HIWIN®
Motion Control and System Technology

HIWIN MECHATROLINK-III

Communication Command Manual

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Revision History

Release Date	Version	Applicable Product	Revision Contents
March 19th, 2018	1.0	D1-N series servo drives	First edition.
November 16th, 2018	1.1	D1-N series servo drives	1. Add main command ZRET. 2. Add section 2.1 **Communication specification**. 3. Add section 7.2 **HIWIN drive variables**. 4. Add chapter 8 **Errors and warnings**.
June 14th, 2019	1.2	D1-N series servo drives	1. Delete transmission cycle 750 μs in table 2.1.1 in section 2.1. 2. Revise ALM_CLR data format in table 4.1.4.1 in section 4.1.4.

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1. About this manual

1.1 Preface

This manual provides information necessary to operate HIWIN D-series servo drives via MECHATROLINK-III communication. For further understanding of D-series servo drives, please refer to related user manuals.

1.2 Trademarks

MECHATROLINK is a trademark of MECHATROLINK Members Association.

2. MECHATROLINK-III communication

2.1 Communication specification

Table 2.1.1

MECHATROLINK-III Specification	
Communication Protocol	MECHATROLINK-III
Station Address Setup	03 to EF hex
Baud Rate	100 Mbps
Transmission Cycle	500 μs, 1.0 ms to 4.0 ms (0.5 ms increment)
Transmission Bytes	32 or 48 bytes
Control Method	Position control, Speed control, or Torque control
Profile	MECHATROLINK-III standard servo profile

Note:
For the details of drive setup, refer to section 6.2.

2.2 Data format

A standard command format is composed of a main command and a subcommand. The data format is shown in table 2.2.1.

Table 2.2.1

	Byte	Command	Response
Main Command Area	0	CMD	RCMD
	1	WDT	RWDT
	2	CMD_CTRL	CMD_STAT
	3		
	4 – 31	CMD_DATA	RSP_DATA
Subcommand Area	32	SUBCMD	RSUBCMD
	33	SUB_CTRL	SUB_STAT
	34		
	35		
	36 – 47	SUB_CMD_DATA	SUB_RSP_DATA

2.3 Communication phase

The communication phases of MECHATROLINK-III are listed in table 2.3.1.

Table 2.3.1

Phase	Operating State	Description
0	Power on	When the slave is turned on, communication phase changes to phase 1.
1	Communication initialization	The slave completes internal initialization and is waiting for CONNECT command.
2	Normal operation	Asynchronous communication is enabled. Only asynchronous commands can be used.
3		Synchronous communication is enabled. Both synchronous commands and asynchronous commands can be used.
4		When the slave receives DISCONNECT command from C1 master, the slave re-initializes and shifts to connection-wait state (phase 1).
5	Power off	The master and the slave are turned off.

2.4 Common command format

Standard servo profile commands are classified into two categories: common command and servo command. Common commands are used for MECHATROLINK-III communication. Servo commands are used for standard servo profile. This section will describe the related information of common commands. The data format of common command is shown in table 2.4.1. Bytes 0 to 31 are used by main command; bytes 32 to 47 are used by subcommand to supplement main command.

Table 2.4.1

	Byte	Command	Response
Main Command Area	0	CMD	RCMD
	1	WDT	RWDT
	2	CMD_CTRL	CMD_STAT
	3		
	4 – 31	CMD_DATA	RSP_DATA
Subcommand Area	32	SUBCMD	RSUBCMD
	33	SUB_CTRL	SUB_STAT
	34		
	35		
	36 – 47	SUB_CMD_DATA	SUB_RSP_DATA

2.5 Command headers of main commands

2.5.1 Command code (CMD/RCMD)

Byte 0 of command field and response field are defined as CMD field and RCMD field. The data in RCMD field is the copy of the data in CMD field. Table 2.5.1.1 shows the command codes used by common commands and servo commands.

Table 2.5.1.1

Profile	Command Code (Hex.)	Command	Operation
Common Command	00	NOP	No operation
	03	ID_RD	Reads drive ID information
	04	CONFIG	Enable parameter setup
	05	ALM_RD	Reads alarm/warning
	06	ALM_CLR	Clears alarm/warning state
	0D	SYNC_SET	Requests for synchronous communication
	0E	CONNECT	Requests for connection
	0F	DISCONNECT	Requests for disconnection
	1D	MEM_RD	Reads virtual memory
Servo Command	21	BRK_ON	Requests to apply brake
	22	BRK_OFF	Requests to release brake
	23	SENS_ON	Requests to turn sensor on
	24	SENS_OFF	Requests to turn sensor off
	30	SMON	Monitors drive status
	31	SV_ON	Servo on
	32	SV_OFF	Servo off
	34	INTERPOLATE	Interpolation
	35	POSING	Positioning
	36	FEED	Constant-speed feed
	39	EX_POSING	Positioning by external input position
	3C	VELCTRL	Velocity control
	3D	TRQCTRL	Torque control
	40	SVPRM_RD	Reads servo parameters
	41	SVPRM_WR	Writes servo parameters

2.5.2 Watchdog data (WDT/RWDT)

Byte 1 of command field and response field are defined as WDT field and RWDT field. The format is shown in figure 2.5.2.1.

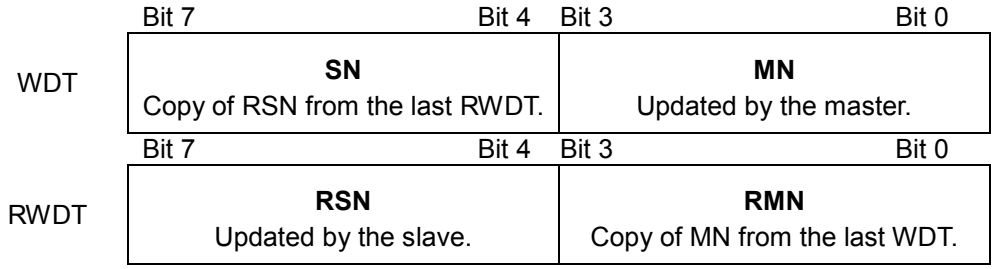

Figure 2.5.2.1

The watchdog data (WDT) is checked after synchronous communication (phase 3) is established. D-series servo drives start refreshing watchdog data (RWDT) before the master sends CONNECT command.

2.5.3 Command control (CMD_CTRL)

Bytes 2 and 3 of command field are defined as CMD_CTRL fields. Table 2.5.3.1 describes the command control data in CMD_CTRL fields. The data in CMD_CTRL fields will still be valid even when an alarm specified by CMD_ALM occurs.

Table 2.5.3.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
CMD_ID		Reserved		ALM_CLR	Reserved		
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved							

- ALM_CLR: Clears alarm or warning state
  (1) Definition
  0: Disabled; 1: Enabled

  (2) Description
  ALM_CLR clears alarm or warning state at the rising edge. The processing is the same as when ALM_CLR_MODE of ALM_CLR command is set to 0 (Clears current alarm or warning state.).

- CMD_ID: Command ID

  (1) Definition

  The master uses command ID to have the slave acknowledge that the command is a new command when the master sends the same command repeatedly. The slave uses command ID to inform the master to which command it is responding. A value from 0 to 3 is used.

  (2) Description

  Since the slave returns the CMD_ID of the command being executed, the master can clearly identify the slave is sending the response of which command. When CMD_RDY = 0, the slave disregards command that has a different CMD_ID and continues executing current command. Commands that can be regarded as new commands by the change in CMD_ID are EX_POSING and ZRET.

2.5.4 Command status (CMD_STAT)

Bytes 2 and 3 of response field are defined as CMD_STAT fields. The data in CMD_STAT fields will still be valid even when an alarm specified by CMD_ALM occurs. CMD_STAT fields are shown in table 2.5.4.1.

Table 2.5.4.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RCMD_ID		Reserved		ALM_CLR_CMP	CMDRDY	D_WAR	D_ALM
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
COMM_ALM				CMD_ALM			

- D_ALM

  (1) Definition

  1: The slave is in alarm state.

  0: Other (Normal state, or alarm states specified by COMM_ALM and CMD_ALM.)

  (2) Description

  When a device-specific alarm other than alarm specified by COMM_ALM and CMD_ALM has occurred, D_ALM is set to 1. D_ALM is independent from COMM_ALM and CMD_ALM. When D_ALM = 1 in servo-on state, the slave will become servo-off. When the slave changes from alarm state to normal state after ALM_CLR command and SVCMD_IO.ALM_CLR are executed, D_ALM is set to 0.

- D_WAR
  (1) Definition
  1: The slave is in warning state.
  0: Other (Normal state, or warning states specified by COMM_ALM and CMD_ALM.)

  (2) Description
  When a device-specific warning other than warning specified by COMM_ALM and CMD_ALM has occurred, D_WAR is set to 1. D_WAR is independent from COMM_ALM and CMD_ALM. When D_WAR = 1 in servo-on state, the slave will remain servo-on. When the slave changes from warning state to normal state after ALM_CLR command and CMD_CTRL.ALM_CLR are executed, D_WAR is set to 0.

- CMDRDY
  (1) Definition
  1: Command reception is ready.
  0: Command reception is not ready.

  (2) Description
  CMDRDY = 0 means that command processing is still in progress. When CMDRDY = 0, the slave continues executing current command, and new command sent from the master will be disregarded. Completion of command execution is confirmed by the confirmation method specified by each command. If command execution is possible despite alarm or warning state, CMDRDY is set to 1.

- ALM_CLR_CMP
  (1) Definition
  1: Execution of ALM_CLR command is completed.
  0: Other

  (2) Description
  ALM_CLR_CMP = 1 means that CMD_CTRL.ALM_CLR = 1 has been received and alarm state has been cleared. ALM_CLR_CMP command can be canceled by setting CMD_CTRL.ALM_CLR to 0.

- RCMD_ID
  (1) Definition
  Echo back of the CMD_ID in the command field

(2) Description

Returns the CMD_ID in the command field.

- CMD_ALM

(1) Definition

Notifies command error.

(2) Description

CMD_ALM is used to indicate command errors. CMD_ALM is independent from COMM_ALM, D_ALM and D_WAR. If a normal command is received after a command error occurs, CMD_ALM is automatically cleared. The communication phase and servo status will not change even when CMD_ALM is not 0.

Table 2.5.4.2

Code		Contents	Remark
Normal	0	Normal	-
Warning	1	Invalid data	The slave notifies a warning state. The command is executed by the specified value or by the maximum or minimum allowable value.
	2	-	
	3	-	
	4	-	
	5	-	
	6	-	
	7	-	
Alarm	8	Unsupported command	The slave notifies an alarm state and the command is not executed.
	9	Invalid data	
	A	Command execution condition error	
	B	Subcommand combination error	
	C	Phase error	
	D	-	
	E	-	
	F	-	

- COMM_ALM

(1) Definition

Notifies communication error.

(2) Description

COMM_ALM is used to indicate errors in MECHATROLINK communication. COMM_ALM is independent from CMD_ALM, D_ALM and D_WAR. COMM_ALM is cleared at the rising edge of CMD_CTRL.ALM_CLR or by ALM_CLR command.

Table 2.5.4.3

Code		Contents	Remark
Normal	0	Normal	-
Warning	1	FCS error	Warning occurs when an error has been detected for the first time. The servo state will be remained. ➢ Error detection method 1: FCS error An error has been detected in frame check sequence. 2: Command data is not received. The command data sent to the slave is not received. 3: Synchronous frame is not received. The synchronous frame is not received.
	2	Command data is not received.	
	3	Synchronous frame is not received.	
	4	-	
	5	-	
	6	-	
	7	-	
Alarm	8	FCS error	Alarm occurs when an error has been detected continuously for specific times. If the system is in communication phase 3 when an alarm occurs, it will shift to phase 2. The servo state will be changed to servo-off. ➢ Error detection method 8, 9, A: Sets if an error has been detected twice. B, C: Sets immediately if an error has been detected.
	9	Command data is not received.	
	A	Synchronous frame is not received.	
	B	Synchronization interval error	
	C	WDT error	
	D	-	
	E	-	
	F	-	

2.6 Command headers of subcommands

2.6.1 Subcommand code (SUB_CMD/SUB_RCMD)

Byte 32 of command field and response field are defined as SUB_CMD field and SUB_RCMD field. The standard subcommands used by D-series servo drives are listed in table 2.6.1.1.

Table 2.6.1.1

Profile	Command Code (Hex.)	Command	Operation
Servo Command	00	NOP	No operation
	05	ALM_RD	Reads alarm/warning
	06	ALM_CLR	Clears alarm/warning
	1D	MEM_RD	Reads virtual memory
	30	SMON	Monitors drive status
	40	SVPRM_RD	Reads servo parameters
	41	SVPRM_WR	Writes servo parameters

2.6.2 Subcommand control (SUB_CTRL)

Bytes 33 to 35 of command field are defined as SUB_CTRL fields. SUB_CTRL fields are defined in table 2.6.2.1.

Table 2.6.2.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
SEL_MON4				Reserved			
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
SEL_MON6				SEL_MON5			

The details of the control bits are shown in table 2.6.2.2.

Table 2.6.2.2

Bit	Name	Contents	Value (Hex.)	Setting
12 – 15	SEL_MON4	Monitoring selection 4	0 to F	Monitoring selection
16 – 19	SEL_MON5	Monitoring selection 5	0 to F	Monitoring selection
20 – 23	SEL_MON6	Monitoring selection 6	0 to 15	Monitoring selection

2.6.3 Subcommand status (SUB_STAT)

Bytes 33 to 35 of response field are defined as SUB_STAT fields. SUB_STAT fields are defined in table 2.6.3.1.

Table 2.6.3.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved					SUBCMDRDY	Reserved	
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
SEL_MON4				SUBCMD_ALM			
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
SEL_MON6				SEL_MON5			

The details of the status bits are shown in table 2.6.3.2.

Table 2.6.3.2

Bit	Name	Contents	Value (Hex.)	Setting
2	SUBCMDRDY	Subcommand reception is ready.	1	Command reception is ready.
			0	Command reception is not ready.
8 – 11	SUBCMD_ALM	Subcommand alarm	0 to F	Refer to section 2.5.4 for CMD_ALM.
12 – 15	SEL_MON4	Monitoring selection 4	0 to F	Monitoring selection
16 – 19	SEL_MON5	Monitoring selection 5	0 to F	Monitoring selection
20 – 23	SEL_MON6	Monitoring selection 6	0 to F	Monitoring selection

2.7 Servo command format

The data format of servo command is shown in table 2.7.1. Byte 0 to 31 is main command area. Servo commands can be expanded to 48 bytes by using subcommands.

Table 2.7.1

	Byte	Command	Response
Main Command Area	0	CMD	RCMD
	1	WDT	RWDT
	2	CMD_CTRL	CMD_STAT
	3		
	4	SVCMD_CTRL	SVCMD_STAT
	5		
	6		
	7		
	8	SVCMD_IO	SVCMD_IO
	9		
	10		
	11		
	12 – 31	CMD_DATA	RSP_DATA

2.8 Command header section

2.8.1 Servo command control (SVCMD_CTRL)

Bytes 4 to 7 of command field are defined as SVCMD_CTRL fields. The control bits are used to specify the operation of the slave. The data in SVCMD_CTRL fields will still be valid even when an alarm specified by CMD_ALM occurs.

Table 2.8.1.1 shows the allocation of the control bits.

Table 2.8.1.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved				STOP_MODE		CMD_CANCEL	CMD_PAUSE
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved		LT_SEL2		LT_SEL1		LT_REQ2	LT_REQ1
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
SEL_MON2				SEL_MON1			
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
Reserved				SEL_MON3			

Table 2.8.1.2 shows the details of the control bits.

Table 2.8.1.2

Bit	Name	Contents	Value (Hex.)	Setting	Enabling Time
0	CMD_PAUSE	Pauses move command	0	None	Level
			1	Pauses move command	
	Pauses the execution of move command: POSING, FEED, EX_POSING, ZRET and VELCTRL. Movement is stopped according to the setting of STOP_MODE.				
1	CMD_CANCEL	Cancels move command	0	None	Level
			1	Cancels move command	
	Cancels the execution of move command: POSING, FEED, EX_POSING, ZRET and VELCTRL. Movement is stopped according to the setting of STOP_MODE.				
2 – 3	STOP_MODE	Selection of stop mode	0	Decelerates to stop	Level
			1	Immediate stop	
			2 - 3	Reserved	
	Selects stop mode for CMD_PAUSE and CMD_CANCEL.				

Bit	Name	Contents	Value (Hex.)	Setting	Enabling Time
8	LT_REQ1	Latch request 1	0	None	Rising edge
			1	Requests for latch	
	Requests to latch by Z phase signal.				
9	LT_REQ2	Latch request 2	0	None	Rising edge
			1	Requests for latch	
	Requests to latch by Z phase signal.				
10 – 11	LT_SEL1	Selection of latch signal 1	0	Z phase signal	Rising edge of LT_REQ1
			1 - 3	Reserved	
	Only Z phase signal is supported.				
12 – 13	LT_SEL2	Selection of latch signal 2	0	Z phase signal	Rising edge of LT_REQ2
			1 - 3	Reserved	
	Only Z phase signal is supported.				
16 – 18	SEL_MON1	Monitoring selection 1	0 – F	Monitoring selection	Level
	Sets monitoring information, please refer to section 5.3.				
19 – 22	SEL_MON2	Monitoring selection 2	0 – F	Monitoring selection	Level
	Sets monitoring information, please refer to section 5.3.				
23 – 26	SEL_MON3	Monitoring selection 3	0 – F	Monitoring selection	Level
	Sets monitoring information, please refer to section 5.3.				

Latch operation starts at the rising edge of LT_REQ. The operations to be performed when commands are changed during latch operations are listed in table 2.8.1.3. (The value of LT_SEL is an example.)

Table 2.8.1.3

Command before switching	Command after switching	Latch operation
Command without latch function LT_SEL = 1 LT_REQ = 1	Common command	The latch request before switching is continued.
Command with latch function LT_SEL = 1 LT_REQ = 1	Common command	Operation of the command with latch function is interrupted.
Command without latch function LT_SEL = 1 LT_REQ = 1	Command without latch function LT_SEL = 1 LT_REQ = 1	The latch request before switching is continued.
Command without latch function LT_SEL = 1 LT_REQ = 1	Command without latch function LT_SEL = 2 LT_REQ = 1	The latch request before switching is continued.
Command without latch function LT_SEL = 1 LT_REQ = 1	Command with latch function LT_SEL = 1 LT_REQ = 1	Switches to the latch request of the command after switching. The servo drive executes its latch request. (internal processing) If the status “L_CMP = 1” is established before command switching, “L_CMP = 0” is set when command switches.
Command with latch function LT_SEL = 1 LT_REQ = 1	Command without latch function LT_SEL = 1 LT_REQ = 1	Switches to the latch request of the command after switching. The servo drive executes its latch request. (internal processing) If the status “L_CMP = 1” is established before command switching, “L_CMP = 0” is set when command switches.
Command with latch function LT_SEL = 1 LT_REQ = 1	Command with latch function LT_SEL = 1 LT_REQ = 1	Switches to the latch request of the command after switching. The servo drive executes its latch request. (internal processing) If the status “L_CMP = 1” is established before command switching, “L_CMP = 0” is set when command switches.

Note:

(1) Command with latch function:
EX_POSING and ZRET

Command without latch function:
POS_SET, BRK_ON, BRK_OFF, SENS_ON, SENS_OFF, SMON, SV_ON, SV_OFF, INTERPOLATE, POSING, FEED, VELCTRL, TRQCTRL, SVPRM_RD and SVPRM_WR

Common command:
NOP, ID_RD, CONFIG, ALM_RD, ALM_CLR, SYNC_SET, CONNECT, DISCONNECT and MEM_RD

(2) LT_SEL: LT_SEL1 or LT_SEL2
LT_REQ: LT_REQ1 or LT_REQ2

2.8.2 Servo command status (SVCMD_STAT)

Bytes 4 to 7 of response field are specified as SVCMD_STAT fields. The status bits indicate the status of the slave. The data in SVCMD_STAT fields will still be valid even when an alarm specified by CMD_ALM occurs.

Table 2.8.2.1 shows the allocation of the status bits.

Table 2.8.2.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved						CMD_CANCEL_CMP	CMD_PAUSE_CMP
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved		SV_ON	M_RDY	PON	POS_RDY	L_CMP2	L_CMP1
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
SEL_MON2				SEL_MON1			
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
Reserved				SEL_MON3			

Table 2.8.2.2 shows the details of the status bits.

Table 2.8.2.2

Bit	Name	Contents	Value (Hex.)	Setting
0	CMD_PAUSE_CMP	Indicates if move command is paused	0	Incomplete
			1	Move command is paused
	This bit is used to indicate if POSING, FEED, EX_POSING, ZRET and VELCTRL commands are paused or not.			
1	CMD_CANCEL_CMP	Indicates if move command is canceled	0	Incomplete
			1	Move command is canceled
	This bit is used to indicate if POSING, FEED, EX_POSING, ZRET and VELCTRL commands are canceled or not.			
8	L_CMP1	Latch completion 1	0	Incomplete
			1	Latch is completed
	This bit is used to indicate if the latch request of LT_REQ1 completes or not. L_CMP1 will remain at 1 until LT_REQ1 is set to 0.			
9	L_CMP2	Latch completion 2	0	Incomplete
			1	Latch is completed
	This bit is used to indicate if the latch request of LT_REQ2 completes or not. L_CMP2 will remain at 1 until LT_REQ2 is set to 0.			
10	POS_RDY	Position data is ready	0	Not ready
			1	Ready
	This bit is used to indicate if position data being monitored is valid or not. (1) When an absolute encoder is used: POS_RDY = 1 means SENS_ON command completes. POS_RDY = 0 means SENS_OFF command completes. (2) When an incremental encoder is used: POS_RDY=1 means CONNECT command completes.			
11	PON	Power on	0	Power off
			1	Power on
	This bit is used to indicate if the power is turned on or not.			
12	M_RDY	Motor energization is ready	0	Not ready
			1	Ready
	This bit is used to indicate if the motor is ready for servo on or not.			
13	SVON	Servo on	0	Servo off
			1	Servo on
	This bit is used to indicate if the motor is energized or not.			
16 – 19	SEL_MON1	Monitoring selection 1: Returns what data is being monitored	0 to F	Monitoring selection
	This bit is used to indicate what data is being monitored.			
20 – 23	SEL_MON2	Monitoring selection 2: Returns what data is being monitored	0 to F	Monitoring selection
	This bit is used to indicate what data is being monitored.			
24 – 27	SEL_MON3	Monitoring selection 3: Returns what data is being monitored	0 to F	Monitoring selection
	This bit is used to indicate what data is being monitored.			

2.8.3 Supplementary information on CMD_PAUSE and CMD_CANCEL

- CMD_PAUSE
  1. CMD_PAUSE is used to pause move command. Move command processing can be continued by clearing CMD_PAUSE.
  2. CMD_PAUSE is only valid for POSING, FEED, EX_POSING, ZRET and VELCTRL commands.
  3. Movement stops according to the setting of STOP_MODE.
  4. CMD_PAUSE is disregarded when it is used for commands other than POSING, FEED, EX_POSING, ZRET and VELCTRL. CMD_PAUSE_CMP remains at 0.
  5. When CMD_PAUSE_CMP changes to 1, DEN remains at 0 (position mode).
  6. When CMD_PAUSE_CMP changes to 1, the previous control mode retains.

  Note:
  CMD_PAUSE_CMP is set to 1 as both CMD_PAUSE and ZSPD are 1.

  Example of pausing POSING command is shown in figure 2.8.3.1.

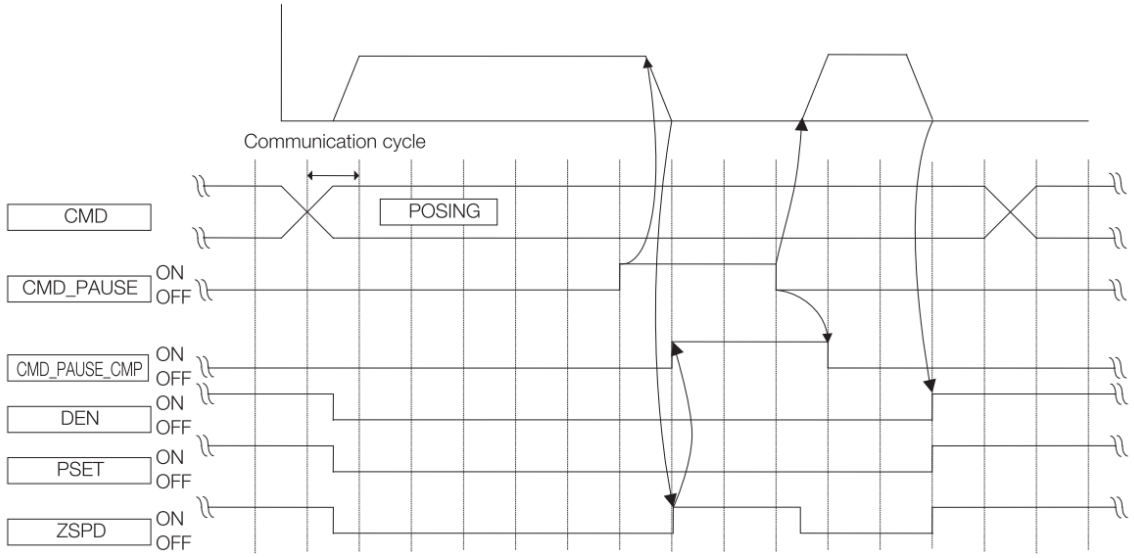

Figure 2.8.3.1

Example of pausing VELCTRL command is shown in figure 2.8.3.2.

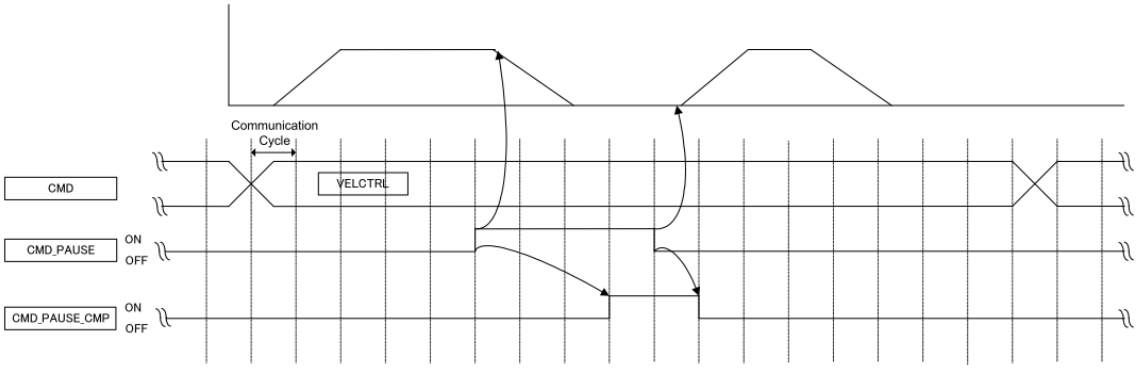

Figure 2.8.3.2

- CMD_CANCEL
  1. CMD_CANCEL is used to interrupt move command. Move command processing is cleared.
  2. CMD_CANCEL is only valid for POSING, FEED, EX_POSING, ZRET and VELCTRL commands.
  3. Movement stops according to the setting of STOP_MODE.
  4. CMD_CANCEL is disregarded when it is used for commands other than POSING, FEED, EX_POSING, ZRET and VELCTRL. CMD_CANCEL_CMP remains at 0.
  5. In position mode, when DEN=1, CMD_CANCEL_CMP will become 1. In velocity mode, when ZSPD=1, CMD_CANCEL_CMP will become 1.
  6. When CMD_CANCEL_CMP changes to 1, the previous control mode retains.
  7. When CMD_PAUSE and CMD_CANCEL are used at the same time or when CMD_CANCEL is used after CMD_PAUSE, CMD_CANCEL takes priority over CMD_PAUSE.

Note:

If 0 is set for CMD_CANCEL during deceleration, the next command (POSING, FEED, EX_POSING, ZRET and VELCTRL) can be restarted before 1 is set for CMD_CANCEL_CMP. However, EX_POSING and ZRET require alternation of CMD_ID.

Example of canceling POSING command is shown in figure 2.8.3.3.

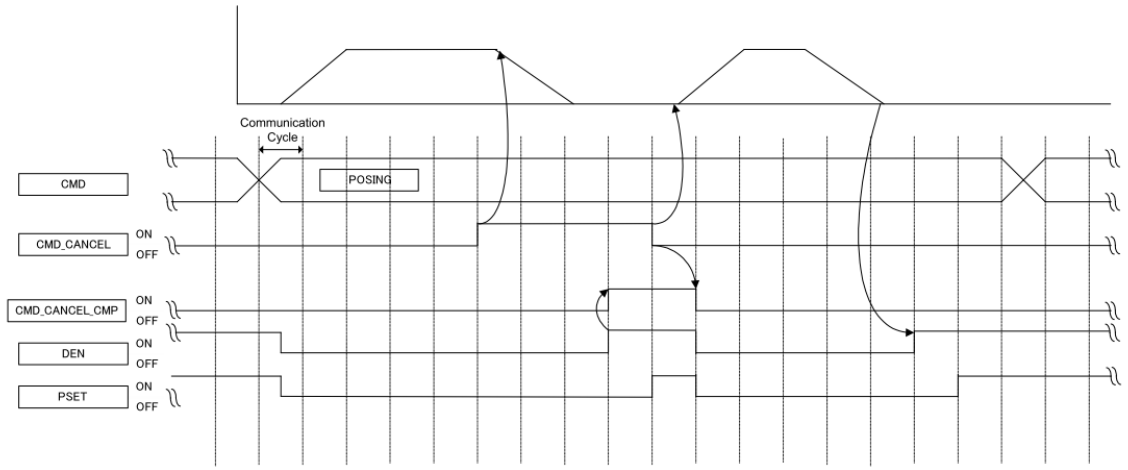

Figure 2.8.3.3

Example of canceling VELCTRL command is shown in figure 2.8.3.4.

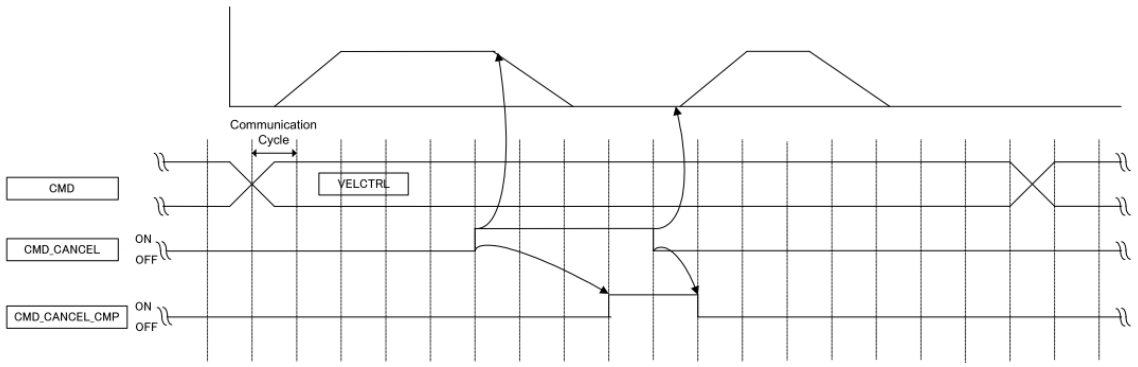

Figure 2.8.3.4

2.9 Servo command I/O signal (SVCMD_IO)

This section describes the I/O signal monitoring of servo command.

2.9.1 Bit allocation of servo command output signal monitoring

Bytes 8 to 11 of command field are defined as I/O signal fields for servo command output signals. Servo command output signals are signals outputted to the slave. Table 2.9.1.1 shows the bit allocation of output signal. The data in SVCMD_IO fields will still be valid even when an alarm specified by CMD_ALM occurs.

Table 2.9.1.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved							
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
O4	O3	O2	O1	Reserved			
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
Reserved							

Table 2.9.1.2 shows the details of output signals.

Table 2.9.1.2

Bit	Name	Contents	Value	Setting
20 - 23	O1 to O4	Output signal control	0	OFF
			1	ON
	Sets output signal to ON/OFF.			

2.9.2 Bit allocation of servo command input signal monitoring

Bytes 8 to 11 of response field are defined as I/O signal fields for servo command input signals. Servo command input signals are used to indicate the states of slave signals. The data in SVCMD_IO fields will still be valid even when an alarm specified by CMD_ALM occurs.

Table 2.9.2.1 shows the bit allocation of input signal.

Table 2.9.2.1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved				N-OT	P-OT	DEC	Reserved
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
ZPOINT	PSET	NEAR	DEN	N-SOT	P-SOT	BRK_ON	Reserved
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Reserved				ZSPD	Reserved	V_LIM	Reserved
Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
I8	I7	I6	I5	I4	I3	I2	I1

Table 2.9.2.2 shows the details of the input signals.

Table 2.9.2.2

Bit	Name	Contents	Value	Setting
1	DEC	Limit switch for deceleration during zero point return operation	0	OFF
			1	ON
	This bit is used to indicate the state of limit switch for deceleration during zero point return operation.			
2	P_OT	Forward hardware limit	0	OFF
			1	ON
	Overtravel (OT) is a function that forcibly stops a movable machine unit if it moves beyond its allowable range of movement. P_OT is used to indicate if the movement of a movable machine unit is in prohibited state in forward direction or not. The OT stop judgment is made based on ZSPD.			
3	N_OT	Reverse hardware limit	0	OFF
			1	ON
	Overtravel (OT) is a function that forcibly stops a movable machine unit if it moves beyond its allowable range of movement. N_OT is used to indicate if the movement of a movable machine unit is in prohibited state in reverse direction or not. The OT stop judgment is made based on ZSPD.			
9	BRK_ON	Brake application	0	Brake is released
			1	Brake is applied
	The holding brake is used in application where servo drive controls the vertical axis. This bit is used to indicate the state of holding brake.			

Bit	Name	Contents	Value	Setting
10	P_SOT	Forward software limit	0	Normal status
			1	Software limit is activated
	Software limit forcibly stops a movable machine unit if it moves beyond the software limit range. The function is the same as overtravel function. Software limit can be used with or without P_OT or N_OT (overtravel signal). This bit is used to indicate if a movable machine unit reaches forward software limit (common parameter 26).			
11	N_SOT	Reverse software limit	0	Normal status
			1	Software limit is activated
	Software limit forcibly stops a movable machine unit if it moves beyond the software limit range. The function is the same as overtravel function. Software limit can be used with or without P_OT or N_OT (overtravel signal). This bit is used to indicate if a movable machine unit reaches reverse software limit (common parameter 28).			
12	DEN	Distribution completed (position mode)	0	During distribution
			1	Distribution is completed
	This bit is used to indicate if the reference position sent from the servo drive is completed. This input signal is only valid in position mode.			
13	NEAR	Near position (position mode)	0	Outside the near-position range
			1	Within the near-position range
	This bit is used to indicate if the current position is within the near-position range (common parameter 67). This input signal is only valid in position mode.			
14	PSET	Positioning completed (position mode)	0	Outside the positioning completion range
			1	Within the positioning completion range
	This bit is used to indicate if the current position is within the in-position range (common parameter 66). This input signal is only valid in position mode.			
15	ZPOINT	Zero point	0	Outside the zero point range
			1	Within the zero point range
	This bit is used to indicate if the current position is within the zero point detection range (common parameter 8B).			
17	V_LIM	Speed limit (torque mode)	0	Speed limit is not detected
			1	Speed limit is detected
	This bit is used to indicate if the speed is clamped at the limit value specified in the command. This input signal is only valid in torque mode.			
19	ZSPD	Zero Speed (velocity mode)	0	Zero speed is not detected
			1	Zero speed is detected
	This bit is used to indicate if the current speed is within the zero speed detection range (common parameter 8E).			
24 - 31	I1 to I8	Input signal monitoring	0	OFF
			1	ON
	Monitoring input signal I1 to I8.			

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3. Details of commands

3.1 Common commands

3.1.1 No operation (NOP: 00h)

The current state is returned to response field.

- Data format

Table 3.1.1.1

Byte	Command	Response
0	NOP (00h)	NOP (00h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 31	Reserved	Reserved

- Command description

Table 3.1.1.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = NOP (00h) and CMD_STAT.CMDRDY = 1.
Alarm Description	N/A

3.1.2 Read ID (ID_RD: 03h)

ID_RD command is used to read the information of the slave. The slave information to be read can be specified by ID_CODE.

- Data format

Table 3.1.2.1

Byte	Command	Response
0	ID_RD (03h)	ID_RD (03h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4	ID_CODE	ID_CODE
5	OFFSET	OFFSET
6 – 7	SIZE	SIZE
8 – 31	Reserved	ID

- Command description

Table 3.1.2.2

Command Classification	Common command Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = ID_RD (03h), CMD_STAT.CMDRDY = 1, and ID_CODE, OFFSET and SIZE in response field.
Command Parameter	● ID_CODE Selection code of ID data ● OFFSET Offset of ID reading ● SIZE Data size (bytes)
Alarm Description	● When ID_CODE data is invalid, CMD_ALM = 9 hex. ● When OFFSET data is invalid or SIZE data does not match, CMD_ALM = 9 hex.

- Details of ID_CODE

  Details of ID_CODE are given in table 3.1.2.3.

Table 3.1.2.3

ID_CODE	Contents	Data Size	Data Type
01h	Vendor ID code	4 bytes	Binary data
	Value: 00000A8Dh An ID code used to indicate the vendor		
02h	Device code	4 bytes	Binary data
	Value: 151A0001h Code used to indicate each device		
03h	Device version	4 bytes	Binary data
	Value: 0 Version information of device		
04h	Device information file version	4 bytes	Binary data
	Set MDI version. Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 Revision No. Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 Major version | Minor version ● Major version: When there are major changes to the MDI associated with function additions and function changes, such as addition of profile ● Minor version: When there are changes to the MDI associated with minor function additions and function changes ● Revision No.: The returned value will normally be 0. Bit 16 to 31 are reserved.		
05h	Extended address setting	4 bytes	Binary data
	The value is always 1 in D-series servo drives. The number of extended addresses		
10h	Profile type 1 (primary)	4 bytes	Binary data
	Value: 00000010h Profile type (primary) that the device supports		
11h	Profile version 1 (primary)	4 bytes	Binary data
	Value: 00000100h Profile version (primary) that the device supports		
12h	Profile type 2	4 bytes	Binary data
	Value: 000000FFh (This code means the function is not supported.) D-series servo drives only support one profile.		
13h	Profile version 2	4 bytes	Binary data
	Value: 00000000h		
14h	Profile type 3	4 bytes	Binary data
	Value: 000000FFh (This code means the function is not supported.) D-series servo drives only support one profile.		

<table>
<tr><th>ID_CODE</th><th>Contents</th><th>Data Size</th><th>Data Type</th></tr>
<tr><td rowspan="2">15h</td><td>Profile version 3</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 00000000h</td></tr>
<tr><td rowspan="2">16h</td><td>Minimum value of transmission cycle</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 50000 [unit: 0.01 µs] (0.5 ms)
The minimum value of transmission cycle that the device supports</td></tr>
<tr><td rowspan="2">17h</td><td>Maximum value of transmission cycle</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 400000 [unit: 0.01 µs] (4 ms)
The maximum value of transmission cycle that the device supports</td></tr>
<tr><td rowspan="2">18h</td><td>Transmission cycle increment (Granularity)</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 00000002h
The increment of transmission cycle that D-series servo drives support
Four levels of transmission cycle increments are provided.
00h: 31.25, 62.5, 125, 250, 500 (µs), and 2 to 64 (ms)
(2 ms increment)
01h: 31.25, 62.5, 125, 250, 500 (µs), and 1 to 64 (ms)
(1 ms increment)
02h: 31.25, 62.5, 125, 250, 500 (µs), and 1 to 64 (ms)
(0.5 ms increment)
03h: 31.25, 62.5, 125, 250, 500, 750 (µs), and 1 to 64 (ms)
(0.5 ms increment)</td></tr>
<tr><td rowspan="2">19h</td><td>Minimum value of communication cycle</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 50000 [unit: 0.01 µs] (0.5 ms)
The minimum value of communication cycle that the device supports</td></tr>
<tr><td rowspan="2">1Ah</td><td>Maximum value of communication cycle</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 3200000 [unit: 0.01 µs] (32 ms)
The maximum value of communication cycle that the device supports</td></tr>
<tr><td rowspan="2">1Bh</td><td>Number of transmission bytes</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">The number of transmission bytes that the device supports
Bytes which can be transmitted are indicated by the following bits. (0: Not supported, 1: Supported)
<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td colspan="3">Reserved</td><td>64 bytes</td><td>48 bytes</td><td>32 bytes</td><td>16 bytes</td><td>8 bytes</td></tr>
<tr><td colspan="3">0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
</table>
Bit 8 to 31 are reserved.</td></tr>
<tr><td rowspan="2">1Ch</td><td>Number of transmission bytes (current setting)</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">The number of transmission bytes for cyclic communication
The mark “*“ will be set to 1 to show current setting. Bytes which can be transmitted are indicated by the following bits.
<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td colspan="3">Reserved</td><td>64 bytes</td><td>48 bytes</td><td>32 bytes</td><td>16 bytes</td><td>8 bytes</td></tr>
<tr><td colspan="3">0</td><td>0</td><td>*</td><td>*</td><td>0</td><td>0</td></tr>
</table>
Bit 8 to 31 are reserved.</td></tr>
<tr><td rowspan="2">1Dh</td><td>Profile type (current setting)</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 00000010h
This is the profile selected by CONNECT command.</td></tr>
</table>

<table>
<tr><th>ID_CODE</th><th>Contents</th><th>Data Size</th><th>Data Type</th></tr>
<tr><td rowspan="2">20h</td><td>Supported communication mode</td><td>4 bytes</td><td>Binary data</td></tr>
<tr><td colspan="3">Value: 00000003h (cyclic communication and event-driven communication)
The communication modes that the device supports</td></tr>
<tr><td rowspan="2">30h</td><td>List of supported main commands</td><td>32 bytes</td><td>Array</td></tr>
<tr><td colspan="3">
The list of main commands that D-series servo drives support
The commands are allocated as below.
● Details of data
Bit 0 to 255: 0: The command is not supported. 1: The command is supported.
<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Reserved</td><td>ALM_CLR</td><td>ALR_RD</td><td>CONFIG</td><td>ID_RD</td><td>PRM_WR</td><td>PRM_RD</td><td>NOP</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table>
<table>
<tr><th>Bit 15</th><th>Bit 14</th><th>Bit 13</th><th>Bit 12</th><th>Bit 11</th><th>Bit 10</th><th>Bit 9</th><th>Bit 8</th></tr>
<tr><td>DISCONNECT</td><td>CONNECT</td><td>SYNC_SET</td><td colspan="5">Reserved</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td colspan="5">0</td></tr>
</table>
Bit 16 to 23 are reserved.
<table>
<tr><th>Bit 31</th><th>Bit 30</th><th>Bit 29</th><th>Bit 28</th><th>Bit 27</th><th>Bit 26</th><th>Bit 25</th><th>Bit 24</th></tr>
<tr><td>Reserved</td><td>MEM_WR</td><td>MEM_RD</td><td>PPRM_WR</td><td>PPRM_RD</td><td colspan="3">Reserved</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td colspan="3">0</td></tr>
</table>
<table>
<tr><th>Bit 39</th><th>Bit 38</th><th>Bit 37</th><th>Bit 36</th><th>Bit 35</th><th>Bit 34</th><th>Bit 33</th><th>Bit 32</th></tr>
<tr><td colspan="3">Reserved</td><td>SENS_OFF</td><td>SENS_ON</td><td>BRK_OFF</td><td>BRK_ON</td><td>POS_SET</td></tr>
<tr><td colspan="3">0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
Bit 40 to 47 are reserved.
<table>
<tr><th>Bit 55</th><th>Bit 54</th><th>Bit 53</th><th>Bit 52</th><th>Bit 51</th><th>Bit 50</th><th>Bit 49</th><th>Bit 48</th></tr>
<tr><td>EX_FEED</td><td>FEED</td><td>POSING</td><td>INTERPOLATE</td><td>Reserved</td><td>SV_OFF</td><td>SV_ON</td><td>SMON</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
</table>
<table>
<tr><th>Bit 63</th><th>Bit 62</th><th>Bit 61</th><th>Bit 60</th><th>Bit 59</th><th>Bit 58</th><th>Bit 57</th><th>Bit 56</th></tr>
<tr><td colspan="2">Reserved</td><td>TRQCTRL</td><td>VELCTRL</td><td>Reserved</td><td>ZRET</td><td>EX_POSING</td><td>Reserved</td></tr>
<tr><td colspan="2">0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><th>Bit 71</th><th>Bit 70</th><th>Bit 69</th><th>Bit 68</th><th>Bit 67</th><th>Bit 66</th><th>Bit 65</th><th>Bit 64</th></tr>
<tr><td colspan="6">Reserved</td><td>SVPRM_WR</td><td>SVPRM_RD</td></tr>
<tr><td colspan="6">0</td><td>1</td><td>1</td></tr>
</table>
Bit 72 to 255 are reserved.
</td></tr>
</table>

<table>
<tr><th>ID_CODE</th><th>Contents</th><th>Data Size</th><th>Data Type</th></tr>
<tr><td rowspan="2">38H</td><td>List of supported subcommands</td><td>32 bytes</td><td>Array</td></tr>
<tr><td colspan="3">
The list of subcommands that the device supports
The commands are allocated as below.
● Details of data
Bit 0 to 255: 0: The command is not supported. 1: The command is supported.
<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Reserved</td><td>ALM_ CLR</td><td>ALM_ RD</td><td colspan="2">Reserved</td><td>PRM_ WR</td><td>PRM_ RD</td><td>NOP</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td colspan="2">0</td><td>0</td><td>0</td><td>1</td></tr>
</table>
Bit 8 to 23 are reserved.
<table>
<tr><th>Bit 31</th><th>Bit 30</th><th>Bit 29</th><th>Bit 28</th><th>Bit 27</th><th>Bit 26</th><th>Bit 25</th><th>Bit 24</th></tr>
<tr><td>Reserved</td><td>MEM_ WR</td><td>MEM_ RD</td><td>PPRM_ WR</td><td>PPRM_ RD</td><td colspan="3">Reserved</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td colspan="3">0</td></tr>
</table>
Bit 32 to 47 are reserved.
<table>
<tr><th>Bit 55</th><th>Bit 54</th><th>Bit 53</th><th>Bit 52</th><th>Bit 51</th><th>Bit 50</th><th>Bit 49</th><th>Bit 48</th></tr>
<tr><td colspan="7">Reserved</td><td>SMON</td></tr>
<tr><td colspan="7">0</td><td>1</td></tr>
</table>
Bit 56 to 63 are reserved.
<table>
<tr><th>Bit 71</th><th>Bit 70</th><th>Bit 69</th><th>Bit 68</th><th>Bit 67</th><th>Bit 66</th><th>Bit 65</th><th>Bit 64</th></tr>
<tr><td colspan="6">Reserved</td><td>SVPRM_ WR</td><td>SVPRM_ RD</td></tr>
<tr><td colspan="6">0</td><td>1</td><td>1</td></tr>
</table>
Bit 72 to 255 are reserved.
</td></tr>
<tr><td rowspan="2">40h</td><td>List of supported common parameters</td><td>32 bytes</td><td>Array</td></tr>
<tr><td colspan="3">
The list of common parameters that the device supports
The common parameters are allocated as below.
● Details of data
Bit 0 to 255: 0: The common parameter is not supported. 1: The common parameter is supported.
<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>07</td><td>06</td><td>05</td><td>04</td><td>03</td><td>02</td><td>01</td><td>Reserved</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><th>Bit 15</th><th>Bit 14</th><th>Bit 13</th><th>Bit 12</th><th>Bit 11</th><th>Bit 10</th><th>Bit 9</th><th>Bit 8</th></tr>
<tr><td colspan="3">Reserved</td><td>0C</td><td>0B</td><td>0A</td><td>09</td><td>08</td></tr>
<tr><td colspan="3">0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
Bit 16 to 31 are reserved.
<table>
<tr><th>Bit39</th><th>Bit38</th><th>Bit37</th><th>Bit36</th><th>Bit 35</th><th>Bit 34</th><th>Bit 33</th><th>Bit 32</th></tr>
<tr><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>Reserved</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><th>Bit 47</th><th>Bit 46</th><th>Bit 45</th><th>Bit 44</th><th>Bit 43</th><th>Bit 42</th><th>Bit 41</th><th>Bit 40</th></tr>
<tr><td colspan="6">Reserved</td><td>29</td><td>28</td></tr>
<tr><td colspan="6">0</td><td>0</td><td>1</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID_CODE</th><th>Contents</th><th>Data Size</th><th>Data Type</th></tr>
<tr><td>40h</td><td>
Bit 48 to 63 are reserved.
<table>
<tr><td>Bit 71</td><td>Bit 70</td><td>Bit 69</td><td>Bit 68</td><td>Bit 67</td><td>Bit 66</td><td>Bit 65</td><td>Bit 64</td></tr>
<tr><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>Reserved</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><td>Bit 79</td><td>Bit 78</td><td>Bit 77</td><td>Bit 76</td><td>Bit 75</td><td>Bit 74</td><td>Bit 73</td><td>Bit 72</td></tr>
<tr><td colspan="6">Reserved</td><td>49</td><td>48</td></tr>
<tr><td colspan="6">0</td><td>1</td><td>1</td></tr>
</table>
Bit 80 to 95 are reserved.
<table>
<tr><td>Bit 103</td><td>Bit 102</td><td>Bit 101</td><td>Bit 100</td><td>Bit 99</td><td>Bit 98</td><td>Bit 97</td><td>Bit 96</td></tr>
<tr><td>67</td><td>66</td><td>65</td><td>64</td><td>63</td><td>62</td><td>61</td><td>Reserved</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Bit 104 to 127 are reserved.
<table>
<tr><td>Bit 135</td><td>Bit 134</td><td>Bit 133</td><td>Bit 132</td><td>Bit 131</td><td>Bit 130</td><td>Bit 129</td><td>Bit 128</td></tr>
<tr><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td><td>Reserved</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
</table>
<table>
<tr><td>Bit 143</td><td>Bit 142</td><td>Bit 141</td><td>Bit 140</td><td>Bit 139</td><td>Bit 138</td><td>Bit 137</td><td>Bit 136</td></tr>
<tr><td>8F</td><td>8E</td><td>8D</td><td>8C</td><td>8B</td><td>8A</td><td>89</td><td>88</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
<table>
<tr><td>Bit 151</td><td>Bit 150</td><td>Bit 149</td><td>Bit 148</td><td>Bit 147</td><td>Bit 146</td><td>Bit 145</td><td>Bit 144</td></tr>
<tr><td colspan="4">Reserved</td><td>93</td><td>92</td><td>91</td><td>90</td></tr>
<tr><td colspan="4">0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
Bit 152 to 255 are reserved.
</td><td></td><td></td></tr>
<tr><td rowspan="2">80h</td><td>Main device name</td><td>32 bytes</td><td>ASCII Code</td></tr>
<tr><td colspan="3">The main device name
Example: D1-N
Note: To identify the device, please use device code (02h) instead of this ID_CODE.</td></tr>
<tr><td rowspan="2">90h</td><td>Sub-device name 1</td><td>32 bytes</td><td>ASCII Code</td></tr>
<tr><td colspan="3">Motor model</td></tr>
<tr><td rowspan="2">A0h</td><td>Sub-device name 2</td><td>32 bytes</td><td>ASCII Code</td></tr>
<tr><td colspan="3">Motor encoder model</td></tr>
</table>

3.1.3 Device setup (CONFIG: 04h)

This command is used to set up devices.

- Data format

Table 3.1.3.1

Byte	Command	Response
0	CONFIG (04h)	CONFIG (04h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4	CONFIG_MOD	CONFIG_MOD
5 – 31	Reserved	Reserved

- Command description

Table 3.1.3.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = CONFIG (04h), CMD_STAT.CMDRDY = 1, and CONFIG_MOD in response field.
Command Parameter	● CONFIG_MOD 0: Recalculating and setting up parameters. Other: Not supported (CMD_ALM = 9)
Alarm Description	● When CONFIG_MOD data is invalid, CMD_ALM = 9h. ● When this command is used in servo-on state, CMD_ALM = Ah.

- State of each status during CONFIG command execution

Table 3.1.3.3

Status	Before CONFIG command is executed	During command execution	After CONFIG command is executed
ALM	Current state	Current state	Current state
CMDRDY	1	0	1
Other statuses	Current state	Undefined	Current state

3.1.4 Read alarm or warning (ALM_RD: 05h)

ALM_RD command is used to read alarm or warning state. The current alarm or warning state can be read in ALM_DATA fields.

■ Data format

Table 3.1.4.1

Byte	Command	Response
0	ALM_RD (05h)	ALM_RD (05h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 5	ALM_RD_MOD	ALM_RD_MOD
6 – 7	ALM_INDEX	ALM_INDEX
8 – 31	Reserved	ALM_DATA

Note:

(1) In ALM_DATA fields, an alarm is indicated by 2 bytes.

(2) The alarm arrangement in alarm history is in the order of occurrence. The first alarm is the latest alarm.

(3) In normal state, ALM_DATA is 0.

(4) ALM_INDEX cannot be used. Settings in ALM_INDEX fields will be ignored.

■ Command description

Table 3.1.4.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = ALM_RD (05h), CMD_STAT.CMDRDY = 1, and ALM_RD_MOD and ALM_INDEX in response field.
Command Parameter	● ALM_RD_MOD 0: Reads current alarm or warning state. 1: Reads alarm history. ● ALM_DATA Stores alarm codes or warning codes.
Alarm Description	● When ALM_RD_MOD data is invalid, CMD_ALM = 9 hex.

- Data format of ALM_DATA

  For D-series servo drives, alarm codes are defined as below.

Table 3.1.4.3

Bit 12 - 15	Bit 8 - 11	Bit 0 - 7
Alarm/Warning remark	Alarm type	Alarm code
0h: Alarm 1h: Warning	0h: Drive error/warning	00h to FFh: Drive error/warning code
	4h: COMM_ALM	01h to 0Fh: Refer to section 2.5.4 for CMD_ALM code and COMM_ALM code
	5h: CMD_ALM	
	6h: SUBCMD_ALM	

3.1.5 Clear alarm or warning (ALM_CLR: 06h)

ALM_CLR command is used to clear alarm or warning state. It changes the state of the slave, but does not eliminate the cause of the alarm or warning. ALM_CLR command should be used to clear the alarm or warning state after the cause of the alarm or warning has been eliminated.

When a communication error (reception error) or synchronous communication error (watchdog data error) occurs during synchronous communication, after ALM_CLR command is executed, please use SYNC_SET command to recover synchronous communication.

- Data format

Table 3.1.5.1

Byte	Command	Response
0	ALM_CLR (06h)	ALM_CLR (06h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 5	ALM_CLR_MOD	ALM_CLR_MOD
6 – 31	Reserved	Reserved

- Command description

Table 3.1.5.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = ALM_CLR (06h), CMD_STAT.CMDRDY = 1, and ALM_CLR_MOD in response field.
Command Parameter	● ALM_CLR_MODE 0: Clears current alarm or warning state. 1: Clears alarm history.
Alarm Description	● When ALM_CLR_MOD data is invalid, CMD_ALM = 9 hex.

3.1.6 Start synchronous communication (SYNC_SET: 0Dh)

SYNC_SET command is used to start synchronous communication. The system will be in synchronous communication mode when the execution of this command is completed. This command can also be used to recover synchronous communication. For example, use this command to change the system from asynchronous communication mode to synchronous communication mode after communication error occurs. During the execution of this command, synchronous communication is established according to the transition of watchdog timer (WDT). The master will maintain this command until the processing has been completed. Watchdog data error detection starts after this command has been completed.

- Data format

Table 3.1.6.1

Byte	Command	Response
0	SYNC_SET (0Dh)	SYNC_SET (0Dh)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 31	Reserved	Reserved

- Command description

Table 3.1.6.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SYNC_SET (0Dh) and CMD_STAT.CMDRDY = 1.
Alarm Description	N/A

3.1.7 Establish connection (CONNECT: 0Eh)

CONNECT command is used to establish MECHATROLINK connection. After the command has been completed, slaves can be controlled via MECHATROLINK communication.

- Data format

Table 3.1.7.1

Byte	Command	Response
0	CONNECT (0Eh)	CONNECT (0Eh)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4	VER	VER
5	COM_MOD	COM_MOD
6	COM_TIM	COM_TIM
7	PROFILE_TYPE	PROFILE_TYPE
8 – 31	Reserved	Reserved

- Command description

Table 3.1.7.2

<table>
<tr><td rowspan="2">Command Classification</td><td>Common command</td></tr>
<tr><td>Asynchronous command</td></tr>
<tr><td>Confirmation Method of Command Completion</td><td>Confirm the command is successfully executed by checking RCMD = CONNECT (0Eh), CMD_STAT.CMDRDY = 1, and VER, COM_MODE, COM_TIME, and PROFILE_TYPE in response field.</td></tr>
<tr><td>Command Parameter</td><td>

VER: Version of MECHATROLINK application layer
VER = 30h
COM_MOD: Communication mode

<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>SUBCMD</td><td colspan="3">0</td><td colspan="2">DTMODE</td><td>SYNCMODE</td><td>0</td></tr>
</table>

SYNCMODE: Synchronization setting

1: Perform synchronous communication.
(Watchdog data error detection is enabled. Synchronous commands can be used.)
0: Perform asynchronous communication.
(Watchdog data error detection is disabled. Synchronous commands cannot be used.)
</td></tr>
</table>

Command Parameter	● DTMODE: Data transfer method 00: Single transmission 01: Reserved 10: Reserved 11: Reserved ● SUBCMD: Subcommand setting 0: Subcommand is disabled. 1: Subcommand is enabled. ● COM_TIM: Communication cycle setting COM_TIM = Communication cycle/Transmission cycle Example: The transmission cycle is 0.5 [ms] and the communication cycle is 2 [ms]. COM_TIM = 2/0.5 = 4 ● PROFILE_TYPE: Profile type setting 10h: Standard servo profile command
Alarm Description	● When VER data is invalid, CMD_ALM = 9 hex. ● When COM_TIM data is invalid, CMD_ALM = 9 hex. ● When PROFILE_TYPE data is invalid, CMD_ALM = 9 hex. ● When the number of transmission bytes is 32, but SUBCMD = 1, CMD_ALM=9 hex.

3.1.8 Release connection (DISCONNECT: 0Fh)

The master sends DISCONNECT command for two or more communication cycles to release a connection. At this time, the slave interrupts the processing of current command and then initializes to wait for the connection establishment request from the master.

DISCONNECT command can be sent regardless of the state of CMD_STAT.CMDRDY. If DISCONNECT command is sent when CMD_STAT.CMDRDY is 0, the processing of current command is interrupted and DISCONNECT command is executed.

- Data format

Table 3.1.8.1

Byte	Command	Response
0	DISCONNECT (0Fh)	DISCONNECT (0Fh)
1 – 31	Reserved	Reserved

- Command description

Table 3.1.8.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm DISCONNECT command has been sent for two or more communication cycles.
Alarm Description	N/A

Note:
When DISCONNECT command is received, the following operation is performed.
(1) Communication phase changes to phase 1.
(2) Slaves are servo-off.
If control power is turned off at the same time when DISCONNECT command is sent, the reliability of the data in response field is not guaranteed.

3.1.9 Read memory (MEM_RD: 1Dh)

MEM_RD command is used to read the data stored in virtual memory by specifying the initial address and data size.

- Data format

Table 3.1.9.1

Byte	Command	Response
0	MEM_RD (1Dh)	MEM_RD (1Dh)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4	Reserved	Reserved
5	MODE/ DATA_TYPE	MODE/ DATA_TYPE
6 – 7	SIZE	SIZE
8 – 11	ADDRESS	ADDRESS
12 – 31	Reserved	DATA

- Command description

Table 3.1.9.2

<table>
<tr><td rowspan="2">Command Classification</td><td>Common command</td></tr>
<tr><td>Asynchronous command</td></tr>
<tr><td>Processing Time</td><td>Within 2 ms</td></tr>
<tr><td>Confirmation Method of Command Completion</td><td>Confirm the command is successfully executed by checking RCMD = MEM_RD (1Dh), CMD_STAT.CMDRDY = 1, and ADDRESS and SIZE in response field.</td></tr>
<tr><td>Command Parameter</td><td>
● MODE/DATA_TYPE
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td colspan="4">MODE</td><td colspan="4">DATA_TYPE</td></tr>
</table>
MODE
1: Volatile memory, 2: Not supported
DATA_TYPE
1: Byte, 2: Short, 3: Long, 4: Not supported
● SIZE
Data size to be read
● ADDRESS
Initial address to be read
● DATA
Data
</td></tr>
<tr><td>Alarm Description</td><td>● When ADDRESS data is invalid, CMD_ALM = 9 hex.
● When MODE/DATA_TYPE data is invalid, CMD_ALM = 9 hex.
● When SIZE data is invalid, CMD_ALM = 9 hex.</td></tr>
</table>

3.2 Servo commands

3.2.1 Apply brake (BRK_ON: 21h)

BRK_ON command is used to output brake operation signal. This command is only valid in servo-off state.

- Data format

Table 3.2.1.1

Byte	Command	Response
0	BRK_ON (21h)	BRK_ON (21h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.1.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = BRK_ON (21H) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.2 Release brake (BRK_OFF: 22h)

BRK_OFF command is used to cancel brake operation signal. This command is only valid in servo-off state.

- Data format

Table 3.2.2.1

Byte	Command	Response
0	BRK_OFF (22h)	BRK_OFF (22h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.2.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SENS_ON (23H) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.3 Turn sensor ON (SENS_ON: 23h)

SENS_ON command is used to request for sensor initialization. After this command is executed, when an absolute encoder is used, the initial position is acquired from the encoder. The current position will be: initial position acquired from the encoder + absolute encoder origin offset (common parameter 23). The coordinate reference point setting, ZPOINT (zero point position) and software limit are valid. When an incremental encoder is used, only a response is returned without processing.

- Data format

Table 3.2.3.1

Byte	Command	Response
0	SENS_ON (23h)	SENS_ON (23h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.3.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SENS_ON (23H) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.4 Turn sensor OFF (SENS_OFF: 24h)

SENS_OFF command is used to turn off the power supplied to the sensor. After this command is executed, when an absolute encoder is used, the reliability of position data is not guaranteed and POS_RDY changes to 0. The coordinate reference point setting, ZPOINT (zero point position) and software limit are invalid. When an incremental encoder is used, only a response is returned without processing.

- Data format

Table 3.2.4.1

Byte	Command	Response
0	SENS_OFF (24h)	SENS_OFF (24h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.4.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SENS_ON (23H) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.5 Servo status monitor (SMON: 30H)

SMON command is used to read alarm, status, monitoring information (position, speed, torque, etc.) specified in monitoring setting, and the state of I/O signal.

- Data format

Table 3.2.5.1

Byte	Command	Response
0	SMON (30h)	SMON (30h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.5.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SMON (30H) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.6 Servo ON (SV_ON: 31h)

SV_ON command is used to request for servo on (motor energization).

- Data format

Table 3.2.6.1

Byte	Command	Response
0	SV_ON (31h)	SV_ON (31h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.6.2

Command Classification	Standard servo command
	Asynchronous command
Processing Time	Normally within 10 ms (Max. 5 s) Note: For the first time of servo on, the processing time could be more than 150 ms. It may vary with motor and encoder types.
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SV_ON (31h), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.SV_ON = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	In the following cases, A hex will be set for CMD_ALM and the command will not be executed: ● When an alarm (COM_ALM = 8 hex or greater, or D_ALM = 1) has occurred. ● When PON = 0. ● When an absolute encoder is used, but the execution of SENS_ON command is not completed.

3.2.7 Servo OFF (SV_OFF: 32h)

SV_OFF command is used to request for servo off (stop motor energization).

- Data format

Table 3.2.7.1

Byte	Command	Response
0	SV_OFF (32h)	SV_OFF (32h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19		CPRM_SEL_MON2
20 – 23		MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.7.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SV_OFF (32h), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.SV_ON = 0.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
Alarm Description	● N/A

3.2.8 Interpolation (INTERPOLATE: 34h)

INTERPOLATE command is used to perform interpolation feeding at the specified interpolation position every communication cycle.

- Data format

Table 3.2.8.1

Byte	Command	Response
0	INTERPOLATE (34h)	INTERPOLATE (34h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	TPOS	CPRM_SEL_MON1
16 – 19	VFF	CPRM_SEL_MON2
20 – 23	TFF	MONITOR1
24 – 27	Reserved	MONITOR2
28 – 31	TLIM	MONITOR3

- Command description

Table 3.2.8.2

Command Classification	Standard servo command
	Synchronous command
Confirmation Method of Command Completion	(1) Confirm the command is successfully executed by checking RCMD = INTERPOLATE (34h) and CMD_STAT.CMDRDY = 1. (2) Confirm the output of reference position is completed by checking SVCMD_IO.DEN = 1, and the completion of positioning by checking SVCMD_IO.PSET = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● TPOS (target position): Set with a signed value. ● VFF (velocity feedforward): Set with a signed value. This value will be cleared when another command is executed. ● TFF (torque feedforward): Set with a signed value. This value will be cleared when another command is executed. ● TLIM (torque limit): Set with an unsigned value.

Alarm Description	In the following cases, an alarm will occur and the command will not be executed: ● When the command is used in communication phase 2, CMD_ALM = C hex. ● When the command is used in servo-off state, CMD_ALM = A hex. ● When the difference to the previous TPOS exceeds the limit value, CMD_ALM = 9 hex. In the following cases, an alarm will occur and the relevant value will be clamped at the limit value: ● When VFF data is invalid, CMD_ALM = 1 hex. ● When TFF data is invalid, CMD_ALM = 1 hex.

3.2.9 Positioning (POSING: 35h)

POSING command is used to position to the target position (P1) at the positioning speed. To pause positioning, set SVCMD_CTRL.CMD_PAUSE to 1.

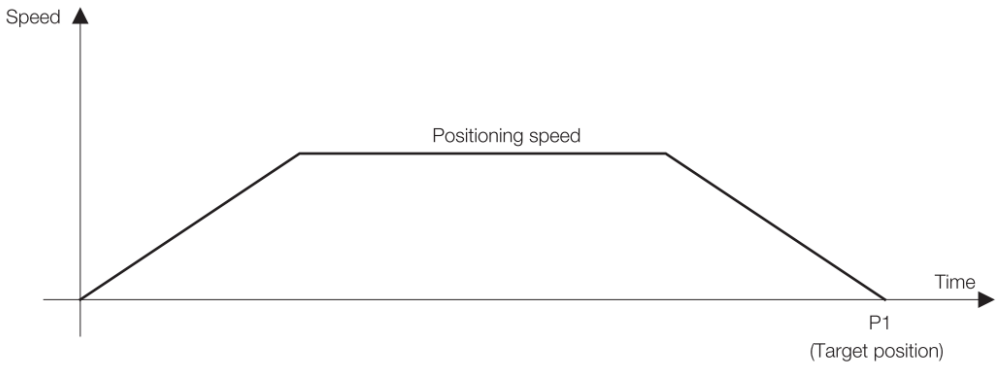

Figure 3.2.9.1

■ Data format

Table 3.2.9.1

Byte	Command	Response
0	POSING (35h)	POSING (35h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	TPOS	CPRM_SEL_MON1
16 – 19	TSPD	CPRM_SEL_MON2
20 – 23	ACCR	MONITOR1
24 – 27	DECR	MONITOR2
28 – 31	TLIM	MONITOR3

■ Command description

Table 3.2.9.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	(1) Confirm the command is successfully executed by checking RCMD = POSING (= 35 hex) and CMD_STAT.CMDRDY = 1. (2) Confirm the output of reference position is completed by checking SVCMD_IO.DEN = 1, and the completion of positioning by checking SVCMD_IO.PSET = 1. (3) Confirm the completion of canceling the command by checking RCMD = POSING (= 35 hex), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_CANCEL_CMP = 1. (4) Confirm the completion of pausing the command by checking RCMD = POSING (= 35 hex), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_PAUSE_CMP = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● TPOS (target position): Set with a signed value. ● TSPD (target speed): Set with an unsigned value. ● ACCR (acceleration): Set with an unsigned value. ● DECR (deceleration): Set with an unsigned value. ● TLIM (torque limit): Set with an unsigned value. When torque limit is not used, set the maximum allowable value. Refer to section 3.2.17 for further information of above command parameters. Refer to section 5.2 for units of above command parameters.
Alarm Description	In the following cases, an alarm will occur and the command will not be executed: ● When the command is used in servo-off state, CMD_ALM = A hex. ● When TSPD data is invalid, CMD_ALM = 9 hex. ● When ACCR or DECR data is invalid, CMD_ALM = 9 hex. If ACCR or DECR is 0, current acceleration or deceleration will be applied, and no alarm will occur. In the following case, an alarm will occur and the relevant value will be clamped at the limit value: ● When TLIM data is invalid, CMD_ALM = 1 hex.

■ Operation for smooth acceleration and deceleration

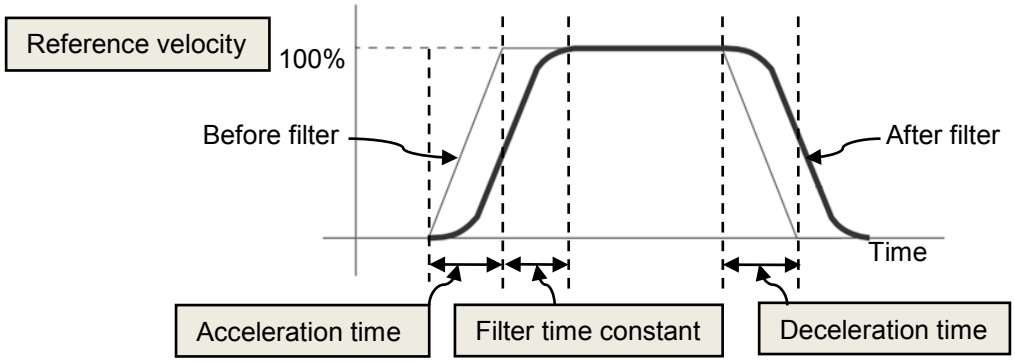

Figure 3.2.9.2

3.2.10 Feed (FEED: 36h)

FEED command is used to perform constant-speed feed at the specified feed speed. The speed and direction of feed can be changed by the setting of feed speed. To cancel constant-speed feed, set SVCMD_CTRL.CMD_CANCEL to 1, and to pause constant-speed feed, set SVCMD_CTRL.CMD_PAUSE to 1.

- Data format

Table 3.2.10.1

Byte	Command	Response
0	FEED (36h)	FEED (36h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	Reserved	CPRM_SEL_MON1
16 – 19	TSPD	CPRM_SEL_MON2
20 – 23	ACCR	MONITOR1
24 – 27	DECR	MONITOR2
28 – 31	TLIM	MONITOR3

- Command description

Table 3.2.10.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	(1) Confirm the completion of canceling the command by checking RCMD = FEED (= 36 hex), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_CANCEL_CMP = 1. (2) Confirm the output of reference position is completed by checking SVCMD_IO.DEN = 1, and the completion of positioning by checking SVCMD_IO.PSET = 1. (3) Confirm the completion of pausing the command by checking RCMD = FEED (= 36 hex), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_PAUSE_CMP = 1.

Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● TSPD (target speed): Set with a signed value. ● ACCR (acceleration): Set with an unsigned value. ● DECR (deceleration): Set with an unsigned value. ● TLIM (torque limit): Set with an unsigned value. When torque limit is not used, set the maximum allowable value. Refer to section 3.2.17 for further information of above command parameters. Refer to section 5.2 for units of above command parameters.
Alarm Description	In the following cases, an alarm will occur and the command will not be executed: ● When the command is used in servo-off state, CMD_ALM = A hex. ● When TSPD data is invalid, CMD_ALM = 9 hex. ● When ACCR or DECR data is invalid, CMD_ALM = 9 hex. ● If ACCR or DECR is 0, current acceleration or deceleration will be applied, and no alarm will occur. In the following case, an alarm will occur and the relevant value will be clamped at the limit value: ● When TLIM data is invalid, CMD_ALM = 1 hex.

■ Operation example of FEED command

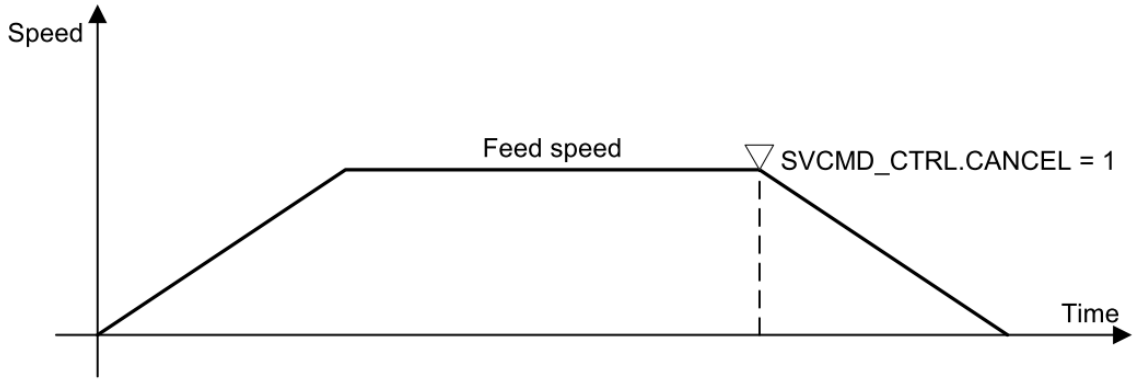

Figure 3.2.10.1

3.2.11 External input positioning (EX_POSING: 39h)

EX_POSING command performs positioning in response to the external positioning signal. To pause EX_POSING command, set SVCMD_CTRL.CMD_PAUSE to 1.

- Data format

Table 3.2.11.1

Byte	Command	Response
0	EX_POSING (39h)	EX_POSING (39h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	TPOS	CPRM_SEL_MON1
16 – 19	TSPD	CPRM_SEL_MON2
20 – 23	ACCR	MONITOR1
24 – 27	DECR	MONITOR2
28 – 31	TLIM	MONITOR3

- Command description

Table 3.2.11.2

Command Classification	Standard servo command Asynchronous command
Confirmation Method of Command Completion	(1) Confirm the command is successfully executed by checking RCMD = EX_POSING (39h) and CMD_STAT.CMDRDY = 1. (2) Confirm the completion of latch by checking SVCMD_IO.L_CMP1 = 1. (3) Confirm the output of reference position is completed by checking SVCMD_IO.DEN = 1, and the completion of positioning by checking SVCMD_IO.PSET = 1. (4) Confirm the completion of canceling the command by checking RCMD = EX_POSING (39h), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.CMD_CANCEL_CMP = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● TPOS (target position): Set with a signed value. ● TSPD (target speed): Set with an unsigned value. ● ACCR (acceleration): Set with an unsigned value. ● DECR (deceleration): Set with an unsigned value. ● TLIM (torque limit): Set with an unsigned value. When torque limit is not used, set the maximum allowable value. Refer to section 3.2.17 for further information of above command parameters. Refer to section 5.2 for units of above command parameters.

Alarm Description	In the following cases, an alarm will occur and the command will not be executed: ● When the command is used in servo-off state, CMD_ALM = A hex. ● When TSPD data is invalid, CMD_ALM = 9 hex. ● When ACCR or DECR data is invalid, CMD_ALM = 9 hex. If ACCR or DECR is 0, current acceleration or deceleration will be applied, and no alarm will occur. In the following case, an alarm will occur and the relevant value will be clamped at the limit value: ● When TLIM data is invalid, CMD_ALM = 1 hex.

■ Operating sequence

The following describes the operating sequence when using EX_POSING command.

1. The master sends EX_POSING command. Target position P1 is set in the target position field to be used as the positioning target if external positioning signal is not inputted. Select latch signal by LT_SEL1 of SVCMD_CTRL and send latch request by setting LT_REQ1 to 1.
2. The motor starts to move toward target position P1 at the specified speed when the slave receives EX_POSING command. At the same time, the slave enters external input positioning mode.
3. When external positioning signal is inputted, the slave sets latch completion status L_CMP1 to 1 to notify the master that latch has completed.
4. The slave calculates external input positioning target position P3 and the motor moves to external input positioning target P3.
   External input positioning target position P3 = Latched position P2 by external positioning signal + Final travel distance for external input positioning
5. After the motor moves to target position P3, the slave sets DEN (distribution completed) to 1 to notify the master the completion of reference position output.

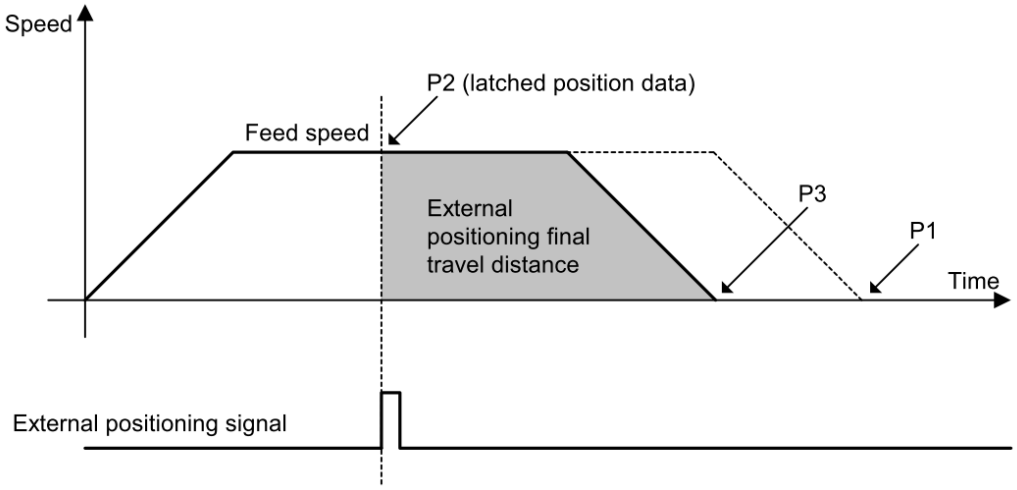

Figure 3.2.11.1

- Supplementary information

  Set SVCMD_CTRL.CMD_CANCEL to 1 to cancel EX_POSING command. The moving direction after latch is determined by the value set for final travel distance for external input positioning.

  (a) If the value set for final travel distance for external input positioning is positive:
  If the motor moves in positive direction when latch occurs, the motor will still move in positive direction (the same direction) for positioning after latch. If the motor moves in negative direction when latch occurs, the motor will move in positive direction (the reverse direction) for positioning after latch.

  (b) If the value set for final travel distance for external input positioning is negative:
  If the motor moves in positive direction when latch occurs, the motor will move in negative direction (the reverse direction) for positioning after latch. If the motor moves in negative direction when latch occurs, the motor will still move in negative direction (the same direction) for positioning after latch.

3.2.12 Zero point return command (ZRET: 3Ah)

ZRET command is used to perform zero point return operation by using zero point limit switch and position latch signal. The signal used to latch position is specified by latch signal selection. To pause zero point return operation, set SVCMD_CTRL.CMD_PAUSE to 1.

- Data format

Table 3.2.12.1

Byte	Command	Response
0	ZRET (3Ah)	ZRET (3Ah)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	MODE	CPRM_SEL_MON1
16 – 19	TSPD	CPRM_SEL_MON2
20 – 23	ACCR	MONITOR1
24 – 27	DECR	MONITOR2
28 – 31	TLIM	MONITOR3

- Command description

Table 3.2.12.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	(1) Confirm the command is successfully executed by checking RCMD = ZRET (3Ah) and CMD_STAT.CMDRDY = 1. (2) Confirm the completion of motion reference output by checking SVCMD_IO.DEN = 1, and the completion of positioning at the zero point by checking SVCMD_IO.ZPOINT (zero point position) = 1 and SVCMD_IO.PSET = 1. (3) Confirm the completion of canceling the command by checking RCMD = ZRET (3Ah), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_CANCEL_CMP = 1. (4) Confirm the completion of pausing the command by checking RCMD = ZRET (3Ah), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.CMD_PAUSE_CMP = 1.

<table>
<tr><td>Command Parameter</td><td>

CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88.
MODE: (Lower 1 byte)

<table>
<tr><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>HOME_DIR</td><td colspan="3">Reserved</td><td colspan="4">TYPE</td></tr>
</table>
(1) MODE.HOME_DIR (zero point return direction): Select zero point return direction.
MODE.HOME_DIR = 0: Positive direction
MODE.HOME_DIR = 1: Negative direction
(2) MODE.TYPE (zero point return type): Set zero point return type from the following patterns.
MODE.TYPE = 0: Latch signal
MODE.TYPE = 1: Deceleration limit switch + latch signal

TSPD (target speed): Set with an unsigned value.
ACCR (acceleration): Set with an unsigned value.
DECR (deceleration): Set with an unsigned value.
TLIM (torque limit): Set with an unsigned value.
When torque limit is not used, set the maximum allowable value.

Refer to section 3.2.17 for further information of above command parameters.
Refer to section 5.2 for units of above command parameters.
</td></tr>
<tr><td>Alarm Description</td><td>
In the following cases, an alarm will occur and the command will not be executed:

When the command is used in servo-off state, CMD_ALM = A hex.
When TSPD data is invalid, CMD_ALM = 9 hex.
When ACCR or DECR data is invalid, CMD_ALM = 9 hex.
If ACCR or DECR is 0, current acceleration or deceleration will be applied, and no alarm will occur.

In the following case, an alarm will occur and the relevant value will be clamped at the limit value:

When TLIM data is invalid, CMD_ALM = 1 hex.

</td></tr>
</table>

- Operation sequence

  The following describes the operating sequence of each zero point return mode.

1. MODE = 0 (Latch signal)
   (1) The C1 master sends ZRET command. Select latch signal[*1] with LT_SEL1 of SVCMD_CTRL and output latch request by setting LT_REQ1 = 1.
   (2) The slave starts feeding in the direction specified by MODE.HOME_DIR at the speed set by the parameter of “Approach Speed of Zero Point Return” (common parameter 84).
   (3) When the latch signal specified by LT_SEL1 of SVCMD_CTRL is input, the slave executes positioning by using the parameters of “Final Travel Distance for Zero Point Return” (common parameter 86) and “Creep Speed of Zero Point Return” (common parameter 85). After positioning completes, the slave sets current position as the zero point of the coordinates.

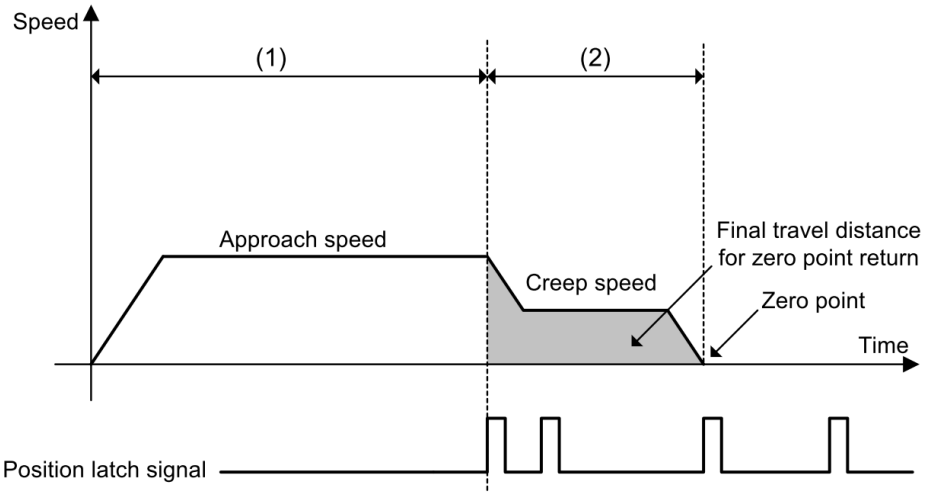

Figure 3.2.12.1 Zero point return sequence (MODE = 0)

2. MODE = 1 (Deceleration limit switch signal + latch signal)
   (1) The C1 master sends ZRET command. Select latch signal[*1] with LT_SEL1 of SVCMD_CTRL and output latch request by setting LT_REQ1 = 1.
   (2) The slave starts feeding in the direction specified by MODE.HOME_DIR at the speed set in the feed speed field.
   (3) When deceleration limit switch is closed (DEC = 1), the rapid speed is switched to the parameter of “Approach Speed of Zero Point Return” (common parameter 84).
   (4) When latch signal is input after deceleration limit switch is opened (DEC = 0), the slave executes positioning by using the parameters of “Final Travel Distance for Zero Point Return” (common parameter 86) and “Creep Speed of Zero Point Return” (common parameter 85). After positioning completes, the slave sets current position as the zero point of the coordinates.

Note:

[*1]Only Z phase signal is supported now. Set SVCMD_CTRL.LT_SEL1 to 0 to select Z phase signal as latch signal.

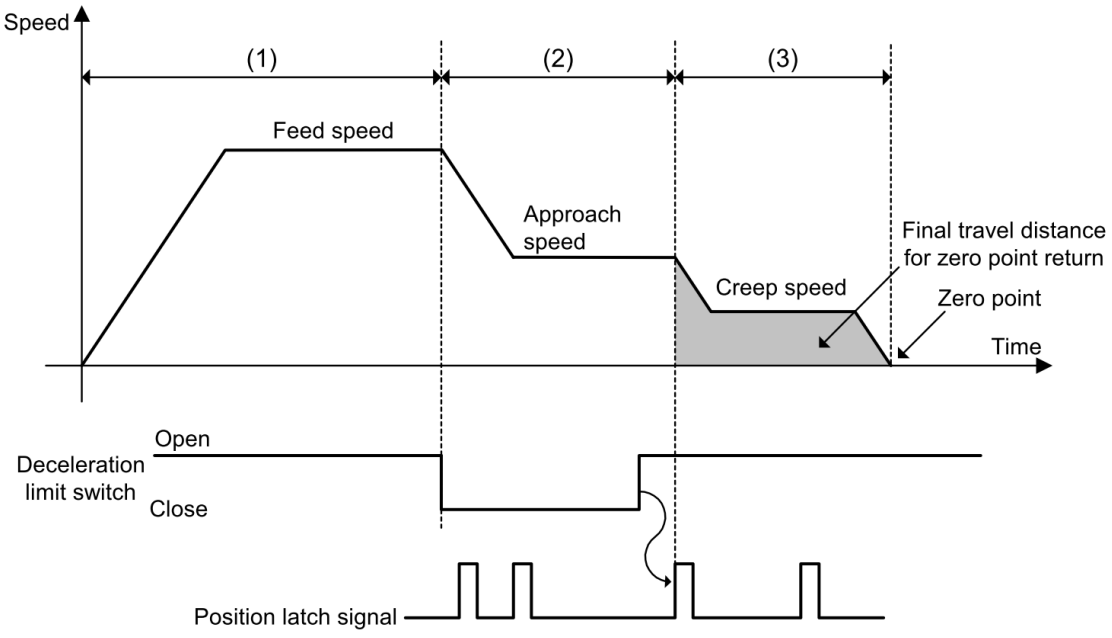

Figure 3.2.12.2 Zero point return sequence (MODE = 1)

- Supplementary information

  Differing from ZRET in MECHATROLINK-II, the motion direction after latching is determined by the sign of the value set for final travel distance for zero point return.

  (a) If final travel distance for zero point return is a positive value
  - If latching occurs during motion in positive direction, the motor rotates in positive direction (the same direction) for positioning.
  - If latching occurs during motion in negative direction, the motor rotates in positive direction (the reverse direction) for positioning.
    (For ZRET in MECHATROLINK-II, the motor rotates in negative direction (the same direction) for positioning.)

  (b) If final travel distance for zero point return is a negative value
  - If latching occurs during motion in positive direction, the motor rotates in negative direction (the reverse direction) for positioning.
  - If latching occurs during motion in negative direction, the motor rotates in negative direction (the same direction) for positioning.
    (For ZRET in MECHATROLINK-II, the motor rotates in positive direction (the reverse direction) for positioning.)

3.2.13 Velocity control (VELCTRL: 3Ch)

VELCTRL command is used to send reference speed to a slave to perform speed control. The slave performs speed control without position control. To cancel speed control, set VREF = 0 or set SVCMD_CTRL.CMD_CANCEL to 1. To pause speed control, set SVCMD_CTRL.CMD_PAUSE to 1.

- Data format

Table 3.2.13.1

Byte	Command	Response
0	VELCTRL (3Ch)	VELCTRL (3Ch)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	TFF	CPRM_SEL_MON1
16 – 19	VREF	CPRM_SEL_MON2
20 – 23	ACCR	MONITOR1
24 – 27	DECR	MONITOR2
28 – 31	TLIM	MONITOR3

- Command description

Table 3.2.13.2

Command Classification	Standard servo command Asynchronous command
Confirmation Method of Command Completion	(5) Confirm the command is successfully executed by checking RCMD = VELCTRL (3Ch) and CMD_STAT.CMDRDY = 1. (6) Confirm the completion of canceling the command by checking RCMD = VELCTRL (3Ch), CMD_STAT.CMDRDY = 1 and SVCMD_STAT.CMD_CANCEL_CMP = 1. (7) Confirm the completion of pausing the command by checking RCMD = VELCTRL (3Ch), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.CMD_PAUSE_CMP = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● VREF (velocity reference): Set with a signed value. ● TFF (torque feedforward): Set with a signed value. ● ACCR (acceleration): Set with an unsigned value. ● DECR (deceleration): Set with an unsigned value. ● TLIM (torque limit): Set with an unsigned value. When torque limit is not used, set the maximum allowable value. Refer to section 3.2.17 for further information of above command parameters. Refer to section 5.2 for units of above command parameters.

Alarm Description	In the following cases, an alarm will occur and the command will not be executed: ● When the command is used in servo-off state, CMD_ALM = A hex. ● When ACCR or DECR data is invalid, CMD_ALM = 9 hex. If ACCR or DECR is 0, current acceleration or deceleration will be applied, and no alarm will occur. In the following cases, an alarm will occur and the relevant value will be clamped at the limit value: ● When VREF data is invalid, CMD_ALM = 1 hex. ● When TLIM data is invalid, CMD_ALM = 1 hex.

■ Supplementary information

The control mode before canceling speed control by setting SVCMD_CTRL.CMD_CANCEL to 1 retains after cancellation.

3.2.14 Torque control (TRQCTRL: 3Dh)

TRQCTRL command is used to send reference torque to a slave to perform torque control. The slave performs torque control without speed control and position control.

- Data format

Table 3.2.14.1

Byte	Command	Response
0	TRQCTRL (3Dh)	TRQCTRL (3Dh)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 15	VLIM	CPRM_SEL_MON1
16 – 19	TQREF	CPRM_SEL_MON2
20 – 23	Reserved	MONITOR1
24 – 27		MONITOR2
28 – 31		MONITOR3

- Command description

Table 3.2.14.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = TRQCTRL (3Dh) and CMD_STAT.CMDRDY = 1.
Command Parameter	● CPRM_SEL_MON1/CPRM_SEL_MON2: Monitoring data can be selected by common parameter 87/88. ● VLIM (speed limit): Set with an unsigned value. ● QREF (torque reference): Set with a signed value. Refer to section 3.2.17 for further information of above command parameters. Refer to section 5.2 for units of above command parameters.
Alarm Description	In the following case, an alarm will occur and the command will not be executed: ● When the command is used in servo-off state, CMD_ALM = A hex. In the following cases, an alarm will occur and the relevant value will be clamped at the limit value: ● When VLIM data is invalid, CMD_ALM = 1 hex. ● When TQREF data is invalid, CMD_ALM = 1 hex.

3.2.15 Read servo parameter (SVPRM_RD: 40h)

SVPRM_RD command is used to read servo parameters by specifying servo parameter number, data size, and reading mode. Select parameter type (common parameter or device parameter) and reading source (RAM area or retentive memory area) in reading mode to read the requested servo parameter. If reading is not completed normally, for example, when a servo parameter that doesn't exist has been specified, the slave detects an alarm and goes into alarm state. The values specified in NO, SIZE and MODE fields will be returned regardless of whether the reading process is completed or not.

- Data format

Table 3.2.15.1

Byte	Command	Response
0	SVPRM_RD (40h)	SVPRM_RD (40h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 13	NO	NO
14	SIZE	SIZE
15	MODE	MODE
16 – 31	Reserved	PARAMETER

- Command description

Table 3.2.15.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SVPRM_RD (40h) and CMD_STAT.CMDRDY = 1, and NO, SIZE and MODE in response field.
Command Parameter	● NO: Servo parameter number ● SIZE: Servo parameter data size [byte] ● MODE: Servo parameter reading mode 00h: Common parameter 01h: Not supported 10h: Drive variable (For more information, please refer to section 7.2.) 11h: Not supported ● PARAMETER: Servo parameter data
Alarm Description	● When NO data is invalid, CMD_ALM = 9 hex. ● When SIZE data is invalid, CMD_ALM = 9 hex. ● When MODE data is invalid, CMD_ALM = 9 hex.

3.2.16 Write servo parameter (SVPRM_WR: 41h)

SVPRM_WR command is used to write servo parameters by specifying servo parameter number, data size, and writing mode. Select parameter type (common parameter or device parameter) and writing destination (RAM area or retentive memory area) in writing mode to write the requested servo parameter. When writing offline parameters (Parameters that take effect after power reset.), CONFIG command must be sent for device setup after parameters are written. If writing is not completed normally, for example, when a servo parameter that doesn't exist has been specified, the slave detects an alarm and goes into alarm state. The values specified in NO,SIZE, MODE and PARAMETER fields will be returned regardless of whether the writing process is completed or not.

- Data format

Table 3.2.16.1

Byte	Command	Response
0	SVPRM_WR (41h)	SVPRM_WR (41h)
1	WDT	RWDT
2 – 3	CMD_CTRL	CMD_STAT
4 – 7	SVCMD_CTRL	SVCMD_STAT
8 – 11	SVCMD_IO	SVCMD_IO
12 – 13	NO	NO
14	SIZE	SIZE
15	MODE	MODE
16 – 31	PARAMETER	PARAMETER

- Command description

Table 3.2.16.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RCMD = SVPRM_RD (40h) and CMD_STAT.CMDRDY = 1, and NO, SIZE and MODE in response field.
Command Parameter	● NO: Servo parameter number ● SIZE: Servo parameter data size [byte] ● MODE: Servo parameter writing mode 00h: Common parameter 01h: Not supported 10h: Drive variable (For more information, please refer to section 7.2.) 11h: Not supported ● PARAMETER: Servo parameter data
Alarm Description	● When NO data is invalid, CMD_ALM = 9 hex. ● When SIZE data is invalid, CMD_ALM = 9 hex. ● When MODE data is invalid, CMD_ALM = 9 hex.

3.2.17 Setting motion command data

Table 3.2.17.1

Name	Description	Operation when data error occurs
TSPD	Target speed For FEED: Set signed 4-byte data For POSING and EX_POSING: Set unsigned 4-byte data	If a command that exceeds the maximum value for the target speed is specified, the speed is clamped at the maximum value for the target speed and 1 is set for CMD_ALM.
VREF	Velocity reference Set signed 4-byte data	If a command that exceeds the maximum value for the value is specified, the value is clamped at the maximum value and 1 is set for CMD_ALM.
VFF	Velocity feedforward Set signed 4-byte data	
TQREF	Torque reference Set signed 4-byte data	If a command that exceeds the maximum value for the value is specified, the value is clamped at the maximum value and 1 is set for CMD_ALM.
TFF	Torque feedforward Set signed 4-byte data	
TLIM	Torque limit Set unsigned 4-byte data	If a command that exceeds the torque limit value is specified, the torque is clamped at the torque limit value and 1 is set for CMD_ALM. If “FFFFFFFFH” is set for TLIM, the torque is clamped at the torque limit and CMD_ALM does not notify a warning.
VLIM	Speed limit Set unsigned 4-byte data	If a command that exceeds the speed limit value is specified, the speed is clamped at the speed limit value and 1 is set for CMD_ALM. If “FFFFFFFFH” is set for VLIM, the speed is clamped at the speed limit and CMD_ALM does not notify a warning.
ACCR	Acceleration Set unsigned 4-byte data	(1) When the unit is the reference unit/s^2 If a command that exceeds the maximum value for acceleration is specified, the acceleration is clamped at the maximum value and 1 is set for CMD_ALM. If “FFFFFFFFH” is set for ACCR, operation is performed at the maximum acceleration and CMD_ALM does not notify a warning. (2) When the unit is ms If a command that exceeds the maximum value for acceleration time is specified, the acceleration is clamped at the minimum value and 1 is set for CMD_ALM. If “0H” is set for ACCR, operation is performed at the maximum acceleration and CMD_ALM does not notify a warning.
DECR	Deceleration Set unsigned 4-byte data	(1) When the unit is the reference unit/s^2 If a command that exceeds the maximum value for deceleration is specified, the deceleration is clamped at the maximum value and 1 is set for CMD_ALM. If “FFFFFFFFH” is set for DECR, operation is performed at the maximum deceleration and CMD_ALM does not notify a warning. (2) When the unit is ms If a command that exceeds the maximum value for deceleration time is specified, the deceleration is clamped at the minimum value and 1 is set for CMD_ALM. If “0H” is set for DECR, operation is performed at the maximum deceleration and CMD_ALM does not notify a warning.

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4. Details of subcommands

4.1 Subcommands

4.1.1 Combinations of main commands and subcommands

The combinations of main commands and subcommands are listed in table 4.1.1.1 and 4.1.1.2. When an invalid combination is specified, an alarm (SUBCMD_ALM = Bh) will occur.

Table 4.1.1.1

Main Command		Subcommand						
		NOP (00h)	ALM_RD (05h)	ALM_CLR (06h)	MEM_RD (1Dh)	SMON (30h)	SVPRM_RD (40h)	SVPRM_WR (41h)
Common Command	NOP (00h)	O	O	O	O	O	O	O
	ID_RD(03h)	O	O	O	O	O	O	O
	CONFIG(04h)	O	X	X	X	O	X	X
	ALM_RD(05h)	O	X	X	X	O	X	X
	ALM_CLR(06h)	O	X	X	X	O	X	X
	SYNC_SET(0Dh)	O	X	X	X	O	X	X
	CONNECT(0Eh)	O	X	X	X	X	X	X
	DISCONNECT (0Fh)	O	X	X	X	X	X	X
	MEM_RD(1Dh)	O	X	X	X	O	X	X

Table 4.1.1.2

Main Command		Subcommand						
		NOP (00h)	ALM_RD (05h)	ALM_CLR (06h)	MEM_RD (1Dh)	SMON (30h)	SVPRM_RD (40h)	SVPRM_WR (41h)
Servo Command	BRK_ON(21h)	O	X	X	X	O	X	X
	BRK_OFF(22h)	O	X	X	X	O	X	X
	SENS_ON(23h)	O	X	X	X	O	X	X
	SENS_OFF(24h)	O	X	X	X	O	X	X
	SMON(30h)	O	O	O	O	O	O	O
	SV_ON(31h)	O	O	O	O	O	O	O
	SV_OFF(32h)	O	O	O	O	O	O	O
	INTERPOLATE (34h)	O	O	O	O	O	O	O
	POSING(35h)	O	O	O	O	O	O	O
	FEED(36h)	O	O	O	O	O	O	O
	EX_POSING(39h)	O	O	O	O	O	O	O
	VELCTRL(3Ch)	O	O	O	O	O	O	O
	TRQCTRL(3Dh)	O	O	O	O	O	O	O
	SVPRM_RD(40h)	O	X	X	X	O	X	X
	SVPRM_WR(41h)	O	X	X	X	O	X	X

Note:

O: This combination is supported.

X: This combination is not supported.

4.1.2 No operation (NOP: 00h)

NOP command is used for network control.

- Data format

Table 4.1.2.1

Byte	Command	Response
32	NOP (00h)	NOP (00h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 47	Reserved	Reserved

- Command description

Table 4.1.2.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = NOP (00h) and SUB_STAT.SBCMDRDY = 1.
Alarm Description	N/A

4.1.3 Read alarm or warning (ALM_RD: 05h)

ALM_RD command is used to read alarm or warning state. The alarm or warning code of current alarm or warning can be read in response field.

- Data format

Table 4.1.3.1

Byte	Command	Response
32	ALM_RD (05h)	ALM_RD (05h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 37	ALM_RD_MOD	ALM_RD_MOD
38 – 39	ALM_INDEX	ALM_INDEX
40 – 47	Reserved	ALM_DATA

Note:

(1) In ALM_DATA fields, an alarm is indicated by 2 bytes.

(2) The alarm arrangement in alarm history is in the order of occurrence. The first alarm is the latest alarm.

(3) In normal state, ALM_DATA is 0.

(4) ALM_INDEX cannot be used. Settings in ALM_INDEX fields will be ignored.

- Command description

Table 4.1.3.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = ALM_RD (05h) and SUB_STAT.SBCMDRDY = 1.
Command Parameter	● ALM_RD_MOD 0: Reads current alarm or warning state. 1: Reads alarm history. ● ALM_DATA Stores alarm codes or warning codes.
Alarm Description	● When ALM_RD_MOD data is invalid, SUBCMD_ALM = 9 hex.

- Data format of ALM_DATA

  For D-series servo drives, alarm codes are defined as below.

Table 4.1.3.3

Bit 12 - 15	Bit 8 - 11	Bit 0 - 7
Alarm/Warning sign	Alarm type	Alarm code
0h: Alarm 1h: Warning	0h: Drive error/warning	00h to FFh: Drive error/warning code
	4h: COMM_ALM	01h to 0Fh: Refer to section 2.5.4 for CMD_ALM code and COMM_ALM code
	5h: CMD_ALM	
	6h: SUBCMD_ALM	

4.1.4 Clear alarm or warning (ALM_CLR: 06h)

ALM_CLR command is used to clear alarm or warning state. It changes the state of the slave, but does not eliminate the cause of the alarm or warning. ALM_CLR command should be used to clear the alarm or warning state after the cause of the alarm or warning has been eliminated.

- Data format

Table 4.1.4.1

Byte	Command	Response
32	ALM_CLR (06h)	ALM_CLR (06h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 37	ALM_CLR_MOD	ALM_CLR_MOD
38 – 47	Reserved	Reserved

- Command description

Table 4.1.4.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = ALM_CLR (06h) and SUB_STAT.SBCMDRDY = 1.
Command Parameter	● ALM_CLR_MODE 0: Clears current alarm or warning state 1: Clears alarm history
Alarm Description	● When ALM_CLR_MOD data is invalid, SUBCMD_ALM = 9 hex.

4.1.5 Read memory (MEM_RD: 1Dh)

MEM_RD command is used to read the data stored in memory by specifying the initial address and data size.

- Data format

Table 4.1.5.1

Byte	Command	Response
32	MEM_RD (1DH)	MEM_RD (1DH)
33 – 35	SUB_CTRL	SUB_STAT
36	Reserved	Reserved
37	MODE/DATA_TYPE	MODE/DATA_TYPE
38 – 39	SIZE	SIZE
40 – 43	ADDRESS	ADDRESS
44 – 47	Reserved	DATA

- Command description

Table 4.1.5.2

<table>
<tr><td rowspan="2">Command Classification</td><td>Common command</td></tr>
<tr><td>Asynchronous command</td></tr>
<tr><td>Confirmation Method of Command Completion</td><td>Confirm the command is successfully executed by checking RSUBCMD = MEM_RD (1Dh), SUB_STAT.SUBCMDRDY = 1, and ADDRESS, SIZE and MODE/DATATYPE in response field.</td></tr>
<tr><td>Command Parameter</td><td>

MODE/DATA_TYPE
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td colspan="4">MODE</td><td colspan="4">DATA_TYPE</td></tr>
</table>
MODE
1: Volatile memory, 2: Not supported
DATA_TYPE
1: Byte, 2: Short, 3: Long, 4: Not supported
SIZE
Data size to be read
ADDRESS
Initial address to be read
DATA
Data

</td></tr>
<tr><td>Alarm Description</td><td>

When ADDRESS data is invalid, SUBCMD_ALM = 9 hex.
When MODE/DATA_TYPE data is invalid, SUBCMD _ALM = 9 hex.
When SIZE data is invalid, SUBCMD _ALM = 9 hex.

</td></tr>
</table>

4.1.6 Servo status monitor (SMON: 30h)

SMON command is used to read alarm, status, monitoring information (position, speed, torque, etc.), and the state of I/O signal.

- Data format

Table 4.1.6.1

Byte	Command	Response
32	SMON (30h)	SMON (30h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 39	Reserved	MONITOR4
40 – 43		MONITOR5
44 – 47		MONITOR6

- Command description

Table 4.1.6.2

Command Classification	Common command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = SMON (30h) and SUB_STAT.SUBCMDRDY = 1.
Command Parameter	● N/A
Alarm Description	● N/A

4.1.7 Read servo parameter (SVPRM_RD: 40h)

SVPRM_RD command is used to read servo parameter by specifying servo parameter number, data size, and reading mode. Select parameter type (common parameter or device parameter) and reading source (RAM area or retentive memory area) in reading mode.

- Data format

Table 4.1.7.1

Byte	Command	Response
32	SVPRM_RD (40h)	SVPRM_RD (40h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 37	NO	NO
38	SIZE	SIZE
39	MODE	MODE
40 – 47	Reserved	PARAMETER

- Command description

Table 4.1.7.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = SVPRM_RD (40h), SUB_STAT.SUBCMDRDY = 1, and NO, SIZE and MODE in response field.
Command Parameter	● NO: Servo parameter number ● SIZE: Servo parameter data size [byte] ● MODE: Servo parameter reading mode 00h: Common parameter 01h: Not supported 10h: Drive variable (For more information, please refer to section 7.2.) 11h: Not supported ● PARAMETER: Servo parameter data
Alarm Description	● When NO data is invalid, SUBCMD_ALM = 9 hex. ● When SIZE data is invalid, SUBCMD _ALM = 9 hex. ● When MODE data is invalid, SUBCMD _ALM = 9 hex.

4.1.8 Write servo parameter (SVPRM_WR: 41h)

SVPRM_WR command is used to write servo parameter by specifying servo parameter number, data size, and writing mode. Select parameter type (common parameter or device parameter) and writing destination (RAM area or retentive memory area) in writing mode to write the requested servo parameter.

- Data format

Table 4.1.8.1

Byte	Command	Response
32	SVPRM_WR (41h)	SVPRM_WR (41h)
33 – 35	SUB_CTRL	SUB_STAT
36 – 37	NO	NO
38	SIZE	SIZE
39	MODE	MODE
40 – 47	PARAMETER	PARAMETER

- Command description

Table 4.1.8.2

Command Classification	Standard servo command
	Asynchronous command
Confirmation Method of Command Completion	Confirm the command is successfully executed by checking RSUBCMD = SVPRM_WR (41h) and SUB_STAT.SUBCMDRDY = 1, and NO, SIZE, MODE and PARAMETER in response field.
Command Parameter	● NO: Servo parameter number ● SIZE: Servo parameter data size [byte] ● MODE: Servo parameter writing mode 00h: Common parameter 01h: Not supported 10h: Drive variable (For more information, please refer to section 7.2.) 11h: Not supported ● PARAMETER: Servo parameter data
Alarm Description	● When NO data is invalid, SUBCMD_ALM = 9 hex. ● When SIZE data is invalid, SUBCMD _ALM = 9 hex. ● When MODE data is invalid, SUBCMD _ALM = 9 hex.

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5. Standard servo profile command data

5.1 Standard servo profile command data

This chapter describes the data used with MECHATROLINK-III standard servo profile commands.

5.2 System unit

System unit can be set by common parameters.

5.2.1 Speed

Table 5.2.1.1

Unit	Description
Reference unit/s	[reference unit/s] The unit is fixed and cannot be user-defined.

5.2.2 Position

Table 5.2.2.1

Unit	Description
Reference unit	[reference unit] The unit is fixed and cannot be user-defined.

5.2.3 Acceleration

Table 5.2.3.1

Unit	Description
Reference unit/s^2	[reference unit/s^2] The unit is fixed and cannot be user-defined.

5.2.4 Torque

Table 5.2.4.1

Unit	Description
% of rated torque	[%] The unit is fixed and cannot be user-defined.

5.3 Monitoring information

To read the monitoring information from the slave, the master can set the selection code of the monitoring data in SEL_MON1 to 3 in servo command control field (SVCMD_CTRL) and SEL_MON4 to 6 in subcommand control field (SUB_CTRL). The specified selection code and monitoring data will be returned in response field.

The monitoring selections are listed in table 5.3.1.

Table 5.3.1

Selection Code (Hex.)	Monitoring Name	Contents	Remark
0	APOS	Feedback position	-
1	CPOS	Command position	-
2	PERR	Position error	-
3	LPOS1	Latched position 1	-
4	LPOS2	Latched position 2	-
5	FSPD	Feedback speed	-
6	CSPD	Reference speed	-
7	TRQ	Torque (force) reference	-
8	ALARM	Detailed information of current alarm	-
9	MPOS	Command position	Internal command position of control loop
C	CMN1	Common monitoring 1	Selects monitoring data specified by common parameter 89.
D	CMN2	Common monitoring 2	Selects monitoring data specified by common parameter 8A.
E	OMN1	Optional monitoring 1	Not supported
F	OMN2	Optional monitoring 2	Not supported

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6. Operation sequence

6.1 Connecting to D-series servo drives (X13)

Use Ethernet crossover cables to connect servo drives to MECHATROLINK-III compatible masters or with MECHATROLINK-III compatible devices. If there is any question about Ethernet crossover cable, please contact HIWIN local agent.

6.2 MECHATROLINK-III communication setup

The rotary switches (S1 and S2) and DIP switch (S3) shown in figure 6.2.1 are used to set MECHATROLINK-III communication specification.

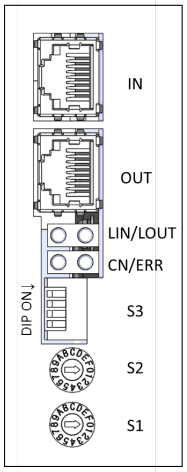

Figure 6.2.1

- Communication specification (S3)

Table 6.2.1

S3	Function	Setting		
		1	2	Number of Transmission Bytes
Pin 1 and 2	Sets the number of transmission bytes	OFF	OFF	Reserved
		ON	OFF	32 bytes
		OFF	ON	48 bytes
		ON	ON	Reserved
Pin 3	Reserved			
Pin 4	Reserved			

- Station address (S1 and S2)

  Set station number by using the rotary switches (S1 and S2). When connecting two or more MECHATROLINK-III compatible products, please set different station number for each product.

Table 6.2.2

S1	S2	Station Address
0	0 to 2	Reserved
0	3	03h
⋮	⋮	⋮
E	F	EFh
F	0 to F	Reserved

Note:

If the settings of the communications switches (S1, S2, and S3) are changed, please reset power for the new settings to take effect.

6.3 Communication status LED

LINK LED, ERR LED and CN LED shown in figure 6.3.1 are used to indicate MECHATROLINK-III communication status.

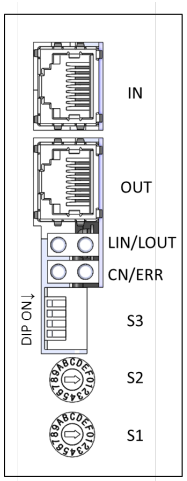

Figure 6.3.1

Table 6.3.1

Name	Description
LINK (LIN and LOUT)	This LED lights up when the power is turned on and a hardware connection is established.
Error (ERR)	This LED lights up when MECHATROLINK-III communication error occurs.
Connection (CN)	This LED lights up when a connection is established.

6.4 Operation when managing parameters by controller

When common parameters and device-specific parameters are managed by a controller, the parameters are transmitted to the servo drive from the controller when power is turned on. In this operation, it is not necessary to change the servo drive setting values when the servo drive is changed, since parameters are stored in the controller. The operation sequence is shown in table 6.4.1.

Table 6.4.1

Step	Operation	Command to Send
1	Turns on the control and main power supplies.	NOP/DISCONNECT
2	Establishes connection. Start the counting of WDT.	CONNECT
3	Reads device type and other information.	ID_RD/SVPRM_RD
4	Sets the necessary parameters in RAM.	SVPRM_WR
5	Enables the set parameters.	CONFIG
6	Turns on the encoder power and acquires position data.	SENS_ON
7	Enables the motor.	SV_ON
8	Starts operation.	POSING, INTERPOLATE, etc.
9	Disables the motor.	SV_OFF
10	Releases connection.	DISCONNECT
11	Turns off the control and main power supplies.	-

Note:

Send NOP command when connection is released correctly. If it is not released correctly, send DISCONNECT command for two or more communication cycles before reconnection. After that, send CONNECT command.

7. Common parameters

7.1 Common parameters

The common parameters listed below allow the controller to modify servo drive settings via MECHATROLINK communication.

Parameters related to device information

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
1	4	Encoder Type	0 to 1	-	-	Read	-
	00H: Absolute encoder 01H: Incremental encoder						
2	4	Motor Type	0 to 1	-	-	Read	-
	00H: Rotary 01H: Linear						
3	4	Semi-closed/ Fully-closed Type	0 to 1	-	-	Read	-
	00H: Semi-closed 01H: Fully-closed						
4	4	Rated Speed	0 to 2147483647	Rotary: rpm Linear: mm/s	-	Read	-
5	4	Maximum Output Speed	0 to 2147483647	Rotary: rpm Linear: mm/s	-	Read	-
6	4	Speed Multiplier	0	-	0	Read	-
7	4	Rated Torque	0 to 2147483647	N•m	-	Read	-
8	4	Maximum Output Torque	0 to 2147483647	N•m	-	Read	-
9	4	Torque Multiplier	-4	-	-4	Read	-
A	4	Resolution (Rotary)	0 to 1073741824	-	-	Read	-
B	4	Linear Scale Pitch	0 to 2147483647	1 nm	-	Read	-
C	4	Pulse Per Scale Pitch	0 to FFFFFFFF	pulse/pitch	-	Read	-

Parameters related to machine specification

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
21	4	Electronic Gear Ratio (Numerator)	1 to 2147483647	-	1	Read/Write	Δ
22	4	Electronic Gear Ratio (Denominator)	1 to 2147483647	-	1	Read/Write	Δ
23	4	Absolute Encoder Origin Offset	-2147483648 to 2147483647	Reference unit	0	Read/Write	○
25	4	Limit Setting	0h to 33h	-	03h	Read/Write	Δ
	Bit 0 (P-OT)	Setting of forward hardware limit (1: Enable, 0: Disable)					
	Bit 1 (N-OT)	Setting of reverse hardware limit (1: Enable, 0: Disable)					
	Bit 2 - 3	Reserved					
	Bit 4 (P-SOT)	Setting of forward software limit (1: Enable, 0: Disable)					
	Bit 5 (N-SOT)	Setting of reverse software limit (1: Enable, 0: Disable)					
	Bit 6 - 7	Reserved					
26	4	Forward Software Limit	-2147483648 to 2147483647	Reference unit	Rotary: 1 rev Linear: 100 mm	Read/Write	◎
28	4	Reverse Software Limit	-2147483648 to 2147483647	Reference unit	Rotary: -1 rev Linear: -100 mm	Read/Write	◎

Parameters related to system unit

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
41	4	Speed Unit	0	-	00h	Read/Write	Δ
	00H	Reference unit/sec (default)					
42	4	Speed Base Unit	0	-	0	Read/Write	Δ
43	4	Position Unit	0	-	00h	Read/Write	Δ
	00H	Reference unit (default)					
44	4	Position Base Unit	0	-	0	Read/Write	Δ

<table>
<tr><th>Parameter No. (Hex.)</th><th>Size (bytes)</th><th>Name</th><th>Setting Range</th><th>Unit</th><th>Default</th><th>Attribute</th><th>Enabling Time</th></tr>
<tr><td rowspan="2">45</td><td>4</td><td>Acceleration Unit</td><td>0</td><td>-</td><td>00h</td><td>Read/Write</td><td>Δ</td></tr>
<tr><td colspan="7"><table><tr><td>00H</td><td>Reference unit/sec^2 (default)</td></tr></table></td></tr>
<tr><td>46</td><td>4</td><td>Acceleration Base Unit</td><td>0</td><td>-</td><td>0</td><td>Read/Write</td><td>Δ</td></tr>
<tr><td rowspan="2">47</td><td>4</td><td>Torque Unit</td><td>1</td><td>-</td><td>01h</td><td>Read/Write</td><td>Δ</td></tr>
<tr><td colspan="7"><table><tr><td>00H</td><td>Percentage (%) of rated torque (default)</td></tr></table></td></tr>
<tr><td>48</td><td>4</td><td>Torque Base Unit</td><td>0</td><td>-</td><td>0</td><td>Read/Write</td><td>Δ</td></tr>
<tr><td rowspan="2">49</td><td>4</td><td>Supported Unit</td><td>-</td><td>-</td><td>2010101h</td><td>Read</td><td>-</td></tr>
<tr><td colspan="7">
<table>
<tr><th colspan="2">Speed Units</th></tr>
<tr><td>Bit 0</td><td>Reference unit/sec</td></tr>
<tr><td>Bit 1</td><td>Reference unit/min</td></tr>
<tr><td>Bit 2</td><td>Percentage (%) of rated speed</td></tr>
<tr><td>Bit 3</td><td>min^{-1} (rpm)</td></tr>
<tr><td>Bit 4</td><td>Maximum motor speed / 4000000hex</td></tr>
<tr><td>Bit 5 - 7</td><td>Reserved</td></tr>
<tr><th colspan="2">Position Units</th></tr>
<tr><td>Bit 8</td><td>Reference unit</td></tr>
<tr><td>Bit 9 - 15</td><td>Reserved</td></tr>
<tr><th colspan="2">Acceleration Units</th></tr>
<tr><td>Bit 16</td><td>Reference unit/sec^2</td></tr>
<tr><td>Bit 17</td><td>ms</td></tr>
<tr><td>Bit 18 - 23</td><td>Reserved</td></tr>
<tr><th colspan="2">Torque Units</th></tr>
<tr><td>Bit 24</td><td>N•m</td></tr>
<tr><td>Bit 25</td><td>Percentage (%) of rated torque</td></tr>
<tr><td>Bit 26</td><td>Maximum torque / 40000000hex</td></tr>
<tr><td>Bit 27 - 31</td><td>Reserved</td></tr>
</table>
Bit setting: (1: Enable, 0: Disable)
</td></tr>
</table>

Parameters for adjustment

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
66	4	In-position Range	0 to 2147483647	Reference unit	100	Read/Write	◎
67	4	Near-position Range	1 to 2147483647	Reference unit	1073741824	Read/Write	◎

Parameters related to command

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
83	4	Final Travel Distance for External Input Positioning (EX_POSING)	-2147483648 to 2147483647	Reference unit	0	Read/Write	◎
84	4	Approach Speed of Zero Point Return	0 to 2147483647	Rotary: $\times 10^{-3}$ min $^{-1}$ Linear: $\times 10^{-3}$ mm/s	Rotary: 6 rpm Linear: 10 mm/s	Read/Write	◎
85	4	Creep Speed of Zero Point Return	0 to 2147483647	Rotary: $\times 10^{-3}$ min $^{-1}$ Linear: $\times 10^{-3}$ mm/s	Rotary: 3 rpm Linear: 5 mm/s	Read/Write	◎
86	4	Final Travel Distance for Zero Point Return	-2147483648 to 2147483647	Reference unit	0	Read/Write	◎

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
87	4	Monitoring Selection 1	0 to F	-	1	Read/Write	◎

0 hex	APOS
1 hex	CPOS
2 hex	PEER
3 hex	LPOS1
4 hex	LPOS2
5 hex	FSPD
6 hex	CSPD
7 hex	TRQ
8 hex	ALARM
9 hex	MPOS
A hex	Reserved
B hex	Reserved
C hex	CMN1 (Common monitoring 1)
D hex	CMN2 (Common monitoring 2)
E hex	Reserved
F hex	Reserved

Parameter No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
88	4	Monitoring Selection 2	0 to F	-	0	Read/Write	◎

0 hex to F hex	The settings are the same as the settings of parameter 87.

<table>
<tr><th>Parameter No. (Hex.)</th><th>Size (bytes)</th><th>Name</th><th>Setting Range</th><th>Unit</th><th>Default</th><th>Attribute</th><th>Enabling Time</th></tr>
<tr><td rowspan="2">89</td><td>4</td><td>Monitoring Selection for SEL_MON1</td><td>0 to 9</td><td>-</td><td>0</td><td>Read/Write</td><td>◎</td></tr>
<tr><td colspan="7">
<table>
<tr><td>0 hex</td><td>TPOS (target position in command coordinate system)</td></tr>
<tr><td>1 hex</td><td>IPOS (reference position in command coordinate system)</td></tr>
<tr><td>2 hex</td><td>POS_OFST (offset value set in POS_SET)</td></tr>
<tr><td>3 hex</td><td>TSPD (target speed)</td></tr>
<tr><td>4 hex</td><td>SPD_LIM (speed limit value)</td></tr>
<tr><td>5 hex</td><td>TRQ_LIM (torque limit value)</td></tr>
<tr><td>6 hex</td><td>SV_STAT (actual operating state of the slave)
● Byte 1: Current communication phase
00h: Phase 0
01h: Phase 1
02h: Phase 2
03h: Phase 3
● Byte 2: Current control mode
00h: Position mode
01h: Velocity mode
02h: Torque mode
● Byte 3: Reserved
● Byte 4: Expanded signal monitor
<table>
<tr><td>Bit 0</td><td>LT_RDY1</td></tr>
<tr><td>Bit 1</td><td>LT_RDY2</td></tr>
<tr><td>Bit 2 - 3</td><td>LT_SEL1R</td></tr>
<tr><td>Bit 4 - 5</td><td>LT_SEL2R</td></tr>
<tr><td>Bit 6 - 7</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>7 hex</td><td>Reserved</td></tr>
<tr><td>8 hex</td><td>Reserved</td></tr>
<tr><td>9 hex</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">8A</td><td>4</td><td>Monitoring Selection for SEL_MON2</td><td>0 to 9</td><td>-</td><td>0</td><td>Read/Write</td><td>◎</td></tr>
<tr><td colspan="7">
<table>
<tr><td>0 hex to 9 hex</td><td>The settings are the same as the settings of parameter 89.</td></tr>
</table>
</td></tr>
<tr><td>8B</td><td>4</td><td>Zero Point Detection Range</td><td>0 to 2147483647</td><td>Reference unit</td><td>100</td><td>Read/Write</td><td>◎</td></tr>
<tr><td>8E</td><td>4</td><td>Zero Speed Detection Range</td><td>0 to 2147483647</td><td>Rotary: $\times 10^{-3}$ min^{-1}
Linear: $\times 10^{-3}$ mm/s</td><td>Rotary: 3 rpm
Linear: 5 mm/s</td><td>Read/Write</td><td>◎</td></tr>
</table>

<table>
<tr><th>Parameter No. (Hex.)</th><th>Size (bytes)</th><th>Name</th><th>Setting Range</th><th>Unit</th><th>Default</th><th>Attribute</th><th>Enabling Time</th></tr>
<tr><td rowspan="2">90</td><td>4</td><td>Supported Bits of SVCMD_CTRL</td><td>-</td><td>-</td><td>FFF3F0Fh</td><td>Read</td><td>-</td></tr>
<tr><td colspan="7">
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td colspan="2">Reserved</td><td colspan="2">ACCFIL</td><td colspan="2">STOP_MODE</td><td>CMD_ CANCEL</td><td>CMD_ PAUSE</td></tr>
<tr><td>Bit 15</td><td>Bit 14</td><td>Bit 13</td><td>Bit 12</td><td>Bit 11</td><td>Bit 10</td><td>Bit 9</td><td>Bit 8</td></tr>
<tr><td colspan="2">Reserved</td><td colspan="2">LT_SEL2</td><td colspan="2">LT_SEL1</td><td>LT_REQ2</td><td>LT_REQ1</td></tr>
<tr><td>Bit 23</td><td>Bit 22</td><td>Bit 21</td><td>Bit 20</td><td>Bit 19</td><td>Bit 18</td><td>Bit 17</td><td>Bit 16</td></tr>
<tr><td colspan="4">SEL_MON2</td><td colspan="4">SEL_MON1</td></tr>
<tr><td>Bit 31</td><td>Bit 30</td><td>Bit 29</td><td>Bit 28</td><td>Bit 27</td><td>Bit 26</td><td>Bit 25</td><td>Bit 24</td></tr>
<tr><td colspan="4">Reserved</td><td colspan="4">SEL_MON3</td></tr>
</table>
Bit setting: (1: Enable, 0: Disable)
</td></tr>
<tr><td rowspan="2">91</td><td>4</td><td>Supported Bits of SVCMD_STAT</td><td>-</td><td>-</td><td>FFF3F03h</td><td>Read</td><td>-</td></tr>
<tr><td colspan="7">
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td colspan="2">Reserved</td><td colspan="2">ACCFIL</td><td colspan="2">Reserved</td><td>CMD_CAN CEL_CMP</td><td>CMD_PA USE_CMP</td></tr>
<tr><td>Bit 15</td><td>Bit 14</td><td>Bit 13</td><td>Bit 12</td><td>Bit 11</td><td>Bit 10</td><td>Bit 9</td><td>Bit 8</td></tr>
<tr><td colspan="2">Reserved</td><td>SV_ON</td><td>M_RDY</td><td>PON</td><td>POS_RDY</td><td>LT_CMP2</td><td>LT_CMP1</td></tr>
<tr><td>Bit 23</td><td>Bit 22</td><td>Bit 21</td><td>Bit 20</td><td>Bit 19</td><td>Bit 18</td><td>Bit 17</td><td>Bit 16</td></tr>
<tr><td colspan="4">SEL_MON2</td><td colspan="4">SEL_MON1</td></tr>
<tr><td>Bit 31</td><td>Bit 30</td><td>Bit 29</td><td>Bit 28</td><td>Bit 27</td><td>Bit 26</td><td>Bit 25</td><td>Bit 24</td></tr>
<tr><td colspan="4">Reserved</td><td colspan="4">SEL_MON3</td></tr>
</table>
Bit setting: (1: Enable, 0: Disable)
</td></tr>
</table>

<table>
<tr><th>Parameter No. (Hex.)</th><th>Size (bytes)</th><th>Name</th><th>Setting Range</th><th>Unit</th><th>Default</th><th>Attribute</th><th>Enabling Time</th></tr>
<tr><td rowspan="2">92</td><td>4</td><td>Supported Bits for I/O Signal (Output)</td><td>-</td><td>-</td><td>F00000h</td><td>Read</td><td>-</td></tr>
<tr><td colspan="7">
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td>N_CL</td><td>P_CL</td><td>P_PPI</td><td>V_PPI</td><td colspan="4">Reserved</td></tr>
<tr><td>Bit 15</td><td>Bit 14</td><td>Bit 13</td><td>Bit 12</td><td>Bit 11</td><td>Bit 10</td><td>Bit 9</td><td>Bit 8</td></tr>
<tr><td colspan="4">Reserved</td><td colspan="4">G_SEL</td></tr>
<tr><td>Bit 23</td><td>Bit 22</td><td>Bit 21</td><td>Bit 20</td><td>Bit 19</td><td>Bit 18</td><td>Bit 17</td><td>Bit 16</td></tr>
<tr><td colspan="4">Output 1 to Output 4</td><td colspan="4">Reserved</td></tr>
<tr><td>Bit 31</td><td>Bit 30</td><td>Bit 29</td><td>Bit 28</td><td>Bit 27</td><td>Bit 26</td><td>Bit 25</td><td>Bit 24</td></tr>
<tr><td colspan="8">Output 1 to Output 4</td></tr>
</table>
Bit setting: (1: Enable, 0: Disable)
</td></tr>
<tr><td rowspan="2">93</td><td>4</td><td>Supported Bits for I/O Signal (Input)</td><td>-</td><td>-</td><td>FF0AFE7Eh</td><td>Read</td><td>-</td></tr>
<tr><td colspan="7">
<table>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td>ESTP</td><td>EXT3</td><td>EXT2</td><td>EXT1</td><td>N-OT</td><td>P-OT</td><td>DEC</td><td>Reserved</td></tr>
<tr><td>Bit 15</td><td>Bit 14</td><td>Bit 13</td><td>Bit 12</td><td>Bit 11</td><td>Bit 10</td><td>Bit 9</td><td>Bit 8</td></tr>
<tr><td>ZPOINT</td><td>PSET</td><td>NEAR</td><td>DEN</td><td>N-SOT</td><td>P-SOT</td><td>BRK_ON</td><td>Reserved</td></tr>
<tr><td>Bit 23</td><td>Bit 22</td><td>Bit 21</td><td>Bit 20</td><td>Bit 19</td><td>Bit 18</td><td>Bit 17</td><td>Bit 16</td></tr>
<tr><td colspan="4">Reserved</td><td>ZSPD</td><td>V_CMP</td><td>V_LIM</td><td>T_LIM</td></tr>
<tr><td>Bit 31</td><td>Bit 30</td><td>Bit 29</td><td>Bit 28</td><td>Bit 27</td><td>Bit 26</td><td>Bit 25</td><td>Bit 24</td></tr>
<tr><td colspan="8">Input 1 to Input 8</td></tr>
</table>
Bit setting: (1: Enable, 0: Disable)
</td></tr>
</table>

Note:

Enabling time:

◎: Immediately (online common parameter)

○: Enabled after SENS_ON command is received

△: Enabled after CONFIG command is received

7.2 HIWIN drive variables

Controller can use the following HIWIN drive variables to modify the setting of drive via MECHATROLINK communication.

Variable No. (Hex.)	Size (bytes)	Name	Setting Range	Unit	Default	Attribute	Enabling Time
0x1001	4	Enable/Disable Error Map Compensation Table	0x01: Enable 0x10: Disable	-	0	Write	◎
	Enable or disable the Error map compensation table in Flash.						
0x1002	4	Enable Error Map Compensation Function	1: Enable	-	0	Read/Write	◎
	1. Enable Error map compensation function. 2. Error map compensation function is only available when Error map compensation table is enabled. 3. This function is only available for absolute encoders. For digital or analog incremental encoders, Error map compensation function is enabled after Error map compensation table is enabled and zero point return (ZRET) operation is completed. 4. This variable can only be used to enable Error map compensation function. To disable Error map compensation function, write 0x10 to HIWIN drive variable 0x1001. 5. Read HIWIN drive variable 0x1003 to check if Error map compensation function is enabled or disabled.						
0x1003	4	The Status of Error Map Compensation Function	-	-	-	Read	◎
	The status of Error map compensation function (1: Enable, 0: Disable)						
0x1901	4	General-purpose Variable 1	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1902	4	General-purpose Variable 2	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1903	4	General-purpose Variable 3	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1904	4	General-purpose Variable 4	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1905	4	General-purpose Variable 5	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1906	4	General-purpose Variable 6	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1907	4	General-purpose Variable 7	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1908	4	General-purpose Variable 8	-2147483648 to 2147483647	-	0	Read/Write	◎
0x1909	4	General-purpose Variable 9	-2147483648 to 2147483647	-	0	Read/Write	◎

Note:

Enabling time:

◎: Immediately (online common variable)

○: Enabled after SENS_ON command is received

△: Enabled after CONFIG command is received

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8. Errors and warnings

8.1 Drive error/warning codes

■ Drive errors

Table 8.1.1

Drive Error No.*1	Response Error Code*2	Name
E01	0x0001	Motor short (over current) detected
E02	0x0002	Over voltage detected
E03	0x0003	Position error too big
E04	0x0004	Encoder error
E05	0x0005	Soft-thermal threshold reached
E06	0x0006	Motor maybe disconnected
E07	0x0007	Amplifier over temperature
E08	0x0008	Motor over temperature sensor activated
E09	0x0009	Under voltage detected
E10	0x000A	5 V for encoder card fail
E11	0x000B	Phase initialization error
E12	0x000C	Serial encoder communication error
E13	0x000D	Hall sensor error
E14	0x000E	Hall phase check error
E15	0x000F	Current control error
E17	0x0011	Hybrid deviation too big
E18	0x0012	STO active
E19	0x0013	HFLT inconsistent error
E20	0x0014	Auto phase center not complete error
E21	0x0015	Incompatible motor model and drive
E22	0x0016	DC bus voltage abnormal
E26	0x001A	Driver overload error
E27	0x001B	Encoder module error
E28	0x001C	Resolver signal fault
E29	0x001D	Invalid MECHATROLINK hardware configuration
E30	0x001E	MECHATROLINK communication error

- Drive warnings

Table 8.1.2

Drive Warning No.*1	Response Warning Code*2	Name
W01	0x1001	Left SW limit
W02	0x1002	Right SW limit
W03	0x1003	Left HW limit
W04	0x1004	Right HW limit
W05	0x1005	Servo voltage big
W06	0x1006	Position error warning
W07	0x1007	Velocity error warning
W08	0x1008	Current limit
W09	0x1009	Acceleration limit
W10	0x100A	Velocity limit
W11	0x100B	Both HW limits are active
W12	0x100C	I2T warning
W15	0x100F	Absolute encoder battery warning
W16	0x1010	Wrong absolute position
W17	0x1011	MECHATROLINK communication warning

- Details of communication related drive errors

Table 8.1.3

Drive Error No.*1	Response Error Code*2	Name	Description	Troubleshooting
E29	0x001D	Invalid MECHATROLINK HW config	MECHATROLINK-III hardware is not detected or setup error.	1. Check if the drive supports MECHATROLINK-III communication. 2. Check if the station address setup is correct and reset the power of the drive. 3. Check if the data length setup is correct and reset the power of the drive.
E30	N/A	MECHATROLINK communication error	MECHATROLINK-III initialization error	Reset the power of the drive.
E30	0x001E	MECHATROLINK communication error	MECHATROLINK-III COMM_ALM error (Refer to section 2.5.4 for COMM_ALM)	1. Check if the communication cable is correctly connected. 2. Clear the cause of COMM_ALM and send ALM_CLR command and then SYNC_SET command. 3. Restart the controller communication or reset the power of the drive.

■ Details of communication related drive warnings

Table 8.1.4

Drive Warning No.*1	Response Warning Code*2	Name	Description	Troubleshooting
W17	0x1011	MECHATROLINK communication warning	Synchronization period is unstable.	Check the controller setup is appropriate.

Note:

(1) *1 The error and warning codes are displayed by Lightening and LCD.

(2) *2 The error or warning code that a drive responds to a controller

For the encoding rules of the response codes, please refer to the description of ALM_RD.

8.2 Communication alarm codes

■ Errors

Table 8.2.1

Response Error Code*1	Description	Troubleshooting
0x0408	FCS error	1. Check the connection. 2. Check the grounding and noise resistance.
0x0409	Command data is not received.	
0x040A	Synchronous frame is not received.	
0x040B	Synchronization interval error	
0x040C	WDT error	

■ Warnings

Table 8.2.2

Response Warning Code*1	Description	Troubleshooting
0x1401	FCS error	1. Check the connection. 2. Check the grounding and noise resistance.
0x1402	Command data is not received.	
0x1403	Synchronous frame is not received.	

Note:

*1 The error or warning code that a drive responds to a controller

8.3 Main command alarm codes

■ Errors

Table 8.3.1

Response Error Code *1	Description	Troubleshooting
0x0508	Unsupported command	Check the command data from the controller.
0x0509	Invalid data	Check if the command data from the controller is valid.
0x050A	Command execution condition error	Check the command sequence of the controller.
0x050B	Subcommand combination error	
0x050C	Phase error	

■ Warnings

Table 8.3.2

Response Warning Code *1	Description	Troubleshooting
0x1501	Invalid data	Check if the command data from the controller is valid.

Note:

*1 The error or warning code that a drive responds to a controller

8.4 Subcommand alarm codes

■ Errors

Table 8.4.1

Response Error Code *1	Description	Troubleshooting
0x0608	Unsupported subcommand	Check the subcommand data from the controller.
0x0609	Invalid data	Check if the subcommand data from the controller is valid.
0x060A	Subcommand execution condition error	Check the subcommand sequence of the controller.
0x060B	Subcommand combination error	
0x060C	Phase error	

■ Warnings

Table 8.4.2

Response Warning Code *1	Description	Troubleshooting
0x1601	Invalid data	Check if the subcommand data from the controller is valid.

Note:

*1 The error or warning code that a drive responds to a controller

9. Virtual memory space

9.1 Allocation of virtual memory space

MECHATROLINK-III protocol defines the address space of virtual memory as figure 9.1.1. The vendor-specific area can be used by each vendor as needed.

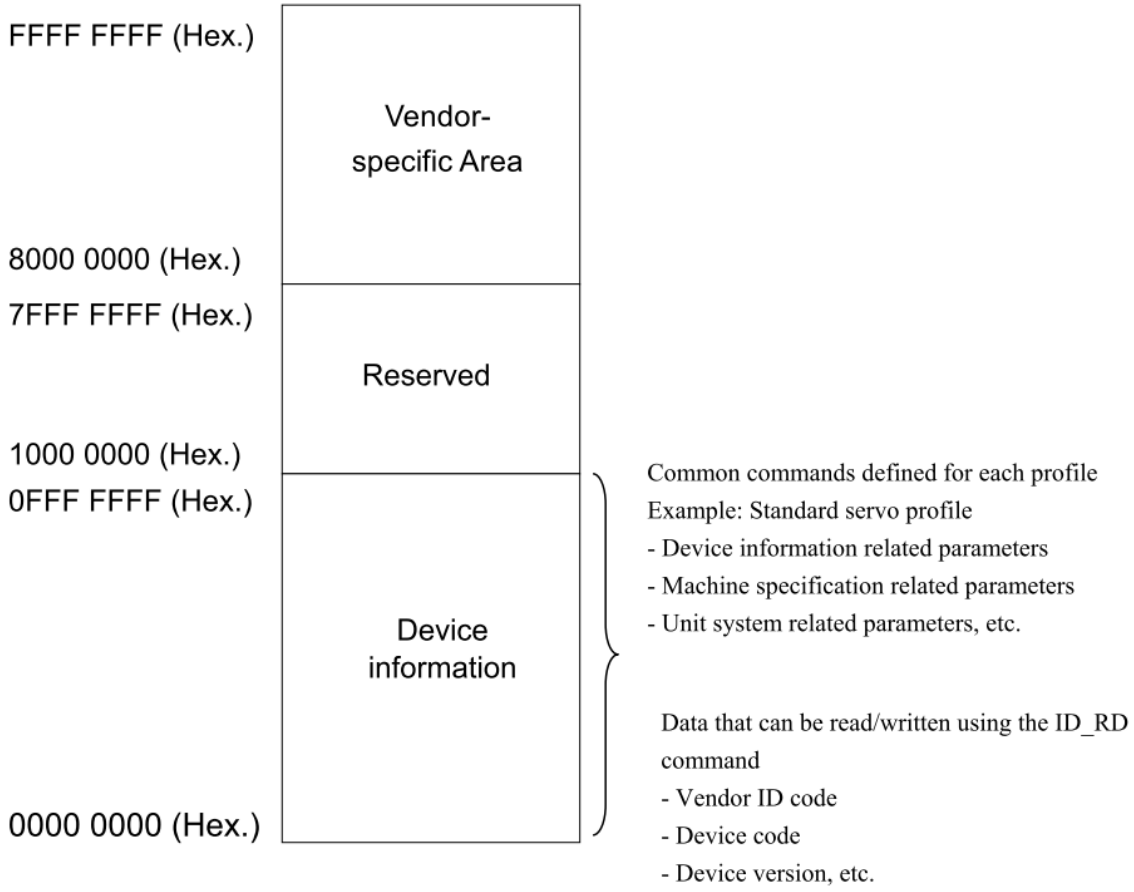
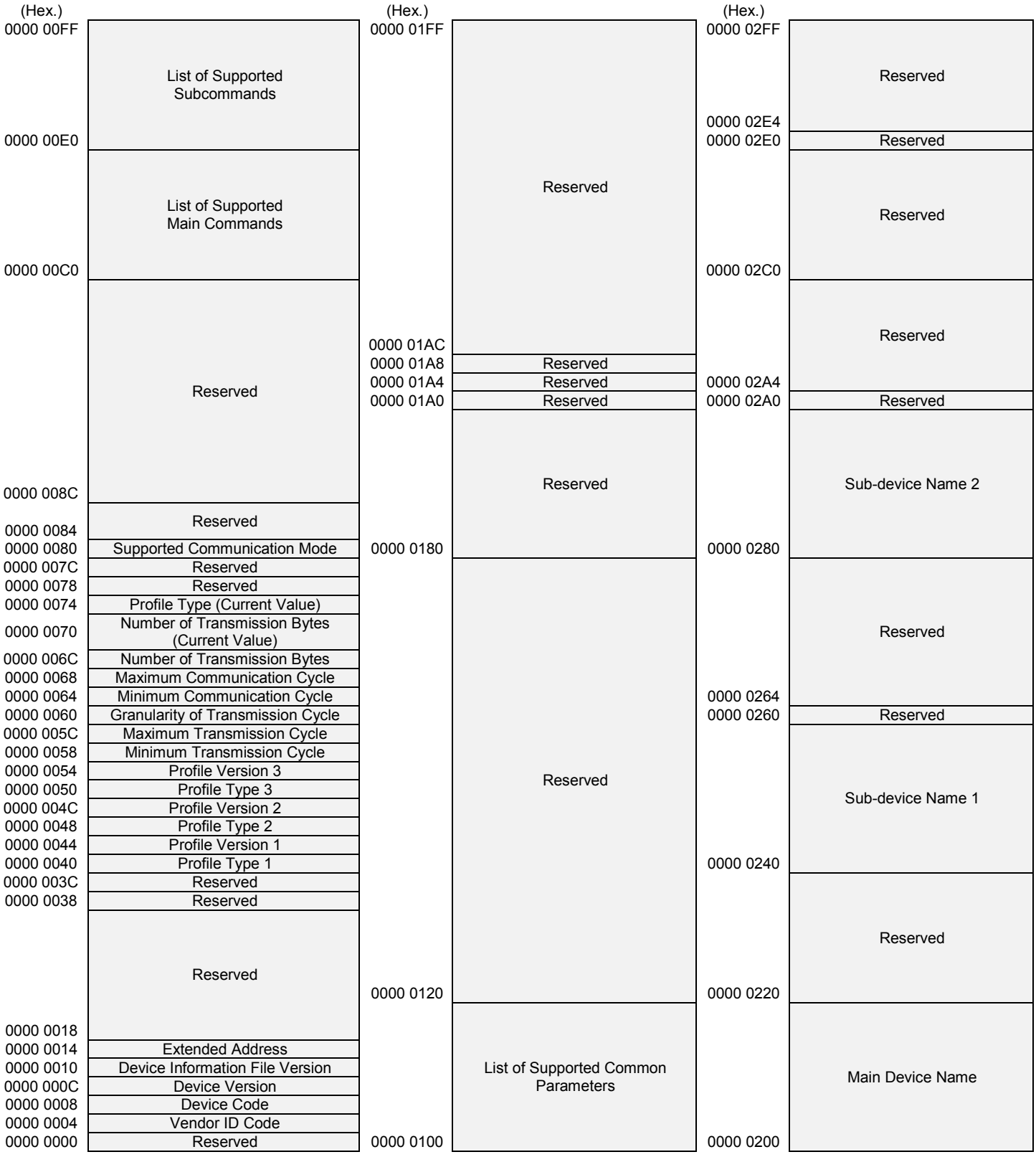


Figure 9.1.1

9.2 ID information area



Note:

0300h - 0x3FFh: Reserved

9.3 Common parameter area

(Hex.)		(Hex.)		(Hex.)	
0000 00FF	Reserved	0000 01FF	Reserved	0000 02FF	Reserved
0000 00A8					
0000 00A4	Reserved				
0000 00A0	Reverse Software Limit	0000 01A0			
0000 009C	Reserved	0000 019C	Near-position Range		
0000 0098	Forward Software Limit	0000 0198	In-position Range		
0000 0094	Limit Setting	0000 0194	Reserved		
0000 0090	Multiturn Limit	0000 0190	Reserved		
0000 008C	Absolute Encoder Origin Offset	0000 018C	Reserved		
0000 0088	Electronic Gear Ratio (Denominator)	0000 0188	Reserved		
0000 0084	Electronic Gear Ratio (Numerator)	0000 0184	Reserved		
	Reserved		Reserved	0000 0250	
				0000 024C	Supported Bits for I/O Signal
				0000 0248	Supported Bits for I/O Signal
				0000 0244	Supported Bits of SVCMD_STAT
				0000 0240	Supported Bits of SVCMD_CTRL
				0000 023C	Reserved
				0000 0238	Zero Speed Detection Range
0000 0034				0000 0234	Reserved
0000 0030	Pulses Per Scale Pitch			0000 0230	Reserved
0000 002C	Linear Scale Pitch			0000 022C	Zero Point Detection Range
0000 0028	Resolution (Rotary)	0000 0128		0000 0228	Monitoring Selection for SEL_MON2
0000 0024	Torque Multiplier	0000 0124	Supported Unit	0000 0224	Monitoring Selection for SEL_MON1
0000 0020	Maximum Output Torque	0000 0120	Torque Base Unit	0000 0220	Monitoring Selection 2
0000 001C	Rated Torque	0000 011C	Torque Unit	0000 021C	Monitoring Selection 1
0000 0018	Speed Multiplier	0000 0118	Acceleration Base Unit	0000 0218	Final Travel Distance for Zero Point Return
0000 0014	Maximum Output Speed	0000 0114	Acceleration Unit	0000 0214	Creep Speed of Zero Point Return
0000 0010	Rated Speed	0000 0110	Position Base Unit	0000 0210	Approach Speed of Zero Point Return
0000 000C	Semi-closed/Fully-closed Type	0000 010C	Position Unit	0000 020C	Final Travel Distance for External Input Positioning
0000 0008	Motor Type	0000 0108	Speed Base Unit	0000 0208	Reserved
0000 0004	Encoder Type	0000 0104	Speed Unit	0000 0204	Reserved
0000 0000	Reserved	0000 0100	Reserved	0000 0200	Reserved