15. COMMUNICATION FUNCTIONS

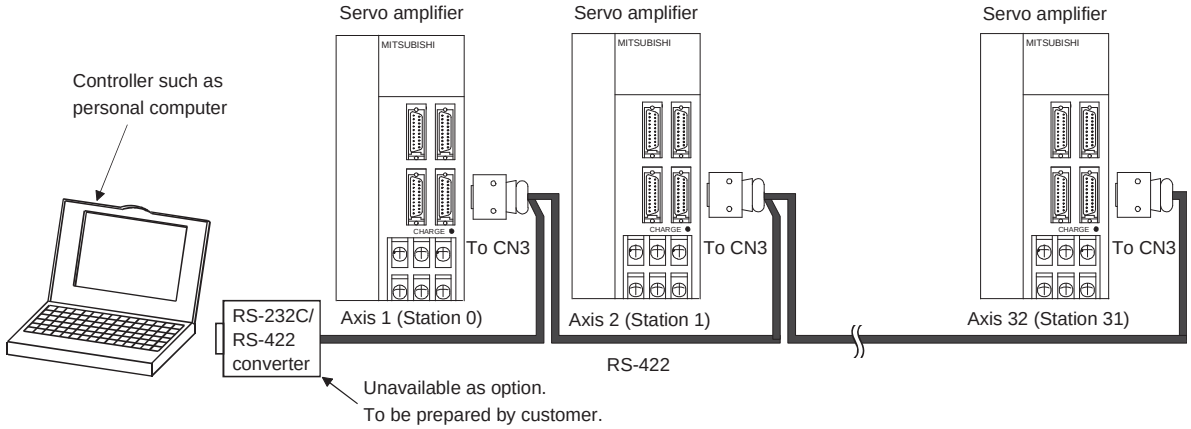
This servo amplifier has the RS-422 and RS-232C serial communication functions. These functions can be used to perform servo operation, parameter changing, monitor function, etc.
However, the RS-422 and RS-232C communication functions cannot be used together. Select between RS-422 and RS-232C with parameter No.16. (Refer to section 15.2.2.)

15.1 Configuration

15.1.1 RS-422 configuration

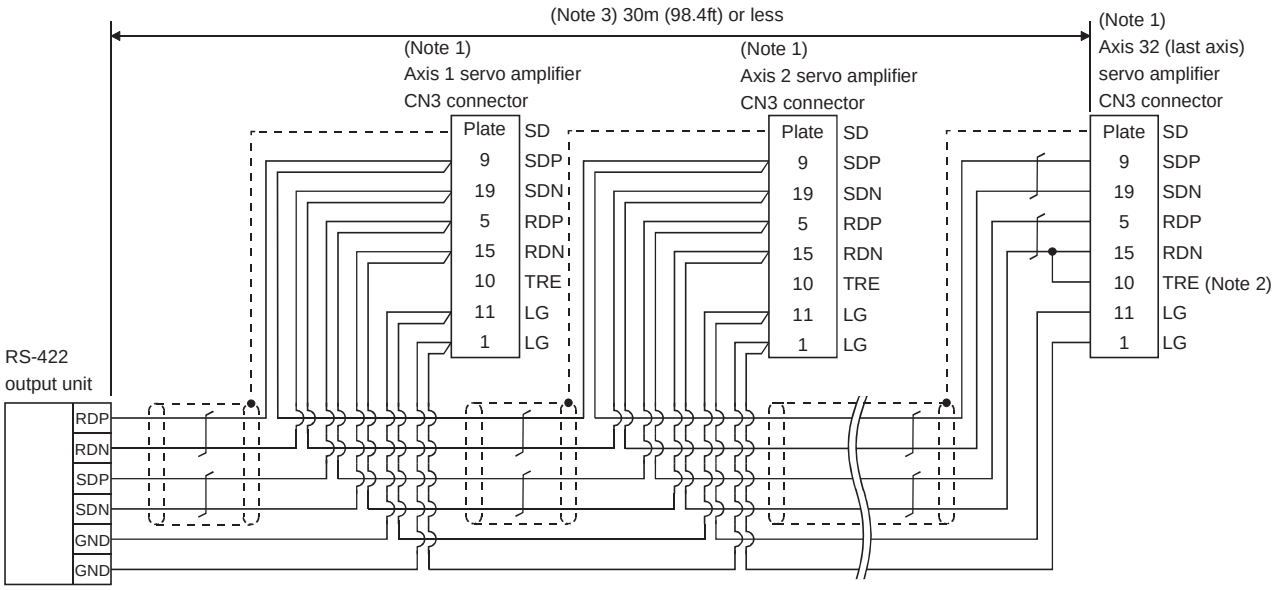
(1) Outline

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.



(2) Cable connection diagram

Wire as shown below.

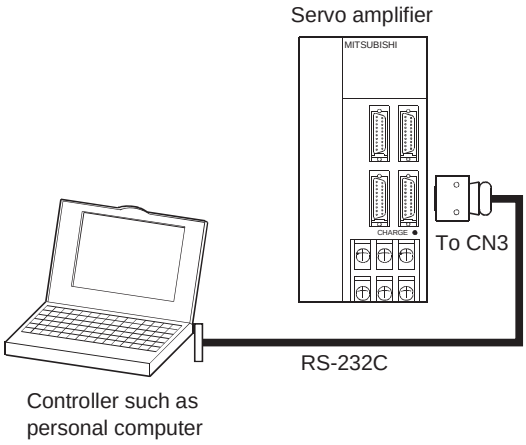


Note 1. Connector set MR-J2CN1 (3M)
Connector: 10120-3000PE
Shell kit: 10320-52F0-008
2. In the last axis, connect TRE and RDN.
3. 30m (98.4ft) or less in environment of little noise.

15.1.2 RS-232C configuration

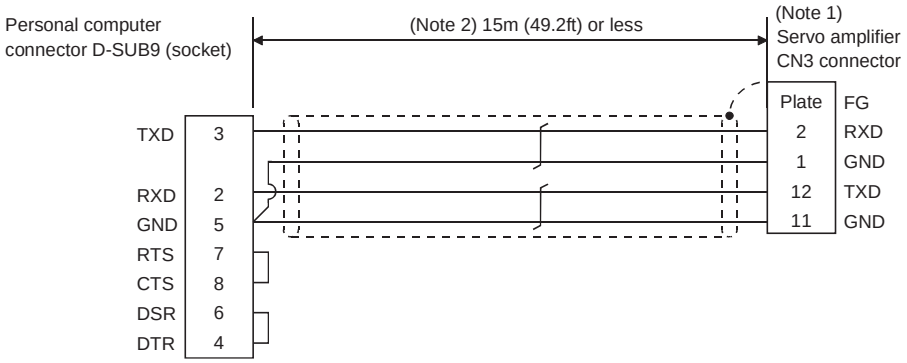
(1) Outline

A single axis of servo amplifier is operated.



(2) Cable connection diagram

Wire as shown below. The communication cable for connection with the personal computer (MR-CPCATCBL3M) is available. (Refer to section 14.1.4.)



Note 1. Connector set MR-J2CN1 (3M)
Connector: 10120-6000EL
Shell kit: 10320-3210-000

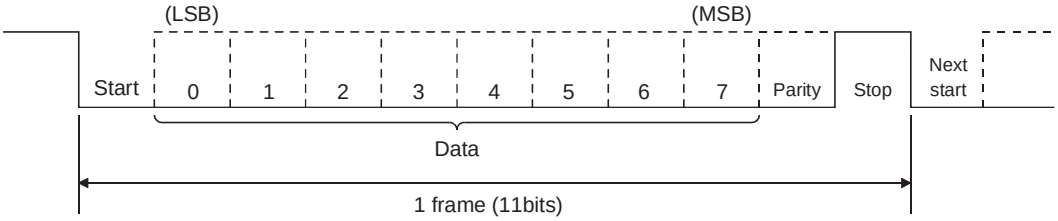
2. 15m (49.2ft) or less in environment of little noise. However, this distance should be 3m (9.84ft) or less for use at 38400bps or more baud rate.

15.2 Communication specifications

15.2.1 Communication overview

This servo amplifier is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (servo amplifier) is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

Item	Description
Baud rate	9600/19200/38400/57600 asynchronous system
Transfer code	Start bit : 1 bit Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system



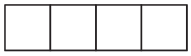
15.2.2 Parameter setting

When the RS-422/RS-232C communication function is used to operate the servo, set the communication specifications of the servo amplifier in the corresponding parameters.
After setting the values of these parameters, they are made valid by switching power off once, then on again.

(1) Serial communication baud rate

Choose the communication speed. Match this value to the communication speed of the sending end (master station).

Parameter No. 16

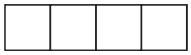


Communication baud rate
0: 9600[bps]
1: 19200[bps]
2: 38400[bps]
3: 57600[bps]

(2) Serial communication selection

Select the RS-422 or RS-232C communication standard. RS-422 and RS-232C cannot be used together.

Parameter No. 16

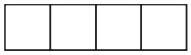


Serial communication standard selection
0: RS-232C used
1: RS-422 used

(3) Serial communication response delay time

Set the time from when the servo amplifier (slave station) receives communication data to when it sends back data. Set "0" to send back data in less than 800μs or "1" to send back data in 800μs or more.

Parameter No. 16



Serial communication response delay time
0: Invalid
1: Valid, reply sent in 800μs or more

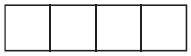
(4) Station number setting

Set the station number of the servo amplifier in parameter No. 15. The setting range is stations 0 to 31.

(5) Protocol station number selection

When communication is made without setting station numbers to servo amplifiers, choose "no station numbers" in parameter No. 57. The communication protocol will be free of station numbers.

Parameter No. 57



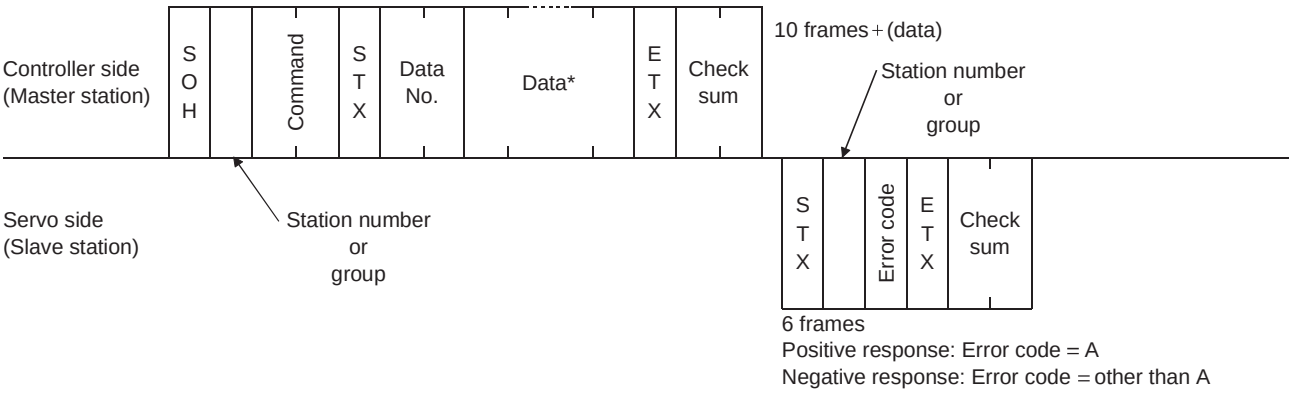
Protocol station number selection
0: With station numbers
1: No station numbers

15.3 Protocol

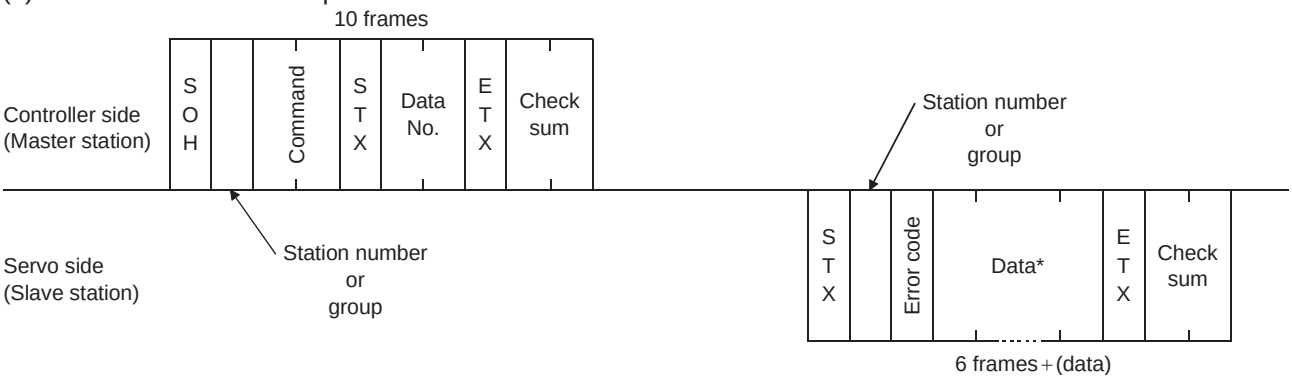
> **POINT**
>
> ▪ Whether station number setting will be made or not must be selected if the RS-232C communication function is used. Note that choosing "no station numbers" in parameter No. 57 will make the communication protocol free of station numbers.

Since up to 32 axes may be connected to the bus, add a station number or group to the command, data No., etc. to determine the destination servo amplifier of data communication. Set the station number to each servo amplifier using the parameter and set the group to each station using the communication command. Transmission data is valid for the servo amplifier of the specified station number or group.
When "*" is set as the station number added to the transmission data, the transmission data is made valid for all servo amplifiers connected. However, when return data is required from the servo amplifier in response to the transmission data, set "0" to the station number of the servo amplifier which must provide the return data.

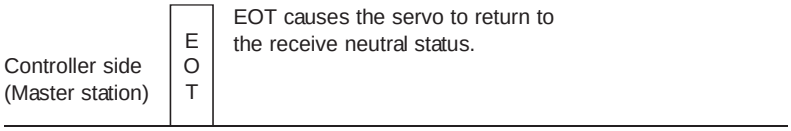
(1) Transmission of data from the controller to the servo



(2) Transmission of data request from the controller to the servo

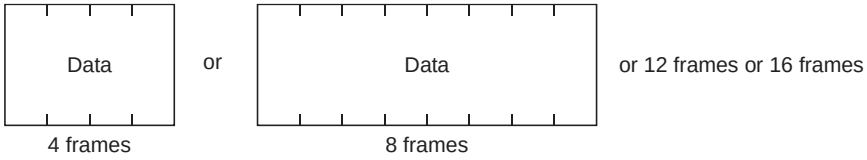


(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



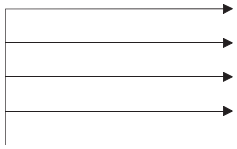
15.4 Character codes

(1) Control codes

Code name	Hexadecimal (ASCII code)	Description	Personal computer terminal key operation (General)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data

ASCII codes are used.



b_8	0	0	0	0	0	0	0	0
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8 to b_5	b_4	b_3	b_2	b_1
	0	0	0	0
	0	0	0	1
	0	0	1	0
	0	0	1	1
	0	1	0	0
	0	1	0	1
	0	1	1	0
	0	1	1	1
	1	0	0	0
	1	0	0	1
	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

R \ C	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC_1	!	1	A	Q	a	q
2	STX	DC_2	“	2	B	R	b	r
3	ETX	DC_3	#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			‘	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	|
13			–	=	M	]	m	}
14			.	>	N	^	n	¯
15			/	?	O	_	o	DEL

(3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the ASCII unit codes are used to specify the stations.

Station number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal for the station number of "0" (axis 1).

(4) Group

Group	a	b	c	d	e	f	All group
ASCII code	a	b	c	d	e	f	*

For example, "61H" is transmitted in hexadecimal for group a.

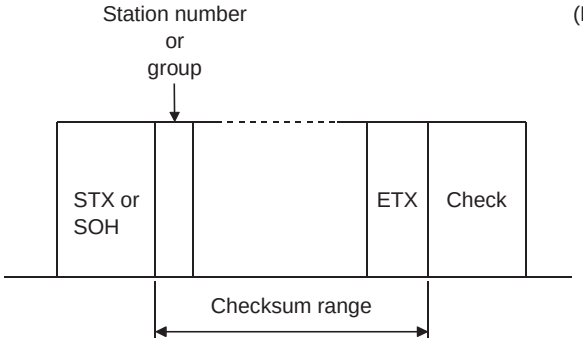
15.5 Error codes

Error codes are used in the following cases and an error code of single-code length is transmitted.
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station.
The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

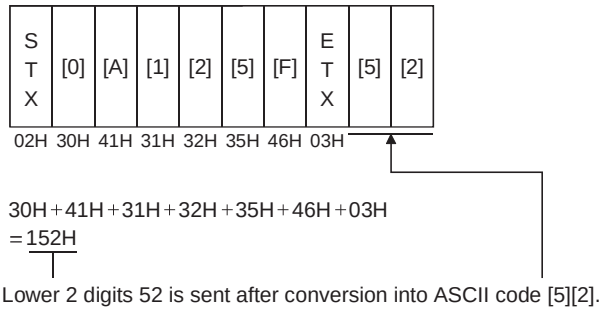
Error code		Error name	Description	Remarks
Servo normal	Servo alarm			
[A]	[a]	Normal operation	Data transmitted was processed properly.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	Character not existing in the specifications was transmitted.	
[E]	[e]	Command error	Command not existing in the specifications was transmitted.	
[F]	[f]	Data No. error	Data No. not existing in the specifications was transmitted.	

15.6 Checksum

The checksum is a ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).

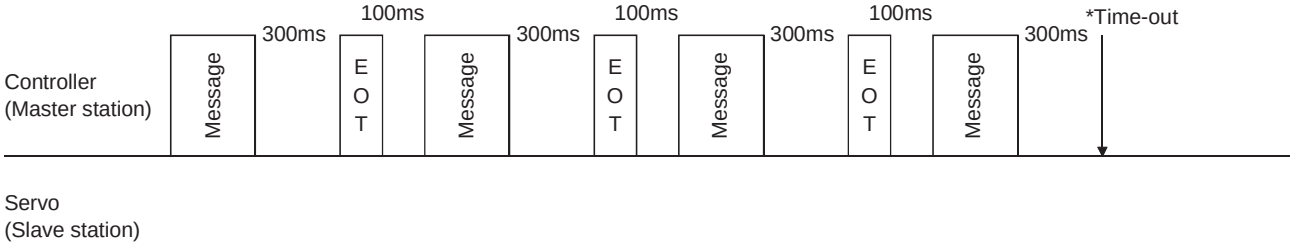


(Example)



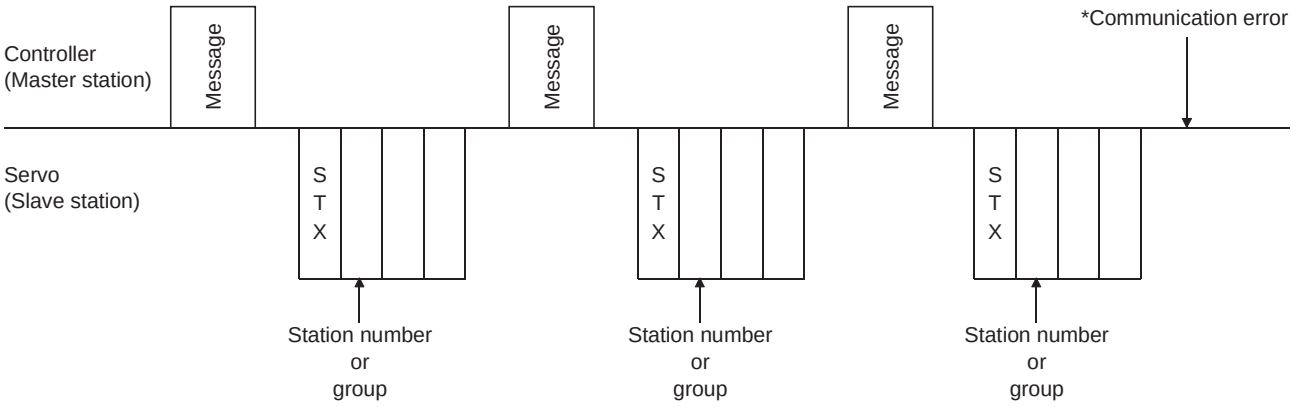
15.7 Time-out operation

The master station transmits EOT when the slave station does not start reply operation (STX is not received) 300[ms] after the master station has ended communication operation. 100[ms] after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above operation three times. (Communication error)



15.8 Retry operation

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (Retry operation). A communication error occurs if the above operation is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry operation is performed three times.

15.9 Initialization

After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after.

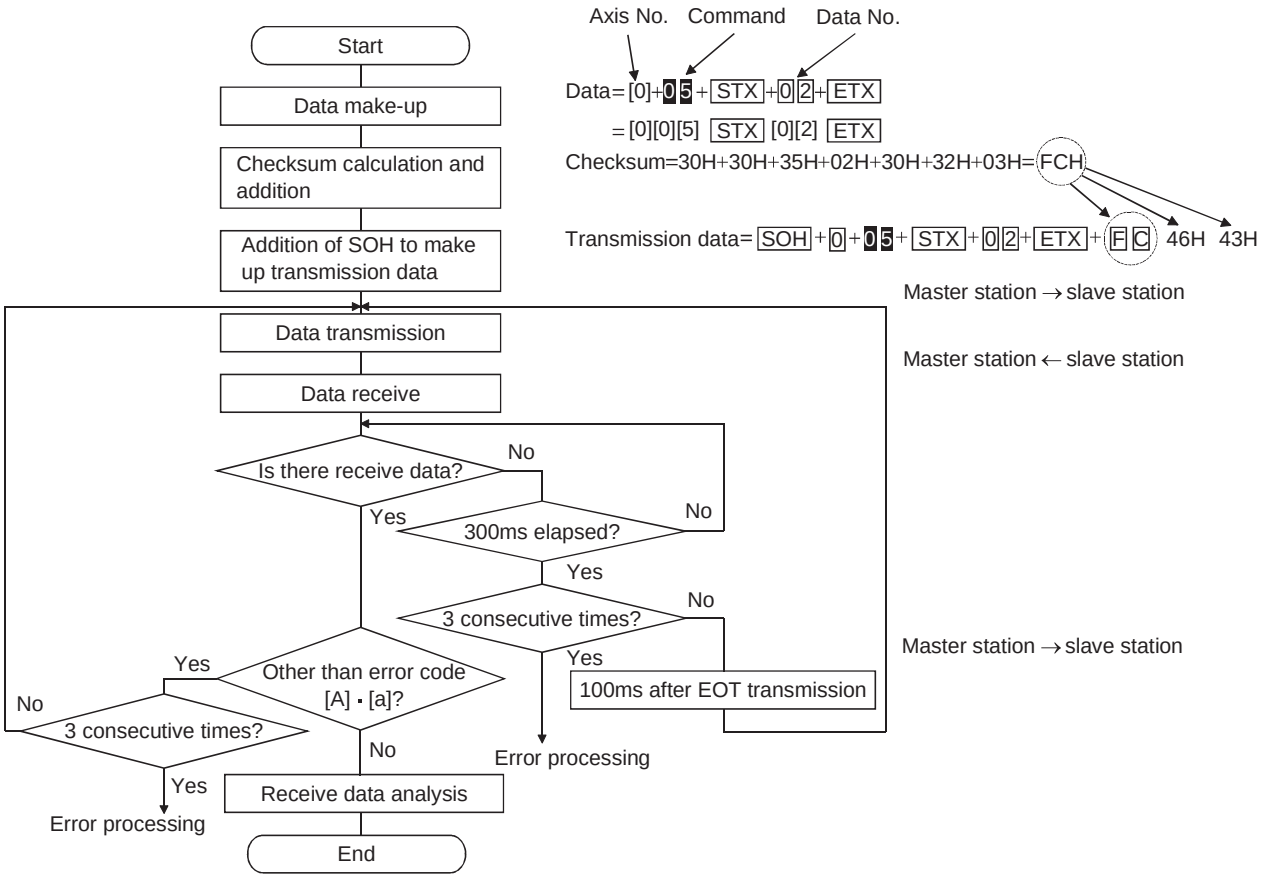
(1) 1s or more time has elapsed after the slave station is switched on; and

(2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

15.10 Communication procedure example

The following example reads the set value of parameter No.2 "function selection 1" from the servo amplifier of station 0.

Data item	Value	Description
Station number	0	Servo amplifier station 0
Command	05	Read command
Data No.	02	Parameter No.2



15.11 Command and data No. list

> **POINT**
> - If the command/data No. is the same, its data may be different from the interface and drive units and other servo amplifiers.

15.11.1 Read commands

(1) Status display (Command [0][1])

Command	Data No.	Description	Display item	Frame length
[0][1]	[8][0]	Status display data value and processing information	Current position	12
[0][1]	[8][1]		Command position	12
[0][1]	[8][2]		Command remaining distance	12
[0][1]	[8][3]		Program No.	12
[0][1]	[8][4]		Step No.	12
[0][1]	[8][5]		Cumulative feedback pulses	12
[0][1]	[8][6]		Servo motor speed	12
[0][1]	[8][7]		Droop pulses	12
[0][1]	[8][8]		Override	12
[0][1]	[8][9]		Torque limit voltage	12
[0][1]	[8][A]		Regenerative load ratio	12
[0][1]	[8][B]		Effective load ratio	12
[0][1]	[8][C]		Peak load ratio	12
[0][1]	[8][D]		Instantaneous torque	12
[0][1]	[8][E]		Within one-revolution position	12
[0][1]	[8][F]		ABS counter	12
[0][1]	[9][0]		Load inertia moment ratio	12
[0][1]	[9][1]		Bus voltage	12

(2) Parameter (Command [0][5])

Command	Data No.	Description	Frame length
[0][5]	[0][0] to [5][A]	Current value of each parameter The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8

(3) External I/O signals (Command [1][2])

Command	Data No.	Description	Frame length
[1][2]	[0][0]	Input device statuses	8
[1][2]	[4][0]	External input pin statuses	8
[1][2]	[6][0]	Statuses of input devices switched on through communication	8
[1][2]	[8][0]	Output device statuses	8
[1][2]	[C][0]	External output pin statuses	8

(4) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm occurrence sequence	Frame length
[3][3]	[1][0]	Alarm number in alarm history	Most recent alarm	4
[3][3]	[1][1]		First alarm in past	4
[3][3]	[1][2]		Second alarm in past	4
[3][3]	[1][3]		Third alarm in past	4
[3][3]	[1][4]		Fourth alarm in past	4
[3][3]	[1][5]		Fifth alarm in past	4
[3][3]	[2][0]	Alarm occurrence time in alarm history	Most recent alarm	8
[3][3]	[2][1]		First alarm in past	8
[3][3]	[2][2]		Second alarm in past	8
[3][3]	[2][3]		Third alarm in past	8
[3][3]	[2][4]		Fourth alarm in past	8
[3][3]	[2][5]		Fifth alarm in past	8

(5) Current alarm (Command [0][2] · [3][5])

Command	Data No.	Description	Frame length
[0][2]	[0][0]	Current alarm number	4

Command	Data No.	Description	Status display item	Frame length
[3][5]	[8][0]	Status display data value and processing information at alarm occurrence	Current position	12
[3][5]	[8][1]		Command position	12
[3][5]	[8][2]		Command remaining distance	12
[3][5]	[8][3]		Program No.	12
[3][5]	[8][4]		Step No.	12
[3][5]	[8][5]		Cumulative feedback pulses	12
[3][5]	[8][6]		Servo motor speed	12
[3][5]	[8][7]		Droop pulses	12
[3][5]	[8][8]		Override	12
[3][5]	[8][9]		Torque limit voltage	12
[3][5]	[8][A]		Regenerative load ratio	12
[3][5]	[8][B]		Effective load ratio	12
[3][5]	[8][C]		Peak load ratio	12
[3][5]	[8][D]		Instantaneous torque	12
[3][5]	[8][E]		Within one-revolution position	12
[3][5]	[8][F]		ABS counter	12
[3][5]	[9][0]		Load inertia moment ratio	12
[3][5]	[9][1]		Bus voltage	12

(6) Current position latch data (Command [6][C])

Command	Data No.	Description	Frame length
[6][C]	[0][1]	Current position latch data.	8

(7) General-purpose register (Rx) value (Command [6][D])

Command	Data No.	Description	Frame length
[6][D]	[0][1]	The value of the general-purpose register (R1)	8
[6][D]	[0][2]	The value of the general-purpose register (R2)	8
[6][D]	[0][3]	The value of the general-purpose register (R3)	8
[6][D]	[0][4]	The value of the general-purpose register (R4)	8

(8) General-purpose register (Dx) value (Command [6][E])

Command	Data No.	Description	Frame length
[6][E]	[0][1]	The value of the general-purpose register (D1)	8
[6][E]	[0][2]	The value of the general-purpose register (D2)	8
[6][E]	[0][3]	The value of the general-purpose register (D3)	8
[6][E]	[0][4]	The value of the general-purpose register (D4)	8

(9) Group setting (Command [1][F])

Command	Data No.	Description	Frame length
[1][F]	[0][0]	Reading of group setting value	4

(10) Software version (Command [0][2])

Command	Data No.	Description	Frame length
[0][2]	[7][0]	Software version	16

15.11.2 Write commands

(1) Status display (Command [8][1])

Command	Data No.	Description	Setting range	Frame length
[8][1]	[0][0]	Status display data clear	1EA5	4

(2) Parameter (Command [8][4])

Command	Data No.	Description	Setting range	Frame length
[8][4]	[0][0] to [5][A]	Each parameter write The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	Depends on the parameter.	8

(3) External I/O signal (Command [9][2])

Command	Data No.	Description	Setting range	Frame length
[9][2]	[6][0]	Communication input device signal	Refer to section 15.12.5	8

(4) Alarm history (Command [8][2])

Command	Data No.	Description	Setting range	Frame length
[8][2]	[2][0]	Alarm history clear	1EA5	4

(5) Current alarm (Command [8][2])

Command	Data No.	Description	Setting range	Frame length
[8][2]	[0][0]	Alarm reset	1EA5	4

(6) General-purpose register (Rx) value (Command [B][9])

Command	Data No.	Description	Setting range	Frame length
[B][9]	[0][1]	The value of the general-purpose register (R1)	Depends on the used instruction.	4
[B][9]	[0][2]	The value of the general-purpose register (R2)		
[B][9]	[0][3]	The value of the general-purpose register (R3)		
[B][9]	[0][4]	The value of the general-purpose register (R4)		

(7) General-purpose register (Dx) value (Command [B][A])

Command	Data No.	Description	Setting range	Frame length
[B][A]	[0][1]	The value of the general-purpose register (D1)	Depends on the used instruction.	4
[B][A]	[0][2]	The value of the general-purpose register (D2)		
[B][A]	[0][3]	The value of the general-purpose register (D3)		
[B][A]	[0][4]	The value of the general-purpose register (D4)		

(8) External input signal disable (Command [9][0])

Command	Data No.	Description	Setting range	Frame length
[9][0]	[0][0]	Turns off the input devices, external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN, independently of the external ON/OFF statuses.	1EA5	4
[9][0]	[0][3]	Disables all output devices (DO).	1EA5	4
[9][0]	[1][0]	Enables the disabled input devices (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.	1EA5	4
[9][0]	[1][3]	Enables the disabled output devices (DO).	1EA5	4

(9) Operation mode selection (Command [8][B])

Command	Data No.	Description	Setting range	Frame length
[8][B]	[0][0]	Operation mode changing 0000: Exit from test operation mode 0001: Jog operation 0002: Positioning operation 0003: Motor-less operation 0004: Output signal (DO) forced output	0000 to 0004	4

(10) Data for test operation mode (Command [9][2] ▪ [A][0])

Command	Data No.	Description	Setting range	Frame length
[9][2]	[0][0]	Input signal for test operation	Refer to section 15.12.7	8
[9][2]	[A][0]	Forced output from signal pin	Refer to section 15.12.9	8

Command	Data No.	Description	Setting range	Frame length
[A][0]	[1][0]	Writes the speed of the test operation mode (jog operation, positioning operation).	0000 to 7FFF	4
[A][0]	[1][1]	Writes the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	00000000 to 7FFFFFFF	8
[A][0]	[1][2]	Clears the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation).	1EA5	4
[A][0]	[1][3]	Writes the moving distance (in pulses) of the test operation mode (jog operation, positioning operation).	80000000 to 7FFFFFFF	8
[A][0]	[1][5]	Temporary stop command of the test operation mode (jog operation, positioning operation)	1EA5	4

(11) Group setting (Command [9][F])

Command	Data No.	Description	Setting range	Frame length
[9][F]	[0][0]	Setting of group	a to f	4

15.12 Detailed explanations of commands

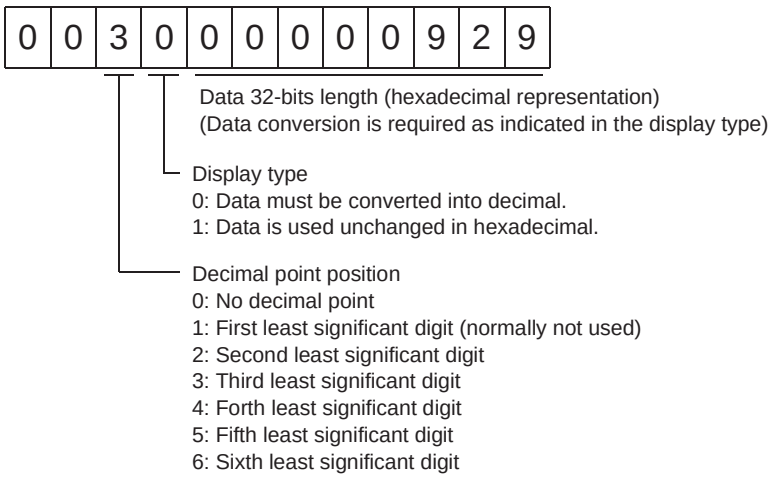
15.12.1 Data processing

When the master station transmits a command + data No. or a command + data No. + data to a slave station, the servo amplifier returns a reply or data according to the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed according to the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing the read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

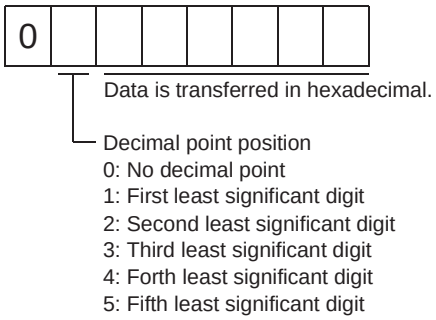


Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(2) Writing the processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.



By way of example, here is described how to process the set data when a value of "15.5" is sent. Since the decimal point position is the second digit, the decimal point position data is "2". As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155→9B

Hence, "0200009B" is transmitted.

15.12.2 Status display

(1) Status display data read

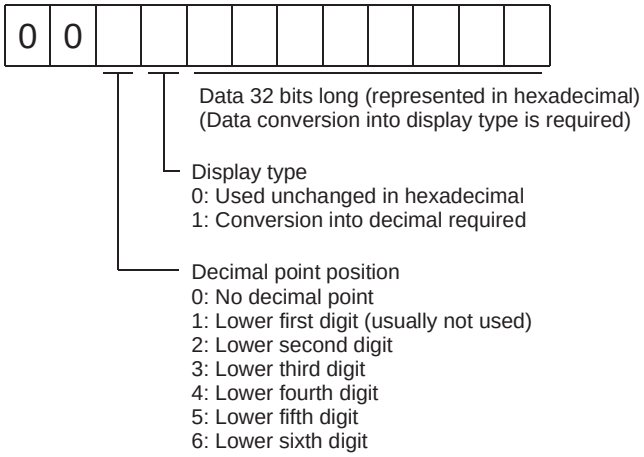
When the master station transmits the data No. to the slave station, the slave station sends back the data value and data processing information.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read. Refer to section 15.11.1.

(b) Reply

The slave station sends back the status display data requested.



(2) Status display data clear

The cumulative feedback pulse data of the status display is cleared. Send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to zero.

Command	Data No.	Data
[8][1]	[0][0]	1EA5

For example, after sending command [0][1] and data No. [8][0] and receiving the status display data, send command [8][1], data No. [0][0] and data [1EA5] to clear the cumulative feedback pulse value to zero.

15.12.3 Parameter

(1) Parameter read

Read the parameter setting.

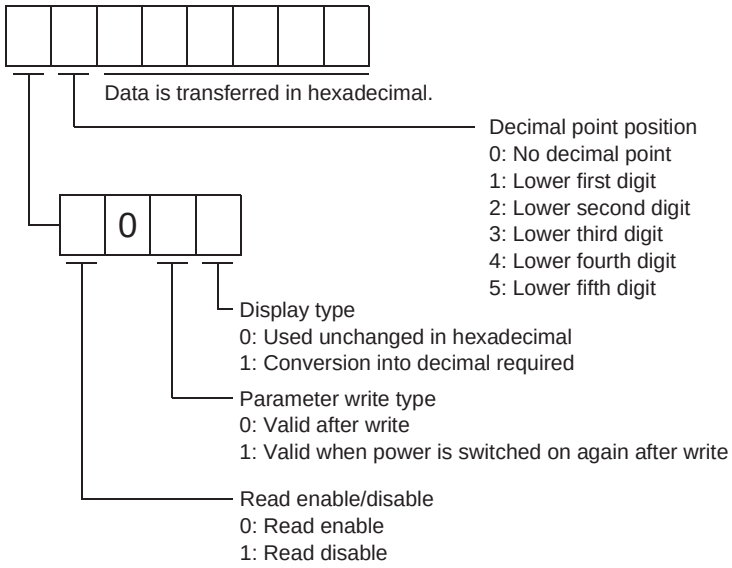
(a) Transmission

Transmit command [0][5] and the data No. corresponding to the parameter No.

Command	Data No.	Data No. definition
[0][5]	[0][0] to [5][A]	Corresponds to the parameter No.

(b) Reply

The slave station sends back the data and processing information of the requested parameter No.



Enable/disable information changes according to the setting of parameter No.19 "parameter write inhibit". When the enable/disable setting is read disable, ignore the parameter data part and process it as unreadable.

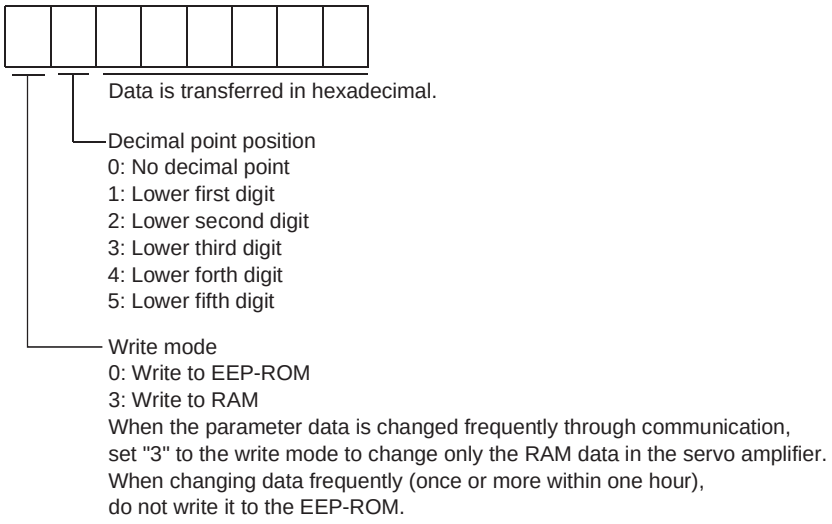
(2) Parameter write

POINT

- If setting values need to be changed with a high frequency (i.e. one time or more per one hour), write the setting values to the RAM, not the EEP-ROM. The EEP-ROM has a limitation in the number of write times and exceeding this limitation causes the servo amplifier to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100, 000.

Write the parameter setting.
Write the value within the setting range. Refer to section 5.1 for the setting range.
Transmit command [8][4], the data No., and the set data.
The data number is represented in hexadecimal. The decimal value converted from the data number value corresponds to the parameter number. Refer to (1) (a) in this section.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.
Write the data after making sure that it is within the upper/lower limit value range given in section 5.1.2. Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Set data
[8][4]	[0][0] to [5][A]	See below.



15.12.4 External I/O signal statuses

(1) Reading of input device statuses

Read the statuses of the input devices.

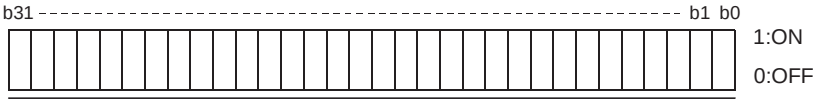
(a) Transmission

Transmit command [1][2] and data No. [0][0].

Command	Data No.
[1][2]	[0][0]

(b) Reply

The slave station sends back the statuses of the input pins.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	Signal name
0	Servo-on (SON)
1	Forward rotation stroke limit (LSP)
2	Reverse rotation stroke limit (LSN)
3	External torque limit selection (TL)
4	Internal torque limit selection (TL2)
5	Proportion control selection (PC)
6	Reset (RES)
7	
8	
9	
10	Current position latch input (LPS)
11	Forward rotation start (ST1)

bit	Signal name
12	Reverse rotation start (ST2)
13	
14	
15	
16	Forced stop (EMG)
17	Automatic/manual selection (MD0)
18	Proximity dog (DOG)
19	Program No. selection 1 (DI0)
20	Program No. selection 2 (DI1)
21	Program No. selection 3 (DI2)
22	Program No. selection 4 (DI3)
23	Override selection (OVR)

bit	Signal name
24	Temporary stop/restart (STP)
25	Manual pulse generator multiplication 1 (TP0)
26	Manual pulse generator multiplication 2 (TP1)
27	Gain switch (CDP)
28	
29	Program input 1 (PI1)
30	Program input 2 (PI2)
31	Program input 3 (PI3)

(2) External input pin status read

Read the ON/OFF statuses of the external output pins.

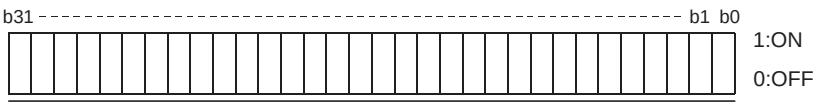
(a) Transmission

Transmit command [1][2] and data No. [4][0].

Command	Data No.
[1][2]	[4][0]

(b) Reply

The ON/OFF statuses of the input pins are sent back.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	External input pin
0	CN1B-16
1	CN1B-17
2	CN1B-15
3	CN1B-5
4	CN1B-14

bit	External input pin
5	CN1A-8
6	CN1B-7
7	CN1B-8
8	CN1B-9
9	CN1A-19

(3) Read of the statuses of input devices switched on through communication

Read the ON/OFF statuses of the input devices switched on through communication.

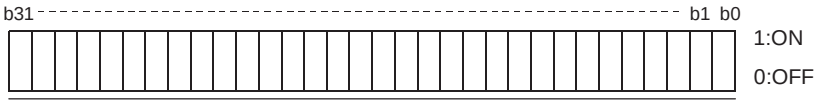
(a) Transmission

Transmit command [1][2] and data No. [6][0].

Command	Data No.
[1][2]	[6][0]

(b) Reply

The slave station sends back the statuses of the input pins.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	Signal name
0	Servo-on (SON)
1	Forward rotation stroke limit (LSP)
2	Reverse rotation stroke limit (LSN)
3	External torque limit selection (TL)
4	Internal torque limit selection (TL2)
5	Proportion control selection (PC)
6	Reset (RES)
7	
8	
9	
10	Current position latch input (LPS)
11	Forward rotation start (ST1)

bit	Signal name
12	Reverse rotation start (ST2)
13	
14	
15	
16	Forced stop (EMG)
17	Automatic/manual selection (MD0)
18	Proximity dog (DOG)
19	Program No. selection 1 (DI0)
20	Program No. selection 2 (DI1)
21	Program No. selection 3 (DI2)
22	Program No. selection 4 (DI3)
23	Override selection (OVR)

bit	Signal name
24	Temporary stop/restart (STP)
25	Manual pulse generator multiplication 1 (TP0)
26	Manual pulse generator multiplication 2 (TP1)
27	Gain switch (CDP)
28	
29	Program input 1 (PI1)
30	Program input 2 (PI2)
31	Program input 3 (PI3)

(4) External output pin status read

Read the ON/OFF statuses of the external output pins.

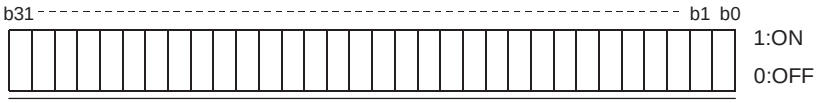
(a) Transmission

Transmit command [1][2] and data No. [C][0].

Command	Data No.
[1][2]	[C][0]

(b) Reply

The slave station sends back the ON/OFF statuses of the output pins.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	External output pin
0	CN1A-19
1	CN1A-18
2	CN1B-19
3	CN1B-6
4	CN1B-4

bit	External output pin
5	CN1B-18
6	CN1A-14

(5) Read of the statuses of output devices

Read the ON/OFF statuses of the output devices.

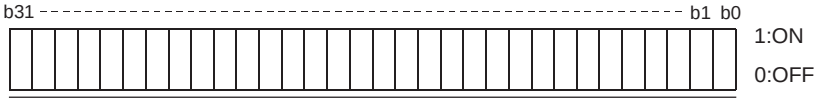
(a) Transmission

Transmit command [1][2] and data No. [8][0].

Command	Data No.
[1][2]	[8][0]

(b) Reply

The slave station sends back the statuses of the output devices.



Command of each bit is transmitted to the master station as hexadecimal data.

bit	Signal name
0	Ready (RD)
1	
2	
3	Limiting torque (TLC)
4	
5	
6	
7	Warning (WNG)
8	Trouble (ALM)
9	

bit	Signal name
10	Electromagnetic brake (MBR)
11	Dynamic brake interlock (DBR)
12	
13	
14	
15	Battery warning (BWNG)
16	
17	Home position return completion (ZP)
18	Position range (POT)

bit	Signal name
19	Temporary stop (PUS)
20	Program output 1 (OUT1)
21	Program output 2 (OUT2)
22	Program output 3 (OUT3)
23	SYNC Synchronous output (SOUT)
24	Movement complete (PED)
25	
26	
27	
28	

15.12.5 Input devices ON/OFF

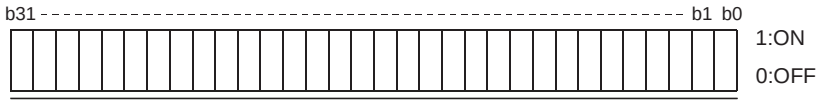
POINT

- The ON/OFF states of all devices in the servo amplifier are the states of the data received last. Hence, when there is a device which must be kept ON, send data which turns that device ON every time.

Each input device can be switched on/off. However, when the device to be switched off exists in the external input signal, also switch off that input signal.

Send command [9][2], data No. [6][0] and data.

Command	Data No.	Set data
[9][2]	[6][0]	See below.



Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Signal name
0	Servo-on (SON)
1	Forward rotation stroke limit (LSP)
2	Reverse rotation stroke limit (LSN)
3	External torque limit selection (TL)
4	Internal torque limit selection (TL2)
5	Proportion control selection (PC)
6	Reset (RES)
7	
8	
9	
10	Current position latch input (LPS)
11	Forward rotation start (ST1)

bit	Signal name
12	Reverse rotation start (ST2)
13	
14	
15	
16	Forced stop (EMG)
17	Automatic/manual selection (MD0)
18	Proximity dog (DOG)
19	Program No. selection 1 (DI0)
20	Program No. selection 2 (DI1)
21	Program No. selection 3 (DI2)
22	Program No. selection 4 (DI3)
23	Override selection (OVR)

bit	Signal name
24	Temporary stop/restart (STP)
25	Manual pulse generator multiplication 1 (TP0)
26	Manual pulse generator multiplication 2 (TP1)
27	Gain switch (CDP)
28	
29	Program input 1 (PI1)
30	Program input 2 (PI2)
31	Program input 3 (PI3)

15.12.6 Disable/enable of I/O devices (DIO)

Inputs can be disabled independently of the I/O devices ON/OFF. When inputs are disabled, the input signals (devices) are recognized as follows. Among the input devices, EMG, LSP and LSN cannot be disabled.

Signal	Status
Input devices (DI)	OFF
External analog input signals	0V
Pulse train inputs	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.
Transmit the following communication commands.

(a) Disable

Command	Data No.	Data
[9][0]	[0][0]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Disabling/enabling the output devices (DO).
Transmit the following communication commands.

(a) Disable

Command	Data No.	Data
[9][0]	[0][3]	1EA5

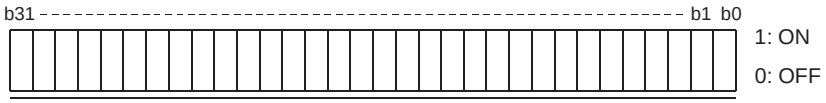
(b) Enable

Command	Data No.	Data
[9][0]	[1][3]	1EA5

15.12.7 Input devices ON/OFF (test operation)

Each input devices can be turned on/off for test operation. when the device to be switched off exists in the external input signal, also switch off that input signal.
Send command [9] [2], data No. [0] [0] and data.

Command	Data No.	Set data
[9][2]	[0][0]	See below



Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Signal name
0	Servo-on (SON)
1	Forward rotation stroke limit (LSP)
2	Reverse rotation stroke limit (LSN)
3	External torque limit selection (TL)
4	Internal torque limit selection (TL2)
5	Proportion control selection (PC)
6	Reset (RES)
7	
8	
9	
10	Current position latch input (LPS)
11	Forward rotation start (ST1)

bit	Signal name
12	Reverse rotation start (ST2)
13	
14	
15	
16	Forced stop (EMG)
17	Automatic/manual selection (MD0)
18	Proximity dog (DOG)
19	Program No. selection 1 (DI0)
20	Program No. selection 2 (DI1)
21	Program No. selection 3 (DI2)
22	Program No. selection 4 (DI3)
23	Override selection (OVR)

bit	Signal name
24	Temporary stop/restart (STP)
25	Manual pulse generator multiplication 1 (TP0)
26	Manual pulse generator multiplication 2 (TP1)
27	Gain switch (CDP)
28	
29	Program input 1 (PI1)
30	Program input 2 (PI2)
31	Program input 3 (PI3)

15.12.8 Test operation mode

(1) Instructions for test operation mode

The test operation mode must be executed in the following procedure. If communication is interrupted for longer than 0.5s during test operation, the servo amplifier causes the motor to be decelerated to a stop and servo-locked. To prevent this, continue communication without a break, e.g. monitor the status display.

(a) Execution of test operation

1) Turn off all input devices.

2) Disable the input devices.

Command	Data No.	Data
[9][0]	[0][0]	1EA5

3) Choose the test operation mode.

Command	Data No.	Transmission data	Selection of test operation mode
[8][B]	[0][0]	0000	Test operation mode cancel
[8][B]	[0][0]	0001	Jog operation
[8][B]	[0][0]	0002	Positioning operation
[8][B]	[0][0]	0003	Motor-less operation
[8][B]	[0][0]	0004	DO forced output

4) Set the data needed for test operation.

5) Start.

6) Continue communication using the status display or other command.

(b) Termination of test operation

To terminate the test operation mode, complete the corresponding operation and.

1) Clear the test operation acceleration/deceleration time constant.

Command	Data No.	Data
[A][0]	[1][2]	1EA5

2) Cancel the test operation mode.

Command	Data No.	Data
[8][B]	[0][0]	0000

3) Enable the disabled input devices.

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Jog operation

Transmit the following communication commands.

(a) Setting of jog operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.

(b) Start

Turn on the input devices SON ▪ LSP ▪ LSN and ST1/ST2 by using command [9][2] + data No. [0][0].

Item	Command	Data No.	Data
Forward rotation start	[9][2]	[0][0]	00000807: Turns on SON ▪ LSP ▪ LSN and ST1.
Reverse rotation start	[9][2]	[0][0]	00001007: Turns on SON ▪ LSP ▪ LSN and ST2.
Stop	[9][2]	[0][0]	00000007: Turns on SON ▪ LSP and LSN.

(3) Positioning operation

Transmit the following communication commands.

(a) Setting of positioning operation data

Item	Command	Data No.	Data
Speed	[A][0]	[1][0]	Write the speed [r/min] in hexadecimal.
Acceleration/deceleration time constant	[A][0]	[1][1]	Write the acceleration/deceleration time constant [ms] in hexadecimal.
Moving distance	[A][0]	[1][3]	Write the moving distance [pulse] in hexadecimal.

(b) Input of servo-on ▪ stroke end

Turn on the input devices SON ▪ LSP and LSN by using command [9][2] + data No. [0][0].

Item	Command	Data No.	Data
Servo-on	[9][2]	[0][0]	00000001: Turns on SON.
Servo OFF Stroke end ON	[9][2]	[0][0]	00000006: Turns off SON and turns on LSP ▪ LSN.
Servo-on Stroke end ON	[9][2]	[0][0]	Turns on SON ▪ LSP ▪ LSN.

(c) Start of positioning operation

Transmit the speed and acceleration/deceleration time constant, turn on the servo-on (SON) and forward/reverse rotation stroke end (LSP・LSN), and then send the moving distance to start positioning operation. After that, positioning operation will start every time the moving distance is transmitted. To start opposite rotation, send the moving distance of a negative value.

When the servo-on (SON) and forward/reverse rotation stroke end (LSP・LSN) are off, the transmission of the moving distance is invalid. Therefore, positioning operation will not start if the servo-on (SON) and forward/reverse rotation stroke end (LSP・LSN) are turned on after the setting of the moving distance.

(d) Temporary stop

A temporary stop can be made during positioning operation.

Command	Data No.	Data
[A][0]	[1][5]	1EA5

Retransmit the same communication commands as at the start time to resume operation.

To stop positioning operation after a temporary stop, retransmit the temporary stop communication command. The remaining moving distance is then cleared.

15.12.9 Output signal pin ON/OFF output signal (DO) forced output

In the test operation mode, the output signal pins can be turned on/off independently of the servo status. Using command [9][0], disable the output signals in advance.

(1) Choosing DO forced output in test operation mode

Transmit command [8][B] + data No. [0][0] + data "0004" to choose DO forced output.

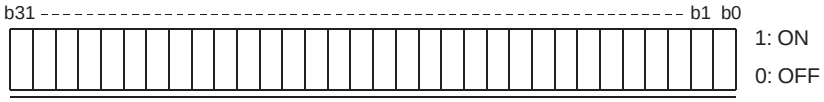
0	0	0	4

Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal ON/OFF

Transmit the following communication commands.

Command	Data No.	Setting data
[9][2]	[A][0]	See below.



Command of each bit is sent to the slave station in hexadecimal.

bit	External output pin
0	CN1A-19
1	CN1A-18
2	CN1B-19
3	CN1B-6
4	CN1B-4
5	CN1B-18
6	CN1A-14
7	

bit	External output pin
8	
9	
10	
11	
12	
13	
14	
15	

bit	External output pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	External output pin
24	
25	
26	
27	
28	
29	
30	
31	

15.12.10 Alarm history

(1) Alarm No. read

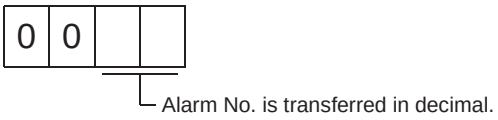
Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No.0 (last alarm) to No.5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][5]. Refer to section 15.11.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.



For example, "0032" means AL.32 and "00FF" AL._ (no alarm).

(2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

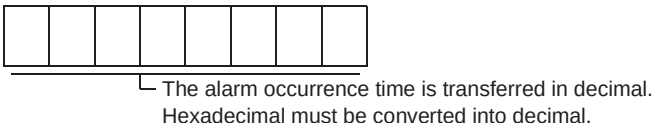
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No. [2][0] to [2][5].

Refer to section 15.11.1.

(b) Reply



For example, data [0][1][F][5] indicates that the alarm occurred 501 hours after start of operation.

(3) Alarm history clear

Erase the alarm history.

Send command [8][2] and data No. [2][0].

Command	Data No.	Data
[8][2]	[2][0]	1EA5

15.12.11 Current alarm

(1) Current alarm read

Read the alarm No. which is occurring currently.

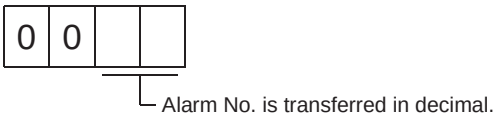
(a) Transmission

Send command [0][2] and data No. [0][0].

Command	Data No.
[0][2]	[0][0]

(b) Reply

The slave station sends back the alarm currently occurring.



For example, "0032" means AL.32 and "00FF" AL._ (no alarm).

(2) Read of the status display at alarm occurrence

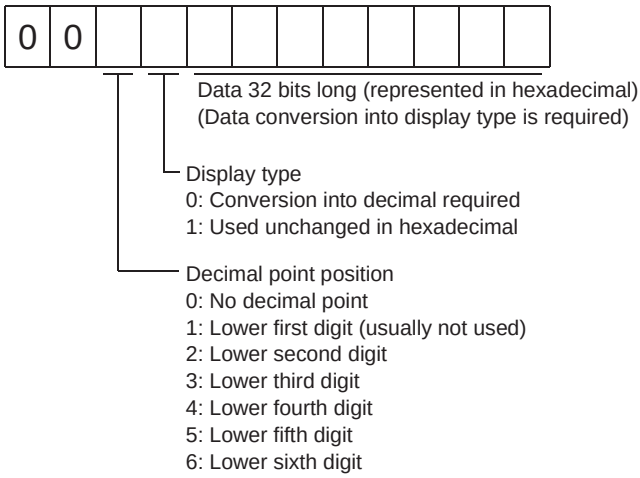
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

Send command [3][5] and any of data No. [8][0] to [8][E] corresponding to the status display item to be read. Refer to section 15.11.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.



(3) Current alarm clear

As by the entry of the Reset (RES), reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

(a) Transmission

Command	Data No.	Data
[8][2]	[0][0]	1EA5

15.12.12 Current position latch data

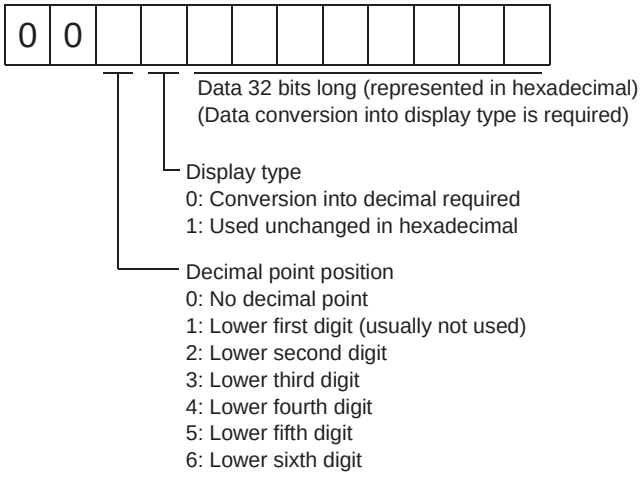
Read the current position latch data. When the data No. is transmitted, the data value and data processing information are sent back.

(1) Transmission

Send command [6][C] and data No. [0][1] to be read.

(2) Reply

The slave station sends back. (Current position latch data.)



15.12.13 General-purpose register

(1) General-purpose register (Rx) read

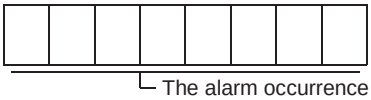
Read the general-purpose register (Rx) value stored in the EEP-ROM.

(a) Transmission

Transmit command [6][D] and any of data No. [0][1] to [0][4] corresponding to the general-purpose register (Rx) to be read. Refer to section 15.11.1.

(b) Reply

The slave station sends back the position data of the requested the value of the general-purpose register (Rx).



The alarm occurrence time is transferred in decimal.
Hexadecimal must be converted into decimal.

(2) General-purpose register (Dx) read

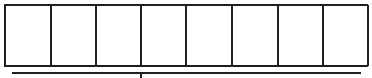
Read the general-purpose register (Dx) value stored in the RAM.

(a) Transmission

Transmit command [6][E] and any of data No. [0][1] to [0][4] corresponding to the general-purpose register (Dx) to be read. Refer to section 15.11.1.

(b) Reply

The slave station sends back the position data of the requested the value of the general-purpose register (Dx).



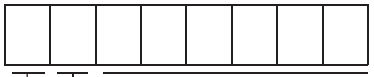
The alarm occurrence time is transferred in decimal.
Hexadecimal must be converted into decimal.

(3) General-purpose register (Rx) write

Write the value of the general-purpose register (Rx).

Write the value within the setting range. Refer to section 4.2.2 (1) for the setting range.

Transmit command [B][9], the data No., and setting value. Data to be written is hexadecimal.



Data is transferred in hexadecimal.

Decimal point position
0: No decimal point
1: Lower first digit
2: Lower second digit
3: Lower third digit
4: Lower forth digit
5: Lower fifth digit

Write mode
0: Write to EEP-ROM
3: Write to RAM
When the parameter data is changed frequently through communication,
set "3" to the write mode to change only the RAM data in the servo amplifier.
When changing data frequently (once or more within one hour),
do not write it to the EEP-ROM.

(4) General-purpose register (Dx) write

Write the value of the general-purpose register (Dx) to the RAM.

Write the value within the setting range. Refer to section 4.2.2 (1) for the setting range.

Transmit command [B][A], the data No., and setting value. Data to be written is hexadecimal.

Data is transferred in hexadecimal.

15.12.14 Servo amplifier group designation

With group setting made to the slave stations, data can be transmitted simultaneously to two or more slave stations set as a group through RS-422 communication.

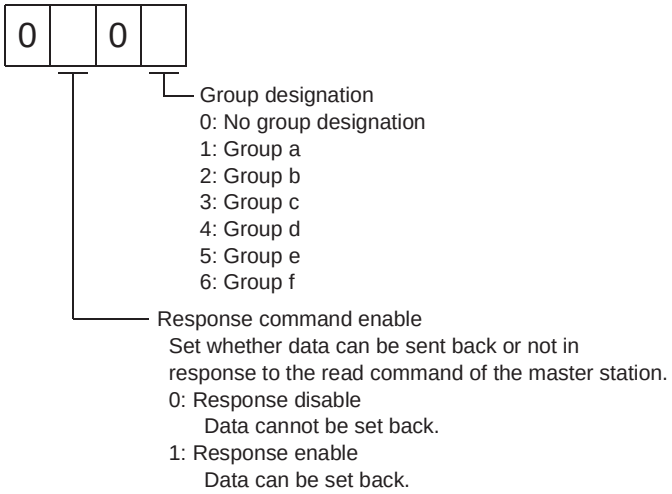
(1) Group setting write

Write the group designation value to the slave station.

(a) Transmission

Transmit command [9][F], data No. [0][0] and data.

Command	Data No.	Data
[9][F]	[0][0]	See below.



(2) Group setting read

Read the set group designation value from the slave station.

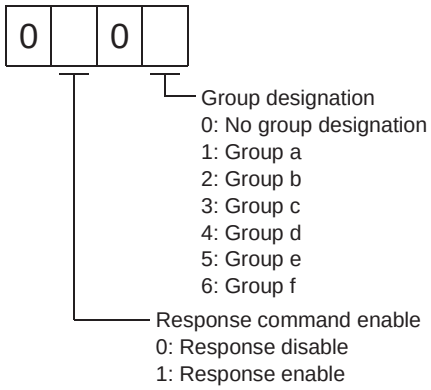
(a) Transmission

Transmit command [1][F] and data No. [0][0].

Command	Data No.
[1][F]	[0][0]

(b) Reply

The slave station sends back the group setting requested.



15.12.15 Software version

Reads the software version of the servo amplifier.

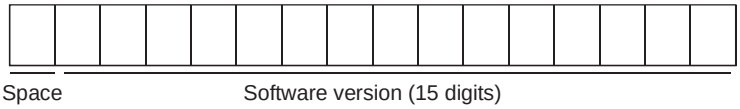
(a) Transmission

Send command [0] [2] and data No. [7] [0].

Command	Data No.
[0][2]	[7][0]

(b) Reply

The slave station returns the software version requested.



App 1. Status indication block diagram