Doc No.LA*－OMS0020-A

Operation Manual

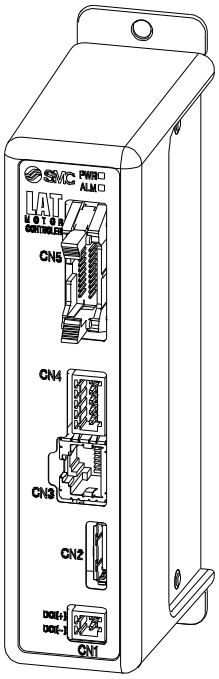
PRODUCT NAME

Card Motor Controller

（Serial Communicationedition)

Model / Series / Product Number

LATCA　Series



SMC Corporation

SMC

About this operation manual

This "Card Motor Controller (Serial Communication edition)" operation manual covers use of the LATCA-□□Card Motor controller when used with serial communication (RS-485) in one manual. Refer to "Card Motor Controller (Step Data Input edition)" for information relating to all control modes. When using in Step Data input mode, refer to the "Card Motor Controller (Step Data Input edition)"; when using in pulse input mode, refer to the "Card Motor Controller (Pulse Input edition)"

Contents

LATCA Series Controller
1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage.
These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)[*1)], and other safety regulations.

*1) ISO 4414:Pneumatic fluid power -- General rules relating to systems.
ISO 4413:Hydraulic fluid power -- General rules relating to systems.
IEC 60204-1:Safety of machinery -- Electrical equipment of machines .(Part 1:General requirements)
ISO 10218-1992:Manipulating industrial robots -Safety.
etc.

Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
Warning	**Warning**indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Danger	**Danger**indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

⚠ Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.
Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.
The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.
This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
The product specified here may become unsafe if handled incorrectly.
The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.
1.The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2.When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4.Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

LATCA Series Controller
1. Safety Instructions

⚠ Caution

1.The product is provided for use in manufacturing industries.
The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.
If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.
Read and accept them before using the product.

Limited warranty and Disclaimer

1.The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***2) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

1. **The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.**
2. **The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.**

2 Summary

2.1 Purpose of the Operation Manual

This operation manual discloses the serial communication specifications for the Card Motor controller (LATCA-□,Ver 2.0).

2.2Notation

Unless explicitely stated otherwise, this operation manual follows the notation detailed below.

(1) Values are written in big-endian byte order.

(2) Values are generally written in decimal, however those ending with "h" are in hexadecimal, and those ending in "b" in binary.

2.3Abbreviations

This manual uses the following abbreviations.

GUI : Graphical User Interface
I/O :Input/Output
I/F : Interface
MSB : Most Significant Bit
ASCII : American Standard Code for Information Interchange
BCD : Binary-coded decimal
MFC : Microsoft Foundation Class
API : Application Programming Interface
PLC : Programmable Logic Controller
PC : Personal computer
COM : Computer on Module
RS-485: Recommended Standard 485
USB : Universal Serial Bus

3. Scope

3.1 Scope

This operation manual applies only to the functions below in 1-to-1 communication with communication devices such as a PLC, other than the Card Motor configuration software for the Card Motor controller (LATCA-□, Ver2.0).

(1) Step Data Configuration

The following parameters may be configured.

- ・Operation mode selection (positioning/pushing)
- ・Operation method (ABS/REL)
- ・Target position
- ・Positioning time
- ・Speed
- ・Acceleration
- ・Deceleration
- ・Thrust setting value
- ・Load mass
- ・Pushing speed
- ・Positioning width
- ・Threshold
- ・Area range

(2) Operation Data Acquisition

The following internal Card Motor controller operation data is acquired.

- ・I/O data
- ・Positioning data
- ・Speed data
- ・Equivalent thrust value data
- ・Target position
- ・Step Data no. executed

(3)Step Data Operation

By employing pre-set Step Data, operation instructions will be given from the communication device such as a PLC without using parallel I/O signal input.

∗When setting Step-Data, turn the power supply to the Card Motor off and then ensure homing operation is performed after configuration is complete.

(4)Direct Operation

By employing direct operation step-data, operation instructions will be given from the communication device such as a PLC without using parallel I/O signal input.

∗Direct operation step-data cannot be saved internally to the Card Motor controller.Homing operation is not required after setting direct operation step-data.The set step-data operation pattern will be reflected when executing the OE operation command.

- Differences between Step Data operation and direct operation:

Configuration of stepdata in Step Data operation and direct operation have the following differences.

Criteria	Step Data operation	Direct operation
Power supply to Card Motor turned OFF when settings are changed.	Yes	No
Step data saved/processed after each change in settings	Yes	No
Homing after setting changes	Yes	No
Configuration data maintained even if the power supply is turned off	Saved	Not saved

(5) Acquisition and clearance of alarm history

The alarm history saved in the controller will be cleared / acquired.

⚠Caution
Please use the controller configuration software to pre-set the basic controller settings (see below). 1. Card Motor part number 2. Return to Origin method 3. Step Data inputmethod 4. Card Motor mounting orientation 5. Controller ID configuration (factory setting = 1) 6. Output signal function selection

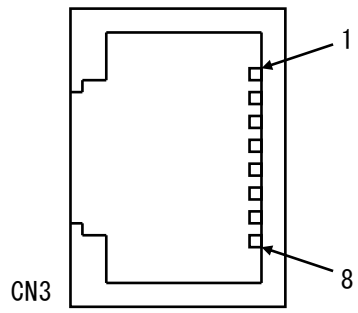
4. Hardware Specifications

4.1 Input Specifications

Based on the RS485 (2-wire type)

4.2 Communication Connector Pin Assignment

Connector used: Hirose Electronics 「TM11R-5M2-88」



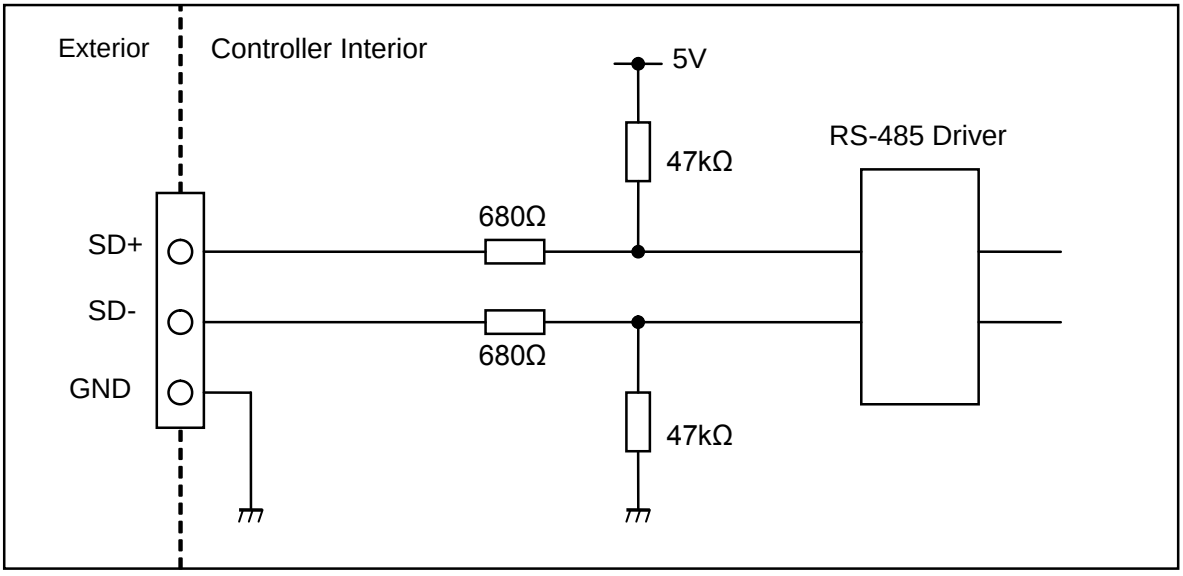
Terminal no.	Function	Description
1	NC	Not connected
2	NC	Not connected
3	SD +	Connect + signal lead *1)
4	SD -	Connect - signal lead *1)
5	NC	Not connected
6	NC	Not connected
7	NC	Not connected
8	GND	Please connect to an input ground as the basis of signals.

Note 1) Please read the operation manual before connecting modules.

If the function is written as A/B, please connect +/- for the signals.

As this product is a 2-wire type, "TXD and RXD" are written together as "SD"

4.3 Communication Circuit



Note 1) There is no terminal resistor built into the controller communication circuit.

5. Software Specifications

5.1 Serial Communication Specification

The LATCA specific (command type) protocol is shown below.

Criteria	Description	
Protocol	Specific to LATCA	
Communication data	ASCII	
Node type	Slave (controller)	
Error Check	None	
Frame size	Variable length; 128 bytes maximum	
Communication mode	RS-485; asynchronous mode	
	Communication speed	19,200bps
	Data bits	8bits
	Parity	Even parity
	Stop bit	1bit
	Flow control	None

5.2 Frame Format

The frame formats used in serial communication are listed below.

(1) Frame Format

(i) Requirements (PLC or other communication device → Card Motor controller)

Start Code	ID [1)]	Space .	Command .	Space .	Parameter .	Check Sum	End Code
1 byte	2 bytes	1 byte	2 bytes	1 byte	0 to 57 bytes	2 bytes	2 bytes
:	"01"-"FF"	20h	Command	20h	Depending on command	LRC	CR, LF

Note 1) This is the controller ID set in the Card Motor controller (initial setting = 1).
ID configuration example)
ID 1 :"01"
ID15 :"0F"
ID16 :"10"

Note 2) Please leave a space of 1 byte between Address-Command-Parameter for parameters with commands only.

(ii) Response (Card Motor controller → PLC or other communication device)

(a) Normal response

Start Code	ID [1)]	Command	Result	Response Data	Check Sum	End Code
1 byte	2 bytes	2 bytes	2 bytes	0 to 55 bytes	2 bytes	2 bytes
:	"01"-"FF"	Sent command received .	"OK"	Depending on command	LRC	CR, LF

Note 1) This is the controller ID set in the Card Motor controller (initial setting = 1).
ID configuration example)
ID 1 :"01"
ID15 :"0F"
ID16 :"10"

(b) Irregular response

Start Code	ID [1)]	Command	Result	Error details	Check Sum	End Code
1 byte	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes	2 bytes
:	"01"-"FF"	Sent command received	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

Note 1) This is the controller ID set in the card motor controller (initial setting = 1).
ID configuration example)
ID 1 :"01"
ID15 :"0F"
ID16 :"10"

(2) Guard processing of received frames

If the ASCII code is broken as a result of noise in the frame received and inaccurate data is mixed, an "NG" will be sent. If only inaccurate data is received, by discarding of the received data, the frame received can be protected. Inaccurate data refers to data other than the ASCII data below.

(a) Alphabet (upper/lower case)

(b) Special characters (BS, space, TAB, comma, full stop, hyphen)

(c) Line-break code (CR+LF)

(3) ID

When communicating between the Card Motor controller and a PLC or other communication device, a request will be received and responded to only when the pre-set Card Motor controller ID and communication data controller ID match.

If the controller ID in the communication data differs to the controller ID set in the Card Motor controller, the received communication data will be discarded and no response will be made.

⚠ Caution

Please use the unique controller IDs for each controller within the same serial communication network.

The use of same IDs may result in interference in response data.

5.3 Command List

A list of possible commands is detailed below.

Command	Parameter	Meaning
EE	INDEX1 INDEX2 DATA	(1) Reading Step Data The INDEX 2 parameter related to the Step-Data no. in INDEX 1 will be read. (2) Step Data configuration[Note1) 2) 3)] The INDEX 2 parameter related to the step-data no. in INDEX 1 will be configured.[Note1)]
EU	None	All parameters set using an EE command are saved simultaneously. [Note1) 2) 3)]
AB	None	All parameters saved using the EU command are reflected simultaneously. [Note1) 2) 3)]
MO	None	I/O state, current card motor position, speed, equivalent thrust force value, target position and Step-Data no of current operation will be read.
MD	MODE	This changes the controller operation mode from parallel I/O to serial communication mode. (Parallel I/O operation mode using I/O signals will be activated when the power supply is turned on).
OE	STEP ENABLE ACTION	Card Motor operation instructions through serial communication (Serial I/O Operation).[Note1),Note4)]
RE	CLEAR	Acquisition and clearance of alarm history

Note1） Step Data no. 1-15 configured using the EE command will not be reflected until the EU or AB commands are executed. TheseStep Data cannot be used with OE command based operation instructions.

Step Data no. 20 configured using the EE command does not require execution of the EU or AB commands. This Step Data can be used with OE command based operation instructions.

Note2） When configuring and reflecting Step Data, execute the EE → EU → AB commands in that order.

Note3） When configuring and reflecting StepData,ensure the power to the Card Motor is turned OFF.

If the EU or AB commands are executed while power is ON to the Card Motor, unexpected malfunction may occur.

Note4） Please execute the OE command after changing the MODE to 1 (serial I/O operation) using the MD command. When set to MODE 0 (parallel I/O operation, no operation will be performed even if the OE command is executed.

5.4 Command Details

(1) Step Data Setting Command "EE" Details

Step Data values identified as "INDEX1" or "INDEX2" will be read.

Step Data values identified as "INDEX1" or "INDEX2" can also be set.

Please see the parameter table below for details.

(i) Required Format

- Data read

Start Code	ID	Space	Command	Space	INDEX1	Space	IND EX2	Check Sum	End Code
:	"01"-"FF"	20h	"EE"	20h	"3"-"17" "22"	20h	"0"-"17"	LRC	CR,LF

- Data Setting

Start Code	ID	Space	Command	Space	INDEX1	Space	IND EX2	Space	DATA	Check Sum	End Code
:	"01"-"FF"	20h	"EE"	20h	"3"-"17" "22"	20h	"0"-"17"	20h	ASCII	LRC	CR, LF

- DATA (Configuration Data)

Please set data value as a multiple of the configuration unit. Values smaller than the configuration unit will be discarded.

(ii) Response Format

- Data read

(a) Normal response

Start Code	ID	Command	Result	Response Data (Saved Data)	Check Sum	End Code
:	"01"-"FF"	"EE"	"OK"	ASCII	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"EE"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

- Data Setting

(a) Normal response

Start Code	ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"EE"	"OK"	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"EE"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

- DATA (Saved Data)

Data will be sent as a value to 5 decimal points.

Response Data	0.00000 to 60000.00000

E.g. 1) When reading Step Data No. 1: Movement Time

Command sent ":EE 3 1D2 (D2 is the checksum)

Data Sent ":EEOK0.030008B" (8B is the checksum)

E.g. 2) When reading Step Data No. 10: Target Position

Command sent ":EE 12 0A3"(A3 is the checksum)

Data sent ":EEOK5000.00000F9" (F9 is the checksum)

(iii) Parameter List

INDEX1		INDEX2		DATA	
Parameter Value	Description	Parameter Value	Description	Configuration Unit	Value Range
0- 2	-	Unavailable			
3	Step Data No. 1 (Step Data No. 0[Note6])	0	Target Position [μm] [Note 1)]	1	Note 1)
		1	PositioningsTime [s]	0.01	0 to 60
		2	Speed [mm/s]	1	0 to 400
		3	Acceleration [mm/s^2]	1	0 to 60000
		4	Deceleration [mm/s^2]	1	0 to 60000
		5	PushingSpeed [mm/s][Note2)]	1	32768 to 32788
		6	Thrust Setting Value [Note 3)]	0.1	More than 1[Note 3)]
		7	Missing	-	-
		8	Missing	-	-
		9	Load Mass [g]	50	0,50,100 to 500
		10	MovementMode (0:ABS, 1:REL)	1	0 , 1
		11	ThresholdForceValue	0.1	0.1 to 5
		12	Positioning width [μm]	1	0 to 30000
		13	AREA A Position 1 [μm] [1)]	1	0 to 30000
		14	AREA A Position 2 [μm] [1)]	1	0 to 30000
		15	AREA B Position 1 [μm] [1)]	1	0 to 30000
		16	AREA B Position 2 [μm] [1)]	1	0 to 30000
		17	Unused	-	-
4	Step Data No. 2 (Step Data No. 1[Note6])	0-17	As above	As above	
5	Step Data No. 3 (Step Data No. 2[Note6])	0-17	As above	As above	
6	Step Data No. 4 (Step Data No. 3[Note6])	0-17	As above	As above	
7	Step Data No. 5 (Not used.)	0-17	As above	As above	
・・・	・・・	・・・		・・・	
17	Step Data No. 15 (Not used.)	0-17	As above	As above	
18-21	Step Data No. 16-19 (Not used.)	Unavailable			
22	Step Data No. No.20 [4)] (Not used.)	0-17	Same as Step Data No. 1-15		

Note 1: Maximum value is the “Card Motor stroke [μm]” (E.g. LAT3-10:10000 maximum)
The minimum values are shown below depending on operation methods.
- RELoperation: CardMotor stroke [μm] x -1 (E.g. LAT3-10:-10000 minimum)
- ABS operation: 0

Note 2: Refer to the following examples for how to set the “Pushing Speed”.

- For positioning operation, set the “Pushing Speed” value to “6” [mm/s].
- For "Pushing Speed" use “32768” as base value, and add pushing speed in [mm/s].
- The Pushing Speed setting range is 0 to 20 [mm/s].

Step Data No. 1 (in Pulse Input mode the corresponding Step Data is No. 0):
The controller uses the "Pushing Speed" value set in Step Data No. 1 (Step Data No. 0 in Pulse Input mode) as speed value for the "Return to Origin" operation.

- Therefore, set the “pushing Speed” value to “6” [mm/s] when performing positioning operation.
- If a value equal to or less than “32768” is input, the pushing operation will not be performed even if a "Thrust Setting Value" has been input.
(For example if "0" or "32768" is used for "Pushing Speed", the speed for the "Return to Origin" operation will become 0 mm/s and therefore the "Return to Origin" operation will not be performed.)

Example 1: Step Data No. 1 is used for a positioning operation at 100 mm/s speed:
- Set the "Travel speed" value to "100" [mm/s].
- Set the "Pushing Speed" value to "6” [mm/s].
(Thus, the travel speed for the "Return to Origin" operation will also be 6 mm/s.)

Example 2: Step Data No. 1 is used for a pushing operation. The Card Motor travels at 100 mm/s up to the position where it starts the pushing operation and operates the pushing operation at 6 mm/s:
- Set the "Speed" value to "100" [mm/s] for the positioning operation movement.
- Set the "Pushing Speed" value to "32774" (32768 + 6 mm/s) for the pushing operation movement.
(Thus, the travel speed for both the pushing operation and "Return to Origin" operation will be 6 mm/s.)

Step Data No. 2 or higher (in Pulse Input mode, the corresponding Step Data is No. 1 or higher):

Example 3:
- For positioning operation:Set the "Pushing Speed" value to "32768".
(Thus, "Pushing Speed" will become 0 mm/s for Step Data No. 2.)
- For pushing operation:Set "Pushing Speed" to“32774”(6 mm/s + 32768).
(Thus, "Pushing Speed" will become 6 mm/s for Step Data No. 2.)
In addition, the “Thrust Setting Value” must also be set.

Note 3: Maximum values differ according the theCard Motor model. （LAT3*-10: 5, LAT3*-20: 4.8,

LAT3*-30: 3.9）

Note 4: Step Data 20 is used in direct operation.

Note 5: If the Target Position exceeds the stroke range, the Card Motor operation speed is over 400mm/s, or any other impossible value is set, during the operationa“Step Data error” will occur.
Please set values as appropriate.

Note 6: Step Data numbersin brackets are valid inPulse Input mode.

⚠ Caution
Do not set any values other than 3-17 or 22 in INDEX1, or 0-6 or 9-16 in INDEX2. Alarms may occur, or the card motor may malfunction unexpectedly.
Step Data will not be changed by only sending an EE command. When configuring/reflecting Step Data, please transmit the commands in the order of EE→EU→AB.
Step Data no. 20 will be reset after the power supply is cut. Please set accordingly for direct operation.
Set the Load Mass and Speed for Return-to-Origin at those for Step Data No. 1 (Step Data No. 0 for Pulse Input mode).

(iv) Parameter Description

<table>
<tr><th>Parameter Name</th><th>Description</th></tr>
<tr><td>Step Data</td><td>The Step Data No. to be read and configured is defined.</td></tr>
<tr><td>Target Position</td><td>Configure either the target position or the thrust starting position.</td></tr>
<tr><td>PositioningTime</td><td>Configures the positioning time in which the target position is to be reached.
In "Step Data input" mode only "CycleTimeEntryMethod"can be used.
⚠ Caution
Depending on the order in which Step Data is read, certain conditions may mean that the commanded operations cannot be executed.
In this case an alarm will be generated, and the operation will not be completed.
Please set according to the customer operation condition.</td></tr>
<tr><td>Speed</td><td>Configures the movement speed to either the Target Position or the thrust starting position.
In "Step Data input" mode only "Speed Entry Method" can be used.
⚠ Caution
If parameters which cannot be executed are set, operation may not be able to be completed according to the settings. Acceleration and deceleration settings are detailed below.</td></tr>
<tr><td>Acceleration</td><td>Setting the movement acceleration.
In"Step Data input" mode only "Speed Entry Method" can be used.</td></tr>
<tr><td>Deceleration</td><td>Setting the movement deceleration.
In "Step Data input" mode only "Speed Entry Method" can be used.</td></tr>
<tr><td>PushingSpeed</td><td>Configuration of movement speed for thrust control.
Pushing speed configuration in Step Data no. 1 will be used for the Return to origin operation.</td></tr>
<tr><td>Thrust Setting Value</td><td>Sets the maximum controlled thrust force.
⚠ Caution
Thrust Setting Values are only provided as a guide. These should be configured after careful consideration of the customer application.</td></tr>
<tr><td>Load Mass</td><td>Sets the weight of the work-piece to be applied to the Card Motor.
Load Mass configuration in Step Data No. 1 will be used in the Return to origin operation.
⚠ Caution
Weights available for selection are only provided as a guide. These should be configured after careful consideration of the customer application.</td></tr>
</table>

<table>
<tr><th>Parameter Name</th><th>Description</th></tr>
<tr><td>Movement Mode</td><td>Target position coordinates will be set.
<table>
<tr><th>Movement Mod</th><th>Details</th></tr>
<tr><td>ABS</td><td>The target position will be set as an absolute coordinate with the Card Motor Origin point used as a reference point.</td></tr>
<tr><td>REL</td><td>The target position will be set as a relative coordinate with the current position used as a reference point.</td></tr>
</table></td></tr>
<tr><td>Threshold Force Value</td><td>Specifies the conditions when to output the INF signal.
The INF signal will turn ON when the thrust force generated by the Card Motor exceeds the Threshold Setting Value.
The Threshold Force Value can be configured independent of the Thrust Setting Value, meaning that if a Thresold Force Value higher than the Thrust Setting Value is entered, the INF signal will not turn ON.</td></tr>
<tr><td>Positioning width</td><td>Configures the range from the Target Position which outputs the INP signal.</td></tr>
<tr><td>AREA A Position 1</td><td rowspan="4">Configures the table position range within which the AREA signal will be output.
The AREA signal is output for both the AREA A and AREA B set configuration.
Set as AREA 1≦AREA 2.</td></tr>
<tr><td>AREA A Position 2</td></tr>
<tr><td>AREA B Position 1</td></tr>
<tr><td>AREA B Position 2</td></tr>
</table>

(2) Step Data Save Command "EU" Details

Use after executing Step Data setting comand "EE".

(i) Required Format

Start Code	ID	Space	Command	Check Sum	End Code
:	"01"-"FF"	20h	"EU"	LRC	CR, LF

(ii) Response Format

(a) Normal response

Start Code	ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"EU"	"OK"	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"EU"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

⚠ Caution

Execute the EE command under the following conditions:

In parallel I/O mode, when the SVON signal is OFF.

In serial I/O operation, when the ACTION byte in the OE command is set to "0".

Otherwise the Card Motor may malfunction unexpectedly.

(3) Step Data Reflection Command "AB" Details

Use after executing the Step Data save command "EU".

(i) Required Format

Start Code	ID	Space	Command	Check Sum	End Code
:	"01"-"FF"	20h	"AB"	LRC	CR, LF

(ii) Response Format

(a) Normal response

Start Code	ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"AB"	"OK"	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"AB"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

(4) Monitor Command "MO" Details

Execute the Return to Origin operation before usingthe Monitor Command.

If the Monitor Command is input before the Return to Origin operation, correct information may not be acquired.

(i) Required Format

Start Code	ID	Space	Command	Check Sum	End Code
:	"01"-"FF"	20h	"MO"	LRC	CR, LF

(ii) Response Format

(a) Normal response

Start Code	ID	Command.	Result	I/O Data	Position Data	Speed Data	Thrust Data	N.C.	Step Data No.	Check Sum	End Code
:	"01"-"FF"	"MO"	"OK"	4bytes	8 bytes	4bytes	2bytes	8bytes	2bytes	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"MO"	"NG"	Refer to "5.5 Error code"	LRC	CR, LF

(iii) Monitor Details

(a) I/O data

In binary, when I/O is ON "1" is displayed, and "0" when it is OFF, this will then be converted to ASCII and sent.

Available Signal	Reserved			INP	Home[1)]	N.C.	OUT 1	OUT 0	ALARM	BUSY	DRIVE	SVON	IN 3	IN 2	IN 1	IN 0
Condition	0	0	0	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b	1b
ASCII	"0000" to "1FFF"															

Note 1) Changes to "1" after completion of the Return to Origin operation.

E.g) Sent data: 0A9Ch ⇒0000,1010,1001,1100b

I/O state: After homing, during OUT1・ALARM signal output, during SVON・IN3・IN2 signal output

(b) Positioning Data (encoder count value)

The current position data is sent as an encoder count value.

Please calculate the position by multiplying the encoder resolution of the Card Motor model being used.

As a reference point, 0mm is set as a count value of 1,000,000.

The count decreases as movement is made in the extended direction from 0mm.

Binary digit (decimal)	900,000 to 1,100,000
ASCII	"000DBBA0" to "0010C8E0"

Formula Example) LAT3-10 (encoder resolution: 0.03mm)

Data response: "000F418C" ⇒999,820count

CardMotor table position: (1,000,000-999,820)x 0.03 mm= 5.4 mm

(c) Speed data mm/s

Responds with data (absolute values) on the current Card Motor movement speed. Direction is not taken into consideration.

Binary digit (decimal)	0 to 1000
ASCII	"0000" to "03E8"

(d) Equivalent thrust value data

A value 10x that of the equivalent thrust force value will be sent.

Binary digit (decimal)	0 to 50
ASCII	"00" to "32"

(e) Step Data number executed

Step Data number being executed sent.

Applicable numbers are as follows.

0: Not executed

1-15: Step Data Operation Step Data number

20: Direct Operation

99: Return to Origin position

Binary digit (decimal)	0 to 99
ASCII	"00" to "63"

(5) Operation Instructions Method Change Command "MD " Details

This changes the controller operation mode from parallel I/O to serial communication mode.

(Parallel I/O operation mode using I/O signals will be activated when the power supply is turned on).

When using this command, after transitioning theCardMotor controller to serial communication operation mode, execute the "OE" command.

- Parallel I/O operation: Operation will follow operation instructions input using I/O signals. (Power ON)

-Serial I/O operation: Parallel I/O input will not be accepted.

Parallel I/O will be output in the same way as in Step Data input mode.

(i) Required Format

Start Code	ID	Space	Command	Space	MODE	Check Sum	End Code
:	"01"-"FF"	20h	"MD"	20h	"0","1"	LRC	CR, LF

(ii) Response Format

(a) Normal response

Start Code	ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"MD"	"OK"	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"MD"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

(iii) Parameter List

MODE		
Parameter Value	Description	Function
0	Parallel I/O Operation	Operation will follow operation instructions input using parallel I/O signals.
1	Serial I/O Operation	Command operation instructions through serial communication followed.

(iv) Precautions when executingtheOperation Instructions Method Change Command [MD]

（a） The controller will automatically start up in I/O operation mode when power is switched on to the controller. If the power supply to the controller is reset, please re-enter serial I/O operation using the "MO" command.

（b） Perform the Return to Origin operation before operating the Card Motor after changing the controller operation instruction mode.

（c） When transitioning from serial I/O operation mode to parallel I/O operation mode, the parallel I/O signals being entered will be disabled. After transitioning to parallel I/O operation mode, please complete input the parallel I/O signals again.

(d) If the controller is configured to Pulse Input mode, serial I/O operation cannot be performed.

Use the configuration software to switch between Step Data Input mode and Pulse Input mode.

(e) Use the "MD" command after turning offthepower to the Card Motor (Sending Action = "0" by "OE" command).

(6) Details on Operation Command "OE"Details

To be able to use this command, the controller must be set to serial I/O operation mode through the "MD" command in advance.This command should also be used in both Step Data and Direct Operation modes.Select the desired Step Data number and send ACTION “0”, once ACTION “1” is send, please execute the Step Data selected in STEP.

Before operating in direct operation mode, use the "EE" command to set Step Data No. 20 parameters in advance. Direct operation will run according to the data configured to Step Data No. 20.

(i) Required Format

Start Code	ID	Space	Command	Space	STEP	Space	ENABLE	Space	ACTION	Check Sum	End Code
:	"01"-"FF"	20h	"OE"	20h	"0"-"15",”20"	20h	"0", "1"	20h	"0", "1"	LRC	CR, LF

(ii) Response Format

(a) Normal response

Start Code	ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"OE"	"OK"	LRC	CR, LF

(b) Irregular response

Start Code	ID	Command	Result	Error details	Check Sum	End Code
:	"01"-"FF"	"OE"	"NG"	Refer to "5.5 Error Code"	LRC	CR, LF

(iii) Parameter Description

STEP		ENABLE		ACTION	
Parameter Value	Description	Parameter Value	Description	Parameter Value	Description
0	Return to Origin	0	Card Motor power OFF	0	Maintain Current Position
1 to 15	Step Data Operation Step Data No.	1	Card Motor power ON	1	Operation Start
20	Direct Operation				

(iv) Operation and Parameter Examples

Operation	Parameter Value		
	STEP	ENABLE	ACTION
Power supply to Card Motor turned ON (servo ON)	0	1	0
Execution of Return to Origin	0	1	1
Position maintained after completion of the Return to Origin operation	0	1	0
Execution of Step Data	#	1	1
Maintain current position after Step Data execution	#	1	0
Card Motor power OFF	0	0	0

#: Operation Step Data No. (1-15, 20)

Caution

Execute the following Step Data only after the Card Motor has completed the current operation.

Otherwise the Card Motor may malfunction unexpectedly.

(7) Alarm History Command "RE"Details

This command reads the alarm history saved in the controller. The alarm history can be cleared by setting the parameter to "0" (sets the whole alarm history to no.0)

This command can be used to check alarm details when they occur.

(i) Required Format

(a) Data read

Start Code	Controller ID	Space	Command	Check Sum	End Code
:	"01"-"FF"	20h	"RE"	LRC	CR, LF

(b) Data clearance

Start Code	Controller ID	Space	Command	Space	Clear	Check Sum	End Code
:	"01"-"FF"	20h	"RE"	20h	"0"	LRC	CR, LF

(ii) Response Format

(a) Data read

Start Code	Controller ID	Command	Result	Entry 1. Error No,	Entry 2. Error No,	Entry 3. Error No,	Entry 4. Error No,	Check Sum	End Code
:	"01"-"FF"	"RE"	"OK"	See below	See below	See below	See below	LRC	CR, LF

(b) Data clearance

Start Code	Controller ID	Command	Result	Check Sum	End Code
:	"01"-"FF"	"RE"	"OK"	LRC	CR, LF

(iii) Alarm No. and Name

Alarm No.	Alarm name	Details
0	No alarm	—
1	Memory error	—
2	Actuator cable disconnected	—
3	Temperature error	—
4	Over current error	Motor overload error
5		I/O signalover current error
6	Parameter error	Originparametererror
7		Step Data parameter error
8		Invalid parametererror
9	Pulse input error	Pulse speed error
10		Pulse overflow error
11	Return to Origin position non-execution error	—

・When an error occurs, the error number will be recorded to entry 1, and the existing entry will be moved to entry 2, the existing entry 2 moved to entry 3, and so on.

For details and solutions to alarms, see section 16, Alarm Detection Details （p.79） in the "Card Motor Controller (Step Data input edition)" operation manual.

⚠Caution

Ensure the alarm history is cleared only after taking corrective action in response to the alarms.

When the alarm history is cleared, any currently occurring alarms will also be cleared.

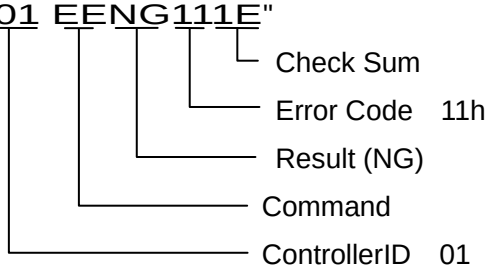
5.5 Error Code

The data responses received from each command is converted to binary (1byte) → ASCII (2bytes).

Error Code	Name	Description
01h	ILLEGAL FUNCTION	Undefined commands issued.
03h	ILLEGAL DATA VALUE	Issue with designated data.
04h	SLAVE DEVICE FAILURE	Error occurred with controller in operation request status.
06h	SLAVE DEVICE BUSY	Required cannot be accepted due to the controller being in a busy status.
11h	CHECKSUM ERROR	Check sum does not match.
12h	NOT ADU	No data.

Note) If a communication error (frame error, overrun error, parity error etc.) occurs, received data will be discarded, as a response cannot be made.

Example) Responsedata ":01 EENG111E"



6. Card Motor Controller Operation Examples

6.1 Basic Settings, I/O Configuration

Set the following criteria in the controller using the controller configuration software.

(See the "Card Motor Controller (Step Data input edition)" operation manual for details)

- Input type (select Step Data input type)
- Card Motor Mounting Orientation
- Return to OriginMethod
- Step Data Input Method
- Output signal functions
- Area Range
- Threshold Force Value

6.2 Step Data Configuration

See below for the Step Data configuration procedure.

(1) Cut the Power from the Card Motor using the "OE" command during Step Data operation.

The power supply to the Card Motor does not need to be cut when configuring Step Data no. 20 in direct operation.

(2) Step Data configuration is performed using the "EE" command.

(3) Configured data is saved into the memory using the "EU" command. (Not required in direct operation)

(4) Control data is reflected into the memory using the "AB" command. (Not required in direct operation)

∗ Points of caution while configuring Step Data

(1) If a communication error (framing error, overrun error, parity error etc.) occurs, a response cannot be made, resulting in received data being discarded and no irregular response with error code sent. Therefore prepare retry/time-out processing in the transmission device.

(2) Use the controller configuration software to pre-set the basic controller settings.

(3) The Step Data overwrite target frequency for Step Data numbers 1-15 is 100,000.Please avoid excessive overwriting.

(4) Do not cut the power while data is being saved.

It is recommended that the controller be initialised using the controller configuration software in the case that the power is cut accidentally.

(5) Always ensure that Step Data configuration is made while the power supply to the Card Motor is off inStep Data operation (ENABLE byte set to “0” in the OE command). If Step Data configuration is done while the Card Motor is powered on, malfunction may occur.

(6) Ensure that the Return to Origin operation is completed before operation after any Step Data changes for Step Data operation.

⚠ Caution

Execute the EE command under the following conditions:

In parallel I/O mode, when the SVON signal is OFF.

In serial I/O operation, when the ACTION byte in the OE command is set to "0".

Otherwise the Card Motor may malfunction unexpectedly.

6.3 Operation Data Acquisition

This explains the Card Motor operation data acquisition procedure.

(1) Operation data is acquired using the "MO" command.

6.4 Operation Instruction Method

This explains the procedure for operation instructions to the Card Motor using serial communication.

(1) Ensure the SVON signal input to the controller is turned OFF and the Card Motor power cut.

(2) Switch the controller to serial I/O operation using the "MD" command.

(3) Specify Step Data to executed and operation instructions using the "OE" command according to each operation method as indicated below.

In Step Data operation: Step Data 1-15 will be defined.

In Direct operation: Step Data 20 will be defined.

⚠ Caution

When operating using the OE command, send ACTION "0" before starting operation, and then ACTION "1" to start the operation.

The Step Data number selected in STEP will be executed after ACTION "1" is sent.

6.5 Program Examples

Program examples of basic parameter setting and Step Data execution using serial communication are shown below.

Here, each request and response is shown in ASCII characters, spaces is shown as "_", MO command monitor details are shown as "**", the checksum completion code is skipped, and shown as the following.

E.g) For MO commands

Data Requested 「:01_MO 」

Response data (normal response) 「:01MOOK** 」

(1) Basic Settings

Configure the Basic Parameters and I/O functions using the configuration.

(2) Step Data Configuration Examples

Instructions issued to set Step Data No. 1 in the Card Motor controller (controller ID1) to movement time: 0.1 sec and target position: 10 mm.

The "EU" and "AB" commands are not required in direct operation (Step Data No. 20).

No	Data Requested	Data Responded	Operation Details
1	:01_EE_3_1_1_0.1	:01EEOK	Step Data No. 1 PositioningTime set to 0.1sec.
2	:01_EE_3_0_10000	:01EEOK	Step Data No. 1 Target Position set to 10mm.
3	:01_EU	:01EUOK	Instruction to save altered Step Data sent.
4	:01_AB	:01ABOK	Instruction to reflect altered Step Data sent.

⚠ Caution

Do not specify any values other than 3-17 and 22 in INDEX1, or 0-6 and 9-16 in INDEX2.
Alarms or Card Motor malfunction may occur unexpectedly.

(3) Return to Origin

Change the Card Motor controller (controller ID1) operation mode to serial I/O operation, and send Return to Origin instructions.

No	Data Requested	Data Responded	Operation Details
1	:01_OE_0_0_0	:01OEOK	Instruction to turn Card Motor power OFF sent.
2	:01_MD_1	:01MDOK	Instruction to change the Card Motor controller operation mode to "serial I/O operation" sent.
3	:01_OE_0_1_0	:01OEOK	Instruction to turn Card Motor power ON sent.
4	:01_OE_0_1_1	:01OEOK	Instruction to perform the Return to Origin operation sent.
5	:01_MO	:01MOOK**	Monitor command to acquire INP signal information sent.
6	Repeat No. 5-6		Repeat until the INP changes to "1" for the I/O data received. Return to Origin is complete once the INP becomes "1".

(4) Positioning Operation (Step Data Operation) Example

Change the Card Motor controller (controller ID1) operation mode to serial I/O operation, perform Return to Origin and repeat Step Data No.1 and 2.

No	Data Requested	Data Responded	Operation Details
1	:01_OE_0_0_0	:01OEOK	Instruction to turn Card Motor power OFF sent.
2	:01_MD_1	:01MDOK	Instruction to change the Card Motor controller operation mode to "serial I/O operation" sent.
3	:01_OE_0_1_0	:01OEOK	Instruction to turn Card Motor power ON sent.
4	:01_OE_0_1_1	:01OEOK	Instruction to perform the Return to Origin operation sent.
5	:01_MO	:01MOOK**	Monitor command to acquire INP signal information sent.
6	Repeat No. 5-6		Repeat until the INP changes to "1" for the I/O data received. (Return to Origin is complete once the INP becomes "1".)
7	:01_OE_1_1_0	:01OEOK	Instruction to hold current position sent. (Preparation for start of Step Data No. 1 operation)
8	:01_OE_1_1_1	:01OEOK	Instruction to execute Step Data no.1 sent.
9	-		Wait until the operation for Step Data No.1 is complete.
10	:01_OE_2_1_0	:01OEOK	Instruction to hold current position sent. (Preparation for start of Step Data No. 2 operation)
11	:01_OE_2_1_1	:01OEOK	Instruction to execute Step Data no.2 sent.
12	-		Wait until the operation for step data No.2 is complete.
13	Repeat No. 7-13		Step Data No. 1-2 will be repeated.

(5) Positioning Operation (Direct Operation) Example

Change the pre-configured Card Motor controller (controller ID1, Cycle Time Input Method) operation mode to serial I/O operation, perform Return to Origin and direct operation instructions are used to move the table from 5 mm to 10 mm.

No	Data Requested	Data Responded	Operation Details
2	:01_OE_0_0_0	:01OEOK	Instruction to turn Card Motor power OFF sent.
1	:01_MD_1	:01MDOK	Instruction to change the Card Motor controller operation mode to "serial I/O operation" sent.
2	:01_OE_0_1_0	:01OEOK	Instruction to turn Card Motor power ON sent.
3	:01_OE_0_1_1	:01OEOK	Instruction to perform the Return to Origin operation sent.
4	:01_MO	:01MOOK**	Monitor command to acquire INP signal information sent.
5	Repeat No. 5-6		Repeat until the INP changes to "1" for the I/O data received. Return to Origin is complete once the INP becomes “1”.
6	:01_EE_22_0_5000	:01EEOK	Direct operation Step Data parameter no. 20 is configured for: Target position 5 mm, positioning time 0.1 s.
7	:01_EE_22_1_0.1	:01EEOK	
8	:01_OE_20_1_0	:01OEOK	Instruction to hold current position sent. (Preparation for start of Step Data No. 20 operation)
9	:01_OE_20_1_1	:01OEOK	Instructions to execute step-data no.20 sent.
10	-		Wait until the operation for step data No.20 is complete.
11	:01_EE_22_0_10000	:01EEOK	Step Data No. 20 target position changed to 10mm.
12	:01_OE_20_1_0	:01OEOK	Instruction to hold current position sent. (Preparation for start of Step Data No. 20 operation)
13	:01_OE_20_1_1	:01OEOK	Instruction to execute Step Data no.20 sent.
14	-		Wait until the operation for step data No.20 is complete.

⚠ Caution

The step data (e.g. target value) currently in operation will not be changed by simply changing Step Data No. 20 using only the EE command. The Step Data will be changed and operation will begin when ACTION “1” is sent in the OE command ("OE_20_1_1").

Step Data no. 20 will be reset after the power supply is cut.

Please set accordingly for direct operation.

(6) Operation Data Acquisition Example

E.g) Card Motor and controller operation data is acquired from the Card Motor controller (controller ID1, CycleTimeEntryMethod).

No	Data Requested	Data Responded	Operation Details
1	:01_MO	:01MOOK**	Monitor command to acquire Card Motor operation information sent.
2	Operation Data Judgement		The Card Motor operation state will be determined from the operation data acquired.

(7) Alarm History Acquisition Example

E.g) The alarm history saved in the Card Motor controller (controller ID1) is acquired.

No	Data Requested	Data Responded	Operation Details
1	:01_RE	:01REOK**	Alarm history command to acquire alarm history sent.
2	Operation Data Judgement		Judgement on acquired alarm history.

(8) Alarm History Clearance Example

E.g) The alarm history saved in the Card Motor controller (controller ID1) is cleared.

No	Data Requested	Data Responded	Operation Details
1	:01_RE_0	:01REOK	Alarm history command to clear alarm history sent.

⚠ Caution

Ensure the alarm history is cleared only after taking corrective action in response to the alarms.

When the alarm history is cleared, any currently occurring alarms will also be cleared.

Alarm Reset

When an alarm occurs, reset the alarm using the SVON reset function (turn the SVON signal ON and back OFF again) after taking corrective measures.

7. Reference Information

7. 1 Checksum Calculation Procedure

The checksum calculation is based on the LRC method.

(1) All sent data is added, excluding the Start/End codes.

(2) Subtract FFh from the last 2 bytes of the calculation result in step (1).

(3) Add 1h to the calculation result in step (2).

7. 2. Checksum Calculation Examples

E.g) When sending the controller monitor command to a controller with ID1.

Transmission data to be used in the checksum calculation …"0" , "1" , "space","M","O"

(1) 30h + 31h + 20h + 4Dh + 4Fh = 11Dh

(2) FFh - 1Dh = E2h

(3) E2h + 1h = E3h … Checksum = "E3" (= 45h,33h)

7. 3 Communication Response Time Guides

Guides for the communication response time are calculated below for each command request.

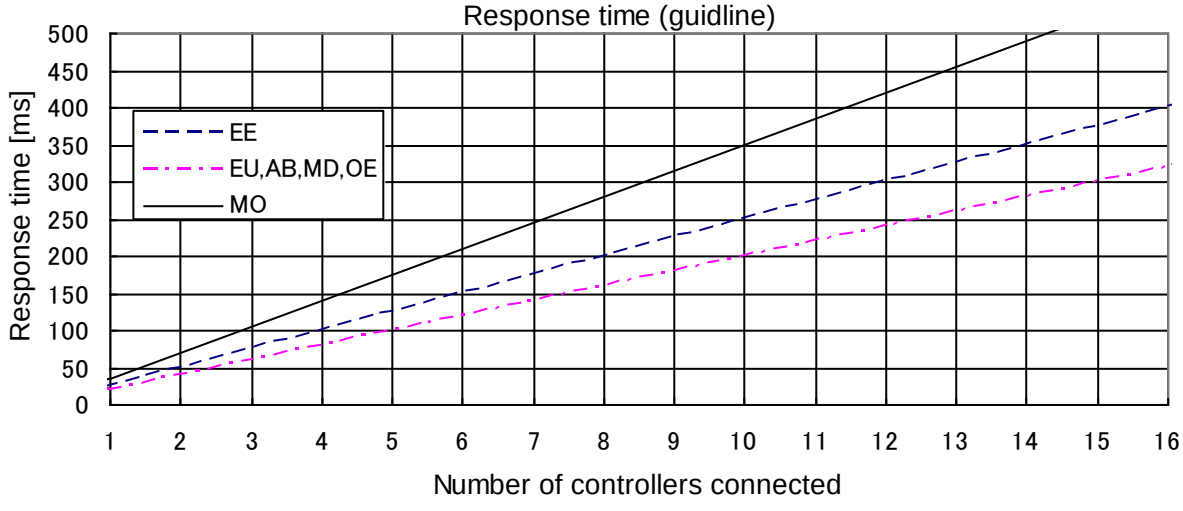
Command	Communication Response time [ms]
EE	25
EU	20
AB	20
MO	35
MD	20
OE	20

Calculation Example)

Number of controllers connected: 5

Required transmission commands: EE,EU, AB

Communication response time (25 + 20 + 20) x 5 = 325 ms



7. 4 ASCII Code List

Decimal	Hexadecimal	ASCII
0	0	NUL
1	1	SOH
2	2	STX
3	3	ETX
4	4	EOT
5	5	ENQ
6	6	ACK
7	7	BEL
8	8	BS
9	9	HT
10	0A	LF
11	0B	VT
12	0C	FF
13	0D	CR
14	0E	SO
15	0F	SI
16	10	DLE
17	11	DC1
18	12	DC2
19	13	DC3
20	14	DC4
21	15	NAK
22	16	SYN
23	17	ETB
24	18	CAN
25	19	EM
26	1A	SUB
27	1B	ESC
28	1C	FS
29	1D	GS
30	1E	RS
31	1F	US

Decimal	Hexadecimal	ASCII
32	20	SP
33	21	!
34	22	″
35	23	#
36	24	$
37	25	%
38	26	&
39	27	’
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	−
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?

Decimal	Hexadecimal	ASCII
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	¥
93	5D	]
94	5E	^
95	5F	_

Decimal	Hexadecimal	ASCII
96	60	`
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	DEL

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