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Robo Cylinder RCP

Serial Communication protocol

Protocol Specifications

IAI Industrieroboter GmbH
Ober der Röth 4
D-65824 Schwalbach am Taunus
Tel.: 06196/8895-0/Fax: 06196/8895-24
E-Mail: info@iai-gmbh.de
Internet: http://www.iai-gmbh.de

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Contents

1. OUTLINE 4

2. TRANSMISSION CONTROL PROCEDURE 5

3. PACKET OUTLINE 7

3-1 COMPOSITION OF COMMAND/RESPONSE PACKET DATA 8
3-1-1 Composition of memory command/response packet data 8
3-1-2 Composition of direct command/response packet data 9

4. PACKET DETAILS 10

4-1 COMMAND LIST 10
4-1-1 Memory command table 10
4-1-2 Direct command table 10
4-2 DIRECT RESPONSE FORMAT 11
4-3 COMMAND REJECTION RESPONSE 13
4-4 COMMAND DETAILS 14
4-4-1 R4 command (memory read) 14
4-4-2 T4 command(write addressing) 15
4-4-3 W4 command (memory write) 16
4-4-4 Q1 command (nonvolatile memory area → edit area forwarding) 17
4-4-5 Q2 command(forward data from edit area → execution area) 18
4-4-6 Q3 command (PTP move to position No.) 19
4-4-7 V5 command (edit area → nonvolatile memory area forwarding) 20
4-4-8 a command (absolute PTP position move command) 21
4-4-9 d command (cancel motion) 22
4-4-10 h command (command bufferring) 23
4-4-11 m command (relative PTP move) 24
4-4-12 n command (status read) 25
4-4-13 o Command (Home) 26
4-4-14 p command (minimum transmission delay time) 27
4-4-15 q command (servo ON/OFF) 28
4-4-16 r command (CPU reset) 29
4-4-17 t command (execute buffered command) 30
4-4-18 v command (set speed and acceleration) 31

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5. TIME-OUT AND RETRY 32

6. COMMUNICATION PROCEDURE 34

6-1 COMMUNICATION ESTABLISHMENT PROCEDURE 34
6-2 HOMING PROCEDURE 36
6-3 POINT TO POINT (PTP) OPERATION 37
6-4 SIMULTANEOUS OPERATION USING BUFFERED COMMANDS 38

7. VIRTUAL MEMORY SPACE 39

7-1 VIRTUAL MEMORY SPACE SYSTEM 39
7-2 MEMORY MAP 41
7-2-1 Data structure of common parameters 41
7-2-2 Data structure of position data 45
7-2-3 Push operation through position data 47
7-2-4 Data structure of amplifier/motor model monitor area 49
7-2-5 Data structure of internal state monitor area 50
7-3 NONVOLATILE MEMORY AREA, EDIT AREA, AND OPERATION DATA AREA 51
7-3-1 Initial value of the execution data area and the method of changing nonvolatile memory area 51
7-3-2 Note for data transmission to the execution data area 52

8. OTHERS 54

8-1 ERROR 54
8-1-1 Error display list (PM1-PM8) 54
8-1-2 Error level 55
8-1-3 Error No. list 55
8-1-4 Error Details 56
8-1-5 Warning Details 59

8-2 METHOD OF CONVERTING ENCODER RESOLUTION AND UNITS 60

9. CHANGE HISTORY 61

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1.Outline

The RC communicates by the RS485 interface, and the communication condition is as follows.

Item	Condition
Transmission rate	9.6kbps, 14.4kbps, 19.2kbps, 28.8kbps, 38.4kbps, 57.6kbps, 76.8kbps, 115.2kbps
Data length	Eight bits
Stop bit	One bit
Parity check	None

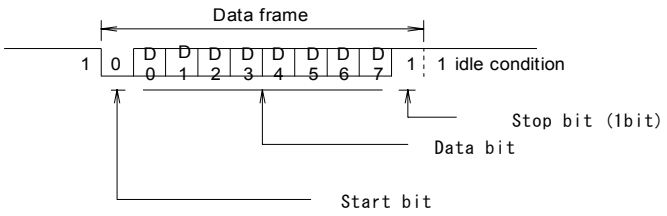
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2.Transmission control procedure

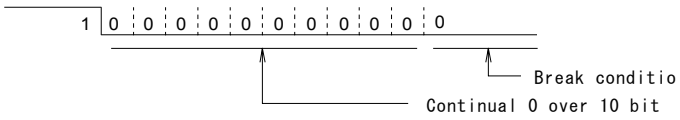
Frame format

The state of the signal on the line is assumed to be either the data frame, idle state or break state shown as follows:

(1) Data frame and idle condition



(2) Break condition



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Packet transmission timing

The basic transmission control procedure is assumed to be the command packet transmitted from the HOST to a slave and the response from that slave back to the HOST. The timing between sending and receiving for the HOST and the communication to the slave station depends as follows:

(1) Minimum delay time from the slave receive to transmit = αmsec

α is the minimum delay time (RTIM) parameter related to the SIO communication (described later). After the slave receives the string, it will wait at least this long before sending the response. Please ensure the HOST can receive from the slave within this time.

(2) Minimum delay time from the HOST receive to transmit = 1 msec

After transmitting the response, the slave will be ready to receive within 1msec. Therefore, the HOST must wait at least this long between receiving a response and sending a command.

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3.Packet outline

The command packet and the response packet are assumed to be a fixed format of 16 characters shown as follows:

(1) Command Packet Format

Header 1char. STX (02H)	Axis No. 1char.	Command Info. 11char.	BCC 2char.	Delimiter 1char. ETX (03H)

(2) Response Packet Format

Header 1char. STX (02H)	Response ID 1char. 'U' (55H)	Axis No. 1char.	Response Info. 10char.	BCC 2char.	Delimiter 1char. ETX (03H)

Header: STX(02H)

Axis No: Hexadecimal number '0-F' representing the axis number.

Command Info: Alphanumeric characters containing command packet information of 11 characters

Response ID: Response identifier hexadecimal (55H)

Response Info: Alphanumeric characters containing response packet information of 10 characters

Delimiter: ETX(03H)

BCC: Two characters '00-FF' showing hexadecimal number digits for block check characters. It is calculated by using the 12 data characters (excluding STX, ETX and BCC). It's calculated by taking last 2 characters of the one's complement of the sum of the ASCII codes of those 12 characters.

Example of calculating BCC

[STX]1a1234567800[BCC][ETX]

First, add all ASCII codes for the 12 data characters:

sum = 31H+61H+31H+32H+33H+34H+35H+36H+37H+38H+30H+30H = 296H

Second, take the last 2 characters of the 1's complement:

[BCC] = "6A"

Only the slave addressed in the string can send a response for each command transmitted by the HOST. Therefore, the axis number in the command packet and the axis number in the response packet are always the same. This is similar for the broadcast command (all slave stations in the line receive it at the same time).

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3-1 Composition of command/response packet data

The available commands are divided roughly into two categories -- memory commands and direct commands.

3-1-1 Composition of memory command/response packet data

(1) Memory Command Data Format 段部

Func-CHAR. 1char.	Func-num. 1char.	Operand 9char.

(2) Memory Response Data Format 部

Func-CHAR. 1char.	Func-num. 1char.	Operand 8char.

Func-CHAR: Letter designation for command/response function.
Capital letters A-Z correspond to memory commands/responses

Func-Num: Supplementary function number '0-7' which accompanies Func-CHAR
When the command is rejected for the Q1, Q2, and Q3 commands, the Func-Num of the command and the response will not be the same (see direct response format).
When command is refuse, the Func-Num will be 8-F.

Operand: Data portion of the string. The content and the effective length are different according to the function.

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3-1-2Composition of direct command/response packet data

(1) Direct Command Packet Data Format

Func-char. 1char.	Operand 10char.

(2) Direct Response Packet Data Format

Func-char. 1char.	Operand 9char.

Func-CHAR: Letter designation for command/response function.

Operand: Data portion of the string. The content and the effective length are different according to the function.

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4.Packet details

4-1Command list

4-1-1Memory command table

Code	Content	Remarks
R4	Memory read	
T4	Write addressing	
W4	Memory write	
Q1	Non-volatile memory area → edit area forwarding	
Q2	Edit area → execution data area forwarding	Note 1
Q3	Position No. PTP move	Note 1
V5	Edit area → non-volatile memory area forwarding	Note 2

Note 1: For driver CPU, the motor drive is included.

Note 2: EEPROM will also be written in.

4-1-2Direct command table

Code	Content	Remarks
a	Absolute position move	Note 3
d	Cancel remaining movement	
h	Command buffer	
m	Relative position move	Note 3
n	Status read	
o	Home	Note 3
p	Minimum transmission delay time	
q	Servo ON/OFF	
r	Internal reset	
t	Buffered command execution	Note 4
v	Set speed and acceleration	

Note 3: The motor drive is included.

Note 4: When the buffered command uses the motor drive, the motor drive is included.

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4-2Direct response format

The format of the response to a direct command is the status response shown below. This string is used as a command refusal sent back when the command is rejected, and all information necessary for understanding the basic internal state of the driver CPU is included in this string. If the data requires multiple bytes the upper byte is sent first using the big endian format.

Response	STX	'U'	Axis #	'n'	Status	Alarm	IN	OUT	'0'	BCC	ETX
	02	55		6E					30		03

Response data

"Status"(hexadecimal ASCII value)

Internal operation of CPU is shown by the following bit patterns.

Bit	Content
Bit 0	Power supply status (1 = ON) This bit is always one when the unit is powered.
Bit 1	Servo status (1 = ON, 0 = OFF) The servo is turned ON and OFF by the servo ON command
Bit 2	RUN status (1 = RUN state, 0 = not in RUN state) When driver CPU is not in alarm, and the servo is ON, this bit becomes one. The driver CPU does not accept a movement instruction when this bit is 0.
Bit 3	HOME status (1 = HOME complete, 0 = HOME not yet complete) This bit shows whether or not the axis has completed homing (same as the ZFIN OUT bit). Absolute/Incremental move instructions are rejected when this bit is 0. Other PTP moves Home first and then move to the specified position.
Bit 4	Buffered Command Status (1 = buffered, 0 = not buffered) When this bit is one, it shows that the driver CPU has an unexecuted buffered command.
Bit 5	State of + direction interlock (1 = interlocked, 0 = free) When this bit is one, it shows that movement in the + direction is interlocked by the software stroke limit (common parameter LIMM).
Bit 6	State of - direction interlock (1 = interlocked, 0 = free) When this bit is one, it shows that movement in the - direction is interlocked by the software stroke limit (common parameter LIML).
Bit 7	Command rejection (1 = rejected, 0 = accepted) When this bit is one, the sent command was rejected by the CPU. When the rejection response is received, the alarm content shows the reason fro rejection

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"Alarm"(hexadecimal ASCII value)

This shows the normal /alarm status of the CPU's. Please refer to the "Error" section for details.

INPUTS (hexadecimal ASCII value)

Input Status (1=ON、0=OFF)

Bit 7	Hold
Bit 6	Not Used
Bit 5	Not Used
Bit 4	Start
Bit 3	Pos # 8
Bit 2	Pos # 4
Bit 1	Pos # 2
Bit 0	Pos # 1

OUTPUTS (hexadecimal ASCII value)

Output Status (1=ON、0=OFF)

Bit 0-3 (PM1~PM8)	Present position number code The present position number is represented by binary code in four bits by PM1-PM8. 20 and PM2 are output, and 21 and PM4 are output and 22 and PM8 can output the position number to 23 and 0-15 the output in the weight of each bit of PM1. PM1-PM8 turn off upon initial power-up of the system and after a new PTP move command is received. When the move is complete, PFIN turns on and PM1-PM8 output the code for the position number in which the system has just moved. Command, edit, area, execution, data area, forward, operate, position, reflect. The driver CPU error code (abbreviated type) is shown by PM1-PM8 when an error occurs (* The ALM signal is off). Please refer to the section "Error display list by PM1-PM8" for details.
Bit 4 (PFIN)	Position complete signal This signal turns on after initial power-up and when axis is within the Positioning Band of the set point data. The PFIN signal is turned off after receiving a PTP move command. Even if positional deflection exceeds the Positioning Band afterwards, the PFIN signal is not turned back off once it has turned on.
Bit 5 (ZFIN)	Home complete signal This signal is off until successful completion of the Homing routine. When the ZFIN signal is turned on once, it does not turn back off until loss of power.
Bit 6 (ZONE)	Zone signal The ZONE signal is turned on when the axis position is between ZONM and ZONL parameters and ZFIN is on. The ZONE signal is not affected by errors or other system operations.
Bit 7 (*ALM)	Driver CPU error signal *ALM signal is on during normal operation, and is turned off in case of error. When there is an error, the *ALM signal is output and the error code (abbreviated type) is output to each signal of PM1-PM8.

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Asterisk (*) is negative-true logic.

4-3Command rejection response

The command rejection response (bit 7 of "Status") is sent to the HOST when the slave station cannot execute a command even when the CPU receives the command from the HOST as a normal command.

When a memory command is rejected, the response contains the staus resond Func-Num and it changes into "Status" using the direct response format. Therefore, if the Func-Num of the response is between 8 and F, it should be interpretted as a command rejection response. This operand response shall be interpretted as a direct response format by judging the command refusal response. This response has the content of "Alarm" as the warning level error No. showing the reason for command rejection.

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4-4Command details

Any information requiring two or more bytes will send the upper byte first using the big endian format.

4-4-1R4 command (memory read)

Command	STX	Axis #	'R4'		Address								'0'	BCC		ETX
	02		52	34									30			03
Response	STX	'U'	Axis #	'R4'		Data								BCC		ETX
	02	55		52	34											03

Function

The data from the address specified (32 bit data) is read.

Command data

Address (hexadecimal ASCII value)

The desired memory address is specified.

Response data

Data (hexadecimal ASCII value)

The data from the specified address (32 bit data) is returned.

Example

The position is read. (When the axis # is three.)

Command	STX	Axis #	'R4'		Address								'0'	BCC		ETX
	02	33	52	34	37	30	30	30	30	34	30	30	30	38	43	03
Response	STX	'U'	Axis #	'R4'		Data								BCC		ETX
	02	55	33	52	34	46	46	46	46	46	30	30	33	36	32	03

- The memory address for the position is 70000400H.
  Address = 70000400H
- RC position data is FFFFF003H

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4-4-2T4 command(write addressing)

Command	STX	Axis#	'T4'		Address								'0'	BCC		ETX
	02		54	34									30			03
Response	STX	'U'	Axis#	'T4'		Address								BCC		ETX
	02	55		54	34											03

Function

This command specifies the memory address for the data in the W4 command to be written to.

Command data

Address (hexadecimal ASCII value)

Specifies the editing memory address.

Response data

Address (hexadecimal ASCII value)

The address specified by the T4 command is returned as is.

Example

Specify the writing address for the minimum transmision delay time in the common parameter edit area.

Command	STX	Axis#	'T4'		Address								'0'	BCC		ETX
	02	33	54	34	30	30	30	30	30	30	30	43	30			03
The address of the minimum transmission delay time is 0000000CH.																

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4-4-3W4 command (memory write)

Command	STX	Axis#	'W4'		Data								'0'	BCC		ETX
	02		57	34									30			03
Response	STX	'U'	Axis#	'W4'		Address								BCC		ETX
	02	55		57	34											03

Function

Data (32 bit data) is written to the address in the edit area.

It is necessary to set the address beforehand by T4 command "Write addressing" for the writing destination. After the W4 command is executed, the memory address automatically increments. Therefore, it is not necessary to set the address by the T4 command every time.

Command data

Data (hexadecimal ASCII value)

The written data (32 bit data) is specified.

Response data

Address (hexadecimal ASCII value)

The next address number (incremented) is returned.

Attention

Addresses not described in this specification are reserved and have the possibility of causing unanticipated and potentially dangerous operations when these areas are written to. Please do not write to these areas.

Example

Data is written in the minimum transmission delay time in the common parameter edit area.

Command	STX	Axis#	'W4'		Data								'0'	BCC		ETX
	02	33	57	34	30	30	30	30	30	30	30	33	30			03
Response	STX	'U'	Axis#	'W4'		Address								BCC		ETX
	02	55	33	57	34	30	30	30	30	30	30	30	44			03

It is necessary to specify address 0000000CH of the minimum transmission delay time by the T4 command beforehand.
The writing data is assumed to be 00000003H(3msec).
Response address 0000000DH : an automatic increment to the address in the response data.

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4-4-4Q1 command (nonvolatile memory area → edit area forwarding)

Command	STX	Axis#	'Q1'		Typ		Pos No.		Five continuous '0'					BCC	ETX
	02		51	31	30	31			30	30	30	30	30		03
Response	STX	'U'	Axis#	'Q'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		51									30		03

Function

Performs batch forwarding to the edit area from the nonvolatile memory area.

Command data

Typ

The type of the forwarding data is specified. It uses the default values from the common parameters when "00". The driver CPU will use the data from the position table when this value is "01".

Pos No. (hexadecimal ASCII value)

Position No. of the position data in the nonvolatile memory which is forwarded is specified by "00-0F". Only effective when the position data of driver CPU is specified (Typ "01").

Response data

Direct response format

Example

The data of position No.1 of the nonvolatile memory area for axis 0 is transmitted to the edit area.

Command	STX	Axis#	"Q1"		Typ		Pos No.		Five continuous '0'					BCC	ETX
	02	30	51	31	30	31	30	31	30	30	30	30	30	39 43	03

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4-4-5Q2 command(forward data from edit area → execution area)

Command	STX	Axis#	'Q2'		Typ		Seven continuous '0'							BCC	ETX
	02		51	31	30	31	30	30	30	30	30	30	30		03
Response	STX	'U'	Axis#	'Q'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		51									30		03

Function

Batch forwarding to the execution data area from common parameters or position data in the edit area.

When position data is specified, the axis makes a PTP move to the data in the edit area. If ZFIN is OFF, the system will home before moving to the specified position. Outputs PM1-PM8 do not show the position number in this case since the axis does not move to a point in the point table.

Command data

Typ

The type of the forwarding data is specified. It uses the default values from the common parameters when "00". The CPU will respond with a command rejection if this value is "01."

Response data

Direct response format

Example

The position data from the edit area of axis 0 is transmitted to the execution data area, and the axis makes a PTP move to that position.

Command	STX	Axis#	"Q2"		Typ		Seven continuous '0'.							BCC		ETX
	02	30	51	31	30	31	30	30	30	30	30	30	30	39	43	03

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4-4-6Q3 command (PTP move to position No.)

Command	STX	Axis#	"Q3"		Typ		Pos No.		Five continuous '0'.					BCC		ETX
	02		51	33	30	31			30	30	30	30	30			03
Response	STX	'U'	Axis#	'Q'	Status		Alarm		IN		OUT		'0'	BCC		ETX
	02	55		51									30			03

Function

This command moves the axis to the specified point in the point table.

In addition, thia command performs a batch forwarding from the nonvolatile memory to the execution are for that point number. If ZFIN is OFF, the system will home before moving to the specified position.

Command data

Typ

"01" is specified for the data type.

Pos No. (hexadecimal ASCII value)

Desired position number is specified by "00"-"0F".

Response data

Direct response format

Example

Axis 0 moves to position No.1 in the point table.

Command	STX	Axis#	"Q3"		Typ		Pos No.		Five continuous '0'.					BCC		ETX
	02	30	51	33	30	31	30	31	30	30	30	30	30	39	41	03

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4-4-7V5 command (edit area → nonvolatile memory area forwarding)

Command	STX	Axis#	'V5'		Typ		Pos No.		Five continuous '0'.						BCC		ETX
	02		56	35	30	31			30	30	30	30	30				03
Response	STX	'U'	Axis#	'V5'		Total # times written									BCC		ETX
	02	55		56	35												03

Function

Performs batch forwarding to the nonvolatile memory area the data of the edit area.

Command data

Typ

The type of the forwarding data is specified. It uses the default values from the common parameters when "00". The driver CPU will use the data from the position table when this value is "01."

Pos No. (hexadecimal ASCII value)

Position No. of the position data in the nonvolatile memory which is forwarded is specified by "00-0F". Only effective when the position data of driver CPU is specified (Typ "01").

Response data

Total # times written (hexadecimal ASCII value) to the data area of the nonvolatile memory is returned. Total # times written is incremented for each V5 command execution.

Attention

The maximum number of times you can write to each data area in the nonvolatile memory is 100,000 times.

Please confirm the logic of the loop frequency and the end condition, etc. to ensure it is not infinite or very large. This can easily overcome the 100,000 limit if a mistake is made.

Example

The position data in the edit area of axis 0 is transmitted to position No.1 in the nonvolatile memory.

Command	STX	Axis#	'V5'		Typ		Pos No.		Five continuous '0'.						BCC		ETX
	02	30	56	35	30	31	30	31	30	30	30	30	30			39	32	03

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4-4-8a command (absolute PTP position move command)

Command	STX	Axis#	'a'	Position							'0'		BCC	ETX
	02		61								30	30		03
Response	STX	'U'	Axis#	'a'	Status		Alarm		IN		OUT	'0'	BCC	ETX
	02	55		61								30		03

Function

This command makes a PTP move to the position specified.

This command rewrites the content of the positional coordinate target position (PCMD) of the position data in the execution data area. Other parameters (i.e. velocity, acceleration) use what's currently in the execution data area.

Command data

Position (hexadecimal ASCII value)

The absolute position value (encoder pulses) is specified. Please refer to the section "Method of converting the encoder pulses" for converting mm → pulses.

- Please specify the value (in hexadecimal after the one's complement) in which the number of pulses from the starting point is subtracted converting the position for actuator models RSAI and RMAI. (In this case, the coordinate range of the actuator is negative.)

Response data

Direct response format

Example

Axis 0 (10mm lead) moves to 100.00mm.

Command	STX	Axis#	'a'	Position								'0'		BCC		ETX
	02	30	61	46	46	46	46	45	30	43	30	30	30	30	46	03

・100.00×800/10=8000 pulses = 1F40H

・When the one's complement of 00001F40H is taken, FFFFE0C0H.

Position = FFFFE0C0H

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4-4-9d command (cancel motion)

Command	STX	Axis#	'd'	'0' ten continuous bytes										BCC	ETX
	02		64	30	30	30	30	30	30	30	30	30	30		03
Response	STX	'U'	Axis#	'd'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		64									30		03

Function

The remaining movement is canceled.

This command changes the target position (PCMD) of the position data in the execution data area to the present position (PNOW) in the internal state monitor area. This effectively stops the motor from continuing motion.

Command data

There is no command data (10 0's).

Response data

Direct response format

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4-4-10 h command (command bufferring)

Command	STX	Axis#	'h'	h-Cmnd						BCC	ETX
	02		68								03
Response	STX	'U'	Axis#	'h'	Status	Alarm	IN	OUT	'0'	BCC	ETX
	02	55		68					30		03

Function

Places a command in the buffer.

The commands that can be buffered include the Q2 command, Q3 command and all direct commands except h. Each commands data area will remove the last extra '0' from the original command to allow the string to fit in the available space. To cancel a buffered command before the t command is executed, use the h command to buffer an n command.

Command data

h-Cmnd

Buffered command character string

Response data

Direct response format

Example

・Buffer a PTP move to 100.00mm for axis 0.

Command	STX	Axis#	'h'	h-Cmnd								BCC	ETX
	02	30	68	61	46	46	46	46	45	30	43		03
	30												
This command buffers the 'a' command. h-Cmnd character string ="a" +"FFFFE0C0" + "0"													

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4-4-11m command (relative PTP move)

Command	STX	Axis#	'm'	Distance								'0'		BCC		ETX
	02		6D									30	30			03
Response	STX	'U'	Axis#	'm'	Status		Alarm		IN		OUT		'0'	BCC		ETX
	02	55		6D									30			03

Function

This command performs an incremental move from its present position.

This command adds the relative position data to the content of the execution area's target position (PCMD). Other parameters (i.e. velocity, acceleration) use what's currently in the execution data area. Please be careful not to send multiple incremental even if attempting to perform a retry after a time-out. Moreover, please use the absolute position move as much as possible.

Command data

Distance (hexadecimal ASCII value)

The relative position value is specified. (units: pulses)

Please refer to the section "Method of converting the encoder pulses" for converting mm → pulses.

- Please specify the value (in hexadecimal after the one's complement) in which the number of pulses from the starting point is subtracted converting the position for actuator models RSAI and RMAI. (In this case, the coordinate range of the actuator is negative.)

Response data

Direct response format

Example

Axis 0 (10mm lead) moves 10mm from present location.

Command	STX	Axis#	'm'	Distance								'0'		BCC		ETX
	02	30	6D	30	30	30	30	30	43	45	30	30	30	38	42	03
10×800/10=800=00000320H pulses When the one's complement of 00000320H is taken, 00000CE0H. Distance = 00000CE0H																	

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4-4-12n command (status read)

Command	STX	Axis#	'n'	Ten continuous '0'.									BCC	ETX
	02		6E	30	30	30	30	30	30	30	30	30	30	03
Response	STX	'U'	Axis#	'n'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		6E									30		03

Function

This command relays the status of the driver CPU.

Command data

There is no command data (10 0's)

Response data

Direct response format.

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4-4-13 o Command (Home)

Command	STX	Axis#	'o'	Org	Eight continuous '0'.								BCC	ETX
	02		6F		30	30	30	30	30	30	30	30		03
Response	STX	'U'	Axis#	'o'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		6F									30		03

Function

The axis performs the homing procedure.

Command data

Org (hexadecimal ASCII value)

Specifies the homing direction.

"07": Normal rotation (motor end)

"08": Reverse rotation (non-motor end)

- Please specify "07" (normal rotation) for rod type actuators.

Response data

Direct response format

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4-4-14p command (minimum transmission delay time)

Command	STX	Axis#	'p'	"trw"			Rtim		Five continuous '0'.					BCC	ETX
	02		70	74	72	77			30	30	30	30	30		03
Response	STX	'U'	Axis#	'p'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		70									30		03

Function

The minimum value of the communications turn-around time is changed.

Command data

"Trw" fixed character string

Rtim (hexadecimal ASCII value)

The time range is "03-FF".

Response data

Direct response format.

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4-4-15q command (servo ON/OFF)

Command	STX	Axis#	'q'	ON/OFF	Nine continuous '0'.								BCC	ETX
	02		71		30	30	30	30	30	30	30	30	30			03
Response	STX	'U'	Axis#	'q'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		71									30			03

Function

Turns servo ON or OFF.

This command turns the servo ON or OFF. Servo is automatically turned ON during initial power-up.

Command data

ON/OFF (hexadecimal ASCII value)

1 = servo ON

0 = servo OFF

Response data

Direct response format

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4-4-16r command (CPU reset)

Command	STX	Axis#	'r'	Rtyp		Eight continuous '0'.								BCC	ETX
	02		72			30	30	30	30	30	30	30	30		03
Response	STX	'U'	Axis#	'r'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		72									30		03

Function

This command resets the CPU.

Command data

Rtyp

Rtyp sets the selection code for the r command. "02" initializes the internal data and "03" resets the alarm.

Upon internal data initialization, the default shipped parameters will be sent to the edit area and the default axis operation parameter data is sent to the execution data area. Also, the target position location in the execution data area is changed to the present position.

Before alarm reset, ensure the cause of the alarm is fixed and the servo is off.

Please take care when initializing internal data. Abnormal parameters may cause erratic behavior.

Response data

Direct response format

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4-4-17t command (execute buffered command)

Command	STX	Axis#	't'	Ten continuous '0'.										BCC	ETX
	02		74	30	30	30	30	30	30	30	30	30	30		03
Response	STX	'U'	Axis#	't'	Status		Alarm		IN		OUT		'0'	BCC	ETX
	02	55		74									30		03

Function

This command executes any buffered command.

The t command is a broadcast command, and all CPU's receive it at the same time. Therefore, when two or more axes have buffered commands, these commands are executed by all axes simultaneously. If an axis has no buffered commands, the t command has no effect. The status response shows if an axis has a buffered command. This bit changes to 0 after t command execution.

Only the axis with the address corresponding to "Axis#" in the t command sends back a response even though the t command is received by all axes at the same time.

Command data

There is no command data (10 0's).

Response data

Direct response format

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4-4-18v command (set speed and acceleration)

Command	STX	Axis#	'v'	Vtyp	Vcmd				Acmd				0	BCC	ETX
	02		76	32									30		03
Response	STX	'U'	Axis#	'v'	Status	Alarm	IN		OUT		'0'	BCC	ETX		
	02	55		76									30		03

Function

The speed and the acceleration are specified by this command.

This command changes the content of speed instruction value (VCMD) and acceleration instruction value (ACMD) of the position data in the execution data area.

Command data

Vcmd (hexadecimal ASCII value)

Please refer to the section "Method of converting the encoder pulses" for converting mm/sec→0.2rpm to the units of speed.

Acmd (hexadecimal ASCII value)

Please refer to the section "Method of converting the encoder pulses" for converting G→0.1rpm/msec to the units of the acceleration.

Response data

Direct response format

Example

Axis 0 (10mm lead) is set to speed 100mm/sec and acceleration 0.3G.

Command	STX	Axis#	'v'	Vtyp	Vcmd				Acmd				0	BCC		ETX
	02	30	76	32	30	42	42	38	30	30	42	30	30	33	41	03

Vcmd[0.2rpm] = 100 × 60 / 10 / 0.2
= 3000 = 0BB8H

Acmd[0.1rpm/msec] = 0.3 × 60 × 9.80665 × 1000 / (10 × 1000) / 0.1
= 176.5197
= 176 (round-down)
= 00B0H

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5.Time-out and Retry

The HOST waits for a normal response from the slave station after completing the command transmission. It is assumed that all the following requirements have been met with a normal response.

1 The response format is satisfied.
2 BCC is normal.
3 Axis# No. of the transmission command is the same as Axis# No. of the reception response.
4 The first character of the command data is the same as the first character of the response data.

When the elapsed time between transmitting the command and receiving the normal response exceeds the time-out value, Trt, the master station should resend the command. Please flag as abnormal communication which cannot be recovered when the retry frequency exceeds upper bound value Nrt. The method of calculating time-out value Trt and retry frequency upper bound value Nrt is shown as follows.

(1) Time-out value Trt

As for the time-out value, the calculation method is different according to the command.

a. Excluding the V5 command

Trt = 20+α+(160/Kbr) [msec]

b. V5 command

Trt = 200+α+(160/Kbr) [msec]

α: Minimum transmission delay time parameter of slave station

Transmission rate shown by unit of Kbr: kbps

(2) Retry frequency upper bound value Nrt

Nrt = 0~3(Select it according to the system)

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Please note the following points about transmission retry in the W4 command, m command, and t command.

(1) W4 command "Memory write"

When the writing address is automatically incremented, the W4 command has a possibility different from the address that the writing address intended. Therefore, please resend the W4 command again when the time-out is generated after setting the writing address again according to the T4 command.

(2) m command "Relative PTP move"

Because resending an incremental command may cause undesired motion, please do not try the recovery procedure by resending this command.

(3) t command "Buffered command execution"

The t command cannot judge the delivery confirmation by normal response alone because it uses a representative Axis# response for the broadcast command. That is, please confirm a 0 for the buffered instruction in the status response by polling which uses n command.

When the watchdog timer times-out during a t command, or the buffered command status bit remains 1, the decision to resend the t command to recover communications depends on the necessity of axis synchronization. Therefore, the specific application determines whether or not to do the recovery procedure by sending the t command again.

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6.Communication procedure

6-1Communication establishment procedure

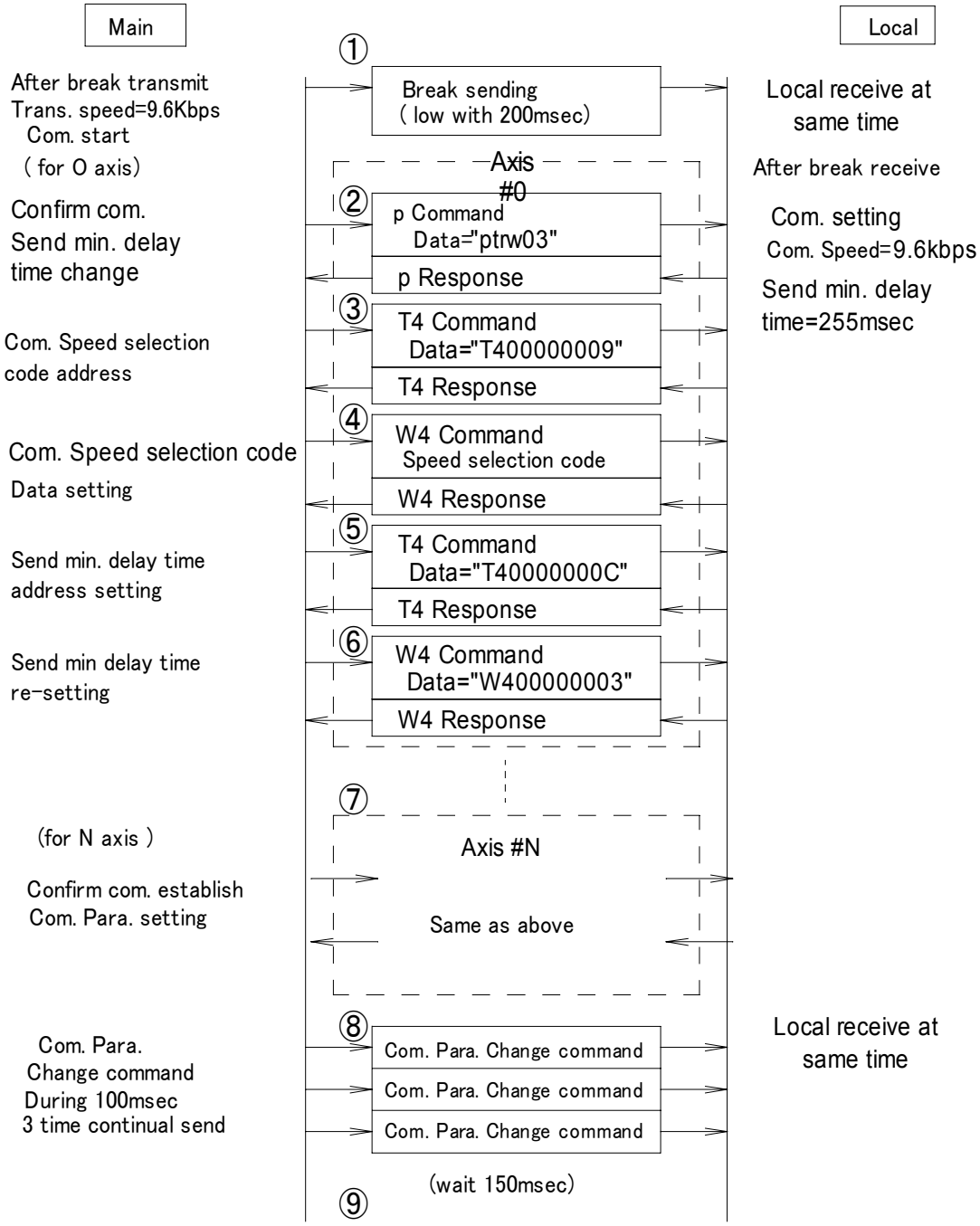
When the HOST can't establich communications with the slave, please reset the parameters in communication tools of the slave station by the communication establishment procedure and restart the communication from the HOST after it is reset.

The communication is established by the following procedure.

1. It returns to the initial communication condition lumping all axes together according to the break signal.
2. Set the minimum transmission relay time by p command (3ms is set here). Delay time (trr2) is effective from the reply of this command.
3. Specify the address of the transmission rate selection code.
4. Write the data of the transmission rate selection code.
5. Specify the address of the minimum transmission relay time.
6. Write the data for the minimum transmission relay time.
7. Repeat steps 2-6 for all axes.
8. The communication tools change instruction is continuously transmitted three times. The communication tools change instruction is a broadcast command (all slaves receive simultaneously), and no response is sent. The string has the following special 16 character format.
   STX + 14 continuous ENQ(05H) characters + ETX
9. Communication is possible after 150ms.
   The communication parameters will be set to nonvolatile memory using the V5 command. After cycling power, the new communications settings take effect. Please ensure there is some method re-establishing comunications during maintenance in order to be sure that you can communicate with the unit.

   In general, when the control power supply is turned on, the HOST should execute the communication establishment procedure without fail to avoid confusion when the RC cards are exchanged, etc.

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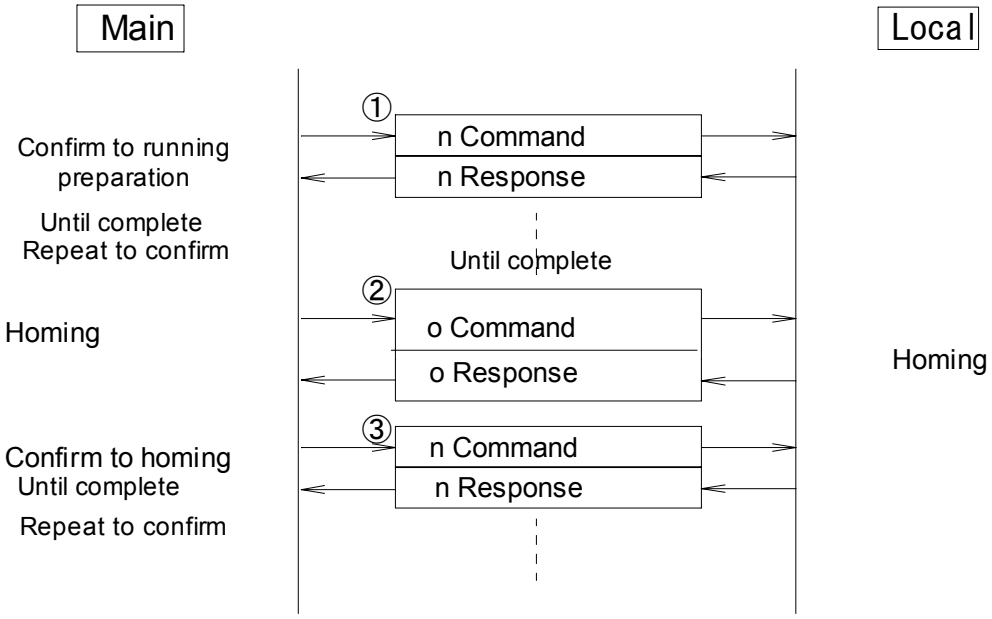
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6-2Homing procedure

Homing is executed by the following procedure:

1. Wait for drive to be ready. Confirm that bit 4 "Positioning completion signal" of “OUT" is one in response to the n command.
2. Homing is executed by the o command "Home".
3. Wait for Home to be complete. Confirm that bit 5 "Home complete signal" of “OUT" becomes one in response to n command.

After homing is completed, the a command "Absolute position move" can be executed. When executing a PTP move by the Q2 or Q3 commands before homing, the system will automatically perform the homing procedure and then move to the designation position.



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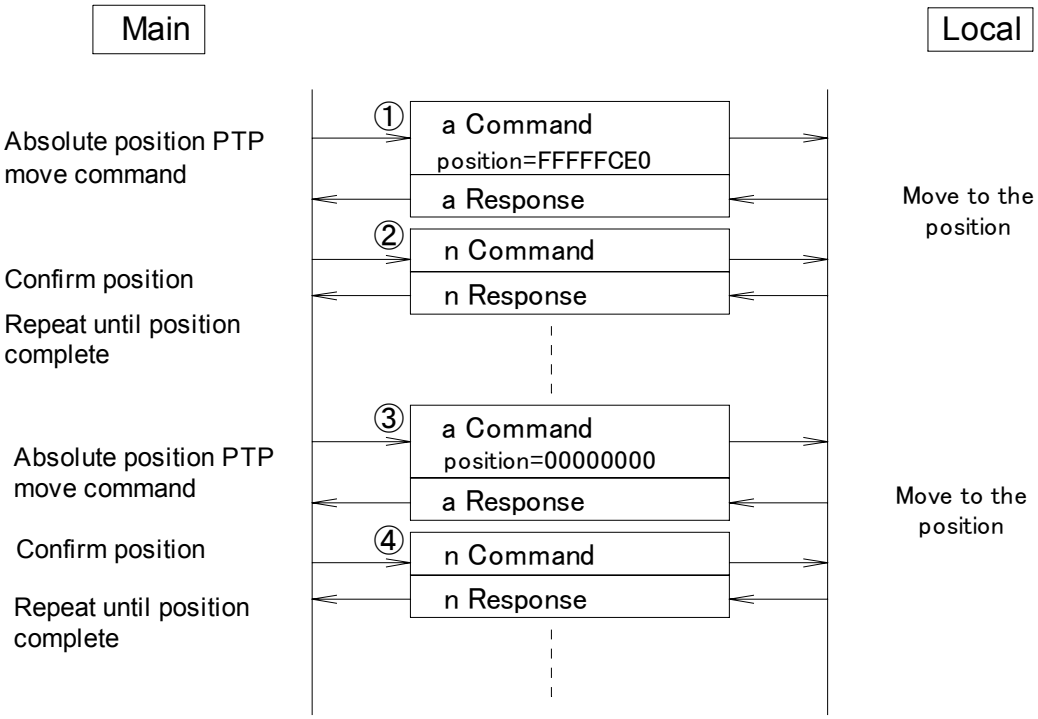
6-3Point to point (PTP) operation

A PTP move can be executed by a Q2, Q3, a or m command. Confirming the move is complete is usually done by looking at bit 4 "Positioning complete" of “OUT" in the response of n command.

The following steps describe how to make continuous moves.

1. Position=FFFFFCE0 is specified by the a command.
2. Position complete is confirmed from “OUT" bit 4 "Positioning complete" from the n command response.
3. Position=00000000 is specified by the a command.
4. Position complete is confirmed from “OUT" bit 4 "Positioning complete" from the n command response.

(Continuous motion is accomplished by repeating steps 1-4.)



Any motion parameter (including vel/acc/position) can be modified “on the fly” even while motion is under way. This opens a variety of possibilities including having a simple passing point operation by using the Position Band with the PFIN signal of “OUT" in the response of n command and the ZONE signal.

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6-4Simultaneous operation using buffered commands

Multiple-axis motion can start simultaneously using buffered comands. You can also execute multiple settings of the axis operation parameter. Buffering can be used when there is an undesirable delay between the starting of several axes in motion. The h command stores the desired command in the axis and the t command is a broadcast command to execute the buffered commands simultaneously. In other words, a PTP move command, a and m, can be buffered for several axes and launched simultaneously using the t command. This minimizes the starting time gap between the axes.

Buffering can also be used to change not only position, but also speed and acceleration at the same time before a move is launched. This can also be accomplished by setting the point data in the edit area by the Q3 command as an edit buffer and the move can be executed by using the Q2 command. The Q2 command is buffered by the h command after an arbitrary point data item is set to the edit area using the W4 command, and this is executed by t command. Utilizing this method moves several axes at the same time using the t command.

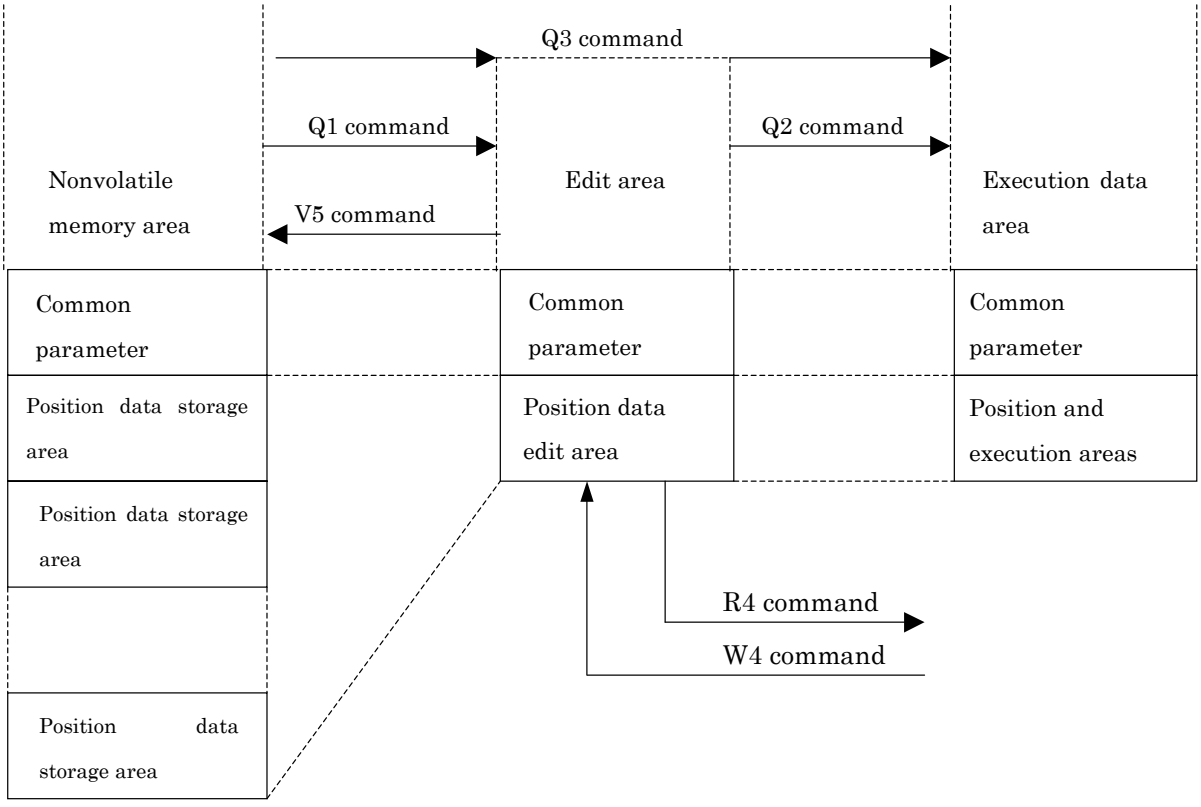
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7.Virtual memory space

7-1Virtual memory space system

Interrelation of nonvolatile memory area, edit area, and execution data areas

The batch transmission of data between these areas can be executed from the HOST. There is a limitation in total number of times written which exceeds 105 times for each data area. Maximum value N of the position number is 15.



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Memory and edit/execution of instruction data

The HOST can move the system by the following methods:

(1) The position data is saved in the nonvolatile memory area beforehand, and the data is sent to the execution data area by Q3 command "Position No. PTP move".

(2) Move to the data stored in the edit area by the Q1 command "nonvolatile memory area → edit area forwarding" or it by the W4 command "Memory write". Then perform a batch forwarding to the execution data area by the Q2 command "Edit area → execution data area forwarding". (The position is not reflected in present location number code PM1-PM8).

(3) Rewrite the data in the execution area directly using the a command "Absolute position PTP move" or the m command "Relative position PTP move".

In any case, the execution data area in the driver CPU must have each motion data item defined in order to make the move.

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7-2 Memory map

Please do not write to any memory areas that are not defined in this manual as it may cause undesirable operation.

7-2-1 Data structure of common parameters

The table below shows the data structure for the common parameters in the virtual memory space.

Address (HEX)	Code	Item	Remarks
000~001		(reserved)	
002	LIMM	Software stroke limit value + side	
003	LIML	Software stroke limit value-side	
004	ZONM	Zone boundary value + side	
005	ZONL	Zone boundary value - side	
006~008	-	(reserved)	
009	BRSL	SIO transmission rate selection code	
00A	OVCM	Home return velocity (Units: 0.2r/min)	
00B	OACC	Home return acceleration (Units: 0.1r/min/ms)	
00C	RTIM	Minimum transmission relay time	
00D	INP	Position band default value	
00E	VCMD	Velocity default value: 0.2r/min	
00F	ACMD	Acceleration default value: 0.1r/min/ms	
010	SPOW	Current limit while in position default value	
011	DPOW	Current limit while moving default value	
012	PLG0	Servo gain number default value	
013	MXAC	Maximum acceleration flag default value	
014	-	(reserved)	
015	PSWT	Push recognition time (Range: 0-255, Units: ms)	
016	-	(reserved)	
017	REG1	Lead type	
018	-	(reserved)	
019	ODPW	Home current limit	
01A	OTIM	Home time-out (Units: 16ms)	
01B~01F		(reserved)	

Note 1) Please take care when using the W4 command to write directly to the execution data area in order to avoid unpredictable behavior.

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Software stroke limit value(LIMM,LIML)

The software stroke limit value in the + direction is set in LIMM in absolute position coordinates and the software stroke limit value in the - side is set in LIML. The servo motor cannot move past these limit values. The units are encoder pulses and the range is –80000000H (80000000H) to 7FFFFFFFH. LIMM must be larger than LIML.

Zone boundary value(ZONM,ZONM)

The zone boundary value of the + side is set in ZONM in absolute coordinates and the zone boundary value of the - side is set in ZONL. The zone signal is turned on when the present location of the servo motor is in the between these values. The units are encoder pulses and the range is –80000000H (80000000H) to 7FFFFFFFH. ZONM must be larger than ZONL.

The zone signal can be monitored through “OUT" in the direct response string.

SIO transmission rate (Baud Rate) selection code(BRSL)

04H : 9.6 kbps 11H : 14.4 kbps

05H : 19.2 kbps 12H : 28.8 kbps

06H : 38.4 kbps 13H : 57.6 kbps

07H : 76.8 kbps 14H : 115.2 kbps

Minimum Transmission Relay time(RTIM)

After driver CPU receives a command, the minimum delay of the response transmission is set to RTIM. Units are msec and the range is 3-255.

Note) Please note that baud rate and minimum transmission relay time operate in the default state of (9.6kbps, 255msec), except when the BRSL parameter is set to one of the values above. In the following communication establishment procedure, be careful not to change the baud rate to a setting other than those listed above.

Velocity & Acceleration during homing (OVCM, OACC)

Velocity OVCM: units 0.2r/min, range 0000H-57E4H

Acceleration OACC: units 0.1r/min/msec, range 0001H-07FFH

Position band default value (INP)

This parameter is used to determine how far from the target position that the position complete output turns ON (range 00000000H-3FFFFFFFH encoder pulses). This item does not exist in a common parameter in the execution data area for the initial value for PTP operation parameter in the position data.

Speed/acceleration instruction default value (VCMD, ACMD)

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The speed instruction default value VCMD (units of 0.2r/min and a range of 0000H-57E4H) and acceleration instruction default value ACMD (units of 0.1r/min/msec and a range of 0001H-07FFH) set the default speed and acceleration for the axis. These items do not exist in the common parameters in the execution data area for the initial value for PTP operation parameter in the position data.

Current limit default value (SPOW, DPOW)

The initial value of the current limit while moving is set in DPOW and the initial value of the current limit while stopped is set in SPOW. These values are set by 256 stages where 0FFH is assumed to be the maximum current. Please note that the SPOW value is limited to 000H-0B4H. If set outside this range the axis sends a B1H error. The DPOW range is 000H-0FFH. These items do not exist in the common parameters in the execution data area for the initial value for PTP operation parameter in the position data.

Servo gain number default value (PLG0)

The initial value for the servo gain number while moving is set by PLG0. The gain number is set in 16 stages from 00H to 0FH. This item does not exist in a common parameter in the execution data area for the initial value for PTP operation parameter in the position data.

The maximum acceleration flag default value (MXAC)

The system accelerates at the maximum acceleration corresponding to the load condition when MXAC is set to 1. The deceleration in this case follows the acceleration instruction value. When MXAC is 0, the system follows the acceleration instruction value for both acceleration and deceleration. This item does not exist in a common parameter in the execution data area for the initial value for PTP operation parameter in the position data.

Push recognition time (PSWT)

This parameter determines the length of time that the push % must be exceeded before the PFIN turns ON.

Current limit during homing (ODPW)

This parameter sets the current limit during homing. These values are set by 256 stages where 0FFH is to be the maximum current (range 000H-0FFH).

Time-out value for homing (OTIM)

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This values determines the length of time that the unit is stopped during homing before it considers that the hard-stop has been encountered. (Units are 16msec).

Lead type (REG1)

Bit 0-3: Lead type bits

Bit 4-7: Reserved

RCP lead type list

Lead type (Hex)	Lead(mm)	Remarks
0	2.5	
1	3	
2	4	
3	5	
4	6	
5	8	
6	10	
7	12	
8	16	
9	20	

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7-2-2Data structure of position data

The table below shows the data structure of the position data in the virtual memory space.

Address (HEX)	Code	Item	Remarks
000	PCMD	Absolute position target position	
001	FLGP	Axis operation parameter default/position data selection flag Position data effective: Bit 7: Position band Bit 6: Max acceleration flag Bit 5: Current limitation value Bit 4: Servo gain number	
002		(reserved)	
003	INP	Position band	
004	VCMD	Velocity (units: 0.2r/min)	
005	ACMD	Acceleration (units 0.1r/min/ms)	
006	SPOW	Current limit while stopped	
007	DPOW	Current limit while moving	
008	PLG0	Servo gain number	
009	MXAC	Maximum acceleration flag	
00A~01F		(reserved)	

Note 1) Please take care when using the W4 command to write directly to the execution data area in order to avoid unpredictable behavior.

Absolute position target position (PCMD)

The target position of the PTP operation is set in this address. The range is C0000000H-3FFFFFFFH (encoder pulses)

Axis operation parameter default/position data selection flag (FLGP)

The axis operation parameter determines whether the initial value of a common parameter is used or the value of the position data is used. Every particular item of the operation parameter is allocated in the bit pattern shown as follows. The position data is used if the bit is one and the parameter default value is used if set to 0. The value of the offset in the following description is assumed to be an offset address in the position data.

Bit 0-3: Reserved

Bit 4: Servo gain (address 008H)

Bit 5: Current limit (address 006H and 007H)

Bit 6: Speed/acceleration/max acc flag (address 004H, 005H, and 009H)

Bit 7: Position band (address 003H)

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Position band (INP)

A permissible value of the difference between the target position and the present location used to detect the move complete when positioning (units: pulse, range: 00000000H-3FFFFFFFH).

Speed/acceleration value for PTP moves (VCMD, ACMD)

The speed instruction value VCMD (units: 0.2r/min, range: 0000H-57E4H) and the acceleration instruction value ACMD (units: 0.1r/min/msec, range: 0001H-07FFH) set the velocity and acceleration respectively.

Current limit value for PTP moves (SPOW, DPOW)

The current limit while moving is set by DPOW and the current limit while stopped is set by SPOW. These values are set by 256 stages where 0FFH is assumed to be the maximum current (range 000H-0FFH).

Servo gain number for PTP moves (PLG0)

The servo gain number when moving is set by PLG0. The gain number uses 16 stages from 00H-0FH.

The maximum acceleration flag for PTP moves (MXAC)

The system accelerates at the maximum acceleration corresponding to the load condition when MXAC is set to 1. The deceleration in this case follows the acceleration instruction value. When MXAC is 0, the system follows the acceleration instruction value for both acceleration and deceleration.

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7-2-3Push operation through position data

The push operation is achieved by using the position data in the virtual memory space. Please use the Q3 command "Position No. PTP move" to perform a push move. The value of bit 1 of MXAC determines whether a given position is either a push or standard PTP move. When bit 1 of MXAC is one, the point is a push move, and when it is 0, the move is a standard PTP move. The push % is only monitored within the INP range.

Code address	Item of position data
PCMD	Approach operation target position
FLGP	Axis operation parameter default/position data selection flag
INP	Push range
VCMD	Speed instruction value
ACMD	Acceleration instruction value
SPOW	Current limit for pushing (push %)
DPOW	Current limit while moving
PLG0	Servo gain number value
MXAC	Maximum acceleration flag/push operation specification flag

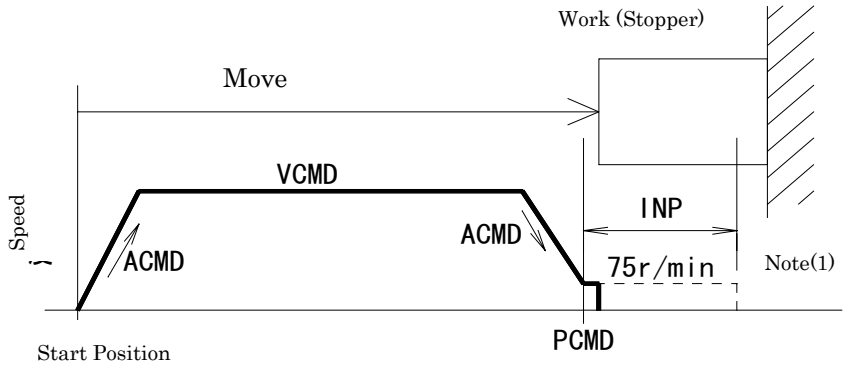
Push move completion is judged by having exceeded the push % for a time exceeding the PSWT parameter and position is within the INP value.

Address (HEX)	Code	Item
0015H	PSWT	Push recognition time parameter (Range: 0-255, Units : ms)

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Approach operation target position (PCMD)

The PCMD value sets the target deceleration positon. In actual operation, the axis decelerates from the approach speed specified (VCMD) at this position, and the low-speed actual pressing operation begins. The units for this item are the same as for PCMD for standard PTP operation.



Note(1): If VCMD is less than 75 rpm, then the velocity remains at VCMD.

Push range (INP)

INP sets the range within which the axis pushes. The position complete signal (PFIN) is turned on at that time if it moves in the direction specified by bit 2 of MXAC and meets the current limit (SPOW) after the approach operation is completed and the system is moving at the speed of 75r/min. If the current limit (SPOW) is not met before the axis moves the full INP range, PFIN remains off. The units of this item are the same as those for INP during standard positioning.

Current limit for pushing (SPOW)

SPOW sets the current limit for the push operation. This value is set by 256 stages where 0FFH is assumed to be the maximum current. However, the range where SPOW can be set is 000H-0B4H. When the push operation is completed normally (reaches the current limit), the force is maintained on the work. This state is released by executing another instruction. Afterwards, bit 1 of MXAC automatically returns to 0 when performing standard PTP moves and the push operation is released. Moreover, the push can be released by the d command "cancel remaining motion" while pushing.

Maximum acceleration flag/push operation flag (MXAC)

Bit 0

The system accelerates at the maximum acceleration corresponding to the load condition when MXAC is set to 1. The deceleration in this case follows the acceleration instruction value. When MXAC is 0, the system follows the acceleration instruction value for both acceleration and deceleration.

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Bit 1

When the set value is one, this position data is executed as a push operation instruction.

When the set value is 0, this position data is executed as a standard PTP instruction.

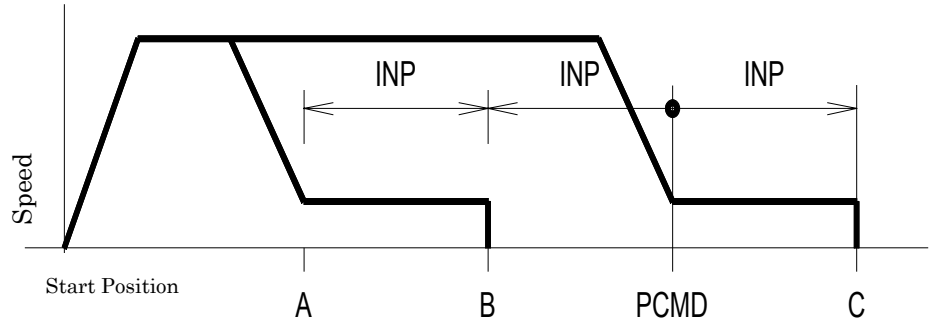
Bit 2

When the set value is one, the direction of the push operation after the approach operation is completed is reversed.

When the set value is 0, the direction of the push operation after the approach operation is completed is the standard direction.

The direction of the final stop position is calculated by this bit and adding/subtracting the INP value and the PCMD value. Please see the following figure.

When the set value of bit 1 is 0, this bit is invalid.



Push current limit not met

When the system does not meet the current limit during the push operation before the axis reaches the end of the INP distance, PFIN remains off. As a result, it can be recognized that the push operation ended abnormally by using PM1-PM8. PM1-PM8 do not change when instructing a push operation by using Q2 command "Edit area → operation data area forwarding".

7-2-4Data structure of amplifier/motor model monitor area

The following data can be read if necessary using the R4 command "Memory read".

The table below shows the data structure of amplifier/motor model monitor in the virtual memory space.

Address(HEX)	Code	Item	Model
00006800	ROM	Driver CPU ROM code	

Driver CPU ROM code (ROM)

This shows the driver CPU firmware (ROM) version.

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7-2-5Data structure of internal state monitor area

The following data can be read if necessary by using R4 command "Memory read".

The table below shows the data structure of the internal state monitor in the virtual memory space.

Address(HEX)	Code	Item	Remarks
00007400	PNOW	Present location	
00007401	VNOW	Present velocity	

Present location (PNOW)

This address reads out the present positional feedback from the encoder in pulses.

Present velocity (VNOW)

This address reads out the present velocity of the axis in 0.2r/min.

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7-3Nonvolatile memory area, edit area, and operation data area

7-3-1Initial value of the execution data area and the method of changing nonvolatile memory area

The content of the common parameters in the nonvolatile memory area is automatically loaded into the common parameters in the execution data area when the power supply is turned on. The initial value of the axis operation parameter of the common parameters (00DH-013H) is loaded into the position data of the execution data area automatically at the same time.

At this time, PCMD is set to 0 (address 00000400H) in the edit area, and FLGP is also set to 0 (address 00000401H). Moreover, the positioning target position of the position data in the execution data area is also set to 0.

Therefore, modifying the common parameters in the nonvolatile memory area can change initial values in the execution data area for values besides PCMD and FLGP. The procedure to change a common parameter and the position data in the nonvolatile memory is shown as follows:

The data in the nonvolatile memory area is read to the edit area by the Q1 command "nonvolatile memory area → edit area forwarding." This data is read by the HOST using R4 command "Memory read". The Host can then send the data back to the slave using the W4 command "Memory write", and then write the to the nonvolatile memory area with the batch transmission by V5 command "Edit area → nonvolatile memory area forwarding".

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7-3-2Note for data transmission to the execution data area

The position data in the nonvolatile memory can be loaded into the execution data area using the Q3 command "Position No. PTP move" via the edit area. Some items may not have a 1 to 1 relationship between the edit area and execution area using batch transmissions.

SIO parameter in communication tools

The edit area data can be transmitted to the execution data area only using BRSL and RTIM. That is, the serial communication condition differs from other data items, and is not influenced according to the batch transmission from the edit area by the Q2 command to the execution data area. The serial parameters in the nonvolatile memory area are read to the execution data area through the edit area when the power supply is turned on and become the initial communication condition for the serial line.

Servo operation parameters

Servo operation parameters (INP, VCMD, ACMD, SPOW, DPOW, PLG0, MXAC) are reflected in the execution data area according to the following figure (relation of batch forwarding between the edit area the execution data area (driver CPU)).

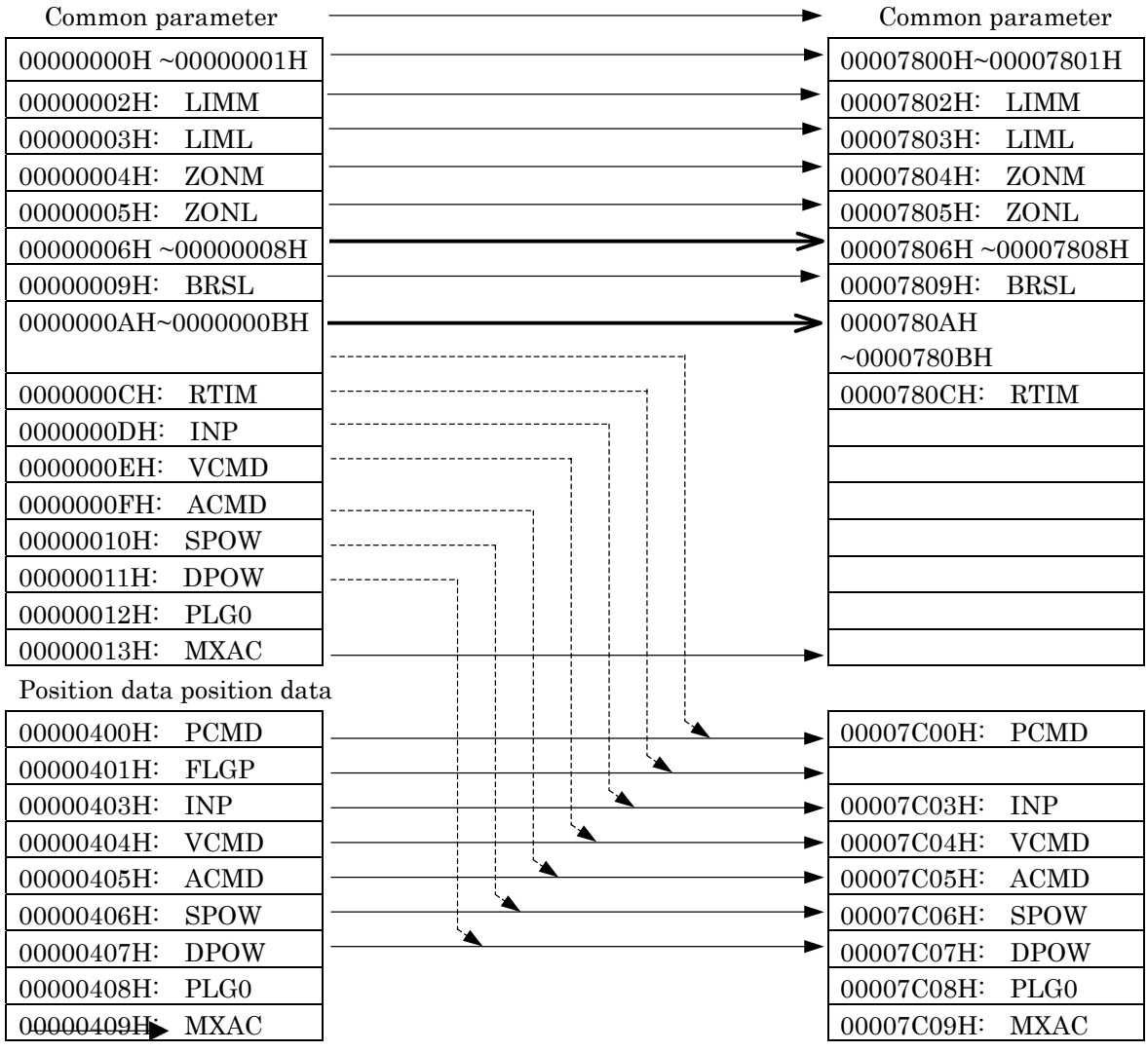
The corresponding bit is forwarded according to the content of the axis operation parameter default/position data selection flag (FLGP) in the edit area when the position data is transmitted from the edit area to the execution data area by the Q2 command "Edit area → execution data area forwarding" and the initial values in the common parameters of the edit area is forwarded to the position data of the execution data area for data with FLGP flag set to 0. The corresponding bit is forwarded and the data with FLGP bit set to 1 is forwarded from the position data of the edit area to the position data of the execution data area.

The Q3 command can be used “position number PTP move” to transmit the position data from nonvolatile memory to the execution area through the edit area. The position data in the nonvolatile memory area will be sent to the edit area first. This data is continuosly transmitted to the execution area. If the corresponding bit in the FLPG content is set to 0, the default value from the common parameters in the edit area to the position data in the execution data area. If the corresponding bit in the FLPG content is 1, the position data will be transmitted from the position data in the edit area to the position dat in the execution area. This action is the same as after initial power-up – the initial value from the nonvolatile emory is batch forwarded to the execution data area through the edit area.

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Relation between edit area and execution data area when batch forwarding (driver CPU)

Edit area Execution data area



Forwarded to execution data area by Q2 and Q3 commands

Forwarded to execution data area by parameters in communication change command

Default value forwarded for items whose FLGP bit is 0 when forwarding to the execution data area from the point data edit area using the Q2 and Q3 commands

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8.Others

8-1 Error

8-1-1 Error display list (PM1-PM8)

There is an error code (abbreviated type) displayed by PM1-PM8 which shows the driver CPU error code. These values can be monitored through “OUT" in the direct response string.
The errors are shown follows.

O =ON and X= OFF

ALM	PM8	PM4	PM2	PM1	Content
O	*	*	*	*	Normal
X	X	O	O	X	Nonvolatile memory data setting error
X	X	O	O	O	Homing or motor excitation error
X	O	X	X	X	Servo Error
X	O	X	X	O	Overcurrent in power conversion
X	O	X	O	X	Other power conversion error
X	O	X	O	O	Deviation error
X	O	O	X	X	(Not used)
X	O	O	X	O	Encoder breakage
X	O	O	O	X	Reserve
X	O	O	O	O	Nonvolatile memory data corrupt

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8-1-2Error level

The errors in this system are divided roughly into the following error levels.

Error No. (Hex)	Error level	Error Reset	Remarks
000~07F	CPU Warning	Acceptable	Command rejection
080~0FF	CPU Error	Acceptable	CPU error

8-1-3Error No. list

Error No.	Content	Error level
00	Normal	Normal
61	Illegal serial character or illegal memory address	Warning
62~64	Illegal operand in the serial string	
70	Attempted to move while the RUN state bit is OFF	
71	Attempted a PTP operation before homing is completed	
73	Attempted to reset alarm while servo ON instruction state bit ON	
74	Attempted to move during motor initialization process	
75	Movement command while homing	
B0	Abnormal parameter data.	Error
B1	Abnormal position data.	
B8~B9	Motor commutation error.	
BC	Encoder error.	
C0~C1	Overspeed or servo error (Try reducing payload, velocity or Acc).	
C8	Overcurrent	
D0~D1	Incoming power supply is out of range.	
D8	Positional deflection is excessive.	
E8~EA	Encoder disconnection	
F8	Nonvolatile memory data error	

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8-1-4Error Details

Nonvolatile memory data setting error

The error number indicates that a value set to the nonvolatile memory is invalid. Therefore, these errors cannot be canceled as long as this data is not set to a valid value. These errors are output as code 06H by PM1-PM8.

B0H: Abnormal parameter data.

The user attempted to set a parameter to a value outside of its valid range.

B1H: Abnormal position data.

The user attempted to set a position that exceeds the range of the coordinates. This error may also occur if the user attempts to move to a point in the point table that has no data.

Homing and motor initialization errors.

The error No. indicates the reason when the motor commutation failed.
These errors are output as code 07H by PM1-PM8.

B8H: Motor commutation error 1.

This error occurs when the motor is not capable of initializing properly. This may be caused by the load condition, the incoming power supply not being strong enough, etc.

B9H: Motor commutation error 2.

This error occurs when the motor is moving and something causes it to abruptly stop moving. This in turn causes it to lose commutation. This may be caused by the load condition, the incoming power supply not being strong enough, etc.

BCH: A and B phases on the encoder are not functioning properly.

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Servo Errors

These errors occur when there is a problem with the servo control loop. These errors are output as code 08H by PM1-PM8.

C0H: Overspeed.

This error occurs when the value of the speed based on the encoder feedback exceeds 1.2 times the speed instruction upper bound value.

C1H: Servo error.

This error occurs when the relation between the instruction speed and the actual speed while executing a motor movement instruction.

Overcurrent

C8H: Overcurrent

This error occurs when there is too much current in the driver circuit, and there is a possibility of a short-circuit in the motor circuit. This error is output as code 09H by PM1-PM8.

Power conversion errors

These errors occur when the electric power conversion circuit has an error.
These errors are output as code 0AH by PM1-PM8.

D0H: The incoming power supply is out of range.

This error occurs when the incoming power supply voltage exceeds the raitings. Please refer to the electrical specification for the voltage regulations for the main power supply input.

D1H: The regeneration power is excessive.

This error occurs when the regenerative current exceeds the maximum value.
This may occur if the system has a vertical payload that is out of range.

Positional deflection error

D8H: Positional deflection is excessive

This error occurs when the system is incapable of keeping up with its instructed move and the motor is somehow restrained. This error is output as code 0BH by PM1-PM8.

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Encoder disconnection detection

These errors occur when the encoder has become disconnected. These errors are output as code 0DH by PM1-PM8.

E8H: A and B phase disconnection

E9H: A phase disconnection

EAH: B phase disconnection

Nonvolatile memory error.

F8H: The nonvolatile memory data has an error.

(Driver CPU)

This error occurs when the nonvolatile memory is damaged, and has resulted in an incorrect checksum. All areas of the nonvolatile memory must be rewritten to the recover from this error. This error is output as code 0FH by PM1-PM8.

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8-1-5Warning Details

Error numbers 00h-7Fh indicate various command rejections.

Improper data warnings

These errors only show the command rejection response when inappropriate data is written via the R4 command.

61H: Illegal serial character or illegal memory address

62H: The first operand in the serial string is not correct.

63H: The second operand in the serial string is not correct.

64H: The third operand in the serial string is not correct.

Warnings indicating improper conditions for executing a command

These errors indicate a command rejection due to the servo amplifier being in a state in which it cannot execute the command.

70H: Attempted to move while the RUN state bit is OFF

This error occurs if the RUN state bit in "Status" of the direct response form (bit 2) is OFF and a PTP operation instruction (a, m, o, and Q2 commands) is issued. This can also occur when a buffered PTP command is executed.

71H: Attempted a PTP operation before homing is completed

This error occurs if the ZFIN signal in "IN" of the direct response form is OFF and a PTP operation instruction (a, m, o, and Q2 commands) is issued. This can also occur when a buffered PTP command is executed.

73H: Attempted to reset alarm while servo ON instruction state bit ON

This error occurs if the Servo ON state bit in "Status" of the direct response form (bit 1) is ON and an alarm reset (r command) is attempted.

74H: Attempted to move during motor initialization process

During the motor initialization, all commands except the n, q, R4, T4, W4, and Q1 commands are rejected. After the system initially powers up, please wait for the PFIN status bit to turn on before attemting a move.

75H: Movement command while homing

All movement commands are rejected during homing.

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8-2Method of converting encoder resolution and units

Encoder count/revolution =800 pulses

Encoder resolution capability = lead mm/800 pulses

Convert standard units to protocol units

Item		Conversion type
Name	Unit	
Position and distance	Pulse	Position and distance mm ×800/lead mm
Speed	0.2rpm	Speed mm/sec ×60/lead mm/0.2
Acceleration	0.1rpm/msec	60×9.80665×1000/acceleration G×0.1x(lead mm ×1000)

Convert protocol units to standard units

Item		Conversion type
Name	Unit	
Position and distance	mm	Position and distance pulse × lead mm/800
Speed	mm/sec	0.2 rpm in speed ×0.2× lead mm/60
Acceleration	G	Acceleration 0.1rpm/msec ×0.1× lead mm ×1000 /(60×9.80665×1000)

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9. Change history

Revision	Date	Content of change	Page
First edition	10/21/2002	-	

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