



# Instruction Manual

## RS-485 Communication Protocol

### ESC11-B

<<For safe use of product>>

Wrong operation of the product may result in unavailability of exhibition of full performance of the product or lead to a serious accident. To prevent occurrence of an accident, be sure to read the Instruction Manual of the product carefully to completely understand the contents given therein before operating the product. If you find any unclear point, contact us.

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## 1. Preface

Thank you for purchasing our ESG1 Series Electric Gripper. The ESC11 controller is a small and high-performance product designed based on our high-level control engineering and abundant experience. The information you need to know before communicating with the ESC11 controller via RS485 are given therein.

## 2. For Safe Use

Cautionary descriptions given here are for correct use of the products and for prevention of hazard on you and other people in vicinity and damage with equipment. Strictly observe the instructions described in the Gripper, Controller, and Support Software Instruction Manuals for safety use. After reading the Controller, Gripper and Support Software instruction manuals, be sure to keep this manual where those using this product have an easy access to it.

### 3. RS485 Communication

To activate the controller, send communication commands via the RS232C port on your PC using a serial converter (ESA-R1) or connect a RS485 communication unit such as a PLC.

### 4. Configuring Communication Parameters

Settings for communication parameters are as follows:

- Baud rate : 9600bps
- Communication system : Asynchronous
- Data bit : 8 bits
- Parity bit : Even
- Stop bit : 1 bit

### 5. Connection

#### 5-1. For communication via RS232C port on PC

Connect the controller and serial converter as the connection diagram illustrated below.

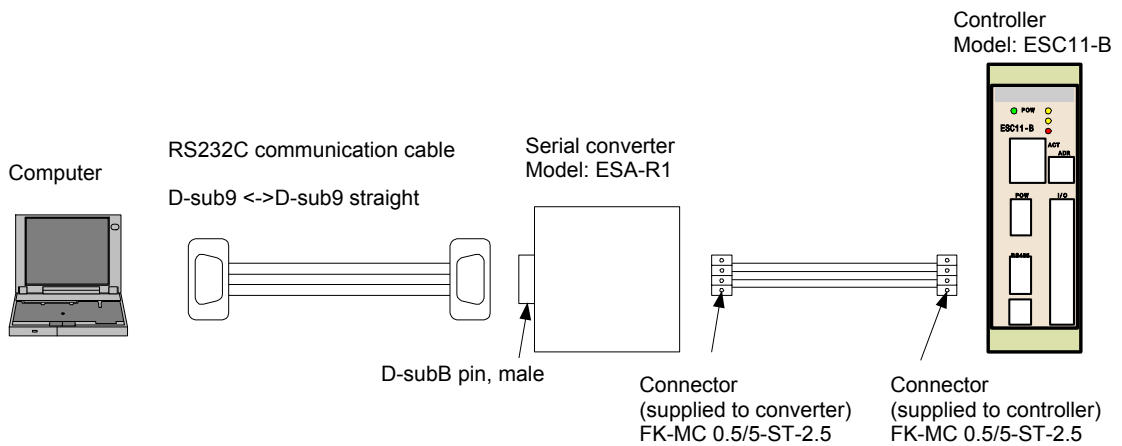


Fig. 5-1

To connect the PC and serial converter, a straight cable (commercially available) is needed.

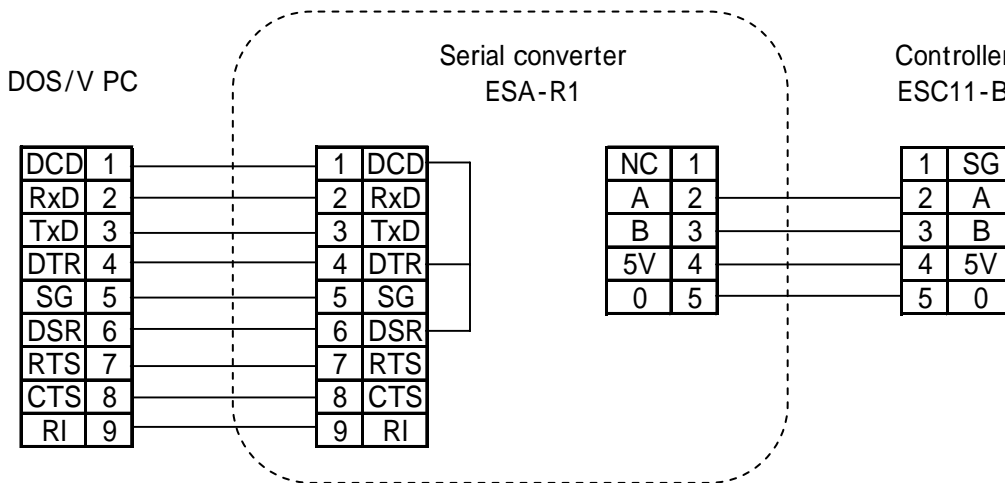


Fig. 5-2

5-2. For communication with serial communication unit such as PLC

Multiple controllers can be cascade-connected with the RS485 communication unit such as PLC.

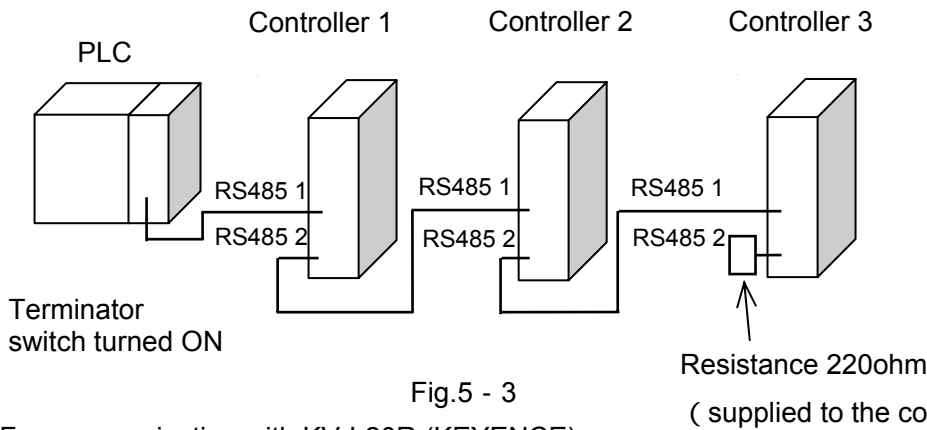
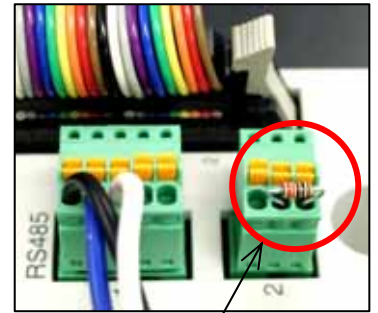


Fig.5 - 3



Resistance  
Fig. 5-4

[1] For communication with KV-L20R (KEYENCE)

Wire Connection between PLC and controller

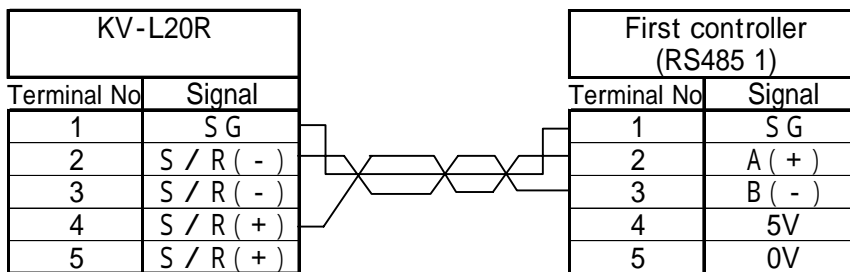


Fig. 5-5

Set the PORT 2 switch on the KV - L20R to "485 (2)".

Set the TERM. Switch to "ON".

Connect between the S/R (+) terminal on KV-L20R and the A terminal on controller and between the S/R (-) and the B terminal on controller with a twisted pair cable.

Connect between the controllers

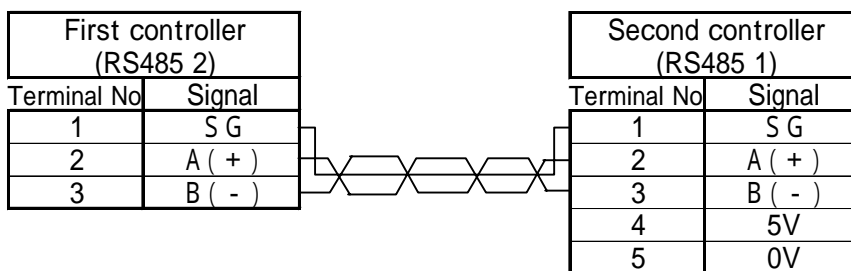


Fig. 5-6

Connect between the A terminals or between the B terminals with a twisted pair cable.

Terminal controller

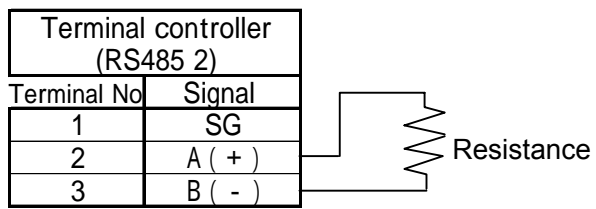


Fig. 5-7

Provide the supplied terminating resistance to the terminal controller (see Figs. 5-4 and 5-7).

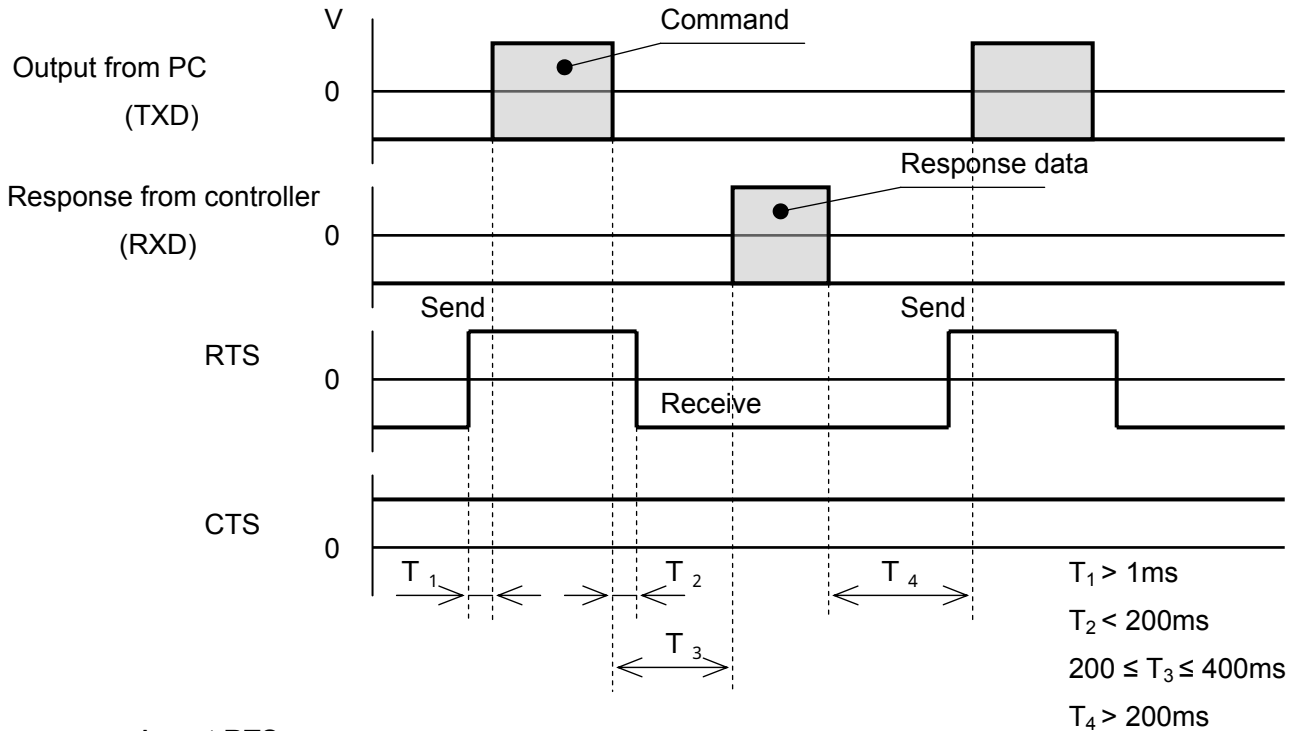
6. Communication System

2-line half-duplex polling system

The PC (master) issues a command (data) to a controller (slave). The controller (slave) responds to the command as soon as the PC issues it to the controller. Whenever the controller (slave) receives the command from the PC, it sends status information back to the PC.

7. Timing Chart

7-1. Input/ Output signal status between PC and serial converter



Assert RTS.

Send a command in 1 ms.

After sending the command, deassert the RTS signal.

In 200ms ( $T_3$ ) after signal was sent, response data are sent from the controller. The PC receives the data.

In 200ms( $T_4$ ) after the PC received the response data from the controller, the next command can be issued.

In the case where the PC still does not receive any response from the controller in 600ms after the first command was sent, the controller or communication error may occur.

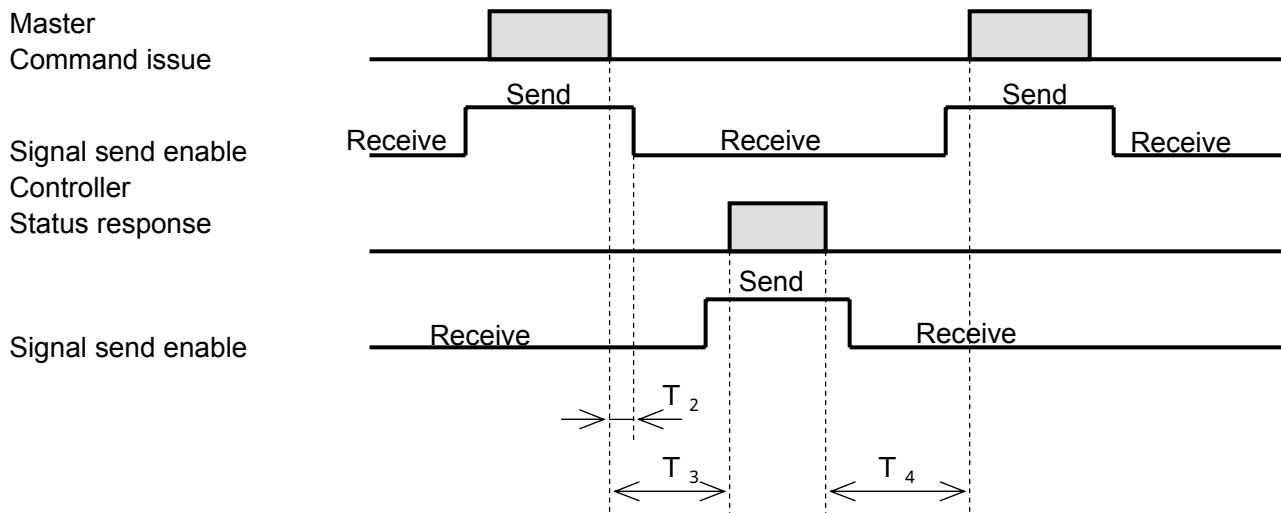
Note1) When power is supplied to the serial converter, CTS is asserted.

7-2 . Input/ Output signal status between master and slave (controller)

The same as descriptions in the section 7-1 (except that RTS and CTS signals are not used)

Master: Serial converter connected to PC, or RS-485 interface unit such as PLC or other devices

Slave: Controller



Communication procedure is as follows:

The master always sends an instruction (a command) after placing its address into the header (packet length).

When the master deasserts SEND ENABLE within 200ms after sending the command, it can receive the command.

Normally all controllers are ready for receive a command while deasserting SEND ENABLE.

All controllers can send a command immediately after receiving the command addressed to the controller.

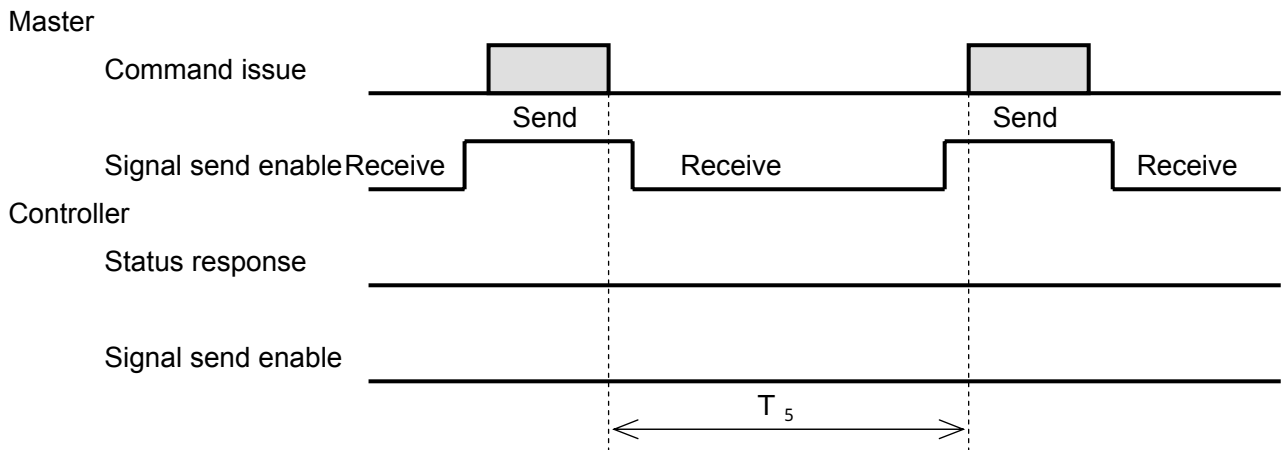
When each controller returns the status information to the master, it places its address into the header.

The controller returns (responds) in the range of 200ms to 400ms ( $T_3$ ) after receiving the command.

The controller deasserts SEND ENABLE within 200 ms after returning a command.

In 200ms ( $T_4$ ) after the master received the command from the controller, it can issue the next command.

### 7-3. When transmission error occurred



When master cannot receive any command from controller for more than 600ms ( $T_5$ ), the device recognizes that timeout error is occurring, and issues the next command (the master can also reissue the command).

In the case where communication between the controller and master has not established for more than 600ms ( $T_5$ ), the controller clears the data that it has received, and regards the data that it will receive next as a header (packet length).

In the event of occurrence of communication error, the master temporarily stops issuing a command for more than 600ms ( $T_5$ ) and empties the receive buffer of the controller.

The controller clears the data that it has received and do not return any command. Opening a line for more than 600 ms ( $T_5$ ) represents communication error.

When the controller receives an unconfigured command, it sends status information as command error.



## 9. Command Description

### 9-1. Movement command

#### 9-1-1. Stop

Code: 10H

Action: Stops the fingers moving

Format: 04H + Address + 10H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H + 00H + 10H + 14H (command), 04H + 00H + 03H + 07H (response)

#### 9-1-2. Original position return

Code: 11H

Action: Returns the fingers to their original positions

Format: 04H + Address + 11H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H + 00H + 11H + 15H (command), 04H + 00H + 03 + 07H (response)

#### 9-1-3. Movement to the specified point in the positive direction

Code: 12H

Action: Moves the fingers by the specified distance at the specified speed and thrust in the positive direction

Format: 07H + Address + 12H + Movement Distance (1 byte) + Speed (1 byte) + Force (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 07H + 00H + 12H + 64H + 32H + 46H + F5H (command)

Movement distance: 1mm, Speed: 50%, Force:70%

Response: 04H+00H+03H+07H

Description: (1) Movement distance

Relatively moves based on the current position in the positive direction

Can be specified up to 2.55 mm in 0.01mm

If you wish to move the fingers in the negative direction, use the command 13 H that is described in section 9-1-4.

(2) Speed

Enter movement speed in percentage

Minimum/Maximum speed may be limited depending on the type of gripper.

(3) Force

Enter gripping force in percentage. This force value is equal to thrust in movement.

#### 9-1-4. Movement by the specified distance in the negative direction

Code: 13H

Action: Moves the fingers by the specified distance at the specified speed and thrust in the negative direction

Format: 07H + Address + 13H + Movement distance (1 byte) + Speed (1 byte) + Force (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 07H + 00H + 13H + 64H + 32H + 46H + F6H (command)

Movement distance: 1mm, Speed: 50%, Force: 70%

04H + 00H + 03H + 07H (response)

Description: (1) Movement distance

Relatively moves based on the current position in the negative direction

Can be specified up to 2.55 mm in 0.01mm

If you wish to move the fingers in the positive direction, use the command 12 H that is described in section 9-1-3.

(2) Speed

Enter movement speed in percentage

Minimum/Maximum speed may be limited depending on the type of gripper.

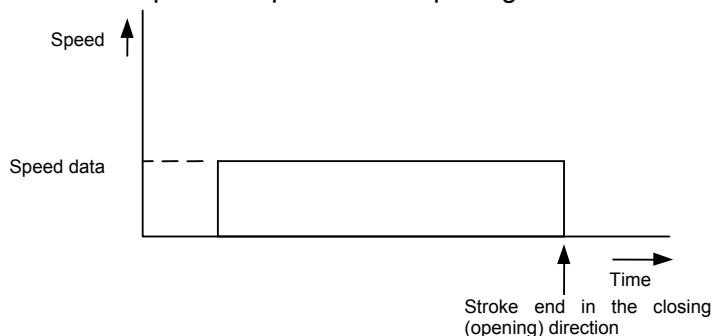
(3) Force

Enter gripping force in percentage. This force value is equal to thrust in movement.

#### 9-1-5. Constant-speed movement (OPEN)

Code: 14H

Action: Moves at the specified speed in the opening direction



Format: 05H + Address + 14H + Speed (1byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 05H+00H+14H+32H+4BH (command), 04H+00H+03H+07H (response)

Description: Speed

Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

### 9-1-6. Constant-speed movement (CLOSE)

Code: 15H

Action: Moves at the specified speed in the opening direction

Format: 05H + Address + 15H + Speed (1byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 05H+00H+15H+32H+4CH (command), 04H+00H+03H+07H (response)

Description: Speed

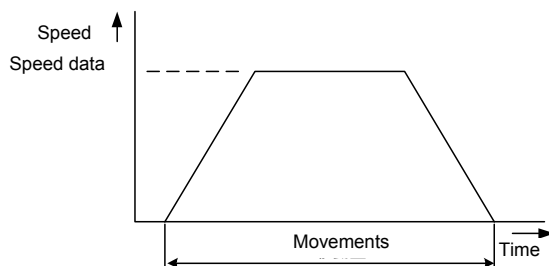
Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

### 9-1-7. Relative movement

Code: 16H

Action: Relatively moves the fingers at the specified speed based on the current position



Format: 09 + Address + 16H + Movement distance (4byte) + Speed (1byte) +Checksum

Response: 04H + Address + Status + Checksum

Example strings: 09H+00H+16H+D0H+07H+00H+00H+32H+28H (command)

Movement distance: 20.00mm, Movement speed: 50%

04H+00H+03H+07H (response)

Description: (1) Movement distance

Relatively moves the fingers based on the current position.

Specify in signed 32bit data in 0.01mm.

Send starting from the lowest 8 bits.

20mm is 2000 in 0.01mm, which is equal to 00007D0H in hexadecimal.

The command string in the "D0H + 07H + 00H + 00H" format is sent starting from the lowest byte.

(2) Speed

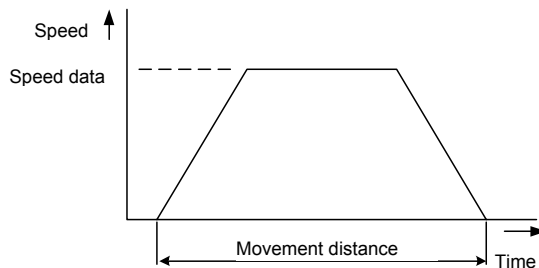
Enter movement speed in percentage

Minimum/Maximum speed may be limited depending on the type of grip.

### 9 - 1 - 8. Absolute movement

Code: 17H

Action: Moves the fingers from the original position to the specified position at the specified speed



Format: 09H + Address + 17H + Movement distance (4 bytes) + Speed (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example: 09H + 00H + 17H + D0H + 07H + 00H + 00H + 32H + 29H (command)

Movement distance: 20.00mm, Speed: 50%

04H+00H+03H+07H (response)

Description (1) Movement distance

Moves to the absolute position from the original position

Specifies in signed 32-bit data in 0.01 mm

Send starting from the lowest 8 bits. 20mm is 2000 in 0.01mm, which is equal to 00007D0H in hexadecimal. 20mm is 2000 in 0.01mm, which is equal to 00007D0H in hexadecimal. The D0H + 07H + 00H + 00H is sent starting from the lowest byte.

(2) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

### 9-1-9. Point movement

Mode: 1AH

Action: Moves according to the point data saved as the point number

Format: 06H + Address + 1AH + Point No. (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 06H+00H+1AH+01H+32H+53H (command)

Point No.:1, Speed: 50%

04H+00H+03H+07H (response)

Description: (1) Point Number

Specify the desired point number

(2) Speed

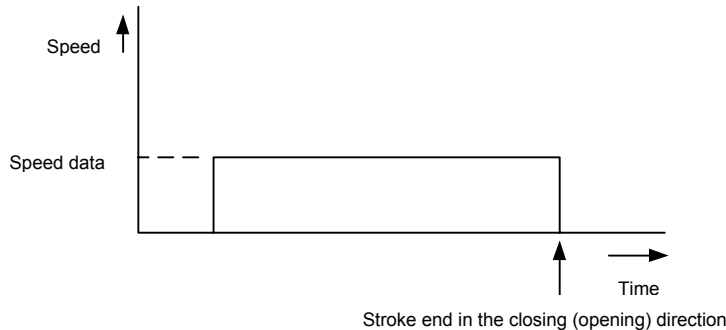
Movement speed in percentage

Actual movement speed: Maximum speed = speed saved as the point number x speed specified by the command. Minimum/Maximum speed may be limit depending on the type of gripper.

### 9-1-10. Constant-speed grip (OPEN)

Code: 20H

Action: Moves the fingers in the opening direction at the specified speed and grips at the specified gripping force.



Format: 06H + Address + 20H + Speed (1 byte) + Force (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 06H+00H+20H+32H+46H+9EH (command)

Speed: 50%, Force: 70%

04H+00H+03H+07H (response)

Description: (1) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may depend on the type of gripper.

(2) Force

Enter gripping force in percentage.

### 9-1-11. Constant-speed grip (CLOSE)

Code: 21H

Action: Moves in the closing direction at the specified speed. Grips a workpiece with the specified gripping force

Format: 06H+Address+21H+Speed (1byte) +Force (1byte) +checksum

Response: 04H+Address+Status+Checksum

Example strings: 06H+00H+21H+32H+46H+9FH (command)

Speed: 50%, Force: 70%

04H+00H+03H+07H (response)

Description: (1) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may depend on the type of gripper.

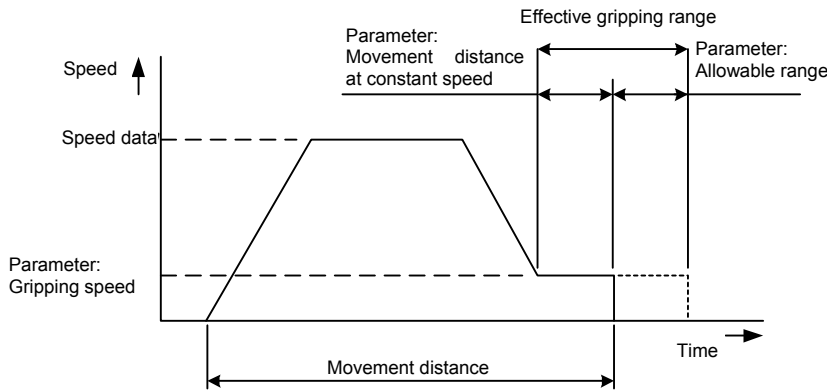
(2) Force

Enter gripping force in percentage.

9-1-12. Accelerated/Decelerated relative movement and grip

Code: 22H

Action: Relatively moves from the current position by the specified movement distance and grip with the specified force.



Format: 0AH+Address+22H+Movement distance (4byte) +Speed (1byte) +Force (1byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 0AH+00H+22H+D0H+07H+00H+00H+32H+46H+7BH

Movement distance: 20.00mm, Speed: 50%, Force: 70%

Response: 04H + 00H + 03H + 07H

Description: (1) Movement distance

Relatively moves from the current position by the specified movement distance  
20mm is 2000 in 0.01mm, which is equal to 00007D0H in hexadecimal. The D0H + 07H + 00H + 00H is sent starting from the lowest byte.

(2) Speed

Enter movement speed in percentage.

Minimum and maximum speed may be limited depending on the type of gripper.

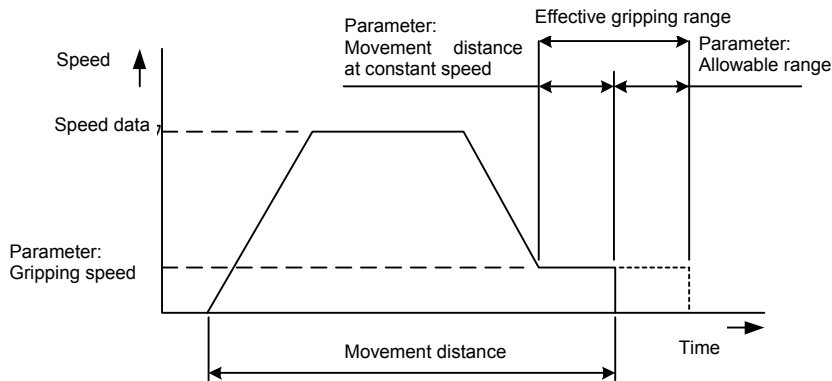
(3) Force

Enter gripping force in percentage.

9-1-13. Accelerated/Decelerated relative movement and grip

Code: 23H

Function: Relatively moves from the current position by the specified movement distance and grips with the specified force.



Format: 0AH + Address + 23H + Movement distance (4 byte) + Speed (1 byte) + Force (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 0AH + 00H + 23H + D0H + 07H + 00H + 00H + 32H + 46H (command)

Movement distance: 20.00mm, Speed: 50%, Force: 70%

Response: 04H + 00H + 03H + 07H

Description (1) Movement distance

Moves from the original position to the absolute position

Relatively moves from the current position by the specified movement distance

20mm is 2000 in 0.01mm, which is equal to 00007D0H in hexadecimal. The D0H + 07H + 00H + 00H is sent starting from the lowest byte.

(2) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

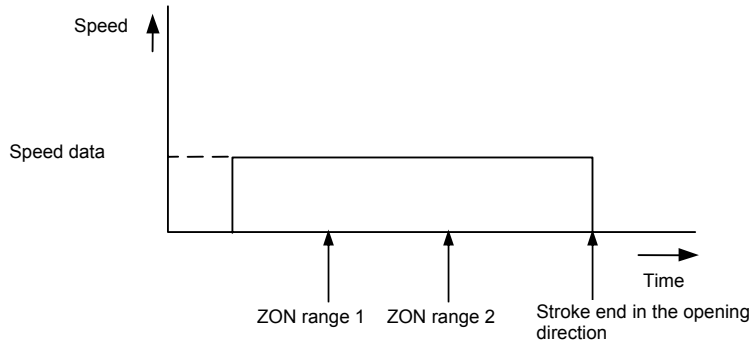
(3) Force

Enter gripping force in percentage.

9-1-14. Constant-speed movement and grip with ZON output (OPEN)

Code: 24H

Action: Moves in the opening direction at constant speed. When the finger stopped within the zone between ZON 1 and ZON 2, the ZON signal is asserted.



Format: OEH + Address + 24H + ZON 1 (4 bytes) + ZON 2 (4 bytes) + Speed (1 byte) + Checksum

Response: 04H Address + Status + Checksum

Example strings: 0EH+00H+24H+F4H+01H+00H+00H+20H+03H+

00H+00H+32H+46H+C2H (command)

ZON 1 : 5mm, ZON 2: 8mm, Speed: 50%, Force: 70%

Response: 04H+00H+03H+07H

Description: (1) ZON 1 and ZON 2

Specify the absolute position in signed 32 bit data in 0.01mm.

When the fingers stop moving within the zone between ZON 1 and ZON 2, the ZON signal is asserted.

(2) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

(3) Force

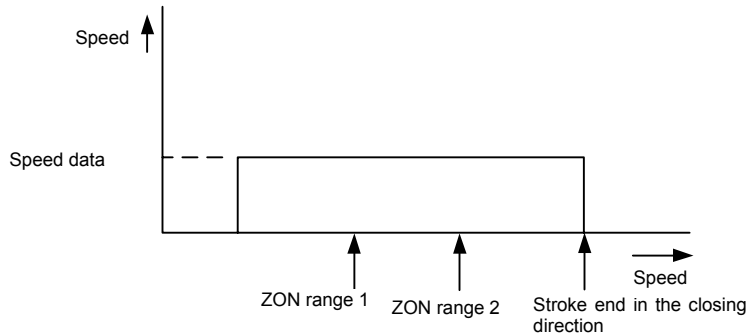
Enter gripping force in percentage.

9-1-15. Constant-speed movement and grip with ZON output (CLOSE)

Code: 25H

Action: Moves in the closing direction at constant speed

The ZON signal is asserted if the fingers stop moving within the zone between ZON1 and ZON2.



Format: 0EH + Address + 25H + ZON1 (4 bytes) + ZON 2 (4 bytes) + Speed (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 0EH + 00H + 25H + F4H + 01H + 00H + 00H + 20H + 03H + 00H + 00H + 32H + 46H + C3H (command)

ZON1: 5mm, ZON2: 8mm, Speed: 50%, Force: 70%

04H+00H+03H+07H (response)

Description: (1) ZON 1, ZON 2

Specify the absolute position in signed 32 bit data in 0.01mm.

The ZON signal is asserted if the fingers stop moving within the zone between ZON 1 and ZON 2.

(2) Speed

Enter movement speed in percentage.

Minimum/Maximum speed may be limited depending on the type of gripper.

(3) Force

Enter gripping force in percentage.

## 9-2. Control command

### 9-2-1. NOP

Code: 30H

Action: Returns response. No action.

Format: 04H + Address + 30H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H + 00H + 30H + 34H (command)

04H + 00H + 00H + 04H (response)

### 9-2-2. Motor excitation

Code: 31H

Action: Excites the motor or enters the device in the non-excitation status

Format: 05H + Address + 31H + Excitation status (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 05H+00H+31H+01H+17H (command)

04H+00H+06H+0AH (in the non-excitation status)

04H+00H+02H+06H (in the excitation status)

Description: Excitation status

00H: In the non-excitation status. SS type fingers can be moved by hand externally

01H: In the excitation status. Used this command for normal movement and grip

### 9-3. Device information check

#### 9-3-1. Reading of version information

Code: 40H

Action: Returns the controller version information

Format: 04H + Address + 40H + Checksum

Response: 0AH + Address + Status + Version No. (6 bytes) + Checksum

Example strings: 04H+00H+40H+44H (command)

0AH+00H+02H+20H+31H+28H+30H+31H+20H + 06H (response)

Version 1.01

Description: Returns version number in 6-byte ASCII code.

#### 9-3-2. Reading of current position

Code: 41H

Action: Reads the current position

Format: 04H + Address + 41H + Checksum

Response: 08H + Address + Status + current position (4 bytes) + Checksum

Example strings: 04H+00H+41H+45H (command)

08H+00H+02H+20H+03H+00H+00H+2DH (response)

Current position: 8.00mm

Description: Returns the current position in signed 32-bit data in 0.01mm

#### 9-3-3. Reading of current point number

Code: 42H

Action: Reads the last number of point that is read

Format: 04H + Address + 42H + Checksum

Response: 05H + Address + Status + Point Number (1byte) + Checksum

Example strings: 04H + 00H + 42H + 46H (command)

05H+00H+02H+03H+0AH (response)

Description: Executed point 3

#### 9-3-4 . Reading of specified parameter

Code: 43H

Action: Reads the specified parameter data

Format: 05H + Address + 43H + Parameter No. (one byte) + Checksum

Response: 06H + Address + Status + Parameter data (2 bytes) + Checksum

Example: 05H + 00H +43H + 01H + 49H (command)

06H+00H+02H+64H+00H+6CH + Soft limit 10.00mm (response)

Description: Return the parameter data in 16-bit data. Refer to the appendix in this instruction manual.

### 9-3-5. Reading of specified point

Code: 44H

Action: Read the specified point data

Format: 05H + Address + 44H + point No. (one byte) + Checksum

Response: 14H + Address + Status + Data (16 bytes) + Checksum

Example strings: 05H+00H+44H+03H+4CH (command)

14h+00h+02h+03h+41h+20h+03h+00h+00H

+64H+00H+00H+00H+00H+00H+00H+00H+00H+00H+E1H

Point No.: 3

Operation mode: Absolute movement

Movement distance: 8.00mm

Speed: 100%

### Description

Details of Point Data

Table 9-1

Item	Byte	Range	Unit
Point No.	1	1-1Fh	
Operation Mode	1	See the table below.	
Signed movement distance	4	F8000001h-7FFFFFFFh	0.01mm/LSB
Speed	1	1-64h	%
Force	1	1-64h	%
ZON 1	4	F8000001h-7FFFFFFFh	0.01mm/LSB
ZON 2	4	F8000001h-7FFFFFFFh	0.01mm/LSB

Operation mode

Table 9-2

Name	Code	Description
Absolute movement	41h	Absolute movement from the original position by the specified distance
Relative movement	49h	Relative movement from the original position by the specified distance
Constant-speed movement and grip (OPEN)	4Fh	Movement in the opening direction at the constant speed and grip a workpiece
Constant-speed movement and grip (CLOSE)	43h	Movement in the closing direction at the constant speed and grip a workpiece
Accelerated/Decelerated Relative Move and Grip	47h	Movement to the specified point by increasing and decreasing speed and grip a workpiece
Accelerated/Decelerated Absolute Move and Grip	48h	Movement to the specified point by increasing and decreasing speed and grip a workpiece
Constant-speed movement and grip with ZON output (OPEN)	4Ah	Movement in the opening direction at constant speed and grip a workpiece (with the ZON signal output)
Constant-speed movement and grip with ZON output (CLOSE)	4Bh	Movement in the closing direction at constant speed and grip an workpiece (with the ZON signal output)

### 9-3-6. Confirming of original position return

Code: 45H

Action: Responds completion or incompleteness of original position return

Format: 04H + Address + 45H + Checksum

Response: 05H + Address + Status + status of original position return (1 byte) + Checksum

Example strings: 04H + 00H + 45H + 49H (command)

05H 00H + 02H + 01H + 08H (response)

Description: Status of original position return

00H: Original position return is not completed.

01H: Original position return is completed.

#### 9-3-7. Motor excitation

Code: 46H

Action: Responds if the motor is excited or not.

Format: 04H + Address + 46H + Checksum

Response: 05H + Address + Status + Status of motor excitation (1 byte) + Checksum

Example strings: 04H + 00H + 46H 4AH (command)

05H + 00H + 02H + 01H + 08H (response)

Description: Excitation status

00H: Non-excitation. If your gripper is SS type, you can externally move the nails by hand.

0H: Non-Excitation. For the SS type gripper, you can move the nails by hand.

01H: In the excitation status. This command is used for normal move or grip.

#### 9-3-8. Reading of alarm and error number

Code: 47H

Action: Reads alarm and error number.

Format: 04H + Address + 47H + Checksum

Response: 05H + Address + Status + Alarm or Error Number (1 byte) + Checksum

Example strings: 04H + 00H + 47H + 4BH (command)

05H + 00H + 02H + 01H + 08H (response)

Alarm 01H: Overload

Description: Refer to the appendix in this instruction manual for details of alarm/error commands.

#### 9-3-9. Reading of cumulative time of energization

Code: 48H

Action: Returns cumulative time that power is supplied to the controller

Format: 04H + Address + 48H + Checksum

Response: 07H + Address + Status + digits of hours of cumulative time of energization (2 bytes) +  
digits of minutes of cumulative time of energization (1 byte) + Checksum

Example strings: 04H + 00H + 48H + 4CH (command)

07H + 00H + 02H + 01H + 00H + 0AH + 14H (response)

Cumulative time: One hour ten minutes

Description: Digit of hours of cumulative time (2 bytes) 0 – FFFFH

Digit of minutes of cumulative time (1 byte) 0 – 3CH

Note: When power supply to the controller is shut down, digit of minutes is truncated.

Time is continuously cumulated after occurrence of alarm.

9-4. Group reading of all data

9-4-1. Continuous reading of point data

Code: 50H

Action: Continuously reads the point data saved as the specified point number.

Format: 05H + Address + 50H + Number of point that is read first (1 byte) + Checksum

Response: XXH + Address + Status + Data1 (16 bytes) + .....+ Data n (16 bytes) + Checksum

The number of data differs depending on the number of point entries.

$$XX = n \cdot 16 + 4 \quad (n = 1-15)$$

Example strings: 05H+00H+50H+03H+58H (command)

14H+00H+02H+03H+41H+20H+03H+00H+00H+64H+00H+00H+00H

00H+00H+00H+00H+00H+00H+00H+E1H (response)

Point No.: 3

Operation mode: Absolute movement

Movement distance: 8.00mm

Speed: 100%

Description: Refer to table 9-1 for details of point data. Maximum 15 point data starting from the command-specified point can be read. The point data that have been deleted are not sent.

9-4-2. Reading of all parameters

Code: 51H

Action: Reads all parameters at a time.

Format : 04H + Address + 51H + Checksum

Response: 68H + Address + Status + Parameter 0 (2 bytes) + .....+ Parameter 31 (2 bytes) + Checksum

Example strings: 04H+00H+51H+55H (command)

68H+00H+02H+6EH+00H+64H+00H+...+00H+00H+DDH (response)

Description: Refer to the appendix in this instruction manual for details of parameters.

### 9-4-3. Reading I/O signal status

Code: 52H

Action: Reads special signal input/output status

Format : 04H + Address + 52H + Checksum

Response: 07H + Address + Status + Data 1 + Data 2 + Data 3 + Checksum (Data 1-3: 1 byte)

Example strings: 04H+00H+52H+56H (command)

07H+00H+02H+00H+00H+00H+09H (response)

Description      Details of data

Data	7bits	6bits	5bits	4bits	3bits	2bits	1bit	0bit
1	INLOK	SEL	START	IPOS4	IPOS3	IPOS2	IPOS1	IPOS0
2	-	ZON	RORG	OPOS4	OPOS3	OPOS2	OPOS1	OPOS0
3	ALM(LED)	READY(LED)	RUN(LED)	HOLD	INPOS	ALRM	BUSY	READY

### 9-4-4. Reading of alarm history

Code: 53H

Action: Reads cumulative time after occurrence of alarm.

Maximum 16 alarms starting from the last one can be read.

Format: 04 + Address + 53H + Checksum

Response: 08H + Address + Status + Digit of hours of cumulative time (2 bytes) + Digit of minutes of cumulative time (1 byte) + Alarm No. (1 byte) + Checksum

Example strings: 04H+00H+53H+57H (command)

08H+00H+02H+03H+00H+14H+01H+21H (response)

Cumulative time: 3 hours and 20 minutes

Alarm 01H: Overload

Description: Digits of hour of cumulative time(2 bytes) 0 – FFFFH

Digit of minutes of cumulative time (1 byte) 0 – 3CH

Refer to the appendix in this instruction manual for details of alarm number 0 – 1FH.

## 9-5. Data writing

### 9-5-1. Writing point data

Code: 60H

Action: Adds new data to the specified point

Format: XXH + Address + 60H + Data 1 (16 bytes) + .....+ Data n (16 bytes) + Checksum

Amount of data differs depending on the number of points to be sent

$XX = n \cdot 16 + 4$  ( $n=1-15$ )

Response: 04H + Address + Status + Checksum

Example strings: 14H+00H+60H+03H+41H+20H+03H+00H+00H+

64H+00H+00H+00H+00H+00H+00H+00H+00H+00H+00H+3FH

Response: 04H+00H+02H+06H

Point Number: 3

Operation mode: Absolute movement

Movement distance: 8.00mm

Speed: 100%

Description: Refer to table 9-1 for details of point data. Maximum 15 point data can be added at a time.

### 9-5-2. Group writing of all parameters

Code: 61H

Action: Writes all parameters to the controller at a time

Format: 68H + Address + 61H + Parameter 0 (2 bytes) + .....+ Parameter 31 (2 bytes) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 68H+00H+61H+6EH+00H+64H+00H+...+00H+00H+DDH (command)

Response: 04H+00H+02H+06H

Description: Refer to the appendix in this instruction manual for details of parameters.

### 9-5-3. Writing a parameter

Code: 62H

Action: Writes a parameter to the controller

Format: 07H + Address + 62H + Parameter No. (1 byte) + Parameter (2 bytes) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 07H+00H+62H+01H+64H+00H+CEH (command)

Response: 04H+00H+02H+06H (response)

Description: Refer to the appendix in this instruction manual for details of parameters.

9-5-4. Writing of point data

Code: 63H

Action: Writes position data

When actually moving the fingers, deassert all IPOS[0:4] and assert START.

Use this command for synchronous start utilizing wiring saving.

Since EEPROM is not used, you can write point data many times.

Format: 14H + Address + 63H + Data (16 bytes) + Checksum

Details of data

Table 1

Item	# bytes	Range	Unit
Point No.	1	0h (fixed)	
Operation mode	1	Refer to table 9-2 in the RS 485 communication instruction manual	
Signed movement distance	4	F8000001h - 7FFFFFFFh	0.01mm/LSB
Speed	1	1 - 64h	%
Force	1	1 - 64h	%
ZON 1	4	F8000001h - 7FFFFFFFh	0.01mm/LSB
ZON 2	4	F8000001h - 7FFFFFFFh	0.01mm/LSB

Response: 04H + Address + Status + Checksum

Example strings: Command: 14H+00H+63H+00H+41H+20H+03H+00H+00H+

64H+64H+00H+00H+00H+00H+00H+00H+00H+00H+00H+00H+3FH

Response: 04H+00H+00H+04H

Operation mode: Absolute movement

Movement distance: 8.00mm

Speed: 100%

Note:

1. After executing this command, you cannot return the fingers to their original positions using I/O signals.
2. The point data will be erased after the power supply to the controller is shut down.
3. After reenergizing the controller, deassert IPOS [0:4] and assert START to return the fingers to their original positions.

## 9-6. Initialization of point data

### 9-6-1. Deleting the point data

Code: 70H

Action: Deletes a sequence of point data

Format: 06H + Address + 70H + number of point that is deleted first (1 byte) + number of points that are deleted (1 byte) + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 06H+00H+70H+05H+04H+7FH (command)

04H+00H+02H+06H (response)

Four points of point 5 to point 9 are deleted.

### 9-6-2. Initialization of all point data

Code:70H

Action: Deletes all point data

Format: 04H + Address + 71H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H+00H+71H+75H (command)

04H+00H+02H+06H (response)

### 9-6-3. Initialization of all parameters

Code: 72H

Action: Initializes all parameters at a time

Format: 06H + Address + 72H + Paramter No. (2 bytes) + Checksum

Response: 04H+ Address + Status + Checksum

Example strings: 06H+00H+72H+6EH+00H+E6H (command)

04H+00H+02H+06H (response)

This command is available for SS20 type actuator.

Description: List of actuator types

Gripper Model	SS20	SS28	SS42	SD20	SD28	SD42	FS(T)20	FS(T)28
Actuator type	110	120	130	210	220	230	310	320

### 9-6-4. Deletion of alarm history

Code: 73H

Action: Deletes all alarm history

Format: 04H + Address + 73H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H+00H+73H+77H (command)

04H+00H+02H+06H (response)

9-6-5. Deletion of cumulative time

Code: 74H

Function: Resets cumulative time to zero

Format: 04H + Address + 74H + Checksum

Response: 04H + Address + Status + Checksum

Example strings: 04H+00H+74H+78H (command)

04H+00H+02H+06H(response)

10. Appendix

10-1. Table of commands

Category	Command Name	Code	Command/Response	Data	Data Name	Range	Unit	Remarks
Move instruction	Stop	10h	Command					
	Original position return	11h	Command					
	Positive-directional movement by specified distance	12h	Command	1	Relative movement distance	1-FFh	0.01mm/LS	
				2	Speed	1-64h	%	*1
				3	Force	0-64h	%	
	Negative-directional movement by specified distance	13h	Command	1	Relative movement distance	1-FFh	0.01mm/LS	
				2	Speed	1-64h	%	*1
				3	Force	0-64h	%	
	Constant-speed movement (OPEN)	14h	Command	1	Speed	1-64h	%	*1
	Constant-speed movement (CLOSE)	15h	Command	1	Speed	1-64h	%	*1
	Relative move	16h	Command	1-4	Signed relative movement distance	F800001h-7FFFFFh	0.01mm/LS	
				5	Speed	0-64h	%	*2
	Absolute movement	17h	Command	1-4	Signed absolute movement distance	F800001h-7FFFFFh	0.01mm/LS	
				5	Speed	0-64h	%	*2
	Point movement	1Ah	Command	1	Point Number	1-1Fh		
				2	Speed	0-64h	%	*2
	Constant-speed movement and grip (OPEN)	20h	Command	1	Speed	0-64h	%	*2
				2	Force	0-64h	%	
	Constant-speed move and grip (CLOSE)	21h	Command	1	Speed	0-64h	%	*2
				2	Force	0-64h	%	
Accelerated/Decelerated relative movement and grip	22h	Command	1-4	Signed relative movement distance	F800001h-7FFFFFh	0.01mm/LS		
			5	Speed	0-64h	%	*2	
			6	Force	0-64h	%		
Absolute move and grip	23h	Command	1-4	Signed relative movement distance	F800001h-7FFFFFh	0.01mm/LS		
			5	Speed	0-64h	%	*2	
			6	Force	0-64h	%		
Constant-speed movement and grip with ZON output (OPEN)	24h	Command	1-4	Position at which ZON was asserted	F800001h-7FFFFFh	0.01mm/LS		
			5-8	Position at which ZON was deasserted	F800001h-7FFFFFh	0.01mm/LS		
			9	Speed	0-64h	%	*2	
			10	Force	0-64h	%		
Constant-speed move and grip with ZON output (CLOSE)	25h	Command	1-4	Position at which ZON was asserted	F800001h-7FFFFFh	0.01mm/LS		
			5-8	Position at which ZON was deasserted	F800001h-7FFFFFh	0.01mm/LS		
			9	Speed	0-64h	%	*2	
			10	Force	0-64h	%		
Control instruction	NOP	30h	Command					
	Excitation of motor	31h	Command	1	0: Non-excitated, 1:Excited			
Status	Read version information	40h	Command	0	Version number			
			Response	6			ASCII code " 0.01_ "	
	Read current position	41h	Command	0				
			Response	1-4	Singed current position	F800001h-7FFFFFh	0.01mm/LS	
	Read current point number	42h	Command	0				
			Response	1	Point number	1-1Fh		
	Read specified parameter	43h	Command	1	Parameter number	1-3Fh		
			Response	2	Parameter data	0-FFFFh		
	Read specified point data	44h	Command	1	Point number	1-1Fh		
			Response	1	Point number	1-1Fh		

check				2	Operation mode	See the operation mode table F3000001h-7FFFFFFh		
				3-6	Signed movement distance	Fh	0.01mm/LS	
				7	Speed	0-64h	%	
				8	Force	0-64h	%	
				9-12	Position at which ZON is asserted	F3000001h-7FFFFFFh	0.01mm/LS	
				13-16	Position at which ZON is deasserted	F3000001h-7FFFFFFh	0.01mm/LS	
		Confirmation of status of original position return	45h	Command	0			
				Response	1	0: Not complete 1: Complete		
		Confirmation of excitation of motor	46h	Command	0			
				Response	1	0: Not excited, 1: Excited		
	Read alarm and error number	47h	Command	0				
			Response	1	Alarm and Error number	0-FFh		
	Read cumulative time	48h	Command	0				
			Response	2	Cumulative time (digit of hour)	0-FFFFh	Time	
				1	Cumulative time (digit of minutes)	0-3Ch		
Read all data	Continuous read of point data	50h	Command	1	Start point	1-1Fh		Read 15 points starting from start point
			Response	1	Point number	1-1Fh		Data length differs depending on the number of points. Deleted point data are not sent.
				2	Operation mode	See the operation mode table F8000001h-7FFFFFFh		
				3-6	Movement distance with sign	Fh	0.01mm/LS	
				7	Speed	0-64h	%	
				8	Force	0-64h	%	
				9-12	Position at which ZON is asserted	F8000001h-7FFFFFFh	0.01mm/LS	
				13-16	Position at which ZON is deasserted	F8000001h-7FFFFFFh	0.01mm/LS	
				17-240	Repeat Data 1 to 16			
				Read all parameters	51h	Command	0	
			Response	1-2	Parameter PRMO	0-FFFFh	Fixed length	
				≈	≈			
				63-64	Parameter PRM31	0-FFFFh		
	Read I/O signal status	52h	Command	0				
			Response	1-3	Refer to I/O monitor data format			
	Read alarm history	53h	Command	0				
			Response	1-2	Cumulative time (hour)		Truncate less than one hour when the power is turned off.	
				3	Time (minute)		Time after power ON (in minute)	
				4	Alarm No.	0-FFh	Fixed length	
				5-64	Repeat Data 1 to 4			
Write data	Write point data	60h	Command	1	Point No.	1-1Fh		Data length differs depending on the number of points.
				2	Operation mode	See the operation mode table F8000001h-7FFFFFFh		
				3-6	Signed movement distance	Fh	0.01mm/LS	
				7	Speed	0-64h	%	
				8	Force	0-64h	%	
				9-12	Position at which ZON was asserted	F8000001h-7FFFFFFh	0.01mm/LS	

				13-16	Position at which ZON was deasserted	F8000001 h-7FFFFF Fh	0.01mm/LS B	
				17-240	Repeat Data 1 to 16			
	Write parameters	61h	Command	1-2 ≈	Parameter PRMO	0-FFFFh		Fixed length
				63-64	Parameter PRM31	0-FFFFh		
	Write a parameter	62h	Command	1	Parameter number	0-3Fh		
			Command	2-3	Parameter data	0-FFFFh		
Initialize data	Delete point data	70h	Command	1	Number of point to be deleted first	1-1Fh		
				2	Number of points to be deleted	1-1Fh		
	Initialize all point data	71h	Command					
	Initialize all parameters	72h	Command	1	Actuator type	1-FFh		
	Erase alarm history	73h	Command	0				
Reset cumulative time	74h	Command	0					

\*1 Maximum speed = Command speed

\*2 Maximum Speed = Maximum speed of PRM30 Actuator (pps) x Command speed (%) x Maximum program speed of PRM9 (%) / 10000

10-2. Table of parameters

No.	Name	Input range
0	Actuator type	0~65535
1	(+) Soft limit	0~999.9 (in 0.1mm)
2	(-) Soft limit	-999.9~0 (in 0.1mm)
3	Stroke	0~999.9 (in 0.1mm)
4	Configured	
5	Return direction	0:OPEN, 1:CLOSE
6	Return speed	Program speed min. ~ 50 (%)
7	Original position shift	-999.9~999.9 (in 0.1mm)
8	Acceleration	1~100(%)
9	Maximum program speed	1~100(%)
10	Gripping speed	1~100(%)
11	Constant-speed movement distance	0.01~99.99 (in 0.1mm)
12	Limit width	0.01~99.99 (in 0.01mm)
13	Positioning completion pulse	1~4000 (pulse)
14	Configured	
15	Configured	
16	Return method	0: Stroke end, 1: Stroke end + Z phase detection method
17	Configured	
18	No parameter entry	
19	No parameter entry	
20	No parameter entry	
21	Configured	
22	Configured	
23	Configured	
24	Configured	
25	Configured	
26	Configured	
27	Configured	
28	Configured	
29	Configured	
30	Configured	
31	Configured	

10-3. Table of alarm and error messages

No.	Message	Definition	Possible cause	What to do
01h	OVER LOAD	Motor overload	<p>Problem in use</p> <p>Motor failure</p> <p>Parameter failure</p> <p>Capacity shortage of power line</p> <p>Large friction of working part</p>	<p>Reduce operation duty of working part.</p> <p>Specify lower acceleration parameter.</p> <p>Specify proper parameter of mass of moving parts.</p> <p>Replace motor assy if armature resistance of motor is low, or if you feel it is extremely heavy to turn handle by hand.</p> <p>Initialize parameters (check working part number).</p> <p>Check capacity of power supply.</p> <p>If it is lacking, increase capacity of power supply.</p>
02h	OVER CURRENT	Motor overcurrent	<p>Shorted motor cable</p> <p>Motor failure</p> <p>Controller failure</p> <p>Parameter failure</p>	<p>Check motor cable for conductivity. If any abnormalities are found, replace motor assy.</p> <p>In the event of short circuit, replace motor.</p> <p>In the case where resistance is less than <math>x</math> ohm between motor terminal <math>\phi A</math> and <math>\phi \underline{A}</math> or between <math>\phi B</math> and <math>\phi \underline{B}</math>, replace controller due to output transistor failure.</p> <p>Initialize parameters (check working part number).</p>
03h	MACHINE REFERENCE OVER	Phase lag of Z phase of encoder	<p>Replaced gripper</p> <p>Nails were replaced when original position is set to closing direction.</p> <p>Broken or damaged line for sending Z phase signal to encoder.</p>	<p>Initialize parameters</p> <p>Initialize parameters</p> <p>Set original positions in the opening direction</p> <p>Replace the gripper</p>
04h	POWER SUPPLY VOLTAGE LOW	Power supply voltage dropped down to less than 80% of rated power supply voltage.	Capacity shortage of power line	Check power capacity. If it is lacking, increase capacity of power supply (largest amount of power is consumed when making a bump at end of stroke, starting moving parts, mechanical section, and accelerating/decelerating the gripper).
05h	DATA NOT WRITE	Writing data into ROM is not possible.	End of service life of ROM or ROM failure	Replace controller.

06h	P.E. COUTNER OVER	Overflow of position deviation	Mechalock  Broken motor cable and wrong connection of motor cable Parameter failure	Check if moving parts of mechanical parts are mechanically locked. Check connection between motor cable and encoder signal cable. Initialize parameters (check mechanical part number).
07h	PNT DATA DESTROY	Point data are broken.	Backup circuit failure  Power was shut down during data writing. Data broken by external noise	Check point data after applying power to gripper. If some data are damaged, modify the data. If all data are damaged, reload data after initializing point data. Even though no damaged data are found, rewrite any data to check to make sure data are not damaged. Check noise environment.
08h	PRM DATA DESTROY	Parameter data are broken.	Backup circuit failure Power was shut down during data writing. Data was damaged by external noise.	Turn on power and initialize parameters  Check noise environment
09h	SYSTEM FAULT1	Software went out of control at M16C side	External noise or other causes made software uncontrolled.	Check noise environment
0ah	FEEDBACK ERROR1	Motor control and force control is impossible	Misalignment between excitation position and encoder position is caused by initial process errors at the time of turning power on. When external applied was applied to nails, they were positioned out of soft limit. Encoder count error was caused by external noise.	Turn off and on power and make sure to check no external load is applied to nails and return fingers to their original positions Check noise environment
0bh	FEEDBACK ERROR2	Encoder signal cable is broken.	Encoder signal cable is broken.	Check connection with encoder signal cable
0ch	ABNORMAL VOLTAGE	Over voltage	Surge of power supply voltage was caused by regeneration. Wrong power supply settings	Reduce operation duty of mechanical parts Check power supply pressure.
0dh	SYSTEM FAULT2	Software went out of control at H8S side	External noise or other causes made software uncontrolled.	Check noise environment
0eh	FEEDBACK ERROR3	Motor cable is broken, misconnected, overloaded.	Broken motor cable and incorrect connection	Check connection with motor cable.

10-4. Table of error messages

No.	Message	Definition	Possible cause	What to do
20h	OVER SOFT LIMIT	Exceeded Soft limit	During jog feeding, direct teaching, or teaching playback, position out of soft limit range was specified.	Recheck soft limit.
21h	PULSE OVERFLOW	Yielded pulse has been overflowed.	The machine did not perform operations according to preset operation pattern.	Recheck settings of acceleration/deceleration speed, maximum limit of speed, load, and regeneration load.
22h	I/O LOGIC ERROR	Wrong logic signal was input to I/O connector.	Signal other than interlock signal was input during operation.	Check input signal.
23h	RETURN ERROR	Movement instruction was executed before the fingers return to their original positions	The fingers failed to return to their original positions.	Return the fingers to their original positions.
24h	SERVO OFF	Movement instruction was executed when servo is off.	Movement instruction was executed before servo is turned on.	Make the controller enter in servo on communication status.
25h	INTERLOCK	Movement command was executed when interlock function was asserted.	Interlock function is not cancelled.	Check interlock signal input is cancelled. (input ON: deasserted.)
26h	NO POINT DATA	Operation cannot be performed, since point having no point data is specified.	Point having no point data is specified.	Check specified point has point data.
27h	OPERATION IN PROGRESS	Execution instruction was input in operation.	Execution instruction was input during operation.	Check input signal.
28h	PROCESS IN PROGRESS	A command was input during data writing.	A command was input during data writing.	Send the command after the BUSY signal was deasserted.
29h	No ORIGINAL POSITION	No Z phase was detected.	Incorrect actuator type was entered. Signal cable of Z phase is broken.	Initialize parameters. Check conductivity of the cable.

30h	NETWORK COMMUNICATION ERROR	Check sum error Parity error Timeout  Overflow	Checksum computing program, parity setting, noise affection, overlong cable Command of data length being longer than specified was output. Commands are sent in a row.	Review program. Check parity setting, ambient noise, and cable length.  Check command. Check response from controller.
31h	COMMUNICATION COMMAND ERROR	Controller received communication commands in unspecified format. Data length of the communication command is incorrect.	Communication command in specified format was not sent. Data length of the communication command is incorrect.	Check commends.  Check data length.
32h	DATA ERROR	Data value out of range is specified.	Incorrect data value	Check data value
33h	NO ACTUATOR CODE	Incorrect actuator type was entered after parameters were initialized.	Unknown actuator type was entered.	Check for correct actuator type.

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