 16-bit index address expressed as a four character hexadecimal number and are located in an object dictionary for each group.

The CoE (CANopen over EtherCAT) object dictionary specified by CiA402 and the object dictionary for this product are shown in the table below.

Please see *"8 Object Dictionary List"* for a list of objects. Please see *"5 Object"* for a detailed description of each object.

Object Dictionary Configuration

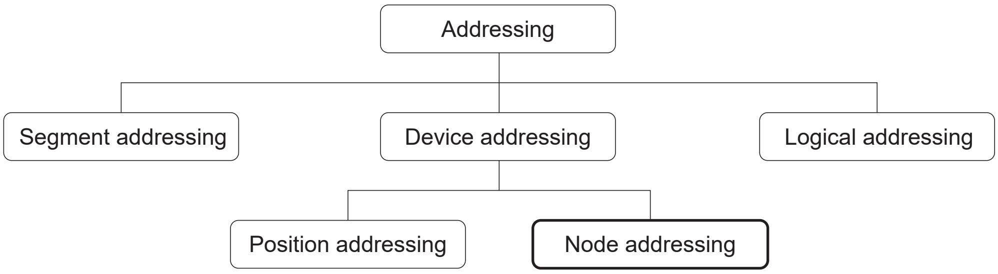
—: N/A

CiA402-specified object dictionary		Object dictionary for this product		
Index	Description	Index	Description	Reference
0000h to 0FFFh	Data type area	0000h to 0FFFh	Data type area	—
1000h to 1FFFh	CoE communication area	1000h to 1FFFh	CoE communication area	*"5.2"*
2000h to 5FFFh	Manufacturer-specific area	2000h to 2FFFh	Reserved	—
		3000h to 3FFFh	Servo parameter area	*"5.3"*
		4000h to 4FFFh	User-specific area	*"5.4"*
		5000h to 5FFFh	Reserved	—
6000h to 9FFFh	Profile area	6000h to 6FFFh	Drive profile area	*"5.5"*
		7000h to 9FFFh	Reserved	—
A000h to FFFFh	Reserved	A000h to FFFFh	Reserved	—

4.6 Node Address

4.6.1 Node Address Setup Method

With this product, Node addressing specifies the unique node ID (station alias) for the main device to use in identifying a sub device.



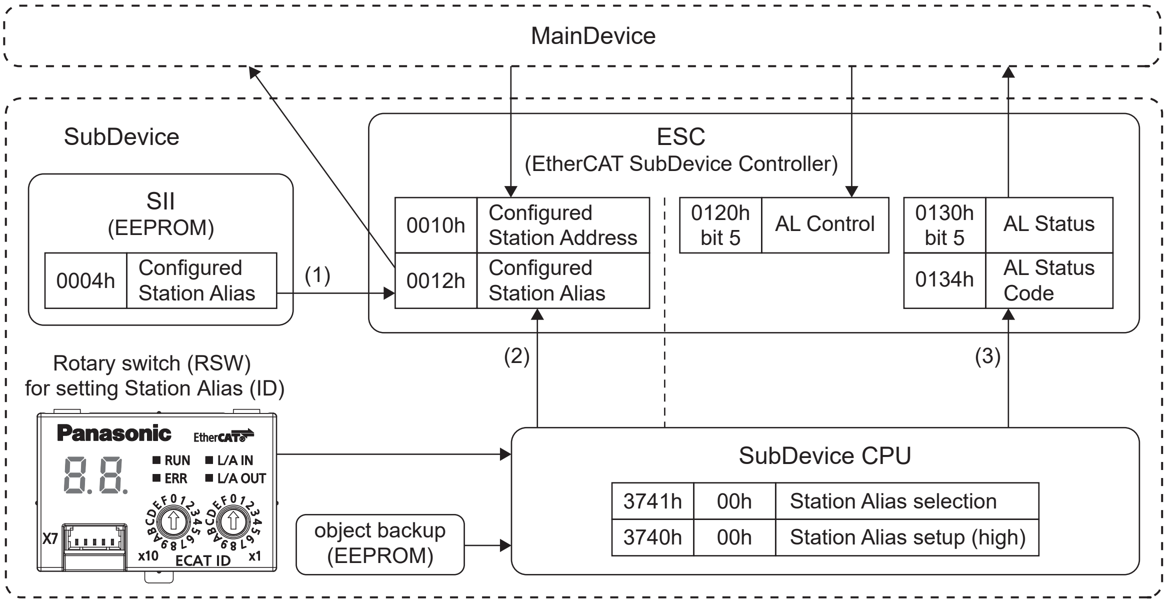
The product offers three methods of reading out address setup values. Use the address setting read method for the usage environment.

A rotary switch may be used depending on the address setup value read method.

Please see *"1.7 Information Needed to Read this Document"* *"Front Panel Configuration"* for the rotary switch locations for this product.

The main device reads the value set in ESC register 0012h "Configured Station Alias" and sets that value to 0010h "Configured Station Address" .

This setting sets addresses for the FPRD commands etc. used by the mailbox.



(1)	SII readouts via Configured Station Alias This section describes how to read the value of SII.0004h "Configured Station Alias" from ESC register 0012h "Configured Station Alias" . This product reads the Obj.3741h:00h "Station Alias selection" value from the backup EEPROM when the control power is turned on. If the value read is 1, the value stored in SII.0004h "Configured Station Alias" is set to ESC register 0012h "Configured Station Alias" . The main device should read this 0012h "Configured Station Alias" value and use it as the node address.

(2)	Rotary switch readout via Configured Station Alias The method by which the value (lower 8 bits) set by the front panel rotary switch and the value (upper 8 bits) set by the Obj.3740h:00h “Station Alias setup (high)” is read from ESC register 0012h “Configured Station Alias” is explained below. (Please see *“4.6.2 Station Alias”* for more information on selecting and setting Station Alias setup values with Obj.3740h:00h “Station Alias setup (high)” .) This product reads the Obj.3741h:00h “Station Alias selection” value from the backup EEPROM when the control power is turned on. If the read value read is 0, the value set by the rotary switch on the front panel and Obj.3740h:00h “Station Alias setup (high)” is set to 0012h “Configured Station Alias” in the ESC register. The main device should read this 0012h “Configured Station Alias” value and use it as the node address.

(3) Rotary switch value read via AL Status Code

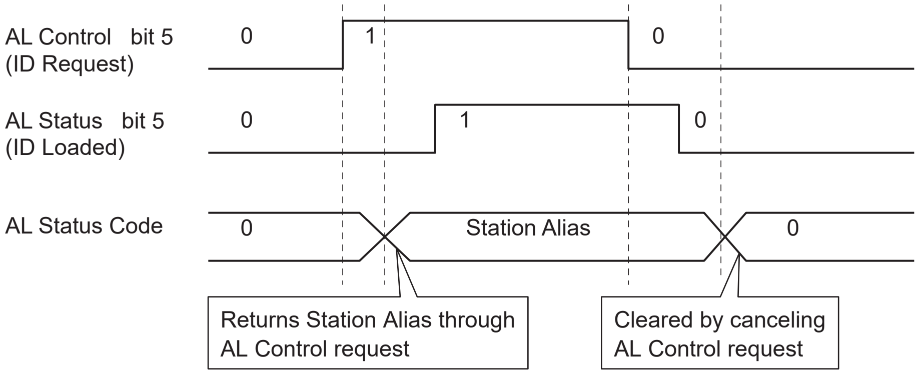
The method by which the value (lower 8 bits) set by the front panel rotary switch and the value (upper 8 bits) set by the Obj.3740h:00h “Station Alias setup (high)” is read from 0134h “AL Status Code” is explained below.

(Please see *“4.6.2 Station Alias”* for more information on selecting and setting Station Alias setup values with Obj.3740h:00h “Station Alias setup (high)” .)

The value read using this method is not the value registered in 0012h “Configured Station Alias” of the ESC register.

The readout proceeds in the following order.

1. Set 0120h “AL Control” :bit 5 “ID Request” to 1.
2. The station alias set by the rotary switch (lower 8 bits) and Obj.3740h (upper 8 bits) is returned to 0134h “AL Status Code” .
3. 1 is returned to 0130h “AL Status” :bit 5 “ID Loaded”.
4. Set 0120h “AL Control” :bit 5 “ID Request” to 0.
5. 0 is returned to 0130h “AL Status” :bit 5 “ID Loaded”.
6. 0134h “AL Status Code” is cleared.

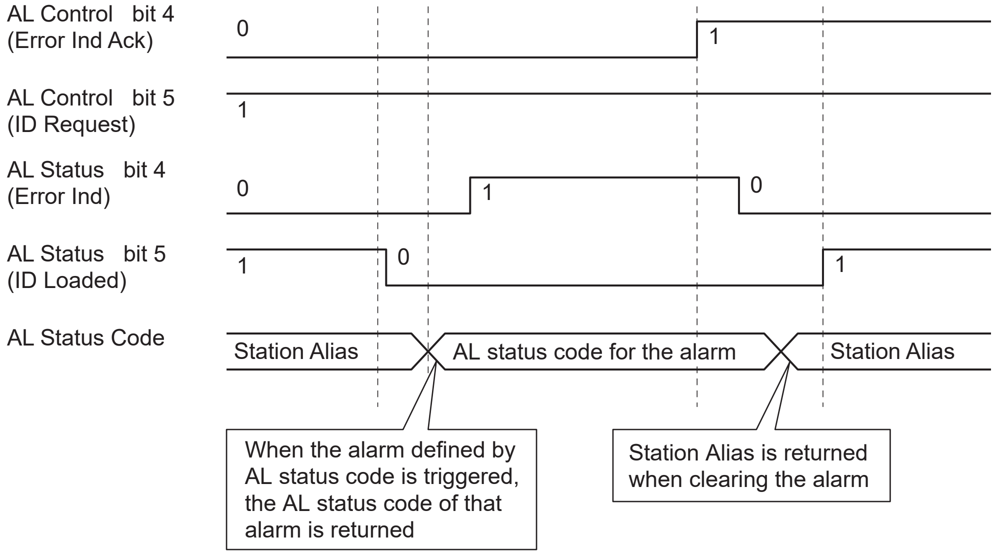


Station Alias: Value set by the rotary switch (lower 8 bits) and
Obj.3740h:00h “Station Alias setup (high)” (higher 8 bits)

Note that if there is an alarm defined in the AL status code (Err80.□.□, Err81.□.□, and Err85.□.□ among EtherCAT communication-related errors) is generated during the station alias reply, the AL status code for the alarm is returned.

When an alarm defined in the AL status code is cleared, it will once again return the Station Alias.

(Please see *“6.1.4 Clearing Alarms, Clearing Warnings”* for how to clear the alarm)



4.6.2 Station Alias

Station Alias settings selection and address setting are performed by the following objects.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3740h	00h	Station Alias setup (high)	—	0 to 255	I16	rw	No	ALL	Yes	R
	● Sets the upper 8 bits of Station Alias.									
3741h	00h	Station Alias selection	—	0 to 2	I16	rw	No	ALL	Yes	R
	● Specify the Station Alias setting method. The initial value is 1.									

Setup value	Function
0	The value (lower 8 bits) set by the front panel rotary switch and the value (upper 8 bits) set by the Obj.3740h:00h “Station Alias setup (high)” are set as the station alias. When the setup value for both the rotary switch and the Obj.3740h:00h “Station Alias setup (high)” are 0, 0 is set as the station alias. Note that the specifications are different from those for the MINAS A5B series.
1	SII.0004h value is set as the station alias.
2	Manufacturer use (setting is prohibited)

When the Obj.3741h:00h “Station Alias selection” value is 0, a value that is the sum of the value (lower 8 bits) set by the front panel rotary switch and the value (upper 8 bits) set by the Obj.3740h:00h “Station Alias setup (high)” is set as the station alias.

Station Alias	
Upper 8 bits	Lower 8 bits
3740h setup value	Rotary switch setup value

- Check Technical Reference Functional Specification “3.2 Switches” concerning the front panel rotary switch setup value (lower 8 bits).

Precautions

- Each set value is enabled when the control power is turned on.

  Therefore, changes made after the control power is turned on are not reflected in the control, but become effective the next time the control power is turned on.

4.7 Communication Synchronous Mode

The product enables selection of the following synchronous modes.

Synchronous mode	Description	Synchronization method	Characteristics
DC	SYNC0 event synchronization	The time information of another sub device is synchronized on the basis of the time on the first axis	● High precision ● Requires compensation processing on the main device side
SM2	SM2 event synchronization	Synchronized with RxPDO reception timing	● Precision is poor without transmission delay correction ● Transmission timing must be constant on the main device side (dedicated hardware, etc.)
FreeRun	Asynchronous	Asynchronous	● Processing is simple ● Lacks real-time properties

Supported Mode Table

◎: Semi-closed and full-closed supported ○: Only semi-closed supported [*1] ×: Not supported

Communication cycle [ms]	Synchronous mode																				
	DC							SM2							FreeRUN						
	pp	csp	hm	pv	csv	tq	cst	pp	csp	hm	pv	csv	tq	cst	pp	csp	hm	pv	csv	tq	cst
0.0625	×	◎	×	×	○	×	○	×	◎	×	×	○	×	○	×	×	×	×	×	×	×
0.125	×	◎	◎	×	○	×	○	×	◎	◎	×	○	×	○	×	×	◎	×	×	×	×
0.250	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
0.5	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
1.0	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
2.0	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
4.0	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
8.0	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×
10.0	◎	◎	◎	○	○	○	○	◎	◎	◎	○	○	○	○	◎	×	◎	○	×	○	×

[*1] External scale position information monitor function for semi-closed control supported

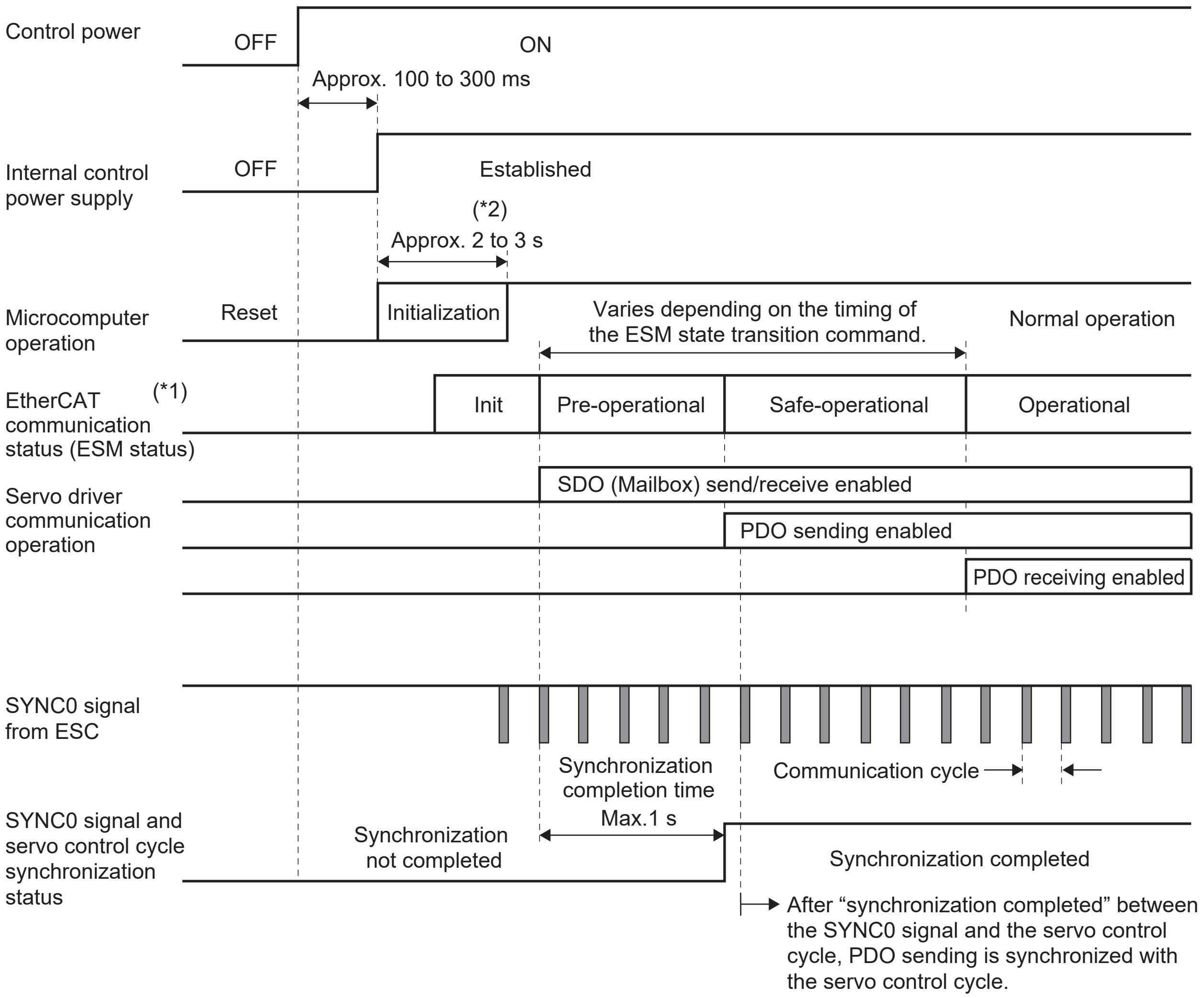
4.7.1 DC (SYNC0 Event Synchronization)

The product is provided with a 64-bit Distributed Clock (DC). EtherCAT Communications are synchronized on the basis of this DC.

The sub device can be synchronized with the DC by sharing the same reference clock (System Time).

The sub device starts a local cycle in response to a synchronization event (SYNC0 event) that occurs in relation to the reference clock (System Time). Since sub device processing (servo processing) is started for the SYNC0 event, it is always synchronized with the SYNC0 event. Propagation delay compensation (offset compensation) must be performed when the main device undergoes communication initialization. Drift compensation must also be performed periodically.

Flow chart from turning on control power to SYNC0 event and sub device processing (servo processing) synchronization completion



*1 The ESM state in the figure above is the internal status of the product. Check on the main device side for transition completion between statuses.

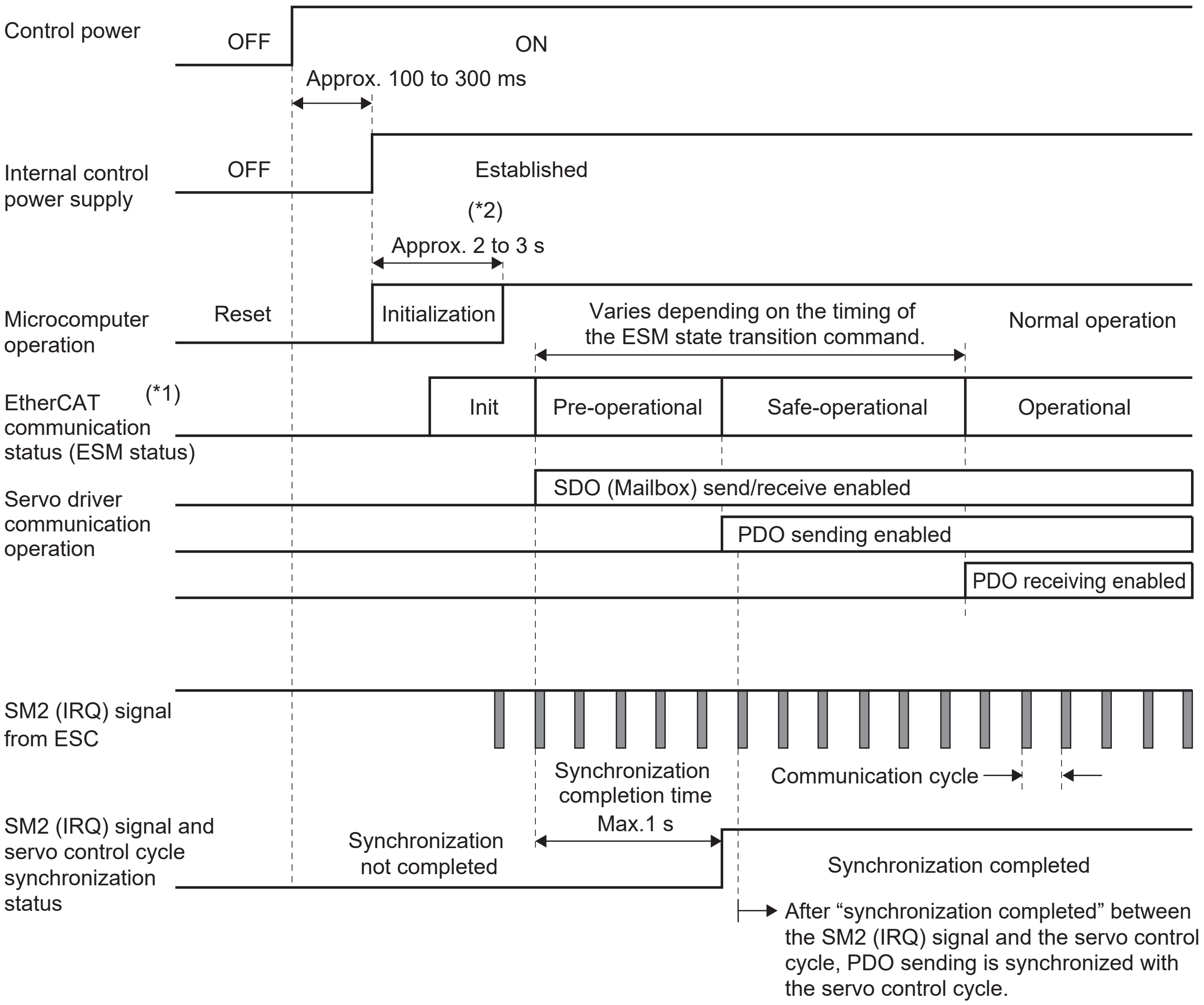
*2 Initialization time can be extended using Obj.3618h:00h "Power-up wait time" .

4.7.2 SM2 (SM2 Event Synchronization)

The sub device starts a local cycle corresponding to the RxPDO receive timing (SM2 event). Since sub device processing is started for the SM2 event, it is always synchronized with the SM2 event. However, since the SM2 event occurs upon completion of PDO reception, communication timing must be kept constant on the main device side.

If there is a large communication jitter (variation) in communication timing, synchronization is not completed, or an alarm is generated. If synchronization incompletion and/or alarm generation become problematic, use DC (SYNC0 event synchronization).

Flow chart from turning on control power to SM2 event and sub device processing (servo processing) synchronization completion



*1 The ESM state in the figure above is the internal status of the product. Check on the main device side for transition completion between statuses.

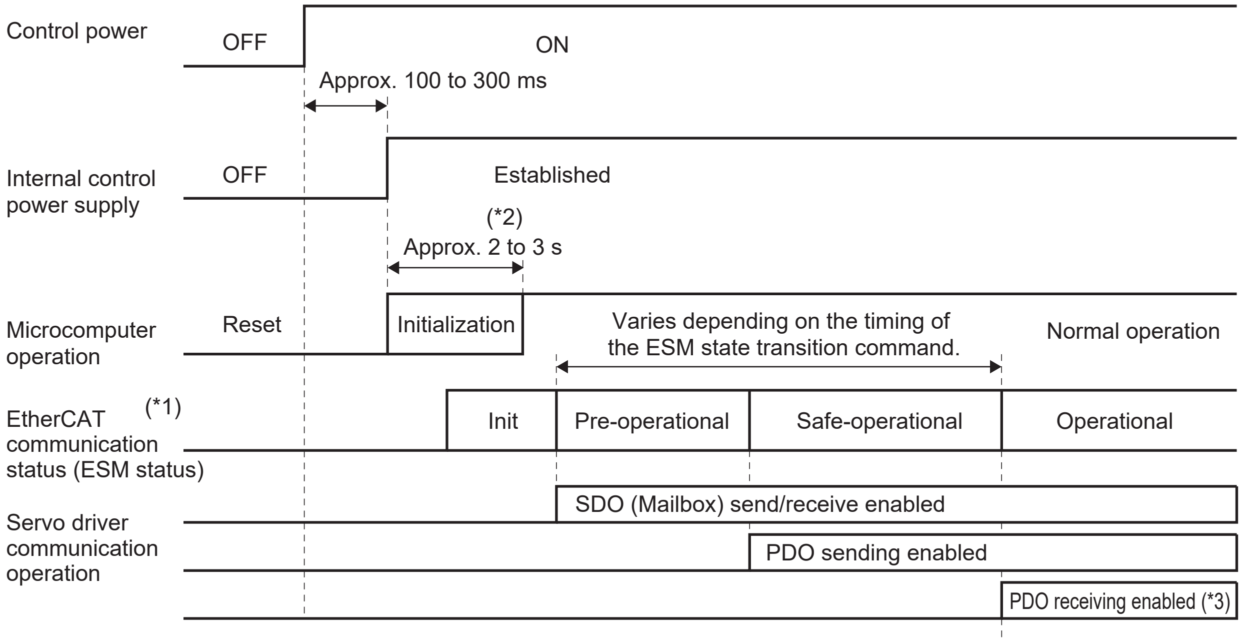
*2 Initialization time can be extended using Obj.3618h:00h “Power-up wait time” .

4.7.3 FreeRun (Asynchronous)

A local cycle is started by the local timer interrupt of a sub device.

The local cycle is asynchronous to the communication cycle and the main device cycle, and operates independently.

Flow chart for when control power is turned on



*1 The ESM state in the figure above is the internal status of the product. Check on the main device side for transition completion between statuses.

*2 Initialization time can be extended using Obj.3618h:00h “Power-up wait time” .

4.8 SDO (Service Data Object)

The product supports SDO (Service Data Object). Mailbox communication is used for SDO data exchange. Note that the timing of SDO data updates is indeterminate.

Object settings and various sub device statuses can be monitored by reading and writing data in entries in the object dictionary on the main device side.

Precautions

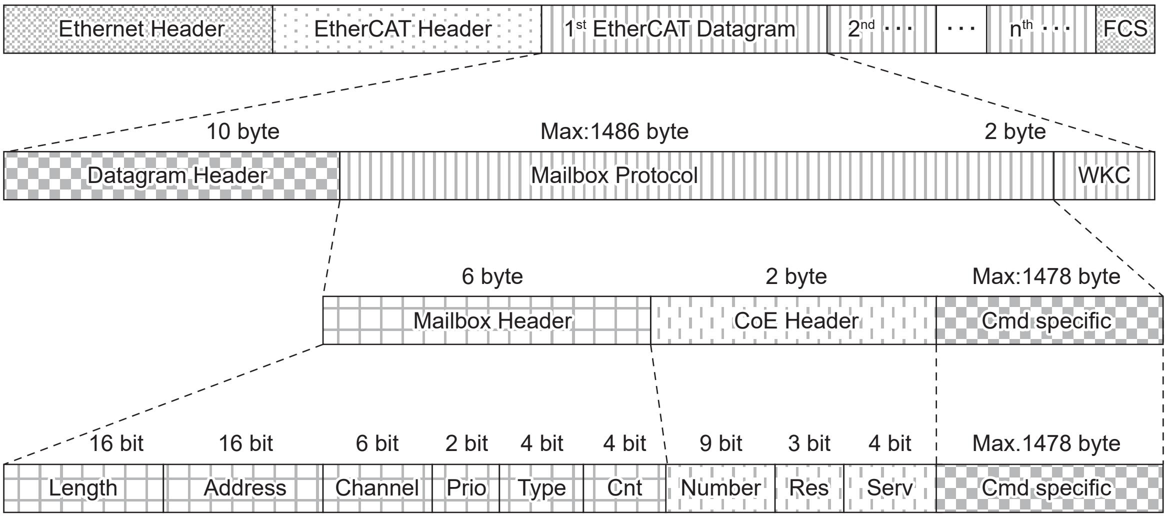
- Response by the SDO to the read/write operation may take time.
- Do not update, using an SDO, objects that have been updated by a PDO.
  They will be overwritten with PDO values. Please see *“4.9 PDO (Process Data Object)”* for a detailed description of PDO.

4.8.1 Mailbox Frame Configuration

The Mailbox/SDO frame configuration is as follows.

For details, see ETG standards ETG.1000.5 and ETG.1000.6 in *"1.5 EtherCAT Reference Documents"* : *"EtherCAT standards"* .

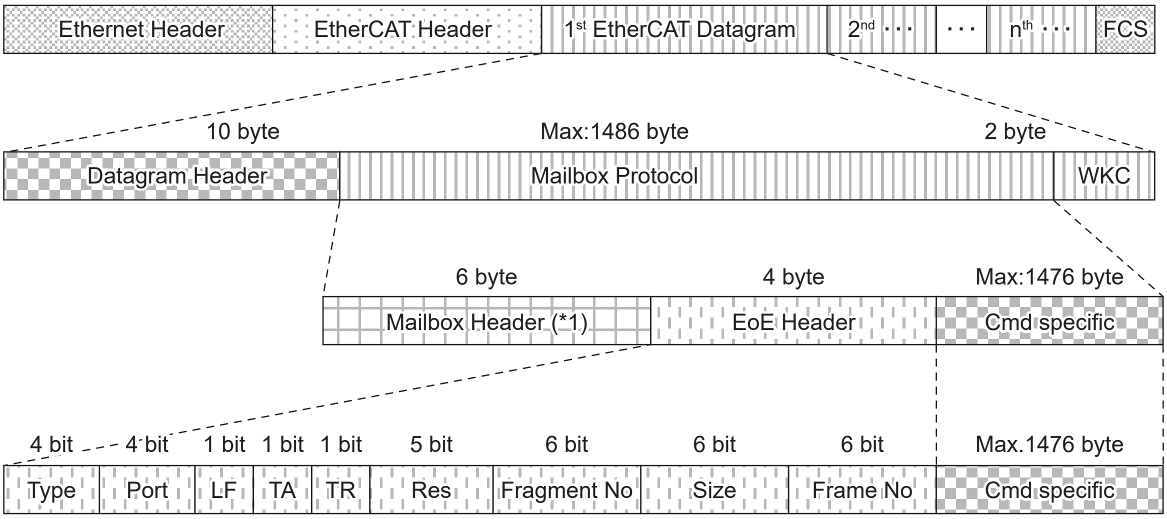
■ CoE scenario



Frame section	Data field	Data type	Function
Mailbox Header	Length	WORD	Mailbox data length
	Address	WORD	Originating station address
	Channel	Unsigned6	(Reserved)
	Priority	Unsigned2	Priority
	Type	Unsigned4	Mailbox type 00h: Error 01h: (Reserved) 02h: EoE (not supported) 03h: CoE 04h: FoE (not supported) 05h: SoE (not supported) 06h to 0Eh: (Reserved) 0Fh: VoE (not supported)
	Cnt	Unsigned3	Mailbox counter
	Reserved	Unsigned1	(Reserved)
CoE Header	Number	Unsigned9	(Reserved)
	Reserved	Unsigned3	(Reserved)
	Service	Unsigned4	Message type
Cmd specific	Size Indicator	Unsigned1	Data set size licensed
	Transfer Type	Unsigned1	Normal transmission, expedited transmission selection
	Data Set Size	Unsigned2	Data size specification
	Complete Access	Unsigned1	Object access method selection (Not supported)
	Command Specifier	Unsigned3	Upload, download requests, responses, etc. - selection
	Index	WORD	Object index

Frame section	Data field	Data type	Function
Cmd specific	Subindex	BYTE	Object sub-index
	□□□	□□□	Object data or abort message, etc. Functions are altered by combining the following data fields. ● Size Indicator ● Transfer Type ● Data Set Size ● Complete Access ● Command Specifier

■ EoE scenario



*1 The Mailbox Header is shared with the CoE frame configuration.

Frame section	Data field	Data type	Function
EoE Header	FrameType	Unsigned4	EoE Service Type
	Port	Unsigned4	Designation of specific ports
	Last Fragment	Unsinged1	Last Fragment Identifier
	Time Appended	Unsinged1	Last Fragment Timestamp Availability
	Time Request	Unsinged1	Timestamp Request
	Reserved	Unsinged5	(Reserved)
	Fragment Number	Unsinged6	Fragment Number
	Frame Number	Unsinged4	Frame Number
Cmd specific	Complete Size	Unsinged6	Frame Length
	EoE Data	BYTE[N-4]	EoE Data (excluding preamble, SFD, FCS, and timestamp)
	TimeStamp	Unsigned32	Frame Receive Time
	Offset	Unsigned6	Offset of 32 octet block of Ethernet frame fragment

4.8.2 Mailbox Timeout

The product sets the following timeout times for mailbox communication.

- Mailbox request timeout time: 100 ms

  The main device transmits a request to a sub device (driver), and the sub device regards the request as normally received if the request frame transmitted data working counter (WKC) has been updated. The request is repeated until the WKC is updated, but there is a timeout on the main device side if the WKC is not updated by the setting time there.

- Mailbox request timeout time: 10 s

  The main device receives from the sub device (driver) a response to the request, and regards the response as normally received if the WKC has been updated. There is a timeout on the main device side if a response for which the WKC has been updated cannot be received by the setting time there.

  The Mailbox request timeout time is the maximum time required by the sub device (driver) for the response operation.

4.8.3 Message When an Error Occurs

4.8.3.1 Abort Messages

If SDO data exchange processing (read/write) fails, an error message that includes an Abort code called an Abort message is returned. The Abort message is an error process that occurs only in SDO data exchange processing; there are no Abort messages in PDO data exchange processing.

The Abort code details may vary, depending on access conditions.

Abort code	Description		This product
05030000h	Toggle bit not changed	Toggle bit not changed	Not supported
05040000h	SDO protocol timeout	SDO protocol timeout	Not supported
05040001h	Client and server command specifiers not valid or unknown	Client and server command specifiers not valid or unknown	Supported
05040005h	Out of memory	Out of memory	Not supported
06010000h	Unsupported access to an object	Unsupported access to an object	Supported
06010001h	Attempt to read to a write only object	Attempt to read to a write only object	Not supported
06010002h	Attempt to write to a read only object	Attempt to write to a read-only object	Supported
06010003h	Subindex cannot be written, SI0 must be 0 for write access	Sub-index cannot be written Sub-index 00h must be set to 0 for write access	Supported
06020000h	The object does not exist in the object directory	The object does not exist in the object directory	Supported
06040041h	The object cannot be mapped into the PDO	The object cannot be mapped into the PDO	Not supported
06040042h	The number and length of the objects to be mapped would exceed the PDO length	The number and length of the objects to be mapped would exceed the PDO length	Not supported
06040043h	General parameter incompatibility reason	General parameter incompatibility	Not supported
06040047h	General internal incompatibility in the device	General internal incompatibility in the device	Not supported
06060000h	Access failed due to a hardware error	Access failed due to a hardware error	Supported
06070010h	Data type does not match, length of service parameter does not match	Data type does not match, length of service parameter does not match	Supported
06070012h	Data type does not match, length of service parameter too high	Data type does not match, length of service parameter too long	Not supported
06070013h	Data type does not match, length of service parameter too low	Data type does not match, length of service parameter too short	Not supported
06090011h	Subindex does not exist	Subindex does not exist	Supported
06090030h	Value range of parameter exceeded (only for write access)	Value range of parameter exceeded (only for write access)	Supported
06090031h	Value of parameter written too high	Value of parameter written too high	Supported
06090032h	Value of parameter written too low	Value of parameter written too low	Supported
06090036h	Maximum value is less than minimum value	Maximum value is less than minimum value	Supported
08000000h	General error	General error	Not supported
08000020h	Data cannot be transferred to or stored in the application	Data cannot be transferred to or stored in the application	Supported
08000021h	Data cannot be transferred to or stored in the application because of local control	Data cannot be transferred to or stored in the application because of local control	Not supported
08000022h	Data cannot be transferred to or stored in the application because of the present device status	Data cannot be transferred to or stored in the application because of the present device status	Supported
08000023h	Object dictionary dynamic generation fails or no object dictionary is present	No object dictionary exists	Supported

4.8.3.2 Emergency Messages

The main device is notified of emergency messages by the sub device via Mailbox communication when there is an error (alarm) in the product (sub device). There is no notification when there has only been a warning, without an error (alarm) occurring.

Up to eight emergency messages generated when the ESM state is “Init” are buffered in the order generated, and returned all at once when the ESM state has transitioned from Init → PreOP or beyond. However, any more than eight are discarded sequentially from that generated first.

Enable or disable emergency message transmission by setting Obj.10F3h:05h “Diagnosis history:Flags” :bit 0.

The default for emergency message transmission is “enabled” (Obj.10F3h:05h “Flags” :bit 0=1).

See *“5.2.6 Diagnosis history (Error (Alarm) History Readout Function) (10F3h)”* for Sub-Indexes other than Obj.10F3h:05h “Diagnosis history:Flags”.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
10F3h	—	Diagnosis history	—	—	—	—	—	—	—	—
● Settings are executed to enable or disable error history readouts and emergency messages.										
10F3h	05h	Flags	—	0 to 65535	U16	See below table	No	ALL	Yes	A

bit 0	rw	Emergency message execution permission 0: Emergency messages disabled 1: An Emergency message is issued for each new error detected (may not be left in a Diagnosis message, depending on the error)
bit 1	r	Not supported: 1 fixed
bit 2	r	Not supported: 1 fixed
bit 3	r	Not supported: 0 fixed
bit 4	r	Not supported: 0 fixed
bit 5	r	Diagnosis message clearing information 0: There is error history information 1: There is no error history information, or error history information clearing (when writing Obj.10F3h:03h=0) has been completed (will be retained until the next error/alarm is generated)
bits 15 to 6	—	Reserved

Precautions

- If multiple errors (alarms) occur and are cleared in a short period of time, the Emergency message as to the final status may be the only notification.

The Emergency message comprises 8 bytes of data, as shown below.

byte	0	1	2	3	4	5	6	7
Description	*“Error code”* (L)	(H)	*“Error register”*	*“Error Field”*				

■ Error code

The same values are returned for the error code as in Obj.603Fh:00h “Error code” .

0000h to FEFFh are defined as per CiA402 Standard IEC61800-7-201.

FF00h to FFFFh can be uniquely defined by the manufacturer. The details are as follows.

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	–	0 to 65535	U16	ro	TxPDO	ALL	No	X

- An alarm (main number only) and/or warning generated by the product are displayed.

  When no alarm or warning is generated, 0000h is displayed.

  When an alarm and a warning are generated simultaneously, the alarm is displayed.

  The alarm and warning are displayed in “FF**h” format.

  The following numbers are displayed in the “**” segment.
  - Alarm (main) numbers (00h to 9Fh)
  - Warning numbers (A0h to A9h, ABh, E1h to E2h, C3h, CAh, D2h)

(Example)

FF0Ch (0Ch=12d): Err12.0.0 “Overvoltage protection” occurs

FF55h (55h=85d): Either Err85.0.0 “TxPDO assignment error protection” or Err85.1.0 “RxPDO assignment error protection” occurs

Notes

- In exceptional cases of Err81.7.0 “SyncManager 2 / 3 setup error protection” , A000h is displayed.
- The timing of alarm number setting for Obj.603Fh:00h “Error code” is the same as for emergency messages. For this reason, the value is set later than for Obj.6041h:00h “Statusword” :bit 3 “fault” .

■ Error register

The same values as Obj.1001h:00h “Error register” are returned in the error register.

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1001h	00h	Error register	–	0 to 255	U8	ro	No	ALL	No	X

- The alarm type (status) generated by the product is displayed.

  When no alarm is generated, 0000h is displayed.

  No warning is displayed.

bit	Description
0	(Not supported)
1	
2	
3	
4	Generation of an alarm defined by AL status code (*1)
5	(Not supported)
6	(reserved)
7	Generation of an alarm not defined by AL status code (*2)

*1 “An alarm defined by AL status code” denotes Err80.0.0 to Err80.4.0, Err80.6.0 to Err80.7.0, Err81.☐.☐, Err85.0.0 to Err85.1.0, and Err85.3.0 among EtherCAT communication-related errors.

*2 “An alarm undefined by AL status code” denotes an error other than that which is EtherCAT communication-related or Err85.2.0 or Err88.☐.☐ among EtherCAT communication-related errors.

Please see *“6.1 Protection Functions”* for a detailed description of alarms.

■ Error Field

Data [0] to [4] are assigned to the Error Field, which returns the alarm sub-number and primary cause number.

The main number of the alarm is indicated by the Error Code. Please see *“Error code”* in this chapter for a detailed description of Error Codes.

- When an error other than Err81.7.0 “SyncManager 2 / 3 setup error protection” occurs with this product

  Alarm sub-number is returned to Data [0].

  Alarm cause number is returned to Data [1].

  00h is returned to Data [2] to [4].

  (Example) When Err16.1.0 “Torque saturation error protection” occurs

byte	0	1	2	3	4	5	6	7
Description	Error code		Error register	Data [0]	Data [1]	Data [2]	Data [3]	Data [4]
Value	FF10h		80h	01h	00h	00h	00h	00h

- When an error status is cleared for this product

  Data [0] to [4] are cleared to 00h.

  (Example) When the alarm status is cleared by Fault reset

byte	0	1	2	3	4	5	6	7
Description	Error code		Error register	Data [0]	Data [1]	Data [2]	Data [3]	Data [4]
Value	0000h		00h	00h	00h	00h	00h	00h

- When Err81.7.0 “SyncManager 2 / 3 setup error protection” occurs during PreOP→SafeOP due to incorrect SyncManager2 and SyncManager3 settings

  The error code is set to A000h, the error register is set to 10h, and specified data is returned. For details, see ETG standard ETG.1000.6 in *“1.5 EtherCAT Reference Documents”* : *“EtherCAT standards”* .

  (Example) When SyncManager2 and SyncManager3 settings are incorrect

1 When the SyncManager2 Length (ESC register: 0812h, 0813h) setting is invalid (*1)

2 When the SyncManager2 physical start address (ESC registers 0810h and 0811h) settings are incorrect (i.e., set outside the range of 1000h to 2FFEh, or to an odd number, etc.)

3 When SyncManager2 settings are incorrect (set to deactivated and 1-buffer, set to Read, etc.)

4 When the SyncManager3 Length (ESC register: 081Ah, 081Bh) setting is invalid (*1)

5 When the SyncManager3 physical start address (ESC registers 0818h and 0819h) settings are incorrect (set outside the range of 1000h to 2FFEh, or to an odd number, etc.)

6 When SyncManager3 settings are incorrect (i.e., set to deactivated and 1-buffer, set to Write, etc.)

byte	0	1	2	3	4	5	6	7
Description	Error code		Error register	Data [0]	Data [1]	Data [2]	Data [3]	Data [4]
“1”	A000h		10h	08h	(L) Length (*2) (H)		(L) Length (*2) (H)	
“2”	A000h		10h	09h	00h	10h	FEh	2Fh
“3”	A000h		10h	0Ah	24h (*3)	00h (*3)	01h (*3)	00h (*3)
“4”	A000h		10h	0Ch	(L) Length (*2) (H)		(L) Length (*2) (H)	
“5”	A000h		10h	0Dh	00h	10h	FEh	2Fh
“6”	A000h		10h	0Eh	20h (*3)	00h (*3)	01h (*3)	00h (*3)

*1 Returned if different from the PDO mapping size, etc. However, Err85.1.0 “RxPDO assignment error protection” will occur if the PDO mapping size exceeds 32 bytes. 01h (the alarm sub-number) is returned to Data [0], 00h (the alarm primary cause number) is returned to Data [1], and 00h is returned to Data [2] to [4].

*2 The value of the PDO mapping size actually set for length is returned.

If, for example, the PDO mapping size is 9, Data [1] = 09h, Data [2] = 00h, Data [3] = 09h, and Data [4] = 00h are respectively returned.

*3 If the PDO mapping size is 0, 00h is returned to Data [1] to [4].

4.9 PDO (Process Data Object)

The product supports PDO (Process Data Object).

EtherCAT performs real-time data transfer via PDO exchange. PDOs include RxPDO, which is transferred from main device to sub device, and TxPDO, which is transferred from sub device to main device.

	Sending side	Receiving side
RxPDO	Main Device	Sub Device
TxPDO	Sub Device	Main Device

Precautions

- Do not update, using an SDO, objects that have been updated by a PDO. They will be overwritten with PDO values.

  Please see *"4.8 SDO (Service Data Object)"* for a detailed description of SDO.

4.9.1 PDO Mapping Object

PDO mapping is the process of selecting the required objects from the object dictionary and assigning them as PDO data.

“Setting example” , described below, is an example of assigning a given object (Obj.6040h:00h and another 4 items) to a PDO mapping object (Obj.1600h) for reception.

In the product, mapping objects in Obj.1600h to Obj.1603h can be used as tables for PDO mapping for the RxPDO, and Obj.1A00h to Obj.1A03h can be used for the TxPDO.

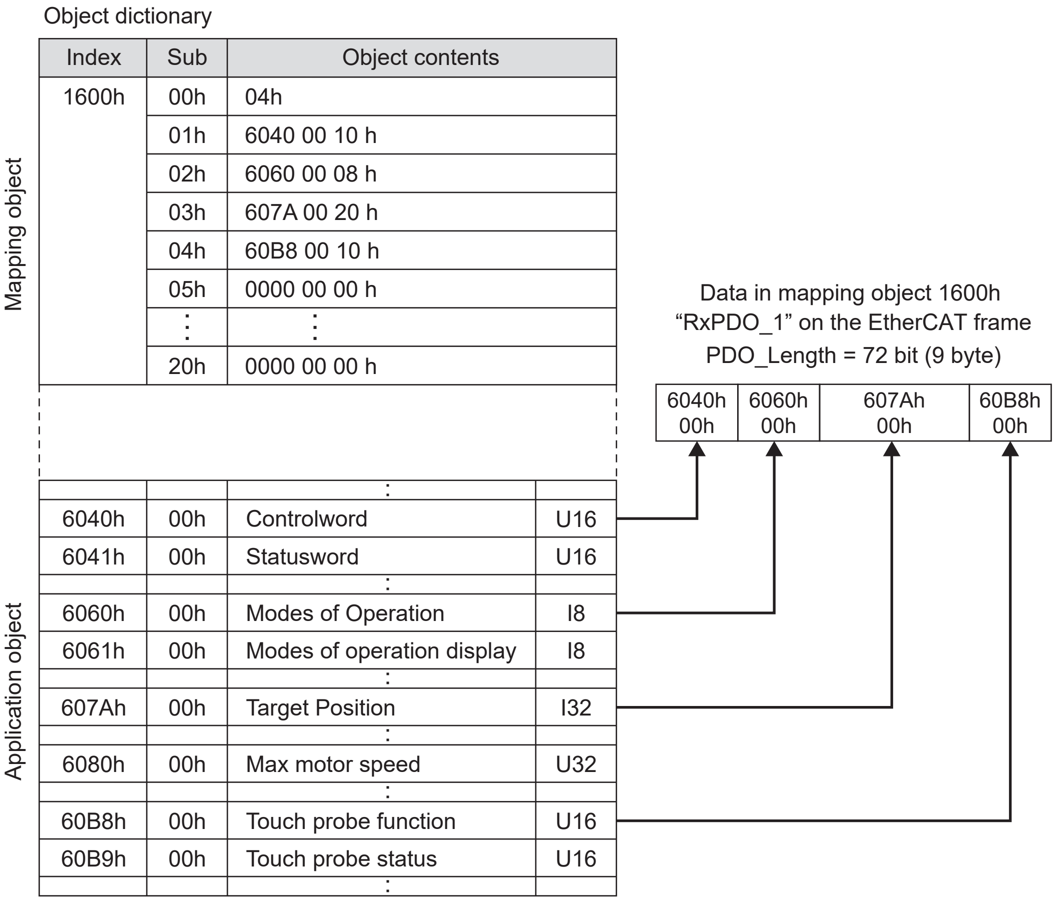
The maximum numbers for application objects mappable in a single mapping object are as follows.

Maximum data length	RxPDO: 32 bytes TxPDO: 32 bytes

A PDO mapping setup example is shown below. Please see *“5.2.3 Process Data Object (PDO) Mapping”* for a detailed description of setup methods.

■ Setting example

The following figure shows the settings for assigning application objects Obj.6040h:00h “Controlword” , Obj.6060h:00h “Modes of operation” , Obj.607Ah:00h “Target position” , and Obj.60B8h:00h “Touch probe function” to the mapping object Obj.1600h: “Receive PDO mapping 1” : “RxPDO_1”.



Object dictionary

Mapping object

Index	Sub	Object contents
1600h	00h	04h
	01h	6040 00 10 h
	02h	6060 00 08 h
	03h	607A 00 20 h
	04h	60B8 00 10 h
	05h	0000 00 00 h
	⋮	⋮
	20h	0000 00 00 h

Application object

		:	
6040h	00h	Controlword	U16
6041h	00h	Statusword	U16
		:	
6060h	00h	Modes of Operation	I8
6061h	00h	Modes of operation display	I8
		:	
607Ah	00h	Target Position	I32
		:	
6080h	00h	Max motor speed	U32
		:	
60B8h	00h	Touch probe function	U16
60B9h	00h	Touch probe status	U16
		:	

Data in mapping object 1600h
“RxPDO_1” on the EtherCAT frame
PDO_Length = 72 bit (9 byte)

6040h 00h	6060h 00h	607Ah 00h	60B8h 00h

4.9.2 PDO Assign Object

PDO Assign assigns a table for PDO mapping to the SyncManager in order to exchange PDO data.

The relation between the table for PDO mapping and the SyncManager is written to the SyncManager PDO Assign object.

In the product, Obj.1C12h: “Sync manager channel 2” can be used for RxPDO (SyncManager 2), and Obj.1C13h: “Sync manager channel 3” for TxPDO (SyncManager 3), as a PDO Assign object.

The maximum numbers of mapping objects that can be assigned to a single Assign object are as follows.

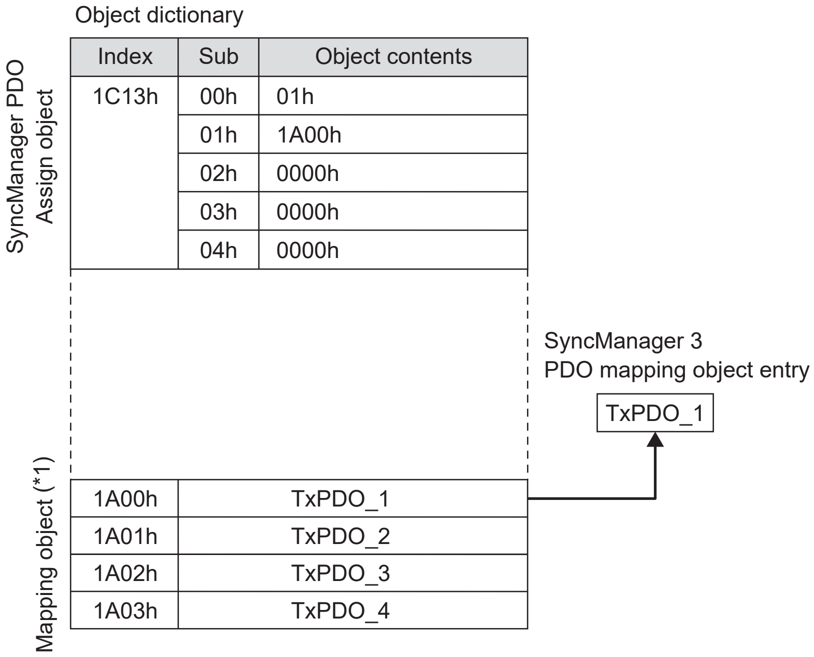
Maximum number of PDO assignments	RxPDO: 4 Table TxPDO: 4 Table

Since one mapping object is usually sufficient, there is no need to make a change from the default.

A SyncManager PDO Assign object setting example is shown below. Please see *“5.2.3 Process Data Object (PDO) Mapping”* for a detailed description of setup methods.

■ Setting example

The following figure shows the settings for assigning mapping object Obj.1A00h: “Transmit PDO mapping 1” to assign object Obj.1C13h: “Sync manager channel 3” .



*1 Please see *“5.2.3.3 Default PDO Mapping”* for a detailed description of mapping object factory default values.

4.10 Ethernet over EtherCAT (EoE) Function

4.10.1 EoE Function

The product supports EoE functionality. EoE is a function that allows Ethernet frames to be transmitted (EoE communication) between the main device and a sub device in the EtherCAT segment by encapsulating the Ethernet packet in a EtherCAT Mailbox packet.

Mailbox communication is used for EoE communication.

EoE communication uses the virtual Ethernet switch function of the host device. Refer to the operating instructions for the host device for how to use the virtual Ethernet switch function.

This function allows a PC on which Set-up Support Software (PANATERM ver.7) is installed to be connected to the product via the EtherCAT communication cable and issue operation commands via EtherCAT communication, which were previously issued via USB communication.

This product supports the following protocols in the TCP/IP stack.

- IPv4 (Internet Protocol version 4) *Only non-fragmented packets are supported
- ARP (Address Resolution Protocol)
- ICMP (Internet Control Message Protocol)
  *Only Echo Request Message receipt and Echo Reply Message sending is supported
- UDP (User Datagram Protocol)
- TCP (Transmission Control Protocol)

For configuration settings of the main device when using the EoE function, see Servo System Operating Instructions “12.1.2.2.1 Network Settings for EoE Communication” .

Related objects

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D16h	—	EoE information display	—	—	—	—	—	—	—	—
	● Displays EoE configuration information.									
4D16h	00h	Number of entries	—	0 to 255	U8	ro	No	ALL	No	X
	● Displays the number of Obj.4D16h: “EoE information display” Sub-Indexes.									
4D16h	01h	Virtual MAC address	—	—	VS	ro	No	ALL	No	X
	● Displays the virtual MAC address (17 bytes) set for the sub device. (Example) “02:01:05:30:03:e9” 18 to 22 bytes are NULL. Values after 23 bytes are undefined. The size of this object is 44 bytes including undefined values.									
4D16h	02h	IP address	—	—	VS	ro	No	ALL	No	X
	● Displays the IP address (max. 15 bytes) set for the sub device. (Example) “192.168.1.2” The IP address is followed by 1 byte of NULL. The values after the next data after NULL are undefined. The size of this object is 36 bytes including undefined values.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D16h	03h	Subnet mask	–	–	VS	ro	No	ALL	No	X
● Displays the subnet mask (max. 15 bytes) set for the sub device. (Example) “255.255.255.0” The subnet mask is followed by 1 byte of NULL. The values after the next data after NULL are undefined. The size of this object is 36 bytes including undefined values.										
4D16h	04h	Default Gateway	–	–	VS	ro	No	ALL	No	X
● Displays the default gateway (max.15 bytes) configured for the sub device. (Example) “172.16.8.12” The default gateway is followed by 1 byte of NULL. The values after the next data after NULL are undefined. The size of this object is 36 bytes including undefined values.										

Precautions

- The EoE function cannot be used in connection with a main device that does not have the virtual Ethernet switch function.
- Set the network settings for EoE communication to this product to a fixed IP address.
- This product requires the sub device to be rebooted when disabling an already-enabled EoE function. Therefore, if EoE communication will not be used, do not enable the EoE function on the sub device side. If you want to communicate without using the EoE function while the EoE function is still enabled on the sub device side, disable the virtual Ethernet switch function on the main device.
- Depending on network load conditions and other factors, operations via EoE communication may not be immediately reflected. Therefore, when extending the trial run timeout time, make sure that the main power supply can be immediately shut off when executing the trial run operation.
- When Set-up Support Software (PANATERM ver.7) is connected via EoE communication, it is not possible to write objects in the object editor.

  To write objects in the object editor, connect Set-up Support Software (PANATERM ver.7) via USB communication. Or, instead of using Set-up Support Software (PANATERM ver.7) , write the object from the main device via CoE communication.

4.10.2 “PANATERM ver.7” Set-up Support Software Connection Procedures

To connect a sub device to Set-up Support Software (PANATERM ver.7) via EoE communication, the IP address of the sub device to be connected must be specified on Set-up Support Software (PANATERM ver.7) and the sub device must be selected.

The network settings of the main device and sub device must be completed before configuring the procedure parameters described in this section. See Servo System Operating Instructions “12.1.2.2.1 Network Settings for EoE Communication” for a detailed description of network settings.

The following procedure is used to connect a Set-up Support Software (PANATERM ver.7) to a sub device.

1. After Set-up Support Software (PANATERM ver.7) startup, select “Connection with driver (EoE Communication)” and click “Network Settings” to display the pop-up menu.
2. In the “Network Settings” pop-up menu, input the IP address of the sub device set in the main device, then click OK to close the pop-up menu.
3. Shortly after closing the “Network Settings” pop-up menu a list of connected sub devices will appear on the screen.

   Select the sub device to be connected to Set-up Support Software (PANATERM ver.7) and click “OK” to begin EoE communication with the sub device.

5 Object

5.1 How to Read the Object Table

The following is an example of entries for the Object Table shown in this section.

Example of table format

Index	Sub-Index	Name	Units	Range	Data type (*1)	Access	PDO (*3)	Op-mode	EEPROM	Attribute (*6)
*****	***	*******	*****	*****	VS	***	RxPDO	***	No	A
*****	***	*******	*****	*****	U16	***	RxPDO	***	No	A
*****	***	*******	*****	*****	VS	***	RxPDO	***	Yes	A

Example of table format for describing details

Index	Sub-Index	Name	Units	Range	Data type (*1)	Access (*2)	PDO (*3)	Op-mode (*4)	EEPROM (*5)	Attribute (*6)
*****	***	*******	*****	*****	VS	***	RxPDO	***	No	A
********************										
*****	***	*******	*****	*****	U16	***	RxPDO	***	No	A
********************										
*****	***	*******	*****	*****	VS	***	RxPDO	***	Yes	A
********************										

*1 "NULL" is placed at the end for objects in which the data type is "VS" (Visible String).

For the size of each object, check the object description, "The size of this object is ☐ byte(s)."

Data type

Abbreviation	Official name
U8	Unsigned8
U16	Unsigned16
U32	Unsigned32
I8	Integer8
I16	Integer16
I32	Integer32
VS	Visible String
BOOL	Boolean
OS	Octet String

*2 Access indicates access settings.

Access

Abbreviation	Official name
rw	read-write

Abbreviation	Official name
ro	read-only
c	constant

*3 PDO indicates whether PDO mapping is available.

For details of PDO mapping, see *"5.2.3 Process Data Object (PDO) Mapping"* .

No: RxRDO, TxPDO mapping not available (only SDO)

RxPDO: RxPDO mapping available

TxPDO: TxPDO mapping available

*4 Op-mode indicates the corresponding control mode.

For the abbreviations of the control modes, see *"2.2 Supported Control Modes"* .

*5 EEPROM indicates whether the object is subject to back-ups.

Yes: Backed up

No: Not backed up

*6 "Attribute" indicates when object change descriptions are enabled.

All objects for which writing to EEPROM is not possible (“No” in the “EEPROM” column) appear as RO in Set-up Support Software (PANATERM ver.7) .

Attribute

Symbol	Description
A	Always enabled
B	Always enabled, but changes are prohibited while the motor is running and during command transfer. Changes while the motor is running and during position command transfer may transiently lead to unstable operation.
C	Enabled after control power reset and after running Config from Set-up Support Software (PANATERM ver.7)
R	Enabled after control power reset
P	Enabled when transitioning from Init to Pre-OP
S	Enabled when transitioning from Pre-OP to SafeOP
H	Enabled after determining position information
X	Objects that cannot be changed, such as read-only objects, or objects that aren’t supported

5.2 CoE Communication Area (1000h to 1FFFh) Details

5.2.1 Device Information

This section describes objects related to sub device information.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1000h	00h	Device type	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays by device type.
  For this product, the value is fixed at 00020192h.

1001h	00h	Error register	–	0 to 255	U8	ro	No	ALL	No	X

- The alarm type (status) generated by the product is displayed.
  When no alarm is generated, 0000h is displayed.
  No warning is displayed.

bit	Description
0	(Not supported)
1	
2	
3	
4	Generation of an alarm defined by AL status code (*1)
5	(Not supported)
6	(reserved)
7	Generation of an alarm not defined by AL status code (*2)

*1 "An alarm defined by AL status code" refers to EtherCAT communication-related errors Err80.0.0 to Err80.4.0, to Err80.6.0, to Err80.7.0, Err81.0.0 to Err81.7.0, Err85.0.0 to Err85.1.0 and Err85.3.0.

*2 "An alarm not defined by AL status code" refers to EtherCAT communication-related errors Err85.2.0, Err88.0.0 to Err88.3.0, and non-EtherCAT communication-related error.

Please see *"6 Protection Functions/Warning Functions"* for a detailed description of alarms.

1008h	00h	Manufacturer device name	–	–	VS	ro	No	ALL	No	X

- Displays the product model in 16 characters. If it is less than 16 characters, it is filled with spaces (20h).
  Two byte NULL is appended at the end. The size of this object is 18 bytes.

(Example) Product model

byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Character	M	A	D	L	N	1	5	B	E	(space)						

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1009h	00h	Manufacturer hardware version	–	–	VS	ro	No	ALL	No	X

- Displays the hardware version of the product in 16 characters. If it is less than 16 characters, it is filled with spaces (20h).
  Two byte NULL is appended at the end. The size of this object is 18 bytes.

(Example) Hardware version: 1.23

byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Character	V	1	.	2	3	(space)										
Purpose	Fixed	Hardware Version														

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
100Ah	00h	Manufacturer software version	–	–	VS	ro	No	ALL	No	X

- Displays the software version 3 of the product in 16 characters. If it is less than 16 characters, it is filled with spaces (20h).
  Two byte NULL is appended at the end. The size of this object is 18 bytes.

(Example) Software version 3: 1.23

byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Character	V	1	.	2	3	(space)										
Purpose	Fixed	Software Version 3														

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1018h	–	Identity object	–	–	–	–	–	–	–	–

- Displays device information.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1018h	00h	Number of entries	–	0 to 255	U8	ro	No	ALL	No	X

- Displays the number of Obj.1018h: “Identity object” Sub-Indexes.
  The value is fixed at 04h.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1018h	01h	Vendor ID	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays the EtherCAT Vendor ID.
  The value is fixed at 0000066Fh.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1018h	02h	Product code	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays the product code.
  Values vary by Product Number. See Servo Driver Specification.
  The value of bits 31 to 28 can be used to determine the driver series.

	bits 31 to 28
A7B Series	7
A6B Series	6
A5B Series	5 or D

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1018h	03h	Revision number	–	0 to 4294967295	U32	ro	No	ALL	No	A

- Displays the product revision number.

(Example) Product revision number: 1.23

bit	31 to 28	27 to 24	23 to 20	19 to 16	15 to 12	11 to 8	7 to 4	3 to 0
Value (hexadecimal)	0	0	0	1	0	0	2	3
Purpose	Major revision				Minor revision			

1018h	04h	Serial number	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays the product serial number.
  When the sequential number part of the product serial number is "A000" to "Z999", bits 15 to 0 of this object are set to FFFFh.
  In this case, see Obj.4D15h:00h "Drive serial number" of *"5.5.8.7 Servo Information Monitoring Object"* .
  The sequentially numbered part refers to the underlined number in the following example.

(Example) Product serial number on nameplate: "P17100001N"

bit	31 to 28	27 to 24	23 to 20	19 to 16	15 to 12	11 to 8	7 to 4	3 to 0
Value (hexadecimal)	1	7	1	0	0	0	0	1

3744h	00h	Software version	–	-2147483648 to 2147483647	I32	ro	No	ALL	Yes	X

- Displays the software version 1 and 2 of the product.

(Example) Software version 1: 1.23, Software version 2: 4.56

bit	31 to 28	27 to 24	23 to 20	19 to 16	15 to 12	11 to 8	7 to 4	3 to 0
Value (hexadecimal)	0	1	2	3	0	4	5	6
Purpose	(reserved)	Software version 1			(reserved)	Software version 2		
		(Major)	(Minor)			(Major)	(Minor)	

5.2.2 Sync manager communication type (1C00h)

This section describes the objects that set the mode of operation for each SyncManager.

The setup value of the object is fixed.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C00h	—	Sync manager communication type	—	—	—	—	—	—	—	—
● Sets the operation mode of each Sync Manager.										
1C00h	00h	Number of used sync manager channels	—	0 to 255	U8	ro	No	ALL	No	X
● Displays the number of Obj.1C00h: “Sync manager communication type” Sub-Indexes. The value is fixed at 4.										
1C00h	01h	Communication type sync manager 0	—	0 to 4	U8	ro	No	ALL	No	X
● Sets the application of Sync Manager 0. 0: Not used 1: Mailbox receive (Main Device > Sub Device) 2: Mailbox send (Sub Device > Main Device) 3: RxPDO (Main Device > Sub Device) 4: TxPDO (Sub Device > Main Device) SyncManager 0 is used for Mailbox receiving, so its value is fixed at 1.										
1C00h	02h	Communication type sync manager 1	—	0 to 4	U8	ro	No	ALL	No	X
● Sets the application of Sync Manager 1. 0: Not used 1: Mailbox receive (Main Device > Sub Device) 2: Mailbox send (Sub Device > Main Device) 3: RxPDO (Main Device > Sub Device) 4: TxPDO (Sub Device > Main Device) SyncManager 1 is used for Mailbox sending, so the value is fixed at 2.										
1C00h	03h	Communication type sync manager 2	—	0 to 4	U8	ro	No	ALL	No	X
● Sets the application of Sync Manager 2. 0: Not used 1: Mailbox receive (Main Device > Sub Device) 2: Mailbox send (Sub Device > Main Device) 3: RxPDO (Main Device > Sub Device) 4: TxPDO (Sub Device > Main Device) SyncManager 2 is used for Process data output (RxPDO), so the value is fixed at 3.										
1C00h	04h	Communication type sync manager 3	—	0 to 4	U8	ro	No	ALL	No	X
● Sets the application of Sync Manager 3. 0: Not used 1: Mailbox receive (Main Device > Sub Device) 2: Mailbox send (Sub Device > Main Device) 3: RxPDO (Main Device > Sub Device) 4: TxPDO (Sub Device > Main Device) SyncManager 3 is used for Process data input (TxPDO), so the value is fixed at 4.										

5.2.3 Process Data Object (PDO) Mapping

This section describes the PDO mapping object. For an overview of PDO mapping, see *"4.9.1 PDO Mapping Object"* and *"4.9.2 PDO Assign Object"* .

5.2.3.1 PDO Assignment Object (1C12h to 1C13h)

The objects Obj.1C12h through Obj.1C13h are used for table allocation for PDO mapping to SyncManager.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C12h	—	Sync manager channel 2	—	—	—	—	—	—	—	—
		● Set the entry for the PDO mapping object in Sync Manager 2. Sync Manager 2 is used as Process data output (RxPDO). The setting value of this object can be changed only when the ESM state is PreOP. (*1)								
1C12h	00h	Number of assigned PDOs	—	0 to 4	U8	rw	No	ALL	Yes	S
		● Indicates the number of assigned objects for this object.								
1C12h	01h	PDO mapping object index of assigned RxPDO 1	—	1600h to 1603h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C12h	02h	PDO mapping object index of assigned RxPDO 2	—	1600h to 1603h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C12h	03h	PDO mapping object index of assigned RxPDO 3	—	1600h to 1603h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C12h	04h	PDO mapping object index of assigned RxPDO 4	—	1600h to 1603h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C13h	—	Sync manager channel 3	—	—	—	—	—	—	—	—
		● Set the entry for the PDO mapping object in Sync Manager 3. Sync Manager 3 is used as Process data input (TxPDO). The setting value of this object can be changed only when the ESM state is PreOP. (*1)								
1C13h	00h	Number of assigned PDOs	—	0 to 4	U8	rw	No	ALL	Yes	—
		● Indicates the number of assigned objects for this object.								
1C13h	01h	PDO mapping object index of assigned TxPDO 1	—	1A00h to 1A03h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C13h	02h	PDO mapping object index of assigned TxPDO 2	—	1A00h to 1A03h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C13h	03h	PDO mapping object index of assigned TxPDO 3	—	1A00h to 1A03h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								
1C13h	04h	PDO mapping object index of assigned TxPDO 4	—	1A00h to 1A03h	U16	rw	No	ALL	Yes	S
		● Specifies the PDO mapping object to be used.								

*1 Sub-Index 00h must first be set to 0 before 01h to 04h can be changed.

Notes

- Sub-Index 01h to 04h of Obj.1C12h: “Sync manager channel 2” and Obj.1C13h: “Sync manager channel 3” can be changed only when the ESM state is PreOP and Sub-Index 00h = 0. In any other status, Abort Code (06010003h) is returned. After changing the setting, set Sub-Index 00h to the number of Sub-Indexes to be used and change the ESM state to SafeOP to apply the PDO assignment object setting.

5.2.3.2 PDO Mapping Object (1600h to 1603h, 1A00h to 1A03h)

As a table for PDO mapping, objects Obj.1600h to Obj.1603h “Receive PDO mapping 1 to 4” can be used for RxPDO and Obj.1A00h to Obj.1A03h “Transmit PDO mapping 1 to 4” can be used for TxPDO.

Sub-Index 01h and after indicate information on the application object to be mapped.

■ For RxPDO

–: N/A

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>1600h</td><td>–</td><td>Receive PDO mapping 1</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td></td><td colspan="10">● Indicates an RxPDO object.
The setting value of this object can be changed only when the ESM state is PreOP. (*1)</td></tr>
<tr><td>1600h</td><td>00h</td><td>Number of entries</td><td>–</td><td>0 to 32</td><td>U8</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Sets the number of RxPDO objects to be mapped to this object.</td></tr>
<tr><td>1600h</td><td>01h</td><td>1st receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 1st object to be mapped.
<table>
<tr><td>bit</td><td>31 to 16</td><td>15 to 8</td><td>7 to 0</td></tr>
<tr><td></td><td>Index number</td><td>SubIndex number</td><td>Bit length</td></tr>
</table></td></tr>
<tr><td>1600h</td><td>02h</td><td>2nd receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 2nd object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>03h</td><td>3rd receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 3rd object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>04h</td><td>4th receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 4th object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>05h</td><td>5th receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 5th object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>06h</td><td>6th receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 6th object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>07h</td><td>7th receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 7th object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1600h</td><td>08h</td><td>8th receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 8th object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td></td><td>⋮</td><td colspan="9">⋮</td></tr>
<tr><td>1600h</td><td>20h</td><td>32nd receive PDO mapped</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Set the 32nd object to be mapped.
The setup method is the same as for Sub-Index 01h.</td></tr>
<tr><td>1601h</td><td>–</td><td>Receive PDO mapping 2</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td></td><td colspan="10">● The specification of this object is the same as Obj.1600h: “Receive PDO mapping 1” .</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1602h	—	Receive PDO mapping 3	—	—	—	—	—	—	—	—
	● The specification of this object is the same as Obj.1600h: “Receive PDO mapping 1” .									
1603h	—	Receive PDO mapping 4	—	—	—	—	—	—	—	—
	● The specification of this object is the same as Obj.1600h: “Receive PDO mapping 1” .									

*1 Sub-Index 00h must first be set to 0 before 01h to 20h can be changed.

Precautions

- Do not map the same object multiple times. Operation is not guaranteed when settings are made multiple times.
- Sub-Index 01h to 20h of Obj.1600h: “Receive PDO mapping 1” to Obj.1603h: “Receive PDO mapping 4” can be changed only when the ESM state is PreOP and Sub-Index 00h = 0. In any other status, Abort Code (06010003h) is returned.
- After changing the setting, set Sub-Index 00h to the number of Sub-Indexes to be used and change the ESM state to SafeOP to apply the PDO mapping object setting.

■ For TxPDO

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1A00h	—	Transmit PDO mapping 1	—	—	—	—	—	—	—	—
	● Indicates a TxPDO object. The setting value of this object can be changed only when the ESM state is PreOP. (*1)									
1A00h	00h	Number of entries	—	0 to 32	U8	rw	No	ALL	Yes	S
	● Sets the number of TxPDO objects to be mapped to this object.									
1A00h	01h	1st transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 1st object to be mapped. bit: 31 to 16 = Index number; 15 to 8 = SubIndex number; 7 to 0 = Bit length									
1A00h	02h	2nd transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 2nd object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A00h	03h	3rd transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 3rd object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A00h	04h	4th transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 4th object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A00h	05h	5th transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 5th object to be mapped. The setup method is the same as for Sub-Index 01h.									

Bit layout for Sub-Index 01h:

bit	31 to 16	15 to 8	7 to 0
	Index number	SubIndex number	Bit length

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1A00h	06h	6th transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 6th object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A00h	07h	7th transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 7th object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A00h	08h	8th transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 8th object to be mapped. The setup method is the same as for Sub-Index 01h.									
	⋮	⋮								
1A00h	20h	32nd transmit PDO mapped	—	0 to 4294967295	U32	rw	No	ALL	Yes	S
	● Set the 32nd object to be mapped. The setup method is the same as for Sub-Index 01h.									
1A01h	—	Transmit PDO mapping 2	—	—	—	—	—	—	—	—
	● The specification of this object is the same as Obj.1A00h: “Transmit PDO mapping 1” .									
1A02h	—	Transmit PDO mapping 3	—	—	—	—	—	—	—	—
	● The specification of this object is the same as Obj.1A00h: “Transmit PDO mapping 1” .									
1A03h	—	Transmit PDO mapping 4	—	—	—	—	—	—	—	—
	● The specification of this object is the same as Obj.1A00h: “Transmit PDO mapping 1” .									

*1 Sub-Index 00h must first be set to 0 before 01h to 20h can be changed.

Precautions

- Do not map the same object multiple times. Behavior is not guaranteed when settings are made multiple times.
- Sub-Index 01h to 20h of Obj.1A00h: “Transmit PDO mapping 1” to Obj.1A03h: “Transmit PDO mapping 4” can be changed when the ESM state is PreOP and Sub-Index 00h = 0. In any other status, Abort Code (06010003h) is returned.
- After changing the setting, set Sub-Index 00h to the number of Sub-Indexes to be used and change the ESM state to SafeOP to apply the PDO mapping object setting.

5.2.3.3 Default PDO Mapping

In this product, the default PDO mapping is defined as follows.

Note that this default PDO mapping is the value at the time of shipment of the PDO mapping object.

This content is also defined in the ESI file (.xml format).

In addition, the factory default values are set in the following format.

bit	31 to 16	15 to 8	7 to 0
	Index number	SubIndex number	Bit length

PDO mapping 1

For position control (touch probe can be used)

	Index	Sub-Index	Size (bit)	Name	Factory default value
RxPDO (1600h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	607Ah	00h	32	Target position	607A0020h
	60B8h	00h	16	Touch probe function	60B80010h
TxPDO (1A00h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe 1 positive edge	60BA0020h
	60F4h	00h	32	Following error actual value	60F40020h
	60FDh	00h	32	Digital inputs	60FD0020h

PDO mapping 2

For position control, velocity control, torque control (touch probe can be used)

	Index	Sub-Index	Size (bit)	Name	Factory default value
RxPDO (1601h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6071h	00h	16	Target torque	60710010h
	607Ah	00h	32	Target position	607A0020h
	6080h	00h	32	Max motor speed	60800020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target velocity	60FF0020h
TxPDO (1A01h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe 1 positive edge	60BA0020h

	Index	Sub-Index	Size (bit)	Name	Factory default value
TxPDO (1A01h)	60FDh	00h	32	Digital inputs	60FD0020h

PDO mapping 3

For position control and velocity control (touch probe, torque limit can be used)

	Index	Sub-Index	Size (bit)	Name	Factory default value
RxPDO (1602h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6072h	00h	16	Max torque	60720010h
	607Ah	00h	32	Target position	607A0020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target velocity	60FF0020h
TxPDO (1A02h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe 1 positive edge	60BA0020h
	60FDh	00h	32	Digital inputs	60FD0020h

PDO mapping 4

For position control, velocity control, torque control (touch probe, torque limit can be used)

	Index	Sub-Index	Size (bit)	Name	Factory default value
RxPDO (1603h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6071h	00h	16	Target torque	60710010h
	6072h	00h	16	Max torque	60720010h
	607Ah	00h	32	Target position	607A0020h
	6080h	00h	32	Max motor speed	60800020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target velocity	60FF0020h
TxPDO (1A03h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe 1 positive edge	60BA0020h

	Index	Sub-Index	Size (bit)	Name	Factory default value
TxPDO (1A03h)	60FDh	00h	32	Digital inputs	60FD0020h

5.2.3.4 PDO Mapping Setup Procedure

Using the case of adding Obj.6081h:00h “Profile velocity” to Obj.1600h: “Receive PDO mapping 1” as an example, the procedure for setting up PDO mapping is described below.

Before change

Index	Setup value	Object contents	
Obj.1600h:01h	60400010h	Obj.6040h:00h	Controlword
Obj.1600h:02h	60600008h	Obj.6060h:00h	Modes of operation
Obj.1600h:03h	607A0020h	Obj.607Ah:00h	Target position
Obj.1600h:04h	60B80010h	Obj.60B8h:00h	Touch probe function

After change

Changed location: Obj.1600h:05h added

Index	Setup value	Object contents	
Obj.1600h:01h	60400010h	Obj.6040h:00h	Controlword
Obj.1600h:02h	60600008h	Obj.6060h:00h	Modes of operation
Obj.1600h:03h	607A0020h	Obj.607Ah:00h	Target position
Obj.1600h:04h	60B80010h	Obj.60B8h:00h	Touch probe function
Obj.1600h:05h	60810020h	Obj.6081h:00h	Profile velocity

■ Setup method 1

Setting up using an SDO message

1 Change the ESM state from Init to PreOP.

SDO messages can be sent using the Mailbox protocol.

2 Set the value of Obj.1600h:00h “Number of entries” to 0 with an SDO message.

It must be set to 0 once in order to change SubIndex 01h and after.

3 Set the value of Obj.1600h:05h “5th receive PDO mapped” to 60810020h with an SDO message.

The meaning of 60810020h is shown in the table below.

6	0	8	1	0	0	2	0	h
Index number				SubIndex number		Bit length		

4 Set the value of Obj.1600h:00h “Number of entries” to 5 with an SDO message.

This means that the Obj.1600h: “Receive PDO mapping 1” setting is used until SubIndex 05h.

5 Change the ESM state from PreOP to SafeOP.

TxPDO is enabled.

6 Change the ESM status from SafeOP to OP.

RxPDO is enabled.

Notes

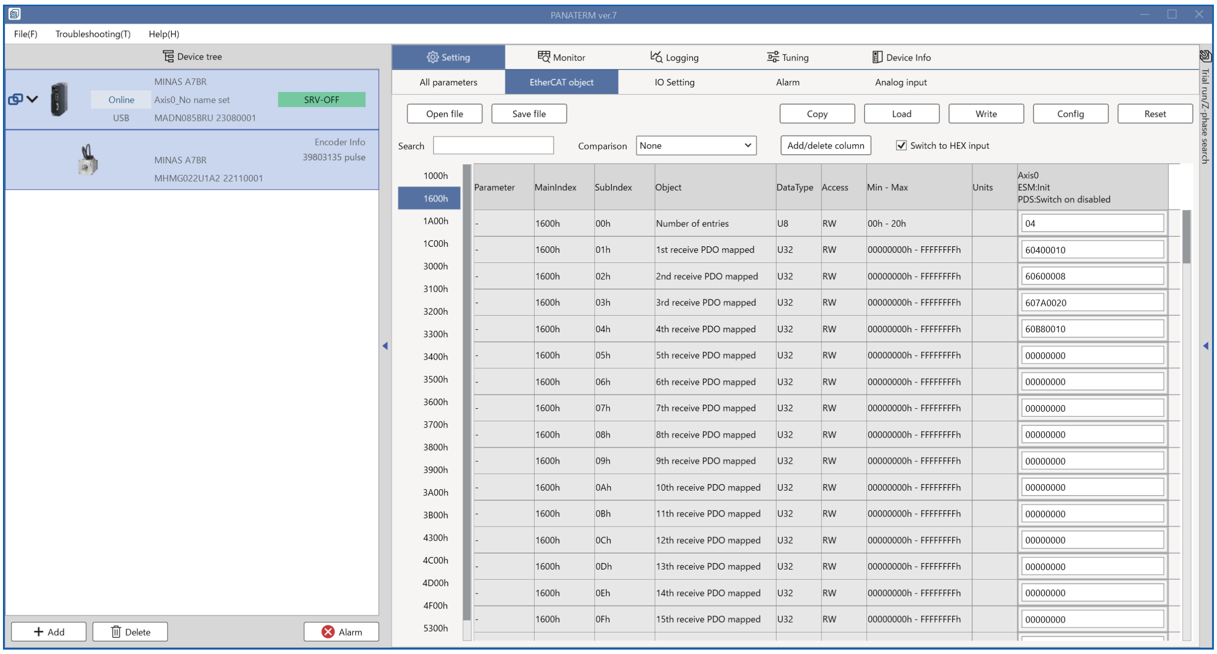
- After setting “4”, if the value of Obj.1010h:01h “Save all parameters” is set to 65766173h with an SDO message and the change is written to EEPROM, setting “2” to “4” is not necessary from the next startup. For information on how to write to EEPROM, see *“5.2.5 Store Parameters (Write Object to EEPROM) (1010h)”* .

■ Setup method 2

When configured using the object editor feature of Set-up Support Software (PANATERM ver.7) .

1 Change the ESM state to Init and start the object editor.

When setting up an object in the object editor, the ESM status must be Init.

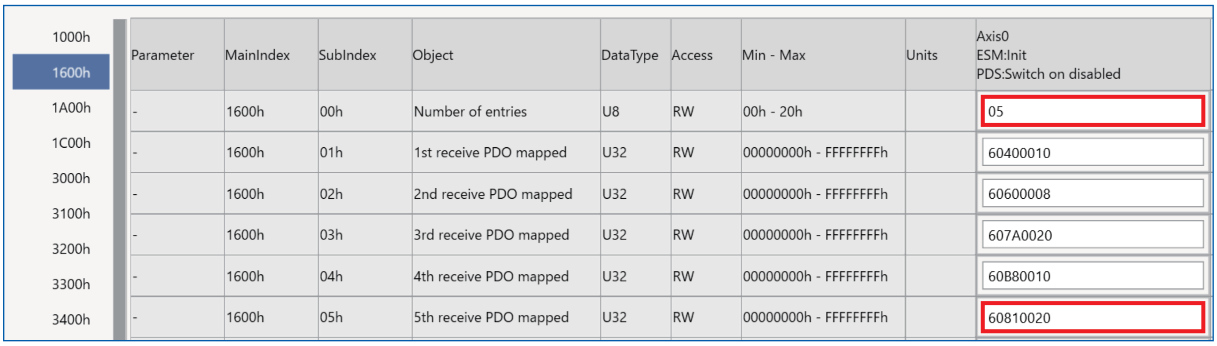


Parameter	MainIndex	SubIndex	Object	DataType	Access	Min - Max	Units	Axis0 ESM:Init PDS:Switch on disabled
-	1600h	00h	Number of entries	U8	RW	00h - 20h		04
-	1600h	01h	1st receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60400010
-	1600h	02h	2nd receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60600008
-	1600h	03h	3rd receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		607A0020
-	1600h	04h	4th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60B80010
-	1600h	05h	5th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	06h	6th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	07h	7th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	08h	8th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	09h	9th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Ah	10th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Bh	11th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Ch	12th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Dh	13th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Eh	14th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000
-	1600h	0Fh	15th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		00000000

2 Input 5 for the value of Obj.1600h:00h “Number of entries” .

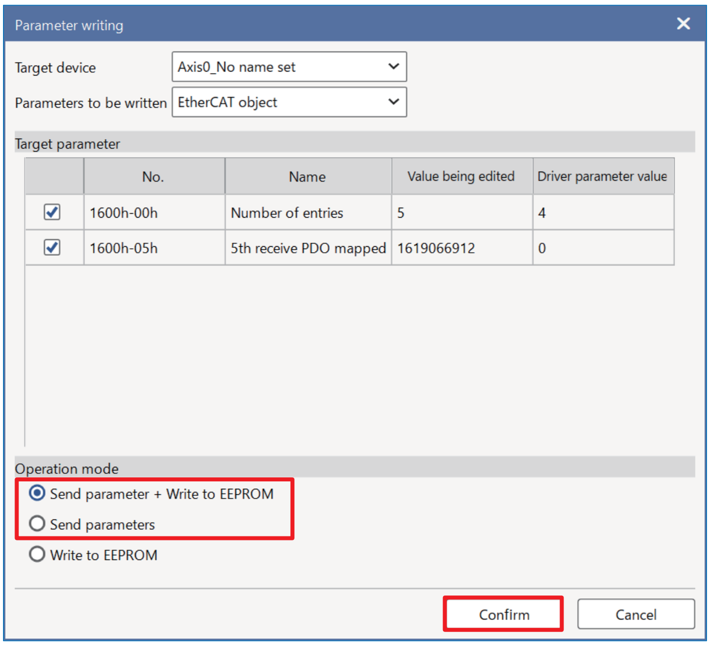
3 Input 60810020h for the value of Obj.1600h:05h “5th receive PDO mapped” .

The order of Steps 2 and 3 can be interchanged.



Parameter	MainIndex	SubIndex	Object	DataType	Access	Min - Max	Units	Axis0 ESM:Init PDS:Switch on disabled
-	1600h	00h	Number of entries	U8	RW	00h - 20h		05
-	1600h	01h	1st receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60400010
-	1600h	02h	2nd receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60600008
-	1600h	03h	3rd receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		607A0020
-	1600h	04h	4th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60B80010
-	1600h	05h	5th receive PDO mapped	U32	RW	00000000h - FFFFFFFFh		60810020

4 Click “Write” in the upper right corner of the screen, select “Send Parameter + Write EEPROM” or “Send Parameter” on the displayed parameter writing screen, and click “Confirm”.



Target device: Axis0_No name set

Parameters to be written: EtherCAT object

Target parameter

	No.	Name	Value being edited	Driver parameter value
☑	1600h-00h	Number of entries	5	4
☑	1600h-05h	5th receive PDO mapped	1619066912	0

Operation mode

● Send parameter + Write to EEPROM

○ Send parameters

○ Write to EEPROM

5 Change the ESM state from Init to PreOP.

6 Change the ESM state from PreOP to SafeOP.

TxPDO is enabled.

7 Change the ESM status from SafeOP to OP.

RxPDO is enabled.

5.2.4 Sync Manager 2/3 Synchronization (1C32h, 1C33h)

This section describes the settings for SyncManager 2 and SyncManager 3.

5.2.4.1 Sync Manager 2 Synchronization (1C32h)

SyncManager 2 is configured with Obj.1C32h: "Sync manager 2 synchronization" .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	—	Sync manager 2 synchronization	—	—	—	—	—	—	—	—
		● Configure the settings for Sync manager 2.								
1C32h	00h	Number of sub-objects	—	0 to 255	U8	ro	No	ALL	No	X
		● Displays the number of Obj.1C32h: "Sync manager 2 synchronization" Sub-Indexes. The value is fixed at 20h.								
1C32h	01h	Sync mode	—	0 to 65535	U16	rw	No	ALL	Yes	S
		● Sets the Sync Manager 2 synchronous mode. 00h: FreeRun (not synchronized) 01h: SM2 (synchronized with SM 2 Event) 02h: DC SYNC0 (synchronized with Sync0 Event) 03h: Not supported (cannot be set) ● The setup value of this object is automatically set at the change from PreOP to SafeOP according to the combination with the setting of ESC register 0981h "Activation" .								

ESC register 0981h setting status	Obj.1C32h:01h setup value		Value of Obj.1C32h:01h is changed during change from PreOP to SafeOP
DC Enable ON	00h: FreeRun	to	02h: DC SYNC0
	01h: SM2		02h: DC SYNC0
	02h: DC SYNC0		02h: DC SYNC0
DC Enable OFF	00h: FreeRun		00h: FreeRun
	01h: SM2		01h: SM2
	02h: DC SYNC0		00h: FreeRun

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	02h	Cycle time	ns	0 to 4294967295	U32	rw	No	ALL	Yes	S
		● Sets the Sync Manager cycle.								

Sync mode (Obj.1C32h:01h)	Function
00h (FreeRun)	Sets the interval between events by the local timer. 0 can also be set. 0 is set when transitioning to Safe-OP.
01h (Synchronous with SM2)	Sets the minimum time interval for SM2 events.
02h (DC SYNC0)	Sync0 Cycle Time (ESC register: 09A0h) is set.

- Set one of 62500 (62.5 μs), 125000 (125 μs), 250000 (250 μs), 500000 (500 μs), 1000000 (1 ms), 2000000 (2 ms), 4000000 (4 ms), 8000000 (8 ms) or 10000000 (10 ms). Any other value will cause Err81.0.0 "Synchronization cycle error protection" to occur.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	03h	Shift time	ns	0 to 4294967295	U32	ro	No	ALL	No	X
		● Not supported								

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>1C32h</td><td>04h</td><td>Sync modes supported</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● The supported synchronization types are set.
<table>
<tr><td>bit 0</td><td>FreeRun mode support</td><td>0: Not supported
1: FreeRun mode support</td><td>1 is set for this product.</td></tr>
<tr><td>bit 1</td><td>SM Synchronous mode support</td><td>0: Not supported
1: SM2 event synchronization support</td><td>1 is set for this product.</td></tr>
<tr><td>bits 4 to 2</td><td>DC synchronous mode support</td><td>000b: Not supported
001b: DC sync0 event support</td><td>001b is set for this product.</td></tr>
<tr><td>bits 6 to 5</td><td>Output shift support</td><td>00b: Not supported
01b : Shift support for local timer</td><td>00b is set for this product.</td></tr>
<tr><td>bits 15 to 7</td><td>Reserved</td><td>–</td><td>–</td></tr>
</table></td></tr>
<tr><td>1C32h</td><td>05h</td><td>Minimum cycle time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● The minimum value of the communication cycle that can be set.
In this product, it is 62500. (*1)</td></tr>
<tr><td>1C32h</td><td>06h</td><td>Calc and copy time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Time from SM2 event and SYNC0 event to ESC reading completion.
If the signal is scattered, this time may be longer.
In this product, it is 15000. (*1)</td></tr>
<tr><td>1C32h</td><td>08h</td><td>Command</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
<tr><td>1C32h</td><td>09h</td><td>Delay time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● The hardware delay time between the completion of the ESC read and its availability to the sub device application.
0 for this servo driver. (*1)</td></tr>
<tr><td>1C32h</td><td>0Ah</td><td>Sync0 cycle time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● For DC SYNC0 (Obj.1C32h:01h = 02h), the value of ESC register 09A0h is set.
For other than DC SYNC0, 0 is set.</td></tr>
<tr><td>1C32h</td><td>0Bh</td><td>SM-event missed</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
<tr><td>1C32h</td><td>0Ch</td><td>Cycle time too small</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
<tr><td>1C32h</td><td>0Dh</td><td>Shift time too short</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
<tr><td>1C32h</td><td>0Eh</td><td>RxPDO toggle failed</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
<tr><td>1C32h</td><td>20h</td><td>Sync error</td><td>–</td><td>0 to 1</td><td>BOOL</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported</td></tr>
</table>

*1 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

5.2.4.2 Sync Manager 3 Synchronization (1C33h)

SyncManager 3 is configured with Obj.1C33h: “Sync manager 3 synchronization” .

—: N/A

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>1C33h</td><td>—</td><td>Sync manager 3 synchronization</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td></td><td colspan="10">● Configure the settings for Sync manager 3.</td></tr>
<tr><td>1C33h</td><td>00h</td><td>Number of sub-objects</td><td>—</td><td>0 to 255</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td></td><td colspan="10">● Displays the number of Obj.1C33h: “Sync manager 3 synchronization” Sub-Indexes.
The value is fixed at 20h.</td></tr>
<tr><td>1C33h</td><td>01h</td><td>Sync mode</td><td>—</td><td>0 to 65535</td><td>U16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Sets the Sync Manager 3 synchronous mode. Set to the same mode as Sync Manager 2.
00h: FreeRun (not synchronized)
01h: Not supported (cannot be set)
02h: DC SYNC0 (synchronized with Sync0 Event)
03h: Not supported (cannot be set)
22h: SM2 (synchronized with SM2 Event)
● The setup value of this object is automatically set at the change from PreOP to SafeOP according to the combination (in the table below) with the setting of ESC register 0981h “Activation” .
<table>
<tr><th>ESC register 0981h setting status</th><th>Obj.1C33h:01h setup value</th><th></th><th>Value of Obj.1C33h:01h is changed during change from PreOP to SafeOP</th></tr>
<tr><td rowspan="3">DC Enable ON</td><td>00h: FreeRun</td><td rowspan="6">to</td><td>02h: DC SYNC0</td></tr>
<tr><td>22h: SM2</td><td>02h: DC SYNC0</td></tr>
<tr><td>02h: DC SYNC0</td><td>02h: DC SYNC0</td></tr>
<tr><td rowspan="3">DC Enable OFF</td><td>00h: FreeRun</td><td>00h: FreeRun</td></tr>
<tr><td>22h: SM2</td><td>22h: SM2</td></tr>
<tr><td>02h: DC SYNC0</td><td>00h: FreeRun</td></tr>
</table>
</td></tr>
<tr><td>1C33h</td><td>02h</td><td>Cycle time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td></td><td colspan="10">● The Sync Manager cycle is set.
The value is set to the same value as Obj.1C32h:02h “Cycle time” .</td></tr>
<tr><td>1C33h</td><td>03h</td><td>Shift time</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>No</td><td>S</td></tr>
<tr><td></td><td colspan="10">● Sets the time from the Sync0 and SM2 events until the sub device CPU writes the RxPDO value to ESC.
Set the value in 62500 increments that are smaller than the Cycle time.
Normally, set to 0.</td></tr>
<tr><td>1C33h</td><td>04h</td><td>Sync modes supported</td><td>—</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td></td><td colspan="10">● The supported synchronization types are set.
<table>
<tr><td>bit 0</td><td>FreeRun mode support</td><td>0: Not supported
1: FreeRun mode support</td><td>1 is set for this product.</td></tr>
<tr><td>bit 1</td><td>SM Synchronous mode support</td><td>0: Not supported
1: SM2 event synchronization support</td><td>1 is set for this product.</td></tr>
<tr><td>bits 4 to 2</td><td>DC synchronous mode support</td><td>000b: Not supported
001b: DC sync0 event support</td><td>001b is set for this product.</td></tr>
<tr><td>bits 6 to 5</td><td>Output Shift Support Input Shift Support</td><td>00b: Not supported
01b : Shift support for local timer</td><td>01b is set for this product.</td></tr>
<tr><td>bits 15 to 7</td><td>Reserved</td><td>—</td><td>—</td></tr>
</table>
</td></tr>
</table>

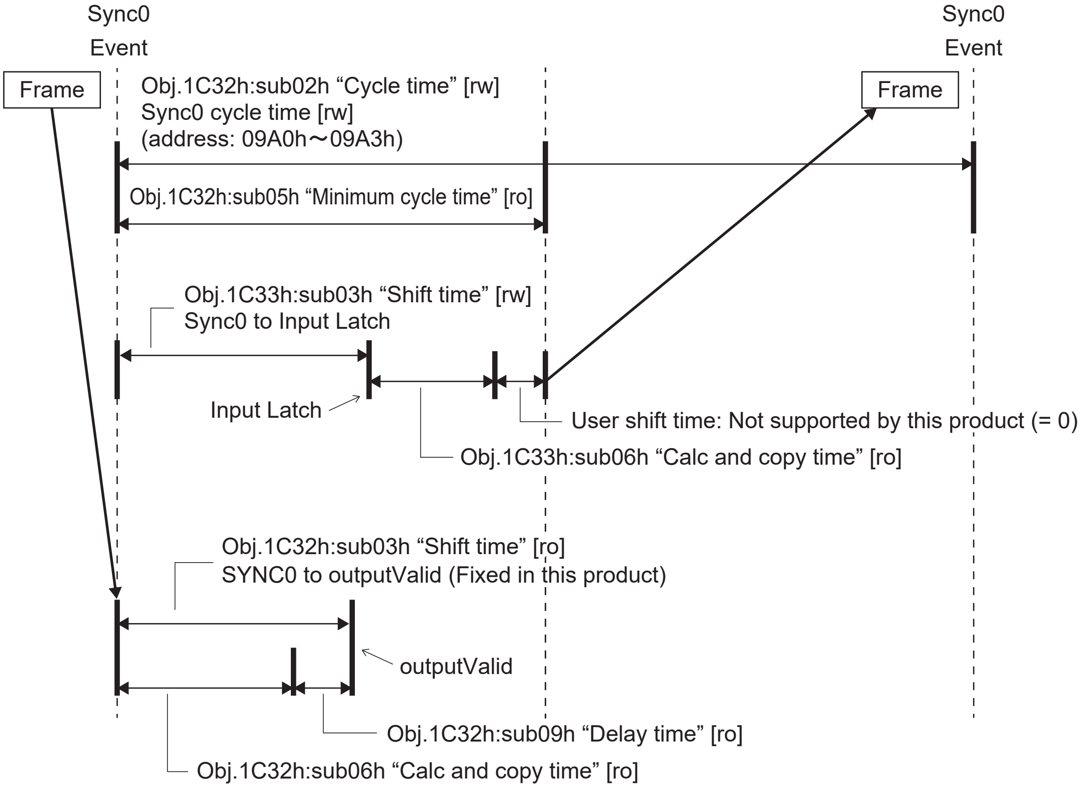
Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C33h	05h	Minimum cycle time	ns	0 to 4294967295	U32	ro	No	ALL	No	X
		● The minimum value of the communication cycle that can be set. The same value as that of Obj.1C32h-05h								
1C33h	06h	Calc and copy time	ns	0 to 4294967295	U32	ro	No	ALL	No	X
		● Time from SM2 event and SYNC0 event to completion of writing to the ESC register. In this product, it is 42000. (*1)								
1C33h	08h	Command	–	0 to 65535	U16	ro	No	ALL	No	X
		● Not supported								
1C33h	09h	Delay time	ns	0 to 4294967295	U32	ro	No	ALL	No	X
		● This is the hardware delay time before data is available to be written to the ESC from the sub device application. In this servo driver, it is set to 0.								
1C33h	0Ah	Sync0 cycle time	ns	0 to 4294967295	U32	ro	No	ALL	No	X
		● The same value as that of Obj.1C32h-0Ah								
1C33h	0Bh	SM-event missed	–	0 to 65535	U16	ro	No	ALL	No	X
		● Not supported								
1C33h	0Ch	Cycle time too small	–	0 to 65535	U16	ro	No	ALL	No	X
		● Not supported								
1C33h	0Dh	Shift time too short	–	0 to 65535	U16	ro	No	ALL	No	X
		● Not supported								
1C33h	0Eh	RxPDO toggle failed	–	0 to 65535	U16	ro	No	ALL	No	X
		● Not supported								
1C33h	20h	Sync error	–	0 to 1	BOOL	ro	No	ALL	No	X
		● Not supported								

*1 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

5.2.4.3 DC (SYNC0 Event Synchronization)

Synchronization method	Characteristics
The time information of another sub device is synchronized on the basis of the time on the first axis	● High precision ● Requires compensation processing on the main device side

The DC synchronous mode specifications for this product are as follows.



Sync manager 2/3 synchronization settings in DC synchronous mode

–: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	00h	Number of sub-objects	–	20h	U8	ro	No	ALL	No	X
	01h	Sync mode	–	02h: "DC SYNC0" (synchronized with Sync0 Event)	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	62.5 μs: 62500 125 μs: 125000 250 μs: 250000 500 μs: 500000 1 ms: 1000000 2 ms: 2000000 4 ms: 4000000 8 ms: 8000000 10 ms: 10000000	U32	rw	No	ALL	Yes	S
	03h	Shift time	ns	Not supported	U32	ro	No	ALL	No	X

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	04h	Sync modes supported	–	bit 4 to 2 “DC synchronous mode support” 001b: DC SYNC0 event support	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	62500 (*1)	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	15000 (*1)	U32	ro	No	ALL	No	X
	09h	Delay time	ns	0 (*1)	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	ESC Register 09A0h value	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	–	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	–	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	–	Not supported	U16	ro	No	ALL	No	X
	20h	Sync error	–	Not supported	BOOL	ro	No	ALL	No	X

*1 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

–: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C33h	00h	Number of sub-objects	–	Same setting as Obj.1C32h:00h “Number of sub-objects”	U8	ro	No	ALL	No	X
	01h	Sync mode	–	02H: DC SYNC0 “synchronized with Sync0 Event”	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	Same setting as Obj.1C32h:02h “Cycle time”	U32	ro	No	ALL	No	X
	03h	Shift time	ns	0 ns to 3875000 ns (Set timing to write TxPDO value from sub device CPU to ESC in 62500 ns increments)	U32	rw	No	ALL	No	S
	04h	Sync modes supported	–	27h (*1)	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	Same setting as Obj.1C32h:05h “Minimum cycle time”	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	42000 (*2)	U32	ro	No	ALL	No	X
	09h	Delay time	ns	Same setting as Obj.1C32h:09h “Delay time”	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	Same setting as Obj.1C32h:0Ah “Sync0 cycle time”	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	–	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	–	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	–	Not supported	U16	ro	No	ALL	No	X
	20h	Sync error	–	Not supported	BOOL	ro	No	ALL	No	X

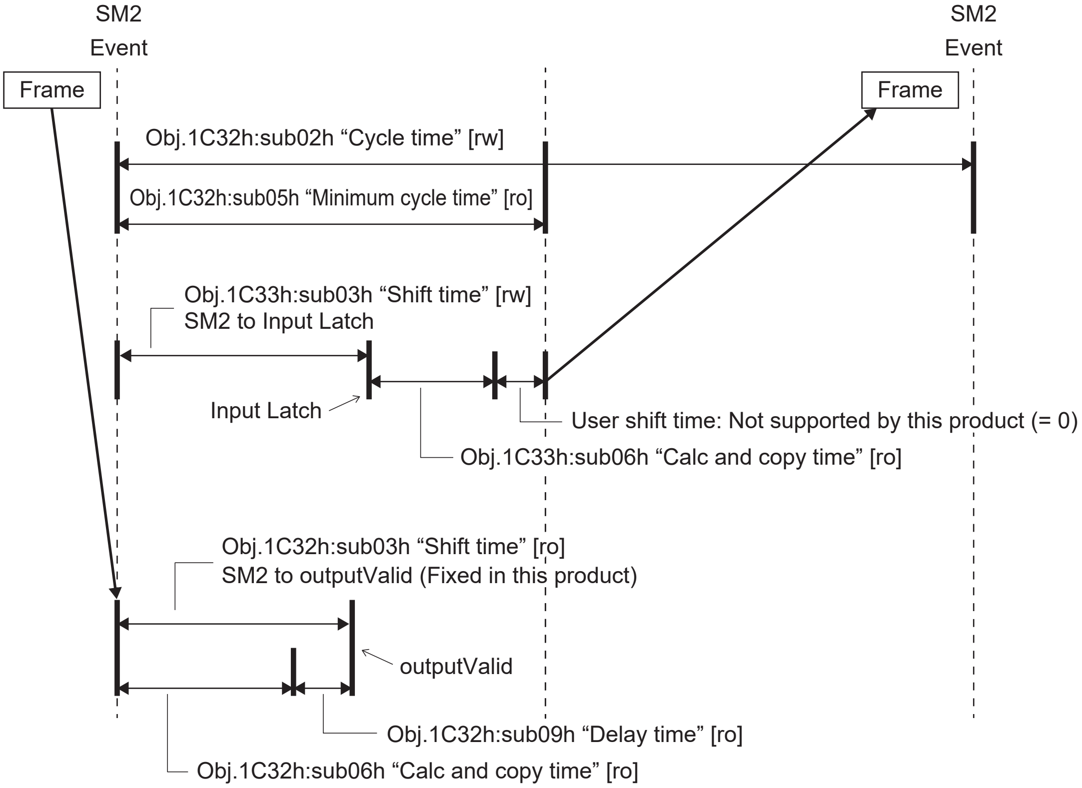
*1 For setup details, see *“5.2.4 Sync Manager 2/3 Synchronization (1C32h, 1C33h)”* .

*2 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

5.2.4.4 SM2 (SM2 Event Synchronization)

Synchronization method	Characteristics
Synchronized with RxPDO reception timing	● Precision is poor without transmission delay correction ● Transmission timing must be kept constant at the controller side (dedicated hardware, etc.)

The SM2 mode specifications for this product are as follows.



Sync manager 2/3 synchronization settings in SM2 Event synchronous mode

–: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	00h	Number of sub-objects	–	20h (fixed)	U8	ro	No	ALL	No	X
	01h	Sync mode	–	01h: SM2 (synchronized with SM2 Event)	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	62.5 μs: 62500 125 μs: 125000 250 μs: 250000 500 μs: 500000 1 ms: 1000000 2 ms: 2000000 4 ms: 4000000 8 ms: 8000000 10 ms: 10000000	U32	rw	No	ALL	Yes	S
	03h	Shift time	ns	Not supported	U32	ro	No	ALL	No	X

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	04h	Sync modes supported	–	bit 1 “SM Synchronous mode support” 1: SM2 event synchronization support	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	62500 (*1)	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	15000 (*1)	U32	ro	No	ALL	No	X
	09h	Delay time	ns	0 (*1)	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	0	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	–	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	–	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	–	Not supported	U16	ro	No	ALL	No	X
	20h	Sync error	–	Not supported	BOOL	ro	No	ALL	No	X

*1 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

–: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C33h	00h	Number of sub-objects	–	Same setting as Obj.1C32h:00h “Number of sub-objects”	U8	ro	No	ALL	No	X
	01h	Sync mode	–	22h: SM2 (synchronized with SM2 Event)	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	Same setting as Obj.1C32h:02h “Cycle time”	U32	ro	No	ALL	No	X
	03h	Shift time	ns	0 ns to 3875000 ns (Set timing to write TxPDO value from sub device CPU to ESC in 62500 ns increments)	U32	rw	No	ALL	No	S
	04h	Sync modes supported	–	27h (*1)	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	Same setting as Obj.1C32h:05h “Minimum cycle time”	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	42000 (*2)	U32	ro	No	ALL	No	X
	09h	Delay time	ns	Same setting as Obj.1C32h:09h “Delay time”	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	Same setting as Obj.1C32h:0Ah “Sync0 cycle time”	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	–	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	–	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	–	Not supported	U16	ro	No	ALL	No	X
	20h	Sync error	–	Not supported	BOOL	ro	No	ALL	No	X

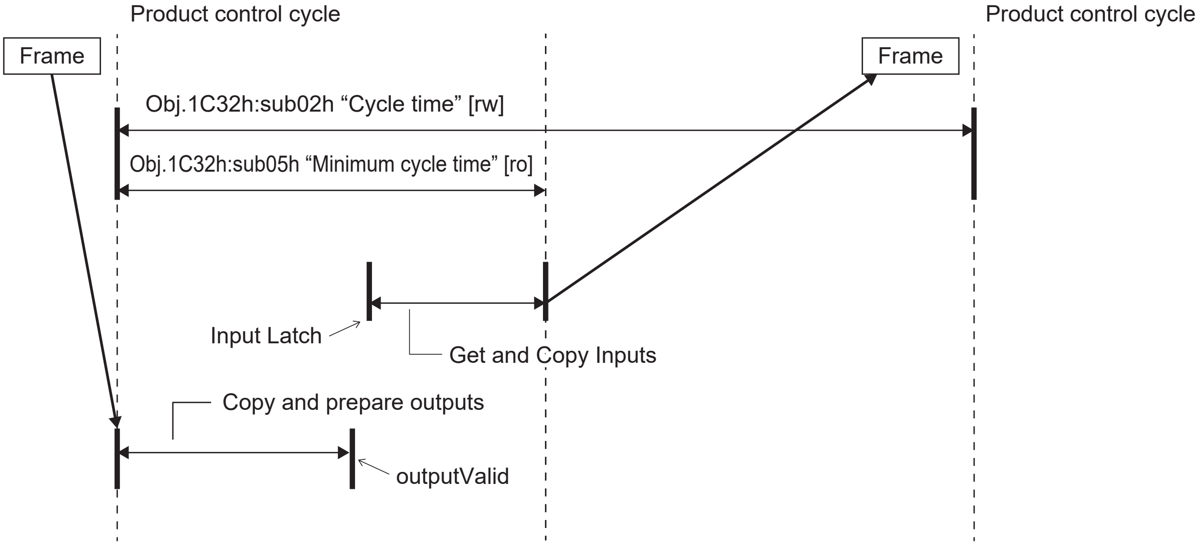
*1 For setup details, see *“5.2.4 Sync Manager 2/3 Synchronization (1C32h, 1C33h)”* .

*2 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

5.2.4.5 FreeRun (Asynchronous)

Synchronization method	Characteristics
Asynchronous	● Processing is simple ● Lacks real-time properties

The FreeRun mode specifications for this product are as follows.



Sync manager 2/3 synchronization settings in FreeRun mode

—: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	00h	Number of sub-objects	—	20h (fixed)	U8	ro	No	ALL	No	X
	01h	Sync mode	—	00h: FreeRun (not synchronized)	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	62.5 μs: 62500 125 μs: 125000 250 μs: 250000 500 μs: 500000 1 ms: 1000000 2 ms: 2000000 4 ms: 4000000 8 ms: 8000000 10 ms: 10000000	U32	rw	No	ALL	Yes	S
	03h	Shift time	ns	Not supported	U32	ro	No	ALL	No	X
	04h	Sync modes supported	—	bit 0 "FreeRun mode support" 1: FreeRun mode support	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	62500 (*1)	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	Not supported	U32	ro	No	ALL	No	X
	09h	Delay time	ns	Not supported	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	0	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	—	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	—	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	—	Not supported	U16	ro	No	ALL	No	X

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C32h	20h	Sync error	—	Not supported	BOOL	ro	No	ALL	No	X

*1 Setting values are for reference only and are not guaranteed. This setup value may change due to the amount of data to be written to the ESC or errors in the timing of transmission from the host device.

—: N/A

Index	Sub-Index	Name	Units	Value	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1C33h	00h	Number of sub-objects	—	Same setting as Obj.1C32h:00h "Number of sub-objects"	U8	ro	No	ALL	No	X
	01h	Sync mode	—	00h: FreeRun (not synchronized)	U16	rw	No	ALL	Yes	S
	02h	Cycle time	ns	Same setting as Obj.1C32h:02h "Cycle time"	U32	ro	No	ALL	No	X
	03h	Shift time	ns	Not supported	U32	rw	No	ALL	No	S
	04h	Sync modes supported	—	27h (*1)	U16	ro	No	ALL	No	X
	05h	Minimum cycle time	ns	Same setting as Obj.1C32h:05h "Minimum cycle time"	U32	ro	No	ALL	No	X
	06h	Calc and copy time	ns	Same setting as Obj.1C32h:06h "Calc and copy time"	U32	ro	No	ALL	No	X
	09h	Delay time	ns	Same setting as Obj.1C32h:09h "Delay time"	U32	ro	No	ALL	No	X
	0Ah	Sync0 cycle time	ns	Same setting as Obj.1C32h:0Ah "Sync0 cycle time"	U32	ro	No	ALL	No	X
	0Bh	SM-event missed	—	Not supported	U16	ro	No	ALL	No	X
	0Ch	Cycle time too small	—	Not supported	U16	ro	No	ALL	No	X
	0Dh	Shift time too short	—	Not supported	U16	ro	No	ALL	No	X
	20h	Sync error	—	Not supported	BOOL	ro	No	ALL	No	X

*1 For setup details, see *"5.2.4 Sync Manager 2/3 Synchronization (1C32h, 1C33h)"* .

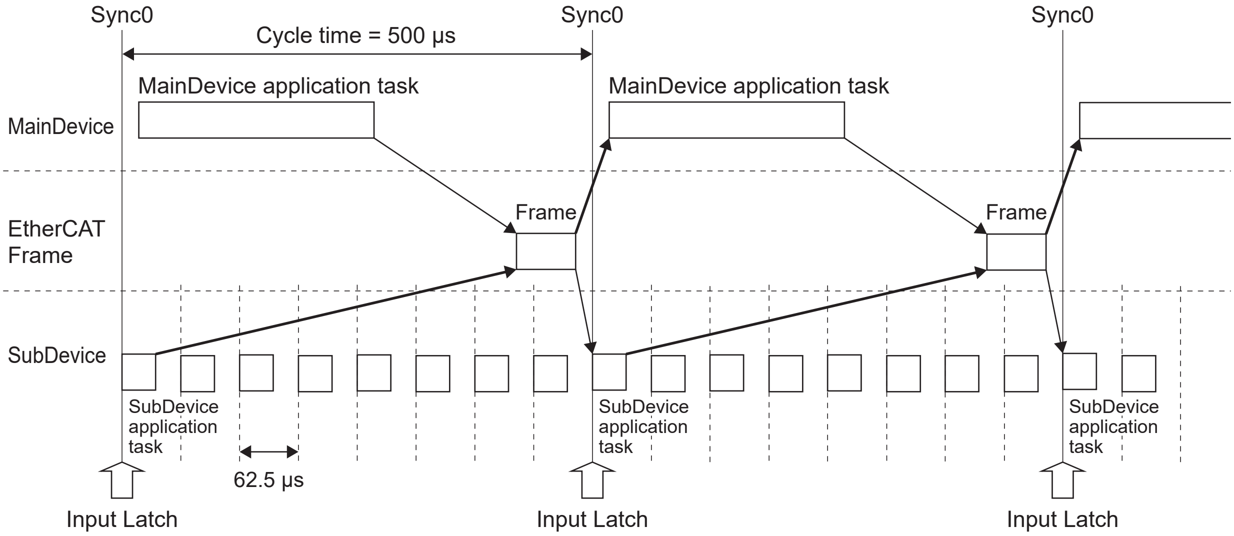
5.2.4.6 Input Shift Time

This product supports Input shift time to provide the latest sub device information to the main device.

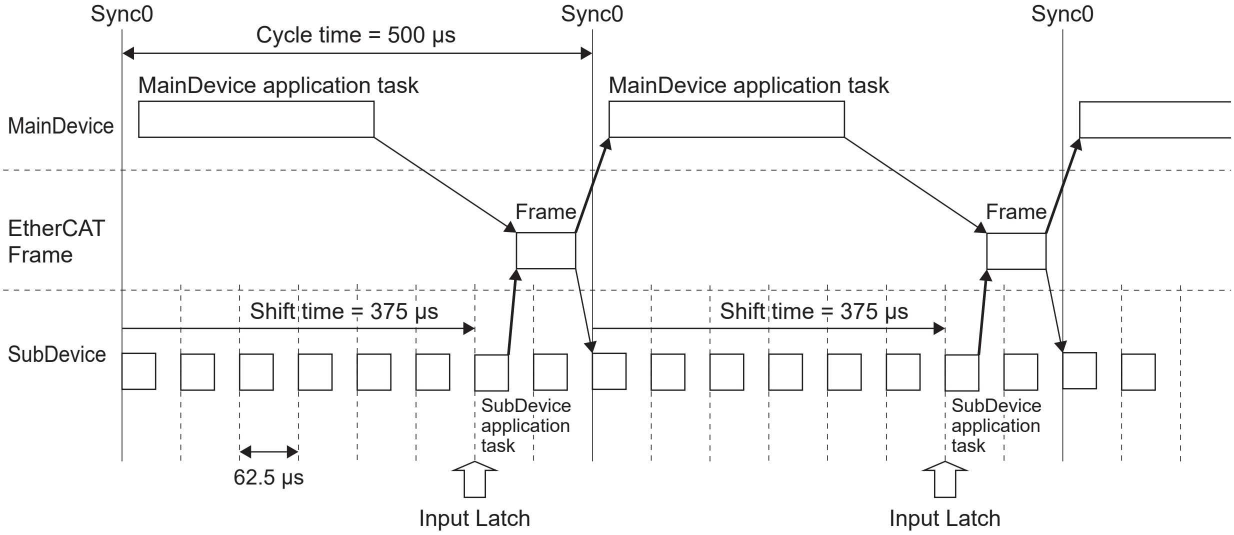
By setting Obj.1C33h:03h “Shift time” , the Input Latch timing can be adjusted in 62.5 μs increments and set to a value as close to the TxPDO frame transmission as possible.

In particular, this is effective when the communication cycle time is long, allowing more recent TxPDO values to be written.

DC cycle time = 500 μs, Input shift time = 0 μs



DC cycle time = 500 μs, Input shift time = 375 μs



5.2.5 Store Parameters (Write Object to EEPROM) (1010h)

This section describes objects for writing object data to EEPROM.

Using Obj.1010h:01h “Save all parameters” , send 65766173h (“save”) with EtherCAT communication data to the sub device, which writes the object data with differences on EEPROM and RAM to EEPROM at once (backup).

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
1010h	—	Store parameters	—	—	—	—	—	—	—	—
	● Writes (backs up) object data to EEPROM.									
1010h	00h	Number of entries	—	0 to 255	U8	ro	No	ALL	No	X
	● Indicates the number of sub-indexes for this object. The value is fixed at 1.									
1010h	01h	Save all parameters	—	0 to 4294967295	U32	rw	No	ALL	No	A
	● By writing 65766173h (“save”) on the EtherCAT communication data, all the object tables to be backed up are backed up to EEPROM together. When the process is completed, the value is 00000001h regardless of success or failure. After the control power is turned on, the value is 00000001h.									

When Err11.0.0 “Control power supply undervoltage protection” occurs, EEPROM cannot be accessed and objects cannot be stored in EEPROM.

Writing time to EEPROM may take up to 10 seconds (For example, when changing all objects.).

Do not shut off the control power supply while writing to the EEPROM.

In the servo parameter area (objects in the 3000h area), writing to the EEPROM is enabled for objects with attributes C and R by resetting the control power supply.

There is a limit to the number of EEPROM writes.

No other SDO commands are accepted while writing to EEPROM.

An abort message is returned in the following cases.

For write access to Obj.1010h:00h “Number of entries”

Write data to Obj.1010h:01h “Save all parameters” is a value other than 65766173h (“save”)

For other Abort messages, see *“4.8.3.1 Abort Messages”* .

5.2.6 Diagnosis history (Error (Alarm) History Readout Function) (10F3h)

This section describes the object for reading the alarm history.

Obj.10F3h: “Diagnosis history” can be used to read max. 30 errors (alarms) from the history.

The error (alarm) history is stored in Obj.10F3h:06h “Diagnosis message 1” starting with the error (alarm) that occurred max. 30 errors before, and max. 30 errors are stored in sequence in the order they occurred up to Obj.10F3h:23h “Diagnosis message 30” .

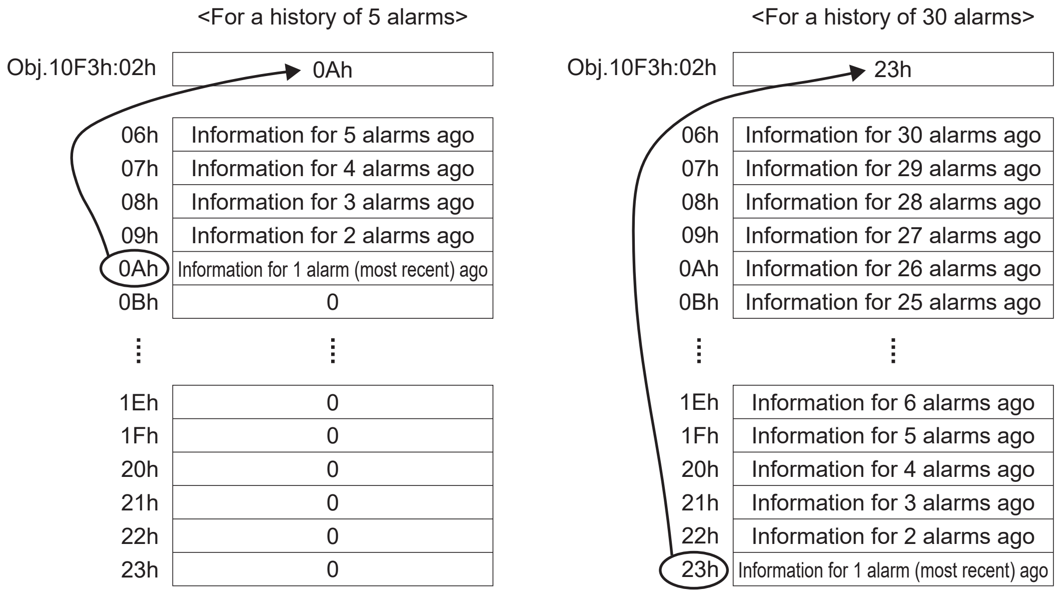
The sub-index number where the most recent error (alarm) history is stored can be checked from Obj.10F3h:02h “Newest message” .

Obj.10F3h: “Diagnosis history” does not support PDO. Each sub-index of Obj.10F3h: “Diagnosis history” is read by SDO so synchronism cannot be guaranteed.

The error (alarm) history displayed in Obj.10F3h: “Diagnosis history” is set by reading the information backed up in the EEPROM of this product when the control power is turned on.

The error (alarm) history displayed in Obj.10F3h: “Diagnosis history” remains only alarms that occurred in the product. Warnings are not displayed or stored.

In addition, there are alarms that are not displayed and stored in Obj.10F3h: “Diagnosis history” .



—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
10F3h	—	Diagnosis history	—	—	—	—	—	—	—	—
● Settings are executed to enable or disable error history readouts and emergency messages.										
10F3h	00h	Number of entries	—	0 to 255	U8	ro	No	ALL	No	X
● Indicates the number of sub-indexes for this object. The value is fixed at 23h.										
10F3h	01h	Maximum messages	—	0 to 255	U8	ro	No	ALL	No	X
● Displays the number of error messages that can be stored by the product. The value is fixed at 1Eh (30 times).										
10F3h	02h	Newest message	—	0 to 255	U8	ro	No	ALL	No	—
● Displays the sub-index where the latest error message is stored. If there is no alarm history, such as immediately after clearing the alarm history, 0 is displayed.										

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>10F3h</td><td>03h</td><td>Newest acknowledged message</td><td>—</td><td>0 to 255</td><td>U8</td><td>rw</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● On read: Always 0
● On write:
Write setting value 00h and all Diagnosis Messages will be cleared.
Write a setting other than 00h and then SDO Abort will output (Code 06090030h).</td></tr>
<tr><td>10F3h</td><td>04h</td><td>New messages available</td><td>—</td><td>0 to 1</td><td>BOOL</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Not supported by this product.
The value is fixed at 0.</td></tr>
<tr><td>10F3h</td><td>05h</td><td>Flags</td><td>—</td><td>0 to 65535</td><td>U16</td><td>See below</td><td>No</td><td>ALL</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">
<table>
<tr><td>bit 0</td><td>rw</td><td>Emergency message execution permission
● 0: Emergency messages disabled
● 1: An emergency message is issued for each new error detected
(May not be left in a diagnosis message, depending on the error)
For more information about Emergency messages, see <i>“4.8.3.2 Emergency Messages”</i> .</td></tr>
<tr><td>bit 1</td><td>r</td><td>Not supported: 1 fixed</td></tr>
<tr><td>bit 2</td><td>r</td><td>Not supported: 1 fixed</td></tr>
<tr><td>bit 3</td><td>r</td><td>Not supported: 0 fixed</td></tr>
<tr><td>bit 4</td><td>r</td><td>Not supported: 0 fixed</td></tr>
<tr><td>bit 5</td><td>r</td><td>Diagnosis message clearing information
● 0: There is error history information
● 1: There is no error history information, or error history information clearing
(When Obj.10F3h:03h “Newest acknowledged message” = 0 is written) Complete
(Stored until the next error (alarm) occurs)</td></tr>
<tr><td>bits 15 to 6</td><td>—</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>10F3h</td><td>06h</td><td>Diagnosis message 1</td><td>—</td><td>—</td><td>OS</td><td>ro</td><td>No</td><td>ALL</td><td>No (*1)</td><td>X</td></tr>
<tr><td colspan="11">Displays error history.
<table>
<tr><td>Example</td><td>00</td><td>E8</td><td>10</td><td>FF</td><td>02</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td><td>00</td></tr>
<tr><td rowspan="3">Purpose</td><td>(L)</td><td>(H)</td><td>(L)</td><td>(H)</td><td>(L)</td><td>(H)</td><td>(L)</td><td>(H)</td><td>(L)</td><td colspan="6"></td><td>(H)</td></tr>
<tr><td colspan="2">(Fixed value)</td><td colspan="2">Error Code</td><td colspan="2">(Fixed value)</td><td colspan="2">Text ID</td><td colspan="8">(Fixed value)</td></tr>
<tr><td colspan="4">Diag code</td><td colspan="2">Flags</td><td colspan="2">Text ID</td><td colspan="8">Timestamp</td></tr>
</table>
Diag code
Diagnostic code identifying the message
Error code returns the value set in Obj.603Fh:00h “Error code” .
Flags
The value is fixed at 0002h.
Text ID
Returns the Text ID defined for the error message (Error code).
The main alarm number is set in the upper 8 bits and the sub alarm number in the lower 8 bits.
Timestamp
The time when the error occurs. The value is fixed at 0000000000000000h because it is not yet supported.</td></tr>
<tr><td></td><td>⋮</td><td colspan="9">⋮</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
10F3h	23h	Diagnosis message 30	–	–	OS	ro	No	ALL	No (*1)	X
- Displays error history. The contents are the same as for sub-index 06h.										

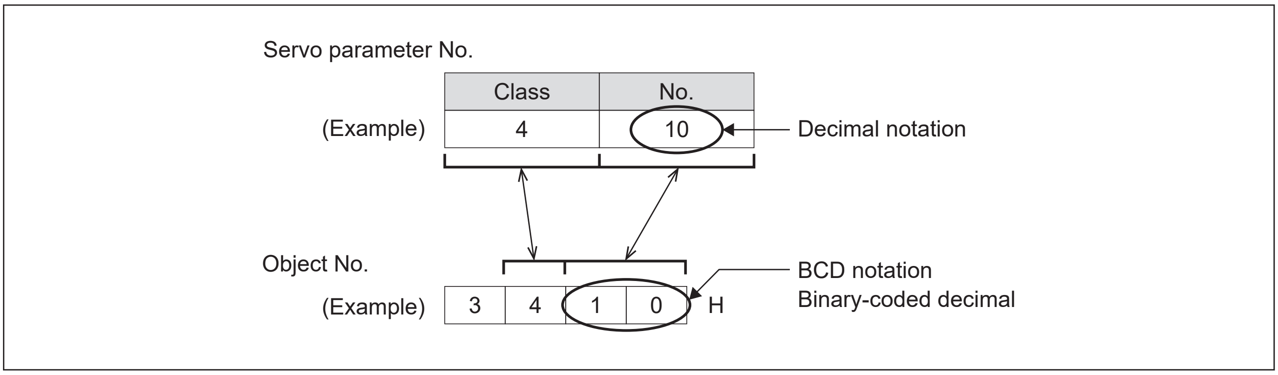
*1 It is not backed up as an object, but is transferred from separately backed up alarm information.

5.3 Servo Parameter Area (3000h to 3FFFh) Details

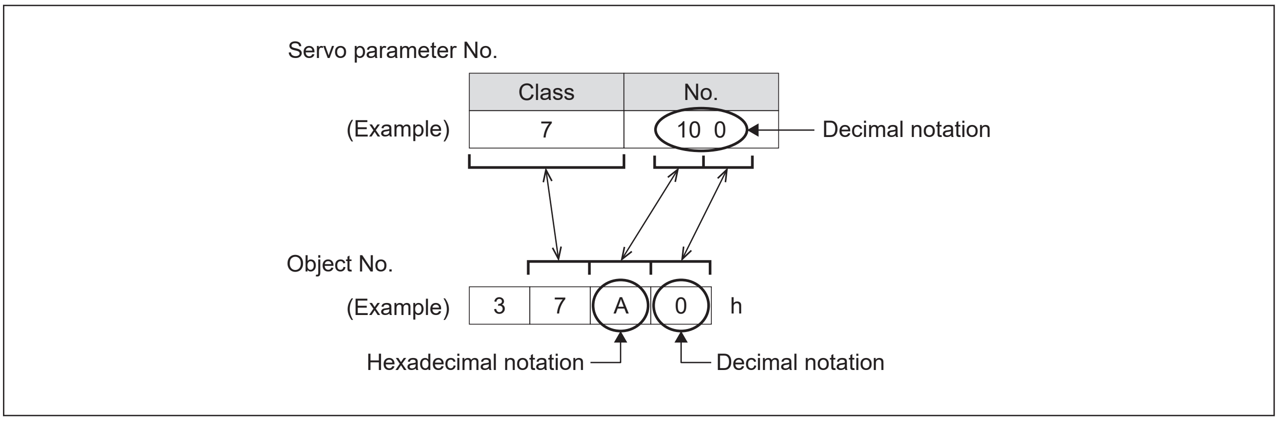
Servo parameters are assigned to objects in the 3000h area.

The servo parameter number and object number are supported as follows.

When the servo parameter number is less than 100



When the servo parameter number is 100 or more



5.4 User-specific Area (4000h to 4FFFh) Details

The user-specific area is an object in the manufacturer-defined area and is used in this product for objects that improve the performance and convenience of the function.

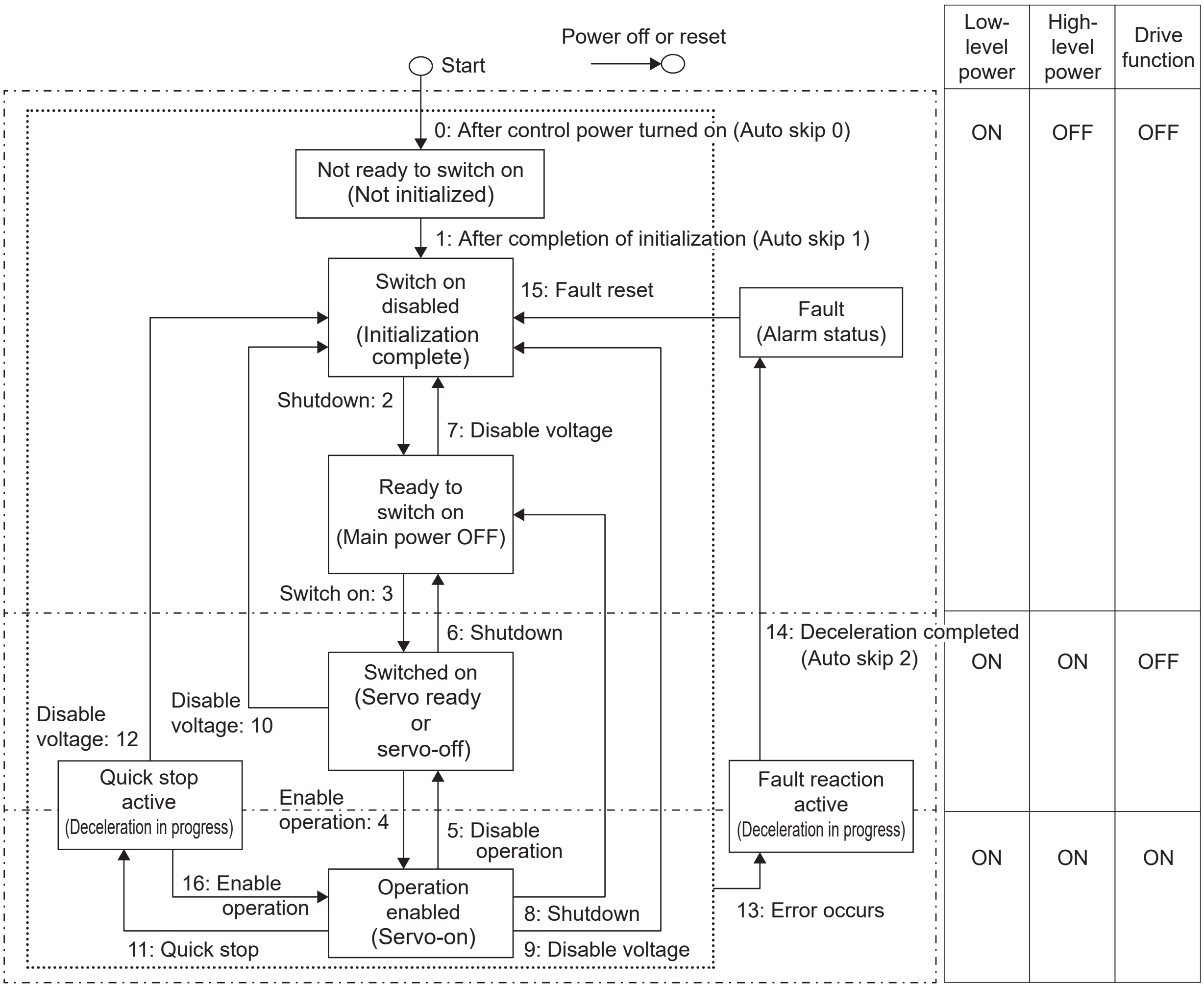
For more information on the objects in the user-specific area, check the description of the functions that use the relevant object. For the section describing the functions, see *“8.3 User-specific Area (4000h to 4FFFh)”* .

5.5 Drive Profile Area (6000h to 6FFFh) Details

5.5.1 Power Drive Systems (PDS) Status

The PDS status indicates the state of the power supply from the product's power control, either by user command or by error detection, etc.

The status transitions of PDS are defined in the figure below.



Low-level power	High-level power	Drive function
ON	OFF	OFF
ON	ON	OFF
ON	ON	ON

* Low-level power: Control power High-level power: Main power Drive function: Servo-on

High-level power (main power) must be ON for this product to be servo ready.

When High-level power (main power) is OFF, the servo is not servo ready and cannot change to the switched on state.

During the safe torque-off state, the Switch on disabled state is set regardless of the High-level power (main power) status.

After changing to Operation enabled (servo-on), wait at least 100 ms before sending an operation command.

PDS state transition events (transition conditions) and transition actions

For PDS transitions, make sure to send the next transition command after confirming that the state has transitioned with Obj.6041h:00h “Statusword” .

PDS transitions		Event (s)	Action (s)
0	Auto skip 0	● Automatic transition after control power is turned on or after application reset.	● Self-diagnosis and initialization process of drive functions are performed.
1	Auto skip 1	● Automatic transition after initialization is completed.	● Communication is established.
2	Shutdown	● Shutdown command received while not in safe torque off state.	● None in particular.
3	Switch on	● A switch on command was received while High-level power was ON.	● None in particular.
4	Enable operation	● Enable operation command received.	● Enables the drive function. In addition, all previous set-point data is cleared.
5	Disable operation	● Disable operation command received.	● Disables the drive function.
6	Shutdown	● Shutdown command was received while High-level power was ON. ● High-level power OFF status detected.	● None in particular.
7	Disable voltage	● When the Disable voltage command is received. ● Quick stop command received. ● Transitioned to Init when ESM state is Pre-OP, SafeOP, or OP. ● Safe torque-off status is now in effect.	● None in particular.
8	Shutdown	● Shutdown command was received while High-level power was ON.	● Disables the drive function.
9	Disable voltage	● Disable voltage command received. ● Detected High-level power OFF with Abort connection option code value of 2. ● Safe torque-off status is now in effect.	● Disables the drive function.
10	Disable voltage	● Disable voltage command received. ● Quick stop command received. ● Transitioned to Init when ESM state is Pre-OP, SafeOP, or OP. ● Safe torque-off status is now in effect.	● None in particular.
11	Quick stop	● Quick stop command received. ● Detected High-level power OFF with Abort connection option code value of 3.	● Starts execution of the Quick stop function.
12	Disable voltage	● Quick stop option code is set to 1, 2, or 3 and the Quick stop operation is completed. ● Disable voltage command was received when the Quick stop option code was 5, 6, or 7 and the Quick stop operation was completed. ● High-level power OFF status detected. ● Safe torque-off status is now in effect.	● Disables the drive function.
13	Error occurs	● Error detected. ● Detected High-level power OFF with Abort connection option code value of 1. ● Trigger to start retracting operation was detected.	● Performs the configured Fault reaction function. ● Performs retracting operation function

PDS transitions		Event (s)	Action (s)
14	Auto skip 2	- Automatic transition occurred after completion of error detection and deceleration processing. - Automatic transition occurred after completion or interruption of retracting operation.	- Disables the drive function.
15	Fault reset	- Fault reset command was received after the error cause was removed.	- If the fault cause is not present, perform a reset of the fault status.
16	Enable operation	- When the Quick stop option code setting value is 5, 6, or 7, the Enable operation command was received.	- Enables the drive function.

5.5.2 Controlword (6040h)

Commands that control the sub device (this product), such as PDS state transitions, are set in Obj.6040h:00h "Controlword" .

Precautions

- Whenever this object is used, it must be used with PDO and the PDO watchdog must be enabled.
  SDO cannot determine if communication is interrupted, and the motor may remain energized, which is unsafe.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands to the product, such as PDS state transitions.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)						(2)	(3)	(4)	(2)			(5)	(6)	(7)	(8)

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on

- Bit 7, 3 to 0 (fault reset, enable operation, quick stop, enable voltage, switch on)

Represents a PDS command. The table below shows the combination of commands and the supported bits.

— : Undefined

Command	bits of the controlword					PDS transitions
	bit 7	bit 3	bit 2	bit 1	bit 0	
	fault reset	enable operation	quick stop	enable voltage	switch on	
Shutdown	0	—	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4 (*1)
Enable operation	0	1	1	1	1	4, 16
Disable voltage	0	—	—	0	—	7, 9, 10, 12
Quick stop	0	—	0 (*2)	1	—	7, 10, 11
Disable operation	0	0	1	1	1	5
Fault reset	↑	—	—	—	—	15

*1 After executing the Switch on command, execute the Enable operation command.

*2 The bit logic of the quick stop command is enabled by 0.

Note that this is the opposite behavior of bit logic for other commands.

- Bit 8 (halt)

When 1, the motor decelerates to a temporary stop according to the Obj.605Dh:00h “Halt option code” setting.

After the temporary stop, the operation is resumed when the value is set back to 0. However, in hm control mode, the operation is interrupted by 1 and does not resume when set back to 0.

- Bit 9, 6 to 4 (operation mode specific (control mode dependent bit))

Control mode (Op-mode) specific operation mode specific bit operations are shown in the table below (For details, see the Related Objects section for each control mode.).

—: Unused (set bits to 0)

Op-mode	bit 9	bit 6	bit 5	bit 4
pp	change on set-point	absolute / relative	change set immediately	new set-point
csp	—	—	—	—
ip	—	—	—	enable interpolation
hm	—	—	—	start homing
pv	—	—	—	—
csv	—	—	—	—
tq	—	—	—	—
cst	—	—	—	—

5.5.3 Statusword (6041h)

The status of the sub device (this product) is checked with Obj.6041h:00h “Statusword” .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on

- bit 6, 5, 3 to 0

  “switch on disabled, quick stop, fault, operation enabled, switched on, ready to switch on”

  You can check the status of PDS with these bits. The states and supported bits are indicated in the table.

Statusword	PDS state	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization complete state
xxxx xxxx x01x 0001 b	Ready to switch on	Main circuit power supply off state
xxxx xxxx x01x 0011 b	Switched on	Servo off, servo ready
xxxx xxxx x01x 0111 b	Operation enabled	Servo-on
xxxx xxxx x00x 0111 b	Quick stop active	Quick stop
xxxx xxxx x0xx 1111 b	Fault reaction active	Error (alarm) recognition
xxxx xxxx x0xx 1000 b	Fault	Error (alarm) state

- bit 4 “voltage enabled”

  A value of 1 indicates that the main circuit power supply voltage is applied to the PDS.

- bit 5 “quick stop”

  A value of 0 indicates that the PDS has accepted the quick stop request.

  The bit logic of quick stop is activated by 0.

  Note that this is the opposite behavior of bit logic for other commands.

- bit 7 “warning”

  A value of 1 indicates that a warning has occurred. When there is a warning, there is no change in PDS state and motor operation continues.

- bit 8 “reserved”

  This bit is unused (fixed at 0).

- bit 9 “remote”

  0 (local) indicates that Obj.6040h:00h “Controlword” cannot be processed.

  1 (remote) indicates that Obj.6040h:00h “Controlword” can be processed.

  1 when the ESM state changes to PreOP or higher.

  In the 0 state, Obj.6041h:00h “Statusword” should not refer to anything other than this bit.

  This bit is set to 0 regardless of the ESM status during operation with Set-up Support Software (PANATERM ver.7) (trial run, frequency characteristics analysis function (FFT function), One Minute TUNING, and Z-phase search).

- Bit 13, 12, 10 “operation mode specific (control mode dependent bit)”

  Control mode specific oms bit operations are shown in the table below.

  (For details, see the “Related Objects” section for each control mode.)

—: Unused (Undefined)

Op-mode	bit 13	bit 12	bit 10
pp	following error	set-point acknowledge	target reached
csp	following error	drive follows command value	—
ip	—	ip mode active	target reached
hm	homing error	homing attained	target reached
pv	max slippage error (Not supported)	speed	target reached
csv	—	drive follows command value	—
tq	—	—	target reached
cst	—	drive follows command value	—

- bit 11 “internal limit active”

  Obj.6041h:00h “Statusword” :bit 11 “internal limit active” is set to 1 when the cause could be an internal limitation.

  The conditions under which Obj.6041h:00h “Statusword” :bit 11 “internal limit active” is 1 are shown in the table below.

Control mode		Internal limitation causes	Servo on/off state
Position control	pp, csp	Emergency stop (*1)	On only
		Torque limit	On only (*2)
		Over-travel inhibit inputs (POT, NOT)	On/off
		Software limit	On/off
	hm	Emergency stop (*1)	On only
		Torque limit	On only (*2)
Velocity control	pv, csv	Emergency stop (*1)	On only
		Torque limit	On only (*2)
		Over-travel inhibit inputs (POT, NOT)	On/off
Torque control	tq, cst	Emergency stop (*1)	On only
		Torque limit (*3)	On only (*2)
		Over-travel inhibit inputs (POT, NOT)	On/off
		Velocity limit	On only

*1 This excludes cases where the torque limit condition is not reached even during an emergency stop.

*2 When the torque limit value is 0, bit 11 “internal limit active” is set to 1 even in the servo-off state.

The torque limit indicates the minimum value among the following.

- t-value (Obj.6071h:00h “Target torque” +Obj.60B2h:00h “Torque offset”) (only during torque control (tq, cst))

- Obj.6072h:00h “Max torque”
- Obj.3013h:00h “1st torque limit”
- Obj.3522h:00h “2nd torque limit” (only when no torque control and (Obj.3521h:00h “Selection of torque limit” = 2 or 4))
- Obj.60E0h:00h “Positive torque limit value” ,Obj.60E1h:00h “Negative torque limit value” (only if Obj.3521h:00h “Selection of torque limit” = 5)

*3 The torque limit judgment condition can be switched during torque control with the Obj.3703h:00h “Output setup during torque limit” setting.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3703h	00h	Output setup during torque limit	—	0 to 1	I16	rw	No	cst tq	Yes	A
● Set up judgment condition of output while torque is limited by torque control. 0: Torque limit judgment condition includes “torque command value (Obj.6071h:00h “Target torque” +Obj.60B2h:00h “Torque offset”)” 1: Torque limit judgment condition does not include “torque command value (Obj.6071h:00h “Target torque” +Obj.60B2h:00h “Torque offset”)”										

- bit 15, 14 “reserved”

  This bit is unused (fixed at 0).

5.5.4 Control Mode Confirmation and Setup

5.5.4.1 Supported Drive Modes (6502h)

The control modes (modes of operation) supported by this product can be confirmed with Obj.6502h:00h "Supported drive modes" .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6502h	00h	Supported drive modes	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays supported control modes (Modes of operation).
  A value of 1 indicates the mode is supported.

—: N/A

bit	Modes of operation	Abbreviation	Supported
0	Profile position mode (Profile position control mode)	pp	Yes
1	Velocity mode (Velocity control mode)	vl	No
2	Profile velocity mode (Profile velocity control mode)	pv	Yes
3	Torque profile mode (Profile torque control mode)	tq	Yes
4	reserved	—	No
5	Homing mode (Homing position control mode)	hm	Yes
6	Interpolated position mode (Interpolated position control mode)	ip	No
7	Cyclic synchronous position mode (Cyclic position control mode)	csp	Yes
8	Cyclic synchronous velocity mode (Cyclic velocity control mode)	csv	Yes
9	Cyclic synchronous torque mode (Cyclic torque control mode)	cst	Yes
10	reserved	—	No
⋮			
15			
16	manufacturer-specific	—	No
⋮			
31			

5.5.4.2 Modes of Operation (6060h)

The control mode is set with Obj.6060h:00h “Modes of operation” .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6060h	00h	Modes of operation	—	-128 to 127	I8	rw	RxPDO	ALL	Yes	A

- Sets the control mode of this product.
  The default value is 0.
  Setting of unsupported control modes is prohibited.

—: N/A

Value	Modes of operation	Abbreviation	Supported
-128 to -1	Reserved	—	—
0	No mode change/no mode assigned (mode not changed/mode not set)	—	Yes
1	Profile position mode (Profile position control mode)	pp	Yes
2	Velocity mode (Velocity control mode)	vl	No
3	Profile velocity mode (Profile velocity control mode)	pv	Yes
4	Torque profile mode (Profile torque control mode)	tq	Yes
6	Homing mode (Homing position control mode)	hm	Yes
7	Interpolated position mode (Interpolated position control mode)	ip	No
8	Cyclic synchronous position mode (Cyclic position control mode)	csp	Yes
9	Cyclic synchronous velocity mode (Cyclic velocity control mode)	csv	Yes
10	Cyclic synchronous torque mode (Cyclic torque control mode)	cst	Yes
11 to 127	Reserved	—	—

Obj.6060h:00h “Modes of operation” is default = (No mode change/no mode assigned), so be sure to set the control mode value to use after the control power is turned on.

If the PDS state is changed to Operation enabled when the setting value of Obj.6060h:00h “Modes of operation” is 0 and the setting value of Obj.6061h:00h “Modes of operation display” is 0, Err88.1.0 “Control mode setting error protection” occurs.

If a control mode not supported by the SDO is set, an Abort message is returned as out of range.

There are some precautions to be taken when switching control modes. For details, see *“5.5.4.4 Precautions for Switching the Control Mode”* .

5.5.4.3 Modes of Operation Display (6061h)

The internal control mode of the product can be checked with Obj.6061h:00h “Modes of operation display” .

After setting Obj.6060h:00h “Modes of operation” , monitor this object to confirm that it is operating as configured.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6061h	00h	Modes of operation display	—	-128 to 127	I8	ro	TxPDO	ALL	No	X

- Displays the current control mode.
  The definition is the same as Obj.6060h:00h “Modes of operation” .

—: N/A

Value	Modes of operation	Abbreviation	Supported
-128 to -1	Reserved	—	—
0	No mode change/no mode assigned (mode not changed/mode not set)	—	Yes
1	Profile position mode (Profile position control mode)	pp	Yes
2	Velocity mode (Velocity control mode)	vl	No
3	Profile velocity mode (Profile velocity control mode)	pv	Yes
4	Torque profile mode (Profile torque control mode)	tq	Yes
6	Homing mode (Homing position control mode)	hm	Yes
7	Interpolated position mode (Interpolated position control mode)	ip	No
8	Cyclic synchronous position mode (Cyclic position control mode)	csp	Yes
9	Cyclic synchronous velocity mode (Cyclic velocity control mode)	csv	Yes
10	Cyclic synchronous torque mode (Cyclic torque control mode)	cst	Yes
11 to 127	Reserved	—	—

5.5.4.4 Precautions for Switching the Control Mode

- The control mode can be switched by changing the value of Obj.6060h:00h “Modes of operation” .
- Check the current control mode of the product with Obj.6061h:00h “Modes of operation display” .
- When switching control modes, synchronize and update the RxPDO objects associated with Obj.6060h:00h “Modes of operation” and the control mode.
- Object values not supported by the modified control mode are undefined.
- It takes approximately 2 ms from the time of control mode change to the completion of switching. In the meantime, the values of the TxPDO objects associated with Obj.6061h:00h “Modes of operation display” and the control mode are undefined.
- This product does not support control mode switching during operation.

Perform control mode switching while the motor is stopped. Operation cannot be guaranteed if the control mode is switched during motor operation (including homing operation and mid-deceleration to stop). The mode may not switch immediately, or Err27.4.0 “Position command error protection” may occur, for example.

- If the PDS state is changed to “Operation enabled” with Obj.6060h:00h “Modes of operation” = 0 and Obj.6061h:00h “Modes of operation display” = 0, Err88.1.0 “Control mode setting error protection” will occur.
- If Obj.6060h:00h “Modes of operation” is once set to a value other than 0 and then Obj.6060h:00h “Modes of operation” = 0, the previous control mode is retained.
- If a control mode not supported by Obj.6060h:00h “Modes of operation” is set, Err88.1.0 “Control mode setting error protection” will occur.
- In full-closed control, only position control-related operation is supported. Therefore, when using full-closed control, if Obj.6060h:00h “Modes of operation” is set to 3 (pv), 4 (tq), 9 (csv), or 10 (cst), Err88.1.0 “Control mode setting error protection” will occur.
- When two-degree-of-freedom control mode (synchronization type) is enabled, Err88.1.0 “Control mode setting error protection” occurs when Obj.6060h:00h “Modes of operation” is set to 3 (pv) or 9 (csv) because velocity control is not supported.

5.5.5 Position Control Function (pp, csp, ip, hm)

The following types of position control mode are available:

- Profile position control (pp)
- Cyclic position control (csp)
- Interpolated position control (ip)
- Homing position control (hm)

This section describes the objects used in the above position control mode functions. For a position control system overview, see Technical Reference Functional Specification “4.3 Position Control” .

5.5.5.1 Position Control Common Functions

This section describes the objects used in each position control mode function.

For control block diagrams, see below.

- Technical Reference Functional Specification “4.3.2 Position Control (Two-degree-of-freedom Control Mode Enabled)”
- Technical Reference Functional Specification “4.3.3 Position Control (Two-degree-of-freedom Control Mode Disabled)”
- Technical Reference Functional Specification “4.6.2 Full-closed Control (Two-degree-of-freedom Control Mode Enabled)”
- Technical Reference Functional Specification “4.6.3 Full-closed Control (Two-degree-of-freedom Control Mode Disabled)”

The control block diagram is described using servo parameter numbers. For the relationship between servo parameter numbers and object numbers, see *“5.3 Servo Parameter Area (3000h to 3FFFh) Details”* .

5.5.5.1.1 Objects Commonly Related to Position Control (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
607Ah	00h	Target position	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp	No	A
607Dh	—	Software position limit	—	—	—	—	—	pp csp ip	—	—
	00h	Number of entries	—	2	U8	ro	No	pp csp ip	No	X
	01h	Min position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp ip	Yes	P H
	02h	Max position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp ip	Yes	P H
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip hm	Yes	B
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6081h	00h	Profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
6082h	00h	End velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	X
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip hm	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip hm	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60F2h	00h	Position option code	—	0 to 65535	U16	rw	RxPDO	pp	Yes	A

There are other objects associated with each position control mode. Also, Obj.6040h:00h "Controlword" has different functions in each position control mode. For a description of the functions of the associated objects and Obj.6040h:00h "Controlword" for each position control mode, see below.

- *"5.5.5.2 Profile Position Control Mode (pp mode)"*
  1. *"5.5.5.2.1 Objects Related to pp Control Mode (Command/Setting-related)"*
  2. *"5.5.5.2.2 Objects Related to pv Control Mode (Monitoring-related)"*
- *"5.5.5.3 Cyclic Position Control Mode (csp mode)"*
  1. *"5.5.5.3.1 Objects Related to csp Control Mode (Command/Setting-related)"*
  2. *"5.5.5.3.2 Objects Related to csp Control Mode (Monitoring-related)"*
- *"5.5.5.5 Homing Position Control Mode (hm mode)"*
  1. *"5.5.5.5.1 Objects Related to hm Control Mode (Command/Setting-related)"*
  2. *"5.5.5.5.2 Objects Related to hm Control Mode (Monitoring-related)"*

5.5.5.1.1.1 Position-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Ah	00h	Target position	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp	No	A
	● Sets the target position.									

5.5.5.1.1.2 Velocity-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3697h	00h	Function expansion setup 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
	● bit 8: Target control mode extension of Obj.607Fh:00h "Max profile velocity" 0: Standard specifications (pp, hm, ip, pv) 1: Extended specifications (pp, hm, ip, pv, tq, cst)									
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp hm ip pv tq cst	Yes	B
	● Sets the velocity limit value. ● The maximum value is limited with Obj.6080h:00h "Max motor speed" by internal processing. ● When Obj.3697h:00h "Function expansion setup 3" :bit 8 is set to 0, the supported control modes are pp, hm, ip, and pv. When Obj.3697h:00h "Function expansion setup 3" :bit 8 is set to 1, the supported control modes are pp, hm, ip, pv, tq, and cst.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
● Sets the maximum motor speed. ● The maximum value is limited to the maximum velocity output by the motor using internal processing.										
6081h	00h	Profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
● Sets the target speed. ● The maximum value is limited by internal processing to the smaller of Obj.607Fh:00h “Max profile velocity” or Obj.6080h:00h “Max motor speed” .										
6082h	00h	End velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	X
● Sets the end speed. ● Not supported by this product and always returns 0.										
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp hm ip pv csp csv	Yes	A
● Set the speed command offset value (speed feedforward). ● The maximum value is limited with Obj.6080h:00h “Max motor speed” by internal processing.										

5.5.5.1.1.3 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
● If Obj.60FEh:01h “Physical outputs” :bit 19 = 1 is set while Obj.60FEh:02h “Bit mask” :bit 19 = 1, the set value limits the torque command value generated by the velocity control loop.										
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
● Sets the maximum motor torque. ● The maximum value is limited to the maximum torque output by the motor using internal processing. ● The maximum motor torque may vary depending on the motor used. ● Disabled if ESM state is Init, enabled if ESM state is PreOP or higher.										
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
● Set the torque command offset value (torque feedforward). ● The torque feedforward value is 0 during deceleration in over-travel inhibition operations (during emergency stops).										
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
● Sets the positive direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set. Limit the torque command by the smallest value among the limit values of Obj.3013h:00h “1st torque limit” , Obj.3522h:00h “2nd torque limit” and Obj.6072h:00h “Max torque” .										
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
● Sets the negative direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set. Limit the torque command by the smallest value among the limit values of Obj.3013h:00h “1st torque limit” , Obj.3522h:00h “2nd torque limit” and Obj.6072h:00h “Max torque” .										

5.5.5.1.1.4 Acceleration/Deceleration-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip pv	Yes	A
● Sets the profile acceleration. ● If set to 0, treated as 1 by internal processing.										
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip pv csp csv	Yes	A
● Sets the profile deceleration. ● In cyclic position control mode (csp) and cyclic velocity control mode (csv), it is valid only during deceleration stop sequences. ● If set to 0, treated as 1 by internal processing.										
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
● Sets the maximum acceleration. ● If set to 0, treated as 1 by internal processing.										
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
● Sets the maximum deceleration. ● If set to 0, treated as 1 by internal processing.										

5.5.5.1.1.5 Software position limit (607Dh)

Sets the operating range (software limit) of the motor with Obj.607Dh: “Software position limit” .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Dh	—	Software position limit	—	—	—	—	—	—	—	—
● Sets the software limit value.										
607Dh	00h	Number of entries	—	2	U8	ro	No	pp ip csp	No	X
● Displays the number of sub-indexes in Obj.607Dh: “Software position limit” .										
607Dh	01h	Min position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
● Sets the software limit value for the negative direction.										

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Dh	02h	Max position limit	Com-mand unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
● Sets the software limit value in the positive direction.										

- Setting unit

  Obj.607Dh: “Software position limit” is set in command units. Therefore, as with Obj.6062h:00h “Position demand value” , etc., set the value with Obj.607Ch:00h “Home offset” taken into account. For Home offset, see *“5.5.8.4 Position Information”* .

- Enabling

  To enable the software limit function, the following conditions must be met.

  - Must be in position control mode (pp, ip, csp)
  - The relationship between object setting values must satisfy Obj.607Dh:01h “Min position limit” < Obj.607Dh:02h “Max position limit”

  When used in incremental mode, the software limit function is disabled when the ESM state changes from Init to PreOP, so perform the homing operation again.

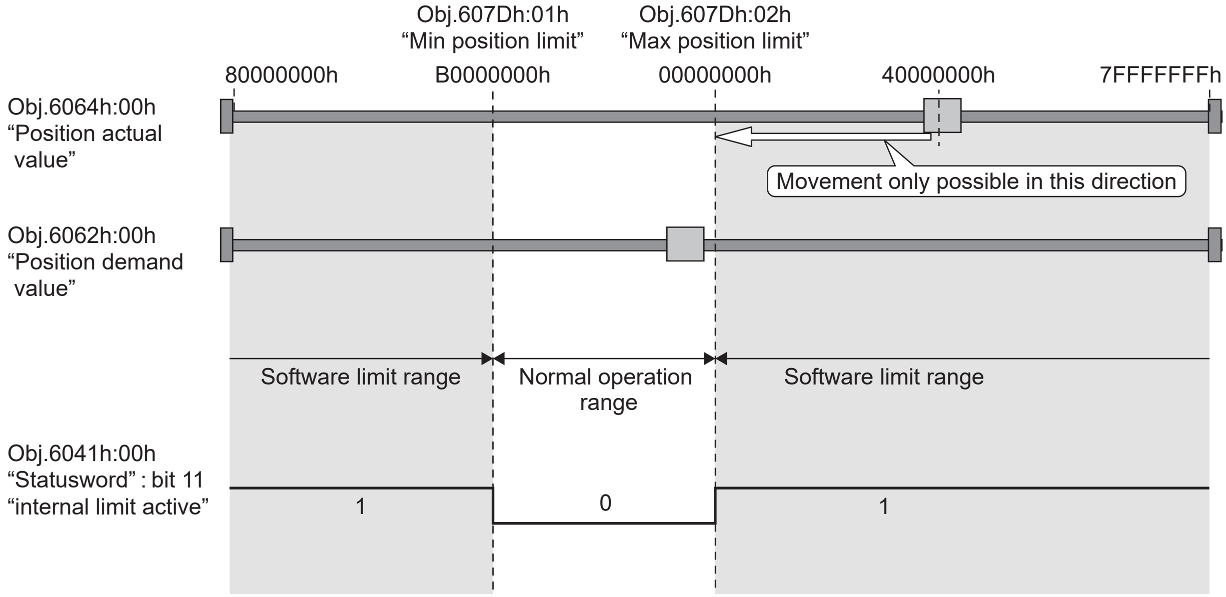
  If homing must be performed multiple times in succession, perform mode switching before executing homing.

  When the homing operation is executed in the absolute mode, the software limit function is disabled until normal completion.

  Set the actual position and command position to be between Obj.607Dh:01h “Min position limit” and Obj.607Dh:02h “Max position limit” (normal operating range) when initializing position information.

  If the actual position and command position is not within the normal operating range, as an exception, it can be moved only in the direction where the actual position falls within the normal operating range (It cannot move in the opposite direction).

  Obj.6041h:00h “Statusword” :bit 11 “internal limit active” is set to 1 (cause is internal limitation) until it falls within the normal operating range.



- Disabling

  To disable the software limit function, change the setup values of each object to the following conditions.

Obj.607Dh:01h “Min position limit” ≥ Obj.607Dh:02h “Max position limit”

(Example)

Obj.607Dh:01h “Min position limit” = 0

Obj.607Dh:02h “Max position limit” = 0

- Wraparound operation

If you want to perform wraparound operation, disable the software limit function. When the software limit function is enabled, Err88.3.0 “Improper operation error protection” occurs if the actual or command position wraps around.

Also, Obj.6041h:00h “Statusword” :bit 11 “internal limit active” is undefined.

- Operation at limit detection

Deceleration starts according to the quick stop ramp when the actual position or command position detects a software limit during motor operation. However, in csp control mode, deceleration start may be delayed depending on the timing of command division.

quick stop ramp: setting Obj.605Ah:00h “Quick stop option code” = 2, 6

5.5.5.1.1.6 Other

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
● bit 7: TFF clear ON/OFF selection from host device 0: Clear 1: Updates using the Obj.60B2h set value										

5.5.5.1.2 Objects Commonly Related to Position Control (Monitoring-related)

─: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
4F01h	00h	Following error actual value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F04h	00h	Position command internal value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F0Ch	00h	Velocity command value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F41h	00h	Number of entries	─	2	U8	ro	No	ALL	No	─
	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA5h	00h	Velocity internal position command	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA6h	00h	Velocity error actual value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FFFh	00h	Target position echo	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6041h	00h	Statusword	─	0 to 65535	U16	ro	TxPDO	ALL	No	X
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6065h	00h	Following error window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp csp	Yes	A
6066h	00h	Following error time out	ms	0 to 65535	U16	rw	RxPDO	pp csp	Yes	A
6067h	00h	Position window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
6068h	00h	Position window time	ms	0 to 65535	U16	rw	RxPDO	pp ip	Yes	A
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN･m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

There are other objects associated with each position control mode. For related objects, see below.

- *“5.5.5.2 Profile Position Control Mode (pp mode)”*
  1. *“5.5.5.2.1 Objects Related to pp Control Mode (Command/Setting-related)”*
  2. *“5.5.5.2.2 Objects Related to pv Control Mode (Monitoring-related)”*
- *“5.5.5.3 Cyclic Position Control Mode (csp mode)”*
  1. *“5.5.5.3.1 Objects Related to csp Control Mode (Command/Setting-related)”*
  2. *“5.5.5.3.2 Objects Related to csp Control Mode (Monitoring-related)”*
- *“5.5.5.5 Homing Position Control Mode (hm mode)”*
  1. *“5.5.5.5.1 Objects Related to hm Control Mode (Command/Setting-related)”*
  2. *“5.5.5.5.2 Objects Related to hm Control Mode (Monitoring-related)”*

5.5.5.1.2.1 Position-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F01h	00h	Following error actual value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
	● Displays position deviation (after filter).									
4F04h	00h	Position command internal value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
	● Displays the internal command position (after filter).									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays position information for the external scale.									
4F41h	—	Motor encoder data	—	—	—	—	—	—	—	—
	● Displays position information.									
4F41h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	● Displays the number of sub-indexes in Obj.4F41h: “Motor encoder data” .									
4F41h	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the mechanical angle of the motor (single-turn encoder data).									
4F41h	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays multi-turn data of the absolute encoder.									
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the electrical angle of the motor.									
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the external scale pulse sum.									
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the absolute position of the external scale.									
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the upper 24 bits of the external scale data.									
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the lower 24 bits of the external scale data.									
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp ip hm csp	No	X
	● Displays the command position (= IPOS).									
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. Encoder units except for full-closed control, and external scale units during full-closed control.									
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. In full-closed control, it is the external scale position.									

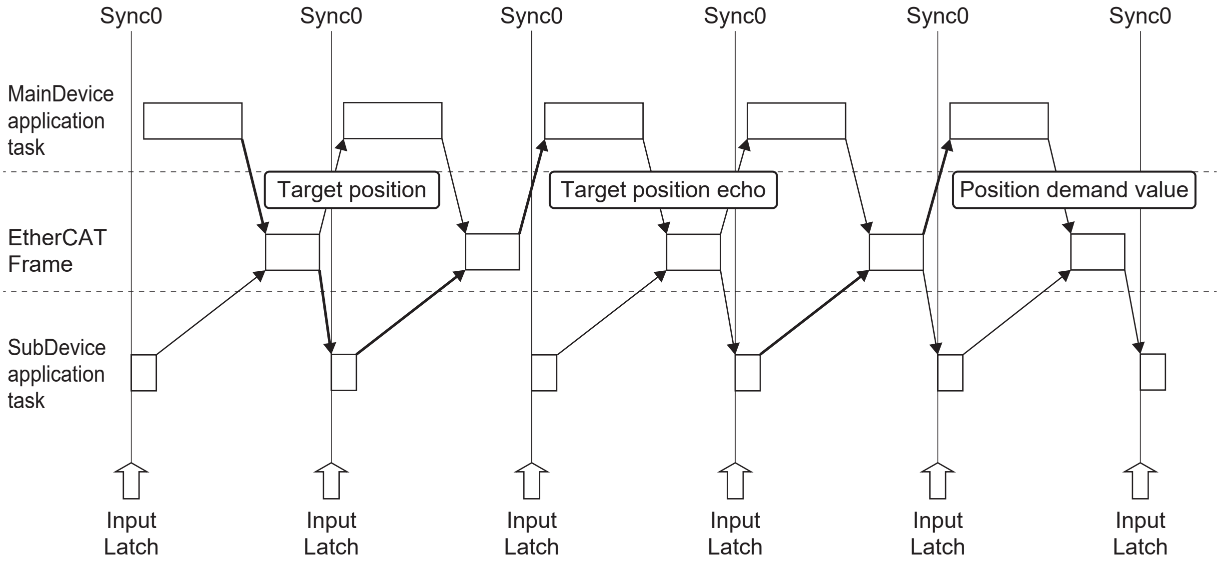
Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp ip hm csp	No	X
● Displays position deviation.										
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	pp ip hm csp	No	X
● Displays the internal command position.										

5.5.5.1.2.2 Target position echo (4FFFh)

Displays the echo back value of Obj.607Ah:00h “Target position” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4FFFh	00h	Target position echo	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
● Displays the value of Obj.607Ah:00h “Target position” .										

Reference: Difference in reply timing between Target position echo and Position demand value



5.5.5.1.2.3 Velocity-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F0Ch	00h	Velocity command value (after filtering)	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
● Displays command speed (after filter).										

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the velocity control command.										
4FA5h	00h	Velocity internal position command	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
• Displays the internal position command speed.										
4FA6h	00h	Velocity error actual value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
• Displays the speed deviation.										
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the actual speed sensor value. Not supported by this product and always returns 0.										
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the actual speed (= FSPD) of the motor.										
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pp ip hm csp	No	X
• Displays internal command speed (output of position loop).										

5.5.5.1.2.4 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
• Displays the overload load factor (ratio of motor rated load).										
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the regenerative load factor (the ratio of regenerative overload protection to the level of alarm occurrence).										
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the inertia ratio. Ratio of load inertia to motor rotor inertia (equivalent to the value of 3004h) Inertia ratio = (Load inertia/Rotor inertia) × 100										
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the torque limit value in the positive direction.										
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the torque limit value in the negative direction.										
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
• Indicates the internal command torque.										
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
• The rated torque is read from the motor and set automatically.										

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X

- Displays the actual torque.
- It is equivalent to the actual current value.
- This output value is for reference only and does not guarantee the actual value.

5.5.5.1.2.5 Statusword (6041h) (Position Control Common Functions)

This section describes the following functions.

- bit 10 “target reached” (Positioning complete detection)
- bit 13 “following error” (Position deviation excess detection)

For more information on this and other features, see the “Related Objects” section for each position control mode below.

- *“5.5.5.2 Profile Position Control Mode (pp mode)”*
  1. *“5.5.5.2.1 Objects Related to pp Control Mode (Command/Setting-related)”*
  2. *“5.5.5.2.2 Objects Related to pv Control Mode (Monitoring-related)”*
- *“5.5.5.3 Cyclic Position Control Mode (csp mode)”*
  1. *“5.5.5.3.1 Objects Related to csp Control Mode (Command/Setting-related)”*
  2. *“5.5.5.3.2 Objects Related to csp Control Mode (Monitoring-related)”*
- *“5.5.5.5 Homing Position Control Mode (hm mode)”*
  1. *“5.5.5.5.1 Objects Related to hm Control Mode (Command/Setting-related)”*
  2. *“5.5.5.5.2 Objects Related to hm Control Mode (Monitoring-related)”*

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	–	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Sets control commands for this product, such as PDS state transitions.

Bit data reference

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="2" rowspan="2">(1)</td><td colspan="2">(2)</td><td rowspan="2">(3)</td><td>(2)</td><td rowspan="2">(4)</td><td rowspan="2">(1)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td><td rowspan="2">(9)</td><td rowspan="2">(10)</td><td rowspan="2">(11)</td><td rowspan="2">(12)</td></tr>
<tr><td>(13)</td><td>(*1)</td><td>(14)</td></tr>
</table>

*1 (Varies by control mode)

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): following error (pp, csp only)
(14): target reached (excluding csp)

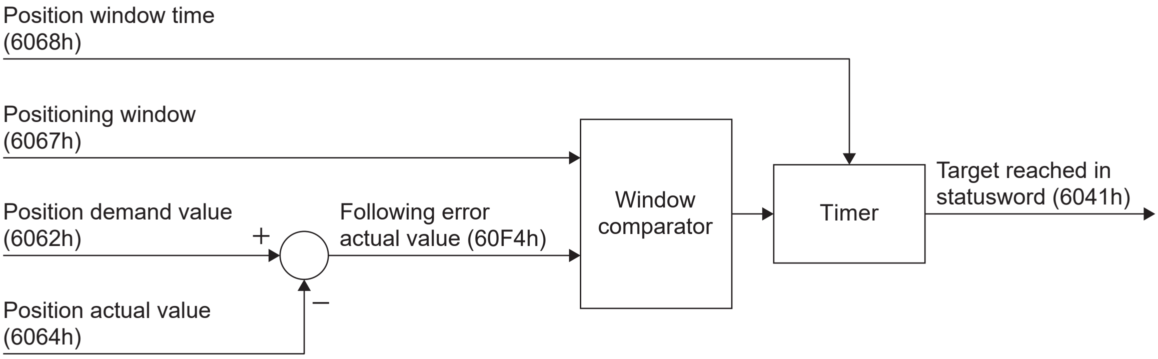
■ Bit 10: target reached (Position reached)

If all of the following conditions are met, Obj.6041h:00h “Statusword” :bit 10 “target reached” is 1.

- Servo-on state (Operation enable state)
- State in which all set-points have been allocated and command generation has been completed
- If the difference between Obj.6062h:00h “Position demand value” and Obj.6064h:00h “Position actual value” is within the range set in Obj.6067h:00h “Position window”
- When the time set in Obj.6068h:00h “Position window time” has elapsed

bit	Name	Value	Definition
10	target reached	0	halt = 0 (during normal operation): Positioning not complete halt = 1 (when stopped by halt): Axis decelerating
		1	halt = 0 (during normal operation): Positioning complete halt = 1 (when stopped by halt): Axis stopped (axis speed is 0)

Position reached (functional overview)



Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6067h	00h	Position window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
	● Sets the threshold value at which the difference between Obj.6062h:00h “Position demand value” and Obj.6064h:00h “Position actual value” is within the set value of this parameter and Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 1 when the time set in Obj.6068h:00h “Position window time” elapses. If the difference between Obj.6062h:00h “Position demand value” and Obj.6064h:00h “Position actual value” is outside the setting of this parameter, Obj.6041h:00h “Statusword” :bit 10 “target reached” will be 0.									
6068h	00h	Position window time	1 ms	0 to 65535	U16	rw	RxPDO	pp ip	Yes	A
	● Sets the time until Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 1 when the difference between Obj.6062h:00h “Position demand value” andObj.6064h:00h “Position actual value” is within the range set in Obj.6067h:00h “Position window” .									

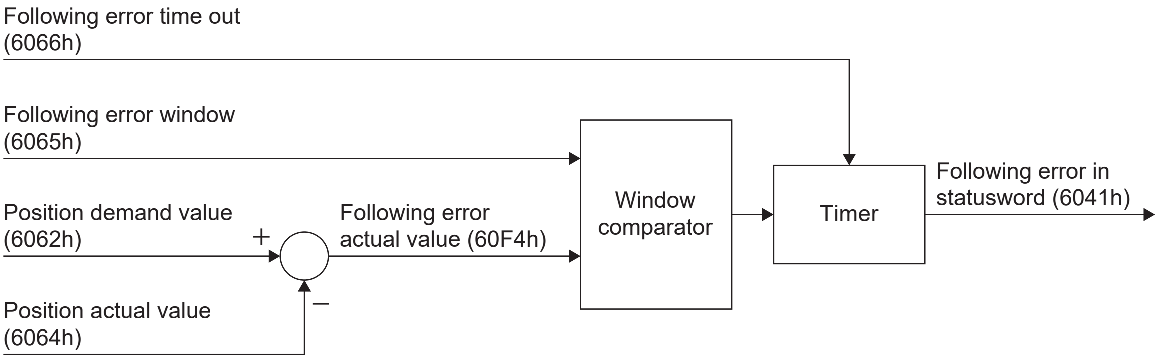
For Positioning Complete Output (INP/INP2) Function, see Technical Reference Functional Specification “3.1.5 Positioning Complete Output (INP/INP2) Signal” .

■ bit 13: following error

If the value of Obj.60F4h:00h “Following error actual value” exceeds the setting range of Obj.6065h:00h “Following error window” for the time set in Obj.6066h:00h “Following error time out” , Obj.6041h:00h “Statusword” :bit 13 “following error” is set to 1.

bit	Name	Value	Definition
13	following error	0	The value of Obj.60F4h:00h “Following error actual value” (=Obj.6062h:00h “Position demand value” to Obj.6064h:00h “Position actual value”) does not exceed the set range of Obj.6065h:00h “Following error window” , or the value of Obj.60F4h:00h “Following error actual value” exceeds the set value of Obj.6065h:00h “Following error window” , but the time set in Obj.6066h:00h “Following error time out” has not elapsed.
		1	The value in Obj.60F4h:00h “Following error actual value” exceeds the set range in Obj.6065h:00h “Following error window” for more than the time set in Obj.6066h:00h “Following error time out” .

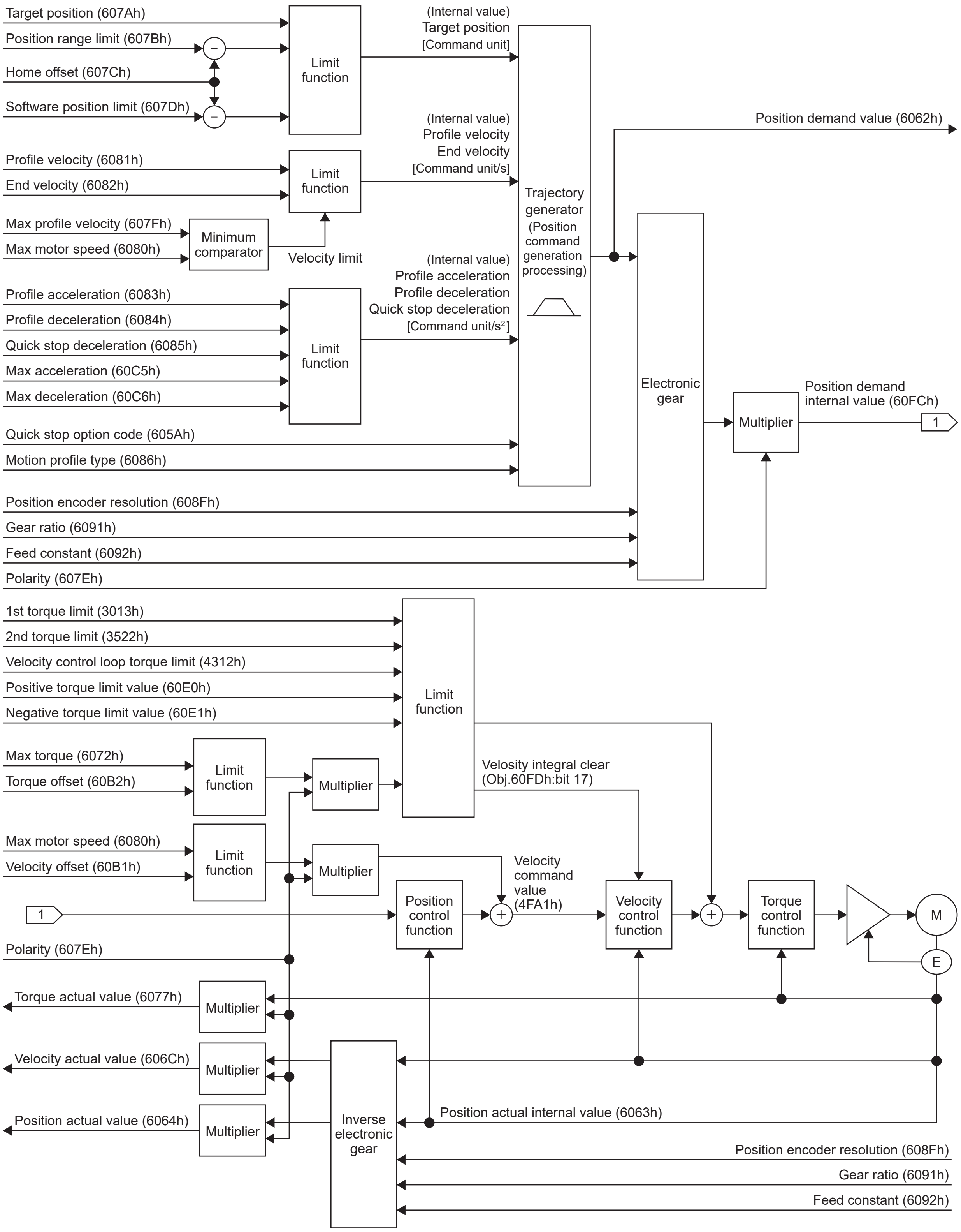
Following error (functional overview)



Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6065h	00h	Following error window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp	Yes	A
		● Sets the threshold at which Obj.6041h:00h “Statusword” :bit 13 “following error” becomes 1 if the value of Obj.60F4h:00h “Following error actual value” is outside the setting of this parameter.								
6066h	00h	Following error time out	ms	0 to 65535	U16	rw	RxPDO	pp csp	Yes	A
		● Sets the threshold value at which Obj.6041h:00h “Statusword” :bit 13 “following error” becomes 1 if the value of Obj.60F4h:00h “Following error actual value” continues to exceed the setting range of Obj.6065h:00h “Following error window” for more than the setting value of this parameter.								

5.5.5.2 Profile Position Control Mode (pp mode)

Profile position control (pp) is a control mode in which the host device commands the target position, target speed, and acceleration/deceleration (parameters), and the product generates position commands internally.



5.5.5.2.1 Objects Related to pp Control Mode (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60F2h	00h	Position option code	—	0 to 65535	U16	rw	RxPDO	pp	Yes	A

There are other related objects commonly used for position control. For details, see *"5.5.5.1 Position Control Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
607Ah	00h	Target position	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp	No	A
607Dh	—	Software position limit	—	—	—	—	—	pp ip csp	—	—
	00h	Number of entries	—	2	U8	ro	No	pp ip csp	No	X
	01h	Min position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
	02h	Max position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp hm ip pv	Yes	B
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6081h	00h	Profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
6082h	00h	End velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	X
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip	Yes	A
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

There are other related objects commonly used for motion. For details, see *“5.5.8 Motion Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
6086h	00h	Motion profile type	—	-32768 to 32767	I16	rw	RxPDO	pp pv ip	Yes	A
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60A3h	00h	Profile jerk use	—	1 to 2, 255	U8	rw	No	pp pv ip	Yes	A
60A4h	—	Profile jerk	—	—	—	—	—	pp pv ip	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	pp pv ip	No	X
	01h	Profile jerk1	Command unit/s^3	0 to 4294967295	U32	rw	No	pp pv ip	Yes	A
	02h	Profile jerk2	Command unit/s^3	0 to 4294967295	U32	rw	No	pp pv ip	Yes	A
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60FEh	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.5.2.1.1 Controlword (6040h) (Functions in pp Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands for this product, such as PDS state transitions.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)						(2)	(3)	(4)	(2)			(5)	(6)	(7)	(8)
						(9)			(10)	(11)	(12)				

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on
(9): change on set-point
(10): absolute / relative
(11): change set immediately
(12): new set-point

■ Bit 9, 6 to 4 (operation mode specific (control mode dependent bit)):

bit	Name	Value	Definition
4	new set-point	0 to 1	Trigger for starting positioning operation and updating set value. Import a new positioning task (Obj.607Ah:00h “Target position” , (Obj.6081h:00h “Profile velocity” , etc.).
5	change set immediately	0	After the current positioning operation is completed, the next positioning operation is started.
		1	The current positioning operation is interrupted and the next positioning operation is started immediately. Additional options for operation switch timing are set in Obj.60F2h:00h “Position option code” :bit 3 to 2 “change immediately option” .
6	absolute / relative	0	Treat Obj.607Ah:00h “Target position” as an absolute position.
		1	Treat Obj.607Ah:00h “Target position” as a relative position. Additional options for relative positioning are set in Obj.60F2h:00h “Position option code” :bit 1 to 0 “relative option” .
9	change on set-point	—	See the following table Not supported in this software version.

The table below shows the differences in operation from combinations of bit 9, bit 5, and bit 4.

bit 9	bit 5	bit 4	Definition
change on set-point	change set immediately	new set-point	
0	0	0 to 1	The next positioning operation is executed after the current positioning operation is completed. (See *“Operation example 1 (basic set-point)”* or *“Operation example 3 (data change during operation with buffer: set of set-points)”* in *“5.5.5.2.3 Operation in pp Control Mode”*)
—	1	0 to 1	The next positioning operation is performed immediately. (See *“Operation example 1 (basic set-point)”* or *“Operation example 2 (data change during operation without buffer: single set-point)”* in *“5.5.5.2.3 Operation in pp Control Mode”*)
1	0	0 to 1	After a positioning operation is executed at the current profile speed to the current target position, upon completion, the next positioning operation is executed. (See *“Operation example 1 (basic set-point)”* or *“Operation example 3 (data change during operation with buffer: set of set-points)”* in *“5.5.5.2.3 Operation in pp Control Mode”*) Not supported in this software version.

Precautions

- Do not change the acceleration/deceleration with the following objects while the motor is running.

  To change the acceleration/deceleration, change bit 4 “new set-point” from 0 to 1 after the motor stops.
  - Obj.6083h:00h “Profile acceleration”
  - Obj.6084h:00h “Profile deceleration”
  - Obj.60C5h:00h “Max acceleration”
  - Obj.60C6h:00h “Max deceleration”
- If a set-point is executed (bit 4 “new set-point” is changed from 0 to 1) under the following conditions, the positioning task is discarded.
  - Set-point at Obj.6081h:00h “Profile velocity” = 0
  - Set-point in the direction that does not leave from a restricted state with software limits
  - Set-point in the direction that does not leave from a restricted state by a drive prohibition
- All positioning tasks are discarded if any of the following conditions occur.
  - When over-travel inhibit is detected during deceleration by halt = 1
  - When a positioning task that operates in the opposite direction of the positioning task being executed is buffered and over-travel inhibit is detected
- Allow 2 ms between starting a pp operation and starting the next pp operation (changing bit 4 “new set-point” from 0 to 1).
- When stopped by halt, the settings of Obj.6040h:00h “Controlword” :bits 5 and 9 and Obj.60F2h:00h “Position option code” in the positioning task being executed (during halt) are cleared internally (set value 0).

5.5.5.2.1.2 Position option code (60F2h)

This object is an additional option that determines the operation specifications for positioning operation in pp mode.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60F2h	00h	Position option code	—	0 to 65535	U16	rw	RxPDO	pp	Yes	A

- Sets the operation specifications for positioning operation.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)	(2)									(3)		(4)		(5)	

(1): manufacturer-specific
(2): reserved
(3): request-response option
(4): change immediately option
(5): relative option

■ Bit 1 to 0 (relative option):

Set Obj.6040h:00h “Controlword” :bit 6 “absolute / relative” to 1 to determine the operation specifications for the relative positioning operation. Normally used in mode 0.

bit 1	bit 0	Relative positioning mode	Definition
0	0	Mode 0	Operates relative to the target position (absolute coordinate values) of the previous operation. (*1) If there is no target position in the immediately preceding operation, or after execution in another control mode, etc., the operation is relative to the absolute coordinate value 0. After execution in other control modes, the previous target position is discarded.
0	1	Mode 1	Operates relative to Obj.6062h:00h “Position demand value” (= trajectory generator output value). (*2)
1	0	Mode 2	Operates relative to Obj.6064h:00h “Position actual value” . (*2)
1	1	Mode 3	reserved

*1 When a positioning operation is started after the previous operation was interrupted by over-travel inhibit detection or Quickstop, the target position is the relative position of the target position of the previous operation.

In this case, the direction of operation is the direction in which the distance from the command position at the point of interruption to the next target position is the shortest.

Note that if the difference between the next target position and the command position at the point of interruption falls outside the range of -2147483648 to 2147483647, the operation will move in the opposite direction of the sign of the set relative position.

If this behavior is problematic for applications that operate in the same direction and are frequently interrupted, use Mode 1.

*2 The expected position may not be arrived at due to propagation delays, etc.

■ Bit 3 to 2 (cio (change immediately option)):

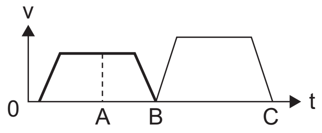
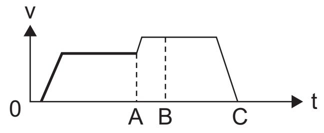
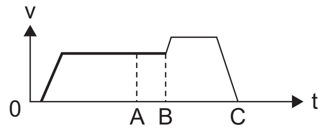
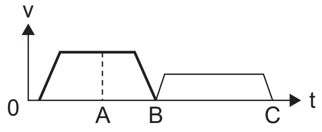
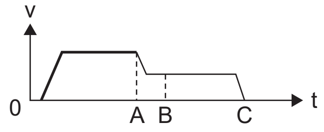
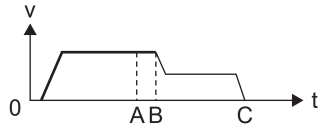
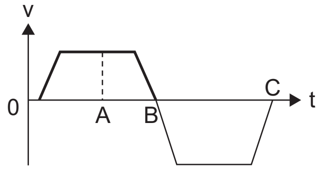
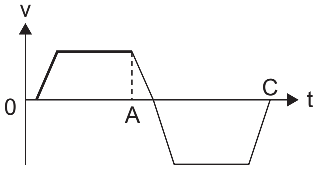
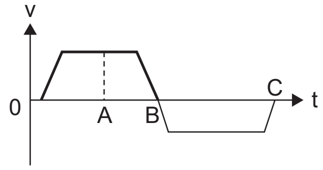
Set Obj.6040h:00h “Controlword” :bit 5 “change set immediately” to 1 to determine the operation specification when immediately starting the next positioning operation.

This software version is supported only when bits 3 and 2 are both 0. Do not set to a value other than 0.

bit 3	bit 2	Definition
0	0	Immediately update the behavior to the new positioning task (including changes to profile velocity, acceleration, etc.).

bit 3	bit 2	Definition
0	1	New positioning tasks (including changes to profile velocity, acceleration, etc.) operate as a continuation of the currently executing positioning task (The operation continues without stopping on the target position of the positioning task currently being executed.). Not supported in this software version.
1	0	reserved
1	1	reserved

The table below shows the operation pattern for the combination of Obj.6040h:00h “Controlword” :bit 5 “change set immediately” and Obj.60F2h:00h “Position option code” :bit 3 to 2 “change immediately option” .

Obj.6040h:00h:bit 5 “change set immediately”	0		1	
Obj.60F2h:00h:bit 3 to 2 “change immediately option”	00	01 (Not Supported)	00	01 (Not Supported)
If the target position is updated in the same direction and the speed is increased				
If the target position is updated in the same direction and the speed is reduced				
When the target position is updated in the opposite direction			 *The previous target position is not reached.	

A: Timing of command change from main device

B: Timing of target position (before update) arrival

C: Timing of target position (after update) arrival

Bold line: Operates under the condition before command change

Thin line: Operates under the condition after the command is changed

■ Bit 5 to 4 (rro (request-response option)):

Normally, after the positioning operation is started, Obj.6040h:00h “Controlword” : bit 4 “new set-point” must be set to 0 by the main device, but this option allows the sub device side to set it to 0 automatically.

bit 5	bit 4	Definition
0	0	Perform the handshake as shown in *“Operation example 1 (basic set-point)”* to *“Operation example 3 (data change during operation with buffer: set of set-points)”* of *“5.5.5.2.3 Operation in pp Control Mode”* .
0	1	The sub device automatically releases bit 4 “new set-point” as soon as the executing set-points have been allocated and command generation is complete (Set to 0).
1	0	The sub device automatically releases bit 4 “new set-point” as soon as it accepts the new target position (Set to 0).
1	1	reserved

5.5.5.2.2 Objects Related to pv Control Mode (Monitoring-related)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	–	0 to 65535	U16	ro	TxPDO	ALL	No	X

There are other related objects commonly used for position control. For details, see *"5.5.5.1 Position Control Common Functions"* .

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6065h	00h	Following error window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp csp	Yes	A
6066h	00h	Following error time out	ms	0 to 65535	U16	rw	RxPDO	pp csp	Yes	A
6067h	00h	Position window	Command unit	0 to 4294967295	U32	rw	RxPDO	pp ip	Yes	A
6068h	00h	Position window time	ms	0 to 65535	U16	rw	RxPDO	pp ip	Yes	A
6069h	00h	Velocity sensor actual value	–	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN･m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.5.2.2.1 Statusword (6041h) (Functions in pp Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="2" rowspan="2">(1)</td><td colspan="2">(2)</td><td rowspan="2">(3)</td><td>(2)</td><td rowspan="2">(4)</td><td rowspan="2">(1)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td><td rowspan="2">(9)</td><td rowspan="2">(10)</td><td rowspan="2">(11)</td><td rowspan="2">(12)</td></tr>
<tr><td>(13)</td><td>(14)</td><td>(15)</td></tr>
</table>

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): following error
(14): set-point acknowledge
(15): target reached

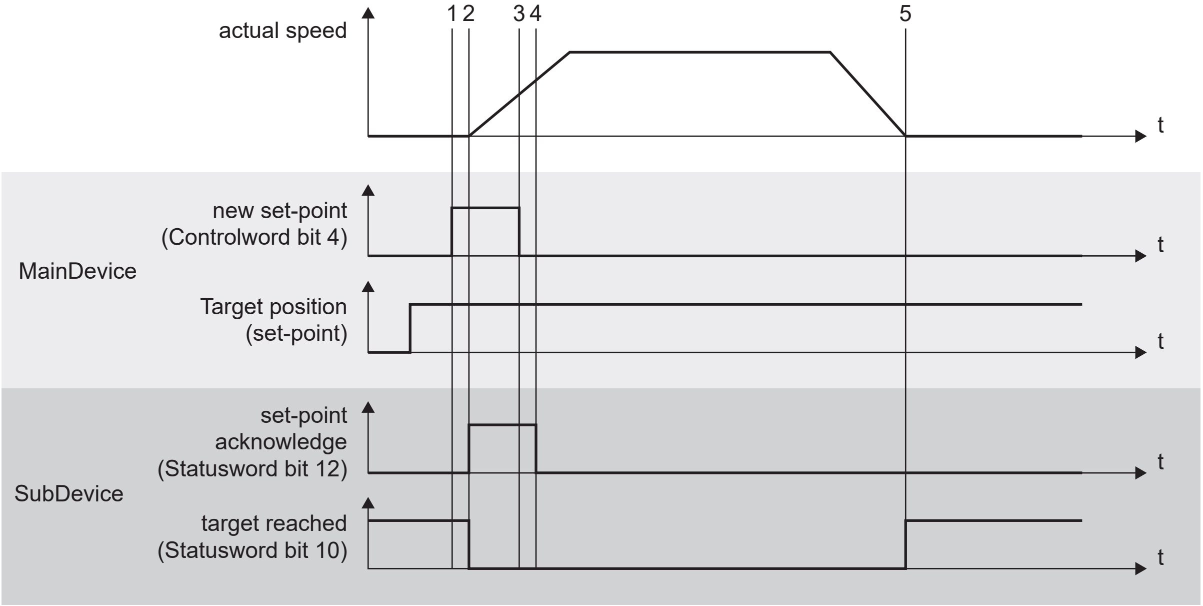
■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

bit	Name	Value	Definition
10	target reached	—	See *“5.5.5.1.2.5 Statusword (6041h) (Position Control Common Functions)”* .
12	set-point acknowledge	0	new-setpoint is 0, an operation for the previous target position has been executed (or is being executed), and the buffer is empty
		1	Buffer is not empty when data for a new positioning task is loaded into the buffer
13	following error	—	See *“5.5.5.1.2.5 Statusword (6041h) (Position Control Common Functions)”* .

5.5.5.2.3 Operation in pp Control Mode

- **Operation example 1 (basic set-point)**

Set-point example



1 After setting the value of Obj.607Ah:00h “Target position” , the main device changes Obj.6040h:00h “Controlword” :bit 4 “new set-point” from 0 to 1 at least one communication cycle later. At this time, please also set Obj.6081h:00h “Profile velocity” .

When Obj.6081h:00h “Profile velocity” is 0, the motor does not operate.

2 The sub device confirms the rising edge (0 to 1) of Obj.6040h:00h “Controlword” :bit 4 “new set-point” and starts positioning operation with Obj.607Ah:00h “Target position” as the target position. At that time, change Obj.6041h:00h “Statusword” : bit 12 “set-point acknowledge” from 0 to 1.

3 The main device confirms that Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” has changed from 0 to 1 and sets Obj.6040h:00h “Controlword” :bit 4 “new set-point” back to 0.

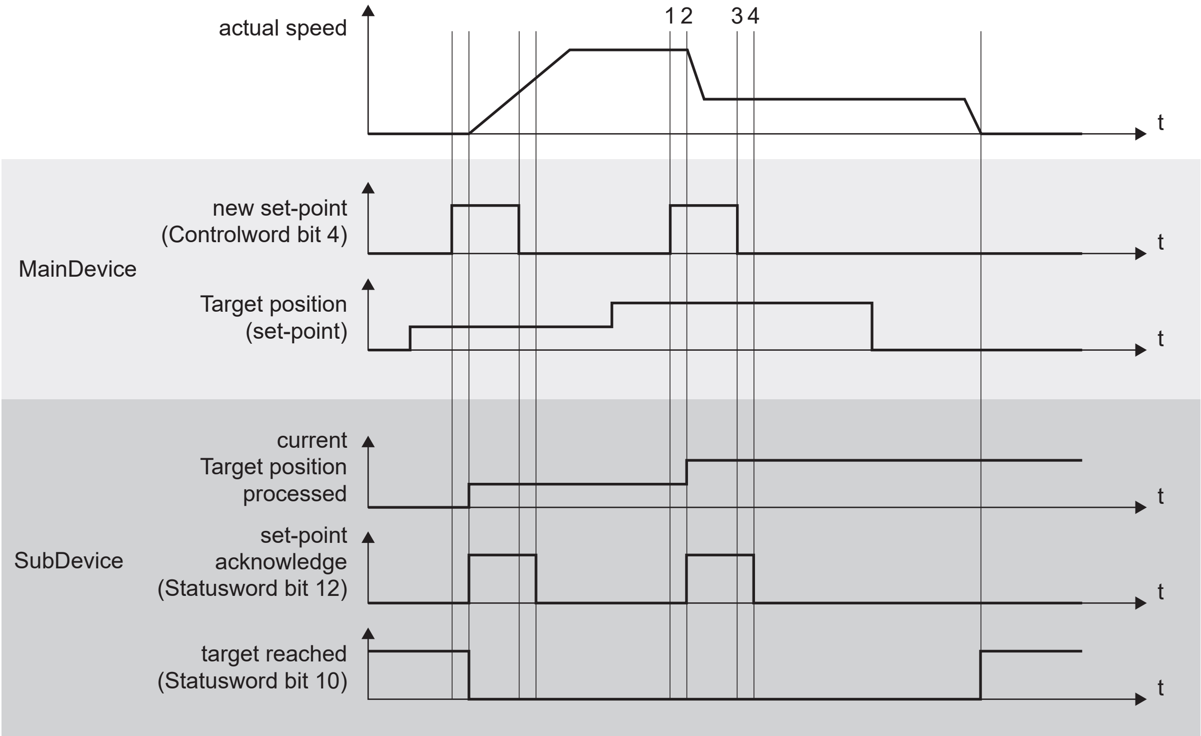
4 The sub device confirms that Obj.6040h:00h “Controlword” :bit 4 “new set-point” is now 0 and sets Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” to 0.

5 When the target position is reached, Obj.6041h:00h “Statusword” :bit 10 “target reached” is changed from 0 to 1.

■ Operation example 2 (data change during operation without buffer: single set-point)

When Obj.6040h:00h “Controlword” :bit 5 “change set immediately” is set to 1, if the data for positioning operation is changed during operation, the current positioning operation is aborted and the next positioning operation starts immediately.

Handshaking procedure for the single set-point method



1 The main device confirms that Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” is 0, changes the value of Obj.607Ah:00h “Target position” , and then changes Obj.6040h:00h “Controlword” :bit 4 “new set-point” from 0 to 1 after one or more communication cycles.

Precautions

- At this time, do not change acceleration/deceleration.

2 The sub device checks the rising edge (0 to 1) of Obj.6040h:00h “Controlword” :bit 4 “new set-point” and immediately updates Obj.607Ah:00h “Target position” as the new target position. At that time, change Obj.6041h:00h “Statusword” : bit 12 “set-point acknowledge” from 0 to 1.

3 The main device confirms that Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” has changed from 0 to 1 and sets Obj.6040h:00h “Controlword” :bit 4 “new set-point” back to 0.

4 The sub device confirms that Obj.6040h:00h “Controlword” :bit 4 “new set-point” is now 0 and sets Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” to 0.

Notes

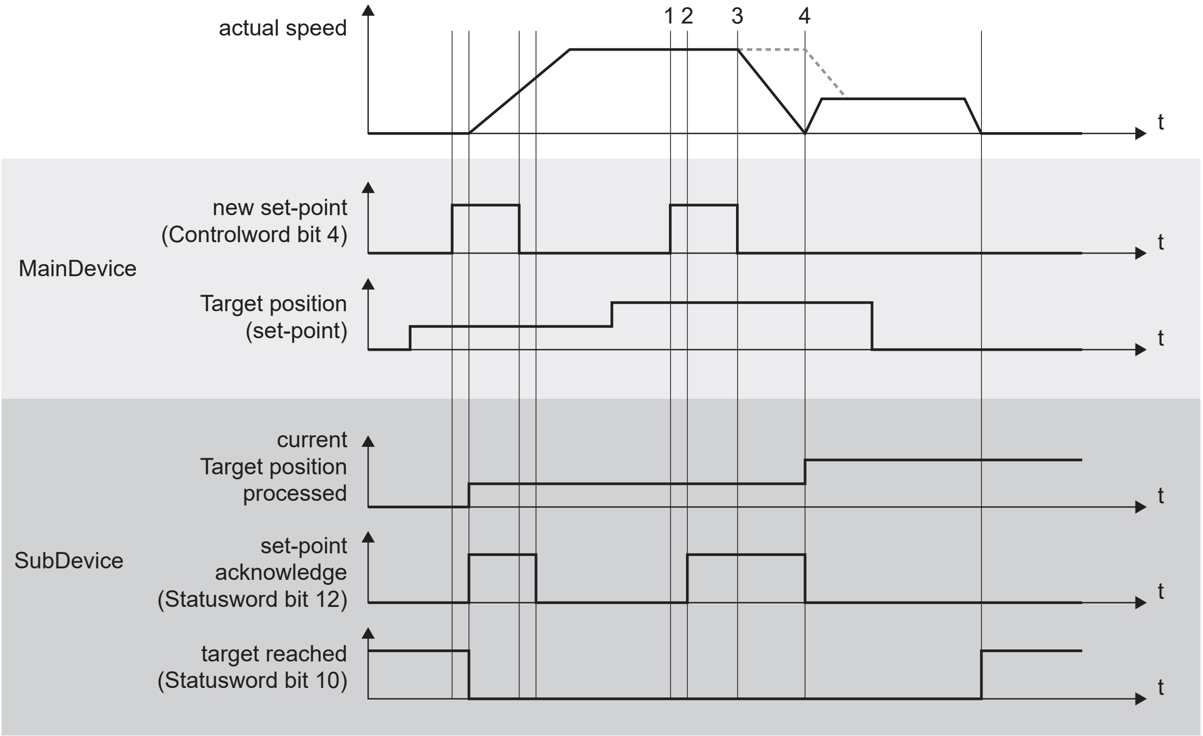
- The same procedure (“1” to “4”) can be used to change Obj.6081h:00h “Profile velocity” .

  After changing Obj.607Ah:00h “Target position” and Obj.6081h:00h “Profile velocity” , update Obj.607Ah:00h “Target position” and Obj.6081h:00h “Profile velocity” at the same time by following steps “1” through “4” above.

■ Operation example 3 (data change during operation with buffer: set of set-points)

When Obj.6040h:00h “Controlword” :bit 5 “change set immediately” is 0, if the data for positioning operation is changed during operation, the next positioning operation starts after the current positioning operation is completed.

Handshaking procedure for the set of set-point method



1 The main device confirms that Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” is 0, changes the value of Obj.607Ah:00h “Target position” , and then changes Obj.6040h:00h “Controlword” :bit 4 “new set-point” from 0 to 1 after one or more communication cycles.

Precautions

- At this time, do not change acceleration/deceleration.

2 The sub device checks the rising edge (0 to 1) of Obj.6040h:00h “Controlword” :bit 4 “new set-point” and buffers Obj.607Ah:00h “Target position” as the new target position. At that time, change Obj.6041h:00h “Statusword” : bit 12 “set-point acknowledge” from 0 to 1.

In this stage, positioning operation continues relative to the target position before the change.

3 The main device confirms that Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” has changed from 0 to 1 and sets Obj.6040h:00h “Controlword” :bit 4 “new set-point” back to 0.

4 The sub device confirms that Obj.6040h:00h “Controlword” :bit 4 “new set-point” is 0 and that the currently executed positioning operation is complete, and starts a positioning operation for a new target position.

Since the buffer is empty here, Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” is set to 0.

Notes

- The same procedure (“1” to “4”) can be used to change Obj.6081h:00h “Profile velocity” .

  After changing Obj.607Ah:00h “Target position” and Obj.6081h:00h “Profile velocity” , update Obj.607Ah:00h “Target position” and Obj.6081h:00h “Profile velocity” at the same time by following steps “1” through “4” above.

- The dashed line in the figure below shows the actual speed when Obj.6040h:00h “Controlword” :bit 9 “change on set-point” is set to 1.

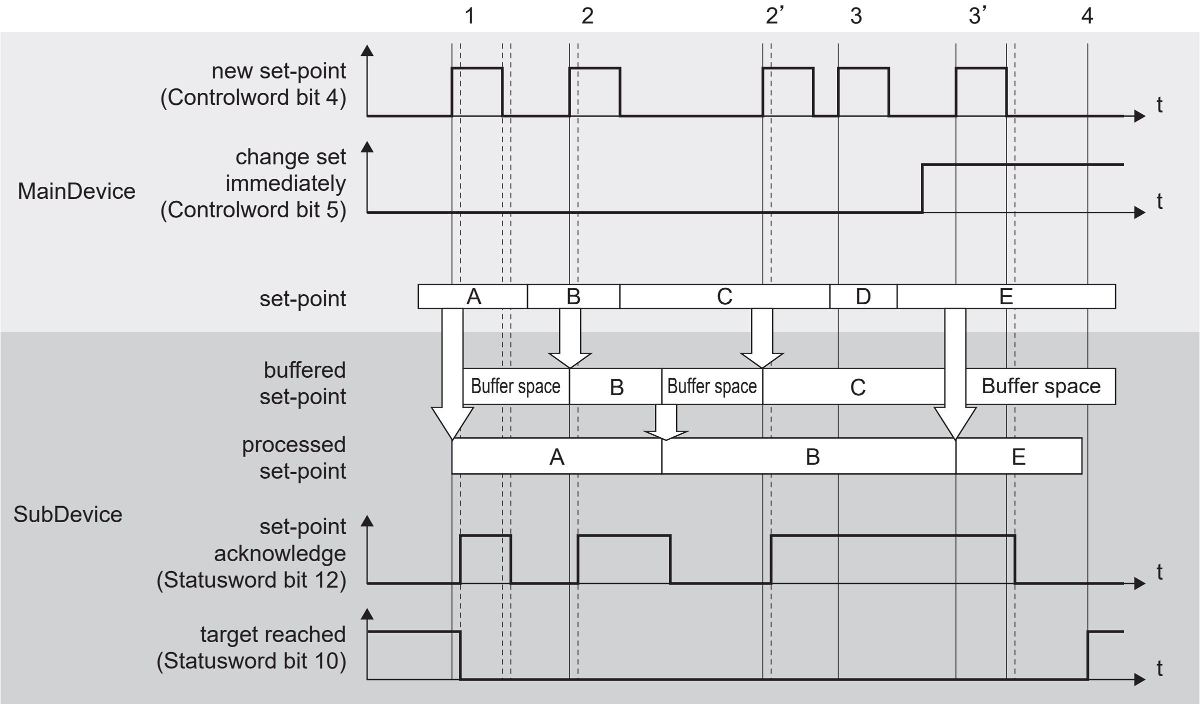
  However, if the new target position is front of the operation direction, the machine stops at the target position before the change and performs a reverse operation.

■ Operation example 4 (buffering of set-point)

There are two set-points: a set-point for execution and a set-point for buffering.

The handling of these set-points is shown in the figure below.

Set-point handling for two set-points



1 If a set-point is not being executed, the new set-point (A) takes effect immediately.

2 If a set-point is being executed, a new set-point (B or C) is stored if the set-point buffer is free.

3 If the set-point buffer is in use, that is, Obj.6041h:00h “Statusword” :bit 12 “set-point acknowledge” is 1, updating the set-point buffer depends on Obj.6040h:00h “Controlword” :bit 5 “change set immediately” .

If Obj.6040h:00h “Controlword” :bit 5 “change set immediately” is not set to 1, the new set-point (D) will be put on hold without being processed.

If Obj.6040h:00h “Controlword” :bit 5 “change set immediately” is set to 1, the new set-point (E) will be processed immediately. At this time, all set-points (B, C, D) loaded before Obj.6040h:00h “Controlword” :bit 5 “change set immediately” is set to 1 are discarded.

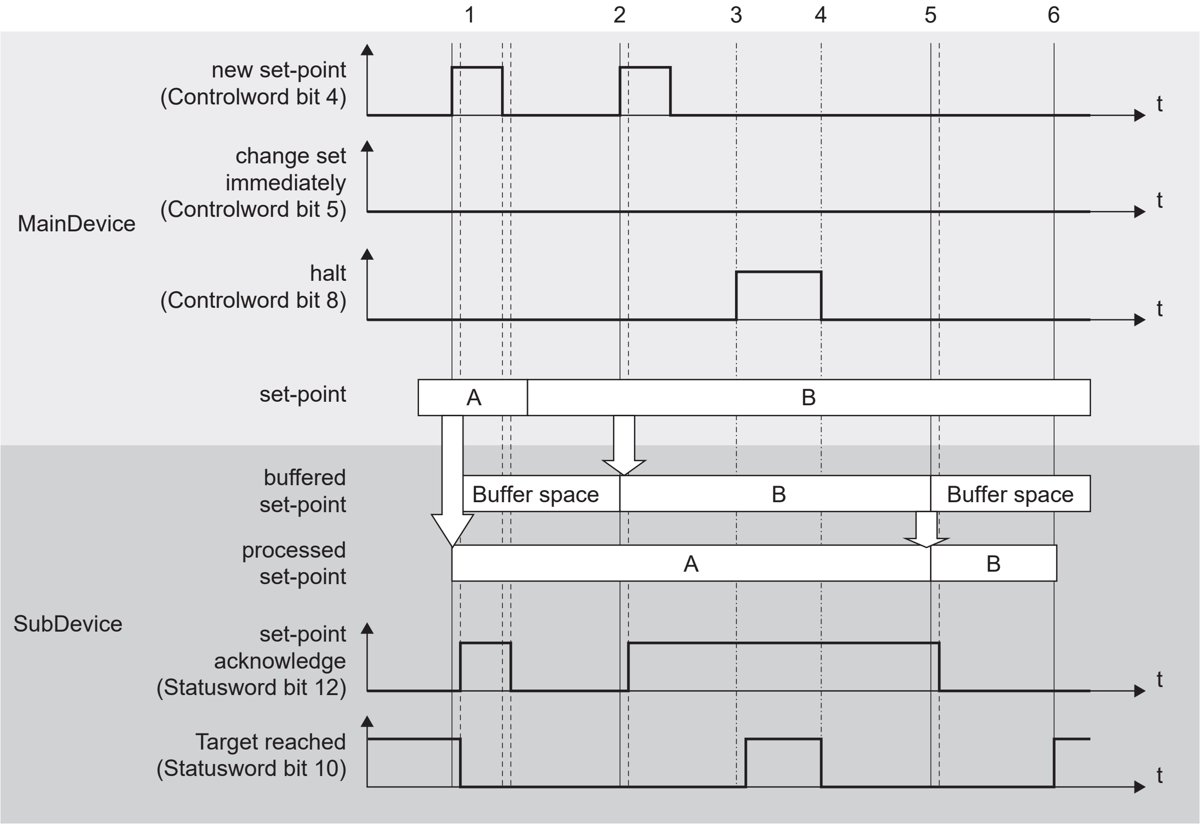
4 Until all set-points are processed, Obj.6041h:00h “Statusword” :bit 10 “target reached” will remain 0.

■ Operation example 5 (temporary stop by halt)

If Obj.6040h:00h “Controlword” :bit 8 “halt” becomes 1 during pp operation, there is a temporary stop of positioning operation and when bit 8 “halt” returns to 0, the positioning operation to the set-point for execution is resumed.

The handling of these set-points is shown in the figure below.

Set-point handling for Resumption of positioning operation after pause by Obj.6040h:00h “Controlword” :bit 8 “halt”



1 If a set-point is not being executed, the new set-point (A) takes effect immediately.

2 If set-point is running, a new set-point (B) is stored if the set-point buffer is free.

3 If Obj.6040h:00h “Controlword” :bit 8 “halt” is set to 1 while the first set-point (A) is running, the first set-point (A) will temporary stop. In this case, if a deceleration stop is performed and the speed becomes 0, Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 1.

4 After that, when Obj.6040h:00h “Controlword” :bit 8 “halt” is set to 0, the operation of the first set-point (A) is resumed. In this case, Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 0.

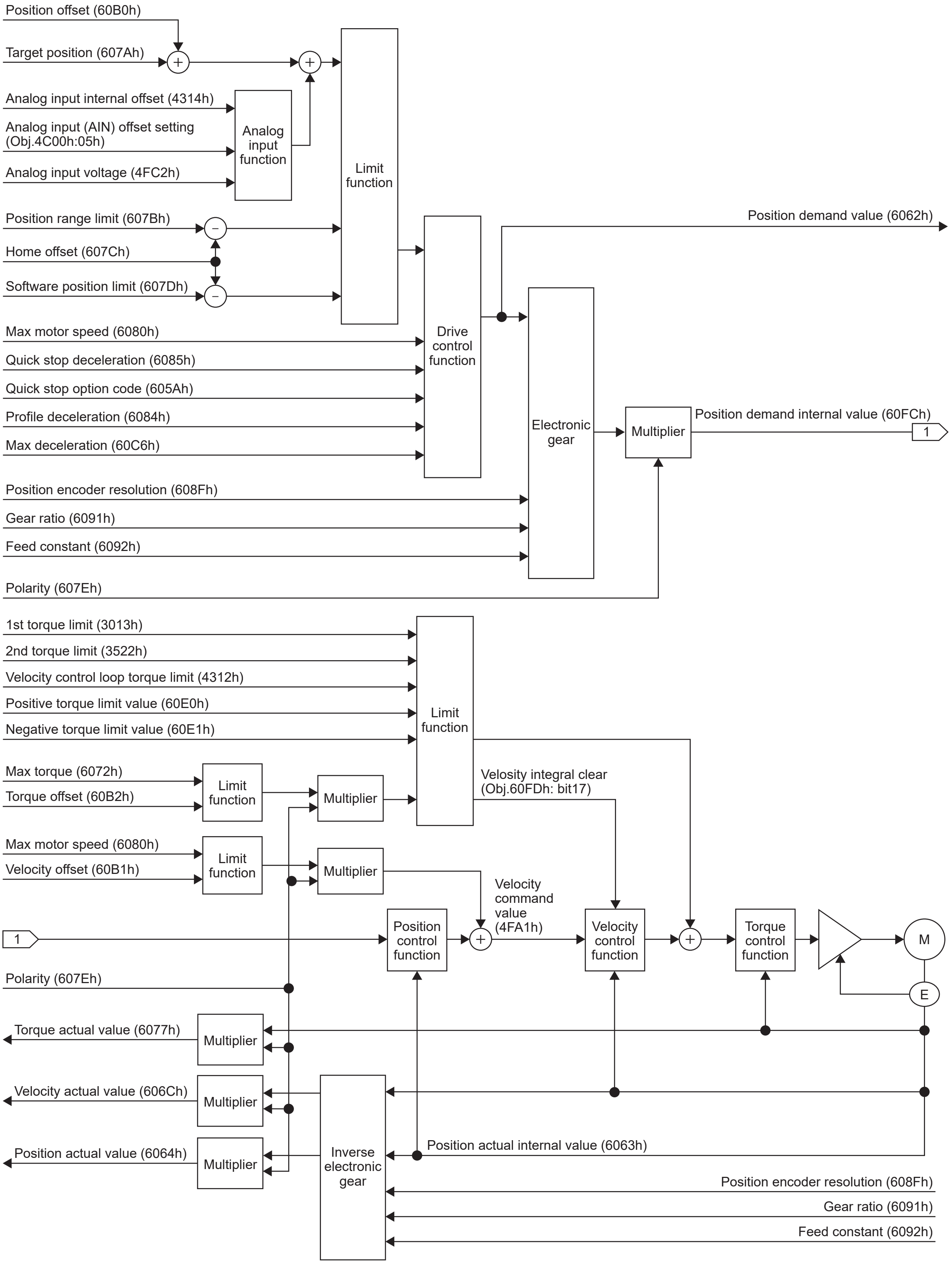
5 When the first set-point (A) operation completes, the new set-point (B) is processed.

6 Until all set-points are processed, Obj.6041h:00h “Statusword” : bit 10 “target reached” will remain as 0.

5.5.5.3 Cyclic Position Control Mode (csp mode)

Cyclic position control mode (csp mode) is a position control mode in which the host device generates position commands and updates (sends) the command position in a command update cycle.

Use in DC or SM2 synchronous mode.



5.5.5.3.1 Objects Related to csp Control Mode (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60B0h	00h	Position offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	A
4314h	00h	Analog input internal offset	mV	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
4351h	00h	Analog input function	—	0 to 65535	U16	rw	RxPDO	ALL	Yes	B
4C00h	05h	Analog input (AIN) offset setting	0.375 mV	-26666 to 26666	I16	rw	No	ALL	Yes	B
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	R
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C

There are other related objects commonly used for position control. For details, see *“5.5.5.1 Position Control Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
607Ah	00h	Target position	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp csp	No	A
607Dh	—	Software position limit	—	—	—	—	—	pp ip csp	—	—
	00h	Number of entries	—	2	U8	ro	No	pp ip csp	No	X
	01h	Min position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
	02h	Max position limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	pp ip csp	Yes	P H
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6091h	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60C2h	—	Interpolation time period	—	—	—	—	—	ip csp csv cst	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ip csp csv cst	No	X
	01h	Interpolation time period value	—	0 to 255	U8	rw	No	ip csp csv cst	Yes	A
	02h	Interpolation time index	—	-128 to 63	I8	rw	No	ip csp csv cst	Yes	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.5.3.1.1 Controlword (6040h) (Functions in csp Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands for this product, such as PDS state transitions.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)						(2)	(3)	(4)	(2)			(5)	(6)	(7)	(8)
						(1)			(1)	(1)	(1)				

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on

In csp mode, the operation mode specific bit is not used.

5.5.5.3.1.2 Position-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B0h	00h	Position offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	csp	Yes	A

- Sets the offset for the position command.

5.5.5.3.1.3 Other

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	R

- bit 5: Obj.6080h:00h “Max motor speed” enable or disable setting in csp (Command position change saturation function selection)
  0: Disabled
  1: Enabled

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C

- bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value”
  0: Includes torque limit and speed limit (cst only)
  1: Does not include torque limit and speed limit (cst only)

5.5.5.3.2 Objects Related to csp Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

There are other related objects commonly used for position control. For details, see *"5.5.5.1 Position Control Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6065h	00h	Following error window	Command unit	0 to 4294967295	U32	rw	TxPDO	pp csp	Yes	A
6066h	00h	Following error time out	ms	0 to 65535	U16	rw	RxPDO	pp csp	Yes	A
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.5.3.2.1 Statusword (6041h) (Functions in csp Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		(13)	(14)		(1)										

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): following error
(14): drive follows command value

■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

bit	Name	Value	Definition
10	reserved	—	Not used
12	drive follows command value	0	Operation is not executed according to the target position (*1)
		1	Operation is executed according to target position (*1)
13	following error	—	See *“5.5.5.1.2.5 Statusword (6041h) (Position Control Common Functions)”* .

*1 An “operation has been executed according to the target position” means that all of the following conditions have been met.

- PDS status is Operation enabled

- Torque limit has not triggered (when Obj.3724h:00h “Communication function extended setup 3” :bit 11 = 0)
- When a positive direction operation command is in progress, the command or actual position does not exceed the Obj.607Dh:02h “Max position limit” setting value.
- When a negative direction operation command is in progress, the command or actual position does not exceed the Obj.607Dh:01h “Min position limit” setting value.

5.5.5.3.2.2 Other

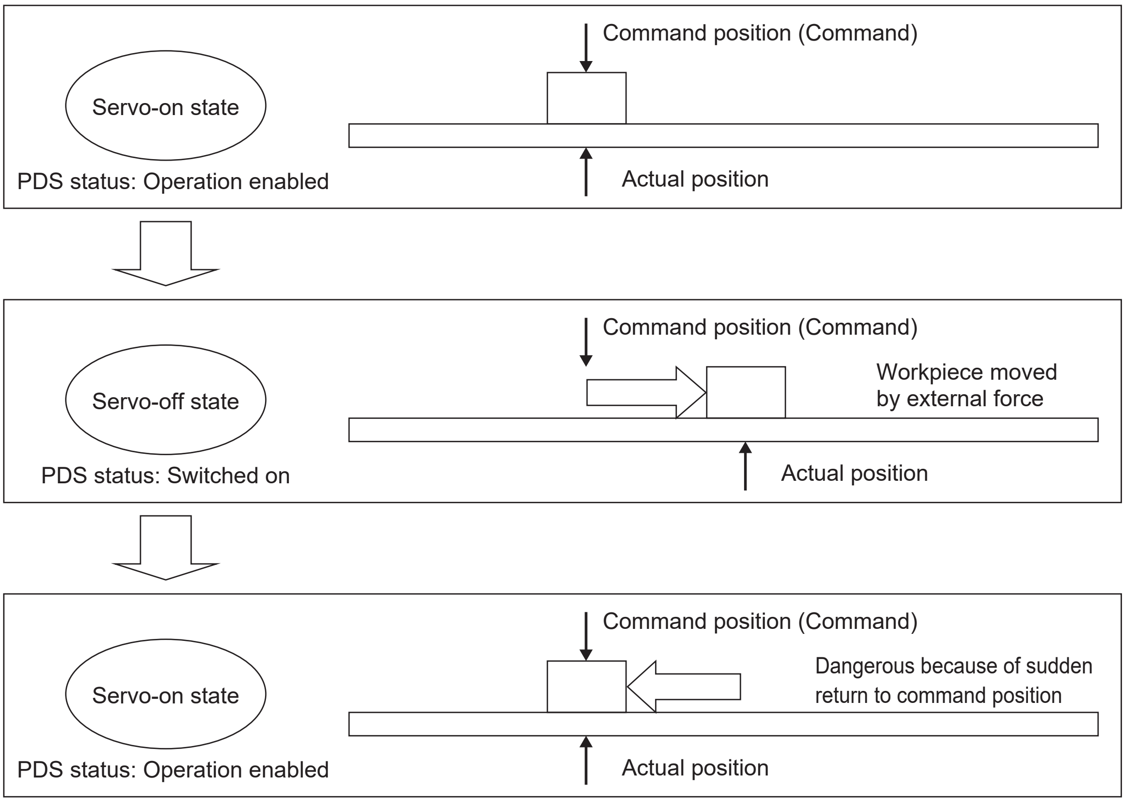
—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
	● bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value” 0: Includes torque limit and speed limit (cst only) 1: Does not include torque limit and speed limit (cst only)									

5.5.5.3.3 Operation in csp Control Mode

- In cyclic position control mode, the motion profile (trajectory) is generated by the main device, not the sub device.
- The target position is the Obj.607Ah:00h “Target position” and the additional value of Obj.60B0h:00h “Position offset” and is interpreted as an absolute position.
- Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).
- Obj.60C2h: “Interpolation time period” indicates a cycle of updating two objects, Obj.607Ah:00h “Target position” and Obj.60B0h:00h “Position offset” . This value is set to the same cycle as Obj.1C32h:02h “Cycle time” . The main device must always update the target position in cycle Obj.60C2h: “Interpolation time period” .
- In the servo-off state, configure the main device process so that Obj.607Ah:00h “Target position” + Obj.60B0h:00h “Position offset” follows Obj.6064h:00h “Position actual value” . If this is not performed, a dangerous situation can arise because the next time the servo is turned on, the motor will try to return to the input target position if it is moved by an external force during servo-off. Also, when switching from a different control mode to csp control mode, this process should be performed in the same way.

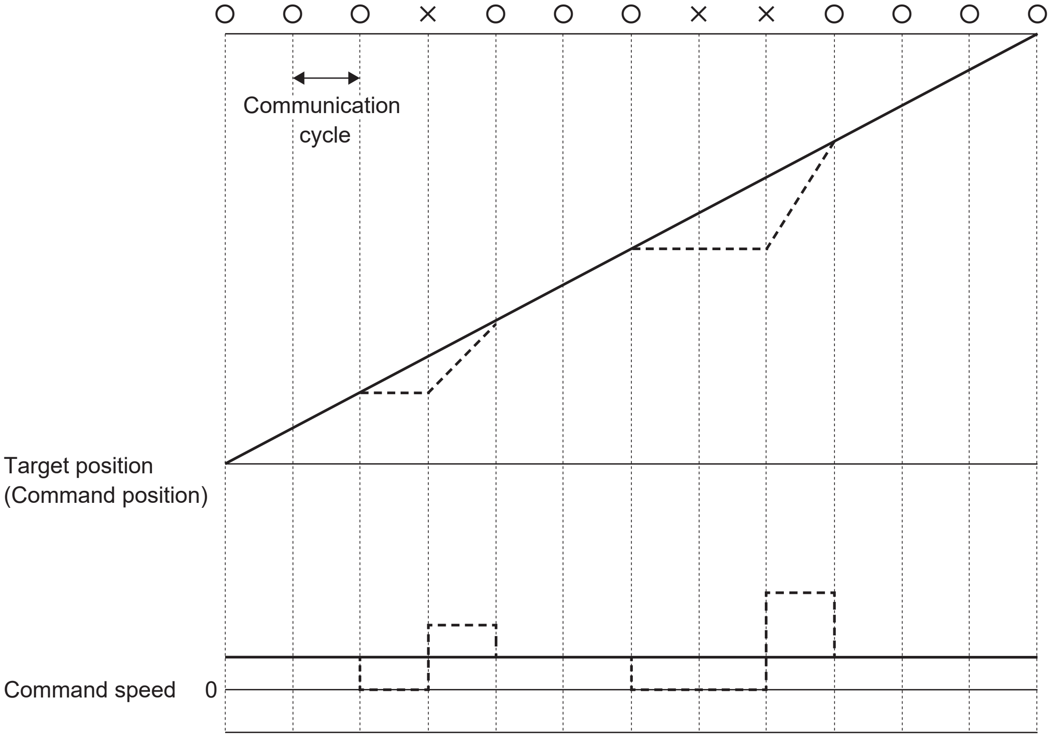
Example of dangerous situation: Command position at servo-off (when the command position does not follow the actual position value)



5.5.5.3.4 Correction Processing when Communication Errors Occur

If a communication error occurs during operation and Obj.607Ah:00h “Target position” cannot be loaded normally, the target position is estimated and correction processing is performed.

An example of the compensation process is shown in the figure below. In the communication cycle in which a communication error occurs (× in the figure), the target position is in the dashed line. In this case, processing is performed to compensate for the target position from the dashed line state to the solid line (estimated target position).



* Solid line: After processing command correction Dashed line: Before processing command correction

○: Communication normal ×: Communication error

5.5.5.3.5 Command Position Change Saturation Function

The command position change saturation function saturates the command position change with a value converted from Obj.6080h:00h “Max motor speed” to prevent Err27.4.0 “Position command error protection” from occurring due to an abnormal command position and to stabilize motor operation.

■ Applicable range

This function is supported only in the following control modes.

	Conditions under which the command position saturation function operates
Control mode	● Position control (csp)

■ Controlword (6040h) (Functions in csp Control Mode)

─: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3722h	00h	Communication function extended setup 1	─	-32768 to 32767	I16	rw	No	ALL	Yes	R
	● bit 5: Obj.6080h:00h “Max motor speed” enable or disable setting in csp (Command position change saturation function selection) 0: Disabled 1: Enabled									
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes (*1)	B
	● Sets the maximum motor speed. ● The maximum value is limited to the maximum velocity output by the motor using internal processing.									

*1 The value stored in EEPROM is set when the control power is turned on.

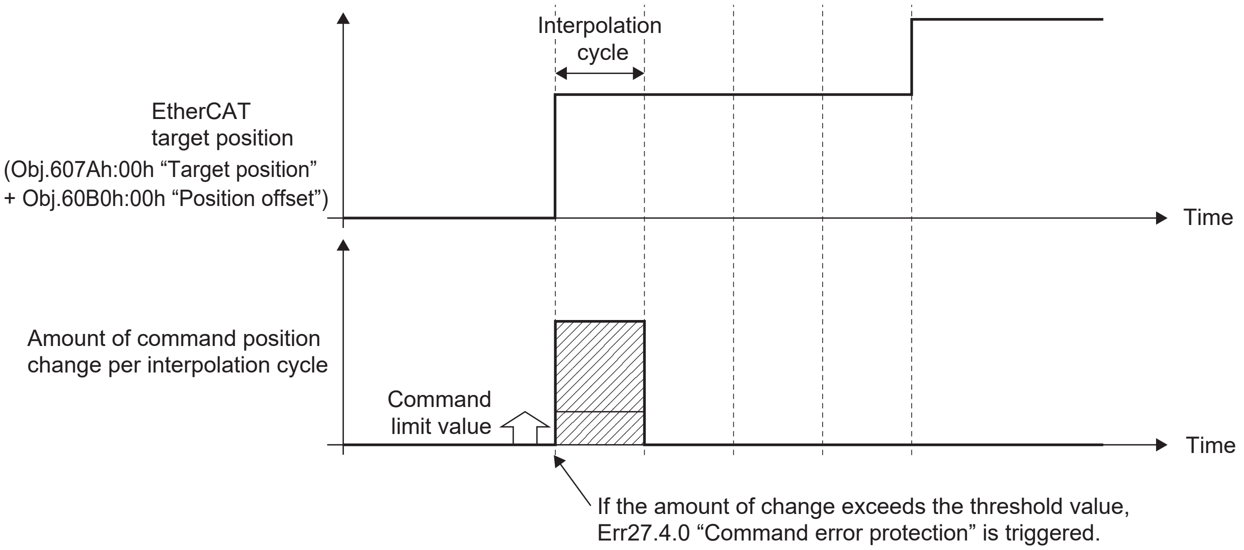
Precautions

- When this function is enabled (Obj.3722h:00h “Communication function extended setup 1” :bit 5 = 1), even if an abnormal command position is received, the command is divided and the occurrence of Err27.4.0 “Position command error protection” is inhibited.
- When this function is enabled (Obj.3722h:00h “Communication function extended setup 1” :bit 5 = 1) and Obj.6080h:00h “Max motor speed” = 0, the command position change is limited to 0 and the motor does not move. Also, Obj.6041h:00h “Statusword” :bit 11 “internal limit active” does not become 1.

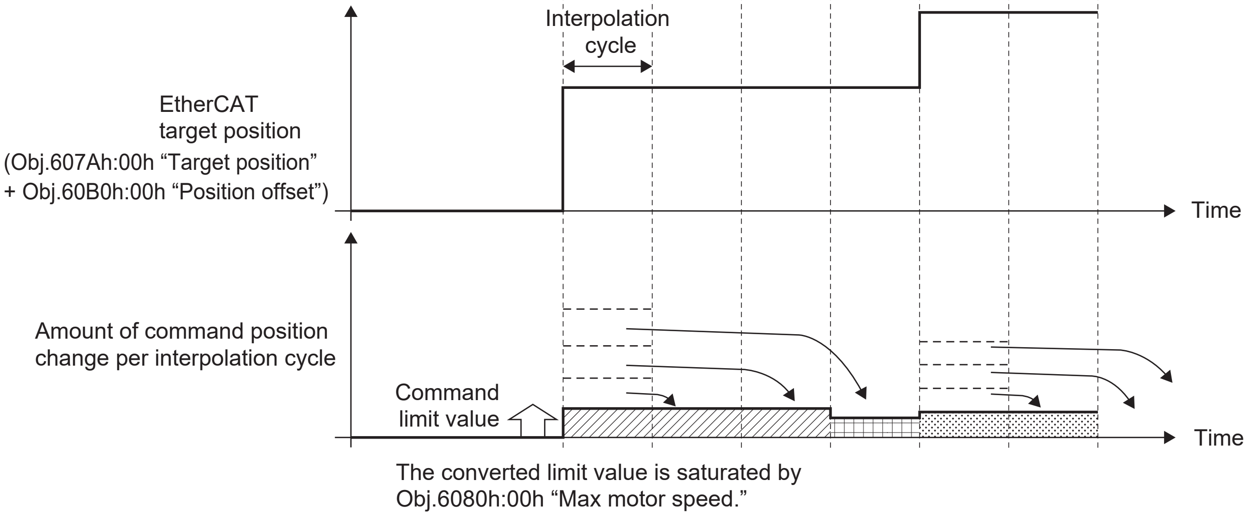
■ Example of operation (Interpolation cycle=125 us)

If the amount of change in the target position (Obj.607Ah:00h “Target position” + Obj.60B0h:00h “Position offset”) from the host device exceeds the command limit value (threshold value generated by Err27.4.0 “Position command error protection”), the amount of change in command position per interpolation cycle is saturated with the limit value converted from Obj.6080h:00h “Max motor speed” . This prevents Err27.4.0 from occurring and stabilizes operation even when a host device sends an abnormal command position.

When the command position change saturation function is disabled



When the command position change saturation function is enabled



5.5.5.3.6 Displacement Control Function

The displacement control function takes an analog input voltage from an external sensor and converts the value as a position compensation value. Settings for adjusting the position compensation value, filter settings for noise filtering, and offset adjustment can be performed.

This function is enabled when Obj.3022h:00h "Sensor feedback control mode setup" = 1 (sensor feedback enabled) and Obj.4351h:00h "Analog input function" :bit 0 "Displacement control function switch" = 1 (displacement control enabled).

Some objects have different object numbers and have the same name and the same function. These objects use the same memory area for their settings. Therefore, if you make settings in one object and then make different settings in the other object, the later settings will be overwritten. For objects with the same name and same functionality under different object numbers, check *"5.5.5.3.6.1 Related Objects"* .

For a control block diagram of displacement control, see Technical Reference Functional Specification "5.7.1 Displacement Control Function" "Control Block Diagram".

5.5.5.3.6.1 Related Objects

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3022h	00h	Sensor feedback control mode setup	—	0 to 1	I16	rw	No	csp	Yes	R
● Selects the sensor feedback control mode for this product. 0: Sensor feedback disabled 1: Sensor feedback enabled (position feedback)										
4C00h	00h	Number of entries	—	7	U8	ro	No	csp	No	B
● Displays the number of sub-indexes in Obj.4C00h: “Analog servo parameters” .										
3333h	00h	Analog input gain	Command unit/mV	0 to 30000	I16	rw	No	csp	Yes	B
4C00h	01h									
● Converts the voltage applied to the analog input to a position compensation value in command units.										
3334h	00h	Analog input polarity	—	0 to 1	I16	rw	No	csp	Yes	B
4C00h	02h									
● Selects the specification method for the positive direction and negative direction of displacement control. 0: Not reversed 1: Reversed										
3335h	00h	Analog input integration time constant	0.01 ms	0 to 100000	I32	rw	No	csp	Yes	B
4C00h	03h									
● Sets the integral time constant of the voltage applied to the analog input. When this setup value is 0 or 100000, the integral time constant setting is disabled.										
3336h	00h	Analog input integration limit	Command unit	0 to 2147483647	I32	rw	No	csp	Yes	B
4C00h	04h									
● Sets the limit for the integral term of the voltage applied to the analog input in absolute value.										
3422h	00h	Analog input (AIN) offset setting	0.375 mV	-26666 to 26666	I16	rw	No	ALL	Yes	B
4C00h	05h									
● Sets the offset adjustment value for the voltage applied to the analog input.										
3423h	00h	Analog input (AIN) filter setting	0.01 ms	0 to 6400	I16	rw	No	ALL	Yes	B
4C00h	06h									
● Sets the time constant of the first order lag filter relative to the voltage applied to the analog input. Disabled when the set value is 0 to 3.										
3424h	00h	Analog input (AIN) excessive setting	0.1 V	0 to 100	I16	rw	No	ALL	Yes	B
4C00h	07h									
● Sets the excessive level for the applied voltage (after offset addition) of the analog input. If the absolute value of the applied voltage exceeds the setup value, Err39.0.0 “Analog input (AIN) excess protection” is triggered.										
4314h	00h	Analog input internal offset	mV	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
● Sets the offset tuningvalue for the voltage applied to the analog input. Set within the range of -10000 to 10000.										
4315h	00h	Analog input deviation limit	mV	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
● Sets the limit value for analog voltage deviation as an absolute value. Disabled when set value is 0. Set within the range of 0 to 10000. If set beyond 10000, 10000 is set internally.										
4316h	—	Analog input voltage setup	—	—	—	—	—	—	—	—
● Configures settings related to analog input voltage.										

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4316h	00h	Number of entries	–	1	U8	ro	No	ALL	No	X
		● Displays the number of sub-indexes in Obj.4316h: “Analog input voltage setup” .								
4316h	01h	Analog input voltage dead zone	mV	0 to 65535	U16	rw	RxPDO	ALL	Yes	B
		● Sets the dead zone for the analog input voltage. When the displacement control function is enabled (Obj.3022h:00h “Sensor feedback control mode setup” = 1 and Obj.4351h:00h “Analog input function” :bit 0 = 1), the dead zone function of the analog input voltage is enabled. Even if the displacement control function is enabled, if this setting value is 0, the dead zone function of the analog input voltage is disabled. For details on the function, see *“Dead zone function for analog input voltage”* below.								
4351h	00h	Analog input function	–	0 to 65535	U16	rw	RxPDO	csp	Yes	B
		● Set the functions in bit units. bit 0: Displacement control function switch 0: Displacement control disabled 1: Displacement control enabled When Obj.3022h:00h “Sensor feedback control mode setup” = 1, function switching is enabled. bit 1: Position command latch switch 0: Latch enabled 1: Latch disabled If bit 0 is changed from 0 (disable displacement control) to 1 (enable displacement control) when bit 1 is 1 (latch disabled), the command position (Obj.607Ah:00h “Target position” + Obj.60B0h:00h “Position offset”) is not latched.								
4D51h	00h	Analog input status	–	0 to 65535	U16	ro	TxPDO	csp	No	X
		● Displays the setting status with Obj.4351h:00h “Analog input function” Bit 0: Setting status of displacement control function switch 0: Displacement control disabled 1: Displacement control enabled Bit 1: Setting status of position command latch switch 0: Latch enabled 1: Latch disabled								
4F03h	00h	Analog input internal voltage	mV	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the level of the applied voltage (after offset and filter) of the analog input.								
4F4Fh	00h	Analog input value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	csp	No	X
		● Displays the position compensation value according to the voltage applied to the analog input.								
4FC2h	00h	Analog input voltage	mV	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the level of the applied voltage (before offset) of the analog input.								

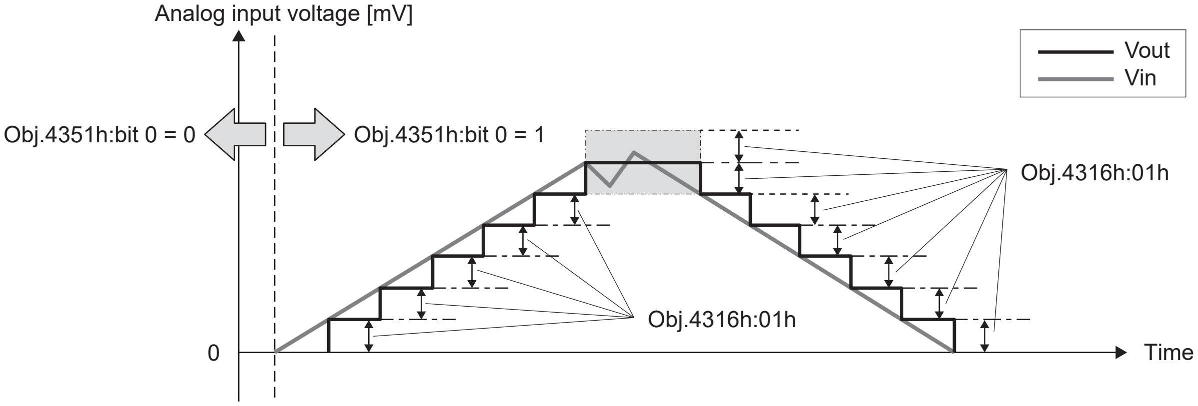
■ Dead zone function for analog input voltage

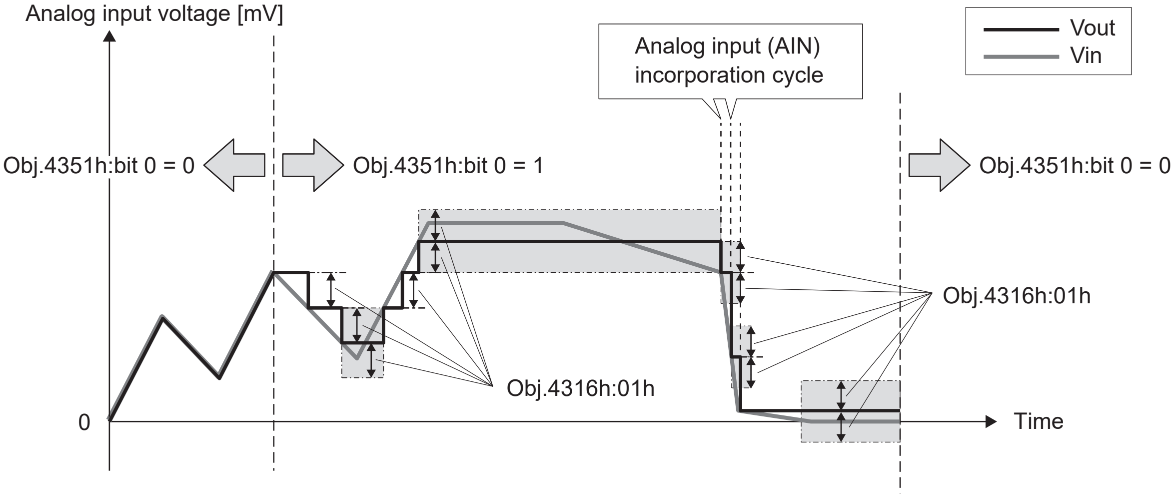
For the operation when the dead zone function of analog input voltage is enabled, see Technical Reference Functional Specification “5.7.1 Displacement Control Function” “Control Block Diagram”.

Vin in the control block diagram is the analog input voltage before the analog input voltage dead zone function processing. The value of Vin can be checked with Obj.4FC2h:00h “Analog input voltage” .

Vout is the analog input voltage after the dead zone function processing of the analog input voltage. Vout holds the original Vout value without reflecting the change in Vin until the change in Vin exceeds Obj.4316h:01h “Analog input voltage dead zone” .

If the change in Vin exceeds Obj.4316h:01h “Analog input voltage dead zone” , Vout reflects the change in Vin and the value of Vout = Vin.





5.5.5.3.6.2 Procedure for Adjusting the Auto-focus Control Function

1 Setting the motor gain

Gain adjustment of the position control system is performed by real-time auto tuning or manual tuning.

2 Displacement control function operation setting

Adjust the displacement control function with Obj.3336h:00h “Analog input integration limit” and Obj.3422h:00h “Analog input (AIN) offset setting” .

- Obj.3336h:00h “Analog input integration limit” setting

  The analog input integration limit is a value that limits the command required for motor operation to ensure a gap. The limit value is set with a margin to the command required for motor operation to ensure a gap.

  Calculate according to the following formula.

  3336h = (1.2 (*1)) × command required for motor operation to ensure a gap [command units]

  For example, if one motor revolution = 10000 command units (*2) and the pitch of the ball screw = 5 mm, a workpiece variation of 30 mm would result in 60000 command units, so the margin is set at 60000.

  3336h = (1.2) × 60000 = 72000

  *1 Margin considering overshoot

  *2 The command required for one motor revolution should be calculated from the electronic gear, encoder resolution, and number of pulses per motor revolution.

- Obj.3422h:00h “Analog input (AIN) offset setting” setting

  The analog input offset refers to the analog output voltage of the target gap.

Calculate according to the following formula.

3422h = Analog output voltage of target gap [mV] × 26666/10000

For example, an analog output voltage of 2500 mV at the target distance to be held from the workpiece would be as follows.

3422h = 2500 × 26666/10000 = 6667

3 Displacement control function switch selection setting

To enable the displacement control function, set Obj.4351h:00h “Analog input function” :bit 0 = 1 to enable the displacement control function.

Before operating the displacement control function, move the displacement sensor to the area of the target distance to be held from the workpiece.

Precautions

- If the displacement control function is activated while the displacement sensor is not near the target distance, the motor rotates at a high speed to approach the target distance, creating a hazard.

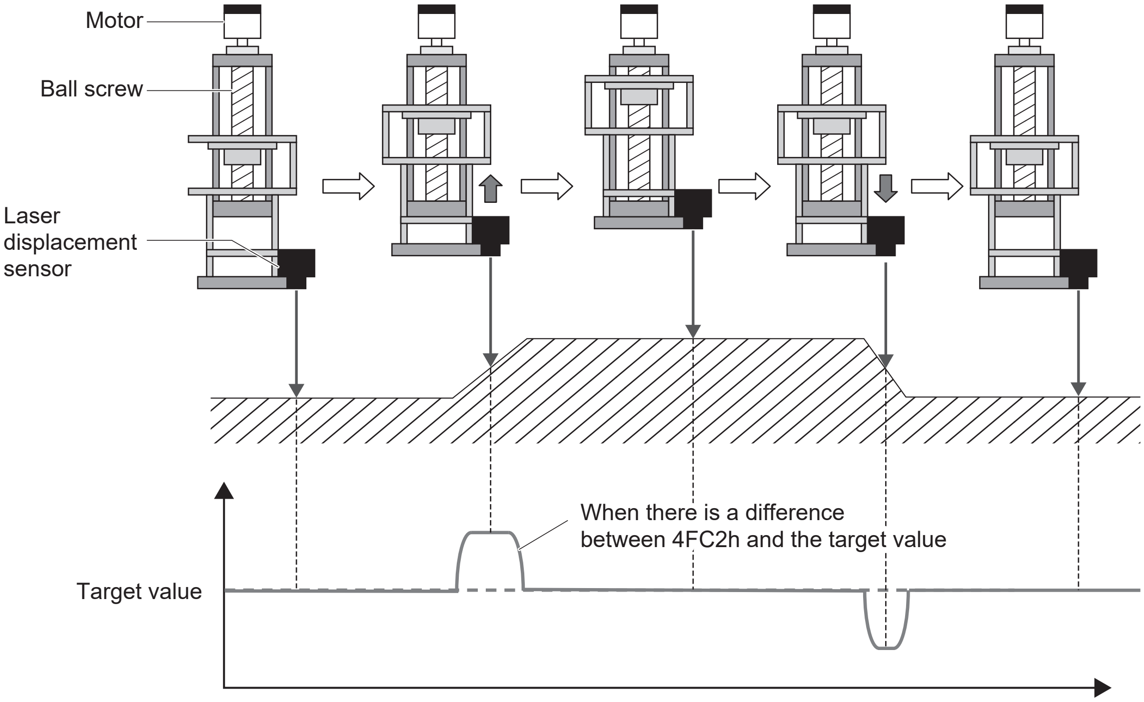
4 Adjustment of displacement control

Adjust the displacement control while checking the analog input voltage with Set-up Support Software (PANATERM ver.7) .

Tune Obj.3333h:00h “Analog input gain” and Obj.3335h:00h “Analog input integration time constant” so that the measurement distance of the displacement sensor is constant regardless of the workpiece position.

Gradually set Obj.3333h:00h “Analog input gain” slightly larger or Obj.3335h:00h “Analog input integration time constant” slightly smaller so that the difference between Obj.4FC2h:00h “Analog input voltage” and the target value becomes smaller.

If the difference from the target value is reduced beyond the limit in the above settings, the product may vibrate.



5.5.5.3.6.3 Precautions

- In the following cases, Obj.4F4Fh:00h “Analog input value” is cleared to 0.
  - When Obj.4351h:00h “Analog input function” :bit 0 = 0 (displacement control disabled)

  - When not in csp control mode
  - During servo-off

- When the displacement control function switch is changed from enabled to disabled (Obj.4351h:00h “Analog input function” :bit 0 = 1 to 0), the motor may suddenly operate.

  To prevent sudden operation, switch the displacement control function to disabled with the value of Obj.607Ah:00h “Target position” +Obj.60B0h:00h “Position offset” matching the value of Obj.6062h:00h “Position demand value” from the host device.

- If vibration or abnormal noise occurs during displacement control function operation, take the following measures.
  - Make Obj.3333h:00h “Analog input gain” smaller or Obj.3335h:00h “Analog input integration time constant” larger.
  - Adjust the gain and filter of the position control system.
  - Match Obj.3223h:00h “Positional command FIR filter” with the EtherCAT communication cycle.
  - Make Obj.3423h:00h “Analog input (AIN) filter setting” larger.
  - Adjust the filter and responsiveness on the displacement sensor side.

- If abnormal noise occurs while the motor position is stable, take the following measures.
  - Set Obj.4316h:01h “Analog input voltage dead zone” .
  - Make Obj.3608h:00h “Positive direction torque compensation value” and Obj.3609h:00h “Negative direction torque compensation value” smaller.

- If the displacement sensor fails to measure the distance and an unexpected voltage is applied to the analog input, the motor may malfunction or operate in a dangerous way.

  The displacement sensor should be installed so that it can always measure the distance even if the difference in the height of the workpiece changes.

  In addition, set the voltage deviation limit at Obj.4315h:00h “Analog input deviation limit” to prevent unexpected operation due to excessive voltage deviation.

5.5.5.4 Interpolated Position Control Mode (ip) (Not Supported)

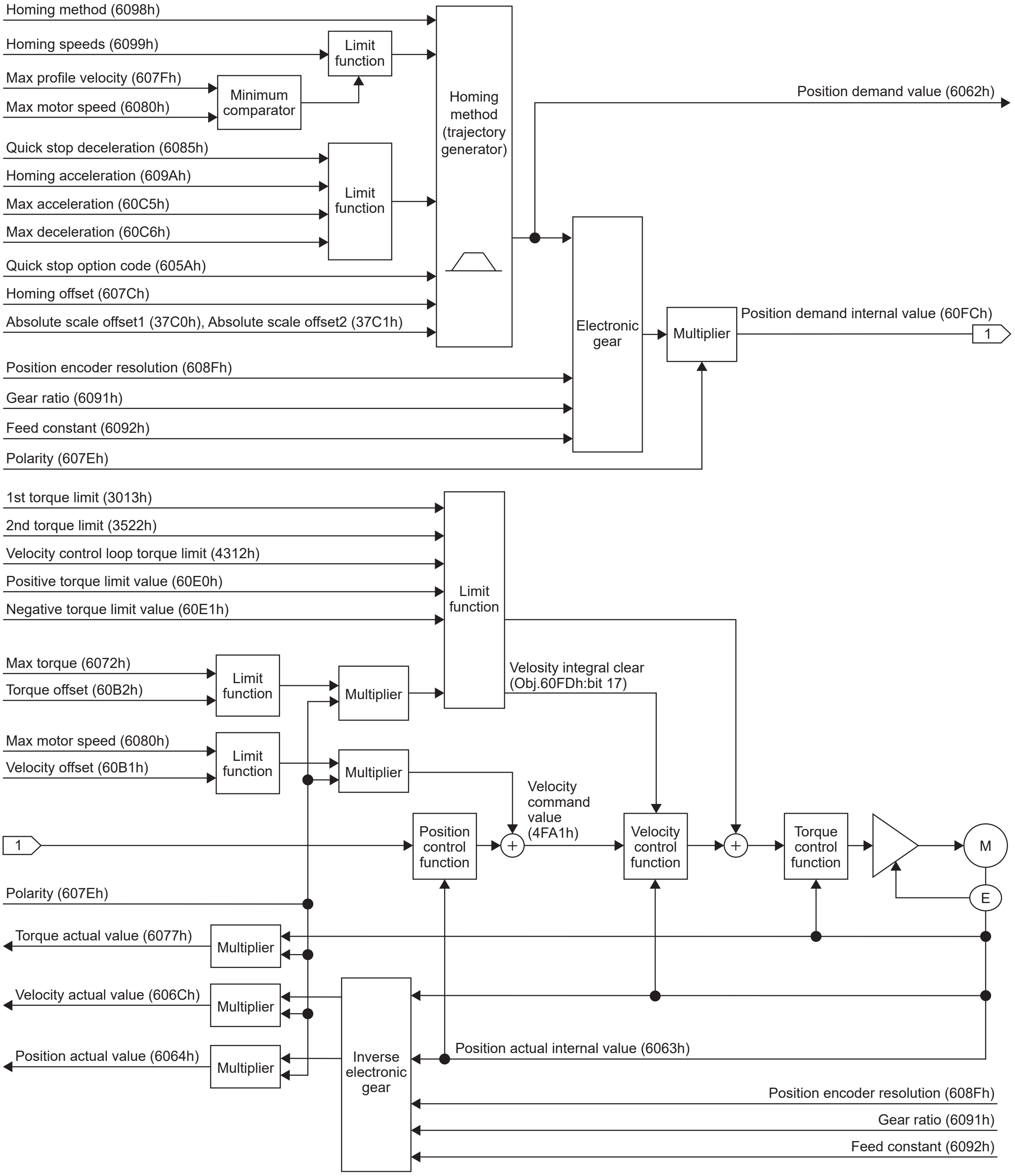
Interpolated position control mode (ip) is not supported in this software version.

Do not set Obj.6060h:00h “Modes of operation” to 7.

This is a position control mode in which the host device generates position commands, buffers them within the product in the communication cycle, and operates by updating the buffered command position in the interpolation time.

5.5.5.5 Homing Position Control Mode (hm mode)

Homing position control (hm mode): A control mode in which the host device designates the homing method and operating velocity, generates position commands inside the servo driver, and performs the homing operation.



■ Incremental mode

After the control power is turned on, a homing operation must be performed before positioning operation.

■ Absolute mode

By performing the homing operation, the driver can automatically set the values of Obj.37C0h:00h “Absolute scale offset1” and Obj.37C1h:00h “Absolute scale offset2” and save them in the EEPROM.

After the homing operation is completed, the value of the sum of pulses of monitor Set-up Support Software (PANATERM ver.7) reflects the values of Obj.37C0h:00h “Absolute scale offset1” and Obj.37C1h:00h “Absolute scale offset2” and becomes 0, but the position information of the encoder and external scale remains unchanged.

Since the values of Obj.37C0h:00h “Absolute scale offset1” and Obj.37C1h:00h “Absolute scale offset2” are stored in EEPROM, there is no need to perform a homing operation each time the control power is turned on.

5.5.5.5.1 Objects Related to hm Control Mode (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3780h	—	Communication function extended setup 8	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
37C0h	—	Absolute scale offset1	Rotation (multi-turn data), or pulse (upper 32 bits of external scale)	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	R
37C1h	—	Absolute scale offset2	Pulse (single-turn data) or pulse (lower 32 bits of external scale)	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	R
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
6098h	00h	Homing method	—	-128 to 127	I8	rw	RxPDO	hm	No	B
6099h	—	Homing speeds	—	—	—	—	—	hm	—	—
	00h	Number of entries	—	2	U8	ro	No	hm	No	X
	01h	Speed during search for switch	Command unit/s	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
	02h	Speed during search for zero	Command unit/s	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A

There are other related objects commonly used for position control. For details, see *“5.5.5.1 Position Control Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp hm ip pv	Yes	B
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.5.5.1.1 Absolute scale offset1 (37C0h)

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
37C0h	00h	Absolute scale offset1	Rotation (multi-turn data), or pulse (upper 32 bits of external scale)	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	R

- When the homing operation is performed in absolute mode, the driver automatically sets the difference (offset value) between the encoder 0 position (or external scale 0 position) and the home detection position so that Obj.6063h:00h “Position actual internal value” becomes 0 at that position after the home position is detected. After setting, only this object is automatically saved in EEPROM.
- Equivalent to the upper 32 bits of 64-bit (consisting of upper 24 bits + lower 24 bits data) encoder multi-turn data or external scale data.
- Do not change this object manually, as changing the value of this object will change the home position.

  Notes
  - To return the home position to the initial state, manually set this object to 0 and write the value to EEPROM.

    Change both Obj.37C0h:00h “Absolute scale offset1” and Obj.37C1h:00h “Absolute scale offset2” to 0. Operation is not guaranteed if a value other than 0 is manually set. The manually set value is enabled by reconnecting the control power supply.
- In incremental mode (Obj.3015h:00h “Absolute encoder setup” = 1), this object is disabled.

5.5.5.5.1.2 Absolute scale offset2 (37C1h)

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
37C1h	00h	Absolute scale offset2	Pulse (single-turn data) or pulse (lower 32 bits of external scale)	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	R

- When the homing operation is performed in absolute mode, the driver automatically sets the difference (offset value) between the encoder 0 position (or external scale 0 position) and the home detection position so that Obj.6063h:00h “Position actual internal value” becomes 0 at that position after the home position is detected. After setting, only this object is automatically saved in EEPROM.
- Equivalent to the lower 32 bits of 64-bit (consisting of upper 24 bits + lower 24 bits data) encoder single-turn data or external scale data.
- Do not change this object manually, as changing the value of this object will change the home position.

  Notes
  - To return the home position to the initial state, manually set this object to 0 and write the value to EEPROM.

    Change both Obj.37C0h:00h “Absolute scale offset1” and Obj.37C1h:00h “Absolute scale offset2” to 0. Operation is not guaranteed if a value other than 0 is manually set. The manually set value is enabled by reconnecting the control power supply.
- In incremental mode (Obj.3015h:00h “Absolute encoder setup” = 1), this object is disabled.

5.5.5.5.1.3 Controlword (6040h) (Functions in hm Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands for this product, such as PDS state transitions.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)						(2)	(3)	(4)	(2)			(5)	(6)	(7)	(8)
						(1)			(1)	(1)	(9)				

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on
(9): start homing

■ bit 9, 6 to 4 (operation mode specific):

—: N/A

bit	Name	Value	Definition
4	start homing	0 to 1	Starts homing operation. (*1)
5	(reserved)	—	Not used
6	(reserved)	—	Not used
9	(reserved)	—	Not used

*1 When Obj.3698h:00h “Function expansion setup 4” :bit 8 = 1 is set, homing operation starts even if the control mode is switched from Obj.6060h:00h “Modes of operation” = 8 (csp) to 6 (hm) with Obj.6040h:00h “Controlword” :bit 4 = 1.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3698h	00h	Function expansion setup 4	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	R

- bit 8: Control mode switch function expansion
  0: Conventional specification
  1: hm operation expanded specification

At the rising edge of Obj.6040h:00h “Controlword” :bit 4 “start homing” , the homing position control mode (hm) related parameters (homing method, speed, acceleration/deceleration, etc.) are taken in and operation starts.

Note that if a new homing operation is started during the homing operation (Obj.6040h:00h “Controlword” :bit 4 starts up again), the new homing operation is ignored.

5.5.5.5.1.4 Homing method (6098h)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6098h	00h	Homing method	—	-128 to 127	I8	rw	RxPDO	hm	Yes	B

- Sets the homing method.

Value	Definition
0	No homing method assigned
1	-Ve LS & Index Pulse
2	+Ve LS & Index Pulse
3	+Ve HS & Index Pulse direction reversal
4	+Ve HS & Index Pulse no direction change
5	-Ve HS & Index Pulse direction reversal
6	-Ve HS & Index Pulse no direction change
7	on +Ve HS -Index Pulse
8	on +Ve HS +Index Pulse
9	After +ve HS reverse +Index Pulse
10	After +ve HS +Index Pulse
11	on -Ve HS -Index Pulse
12	on -Ve HS +Index Pulse
13	After -ve HS reverse +Index Pulse
14	After -ve HS +Index Pulse
15	Reserved
16	Reserved
17	Same as 1 without Index Pulse
18	Same as 2 without Index Pulse
19	Same as 3 without Index Pulse

Value	Definition
20	Same as 4 without Index Pulse
21	Same as 5 without Index Pulse
22	Same as 6 without Index Pulse
23	Same as 7 without Index Pulse
24	Same as 8 without Index Pulse
25	Same as 9 without Index Pulse
26	Same as 10 without Index Pulse
27	Same as 11 without Index Pulse
28	Same as 12 without Index Pulse
29	Same as 13 without Index Pulse
30	Same as 14 without Index Pulse
33	On Index Pulse +Ve direction
34	On Index Pulse -Ve direction
35	Current position = home
37	Current position = home

+Ve: positive direction
-Ve: negative direction
LS: Limit switch
HS: Home switch

Precautions

- If Homing Operation Start is set to a setup value other than the one supported by Obj.6098h:00h “Homing method” , the Homing error (Obj.6041h:00h “Statusword” :bit 13) is set to 1. The homing method cannot be switched while the homing position control mode (hm) is running. Switch methods when the motor is stopped (hm not running).

5.5.5.5.1.5 Homing speeds (6099h)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6099h	00h	Number of entries	—	2	U8	ro	No	hm	No	X

- Displays the number of sub-indexes in Obj.6099h: “Homing speeds” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6099h	01h	Speed during search for switch	Command unit/s	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
		● Sets the operation speed until the switch signal is detected. ● The maximum value is limited by an internal process to the smallest of Obj.607Fh:00h “Max profile velocity” , Obj.6080h:00h “Max motor speed” , and 2147483647.								
6099h	02h	Speed during search for zero	Command unit/s	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
		● Sets the operation speed to the home detection position. When using the edge of the switch signal as the home detection position, set this value as small as possible to reduce the detection error. ● The maximum value is limited by an internal process to the smallest of Obj.607Fh:00h “Max profile velocity” , Obj.6080h:00h “Max motor speed” , and 2147483647.								

For more information on the application of each speed, please see the operating examples of each Homing method (*“5.5.5.5.3 hm Control Mode Operation (Homing Operation)”*).

5.5.5.5.1.6 Homing acceleration (609Ah)

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
		● Sets acceleration and deceleration in homing position control mode (hm). ● The deceleration in homing position control mode (hm) is also used by this object. ● At the final stop of each homing method (when the home position is detected), this object’s setup value is not used and the servo lock stops. ● If set to 0, treated as 1 by internal processing.								

5.5.5.5.2 Objects Related to hm Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60E3h	—	Supported homing methods	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	1 to 32	U8	ro	No	ALL	No	X
	01h	1st supported homing method	—	-128 to 127	I8	ro	No	ALL	No	X
	⋮									
	20h	32nd supported homing method	—	-128 to 127	I8	ro	No	ALL	No	X

There are other related objects commonly used for position control. For details, see *“5.5.5.1 Position Control Common Functions”* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN・m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.5.5.2.1 Statusword (6041h) (Functions in hm Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="2" rowspan="2">(1)</td><td colspan="2">(2)</td><td rowspan="2">(3)</td><td>(2)</td><td rowspan="2">(4)</td><td rowspan="2">(1)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td><td rowspan="2">(9)</td><td rowspan="2">(10)</td><td rowspan="2">(11)</td><td rowspan="2">(12)</td></tr>
<tr><td>(13)</td><td>(14)</td><td>(15)</td></tr>
</table>

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): homing error
(14): homing attained
(15): target reached

■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

bit	Name	Value	Definition
10	target reached	0	In operation
		1	Stopped
12	homing attained	0	Homing operation not completed (*1)
		1	Homing operation has been successfully executed and completed (*2)
13	homing error	0	No homing error occurred (Normal)
		1	Homing error occurred (Homing operation was not executed properly)

Combinations of bit 13, bit 12, and bit 10 values are shown in the table below.

bit 13	bit 12 (*2)	bit 10	Definition
0	0	0	Homing in operation
0	0	1	Homing operation interrupted or not started
0	1	0	Homing operation is completed, but target position has not been reached
0	1	1	Homing operation completed successfully
1	0	0	Homing error detected but still in operation
1	0	1	Homing error detected and stopped

*1 In increment mode, bit 12 “homing attained” is set to 0 when the following is true.

- When control power is turned on

- When the ESM state changes from Init to PreOP
- When homing operation starts

  When the homing operation (Method 35, Method 37) without motor operation is activated, homing attained is 0. However, the time to zero is short (approximately 2 ms).
- Operation in Set-up Support Software (PANATERM ver.7) (trial run, frequency characteristics analysis function (FFT function), One Minute TUNING, Z-phase search, Config execution) at completion (Obj.3799h:00h “Communication function extended setup 6” :bit 0 is set to 1)
- When Err27.4.0 “Position command error protection” occurs

*2 In absolute mode, bit 12 “homing attained” is set to 1 when power is activated, but is set to 0 under the following.

- When homing operation starts
- When homing operation ends abnormally
- When the multi-turn data clear is executed in hm control mode, bit 12 “homing attained” is set to 0 once.

  After completion of the multi-turn data clear, bit 12 “homing attained” returns to 1.
- When Set-up Support Software (PANATERM ver.7) (trial run, frequency characteristics analysis function (FFT function), One Minute TUNING, Z-phase search, Config execution) finishes during homing command startup (Obj.3799h:00h “Communication function extended setup 6” :bit 0 is 1)

5.5.5.5.2.2 Supported homing methods (60E3h)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60E3h	—	Supported homing methods	—	—	—	—	—	—	—	—
● Displays supported homing methods.										
60E3h	00h	Number of entries	—	32	U8	ro	No	ALL	No	X
● Displays the number of homing methods supported by Obj.60E3h: “Supported homing methods” .										
60E3h	01h	1st supported homing method	—	-128 to 127	I8	ro	No	ALL	No	X
● Displays the first homing method supported.										
⁝										
60E3h	20h	32nd supported homing method	—	-128 to 127	I8	ro	No	ALL	No	X
● Displays the 32nd homing method supported.										

Index	Sub-Index	bits 15 to 8	bits 7 to 0
		Reserved	Supported Homing method (*1)
60E3h	01h	0	1
	02h	0	2
	03h	0	3
	04h	0	4
	05h	0	5
	06h	0	6
	07h	0	7
	08h	0	8
	09h	0	9
	0Ah	0	10
	0Bh	0	11

Index	Sub-Index	bits 15 to 8	bits 7 to 0
		Reserved	Supported Homing method (*1)
60E3h	0Ch	0	12
	0Dh	0	13
	0Eh	0	14
	0Fh	0	17
	10h	0	18
	11h	0	19
	12h	0	20
	13h	0	21
	14h	0	22
	15h	0	23
	16h	0	24
	17h	0	25
	18h	0	26
	19h	0	27
	1Ah	0	28
	1Bh	0	29
	1Ch	0	30
	1Dh	0	33
	1Eh	0	34
	1Fh	0	35
	20h	0	37

*1 For the relationship between the value and the homing method, see *“5.5.5.5.1.4 Homing method (6098h)”* in *“5.5.5.5.1 Objects Related to hm Control Mode (Command/Setting-related)”* .

Homing supports the setting values in the table below. If Homing Operation Start is performed with unsupported setup values, homing error (Obj.6041h:00h “Statusword” :bit 13) will be set to 1.

Homing support list

○: Supported ×: Not supported

Obj.3001h:00h “Control mode setup”	Obj.3015h:00h “Absolute encoder setup”	Homing
0: Semi-closed control	0: Absolute mode	○
	1: Incremental mode	○
	2: Absolute mode (multi-turn counter over ignored)	○
	3: Absolute mode (single-turn absolute mode)	○
	4: Absolute mode (continuous rotating absolute encoder mode)	○
6: Full-closed control	Obj.3323h:00h “External scale selection”	Homing
	0: A/B-phase output type	○
	1: Serial communication type (incremental)	○
	2: Serial communication type (absolute)	○

5.5.5.5.3 hm Control Mode Operation (Homing Operation)

When using in incremental mode, perform a Homing operation because the position information must be initialized before starting normal operation.

When used in absolute mode, homing operation is not required, but by performing the homing operation, the driver can automatically set the values of Obj.37C0h:00h "Absolute scale offset1" and Obj.37C1h:00h "Absolute scale offset2" and save them in the EEPROM.

After the home position is detected, the following objects are initialized (preset) based on that position.

Obj.6062h:00h "Position demand value" = Obj.6064h:00h "Position actual value" = Obj.607Ch:00h "Home offset"

Obj.6063h:00h "Position actual internal value" = Obj.60FCh:00h "Position demand internal value" = 0

When homing is performed, the position information is initialized (preset). Therefore, data acquired based on old location information (e.g., Touch probe position, etc.) must be reacquired.

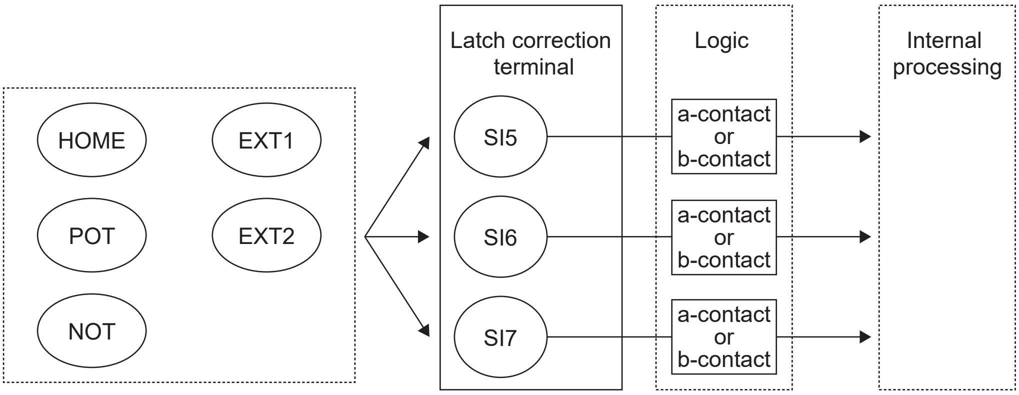
If Obj.607Ch:00h "Home offset" is changed during a Homing operation, it will not be reflected in the running Homing operation.

It will be applied to the next Homing operation (initialization of location information upon completion).

If the edge of the Switch signal (HOME, POT, NOT) is used as the home detection position, it can be freely assigned to the latch correction terminals SI5, SI6, and SI7. If it is not assigned correctly, a Homing error will result.

During homing operation, the Obj.3504h:00h "Over-travel inhibit input setup" setting is temporarily disabled.

- Connection when the sensor signal edge is home or latched



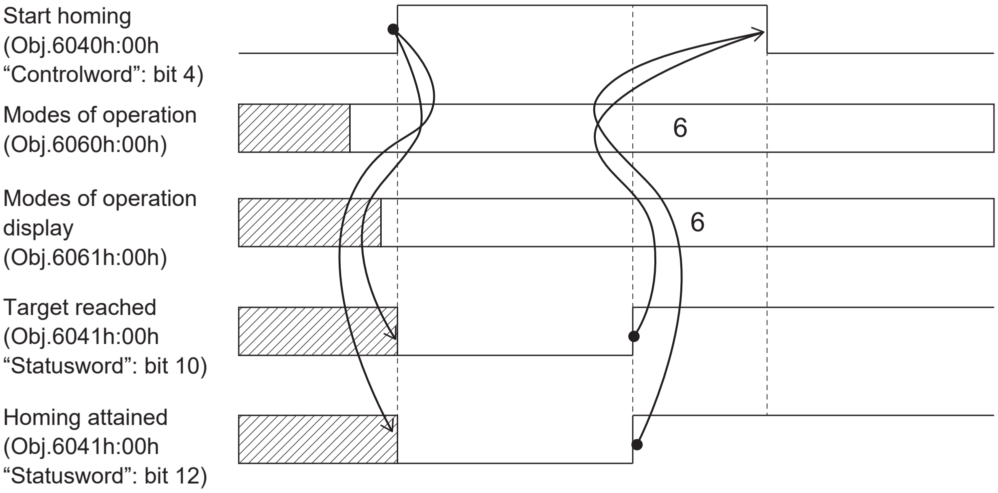
Description of terms shown in each Method diagram

Index pulse	Z-phase signal of the encoder (external scale for full-closed control)
Home switch	Logic signal state of proximity to home input (HOME)
Positive limit	Logic signal state of positive direction over-travel inhibit input (POT)
Negative limit	Logic signal state of negative direction over-travel inhibit input (NOT)

Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).

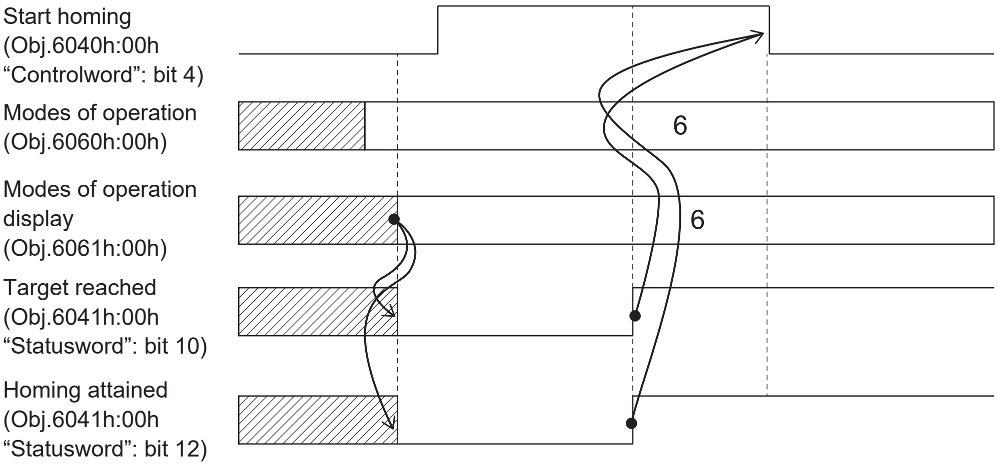
- Sequence of hm control mode

- **Obj.3780h:00h “Communication function extended setup 8” :bit 6 = 0**



Homing is not complete when Obj.6040h:00h “Controlword” :bit 4 is set to 1.

- **Obj.3780h:00h “Communication function extended setup 8” :bit 6 = 1**



With this setting, homing is not completed when the control mode is switched to the homing position control mode. When performing consecutive homing operations, perform control mode switching before executing homing in order to make the homing operation incomplete again.

For homing operation using index pulse, it is recommended to set Obj.3722h:00h “Communication function extended setup 1” :bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” to 1.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	B
	● bit 7: Over-travel inhibit input detection setting during Z-phase homing return operation 0: Disabled 1: Enabled									
3780h	00h	Communication function extended setup 8	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
	● bit 6: Obj.6041h:00h “Statusword” : bit 12 Expansion setup for “homing attained” 0: Set when homing operation starts 1: Set during mode of homing position control switching									

By setting Obj.3722h:00h “Communication function extended setup 1” :bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” to 1, protection can be provided by triggering Err94.3.0 “Homing error protection 2” when the amount of movement becomes abnormal in the return operation to the index pulse detection position and over-travel inhibit input is detected.

During homing operation, if a cancellation of homing is executed by halt or other means from a host device during the period from homing detection to completion of homing, Err27.7.0 “Position information initialization error protection” occurs.

■ Homing return velocity limit function

Performs a return operation to return by the amount past the home position when the home position is detected. At this time, if homing is performed using a setting with a high response to position commands and at a high speed, such as when two-degree-of-freedom control is enabled, sound may be generated upon completion.

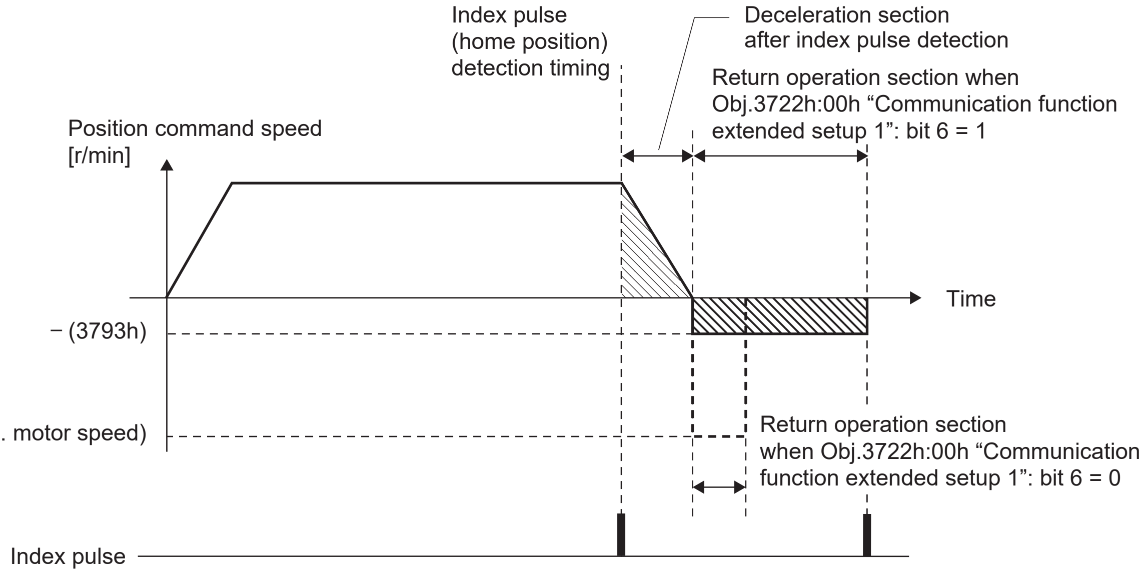
If Obj.3722h:00h “Communication function extended setup 1” :bit 6 “Homing return operation velocity limit enabled” is set to 1 and the homing return velocity limit function is enabled, the return operation speed is limited by the Obj.3793h:00h “Homing return speed limit value” setting value, which is expected to have the effect of reducing sound generation.

If this function is enabled, the time to complete homing may be extended.

When this function is disabled, the return operating speed is limited by the maximum motor speed saved inside the driver.

If the return operation speed exceeds Obj.3513h:00h “Over-speed level setup” , Err26.0.0 “Overspeed protection” occurs, and if the return operation speed exceeds the set value of Obj.3615h:00h “2nd over-speed level setup” , Err26.1.0 “2nd Overspeed protection” occurs.

Example of homing (positive direction) using index pulse



—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	R
		● bit 6: Homing return velocity limit enabled 0: Disabled 1: Enabled								

R1.1

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3793h	00h	Homing return speed limit value	r/min	0 to 20000	I16	rw	No	hm	Yes	C
		● Sets the homing return speed limit value. If the setting value is less than the internal minimum speed, the velocity is limited by the internal minimum speed. If the set value is greater than the maximum motor speed, it is limited by the maximum motor speed.								

■ Protection function setup in homing using Z-phase

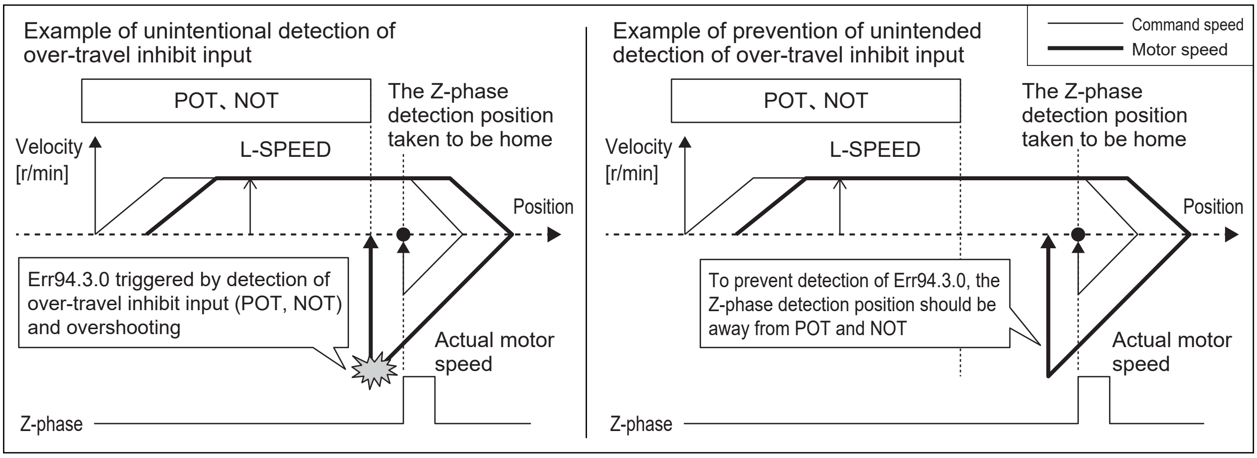
By setting to Obj.3722h:00h "Communication function extended setup 1" :bit 7 "Over-travel inhibit input detection setting during Z-phase homing return operation" = 1, the over-travel inhibit input (POT, NOT) will be detected while returning to the Z-phase detection position, which is treated as the home in homing using the Z-phase.

If over-travel inhibit input is detected during the return operation, Err94.3.0 "Homing error protection 2" can be triggered to enable the protection function used to stop the motor by shutting off current to it.

Precautions

- If set to Obj.3722h:00h "Communication function extended setup 1" :bit 7 "Over-travel inhibit input detection setting during Z-phase homing return operation" = 1 and the home Z-phase in proximity to over-travel inhibit input (POT, NOT) is taken to be home, Err94.3.0 "Homing error protection 2" may be unintentionally triggered through detection of over-travel inhibit input when the return operation to the Z-phase detection position has overshot.

  In order to prevent unintentional detection of over-travel inhibit inputs, the position at which over-travel inhibit is input must be separated from the Z-phase, which is treated as the position for completing homing. Prevent the return operation from occurring in the proximity of over-travel inhibit input (POT, NOT).



- If not set to Obj.3722h:00h "Communication function extended setup 1" :bit 7 "Over-travel inhibit input detection setting during Z-phase homing return operation" = 1, detection of over-travel inhibit input (POT/ NOT) is disabled during return to the Z-phase detection position when homing by use of the Z-phase.

Related Objects

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3504h	00h	Over-travel inhibit input setup	—	0 to 2	I16	rw	No	ALL	Yes	C
Sets the input operations for the over-travel inhibit inputs (POT, NOT). Set according to the host device specification. Normally set to 1 (disabled) in order for the host device to control the operation. ● 0: Servo (this product) side deceleration to stop (sequence during over-travel inhibit input) Functions as POT -> Positive direction over-travel inhibit, NOT -> Negative direction over-travel inhibit. Stops as per Obj.3505h:00h “Sequence at over-travel inhibit” when POT is input when operating in a positive direction. Operation is similar when NOT is input when operating in a negative direction. ● 1: CoE (CiA402)-side deceleration to stop Functions as POT -> Positive direction over-travel inhibit, NOT -> Negative direction over-travel inhibit. If POT is input during positive direction travel or NOT is input during negative direction travel, the EtherCAT profile deceleration operation defined in CoE (CiA402) is executed to bring it to a stop. The deceleration constant differs for each control mode. ● 2: Servo (this product) side deceleration to stop (sequence at alarm) Inputting either POT or NOT triggers Err38.0.0 “Over-travel inhibit input protection 1” .										
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	B
● bit 7: Over-travel inhibit input detection setting during Z-phase homing return operation 0: Disabled 1: Enabled										

Related protection functions

Alarm number			Name	Cause	Handling
Main	Sub	Primary cause			
94	3	0	Homing error protection 2	● Either positive direction or negative direction over-travel inhibit input (POT or NOT) was turned ON during the return operation to the Z-phase position detected during homing using Z-phase while Obj.3722h:00h “Communication function extended setup 1” :bit 7 = 1.	● Increase the distance between the Z-phase and the positive direction/ negative direction over-travel inhibit input (POT/NOT). ● After ensuring safety, set Obj.3722h:00h:bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 0 (disabled).

■ Conditions for Homing error

The table below shows the conditions that cause an error (Homing error = 1) in the homing operation.

Conditions for Homing error	Details
Start in absolute mode	Homing started in absolute mode (*2)
Startup in state other than Operation enabled	Homing started when PDS state is not Operation enabled (*2) (Excluding method 35 and 37)
Startup with target speed 0	Homing started when Obj.6099h:01h “Speed during search for switch” and Obj.6099h:02h “Speed during search for zero” are set to 0 (*2) (except when Obj.6099h:02h “Speed during search for zero” in methods 33 and 34 and Obj.6099h:01h “Speed during search for switch” and Obj.6099h:02h “Speed during search for zero” in methods 35 and 37 are 0)
Both limit switches detected	Both positive and negative limit switches detected during homing startup (*2) or homing operation (*3)

Conditions for Homing error	Details
Limit switch has been passed	In the case of a method that reverses from the limit switch, the falling edge of limit switch is detected during the deceleration operation for reversal after the rising edge of limit switch is detected
Home switch was passed	In the case of a method that reverses from the home switch, the falling edge of home switch is detected during the deceleration operation for reversal after the rising edge of home switch is detected
Improper installation relationship between home switch and limit switch	In the case of a method that reverses from the home switch, the rising edge of limit switch is detected during the deceleration operation for reversal after the rising edge of home switch is detected
	Limit switch is detected during home switch search in a method that is not reversed by limit switch (*1)
Inappropriate installation relationship between index pulse and limit switch	In a method that detects index pulses, the rising edge of limit switch is detected during index pulse search
	Limit switch is detected during index pulse search in a Method that is not reversed by Limit switch (*1)
Home switch and limit switch are not assigned.	When the edge of the switch signal (HOME, POT, NOT) is used as the home detection position, HOME, POT, NOT are not assigned to SI5, SI6, SI7

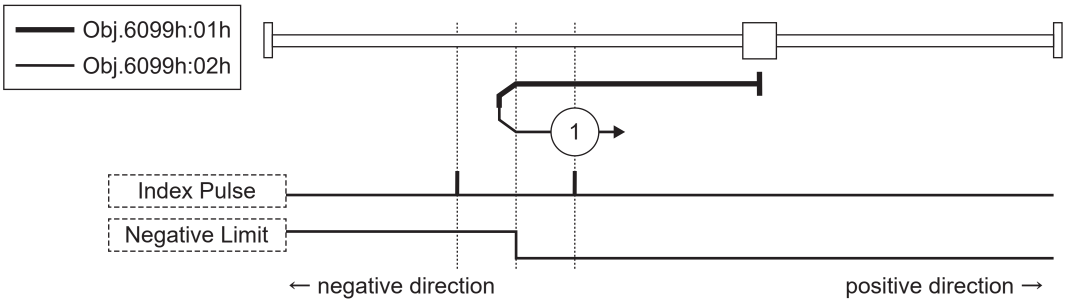
*1 If the limit switch is detected at the time of homing startup (*2) and an operation is performed to exit the limit switch at startup (operation in the opposite direction of the limit direction), a homing error will not be detected.

*2 Homing startup means the timing when Obj.6040h:00h “Controlword” :bit 4 “start homing” receives the change from 0 to 1.

*3 When Obj.3504h:00h “Over-travel inhibit input setup” = 0, no homing error occurs and Err38.0.0 “Over-travel inhibit input protection 1” is generated.

■ Method 1

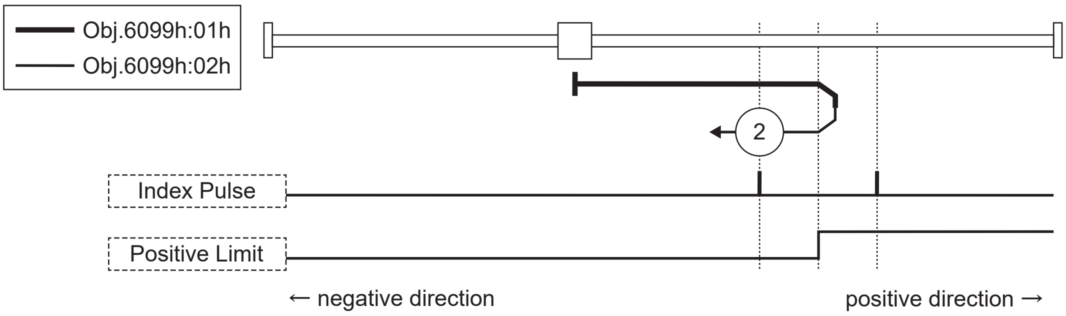
- When the negative limit switch is inactive, the initial operating direction of this method is negative (In the figure below, the inactive state is shown as a low-level state.).
- The home detection position is the first index pulse detection position on the positive side position after the negative limit signal becomes inactive.
- If NOT is not assigned, then Homing error = 1.



Homing on negative limit switch and index pulse

■ Method 2

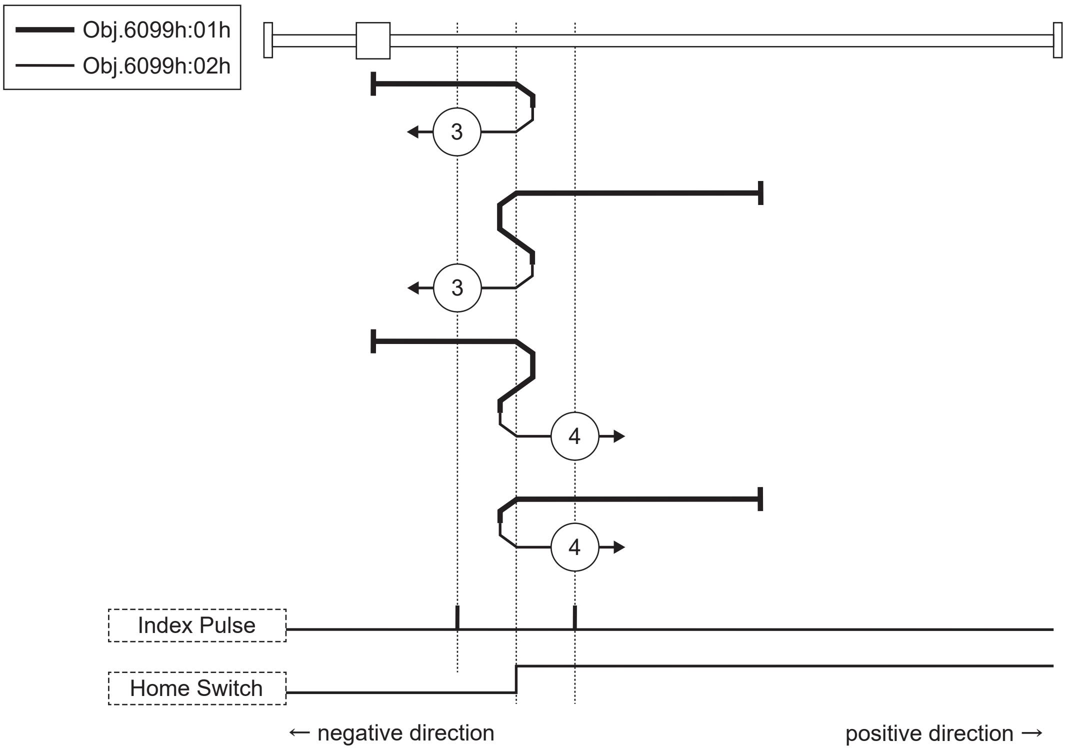
- When the positive limit switch is inactive, the initial operating direction of this Method is positive (In the figure below, the inactive state is shown as a low-level state.).
- The home detection position is the first index pulse detection position on the negative side position after the positive limit signal becomes inactive.
- If POT is not assigned, then Homing error = 1.



Homing on positive limit switch and index pulse

■ Method 3, Method 4

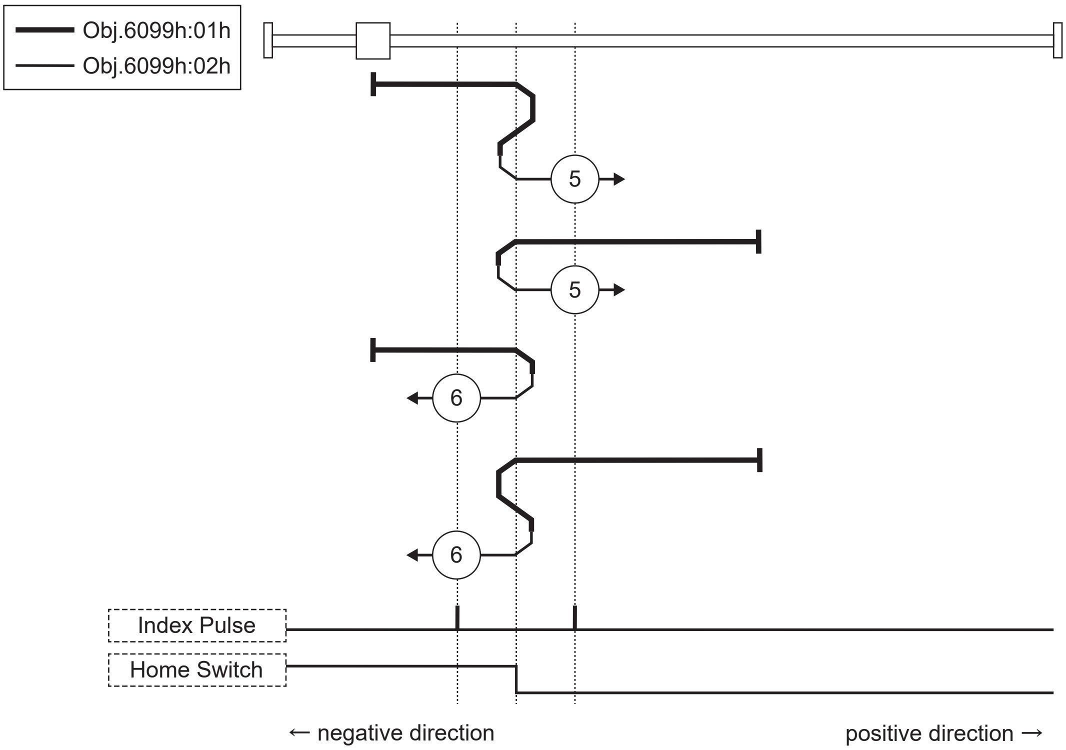
- ● The initial operating direction of these Methods changes according to the status of the home switch at startup (In the figure below, the inactive state is shown as a low-level state.).
- ● The home detection position is the first index pulse detection position on the negative or positive side after the home switch state change.
- ● If HOME is not assigned, then Homing error = 1.



Homing on positive home switch and index pulse

■ Method 5, Method 6

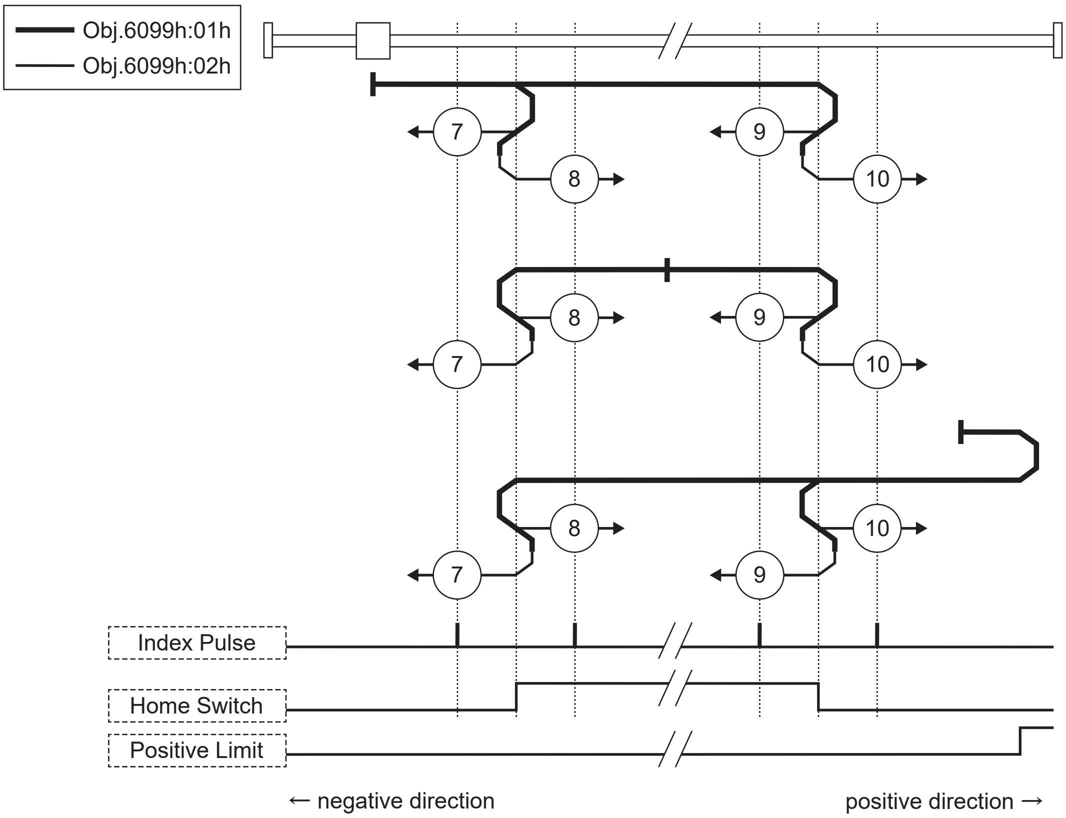
- ● The initial operating direction of these Methods changes according to the status of the home switch at startup (In the figure below, the inactive state is shown as a low-level state.).
- ● The home detection position is the first index pulse detection position on the negative or positive side after the home switch state change.
- ● If HOME is not assigned, then Homing error = 1.



Homing on negative home switch and index pulse

■ Method 7, Method 8, Method 9, Method 10

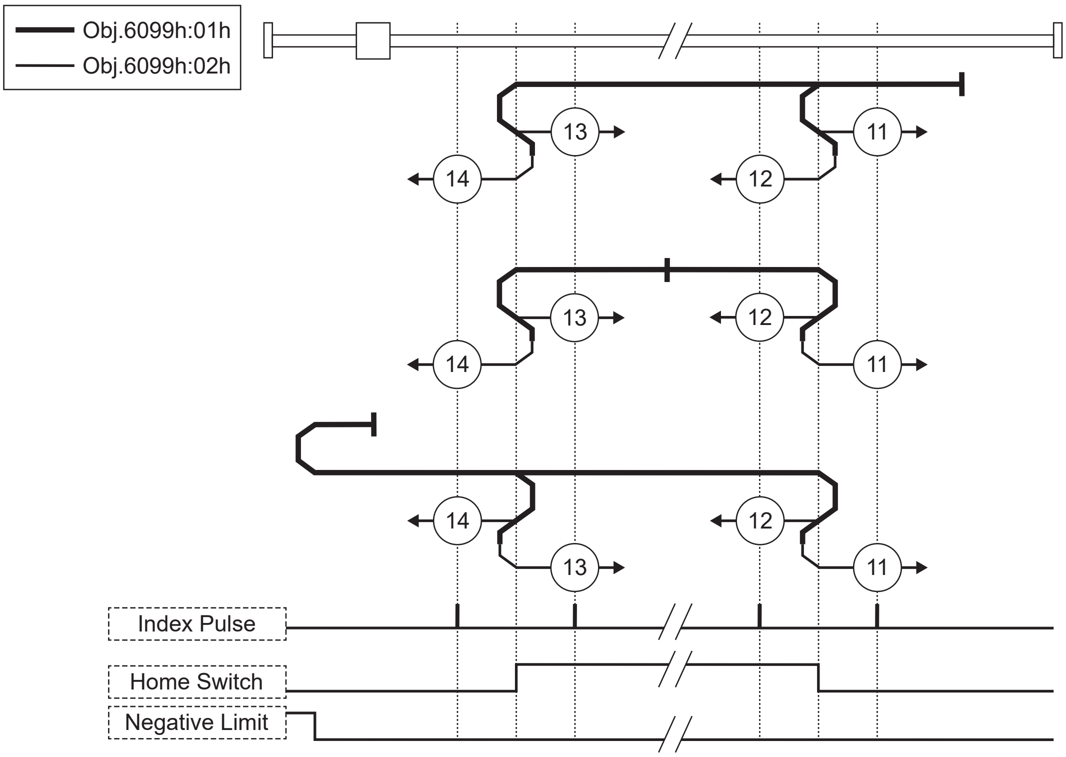
- These methods use Home switch and Index pulse (In the figure below, the inactive state is shown as a low-level state.).
- The initial operating direction of Method 7 and Method 8 is the negative direction if the Home switch is active at the start of operation.
- The initial operating direction of Method 9 and Method 10 is the positive direction if the Home switch is active at the start of operation.
- The home detection position is the index pulse near the rising or falling edge of the Home switch.
- If HOME and POT are not assigned, then Homing error = 1.



Homing on home switch and index pulse - positive initial motion

■ Method 11, Method 12, Method 13, Method 14

- These methods use Home switch and Index pulse (In the figure below, the inactive state is shown as a low-level state.).
- The initial operating direction of Method 11 and Method 12 is the positive direction if the Home switch is active at the start of operation.
- The initial operating direction of Method 13 and Method 14 is the negative direction if the Home switch is active at the start of operation.
- The home detection position is the index pulse near the rising or falling edge of the Home switch.
- If HOME and NOT is not assigned, then Homing error = 1.

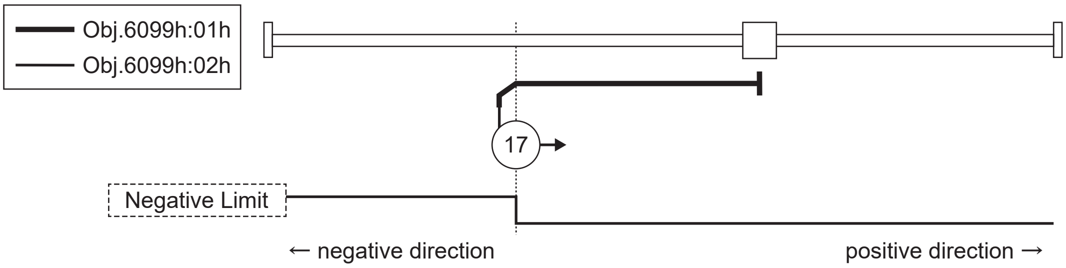


Homing on home switch and index pulse - negative initial motion

■ Method 17

- This Method is similar to Method 1.

  The difference from Method 1 is that the home detection position is not the Index pulse, but the position at which the Limit switch changes (In the figure below, the inactive state is shown as a low-level state.).
- If NOT is not assigned to any of SI5, SI6, or SI7, then Homing error = 1.

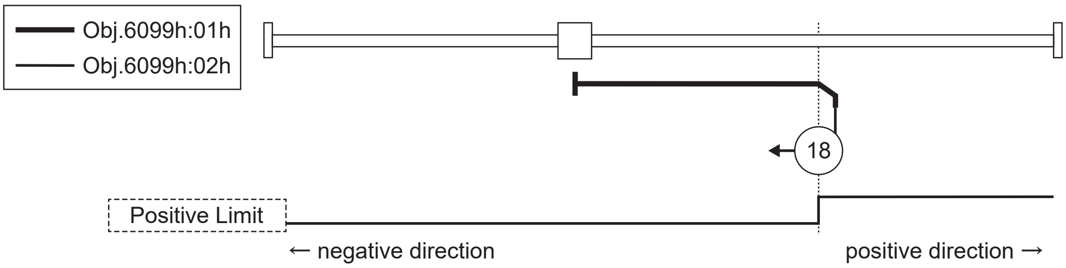


Homing on negative limit switch

■ Method 18

- This Method is similar to Method 2.

  The difference from Method 2 is that the home detection position is not the Index pulse, but the position at which the Limit switch changes (In the figure below, the inactive state is shown as a low-level state.).
- If POT is not assigned to any of SI5, SI6, or SI7, then Homing error = 1.

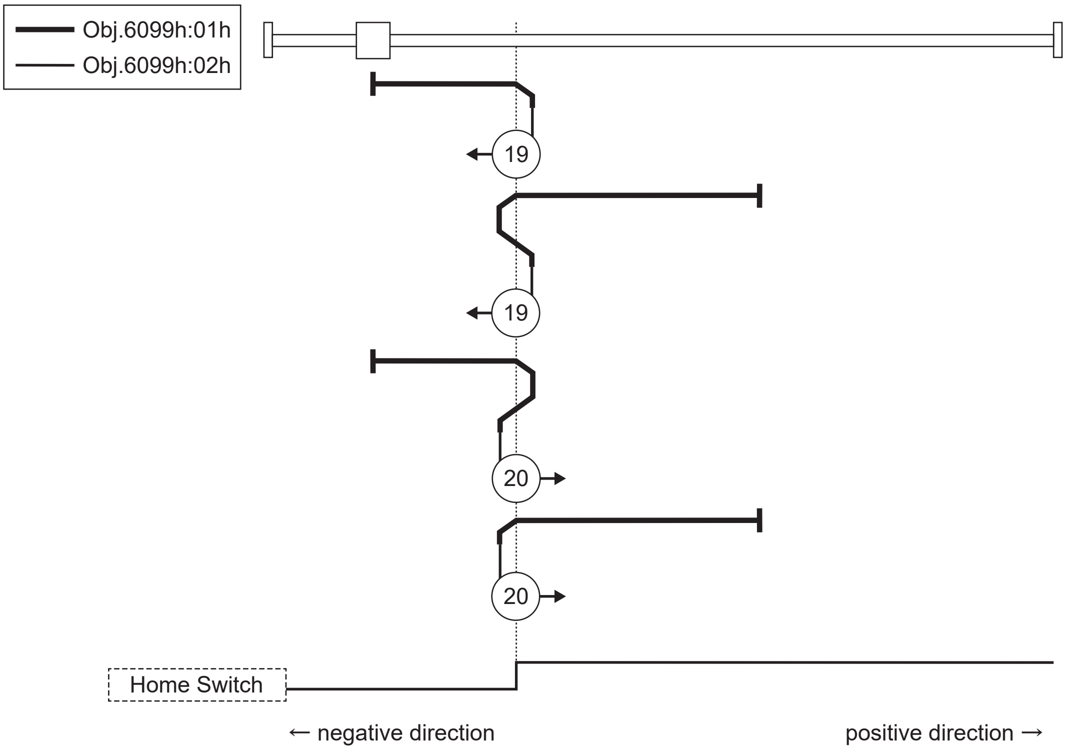


Homing on positive limit switch

■ Method 19, Method 20

- These Methods are similar to Method 3 and Method 4.

  The difference from Method 3 and 4 is that the home detection position is not the Index pulse, but the position at which the Home switch changes (In the figure below, the inactive state is shown as a low-level state.).
- If HOME is not assigned to any of SI5, SI6, or SI7, then Homing error = 1.

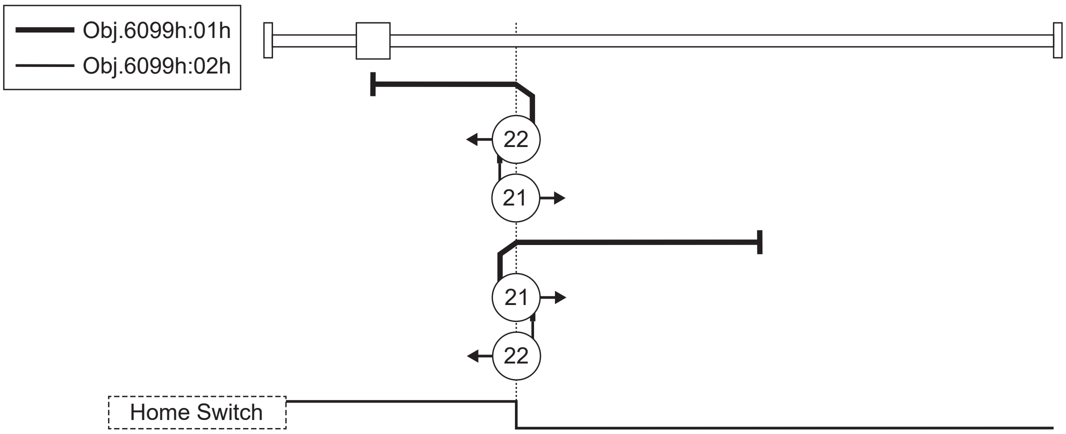


Homing on positive home switch

■ Method 21, Method 22

- These Methods are similar to Method 5 and Method 6.

  The difference from Method 5 and 6 is that the home detection position is not the Index pulse, but the position at which the Home switch changes (In the figure below, the inactive state is shown as a low-level state.).
- If HOME is not assigned to any of SI5, SI6, or SI7, then Homing error = 1.



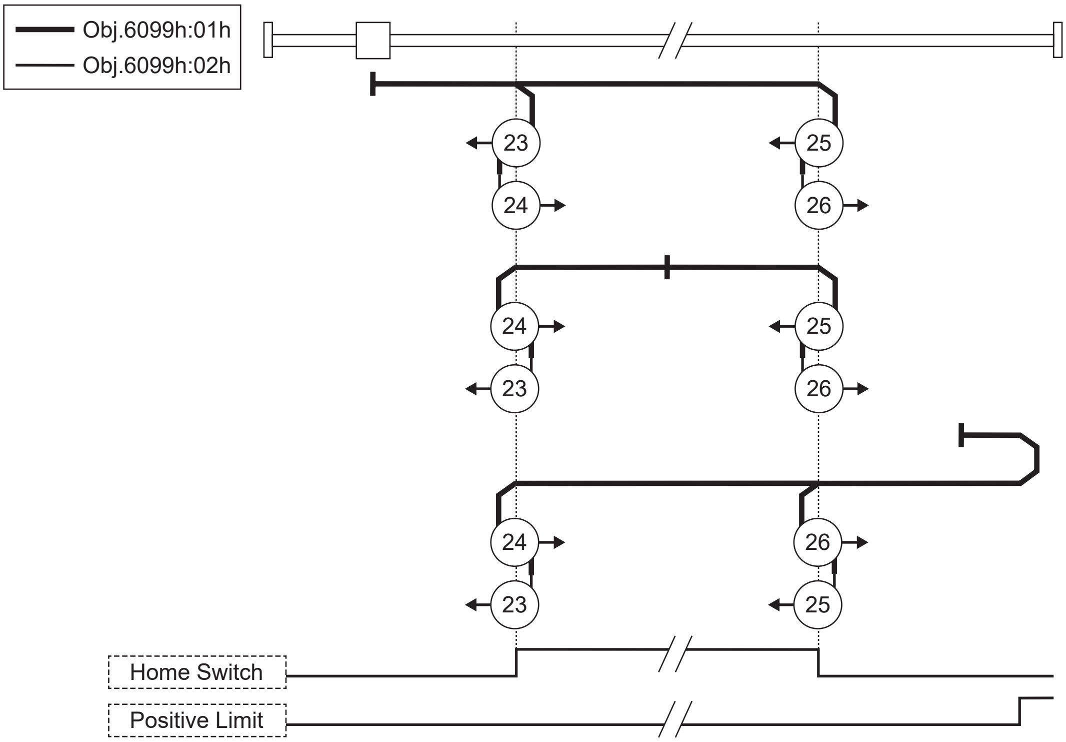
← negative direction positive direction →

Homing on negative home switch and index pulse

■ Method 23, Method 24, Method 25, Method 26

- These methods are similar to Method 7, Method 8, Method 9, and Method 10.

  The difference from methods 7, 8, 9, 10 is that the home detection position is not the Index pulse, but the position at which the Home switch changes (In the figure below, the inactive state is shown as a low-level state.).
- If HOME is not assigned to SI5, SI6, or SI7, or if POT is not assigned, then Homing error = 1.



← negative direction positive direction →

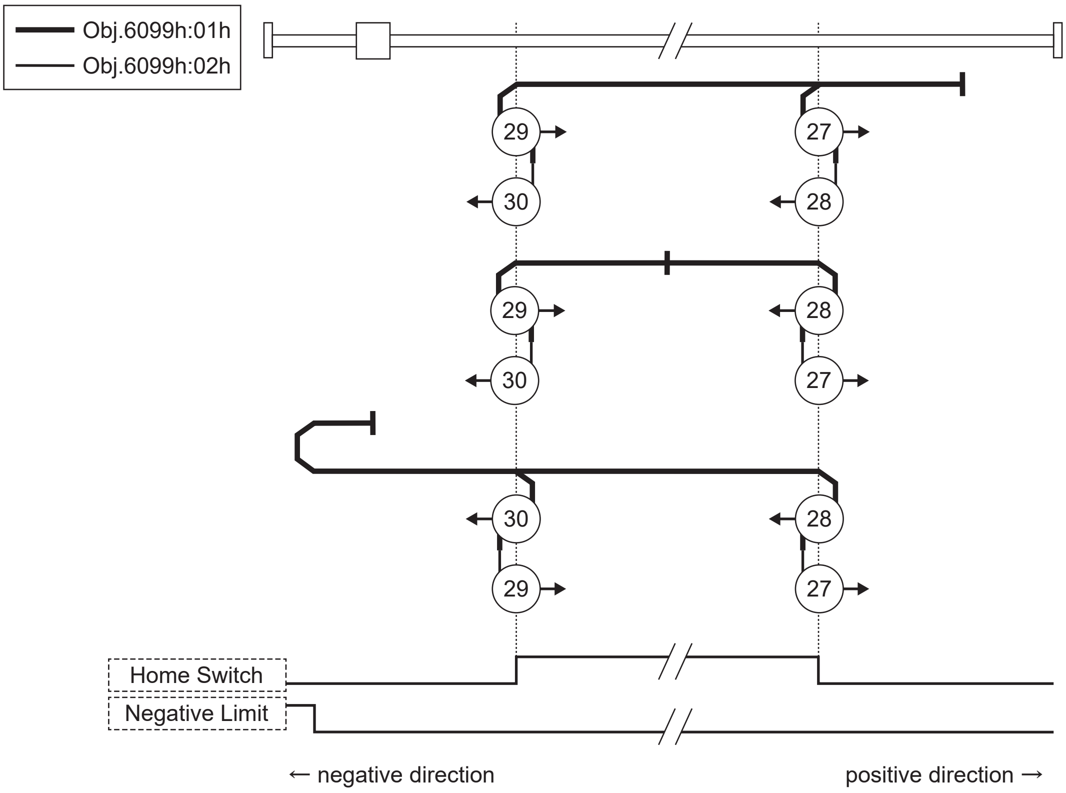
Homing on home switch and index pulse - positive initial motion

■ Method 27, Method 28, Method 29, Method 30

- These methods are similar to Method 11, Method 12, Method 13, and Method 14.

  The difference from methods 11, 12, 13, 14 is that the home detection position is not the Index pulse, but the position at which the Home switch changes (In the figure below, the inactive state is shown as a low-level state.).

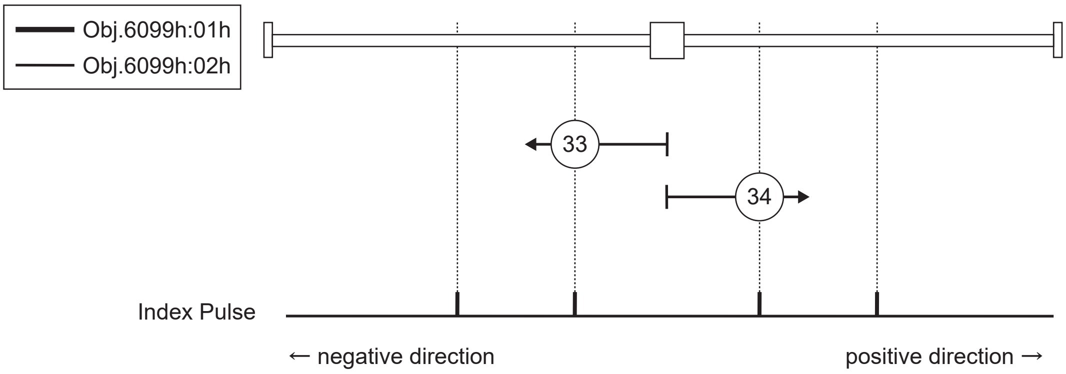
- If HOME is not assigned to SI5, SI6, or SI7, or if NOT is not assigned, then Homing error = 1.



Homing on home switch and index pulse - negative initial motion

Method 33, Method 34

- These Methods use only Index pulse.
- The Index pulse detected by operation in the direction shown in the figure is used as the home detection position.



Homing on index pulse

Method 35, Method 37

- Used to set the coordinate system of the product (location information setting).

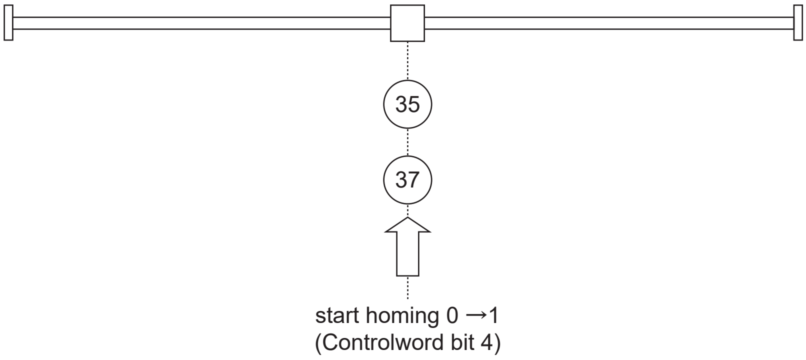
  When homing is started, the following objects are initialized (preset) based on the position.

  Obj.607Ch:00h “Home offset” is added to Obj.6062h:00h “Position demand value” and Obj.6064h:00h “Position actual value” .

  Obj.6062h:00h “Position demand value” = Obj.6064h:00h “Position actual value” = Obj.607Ch:00h “Home offset”

  Obj.6063h:00h “Position actual internal value” = Obj.60FCh:00h “Position demand internal value” = 0
- It can be executed even if the PDS state is not Operation Enabled.

- Method 35 and Method 37 should be executed after a time interval of 100 ms or more after the command position is stopped.
- Method 35 and Method 37 have the same functionality, but for new designs, use Method 37 in accordance with ETG standards.



5.5.6 Velocity Control Function (pv, csv)

The following types of velocity control mode are available:

- Profile velocity control (pv)
- Cyclic velocity control (csv)

This section describes the objects used in the velocity control mode functions described above.

For a system overview of velocity control, see Technical Reference Functional Specification “4.4 Velocity Control” .

5.5.6.1 Velocity Control Common Functions

This section describes the objects used in functions common to each velocity control mode.

For control block diagrams, see below.

- Technical Reference Functional Specification “4.4.2 Velocity Control (Two-degree-of-freedom Control Mode Enabled)”
- Technical Reference Functional Specification “4.4.3 Velocity Control (Two-degree-of-freedom Control Mode Disabled)”

The control block diagram is described using servo parameter numbers. For the relationship between servo parameter numbers and object numbers, see *“5.3 Servo Parameter Area (3000h to 3FFFh) Details”* .

5.5.6.1.1 Objects Commonly Related to Velocity Control (Command/Setting-related)

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3312h	00h	Acceleration time setup	ms/ (1000 r/ min)	0 to 10000	I16	rw	No	csv pv	Yes	B
3313h	00h	Deceleration time setup	ms/ (1000 r/ min)	0 to 10000	I16	rw	No	csv pv	Yes	B
3314h	00h	Sigmoid acceleration / deceleration time setup	ms	0 to 1000	I16	rw	No	csv pv	Yes	B
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60FFh	00h	Target velocity	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pv	No	A

There are other objects associated with each velocity control mode. Also, Obj.6040h:00h “Controlword” has different functions in each velocity control mode. For a description of the associated objects and Obj.6040h:00h “Controlword” functions for each velocity control mode, see below.

- *“5.5.6.2 Profile Velocity Control Mode (pv mode)”*
  1. *“5.5.6.2.1 Objects Related to pv Control Mode (Command/Setting-related)”*
  2. *“5.5.6.2.2 Objects Related to pv Control Mode (Monitoring-related)”*
- *“5.5.6.3 Cyclic Velocity Control Mode (csv mode)”*
  1. *“5.5.6.3.1 Objects Related to csv Control Mode (Command/Setting-related)”*
  2. *“5.5.6.3.2 Objects Related to csv Control Mode (Monitoring-related)”*

5.5.6.1.1.1 Velocity-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3312h	00h	Acceleration time setup	ms/ (1000 r/ min)	0 to 10000	I16	rw	No	csv pv	Yes	B
		● Sets the acceleration time for acceleration processing with respect to speed command input.								

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3313h	00h	Deceleration time setup	ms/ (1000 r/ min)	0 to 10000	I16	rw	No	csv pv	Yes	B
		● Sets the deceleration time for deceleration processing with respect to speed command input.								
3314h	00h	Sigmoid acceleration / deceleration time setup	ms	0 to 1000	I16	rw	No	csv pv	Yes	B
		● Sets the S-curve time for acceleration/deceleration processing with respect to speed command input.								
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes (*1)	B
		● Sets the maximum motor speed. ● The maximum value is limited to the maximum velocity output by the motor using internal processing.								
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
		● Set the speed command offset value (speed feedforward). ● The maximum value is limited with Obj.6080h:00h "Max motor speed" by internal processing.								
60FFh	00h	Target velocity	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pv csv	No	A
		● Sets the target speed. ● The setting value of this object and the additional value of Obj.60B1h:00h "Velocity offset" is the internal target speed. ● The maximum internal target speed is limited by an internal process to the smaller of Obj.607Fh:00h "Max profile velocity" and Obj.6080h:00h "Max motor speed" .								

*1 The value stored in EEPROM is set when the control power is turned on.

5.5.6.1.1.2 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
		● If Obj.60FEh:01h "Physical outputs" :bit 19 = 1 is set while Obj.60FEh:02h "Bit mask" :bit 19 = 1, the torque command value generated by the velocity control loop is limited by the setting value.								
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
		● Sets the maximum motor torque. ● The maximum value is limited to the maximum torque output by the motor using internal processing. ● The maximum motor torque may vary depending on the motor used. ● Disabled if ESM state is Init, enabled if ESM state is PreOP or higher.								
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
		● Set the torque command offset value (torque feedforward). ● The torque feedforward value is 0 during deceleration in over-travel inhibition operations (during emergency stops).								

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
		● Sets the positive direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set. Limits the torque command by the smallest value among the limit values of Obj.3013h:00h “1st torque limit” , Obj.3522h:00h “2nd torque limit” and Obj.6072h:00h “Max torque” .								
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
		● Sets the negative direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set. Limits the torque command by the smallest value among the limit values of Obj.3013h:00h “1st torque limit” , Obj.3522h:00h “2nd torque limit” and Obj.6072h:00h “Max torque” .								

5.5.6.1.1.3 Other

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
		● bit 7: TFF clear ON/OFF selection from host device 0: Clear 1: Updates using the Obj.60B2h set value								

5.5.6.1.2 Objects Commonly Related to Velocity Control (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F41h	00h	Number of entries	—	2	U8	ro	No	ALL	No	—
	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	Yes	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
606Bh	00h	Velocity demand value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pv csv	Yes	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	Yes	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	Yes	X
6076h	00h	Motor rated torque	mN・m	0 to 4294967295	U32	ro	TxPDO	ALL	Yes	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	Yes	X

There are other objects associated with each velocity control mode. Also, Obj.6041h:00h “Statusword” has different functions in each velocity control mode. For a description of the associated objects and Obj.6041h:00h “Statusword” functions for each velocity control mode, see below.

- *“5.5.6.2 Profile Velocity Control Mode (pv mode)”*
  1. *“5.5.6.2.1 Objects Related to pv Control Mode (Command/Setting-related)”*
  2. *“5.5.6.2.2 Objects Related to pv Control Mode (Monitoring-related)”*
- *“5.5.6.3 Cyclic Velocity Control Mode (csv mode)”*
  1. *“5.5.6.3.1 Objects Related to csv Control Mode (Command/Setting-related)”*
  2. *“5.5.6.3.2 Objects Related to csv Control Mode (Monitoring-related)”*

5.5.6.1.2.1 Position-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays position information for the external scale.									
4F41h	—	Motor encoder data	—	—	—	—	—	ALL	—	—
	● Displays position information.									
4F41h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	● Displays the number of sub-indexes in Obj.4F41h: “Motor encoder data” .									
4F41h	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the mechanical angle of the motor (single-turn encoder data).									
4F41h	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays multi-turn data of the absolute encoder.									
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the electrical angle of the motor.									
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the external scale pulse sum.									
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the absolute position of the external scale.									
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the upper 24 bits of the external scale data.									
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the lower 24 bits of the external scale data.									
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. Encoder units except for full-closed control, and external scale units during full-closed control.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. In full-closed control, it is the external scale position.									

5.5.6.1.2.2 Velocity-related

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the velocity control command.									
6069h	00h	Velocity sensor actual value	–	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual speed sensor value. Not supported by this product and always returns 0.									
606Bh	00h	Velocity demand value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pv csv	No	X
	● Displays the internal command speed.									
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual speed of the motor.									

5.5.6.1.2.3 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
	● Displays the overload load factor (ratio of motor rated load).									
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the regenerative load factor (the ratio of regenerative overload protection to the level of alarm occurrence).									
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the inertia ratio. Ratio of load inertia to motor rotor inertia (equivalent to the value in Obj.3004h) Inertia ratio = (Load inertia/Rotor inertia) × 100									
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the torque limit value in the positive direction.									
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the torque limit value in the negative direction.									
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
	● Displays the internal command torque.									
6076h	00h	Motor rated torque	mN･m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
	● Automatically sets the rated torque from the motor.									

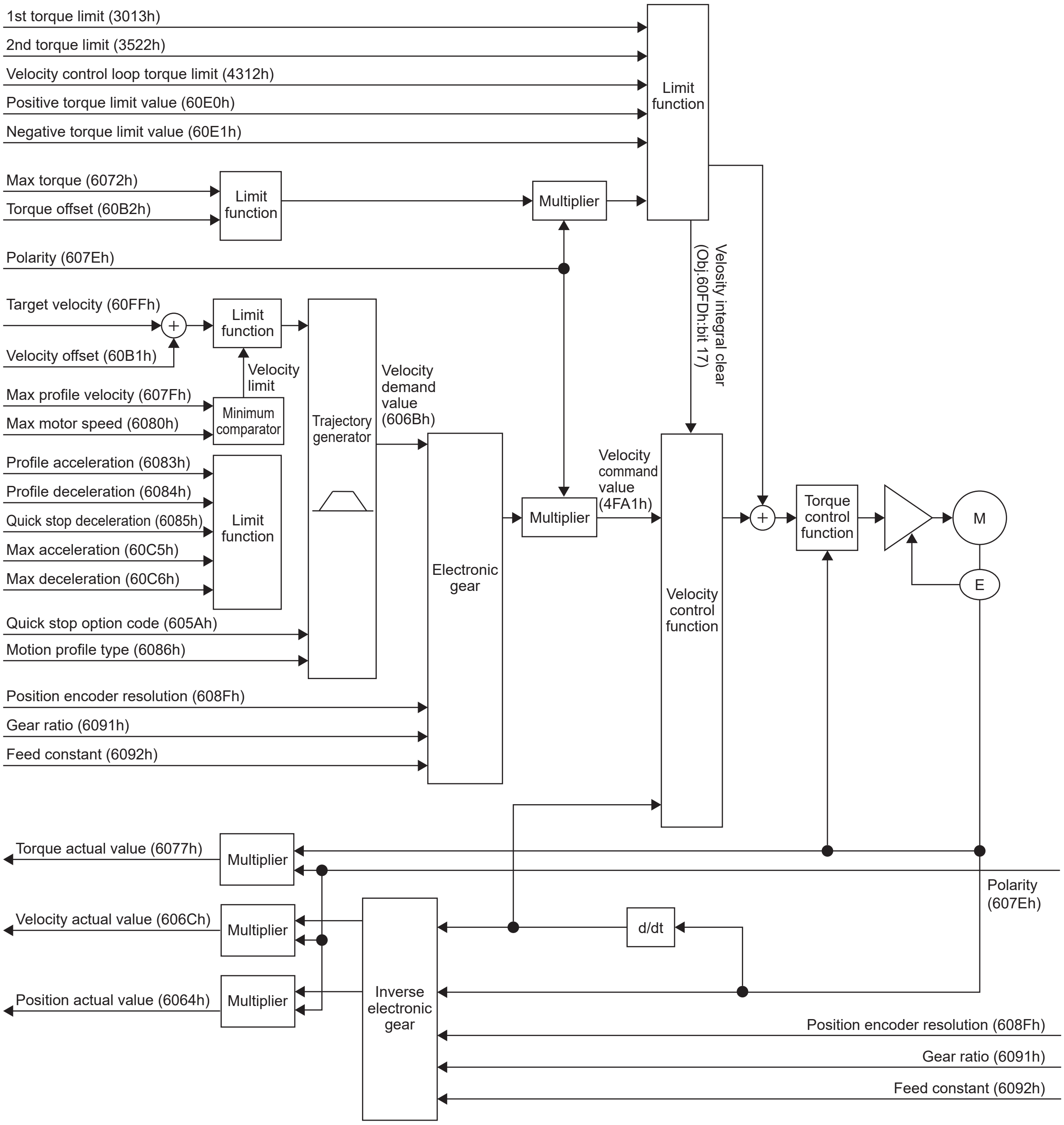
Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X

- Displays the actual torque.
- It is equivalent to the actual current value.
- This output value is for reference only and does not guarantee the actual value.

5.5.6.2 Profile Velocity Control Mode (pv mode)

Profile velocity control mode (pv mode) is a velocity control mode in which the host device specifies a target speed, acceleration/deceleration, etc., and this product generates position commands internally.

Use this control mode with a communication cycle of at least 250 µs.



5.5.6.2.1 Objects Related to pv Control Mode (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
606Ah	00h	Sensor selection code	—	-32768 to 32767	I16	rw	RxPDO	pv	No	X
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip	Yes	A
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A

There are other related objects common to velocity control. For details, see *"5.5.6.1 Velocity Control Common Functions"* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60FFh	00h	Target velocity	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pv csv	No	A

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
6086h	00h	Motion profile type	—	-32768 to 32767	I16	rw	RxPDO	pp pv ip	Yes	A
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6092h	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	A
60A3h	00h	Profile jerk use	—	1 to 2, 255	U8	rw	No	pp pv ip	Yes	A
60A4h	—	Profile jerk	—	—	—	—	—	pp pv ip	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	pp pv ip	No	X
	01h	Profile jerk1	Command unit/s^3	0 to 4294967295	U32	rw	No	pp pv ip	Yes	A
	02h	Profile jerk2	Command unit/s^3	0 to 4294967295	U32	rw	No	pp pv ip	Yes	A
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.6.2.1.1 Controlword (6040h) (Functions in pv Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands for this product, such as PDS state transitions.
  For the following setting values, the operation mode specific bit is not used in pv control mode.

Bit data reference

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="6" rowspan="2">(1)</td><td>(2)</td><td rowspan="2">(3)</td><td rowspan="2">(4)</td><td colspan="3">(2)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td></tr>
<tr><td>(1)</td><td>(1)</td><td>(1)</td><td>(1)</td></tr>
</table>

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on

5.5.6.2.1.2 Velocity-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3697h	00h	Function expansion setup 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
		- bit 8: Target control mode extension of Obj.607Fh:00h “Max profile velocity” 0: Standard specifications (pp, hm, ip, pv) 1: Extended specifications (pp, hm, ip, pv, tq, cst)								
606Ah	00h	Sensor selection code	—	-32768 to 32767	I16	rw	RxPDO	pv	No	X
		- Set the speed sensor to detect Obj.606Ch:00h “Velocity actual value” . This product does not support speed sensors, so it is always set to 0. 0: Detect actual speed from position sensor 1: Detect actual speed from speed sensor (not supported)								
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp hm ip pv	Yes	B
		- Sets the velocity limit value. - The maximum value is limited with Obj.6080h:00h “Max motor speed” by internal processing. - When Obj.3697h:00h “Function expansion setup 3” :bit 8 = 0 is set, this object targets pp, hm, ip, and pv. When Obj.3697h:00h “Function expansion setup 3” :bit 8 = 1 is set, this object targets pp, hm, ip, pv, tq, and cst.								

5.5.6.2.1.3 Acceleration/Deceleration-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip	Yes	A
		- Sets the profile acceleration. - If set to 0, treated as 1 by internal processing.								
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
		- Sets the profile deceleration. - In cyclic position control mode (csp) and cyclic velocity control mode (csv), this is enabled only during deceleration stop sequences. - If set to 0, treated as 1 by internal processing.								
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
		- Sets the maximum acceleration. - If set to 0, treated as 1 by internal processing.								

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
- Sets the maximum deceleration. - If set to 0, treated as 1 by internal processing.										

5.5.6.2.2 Objects Related to pv Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
606Dh	00h	Velocity window	Command unit/s	0 to 65535	U16	rw	RxPDO	pv	Yes	A
606Eh	00h	Velocity window time	ms	0 to 65535	U16	rw	RxPDO	pv	Yes	A
606Fh	00h	Velocity threshold	Command unit/s	0 to 65535	U16	rw	RxPDO	pv	Yes	A
6070h	00h	Velocity threshold time	ms	0 to 65535	U16	rw	RxPDO	pv	Yes	A

There are other related objects common to velocity control. For details, see *“5.5.6.1 Velocity Control Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Bh	00h	Velocity demand value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pv csv	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X

There are other related objects commonly used for motion. For details, see *“5.5.8 Motion Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.6.2.2.1 Statusword (6041h) (Functions in pv Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		(13)	(14)		(15)										

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): max slippage error
(14): speed
(15): target reached

■ Bit 13 (operation mode specific (control mode dependent bit)):

—: N/A

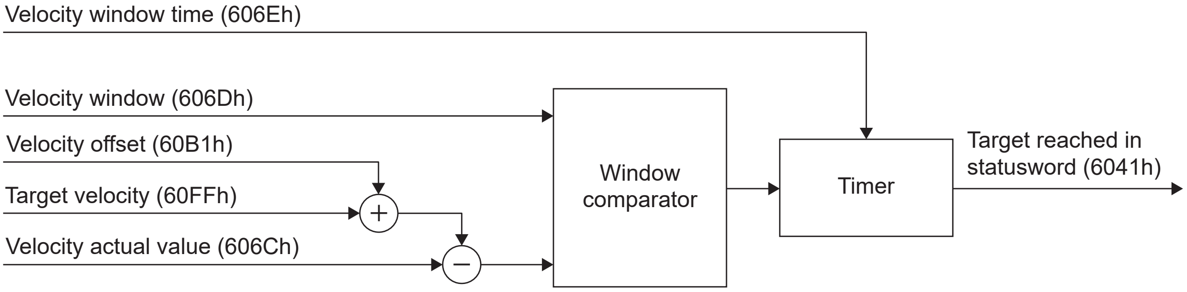
bit	Name	Value	Definition
13	max slippage error	—	(not supported)

■ bit 10 (target reached (Velocity reached)):

If the difference of the sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” with Obj.606Ch:00h “Velocity actual value” is within the range set for Obj.606Dh:00h “Velocity window” and the time set for Obj.606Eh:00h “Velocity window time” has elapsed, Obj.6041h:00h “Statusword” :bit 10 is set to 1.

bit	Name	Value	Definition
10	target reached	0	halt = 0 (normal): Velocity control not complete halt = 1 (when stopped by halt): Axis decelerating
		1	halt = 0 (normal): Velocity control complete halt = 1 (when stopped by halt): Axis stopped (axis speed is 0)

Velocity reached (functional overview)



Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
606Dh	00h	Velocity window	Com-mand unit/s	0 to 65535	U16	rw	RxPDO	pv	Yes	A
	● Sets the threshold value at which Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 1 when the difference between the sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” and Obj.606Ch:00h “Velocity actual value” is within the value set in this parameter and the time set in Obj.606Eh:00h “Velocity window time” elapses. If the speed deviation is outside the setting value of this parameter, Obj.6041h:00h “Statusword” :bit 10 is set to 0.									
606Eh	00h	Velocity window time	ms	0 to 65535	U16	rw	RxPDO	pv	Yes	A
	● Set the time until Obj.6041h:00h “Statusword” :bit 10 “target reached” becomes 1 after the sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” and the Obj.606Ch:00h “Velocity actual value” difference reach the set value of Obj.606Dh:00h “Velocity window” .									

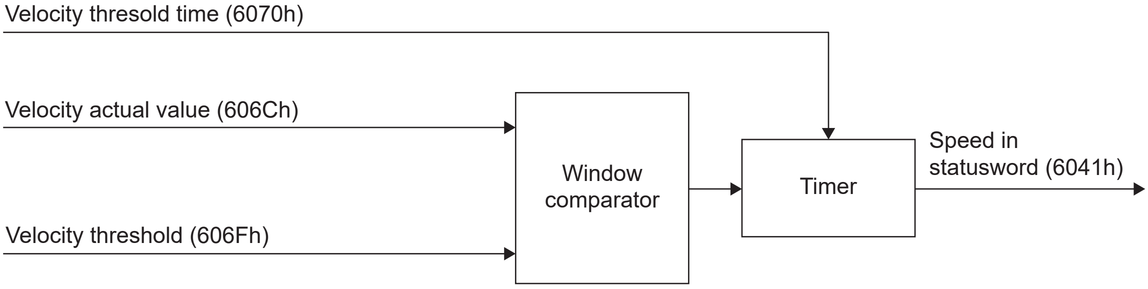
■ bit 12 (speed):

If Obj.606Ch:00h “Velocity actual value” exceeds the value set for Obj.606Fh:00h “Velocity threshold” and the time set for Obj.6070h:00h “Velocity threshold time” has elapsed, Obj.6041h:00h “Statusword” :bit 12 is set to 0.

When Obj.606Ch:00h “Velocity actual value” falls below the value set for Obj.606Fh:00h “Velocity threshold” , Obj.6041h:00h “Statusword” :bit 12 is set to 1, indicating that the motor has stopped.

bit	Name	Value	Definition
12	speed	0	Motor in operation
		1	Motor stopped

Speed (functional overview)



Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
606Fh	00h	Velocity threshold	Command unit/s	0 to 65535	U16	rw	RxPDO	pv	Yes	A
	● Set the threshold value at which Obj.6041h:00h “Statusword” :bit 12 “speed” becomes 0 when Obj.606Ch:00h “Velocity actual value” exceeds the value set in this parameter and the time set in Obj.6070h:00h “Velocity threshold time” elapses. If the speed is less than the value set in this parameter, Obj.6041h:00h “Statusword” :bit 12 is set to 1.									
6070h	00h	Velocity threshold time	ms	0 to 65535	U16	rw	RxPDO	pv	Yes	A
	● Sets the time until Obj.6041h:00h “Statusword” :bit 12 becomes 0 when Obj.606Ch:00h “Velocity actual value” exceeds the value set in Obj.606Fh:00h “Velocity threshold” .									

5.5.6.2.3 Operation in pv Control Mode

Profile velocity control mode generates speed command values according to the following parameters.

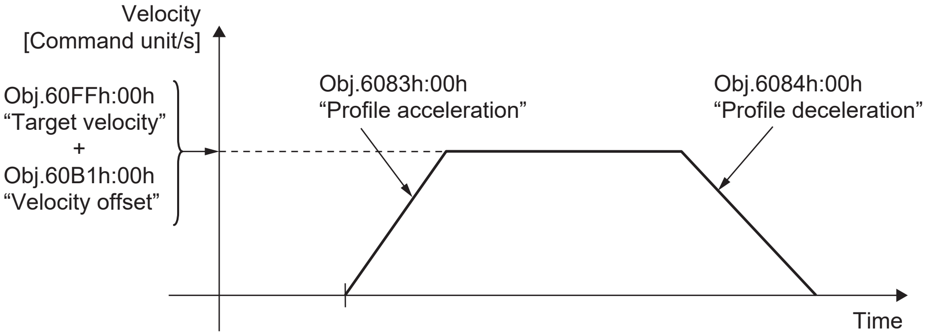
- Obj.60FFh:00h “Target velocity”
- Obj.60B1h:00h “Velocity offset”
- Obj.6083h:00h “Profile acceleration”
- Obj.6084h:00h “Profile deceleration”

The target speed is the sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” .

Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).

Various sensors exist for speed detection, but this product uses an encoder (position sensor) to detect position and speed.

Obj.606Ch:00h “Velocity actual value” etc. is provided as monitoring information.



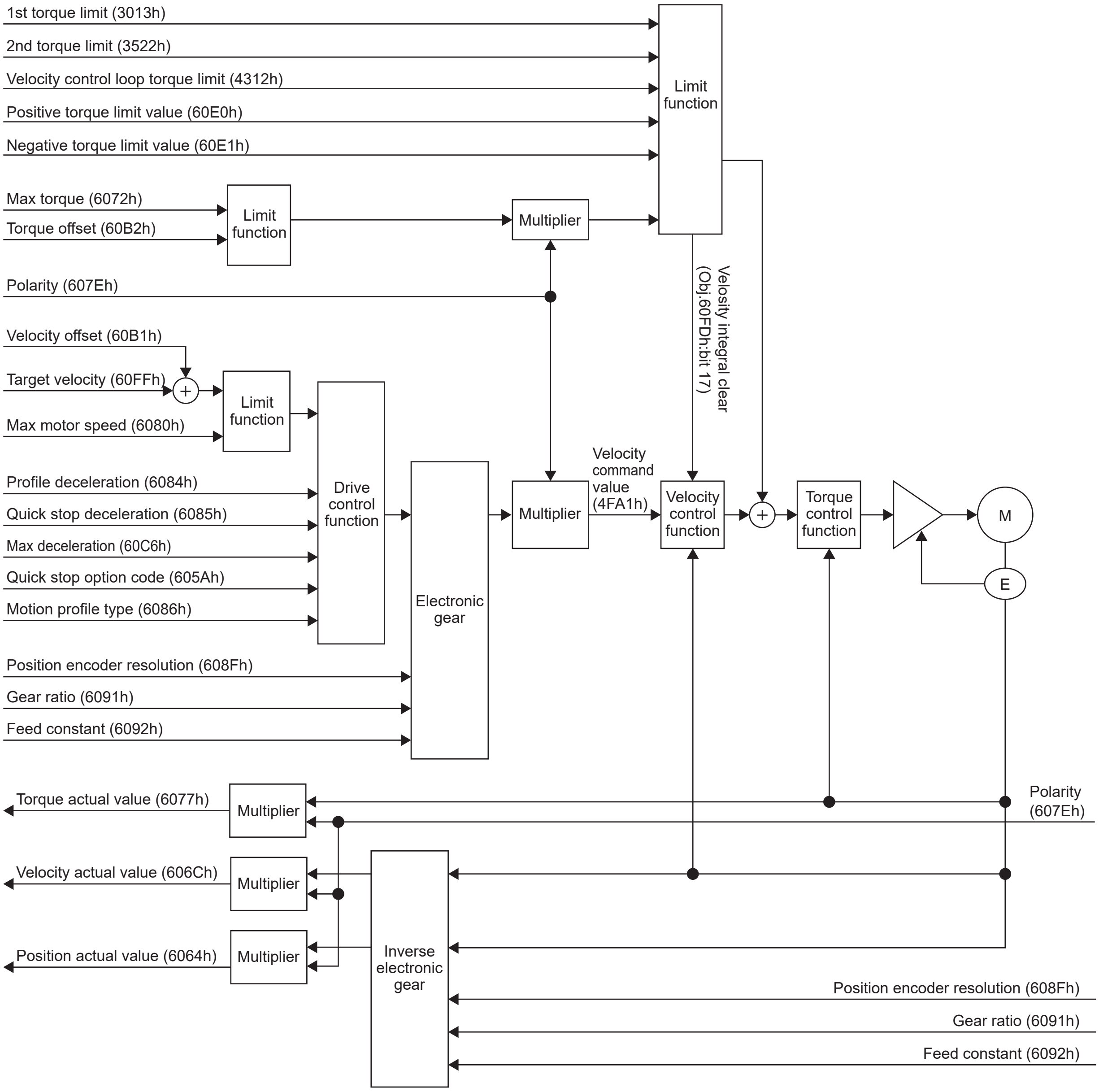
Precautions

- The sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” is limited by the minimum value of Obj.607Fh:00h “Max profile velocity” , Obj.6080h:00h “Max motor speed” , and 2147483647. However, changes to the Obj.607Fh:00h “Max profile velocity” and Obj.6080h:00h “Max motor speed” settings are not reflected during operation.

5.5.6.3 Cyclic Velocity Control Mode (csv mode)

Cyclic velocity control mode (csv mode) is a velocity control mode in which the host device generates speed commands and updates (transmits) the command speed in a communication cycle.

Use in DC or SM2 synchronous mode.



5.5.6.3.1 Objects Related to csv Control Mode (Command/Setting-related)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	–	0 to 65535	U16	rw	RxPDO	ALL	No	A
3724h	00h	Communication function extended setup 3	–	-32768 to 32767	I16	rw	No	ALL	Yes	C

There are other related objects common to velocity control. For details, see *“5.5.6.1 Velocity Control Common Functions”* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60FFh	00h	Target velocity	Command unit/s	-2147483648 to 2147483647	I32	rw	RxPDO	pv csv	No	A

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60C2h	—	Interpolation time period	—	—	—	—	—	ip csp csv cst	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ip csp csv cst	No	X
	01h	Interpolation time period value	—	0 to 255	U8	rw	No	ip csp csv cst	Yes	A
	02h	Interpolation time index	—	-128 to 63	I8	rw	No	ip csp csv cst	Yes	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.6.3.1.1 Controlword (6040h) (Functions in csv Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands to the product, such as PDS state transitions.
  For the following setting values, the operation mode specific bit is not used csv control mode.

Bit data reference

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="6" rowspan="2">(1)</td><td>(2)</td><td rowspan="2">(3)</td><td rowspan="2">(4)</td><td colspan="3">(2)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td></tr>
<tr><td>(1)</td><td>(1)</td><td>(1)</td><td>(1)</td></tr>
</table>

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on

5.5.6.3.1.2 Other

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C

- bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value”
  0: Includes torque limit and speed limit (cst only)
  1: Does not include torque limit and speed limit (cst only)

5.5.6.3.2 Objects Related to csv Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

There are other related objects common to velocity control. For details, see *“5.5.6.1 Velocity Control Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Bh	00h	Velocity demand value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	pv csv	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6076h	00h	Motor rated torque	mN・m	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.6.3.2.1 Statusword (6041h) (Functions in csv Control Mode)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	–	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

Bit data reference

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		(1)	(13)		(1)										

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): drive follows command value

■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

–: N/A

bit	Name	Value	Definition
10	reserved	–	Not used
12	drive follows command value	0	Operation is not executed according to the target speed (*1)
		1	Operation was executed according to the target speed (*1)
13	reserved	–	Not used

*1 An “operation has been executed according to the target speed” means that all of the following conditions have been met.

- PDS status is Operation enabled
- Not in a deceleration process (Halt, POT, NOT, Quickstop, Shutdown, Disable operation, Fault)
- Not in halt stop state
- POT is not detected during a positive direction operation command or NOT is not detected during a negative direction operation command
- Torque limit has not triggered (when Obj.3724h:00h “Communication function extended setup 3” :bit 11 = 0)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
● bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value” 0: Includes torque limit and speed limit (cst only) 1: Does not include torque limit and speed limit (cst only)										

5.5.6.3.3 Operation in csv Control Mode

In cyclic velocity control mode, the motion profile (trajectory) is generated by the main device, not the sub device.

The target speed is the sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” .

Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).

Obj.60C2h: “Interpolation time period” indicates a cycle of updating two objects, Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” . This value is set to the same cycle as Obj.1C32h:02h “Cycle time” .

Obj.606Ch:00h “Velocity actual value” etc. is provided as monitoring information.

Precautions

- The sum of Obj.60FFh:00h “Target velocity” and Obj.60B1h:00h “Velocity offset” is limited by the smaller of Obj.6080h:00h “Max motor speed” and 2147483647. However, changes to the Obj.6080h:00h “Max motor speed” setting value are not reflected during operation.

5.5.7 Torque Control Function (tq, cst)

The following types of torque control mode are available.

- Profile torque control (tq)
- Cyclic torque control (cst)

This section describes the objects used in the torque control mode functions described above. For a system overview of torque control, see Technical Reference Functional Specification “4.5 Torque Control” .

5.5.7.1 Torque Control Common Functions

This section describes objects used in functions common to each torque control mode.

For control block diagrams, see below.

- Technical Reference Functional Specification “4.5 Torque Control”

The control block diagram is described using servo parameter numbers. For the relationship between servo parameter numbers and object numbers, see *“5.3 Servo Parameter Area (3000h to 3FFFh) Details”* .

5.5.7.1.1 Objects Commonly Related to Torque Control (Command/Setting-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	tq cst	No	A
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	tq cst	No	A
6071h	00h	Target torque	0.1%	-32768 to 32767	I16	rw	RxPDO	tq cst	Yes	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	tq cst	Yes	A
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	B (*1)
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	B
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	tq cst	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	tq cst	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	tq cst	Yes	A

*1 Supported only when Obj.3697h:00h “Function expansion setup 3” :bit 8 = 1 (extended specification) is set. The factory default value is bit 8=0 (standard specification), so change the setting before use.

There are other objects associated with each torque control mode. Also, Obj.6040h:00h “Controlword” has different functions in each torque control mode. For a description of the associated objects and Obj.6040h:00h “Controlword” functions for each torque control mode, see below.

- *“5.5.7.2 Profile Torque Control Mode (tq mode)”*
  1. *“5.5.7.2.1 Objects Related to tq Control Mode (Command/Setting-related)”*
  2. *“5.5.7.2.2 Objects Related to tq Control Mode (Monitoring-related)”*
- *“5.5.7.3 Cyclic Torque Control Mode (cst mode)”*
  1. *“5.5.7.3.1 Objects Related to cst Control Mode (Command/Setting-related)”*
  2. *“5.5.7.3.2 Objects Related to cst Control Mode (Monitoring-related)”*

5.5.7.1.1.1 Velocity-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3697h	00h	Function expansion setup 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
● bit 8: Target control mode extension of Obj.607Fh:00h “Max profile velocity” 0: Standard specifications (pp, hm, ip, pv) 1: Extended specifications (pp, hm, ip, pv, tq, cst)										

R1.1

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>607Fh</td><td>00h</td><td>Max profile velocity</td><td>Command unit/s</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">● Sets the velocity limit value.
● The maximum value is limited with Obj.6080h:00h “Max motor speed” by internal processing.
● When Obj.3697h:00h “Function expansion setup 3” :bit 8 is set to 0, the supported control modes are pp, hm, ip, and pv.
When Obj.3697h:00h “Function expansion setup 3” :bit 8 is set to 1, the supported control modes are pp, hm, ip, pv, tq, and cst.</td></tr>
<tr><td>6080h</td><td>00h</td><td>Max motor speed</td><td>r/min</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">● Sets the maximum motor speed.
● The maximum value is limited to the maximum velocity output by the motor using internal processing.</td></tr>
</table>

5.5.7.1.1.2 Torque-related

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4312h</td><td>00h</td><td>Velocity control loop torque limit</td><td>0.1%</td><td>0 to 65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>No</td><td>A</td></tr>
<tr><td colspan="11">● If Obj.60FEh:01h “Physical outputs” :bit 19 = 1 is set in the state of Obj.60FEh:02h “Bit mask” :bit 19 = 1, the torque command value generated from the velocity control loop will be limited by the setting value.</td></tr>
<tr><td>6071h</td><td>00h</td><td>Target torque</td><td>0.1%</td><td>-32768 to 32767</td><td>I16</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Set the target torque in profile torque control mode (tq) and cyclic torque control mode (cst).
For values greater than Obj.6072h:00h “Max torque” , the value is limited by Obj.6072h.</td></tr>
<tr><td>6072h</td><td>00h</td><td>Max torque</td><td>0.1%</td><td>0 to 65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Sets the maximum motor torque.
● The maximum value is limited to the maximum torque output by the motor using internal processing.
● The maximum motor torque may vary depending on the motor used.
● Disabled if ESM state is Init, enabled if ESM state is PreOP or higher.</td></tr>
<tr><td>6087h</td><td>00h</td><td>Torque slope</td><td>0.1%/s</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Sets the parameter value to give a gradient to the torque command.
● In cyclic torque control mode (cst), this is enabled only during deceleration to stop sequences.
● If set to 0, treated as 1 by internal processing.</td></tr>
<tr><td>60B2h</td><td>00h</td><td>Torque offset</td><td>0.1%</td><td>-32768 to 32767</td><td>I16</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Set the torque command offset value (torque feedforward).
● The torque feedforward value is 0 during deceleration in over-travel inhibition operations (during emergency stops).</td></tr>
<tr><td>60E0h</td><td>00h</td><td>Positive torque limit value</td><td>0.1%</td><td>0 to 65535</td><td>U16</td><td>rw</td><td>RxPDO</td><td>tq
cst</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Sets the positive direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set.
Limit the torque command by the minimum value among the following object limit values.
• Obj.3013h:00h “1st torque limit”
• Obj.3522h:00h “2nd torque limit”
• Obj.6072h:00h “Max torque”</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	tq cst	Yes	A
● Sets the negative direction torque limit when Obj.3521h:00h “Selection of torque limit” = 5 is set. Limit the torque command by the minimum value among the following object limit values. • Obj.3013h:00h “1st torque limit” • Obj.3522h:00h “2nd torque limit” • Obj.6072h:00h “Max torque”										

5.5.7.1.2 Objects Commonly Related to Torque Control (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F41h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6075h	00h	Motor rated current	mA	0 to 4294967295	U32	rw	No	ALL	No	X
6076h	00h	Motor rated torque	mN･m	0 to 4294967295	U32	ro	No	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6078h	00h	Current actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6079h	00h	DC link circuit voltage	mV	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

There are other objects associated with each torque control mode. Also, Obj.6041h:00h “Statusword” has different functions in each torque control mode. For a description of the associated objects and Obj.6041h:00h “Statusword” functions for each torque control mode, see below.

- *“5.5.7.2 Profile Torque Control Mode (tq mode)”*
  1. *“5.5.7.2.1 Objects Related to tq Control Mode (Command/Setting-related)”*
  2. *“5.5.7.2.2 Objects Related to tq Control Mode (Monitoring-related)”*
- *“5.5.7.3 Cyclic Torque Control Mode (cst mode)”*
  1. *“5.5.7.3.1 Objects Related to cst Control Mode (Command/Setting-related)”*
  2. *“5.5.7.3.2 Objects Related to cst Control Mode (Monitoring-related)”*

5.5.7.1.2.1 Position-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays position information for the external scale.									
4F41h	—	Motor encoder data	—	—	—	—	—	—	—	—
	● Displays position information.									
4F41h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	● Displays the number of sub-indexes in Obj.4F41h: “Motor encoder data” .									
4F41h	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the mechanical angle of the motor (single-turn encoder data).									
4F41h	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays multi-turn data of the absolute encoder.									
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the electrical angle of the motor.									
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the external scale pulse sum.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the absolute position of the external scale.									
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the upper 24 bits of the external scale data.									
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the lower 24 bits of the external scale data.									
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. Encoder units except for full-closed control, and external scale units during full-closed control.									
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual position of the motor. In full-closed control, it is the external scale position.									

5.5.7.1.2.2 Velocity-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the velocity control command.									
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual speed sensor value. Not supported by this product and always returns 0.									
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the actual speed (= FSPD) of the motor.									

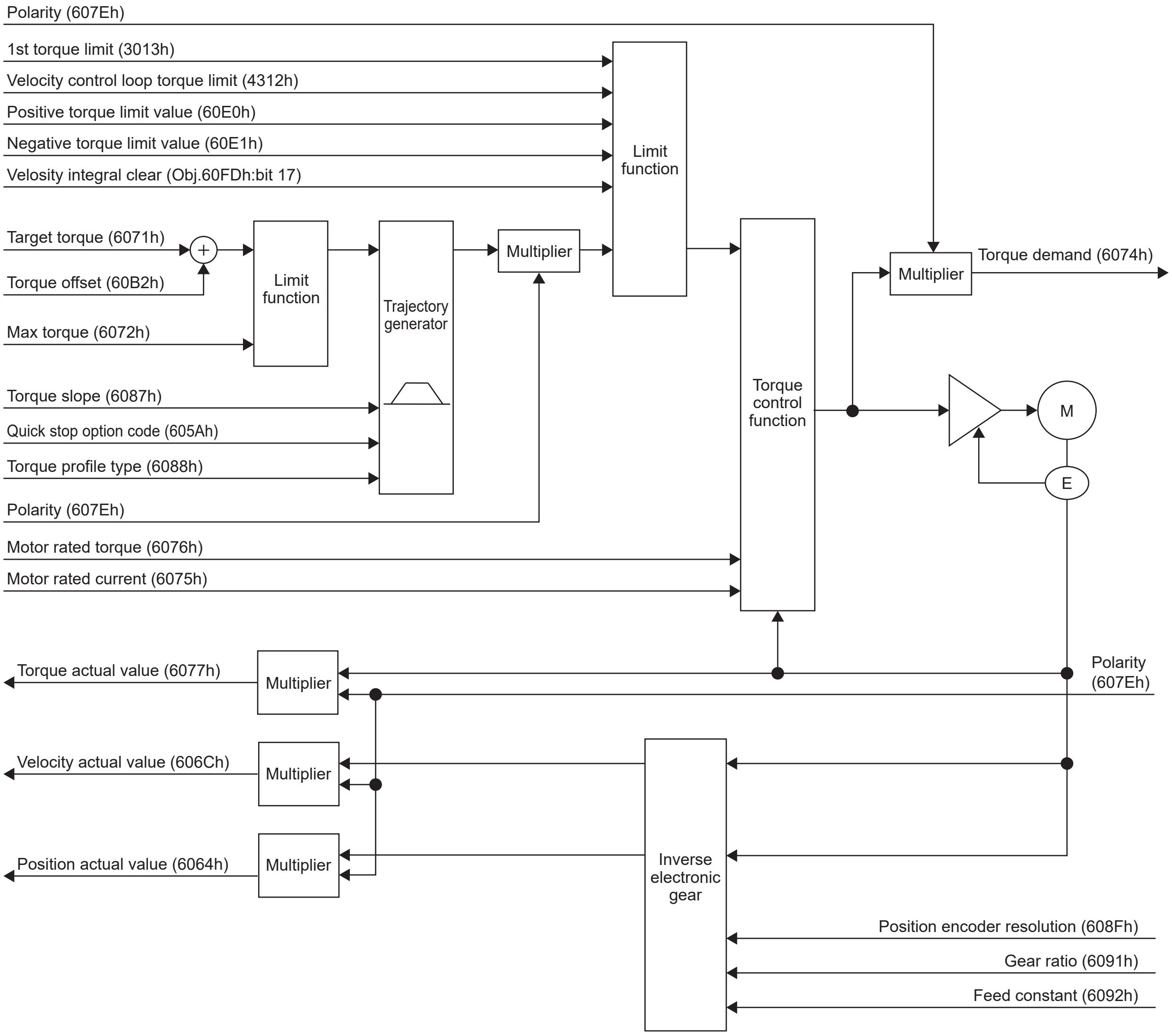
5.5.7.1.2.3 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D29h	00h	Over load factor	0.1%	0 to 65535	U16	ro	TxPDO	ALL	No	X
	● Displays the overload load factor (ratio of motor rated load).									
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the regenerative load factor (the ratio of regenerative overload protection to the level of alarm occurrence).									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the inertia ratio. Ratio of load inertia to motor rotor inertia (equivalent to the value in Obj.3004h) Inertia ratio = (Load inertia/Rotor inertia) × 100									
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the torque limit value in the positive direction.									
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the torque limit value in the negative direction.									
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
	● Indicates the internal command torque.									
6075h	00h	Motor rated current	mA	0 to 4294967295	U32	rw	No	ALL	No	X
	● The motor rated current is automatically set. ● The access setting is rw, but writing does not reflect the value.									
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	U32	ro	No	ALL	No	X
	● The motor rated torque is automatically set.									
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
	● Displays the actual torque. ● This output value is a reference value calculated from the actual current and does not guarantee the actual value.									
6078h	00h	Current actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
	● Displays the actual current value. ● This output value may not match the internal command torque.									
6079h	00h	DC link circuit voltage	mV	0 to 4294967295	U32	ro	TxPDO	ALL	No	X
	● Displays the voltage across PN of the main circuit power supply.									

5.5.7.2 Profile Torque Control Mode (tq mode)

Profile torque control mode (tq mode) is a torque control mode in which the host device specifies a target torque, acceleration/deceleration, etc., and this product generates position commands internally.



5.5.7.2.1 Objects Related to tq Control Mode (Command/Setting-related)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	–	0 to 65535	U16	rw	RxPDO	ALL	No	A
6088h	00h	Torque profile type	–	-32768 to 32767	I16	rw	RxPDO	tq	Yes	A

There are other related objects common to torque control. For details, see *"5.5.7.1 Torque Control Common Functions"* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6071h	00h	Target torque	0.1%	-32768 to 32767	I16	rw	RxPDO	tq cst	Yes	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	pp hm ip pv	Yes	B
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

There are other related objects commonly used for motion. For details, see *“5.5.8 Motion Common Functions”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6091h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.7.2.1.1 Controlword (6040h) (Functions in tq Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands for this product, such as PDS state transitions.
  For the following setting values, the operation mode specific bit is not used in tq control mode.

bit information details

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)						(2)	(3)	(4)	(2)			(5)	(6)	(7)	(8)
						(1)			(1)	(1)	(1)				

(1): reserved (not supported)

(2): operation mode specific (control mode dependent bit)

(3): halt

(4): fault reset

(5): enable operation

(6): quick stop

(7): enable voltage

(8): switch on

5.5.7.2.1.2 Torque-related

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
		● Sets the parameter value to give a gradient to the torque command. ● In cyclic torque control mode (cst), this is enabled only during deceleration to stop sequences. ● If set to 0, treated as 1 by internal processing.								
6088h	00h	Torque profile type	—	-32768 to 32767	I16	rw	RxPDO	tq	Yes	A
		● Sets the torque profile type used to perform torque changes. 0: Straight line slope 1: Not supported (sin2 slope)								

5.5.7.2.2 Objects Related to tq Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
6073h	00h	Max current	0.1%	0 to 65535	U16	rw	No	tq	No	X

There are other related objects common to torque control. For details, see *"5.5.7.1 Torque Control Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6075h	00h	Motor rated current	mA	0 to 4294967295	U32	rw	No	ALL	No	X
6076h	00h	Motor rated torque	mN･m	0 to 4294967295	U32	ro	No	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6078h	00h	Current actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6079h	00h	DC link circuit voltage	mV	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.7.2.2.1 Statusword (6041h) (Functions in tq Control Mode)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	–	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Displays the status of the product.

bit information details

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		(1)	(1)		(13)										

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): target reached

■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

–: N/A

bit	Name	Value	Definition
10	target reached	0	halt = 0 (normal): Obj.6074h:00h “Torque demand” has not reached target torque halt = 1 (when stopped by halt): Axis decelerating
		1	halt = 0 (normal): Obj.6074h:00h “Torque demand” has reached target torque halt = 1 (when stopped by halt): Axis stopped (axis speed is 0)
12	(reserved)	–	Not used
13	(reserved)	–	Not used

5.5.7.2.2.2 Torque-related

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6073h	00h	Max current	0.1%	0 to 65535	U16	rw	No	tq	No	X
		● Displays the maximum current. ● The access setting is rw, but writing does not reflect the value.								

5.5.7.2.3 Operation in tq Control Mode

Profile torque control mode generates torque command values according to the following parameters.

Obj.6071h:00h “Target torque”

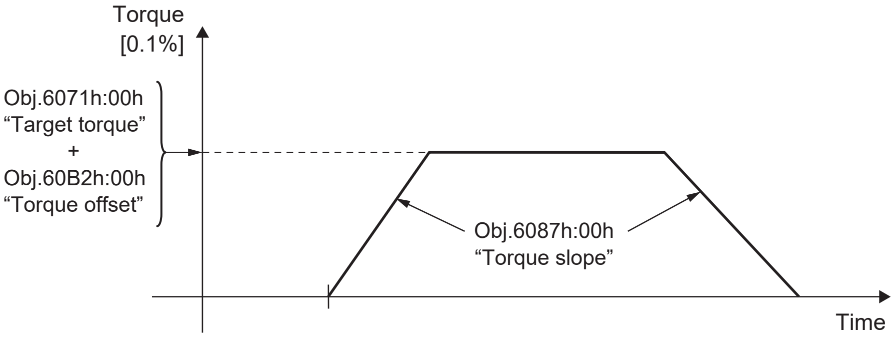
Obj.60B2h:00h “Torque offset”

Obj.6087h:00h “Torque slope”

The target torque is the sum of Obj.6071h:00h “Target torque” and Obj.60B2h:00h “Torque offset” .

Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).

Obj.6077h:00h “Torque actual value” etc. is provided as monitoring information.



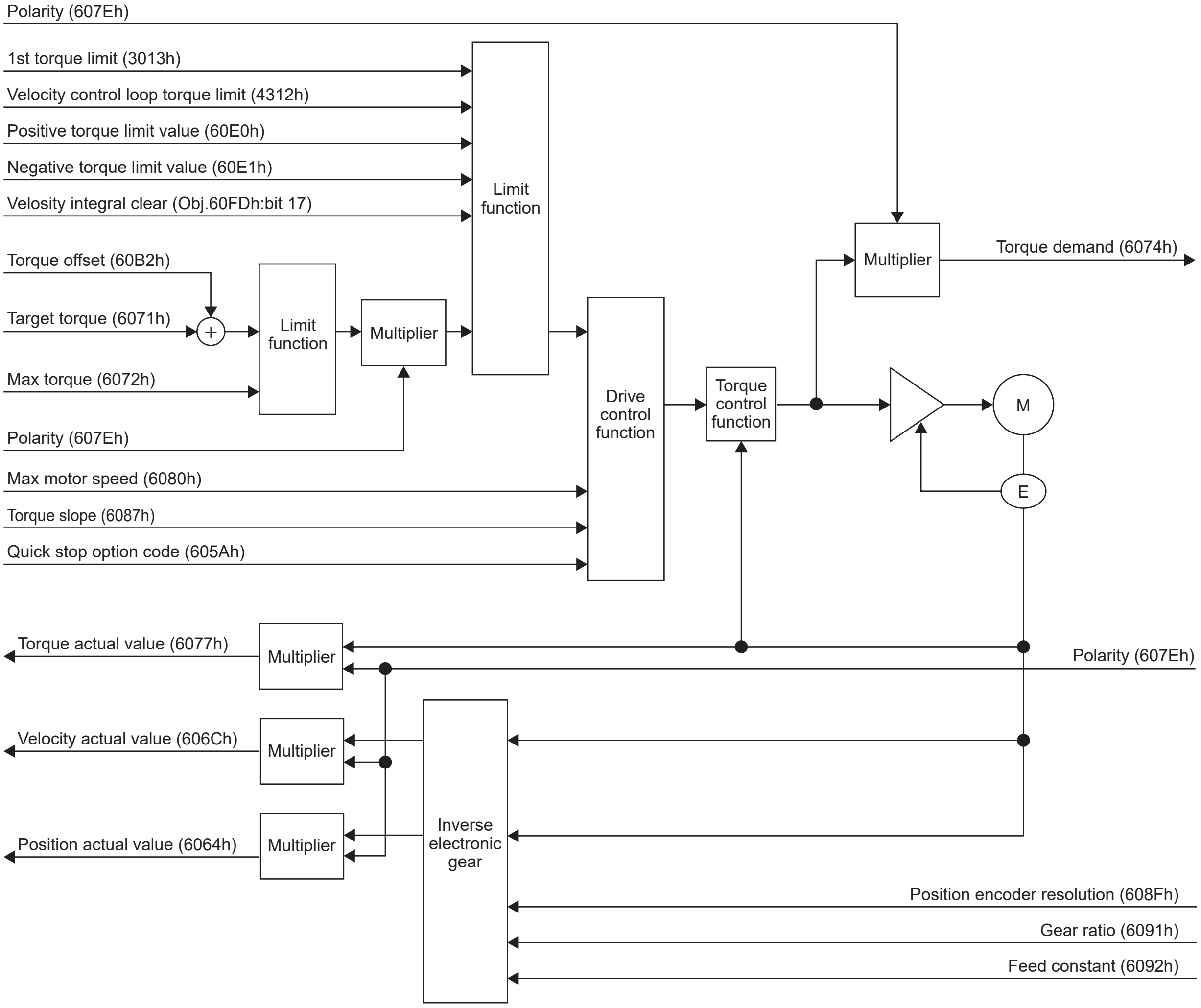
Precautions

- The sum of Obj.6071h:00h “Target torque” and Obj.60B2h:00h “Torque offset” is limited by the minimum value from among the following.
  - When Obj.3521h:00h “Selection of torque limit” = 5 is set:
    Obj.60E0h:00h “Positive torque limit value” , Obj.60E1h:00h “Negative torque limit value” , Obj.6072h:00h “Max torque”
  - When Obj.3521h:00h “Selection of torque limit” ≠ 5 is set:
    Obj.6072h:00h “Max torque” , Obj.3013h:00h “1st torque limit”
- Speed is limited by Obj.6080h:00h “Max motor speed” .
- Changes to these settings during operation are not reflected during that operation.

5.5.7.3 Cyclic Torque Control Mode (cst mode)

Cyclic torque control mode (cst mode) is a torque control mode in which the host device generates torque commands and updates (transmits) the command torque in a communication cycle.

Use in DC or SM2 synchronous mode.



5.5.7.3.1 Objects Related to cst Control Mode (Command/Setting-related)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	–	0 to 65535	U16	rw	RxPDO	ALL	No	A
3697h	00h	Function expansion setup 3	–	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
3724h	00h	Communication function extended setup 3	–	-32768 to 32767	I16	rw	No	ALL	Yes	C

There are other related objects common to torque control. For details, see *“5.5.7.1 Torque Control Common Functions”* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6071h	00h	Target torque	0.1%	-32768 to 32767	I16	rw	RxPDO	tq cst	Yes	A
6072h	00h	Max torque	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6080h	00h	Max motor speed	r/min	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	B
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
60B2h	00h	Torque offset	0.1%	-32768 to 32767	I16	rw	RxPDO	ALL	Yes	A
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	U16	rw	RxPDO	ALL	Yes	A

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A
607Bh	—	Position range limit	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H
608Fh	—	Position encoder resolution	—	—	—	—	—	ALL	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
6091h	—	Gear ratio	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6091h	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
6092h	—	Feed constant	—	—	—	—	—	ALL	—	
	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P H
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P H
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	Yes	B
60C2h	—	Interpolation time period	—	—	—	—	—	ip csp csv cst	—	—
	00h	Highest sub-index supported	—	2	U8	ro	No	ip csp csv cst	No	X
	01h	Interpolation time period value	—	0 to 255	U8	rw	No	ip csp csv cst	Yes	A
	02h	Interpolation time index	—	-128 to 63	I8	rw	No	ip csp csv cst	Yes	A
60FEh	—	Digital outputs	—	—	—	—	—	ALL	—	—
	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	01h	Physical outputs	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A
	02h	Bit mask	—	0 to 4294967295	U32	rw	RxPDO	ALL	Yes	A

5.5.7.3.1.1 Controlword (6040h) (Functions in cst Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6040h	00h	Controlword	—	0 to 65535	U16	rw	RxPDO	ALL	No	A

- Sets control commands to the product, such as PDS state transitions.
  For the following setting values, the operation mode specific bit is not used cst control mode.

bit information details

<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="6" rowspan="2">(1)</td><td>(2)</td><td rowspan="2">(3)</td><td rowspan="2">(4)</td><td colspan="3">(2)</td><td rowspan="2">(5)</td><td rowspan="2">(6)</td><td rowspan="2">(7)</td><td rowspan="2">(8)</td></tr>
<tr><td>(1)</td><td>(1)</td><td>(1)</td><td>(1)</td></tr>
</table>

(1): reserved (not supported)
(2): operation mode specific (control mode dependent bit)
(3): halt
(4): fault reset
(5): enable operation
(6): quick stop
(7): enable voltage
(8): switch on

5.5.7.3.1.2 Other

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3697h	00h	Function expansion setup 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B

- bit 12: Speed limit priority function during torque control
  0: Torque command priority
  1: Velocity limit priority

bit 12 = 1 (Speed limit priority) is only enabled for cyclic torque control mode (cst).

With velocity limit priority, if Obj.606Ch:00h “Velocity actual value” exceeds the velocity limit value (Obj.607Fh:00h “Max profile velocity” or Obj.6080h:00h “Max motor speed”), the torque limit is disabled by Obj.60E0h:00h “Positive torque limit value” or Obj.60E1h:00h “Negative torque limit value” and the required torque is generated and controlled such that the velocity does not exceed the limit value. However, the maximum motor torque will be Obj.6072h:00h “Max torque” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C

- bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value”
  0: Includes torque limit and speed limit (cst only)
  1: Does not include torque limit and speed limit (cst only)

5.5.7.3.2 Objects Related to cst Control Mode (Monitoring-related)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

There are other related objects common to torque control. For details, see *"5.5.7.1 Torque Control Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6069h	00h	Velocity sensor actual value	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6074h	00h	Torque demand	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6075h	00h	Motor rated current	mA	0 to 4294967295	U32	rw	No	ALL	No	X
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	U32	ro	No	ALL	No	X
6077h	00h	Torque actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6078h	00h	Current actual value	0.1%	-32768 to 32767	I16	ro	TxPDO	ALL	No	X
6079h	00h	DC link circuit voltage	mV	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

There are other related objects commonly used for motion. For details, see *"5.5.8 Motion Common Functions"* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FDh	00h	Digital inputs	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

5.5.7.3.2.1 Statusword (6041h) (Functions in cst Control Mode)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6041h	00h	Statusword	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

- Sets control commands to the product, such as PDS state transitions.
  For the following setting values, the operation mode specific bit is not used cst control mode.

bit information details

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
(1)		(2)		(3)	(2)	(4)	(1)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		(1)	(13)		(1)										

(1): reserved (not supported)
(2):operation mode specific (control mode dependent bit)
(3): internal limit active
(4): remote
(5): warning
(6): switch on disabled
(7): quick stop
(8): voltage enabled
(9): fault
(10): operation enabled
(11): switched on
(12): ready to switch on
(13): drive follows command value

■ Bit 13, 12, 10 (operation mode specific (control mode dependent bit)):

—: N/A

bit	Name	Value	Definition
10	reserved	—	Not used
12	drive follows command value	0	Operation is not executed according to the target torque (*1)
		1	Operation performed according to target torque (*1)
13	reserved	—	Not used

*1 An "operation has been executed according to the target torque" means that all of the following conditions have been met.

If the condition is not met, the operation is not executed according to the target torque.

- PDS status is Operation enabled
- Not in a deceleration process (Halt, POT, NOT, Quickstop, Shutdown, Disable operation, Fault)
- Not in halt stop state
- POT is not detected during a positive direction operation command or NOT is not detected during a negative direction operation command
- Torque limit has not been triggered (when 3724h:bit 11 = 0)
- Velocity limit has not been triggered (when 3724h:bit 11 = 0)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	—	-32768 to 32767	I16	rw	No	ALL	Yes	C
● bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value” 0: Includes torque limit and speed limit (cst only) 1: Does not include torque limit and speed limit (cst only)										

5.5.7.3.3 Operation in cst Control Mode

In cyclic torque control mode, the motion profile (trajectory) is generated by the main device, not the sub device.

The target torque is the sum of Obj.6071h:00h “Target torque” and Obj.60B2h:00h “Torque offset” .

Input the operation command update (transmission) after approximately 100 ms have elapsed since servo-on command (operation enabled command).

Obj.60C2h: “Interpolation time period” indicates a cycle of updating two objects, Obj.6071h:00h “Target torque” and Obj.60B2h:00h “Torque offset” . This value is set to the same cycle as Obj.1C32h: “Sync manager 2 synchronization” : Obj.1C32h:02h “Cycle time” .

Obj.6077h:00h “Torque actual value” etc. is provided as monitoring information.

Precautions

- The sum of Obj.6071h:00h “Target torque” and Obj.60B2h:00h “Torque offset” is limited by the minimum value from among the following.
  - When Obj.3521h:00h “Selection of torque limit” = 5 is set:
    Obj.60E0h:00h “Positive torque limit value” , Obj.60E1h:00h “Negative torque limit value” , Obj.6072h:00h “Max torque”
  - When Obj.3521h:00h “Selection of torque limit” ≠ 5 is set:
    Obj.6072h:00h “Max torque” , Obj.3013h:00h “1st torque limit”
- Speed is limited by Obj.6080h:00h “Max motor speed” .

5.5.8 Motion Common Functions

5.5.8.1 Touch Probe Function (Position Latch Request, Release)

This function latches the feedback position by selecting a latch trigger signal from the external inputs (EXT1 and EXT2) or the Z-phase.

The Z-phase in semi-closed control can be selected from the position where the rotary encoder's single-turn data is 0 or the Z-phase position of the external incremental scale.

The Z-phase in full-closed control is the Z-phase position of the external incremental scale.

Z-phase of external incremental scale can be selected even in semi-closed control. For details, see *"5.5.8.1.9 External Scale Z-phase Latch Function for Semi-closed Control"* .

Rising and falling edges can be set simultaneously for the same TouchProbe. The input ON and OFF widths of the latch trigger signal should be at least 2 ms each.

When Obj.3722h:00h "Communication function extended setup 1" :bit 4 = 1 and Obj.3697h:00h "Function expansion setup 3" :bit 11 = 1, the encoder and external scale feedback positions can be latched simultaneously.

By setting Obj.3697h:00h "Function expansion setup 3" :bit 13 = 1, Obj.60B9h:00h "Touch probe status" :bits 1, 2, 9, and 10 are reversed and output.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3697h	00h	Function expansion setup 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B

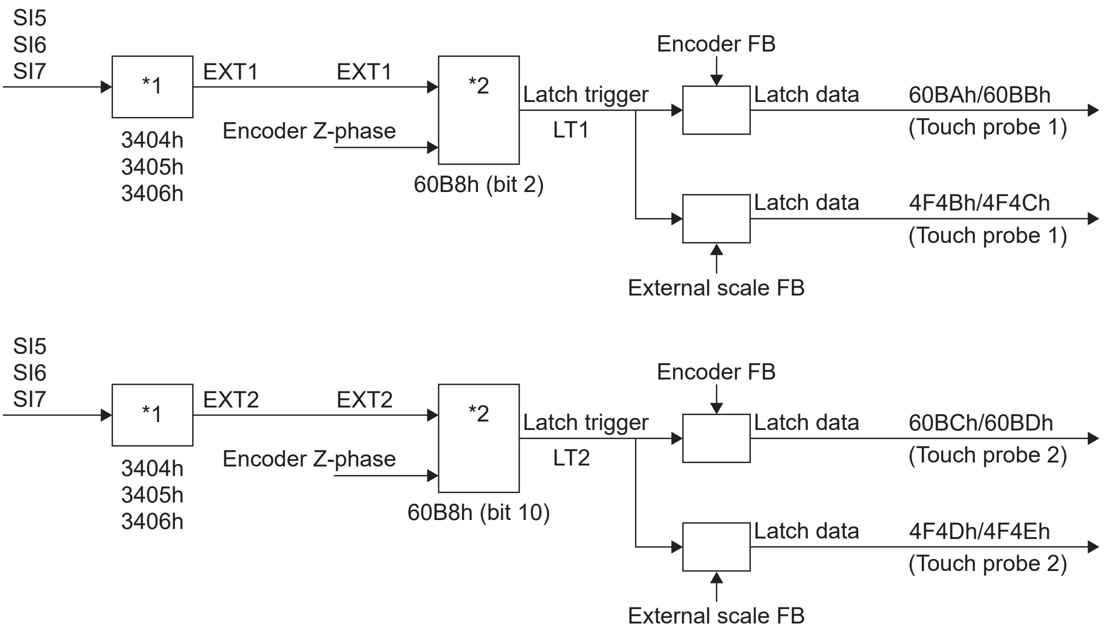
- bit 11: External scale position latch during semi-closed control
  0: Disabled
  1: Enabled
- bit 13: Touch probe latch completion status toggle output enabled
  0: Disabled
  1: Enabled

Precautions

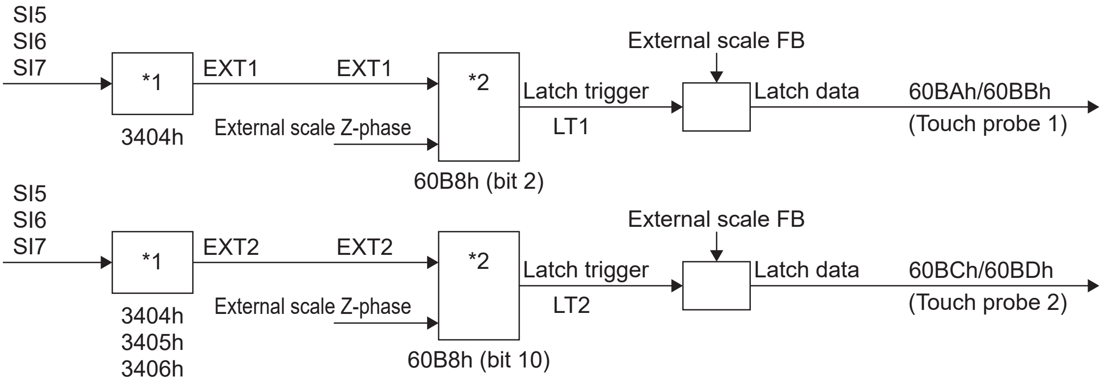
- When using an external input (EXT1 or EXT2) for the latch trigger signal, assign EXT1 or EXT2 to one of SI5, SI6, or SI7. Touch probing without assignment will result in Err88.3.0 "Improper operation error protection" .
- If the latch trigger signal is an external input (EXT1, EXT2), an acquisition error occurs. The speed near the latch trigger signal input should be as low as possible.
- When in full-closed control and the trigger selection is set to be Z-phase when using the absolute scale, Err88.3.0 "Improper operation error protection" will be triggered.
- When Z-phase is selected for trigger selection, do not select the falling edge. Operation cannot be guaranteed with the above settings.
- The touch probe function is disabled (canceled) in the following cases.
  (The value of Obj.60B9h:00h "Touch probe status" is cleared to 0)
  1 When ESM state is Init
  2 When switched to hm mode
- Do not perform multi-turn data clear, trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING, or Config execution from Set-up Support Software (PANATERM ver.7) while TouchProbe is running. Operation is not guaranteed when the above is implemented.

5.5.8.1.1 Touch Probe Function Configuration

- When using semi-closed control



- When using full-closed control



*1 The table below shows the objects corresponding to the latch correction terminals and the external inputs that can be assigned.

Latch correction terminal and corresponding object	Setup value	Assignment
SI5: Obj.3404h:00h “SI5 input selection” SI6: Obj.3405h:00h “SI6 input selection” SI7: Obj.3406h:00h “SI7 input selection”	00202020h	Select EXT1 a-contact
	00A0A0A0h	Select EXT1 b-contact
	00212121h	Select EXT2 a-contact
	00A1A1A1h	Select EXT2 b-contact

*2 Obj.60B8h:00h “Touch probe function” :bit 10 and bit 2 are used to select the latch trigger signal.

- bit 10
  - 0: LT2 = EXT2
  - 1: LT2 = Z-phase
- bit 2
  - 0: LT1 = EXT1
  - 1: LT1 = Z-phase

* Obj.60B8h:00h “Touch probe function”

Obj.60BAh:00h “Touch probe 1 positive edge”

Obj.60BBh:00h “Touch probe 1 negative edge”

Obj.60BCh:00h “Touch probe 2 positive edge”

Obj.60BDh:00h “Touch probe 2 negative edge”

Obj.4F4Bh:00h “Touch probe external scale 1 positive edge”

Obj.4F4Ch:00h “Touch probe external scale 1 negative edge”

Obj.4F4Dh:00h “Touch probe external scale 2 positive edge”

Obj.4F4Eh:00h “Touch probe external scale 2 negative edge”

- For a configuration that uses the external scale Z-phase as the latch trigger during semi-closed control, see *“5.5.8.1.9 External Scale Z-phase Latch Function for Semi-closed Control”* .

The table below shows what is latched by the touch probe in each mode.

—: No applicable conditions

Control mode	External scale position information Monitor function	Function expansion setup 3 (External scale position latch)	Latch target object	
			Obj.60BAh, Obj.60BBh, Obj.60BCh, Obj.60BDh	Obj.4F4Bh, Obj.4F4Ch, Obj.4F4Dh, Obj.4F4Eh
When using semi-closed control	Enable (Obj.3722h:00h “Communication function extended setup 1” :bit 4 = 1)	Enable (Obj.3697h:00h “Function expansion setup 3” :bit 11 = 1)	Encoder FB	External scale FB
		Disable (Obj.3697h:00h “Function expansion setup 3” :bit 11 = 0)		—
	Disable (Obj.3722h:00h “Communication function extended setup 1” :bit 4 = 0)	—		
When using full-closed control	—	—	External scale FB	

5.5.8.1.2 Touch Probe Related Objects

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4304h	00h	Touch probe function expansion setup	—	0 to 65535	U16	rw	RxPDO	ALL	Yes	B
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F48h	00h	External scale pulse total	—	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F4Bh	00h	Touch probe external scale 1 positive edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F4Ch	00h	Touch probe external scale 1 negative edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F4Dh	00h	Touch probe external scale 2 positive edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F4Eh	00h	Touch probe external scale 2 negative edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
3697h	00h	Function expansion set-up 3	—	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
3709h	00h	Correction time of latch delay 1	25 ns	-2000 to 2000	I16	rw	No	ALL	Yes	B
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	I16	rw	No	ALL	Yes	R
3792h	00h	Correction time of latch delay 2	25 ns	-2000 to 2000	I16	rw	No	ALL	Yes	B
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

5.5.8.1.3 Touch probe function (60B8h)

Basic object used to start touch probe operation and various settings.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B8h	00h	Touch probe function	—	0 to 65535	U16	rw	RxPDO	ALL	No	A
	● Configure settings for the Touch probe function.									

Supported bit description

—: N/A

bit	value	Note	
0	0	Switch off touch probe 1	Touch Probe 1 Execute, stop
	1	Enable touch probe 1	
1	0	Trigger first event	Touch Probe 1 Event mode selection
	1	Continuous	
2	0	Trigger with touch probe 1 input	Touch Probe 1 Trigger select (External input, Z-phase)
	1	Trigger with zero impulse signal of position encoder	
3	—	Reserved	Not used
4	0	Switch off sampling at positive edge of touch probe 1	Touch Probe 1 (*1) (*3) Rising edge select
	1	Enable sampling at positive edge of touch probe 1	
5	0	Switch off sampling at negative edge of touch probe 1	Touch Probe 1 (*1) (*2) (*3) Falling edge select
	1	Enable sampling at negative edge of touch probe 1	
7 to 6	—	Not Supported	Not used

bit	value	Note	
8	0	Switch off touch probe 2	Touch Probe 2 Execute, stop
	1	Enable touch probe 2	
9	0	Trigger first event	Touch Probe 2 Event mode selection (Single, continuous)
	1	Continuous	
10	0	Trigger with touch probe 2 input	Touch Probe 2 Trigger select (External input, Z-phase)
	1	Trigger with zero impulse signal of position encoder	
11	—	Reserved	Not used
12	0	Switch off sampling at positive edge of touch probe 2	Touch Probe 2 (*1) (*3) Rising edge select
	1	Enable sampling at positive edge of touch probe 2	
13	0	Switch off sampling at negative edge of touch probe 2	Touch Probe 2 (*1) (*2) (*3) Falling edge select
	1	Enable sampling at negative edge of touch probe 2	
14	—	Not Supported	Not used
15	0	Switch off external scale position monitor value 0 clear	External scale monitor value 0 clear enable, disable (*4) (*5)
	1	Enable external scale position monitor value 0 clear	

*1 Only when external input is selected for trigger selection, rising and falling edges can be set simultaneously in the same TouchProbe.

In that case, both edges are used as trigger signals.

*2 When Z-phase is selected for trigger selection, do not select the falling edge.

Operation cannot be guaranteed with the above settings.

*3 The rising edge indicates when the logic state of the target signal changes from OFF (inactive) to ON (active), and the falling edge indicates when the logic state of the target signal changes from ON to OFF.

*4 When external scale monitor value 0 clear is enabled, monitor values Obj.4F0Dh:00h “External scale position” and Obj.4F48h:00h “External scale pulse total” are always set to 0.

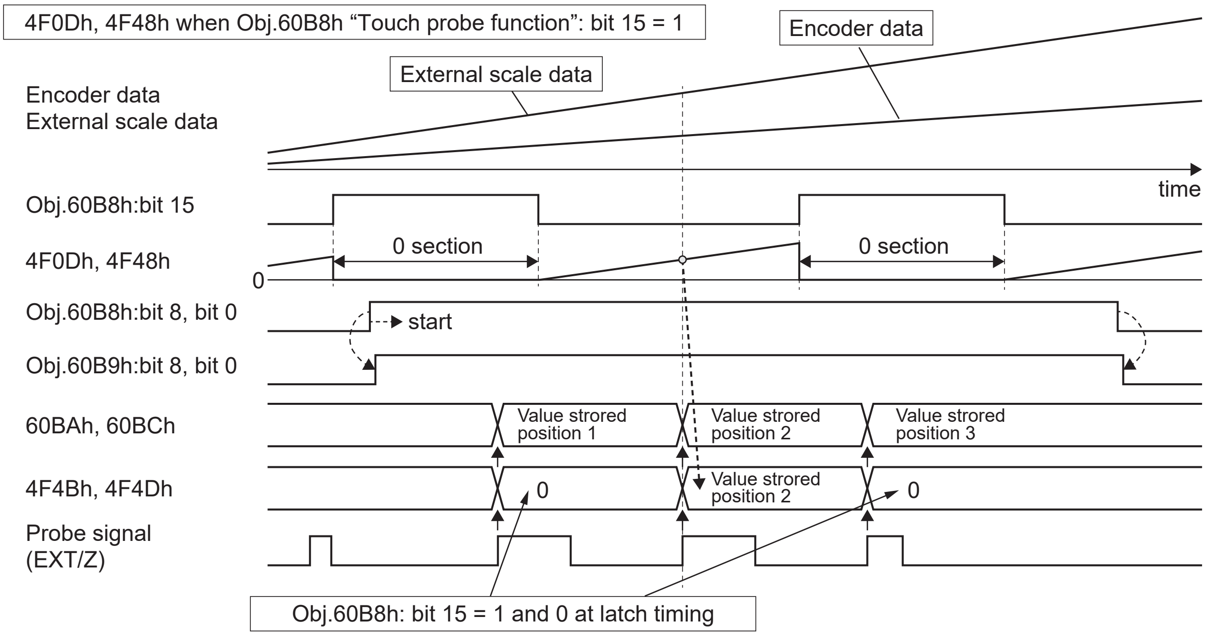
If latched at this time, Obj.4F4Bh to Obj.4F4Eh will be 0.

The amount of scale position change from the timing when 0 clear is set to disabled is added to the above monitor value.

After power reset, the values of Obj.4F0Dh:00h “External scale position” and Obj.4F48h:00h “External scale pulse total” are set to the external scale pulse sum read from the external scale.

*5 This function (external scale monitor value 0 clear enable/disable) is not a function specified in the ETG standard.

During semi-closed control, it is possible to simultaneously latch encoder feedback (Obj.60BAh:00h “Touch probe 1 positive edge” , Obj.60BBh:00h “Touch probe 1 negative edge” , Obj.60BCh:00h “Touch probe 2 positive edge” , Obj.60BDh:00h “Touch probe 2 negative edge”) and external scale feedback (Obj.4F4Bh:00h “Touch probe external scale 1 positive edge” , Obj.4F4Ch:00h “Touch probe external scale 1 negative edge” , Obj.4F4Dh:00h “Touch probe external scale 2 positive edge” , Obj.4F4Eh:00h “Touch probe external scale 2 negative edge”) with probe signal (EXT, Z).



5.5.8.1.4 Touch probe status (60B9h)

Displays the status of the touch probe operation.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60B9h	00h	Touch probe status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
		● Displays the status of the touch probe function.								

Supported bit description

—: N/A

bit	value	Note	
0	0	Touch probe 1 is switch off	Touch probe 1 operation stop
	1	Touch probe 1 is enabled	Touch probe 1 in operation
1	0	Touch probe 1 no positive edge value stored	Rising edge touch probe 1 Not complete state
	1	Touch probe 1 positive edge value stored	Rising edge touch probe 1 completed state
2	0	Touch probe 1 no negative edge value stored	Falling edge touch probe 1 Not complete state
	1	Touch probe 1 negative edge value stored	Falling edge touch probe 1 complete state
5 to 3	—	Reserved	Not used
7 to 6	—	Not Supported	Not used
8	0	Touch probe 2 is switch off	Touch probe 2 operation stop
	1	Touch probe 2 is enabled	Touch probe 2 in operation
9	0	Touch probe 2 no positive edge value stored	Rising edge touch probe 2 Not complete state
	1	Touch probe 2 positive edge value stored	Rising edge touch probe 2 completed state
10	0	Touch probe 2 no negative edge value stored	Falling edge touch probe 2 Not complete state
	1	Touch probe 2 negative edge value stored	Falling edge touch probe 2 complete state

bit	value	Note	
13 to 11	—	Reserved	Not used
15 to 14	—	Not Supported	Not used

* By setting Obj.3697h:00h "Function expansion setup 3" :bit 13 = 1, Obj.60B9h:00h "Touch probe status" :bits 1, 2, 9, and 10 are reversed and output (toggled output).

5.5.8.1.5 Touch Probe Position

Touch probe position displays the captured latch position.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The rising edge of touch probe 1 displays the latched position.									
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The falling edge of touch probe 1 displays the latched position.									
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The rising edge of touch probe 2 displays the latched position.									
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The falling edge of touch probe 2 displays the latched position.									

Touch probe external scale position displays the captured external scale latch position.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F4Bh	00h	Touch probe external scale 1 positive edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The rising edge of touch probe 1 displays the latched external scale feedback position. Updates when the external scale latch condition is met during semi-closed control. The value does not change after homing.									
4F4Ch	00h	Touch probe external scale 1 negative edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The falling edge of touch probe 1 displays the latched external scale feedback position. Updates when the external scale latch condition is met during semi-closed control. The value does not change after homing.									
4F4Dh	00h	Touch probe external scale 2 positive edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● The rising edge of touch probe 2 displays the latched external scale feedback position. Updates when the external scale latch condition is met during semi-closed control. The value does not change after homing.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F4Eh	00h	Touch probe external scale 2 negative edge	Pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
● The falling edge of touch probe 2 displays the latched external scale feedback position. Updates when the external scale latch condition is met during semi-closed control. The value does not change after homing.										

5.5.8.1.6 Activation of Touch Probe Operation

When Obj.60B8h:00h “Touch probe function” :bit 8, bit 0 “Touch probe execute, stop” changes from 0 (stop) to 1 (start), the various setting conditions (Obj.60B8h:bits 15 to 9, bits 7 to 1) are taken in, touch probe operation is started. To enable changes to various setting conditions, set bit 8 and bit 0 back to 0 (stop) and then set bit 8 and bit 0 to 1 (start) again.

5.5.8.1.7 Touch Probe Event Mode

With Obj.60B8h:00h “Touch probe function” :bit 9, bit 1 “Event mode selection”, 0 “Trigger first event mode”, -1 “Continuous mode” can be selected.

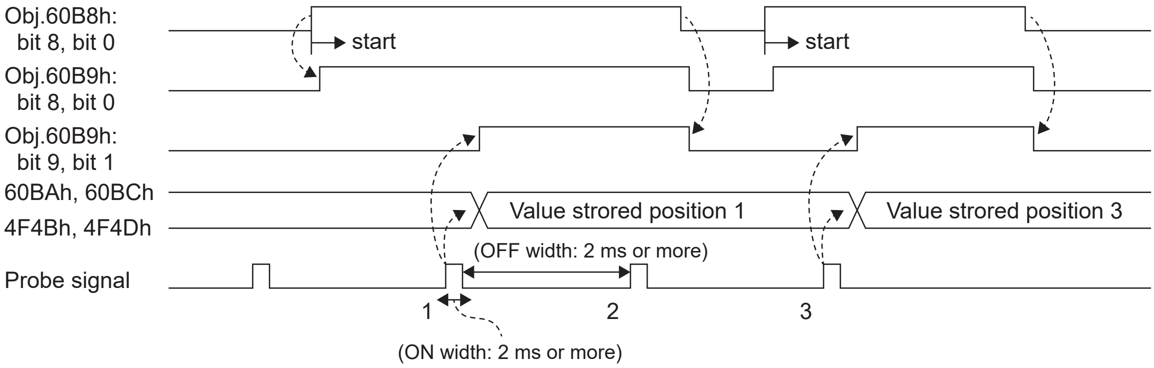
■ Trigger first event mode

(Obj.60B8h:00h “Touch probe function” :bit 9 = 0, bit 1 = 0)

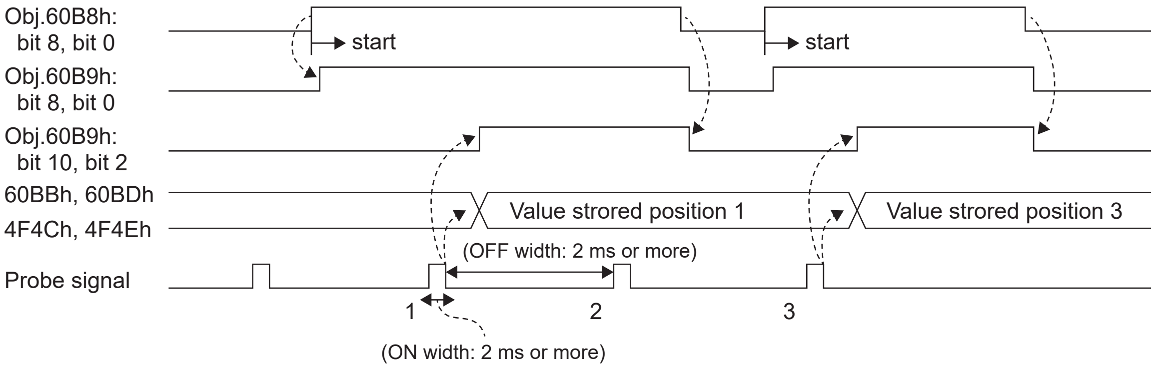
This mode latches only at the first trigger signal after startup.

When both rising and falling edges are set to enable, latch is performed once each at the rising and falling edges of the trigger signal. Any order of edges is acceptable. To capture it again, the touch probe must be restarted.

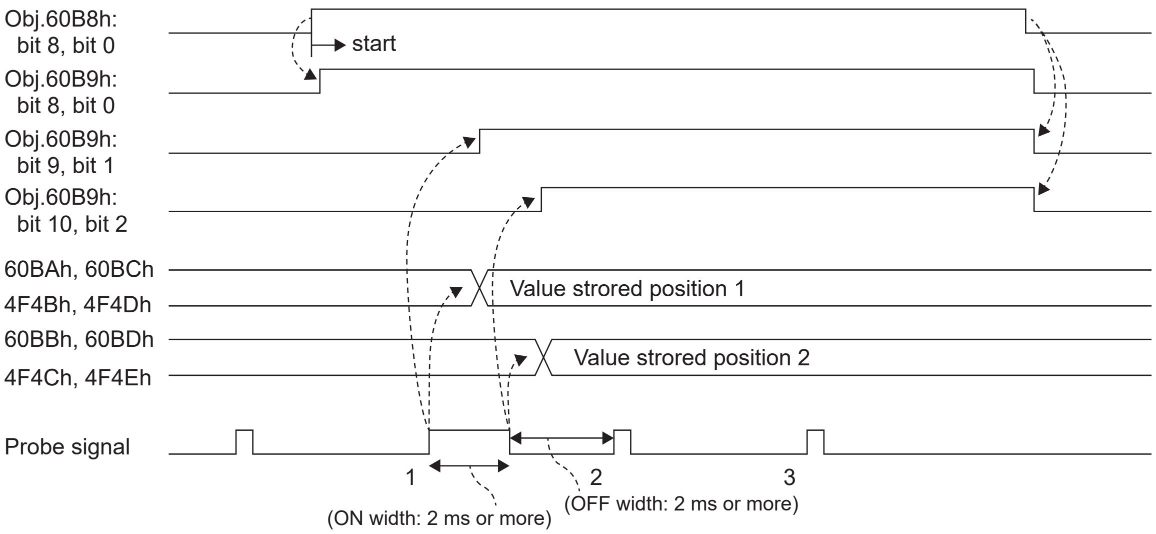
● Positive edge



● Negative edge



- **Positive edge and Negative edge**



■ Continuous mode

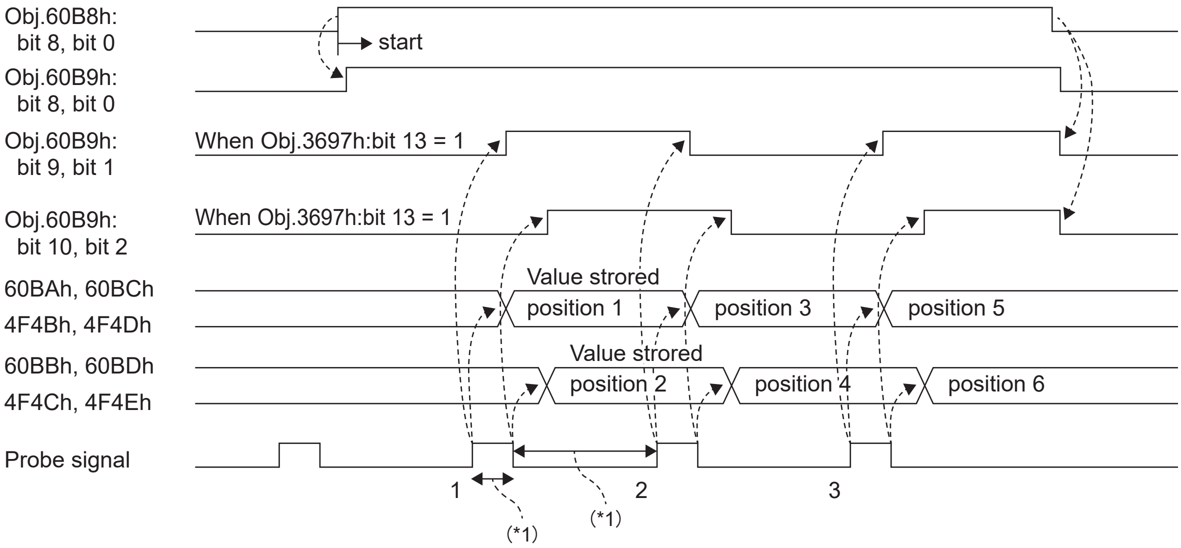
(Obj.60B8h:00h “Touch probe function” :bit 9 = 1, bit 1 = 1)

This mode latches every time a trigger signal is detected after startup.

The captured value is retained until the next probe signal.

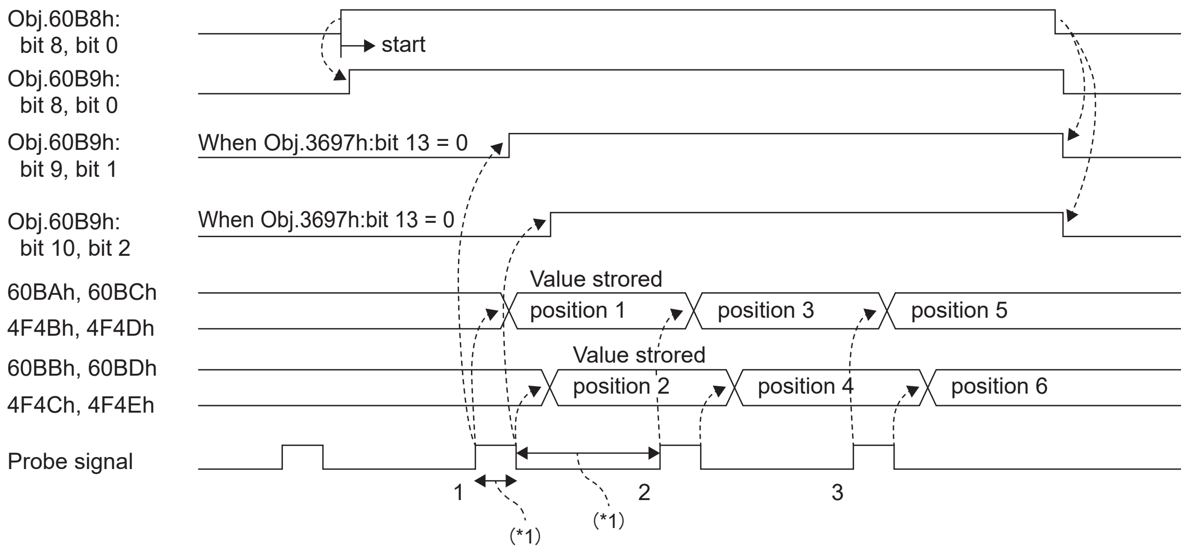
Setting Obj.3697h:00h “Function expansion setup 3” :bit 13 = 1 reverses bits 1, 2, 9, and 10 of Obj.60B9h:00h “Touch probe status” and outputs them (toggle output) each time they are latched.

- **Positive edge, Negative edge Obj.3697h:bit 13 = 1**



*1 The ON and OFF widths should be at least 2 ms each.

- **Positive edge, Negative edge Obj.3697h:bit 13 = 0**



*1 The ON and OFF widths should be at least 2 ms each.

5.5.8.1.8 Latch Position Detection Delay Compensation Function

The latch position detection delay compensation function allows setting of a compensation time for the delay in latch trigger signal detection.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3709h	00h	Correction time of latch delay 1	25 ns	-2000 to 2000	I16	ro	TxPDO	ALL	Yes	B
		● Sets the compensation time for the delay in latch trigger signal detection. This object allows switching of compensation of the latch position detection delay amount at Obj.3724h:00h “Communication function extended setup 3” :bit 5. bit 5 = 0: Reflected in the detection delay amount for both rising edge detection and falling edge detection. bit 5 = 1: Reflected in the detection delay amount for rising edge detection. **Notes** ● Edge detection signal states refer to the following. Rising edge: Isolator OFF to ON Falling edge: Isolator ON to OFF								
3724h	00h	Communication function extended setup 3	Command unit	-32768 to 32767	I16	ro	TxPDO	ALL	Yes	C
		● bit 5: Latch position detection delay compensation function switching 0: Sets the compensation time for the amount of delay of the rising and falling edge to be shared with Obj.3709h:00h “Correction time of latch delay 1” 1: Sets rising and falling edge delay compensation times separately with Obj.3709h:00h “Correction time of latch delay 1” and Obj.3792h:00h “Correction time of latch delay 2”								

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3792h	00h	Correction time of latch delay 2	25 ns	-2000 to 2000	I16	ro	TxPDO	ALL	Yes	B

- Sets the compensation time for the delay in latch trigger signal detection.

  This object allows switching of compensation of the latch position detection delay amount at Obj.3724h:00h “Communication function extended setup 3” : bit 5.

  bit 5 = 0: Disabled

  bit 5 = 1: Reflected in the detection delay amount for falling edge detection.

  Notes

  - Edge detection signal states refer to the following.

    Rising edge: Isolator OFF to ON

    Falling edge: Isolator ON to OFF

Precautions

- The amount of delay for the latch trigger signal detection may vary depending on the operating environment or aging deterioration. Set the delay correction time as necessary if latch precision is required.

5.5.8.1.9 External Scale Z-phase Latch Function for Semi-closed Control

During semi-closed control, the external scale position latched by the Z-phase of the external incremental scale can be acquired.

To enable this function, the external scale position information monitor function must be enabled (Obj.3722h:00h “Communication function extended setup 1” :bit 4 = 1) and the external scale position latch must be enabled (Obj.3697h:00h “Function expansion setup 3” :bit 11 = 1).

To use this function when the external scale is A/B-phase output type, make the following settings. If a touch probe operation is activated with a different setting, Err91.3.☐ “Command error protection2” will be triggered.

- Set Obj.4304h:00h “Touch probe function expansion setup” :bit 8 and bit 0 to the same value.
- If Obj.4304h:00h “Touch probe function expansion setup” :bit 8 and bit 0 are set to 1, Obj.60B8h:00h “Touch probe function” :bit 10 and bit 2 are set to 1.

If either Obj.4304h:00h “Touch probe function expansion setup” :bit 8 or bit 0 or both are set to 1 and homing is started, Err91.3.☐ will be triggered.

When the external scale feedback position is stored in the following objects with Obj.4304h:00h “Touch probe function expansion setup” :bit 9 and bit 1, the unit of each object is pulse (external scale).

- Obj.60BAh:00h “Touch probe 1 positive edge” and Obj.60BBh:00h “Touch probe 1 negative edge”
- Obj.60BCh:00h “Touch probe 2 positive edge” and Obj.60BDh:00h “Touch probe 2 negative edge”

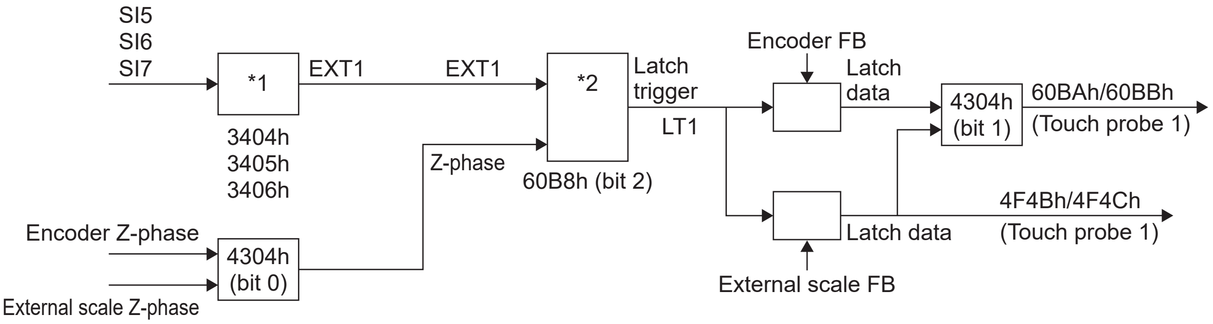
Touch probe function expansion setup object

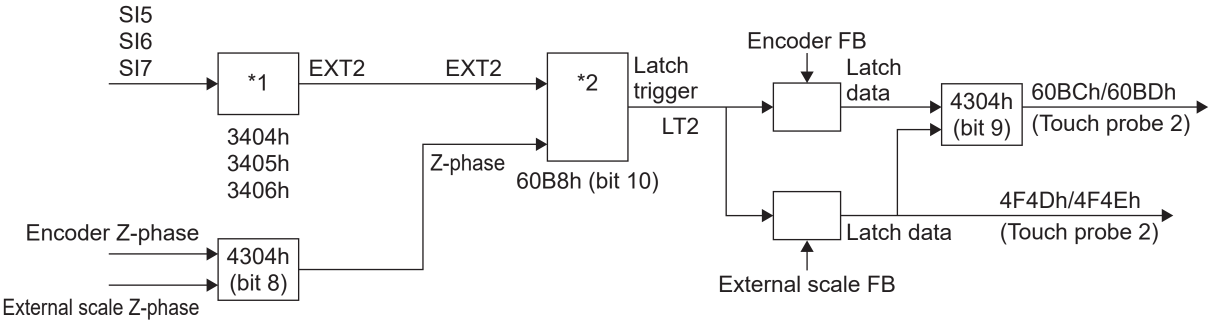
—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4304h	00h	Touch probe function expansion setup	—	0 to 65535	U16	rw	RxPDO	ALL	Yes	B

bit	Value	Note	
0	0	Encoder Z-phase	Touch probe 1 External scale position latch Z-phase switching in semi-closed control **Precautions** ● bit 0 is enabled only when using semi-closed control.
	1	External scale Z-phase	
1	0	Encoder FB	Touch probe 1 Change storage location of external scale feedback position in semi-closed control **Precautions** ● bit 1 is enabled only when using semi-closed control.
	1	External scale FB	
2 to 7	Fixed to 0	Manufacturer use	
8	0	Encoder Z-phase	Touch probe 2 External scale position latch Z-phase switching in semi-closed control **Precautions** ● bit 8 is enabled only when using semi-closed control.
	1	External scale Z-phase	
9	0	Encoder FB	Touch probe 2 Change storage location of external scale feedback position in semi-closed control **Precautions** ● bit 9 is enabled only when using semi-closed control.
	1	External scale FB	
10 to 15	Fixed to 0	Manufacturer use	

- When using semi-closed control





*1 The table below shows the objects corresponding to the latch correction terminals and the external inputs that can be assigned.

Latch correction terminal and corresponding object	Setup value	Assignment
SI5: Obj.3404h:00h “SI5 input selection” SI6: Obj.3405h:00h “SI6 input selection” SI7: Obj.3406h:00h “SI7 input selection”	00202020h	Select EXT1 a-contact
	00A0A0A0h	Select EXT1 b-contact
	00212121h	Select EXT2 a-contact
	00A1A1A1h	Select EXT2 b-contact

*2 Obj.60B8h:00h “Touch probe function” :bit 10 and bit 2 are used to select the latch trigger signal.

- bit 10
  - 0: LT2 = EXT2
  - 1: LT2 = Z-phase
- bit 2
  - 0: LT1 = EXT1
  - 1: LT1 = Z-phase

* Obj.60B8h:00h “Touch probe function”

Obj.60BAh:00h “Touch probe 1 positive edge”

Obj.60BBh:00h “Touch probe 1 negative edge”

Obj.60BCh:00h “Touch probe 2 positive edge”

Obj.60BDh:00h “Touch probe 2 negative edge”

Obj.4304h:00h “Touch probe function expansion setup”

Obj.4F4Bh:00h “Touch probe external scale 1 positive edge”

Obj.4F4Ch:00h “Touch probe external scale 1 negative edge”

Obj.4F4Dh:00h “Touch probe external scale 2 positive edge”

Obj.4F4Eh:00h “Touch probe external scale 2 negative edge”

5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)

Sets the motor deceleration to stop method in the event of a main power failure or alarm when PDS is in the operation enabled state (servo-on state).

Uses the deceleration function (optional code) defined in CoE (CiA402) and the deceleration function on the servo (this product) side (dynamic brake stop, free-run stop, emergency stop) in combination.

The deceleration settings must be changed from their factory default values to values appropriate for the environment in which the device is used. For the factory default values of each parameter and EtherCAT object, see *“8 Object Dictionary List”* .

List of PDS option codes

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6007h	00h	Abort connection option code	—	0 to 3	I16	rw	No	ALL	Yes	A
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Ch	00h	Disable operation option code	—	0 to 1	I16	rw	No	ALL	Yes	A
605Dh	00h	Halt option code	—	-1 to 3	I16	rw	No	ALL	Yes	A
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A

Related object list

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
		● Sets the profile deceleration. ● In cyclic position control mode (csp) and cyclic velocity control mode (csv), this is enabled only during deceleration stop sequences. ● If set to 0, treated as 1 by internal processing.								
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp ip pv hm csp csv	Yes	A
		● If Obj.605Ah:00h “Quick stop option code” is 2 or 6, sets the deceleration parameter value used for motor deceleration to stop during Quick stop. ● It is also used when Obj.605Dh:00h “Halt option code” and Obj.605Eh:00h “Fault reaction option code” are 2. ● If set to 0, treated as 1 by internal processing.								
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
		● Sets the parameter value to give a gradient to the torque command. ● In cyclic torque control mode (cst), this is enabled only during deceleration to stop sequences. ● If set to 0, treated as 1 by internal processing.								

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>609Ah</td><td>00h</td><td>Homing acceleration</td><td>Command unit/s^2</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>hm</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">
● Sets acceleration and deceleration in homing position control mode (hm).
● The deceleration in homing position control mode (hm) is also used by this object.
● At the final stop of each homing method (when the home position is detected), this object’s setup value is not used and the servo lock stops.
● If set to 0, treated as 1 by internal processing.
</td></tr>
<tr><td>60C6h</td><td>00h</td><td>Max deceleration</td><td>Command unit/s^2</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>pp
hm
pv
ip</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">
● Sets the maximum deceleration.
● If set to 0, treated as 1 by internal processing.
</td></tr>
<tr><td>3506h</td><td>00h</td><td>Sequence at Servo-Off</td><td>—</td><td>0 to 9</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">
● Sets the status of the following (1) through (5) during deceleration and after stopping.
<table>
<tr><td>(1)</td><td>Obj.605Ah:00h “Quick stop option code” = 0</td><td>When Quick stop is received</td></tr>
<tr><td>(2)</td><td>Obj.605Bh:00h “Shutdown option code” = 0</td><td>When Shutdown or Disable voltage is received</td></tr>
<tr><td>(3)</td><td>Obj.605Ch:00h “Disable operation option code” = 0</td><td>When Disable operation is received</td></tr>
<tr><td>(4)</td><td>Obj.6007h:00h “Abort connection option code” = 2
Obj.605Bh = 0</td><td>When main power is turned off</td></tr>
<tr><td>(5)</td><td>Obj.6007h:00h “Abort connection option code” = 3
Obj.605Ah = 0</td><td>When main power is turned off</td></tr>
</table>
</td></tr>
<tr><td>3510h</td><td>00h</td><td>Sequence at alarm</td><td>—</td><td>0 to 7</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">
● Sets the status during deceleration and after stopping when an alarm other than Err80.☐.☐, Err81.☐.☐, Err85.0.0 to Err85.3.0, and Err88.0.0 to Err88.3.0 occurs.
</td></tr>
</table>

If another deceleration factor (such as an alarm) occurs during deceleration, deceleration will occur according to the following priority order. Put simply, the deceleration function on the servo (this product) side has priority.

When a factor with a higher priority occurs, the deceleration process switches to the higher priority deceleration process even during deceleration operation. (*3)

If a factor with a lower priority occurs, the previously received deceleration operation is retained.

(Example) If an alarm occurs during deceleration at Obj.605Ah:00h “Quick stop option code” , the deceleration rate switches to that of Obj.605Eh:00h “Fault reaction option code” from the time the alarm occurs.

<Highest Priority> ● Servo (this product) side deceleration (during alarm)
↓ ● STO deceleration (*4)
↓ ● Servo (this product) side deceleration (when servo or main power are off)
↓ ● Servo (this product) side deceleration (when drive is disabled) (*6)
↓ ● Fault deceleration
↓ ● Retracting operation (*5)
↓ ● Other CoE (CiA402) side deceleration (*1) (*3)
↓ ● Limit system deceleration (*2)
↓ ● Halt deceleration
<Lowest Priority> ● Normal deceleration

*1 Refers to deceleration by Quick stop, Shutdown, and Disable operation.

*2 This refers to the over-travel inhibit input (POT, NOT) and deceleration by software limits.

*3 If 0 (servo side deceleration) is selected for the option code for other CoE side deceleration, the priority is the same as that of the servo side deceleration (servo-off). However, even in this case, if other CoE-side deceleration factors occur during fault deceleration, fault deceleration continues instead of servo-side deceleration.

*4 STO deceleration is deceleration with the STO function and is set in Obj.3510h.

*5 During the retracting operation, the PDS state becomes “Fault reaction active” and PDS state transition initiated by user command cannot be performed. Therefore, even if the servo (this product) decelerates (when the servo is off), the retracting operation continues regardless of the priority level.

*6 If the servo is turned off during deceleration by the servo (this product) side deceleration (when drive is disabled), the servo (this product) side deceleration (when drive is disabled) is retained.

5.5.8.2.1 Abort connection option code (6007h)

Sets the motor deceleration stop method when the main power shuts off.

The operation sequence when the main power shuts off depends on the combination of Obj.6007h:00h “Abort connection option code” , Obj.3508h:00h “L/V trip selection upon main power off” , Obj.3509h:00h “Detection time of main power off” , etc.

—: N/A

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>6007h</td><td>00h</td><td>Abort connection option code</td><td>—</td><td>0 to 3</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>A</td></tr>
<tr><td colspan="11">● Sets the deceleration stop sequence to be executed 70 ms after the main power shuts off until the main power off detection time set by Obj.3509h:00h “Detection time of main power off” in the event the main power shuts off physically.
When Obj.3509h:00h “Detection time of main power off” = 2000, only the deceleration stop sequence set by this object is executed.
Settings other than the following values are prohibited.
0: No action
1: Fault signal (decelerates according to Obj.605Eh:00h “Fault reaction option code”)
2: Disable voltage command (decelerates according to Obj.605Bh:00h “Shutdown option code”)
3: Quick stop command (decelerates according to Obj.605Ah:00h “Quick stop option code”)</td></tr>
<tr><td>3507h</td><td>00h</td><td>Sequence upon main power off</td><td>—</td><td>0 to 9</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">● Sets the deceleration mode (sequence upon main power off) for the servo side (this product).
Sets the status during deceleration and after stopping when Obj.3508h:00h “L/V trip selection upon main power off” : bit 0 is “0”, Obj.3509h:00h “Detection time of main power off” is not “2000”, and the main power is shut off.</td></tr>
<tr><td>3508h</td><td>00h</td><td>L/V trip selection upon main power off</td><td>—</td><td>0 to 3</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">● Select whether to trip LV or servo-off when there is a main power supply alarm.
bit 0 = 0: Servo-off according to the settings for Obj.3507h:00h “Sequence upon main power off” or Obj.6007h:00h “Abort connection option code” .
bit 0 = 1: Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” detected
bit 1 = 0: Main power off warning detected only when servo-on
bit 1 = 1: Main power off warning always detected</td></tr>
<tr><td>3509h</td><td>00h</td><td>Detection time of main power off</td><td>ms</td><td>20 to 2000</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>C</td></tr>
<tr><td colspan="11">● Obj.3507h:00h “Sequence upon main power off” sets the start time for deceleration processing.
Obj.3507h:00h “Sequence upon main power off” disables deceleration processing when the setting value is 2000.
Precautions
● Setting “2000” does not disable the deceleration process for the CoE (CiA402) side.
● Resolution is set to 2 ms. For example, when the set value = 99, processing is performed at 100 ms.</td></tr>
</table>

There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
3506h	00h	Sequence at Servo-Off	—	0 to 9	I16	rw	No	ALL	Yes	B
3510h	00h	Sequence at alarm	—	0 to 7	I16	rw	No	ALL	Yes	B

The table below shows the operation sequence depending on the combination of objects.

In principle, the deceleration function defined by CoE (CiA402) remains in effect until the deceleration function on the servo-side (this product) is activated when an interruption to the main power supply AC (between L1 and L3) is detected.

If set to “No action” by Obj.6007h:00h “Abort connection option code” = 0, the deceleration function on the servo-side (this product) is activated rather than the CoE (CiA402) deceleration function.

When the voltage across P-N drops, Err13.0.☐ “Main power supply undervoltage protection (voltage across PN)” is triggered with the highest priority. Operation is initiated in accordance with Obj.3510h:00h “Sequence at alarm” .

When Obj.3509h:00h “Detection time of main power off” = 2000 (when main power AC off detection is disabled)

—: No applicable conditions

Status	Obj.6007h:00h “Abort connection option code” Setup value	Target option code Setup value	Deceleration method
When voltage across P-N drops	—	—	Decelerates according to Obj.3510h:00h “Sequence at alarm” after Err13.0.☐ “Main power supply undervoltage protection (voltage across PN)” is triggered
When main power AC (between L1 and L3) is off	0 (No action)	—	Operational status is retained
	1 (Fault signal)	Obj.605Eh:00h “Fault reaction option code” = 0	Decelerates according to Obj.3510h:00h “Sequence at alarm” after Err88.0.0 “Main power supply undervoltage protection (AC interrupt detection 2)” is triggered

Status	Obj.6007h:00h "Abort connection option code" Setup value	Target option code Setup value	Deceleration method
When main power AC (between L1 and L3) is off	1 (Fault signal)	Obj.605Eh:00h "Fault reaction option code" = Other than 0	Err88.0.0 "Main power supply undervoltage protection (AC interrupt detection 2)" is triggered after deceleration according to Obj.605Eh:00h "Fault reaction option code"
	2 (Disable voltage command)	Obj.605Bh:00h "Shutdown option code" = 0	Decelerates according to Obj.3506h:00h "Sequence at Servo-Off"
		Obj.605Bh:00h "Shutdown option code" = Other than 0	Decelerates according to Obj.605Bh:00h "Shutdown option code"
	3 (Quick stop command)	Obj.605Ah:00h "Quick stop option code" = 0	Decelerates according to Obj.3506h:00h "Sequence at Servo-Off"
		Obj.605Ah:00h "Quick stop option code" = Other than 0	Decelerates according to Obj.605Ah:00h "Quick stop option code"

When Obj.3509h is not 2000 (when main power AC off detection is enabled)

—: N/A

Status	Obj.6007h:00h "Abort connection option code" Setup value	Target option code Setup value	Deceleration method			
			Before set time for Obj.3509h:00h "Detection time of main power off" has passed (*2)	→	After set time for Obj.3509h:00h "Detection time of main power off" has passed (*1)	
					Obj.3508h:00h "L/V trip selection upon main power off" : bit 0	
When voltage across P-N drops	—	—	Decelerates according to Obj.3510h:00h "Sequence at alarm" after Err13.0.☐ "Main power supply undervoltage protection (voltage across PN)" is triggered			
When main power AC (between L1 and L3) is off	0 (No action)	—	Operational status is retained	→	0	Decelerates according to Obj.3507h:00h "Sequence upon main power off"
					1	Decelerates according to Obj.3510h:00h "Sequence at alarm" after Err13.1.0 "Main power supply undervoltage protection (AC interrupt detection)" is triggered
	1 (Fault signal)	Obj.605Eh:00h "Fault reaction option code" = 0	Decelerates according to Obj.3510h:00h "Sequence at alarm" after Err88.0.0 "Main power supply undervoltage protection (AC interrupt detection 2)" is triggered			
		Obj.605Eh:00h "Fault reaction option code" = Other than 0	Err88.0.0 "Main power supply undervoltage protection (AC interrupt detection 2)" is triggered after deceleration according to Obj.605Eh:00h "Fault reaction option code"	→	0	Decelerates according to Obj.3507h:00h "Sequence upon main power off" After deceleration, Err88.0.0 "Main power supply undervoltage protection (AC interrupt detection 2)" is triggered Transition to post-stop operation by Obj.3510h:00h "Sequence at alarm"

Status	Obj.6007h: 00h “Abort connection option code” Set-up value	Target option code Setup value	Deceleration method			
			Before set time for Obj.3509h:00h “Detection time of main power off” has passed (*2)	→	After set time for Obj.3509h:00h “Detection time of main power off” has passed (*1)	
					Obj.3508h:00h “L/V trip selection upon main power off” : bit 0	
When main power AC (between L1 and L3) is off	1 (Fault signal)	Obj.605Eh:00h “Fault reaction option code” = Other than 0	Err88.0.0 “Main power supply undervoltage protection (AC interrupt detection 2)” is triggered after deceleration according to Obj.605Eh:00h “Fault reaction option code”	→	1	Decelerates according to Obj.3510h:00h “Sequence at alarm” after Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is triggered (Err88.0.0 “Main power supply undervoltage protection (AC interrupt detection 2)” is triggered after deceleration)
	2 (Disable voltage command)	Obj.605Bh:00h “Shutdown option code” = 0	Decelerates according to Obj.3506h:00h “Sequence at Servo-Off”	→	0	Decelerates according to Obj.3507h:00h “Sequence upon main power off” (*3)
					1	Decelerates according to Obj.3507h:00h “Sequence upon main power off” (*3)
		Obj.605Bh:00h “Shutdown option code” = Other than 0	Decelerates according to Obj.605Bh:00h “Shutdown option code”	→	0	Decelerates according to Obj.3507h:00h “Sequence upon main power off”
					1	Decelerates according to Obj.3510h:00h “Sequence at alarm” after Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is triggered
	3 (Quick stop command)	Obj.605Ah:00h “Quick stop option code” = 0	Decelerates according to Obj.3506h:00h “Sequence at Servo-Off”	→	0	Decelerates according to Obj.3507h:00h “Sequence upon main power off” (*3)
					1	Decelerates according to Obj.3507h:00h “Sequence upon main power off” (*3)
		Obj.605Ah:00h “Quick stop option code” = Other than 0	Decelerates according to Obj.605Ah:00h “Quick stop option code”	→	0	Decelerates according to Obj.3507h:00h “Sequence upon main power off”
					1	Decelerates according to Obj.3510h:00h “Sequence at alarm” after Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” is triggered

*1 Not executed if the actual speed falls below 30 r/min before the time set by Obj.3509h:00h “Detection time of main power off” elapses.

*2 Not executed if the time set in Obj.3509h:00h “Detection time of main power off” is 70 ms or less.

*3 If the time set in Obj.3509h:00h “Detection time of main power off” exceeds 70 ms, a supplemental deceleration stop is made.

Example of deceleration stop operation due to main power off

A: Once 70 ms elapses after main power OFF, deceleration stop is started by Obj.6007h:00h “Abort connection option code” .

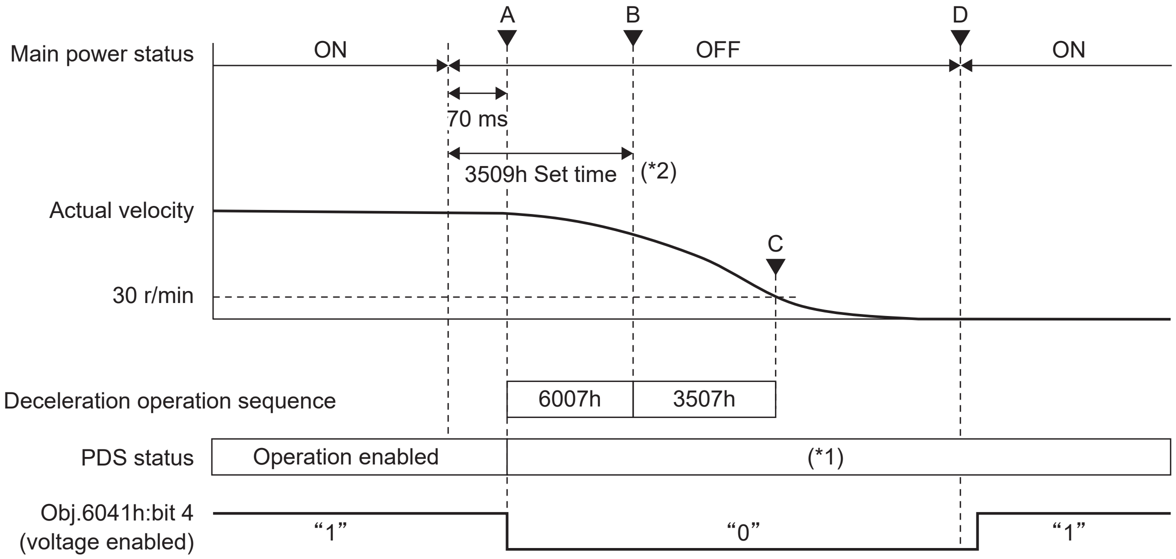
B: When the time set by Obj.3509h:00h “Detection time of main power off” elapses after main power OFF, switches to deceleration stop by Obj.3507h:00h “Sequence upon main power off” .

C: The motor stops when the actual speed is detected as being 30 r/min or less.

D: When the main power is on, Obj.6041h:bit 4 “Statusword:voltage enabled” changes to 1.

Notes

- If main power off is detected during Obj.3506h:00h “Sequence at Servo-Off” , Obj.3506h:00h “Sequence at Servo-Off” performs a deceleration stop, after which a transition is made to the operation following a stop by Obj.3507h:00h “Sequence upon main power off” .



*1 The PDS status during deceleration and after stopping will differ depending on this object, and Obj.3508h:00h “L/V trip selection upon main power off” : bit 0, and the set value for Obj.3509h.See the table “PDS status at deceleration stop operation” shown in “2”.

*2 When Obj.3509h:00h “Detection time of main power off” = 2000 (main AC power off detection disabled) and if the actual speed falls below 30 r/min before the time set by Obj.3509h:00h “Detection time of main power off” elapses, deceleration stop processing by Obj.3507h is not performed.

PDS status at deceleration stop operation

Before the time set by Obj.3509h:00h “Detection time of main power off” elapses, or when Obj.3509h:00h “Detection time of main power off” = 2000 (when main power AC off detection is disabled)

Obj.6007h:00h “Abort connection option code” Setup value	PDS status during deceleration	PDS status after stopping (approx. 30 r/min or below)
0	Current status retained	When the PDS status at main power off is “Operation enabled”: Operation enabled
		When the PDS status at main power off is “Quick stop active”: Switch on disabled
1	Fault reaction active	Fault
2	Current status retained	Switch on disabled
3	Quick stop active	Switch on disabled

Notes

- Obj.3508h:00h “L/V trip selection upon main power off” : Not dependent on the set value for bit 0.

After the time set by Obj.3509h:00h “Detection time of main power off” elapses

—: No applicable conditions

Obj.6007h:00h “Abort connection option code” Setup value	Target option code Setup value	Obj.3508h:00h “L/V trip selection upon main power off” : bit 0 set value	PDS status during deceleration	PDS status after stopping (approx. 30 r/min or below)
0	—	0	Current status retained	When the PDS status at main power off is “Operation enabled”: Ready to switch on
				When the PDS status at main power off is “Quick stop active”: Switch on disabled
		1	Fault reaction active	Fault
1	—	—	Fault reaction active	Fault
2	Obj.605Bh:00h “Shutdown option code” = 0	—	Current status retained	Switch on disabled
	Obj.605Bh:00h “Shutdown option code” = Other than 0	0	Current status retained	Switch on disabled
		1	Fault reaction active	Fault
3	Obj.605Ah:00h “Quick stop option code” = 0	—	Quick stop active	Switch on disabled
	Obj.605Ah:00h “Quick stop option code” = Other than 0	0	Quick stop active	Switch on disabled
		1	Fault reaction active	Fault

5.5.8.2.2 Quick stop option code (605Ah)

Sets the motor deceleration stop method when the PDS command “Quick Stop” is received.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
605Ah	00h	Quick stop option code	—	-2 to 7	I16	rw	No	ALL	Yes	A

- Sets the sequence for use during Quick stop. The definition differs by control mode.
  Settings other than the following values are prohibited. If set to a prohibited value, an abortcode will be triggered.
- pp, csp, ip, csv, pv
  - -1, -2: Manufacturer use
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Switch on disabled” after the motor is stopped by Obj.6084h:00h “Profile deceleration” .
  - 2: Transitions to “Switch on disabled” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
  - 3: Transitions to “Switch on disabled” after the motor is stopped by Obj.60C6h:00h “Max deceleration” .
  - 5: Transitions to “Quick stop active” after the motor is stopped by Obj.6084h:00h “Profile deceleration” . (*1)
  - 6: Transitions to “Quick stop active” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” . (*1)
  - 7: Transitions to “Quick stop active” after the motor is stopped by Obj.60C6h:00h “Max deceleration” . (*1)
- hm
  - -1, -2: Manufacturer use
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Switch on disabled” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” .
  - 2: Transitions to “Switch on disabled” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
  - 3: Transitions to “Switch on disabled” after the motor is stopped by Obj.60C6h:00h “Max deceleration” .
  - 5: Transitions to “Quick stop active” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” . (*1)
  - 6: Transitions to “Quick stop active” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” . (*1)
  - 7: Transitions to “Quick stop active” after the motor is stopped by Obj.60C6h:00h “Max deceleration” . (*1)
- cst, tq
  - -1, -2: Manufacturer use
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1, 2: Transitions to “Switch on disabled” after the motor is stopped by Obj.6087h:00h “Torque slope” .
  - 3: Transitions to “Switch on disabled” after the motor is stopped by zero torque.
  - 5, 6: Transitions to “Quick stop active” after the motor is stopped by Obj.6087h:00h “Torque slope” . (*1)
  - 7: Transitions to “Quick stop active” after the motor is stopped by zero torque. (*1)

*1 If the main power is shut off when Obj.6007h:00h “Abort connection option code” = 3, it transitions to “Switch on disabled.”

There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* .

—: N/A

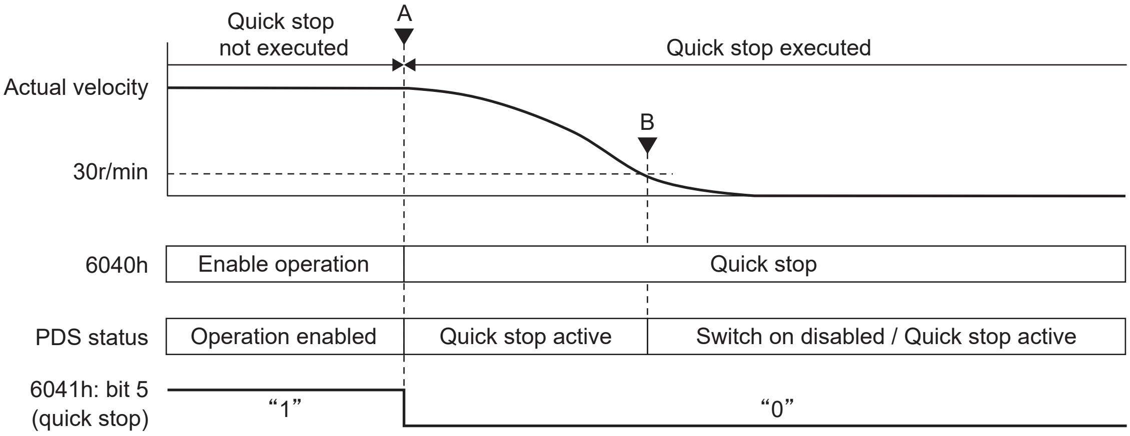
Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A
3506h	00h	Sequence at Servo-Off	—	0 to 9	I16	rw	No	ALL	Yes	B

Example of deceleration stop operation by Quick stop command

A: Deceleration stop starts when Obj.6040h:bit 2 “Controlword:quick stop” changes from 1 to 0. The PDS status during deceleration is “Quick stop active”.

B: The motor stops when the actual speed is detected as being 30 r/min or less. Once stopped, the PDS status changes to “Switch on disabled” or “Quick stop active”.



5.5.8.2.3 Shutdown option code (605Bh)

Sets the motor deceleration stop method when the PDS commands “Shutdown” and “Disable voltage” are received.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
605Bh	00h	Shutdown option code	—	0 to 1	I16	rw	No	ALL	Yes	A

- Sets the sequence when the PDS commands “Shutdown” and “Disable voltage” are received. The definition differs by control mode.

  Settings other than the following values are prohibited.

When the PDS command “Shutdown” is received

- pp, csp, ip, csv, pv
  - 0: Transitions to “Ready to switch on” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Ready to switch on” after the motor is stopped by Obj.6084h:00h “Profile deceleration” .
- hm
  - 0: Transitions to “Ready to switch on” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Ready to switch on” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” .
- cst, tq
  - 0: Transitions to “Ready to switch on” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Ready to switch on” after the motor is stopped by Obj.6087h:00h “Torque slope” .

When the PDS command “Disable voltage” is received

- pp, csp, ip, csv, pv
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Switch on disabled” after the motor is stopped by Obj.6084h:00h “Profile deceleration” .
- hm
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Switch on disabled” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” .
- cst, tq
  - 0: Transitions to “Switch on disabled” after the motor is stopped by Obj.3506h:00h “Sequence at Servo-Off” .
  - 1: Transitions to “Switch on disabled” after the motor is stopped by Obj.6087h:00h “Torque slope” .

There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* .

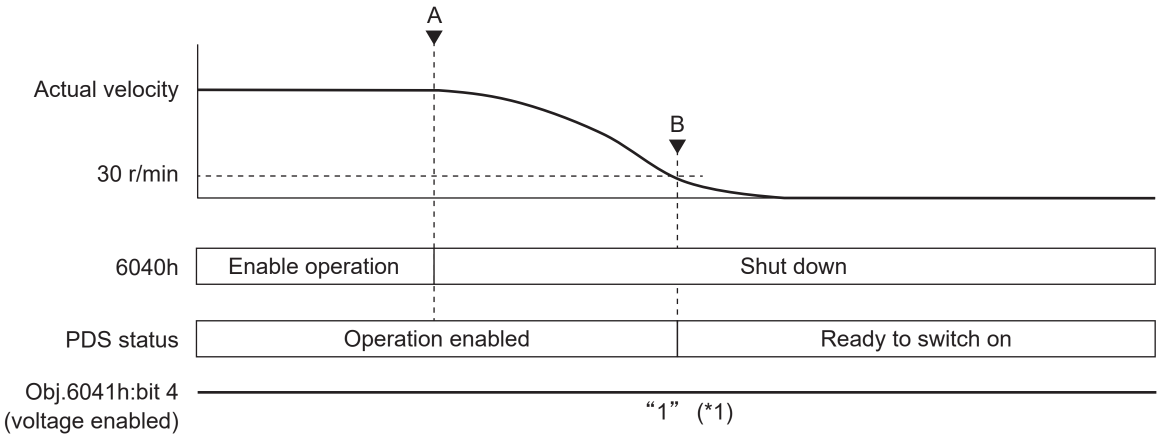
—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
3506h	00h	Sequence at Servo-Off	—	0 to 9	I16	rw	No	ALL	Yes	B

Example of deceleration stop operation by Shutdown command

A: Starts deceleration stop when the PDS command “Shutdown” is received. The PDS status during deceleration remains as “Operation enabled”.

B: The motor stops when the actual speed is detected as being 30 r/min or less. Once stopped, the PDS status changes to “Ready to switch on”.



*1 Obj.6041h:bit 4 "Statusword:voltage enabled" remains unchanged at 1.

5.5.8.2.4 Disable Operation Option Code (605Ch)

Sets the motor deceleration stop method when the PDS command "Disable operation" is received.

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
605Ch	00h	Disable operation option code	–	0 to 1	I16	rw	No	ALL	Yes	A

- Sets the sequence when the PDS command "Disable operation" is received. The definition differs by control mode.

  Settings other than the following values are prohibited.
- pp, csp, ip, csv, pv
  - 0: Transitions to "Switched on" after the motor is stopped by Obj.3506h:00h "Sequence at Servo-Off" .
  - 1: Transitions to "Switched on" after the motor is stopped by Obj.6084h:00h "Profile deceleration" .
- hm
  - 0: Transitions to "Switched on" after the motor is stopped by Obj.3506h:00h "Sequence at Servo-Off" .
  - 1: Transitions to "Switched on" after the motor is stopped by Obj.609Ah:00h "Homing acceleration" .
- cst, tq
  - 0: Transitions to "Switched on" after the motor is stopped by Obj.3506h:00h "Sequence at Servo-Off" .
  - 1: Transitions to "Switched on" after the motor is stopped by Obj.6087h:00h "Torque slope" .

There are other related objects. For details, see the first part of *"5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)"* .

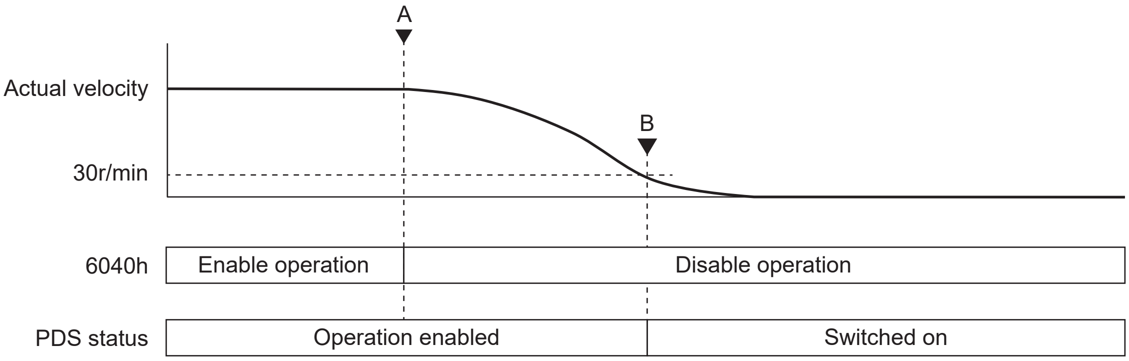
–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
3506h	00h	Sequence at Servo-Off	–	0 to 9	I16	rw	ALL	ALL	Yes	B

Example of deceleration stop operation by the Disable operation command

A: When the PDS command “Disable operation” is received, deceleration stop is started. The PDS status during deceleration remains as “Operation enabled”.

B: The motor stops when the actual speed is detected as being 30 r/min or less. Once stopped, the PDS status changes to “Switched on”.



5.5.8.2.5 Halt option code (605Dh)

Sets the motor deceleration stop method when Obj.6040h:00h “Controlword” :bit 8 “halt” is set to “1”.

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
605Dh	00h	Halt option code	–	-1 to 3	I16	rw	No	ALL	Yes	A

- Sets the sequence during Halt operation. The definition differs by control mode.
  Settings other than the following values are prohibited.
- pp, csp, ip, csv, pv
  - -1: Manufacturer use
  - 1: Retains “Operation enabled” after the motor is stopped by Obj.6084h:00h “Profile deceleration” .
  - 2: Retains “Operation enabled” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
  - 3: Retains “Operation enabled” after the motor is stopped by Obj.6072h:00h “Max torque” and Obj.60C6h:00h “Max deceleration” .
- hm
  - -1: Manufacturer use
  - 1: Retains “Operation enabled” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” .
  - 2: Retains “Operation enabled” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
  - 3: Retains “Operation enabled” after the motor is stopped by Obj.6072h:00h “Max torque” and Obj.60C6h:00h “Max deceleration” .
- cst, tq
  - -1: Manufacturer use
  - 1, 2: Retains “Operation enabled” after the motor is stopped by Obj.6087h:00h “Torque slope” .
  - 3: Retains “Operation enabled” after the motor is stopped by zero torque.

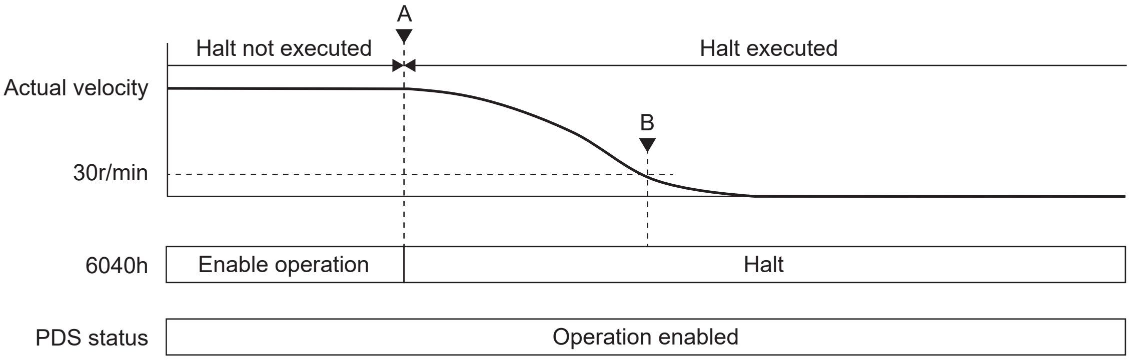
There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A

Example of deceleration stop operation by Halt function

A: Deceleration stop starts when Obj.6040h:bit 8 “Controlword halt” changes from 0 to 1. The PDS status during deceleration remains as “Operation enabled”.

B: The motor stops when the actual speed is detected as being 30 r/min or less. Once stopped, the PDS status remains as “Operation enabled”.



5.5.8.2.6 Fault reaction option code (605Eh)

Sets the motor deceleration method when an EtherCAT communication-related alarm is triggered.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
605Eh	00h	Fault reaction option code	—	0 to 2	I16	rw	No	ALL	Yes	A

- Sets the sequence for when an alarm is triggered. The definition differs by control mode.
  Settings other than the following values are prohibited.

1 When Err80.☐.☐, Err 81.☐.☐, Err85.☐.☐, or Err88.☐.☐ is triggered

- pp, csp, ip, csv, pv
  0: Transitions to “Fault” after the motor is stopped by Obj.3510h:00h “Sequence at alarm” .
  1: Transitions to “Fault” after the motor is stopped by Obj.6084h:00h “Profile deceleration” .
  2: Transitions to “Fault” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
- hm
  0: Transitions to “Fault” after the motor is stopped by Obj.3510h:00h “Sequence at alarm” .
  1: Transitions to “Fault” after the motor is stopped by Obj.609Ah:00h “Homing acceleration” .
  2: Transitions to “Fault” after the motor is stopped by Obj.6085h:00h “Quick stop deceleration” .
- cst, tq
  0: Transitions to “Fault” after the motor is stopped by Obj.3510h:00h “Sequence at alarm” .
  1, 2: Transitions to “Fault” after the motor is stopped by Obj.6087h:00h “Torque slope” .

2 When an alarm other than the alarms specified in 1 above is triggered
0, 1, 2: Transitions to “Fault” after the motor is stopped by Obj.3510h:00h “Sequence at alarm” .

There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* .

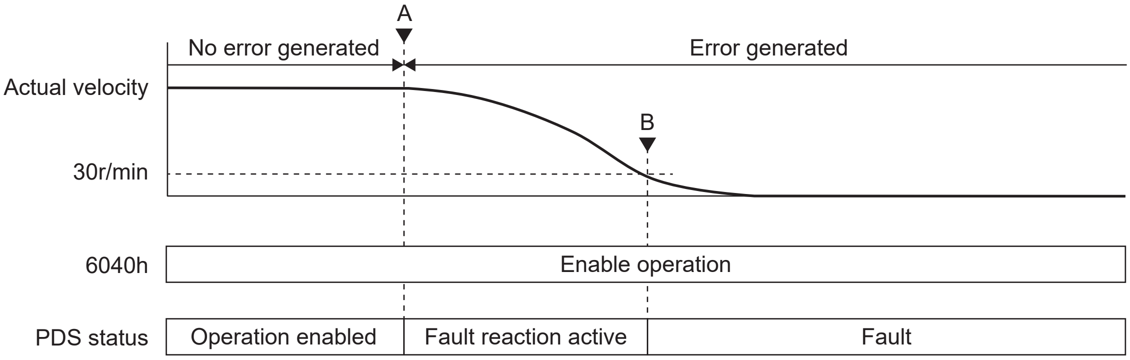
—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv ip csp csv	Yes	A
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	hm	Yes	A
3510h	00h	Sequence at alarm	—	0 to 7	I16	rw	No	ALL	Yes	B

Example of deceleration stop operation due to alarm triggering

A: Deceleration stop starts when an alarm is triggered. The PDS status during deceleration is “Fault reaction active”.

B: The motor stops when the actual speed is detected as being 30 r/min or less. Once stopped, the PDS status changes to “Fault”.



5.5.8.2.7 Sequence During Over-travel Inhibit Inputs (POT, NOT)

Sets the post-input operation sequence input for over-travel inhibit inputs (POT, NOT).

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3504h	00h	Over-travel inhibit input setup	–	0 to 2	I16	rw	No	ALL	Yes	C
	Sets the input operations for the over-travel inhibit inputs (POT, NOT). ● 0: POT -> Positive direction over-travel inhibit, NOT -> Negative direction over-travel inhibit. If POT is input during positive direction travel or NOT is input during negative direction travel, Obj.3505h:00h “Sequence at over-travel inhibit” brings it to a stop. ● 1: POT -> Positive direction over-travel inhibit, NOT -> Negative direction over-travel inhibit. If POT is input during positive direction travel or NOT is input during negative direction travel, it comes to a stop in accordance with the following. • pp, csp, ip, csv, pv Motor stopped by Obj.6085h:00h “Quick stop deceleration” • cst, tq Motor stopped by Obj.6087h:00h “Torque slope” ● 2: POT or NOT input activates Err38.0.0 “Over-travel inhibit input protection 1”									
3505h	00h	Sequence at over-travel inhibit	–	0 to 2	I16	rw	No	ALL	Yes	C
	● Sets the status for during deceleration and after coming to a stop after over-travel inhibit inputs (POT, NOT) are entered when Obj.3504h:00h “Over-travel inhibit input setup” = 0.									
3511h	00h	Torque setup for emergency stop	%	0 to 500	I16	rw	No	ALL	Yes	B
	● Sets the torque limit for emergency stop. The normal torque limit is used when this setup value is 0.									
36A2h	00h	Over-travel inhibit release level setup	Command unit	0 to 2147483647	I32	rw	No	csp	Yes	B
	● Sets the position deviation amount using an absolute value for canceling the over-travel inhibited state. If the position deviation amount is greater than the set value, the over-travel inhibit state cannot be canceled. If Obj.3504h:00h “Over-travel inhibit input setup” ≠ 1, set Obj.36A2h:00h “Over-travel inhibit release level setup” = 0.									

There are other related objects. For details, see the first part of *“5.5.8.2 Option Code (Deceleration to Stop Sequence Setting)”* and *“4.8.3 Message When an Error Occurs”* .

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	U32	rw	RxPDO	tq cst	Yes	A
603Fh	00h	Error code	—	0 to 65535	U16	ro	TxPDO	ALL	No	X

Precautions

- The sensor must be set up so that the over-travel inhibit inputs (POT, NOT) can be input correctly.
- Operation cannot be guaranteed if not set up correctly (NOT installed on the positive direction travel side, POT installed on the negative direction travel side, etc.).
- Install the device at a position that takes into account the amount of movement required until deceleration stops.
- If the torque limit and deceleration set values are low, the amount of movement necessary until deceleration stops may increase.

5.5.8.3 Digital Inputs, Digital Outputs

Of the function signals assigned using servo parameters 3400h to 3407h, 3410h, 3411h, and 3412h, each bit of digital inputs and digital outputs represents the logic input states of positive limit switch (POT), negative limit switch (NOT), home switch (HOME), EXT1, EXT2, E-STOP, and SI-MON1 to SI-MON5, as well as the logical output settings of EX-OUT1 and set_brake.

5.5.8.3.1 Digital inputs (60FDh)

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60FDh	00h	Digital inputs	–	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the logic input status of external input signals.

bit	31	30	29	28	27	26	25	24
Function	(Not Supported)						RET status [RET-STAT]	[INP]
bit	23	22	21	20	19	18	17	16
Function	[SI-MON5] / [E-STOP]	[SI-MON4]	[SI-MON3]	[SI-MON2] / [EXT2]	[SI-MON1] / [EXT1]	[RET]	Velocity integral clear [VI-CLR]	(reserved)
bit	15	14	13	12	11	10	9	8
Function	(reserved)							
bit	7	6	5	4	3	2	1	0
Function	(reserved)				(Not Supported)	home switch [HOME]	positive limit switch [POT]	negative limit switch [NOT]

* The symbols in [ ] are symbol names for I/O connector input signals and output signals.

The details of each bit are as follows.

Value	Definition
0	Switched off (logic input status OFF)
1	Switched on (logic input status ON)

Obj.60FDh:00h “Digital inputs” :bit 2 “home switch” , bit 1 “positive limit switch” , and bit 0 “negative limit switch” indicate the signal status of the near home input (HOME) of the parallel I/O connector, positive direction over-travel inhibit input (POT), and negative direction over-travel inhibit input (NOT).

bit 17 “VI-CLR” is set to 1 when the velocity integral value is cleared by internal processing or by setting Obj.60FEh: “Digital outputs” :bit 20 “vel-loop integral clear” .

5.5.8.3.2 Digital outputs (60FEh)

Precautions

- If using this object for set brake signal control, make sure to use PDO and enable the PDO watchdog. Using SDO is unsafe as it may not be able to determine that communication has been interrupted, causing the brake to remain released.
- If using the set brake signal, assign output signals (settings Obj.3410h:00h “SO1 output selection” , Obj.3411h:00h “SO2 output selection” , and Obj.3412h:00h “SO3 output selection”). Also assign output signals (settings Obj.3410h:00h “SO1 output selection” , Obj.3411h:00h “SO2 output

selection” , and Obj.3412h:00h “SO3 output selection”) if using the external brake release signal (BRK-OFF) instead of the set brake signal.

—: N/A

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>60FEh</td><td>—</td><td>Digital outputs</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td></td><td colspan="10">● Used when operating the output transistor for external output signals.
<table>
<tr><td>bit</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr>
<tr><td>Function</td><td colspan="3">(Not Supported)</td><td>Time-stamp reference time reset</td><td colspan="4">(Not Supported)</td></tr>
<tr><td>bit</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr>
<tr><td>Function</td><td colspan="3">(Not Supported)</td><td>vel-loop integral clear</td><td>vel-loop torque limit</td><td colspan="2">(Not Supported)</td><td>EX-OUT1</td></tr>
<tr><td>bit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td>Function</td><td colspan="8">(reserved)</td></tr>
<tr><td>bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td colspan="7">(reserved)</td><td>set brake</td></tr>
</table></td></tr>
<tr><td>60FEh</td><td>00h</td><td>Number of entries</td><td>—</td><td>2</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td></td><td colspan="10">● Displays the number of Obj.60FEh: “Digital outputs” Sub-Indexes.</td></tr>
<tr><td>60FEh</td><td>01h</td><td>Physical outputs</td><td>—</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>ALL</td><td>Yes</td><td>A</td></tr>
<tr><td></td><td colspan="10">● Operates to output external output signals.</td></tr>
<tr><td>60FEh</td><td>02h</td><td>Bit mask</td><td>—</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>RxPDO</td><td>ALL</td><td>Yes</td><td>A</td></tr>
<tr><td></td><td colspan="10">● Sets the external operation masking function for external output signals.</td></tr>
</table>

The details of each bit are shown in the table below.

Sub-Index 01h: Physical outputs

bit	Name	value	Note
0	set brake	0	don’t set brake (= brakes don’t operate)
		1	set brake (= brakes operate)
16	EX-OUT1	0	Switched off (output transistor OFF)
		1	Switched on (output transistor ON)
19 (*1) (*3)	vel-loop torque limit	0	Velocity control loop torque limit disabled
		1	Velocity control loop torque limit enabled
20 (*2) (*3)	vel-loop integral clear	0	Speed integration value not cleared
		1	Speed integration value cleared
28 (*4)	Timestamp reference time reset	0	The following values are not incorporated. ● Obj.430Eh: “Timestamp reference time” : Obj.430Eh:01h “Timestamp reference time setting 1” ● Obj.430Eh: “Timestamp reference time” : Obj.430Eh:02h “Timestamp reference time setting 2”

bit	Name	value	Note
28 (*4)	Timestamp reference time reset	1	The following values are incorporated when this bit changes from 0 to 1. ● Obj.430Eh: “Timestamp reference time” : Obj.430Eh:01h “Timestamp reference time setting 1” ● Obj.430Eh: “Timestamp reference time” : Obj.430Eh:02h “Timestamp reference time setting 2”

*1 Enables or disables the torque limit function of the velocity control loop by Obj.4312h:00h “Velocity control loop torque limit” .

*2 The velocity integral value is always 0 when bit 20 = 1.

*3 For details, see the control block diagrams shown in *“5.5.5 Position Control Function (pp, csp, ip, hm)”* to *“5.5.7 Torque Control Function (tq, cst)”* .

*4 When synchronizing multiple axes, change Obj.60FEh:01h “Physical outputs” :bit 28 “Timestamp reference time reset” for all axes simultaneously.

Also, perform changes for bit 28 “Timestamp reference time reset” under the following conditions.

- DC synchronous mode or SM2 synchronous mode
- The ESM state is the OP state

Sub-Index 02h: Bit mask

bit	Name	value	Note
0	Bit mask for set brake	0	Disable output (set brake output disabled)
		1	Enable output (set brake output enabled)
16	Bit mask for EX-OUT1	0	Disable output (EX-OUT1 output disabled)
		1	Enable output (EX-OUT1 output enabled)
19	Bit mask for vel-loop torque limit	0	Disable output (vel-loop torque limit disabled)
		1	Enable output (vel-loop torque limit enabled)
20	Bit mask for vel-loop integral clear	0	Disable output (vel-loop integral clear disabled)
		1	Enable output (vel-loop integral clear enabled)
28	Bit mask for Timestamp reference time reset	0	Disable output (Timestamp reference time reset disabled)
		1	Enable output (Timestamp reference time reset enabled)

Notes

- If the bit mask is disabled, this product internally processes each physical output as a default value (set value = 0).

The output transistor state for each communication state transitions as shown in the following table.

—: No applicable conditions

Symbol	3724h Setup value	60FEh setup value		Output transistor state			
		01h (Physical outputs)	02h (Bit mask)	When reset	Communication established (*1)	When communication is interrupted (*1)	Communication re-established (*1)
set brake	—	0	0	set brake = 1 (Brake ON)	set brake = 1 (Brake ON)	set brake = 1 (Brake ON)	set brake = 1 (Brake ON)
		1					
		0	1	set brake = 1 (Brake ON)	set brake = 0	set brake = 1 (Brake ON)	set brake = 0
		1			set brake = 1 (Brake ON)		set brake = 1 (Brake ON)
EX-OUT1	bit 0 = 0 (Retained)	0	0	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0
		1					

Symbol	3724h Setup value	60FEh setup value		Output transistor state			
		01h (Physical outputs)	02h (Bit mask)	When reset	Communication established (*1)	When communication is interrupted (*1)	Communication re-established (*1)
EX-OUT1	bit 0 = 0 (Retained)	0	1	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0 (Retained)	EX-OUT1 = 0
		1			EX-OUT1 = 1	EX-OUT1 = 1 (Retained)	EX-OUT1 = 1
	bit 0 = 1 (Initialized)	0	0	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0
		1					
		0	1	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0	EX-OUT1 = 0
		1			EX-OUT1 = 1		EX-OUT1 = 1
vel-loop torque limit	—	0	0	vel-loop torque limit = 0	vel-loop torque limit = 0	vel-loop torque limit = 0	vel-loop torque limit = 0
		1					
		0	1	vel-loop torque limit = 0	vel-loop torque limit = 0	vel-loop torque limit = 0	vel-loop torque limit = 0
		1			vel-loop torque limit = 1 (Torque limited)		vel-loop torque limit = 1 (Torque limited)
vel-loop integral clear	—	0	0	vel-loop integral clear = 0	vel-loop integral clear = 0	vel-loop integral clear = 0	vel-loop integral clear = 0
		1					
		0	1	vel-loop integral clear = 0	vel-loop integral clear = 0	vel-loop integral clear = 0	vel-loop integral clear = 0
		1			vel-loop integral clear = 1 (Speed integration value cleared)		vel-loop integral clear = 1 (Speed integration value cleared)
Timestamp reference time reset	—	0	0	Timestamp reference time reset = 0	Timestamp reference time reset = 0	Timestamp reference time reset = 0	Timestamp reference time reset = 0
		1					
		0	1	Timestamp reference time reset = 0	Timestamp reference time reset = 0	Timestamp reference time reset = 0	Timestamp reference time reset = 0
		1			Timestamp reference time reset = 0 -> 1 (incorporates the values of 430Eh:01h and 430Eh:02h)		Timestamp reference time reset = 0 -> 1 (incorporates the values of 430Eh:01h and 430Eh:02h)

*1 "Communication established", "Communication interrupted", "Communication re-established" refer to the meanings in the following table.

Communication established	The ESM state is PreOP or higher
When communication is interrupted (*2)	RxPDO communication is not possible (ESM status transitions from OP to something other than OP) or SDO communication is not possible (ESM status transitions to Init)
Communication re-established	Obj.60FEh:01h or Obj.60FEh:02h was written successfully

*2 When using Obj.60FEh: "Digital outputs" , map to RxPDO.

Related objects

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
3724h	00h	Communication function extended setup 3	–	-32768 to 32767	I16	rw	No	ALL	Yes	C
		● bit 0: EX-OUT1 output status setting at the time of communication interrupted after EtherCAT communication is established 0: Retained 1: Initialized (output when EX-OUT1 = 0) ● bit 1: Manufacturer use Please fix to 0.								
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	U16	rw	RxPDO	ALL	No	A
		● If Obj.60FEh:01h “Physical outputs” :bit 19 = 1 is set while Obj.60FEh:02h “Bit mask” :bit 19 = 1, the torque command value generated by the velocity control loop is limited by the setting value.								

5.5.8.4 Position Information

5.5.8.4.1 Initialization Timing for Position Information

The product initializes (presets) position-related objects at the following times.

■ Initialization timing (condition)

- When control power is turned on
- When communication is established (when ESM state transitions from Init → PreOP)
- When homing is completed
- When clearing multi-turn data
- When operation of the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends
- When executing Config for Set-up Support Software (PANATERM ver.7)
- When Err27.4.0 "Position command error protection" occurs

■ Object being initialized

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F04h	00h	Position command internal value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL (*1)	No	X
4F41h (*2)	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	I32	ro	TxPDO (*1)	ALL	No	X
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL (*1)	No	X
4F86h	00h	Hybrid deviation	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp (*1)	No	X
4FA7h	00h	External scale position (Applied polarity)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL (*1)	No	X
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm ip csp	No	X

*1 Only supported during full-closed control.

*2 This is only supported when multi-turn data is cleared.

These objects are initialized (preset) based on Obj.6063h:00h “Position actual internal value” , which indicates the motor feedback position, taking into account the electronic gear function, sign conversion by polarity, home offset, etc., as described below.

Also, changes in the electronic gear ratio, polarity, and home offset set values are reflected at the times described later in this section.

Refer to *“5.5.8.4.4 Initialization of Absolute Encoder (During Semi-closed Control)”* for precautions to be taken when using an absolute encoder.

5.5.8.4.2 Electronic Gear Function

The electronic gear is a function that uses a value obtained by multiplying the position control command input from the host device by the electronic gear ratio set by the object as the position command for the position control unit.

This function can be used to set motor rotation and movement amounts arbitrarily on a per-command-unit basis.

This product does not support the setting of electronic gear ratios using the parameters Pr0.08 “Number of command pulses per one motor revolution” , Pr0.09 “Numerator of electronic gear” , and Pr0.10 “Denominator of electronic gear” . Electronic gear ratios are set by the objects Obj.608Fh: “Position encoder resolution” , Obj.6091h: “Gear ratio” , and Obj.6092h: “Feed constant” specified in CoE (CiA402).

The relationship between user-defined units (command units) and internal units (pulse) is calculated using the following equation.

$$\text{Electronic gear ratio} = \frac{\text{Position encoder resolution} \times \text{Gear ratio}}{\text{Feed constant}}$$

Position demand value × Electronic gear ratio = Position demand internal value

■ Precautions

- The electronic gear ratio is only valid within the range of 128000× to 1/1000×.

  If ranges are exceeded, values are saturated at the upper and lower limits of the range and Err88.3.0 “Improper operation error protection” is triggered.
- If the denominator or numerator exceeds the unsigned 64-bit size during calculation of the electronic gear ratio, Err88.3.0 “Improper operation error protection” is triggered.
- If the denominator or numerator exceeds the unsigned 32-bit size in the final calculation result for the electronic gear ratio, Err88.3.0 “Improper operation error protection” is triggered.
- The electronic gear ratio is set using multiple objects.

  Error incidence may increase depending on the combination of settings.
- Obj.608Fh:01h “Encoder increments” is set automatically depending on the encoder resolution.

  This is also set automatically depending on the encoder resolution when using full-closed controls.

  The initial value for Obj.6092h:01h “Feed” is set so that the motor makes a single turn in 2^{23} [command unit].

  If using anything other than semi-closed control, set the electronic gear ratio accordingly.
- The setting for the electronic gear ratio is reflected at the times indicated below.
  - When control power is turned on
  - When communication is established (when ESM state transitions from Init → PreOP)
  - When homing is completed
  - When clearing multi-turn data
  - When the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends
  - When Config is executed by Set-up Support Software (PANATERM ver.7)
  - When Err27.4.0 “Position command error protection” occurs

  Even if the set values for related objects are changed, they are not reflected as-is.

- The absolute encoder position [pulse/unit]/electronic gear ratio values must be within the range of -2^{31} (-2147483648) to $+2^{31}-1$(2147483647) in the positional information initialization processing when going from Init to PreOP in absolute mode. Operation outside this cannot be guaranteed.

  Check the operational range for the absolute encoder position and the electronic gear ratio.
- The unit for setting the moving distance for the trial run function by Set-up Support Software (PANATERM ver.7) is [command unit].

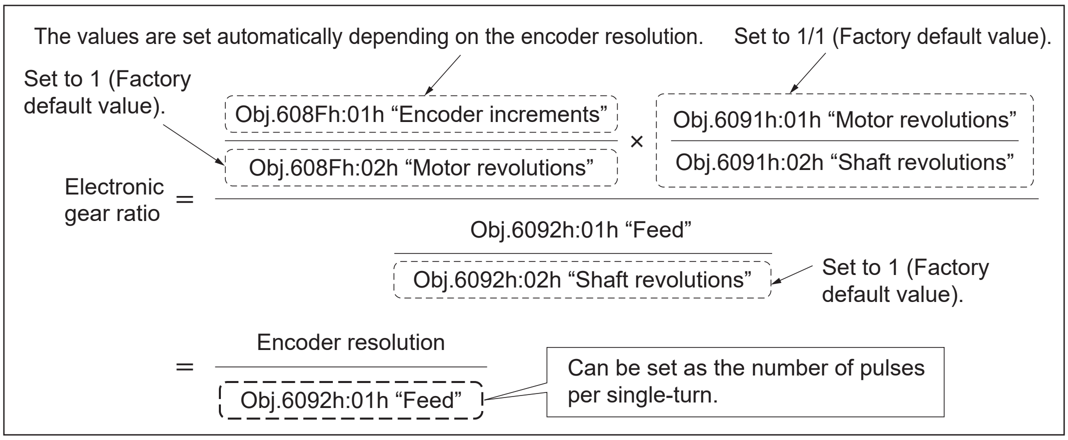
■ Electronic gear settings

1 Example of electronic gear settings

Unlike the MINAS A7N series, this product does not support electronic gear settings using “Pr0.08 “Number of command pulses per one motor revolution” ” and “Pr0.09 “Numerator of electronic gear” /Pr0.10 “Denominator of electronic gear” ”.

For electronic gear setting for the MINAS A7N series, see the following.

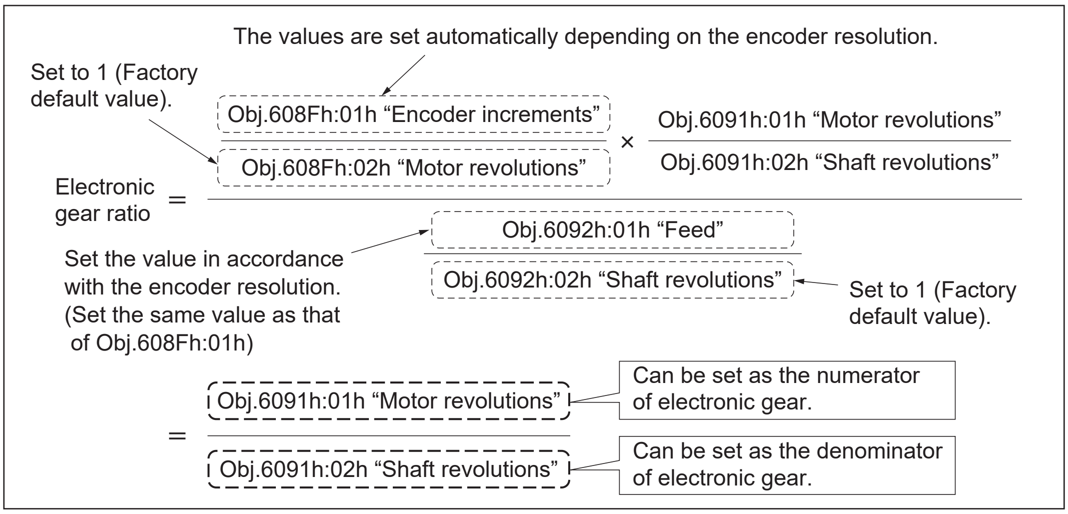
- If setting the electronic gear ratio by setting the command pulse count per motor revolution when using semi-closed controls



Obj.608Fh:01h “Encoder increments” is automatically set based on the resolution of the connected encoder.

By setting Obj.608Fh:02h “Motor revolutions” , Obj.6091h:01h “Motor revolutions” , Obj.6091h:02h “Shaft revolutions” and Obj.6092h:02h “Shaft revolutions” to “1” (factory default value), Obj.6092h:01h “Feed” can be set as the ”command pulse count per motor revolution”.

- If setting the electronic gear ratio by setting the numerator/denominator of electronic gear when using semi-closed controls or full-closed controls



Obj.608Fh:01h “Encoder increments” is automatically set based on the resolution of the connected encoder.

By setting Obj.6092h:01h “Feed” to the same value as the encoder resolution (Obj.608Fh:01h “Encoder increments”) (factory default value for 27-bit/r encoders) and setting Obj.608Fh:02h “Motor revolutions” and Obj.6092h:02h “Shaft revolutions” to 1 (factory default value), Obj.6091h:01h “Motor revolutions” can be set as the “electronic gear numerator” and Obj.6091h:02h “Shaft revolutions” as the “electronic gear denominator”.

2 Backing up electronic gear setup values

Electronic gear related objects (Obj.6091h:01h “Motor revolutions” , Obj.6091h:02h “Shaft revolutions” , Obj.6092h:01h “Feed” , Obj.6092h:02h “Shaft revolutions”) are objects to be backed up.

Backing up (writing to EEPROM) is recommended after making any changes.

Backing up means that there is no need to change settings each time you activate the control power.

For backup methods, see *“5.2.5 Store Parameters (Write Object to EEPROM) (1010h)”* .

■ Position encoder resolution (Obj.608Fh)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
608Fh	—	Position encoder resolution	—	—	—	—	—	—	—	—
	● The encoder resolution is set automatically.									
608Fh	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	● Displays the number of Obj.608Fh: “Position encoder resolution” Sub-Indexes.									
608Fh	01h	Encoder increments	pulse	1 to 4294967295	U32	ro	No	ALL	No	X
	● Indicates the amount of encoder movement. The value automatically sets the encoder resolution. The encoder resolution is also set automatically when using full-closed controls.									
608Fh	02h	Motor revolutions	r (motor)	1 to 4294967295	U32	ro	No	ALL	No	X
	● Displays the number of motor rotations. The value is fixed at 1.									

This object defines the encoder resolution per one motor revolution.

$$\text{Position encoder resolution} = \frac{\text{Obj.608Fh:01h “Encoder increments”}}{\text{Obj.608Fh:02h “Motor revolutions”}}$$

This object is automatically set based on the information read from the motor connected to this product.

Example: When a 27 bit/r encoder is connected

Obj.608Fh:01h “Encoder increments” = 134217728

Obj.608Fh:02h “Motor revolutions” = 1

Position encoder resolution = 134217728/1 = 134217728

■ Gear ratio (Obj.6091h)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6091h	—	Gear ratio	—	—	—	—	—	—	—	—
	● Sets the gear ratio.									
6091h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
	● Displays the number of Obj.6091h: “Gear ratio” Sub-Indexes.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6091h	01h	Motor revolutions	r (motor)	1 to 4294967295	U32	rw	No	ALL	Yes	P, H
		● Sets the number of motor rotations.								
6091h	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P, H
		● Sets the number of shaft rotations.								

This object defines the relationship between the number of motor rotations and the number of shaft rotations after gearbox output.

$$\text{Gear ratio} = \frac{\text{Obj.6091h:01h “Motor shaft revolutions”}}{\text{Obj.6091h:02h “Driving shaft revolutions”}}$$

■ Feed constant (Obj.6092h)

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
6092h	—	Feed constant	—	—	—	—	—	—	—	—
		● Sets the feed constant.								
6092h	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
		● Displays the number of Obj.6092h: “Feed constant” Sub-Indexes.								
6092h	01h	Feed	Command unit	1 to 4294967295	U32	rw	No	ALL	Yes	P, H
		● Sets the feed amount.								
6092h	02h	Shaft revolutions	r (shaft)	1 to 4294967295	U32	rw	No	ALL	Yes	P, H
		● Sets the number of shaft rotations.								

This object indicates the amount of movement per single turn of the shaft after gearbox output.

$$\text{Feed constant} = \frac{\text{Obj.6092h:01h “Feed”}}{\text{Obj.6092h:02h “Driving shaft revolutions”}}$$

5.5.8.4.3 Polarity (607Eh)

This can be used for setting the polarity (motor rotational direction) for the position command, speed command, torque command, and the various offsets.

This product does not support the setting of rotational direction using the parameter Pr0.00 “Rotational direction setup” . The rotational direction is set by Obj.607Eh:00h “Polarity” as specified in CoE (CiA402). Note that Obj.607Eh:00h “Polarity” is not a direct replacement for the parameter Pr0.00 “Rotational direction setup” , but is enabled when transferring data for corresponding objects in the following table between the CoE (CiA402) processing section and motor control processing section.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Eh	00h	Polarity	—	0 to 255	U8	rw	No	ALL	Yes	P H

- Sets the polarity for when transferring position commands, speed commands, torque commands, position offsets, speed offsets (added speed) and torque offsets (added torque) values from objects to the internal processing, and for when transferring position feedback, speed feedback and torque feedback values from the internal processing to objects.

Setup value	Description
0	No position, velocity or torque sign inversion
224	With position, velocity or torque sign inversion
Other than the above	Not supported (do not attempt to configure settings)

bits 4 to 0: Reserved
  Set to 0.
bit 5: Torque polarity
  0: No sign inversion
  1: Sign inversion
bit 6: Speed polarity
  0: No sign inversion
  1: Sign inversion
bit 7: Position polarity
  0: No sign inversion
  1: Sign inversion
Target object <commands/settings>
  Obj.607Ah:00h “Target position”
  Obj.60B0h:00h “Position offset”
  Obj.60FFh:00h “Target velocity”
  Obj.60B1h:00h “Velocity offset”
  Obj.6071h:00h “Target torque”
  Obj.60B2h:00h “Torque offset”
<Monitoring>
  Obj.4F04h:00h “Position command internal value (after filtering)”
  Obj.6062h:00h “Position demand value”
  Obj.6064h:00h “Position actual value”
  Obj.606Bh:00h “Velocity demand value”
  Obj.606Ch:00h “Velocity actual value”
  Obj.6074h:00h “Torque demand”
  Obj.6077h:00h “Torque actual value”
  Obj.60FAh:00h “Control effort”
<External input>
  Obj.60FDh:00h “Digital inputs” :bit 0 “negative limit switch” (NOT)
  Obj.60FDh:00h “Digital inputs” :bit 1 “positive limit switch” (POT)
  POT and NOT for external input signals

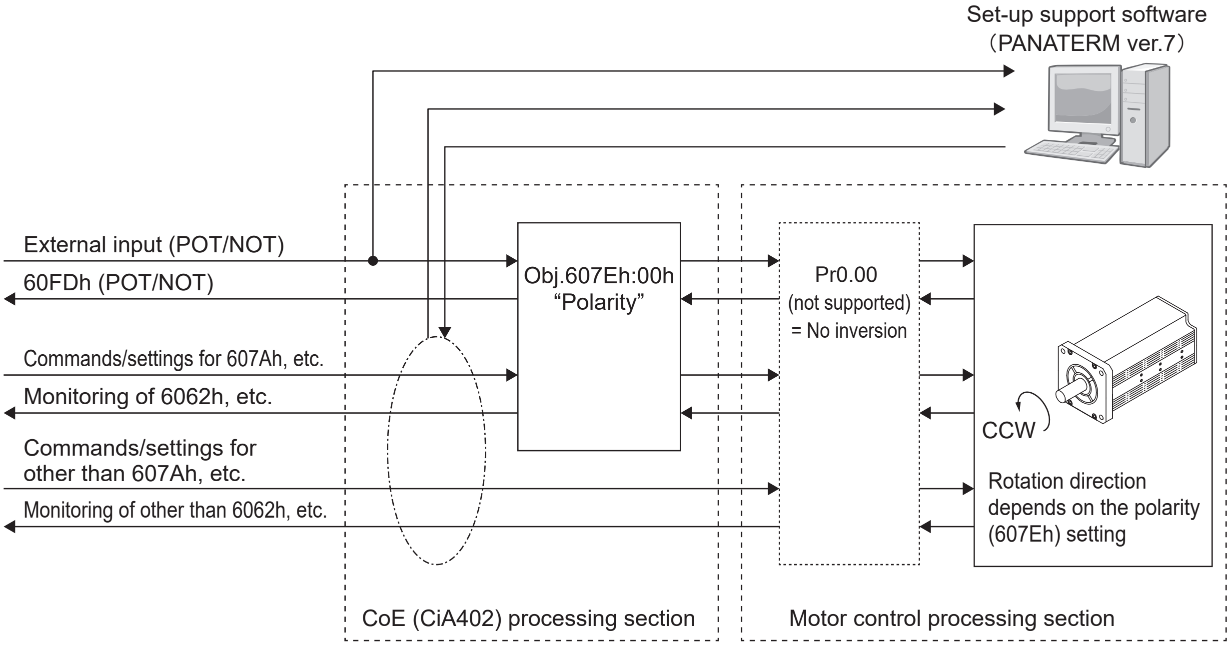
Precautions

- Set the value for Obj.607Eh:00h “Polarity” to 0 (bits 7 to 5 = all 0) or 224 (bits 7 to 5 = all 1) to ensure that the position, speed, and torque polarity are all the same.
- Operations cannot be guaranteed with other settings.

In addition to the data for corresponding objects in the above table, the set value for Obj.607Eh:00h “Polarity” is reflected in monitor data on Set-up Support Software (PANATERM ver.7) related to the corresponding objects.

Additionally, the setting for Set-up Support Software (PANATERM ver.7) will also be reflected in POT and NOT during the execution of functions such as the trial run function, frequency characteristics analysis function, and Z-phase search function in Obj.607Eh:00h “Polarity” (POT is the positive direction in the command unit.).

Set Obj.607Eh:00h “Polarity” to “Sign inversion” and pay attention to the logic of over-travel inhibit when conducting a trial run, etc.

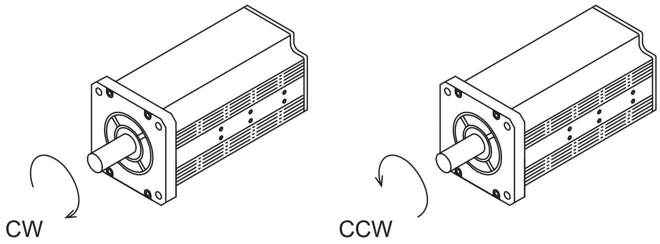


No sign inversion: The rotational direction of the motor for positive direction commands is CCW

Sign inversion: The rotational direction of the motor for positive direction commands is CW

Notes

- The motor rotational direction, when viewed from the load side axis end, is defined as CW when clockwise and CCW when counterclockwise.



Precautions

- The setting for Obj.607Eh:00h “Polarity” is reflected at the times indicated below.
  - When control power is turned on
  - When communication is established (when ESM state transitions from Init → PreOP)
  - When the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends
  - When Config is executed by Set-up Support Software (PANATERM ver.7)
  - When Err27.4.0 “Position command error protection” occurs

    Settings for Obj.607Eh:00h “Polarity” are not reflected when homing is completed or when multi-turn data is cleared.

- With the One Minute TUNING function, the motor reciprocates multiple times. If the One Minute TUNING function is executed when only the set value for Obj.607Eh:00h “Polarity” is changed and the set value is not reflected in the operation, the setting for Obj.607Eh:00h “Polarity” is reflected at the end of the first motor operation. This means that the drive direction is reversed from the second motor operation.

  Use the One Minute TUNING function with the setting for Obj.607Eh:00h “Polarity” reflected in advance.
- The setup value for Obj.607Eh:00h “Polarity” when the control power is turned on is reflected in the pulse regeneration function.

5.5.8.4.4 Initialization of Absolute Encoder (During Semi-closed Control)

Although there is no need for a homing operation (except when using the absolute encoder in incremental mode) when using an absolute encoder in position control mode, multi-turn data must be cleared when initially starting the machine (Excluding single-turn absolute encoder mode.).

The multi-turn data must be cleared when Err94.3.0 “Homing error protection 2” is triggered during homing in absolute encoder mode.

■ Absolute data

Data read from the absolute encoder (27 bits/r) includes single-turn data that indicates the position within a single turn of the motor and multi-turn data that counts once per turn. Of the two, the multi-turn data uses an electrical counter, so it is configured to be backed up internally.

Both types of data have polarities that increase with CCW rotation when seen from the motor axis end.

Using Obj.3015h:00h “Absolute encoder setup” , you can select whether Err41.0.0 “Absolute counter over error protection” is triggered when multi-turn data overflows.

	Backup during control power shut off	Data width	Sign	Data range
Single-turn data	Unnecessary	27 bits	No	0 to 134217727
Multi-turn data	(*2)	16 bits	No	0 to 65535 (Max.) (*1)

*1 Upper-limit values in continuous rotating absolute encoder mode can be set using Obj.3688h:00h “Absolute encoder multi-turn data upper-limit value” .

Except when in continuous rotating absolute encoder mode, the maximum value will be 65535.

*2 Backup during power shut off will vary depending on Obj.3015h:00h “Absolute encoder setup” .

Absolute encoder type	Obj.3015h:00h “Absolute encoder setup”	
	0, 2, 4	1, 3
Battery backup	Battery required	Battery not required
Batteryless	Battery not required	

The product initializes position information at the times listed in *“5.5.8.4.1 Initialization Timing for Position Information”* .

With a 27-bit absolute encoder, the single-turn data is 27 bits and the multi-turn data is 16 bits. Although the combined position information of these is 43 bits wide, the value set in the object as the position information is only 32 bits wide.

Because Obj.6063h:00h “Position actual internal value” sets only the lower 32 bits of the absolute encoder data as positional information, the higher 11 bits of the multi-turn data’s 16 bits are lost, resulting in an effective bit length of 5 bits.

Obj.6064h:00h “Position actual value” calculates position information based on the following formula, resulting in position information that is 32 bits wide. For this reason, the effective bit length of multi-turn data will vary depending on the electronic gear inverse conversion value.

Obj.607Eh:00h “Polarity”	Position information
If 0 (CCW is the positive direction)	6063h = (M × 2^{27} + S) + (37C0h × 2^{27} + 37C1h)
	6064h = (6063h × Electronic gear inverse conversion value) + 607Ch
If 224 (CW is the positive direction)	6063h = (M × 2^{27} + S) + (37C0h × 2^{27} + 37C1h)
	6064h = - (6063h × Electronic gear inverse conversion value) + 607Ch

* Obj.37C0h:00h “Absolute scale offset1”

* Obj.37C1h:00h “Absolute scale offset2”

* Obj.6063h:00h “Position actual internal value”

* Obj.6064h:00h “Position actual value”

* Obj.607Ch:00h “Home offset”

* M: Multi-turn_Data

* S: Single-turn_Data

The effective range of multi-turn data can be specified using Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” .

Pr6.98 bit 3	Effective range of encoder data [pulse unit]	Actual position data [command unit] (*2) (Obj.6063h × Electronic gear inverse conversion value)		Effective maximum number of rotations (*1)	Err29.1.0
		Electronic gear ratio	Data range		
1	Single-turn data: 27 bit Multi-turn data: 5 bit, 11 bit Ignore	1× or more	Actual position data Max. 32 bits	31 (-16 to 15)	Not detected (*4)
		Less than 1×		Less than 30 (Between -15 and 14) Supplement: Dependent upon the electronic gear ratio	Not detected (*4)
0	Single-turn data: 27 bit Multi-turn data: 16 bit	2048× or more	Actual position data Max. 32 bits	65535 (-32768 to 32767)	Not detected (*4)
		Less than 2048×	Actual position data Max. 32 bits ▨ Err29.1.0 triggered	Less than 65534 (Between -32767 and 32766) Supplement: Dependent upon the electronic gear ratio	Detected (*3)

*1 On the Set-up Support Software (PANATERM ver.7) and EtherCAT, multi-turn data values are displayed as unrestricted information (0 to 65535) in the form of unsigned data (In continuous rotating absolute encoder mode, the value Pr6.88 is the upper limit value displayed.).

Signed data in parentheses ( ) is used for the generated real position [command unit].

- When Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 0

  The actual position is calculated within the range of the maximum effective number of rotations with the higher 16 bits of the multi-turn data being effective.

  (Example) Multi-turn data 1 is calculated as 1, 32768 is calculated as -32768, and 65535 is calculated as -1 for the actual position.

- When Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 1

  The actual position is calculated within the range of the maximum effective number of rotations by ignoring the higher 11 bits of multi-turn data.

(Example) Multi-turn data 1 is calculated as 1, 16 is calculated as -16, and 31 is calculated as -1 for the actual position.

If the value is outside the range of the effective maximum number of rotations (when the higher 11 bits of the multi-turn data are not 0), it will be initialized to the same actual position as when it is within the range of the effective maximum number of rotations (when the higher 11 bits of the multi-turn data are 0).

*2 The value of the actual position calculated from single-turn data, multi-turn data, and electronic gear inverse calculated values must be within a 32-bit width. The host device should not allow position commands to exceed this range.

*3 If the value of the actual position calculated from single-turn data, multi-turn data, and electronic gear inverse converted values exceeds a 32-bit width, Err29.1.0 “Counter overflow protection 1” is triggered.

*4 To rotate infinitely in one direction, set Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 0 and the electronic gear ratio to 2048× or more, or Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 1 to avoid detecting errors. However, depending on the electronic gear ratio setting, the position at which the actual position exceeds 32 bits and the power turns back on may differ from the position before power was shut off.

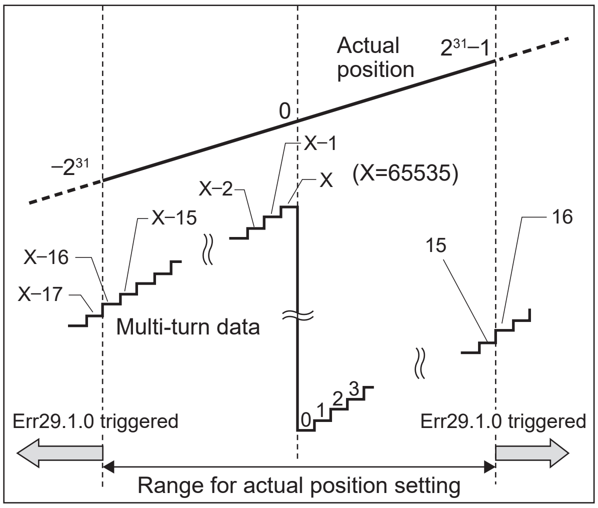
Related objects

–: N/A

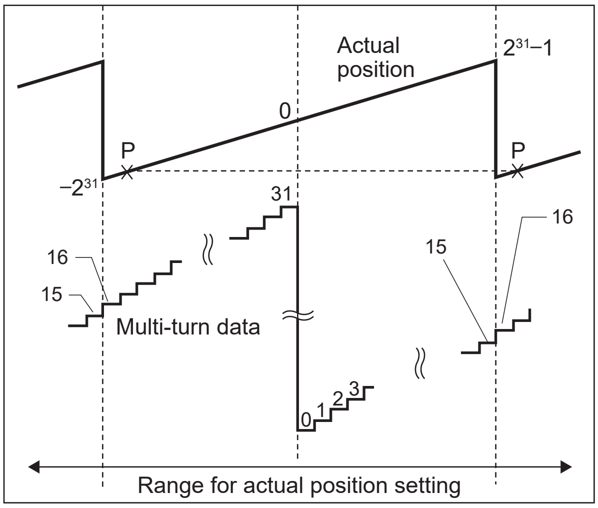
<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>3698h</td><td>00h</td><td>Function expansion setup 4</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>R</td></tr>
<tr><td colspan="11">● bit 3: Effective bit expansion for multi-turn data
0: Enabled (-32768 to 32767 rotations)
1: Disabled (-16 to 15 rotations)</td></tr>
</table>

The following figure shows the difference in the actual position depending on the number of enabled multi-turn bits when the electronic gear ratio is 1×.

3698h:bit 3 = 0



3698h:bit 3 = 1



The location information handled by this product is 32-bit wide data. If absolute encoder position information of 33 bits or more is required, it can be calculated using the following formula.

When using an electronic gear, multiply the reciprocal of the electronic gear ratio by this result.

Obj.4F41h:02h “Multi-turn data” × 2^{27} + Obj.4F41h:01h “Mechanical angle (Single-turn data)”

Note that in order to obtain position information, Obj.4F41h:01h “Mechanical angle (Single-turn data)” and Obj.4F41h:02h “Multi-turn data” should be allocated to TxPDO.

Obj.4F41h:01h “Mechanical angle (Single-turn data)” If Obj.4F41h:01h “Mechanical angle (Single-turn data)” and Obj.4F41h:02h “Multi-turn data” are not allocated to TxPDO, read them at the same time in SDO if at all possible.

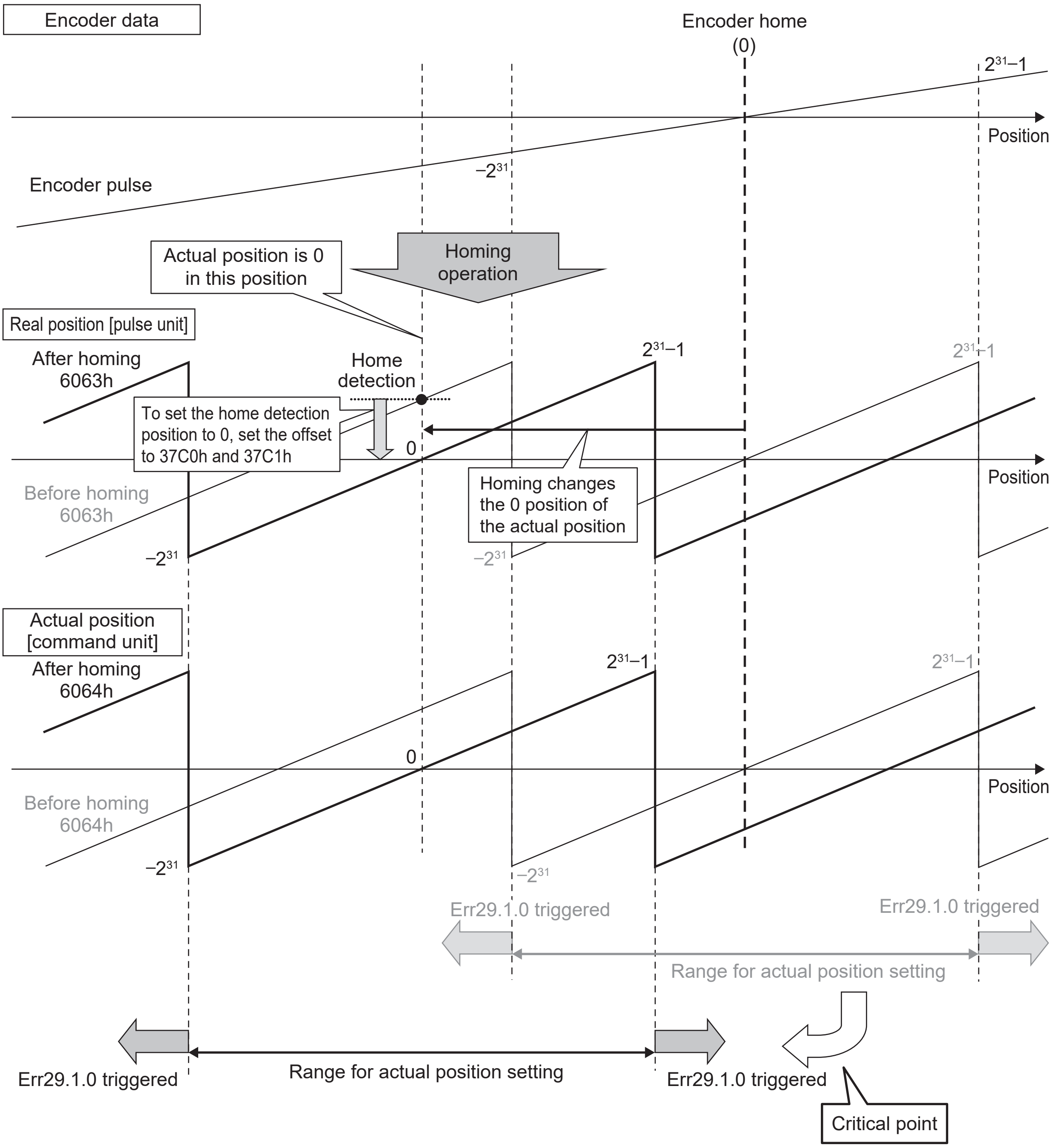
When doing so, there may be a deviation of approximately a single turn in the vicinity of changes to multi-turn data. For this reason, do not use the data that was read in the vicinity of the changes to multi-turn data, but instead use the data read when the motor stops in the vicinity where the single-turn data is approximately 2^{26}, which is the farthest position.

■ Precautions

- Changing the possible setting range for actual position

  Electronic gear ratio: 1/1, Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 0

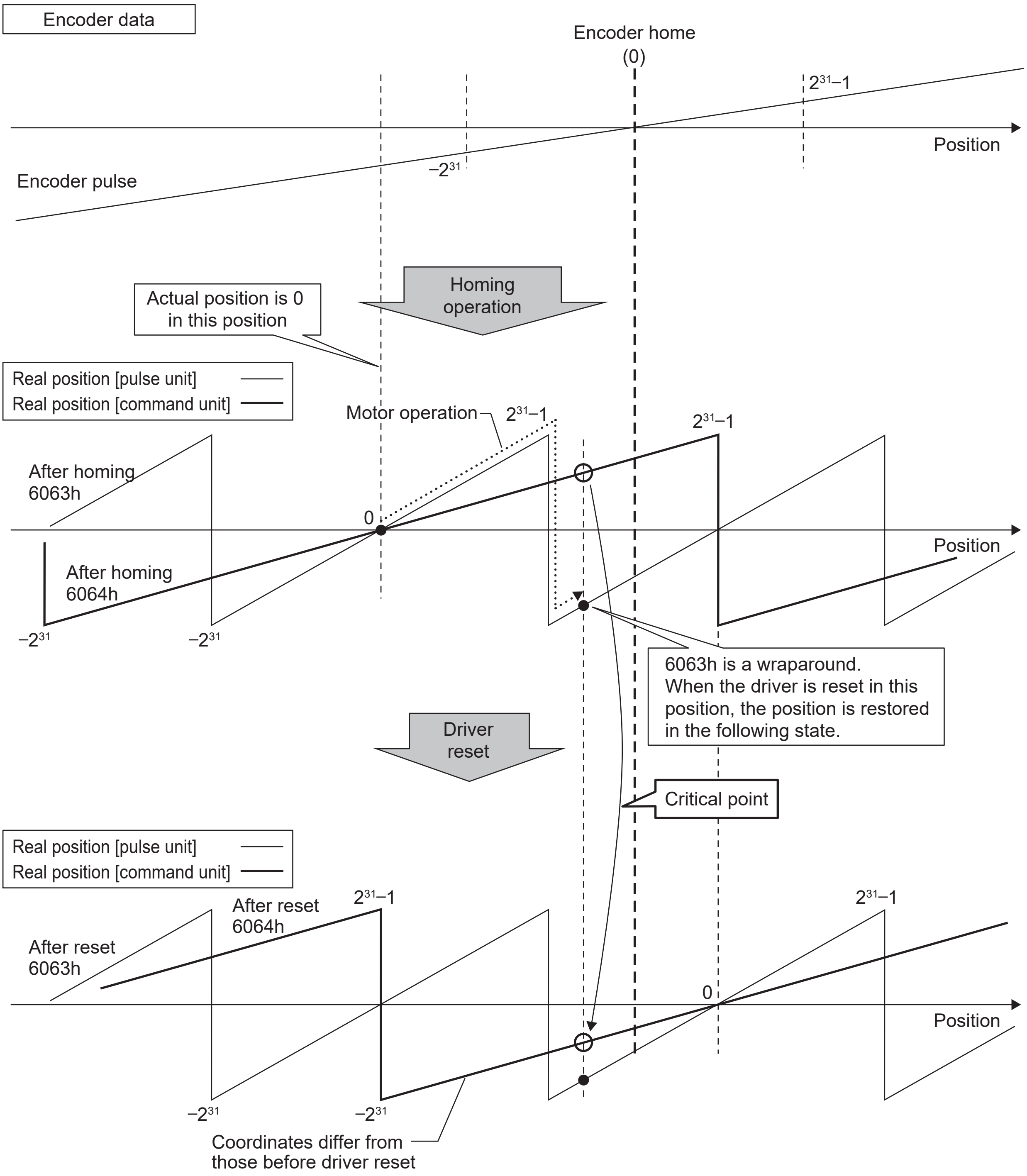
  The possible setting range for the actual position and the range in which Err29.1.0 “Counter overflow protection 1” is triggered can also be change in accordance with changes to real position 0 by executing homing (Refer to “Critical point” in the figure below.).



- Changing Obj.6064h:00h “Position actual value” after driver reset

Electronic gear ratio: 2/1, Obj.3698h:00h “Function expansion setup 4” :bit 3 “Effective bit expansion for multi-turn data” = 1

If the electronic gear ratio is not 1/1 and the driver is reset while the actual position [pulse unit] (Obj.6063h:00h “Position actual internal value”) is a wraparound, the actual position [command unit] (Obj.6064h:00h “Position actual value”) will change. (Refer to “Critical point” in the figure below.)



■ Clearing multi-turn data

Clearing multi-turn data will cause the location of the change to multi-turn data on the CW side of the position where multi-turn data was cleared to become actual position 0.

Because multi-turn data may change intermittently near the location where the multi-turn data changed, clearing the multi-turn data at this time will shift the position of actual position 0 by approximately a single turn depending on the value of the multi-turn data.

To prevent such deviation, clear the data at a position near where the single-turn data, which is the furthest position from the location where the multi-turn data was changed, becomes 2^{26}.

Precautions

- When clearing multi-turn data, ensure safety by making sure to leave the servo off and securing it with the brake, etc., if necessary.
- Also leave the servo off during execution and make sure to turn off the control power once execution is complete before turning it on again.

Multi-turn data is cleared via the Set-up Support Software (PANATERM ver.7) or EtherCATcommunication.

Although Err27.1.0 “Absolute clear protection” will be triggered if multi-turn data is cleared via the Set-up Support Software (PANATERM ver.7) , this is only a safety measure and not an error.

Via EtherCAT communication, both Obj.4D00h:01h “Special function start flag 1” and Obj.4D01h:00h “Special function setting 9” can be used to clear multi-turn data.

After setting 0031h to Obj.4D01h:00h “Special function setting 9” , multi-turn data can be cleared by changing Obj.4D00h:01h “Special function start flag 1” :bit 9 from 0 to 1.

When multi-turn data is cleared in the hm control mode, Obj.6041h:00h “Statusword” :bit 12 “homing attained” will be temporarily set to 0.

Once the multi-turn data has been cleared, Obj.6041h:00h “Statusword” :bit 12 “homing attained” returns to 1.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D00h	—	Special function start	—	—	—	—	—	—	—	—
		● Executes special functions in accordance with the set value for Obj.4D01h:00h.								
4D00h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X
		● Displays the number of Obj.4D00h: “Special function start” Sub-Indexes.								
4D00h	01h	Special function start flag 1	—	0 to 4294967295	U32	rw	No	ALL	No	B
		● bit 9: When the rising edge (0 → 1) of this bit is detected, a special function is executed in accordance with the set value for Obj.4D01h:00h “Special function setting 9” . After this bit is set to 1, it can be returned to 0 at any time. Even if the value is returned to 0 during the execution of a special function, the process being executed will continue.								
4D00h	02h	Special function start flag 2	—	0 to 4294967295	U32	rw	No	ALL	No	B
		Manufacturer use (Do not change, leave set to the factory default value (0))								
4D01h	00h	Special function setting 9	—	0 to 65535	U16	rw	No	ALL	No	B
		● Set the values in the following table to this object and perform the corresponding special function by starting Obj.4D00h:01h “Special function start flag 1” :bit 9 (change 0 to 1). The value of this object returns to 0000h once the special function has been completed. If Obj.4D00h:01h “Special function start flag 1” :bit 9 is started and an Abort Message appears while the in a state where the multi-turn data cannot be cleared, it will not return to 0000h.								

Value	Function
0000h	Nothing happens
0031h	Absolute encoder multi-turn clear
Other than the above	Operation indeterminate. Do not set.

Precautions

- Note the following when clearing multi-turn data via EtherCAT communication.
  - Do so with the servo off.
  - Do not attempt to clear multi-turn data during execution of the touch probe function.
  - Do not attempt to transition the ESM status while clearing multi-turn data.
  - Do not attempt to change the control mode while clearing multi-turn data.

- Do not attempt to clear multi-turn data via the Set-up Support Software (PANATERM ver.7) or refresh the battery while clearing multi-turn data via EtherCAT communication.
- Attempting to clear multi-turn data via EtherCAT communication in the following states will return Abort Message “08000022h”. Ensure that the following states are not present when attempting to clear multi-turn data via EtherCAT communication.
  - Servo-on state
  - Clearing of multi-turn data is in progress (via EtherCAT communication)
  - Clearing of multi-turn data is in progress via the Set-up Support Software (PANATERM ver.7)
  - When using an incremental encoder
  - When the touch probe function is being executed
  - When in single-turn absolute encoder mode (Obj.3015h = 3)

  Notes

  - ● Obj.4D01h:00h “Special function setting 9” will not return a 0 when an Abort Message appears.

- Err27.1.0 “Absolute clear protection” will not be triggered if multi-turn data is cleared via EtherCAT communication.

5.5.8.4.5 Position range limit (607Bh)

If the value for Obj.607Ah:00h “Target position” straddles Obj.607Bh: “Position range limit” , wraparound processing will take effect.

Note that the same wraparound processing will also take effect for absolute systems. However, in continuous rotating absolute encoder and in the case of absolute positioning or csp control with pp control, the value at which wraparound occurs will change depending on Obj.3688h:00h “Absolute encoder multi-turn data upper-limit value” and electronic gear settings. Also, setting Obj.607Ah:00h “Target position” outside the range of Obj.607Bh: “Position range limit” will trigger Err91.1.0 “Command error protection” .

Precautions

- ● Obj.607Ah:00h “Target position” should be set so as to not exceed the value of Obj.607Bh: “Position range limit” .
- ● Except in continuous rotating absolute encoder mode, it is treated internally as Obj.607Bh:01h “Min position range limit” = 80000000h and Obj.607Bh:02h “Max position range limit” = 7FFFFFFFh.

—: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Bh	—	Position range limit	—	—	—	—	—	—	—	—
	● Sets the boundary where position coordinates wrap around.									
607Bh	00h	Highest sub-index supported	—	2	U8	ro	No	ALL	No	X
	● Displays the number of sub-indexes in Obj.607Bh: “Position range limit” .									
607Bh	01h	Min position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X
	● When position coordinates are below this set value (minimum value), wraparound to the other side of the range (maximum value) occurs. In continuous rotating absolute encoder mode, the value calculated by internal processing is set automatically. Except in continuous rotating absolute encoder mode, it is treated internally as 80000000h (factory default value).									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Bh	02h	Max position range limit	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	X

- When position coordinates are above this set value (maximum value), wraparound to the other side of the range (minimum value) occurs.

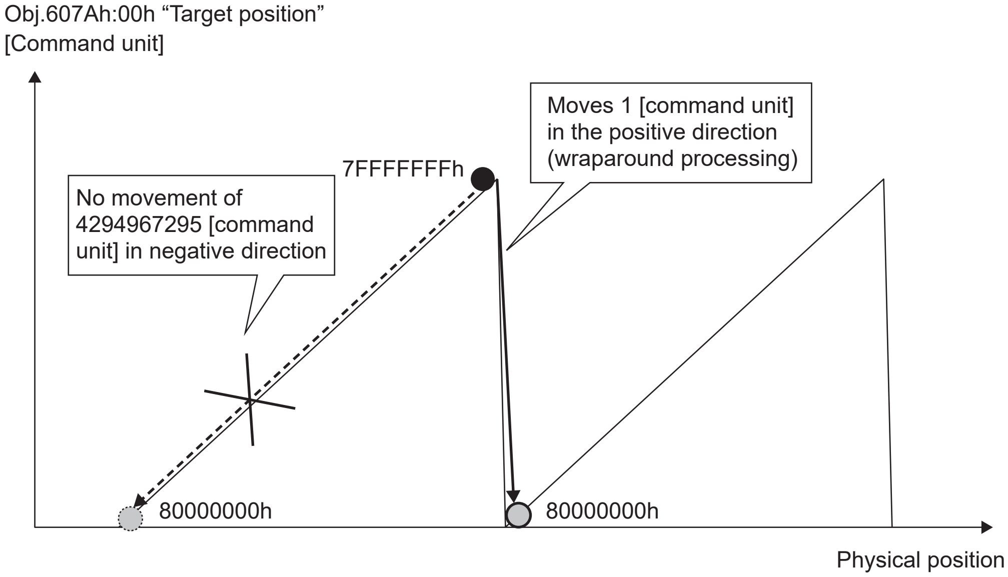
  In continuous rotating absolute encoder mode, the value calculated by internal processing is set automatically.

  Except in continuous rotating absolute encoder mode, it is treated internally as 7FFFFFFFh (factory default value).

Example of wraparound

Obj.607Bh:01h “Min position range limit” = 80000000h

If Obj.607Ah:00h “Target position” changes from 7FFFFFFFh to 80000000h (absolute value movement) when Obj.607Bh:02h “Max position range limit” = 7FFFFFFFh

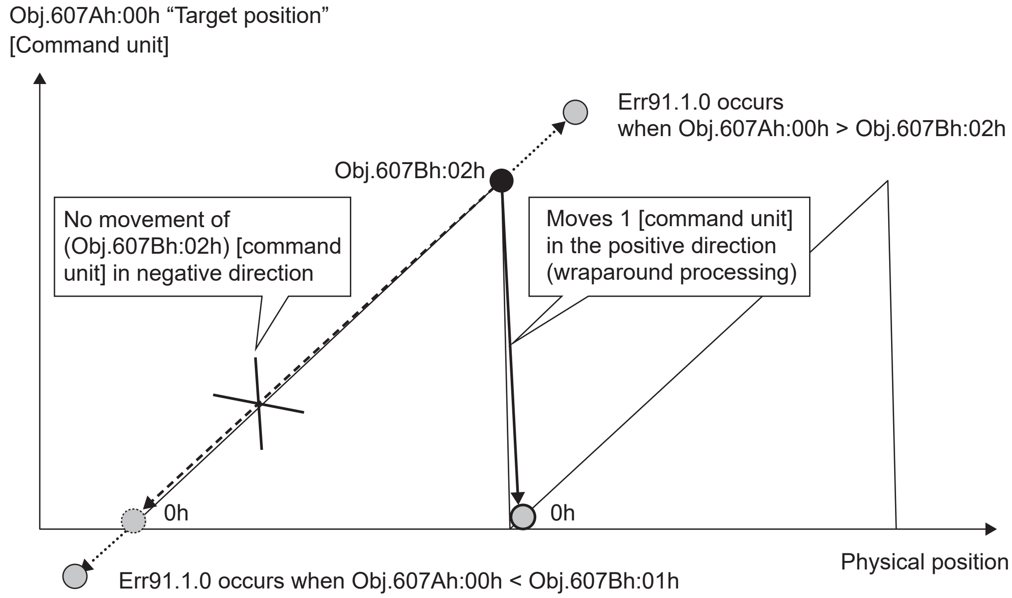


Example of wraparound (continuous rotating absolute encoder mode)

Obj.607Bh:01h “Min position range limit” = 0h

When Obj.607Bh:02h “Max position range limit” $= \dfrac{2^{27}}{\text{Electronic gear ratio}} \times (3688\text{h} + 1) - 1$,

If Obj.607Ah:00h “Target position” changes from Obj.607Bh:02h “Max position range limit” to Obj.607Bh:01h “Min position range limit” (absolute value movement)



5.5.8.4.6 Home offset (607Ch)

Although this object can be updated at any time, the actual position information will be reflected at the following times.

(Example) When the electronic gear ratio is 1/1 and there is no polarity reversal

- When control power is turned on
- When communication is established (when ESM state transitions from Init → PreOP)
- When homing is completed
- When clearing of multi-turn data via the Set-up Support Software (PANATERM ver.7) and EtherCAT
- When the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends
- When Config is executed by Set-up Support Software (PANATERM ver.7)
- When Err27.4.0 “Position command error protection” occurs

The following objects are initialized (preset) based on the position at the above time.

- When the home position is detected

  Obj.6063h:00h “Position actual internal value” = Obj.60FCh:00h “Position demand internal value” = 0

  Obj.6062h:00h “Position demand value” = Obj.6064h:00h “Position actual value” = Obj.607Ch:00h “Home offset”
- During initialization to “presets” at times other than when the home position is detected

  Obj.6063h:00h “Position actual internal value” = Obj.60FCh:00h “Position demand internal value”

  Obj.6062h:00h “Position demand value” = Obj.6064h:00h “Position actual value” = Obj.6063h:00h “Position actual internal value” + Obj.607Ch:00h “Home offset”

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	I32	rw	RxPDO	ALL	Yes	P H

- After completing the execution of homing position control mode (hm), the position information is set so that the detected Index Pulse position functions as the value for this object.

  The value of this object will also be added to the position information at the following times.
  - When control power is turned on
  - When communication is established (when ESM state transitions from Init → PreOP)
  - When homing is completed
  - When clearing of multi-turn data via the Set-up Support Software (PANATERM ver.7) and EtherCAT
  - When the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends
  - When Config is executed by Set-up Support Software (PANATERM ver.7)
- When Err27.4.0 “Position command error protection” occurs

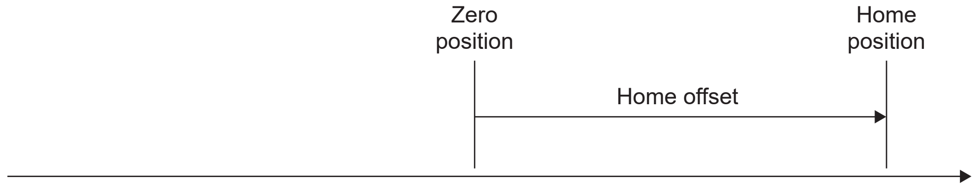
Precautions

- Position information will be preset when homing is performed. For this reason, data acquired using the old coordinate system (e.g., Touch probe position) must be reacquired.

- For an incremental system

  Home position: Position detected as home

  Zero position: 0 (the position when control power-is turned on or the position obtained by subtracting the Home offset from the Home position detected by hm)



<Home offset definition>

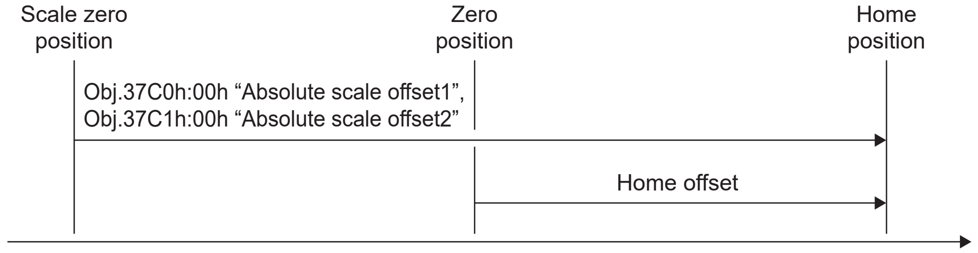
- For an absolute system

  Home position: Position detected as home

  Zero position: The position obtained by subtracting the home offset from the home position detected by hm

  Scale zero position, in semi-closed control: Zero position of the absolute encoder

  Scale zero position, in full-closed control: Zero position of absolute external scale or the home position minus Obj.37C0h and Obj.37C1h



<Home offset definition>

5.5.8.4.7 Initialization of Absolute Scale (During Full-closed Control)

■ Absolute data

The absolute scale position information during full-closed control is 48 bits wide, which consists of the lower 24 bits and higher 24 bits of external scale position data. However, the value set in the object as the position information is 32 bits wide.

Because Obj.6063h:00h “Position actual internal value” sets only the lower 32 bits of the absolute scale data as position information, only the lower 8 bits of the higher 24-bit data are effective.

Obj.6064h:00h “Position actual value” calculates position information based on the following formula, resulting in position information that is 32 bits wide.

For this reason, the effective bit length of the external scale position information data during full-closed control will vary depending on the electronic gear inverse conversion value.

In full-closed control, Err29.1.0 “Counter overflow protection 1” is generated when the calculated value of $(((H\times2^{24} + L) + (37C0h\times2^{24} + 37C1h)) \times$ electronic gear inverse conversion value) exceeds a width of 32 bits, or when an overflow occurs in the process of the above calculation.

607Eh “Polarity”	Maximum effective bit length of H	Position Information
0 (No sign inversion)	8 bits	Obj.6063h = $(H \times 2^{24} + L) + (\text{Obj.37C0h} \times 2^{24} + \text{Obj.37C1h})$
	21 bits	Obj.6064h = $(((H \times 2^{24} + L + (\text{Obj.37C0h} \times 2^{24} + \text{Obj.37C1h})) \times$ Electronic gear inverse conversion value) + Obj.607Ch
224 (Sign inversion)	8 bits	Obj.6063h = $(H \times 2^{24} + L) + (\text{Obj.37C0h} \times 2^{24} + \text{Obj.37C1h})$
	21 bits	Obj.6064h = $-((((H \times 2^{24} + L) + (\text{Obj.37C0h} \times 2^{24} + \text{Obj.37C1h})) \times$ Electronic gear inverse conversion value)) + Obj.607Ch

H: External scale data (Higher 24 bit)

L: External scale data (Lower 24 bit)

Obj.37C0h:00h “Absolute scale offset1” Position information in which the H sign is inverted during homing

Obj.37C1h:00h “Absolute scale offset2” Position information in which the L sign is inverted during homing

Obj.6063h:00h “Position actual internal value”

Obj.6064h:00h “Position actual value”

Obj.607Ch:00h “Home offset”

■ Clearing multi-turn data

Multi-turn data can be cleared when using the full-closed control function on a rotary scale. For clearing multi-turn data, see *“5.5.8.4.4 Initialization of Absolute Encoder (During Semi-closed Control)”* .

5.5.8.4.8 Backlash Compensation Function

Obj.3704h:00h “Backlash compensation enable” , Obj.3705h:00h “Backlash compensation value” , and Obj.3706h:00h “Constant for backlash compensation” can compensate for backlash (mechanical clearance between the driving axis and the driven axis) during position control (including full-closed control).

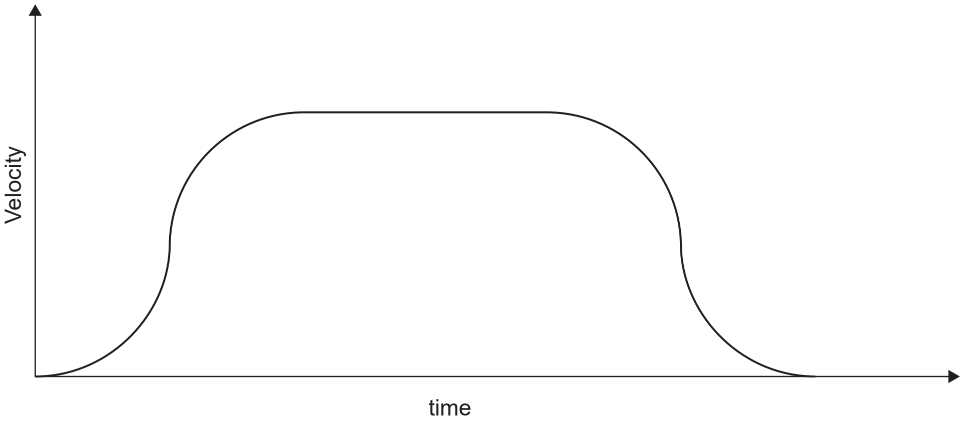
Although the feedback position during backlash compensation returns a value that is the result of removing the amount of backlash compensation after backlash has been corrected, the amount of backlash compensation appears in the transient state during backlash compensation.

5.5.8.5 Jerk (Not Supported)

Jerk is not supported by this software version.

Set Obj.6086h:00h “Motion profile type” , Obj.60A4h:01h “Profile jerk1” , and Obj.60A4h:02h “Profile jerk2” to 0, and Obj.60A3h:00h “Profile jerk use” to 1.

Setting jerk can smooth switching between acceleration and deceleration.



<Velocity/time diagram with jerk positions>

This function is not supported and cannot be used, but smoothing can also be achieved using Obj.3222h:00h “Positional command smoothing filter” and Obj.3223h:00h “Positional command FIR filter” .

5.5.8.6 Interpolation Time Period (60C2h)

Obj.60C2h: “Interpolation time period” is automatically set according to the communication cycle as shown in the table below and should not be changed.

Communication cycle	Obj.60C2h:01h	Obj.60C2h:02h
62.5 μs	62	-6
125 μs	125	-6
250 μs	25	-5
500 μs	5	-4
1 ms	1	-3
2 ms	2	-3
4 ms	4	-3
8 ms	8	-3
10 ms	1	-2

Precautions

- If the communication cycle is operating at 62.5 μs, 60C2h:01h is set to 62 instead of 62.5.

–: N/A

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60C2h	–	Interpolation time period	–	–	–	–	–	–	–	–
● Sets the interpolation time cycle.										

R1.1

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
60C2h	00h	Highest sub-index supported	—	2	U8	ro	No	ip csp csv cst	No	X
	● Displays the number of sub-indexes in Obj.60C2h: “Interpolation time period” .									
60C2h	01h	Interpolation time period value	—	0 to 255	U8	rw	No	ip csp csv cst	Yes	A
	● Sets the interpolation time cycle. This is automatically set according to the communication cycle.									
60C2h	02h	Interpolation time index	—	-128 to 63	I8	rw	No	ip csp csv cst	Yes	A
	● Sets the interpolation time index. This is automatically set according to the communication cycle.									

5.5.8.7 Servo Information Monitoring Object

This object is used to monitor the information retained by this product.

—: N/A

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4308h</td><td>00h</td><td>History number</td><td>—</td><td>0 to 3</td><td>U8</td><td>rw</td><td>No</td><td>ALL</td><td>No</td><td>A</td></tr>
<tr><td></td><td colspan="10">● Selects the alarm supplementary information to be displayed using Obj.4DA0h: “Alarm accessory information” .
If set to 0, supplementary information for the current alarm is displayed.
When set to 1 to 3, supplementary information for 1 to 3 alarms ago is displayed.
(Alarms with attributes that do not remain in the history are not eligible as past alarms.)</td></tr>
<tr><td>430Eh</td><td>—</td><td>Timestamp reference time</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td></td><td colspan="10">● Sets the reference time for timestamping used by the timestamping function. For details on the timestamping function, see Technical Reference Functional Specification “7.3 Timestamp Function” .
The reference time for timestamping should be set to the elapsed time in ns units, starting at 0:00:0:0 on January 1, 2000.
(Example) April 1, 2023, 0:00:00:00
Sets 0A2E59AF97450000h (=733622400000000000).
The reference time for timestamping is reflected internally by the product using the following procedure.
1 The reference time for timestamping is set as 64-bit data and sent to this product by SDO. Of the 64-bit data, the lower 32 bits are set using Obj.430Eh:01h “Timestamp reference time setting 1” , while the higher 32 bits are set using Obj.430Eh:02h “Timestamp reference time setting 2” .
2 Change Obj.60FEh: “Digital outputs” Obj.60FEh:01h “Physical outputs” :bit 28 “Timestamp reference time reset” from 0 to 1 with PDO. The set values of 430Eh:01h and 430Eh:02h sent to this product are reflected inside the servo driver when 60FEh:01h:bit 28 changes from 0 to 1. If synchronizing multiple axes, changes to Obj.60FEh: “Digital outputs” Obj.60FEh:01h “Physical outputs” :bit 28 “Timestamp reference time reset” must be made for all axes simultaneously. Accordingly, changes to 60FEh:01h:bit 28 should be made in DC synchronous mode or SM2 synchronous mode and with the ESM status set to OP.
The reference time for timestamping will not be set in this product when 60FEh:01h:bit 28 is changed from 0 to 1 and the reference time for timestamping has not been set at 430Eh:01h and 430Eh:02h, or when 60FEh:01h:bit 28 is not changed from 0 to 1 (the reference time for timestamping has not been updated in this product). In such a case, the time for timestamping would be as follows.
• In DC synchronous mode, the product reads the Distributed Clock from the ESC and uses it as the time for timestamping.
• In modes other than DC synchronous mode, the time for timestamping is fixed at 0000000000000000h (January 1, 2000, 0:00:00:00).</td></tr>
<tr><td>430Eh</td><td>00h</td><td>Number of entries</td><td>—</td><td>2</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td></td><td colspan="10">● Displays the number of Obj.430Eh: “Timestamp reference time” Sub-Indexes.</td></tr>
<tr><td>430Eh</td><td>01h</td><td>Timestamp reference time setting 1</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>No</td><td>A</td></tr>
<tr><td></td><td colspan="10">● Sets the lower 32 bits of the reference time for timestamping.
Sets bits 0 to 31 of the elapsed time in ns units, with January 1, 2000 0:00:0:0 as 0.
(Example) For April 1, 2023, 0:00:00:00 (733622400 seconds have elapsed since January 1, 2000, 0:00:00:00)
Because 0A2E59AF97450000h (=733622400000000000) is bits 0 to 31, set 97450000h (=2537881600).</td></tr>
<tr><td>430Eh</td><td>02h</td><td>Timestamp reference time setting 2</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>rw</td><td>No</td><td>ALL</td><td>No</td><td>A</td></tr>
<tr><td></td><td colspan="10">● Sets the higher 32 bits of the reference time for timestamping.
Sets bits 32 to 63 of the elapsed time in ns units, with January 1, 2000 0:00:0:0 as 0.
(Example) For April 1, 2023, 0:00:00:00 (733622400 seconds have elapsed since January 1, 2000, 0:00:00:00)
Because 0A2E59AF97450000h (=733622400000000000) is bits 32 to 63, set 0A2E59AFh (=170809775).</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4310h	00h	Alarm main no	—	0 to 127	U8	rw	No	ALL	No	A

- Alarm sub-number information for the alarm main number set in Obj.4310h:00h “Alarm main no” is displayed in Obj.4F37h:10h “Multiple sub alarm information” .

  Furthermore, alarm primary cause number information for alarms that correspond to the combination of the alarm main numbers set in Obj.4310h:00h “Alarm main no” and alarm sub-numbers set in Obj.4317h:00h “Alarm sub no” is displayed in Obj.4F37h:20h “Multiple alarm cause information 1” to Obj.4F37h:23h “Multiple alarm cause information 4” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4317h	00h	Alarm sub no	—	0 to 127	U8	rw	No	ALL	No	A

- For details, see Obj.4310h:00h “Alarm main no” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D0Eh	—	Expansion warning flags	—	—	—	—	—	—	—	—

- Displays flags indicating the status of currently triggered warnings.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D0Eh	00h	Number of entries	—	3	U8	ro	No	ALL	No	X

- Displays the number of Obj.4D0Eh: “Expansion warning flags” Sub-Indexes.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D0Eh	01h	Expansion warning flags 1	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays flags indicating the status of currently triggered warnings.

  Bit assignments are as follows.

—: No assignment

bit	Warning flag
0	Battery warning
1	—
2	Lifetime detection warning
3	Encoder overheat warning
4	Encoder communication warning
5	Over-regeneration warning
6	Fan lock warning
7	Motor overload warning
8	External scale error warning
9	—
⋮	
11	
12	Main power off warning

bit	Warning flag
13	Oscillation detection warning
14	External scale communication warning
15	—
⋮	
23	
24	Set-up Support Software (PANATERM ver.7) command execution warning
25	Over-travel inhibit warning
26	—
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D0Eh	02h	Expansion warning flags 2	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays flags indicating the status of currently triggered warnings.
  Bit assignments are as follows.

—: No assignment

bit	Warning flag
0	—
⋮	
7	
8	Main power phase loss warning
9	Fan speed reduction warning
10	Driver overload warning
11	Lifetime detection warning 2
12	—
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D0Eh	03h	Expansion warning flags 3	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays flags indicating the status of currently triggered warnings.
  Bit assignments are as follows.

—: No assignment

bit	Warning flag
0	—
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D10h	—	External scale ID	—	—	—	—	—	—	—	—

- Displays the external scale ID.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D10h	00h	Number of entries	—	2	U8	ro	No	ALL	No	X

- Displays the number of sub-indexes in Obj.4D10h: “External scale ID” .

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4D10h	01h	External scale vendor ID	—	—	VS	ro	No	ALL	No	X

- Displays the external scale vendor ID.
  One byte NULL is appended at the end. The size of this object is 2 bytes.
  3: Mitutoyo Corporation
  4: Magnescale Co., Ltd.
  5: Common ID (Panasonic communication specifications)

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4D10h</td><td>02h</td><td>External scale model ID</td><td>–</td><td>–</td><td>VS</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">
● Displays the external scale model ID.
One byte NULL is appended at the end. The size of this object is 2 bytes.
<table>
<tr><th>Vendor name</th><th>Model ID</th><th>Absolute/ Incremental</th></tr>
<tr><td rowspan="3">Mitutoyo Corporation</td><td>1</td><td>Absolute</td></tr>
<tr><td>2</td><td>Absolute (Electromagnetic induction type)</td></tr>
<tr><td>3</td><td>Incremental</td></tr>
<tr><td rowspan="3">Magnescale Co., Ltd.</td><td>1</td><td>Absolute</td></tr>
<tr><td>2</td><td>Incremental</td></tr>
<tr><td>3</td><td>Incremental (Laser scale)</td></tr>
<tr><td rowspan="2">Common ID (Panasonic communication specifications)</td><td>1</td><td>Absolute</td></tr>
<tr><td>2</td><td>Incremental</td></tr>
</table>
</td></tr>
<tr><td>4D12h</td><td>00h</td><td>Motor serial number</td><td>–</td><td>–</td><td>VS</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the motor serial number (Max. 8 characters).
Two byte NULL is appended at the end. The size of this object is 10 bytes.
(Example) “17040021”</td></tr>
<tr><td>4D15h</td><td>00h</td><td>Drive serial number</td><td>–</td><td>–</td><td>VS</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the driver serial number (Max. 8 characters).
A NULL occupies 2 bytes at the end. The size of this object is 10 bytes.
(Example) “17100001”</td></tr>
<tr><td>4D29h</td><td>00h</td><td>Over load factor</td><td>0.1%</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the overload load factor (ratio of motor rated load).</td></tr>
<tr><td>4D51h</td><td>00h</td><td>Analog input status</td><td>–</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>csp</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the setting status Obj.4351h:00h “Analog input function” .
Bit 0: Setting status of position compensation function switching
0: Position compensation disabled
1: Position correction enabled</td></tr>
<tr><td>4D57h</td><td>00h</td><td>Driver derating monitor</td><td>%</td><td>0 to 65535</td><td>U16</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the ratio of driver overload warnings to the warning trigger level.</td></tr>
<tr><td>4DA0h</td><td>–</td><td>Alarm accessory information</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td colspan="11">● Displays supplementary information for the alarm specified by Obj.4308h:00h “History number” .
• When Obj.4308h:00h “History number” = 0, supplementary information for the current alarm is displayed.
• When Obj.4308h:00h “History number” = 1 to 3, supplementary information for 1 to 3 alarms ago is displayed.
Precautions
● Obj.4DA0h: “Alarm accessory information” does not support PDO.
● Each sub-index of Obj.4DA0h: “Alarm accessory information” is read by SDO so synchronism cannot be guaranteed.</td></tr>
<tr><td>4DA0h</td><td>00h</td><td>Number of entries</td><td>–</td><td>71</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the number of sub-indexes in Obj.4DA0h: “Alarm accessory information” .</td></tr>
</table>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4DA0h</td><td>01h</td><td>History number echo</td><td>–</td><td>0 to 3</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the echo back of the history number set in Obj.4308h:00h “History number” .</td></tr>
<tr><td>4DA0h</td><td>02h</td><td>Alarm code</td><td>–</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the alarm number.
bits 7 to 0: Alarm sub-numbers
bits 14 to 8: Alarm main numbers
bits 31 to 15: Manufacturer use</td></tr>
<tr><td>4DA0h</td><td>03h</td><td>Control mode</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the control mode.
0: Position control mode
1: Velocity control mode
2: Torque control mode
3: Full-closed control mode</td></tr>
<tr><td>4DA0h</td><td>04h</td><td>Motor speed</td><td>r/min</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the motor speed.</td></tr>
<tr><td>4DA0h</td><td>05h</td><td>Positional command velocity</td><td>r/min</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the position command speed.</td></tr>
<tr><td>4DA0h</td><td>06h</td><td>Velocity control command</td><td>r/min</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the velocity control command.</td></tr>
<tr><td>4DA0h</td><td>07h</td><td>Torque command</td><td>0.05%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the torque command.</td></tr>
<tr><td>4DA0h</td><td>08h</td><td>Position command deviation</td><td>Command unit</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the position command deviation.</td></tr>
<tr><td>4DA0h</td><td>09h</td><td>Position actual internal value</td><td>pulse</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the motor position.</td></tr>
<tr><td>4DA0h</td><td>0Bh</td><td>Input port (logic signal)</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays input ports (logical signals).</td></tr>
<tr><td>4DA0h</td><td>0Ch</td><td>Output port (logic signal)</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays output ports (logical signals).</td></tr>
<tr><td>4DA0h</td><td>0Dh</td><td>Analog input</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays analog inputs.</td></tr>
<tr><td>4DA0h</td><td>10h</td><td>Overload ratio</td><td>0.2 %</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the overload load factor.</td></tr>
<tr><td>4DA0h</td><td>11h</td><td>Regenerative load ratio</td><td>%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the regenerative load factor.</td></tr>
<tr><td>4DA0h</td><td>12h</td><td>Voltage across PN</td><td>V</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the voltage across P and N.</td></tr>
<tr><td>4DA0h</td><td>13h</td><td>Temperature of amplifier</td><td>°C</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the driver temperature.</td></tr>
</table>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4DA0h</td><td>14h</td><td>Warning flags</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays warning flags.
Bit assignments are as follows.
—: No assignment
<table>
<tr><th>bit</th><th>Warning flag</th></tr>
<tr><td>0</td><td>Battery warning</td></tr>
<tr><td>1</td><td>—</td></tr>
<tr><td>2</td><td>Lifetime detection warning</td></tr>
<tr><td>3</td><td>Encoder overheat warning</td></tr>
<tr><td>4</td><td>Encoder communication warning</td></tr>
<tr><td>5</td><td>Over-regeneration warning</td></tr>
<tr><td>6</td><td>Fan lock warning</td></tr>
<tr><td>7</td><td>Motor overload warning</td></tr>
<tr><td>8</td><td>External scale error warning</td></tr>
<tr><td>9</td><td>—</td></tr>
<tr><td>10</td><td>—</td></tr>
</table>
<table>
<tr><th>bit</th><th>Warning flag</th></tr>
<tr><td>11</td><td>—</td></tr>
<tr><td>12</td><td>Main power off warning</td></tr>
<tr><td>13</td><td>Oscillation detection warning</td></tr>
<tr><td>14</td><td>External scale communication warning</td></tr>
<tr><td>15</td><td rowspan="3">—</td></tr>
<tr><td>⋮</td></tr>
<tr><td>31</td></tr>
</table>
</td></tr>
<tr><td>4DA0h</td><td>15h</td><td>Inertia ratio</td><td>%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the inertia ratio.</td></tr>
<tr><td>4DA0h</td><td>19h</td><td>Temperature of encoder</td><td>°C</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the encoder temperature.</td></tr>
<tr><td>4DA0h</td><td>1Dh</td><td>U-phase current detection value</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the U-phase current detection value.</td></tr>
<tr><td>4DA0h</td><td>1Eh</td><td>W-phase current detection value</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the W-phase current detection value.</td></tr>
<tr><td>4DA0h</td><td>21h</td><td>Encoder single-turn data</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays encoder single-turn data.</td></tr>
<tr><td>4DA0h</td><td>22h</td><td>Encoder communication error count (accumulated)</td><td>Inciden-ces</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the cumulative number of successive encoder communication errors.</td></tr>
<tr><td>4DA0h</td><td>23h</td><td>External scale communication data error count (accumulated)</td><td>Inciden-ces</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the cumulative number of successive external scale communication errors.</td></tr>
</table>

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4DA0h</td><td>25h</td><td>Alarm occurrence time on timestamp standard (Lower)</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the lower 32 bits at the time an alarm is triggered. The displayed value changes depending whether the set reference time for timestamping has been applied to this product and on the synchronization mode. For information on how the set reference time for timestamping is applied to this product, see the explanation for Obj.430Eh: “Timestamp reference time” in *“5.5.8.7 Servo Information Monitoring Object”* .
• If the alarm was triggered after the set reference time for timestamping was applied to this product, bits 0 to 31 of the elapsed time from the reference time for timestamping are displayed.
• If the alarm was triggered in DC synchronous mode and before the set reference time for timestamping was applied to this product, the product displays bits 0 to 31 of the Distributed Clock time read from the ESC.
• If the alarm was triggered in a mode other than DC synchronous mode and before the set reference time for timestamping was applied to this product, the data to be read is fixed at 0.</td></tr>
<tr><td>4DA0h</td><td>26h</td><td>Alarm occurrence time on timestamp standard (Higher)</td><td>ns</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the higher 32 bits at the time an alarm is triggered. The displayed value changes depending whether the set reference time for timestamping has been applied to this product and on the synchronization mode. For information on how the set reference time for timestamping is applied to this product, see the explanation for Obj.430Eh: “Timestamp reference time” in *“5.5.8.7 Servo Information Monitoring Object”* .
• If the alarm was triggered after the set reference time for timestamping was applied to this product, bits 32 to 63 of the elapsed time from the reference time for timestamping are displayed.
• If the alarm was triggered in DC synchronous mode and before the set reference time for timestamping was applied to this product, the product displays bits 32 to 63 of the Distributed Clock time read from the ESC.
• If the alarm was triggered in a mode other than DC synchronous mode and before the set reference time for timestamping was applied to this product, the data to be read is fixed at 0.</td></tr>
<tr><td>4DA0h</td><td>27h</td><td>Alarm occurrence time on power on time</td><td>0.5 h</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the total time of control power energization of the servo driver when an alarm is detected.</td></tr>
<tr><td>4DA0h</td><td>28h</td><td>Alarm occurrence time on power on time (detail)</td><td>62.5 μs</td><td>0 to 4294967295</td><td>U32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Out of the total time of control power energization of the servo driver when an alarm is detected, this displays amounts of time less than 30 minutes that are not displayed by Obj.4DA0h:27h “Alarm occurrence time on power on time” .</td></tr>
<tr><td>4DA0h</td><td>2Ah</td><td>Alarm code (extended)</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the extended alarm number.
bits 7 to 0: Manufacturer use
bits 15 to 8: Alarm cause numbers
bits 23 to 16: Alarm sub-numbers
bits 31 to 24: Alarm main numbers</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4DA0h	2Bh	Warning flags1	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays warning flag 1.
  Bit assignments are as follows.

–: No assignment

bit	Warning flag
0	Battery warning
1	–
2	Lifetime detection warning
3	Encoder overheat warning
4	Encoder communication warning
5	Over-regeneration warning
6	Fan lock warning
7	Motor overload warning
8	External scale error warning
9	–
⋮	
11	

bit	Warning flag
12	Main power off warning
13	Oscillation detection warning
14	External scale communication warning
15	–
⋮	
23	
24	Set-up Support Software (PANATERM ver.7) command execution warning
25	Over-travel inhibit warning
26	–
⋮	
31	

4DA0h	2Ch	Warning flags2	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays warning flag 2.
  Bit assignments are as follows.

–: No assignment

bit	Warning flag
0	–
⋮	
7	
8	Main power phase loss warning
9	Fan speed reduction warning
10	Driver overload warning
11	Lifetime detection warning 2
12	–
⋮	
31	

4DA0h	2Dh	Warning flags3	–	0 to 4294967295	U32	ro	No	ALL	No	X

- Displays warning flag 3.
  Bit assignments are as follows.

–: No assignment

bit	Warning flag
0	–
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F01h	00h	Following error actual value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
• Displays position deviation (after filter).										
4F03h	00h	Analog input internal voltage	mV	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the level of the applied voltage (after offset and filter) of the analog input.										
4F04h	00h	Position command internal value (after filtering)	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
• Displays the internal command position (after filter).										
4F0Ch	00h	Velocity command value (after filtering)	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
• Displays command speed (after filter). **Notes** • Returns the same value as Obj.4FA5h:00h “Velocity internal position command” . • If monitoring, use Obj.4FA5h.										
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays position information for the external scale.										
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
• Displays the regenerative load factor (the ratio of regenerative overload protection to the level of alarm occurrence).										

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F21h	00h	Logical input signal	–	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the logical level status of the input signal.
  Bit assignments are as follows.

–: No assignment

bit	Input signal logical level status
0	–
1	External alarm clear input (A-CLR)
2	Negative direction over-travel inhibit input (NOT)
3	Positive direction over-travel inhibit input (POT)
4	–
5	–
6	–
7	Forced alarm input (E-STOP)
8	–
⁞	
26	
27	Safety input 1 (SF1) (*1)
28	Safety input 2 (SF2) (*1)
29	–
30	–
31	Dynamic brake switching input (DB-SEL)

*1 Within 100 ms after the safety input turns from OFF to ON, there are times at which the self-diagnosis function turns OFF max. 6 times for 5 ms. Note that acquiring the logical level status during this period may result in acquiring an OFF status due to the diagnostic signal.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F22h	00h	Logical output signal	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the logical level status of the output signal.
  Bit assignments are as follows.

—: No assignment

bit	Output signal logical level status
0	Servo-ready output (S-RDY)
1	Servo alarm output (ALM)
2	Positioning complete output (INP)
3	Brake release output (BRK-OFF)
4	Zero-speed detection output (ZSP)
5	Output during torque limitation (TLC)
6	Velocity coincidence output (V-COIN)
7	—
8	—
9	Speed arrival output (AT-SPEED)
10	Deterioration diagnosis velocity output (V-DIAG)
11	—
⋮	
14	

bit	Output signal logical level status
15	Servo-on export (SRV-ST) (*1)
16	Warning output 1 (WARN1)
17	Warning output 2 (WARN2)
18	Position command ON/OFF output (P-CMD)
19	Positioning complete output 2 (INP2)
20	Output during velocity limit (V-LIMIT)
21	Alarm clear attribute output (ALM-ATB)
22	Speed command ON/OFF output (V-CMD)
23	EDM output (EDM)
24	General-purpose output (EX-OUT1)
25	—
⋮	
29	
30	STO status monitor output (STO) (*2)
31	—

*1 Indicates servo-on status if 0, and servo-off status if 1.

*2 The STO status monitoring output signal is not safety-related.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F23h	00h	Logical input signal (expansion portion)	—	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the logical level status of the input signal (extended portion).
  Bit assignments are as follows.

—: No assignment

bit	Input signal logical level status
0	External latch input 1 (EXT1)
1	External latch input 2 (EXT2)
2	—
3	—
4	Near home input (HOME)
5	—
⋮	
12	
13	Retracting operation input (RET)

bit	Input signal logical level status
14	—
⋮	
17	
18	General-purpose monitor input 1 (SI-MON1)
19	General-purpose monitor input 2 (SI-MON2)
20	General-purpose monitor input 3 (SI-MON3)
21	General-purpose monitor input 4 (SI-MON4)
22	General-purpose monitor input 5 (SI-MON5)
23	—
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F25h	00h	Physical input signal	–	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the physical level status of the input signal.
  Bit assignments are as follows.

–: No assignment

bit	Input signal physical level status
0	SI1 input
1	SI2 input
2	SI3 input
3	SI4 input
4	SI5 input
5	SI6 input
6	SI7 input
7	SI8 input
8	–
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F26h	00h	Physical output signal	–	0 to 4294967295	U32	ro	TxPDO	ALL	No	X

- Displays the physical level status of the output signal.
  Bit assignments are as follows.

–: No assignment

bit	Output signal physical level status
0	SO1 output
1	SO2 output
2	SO3 output
3	–
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X

- Displays the inertia ratio.
  Ratio of load inertia to motor rotor inertia (equivalent to the value in Obj.3004h)
  Inertia ratio: (load inertia/rotor inertia) × 100

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F32h	00h	Motor automatic identification	–	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays the motor automatic recognition enable status.
  255: Automatic recognition enabled
  Other than 255: Automatic recognition disabled

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F33h	00h	Cause of motor no work	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays a number indicating the cause of the motor being inoperative.

Cause No. (*1)	Item	Description (*2)
0	No cause	The cause of inoperation could not be detected. Operation would normally be possible in this state.
1	The servo is not in ready status.	● The main power supply of the driver is off, or an error occurred. ● Communication and servo synchronization are incomplete. This includes other cases in which the servo ready signal is off.
2	The servo-on command is off.	The servo-on command is off. ● The PDS status is not operation enabled. Etc.
3	Over-travel inhibit input is enabled.	When Pr5.04 “Over-travel inhibit input setup” = 0, 1 (over-travel inhibit input enabled) ● Positive direction over-travel inhibit input (POT) is on and the motion command is positive direction. ● Negative direction over-travel inhibit input (NOT) is on and the motion command is negative direction. When Pr5.04 “Over-travel inhibit input setup” = 2 (alarm triggered at over-travel inhibit input) ● The positive direction over-travel inhibit input (POT) or negative direction over-travel inhibit input (NOT) is turned on regardless of whether there is operation command input.
4	The torque limit setting is low	The enabled torque limit set value is set to 5% or less of the rating.
7	The position command input frequency is low	The position command per control cycle is one command unit or less.
10	The command speed from EtherCAT communication is low	The command speed from EtherCAT communication is set to 30 r/min or less.
11	Manufacturer use	—
12	The command torque from EtherCAT communication is small	The command torque from the EtherCAT communication is small as it is 5% or less of the rated torque.
13	The velocity limit is small	The velocity limit of Obj.6080h:00h “Max motor speed” is set to 30 r/min or less.
14	Other causes	Causes 1 to 13 do not apply and the motor is not rotating (Low command, heavy load/locking/collision, driver/motor failure, etc.).

*1 The motor may operate even if the read value is a number other than 0.

*2 Note that there are some exceptional detections, such as when over-travel inhibit input stops the position command generation process, resulting in cause 7 instead of cause 3.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F34h	00h	Warning flags	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays flags indicating the status of currently triggered warnings.

  Bit assignments are as follows.

—: No assignment

bit	Warning flag
0	Battery warning
1	—
2	Lifetime detection warning
3	Encoder overheat warning
4	Encoder communication warning
5	Over-regeneration warning
6	Fan lock warning
7	Motor overload warning
8	External scale error warning

bit	Warning flag
9	—
⋮	
11	
12	Main power off warning
13	Oscillation detection warning
14	External scale communication warning
15	—
⋮	
22	

bit	Warning flag
23	—
24	Set-up Support Software (PANATERM ver.7) command execution warning
25	Over-travel inhibit warning
26	—
⋮	
31	

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	—	Multiple alarm/warning information	—	—	—	—	—	—	—	—

- Displays the currently triggered alarm and warning information in the corresponding bit.

  The following is a procedure for reading alarms. When reading alarm numbers, acquire the main number first, and then the sub number.

  (Example) When reading alarm information with Err26.1.0 “2nd Overspeed protection” and Err38.0.0 “Over-travel inhibit input protection 1” triggered at the same time

1. Alarm information for alarm main numbers 0 to 31 are acquired by Obj.4F37h:01h “Multiple alarm information 1” .

   1 is returned for bit 26 because the corresponding alarm, Err26.1.0 “2nd Overspeed protection” , has been triggered. This result indicates that an alarm main number 26 error has been triggered.
2. Alarm information for alarm main numbers 32 to 63 are acquired by Obj.4F37h:02h “Multiple alarm information 2” .

   1 is returned for bit 6 because the corresponding alarm, Err38.0.0 “Over-travel inhibit input protection 1” , has been triggered. This result indicates that an alarm main number 38 error has been triggered.
3. Alarm information for alarm main numbers 64 to 95 are acquired by Obj.4F37h:03h “Multiple alarm information 3” .

   Because no corresponding alarm is triggered, 0 is returned.
4. Alarm information for alarm main numbers 96 to 127 are acquired by Obj.4F37h:04h “Multiple alarm information 4” .

   Because no corresponding alarm is triggered, 0 is returned.
5. Sets the main alarm number 26 that is being triggered to Obj.4310h:00h “Alarm main no” , and acquires the alarm sub-number of alarm main number 26 from Obj.4F37h:10h “Multiple sub alarm information” .

   Because Err26.1.0 “2nd Overspeed protection” was triggered, 1 is returned for bit 1. This result indicates that an alarm sub-number 1 error has been triggered.
6. Sets the main alarm number 38 that is being triggered to Obj.4310h:00h “Alarm main no” , and acquires the alarm sub-number of alarm main number 38 from Obj.4F37h:10h “Multiple sub alarm information” .

   Because Err38.0.0 “Over-travel inhibit input protection 1” was triggered, 1 is returned for bit 0. This result indicates that an alarm sub-number 1 error has been triggered.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	00h	Number of entries	—	35	U8	ro	No	ALL	No	X

- Displays the number of sub-indexes in Obj.4F37h: “Multiple alarm/warning information” .

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4F37h</td><td>01h</td><td>Multiple alarm information 1</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays alarm information for alarm main numbers 0 to 31.
Bit assignments are as follows. Non-existent alarm numbers are also shown.
<table>
<tr><th>bit</th><th>Alarm main number</th></tr>
<tr><td>0</td><td>Err0.□.□</td></tr>
<tr><td>1</td><td>Err1.□.□</td></tr>
<tr><td>2</td><td>Err2.□.□</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>29</td><td>Err29.□.□</td></tr>
<tr><td>30</td><td>Err30.□.□</td></tr>
<tr><td>31</td><td>Err31.□.□</td></tr>
</table></td></tr>
<tr><td>4F37h</td><td>02h</td><td>Multiple alarm information 2</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays alarm information for alarm main numbers 32 to 63.
Bit assignments are as follows. Non-existent alarm numbers are also shown.
<table>
<tr><th>bit</th><th>Alarm main number</th></tr>
<tr><td>0</td><td>Err32.□.□</td></tr>
<tr><td>1</td><td>Err33.□.□</td></tr>
<tr><td>2</td><td>Err34.□.□</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>29</td><td>Err61.□.□</td></tr>
<tr><td>30</td><td>Err62.□.□</td></tr>
<tr><td>31</td><td>Err63.□.□</td></tr>
</table></td></tr>
<tr><td>4F37h</td><td>03h</td><td>Multiple alarm information 3</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays alarm information for alarm main numbers 64 to 95.
Bit assignments are as follows. Non-existent alarm numbers are also shown.
<table>
<tr><th>bit</th><th>Alarm main number</th></tr>
<tr><td>0</td><td>Err64.□.□</td></tr>
<tr><td>1</td><td>Err65.□.□</td></tr>
<tr><td>2</td><td>Err66.□.□</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>29</td><td>Err93.□.□</td></tr>
<tr><td>30</td><td>Err94.□.□</td></tr>
<tr><td>31</td><td>Err95.□.□</td></tr>
</table></td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	04h	Multiple alarm information 4	–	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays alarm information for alarm main numbers 96 to 127.
  Bit assignments are as follows. Non-existent alarm numbers are also shown.

bit	Alarm main number
0	Err96.□.□
1	Err97.□.□
2	Err98.□.□
⋮	⋮
29	Err125.□.□
30	Err126.□.□
31	Err127.□.□

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	10h	Multiple sub alarm information	–	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays alarm information for the sub-numbers of alarm main numbers set by Obj.4310h:00h “Alarm main no” .
  Bit assignments are as follows. Non-existent alarm numbers are also shown.

bit	Alarm sub-number
0	Err□.0.□
1	Err□.1.□
2	Err□.2.□
⋮	⋮
29	Err□.29.□
30	Err□.30.□
31	Err□.31.□

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	11h	Multiple warning information 1	–	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays warning information for warning numbers A0h to BFh.
  Bit assignments are as follows. Non-existent warning numbers are also shown.

bit	Warning No.	bit	Warning No.	bit	Warning No.	bit	Warning No.
0	WngA0h	8	WngA8h	16	WngB0h	24	WngB8h
1	WngA1h	9	WngA9h	17	WngB1h	25	WngB9h
2	WngA2h	10	WngAAh	18	WngB2h	26	WngBAh
3	WngA3h	11	WngABh	19	WngB3h	27	WngBBh
4	WngA4h	12	WngACh	20	WngB4h	28	WngBCh
5	WngA5h	13	WngADh	21	WngB5h	29	WngBDh
6	WngA6h	14	WngAEh	22	WngB6h	30	WngBEh
7	WngA7h	15	WngAFh	23	WngB7h	31	WngBFh

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	12h	Multiple warning information 2	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays warning information for warning numbers C0h to DFh.
  Bit assignments are as follows. Non-existent warning numbers are also shown.

bit	Warning No.	bit	Warning No.	bit	Warning No.	bit	Warning No.
0	WngC0h	8	WngC8h	16	WngD0h	24	WngD8h
1	WngC1h	9	WngC9h	17	WngD1h	25	WngD9h
2	WngC2h	10	WngCAh	18	WngD2h	26	WngDAh
3	WngC3h	11	WngCBh	19	WngD3h	27	WngDBh
4	WngC4h	12	WngCCh	20	WngD4h	28	WngDCh
5	WngC5h	13	WngCDh	21	WngD5h	29	WngDDh
6	WngC6h	14	WngCEh	22	WngD6h	30	WngDEh
7	WngC7h	15	WngCFh	23	WngD7h	31	WngDFh

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	13h	Multiple warning information 3	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Displays warning information for warning numbers E0h to FFh.
  Bit assignments are as follows. Non-existent warning numbers are also shown.

bit	Warning No.	bit	Warning No.	bit	Warning No.	bit	Warning No.
0	WngE0h	8	WngE8h	16	WngF0h	24	WngF8h
1	WngE1h	9	WngE9h	17	WngF1h	25	WngF9h
2	WngE2h	10	WngEAh	18	WngF2h	26	WngFAh
3	WngE3h	11	WngEBh	19	WngF3h	27	WngFBh
4	WngE4h	12	WngECh	20	WngF4h	28	WngFCh
5	WngE5h	13	WngEDh	21	WngF5h	29	WngFDh
6	WngE6h	14	WngEEh	22	WngF6h	30	WngFEh
7	WngE7h	15	WngEFh	23	WngF7h	31	WngFFh

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F37h	20h	Multiple alarm cause information 1	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X

- Alarm cause number information for alarms that correspond to the combination of the alarm main numbers set in Obj.4310h:00h “Alarm main no” and alarm sub-numbers set in Obj.4317h:00h “Alarm sub no” is displayed.

bit	Alarm Cause No.
0	Err□.□.0
1	Err□.□.1
⋮	⋮
31	Err□.□.31

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4F37h</td><td>21h</td><td>Multiple alarm cause information 2</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Alarm cause number information for alarms that correspond to the combination of the alarm main numbers set in Obj.4310h:00h “Alarm main no” and alarm sub-numbers set in Obj.4317h:00h “Alarm sub no” is displayed.
<table>
<tr><th>bit</th><th>Alarm Cause No.</th></tr>
<tr><td>0</td><td>Err□.□.32</td></tr>
<tr><td>1</td><td>Err□.□.33</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>31</td><td>Err□.□.63</td></tr>
</table></td></tr>
<tr><td>4F37h</td><td>22h</td><td>Multiple alarm cause information 3</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Alarm cause number information for alarms that correspond to the combination of the alarm main numbers set in Obj.4310h:00h “Alarm main no” and alarm sub-numbers set in Obj.4317h:00h “Alarm sub no” is displayed.
<table>
<tr><th>bit</th><th>Alarm Cause No.</th></tr>
<tr><td>0</td><td>Err□.□.64</td></tr>
<tr><td>1</td><td>Err□.□.65</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>31</td><td>Err□.□.95</td></tr>
</table></td></tr>
<tr><td>4F37h</td><td>23h</td><td>Multiple alarm cause information 4</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Alarm cause number information for alarms that correspond to the combination of the alarm main numbers set in Obj.4310h:00h “Alarm main no” and alarm sub-numbers set in Obj.4317h:00h “Alarm sub no” is displayed.
<table>
<tr><th>bit</th><th>Alarm Cause No.</th></tr>
<tr><td>0</td><td>Err□.□.96</td></tr>
<tr><td>1</td><td>Err□.□.97</td></tr>
<tr><td>⋮</td><td>⋮</td></tr>
<tr><td>31</td><td>Err□.□.127</td></tr>
</table></td></tr>
<tr><td>4F41h</td><td>—</td><td>Motor encoder data</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td colspan="11">● Displays position information.</td></tr>
<tr><td>4F41h</td><td>00h</td><td>Number of entries</td><td>—</td><td>2</td><td>U8</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the number of sub-indexes in Obj.4F41h: “Motor encoder data” .</td></tr>
<tr><td>4F41h</td><td>01h</td><td>Mechanical angle (Single-turn data)</td><td>pulse</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO
(*1)</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the motor mechanical angle (encoder single-turn data).</td></tr>
<tr><td>4F41h</td><td>02h</td><td>Multi-turn data</td><td>Rotation</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO
(*1)</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays multi-turn data of the absolute encoder.
Notes
● Multi-turn data is undefined in increment mode (Obj.3015h:00h “Absolute encoder setup” = 1).</td></tr>
<tr><td>4F42h</td><td>00h</td><td>Electrical angle</td><td>0.0879°</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the electrical angle of the motor.</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F44h	00h	Encoder status	—	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the encoder status.									
4F48h	00h	External scale pulse total	Pulse (external scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the external scale pulse sum.									
4F49h	00h	External scale absolute position	Pulse (external scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the absolute position of the external scale.									
4F4Ah	00h	External scale position deviation	Pulse (external scale)	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
	● Displays the full-closed deviation.									
4F4Fh	00h	Analog input value	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	csp	No	X
	● Displays the position compensation value according to the voltage applied to the analog input.									
4F61h	00h	Power on cumulative time	30 minutes	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
	● Displays the total time of control power energization of this product.									
4F62h	00h	Temperature of amplifier	°C	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the product's internal temperature.									
4F63h (*1)	00h	Temperature of encoder	°C	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the encoder's internal temperature.									
4F64h	00h	Inrush resistance relay operating count	Incidences	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the number of times the relay for inrush current suppression resistance changes. Saturates at a maximum value of 40000000h. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed.									
4F65h	00h	Dynamic brake operating count	Incidences	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the number of times the relay for the dynamic brake changes. Saturates at a maximum value of 40000000h. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed.									
4F66h	00h	Fan operating time	30 minutes	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the operating time of the cooling fan. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed. Displayed as 0 if no fan is installed.									
4F67h	00h	Fan life expectancy	0.1%	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
	● Displays the ratio of cooling fan service life with full as 100%. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed. Displayed as 0 if no fan is installed.									

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F68h	00h	Capacitor life expectancy	0.1%	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the ratio of main power capacitor service life with full as 100%. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed.								
4F6Ch	00h	Motor power consumption	W	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays motor power consumption.								
4F6Dh	00h	Amount of motor power consumption	Wh	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the amount of motor power consumption.								
4F6Eh	00h	Cumulative value of motor power consumption	Wh	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the integrated amount of motor power consumption. Saturates at a maximum value of 2147483647. Because recording takes place in 30-minute increments, adding will not take place if the control power is shut off before the recording time has elapsed.								
4F77h	00h	Lost link error count	Inciden-ces	0 to 65535	U16	ro	No	ALL	No	X
		● Displays the lost link count.								
4F78h	00h	Synchronization signal error count	Inciden-ces	0 to 65535	U16	ro	No	ALL	No	X
		● Displays the number of consecutive synchronization or IRQ errors.								
4F81h	00h	Encoder communication error count (accumulated)	Inciden-ces	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the cumulative number of encoder communication errors. Saturates at a maximum value of FFFFh. It is cleared when this product is rebooted or the control power is reset.								
4F83h	00h	External scale communication error count (accumulated)	Inciden-ces	0 to 65535	U16	ro	TxPDO	ALL	No	X
		● Displays the cumulative number of external scale communication errors. Saturates at a maximum value of FFFFh. It is cleared when this product is rebooted or the control power is reset.								
4F84h	00h	External scale communication data error count (accumulated)	Inciden-ces	0 to 65535	U16	ro	TxPDO	ALL	No	X
		● Displays the cumulative number of external scale communication data errors. Saturates at a maximum value of FFFFh. It is cleared when this product is rebooted or the control power is reset.								
4F86h	00h	Hybrid deviation	Command unit	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
		● Displays the hybrid deviation.								
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the upper 24 bits of the external scale data.								

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the lower 24 bits of the external scale data.								
4F89h	00h	External scale status	—	0 to 65535	U16	ro	TxPDO	ALL	No	X
		● Displays external scale status.								
4F8Ah	00h	External scale Z phase counter	—	0 to 65535	U16	ro	No	ALL	No	X
		● Displays the Z-phase counter value read from the external scale in 0 to F [hex] when the incremental external scale is used in full-closed control or semi-closed control with the external scale position information monitoring function enabled.								
4F8Ch	00h	External scale single-turn data	pulse	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays external scale single-turn data.								
4F91h	00h	Estimation accuracy of magnetic pole position	Degrees	0 to 180	U8	ro	TxPDO	ALL	No	X
		● Displays the estimation accuracy (electrical angle: 0 to 180 degrees) when estimating the magnetic pole position. Because this object is not supported by the standard type, multi-function type, or application specialized type, it always returns 0.								
4F92h	00h	Execution time of estimation of magnetic pole position	ms	0 to 65535	U16	ro	TxPDO	ALL	No	X
		● Displays the execution time for magnetic pole position estimation. Because this object is not supported by the standard type, multi-function type, or application specialized type, it always returns 0.								
4F93h	00h	Maximum travel distance to plus direction when estimating magnetic pole position	pulse (Feedback scale unit)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Returns the maximum amount of movement in the positive direction based on the start position for executing magnetic pole position estimation. Because this object is not supported by the standard type, multi-function type, or application specialized type, it always returns 0.								
4F94h	00h	Maximum travel distance to minus direction when estimating magnetic pole position	pulse (Feedback scale unit)	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Returns the maximum amount of movement in the negative direction based on the start position for executing magnetic pole position estimation. Because this object is not supported by the standard type, multi-function type, or application specialized type, it always returns 0.								
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the velocity control command.								
4FA5h	00h	Velocity internal position command	r/min	-2147483648 to 2147483647	I32	ro	TxPDO	pp hm csp	No	X
		● Displays the internal position command speed.								

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>4FA6h</td><td>00h</td><td>Velocity error actual value</td><td>r/min</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO</td><td>pp
hm
csp</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the speed deviation. Displays 0 when using full-closed control.</td></tr>
<tr><td>4FA7h</td><td>00h</td><td>External scale position (Applied polarity)</td><td>pulse (External scale)</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the external scale position (after Polarity is applied).</td></tr>
<tr><td>4FA8h</td><td>00h</td><td>Positive direction torque limit value</td><td>0.05%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the torque limit value in the positive direction.</td></tr>
<tr><td>4FA9h</td><td>00h</td><td>Negative direction torque limit value</td><td>0.05%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the torque limit value in the negative direction.</td></tr>
<tr><td>4FABh</td><td>00h</td><td>Gain switching flag</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>TxPDO</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the gain switching flag.
0: 1st gain section
1: 2nd gain section
3: 3rd gain section</td></tr>
<tr><td>4FB1h</td><td>00h</td><td>Deterioration diagnosis state</td><td>—</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the deterioration diagnosis status.
bit 0: Deterioration diagnosis warning enabled
bit 1: Load characteristic estimation enabled
bit 2: Load characteristic estimation convergence complete
bit 3: Deterioration diagnosis velocity output
bit 4: Deterioration diagnosis torque average time elapsed
bit 5: Deterioration diagnosis warning cause (torque command average value)
bit 6: Deterioration diagnosis warning cause (inertia ratio)
bit 7: Deterioration diagnosis warning cause (unbalanced load)
bit 8: Deterioration diagnosis warning cause (dynamic friction)
bit 9: Deterioration diagnosis warning cause (viscous friction)</td></tr>
<tr><td>4FB2h</td><td>00h</td><td>Deterioration diagnosis torque command average value</td><td>0.1%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the deterioration diagnosis torque command average value.</td></tr>
<tr><td>4FB3h</td><td>00h</td><td>Deterioration diagnosis torque command standard value</td><td>0.1%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the deterioration diagnosis torque command standard deviation.</td></tr>
<tr><td>4FB4h</td><td>00h</td><td>Deterioration diagnosis inertia ratio estimate value</td><td>%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the deterioration diagnosis inertia ratio estimation.</td></tr>
<tr><td>4FB5h</td><td>00h</td><td>Deterioration diagnosis offset load estimate value</td><td>0.1%</td><td>-2147483648 to 2147483647</td><td>I32</td><td>ro</td><td>No</td><td>ALL</td><td>No</td><td>X</td></tr>
<tr><td colspan="11">● Displays the deterioration diagnosis unbalanced load estimation.</td></tr>
</table>

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
4FB6h	00h	Deterioration diagnosis dynamic friction estimate value	0.1%	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the deterioration diagnosis dynamic friction estimation.								
4FB7h	00h	Deterioration diagnosis viscous friction estimate value	0.1 %/ (10000 r/ min)	-2147483648 to 2147483647	I32	ro	No	ALL	No	X
		● Displays the deterioration diagnosis viscous friction estimation.								
4FC2h	00h	Analog input voltage	mV	-2147483648 to 2147483647	I32	ro	TxPDO	ALL	No	X
		● Displays the level of the applied voltage (before offset) of the analog input.								
6403h	00h	Motor catalogue number	—	—	VS	ro	No	ALL	No	X
		● Displays the motor part no.								

*1 Only 27-bit encoders are supported. When not supported, it is set to 0.

6 Protection Functions/Warning Functions

6.1 Protection Functions

Protection functions ensure safety by stopping the motor when errors are detected in the equipment.

Protection functions are assigned alarm numbers beginning with “Err”.

Alarm numbers are divided into main numbers, sub-numbers, and cause numbers.

For example, in the case of Err13.1.0 “Main power supply undervoltage protection (AC interrupt detection)” , the main number is 13, the sub-number is 1, and the cause number is 0.

6.1.1 List of Protection Functions

A list of protection functions is shown below.

○: Supported ×: Not supported -: N/A

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
11	0	0	Control power supply undervoltage protection	×	○	×	OFF	0000h
12	0	0	Overvoltage protection	○	○	×	OFF	0000h
13	0	0 to 1	Main power supply undervoltage protection (voltage across PN)	×	○	○	OFF	0000h
	1	0	Main power supply undervoltage protection (AC interrupt detection)	×	○	○	OFF	0000h
	2	0	Main power supply phase loss protection (AC interception detection)	×	○	○	OFF	0000h
14	0	0	Overcurrent protection 1	○	×	×	OFF	0000h
	1	0	Overcurrent protection 2	○	×	×	OFF	0000h
		1	Overheat protection 2	○	×	×	OFF	0000h
		2	Overheat protection 3	○	×	×	OFF	0000h
15	0	0	Overheat protection 1	○	×	○	OFF	0000h
	1	0	Encoder overheat error protection	○	×	○	OFF	0000h
16	0	0	Overload protection	○	○ (*6)	×	OFF	0000h
	1	0	Torque saturation error protection	○	○	×	OFF	0000h
18	0	0	Regenerative overload protection	○	×	○	OFF	0000h
	1	0	Regenerative transistor error protection	○	×	×	OFF	0000h
21	0	0 to 1 90	Encoder communication disconnection error protection	○	×	×	OFF	0000h
	1	0 to 3	Encoder communication error protection	○	×	×	OFF	0000h
23	0	0	Encoder communication data error protection	○	×	×	OFF	0000h
24	0	0	Position deviation excess protection	○	○	○	OFF	0000h

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
24	1	0	Speed deviation excess protection	○	○	○	OFF	0000h
25	0	0	Hybrid deviation excess protection	○	×	○	OFF	0000h
26	0	0	Overspeed protection	○	○	○	OFF	0000h
	1	0	2nd Overspeed protection	○	○	×	OFF	0000h
27	1	0	Absolute clear protection	○	×	×	OFF	0000h
	4	0	Position command error protection	○	○	○	OFF	0000h
	5	0	Command generation error protection	○	×	○	OFF	0000h
	6	0 to 1	Operation command contention protection	○	○	×	OFF	0000h
	7	0	Position information initialization error protection	○	×	×	OFF	0000h
28	0	0	Pulse regeneration limit protection	○	○	○	OFF	0000h
29	1	0	Counter overflow protection 1	○	×	×	OFF	0000h
	2	0 to 5	Counter overflow protection 2	○	×	×	OFF	0000h
31	0	0 to 2 10 to 12 20 to 25 30 to 37 40 to 43	Safety function error protection 1	○	×	×	OFF	0000h
	2	0 to 3	Safety function error protection 2	○	×	×	OFF	OFF
33	0	0	Input overlapping assignment error 1 protection	○	×	×	OFF	0000h
	1	0	Input overlapping assignment error 2 protection	○	×	×	OFF	0000h
	2	0	Input function number error 1 protection	○	×	×	OFF	0000h
	3	0	Input function number error 2 protection	○	×	×	OFF	0000h
	4	0	Output function number error 1 protection	○	×	×	OFF	0000h
	5	0	Output function number error 2 protection	○	×	×	OFF	0000h
	8	0	Latch input assignment error protection	○	×	×	OFF	0000h
34	0	0	Motor movable range setup error protection	○	○	×	OFF	0000h
	1	0	Single-turn absolute movable range error protection	○	○	×	OFF	0000h
36	0 to 1	0	EEPROM parameter error protection	×	×	×	OFF	0000h

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
37	0 to 2	0	EEPROM check code error protection	×	×	×	OFF	0000h
38	0	0	Over-travel inhibit input protection 1	×	○	×	OFF	0000h
	1	0	Over-travel inhibit input protection 2	×	○	×	OFF	0000h
	2	0	Over-travel inhibit input protection 3	○	×	×	OFF	0000h
39	0	0	Analog input (AIN) excess protection	○	○	○	OFF	0000h
40	0	0	Absolute system down error protection	○	○ (*7)	×	OFF	0000h
41	0	0	Absolute counter over error protection	○	×	×	OFF	0000h
42	0	0	Absolute overspeed error protection	○	○ (*7)	×	OFF	0000h
44	0	0	Single-turn counter error protection	○	×	×	OFF	0000h
45	0	0	Multi-turn counter error protection	○	×	×	OFF	0000h
47	0	0	Absolute status error protection	○	×	×	OFF	0000h
50	0	0	External scale wiring error protection	○	×	×	OFF	0000h
	1	0 to 2	External scale communication error protection	○	×	×	OFF	0000h
	2	0	External scale communication data error protection	○	×	×	OFF	0000h
51	0	0	External scale status error protection 0	○	×	×	OFF	0000h
	1	0	External scale status error protection 1	○	×	×	OFF	0000h
	2	0	External scale status error protection 2	○	×	×	OFF	0000h
	3	0	External scale status error protection 3	○	×	×	OFF	0000h
	4	0	External scale status error protection 4	○	×	×	OFF	0000h
	5	0	External scale status error protection 5	○	×	×	OFF	0000h
55	0	0	A-phase connection error protection	○	×	×	OFF	0000h
	1	0	B-phase connection error protection	○	×	×	OFF	0000h
	2	0	Z-phase connection error protection	○	×	×	OFF	0000h
68	0	0	Internal communication processing error protection1	○	×	×	OFF	0000h
	3	0 to 3	Internal communication processing error protection4	○	×	×	OFF	0000h

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
68	5	0	Internal communication processing error protection6	○	×	×	OFF	0000h
	6	0	Internal communication processing error protection7	○	×	×	OFF	0000h
	7	0	Internal communication processing error protection8	○	×	×	OFF	0000h
	8	0	Internal communication processing error protection9	○	×	×	OFF	0000h
	9	0	Internal communication processing error protection10	○	×	×	OFF	0000h
	10	0	Internal communication processing error protection11	○	×	×	OFF	0000h
	11	0	Internal communication processing error protection12	○	×	×	OFF	0000h
	14	0	Internal communication processing error protection15	○	×	×	OFF	0000h
	19	0	Internal communication processing error protection20	○	×	×	OFF	0000h
	21	0	Internal communication processing error protection22	○	×	×	OFF	0000h
70	0	0	U-phase current detector error protection 1	○	×	×	OFF	0000h
		1	U-phase current detector error protection 2	○	×	×	OFF	0000h
	1	0	W-phase current detector error protection 1	○	×	×	OFF	0000h
		1	W-phase current detector error protection 2	○	×	×	OFF	0000h
72	0	0	Thermal error protection	○	×	×	OFF	0000h
75	0	0 to 1	External memory access error protection	○	×	×	OFF	0000h
77	0	0	Microcomputer error protection 1	○	×	×	OFF	0000h
	2	0	Microcomputer error protection 3	○	×	×	OFF	0000h
	6	0 to 3	Microcomputer error protection7	○	×	×	OFF	0000h
80	0	0	ESM unauthorized request error protection	○	○	○	Blinking	0011h
	1	0	ESM undefined request error protection	○	○	○	Blinking	0012h
	2	0	Bootstrap requests error protection	○	○	×	Blinking	0013h
	3	0	Incomplete PLL error protection	○	○	×	Single flash	002Dh
	4	0	PDO watchdog error protection	○	○	○	Double flash	001Bh
	6	0	PLL error protection	○	○	○	Single flash	0032h
	7	0	Synchronization signal error protection	○	○	○	Single flash	002Ch
81	0	0	Synchronization cycle error protection	○	○	×	Blinking	0035h

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
81	1	0	Mailbox error protection	○	○	×	Blinking	0016h
	4	0	PDO watchdog setup error protection	○	○	×	Blinking	001Fh
	5	0	DC error protection	○	○	×	Blinking	0030h
	6	0	SM event mode error protection	○	○	×	Blinking	0028h
	7	0	SyncManager 2 / 3 setup error protection	○	○	×	Blinking	001Dh 001Eh
84	3	0	Initialization of synchronization establishment error protection	○	×	×	OFF	0000h
85	0	0	TxPDO assignment error protection	○	○	×	Blinking	0024h
	1	0	RxPDO assignment error protection	○	○	×	Blinking	0025h
	2	0	Lost link error protection	○	○	○	Double flash	0000h
	3	0	SII EEPROM error protection	○	×	×	Flickering	0051h
87	0	0	Forced alarm input protection	×	○	○	OFF	0000h
	1	0	Retracting operation completion (I/O)	○	(*8)	○ (*9)	OFF	0000h
	2	0	Retracting operation completion (communication)	○	(*8)	○ (*9)	OFF	0000h
	3	0 to 6	Retracting operation error	○	(*8)	○	OFF	0000h
88	0	0	Main power supply undervoltage protection (AC interrupt detection 2)	×	○	○	OFF	0000h
	1	0	Control mode setting error protection	○	○	○	OFF	0000h
	2	0	ESM requirements during operation error protection	○	○	○	OFF	0000h
	3	0	Improper operation error protection	○	×	○	OFF	0000h
91	1	0	Command error protection	○	○	×	OFF	0000h
92	0	0	Encoder data recovery error protection	○	×	×	OFF	0000h
	1	0	External scale data recovery error protection	○	×	×	OFF	0000h
	3	0 to 2	Multi-turn data upper limit value disagreement error protection	○	×	×	OFF	0000h
93	2	0	Parameter setup error protection 2	○	×	×	OFF	0000h
	3	0 to 5	External scale connection error protection	○	×	×	OFF	0000h
	5	0	Parameter setup error protection 4	○	×	×	OFF	0000h
	8	0	Parameter setup error protection 6	○	×	×	OFF	0000h
94	3	0	Homing error protection 2	○	○	×	OFF	0000h
95	0	0	Motor automatic recognition error protection 1	×	×	×	OFF	0000h

Alarm number			Alarm name	Attribute			ERR indicator display (*4)	ESC register AL status code (*5)
Main	Sub	Primary cause		History (*2)	Alarm clear	Emergency stop (*3)		
95	1	0	Motor automatic recognition error protection 2	×	×	×	OFF	0000h
	2	0	Motor automatic recognition error protection 3	×	×	×	OFF	0000h
	3	0	Motor automatic recognition error protection 4	×	×	×	OFF	0000h
	4	0	Motor automatic recognition error protection 5	×	×	×	OFF	0000h
	5	0	Motor automatic recognition error protection 6	×	×	×	OFF	0000h
96	4	0	Host controller error protection 3	○	×	×	OFF	0000h
	6	0	Host controller error protection 5	○	×	×	OFF	0000h
98	2	0	Communication hardware error protection 2	○	×	×	OFF	0000h
	3	0	Communication hardware error protection 3	○	×	×	OFF	0000h
	5	0	Hardware self-diagnostic error protection 1	×	×	×	OFF	0000h
Other numbers			Other error protection	–	–	–	–	–
Special 7-segment display 71 72 73 75 76 77			System error protection	×	×	×	OFF	0000h

*1 The alarm number is displayed in the 7-segment LED when the alarm is generated.

For details on 7-segment LED operation when an alarm is generated, see Technical Reference Functional Specification "3.4.1 7-Segment LED" .

*2 Alarms that support history (○) are stored in Sub-Index 06h to 23h "Diagnosis message 1 to 30" of Obj.10F3h: "Diagnosis history" when triggered.

*3 When a supported (○) emergency stop alarm triggers, an emergency stop will be performed if 4 to 7 is set in Pr5.10 "Sequence at alarm" . For details, see Technical Reference Functional Specification "5.15 Deceleration to Stop Function When an Alarm is Triggered" .

*4 ERR Indicator refers to the alarm status defined by the AL status code.

The light is red.

For details about the ERR Indicator display, see Technical Reference Functional Specification "3.4.2 EtherCAT Indicators" .

*5 AL Status sets an error code at 0134h to 0135h "AL Status Code" of the ESC register when there is a problem in EtherCAT communication.

*6 Err16.0.0 "Overload protection" When issued, it can be cleared 10 seconds after issuance.

If the device is not in a clearable state when the alarm clear command is sent, only the alarm clear command is accepted, and then the clearing process is performed when the device is in a clearable state.

*7 If Err40.0.0 "Absolute system down error protection" or Err42.0.0 "Absolute overspeed error protection" occurs, the error cannot be cleared until an absolute clear is executed.

*8 Alarm clear is switched between enabled and disabled by Pr6.86:bits 2 to 0 "Retracting operation alarm clear attribute".

bit 0:Err87.1.0 "Retracting operation completion (I/O)" alarm clear attribute

bit 1:Err87.2.0 "Retracting operation completion (communication)" alarm clear attribute

bit 2:Err87.3.□ "Retracting operation error" alarm clear attribute

In all cases, 0: Alarm clear disable, 1: Alarm clear enable.

*9 The attribute for Err87.1.0 “Retracting operation completion (I/O)” and Err87.2.0 “Retracting operation completion (communication)” is the emergency stop response alarm, but when the conditions to initiate the retracting operation are met, operation proceeds according to the retracting operation function, not according to Pr5.10 “Sequence at alarm” and an alarm is generated after the retracting operation is complete.

For details on retracting operation function, see Technical Reference Functional Specification “5.10 Retracting Operation Function” .

The alarm behaves as an emergency stop response alarm, with the fall prevention function triggered when an alarm is generated after completion of the retracting operation.

For the fall prevention function when an alarm is triggered, see Technical Reference Functional Specification “5.17 Fall Prevention Function When an Alarm is Triggered” .

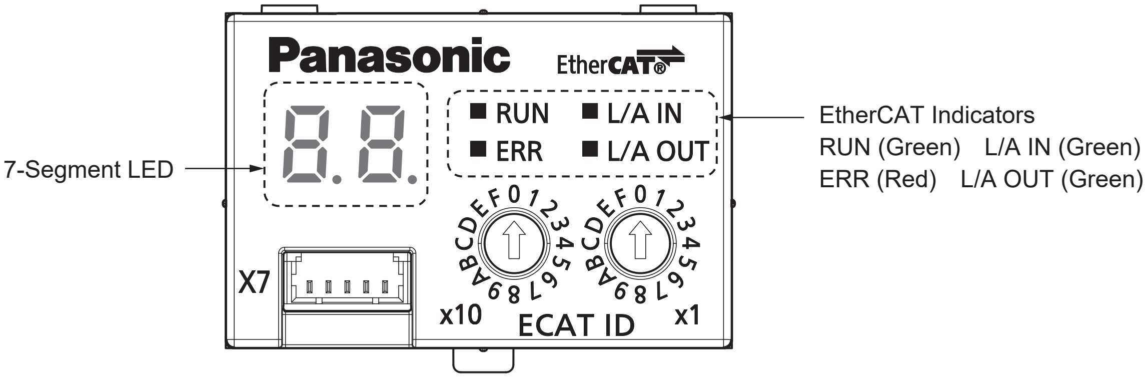
6.1.2 Protection Function Details

This shows details of protection functions.

The AL Status Code and ESM state are updated to the latest EtherCAT related error status every time an EtherCAT related error is detected.

However, the display at Set-up Support Software (PANATERM ver.7) , the 7-segment LED display, and the Abort message are not updated to the latest EtherCAT-related error status, and the first alarm number detected is displayed. The display of the first detected alarm number is retained until the alarm is cleared.

Check the front panel configuration in the figure below for the locations of the various LEDs and EtherCAT indicators.



Err11.0.0 “Control power supply undervoltage protection”

Primary cause	The voltage across PN of the control power supply converter has fallen and dropped below the specified value. Consider the following causes. 1 There was a momentary power failure due to low power supply voltage or a drop in power supply voltage. 2 Power supply voltage dropped due to inrush current on powering up the main power supply leading to insufficient power supply capacity. 3 The product is malfunctioning.
Handling	Measure the L1C-L2C line voltage of connector and terminal block. Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 Increase the supply voltage or replace the power supply with another one. 2 Increase the power supply capacity. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err12.0.0 “Overvoltage protection”

Primary cause	● Power supply voltage exceeds the allowable input voltage across PN of the converter. ● Power supply voltage is high. ● A voltage surge has occurred due to the phase advance capacitor or UPS (Uninterruptible Power Supply). Consider the following causes. 1 The regenerative resistor was disconnected. 2 The external regenerative resistor is unsuitable and unable to absorb the regenerative energy. 3 The product is malfunctioning.

Handling	Measure the line voltage between connectors (L1, L2, L3). Input the correct voltage. Remove the phase advance capacitor. Next, take the actions listed in "1" to "3" below for the cause with the respective corresponding number. 1 Use a tester to measure the resistance of the external resistor between the P and B terminals of this product and replace the external resistor if the tester reads ∞, as this means a broken connection. 2 Change to the specified regenerative resistance value and wattage. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err13.0.☐ "Main power supply undervoltage protection (voltage across PN)" , Err13.1.0 "Main power supply undervoltage protection (AC interrupt detection)"

- Err13.0.0 to Err13.0.1 "Main power supply undervoltage protection (voltage across PN)"
- Err13.1.0 "Main power supply undervoltage protection (AC interrupt detection)"

Primary cause	● When Pr5.08 "L/V trip selection upon main power off" :bit 0 = 1, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr5.09 "Detection time of main power off" . ● The voltage across PN of the main power supply converter has fallen and dropped below the specified value during servo-on. Consider the following causes. 1 There was a momentary power failure due to low power supply voltage or a drop in power supply voltage. 2 Momentary power failure has occurred even though power supply voltage is normal. 3 Power supply capacity was insufficient. Power supply voltage dropped due to inrush current on powering up the main power supply. 4 The product is malfunctioning.
Handling	Measure the line voltage between connectors (L1, L2, L3). Next, take the actions listed in "1" to "4" below for the cause with the respective corresponding number. 1 Increase the power supply voltage, change the power supply, eliminate whatever caused the electromagnetic contactor in the main power supply to drop, then turn the power back on. 2 Check the setting for Pr5.09 "Detection time of main power off" and set it properly for each phase of the power supply. 3 Increase the power supply capacity. For information on power supply capacity, see Servo Driver Specification "10.2.2 List of Peripheral Devices" . 4 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err13.2.0 "Main power supply phase loss protection (AC interception detection)"

Primary cause	Missing phases of connectors (L1, L2, L3) were detected with main power supply established when Pr6.104 "Open-phase monitoring setup" = 2 (alarm enabled) or when using a 3-phase input dedicated servo driver and Pr6.104 = 0 (automatic) is set. The cause may be that phases L1, L2, and L3 are disconnected or dropped, or that a three-phase input specification servo driver has operated with a single-phase power supply. Additionally, consider the following causes. 1 L1-L2 line voltage, L2-L3 line voltage, and L1-L3 line voltage are not balanced. 2 Main power supply voltage is low. 3 The product is malfunctioning.

Handling	Check the connection of the main power input line. If there is no problem with the connection, measure the line voltage between connectors (L1, L2, L3). Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 Measure the line voltage between connectors (L1, L2, L3) and eliminate line voltage imbalance. 2 Confirm that the line voltage between connectors (L1, L2, L3) is the specified value. 3 Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Related parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	104	B	Open-phase monitoring setup	0 to 3	—	Sets open-phase monitoring. A setting value of 0 (automatic) disables open-phase monitoring for servo drivers with single-phase/three-phase common specifications, and enables alarms for servo drivers with three-phase input only. 0: Automatic 1: Warning enabled 2: Alarm enabled 3: Disabled

*1 For attributes, see Technical Reference Functional Specification “8 List of Parameters” .

Err14.0.0 “Overcurrent protection 1” , Err14.1.0 “Overcurrent protection 2”

Primary cause	Current through the converter has exceeded the specified value. Consider the following causes. 1 If this alarm occurs immediately when the motor cables are disconnected and after servo-on, the product is malfunctioning. (Circuit, IGBT component failure) 2 Short in motor cables U, V, W. 3 Check the insulation resistance between motor cables U, V, W and the motor earth cable and if there is an insulation failure, there is an earth fault in the motor wire. 4 Check the resistance balance between the various motor cables and if there is an imbalance, the motor is burned out. 5 Connection fault in motor cables. 6 Dynamic brake relay has fused due to frequent servo-on/servo-off operation. 7 The timing of the command input is either the same as or earlier than servo-on.
Handling	Take the actions listed in “1” to “7” below for the cause with the respective corresponding number. 1 Replace the servo driver with a new one. 2 Check for any stray strands in the lead wires at the connectors, and connect the motor cables correctly. 3 Replace the motor. 4 Replace the motor. 5 Remove and check the connector pins in the U, V, W, connectors on the motor and firmly secure to ensure they are not loose or disconnected. 6 Replace the servo driver. Do not operate or stop via servo-on/off after replacement. 7 Wait at least 100 ms after servo-on before inputting a command.

Err14.1.1 “Overheat protection 2”

Primary cause	Temperature of the power element of this product has risen over the specified temperature. Consider the following causes. 1 The ambient temperature of this product has risen over the specified temperature. 2 Used with overload.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of this product. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Err14.1.2 “Overheat protection 3”

Primary cause	The dynamic brake circuit overheated and the thermal fuse has blown.
Handling	Replace the servo driver.

Err15.0.0 “Overheat protection 1”

Primary cause	Temperature of the heat sink of this product has risen over the specified temperature. Consider the following causes. 1 The ambient temperature of this product has risen over the specified temperature. 2 Used with overload.
Handling	Make sure that the ambient temperature of this product does not exceed the operating temperature range. Next, take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of this product. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Err15.1.0 “Encoder overheat error protection”

Primary cause	The encoder temperature has exceeded the encoder overheat error level. Consider the following causes. 1 The ambient temperature of the motor is high. 2 Used with overload.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Improve the ambient temperature and cooling conditions of the motor. 2 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load.

Related parameters

—: None

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	10	B	Function expansion setup	-32768 to 32767	—	bit 11: Encoder overheat error protection detection 0: Disabled 1: Enabled

*1 For attributes, see Technical Reference Functional Specification “8 List of Parameters” .

Err16.0.0 “Overload protection”

Primary cause	When the actual running value of the torque command exceeds the overload level set by Pr5.12 “Motor overload level setup” , overload protection will be triggered based on the time characteristics. Consider the following causes. 1 Operation was continued for a long time under a heavy load and with the effective torque exceeding the rated torque. 2 Due to poor gain adjustment, oscillation or hunting operation, or vibration or abnormal noise from the motor occurred, or the Pr0.04 “Inertia ratio” setting is abnormal. 3 Motor is wired incorrectly or there is a disconnection. 4 The equipment to which the motor is mounted is interfering in some way. Or the load was suddenly increased due to a problem with the equipment to which the motor is mounted. 5 Operated with the holding brake engaged. 6 When wiring multiple machines, there was a wiring error with the motor cable connected to the wrong axis. 7 Pr5.12 “Motor overload level setup” is too low.
Handling	● Check that the torque (current) waveform does not oscillate or fluctuate excessively up and down in the analog output or communication. ● Check the overload warning display and load factor on the front panel or in the communication. Next, take the actions listed in “1” to “7” below for the cause with the respective corresponding number. 1 Take the following actions. ● Increase the capacity of the servo driver and motor. ● Set a longer acceleration/deceleration time. ● Lighten the load. 2 Readjust the gain. 3 Connect the motor wiring according to the wiring diagram, and if this does not improve the problem, replace the cables. 4 Eliminate problems with the machinery and lighten the load. 5 Measure the brake terminal voltage and release the brake. 6 Wire the motor cables and encoder cables correctly to match the axes. 7 Set Pr5.12 “Motor overload level setup” = 0. (Set to the maximum value allowed for the motor) **Notes** ● For details on how to confirm the overload protection time characteristics, see Technical Reference Functional Specification “7.1.5 Checking Overload Protection Time Characteristics” .

Err16.1.0 “Torque saturation error protection”

Primary cause	The torque saturation condition continued between Pr7.16 “Torque saturation error protection frequency” or Pr6.57 “Torque saturation error protection detection time” setting values.
Handling	Check the operating state of this product and take the same action as for Err16.0.0.

Err18.0.0 “Regenerative overload protection”

Primary cause	The regenerative energy has exceeded the processing capacity of the regenerative resistor. Consider the following causes. 1 The converter voltage was increased by the regenerative energy during deceleration due the size of the load inertia, which further increased the voltage due to insufficient absorption of energy by the regenerative resistor. 2 Regenerative energy was not absorbed in the specified deceleration time due to high number of rotations of the motor. 3 The operating limit of the external resistor is limited to 10% duty.
Handling	Check the regenerative resistance load factor on the front panel or in the communication. Cannot be used with continuous regeneration control. Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 When checking the operating pattern (velocity monitor), check the regenerative resistance load factor and the over-regeneration warning display and take the following actions. ● Increase the capacity of the motor and servo driver. ● Increase the acceleration/deceleration time. ● Install an external regenerative resistor. 2 When checking the operating pattern (velocity monitor), check the regenerative resistance load factor and the over-regeneration warning display and take the following actions. ● Increase the capacity of the motor and servo driver. ● Increase the acceleration/deceleration time. ● Reduce the number of rotations of the motor. ● Install an external regenerative resistor. 3 Set Pr0.16 “External regenerative resistor setup” to 2. Be sure to install external protection such as a thermal fuse when Pr0.16 “External regenerative resistor setup” is set to 2. **Precautions** ● If external protection is not installed, regenerative resistor protection may be lost, so that the regenerative resistor heats up abnormally and burns out.

Err18.1.0 “Regenerative transistor error protection”

Primary cause	The regenerative drive transistor of this product is malfunctioning.
Handling	Replace the servo driver.

Err21.0.☐ “Encoder communication disconnection error protection”

- Err21.0.0 to Err21.0.1 “Encoder communication disconnection error protection”
- Err21.0.90 “Encoder communication disconnection error protection”

Primary cause	Communication between the encoder and this product has been interrupted a set number of times, triggering the disconnection detecting function.
Handling	● Wire the encoder cables correctly. ● Connect the connector pin correctly.

Err21.1.☐ “Encoder communication error protection”

- Err21.1.0 to Err21.1.3 “Encoder communication disconnection error protection”

Primary cause	This is primarily a data error due to noise. ● There is a communication error in data from the encoder. ● The encoder cables are connected but there is an error in the communication data.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err23.0.0 “Encoder communication data error protection”

Primary cause	This is primarily a data error due to noise. ● Communication data from the encoder has become abnormal, even though there is not a communication error. ● The encoder cables are connected but there is an error in the communication data.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err24.0.0 “Position deviation excess protection”

Primary cause	The position deviation pulse has exceeded the setting for Pr0.14 “Position deviation excess setup” . Consider the following causes. 1 Motor movement is not tracking commands. 2 The value of Pr0.14 “Position deviation excess setup” is low.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Take the following actions. ● Check that the motor is rotating according to position command pulses. ● Check whether the torque output by the torque monitor is saturated. ● Adjust the gain. ● Maximize Pr0.13 “1st torque limit” and Pr5.22 “2nd torque limit” . ● Wire the encoder connections according to the wiring diagram. ● Increase the acceleration/deceleration time. ● Lighten the load and decrease the velocity. 2 Increase the value set for Pr0.14.

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
0	14	A	Position deviation excess setup	0 to 2^{30}	Command unit	Sets the position deviation excess setup range. Err24.0.0 “Position deviation excess protection” detection is disabled when the setup value is 0. Units follow Pr5.20 “Position setup unit select” . The factory default value is equivalent to 10 motor revolutions at 23 bits. If the command pulse per single-turn is changed, this setup value will also be affected. Configure settings appropriately according to the safety features of the equipment.

*1 For attributes, see Technical Reference Functional Specification “8 List of Parameters” .

Err24.1.0 “Speed deviation excess protection”

Primary cause	The difference between the internal position command speed and the actual speed (speed deviation) has exceeded the value set for Pr6.02 “Speed deviation excess setup” . **Precautions** ● If the internal position command speed is forcibly set to 0 by an emergency stop caused by an over-travel inhibit input in a positive direction or negative direction, the speed deviation increases in that instant. Make sure there is enough allowance in the setting because the internal position command speed rise time and the speed deviation will also be large in this case.
Handling	● Increase the value set for Pr6.02 “Speed deviation excess setup” . ● Lengthen the acceleration/deceleration time for the internal position command speed, or improve tracking by adjusting the gain. ● Disable excessive speed deviation detection (Pr6.02 = 0).

Related parameters

Class	No.	Attribute (*1)	Parameter name	Setting range	Unit	Function
6	02	A	Speed deviation excess setup	0 to 20000	r/min	Sets the threshold for Err24.1.0 “Speed deviation excess protection” . Detection of speed deviation excess protection is disabled when this setup value is 0.

*1 For attributes, see Technical Reference Functional Specification “8 List of Parameters” .

Err25.0.0 “Hybrid deviation excess protection”

Primary cause	When in full-closed control, the load position from the external scale and the motor position from the encoder have shifted more than the number of pulses set by Pr3.28 “Hybrid deviation excess setup” .

Handling	- Check the motor and load connections. - Check connection of the external scale and this product. - If the load has moved, check that the change in motor position (encoder feedback value) and the change in load position (external scale feedback value) have the same sign. - Check if Pr3.24 “Numerator of external scale division” , Pr3.25 “Denominator of external scale division” , and Pr3.26 “Reversal of direction of external scale” are set correctly.

Err26.0.0 “Overspeed protection”

Primary cause	The motor rotational speed has exceeded the value set for Pr5.13 “Over-speed level setup” .
Handling	- Do not give excessively high speed commands. - Check the input frequency of command pulses and the dividing/multiplying ratio. - Adjust the gain if overshoot is generated due to poor gain adjustment. - Wire the encoder cables according to the wiring diagram.

Err26.1.0 “2nd Overspeed protection”

Primary cause	The motor rotational speed has exceeded the value set for Pr6.15 “2nd overspeed level setting” .
Handling	- Do not give excessively high speed commands. - Check the input frequency of command pulses and the dividing/multiplying ratio. - Adjust the gain if overshoot is generated due to poor gain adjustment. - Wire the encoder cables according to the wiring diagram.

Err27.1.0 “Absolute clear protection”

Primary cause	Absolute encoder multi-turn data clear was executed with Set-up Support Software (PANATERM ver.7) .
Handling	Confirm that absolute encoder multi-turn data clear was executed with Set-up Support Software (PANATERM ver.7) . **Notes** - Err27.1.0 “Absolute clear protection” is a safety measure and not an error.

Err27.4.0 “Position command error protection”

Primary cause	The position command variation (value after electronic gear) exceeded the specified value. Or, when the backlash compensation function is enabled (Pr7.04 “Backlash compensation enable” :bits 1 to 0 are non-zero), the value set in Pr7.05 “Backlash compensation value” is not appropriate.
Handling	- Confirm that there is no great position command variation as a result of cyclic position control (csp) - Check the electronic gear ratio Or, check Pr7.05 “Backlash compensation value” . - Because homing is not completed after Err27.4.0 has occurred in incremental mode, rerun homing after clearing the alarm.

Err27.5.0 “Command generation error protection”

Primary cause	An error, such as position command generation processing exceeding the computation range, has occurred.
Handling	Confirm that the electronic gear ratio and acceleration/deceleration constraints are fulfilled.

Err27.6.0 “Operation command contention protection”

Primary cause	When Pr7.99 “Communication function extended setup 6” :bit 0 = 1, a servo-on command was received by EtherCAT communication while the frequency characteristics analysis function (FFT function) that operates with this product alone, as well as a trial run, were being executed.
Handling	When Pr7.99 “Communication function extended setup 6” :bit 0 = 1, check whether the host device has sent a servo-on command by EtherCAT communication during frequency characteristics analysis function (FFT function) or trial run execution.

Err27.6.1 “Operation command contention protection”

Primary cause	When Pr7.99 “Communication function extended setup 6” :bit 0 = 0, EtherCAT communication was established while the frequency characteristics analysis function (FFT function) that operates with this product alone, as well as a trial run, were being executed.
Handling	When Pr7.99 “Communication function extended setup 6” :bit 0 = 0, check whether EtherCAT communication has been established during frequency characteristics analysis function (FFT function) or trial run execution.

Err27.7.0 “Position information initialization error protection”

Primary cause	In homing position control mode (hm), homing was canceled by Obj.6040h:00h “Controlword” :bit 8 “halt” or similar function from the host device during the period from home detection to when homing is completed.
Handling	Check if homing is being canceled in proximity to the home signal.

Err28.0.0 “Pulse regeneration limit protection”

Primary cause	The output frequency of pulse regeneration has exceeded the limit.
Handling	● Check the setup values of Pr0.11 “Number of output pulses per motor revolution” and Pr5.03 “Denominator of pulse output division” . ● Set Pr5.33 “Pulse regenerative output limit setup” to 0. **Precautions** ● This disables detection of the pulse regeneration limit. Note that this action does not resolve the primary cause.

Err29.1.0 “Counter overflow protection 1”

Primary cause	● The calculated value of absolute encoder (absolute external scale) position [pulse unit]/ electronic gear ratio exceeded 32-bit width when the position information initialization process was performed under the following conditions. • After turning on control power in absolute mode • When communication is established (when ESM state transitions from Init → PreOP) • When clearing of multi-turn data via Set-up Support Software (PANATERM ver.7) and EtherCAT • When the Set-up Support Software (PANATERM ver.7) function (trial run, frequency characteristics analysis, Z-phase search, One Minute TUNING) ends • When Config is executed by Set-up Support Software (PANATERM ver.7) ● An overflow has occurred in the calculation process.
Handling	Check the operational range for the absolute encoder (absolute external scale) position and review the electronic gear ratio.

Err29.2.☐ “Counter overflow protection 2”

- Err29.2.0 to Err29.2.5 “Counter overflow protection 2”

Primary cause	● When using semi-closed control The value of position deviation in pulse units has exceeded ± (2^{34}–1) (17179869183). The value of position deviation in command units has exceeded ± 2^{30} (1073741824). ● When using full-closed control The value of position deviation in pulse units has exceeded ± 2^{30} (1073741824). The value of position deviation in command units has exceeded ± 2^{30} (1073741824).
Handling	● Check whether the motor is rotating according to the position command. ● Check whether the torque output by the torque monitor is saturated. ● Tune the gain. ● Maximize the torque limit setting. ● Wire the encoder connections according to the wiring figure.

Err31.0.☐ “Safety function error protection 1”

- Err31.0.0 to Err31.0.2 “Safety function error protection 1”
- Err31.0.10 to Err31.0.12 “Safety function error protection 1”
- Err31.0.20 to Err31.0.25 “Safety function error protection 1”
- Err31.0.30 to Err31.0.37 “Safety function error protection 1”
- Err31.0.40 to Err31.0.43 “Safety function error protection 1”

Primary cause	A safety function has detected an error.
Handling	● If this repeats even after taking action to resolve the error, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair). ● When any of Err31.0.10 to Err31.0.12 occurs, please check that a state of differing logic between SF1 and SF2 has not persisted for more than 10 seconds.

Err31.2.☐ “Safety function error protection 2”

- Err31.2.0 to Err31.2.3 “Safety function error protection 2”

Primary cause	A safety function has detected an error.
Handling	If this repeats even after taking action to resolve the error, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err33.0.0 “Input overlapping assignment error 1 protection”

Primary cause	There are overlapping input signal (SI1, SI2, SI3, and SI4) function assignment settings.
Handling	Assign the functions correctly to the connector pins.

Err33.1.0 “Input overlapping assignment error 2 protection”

Primary cause	There are overlapping input signal (SI5, SI6, SI7, and SI8) function assignment settings.
Handling	Assign the functions correctly to the connector pins.

Err33.2.0 “Input function number error 1 protection”

Primary cause	● There are undefined numbers specified in input signal (SI1, SI2, SI3, and SI4) function assignments. Or there is an error in logical settings. ● When using Dynamic brake switching input (DB-OFF), forced alarm input (E_STOP) at input signals SI1, SI2, SI3, and SI4, only one or two control modes were set.
Handling	Assign the functions correctly to the connector pins.

Err33.3.0 “Input function number error 2 protection”

Primary cause	● Undefined numbers have been specified in the input signal (SI5, SI6, SI7, SI8) function assignment settings. Or there is an error in logical settings. ● When using Dynamic brake switching input (DB-OFF), forced alarm input (E_STOP) at input signals SI5, SI6, SI7, and SI8, only one or two control modes were set.
Handling	Assign the functions correctly to the connector pins.

Err33.4.0 “Output function number error 1 protection”

Primary cause	An undefined number has been specified in the output signal (SO1) function assignment setting.
Handling	Assign the functions correctly to the connector pins.

Err33.5.0 “Output function number error 2 protection”

Primary cause	There are undefined numbers specified in output signals (SO2 and SO3) function assignments.
Handling	Assign the functions correctly to the connector pins.

Err33.8.0 “Latch input assignment error protection”

Primary cause	There are errors in latch correction pin (SI5, SI6, and SI7) function assignments. ● EXT1 and EXT2 are assigned to pins other than SI5 to SI7. ● Not all the control modes have been assigned.
Handling	Assign the functions correctly to the connector pins.

Err34.0.0 “Motor movable range setup error protection”

Primary cause	When a position command within the specified range is input, the motor has operated outside its movable range specified in Pr5.14 “Motor working range setup” . Consider the following causes. 1 The gain is not suitable. 2 The value set for Pr5.14 is low. 3 When Pr6.97 “Function expansion setup 3” :bit 2 = 1, the conditions for forcibly issuing Err34.0.0 were fulfilled.
Handling	Next, take the actions listed in “1” to “3” below for the cause with the respective corresponding number. 1 Check the gain (balance between position loop gain and speed loop gain) and inertia ratio. 2 Increase the value set for Pr5.14, or set Pr5.14 to 0 and disable the protection function. 3 Review the setting and operating conditions. See Technical Reference Functional Specification “4.2.4 Motor Working Range Setup Function” .

Err34.1.0 “Single-turn absolute movable range error protection”

Primary cause	When an absolute encoder is connected, and Pr0.15 “Absolute encoder setup” = 3, the motor (encoder) position went outside the motor movable range (encoder single-turn data).
Handling	● Check the operational range for the absolute encoder (absolute scale) position including Obj.607Ch:00h “Home offset” and review the electronic gear ratio. ● Return the motor (encoder) position to within the motor movable range (in the encoder single-turn data). ● Return the command position to within the motor movable range (in the encoder single-turn data).

Err36.☐.0 “EEPROM parameter error protection”

- Err36.0.0 to Err36.1.0 “EEPROM parameter error protection”

Primary cause	Data in the parameter storage area has been damaged when reading the data from EEPROM at power-on.
Handling	● Reset all parameters. ● If this happens repeatedly, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err37.☐.0 “EEPROM check code error protection”

- Err37.0.0 to Err37.2.0 “EEPROM check code error protection”

Primary cause	Data for EEPROM write confirmation was damaged when the data was read from the EEPROM at power-on.
Handling	● The product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err38.0.0 “Over-travel inhibit input protection 1”

Primary cause	● Positive direction/negative direction over-travel inhibit input (POT, NOT) were both switched ON when Pr5.04 “Over-travel inhibit input setup” = 0. ● One of positive direction/negative direction over-travel inhibit input (POT, NOT) was switched ON when Pr5.04 “Over-travel inhibit input setup” = 2.
Handling	Check that there are no anomalies with the switches, cables or power supply connected to the positive direction over-travel inhibit input/negative direction over-travel inhibit input. In particular, check that the rise in the control signal power supply (12 to 24 V DC) is not delayed.

Err38.1.0 “Over-travel inhibit input protection 2”

Primary cause	● An operating command (trial run, frequency characteristics analysis function (FFT function), etc.) was received from Set-up Support Software (PANATERM ver.7) while Pr5.04 “Over-travel inhibit input setup” = 0, 1 and EtherCAT communication is in an off state and either POT or NOT are in an on state. ● POT or NOT was turned on while an operating command from Set-up Support Software (PANATERM ver.7) was in operation.
Handling	Check that there are no anomalies with the switches, cables or power supply connected to the positive direction/negative direction over-travel inhibit input. In particular, check that the rise in the control signal power supply (12 to 24 V DC) is not delayed.

Err38.2.0 “Over-travel inhibit input protection 3”

Primary cause	POT or NOT was set to a value other than Pr5.04 “Over-travel inhibit input setup” = 1 (CoE-side deceleration to stop) while the assignment function implemented any of SI5 to SI7.
Handling	Check that Pr5.04 “Over-travel inhibit input setup” = 1 (CoE-side deceleration to stop) is configured.

Err39.0.0 “Analog input (AIN) excess protection”

Primary cause	A voltage higher than that set in Pr4.24 “Analog input (AIN) excessive setting” was applied to analog input.
Handling	● Correctly configure Pr4.24 “Analog input (AIN) excessive setting” correctly. ● Check the connection status of the input/output connector. ● Set Pr4.24 to 0 and disable the protection function.

Err40.0.0 “Absolute system down error protection”

Primary cause	1 The power supply to the absolute encoder and the battery power supply are down and the built-in capacitor voltage dropped below the specified value. 2 The absolute encoder has not been cleared even once by the batteryless absolute encoder.
Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. 1 Connect the absolute encoder battery and then clear the absolute encoder (battery backup). 2 Clear the batteryless absolute encoder. For absolute encoder clearing operation, see Technical Reference Functional Specification “4.2.7 Absolute Encoder” .

Err41.0.0 “Absolute counter over error protection”

Primary cause	The multi-turn counter of the absolute encoder has exceeded the specified value.
Handling	● Clear the absolute encoder near the center of the movable range such that the amount of movement from the center of the movable range is within 32765 rotations. ● Change Pr0.15 “Absolute encoder setup” to the setting value 2 (absolute system: ignore multi-turn counter over), and consider monitoring the multi-turn data with the host device.

Err42.0.0 “Absolute overspeed error protection”

Primary cause	If this happens while using an absolute encoder (battery backup), consider the following causes. 1 The motor rotational speed has exceeded the specified value when only battery power is being supplied during a power failure. 2 The encoder power has been interrupted for some reason during normal operation and switched to power failure mode, and the rotational speed has exceeded the specified value. **Notes** ● This does not happen with a batteryless absolute encoder.

Handling	Take the actions listed in “1” to “2” below for the cause with the respective corresponding number. To clear the alarm, in addition to performing the following actions, the absolute encoder must be cleared. For absolute encoder clearing operation, see Technical Reference Functional Specification “4.2.7 Absolute Encoder” . 1 Check whether there is external drive during the power failure and check the rotational speed if there is, and operate at a speed below the specified value. 2 Take the following actions. ● Check the power supply voltage (5 V ±5%) on the encoder side. ● Check the connection status of the Connector X6.

Err44.0.0 “Single-turn counter error protection”

Primary cause	A single-turn counter error has been detected.
Handling	Replace the motor with a new one. Return the motor that generated the alarm to the vendor for examination (repair).

Err45.0.0 “Multi-turn counter error protection”

Primary cause	A multi-turn counter error has been detected.
Handling	Replace the motor with a new one. Return the motor that generated the alarm to the vendor for examination (repair).

Err47.0.0 “Absolute status error protection”

Primary cause	The encoder turned more than the specified value during power-up.
Handling	Set so that the motor does not operate during power-up.

Err50.0.0 “External scale wiring error protection”

Primary cause	Communication between the external scale and this product has been interrupted more than a set number of times, triggering the disconnection detecting function.
Handling	● Wire the external scale wiring according to the connections. ● Reconnect connector pins connected incorrectly.

Err50.1.☐ “External scale communication error protection”

- Err50.1.0 to Err50.1.2 “External scale communication error protection”

Primary cause	This is primarily a data error due to noise. ● There is a communication error in data from the external scale. ● The external scale connection cable is connected but there is an error in the communication data.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. For details on wiring, see Connection to Servo Driver Specification external scale.

Err50.2.0 “External scale communication data error protection”

Primary cause	This is primarily a data error due to noise. ● There was an error in communication data from the external scale even though there was not a communication error. ● The external scale connection cable is connected but there is an error in the communication data.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. For details on wiring, see Connection to Servo Driver Specification external scale.

Err51.0.0 “External scale status error protection 0”

Primary cause	1 was returned for bit 0 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.1.0 “External scale status error protection 1”

Primary cause	1 was returned for bit 1 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.2.0 “External scale status error protection 2”

Primary cause	1 was returned for bit 2 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.3.0 “External scale status error protection 3”

Primary cause	1 was returned for bit 3 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.4.0 “External scale status error protection 4”

Primary cause	1 was returned for bit 4 of the external scale error code (ALMC).
Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err51.5.0 “External scale status error protection 5”

Primary cause	1 was returned for bit 5 of the external scale error code (ALMC).

Handling	Check the external scale specifications, resolve the cause of the error, and then clear the external scale error. When that is done, shut off and reset the control power supply.

Err55.0.0 “A-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the A-phase wiring of the external scale.
Handling	Check the A-phase wiring of the external scale.

Err55.1.0 “B-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the B-phase wiring of the external scale.
Handling	Check the B-phase wiring of the external scale.

Err55.2.0 “Z-phase connection error protection”

Primary cause	An error, such as a broken wire, has occurred in the Z-phase wiring of the external scale.
Handling	Check the Z-phase wiring of the external scale.

Err68.□.□ “Internal communication processing error protection□”

- Err68.0.0 “Internal communication processing error protection1”
- Err68.3.0 to Err68.3.3 “Internal communication processing error protection4”
- Err68.5.0 “Internal communication processing error protection6”
- Err68.6.0 “Internal communication processing error protection7”
- Err68.7.0 “Internal communication processing error protection8”
- Err68.8.0 “Internal communication processing error protection9”
- Err68.9.0 “Internal communication processing error protection10”
- Err68.10.0 “Internal communication processing error protection11”
- Err68.11.0 “Internal communication processing error protection12”
- Err68.14.0 “Internal communication processing error protection15”
- Err68.19.0 “Internal communication processing error protection20”
- Err68.21.0 “Internal communication processing error protection22”

Primary cause	An error has occurred in the internal microcomputer-to-microcomputer communication.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err70.0.0 “U-phase current detector error protection 1”

Primary cause	● There is an error in the U-phase current detection offset value.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.0.1 “U-phase current detector error protection 2”

Primary cause	Detected U-phase current sticking.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.1.0 “W-phase current detector error protection 1”

Primary cause	● There is an error in the W-phase current detection offset value.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err70.1.1 “W-phase current detector error protection 2”

Primary cause	Detected W-phase current sticking.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair).

Err72.0.0 “Thermal error protection”

Primary cause	A thermal error has occurred.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err75.0.☐ “External memory access error protection”

- Err75.0.0 to Err75.0.1 “External memory access error protection”

Primary cause	An error occurred in the access process with peripheral components.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.0.0 “Microcomputer error protection 1”

Primary cause	An error has occurred in the internal microcontroller.

Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.2.0 “Microcomputer error protection 3”

Primary cause	An error has occurred in the internal microcontroller.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err77.6.☐ “Microcomputer error protection7”

- Err77.6.0 to Err77.6.3 “Microcomputer error protection7”

Primary cause	● An error has occurred in the internal microcontroller. ● ESC malfunctioned due to unsupported ESC register access while ESM status was beyond PreOP.
Handling	● Turn the power supply off and then on again. ● ESC register access is restricted for this product. Check that the following registers are not being accessed: 0510h "MII Management Control/Status" 0512h "PHY Address" 0513h "PHY Register Address" 0514h "PHY Data" ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err80.0.0 “ESM unauthorized request error protection”

Primary cause	A state change request that is not possible from the current state has been received. Init -> SafeOP Init -> OP PreOP -> OP
Detected ESM state	All ESM
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	● When the current state is anything other than OP: Remains in the current ESM state. ● When the current state is OP: SafeOP
ESC Register AL Status Code	0011h
Handling	Check the host device status change request.
Alarm clear	○
ERR Indicator Display	Blinking

Err80.1.0 “ESM undefined request error protection”

Primary cause	Received an undefined status change request other than the following. 1: Request Init State 2: Request Pre-Operational State 4: Request Safe-Operational State 8: Request Operational State
Detected ESM state	All ESM
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	● When the current state is anything other than OP: Remains in the current ESM state. ● When the current state is OP: SafeOP
ESC Register AL Status Code	0012h
Handling	Check the host device status change request.
Alarm clear	○
ERR Indicator Display	Blinking

Err80.2.0 “Bootstrap requests error protection”

Primary cause	The following change state request was received. 3: Request Bootstrap State
Detected ESM state	form Init to Bootstrap
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Init
ESC Register AL Status Code	0013h
Handling	Check the change state request of host controller.
Alarm clear	○
ERR Indicator Display	Blinking

Err80.3.0 “Incomplete PLL error protection”

Primary cause	● Phase alignment (PLL lock) of EtherCAT communication synchronization could not be completed even after 1s has elapsed from the start of synchronization processing during PreOP→SafeOP transition. ● Obj.37B0h:00h “Communication function extended setup 7” :bit 8 (Pr7.110:bit 8) is 1, SYNC0 or interrupt processing by IRQ or interrupt processing by IRQ occurred for more than 9.5 seconds during SafeOP→OP transition after synchronization processing is completed. See *“Conditions for occurrence of Err80.3.0 to Err80.7.0”* .
Detected ESM state	PreOP→SafeOP, SafeOp, SafeOP→OP
Detected synchronous mode	DC, SM2
ESM state after detection	● When the ESM state at the time of detection is in the PreOP→SafeOP transition: PreOP ● When the ESM state at the time of detection is in the SafeOP or during the SafeOP→OP transition: SafeOP
ESC Register AL Status Code	002Dh

Handling	Take the following actions depending on the synchronous mode at the time of detection. If the following actions do not resolve the problem, turn the power supply off and then on again. If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair). For DC ● If the ESC register 0920h “System Time Offset” is anything other than 0, check that the ESC register 0920h “System Time Offset” is set before enabling the SYNC0 signal. ● Check the DC setting. ● Check that the propagation delay compensation and drift compensation are correct. For SM2 ● Check whether the ESC register 0920h “System Time Offset” is set to anything other than 0. ● Confirm that the PDO send timing from the host device is consistent. ● Check for problems with the EtherCAT communication cable wiring. ● Check whether there is excessive noise on the EtherCAT communication cable. ● When this has been resolved, shut off and reset the control power supply.
Alarm clear	○
ERR Indicator Display	Single flash

Related objects

Index	Sub-Index	Name	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM	Attribute
37B0h	00h	Communication function extended setup 7	–	-2147483648 to 2147483647	I32	rw	No	ALL	Yes	B
● bit 8: Err80.3.0 detection function expansion 0: Disabled 1: Enabled										

Err80.4.0 “PDO watchdog error protection”

Primary cause	1 0220h to 0223h “AL Event Request” :bit 10 did not turn ON within the time (detection timeout value) set by ESC registers 0400h “Watchdog Divider” and 0420h “Watchdog Time Process Data” during PDO communication (in SafeOP or OP state). See *“Conditions for occurrence of Err80.3.0 to Err80.7.0”* . 2 <If the error cannot be resolved by addressing the primary causes above, or if ESM cannot be changed to OP> Logical Start Address of FMMU set from EtherCAT MainDevice (controller) does not match this product's specifications.
Detected ESM state	SafeOP (*1) , OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	SafeOP
ESC Register AL Status Code	001Bh

Handling	Take the actions listed in "1" to "2" below for the cause with the respective corresponding number. 1 Check the following and take the following actions. ● Confirm that the PDO send timing from the host device is consistent (is not interrupted). ● Increase the PDO watchdog detection timeout value. ● Check for problems with the EtherCAT communication cable wiring. ● Check whether there is excessive noise on the EtherCAT communication cable. 2 Take one of the following actions. This product places restrictions on the Logical Start Address settings of the FMMU. See *"1.2.7 Functional Differences from Previous Series"* "EtherCAT SubDevice Controller" or "LRW Command for Process Data RAM Area (1000h to FFFFh)" for more information on these restrictions. ● In the EtherCAT MainDevice (controller) communication settings, check the Logical Start Address of the FMMU for PDO communication input and output. If the Logical Start Addresses of the two are different, change them to the same value. ● In the EtherCAT MainDevice (controller) communication settings, check the LRW command for PDO communication. If using the LRW command, replace it with the LRD/LWR command. **Precautions** • When replacing the LRW command with the LRD/LWR command, please do so after confirming the communication cycle, PDO size, and number of connected axes. Up to twice as much data may be required, and the number of connected axes may be halved compared to the number of connected axes currently in use, as with the MINAS A6B series. If you have any questions, please contact the retailer (dealer) from which you purchased the product.
Alarm clear	○
ERR Indicator Display	Double flash

*1 The watchdog at SM3 (TxPDO) is disabled with this product, and detection is only executed by the watchdog at SM2 (RxPDO). Thus, an alarm is detected only in the OP state.

Err80.6.0 "PLL error protection"

Primary cause	With the ESM state in SafeOP or OP, the phase matching (PLL lock) of EtherCAT communication synchronization has been lost. See *"Conditions for occurrence of Err80.3.0 to Err80.7.0"* .
Detected ESM state	SafeOP, OP
Detected synchronous mode	DC, SM2
ESM state after detection	SafeOP
ESC Register AL Status Code	0032h

Handling	Take the following actions depending on the synchronous mode at the time of detection. If the following actions do not resolve the problem, turn the power supply off and then on again. If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair). For DC ● If the ESC register 0920h “System Time Offset” is anything other than 0, check that the ESC register 0920h “System Time Offset” is set before enabling the SYNC0 signal. ● Check the DC setting. ● Check that the propagation delay compensation and drift compensation are correct. For SM2 ● Check whether the ESC register 0920h “System Time Offset” is set to anything other than 0. ● Confirm that the PDO send timing from the host device is consistent. ● Check for problems with the EtherCAT communication cable wiring. ● Check whether there is excessive noise on the EtherCAT communication cable.
Alarm clear	○
ERR Indicator Display	Single flash

Err80.7.0 “Synchronization signal error protection”

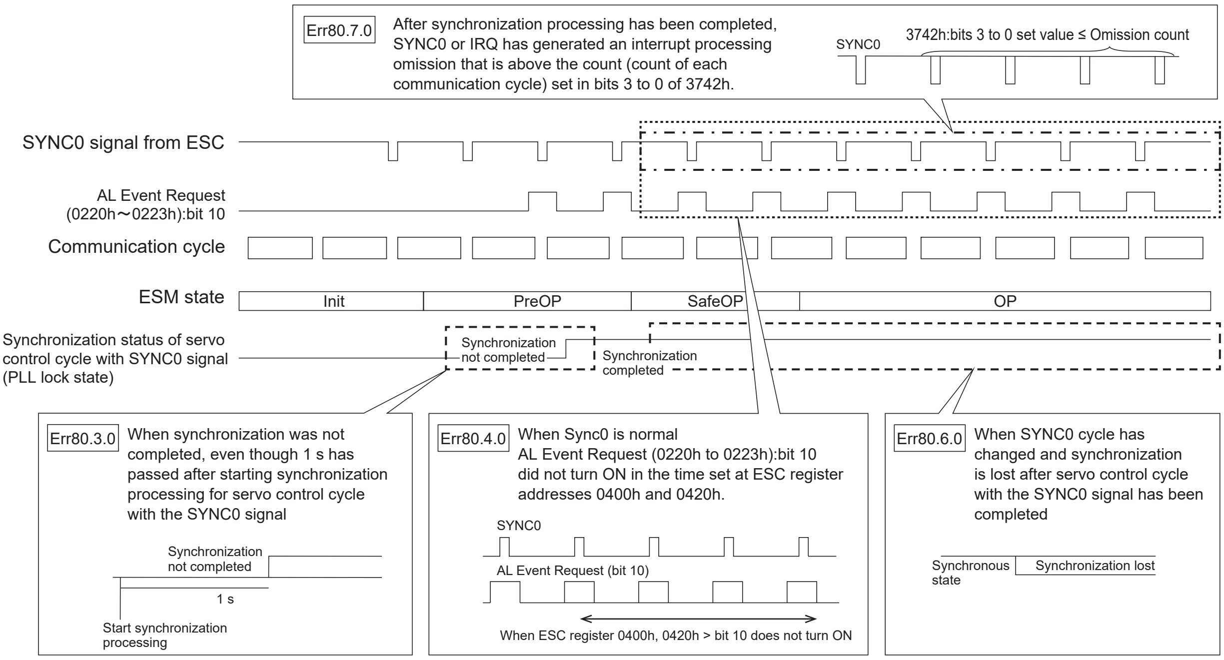
Primary cause	After the completion of synchronization processing, an interrupt process missed by SYNC0 or IRQ occurred above the threshold set by Obj.3742h:00h “Maximum continuation communication error” :bits 0 to 3 (Pr7.42 “Maximum continuation communication error” :bits 3 to 0). See *“Conditions for occurrence of Err80.3.0 to Err80.7.0”* .
Detected ESM state	If Obj.37B0h:00h “Communication function extended setup 7” :bit 7 (Pr7.110:bit 7) is 0: Safe-OP, OP If Obj.37B0h:00h “Communication function extended setup 7” :bit 7 (Pr7.110:bit 7) is 1: OP
Detected synchronous mode	DC, SM2
ESM state after detection	SafeOP
ESC Register AL Status Code	002Ch
Handling	Take the following actions depending on the synchronous mode at the time of detection. If the following actions do not resolve the problem, turn the power supply off and then on again. If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the motor and servo driver with new ones. Return the motor and servo driver that generated the alarm to the vendor for examination (repair). For DC ● Check the DC setting. ● Check that the propagation delay compensation and drift compensation are correct. For SM2 ● Confirm that the PDO send timing from the host device is consistent. ● Check for problems with the EtherCAT communication cable wiring. ● Check whether there is excessive noise on the EtherCAT communication cable. ● Increase the setting value of Obj.3742h:00h “Maximum continuation communication error” :bits 3 to 0 (Pr7.42 “Maximum continuation communication error” :bits 3 to 0).
Alarm clear	○
ERR Indicator Display	Single flash

Related objects

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Units</th><th>Range</th><th>Data Type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th><th>Attribute</th></tr>
<tr><td>3742h</td><td>00h</td><td>Maximum continuation communication error</td><td>–</td><td>-32768 to 32767</td><td>I16</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>R</td></tr>
<tr><td colspan="11">● Set the continuation communication error upper limit.
bits 3 to 0: Err80.7.0 Detection threshold (0 to 15 times, detection disabled when 0)
bits 7 to 4: Reserved
bits 11 to 8: Reserved
bits 15 to 12: Reserved</td></tr>
<tr><td>37B0h</td><td>00h</td><td>Communication function extended setup 7</td><td>–</td><td>-2147483648 to 2147483647</td><td>I32</td><td>rw</td><td>No</td><td>ALL</td><td>Yes</td><td>B</td></tr>
<tr><td colspan="11">● bit 7: Err80.7.0 detection function expansion
0: Disabled
1: Enabled</td></tr>
</table>

Conditions for occurrence of Err80.3.0 to Err80.7.0

For conditions for occurrence of Err80.3.0 to Err80.7.0, an example using DC synchronization is shown in the figure below (In SM2 synchronization, the SYNC0 signal is replaced by an IRQ signal).



Err80.7.0 After synchronization processing has been completed, SYNC0 or IRQ has generated an interrupt processing omission that is above the count (count of each communication cycle) set in bits 3 to 0 of 3742h.

Err80.3.0 When synchronization was not completed, even though 1 s has passed after starting synchronization processing for servo control cycle with the SYNC0 signal

Err80.4.0 When Sync0 is normal AL Event Request (0220h to 0223h):bit 10 did not turn ON in the time set at ESC register addresses 0400h and 0420h.

Err80.6.0 When SYNC0 cycle has changed and synchronization is lost after servo control cycle with the SYNC0 signal has been completed

Err81.0.0 “Synchronization cycle error protection”

For SYNC0 cycle setting error

Primary cause	The following currently unsupported synchronization cycle (SYNC0 cycle) has been set. ● One of either ESC register 09A0h “SYNC0 Cycle Time” or Obj.1C32h:02h “Cycle time” has been set to a value other than 62500, 125000, 250000, 500000, 1000000, 2000000, 4000000, 8000000 or 10000000 ns.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC
ESM state after detection	PreOP
ESC Register AL Status Code	0035h

Handling	Correctly configure the synchronization cycle.
Alarm clear	○
ERR Indicator Display	Blinking

For IRQ cycle setting error

Primary cause	The following currently unsupported synchronization cycle (IRQ cycle) has been set. ● Obj.1C32h:02h “Cycle time” was set to a value other than 62500, 125000, 250000, 500000, 1000000, 2000000, 4000000, 8000000, and 10000000 ns.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	SM2
ESM state after detection	PreOP
ESC Register AL Status Code	0035h
Handling	Correctly configure the synchronization cycle.
Alarm clear	○
ERR Indicator Display	Blinking

Err81.1.0 “Mailbox error protection”

Primary cause	The following Mailbox SyncManager0/1 setting is wrong. ● When the SyncManager0/1 Physical Start Address (ESC register: 0800h, 0801h/0808h, 0809h) setting is invalid • The Mailbox receiving range and sending range are overlapping. • The Mailbox sending/receiving range is overlapping the SyncManager2/3 sending/receiving range. • The address specification for the Mailbox sending/receiving range is set to an odd number. ● When SyncManager0/1 Length (ESC register: 0802h, 0803h/080Ah, 080Bh) setting is invalid • SyncManager0: It is set outside the 32 to 256 byte range. • SyncManager1: It is set outside the 40 to 256 byte range. ● When SyncManager0/1 Control Register (ESC register: 0804h/080Ch) setting is invalid • 0804h:bits 3 to 0 are set to something other than 0110b. • 080Ch:bits 3 to 0 are set to something other than 0010b.
Detected ESM state	Init -> PreOP, PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Init
ESC Register AL Status Code	0016h
Handling	Set Sync manager correctly as described in the ESI file.
Alarm clear	○
ERR Indicator Display	Blinking

Err81.4.0 “PDO watchdog setup error protection”

Primary cause	The PDO watchdog setting is wrong. ● For DC, SM2 Although the PDO watchdog trigger is enabled (SyncManager: ESC register 0804h “SyncManager” :bit 6 is set to 1), the setting for the PDO watchdog detection timeout (ESC register 0400h, 0420h) is less than “Communication cycles × 2”. Or, the PDO watchdog detection timeout value (ESC register 0400h) is set to 8190 or higher. ● For FreeRun Although the PDO watchdog trigger is enabled (SyncManager: ESC register 0804h “SyncManager” :bit 6 is set to 1), the setting for the PDO watchdog detection timeout (ESC register 0400h, 0420h) is less than 2 ms. Or, the PDO watchdog detection timeout value (ESC register 0400h) is set to 8190 or higher.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	001Fh
Handling	Set a valid watchdog detection timeout value.
Alarm clear	○
ERR Indicator Display	Blinking

Err81.5.0 “DC error protection”

Primary cause	The DC setup is incorrect. ● ESC register 0981h “Activation” :bits 2 to 0 have been set to something other than the following values. bits 2 to 0 = 000b bits 2 to 0 = 011b
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	0030h
Handling	Check the DC setting.
Alarm clear	○
ERR Indicator Display	Blinking

Err81.6.0 “SM event mode error protection”

Primary cause	One of the following unsupported SM event modes has been set. ● Obj.1C32h:01h “Sync mode” has been set to a value other than 00h “FreeRun”, 01h “SM2”, or 02h “DC SYNC0”. ● Obj.1C33h:01h “Sync mode” has been set to a value other than 00h “FreeRun”, 02h “DC SYNC0”, or 22h “SM2”. ● ESC register 0981h “Activation” :bits 2 to 0 = 000b, and only one of either Obj.1C32h–01h or Obj.1C33h–01h has been set to SM2.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	0028h

Handling	● Set Obj.1C32h:01h “Sync mode” to any of 00h “FreeRun”, 01h “SM2” or 02h “DC SYNC0”. ● Set Obj.1C33h:01h “Sync mode” to any of 00h “FreeRun”, 02h “DC SYNC0” or 22h “SM2”. ● Match the settings for Obj.1C32h-01h and Obj.1C33h-01h.
Alarm clear	○
ERR Indicator Display	Blinking

Err81.7.0 “SyncManager 2 / 3 setup error protection”

SyncManager2

Primary cause	SyncManager2 setting has been set to an invalid value. ● When the SyncManager2 Physical Start Address (ESC register: 0810h) setting is invalid • The receiving range and sending range are overlapping. • The Mailbox sending/receiving range is overlapping the SyncManager2 sending/receiving range. • The address specification for the sending/receiving range is set to an odd number. • The start address is out of range. ● When the SyncManager2 Length (ESC register: 0812h) setting is invalid • Differs from the RxPDO size. ● When the SyncManager2 Control Register (ESC register: 0814h) setting is invalid • bits 3 to 2 are set to something other than 01b.
Detected ESM state	PreOP -> SafeOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	001Dh
Handling	Set SyncManager2 correctly as described in the ESI file.
Alarm clear	○
ERR Indicator Display	Blinking

SyncManager3

Primary cause	SyncManager3 setting has been set to an invalid value. ● When the SyncManager3 Physical Start Address (ESC register: 0818h) setting is invalid • The receiving range and sending range are overlapping. • The Mailbox sending/receiving range is overlapping the SyncManager3 sending/receiving range. • The address specification for the sending/receiving range is set to an odd number. • The start address is out of range. ● When the SyncManager3 Length (ESC register: 081Ah) setting is invalid • Differs from the TxPDO size. ● When the SyncManager3 Control Register (ESC register: 081Ch) setting is invalid • bits 3 to 2 are set to something other than 00b.
Detected ESM state	PreOP -> SafeOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	001Eh
Handling	Set SyncManager3 correctly as described in the ESI file.
Alarm clear	○
ERR Indicator Display	Blinking

Err84.3.0 “Initialization of synchronization establishment error protection”

Primary cause	An error occurred in the internal synchronization process.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err85.0.0 “TxPDO assignment error protection”

Primary cause	The data size for the TxPDO map has been set in excess of 32 bytes.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	0024h
Handling	Set the TxPDO data size to 32 bytes or less.
Alarm clear	○
ERR Indicator Display	Blinking

Err85.1.0 “RxPDO assignment error protection”

Primary cause	The data size for the RxPDO map has been set in excess of 32 bytes.
Detected ESM state	PreOP -> SafeOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	PreOP
ESC Register AL Status Code	0025h
Handling	Set the RxPDO size to 32 bytes or less.
Alarm clear	○
ERR Indicator Display	Blinking

Err85.2.0 “Lost link error protection”

Primary cause	The ESM state transitions from Init -> PreOP while either Port0 or Port1 show as “Lost link” (except ports that show as “Lost link” from the moment of transition from Init -> PreOP) and the time set in Obj.3743h:00h “Lost link detection time” has elapsed.
Detected ESM state	PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Init
ESC Register AL Status Code	0000h
Handling	● Check for problems with the EtherCAT communication cable wiring. ● Check for problems with communication from the host device.
Alarm clear	○
ERR Indicator Display	Double flash

Related objects

Index	Sub-Index	Name	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM	Attribute
3743h	00h	Lost link detection time	ms	0 to 32767	I16	rw	No	ALL	Yes	R
		● Err85.2.0 “Lost link error protection” is triggered when the time set by this parameter has passed after the ESM state shifts from Init -> PreOP if either Port0 or Port1 show as “Lost link” (excludes Ports that show as “Lost link” from the moment of transition from Init -> PreOP). ● If set to 0, Err85.2.0 “Lost link error protection” detection is disabled.								

Precautions

- This alarm is triggered only by the sub drive that detected the Lost link.
- Downline sub drives that do not detect the Lost link will not detect this alarm.
- To have the alarm detected by a downline sub device, activate the PDO watchdog to which the PDO is assigned.
- Please note that the factory default value for Obj.3743h:00h “Lost link detection time” is 0 (disabled).

Err85.3.0 “SII EEPROM error protection”

Primary cause	● The values for VendorID, Product code and Revision number in SII (EEPROM) and the object do not match. ● Reading and writing of SII (EEPROM) are invalid. Or, the SII area is corrupted. The detection range is different from that of A6B. ● Any one of bits 14, 13, 11 at ESC register 0502h is set to 1.
Detected ESM state	All ESM
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Init
ESC Register AL Status Code	0051h
Handling	● Check the SII data. ● Re-execute reading and writing to and from SII.
Alarm clear	×
ERR Indicator Display	Flickering

Precautions

- If Err85.3.0 is triggered while disconnected from the host device, it is possible that the product has failed. In such a case, replace the servo driver.

Err87.0.0 “Forced alarm input protection”

Primary cause	Forced alarm input (E-STOP) has been entered.
Handling	If this alarm occurs unintentionally, check the wiring as the input state of the forced alarm input (E-STOP) may be in an unintended state.

Err87.1.0 “Retracting operation completion (I/O)”

Primary cause	The I/O retracting operation has been completed normally.
Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err87.2.0 “Retracting operation completion (communication)”

Primary cause	The communication retracting operation has been completed normally.
Handling	This is a safety measure to notify the operator that the retracting operation has been run, and is not a problem as long as the retracting operation was intended. Be sure to run homing after clearing the alarm.

Err87.3.☐ “Retracting operation error”

Primary cause	The retracting operation could not be started due to the following conditions. The retracting operation may also have been interrupted. ● When the Pr6.85 “Retracting operation condition setting” setting has an error ● When the retracting operation is enabled and the communication cycle is set to less than 250 μs ● When over-travel inhibit input (POT, NOT) is detected during the retracting operation ● When the retracting operation execution condition is met in a state when over-travel inhibit input (POT, NOT) is detected ● When the retracting operation condition is met while an operation other than a communication command from the host (trial run, etc.) is being executed ● When the retracting operation is interrupted by an alarm being detected during the retracting operation ● When the retracting operation could not be started due to something like a servo-off state
Handling	● Check that there are no problems with the parameter settings. ● Check that there are no problems with the operating environment. ● Be sure to run homing after clearing the alarm.

Err88.0.0 “Main power supply undervoltage protection (AC interrupt detection 2)”

Primary cause	● A main circuit power supply off was detected when the Obj.6007h:00h “Abort connection option code” setting was 1 and the PDS state was “Operation enabled” or “Quick stop active”. ● A Switch on command was received when the Obj.6007h:00h “Abort connection option code” setting was 1, the PDS state was “Ready to switch on” and the main circuit power supply was off.
Detected ESM state	PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Remains in the current ESM state.
ESC Register AL Status Code	0000h
Handling	● Increase the power supply voltage capacity, change the power supply, eliminate whatever caused the electromagnetic contactor in the main power supply to drop, then turn the power back on. ● Properly connect each phase (L1, L2, L3) of the power supply. Use L1, L3 for single phase 100 V and single phase 200 V. ● Replace the servo driver with a new one.
Alarm clear	○
ERR Indicator Display	OFF

Err88.1.0 “Control mode setting error protection”

Primary cause	● The PDS state is changed to “Operation enabled” when the set value of Obj.6060h:00h “Modes of operation” is 0 and the set value of Obj.6061h:00h “Modes of operation display” is 0. ● A currently unsupported control mode was set at Obj.6060h:00h “Modes of operation” . ● A mode other than position control was set at Obj.6060h:00h “Modes of operation” during full-closed control. ● One of the following was set in two-degree-of-freedom control mode (synchronization type). • Obj.3001h:00h “Control mode setup” = 6 (Full-closed control) • Obj.6060h:00h “Modes of operation” = 3 (pv) or 9 (csv) ● Was set to two-degree-of-freedom control mode (synchronization type) during velocity control or full-closed control.
Detected ESM state	All ESM
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Remains in the current ESM state.
ESC Register AL Status Code	0000h
Handling	● Check the set value of Obj.6060h:00h “Modes of operation” . ● Check the two-degree-of-freedom control-related parameters Pr6.47:bit 3, bit 0.
Alarm clear	○
ERR Indicator Display	OFF

Err88.2.0 “ESM requirements during operation error protection”

Primary cause	● While the PDS state was “Operation enabled” or “Quick stop active”, a command to change to another ESM state was received. ● When set to Obj.3799h:bit 0 = 1, a command was received from Set-up Support Software (PANATERM ver.7) to change from the current ESM state to another ESM state while the servo was on (triggering warning D2).
Detected ESM state	Init, PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Comply with the state change request from the host device.
ESC Register AL Status Code	0000h
Handling	Check the state change request from the host device.
Alarm clear	○
ERR Indicator Display	OFF

Err88.3.0 “Improper operation error protection”

Primary cause	● EXT1/EXT2 was selected by touch probe trigger selection (Obj.60B8h:00h “Touch probe function”) when EXT1/EXT2 was not assigned to the input signal. ● Z-phase was selected in the trigger selection (Obj.60B8h:00h “Touch probe function”) of the touch probe when in full-closed absolute mode. ● The actual position or command position was wrapped around when the software limit function was enabled.
Detected ESM state	PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Remains in the current ESM state.
ESC Register AL Status Code	0000h

Handling	● Set the function assignment to the input signal correctly. ● Set the trigger selection correctly. ● Check the relationship between the operating range and software limit settings.
Alarm clear	×
ERR Indicator Display	OFF

Primary cause	● The calculated result for the electronic gear ratio was outside the range of 128000× to 1/1000×. ● The denominator or numerator exceeded the unsigned 64-bit size in the process of calculating the electronic gear ratio. ● The denominator or numerator exceeded the unsigned 32-bit size in the final calculation result for the electronic gear ratio.
Detected ESM state	Init -> PreOP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Comply with the state change request from the main device.
ESC Register AL Status Code	0000h
Handling	Review the electronic gear setting and turn the control power supply back on.
Alarm clear	×
ERR Indicator Display	OFF

Err91.1.0 “Command error protection”

Primary cause	● A position that cannot be reached in continuous rotating absolute encoder mode (outside the range of Obj.607Bh: “Position range limit”) was set as the target position. ● A Trial Run with Set-up Support Software (PANATERM ver.7) was executed when the communication cycle is 62.5 μs.
Handling	● When using absolute positioning under pp control when in continuous rotating absolute encoder mode, or when using csp control, set a reachable position (within the range of the Obj.607Bh: “Position range limit”) to the target position. ● When executing a trial run using Set-up Support Software (PANATERM ver.7) , set the communication cycle to 125 μs or more.

Err92.0.0 “Encoder data recovery error protection”

Primary cause	The internal position information initialization process was not executed normally when in semi-closed control and absolute mode.
Handling	● Keep the encoder power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the encoder cables are long. ● If the motor cables and encoder cables are bundled together, separate them. ● Connect shielding to FG.

Err92.1.0 “External scale data recovery error protection”

Primary cause	The internal position information initialization process was not executed normally when in full-closed control and absolute mode.
Handling	● Keep the external scale power supply voltage at 5 V DC ±5% (4.75 to 5.25 V). This is particularly important when the external scale connection cable is long. ● If the motor cables and external scale connection cable are bundled together, separate them. ● Connect shielding to FG. See Connection to Servo Driver Specification external scale.

Err92.3.☐ “Multi-turn data upper limit value disagreement error protection”

- Err92.3.0 to Err92.3.2 “Multi-turn data upper limit value disagreement error protection”

Primary cause	In continuous rotating absolute encoder mode, the encoder multi-turn data upper-limit value does not agree with the multi-turn data upper-limit value for the driver parameters.
Handling	Check the parameter setup values.

Err93.2.0 “Parameter setup error protection 2”

Primary cause	The external scale ratio was outside the allowable range.
Handling	Check the value set for the parameter, and set it so that it is in the range of 1/40 ≦ External scale ratio ≦ 20480.

Err93.3.☐ “External scale connection error protection”

- Err93.3.0 to Err93.3.5 “External scale connection error protection”

Primary cause	● The value set for Pr3.23 “External scale selection” does not match the external scale type for the connected serial communication type.
Handling	● Set Pr3.23 “External scale selection” in accordance with the connected external scale type. ● Review the setting of Pr3.23 “External scale selection” .

Err93.5.0 “Parameter setup error protection 4”

Primary cause	Pr6.102 “Over-travel inhibit release level setup” was set to a value over 0 when Pr5.04 “Over-travel inhibit input setup” was set to a value other than 1.
Handling	Check the parameter setup values.

Err93.8.0 “Parameter setup error protection 6”

Primary cause	● Set to continuous rotating absolute encoder mode with anything other than a 27-bit or 23-bit resolution absolute encoder. ● The absolute home position offset was set to a value exceeding the upper-limit value of the command position in continuous rotating absolute encoder mode. ● The upper-limit values for actual position and command position were set to 2^{31} or more in continuous rotating absolute encoder mode.
Handling	Check the parameter setup values.

Err94.3.0 “Homing error protection 2”

Primary cause	● Either positive direction or negative direction over-travel inhibit input (POT or NOT) was turned ON during the return operation to the Z-phase position detected during homing using Z-phase while Pr7.22 “Communication function extended setup 1” :bit 7 = 1 and Pr5.04 “Over-travel inhibit input setup” = 0 or 1 (independent of Pr5.04 for profile position control (pp)). ● An error occurred in EEPROM writing of Pr7.120 “Absolute scale offset 1” or Pr7.121 “Absolute scale offset 2” during a homing operation in absolute mode.

Handling	● Increase the distance between the Z-phase and the positive direction over-travel inhibit input (POT)/negative direction over-travel inhibit input (NOT). ● After ensuring safety, set Pr7.22:bit 7 “Over-travel inhibit input detection setting during Z-phase homing return operation” = 0 (disabled). ● Clear the alarm, then re-run the homing operation. If the alarm still occurs after performing the homing operation again, this product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err95.☐.0 “Motor automatic recognition error protection ☐”

Primary cause	The motor and this product do not match.
Handling	Replace the motor with one that matches this product.

Err96.4.0 “Host controller error protection 3”

Primary cause	An error occurred in the host controller of this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err96.6.0 “Host controller error protection 5”

Primary cause	An error occurred in the host controller of this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err98.☐.0 “Communication hardware error protection ☐”

- Err98.2.0 to Err98.3.0 “Communication hardware error protection ☐”

Primary cause	An error occurred in the internal EtherCAT communication peripheral circuit.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Err98.5.0 “Hardware self-diagnostic error protection 1”

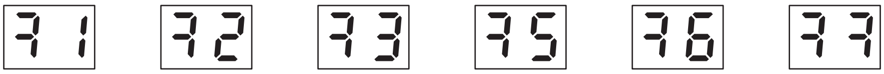
Primary cause	● The current detector has malfunctioned.
Handling	Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Other numbers “Other error protection”

Primary cause	● The control circuit has malfunctioned due to excessive noise, etc. ● The self-diagnosis function of this product was started and an error of some kind occurred inside this product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

Special 7-segment display “System error protection”

Front panel display:



For details, see Technical Reference Functional Specification “3.1.4 Output Signal Assignment” “Precautions” 5.

Primary cause	An error has occurred inside the product.
Handling	● Turn the power supply off and then on again. ● If the alarm still occurs after the power is turned on again, the product may be malfunctioning. Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).

6.1.3 Alarm Reading

With this product, the alarm number for a triggered alarm can be invoked using the following two methods.

1 Method of reading an alarm using Obj.603Fh:00h “Error code”

Displays the main number of the alarm number using Obj.603Fh:00h “Error code” .

Of the Obj.603Fh:00h “Error code” setup values 0000h to FFFFh (0 to 65535), 0000h to FEFFh are defined by IEC61800-7-201 and FF00h to FFFFh can be uniquely defined by the manufacturer.

For this product, the values FF00h to FFFFh that can be uniquely defined are used to represent the alarm number and the lower 8 bits are the main number of the alarm number. The main number of the alarm number is expressed in hexadecimal notation. (See below table)

The sub-number of the alarm number and the cause number cannot be indicated for this object. When reading the sub-number of an alarm, see *“Method of reading an alarm using Obj.4F37h: “Multiple alarm/warning information” ”* below.

Index	Sub-Index	Name	Units	Range	Data type	Access	PDO	Op-mode	EEPROM	Attribute
603Fh	00h	Error code	–	0 to 65535	U16	ro	Yes	ALL	No	X
● An alarm number (main number only) and/or warning number generated by the servo driver are displayed. When no alarm or warning is generated, 0000h is displayed. When an alarm and a warning are generated simultaneously, the alarm number is displayed. The alarm number and warning number are displayed in “FF**h” format. The following numbers are displayed in the “**” segment. • Alarm (main) numbers (00h to 9Fh) • Warning numbers (A0h to A9h, ABh, E1h to E2h, C3h, CAh, D2h) (Example) FF0Ch (0Ch=12d): Err12.0.0 “Overvoltage protection” occurs FF55h (55h=85d): Either Err85.0.0 “TxPDO assignment error protection” or Err85.1.0 “RxPDO assignment error protection” occurs										

Notes

- In exceptional cases of Err81.7.0 “SyncManager 2 / 3 setup error protection” , A000h is displayed.
- The timing of alarm number setting for Obj.603Fh:00h “Error code” is the same as for emergency messages.
  For this reason, the value is set later than for Obj.6041h:00h “Statusword” :bit 3 “fault” .

2 Method of reading an alarm using Obj.4F37h: “Multiple alarm/warning information”

Displays main numbers and sub-numbers of alarm numbers using Obj.4F37h: “Multiple alarm/warning information” . This method cannot display the cause number of an alarm number.

For details on Obj.4F37h: “Multiple alarm/warning information” , see *“5.5.8.7 Servo Information Monitoring Object”* .

6.1.4 Clearing Alarms, Clearing Warnings

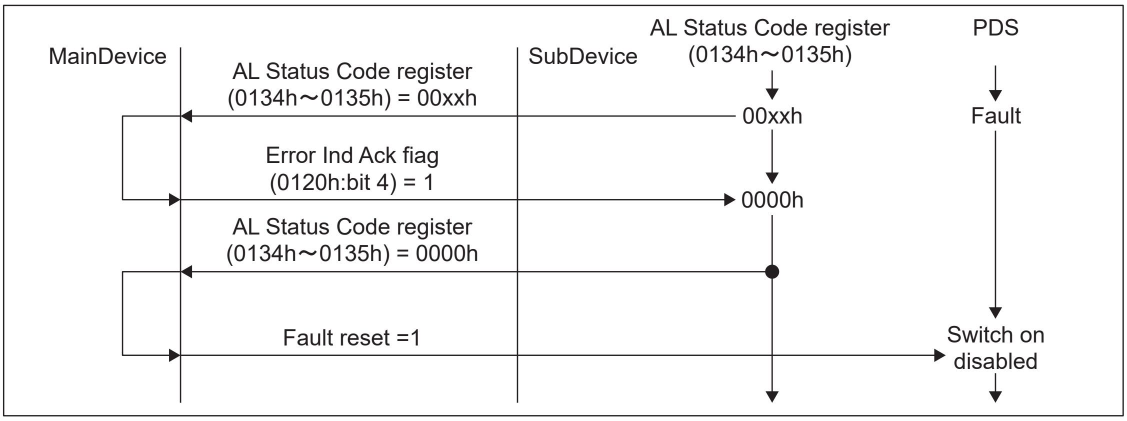
■ Alarm Clearing Methods

If an alarm occurs for this product, this product can be returned from an alarm status by clearing the alarm after eliminating the cause of the alarm.

The product offers the following three alarm clearing methods. When an alarm other than a EtherCAT communication-related alarm (Err80.□.□, Err81.□.□, Err85.□.□, Err88.□.□) is triggered, clear the alarm by the method “2” or “3”.

1 Clearing alarms with AL Control

- 1-1 Set the AL Control bit 4 “Error Ind Ack” to 1.
- 1-2 Set Obj.6040h:00h “Controlword” :bit 7 “fault reset” from 0 to 1 (send Fault reset command) to complete clearing of the alarm.
- 1-3 After completing alarm clearing, the PDS status transitions from Fault to Switch on disabled.



2 Clearing alarms with Set-up Support Software (PANATERM ver.7)

- 2-1 Check Set-up Support Software (PANATERM ver.7) Operating Manual and clear the alarm from Set-up Support Software (PANATERM ver.7) .
- 2-2 After completing alarm clearing, the PDS status transitions from Fault to Switch on disabled.

3 Clearing alarms with external alarm clear input (A-CLR)

- 3-1 Change the external alarm clear input (A-CLR) from OFF status to ON status to complete clearing of the alarm.
- 3-2 After completing alarm clearing, the PDS status transitions from Fault to Switch on disabled.

Precautions

- The AL Status notification and the alarm or warning notification timings are not synchronized.
- The front panel LED display (RUN, ERR), ESM state and AL status are updated to the latest communication error status every time a communication error is detected. However, the first detected alarm number is displayed in the 7-segment LED and retained until Fault reset is executed.

  (Even after Fault reset is executed for an alarm that cannot be cleared, the display is retained.)
- If multiple alarms are generated at the same time, unless the causes of all of the alarms are resolved, the alarms for which the causes have been resolved may not be cleared.
- The alarm is not normally cleared when the external alarm clear input (A-CLR) is in the ON state even if a Fault reset command is sent or the alarm is cleared from Set-up Support Software (PANATERM ver.7) .

  To clear the alarm normally, turn the external alarm clear input (A-CLR) to OFF and then send the Fault reset command and clear the alarm from Set-up Support Software (PANATERM ver.7) .
- When the PDS status is Fault reaction active, the alarm cannot be cleared.

■ Warning Clearing Method

If the warning latch state is set to latch for Obj.3627h:00h “Warning latch state setup” , the warning status is not cleared even if the cause is resolved after a warning is generated for the latch target.

If the warning latch state is set to latch, the warning currently generated can be cleared by setting Obj.6040h:00h “Controlword” :bit 7 “fault reset” from 0 to 1 (sending the fault reset command), clearing the external alarm from Set-up Support Software (PANATERM ver.7) , or switching the alarm clear input (A-CLR) from OFF to ON.

However, the warning cannot be cleared when the PDS status is Fault reaction active.

A warning is not triggered if external alarm clear input (A-CLR) is in the ON state.

6.2 Warning Functions

Warning functions generate a warning before a protection function is triggered to alert the operator in advance of a condition, such as an overload.

If use continues in a warning environment, it may stop, reduce life, or failure due to the protection function of the servo drive. Please do not use until the cause of the warning is ruled out.

Warning functions have the following two modes.

- Warning non-latch mode: Mode in which, if the primary cause of the warning is resolved, it is automatically cleared after 1 s and returns to the state before the warning was triggered
- Warning latch mode: Mode in which the warning state is maintained even if the primary cause of the warning is resolved

You can switch between the two modes with Pr6.27 “Warning latch state setup” . The warning state is cleared by the same procedure as used for clearing a protection function alarm. If the primary cause is not resolved, the warning may be cleared but will be detected again.

However, battery warnings are latched on the encoder side. The latch state on the encoder side can be cleared and the warning canceled by clearing the alarm after replacing the battery.

A warning will not be triggered if external alarm clear (A-CLR) is in the ON state.

6.2.1 List of Warning Functions

Warning functions have the following two types.

General warnings: Warnings common to the A7 family

Expanded warnings: Warnings unique to the MINAS A7B Series

A list of warning functions is shown below.

■ General warnings

Warning No. (hex.)	Warning name	Description	Warning latch	Output setting	Warning mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
A0	Motor overload warning	The warning detection specifications vary depending on the values of Pr6.95 “Motor overload warning detection level” and Pr6.96 “Motor overload warning release level” . For details, see the table below. The motor overload warning detection specifications can be switched to the expanded specifications with the settings for Pr6.95 and Pr6.96.	○	1	Pr6.38 bit 7

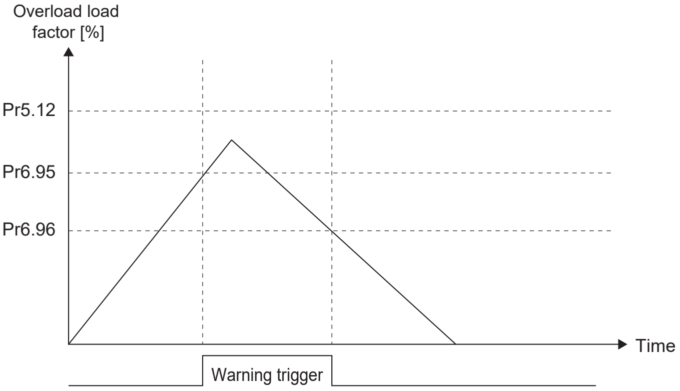
- Details of Warning No. A0 (Motor overload warning)

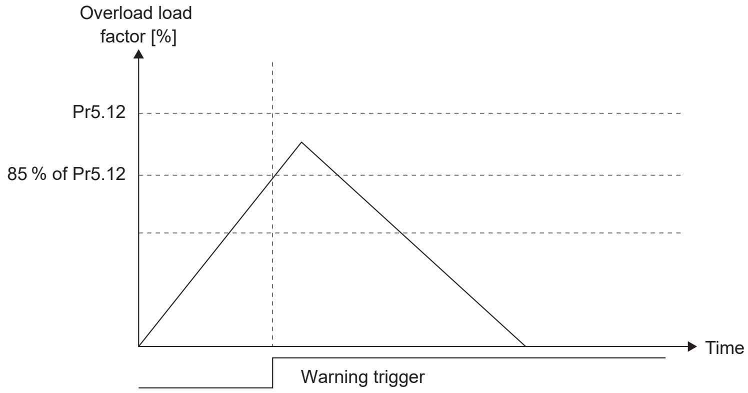
Pr6.95	Pr6.96	Size relationship between Pr6.95 and Pr6.96	Warning detection specifications	Warning release specifications	Remarks
Other than 0	Other than 0	Pr6.95 ≥ Pr6.96	Load factor ≥ Pr6.95	Load factor < Pr6.96	Expanded specification
		Pr6.95 < Pr6.96	Load factor is ≥ 85% of protection level	Load factor is < 85% of protection level	Do not set.
	0	—			
0	Other than 0				
	0				Conventional specifications

- Details on expanded specifications

  The warning latch function is disabled in the expanded specifications.

  - When Pr6.95 “Motor overload warning detection level” and Pr6.96 “Motor overload warning release level” are anything other than 0 and Pr6.96 ≤ Pr6.95 and Pr6.95 < Pr5.12 “Motor overload level setup”



<table>
<tr><th rowspan="2">Warning No. (hex.)</th><th rowspan="2">Warning name</th><th rowspan="2">Description</th><th>Warning latch</th><th>Output setting</th><th>Warning mask</th></tr>
<tr><th>Pr6.27 (*1)</th><th>Pr4.40, Pr4.41 (*2)</th><th>Pr6.38/ Pr6.39 supported bit (*3)</th></tr>
<tr><td colspan="6">● Details on conventional specifications
In the conventional specifications, the warning latch function is dependent on the setting for Pr6.27 “Warning latch state setup” .
• Under conditions other than expanded functions


When the warning latch function setting is enabled, if the setting for Pr6.95 or Pr6.96 is changed to switch the motor overload warning detection specification to the expanded specification after a motor overload warning is triggered, latched motor overload warnings will be cleared because the warning latch function is disabled.</td></tr>
<tr><td>A1</td><td>Over-regeneration warning</td><td>The regenerative load factor exceeded 85% of the protection level.</td><td>○</td><td>2</td><td>Pr6.38 bit 5</td></tr>
<tr><td>A2</td><td>Battery warning</td><td>Battery voltage is 3.2 V or less.
The battery warning will not be detected when Pr0.15 = 1 (incremental mode) or Pr0.15 = 3 (single-turn absolute mode) with an absolute encoder (battery backup), or when a batteryless absolute encoder is used.</td><td>Fixed latch</td><td>3</td><td>Pr6.38 bit 0</td></tr>
<tr><td>A3</td><td>Fan lock warning</td><td>Fan stopped status continued for 1 second.</td><td>○</td><td>4</td><td>Pr6.38 bit 6</td></tr>
<tr><td>A4</td><td>Encoder communication warning</td><td>The number of consecutive occurrences of encoder communication errors exceeded the standard value.</td><td>○</td><td>5</td><td>Pr6.38 bit 4</td></tr>
<tr><td>A5</td><td>Encoder overheat warning</td><td>The encoder temperature exceeded the standard value.
Take measures such as lowering the ambient temperature, reducing the load, and/or reviewing heat dissipation.</td><td>○</td><td>6</td><td>Pr6.38 bit 3</td></tr>
<tr><td>A6</td><td>Oscillation detection warning</td><td>Oscillation was detected.</td><td>○</td><td>7</td><td>Pr6.38 bit 13</td></tr>
<tr><td>A7</td><td>Lifetime detection warning</td><td>The remaining life of the capacitor or fan was below the specified level.</td><td>Fixed latch</td><td>8</td><td>Pr6.38 bit 2</td></tr>
<tr><td>A8</td><td>External scale error warning</td><td>An external scale detected a warning.</td><td>○</td><td>9</td><td>Pr6.38 bit 8</td></tr>
<tr><td>A9</td><td>External scale communication warning</td><td>The number of consecutive occurrences of external scale communication errors exceeded the standard value.</td><td>○</td><td>10</td><td>Pr6.38 bit 14</td></tr>
<tr><td>AB</td><td>Fan speed reduction warning</td><td>Low fan speed detected.</td><td>○</td><td>43</td><td>Pr6.126 bit 9</td></tr>
<tr><td>E1</td><td>Driver overload warning</td><td>ver derating monitor is more than 100 %.</td><td>○</td><td>44</td><td>Pr6.126 bit 10</td></tr>
</table>

Warning No. (hex.)	Warning name	Description	Warning latch	Output setting	Warning mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
E2	Lifetime detection warning 2	The remaining life of the nonvolatile memory is below the specified value.	○	45	Pr6.126 bit 11

*1 The "○" part can be switched between non-latch mode (latched for 1 s) and latched mode using Pr6.27 "Warning latch state setup" . Battery warning and lifetime detection warning are fixed in latch mode and cannot be switched.

*2 The warning that is output in warning output signal 1 (WARN1) and signal 2 (WARN2) is selected using Pr4.40 "Selection of alarm output 1" and Pr4.41 "Selection of alarm output 2" . In case of setting value 0, OR output of all warnings will be obtained. In addition, do not use the setup values other than those listed in the above table.

*3 Each warning detection can be disabled with Pr6.38 "Warning mask setup" , Pr6.39 "Warning mask setup 2" and Pr6.126 "Warning 2 mask setup" .

Supported bits are indicated in the table. Warning detection is disabled by setting the corresponding bit to 1.

For expanded warnings, it is possible to disable warning detection with the respective setting parameters.

■ Expanded warnings

Warning No. (hex.)	Warning name	Description	Warning latch	Output setting	Warning mask
			Pr6.27 (*1)	Pr4.40, Pr4.41 (*2)	Pr6.38/ Pr6.39 supported bit (*3)
C3	Main power off warning	When the setting for Pr7.14 "Main power off warning detection time" is 10 to 1999, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr7.14.	○	14	Pr6.38 bit 12
CA	Main power phase loss warning	An open phase was detected in the main power supply when Pr6.104 "Open-phase monitoring setup" had warnings enabled.	○	42	Pr6.126 bit 8
D2	Set-up Support Software (PANATERM ver.7) command execution warning	Operation commands (trial run, frequency characteristics analysis function (FFT function), Config, etc.) by Set-up Support Software (PANATERM ver.7) were executed when EtherCAT communication was established with bit 0 of Pr7.99 "Communication function extended setup 6" set to 1.	○	30	Pr6.39 bit 8
D3	Over-travel inhibit warning	The over-travel inhibit is now disabled. Disabled when Pr6.97 "Function expansion setup 3" :bit 14 = 0. Occurs only if the setting Pr5.04 "Over-travel inhibit input setup" = 1 is applied.	○	31	Pr6.39 bit 9

*1 The "○" part can be switched between non-latch mode (latched for 1 s) and latched mode using Pr6.27 "Warning latch state setup" . Battery warning and lifetime detection warning are fixed in latch mode and cannot be switched.

*2 The warning that is output in warning output signal 1 (WARN1) and signal 2 (WARN2) is selected using Pr4.40 "Selection of alarm output 1" and Pr4.41 "Selection of alarm output 2" . In case of setting value 0, OR output of all warnings will be obtained. In addition, do not use the setup values other than those listed in the above table.

*3 Each warning detection can be disabled with Pr6.38 "Warning mask setup" , Pr6.39 "Warning mask setup 2" and Pr6.126 "Warning 2 mask setup" .

Supported bits are indicated in the table. Warning detection is disabled by setting the corresponding bit to 1.

For expanded warnings, it is possible to disable warning detection with the respective setting parameters.

6.2.2 Warning Function Details

Details about expanded warnings are shown below.

For general warnings among the warning functions, check the warning names and warning descriptions in the table in *"6.2.1 List of Warning Functions"* and check the corresponding parts.

WngC3h "Main power off warning"

Primary cause	When the setting for Pr7.14 "Main power off warning detection time" is 10 to 1999, power is instantaneously interrupted between L1 and L3 for at least the time set with Pr7.14.
Detected ESM state	No
Detected synchronous mode	No
ESM state after detection	No
Handling	Measure the voltage in the lines between connectors (L1, L2, L3) and take the following actions. ● Increase the power supply voltage capacity, change the power supply, eliminate whatever caused the electromagnetic contactor in the main power supply to drop, then turn the power back on. ● Check the setting for Pr7.14 "Main power off warning detection time" and set it properly for each phase of the power supply. ● Increase the power supply capacity. For information on power supply capacity, see Servo Driver Specification "10.2.2 List of Peripheral Devices" . ● Properly connect each phase (L1, L2, L3) of the power supply. Use L1, L3 for single phase 100 V and single phase 200 V. ● Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngCAh "Main power phase loss warning"

Primary cause	An open phase was detected in the main power supply when Pr6.104 "Open-phase monitoring setup" had warnings enabled.
Detected ESM state	No
Detected synchronous mode	No
ESM state after detection	No
Handling	● Check the connection of the main power input line. ● Measure the line voltage between connectors (L1, L2, L3) and eliminate line voltage imbalance. ● Confirm that the line voltage between connectors (L1, L2, L3) is the specified value. ● Replace the servo driver with a new one. Return the servo driver in which the alarm occurred to the dealer for examination (repair).
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

WngD2h "Set-up Support Software (PANATERM ver.7) command execution warning"

This warning notifies that an operation command (trial run, frequency characteristics analysis function (FFT function), Z-phase search, One Minute TUNING) or Config execution was run by Set-up Support Software (PANATERM ver.7) while EtherCAT communication is established when Obj.3799h:00h "Communication function extended setup 6" :bit 0 is 1. This warning is not generated when a device error is detected.

Primary cause	Operation commands (trial run, frequency characteristics analysis function (FFT function), etc.) by Set-up Support Software (PANATERM ver.7) were executed or Config was executed when EtherCAT communication was established with Pr7.99 “Communication function extended setup 6” :bit 0 set to 1.
Detected ESM state	PreOP, SafeOP, OP
Detected synchronous mode	DC, FreeRun, SM2
ESM state after detection	Remains in the current ESM state.
Handling	Stop the operating command through Set-up Support Software (PANATERM ver.7) .
Method of warning status clearing after the cause is resolved	For details on clearing warnings, see *“6.1.4 Clearing Alarms, Clearing Warnings”* .

WngD3h “Over-travel inhibit warning”

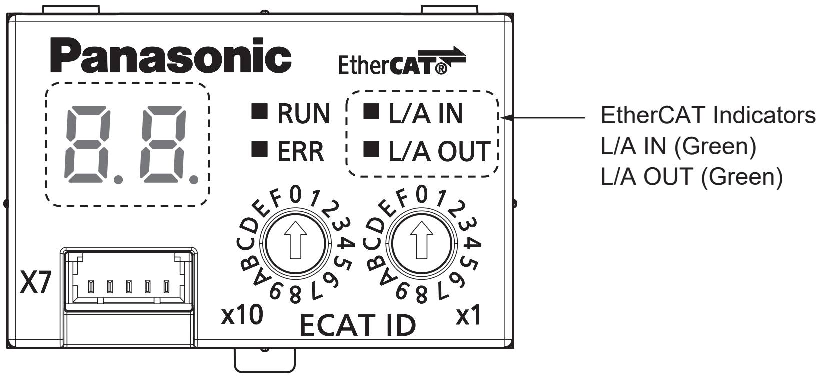
Primary cause	The over-travel inhibit is now disabled.
Detected ESM state	No
Detected synchronous mode	No
ESM state after detection	No
Handling	If the over-travel inhibit warning occurs unintentionally, perform the following process. ● Check if the input is not an input that causes an over-travel inhibit condition. ● Check the POT and NOT assignment settings. ● Check Pr5.04 “Over-travel inhibit input setup” . ● Set Pr6.97 “Function expansion setup 3” :bit 14 to 0 to disable the over-travel inhibit warning that occurs in the over-travel inhibit state.
Method of warning status clearing after the cause is resolved	● Clear the alarm after disabling this warning. ● Reboot if there is a power reset or if a reset command is executed.

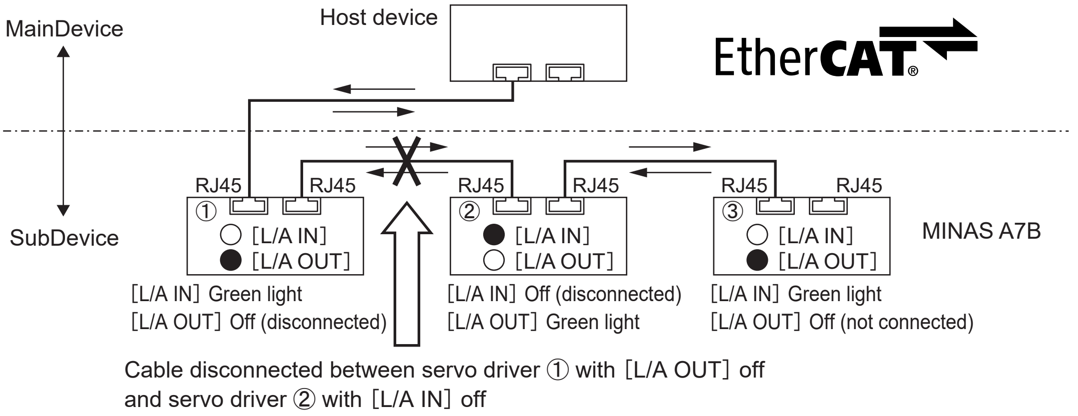
7 Troubleshooting

7.1 Network Cable Break Location Identification Method

If the network status LED [L/A IN] or [L/A OUT] is not lit when the power supply is on for all nodes, check the network cable connected to the [L/A IN] or [L/A OUT] connector on the servo driver to see if there is a problem such as a cable break or bad contact.

The conditions for illumination of [L/A IN] and [L/A OUT] are determined by whether there is a normal electrical connection. For details, see Technical Reference Functional Specification “3.4.2 EtherCAT Indicators” .

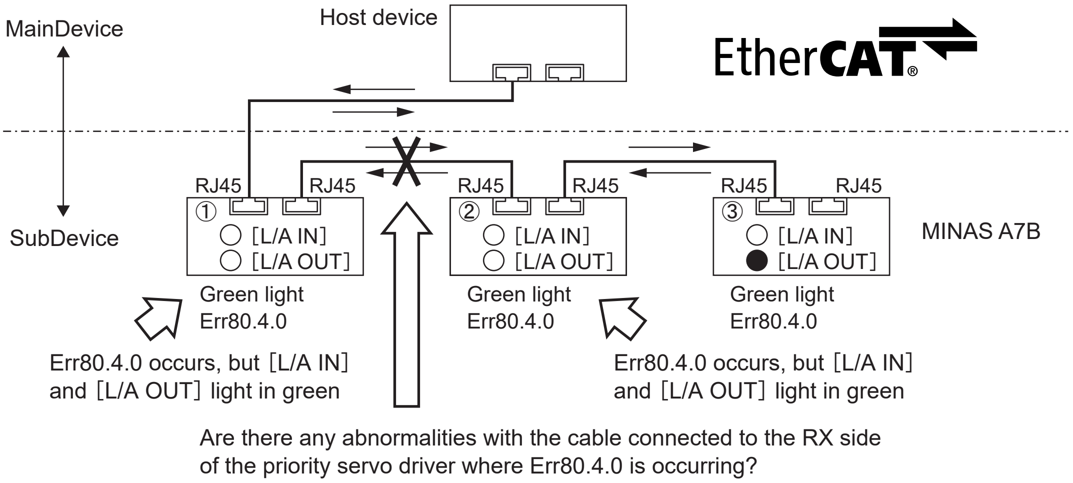




If there is a break in the [L/A IN] or [L/A OUT] network cable when EtherCAT communication is established, Err80.4.0 “PDO watchdog error protection” is generated.

If [L/A IN] or [L/A OUT] is lit green when the status of illumination is checked, consider the following causes.

- Temporary cable break or bad contact
- Excessive noise on the EtherCAT communication cable



Precautions

- If the main device detects a timeout, input a servo-off command to all servo drivers without initializing communication and stop the servo driver at the location preceding the cable break.
- If communication is initialized, Err80.4.0 "PDO watchdog error protection" is generated for all servos and it is difficult to identify the cable break location.

8 Object Dictionary List

For how to view the Object Dictionary List, see *“5.1 How to Read the Object Table”* .

For details on abbreviations used for document names, see *“1.3 Related Documents”* .

8.1 CoE Communication Area (1000h to 1FFFh)

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1000h	00h	Device type	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	*“5.2.1”*
1001h	00h	Error register	–	0 to 255	–	U8	ro	No	ALL	No	X	–
		● bit 4: Generation of an alarm defined by AL status code										*“4.8.3.2”* *“5.2.1”*
		● bit 7: Generation of an alarm not defined by AL status code										
1008h	00h	Manufacturer device name	–	–	–	VS	ro	No	ALL	No	X	*“5.2.1”*
1009h	00h	Manufacturer hardware version	–	–	–	VS	ro	No	ALL	No	X	
100Ah	00h	Manufacturer software version	–	–	–	VS	ro	No	ALL	No	X	
1010h	–	Store parameters	–	–	–	–	–	–	–	–	–	*“5.2.5”*
	00h	Number of entries	–	0 to 255	–	U8	ro	No	ALL	No	X	
	01h	Save all parameters	–	0 to 4294967295	1	U32	rw	No	ALL	No	A	
1018h	–	Identity object	–	–	–	–	–	–	–	–	–	*“5.2.1”*
	00h	Number of entries	–	0 to 255	–	U8	ro	No	ALL	No	X	
	01h	Vendor ID	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	02h	Product code	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	03h	Revision number	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	04h	Serial number	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
10F3h	–	Diagnosis history	–	–	–	–	–	–	–	–	–	*“5.2.6”*
	00h	Number of entries	–	0 to 255	–	U8	ro	No	ALL	No	X	
	01h	Maximum messages	–	0 to 255	–	U8	ro	No	ALL	No	X	
	02h	Newest message	–	0 to 255	–	U8	ro	No	ALL	No	X	
	03h	Newest acknowledged message	–	0 to 255	0	U8	rw	No	ALL	No	A	
	04h	New messages available	–	0 to 1	–	BOOL	ro	No	ALL	No	X	
	05h	Flags	–	0 to 65535	39	U16	rw	No	ALL	Yes	A	–
		● bit 0: Emergency message execution permission										*“4.8.3.2”* *“5.2.6”*
		● bit 5: Diagnosis message clearing information										
	06h	Diagnosis message 1	–	–	–	OS	ro	No	ALL	No	X	*“5.2.6”*
	⋮											
	23h	Diagnosis message 30	–	–	–	OS	ro	No	ALL	No	X	
1600h	–	Receive PDO mapping 1	–	–	–	–	–	–	–	–	–	*“5.2.3.2”*
	00h	Number of entries	–	0 to 32	4	U8	rw	No	ALL	Yes	S	
	01h	1st receive PDO mapped	–	0 to 4294967295	1614807056	U32	rw	No	ALL	Yes	S	
	02h	2nd receive PDO mapped	–	0 to 4294967295	1616904200	U32	rw	No	ALL	Yes	S	
	03h	3rd receive PDO mapped	–	0 to 4294967295	1618608160	U32	rw	No	ALL	Yes	S	
	04h	4th receive PDO mapped	–	0 to 4294967295	1622671376	U32	rw	No	ALL	Yes	S	
	05h	5th receive PDO mapped	–	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1600h	06h	6th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	*“5.2.3.2”*
	07h	7th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	08h	8th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1601h	—	Receive PDO mapping 2	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	0 to 32	7	U8	rw	No	ALL	Yes	S	
	01h	1st receive PDO mapped	—	0 to 4294967295	1614807056	U32	rw	No	ALL	Yes	S	
	02h	2nd receive PDO mapped	—	0 to 4294967295	1616904200	U32	rw	No	ALL	Yes	S	
	03h	3rd receive PDO mapped	—	0 to 4294967295	1618018320	U32	rw	No	ALL	Yes	S	
	04h	4th receive PDO mapped	—	0 to 4294967295	1618608160	U32	rw	No	ALL	Yes	S	
	05h	5th receive PDO mapped	—	0 to 4294967295	1619001376	U32	rw	No	ALL	Yes	S	
	06h	6th receive PDO mapped	—	0 to 4294967295	1622671376	U32	rw	No	ALL	Yes	S	
	07h	7th receive PDO mapped	—	0 to 4294967295	1627324448	U32	rw	No	ALL	Yes	S	
	08h	8th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1602h	—	Receive PDO mapping 3	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	0 to 32	6	U8	rw	No	ALL	Yes	S	
	01h	1st receive PDO mapped	—	0 to 4294967295	1614807056	U32	rw	No	ALL	Yes	S	
	02h	2nd receive PDO mapped	—	0 to 4294967295	1616904200	U32	rw	No	ALL	Yes	S	
	03h	3rd receive PDO mapped	—	0 to 4294967295	1618083856	U32	rw	No	ALL	Yes	S	
	04h	4th receive PDO mapped	—	0 to 4294967295	1618608160	U32	rw	No	ALL	Yes	S	
	05h	5th receive PDO mapped	—	0 to 4294967295	1622671376	U32	rw	No	ALL	Yes	S	
	06h	6th receive PDO mapped	—	0 to 4294967295	1627324448	U32	rw	No	ALL	Yes	S	
	07h	7th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	08h	8th receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd receive PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1603h	—	Receive PDO mapping 4	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	0 to 32	8	U8	rw	No	ALL	Yes	S	
	01h	1st receive PDO mapped	—	0 to 4294967295	1614807056	U32	rw	No	ALL	Yes	S	
	02h	2nd receive PDO mapped	—	0 to 4294967295	1616904200	U32	rw	No	ALL	Yes	S	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1603h	03h	3rd receive PDO mapped	–	0 to 4294967295	1618018320	U32	rw	No	ALL	Yes	S	*“5.2.3.2”*
	04h	4th receive PDO mapped	–	0 to 4294967295	1618083856	U32	rw	No	ALL	Yes	S	
	05h	5th receive PDO mapped	–	0 to 4294967295	1618608160	U32	rw	No	ALL	Yes	S	
	06h	6th receive PDO mapped	–	0 to 4294967295	1619001376	U32	rw	No	ALL	Yes	S	
	07h	7th receive PDO mapped	–	0 to 4294967295	1622671376	U32	rw	No	ALL	Yes	S	
	08h	8th receive PDO mapped	–	0 to 4294967295	1627324448	U32	rw	No	ALL	Yes	S	
	09h	9th receive PDO mapped	–	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd receive PDO mapped	–	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1A00h	–	Transmit PDO mapping 1	–	–	–	–	–	–	–	–	–	
	00h	Number of entries	–	0 to 32	8	U8	rw	No	ALL	Yes	S	
	01h	1st transmit PDO mapped	–	0 to 4294967295	1614741520	U32	rw	No	ALL	Yes	S	
	02h	2nd transmit PDO mapped	–	0 to 4294967295	1614872592	U32	rw	No	ALL	Yes	S	
	03h	3rd transmit PDO mapped	–	0 to 4294967295	1616969736	U32	rw	No	ALL	Yes	S	
	04h	4th transmit PDO mapped	–	0 to 4294967295	1617166368	U32	rw	No	ALL	Yes	S	
	05h	5th transmit PDO mapped	–	0 to 4294967295	1622736912	U32	rw	No	ALL	Yes	S	
	06h	6th transmit PDO mapped	–	0 to 4294967295	1622802464	U32	rw	No	ALL	Yes	S	
	07h	7th transmit PDO mapped	–	0 to 4294967295	1626603552	U32	rw	No	ALL	Yes	S	
	08h	8th transmit PDO mapped	–	0 to 4294967295	1627193376	U32	rw	No	ALL	Yes	S	
	09h	9th transmit PDO mapped	–	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd transmit PDO mapped	–	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1A01h	–	Transmit PDO mapping 2	–	–	–	–	–	–	–	–	–	
	00h	Number of entries	–	0 to 32	9	U8	rw	No	ALL	Yes	S	
	01h	1st transmit PDO mapped	–	0 to 4294967295	1614741520	U32	rw	No	ALL	Yes	S	
	02h	2nd transmit PDO mapped	–	0 to 4294967295	1614872592	U32	rw	No	ALL	Yes	S	
	03h	3rd transmit PDO mapped	–	0 to 4294967295	1616969736	U32	rw	No	ALL	Yes	S	
	04h	4th transmit PDO mapped	–	0 to 4294967295	1617166368	U32	rw	No	ALL	Yes	S	
	05h	5th transmit PDO mapped	–	0 to 4294967295	1617690656	U32	rw	No	ALL	Yes	S	
	06h	6th transmit PDO mapped	–	0 to 4294967295	1618411536	U32	rw	No	ALL	Yes	S	
	07h	7th transmit PDO mapped	–	0 to 4294967295	1622736912	U32	rw	No	ALL	Yes	S	
	08h	8th transmit PDO mapped	–	0 to 4294967295	1622802464	U32	rw	No	ALL	Yes	S	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1A01h	09h	9th transmit PDO mapped	—	0 to 4294967295	1627193376	U32	rw	No	ALL	Yes	S	*"5.2.3.2"*
	0Ah	10th transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1A02h	—	Transmit PDO mapping 3	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	0 to 32	9	U8	rw	No	ALL	Yes	S	
	01h	1st transmit PDO mapped	—	0 to 4294967295	1614741520	U32	rw	No	ALL	Yes	S	
	02h	2nd transmit PDO mapped	—	0 to 4294967295	1614872592	U32	rw	No	ALL	Yes	S	
	03h	3rd transmit PDO mapped	—	0 to 4294967295	1616969736	U32	rw	No	ALL	Yes	S	
	04h	4th transmit PDO mapped	—	0 to 4294967295	1617166368	U32	rw	No	ALL	Yes	S	
	05h	5th transmit PDO mapped	—	0 to 4294967295	1617690656	U32	rw	No	ALL	Yes	S	
	06h	6th transmit PDO mapped	—	0 to 4294967295	1618411536	U32	rw	No	ALL	Yes	S	
	07h	7th transmit PDO mapped	—	0 to 4294967295	1622736912	U32	rw	No	ALL	Yes	S	
	08h	8th transmit PDO mapped	—	0 to 4294967295	1622802464	U32	rw	No	ALL	Yes	S	
	09h	9th transmit PDO mapped	—	0 to 4294967295	1627193376	U32	rw	No	ALL	Yes	S	
	0Ah	10th transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1A03h	—	Transmit PDO mapping 4	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	0 to 32	9	U8	rw	No	ALL	Yes	S	
	01h	1st transmit PDO mapped	—	0 to 4294967295	1614741520	U32	rw	No	ALL	Yes	S	
	02h	2nd transmit PDO mapped	—	0 to 4294967295	1614872592	U32	rw	No	ALL	Yes	S	
	03h	3rd transmit PDO mapped	—	0 to 4294967295	1616969736	U32	rw	No	ALL	Yes	S	
	04h	4th transmit PDO mapped	—	0 to 4294967295	1617166368	U32	rw	No	ALL	Yes	S	
	05h	5th transmit PDO mapped	—	0 to 4294967295	1617690656	U32	rw	No	ALL	Yes	S	
	06h	6th transmit PDO mapped	—	0 to 4294967295	1618411536	U32	rw	No	ALL	Yes	S	
	07h	7th transmit PDO mapped	—	0 to 4294967295	1622736912	U32	rw	No	ALL	Yes	S	
	08h	8th transmit PDO mapped	—	0 to 4294967295	1622802464	U32	rw	No	ALL	Yes	S	
	09h	9th transmit PDO mapped	—	0 to 4294967295	1627193376	U32	rw	No	ALL	Yes	S	
	0Ah	10th transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
	⋮											
	20h	32nd transmit PDO mapped	—	0 to 4294967295	0	U32	rw	No	ALL	Yes	S	
1C00h	—	Sync manager communication type	—	—	—	—	—	—	—	—	—	*"5.2.2"*

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1C00h	00h	Number of used sync manager channels	–	0 to 255	–	U8	ro	No	ALL	No	X	*“5.2.2”*
	01h	Communication type sync manager 0	–	0 to 4	–	U8	ro	No	ALL	No	X	
	02h	Communication type sync manager 1	–	0 to 4	–	U8	ro	No	ALL	No	X	
	03h	Communication type sync manager 2	–	0 to 4	–	U8	ro	No	ALL	No	X	
	04h	Communication type sync manager 3	–	0 to 4	–	U8	ro	No	ALL	No	X	
1C12h	–	Sync manager channel 2	–	–	–	–	–	–	–	–	–	*“5.2.3.1”*
	00h	Number of assigned PDOs	–	0 to 4	1	U8	rw	No	ALL	Yes	S	
	01h	PDO mapping object index of assigned RxPDO 1	–	1600h to 1603h	5632	U16	rw	No	ALL	Yes	S	
	02h	PDO mapping object index of assigned RxPDO 2	–	1600h to 1603h	5633	U16	rw	No	ALL	Yes	S	
	03h	PDO mapping object index of assigned RxPDO 3	–	1600h to 1603h	5634	U16	rw	No	ALL	Yes	S	
	04h	PDO mapping object index of assigned RxPDO 4	–	1600h to 1603h	5635	U16	rw	No	ALL	Yes	S	
1C13h	–	Sync manager channel 3	–	–	–	–	–	–	–	–	–	
	00h	Number of assigned PDOs	–	0 to 4	1	U8	rw	No	ALL	Yes	S	
	01h	PDO mapping object index of assigned TxPDO 1	–	1A00h to 1A03h	6656	U16	rw	No	ALL	Yes	S	
	02h	PDO mapping object index of assigned TxPDO 2	–	1A00h to 1A03h	6657	U16	rw	No	ALL	Yes	S	
	03h	PDO mapping object index of assigned TxPDO 3	–	1A00h to 1A03h	6658	U16	rw	No	ALL	Yes	S	
	04h	PDO mapping object index of assigned TxPDO 4	–	1A00h to 1A03h	6659	U16	rw	No	ALL	Yes	S	
1C32h	–	Sync manager 2 synchronization	–	–	–	–	–	–	–	–	–	*“5.2.4”*
	00h	Number of sub-objects	–	0 to 255	–	U8	ro	No	ALL	No	X	
	01h	Sync mode	–	0 to 65535	2	U16	rw	No	ALL	Yes	S	
	02h	Cycle time	ns	0 to 4294967295	1000000	U32	rw	No	ALL	Yes	S	
	03h	Shift time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	04h	Sync modes supported	–	0 to 65535	–	U16	ro	No	ALL	No	X	–
		● bit 0: FreeRun mode support										*“5.2.4.1”* *“5.2.4.5”*
		● bit 1: SM Synchronous mode support										*“5.2.4.1”* *“5.2.4.4”*
		● bits 4 to 2: DC synchronous mode support										*“5.2.4.1”* *“5.2.4.3”*
		● bits 6 to 5: Output shift support										*“5.2.4.1”*
	05h	Minimum cycle time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	*“5.2.4”*
	06h	Calc and copy time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	08h	Command	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	09h	Delay time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	0Ah	Sync0 cycle time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	0Bh	SM-event missed	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Ch	Cycle time too small	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Dh	Shift time too short	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Eh	RxPDO toggle failed	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	20h	Sync error	–	0 to 1	–	BOOL	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
1C33h	–	Sync manager 3 synchronization	–	–	–	–	–	–	–	–	–	"5.2.4"
	00h	Number of sub-objects	–	0 to 255	–	U8	ro	No	ALL	No	X	
	01h	Sync mode	–	0 to 65535	2	U16	rw	No	ALL	Yes	S	
	02h	Cycle time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	03h	Shift time	ns	0 to 4294967295	0	U32	rw	No	ALL	No	S	
	04h	Sync modes supported	–	0 to 65535	–	U16	ro	No	ALL	No	X	–
		• bit 0: FreeRun mode support										"5.2.4.2" "5.2.4.5"
		• bit 1: SM Synchronous mode support										"5.2.4.2" "5.2.4.4"
		• bits 4 to 2: DC synchronous mode support										"5.2.4.2" "5.2.4.3"
		• bits 6 to 5: Output Shift Support Input Shift Support										"5.2.4.2"
	05h	Minimum cycle time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	"5.2.4"
	06h	Calc and copy time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	08h	Command	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	09h	Delay time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	0Ah	Sync0 cycle time	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	0Bh	SM-event missed	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Ch	Cycle time too small	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Dh	Shift time too short	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	0Eh	RxPDO toggle failed	–	0 to 65535	–	U16	ro	No	ALL	No	X	
	20h	Sync error	–	0 to 1	–	BOOL	ro	No	ALL	No	X	

8.2 Servo Parameter Area (3000h to 3FFFh)

For correspondence between parameter numbers and object numbers, see *“5.3 Servo Parameter Area (3000h to 3FFFh) Details”* .

8.2.1 Class 0: Basic Settings

—: N/A

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3000h	00h	Reserved	—	—	1	I16	—	—	—	—	—	—
3001h	00h	Control mode setup	—	0 to 6	0	I16	rw	No	ALL	Yes	R	TR_FS “4.6.6”
3002h	00h	Real-time auto-gain tuning setup	—	0 to 7	1	I16	rw	No	ALL	Yes	B	OI_A
3003h	00h	Real-time auto-tuning machine stiffness setup	—	0 to 31	Sizes A, B: 13 Sizes C, D: 11 (13) (*3)	I16	rw	No	ALL	Yes	B	
3004h	00h	Inertia ratio	%	0 to 100000	250	I32	rw	No	ALL	Yes	B	OI_A
3008h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
3009h	00h	Reserved	—	—	1	I32	—	—	—	—	—	
3010h	00h	Reserved	—	—	1	I32	—	—	—	—	—	
3011h	00h	Number of output pulses per motor revolution	pulse/r	1 to 33554432	2500	I32	rw	No	ALL	Yes	R	TR_FS “5.6”
3012h	00h	Reversal of pulse output logic	—	0 to 3	0	I16	rw	No	ALL	Yes	R	
3013h	00h	1st torque limit	%	0 to 500	500 (*2)	I16	rw	No	ALL	Yes	B	TR_FS “5.1”
3014h	00h	Position deviation excess setup	Command unit	0 to 1073741824	83886080	I32	rw	No	csp pp hm ip	Yes	A	TR_FS “4.2.9” *“Err24.0.0”*
3015h	00h	Absolute encoder setup	—	0 to 4	1	I16	rw	No	csp (S) pp (S) hm (S) ip (S) csv (S) pv (S) cst (S) tq (S)	Yes	C	TR_FS “4.2.7” TR_FS “4.6.6” TR_FS “5.4” TR_FS “5.5”
3016h	00h	External regenerative resistor setup	—	0 to 3	Sizes A, B: 3 Sizes C, D: 0	I16	rw	No	ALL	Yes	C	TR_FS “4.2.6”
3017h	00h	Selection of load factor for external regenerative resistor	—	0 to 4	0	I16	rw	No	ALL	Yes	C	
3018h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3022h	00h	Sensor feedback control mode setup (*1)	—	0 to 1	0	I16	rw	No	csp	Yes	R	*“5.5.5.3.6”*
3027h	00h	Selection of machine stiffness at real-time auto-gain tuning 2	—	0 to 44	Sizes A, B: 16 Sizes C, D: 12 (16) (*3)	I16	rw	No	ALL	Yes	B	OI_A
3028h	00h	Selection of feed forward stiffness at real-time auto-gain tuning	—	0 to 44	Sizes A, B: 16 Sizes C, D: 12 (16) (*3)	I16	rw	No	ALL	Yes	B	

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

*2 Factory default values vary depending on the servo driver and motor combination.

For details, see Technical Reference Functional Specification “5.1 Torque Limit Switching Function” .

*3 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

8.2.2 Class 1: Gain Adjustment

—: N/A

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3100h	00h	1st gain of position loop	0.1 s^{-1}	0 to 30000	Sizes A, B: 480 Sizes C, D: 320 (480) (*1)	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3101h	00h	1st velocity loop gain	0.1 Hz	1 to 32767	Sizes A, B: 270 Sizes C, D: 180 (270) (*1)	I16	rw	No	ALL	Yes	B	
3102h	00h	1st velocity loop integration time constant	0.1 ms	1 to 10000	Sizes A, B: 210 Sizes C, D: 310 (210) (*1)	I16	rw	No	ALL	Yes	B	
3103h	00h	1st filter of velocity detection	—	0 to 5	0	I16	rw	No	ALL	Yes	B	
3104h	00h	1st torque filter time constant	0.01 ms	0 to 2500	Sizes A, B: 84 Sizes C, D: 126 (84) (*1)	I16	rw	No	ALL	Yes	B	OI_A
3105h	00h	2nd gain of position loop	0.1 s^{-1}	0 to 30000	Sizes A, B: 480 Sizes C, D: 320 (480) (*1)	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3106h	00h	2nd velocity loop gain	0.1 Hz	1 to 32767	Sizes A, B: 270 Sizes C, D: 180 (270) (*1)	I16	rw	No	ALL	Yes	B	
3107h	00h	2nd velocity loop integration time constant	0.1 ms	1 to 10000	Sizes A, B: 210 Sizes C, D: 310 (210) (*1)	I16	rw	No	ALL	Yes	B	
3108h	00h	2nd filter of velocity detection	—	0 to 5	0	I16	rw	No	ALL	Yes	B	
3109h	00h	2nd torque filter time constant	0.01 ms	0 to 2500	Sizes A, B: 84 Sizes C, D: 126 (84) (*1)	I16	rw	No	ALL	Yes	B	OI_A
3110h	00h	Velocity feed forward gain	0.1%	0 to 4000	1000	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3111h	00h	Velocity feed forward filter	0.01 ms	0 to 6400	0	I16	rw	No	csp pp hm ip	Yes	B	
3112h	00h	Torque feed forward gain	0.1%	0 to 2000	1000	I16	rw	No	ALL	Yes	B	
3113h	00h	Torque feed forward filter	0.01 ms	0 to 6400	0	I16	rw	No	ALL	Yes	B	
3114h	00h	2nd gain setup	—	0 to 1	1	I16	rw	No	ALL	Yes	B	OI_A
3115h	00h	Mode of position control switching	—	0 to 10	0	I16	rw	No	csp pp hm ip	Yes	B	
3116h	00h	Delay time of position control switching	0.1 ms	0 to 10000	10	I16	rw	No	csp pp hm ip	Yes	B	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3117h	00h	Level of position control switching	–	0 to 20000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3118h	00h	Hysteresis at position control switching	–	0 to 20000	0	I16	rw	No	csp pp hm ip	Yes	B	
3119h	00h	Position gain switching time	0.1 ms	0 to 10000	10	I16	rw	No	csp pp hm ip	Yes	B	
3120h	00h	Mode of velocity control switching	–	0 to 5	0	I16	rw	No	csv pv	Yes	B	
3121h	00h	Delay time of velocity control switching	0.1 ms	0 to 10000	0	I16	rw	No	csv pv	Yes	B	
3122h	00h	Level of velocity control switching	–	0 to 20000	0	I16	rw	No	csv pv	Yes	B	
3123h	00h	Hysteresis at velocity control switching	–	0 to 20000	0	I16	rw	No	csv pv	Yes	B	
3124h	00h	Mode of torque control switching	–	0 to 3	0	I16	rw	No	cst tq	Yes	B	
3125h	00h	Delay time of torque control switching	0.1 ms	0 to 10000	0	I16	rw	No	cst tq	Yes	B	
3126h	00h	Level of torque control switching	–	0 to 20000	0	I16	rw	No	cst tq	Yes	B	
3127h	00h	Hysteresis at torque control switching	–	0 to 20000	0	I16	rw	No	cst tq	Yes	B	
3128h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
⋮												
3178h	00h	Reserved	–	–	0	I16	–	–	–	–	–	
31A6h	00h	1st position loop gain change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	OI_A
31A7h	00h	1st velocity integration change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31A8h	00h	1st torque filter change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31A9h	00h	2nd position loop gain change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B0h	00h	2nd velocity loop gain change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B1h	00h	2nd velocity integration change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B2h	00h	2nd torque filter change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B3h	00h	Load fluctuation compensation filter change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B4h	00h	Smoothing filter change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	
31B5h	00h	Tuning filter change ratio	%	0 to 300	100	I16	rw	No	ALL	Yes	B	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

8.2.3 Class 2: Vibration Suppression

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3200h	00h	Adaptive filter mode setup	—	0 to 6	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	OI_A
3201h	00h	1st notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	OI_A
3202h	00h	1st notch width selection	—	0 to 20	2	I16	rw	No	ALL	Yes	B	
3203h	00h	1st notch depth selection	—	0 to 99	0	I16	rw	No	ALL	Yes	B	
3204h	00h	2nd notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	
3205h	00h	2nd notch width selection	—	0 to 20	2	I16	rw	No	ALL	Yes	B	
3206h	00h	2nd notch depth selection	—	0 to 99	0	I16	rw	No	ALL	Yes	B	
3207h	00h	3rd notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	OI_A
3208h	00h	3rd notch width selection	—	0 to 20	2	I16	rw	No	ALL	Yes	B	
3209h	00h	3rd notch depth selection	—	0 to 99	0	I16	rw	No	ALL	Yes	B	
3210h	00h	4th notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	
3211h	00h	4th notch width selection	—	0 to 20	2	I16	rw	No	ALL	Yes	B	
3212h	00h	4th notch depth selection	—	0 to 99	0	I16	rw	No	ALL	Yes	B	
3213h	00h	Selection of damping filter switching	—	0 to 7	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3214h	00h	1st damping frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3215h	00h	1st damping filter setup	0.1 Hz	0 to 1500	0	I16	rw	No	csp pp hm ip	Yes	B	
3216h	00h	2nd damping frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp pp hm ip	Yes	B	
3217h	00h	2nd damping filter setup	0.1 Hz	0 to 1500	0	I16	rw	No	csp pp hm ip	Yes	B	
3218h	00h	3rd damping frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp pp hm ip	Yes	B	
3219h	00h	3rd damping filter setup	0.1 Hz	0 to 1500	0	I16	rw	No	csp pp hm ip	Yes	B	
3220h	00h	4th damping frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp pp hm ip	Yes	B	
3221h	00h	4th damping filter setup	0.1 Hz	0 to 1500	0	I16	rw	No	csp pp hm ip	Yes	B	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3222h	00h	Positional command smoothing filter	0.1 ms	0 to 10000	Sizes A, B: 92 Sizes C, D: 139 (92) (*1)	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “4.3.2” TR_FS “4.3.3” TR_FS “4.4.2” TR_FS “4.6.2” TR_FS “4.6.3” OI_A
3223h	00h	Positional command FIR filter	0.1 ms	0 to 10000	10	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3224h	00h	5th notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	OI_A
3225h	00h	5th notch width selection	–	0 to 20	2	I16	rw	No	ALL	Yes	B	
3226h	00h	5th notch depth selection	–	0 to 99	0	I16	rw	No	ALL	Yes	B	
3227h	00h	1st damping width setting	–	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3228h	00h	2nd damping width setting	–	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3229h	00h	3rd damping width setting	–	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3230h	00h	4th damping width setting	–	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3231h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
⁝												
3237h	00h	Reserved	–	–	0	I16	–	–	–	–	–	
3238h	00h	Filter function switching	–	-32768 to 32767	3	I16	rw	No	ALL	Yes	B	–
		● bit 0: Custom notch filter										TR_FS “4.3.2” TR_FS “4.4.2” TR_FS “4.6.2”
		● bit 1: Tuning filter 2										TR_FS “4.3.2” TR_FS “4.4.2” TR_FS “4.6.2” OI_A
3239h	00h	Custom notch compensation coefficient	0.01	0 to 1000	0	I16	rw	No	ALL	Yes	B	TR_FS “4.3.2” TR_FS “4.4.2” TR_FS “4.6.2” OI_A
3240h	00h	Custom notch compensation frequency1	0.1 Hz	0 to 10000	0	I16	rw	No	ALL	Yes	B	
3241h	00h	Custom notch compensation frequency2	0.1 Hz	0 to 10000	0	I16	rw	No	ALL	Yes	B	
3242h	00h	Custom notch frequency	Hz	10 to 5000	5000	I16	rw	No	ALL	Yes	B	
3243h	00h	Custom notch width	–	0 to 20	2	I16	rw	No	ALL	Yes	B	
3244h	00h	Custom notch depth	–	0 to 99	0	I16	rw	No	ALL	Yes	B	
3245h	00h	Function expansion setup 10	–	-2147483648 to 2147483647	61	I32	rw	No	ALL	Yes	B	–
		● bit 1 to 0: Two-degree-of-freedom control function setting										TR_FS “4.2.5” OI_A
		● bit 2: Friction torque compensation parameter selection										OI_A
		● bit 3: Load fluctuation suppression function automatic calculation										OI_A
		● bit 5 to 4: Stiffness setting resolution, individual FB/FF setting switching										OI_A

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3246h	00h	Tuning filter 2	0.01 ms	0 to 20000	Size A: 110 Size B: 120 Sizes C, D: 170 (120) (*1)	I16	rw	No	csp pp hm ip	Yes	B	TR_FS “4.2.5” TR_FS “4.3.2” TR_FS “4.6.2”
3250h	00h	Detection start vibration count	—	0 to 100	3	I16	rw	No	csp pp	Yes	B	OI_A
3251h	00h	Detected vibration amplitude	Command unit	0 to 134217728	0	I32	rw	No	csp pp	Yes	B	
3252h	00h	Torque command additional value 2	0.1%	-1000 to 1000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	OI_A
3253h	00h	Positive direction torque compensation value 2	0.1%	-1000 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3254h	00h	Negative direction torque compensation value 2	0.1%	-1000 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3261h	00h	Target settling time	ms	0 to 32767	0	I16	rw	No	ALL	Yes	A	OI_A
3262h	00h	Settling time count condition	—	0 to 1	0	I16	rw	No	ALL	Yes	A	
3263h	00h	Allowable overshoot amount	%	0 to 500	100	I16	rw	No	ALL	Yes	A	
3264h	00h	Tuning amount of movement	Command unit	0 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3265h	00h	Tuning max speed	r/min	0 to 20000	0	I16	rw	No	ALL	Yes	A	
3266h	00h	Tuning acceleration and deceleration time	ms	0 to 5000	0	I16	rw	No	ALL	Yes	A	
3267h	00h	Tuning wait time	ms	0 to 10000	2000	I16	rw	No	ALL	Yes	A	
3268h	00h	Tuning operating range upper limit	Command unit	0 to 1073741823	8388608	I32	rw	No	ALL	Yes	A	
3269h	00h	Tuning operating range lower limit	Command unit	-1073741824 to 0	-8388608	I32	rw	No	ALL	Yes	A	
3270h	00h	Tuning overspeed level setting	r/min	0 to 20000	0	I16	rw	No	ALL	Yes	A	
3271h	00h	Tuning torque limit	%	0 to 500	0	I16	rw	No	ALL	Yes	A	
3272h	00h	Tuning start RTAT machine stiffness setting	—	0 to 44	8	I16	rw	No	ALL	Yes	A	
3273h	00h	Tuning stability margin	%	0 to 100	80	I16	rw	No	ALL	Yes	A	
3274h	00h	Tuning auto tuning application selection	—	-32768 to 32767	0	I16	rw	No	ALL	Yes	A	OI_A
3275h	00h	Tuning step selection	—	-32768 to 32767	3	I16	rw	No	ALL	Yes	A	—
		● bit 0: Advance operation										OI_A
		● bit 1: Homing operation										
3276h	00h	Tuning target function selection	—	-32768 to 32767	1009	I16	rw	No	ALL	Yes	A	—
		● bit 0: Inertia ratio										OI_A
		● bit 1: Unbalanced load compensation (default disabled)										
		● bit 2: Dynamic friction compensation (default disabled)										
		● bit 3: Viscous friction compensation (default disabled)										
		● bit 4: RTAT machine stiffness setting (position and speed gains, speed integration time constant, torque filter)										
		● bit 5: RTAT feedforward control section stiffness setting (smoothing filter time constant)										
		● bit 6: Notch filter										
		● bit 7: 1st damping filter										

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3276h	00h	• bit 8: 2nd damping filter • bit 9: Load fluctuation control function										OI_A
3277h	00h	Tuning start position	Command unit	-1073741824 to 1073741823	0	I32	rw	No	ALL	Yes	A	OI_A
3278h	00h	Tuning vibration automatic suppression effective level	%	0 to 100	15	I16	rw	No	ALL	Yes	A	
3279h	00h	Tuning JOG test run command speed	r/min	0 to 500	60	I16	rw	No	ALL	Yes	A	
3280h	00h	Tuning JOG test run acceleration and deceleration time	ms	0 to 5000	50	I16	rw	No	ALL	Yes	A	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

8.2.4 Class 3: Velocity/Torque Control/Full-closed Control

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3304h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
⋮												
3307h	00h	Reserved	—	—	0	I16	—	—	—	—	—	
3312h	00h	Acceleration time setup	ms/(1000 r/min)	0 to 10000	0	I16	rw	No	csv pv	Yes	B	OI_A
3313h	00h	Deceleration time setup	ms/(1000 r/min)	0 to 10000	0	I16	rw	No	csv pv	Yes	B	
3314h	00h	Sigmoid acceleration / deceleration time setup	ms	0 to 1000	0	I16	rw	No	csv pv	Yes	B	
3317h	00h	Selection of speed limit	—	2	2	I16	rw	No	cst tq	Yes	B	TR_FS “4.5.2”
3321h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3322h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3323h	00h	External scale selection	—	0 to 2	0	I16	rw	No	ALL	Yes	R	TR_FS “4.2.8” TR_FS “4.6.6” TR_FS “5.8”
3324h	00h	Numerator of external scale division	—	0 to 134217728	0	I32	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	R	TR_FS “4.6.4” TR_FS “4.6.6”
3325h	00h	Denominator of external scale division	—	1 to 134217728	10000	I32	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	R	
3326h	00h	Reversal of direction of external scale	—	0 to 3	0	I16	rw	No	ALL	Yes	R	TR_FS “4.2.8” TR_FS “4.6.6” TR_FS “5.8”
3327h	00h	External scale Z phase disconnection detection disable	—	0 to 1	0	I16	rw	No	ALL	Yes	R	TR_FS “5.8”
3328h	00h	Hybrid deviation excess setup	Command unit	1 to 134217728	16000	I32	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	C	TR_FS “4.6.5”
3329h	00h	Hybrid deviation clear setup	Rotation	0 to 100	0	I16	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	C	
3333h (*1)	00h	Analog input gain	Command unit/mV	0 to 30000	0	I16	rw	No	csp	Yes	B	*“5.5.5.3.6”*
3334h (*1)	00h	Analog input polarity	—	0 to 1	0	I16	rw	No	csp	Yes	B	
3335h (*1)	00h	Analog input integration time constant	0.01 ms	0 to 100000	0	I32	rw	No	csp	Yes	B	
3336h (*1)	00h	Analog input integration limit	Command unit/mV	0 to 2147483647	0	I32	rw	No	csp	Yes	B	

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

8.2.5 Class 4: I/O Monitor Settings

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3400h	00h	SI1 input selection	—	0 to 16777215	3289650	I32	rw	No	ALL	Yes	C	TR_FS “3.1.2”
3401h	00h	SI2 input selection	—	0 to 16777215	8487297	I32	rw	No	ALL	Yes	C	
3402h	00h	SI3 input selection	—	0 to 16777215	8553090	I32	rw	No	ALL	Yes	C	
3403h	00h	SI4 input selection	—	0 to 16777215	2236962	I32	rw	No	ALL	Yes	C	
3404h	00h	SI5 input selection	—	0 to 16777215	2105376	I32	rw	No	ALL	Yes	C	
3405h	00h	SI6 input selection	—	0 to 16777215	2171169	I32	rw	No	ALL	Yes	C	
3406h	00h	SI7 input selection	—	0 to 16777215	3158064	I32	rw	No	ALL	Yes	C	
3407h	00h	SI8 input selection	—	0 to 16777215	3223857	I32	rw	No	ALL	Yes	C	
3410h	00h	SO1 output selection	—	0 to 16777215	197379	I32	rw	No	ALL	Yes	C	TR_FS “3.1.4”
3411h	00h	SO2 output selection	—	0 to 16777215	1052688	I32	rw	No	ALL	Yes	C	
3412h	00h	SO3 output selection	—	0 to 16777215	65793	I32	rw	No	ALL	Yes	C	
3416h	00h	Type of analog monitor 1	—	0 to 35	0	I16	rw	No	ALL	Yes	A	TR_FS “3.5”
3417h	00h	Analog monitor 1 output gain	—	0 to 214748364	0	I32	rw	No	ALL	Yes	A	
3418h	00h	Type of analog monitor 2	—	0 to 35	4	I16	rw	No	ALL	Yes	A	
3419h	00h	Analog monitor 2 output gain	—	0 to 214748364	0	I32	rw	No	ALL	Yes	A	
3421h	00h	Analog monitor output setup	—	0 to 2	0	I16	rw	No	ALL	Yes	A	
3422h (*1)	00h	Analog input (AIN) offset setting	0.375 mV	-26666 to 26666	0	I16	rw	No	ALL	Yes	B	*“5.5.5.3.6”*
3423h (*1)	00h	Analog input (AIN) filter setting	0.01 ms	0 to 6400	0	I16	rw	No	ALL	Yes	B	
3424h (*1)	00h	Analog input (AIN) excessive setting	0.1 V	0 to 100	0	I16	rw	No	ALL	Yes	B	
3431h	00h	Positioning complete (In-position) range	Command unit	0 to 2097152	8400	I32	rw	No	csp pp hm ip	Yes	A	TR_FS “3.1.5” OI_A
3432h	00h	Positioning complete (In-position) output setup	—	0 to 10	0	I16	rw	No	csp pp hm ip	Yes	A	TR_FS “3.1.5”
3433h	00h	INP hold time	ms	0 to 30000	0	I16	rw	No	csp pp hm ip	Yes	A	
3434h	00h	Zero-speed	r/min	10 to 20000	50	I16	rw	No	ALL	Yes	A	TR_FS “3.1.4”
3435h	00h	Speed coincidence range	r/min	10 to 20000	50	I16	rw	No	csv pv cst tq	Yes	A	TR_FS “3.1.7”
3436h	00h	At-speed (Speed arrival)	r/min	10 to 20000	1000	I16	rw	No	csv pv cst tq	Yes	A	TR_FS “3.1.6”
3437h	00h	Mechanical brake action at stalling setup	ms	0 to 10000	0	I16	rw	No	ALL	Yes	B	TR_FS “5.13”
3438h	00h	Mechanical brake action at running setup	ms	0 to 32000	0	I16	rw	No	ALL	Yes	B	TR_FS “5.13” TR_FS “5.15” TR_FS “5.16” TR_FS “5.19”
3439h	00h	Brake release speed setup	r/min	30 to 3000	30	I16	rw	No	ALL	Yes	B	TR_FS “5.13” TR_FS “5.15” TR_FS “5.16”
3440h	00h	Selection of alarm output 1	—	0 to 32767	0	I16	rw	No	ALL	Yes	A	TR_FS “7.2”

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3441h	00h	Selection of alarm output 2	—	0 to 32767	0	I16	rw	No	ALL	Yes	A	TR_FS “7.2”
3442h	00h	Positioning complete (In-position) range 2	Command unit	0 to 2097152	8400	I32	rw	No	csp pp hm ip	Yes	A	TR_FS “3.1.5”
3444h	00h	Position comparison output pulse width setting	0.1 ms	0 to 32767	0	I16	rw	No	ALL	Yes	R	TR_FS “5.3”
3445h	00h	Position comparison output polarity selection	—	0 to 7	0	I16	rw	No	ALL	Yes	R	—
		● bit 0: Polarity for SO1 (general-purpose output) or OCMP1 (encoder/position comparison output terminal)										TR_FS “5.3”
		● bit 1: Polarity for SO2 (general-purpose output) or OCMP2 (encoder/position comparison output terminal)										
		● bit 2: Polarity for SO3 (general-purpose output) or OCMP3 (encoder/position comparison output terminal)										
3447h	00h	Pulse output selection	—	0 to 1	0	I16	rw	No	ALL	Yes	R	TR_FS “5.3” TR_FS “5.6”
3448h	00h	Position comparison value 1	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	TR_FS “5.3”
3449h	00h	Position comparison value 2	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3450h	00h	Position comparison value 3	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3451h	00h	Position comparison value 4	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3452h	00h	Position comparison value 5	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3453h	00h	Position comparison value 6	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3454h	00h	Position comparison value 7	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3455h	00h	Position comparison value 8	Command unit	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	A	
3456h	00h	Position comparison output delay compensation amount	0.1 μs	-32768 to 32767	0	I16	rw	No	ALL	Yes	R	
3457h	00h	Position comparison output assignment setting	—	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	R	—
		● bit 3 to 0: Position comparison 1										TR_FS “5.3”
		● bit 7 to 4: Position comparison 2										
		● bit 11 to 8: Position comparison 3										
		● bit 15 to 12: Position comparison 4										
		● bit 19 to 16: Position comparison 5										
		● bit 23 to 20: Position comparison 6										
		● bit 27 to 24: Position comparison 7										
		● bit 31 to 28: Position comparison 8										
3463h	00h	Reserved	—	—	5242884	I32	—	—	—	—	—	—
3464h	00h	Reserved	—	—	64	I32	—	—	—	—	—	—

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

8.2.6 Class 5: Enhancing Settings

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3503h	00h	Denominator of pulse output division	–	0 to 134217728	0	I32	rw	No	ALL	Yes	R	TR_FS “5.6”
3504h	00h	Over-travel inhibit input setup	–	0 to 2	1	I16	rw	No	ALL	Yes	C	TR_FS “5.12” *“5.5.5.5.3”* *“5.5.8.2.7”*
3505h	00h	Sequence at over-travel inhibit	–	0 to 2	0	I16	rw	No	ALL	Yes	C	TR_FS “5.12” TR_FS “5.19” *“5.5.8.2.7”*
3506h	00h	Sequence at Servo-Off	–	0 to 9	0	I16	rw	No	ALL	Yes	B	TR_FS “5.13” TR_FS “5.19” *“5.5.8.2”*
3507h	00h	Sequence upon main power off	–	0 to 9	0	I16	rw	No	ALL	Yes	B	TR_FS “5.14” TR_FS “5.19” *“5.5.8.2.7”*
3508h	00h	L/V trip selection upon main power off	–	0 to 3	0	I16	rw	No	ALL	Yes	B	–
		● bit 0: Operation selection with main power supply OFF ● bit 1: Main power off warning condition detection time										TR_FS “5.10” TR_FS “5.14” *“5.5.8.2.1”*
3509h	00h	Detection time of main power off	ms	20 to 2000	2000	I16	rw	No	ALL	Yes	C	TR_FS “5.10” TR_FS “5.14” *“5.5.8.2.1”*
3510h	00h	Sequence at alarm	–	0 to 7	0	I16	rw	No	ALL	Yes	B	TR_FS “5.15” TR_FS “5.16” TR_FS “5.17” TR_FS “5.19” *“5.5.8.2”*
3511h	00h	Torque setup for emergency stop	%	0 to 500	0	I16	rw	No	ALL	Yes	B	TR_FS “5.1” TR_FS “5.12” TR_FS “5.13” TR_FS “5.14” TR_FS “5.16” *“5.5.8.2.7”*
3512h	00h	Motor over-load level setup	%	0 to 500	0	I16	rw	No	ALL	Yes	A	TR_FS “7.2”
3513h	00h	Over-speed level setup	r/min	0 to 20000	0	I16	rw	No	ALL	Yes	B	TR_FS “5.16”
3514h	00h	Motor working range setup	0.1 rotation	0 to 1000	10	I16	rw	No	csp pp hm ip	Yes	A	TR_FS “4.2.4”
3515h	00h	Control input signal reading setup	–	0 to 3	0	I16	rw	No	ALL	Yes	C	TR_FS “3.1.2”
3516h	00h	Reserved	–	–	1	I16	–	–	–	–	–	–
3520h	00h	Position setup unit select	–	0 to 1	0	I16	rw	No	csp pp hm ip	Yes	C	TR_FS “3.1.5” TR_FS “4.2.9”
3521h	00h	Selection of torque limit	–	0 to 5	1	I16	rw	No	ALL	Yes	B	TR_FS “5.1”
3522h	00h	2nd torque limit	%	0 to 500	500 (*1)	I16	rw	No	csp pp hm ip csv pv	Yes	B	
3525h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3526h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3529h	00h	Reserved	–	–	2	I16	–	–	–	–	–	–

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3531h	00h	USB axis address	—	0 to 127	1	I16	rw	No	ALL	Yes	C	PT_OM
3533h	00h	Pulse regenerative output limit setup	—	0 to 1	0	I16	rw	No	ALL	Yes	C	TR_FS “5.6”
3534h	00h	Reserved	—	—	4	I16	—	—	—	—	—	—
3536h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3545h	00h	Quadrant glitch positive-direction compensation value	0.1%	-1000 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3546h	00h	Quadrant glitch negative-direction compensation value	0.1%	-1000 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3547h	00h	Quadrant glitch compensation delay time	ms	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3548h	00h	Quadrant glitch compensation filter setting L	0.01 ms	0 to 6400	0	I16	rw	No	csp pp hm ip	Yes	B	
3549h	00h	Quadrant glitch compensation filter setting H	0.1 ms	0 to 10000	0	I16	rw	No	csp pp hm ip	Yes	B	
3550h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
				⁝								
3555h	00h	Reserved	—	—	0	I32	—	—	—	—	—	
3556h	00h	Slow stop deceleration time setting	ms/ (1000 r/min)	0 to 10000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S) csv (S) pv (S) cst (S) tq (S)	Yes	B	TR_FS “5.19”
3557h	00h	Slow stop S-shape acceleration and deceleration setting	ms	0 to 1000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S) csv (S) pv (S) cst (S) tq (S)	Yes	B	
3566h	00h	Deterioration diagnosis convergence judgment time	0.1 s	0 to 10000	0	I16	rw	No	ALL	Yes	A	TR_FS “5.9”
3567h	00h	Deterioration diagnosis inertia ratio upper limit	%	0 to 10000	0	I16	rw	No	ALL	Yes	A	
3568h	00h	Deterioration diagnosis inertia ratio lower limit	%	0 to 10000	0	I16	rw	No	ALL	Yes	A	
3569h	00h	Deterioration diagnosis unbalanced load upper limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	
3570h	00h	Deterioration diagnosis unbalanced load lower limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	
3571h	00h	Deterioration diagnosis dynamic friction upper limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	
3572h	00h	Deterioration diagnosis dynamic friction lower limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3573h	00h	Deterioration diagnosis viscous friction upper limit	0.1%/ (10000 r/min)	0 to 10000	0	I16	rw	No	ALL	Yes	A	TR_FS “5.9”
3574h	00h	Deterioration diagnosis viscous friction lower limit	0.1%/ (10000 r/min)	0 to 10000	0	I16	rw	No	ALL	Yes	A	
3575h	00h	Deterioration diagnosis velocity setting	r/min	-20000 to 20000	0	I16	rw	No	ALL	Yes	A	
3576h	00h	Deterioration diagnosis torque average time	ms	0 to 10000	0	I16	rw	No	ALL	Yes	A	
3577h	00h	Deterioration diagnosis torque upper limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	
3578h	00h	Deterioration diagnosis torque lower limit	0.1%	-1000 to 1000	0	I16	rw	No	ALL	Yes	A	
3595h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
35B0h	00h	Driver derating factor	%	0 to 100	100	I16	rw	No	ALL	Yes	A	TR_FS “5.20”
35B2h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—

*1 Factory default values vary depending on the servo driver and motor combination.

For details, see Technical Reference Functional Specification “5.1 Torque Limit Switching Function” .

8.2.7 Class 6: Special Settings

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3602h	00h	Speed deviation excess setup	r/min	0 to 20000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	A	*“Err24.1.0”*
3603h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3605h	00h	Position 3rd gain valid time	0.1 ms	0 to 10000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3606h	00h	Position 3rd gain scale factor	%	50 to 1000	100	I16	rw	No	csp pp hm ip	Yes	B	
3607h	00h	Torque command additional value	%	-100 to 100	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	OI_A
3608h	00h	Positive direction torque compensation value	%	-100 to 100	0	I16	rw	No	csp pp hm ip	Yes	B	
3609h	00h	Negative direction torque compensation value	%	-100 to 100	0	I16	rw	No	csp pp hm ip	Yes	B	
3610h	00h	Function expansion setup	–	-32768 to 32767	528	I16	rw	No	ALL	Yes	B	–
		● bit 1: Load fluctuation control function										OI_A
		● bit 2: Load fluctuation stabilization setting										
		● bit 4: Current response improvement										OI_A
		● bit 10: Fall prevention function during an alarm										TR_FS “5.17” TR_FS “5.19”
		● bit 11: Encoder overheat error protection detection										*“Err15.1.0”*
		● bit 14: Load fluctuation suppression function automatic tuning										OI_A
		● bit 15: Slow stop function										TR_FS “5.19”
3611h	00h	Current loop gain response setup	%	10 to 300	100	I16	rw	No	ALL	Yes	B	OI_A
3614h	00h	Emergency stop time at alarm	ms	0 to 1000	200	I16	rw	No	ALL	Yes	B	TR_FS “5.16” TR_FS “5.19”
3615h	00h	2nd over-speed level setup	r/min	0 to 20000	0	I16	rw	No	ALL	Yes	B	TR_FS “5.16”
3618h	00h	Power-up wait time	100 ms	0 to 100	0	I16	rw	No	ALL	Yes	R	TR_FS “3.4.2” TR_FS “4.1”
3619h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3620h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3621h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3622h	00h	AB phase external scale pulse outputting method selection	–	0 to 1	0	I16	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	R	TR_FS “5.6”

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3623h	00h	Load change compensation gain	%	-100 to 100	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	OI_A
3624h	00h	Load change compensation filter	0.01 ms	10 to 2500	53	I16	rw	No	csp pp hm ip csv pv	Yes	B	
3626h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3627h	00h	Warning latch state setup	–	0 to 3	3	I16	rw	No	ALL	Yes	C	–
		● bit 0: Expanded warnings										TR_FS “7.2”
		● bit 1: General warnings										
3630h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3631h	00h	Real time auto tuning estimation speed	–	0 to 3	1	I16	rw	No	ALL	Yes	B	OI_A
3632h	00h	Real time auto tuning custom set-up	–	-32768 to 32767	0	I16	rw	No	ALL	Yes	B	–
		● bit 1 to 0: Load characteristics estimation										OI_A
		● bit 3 to 2: Inertia Ratio Update										
		● bit 6 to 4: Torque compensation										
		● bit 7: Stiffness Setup										
		● bit 8: Fixed Parameter Setup										
		● bit 10 to 9: Gain Switching Setup										
		● bit 11: Torque compensation setting switching										
		● bit 15 to 12: Individual torque compensation settings										
3634h	00h	Hybrid vibration suppression gain	0.1 s^{-1}	0 to 30000	0	I16	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	B	OI_A
3635h	00h	Hybrid vibration suppression filter	0.01 ms	0 to 32000	10	I16	rw	No	csp (F) pp (F) hm (F) ip (F)	Yes	B	
3636h	00h	Dynamic brake operation input setup	–	0 to 1	0	I16	rw	No	ALL	Yes	R	TR_FS “5.14”
3637h	00h	Oscillation detecting level	0.1%	0 to 1000	0	I16	rw	No	ALL	Yes	B	TR_FS “7.2”
3638h	00h	Warning mask setup	–	-32768 to 32767	4	I16	rw	No	ALL	Yes	C	
3639h	00h	Warning mask setup 2	–	-32768 to 32767	0	I16	rw	No	ALL	Yes	C	
3641h	00h	1st damping depth	–	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3642h	00h	2-stage torque filter time constant	0.01 ms	0 to 2500	0	I16	rw	No	ALL	Yes	B	OI_A
3643h	00h	2-stage torque filter attenuation term	–	0 to 1000	1000	I16	rw	No	ALL	Yes	B	
3647h	00h	Function expansion setup 2	–	-32768 to 32767	1	I16	rw	No	ALL	Yes	R	–
		● bit 0: Two-degree-of-freedom control mode										TR_FS “4.2.5” OI_A
		● bit 2: Encoder communication error/warning judgment setup										TR_FS “7.2”

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3647h	00h	● bit 3: Two-degree-of-freedom control real-time auto tuning selection										TR_FS “4.2.5” OI_A
		● bit 14: Quadrant glitch compensation function										OI_A
3648h	00h	Tuning filter	0.1 ms	0 to 2000	Size A: 11 Size B: 12 Sizes C, D: 17 (12) (*1)	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “4.3.2” TR_FS “4.4.2” TR_FS “4.6.2”
3649h	00h	Command/tuning filter damping	—	0 to 99	15	I16	rw	No	csp pp hm ip	Yes	B	TR_FS “4.3.2” TR_FS “4.4.2” TR_FS “4.6.2” OI_A
3650h	00h	Viscous friction compensating gain	0.1%/ (10000 r/min)	0 to 10000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “4.3.2” TR_FS “4.6.2” OI_A
3651h	00h	Wait time for emergency stop	ms	0 to 10000	0	I16	rw	No	ALL	Yes	B	TR_FS “5.17”
3652h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
⁝												
3654h	00h	Reserved	—	—	0	I16	—	—	—	—	—	
3657h	00h	Torque saturation error protection detection time	ms	0 to 5000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “5.2”
3658h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
3659h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3660h	00h	2nd damping depth	—	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3661h	00h	1st resonance frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	OI_A
3662h	00h	1st resonance attenuation ratio	—	0 to 1000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3663h	00h	1st anti-resonance frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3664h	00h	1st anti-resonance attenuation ratio	—	0 to 1000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3665h	00h	1st response frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3666h	00h	2nd resonance frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	OI_A
3667h	00h	2nd resonance attenuation ratio	—	0 to 1000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3668h	00h	2nd anti-resonance frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3669h	00h	2nd anti-resonance attenuation ratio	—	0 to 1000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3670h	00h	2nd response frequency	0.1 Hz	0 to 3000	0	I16	rw	No	csp (S) pp (S) hm (S) ip (S)	Yes	B	
3671h	00h	3rd damping depth	—	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	OI_A
3672h	00h	4th damping depth	—	0 to 1000	0	I16	rw	No	csp pp hm ip	Yes	B	
3673h	00h	Load estimation filter	0.01 ms	0 to 2500	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	OI_A
3674h	00h	Torque compensation frequency 1	0.1 Hz	0 to 5000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	
3675h	00h	Torque compensation frequency 2	0.1 Hz	0 to 5000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	
3676h	00h	Load estimation count	—	0 to 8	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	
3685h	00h	Retracting operation condition setting	—	-32768 to 32767	0	I16	rw	No	ALL	Yes	C	—
		● bits 3 to 0: Non-communication settings										TR_FS “5.10”
		● bits 7 to 4: Communication-related setting										
		● bits 9 to 8: Judgment condition for stopping retracting operation										
3686h	00h	Retracting operation alarm setting	—	0 to 7	0	I16	rw	No	ALL	Yes	C	—

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3686h	00h	● bit 0: Err87.1.0 “Retracting operation completion (I/O)”										TR_FS “5.10”
		● bit 1: Err87.2.0 “Retracting operation completion (communication)”										
		● bit 2: Err87.3.0 “Retracting operation error”										
3687h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3688h	00h	Absolute encoder multi-turn data upper-limit value	–	0 to 65534	0	I32	rw	No	ALL	Yes	C	TR_FS “5.5”
3695h	00h	Motor over-load warning detection level	%	0 to 114	0	I16	rw	No	ALL	Yes	A	TR_FS “7.2”
3696h	00h	Motor over-load warning release level	%	0 to 114	0	I16	rw	No	ALL	Yes	A	
3697h	00h	Function expansion setup 3	–	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	B	–
		● bit 0: Quadrant glitch compensation HPF clear										OI_A
		● bit 1: Deterioration Diagnosis Warning Function										TR_FS “5.9” TR_FS “7.2”
		● bit 2: Motor movable range error protection expansion										TR_FS “4.2.4”
		● bit 3: Selection of external scale single-turn data monitor										TR_FS “4.6.6”
		● bit 6: Switches position information during backlash correction										OI_A
		● bit 8: Target control mode extension of Obj.607Fh:00h “Max profile velocity”										*“5.5.5.1.2”* *“5.5.6.2.1.2”* *“5.5.7.1.1.1”*
		● bit 11: External scale position latch during semi-closed control										*“5.5.8.1”*
		● bit 12: Speed limit priority function during torque control										TR_FS “4.5.2” *“5.5.7.3.1.2”*
		● bit 13: Touch probe latch completion status toggle output enabled										*“5.5.8.1”*
		● bit 14: Over-travel inhibit warning										TR_FS “7.2”
		● bit 27: Alarm display switch setting										TR_FS “3.4.1”
3698h	00h	Function expansion setup 4	–	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	R	–
		● bit 3: Effective bit expansion for multi-turn data										TR_FS “5.5” *“5.5.8.4.4”*
		● bit 8: Control mode switch function expansion										*“5.5.5.5.1.3”*
		● bit 10: Selection of external scale single-turn data output format										TR_FS “4.6.6”
		● bit 21: Expand conditions for canceling over-travel inhibit										TR_FS “5.12”
36A0h	00h	Reserved	–	–	4000	I16	–	–	–	–	–	–
36A1h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
36A2h	00h	Over-travel inhibit release level setup	Command unit	0 to 2147483647	0	I32	rw	No	csp	Yes	B	TR_FS “5.12” *“5.5.8.2.7”*
36A4h	00h	Open-phase monitoring setup	–	0 to 3	0	I16	rw	No	ALL	Yes	B	TR_FS “7.2” *“Err13.2.0”*
36A6h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
36C1h	00h	Current feed forward response setup	%	0 to 300	100	I16	rw	No	ALL	Yes	B	OI_A
36C5h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
36C6h	00h	Warning2 mask setup	–	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	C	TR_FS “7.2”
36C7h	00h	Warning3 mask setup	–	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	C	

*1 Values in parentheses are initial values for models with an instantaneous maximum current (peak value) of less than 24 A.

8.2.8 Class 7: Special Settings 2

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3700h	00h	Display on LED	—	0 to 32767	0	I16	rw	No	ALL	Yes	A	TR_FS “3.4.1”
3701h	00h	Display time setup upon power-up	100 ms	0 to 1000	0	I16	rw	No	ALL	Yes	R	
3703h	00h	Output setup during torque limit	—	0 to 1	0	I16	rw	No	cst tq	Yes	A	TR_FS “5.2” *“5.5.3”*
3704h	00h	Backlash compensation enable	—	0 to 7	0	I16	rw	No	csp pp hm ip	Yes	B	—
		● bits 1 to 0: Enable or disable backlash compensation and select the direction of operation during compensation										OI_A
		● bit 2: Expand backlash compensation retention conditions										
3705h	00h	Backlash compensation value	pulse	-1073741824 to 1073741823	0	I32	rw	No	csp pp hm ip	Yes	B	OI_A
3706h	00h	Constant for backlash compensation	0.01 ms	0 to 6400	0	I16	rw	No	csp pp hm ip	Yes	B	
3707h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3708h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3709h	00h	Correction time of latch delay 1	25 ns	-2000 to 2000	360	I16	rw	No	ALL	Yes	B	*“5.5.8.1.8”*
3710h	00h	Reserved	—	—	3	I16	—	—	—	—	—	—
3711h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
			⋮									
3713h	00h	Reserved	—	—	0	I32	—	—	—	—	—	
3714h	00h	Main power off warning detection time	ms	0 to 2000	0	I16	rw	No	ALL	Yes	C	TR_FS “7.2”
3715h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
3716h	00h	Torque saturation error protection frequency	Incidences	0 to 30000	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “5.2”
3718h	00h	Backlash compensation value holding range	Command unit	0 to 2147483647	0	I32	rw	No	csp pp hm ip	Yes	B	OI_A
3722h	00h	Communication function extended setup 1	—	-32768 to 32767	0	I16	rw	No	ALL	Yes	R	—
		● bit 4: External scale position information monitoring function setting for semi-closed control										TR_FS “5.8”
		● bit 5: Command position change saturation function selection										*“5.5.5.3.1.3”* *“5.5.5.3.5”*
		● bit 6: Homing return velocity limit enabled										*“5.5.5.5.3”*
		● bit 7: Over-travel inhibit input detection setting during Z-phase homing return operation										
		● bit 11: LINK establishment mode selection										TR_FS “3.4.2”
3723h	00h	Communication function extended setup 2	—	-32768 to 32767	16384	I16	rw	No	ALL	Yes	B	—

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3723h	00h	● bit 14: Position deviation [command unit] output setup										TR_FS “3.1.5” TR_FS “4.3.2” TR_FS “4.3.3” TR_FS “4.6.2” TR_FS “4.6.3”
3724h	00h	Communication function extended setup 3	–	-32768 to 32767	14352	I16	rw	No	ALL	Yes	C	–
		● bit 0: EX-OUT1 output status setting at the time of communication interrupted after EtherCAT communication is established										TR_FS “3.1.3” *“5.5.8.3.2”*
		● bit 5: Latch position detection delay compensation function switching										*“5.5.8.1.8”*
		● bit 7: TFF clear ON/OFF selection from host device										TR_FS “5.18” *“5.5.5.1.1.6”* *“5.5.6.1.1.3”*
		● bit 11: Condition setting for Obj.6041h: bit 12 “drive follows command value”										*“5.5.5.3.1.3”* *“5.5.5.3.2.2”* *“5.5.6.3.1.2”* *“5.5.6.3.2.1”* *“5.5.7.3.1.2”* *“5.5.7.3.2.1”*
3739h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3740h	00h	Station Alias setup (high)	–	0 to 255	0	I16	rw	No	ALL	Yes	R	*“4.6”*
3741h	00h	Station Alias selection	–	0 to 2	1	I16	rw	No	ALL	Yes	R	
3742h	00h	Maximum continuation communication error	–	-32768 to 32767	-30584	I16	rw	No	ALL	Yes	R	–
		● bits 3 to 0: Err80.7.0 detection threshold										*“Err80.3.0”* *“Err80.7.0”*
3743h	00h	Lost link detection time	ms	0 to 32767	0	I16	rw	No	ALL	Yes	R	*“Err85.2.0”*
3744h	00h	Software version	–	-2147483648 to 2147483647	16908546	I32	ro	No	ALL	Yes	X	*“5.2.1”*
3779h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3780h	00h	Communication function extended setup 8	–	-32768 to 32767	2048	I16	rw	No	ALL	Yes	C	–
		● bit 6: Obj.6041h:00h “Statusword” : bit 12 Expansion setup for “homing attained”										*“5.5.5.5.3”*
3787h	00h	Communication function extended setup 5	–	-32768 to 32767	3072	I16	rw	No	ALL	Yes	C	–
3792h	00h	Correction time of latch delay 2	25 ns	-2000 to 2000	0	I16	rw	No	ALL	Yes	B	*“5.5.8.1.8”*
3793h	00h	Homing return speed limit value	r/min	0 to 20000	0	I16	rw	No	hm	Yes	C	*“5.5.5.5.3”*
3799h	00h	Communication function extended setup 6	–	-32768 to 32767	0	I16	rw	No	ALL	Yes	B	–
		● bit 0: Enable/disable FFT execution while EtherCAT communication is established										TR_FS “7.2” *“4.4”*
		● bit 3: Command pulse accumulated value [command unit] output setting										TR_FS “4.3.2” TR_FS “4.3.3” TR_FS “4.6.2” TR_FS “4.6.3”
37A0h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
				⁝								
37A4h	00h	Reserved	–	–	0	I32	–	–	–	–	–	
37A8h	00h	Reserved	–	–	7	I16	–	–	–	–	–	–
37A9h	00h	Reserved	–	–	1	I16	–	–	–	–	–	–
37B0h	00h	Communication function extended setup 7	–	-2147483648 to 2147483647	384	I32	rw	No	ALL	Yes	B	–
		● bit 7: Err80.7.0 detection function expansion										*“Err80.7.0”*
		● bit 8: Err80.3.0 detection function expansion										*“Err80.3.0”*
		● bit 12: ERR Indicator off specification expansion										TR_FS “3.4.2”

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
37B3h	00h	Torque offset filter	0.01 ms	0 to 6400	0	I16	rw	No	csp pp hm ip csv pv	Yes	B	TR_FS “4.3.2” TR_FS “4.3.3” TR_FS “4.4.2” TR_FS “4.4.3” TR_FS “4.6.2” TR_FS “4.6.3” TR_FS “5.18”
37B7h	00h	Reserved	—	-2147483648～ 2147483647	0	I32	—	—	—	—	—	—
37C0h	00h	Absolute scale offset1	Rotation (multi-turn data), or pulse (external scale upper 32 bits)	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	R	*“5.5.5.5.1.1”*
37C1h	00h	Absolute scale offset2	pulse (single-turn data), or pulse (external scale lower 32 bits)	-2147483648 to 2147483647	0	I32	rw	No	ALL	Yes	R	*“5.5.5.5.1.2”*
37C7h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—

8.2.9 Class 8: Special Settings 3

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3800h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3801h	00h	Profile linear acceleration constant	10,000 command units/s^2	1 to 429496	1	I32	rw	No	ALL	Yes	B	TR_FS “5.10”
3802h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3803h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3804h	00h	Profile linear deceleration constant	10,000 command units/s^2	1 to 429496	1	I32	rw	No	ALL	Yes	B	TR_FS “5.10”
3805h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3810h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
3812h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—
3813h	00h	Reserved	—	—	0	I32	—	—	—	—	—	—
			⋮									
3815h	00h	Reserved	—	—	0	I32	—	—	—	—	—	
3817h	00h	Relative movement of retracting operation	Command unit	-2147483647 to 2147483647	0	I32	rw	No	ALL	Yes	B	TR_FS “5.10”
3818h	00h	Retracting operation speed	Command unit/s	0 to 2147483647	0	I32	rw	No	ALL	Yes	B	
3819h	00h	Reserved	—	—	0	I16	—	—	—	—	—	—

8.2.10 Class 9: Linear Relationship

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3901h	00h	Feedback scale resolution / Number of scale pulses per rotation	pulse	0 to 536870912	0	I32	rw	No	ALL	Yes	R	TR_FS “4.6.6”

8.2.11 Class 10: Special Settings 4

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3A00h	00h	Reserved	–	–	–	I16	–	–	–	–	–	–
3A01h	00h	Reserved	–	0～4	0	I16	–	–	–	–	–	–

8.2.12 Class 11: Manufacturer Use

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
3B00h	00h	Reserved	–	–	1	I16	–	–	–	–	–	–
3B01h	00h	Reserved	–	–	503578880	I32	–	–	–	–	–	–
3B02h	00h	Reserved	–	–	658185	I32	–	–	–	–	–	–
3B03h	00h	Reserved	–	–	-1	I32	–	–	–	–	–	–
⋮												
3B06h	00h	Reserved	–	–	-1	I32	–	–	–	–	–	
3B07h	00h	Reserved	–	–	16	I16	–	–	–	–	–	–
3B08h	00h	Reserved	–	–	6	I16	–	–	–	–	–	–
3B09h	00h	Reserved	–	–	1	I16	–	–	–	–	–	–
3B10h	00h	Reserved	–	–	129	I16	–	–	–	–	–	–
3B11h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B12h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3B13h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B14h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B15h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3B16h	00h	Reserved	–	–	255	I16	–	–	–	–	–	–
3B17h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B18h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3B19h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B20h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B21h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
3B22h	00h	Reserved	–	–	0	I16	–	–	–	–	–	–
3B23h	00h	Reserved	–	–	0	I32	–	–	–	–	–	–
⋮												
3B26h	00h	Reserved	–	–	0	I32	–	–	–	–	–	

8.3 User-specific Area (4000h to 4FFFh)

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4304h	00h	Touch probe function expansion setup	—	0 to 65535	0	U16	rw	RxPDO	ALL	Yes	B	—
		● bit 0: Touch probe 1 External scale position latch Z-phase switching in semi-closed control										*“5.5.8.1.9”*
		● bit 1: Touch probe 1 Change storage location of external scale feedback position in semi-closed control										
		● bit 8: Touch probe 2 External scale position latch Z-phase switching in semi-closed control										
		● bit 9: Touch probe 2 Change storage location of external scale feedback position in semi-closed control										
4308h	00h	History number	—	0 to 3	0	U8	rw	No	ALL	No	A	*“5.5.8.7”*
430Eh	—	Timestamp reference time	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	
	01h	Timestamp reference time setting 1	ns	0 to 4294967295	0	U32	rw	No	ALL	No	A	
	02h	Timestamp reference time setting 2	ns	0 to 4294967295	0	U32	rw	No	ALL	No	A	
4310h	00h	Alarm main no	—	0 to 127	0	U8	rw	No	ALL	No	A	
4311h	00h	Reserved	—	—	—	U8	—	—	—	—	—	—
4312h	00h	Velocity control loop torque limit	0.1%	0 to 65535	0	U16	rw	RxPDO	ALL	No	A	*“5.5.5.1.1.3”* *“5.5.6.1.1.2”* *“5.5.7.1.1.2”* *“5.5.8.3.2”*
4314h (*1)	00h	Analog input internal offset	mV	-32768 to 32767	0	I16	rw	RxPDO	ALL	Yes	A	*“5.5.5.3.6.1”*
4315h (*1)	00h	Analog input deviation limit	mV	0 to 65535	0	U16	rw	RxPDO	ALL	Yes	A	
4316h (*1)	—	Analog input voltage setup	—	—	—	—	—	—	—	—	—	
	00h	Number of entries	—	1	—	U8	ro	No	csp	No	X	
	01h	Analog input voltage dead zone	mV	0 to 65535	0	U16	rw	RxPDO	ALL	Yes	B	
4317h	00h	Alarm sub no	—	0 to 127	0	U8	rw	No	ALL	No	A	*“5.5.8.7”*
4320h (*5)	00h	Analog monitor output 1	—	-32768 to 32767	0	I16	rw	RxPDO	ALL	No	A	—
4321h (*5)	00h	Analog monitor output 2	—	-32768 to 32767	0	I16	rw	RxPDO	ALL	No	A	—
4351h (*5)	00h	Analog input function	—	0 to 65535	0	U16	rw	RxPDO	csp	Yes	B	—
		● bit 0: Displacement control function switch										*“5.5.5.3.6.1”*
		● bit 1: Position command latch switch										
4C00h (*1)	—	Analog servo parameters	—	—	—	—	—	—	—	—	—	*“5.5.5.3.6.1”*
	00h	Number of entries	—	7	—	U8	ro	No	csp	No	B	
	01h	Analog input gain	Command unit/mV	0 to 30000	0	I16	rw	No	csp	Yes	B	
	02h	Analog input polarity	—	0 to 1	0	I16	rw	No	csp	Yes	B	
	03h	Analog input integration time constant	0.01 ms	0 to 100000	0	I32	rw	No	csp	Yes	B	
	04h	Analog input integration limit	Command unit	0 to 2147483647	0	I32	rw	No	csp	Yes	B	
	05h	Analog input (AIN) offset setting	0.375 mV	-26666 to 26666	0	I16	rw	No	ALL	Yes	B	
	06h	Analog input (AIN) filter setting	0.01 ms	0 to 6400	0	I16	rw	No	ALL	Yes	B	
	07h	Analog input (AIN) excessive setting	0.1 V	0 to 100	0	I16	rw	No	ALL	Yes	B	
4D00h	—	Special function start	—	—	—	—	—	—	—	—	—	*“5.5.8.4.4”*
	00h	Number of entries	—	3	—	U8	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4D00h	01h	Special function start flag 1	—	0 to 4294967295	0	U32	rw	No	ALL	No	B	—
		● bit 9: Special function start trigger										*"5.5.8.4.4"*
	02h	Special function start flag 2	—	0 to 4294967295	0	U32	rw	No	ALL	No	B	
	03h	Reserved	—	—	0	U32	rw	—	—	—	—	—
4D01h	00h	Special function setting 9	—	0 to 65535	0	U16	rw	No	ALL	No	B	*"5.5.8.4.4"*
4D0Eh	—	Expansion warning flags	—	—	—	—	—	—	—	—	—	*"5.5.8.7"*
	00h	Number of entries	—	3	—	U8	ro	No	ALL	No	X	
	01h	Expansion warning flags 1	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	02h	Expansion warning flags 2	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	03h	Expansion warning flags 3	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4D0Fh	00h	Reserved	—	—	—	U16	—	—	—	—	—	—
4D10h	—	External scale ID	—	—	—	—	—	—	—	—	—	*"5.5.8.7"*
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	
	01h	External scale vendor ID	—	—	—	VS	ro	No	ALL	No	X	
	02h	External scale model ID	—	—	—	VS	ro	No	ALL	No	X	
4D11h	—	Reserved	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	13	—	U8	—	—	—	—	—	—
	01h	Reserved 1	—	—	—	U32	—	—	—	—	—	—
	⋮											
	0Dh	Reserved 13	—	—	—	U32	—	—	—	—	—	
4D12h	00h	Motor serial number	—	—	—	VS	ro	No	ALL	No	X	*"5.5.8.7"*
4D13h	00h	Reserved	—	—	—	VS	—	—	—	—	—	—
4D14h	00h	Reserved	—	—	—	VS	—	—	—	—	—	—
4D15h	00h	Drive serial number	—	—	—	VS	ro	No	ALL	No	X	*"5.5.8.7"*
4D29h	00h	Over load factor	0.1%	0 to 65535	—	U16	ro	TxPDO	ALL	No	X	*"5.5.5.1.2.4"* *"5.5.6.1.2.3"* *"5.5.7.1.2.3"* *"5.5.8.7"*
4D35h	—	Reserved	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	2	—	U8	—	—	—	—	—	—
	01h	Reserved 1	—	—	—	U16	—	—	—	—	—	—
	02h	Reserved 2	—	—	—	U16	—	—	—	—	—	—
4D36h	—	Reserved	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	2	—	U8	—	—	—	—	—	—
	01h	Reserved 1	—	—	—	U16	—	—	—	—	—	—
	02h	Reserved 2	—	—	—	U16	—	—	—	—	—	—
4D51h (*2)	00h	Analog input status	—	0 to 65535	—	U16	ro	TxPDO	csp	No	X	*"5.5.5.3.6.1"* *"5.5.8.7"*
4D52h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4D53h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4D54h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4D55h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4D57h	00h	Driver derating monitor	%	0 to 65535	—	U16	ro	TxPDO	ALL	No	X	*"5.5.8.7"*
4DA0h (*3)	—	Alarm accessory information	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	71	—	U8	ro	No	ALL	No	X	*"5.5.8.7"*
	01h	History number echo	—	0 to 3	—	U8	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4DA0h (*3)	02h	Alarm code	—	0 to 4294967295	—	U32	ro	No	ALL	No	X	*“5.5.8.7”*
	03h	Control mode	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	04h	Motor speed	r/min	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	05h	Positional command velocity	r/min	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	06h	Velocity control command	r/min	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	07h	Torque command	0.05%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	08h	Position command deviation	Command unit	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	09h	Position actual internal value	pulse	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	0Ah	Reserved 10	—	—	—	I32	—	—	—	—	—	—
	0Bh	Input port (logic signal)	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
	0Ch	Output port (logic signal)	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	0Dh	Analog input	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	0Eh	Reserved 14	—	—	—	I32	—	—	—	—	—	—
	0Fh	Reserved 15	—	—	—	I32	—	—	—	—	—	—
	10h	Overload ratio	0.2 %	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
	11h	Regenerative load ratio	%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	12h	Voltage across PN	V	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	13h	Temperature of amplifier	°C	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	14h	Warning flags	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	15h	Inertia ratio	%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	16h	Reserved 22	—	—	—	I32	—	—	—	—	—	—
				⁝								
	18h	Reserved 24	—	—	—	I32	—	—	—	—	—	
	19h	Temperature of encoder	°C	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
	1Ah	Reserved 26	—	—	—	I32	—	—	—	—	—	—
				⁝								
	1Ch	Reserved 28	—	—	—	I32	—	—	—	—	—	
	1Dh	U-phase current detection value	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
	1Eh	W-phase current detection value	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	1Fh	Reserved 31	—	—	—	I32	—	—	—	—	—	—
	20h	Reserved 32	—	—	—	I32	—	—	—	—	—	—
	21h	Encoder single-turn data	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
	22h	Encoder communication error count (accumulated)	Incidences	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	23h	External scale communication data error count (accumulated)	Incidences	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4DA0h (*3)	24h	Reserved 36	–	–	–	I32	–	–	–	–	–	–
	25h	Alarm occurrence time on timestamp standard (Lower)	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	*"5.5.8.7"*
	26h	Alarm occurrence time on timestamp standard (Higher)	ns	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	27h	Alarm occurrence time on power on time	0.5 h	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	28h	Alarm occurrence time on power on time (detail)	62.5 µs	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	29h	Reserved 41	–	–	–	U32	–	–	–	–	–	–
	2Ah	Alarm code (extended)	–	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	*"5.5.8.7"*
	2Bh	Warning flags1	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	2Ch	Warning flags2	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	2Dh	Warning flags3	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	2Eh	Reserved 46	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	–
	⋮											
	3Dh	Reserved 61	–	0 to 4294967295	–	U32	ro	No	ALL	No	X	
	3Eh	Reserved 62	–	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	
	⋮											
	47h	Reserved 71	–	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	
4DB0h	–	Reserved	–	–	–	–	–	–	–	–	–	–
	00h	Number of entries	–	8	–	U8	–	–	–	–	–	–
	02h	Reserved 2	–	–	–	U32	–	–	–	–	–	–
	08h	Reserved 8	–	–	–	U32	–	–	–	–	–	–
4F01h	00h	Following error actual value (after filtering)	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	*"5.5.5.1.2.1"* *"5.5.8.7"*
4F03h (*2)	00h	Analog input internal voltage	mV	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	*"5.5.5.3.6.1"* *"5.5.8.7"*
4F04h	00h	Position command internal value (after filtering)	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	*"5.5.5.1.2.1"* *"5.5.8.7"*
4F0Bh	00h	Reserved	–	–	–	I32	–	–	–	–	–	–
4F0Ch	00h	Velocity command value (after filtering)	r/min	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	*"5.5.5.1.2.3"* *"5.5.8.7"*
4F0Dh	00h	External scale position	pulse (External scale)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	*"5.5.5.1.2.1"* *"5.5.6.1.2.1"* *"5.5.7.1.2.1"* *"5.5.8.7"*
4F11h	00h	Regenerative load ratio	%	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	*"5.5.5.1.2.4"* *"5.5.6.1.2.3"* *"5.5.7.1.2.3"* *"5.5.8.7"*
4F21h	00h	Logical input signal	–	0 to 4294967295	–	U32	ro	TxPDO	ALL	No	X	*"5.5.8.7"*
4F22h	00h	Logical output signal	–	0 to 4294967295	–	U32	ro	TxPDO	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4F23h	00h	Logical input signal (expansion portion)	—	0 to 4294967295	—	U32	ro	TxPDO	ALL	No	X	“5.5.8.7”
4F24h	00h	Reserved	—	—	—	U32	—	—	—	—	—	—
4F25h	00h	Physical input signal	—	0 to 4294967295	—	U32	ro	TxPDO	ALL	No	X	“5.5.8.7”
4F26h	00h	Physical output signal	—	0 to 4294967295	—	U32	ro	TxPDO	ALL	No	X	
4F31h	00h	Inertia ratio	%	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	“5.5.5.1.2.4” “5.5.6.1.2.3” “5.5.7.1.2.3” “5.5.8.7”
4F32h	00h	Motor automatic identification	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.8.7”
4F33h	00h	Cause of motor no work	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F34h	00h	Warning flags	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F36h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F37h	—	Multiple alarm/warning information	—	—	—	—	—	—	—	—	—	“5.5.8.7”
	00h	Number of entries	—	35	—	U8	ro	No	ALL	No	X	
	01h	Multiple alarm information 1	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	02h	Multiple alarm information 2	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	03h	Multiple alarm information 3	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	04h	Multiple alarm information 4	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	05h	Reserved 5	—	—	—	I32	—	—	—	—	—	—
	⋮											
	0Fh	Reserved 15	—	—	—	I32	—	—	—	—	—	
	10h	Multiple sub alarm information	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.8.7”
	11h	Multiple warning information 1	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	12h	Multiple warning information 2	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	13h	Multiple warning information 3	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	14h	Reserved 20	—	—	—	I32	—	—	—	—	—	—
	⋮											
	1Fh	Reserved 31	—	—	—	I32	—	—	—	—	—	
	20h	Multiple alarm cause information 1	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.8.7”
	21h	Multiple alarm cause information 2	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	22h	Multiple alarm cause information 3	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
	23h	Multiple alarm cause information 4	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F41h	—	Motor encoder data	—	—	—	—	—	—	—	—	—	“5.5.5.1.2.1” “5.5.6.1.2.1” “5.5.7.1.2.1” “5.5.8.7”
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	
	01h	Mechanical angle (Single-turn data)	pulse	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
	02h	Multi-turn data	Rotation	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4F42h	00h	Electrical angle	0.0879°	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.5.1.2.1” “5.5.6.1.2.1” “5.5.7.1.2.1” “5.5.8.7”
4F44h	00h	Encoder status	—	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.8.7”
4F46h	00h	Reserved	—	—	—	U16	—	—	—	—	—	—
4F48h	00h	External scale pulse total	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	“5.5.5.1.2.1” “5.5.6.1.2.1” “5.5.7.1.2.1” “5.5.8.7”
4F49h	00h	External scale absolute position	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
4F4Ah	00h	External scale position deviation	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	pp hm csp	No	X	“5.5.8.7”
4F4Bh	00h	Touch probe external scale 1 positive edge	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	“5.5.8.1.5”
4F4Ch	00h	Touch probe external scale 1 negative edge	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
4F4Dh	00h	Touch probe external scale 2 positive edge	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
4F4Eh	00h	Touch probe external scale 2 negative edge	pulse (External scale)	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
4F4Fh (*2)	00h	Analog input value	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	csp	No	X	“5.5.5.3.6.1” “5.5.8.7”
4F51h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F53h	00h	Reserved	—	—	—	U32	—	—	—	—	—	—
4F61h	00h	Power on cumulative time	30 minutes	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	“5.5.8.7”
4F62h	00h	Temperature of amplifier	°C	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F63h	00h	Temperature of encoder	°C	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F64h	00h	Inrush resistance relay operating count	Incidences	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F65h	00h	Dynamic brake operating count	Incidences	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F66h	00h	Fan operating time	30 minutes	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F67h	00h	Fan life expectancy	0.1%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F68h	00h	Capacitor life expectancy	0.1%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F6Ah	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F6Bh	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F6Ch	00h	Motor power consumption	W	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	“5.5.8.7”
4F6Dh	00h	Amount of motor power consumption	Wh	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F6Eh	00h	Cumulative value of motor power consumption	Wh	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4F72h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F73h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4F74h	00h	Reserved	—	—	—	U16	—	—	—	—	—	—
4F77h	00h	Lost link error count	Incidences	0 to 65535	—	U16	ro	No	ALL	No	X	“5.5.8.7”
4F78h	00h	Synchronization signal error count	Incidences	0 to 65535	—	U16	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4F81h	00h	Encoder communication error count (accumulated)	Incidences	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	“5.5.8.7”
4F82h	00h	Reserved	–	–	–	I32	–	–	–	–	–	–
4F83h	00h	External scale communication error count (accumulated)	Incidences	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	“5.5.8.7”
4F84h	00h	External scale communication data error count (accumulated)	Incidences	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	
4F85h	00h	Reserved	–	–	–	I32	–	–	–	–	–	–
4F86h	00h	Hybrid deviation	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	“5.5.8.7”
4F87h	00h	External scale data (Higher)	pulse (External scale)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	“5.5.5.1.2.1” “5.5.6.1.2.1” “5.5.7.1.2.1” “5.5.8.7”
4F88h	00h	External scale data (Lower)	pulse (External scale)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
4F89h	00h	External scale status	–	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	“5.5.8.7”
4F8Ah	00h	External scale Z phase counter	–	0 to 65535	–	U16	ro	No	ALL	No	X	
4F8Ch	00h	External scale single-turn data	pulse	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
4F91h (*4)	00h	Estimation accuracy of magnetic pole position	Degrees	0 to 180	–	U8	ro	TxPDO	ALL	No	X	
4F92h (*4)	00h	Execution time of estimation of magnetic pole position	ms	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	
4F93h (*4)	00h	Maximum travel distance to plus direction when estimating magnetic pole position	pulse (Feedback scale unit)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
4F94h (*4)	00h	Maximum travel distance to minus direction when estimating magnetic pole position	pulse (Feedback scale unit)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
4FA1h	00h	Velocity command value	r/min	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	“5.5.5.1.2.3” “5.5.6.1.2.2” “5.5.7.1.2.2” “5.5.8.7”
4FA4h	00h	Reserved	–	–	–	I32	–	–	–	–	–	–
4FA5h	00h	Velocity internal position command	r/min	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	“5.5.5.1.2.3” “5.5.8.7”
4FA6h	00h	Velocity error actual value	r/min	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm csp	No	X	
4FA7h	00h	External scale position (Applied polarity)	pulse (External scale)	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	“5.5.8.7”
4FA8h	00h	Positive direction torque limit value	0.05%	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	“5.5.5.1.2.4” “5.5.6.1.2.3” “5.5.7.1.2.3” “5.5.8.7”
4FA9h	00h	Negative direction torque limit value	0.05%	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
4FABh	00h	Gain switching flag	–	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	“5.5.8.7”
4FACh	00h	Reserved	–	–	–	I32	–	–	–	–	–	–
4FAFh	00h	Estimated position for seamless mode change	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	–
4FB1h	00h	Deterioration diagnosis state	–	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	“5.5.8.7”
4FB2h	00h	Deterioration diagnosis torque command average value	0.1%	-2147483648 to 2147483647	–	I32	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
4FB3h	00h	Deterioration diagnosis torque command standard value	0.1%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	*“5.5.8.7”*
4FB4h	00h	Deterioration diagnosis inertia ratio estimate value	%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4FB5h	00h	Deterioration diagnosis offset load estimate value	0.1%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4FB6h	00h	Deterioration diagnosis dynamic friction estimate value	0.1%	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4FB7h	00h	Deterioration diagnosis viscous friction estimate value	0.1%/ (10000 r/min)	-2147483648 to 2147483647	—	I32	ro	No	ALL	No	X	
4FC2h (*2)	00h	Analog input voltage	mV	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	*“5.5.5.3.6.1”* *“5.5.8.7”*
4FF5h	00h	Reserved	—	—	—	I32	—	TxPDO	—	—	—	—
4FF6h	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4FF7h	—	Reserved	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	—
	01h	Reserved 1	—	—	—	I32	—	—	—	—	—	—
	02h	Reserved 2	—	—	—	I32	—	—	—	—	—	—
4FF8h	—	Reserved	—	—	—	—	—	—	—	—	—	—
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	—
	01h	Reserved 1	—	—	—	I32	—	—	—	—	—	—
	02h	Reserved 2	—	—	—	I32	—	—	—	—	—	—
4FFDh	00h	Reserved	—	—	—	I32	—	—	—	—	—	—
4FFFh	00h	Target position echo	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	*“5.5.5.1.2.2”*

*1 Cannot be used with the standard type or multi-function type. Do not change the factory default value.

*2 Cannot be used with the standard type or multi-function type.

*3 Obj.4DA0h: “Alarm accessory information” is not compatible with PDO.

Each sub-index of Obj.4DA0h is read by SDO, so synchronism cannot be guaranteed.

*4 Cannot be used with the standard type, multi-function type, or application specialized type.

*5 Cannot be used with the standard type or multi-function type. Do not change the initial value.

8.4 Drive Profile Area (6000h to 6FFFh)

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
6007h	00h	Abort connection option code	–	0 to 3	1	I16	rw	No	ALL	Yes	A	“5.5.8.2.1”
603Fh	00h	Error code	–	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	“4.8.3.2” “6.1.3”
6040h	00h	Controlword	–	0 to 65535	0	U16	rw	RxPDO	ALL	No	A	“5.5.2”
		● bit 0: switch on										“5.5.2”
		● bit 1: enable voltage										
		● bit 2: quick stop										
		● bit 3: enable operation										
		● bit 4: operation mode specific (control mode dependent bit)										“5.5.2” “5.5.5.2.1.1” “5.5.5.5.1.3”
		● bit 5: operation mode specific (control mode dependent bit)										“5.5.2” “5.5.5.2.1.1”
		● bit 6: operation mode specific (control mode dependent bit)										
		● bit 7: fault reset										“5.5.2”
		● bit 8: halt										
		● bit 9: operation mode specific (control mode dependent bit)										“5.5.2” “5.5.5.2.1.1”
6041h	00h	Statusword	–	0 to 65535	–	U16	ro	TxPDO	ALL	No	X	“5.5.3”
		● bit 0: ready to switch on										“5.5.3”
		● bit 1: switched on										
		● bit 2: operation enabled										
		● bit 3: fault										
		● bit 4: voltage enabled										
		● bit 5: quick stop										
		● bit 6: switch on disabled										
		● bit 7: warning										
		● bit 9: remote										
		● bit 10: operation mode specific (control mode dependent bit)										“5.5.3” “5.5.5.1.2.5” “5.5.5.5.2.1” “5.5.6.2.2.1” “5.5.7.2.2.1”
		● bit 11: internal limit active										“5.5.3”
		● bit 12: operation mode specific (control mode dependent bit)										“5.5.3” “5.5.5.2.2.1” “5.5.5.3.2.1” “5.5.5.5.2.1” “5.5.6.2.2.1” “5.5.6.3.2.1” “5.5.7.3.2.1”
		● bit 13: operation mode specific (control mode dependent bit)										“5.5.3” “5.5.5.1.2.5” “5.5.5.5.2.1”
605Ah	00h	Quick stop option code	–	-2 to 7	2	I16	rw	No	ALL	Yes	A	“5.5.8.2.2”
605Bh	00h	Shutdown option code	–	0 to 1	1	I16	rw	No	ALL	Yes	A	“5.5.8.2.3”
605Ch	00h	Disable operation option code	–	0 to 1	1	I16	rw	No	ALL	Yes	A	“5.5.8.2.4”
605Dh	00h	Halt option code	–	-1 to 3	1	I16	rw	No	ALL	Yes	A	“5.5.8.2.5”
605Eh	00h	Fault reaction option code	–	0 to 2	2	I16	rw	No	ALL	Yes	A	“5.5.8.2.6”
6060h	00h	Modes of operation	–	-128 to 127	0	I8	rw	RxPDO	ALL	Yes	A	“5.5.4.2”
6061h	00h	Modes of operation display	–	-128 to 127	–	I8	ro	TxPDO	ALL	No	X	“5.5.4.3”

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
6062h	00h	Position demand value	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm ip csp	No	X	"5.5.5.1.2.1"
6063h	00h	Position actual internal value	pulse	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	"5.5.5.1.2.1" "5.5.6.1.2.1" "5.5.7.1.2.1"
6064h	00h	Position actual value	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	
6065h	00h	Following error window	Command unit	0 to 4294967295	100000	U32	rw	RxPDO	pp csp	Yes	A	"5.5.5.1.2.5"
6066h	00h	Following error time out	ms	0 to 65535	0	U16	rw	RxPDO	pp csp	Yes	A	
6067h	00h	Position window	Command unit	0 to 4294967295	10	U32	rw	RxPDO	pp ip	Yes	A	
6068h	00h	Position window time	ms	0 to 65535	0	U16	rw	RxPDO	pp ip	Yes	A	
6069h	00h	Velocity sensor actual value	–	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	"5.5.5.1.2.3" "5.5.6.1.2.2" "5.5.7.1.2.2"
606Ah	00h	Sensor selection code	–	-32768 to 32767	0	I16	rw	RxPDO	pv	No	X	"5.5.6.2.1.2"
606Bh	00h	Velocity demand value	Command unit/s	-2147483648 to 2147483647	–	I32	ro	TxPDO	pv csv	No	X	"5.5.6.1.2.2"
606Ch	00h	Velocity actual value	Command unit/s	-2147483648 to 2147483647	–	I32	ro	TxPDO	ALL	No	X	"5.5.5.1.2.3" "5.5.6.1.2.2" "5.5.7.1.2.2"
606Dh	00h	Velocity window	Command unit/s	0 to 65535	52429	U16	rw	RxPDO	pv	Yes	A	"5.5.6.2.2.1"
606Eh	00h	Velocity window time	ms	0 to 65535	0	U16	rw	RxPDO	pv	Yes	A	
606Fh	00h	Velocity threshold	Command unit/s	0 to 65535	52429	U16	rw	RxPDO	pv	Yes	A	
6070h	00h	Velocity threshold time	ms	0 to 65535	0	U16	rw	RxPDO	pv	Yes	A	
6071h	00h	Target torque	0.1%	-32768 to 32767	0	I16	rw	RxPDO	tq cst	Yes	A	"5.5.7.1.1.2"
6072h	00h	Max torque	0.1%	0 to 65535	5000	U16	rw	RxPDO	ALL	Yes	A	"5.5.5.1.1.3" "5.5.6.1.1.2" "5.5.7.1.1.2"
6073h	00h	Max current	0.1%	0 to 65535	0	U16	rw	No	tq	No	X	"5.5.7.2.2.2"
6074h	00h	Torque demand	0.1%	-32768 to 32767	–	I16	ro	TxPDO	ALL	No	X	"5.5.5.1.2.4" "5.5.6.1.2.3" "5.5.7.1.2.3"
6075h	00h	Motor rated current	mA	0 to 4294967295	0	U32	rw	No	ALL	No	X	"5.5.7.1.2.3"
6076h	00h	Motor rated torque	mN·m	0 to 4294967295	–	U32	ro	No	ALL	No	X	"5.5.5.1.2.4" "5.5.6.1.2.3" "5.5.7.1.2.3"
6077h	00h	Torque actual value	0.1%	-32768 to 32767	–	I16	ro	TxPDO	ALL	No	X	
6078h	00h	Current actual value	0.1%	-32768 to 32767	–	I16	ro	TxPDO	ALL	No	X	"5.5.7.1.2.3"
6079h	00h	DC link circuit voltage	mV	0 to 4294967295	–	U32	ro	TxPDO	ALL	No	X	
607Ah	00h	Target position	Command unit	-2147483648 to 2147483647	0	I32	rw	RxPDO	pp csp	No	A	"5.5.5.1.1.1"
607Bh	–	Position range limit	–	–	–	–	–	–	ALL	–	–	"5.5.8.4.5"
	00h	Highest sub-index supported	–	2	–	U8	ro	No	ALL	No	X	
	01h	Min position range limit	Command unit	-2147483648 to 2147483647	-2147483648	I32	rw	RxPDO	ALL	Yes	X	
	02h	Max position range limit	Command unit	-2147483648 to 2147483647	2147483647	I32	rw	RxPDO	ALL	Yes	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
607Ch	00h	Home offset	Command unit	-2147483648 to 2147483647	0	I32	rw	RxPDO	ALL	Yes	P, H	“5.5.8.4.6”
607Dh	—	Software position limit	—	—	—	—	—	—	pp ip csp	—	—	“5.5.5.1.1.5”
	00h	Number of entries	—	2	—	U8	ro	No	pp ip csp	No	X	
	01h	Min position limit	Command unit	-2147483648 to 2147483647	0	I32	rw	RxPDO	pp ip csp	Yes	P, H	
	02h	Max position limit	Command unit	-2147483648 to 2147483647	0	I32	rw	RxPDO	pp ip csp	Yes	P, H	
607Eh	00h	Polarity	—	0 to 255	0	U8	rw	No	ALL	Yes	P, H	—
		● bit 5: Torque polarity										“5.5.8.4.3”
		● bit 6: Speed polarity										
		● bit 7: Position polarity										
607Fh	00h	Max profile velocity	Command unit/s	0 to 4294967295	999642454	U32	rw	RxPDO	pp hm ip pv	Yes	B	“5.5.5.1.1.2” “5.5.6.2.1.2” “5.5.7.1.1.1”
6080h	00h	Max motor speed	r/min	0 to 4294967295	7150	U32	rw	RxPDO	ALL	Yes	B	“5.5.5.1.1.2” “5.5.5.3.5” “5.5.6.1.1.1” “5.5.7.1.1.1”
6081h	00h	Profile velocity	Command unit/s	0 to 4294967295	0	U32	rw	RxPDO	pp ip	Yes	A	“5.5.5.1.1.2”
6082h	00h	End velocity	Command unit/s	0 to 4294967295	0	U32	rw	RxPDO	pp ip	Yes	X	
6083h	00h	Profile acceleration	Command unit/s^2	0 to 4294967295	4194304000	U32	rw	RxPDO	pp pv ip	Yes	A	“5.5.5.1.1.4” “5.5.6.2.1.3”
6084h	00h	Profile deceleration	Command unit/s^2	0 to 4294967295	4194304000	U32	rw	RxPDO	pp pv ip csp csv	Yes	A	“5.5.5.1.1.4” “5.5.6.2.1.3” “5.5.8.2”
6085h	00h	Quick stop deceleration	Command unit/s^2	0 to 4294967295	4194304000	U32	rw	RxPDO	pp pv hm ip csp csv	Yes	A	“5.5.8.2”
6086h	00h	Motion profile type	—	-32768 to 32767	0	I16	rw	RxPDO	pp pv ip	Yes	A	“5.5.8.5”
6087h	00h	Torque slope	0.1%/s	0 to 4294967295	1000	U32	rw	RxPDO	tq cst	Yes	A	“5.5.7.1.1.2” “5.5.7.2.1.2” “5.5.8.2”
6088h	00h	Torque profile type	—	-32768 to 32767	0	I16	rw	RxPDO	tq	Yes	A	“5.5.7.2.1.2”
608Fh	—	Position encoder resolution	—	—	—	—	—	—	ALL	—	—	“5.5.8.4.2”
	00h	Highest sub-index supported	—	2	—	U8	ro	No	ALL	No	X	
	01h	Encoder increments	pulse	1 to 4294967295	—	U32	ro	No	ALL	No	X	

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
608Fh	02h	Motor revolutions	r (motor)	1 to 4294967295	—	U32	ro	No	ALL	No	X	“5.5.8.4.2”
6091h	—	Gear ratio	—	—	—	—	—	—	ALL	—	—	
	00h	Number of entries	—	2	—	U8	ro	No	ALL	No	X	
	01h	Motor revolutions	r (motor)	1 to 4294967295	1	U32	rw	No	ALL	Yes	P, H	
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	1	U32	rw	No	ALL	Yes	P, H	
6092h	—	Feed constant	—	—	—	—	—	—	ALL	—		
	00h	Highest sub-index supported	—	2	—	U8	ro	No	ALL	No	X	
	01h	Feed	Command unit	1 to 4294967295	8388608	U32	rw	No	ALL	Yes	P, H	
	02h	Shaft revolutions	r (shaft)	1 to 4294967295	1	U32	rw	No	ALL	Yes	P, H	
6098h	00h	Homing method	—	-128 to 127	0	I8	rw	RxPDO	hm	Yes	B	“5.5.5.5.1.4”
6099h	—	Homing speeds	—	—	—	—	—	—	hm	—	—	“5.5.5.5.1.5”
	00h	Number of entries	—	2	—	U8	ro	No	hm	No	X	
	01h	Speed during search for switch	Command unit/s	0 to 4294967295	873813	U32	rw	RxPDO	hm	Yes	A	
	02h	Speed during search for zero	Command unit/s	0 to 4294967295	87381	U32	rw	RxPDO	hm	Yes	A	
609Ah	00h	Homing acceleration	Command unit/s^2	0 to 4294967295	4194304000	U32	rw	RxPDO	hm	Yes	A	“5.5.5.5.1.6” “5.5.8.2”
60A3h	00h	Profile jerk use	—	1 to 2, 255	1	U8	rw	No	pp pv ip	Yes	A	“5.5.8.5”
60A4h	—	Profile jerk	—	—	—	—	—	—	pp pv ip	—	—	
	00h	Highest sub-index supported	—	2	—	U8	ro	No	pp pv ip	No	X	
	01h	Profile jerk1	Command unit/s^3	0 to 4294967295	0	U32	rw	No	pp pv ip	Yes	A	
	02h	Profile jerk2	Command unit/s^3	0 to 4294967295	0	U32	rw	No	pp pv ip	Yes	A	
60B0h	00h	Position offset	Command unit	-2147483648 to 2147483647	0	I32	rw	RxPDO	csp	Yes	A	“5.5.5.3.1.2”
60B1h	00h	Velocity offset	Command unit/s	-2147483648 to 2147483647	0	I32	rw	RxPDO	pp pv hm ip csp csv	Yes	A	“5.5.5.1.1.2” “5.5.6.1.1.1”
60B2h	00h	Torque offset	0.1%	-32768 to 32767	0	I16	rw	RxPDO	ALL	Yes	A	“5.5.5.1.1.3” “5.5.6.1.1.2” “5.5.7.1.1.2”
60B8h	00h	Touch probe function	—	0 to 65535	0	U16	rw	RxPDO	ALL	No	A	—
		● bit 0: Touch Probe 1 execute, stop										“5.5.8.1.3”
		● bit 1: Touch Probe 1 event mode selection										
		● bit 2: Touch Probe 1 trigger selection (external input, Z-phase)										
		● bit 4: Touch Probe 1 rising edge selection										
		● bit 5: Touch Probe 1 falling edge selection										

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
60B8h	00h	● bit 8: Touch Probe 2 execute, stop										*“5.5.8.1.3”*
		● bit 9: Touch Probe 2 event mode selection (single, continuous)										
		● bit 10: Touch Probe 2 trigger selection (external input, Z-phase)										
		● bit 12: Touch Probe 2 rising edge selection										
		● bit 13: Touch Probe 2 falling edge selection										
		● bit 15: External scale monitor value 0 clear enable, disable										
60B9h	00h	Touch probe status	—	0 to 65535	—	U16	ro	TxPDO	ALL	No	X	*“5.5.8.1.4”*
60BAh	00h	Touch probe 1 positive edge	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	*“5.5.8.1.5”*
60BBh	00h	Touch probe 1 negative edge	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
60BCh	00h	Touch probe 2 positive edge	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
60BDh	00h	Touch probe 2 negative edge	Command unit	-2147483648 to 2147483647	—	I32	ro	TxPDO	ALL	No	X	
60C2h	—	Interpolation time period	—	—	—	—	—	—	ip csp csv cst	—	—	*“5.5.8.6”*
	00h	Highest sub-index supported	—	2	—	U8	ro	No	ip csp csv cst	No	X	
	01h	Interpolation time period value	—	0 to 255	1	U8	rw	No	ip csp csv cst	Yes	A	
	02h	Interpolation time index	—	-128 to 63	-3	I8	rw	No	ip csp csv cst	Yes	A	
60C5h	00h	Max acceleration	Command unit/s^2	0 to 4294967295	4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A	*“5.5.5.1.1.4”* *“5.5.6.2.1.3”*
60C6h	00h	Max deceleration	Command unit/s^2	0 to 4294967295	4294967295	U32	rw	RxPDO	pp hm pv ip	Yes	A	*“5.5.5.1.1.4”* *“5.5.6.2.1.3”* *“5.5.8.2”*
60E0h	00h	Positive torque limit value	0.1%	0 to 65535	5000	U16	rw	RxPDO	ALL	Yes	A	*“5.5.5.1.1.3”* *“5.5.6.1.1.2”* *“5.5.7.1.1.2”*
60E1h	00h	Negative torque limit value	0.1%	0 to 65535	5000	U16	rw	RxPDO	ALL	Yes	A	
60E3h	—	Supported homing methods	—	—	—	—	—	—	ALL	—	—	*“5.5.5.5.2.2”*
	00h	Number of entries	—	32	—	U8	ro	No	ALL	No	X	
	01h	1st supported homing method	—	-128 to 127	—	I8	ro	No	ALL	No	X	
	⋮											
	20h	32nd supported homing method	—	-128 to 127	—	I8	ro	No	ALL	No	X	
60F2h	00h	Position option code	—	0 to 65535	0	U16	rw	RxPDO	pp	Yes	A	—
		● bits 1 to 0: relative option										*“5.5.5.2.1.2”*
		● bits 3 to 2: change immediately option										
		● bits 5 to 4: request-response option										
		● bit 15: manufacturer-specific										

Index	Sub-Index	Name	Units	Range	Initial value	Data type	Access	PDO	Op-mode	EEPROM	Attribute	Reference
60F4h	00h	Following error actual value	Command unit	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm ip csp	No	X	*“5.5.5.1.2.1”*
60FAh	00h	Control effort	Command unit/s	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm ip csp	No	X	*“5.5.5.1.2.3”*
60FCh	00h	Position demand internal value	pulse	-2147483648 to 2147483647	–	I32	ro	TxPDO	pp hm ip csp	No	X	*“5.5.5.1.2.1”*
60FDh	00h	Digital inputs	–	0 to 4294967295	–	U32	ro	TxPDO	ALL	No	X	*“5.5.8.3.1”*
60FEh	–	Digital outputs	–	–	–	–	–	–	ALL	–	–	–
		● bit 0: set brake										*“5.5.8.3.2”*
		● bit 16: EX-OUT1										
		● bit 19: vel-loop torque limit										
		● bit 20: vel-loop integral clear										
		● bit 28: Timestamp reference time reset										
	00h	Number of entries	–	2	–	U8	ro	No	ALL	No	X	
	01h	Physical outputs	–	0 to 4294967295	0	U32	rw	RxPDO	ALL	Yes	A	
	02h	Bit mask	–	0 to 4294967295	0	U32	rw	RxPDO	ALL	Yes	A	
60FFh	00h	Target velocity	Command unit/s	-2147483648 to 2147483647	0	I32	rw	RxPDO	pv csv	No	A	*“5.5.6.1.1.1”*
6403h	00h	Motor catalogue number	–	–	–	VS	ro	No	ALL	No	X	*“5.5.8.7”*
6502h	00h	Supported drive modes	–	0 to 4294967295	–	U32	ro	TxPDO	ALL	No	X	*“5.5.4.1”*

9 Glossary

Abbreviations used in this document and their official names are shown below.

■ Servo Driver-related/Servo Motor-related

Abbreviation	Official Name
CCW	Counterclockwise Rotation
csp	Cyclic synchronous position mode
cst	Cyclic synchronous torque mode
cstca	Cyclic synchronous torque mode with commutation angle
csv	Cyclic synchronous velocity mode
CW	Clockwise Rotation
DB	Dynamic Brake
EDM	External Device Monitoring
FB	Feedback
FF	Feed forward
FFT	Fast Fourier Transform
FIR	Finite Impulse Response
hm	Homing mode
HPF	High Pass Filter
ip	Interpolated position mode
LSD	Least Significant Digit
LV	Low Voltage
MSD	Most Significant Digit
OSS	Open Source Software
pp	Profile position mode
pv	Profile velocity mode
Recv	Receive
RTAT	Real-Time Auto Tuning
SRV	Servo
SSU	STO Signal Unmatch
STO	Safe Torque Off
TFF	Torque Feed Forward
tq	Torque profile mode
vl	Velocity mode

■ EtherCAT Communication-related

Abbreviation	Official Name
AL	Application Layer
Boot	Bootstrap
CoE	CANopen over EtherCAT
DC	Distributed Clocks
ENI	EtherCAT Network Information
EoE	Ethernet over EtherCAT
ESC	EtherCAT SubDevice Controller

Abbreviation	Official Name
ESI	EtherCAT SubDevice Information
ESM	EtherCAT State Machine
ETG	EtherCAT Technology Group
FMMU	Fieldbus Memory Management Unit
FoE	File Access over EtherCAT
FSA	Finite State Automaton
OP	Operational
PDI	Physical Device Interface
PDO	Process Data Object
PDS	Power Drive Systems
PreOP	Pre-Operational
RxPDO	Receive PDO
SafeOP	Safe-Operational
SDO	Service Data Object
SII	SubDevice Information Interface
SM	SyncManager
SoE	Sercos over EtherCAT
TxPDO	Transmit PDO
VoE	Vendor-specific over EtherCAT

■ Object-related

Data type

Abbreviation	Official Name
U8	Unsigned8
U16	Unsigned16
U32	Unsigned32
I8	Integer8
I16	Integer16
I32	Integer32
VS	Visible String
BOOL	Boolean
OS	Octet String

Access

Abbreviation	Official Name
r	read
rw	read-write
ro, RO	read-only
c	constant