COOL MUSCLE 3M

Modbus RTU (RS485)

User's Guide

MDUG-CM3M/25101E-01
CM3M Firmware Version v1.03

MUSCLE

Table of Contents

Before Use

- ☐ Before use, read through this User's Guide to ensure proper use.
- ☐ In particular, be sure to read "Instructions for Safety" without fail for safety purpose.
- ☐ Keep this User's Guide at an easily accessible place so as to be referred anytime as necessary.

- The contents of this User's Guide are subject to change without notice for the improvement in product, specification, or usability of this User's Guide.
- This User's Guide is only intended to provide information about the product and does not guarantee any results from usage of the product. MUSCLE CORPORATION is not responsible for any damages and/or injuries resulting from the implementation in accordance with the contents of this User's Guide.
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Instructions for Safety

Be sure to read before use for safety

☐ To ensure safe use

To ensure the safe and proper use of our products, it is important that you read this User's Guide thoroughly prior to its use. Failure to read, fully understand and implement following instructions and precautions may result in damage to the product, the machine to which it is installed, or operator injury.

☐ About product application

These products are manufactured as a general-purpose part for the application in general industries. They are not designed or manufactured for equipment or systems which affect human life or applications in which faulty operation or failure may result in personal injury or significant damage to property. These products shall not be used in applications which require an extremely high degree of reliability and safety, such as those listed below.

- Medical equipment or system that have a direct affect on human life.
- Applications that directly affect on the safety of people. (For example, the operation and control of aircraft, cars, elevators railroads, etc.)
- Applications in which failure may significantly damage or impact the society and public. (For example, nuclear power, electric power, aerospace, public transportation system, etc.)
- Equipments or systems used under special environmental condition.
- Applications with the same level of importance as those described above. (When considering the product for use in such special applications, please contact our sales representative.)

We ask that you employ fail-safe systems when applying these products to the equipment in which any failure on its part can be expected to cause a serious accident or loss.

☐ Safety Precautions

- Please read following precautions in order to ensure safe and proper use of the product and avoid damages on machinery and injuries to the operators and other people.
- This User's Guide should carefully be kept in a convenient place for the operator's easy reference.
- In this User's Guide, safety precautions are classified as either “Warning” or “Caution” , indicating the level of hazard seriousness possibly occurred when handling the product incorrectly. The symbols are explained below.

Warning	Indicates an imminently hazardous situation which, if not handled properly, may result in death or serious injury.
Caution	Indicates a potentially hazardous situation which, if not handled properly, may result in injury or property damage.

“What must not be done” and “What must be done” are indicated by the following symbols.

Indicates a prohibited action What must not be done			Ex. No disassemble
Indicates a necessary action What must be done			Ex. Grounding

Warning

Never touch the rotating part of CM3+ while operating.

The failure could result in injuries. Take a measure for safety to keep away contact by personnel.

Do not touch CM3+ and driver while power is ON or for some time after power-OFF.

Temperatures may be high and you may get burnt.

Do not change the wiring while power is ON.

Be sure to remove wiring and unplug a connector after power-OFF. The failure could result in electric shocks, runaway or damages.

Do not give damage to, apply excessive force to, place something heavy upon, or pinch the cable.

Do not pull the cable by too much power. The failure could result in damages to connection section, or electric shocks.

Never disassemble, modify, or repair the product.

Do not open the cover of the product, or disassemble or modify the parts inside. The failure could result in fire, electric shocks, malfunction or injuries

Do not install the product on or near combustibles.

Attach the product to noncombustible matter such as metal. The failure could result in fire.

Do not tamper with water, corrosive gas, inflammable gas, flammable material, or electrically conductive material such as screw or metal piece.

Do not insert metal pieces into the venting holes of enclosure. The failure could result in fire, electric shocks, or damages.

Be sure to ground the terminal of the earth wire.

Securely ground to prevent electric shocks and to stabilize the potential in the control circuit.

Caution (Environment)

Keep or use the product under the following environmental conditions.

Operating ambient temperature: 0 to 40°C
Storage ambient temperature: -20 to 60°C (non freezing)
Ambient humidity : Below 90%RH (non condensing)
Vibration / Shock resistance : JIS Z 0232 Level2 / JIS Z 0202 Level3
Avoid store or use in such an environment where the product is exposed to oil or water. (It is not waterproof structure.)
Indoor use only (no direct sunlight). No corrosive gas, inflammable gas, oil mist or dust.

Caution (Transportation)

The product is precision mechanical equipment.

Do not drop or give any strong impact to the product.
The failure could result in damages or malfunction.

Do not hold the cables or output shaft when transporting the product.

The failure could result in damages or malfunction.

Do not climb, stand, or put heavy objects on the product.

The failure could result in damages or malfunction.

Do not stack in excess of the specified number of products.

The failure could result in damages or malfunction.

Caution (Installation)

When installing a pulley or coupling to the machine, do not hammer on the output shaft.

The failure could result in damages or malfunction.

Be sure to fix the product on the machine firmly.

If fixation is not tight enough, the product may come off while operating.

Be sure to make precise centering between the output shaft and the machine.

Deviation from the center could result in vibration or damages.

The load inertia moment should be below the recommended load inertia moment ratio of CM3+ being used.

If it is too large, desired performance may not be attainable.

Carefully consider the heat radiation of the product, and make sure to install it in the condition with proper airflow.

Be sure to avoid interference with the heat radiation of motor and driver.

Caution (Wiring)

Wiring must always be performed properly and reliably.

Ensure that terminal connection or polarity (+, -) is correct. The failure could result in damages or malfunction.

Carefully consider the cable clamping method, and make sure that bending stress and the stress of the cable' s own weight are not applied on the cable connection section.

The failure could result in damages or bursts.

Do not apply a voltage exceeding the specified voltage to the input terminal.

The failure could result in damages or bursts.

Do not modify the connector or terminals on the end of the cable.

The failure could result in damages or bursts.

Caution (Corrective Action)

If any alarm has occurred, eliminate its causes of the alarm and secure the safety before restarting the operation.

The failure could result in damages or bursts.

When it is assumed that a hazardous condition may take place at the occurrence due to a product fault, use an external holding brake mechanism.

If any alarm has occurs, CM3+ goes into free-run state.

If any product fault has occurred, shut off the power immediately and do not turn on the power.

The failure could result in damages or bursts.

Caution (Operation)

Provide an external emergency stop circuit to ensure that operation can be stopped, and power switched off immediately.

When a trouble occurs, shut off the power immediately.

Before operation, check the parameter settings to ensure that there are no operation errors. Connect a load to the products after the successful trial-operations.

Improper settings may cause some machines to perform unexpected operation, resulting in damages.

Do not rotate output shaft by external force.

Rotating the shaft may cause regenerated voltage within CM3+. This regenerated voltage may damage the driver board.

Do not apply a load exceeding the tolerable load onto the output shaft.

The failure could result in break of the shaft.

Do not turn on or off the power frequently.

The failure could result in degradation of circuit element.

Do not change the parameter settings excessively.

The failure could result in instable or unexpected operation.

Caution (Maintenance and Inspection)

Only persons who are trained and qualified to work or on electrical equipment are permitted to maintain or inspect the product.

Incorrect handling or operation could cause electric shocks or damages.

Do not perform a dielectric voltage-withstand test. The failure could result in destruction of circuit element.

MUSCLE CORPORATION is not responsible for any damages resulting from modifications or repairs made to the product.

☐ About processing of waste

This product should be treated as an industrial waste when it is disposed.

Chapter 1 Product Overview

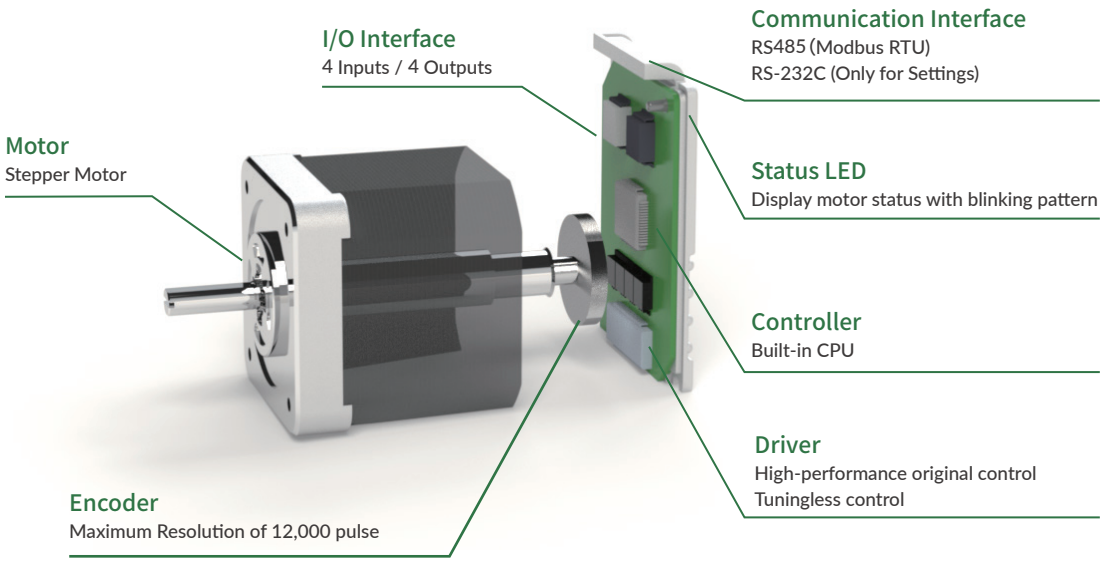
1.1 Overview

The COOL MUSCLE 3 series is designed to provide servo motor equivalent performance with the same ease of use as a stepping motor while maintaining the size of the COOL MUSCLE 1, and is available in three models, COOL MUSCLE 3, COOL MUSCLE 3+, and COOL MUSCLE 3M

"COOL MUSCLE 3M" (hereafter CM3M) Modbus RTU (RS485) type supports the Modbus RTU protocol. It is possible to set parameters and give operation commands from a controller with RS485 communication.

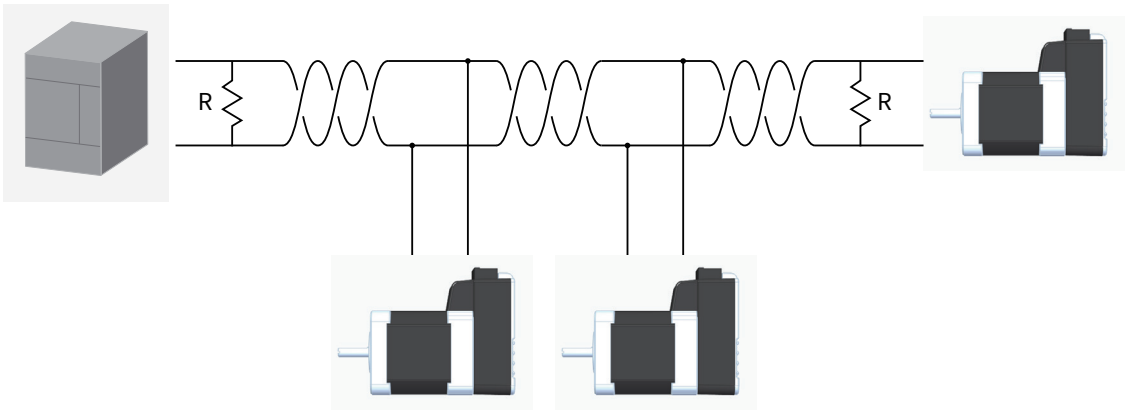
☐ Integrated but Compact Design

Since the motor, encoder, driver, controller, and network functions are integrated, a system can be built without a control panel without the need for a general separate driver or controller. In addition, it is more compact than our conventional CM1 but has more powerful performance.



☐ Multi-axis network with reduced wiring

Max.31 axes of CM3Ms can be contorlled as slaves from a host controller such as a PLC or PC. Since an external driver is not required, easy and fast start up of yuor application without taiking a time for wirings is possible.



☐ Simple Operation Pattern

The CM3M Modbus RTU allows the following modes of operation.

- PTP operation (absolute positioning)
- INC operation (relative positioning)
- PTP push operation (absolute push positioning)
- INC push operation (relative push positioning)

☐ Protective function

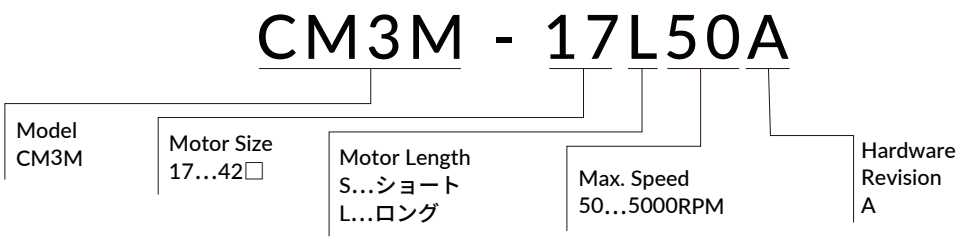
The following protection functions are installed for safe operation.

- Soft limit / hard limit function
- Speed override function
- Over current protection function
- Position deviation overflow function
- Over voltage detection function
- Low voltage detection function
- Internal temperature monitor function
- Overload function
- STO (Safe Torque Off) function
- Reverse connection prevention function

Chapter 2 Configuration

2.1 Product Code Scheme

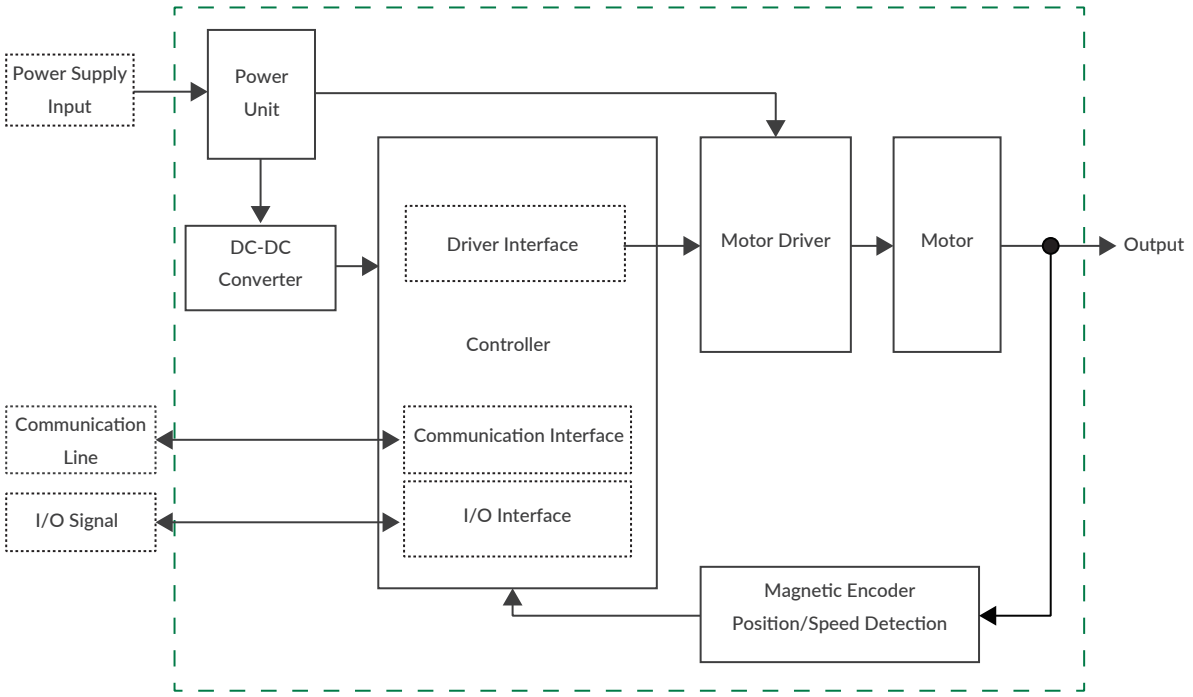
CM3M product code scheme is described as below.



☐ Product Name

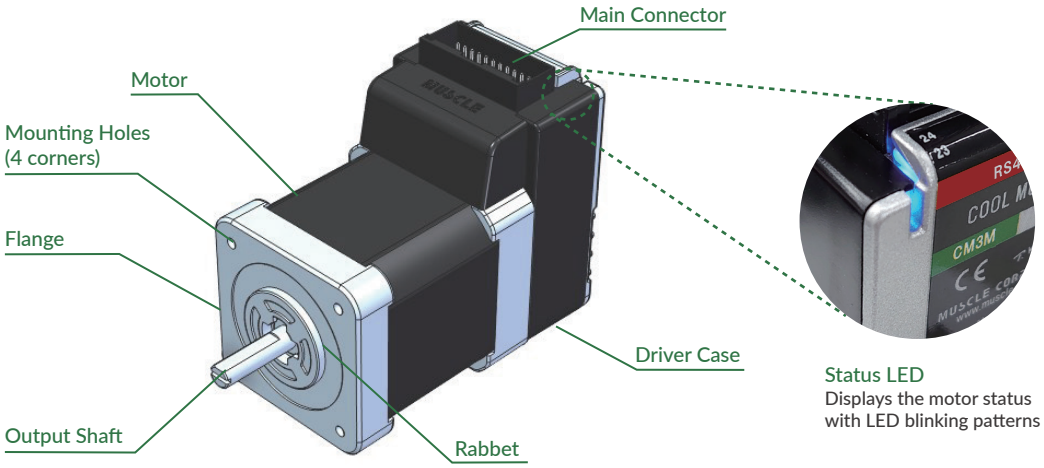
Product Name	Product Code
CM3M 42 Short Modbus RTU	CM3M-17S50A
CM3M 42 Long Modbus RTU	CM3M-17L50A
CM3M 56 Short Modbus RTU	CM3M-23S50A
CM3M 56 Long Modbus RTU	CM3M-23L50A

2.2 Function Block Diagram



2.3 Parts Description

The names of parts of CM3M are as shown below.



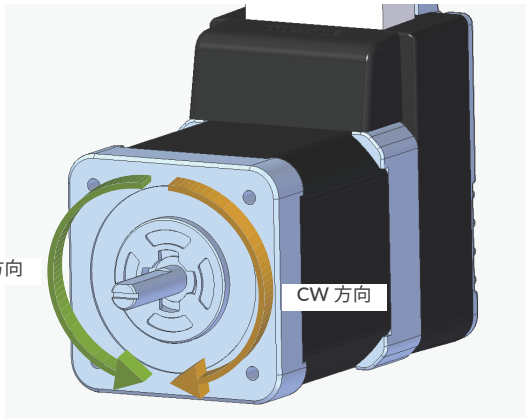
＊ Please refer to "11.10 Status LED" for the status LED blinking pattern.

2.4 Rotating Direction and Coordinate

Rotating direction and coordination are defined as below.

CW (Clockwise) Direction ：Clockwise direction defined as viewed from output shaft side.

CCW（Counterclockwise）Direction ：Counterclockwise direction defined as viewed from output shaft side.



☐ Coordinate Direction

By the default setting, CW direction is positive direction and CCW direction is negative direction in coordinate.

Coordinate direction can be reversed by parameter.

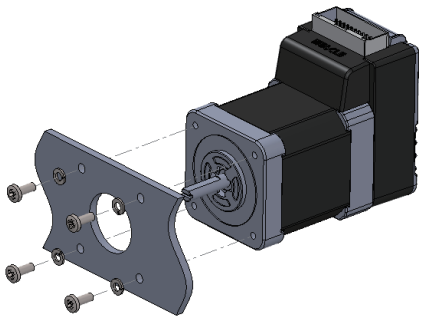
Ref: "10.2 Coordinate Direction（K4）(0x012E, 0x012F)"

Chapter 3 Installation

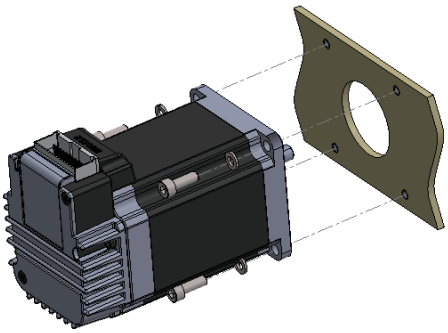
3.1 Mounting to Machinery

CM3M can be mounted either horizontally or vertically. Mount CM3M on the smooth and rigid surface of a metal plate. When installing CM3M, insert the rabbet located on the motor's installation surface into the mounting plate's counterbore or through holes then screw it with four bolts through the four mounting holes on CM3M's installing surface leaving no gaps between the surface and metal plate.
(Tolerance of rabbet is on "Chapter 13 Specifications".)

CM3M-17L50



CM3M-23L50



The sizes of mounting bolts are as follows.

Model	Bolt	Depth
CM3M-17S50 / CM3M-17L50	M3	5.0 mm
CM3M-23S50 / CM3M-23L50	M4	-

Be sure to mount the motor on a metal plate to dissipate heat.
If the motor is mounted on plastic or other materials, it may cause a failure due to heat generation.

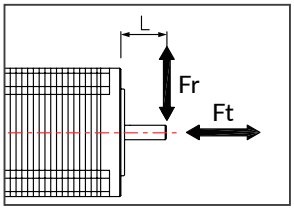
☐ Mounting Metal Plate Reference dimension

Model	Dimension
CM3M-17S50 / CM3M-17L50	100 x 100 x 2 mm
CM3M-23S50 / CM3M-23L50	160 x 160 x 6 mm

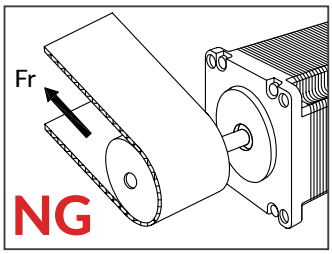
3.2 Load Installation

Attach the coupling to the output shaft and adjust so that the load shaft and output shaft are centered. Flexible coupling with torsional rigidity is recommended. Design the machinery and align the assembly to ensure that radial road and thrust load on output shaft do not exceed the allowable values. (Allowable radial load and thrust load of each CM3M motor size are stated in "Chapter 13 Specifications".)

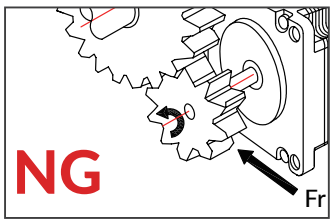
Radial Load (Fr): Perpendicular force applied to the shaft end.
Thrust Load (Ft): Parallel force applied to the shaft end.



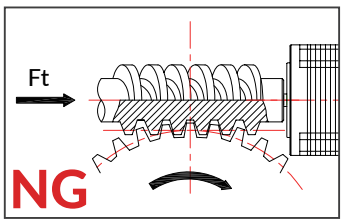
> ⚠ Mounting a load directly to the output shaft would increase the force and damage the motor.
> Consider reviewing the mechanical system so that excessive load is not applied to the output shaft.



When a pulley is directly mounted onto output shaft, radial force (Fr) will be produced by belt tension and may result in damaging bearings in a motor.



When a gear is directly mounted onto output shaft, smaller the dimensions of gear, bigger radial force (Fr) will be produced and may result in damaging bearings in a motor.



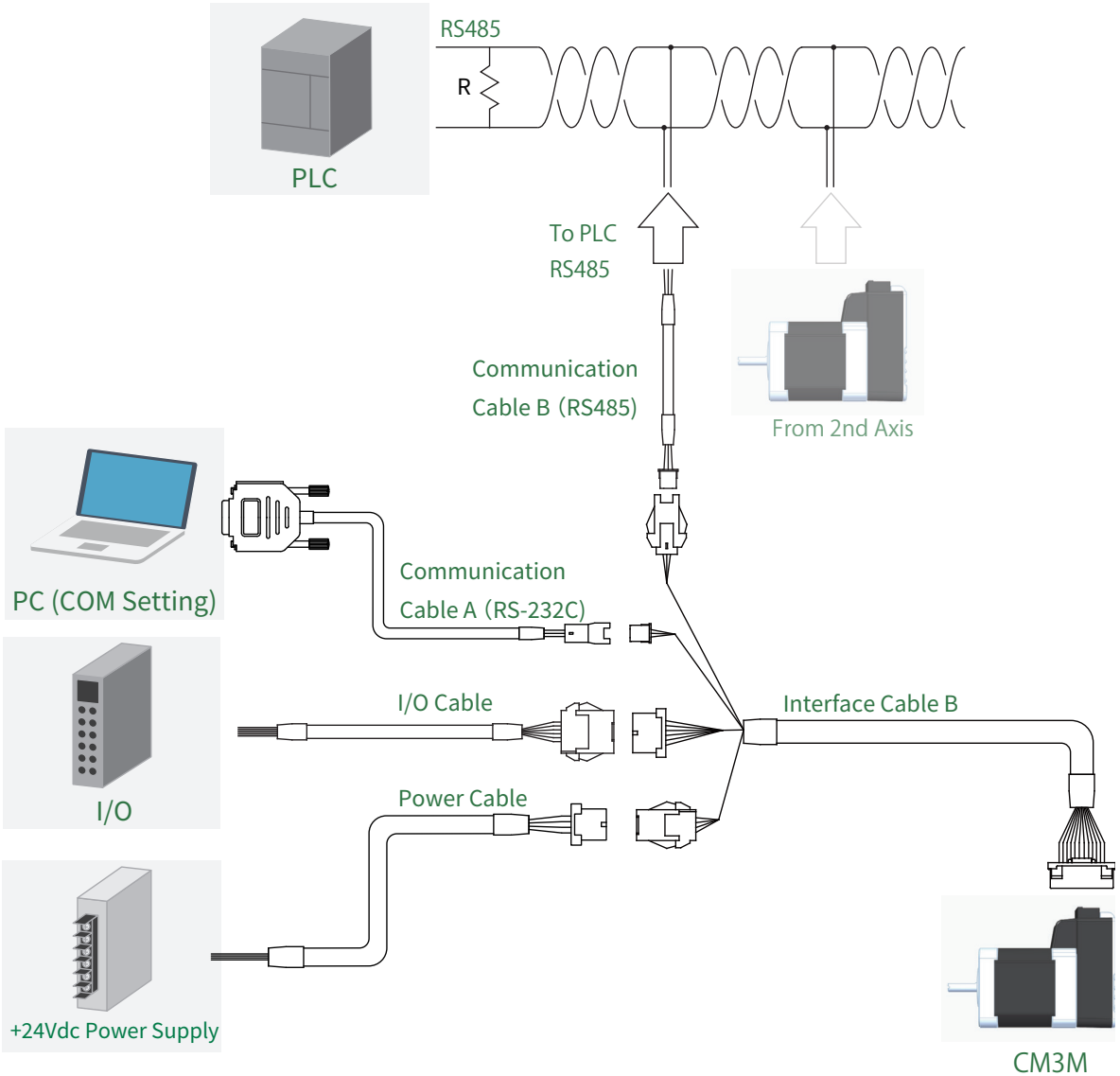
When a worm gear is directly mounted onto output shaft, thrust load (Fr) will be produced and forced to motor shaft. Output shaft will be moved, and it may result in damaging the inside of motor.

Chapter 4 Wiring and Connection

4.1 Typical Connection Example

☐ Caution about Cabling

- Be sure that the power is off before plugging or unplugging connectors.
- Pay attention for straight insertion and removal of connectors by holding connector's body.
- Be sure there is no stress on connectors.
- Be sure not to pull cables hard or hung CM3M by holding cables. It may result in damaging connectors.



4.2 Connector Pin Layout and Functions

Pin layout and functions of CM3M cables are described below.

☐ Main Connector

CM3M has a 24-pin connector on the top. The pin layout, names and functions are as follows.

No.	名称	機能
2	5V	5V Output
4	D_GND	Digital Ground
6	TRD+	RS485 Data (Modbus RTU)
8	TRD-	RS485 Data (Modbus RTU)
10	OUT3	Output 3
12	OUT1	Output 1
14	D_GND	Digital Ground
16	STO_IN+	STO Input +
18	IN3	General Input 3
20	IN1	General Input 1
22	P-GND	Power Ground
24	POWER	+24Vdc

No.	名称	機能
1	FG	Frame Ground
3	D_GND	Digital Ground
5	RXD0	RS232C Receive Data (Setting)
7	TXD0	RS232C Transmit Data (Setting)
9	ALARM	Alarm Output
11	OUT2	Output 2
13	STO_IN-	STO Input -
15	IN4	General Input 4
17	IN2	General Input 2
19	IN_COM	IN1 to 4 Common
21	P-GND	Power Ground
23	POWER	+24Vdc

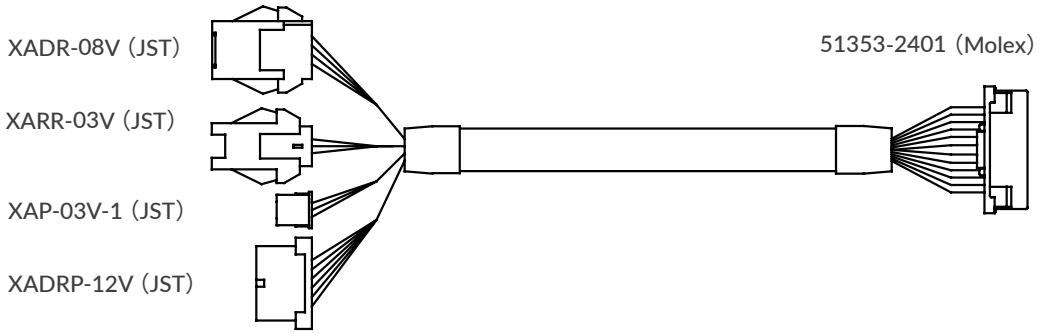
Connector: 55959-2431（Molex）

☐ Interface Cable B（400mm, 1000mm, 2000mm, 3000mm, 5000mm）

Product Number:　CMIFB1-****WR（****: Cable Length）

Wires:　1 - 20 pin … AWG26 UL20276 (80°C / 30V)

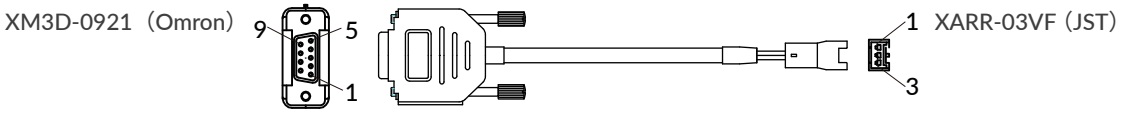
21 - 24 pin … AWG24 UL20276 (80°C / 30V)



☐ Communication Cable A（1000mm, 2000mm, 3000mm, 5000mm）

Product Number: CMRSA1-****W（****: Cable Length）

Wires: AWG26 UL1007 (80°C / 300V)



PC side

Color	No.	Name	Function
GRY	2	TXD	RS232C Transmit Data from PC
ORG	3	RXD	RS232C Receive Data from PC
WHT	5	D_GND	Digital Ground

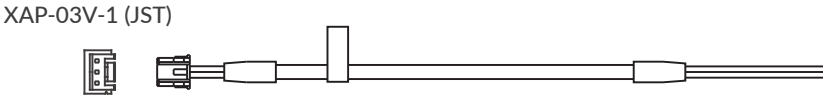
CM3+ side

Color	No.	Name	Function
ORG	1	RXD	RS232C Receive Data from CM3+
GRY	2	TXD	RS232C Transmit Data from CM3+
WHT	3	D_GND	Digital Ground

☐ Communication Cable B（500mm, 1000mm, 2000mm）

Product Number: CMRSB1-****S (****: Cable Length)

Wires: AWG22 UL758 Style20276（80°C / 30V）



PLC Side

Color	No.	Name	Function
YLW	1	TRD-	RS485 (Modbus RTU)
BLU	2	TRD+	RS485 (Modbus RTU)
WHT	3	D_GND	Digital Ground

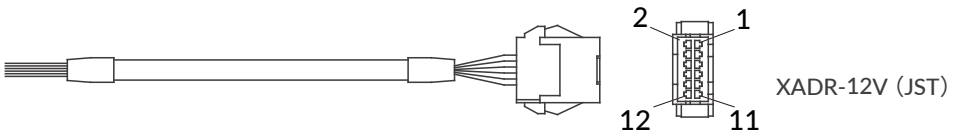
CM3 Side

Color	No.	Name	Function
YLW	1	TRD-	RS485 (Modbus RTU)
BLU	2	TRD+	RS485 (Modbus RTU)
WHT	3	D_GND	Digital Ground

☐ I/O Cable B (1000mm, 3000mm, 5000mm)

Product Number: CMIOB1-****S (****: Cable Length)

Wires: AWG28 UL758 Style2464（80°C / 300V）



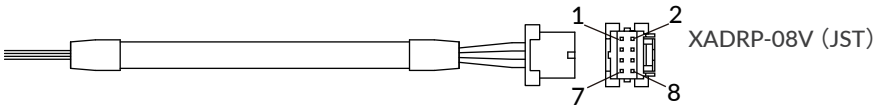
Color	Dot	No.	Name	Function
PPL		1	5V	5V Output
GRN		3	IN2	General Input 2
ORG		5	IN4	General Input 4
BLK		7	OUT1	Output 1
WHT		9	OUT3	Output 3
WHT	-	11	D_GND	Digital Ground

Color	Dot	No.	Name	Function
BLU		2	IN1	General Input 1
YLW		4	IN3	General Input 3
RED		6	IN_COM	IN1 to 4 Common
BRW		8	OUT2	Output 2
GRY		10	ALARM	Alarm Output
WHT		12	N/A	N/A

☐ Power Cable A (1000mm, 3000mm, 5000mm)

Product Number: CMPWA1-****S (****: Cable Length)

Wires: AWG24 UL758 Style2464 (80°C / 300V)



Color	No.	Name	Function
RED	1	POWER	+24Vdc
BLK	3	P-GND	Power Ground
GRY	5	STO_IN+	STO Input +
BRW	7	FG	Frame Ground

Color	No.	Name	Function
GRN	2	POWER	+24Vdc
WHT	4	P-GND	Power Ground
BLU	6	STO_IN-	STO Input -
-	8	N/A	N/A

4.3 Electrical Specifications

Item		Value
Digital Input	Applied Voltage	0 - 26 [V]
	Low Level Voltage	0.8 [V]
	High Level Voltage	4.2 [V]
Digital Output	Withstanding Voltage	26 [V]
	Max. Continuous Load Current	10 [mA]

4.4 Input/Output Circuit

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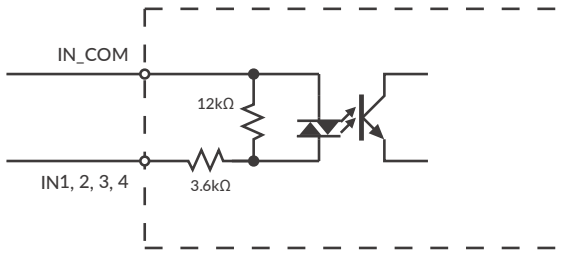
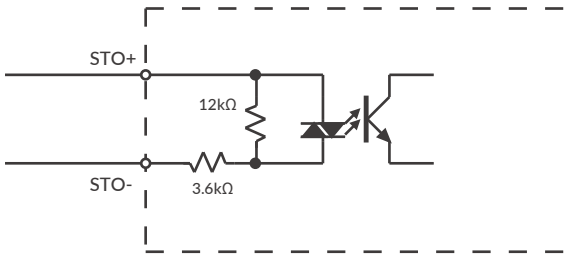
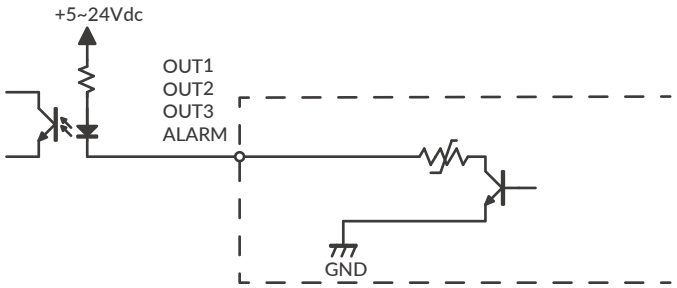
No Polarity</td><td> 
</td></tr>
<tr><td>STO
No Polarity</td><td> 
</td></tr>
<tr><td>Output</td><td>OUT1, 2, 3
ALARM
Open-Collector</td><td> 
</td></tr>
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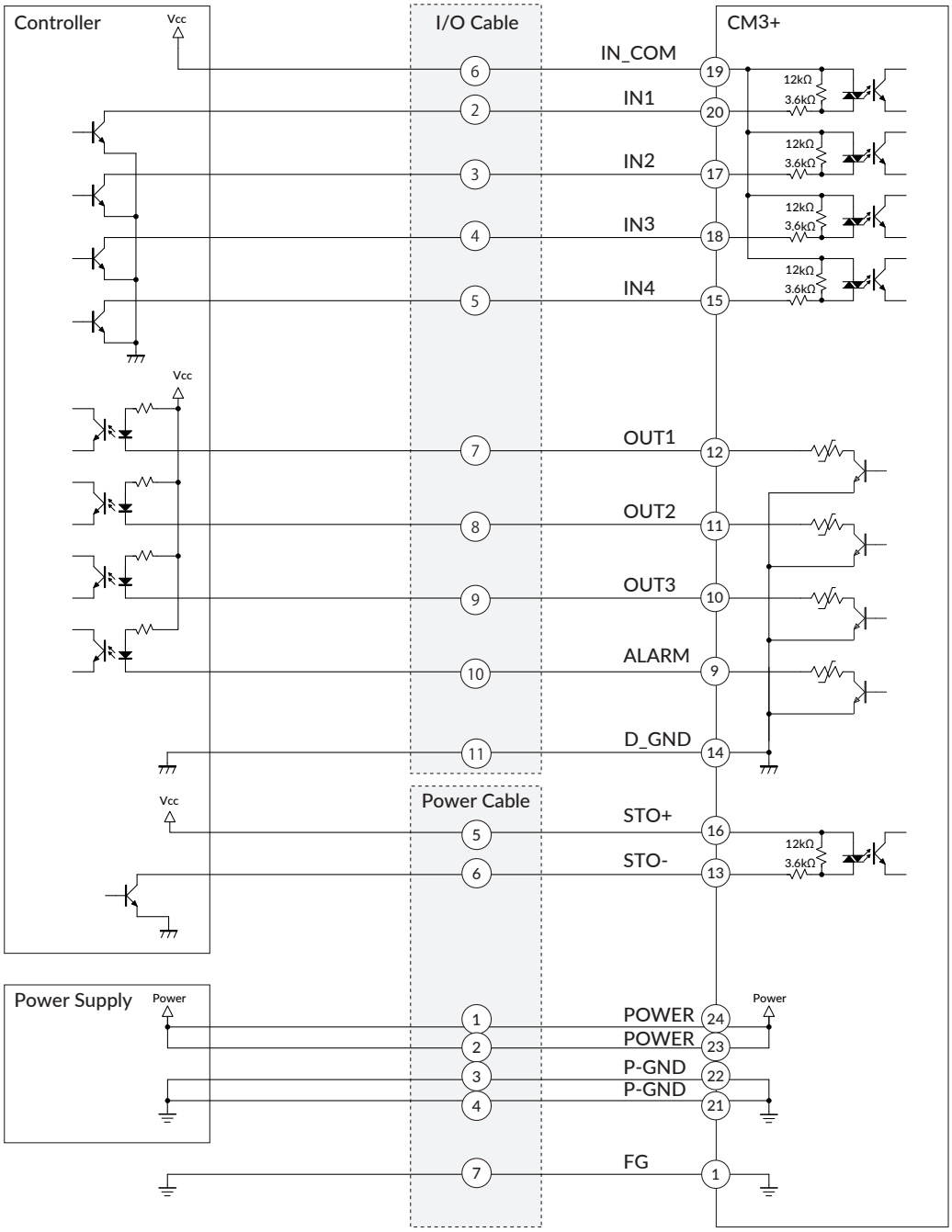
✳ When not using the STO function, apply a voltage of 5 to 24V between STO+ and STO-.

4.5 Circuit Connection

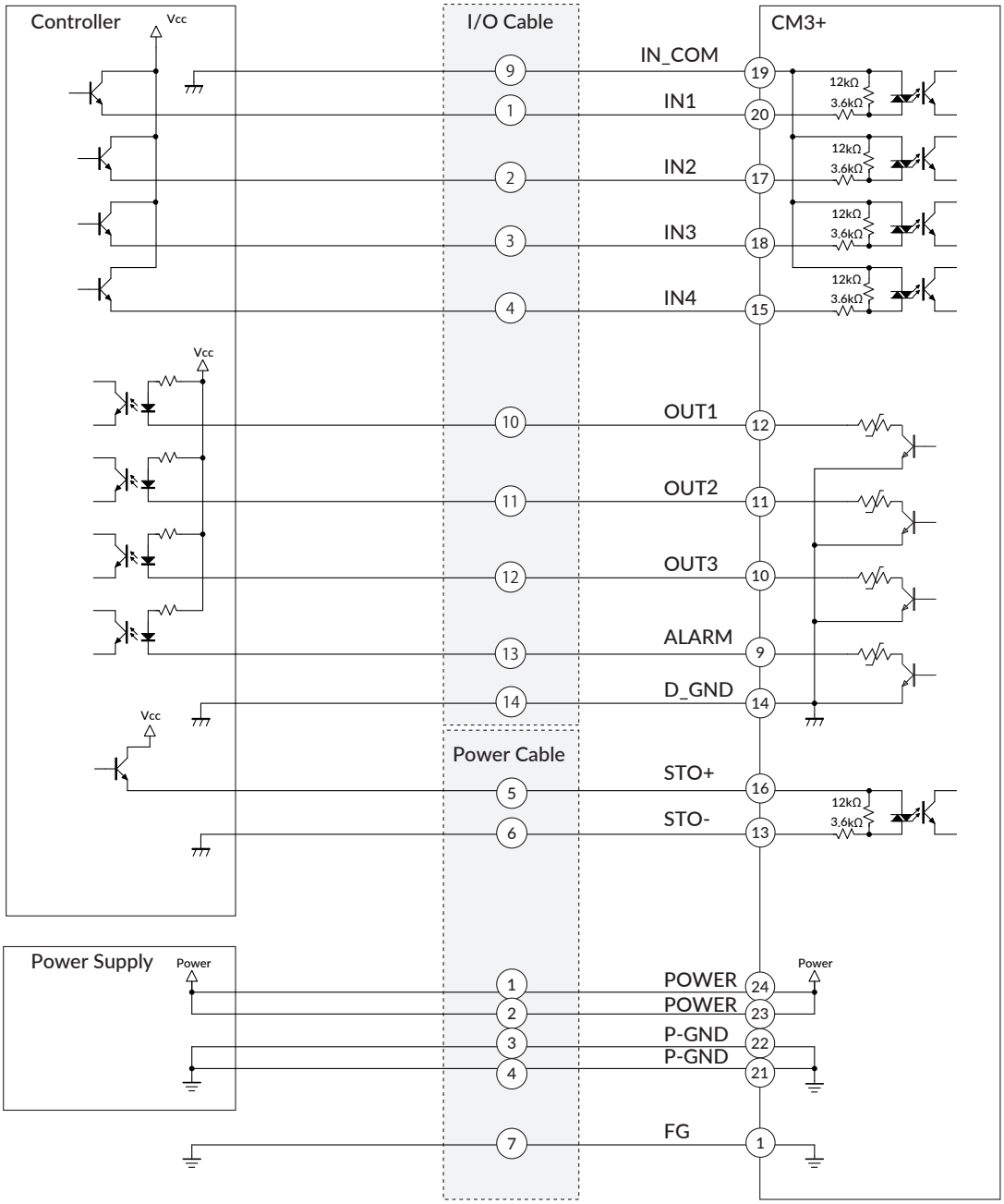
☐ Connection Example with Sink Output Circuit



Make sure that the power is OFF while connecting the cables.
Power ON after confirming the wiring is thoroughly correct.

Make sure to ground the FG

Connection Example with Source Output Circuit



Make sure that the power is OFF while connecting the cables.
Power ON after confirming the wiring is thoroughly correct.

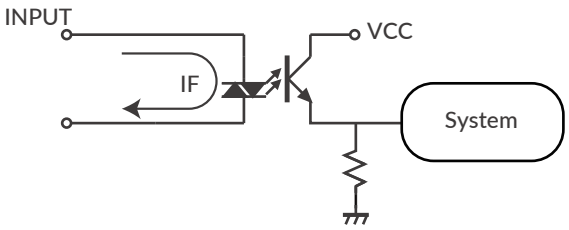
Make sure to ground the FG

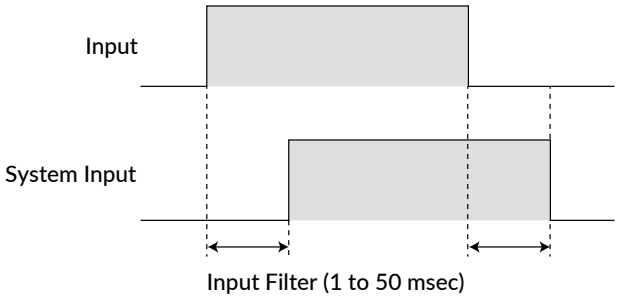
Chapter 5 Input/Output

5.1 Input Signal

5.1.1 Input Filter

CM3M has 4 digital inputs, IN1 to IN4, do not come with polarity. Filter function (1 to 50 msec) by software is available on all inputs. The filter function by software cannot be removed. The minimum filtering time is 1msec and the detection sequence is shown in the below diagram.

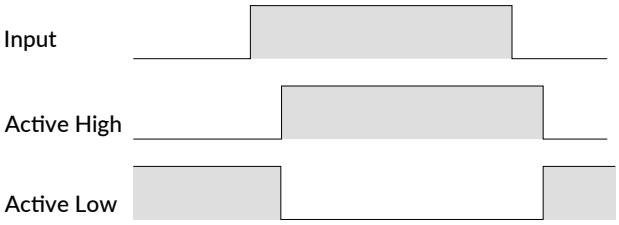




When Input Filter is set, the signal shorter than the set time is not detected as a signal.

5.1.2 Input Logic

Input signal logic can be set by a parameter. Active High and Active Low settings are as shown in the below diagram. Set it to suit the logic on the controller side.



5.2 Output Signal

5.2.1 Output function

The output signal is an open collector output of all four points. OUT4 is fixed to the alarm output, and the functions of other Outputs (OUT1 to 3) can be selected by parameters.

5.2.2 Output Logic

When selecting "User Defined" by Output Function parameter, the logic for Output 1 to Output 3 can be switched.

＊ Output 4 (Alarm output) is fixed as Active Low logic.

Active High:	Gate in open-collector circuit is ON when output condition is true
Active Low:	Gate in open-collector circuit is ON when output condition is false

Refer to "11.7 Output Functions" for further information.

Chapter 6 Communication

6.1 Communication Specification

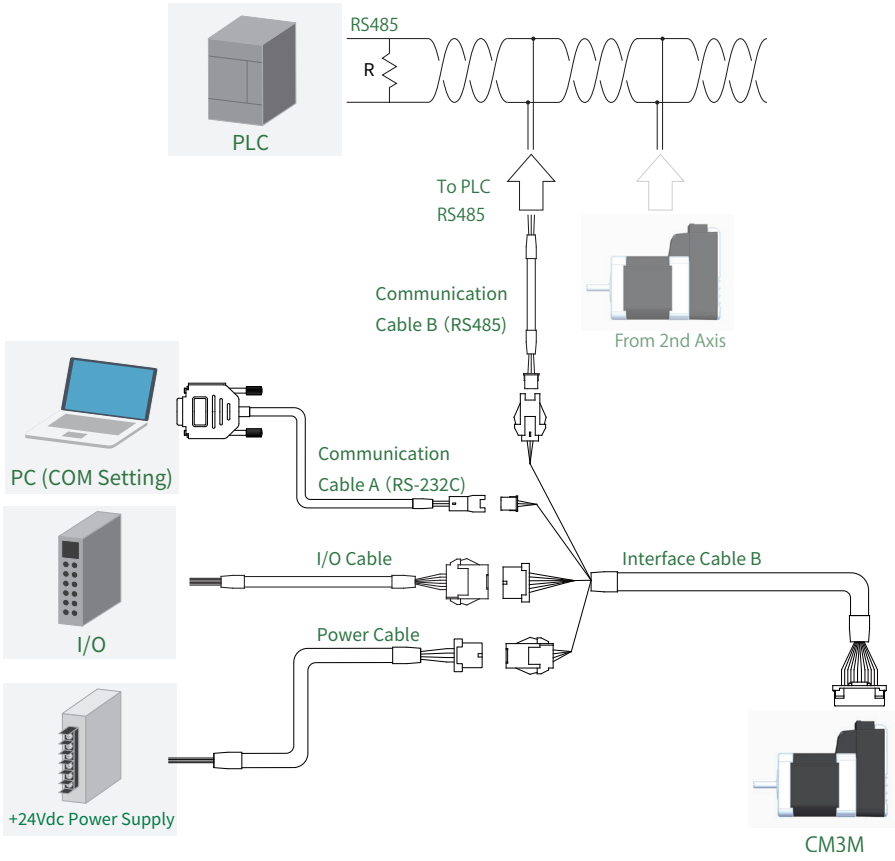
PLC (RS485)

Items	Contents
Electrical Spec	RS485
Communication	Modbus RTU
Method	2-Wire (Half-Duplex)
Connection	31 connections per master
Cable Length	Up to 20 m from master (terminator required) Stab 2m
Baudrate	9.6 / 19.2 / 38.4 / 57.6 / 115.2 kbps
Parity	None / Odd / Even
Stop Bits	1 / 2
Endian	Little / Big

PC Side (RS-232C)

Items	Contents
Electrical Spec	RS-232C
Baudrate	38.4 kbps
Data	8
Parity	None / Odd /Even
Stop Bits	1 / 2
Flow Control	None

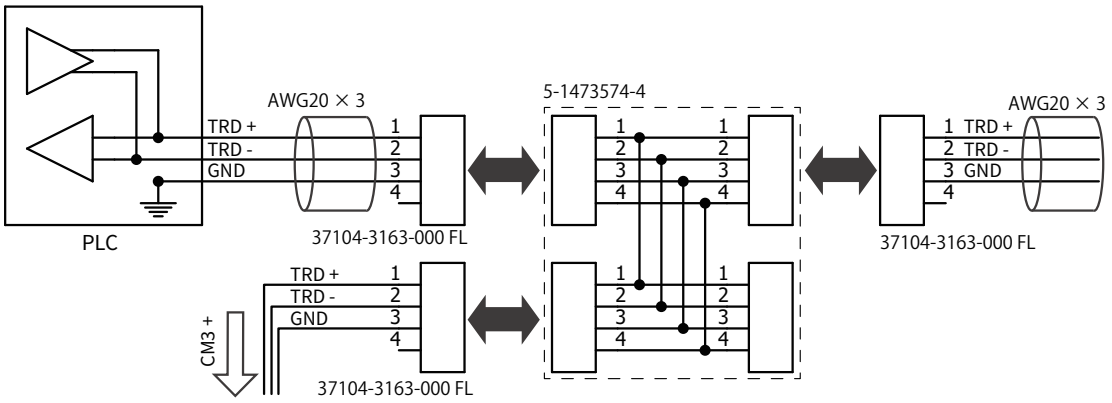
6.2 Typical Connection Example



6.3 Branching of RS485 communication

By using branch connectors, a multi-drop type network of up to 32 axes can be constructed.

☐ Example of T-branch connection



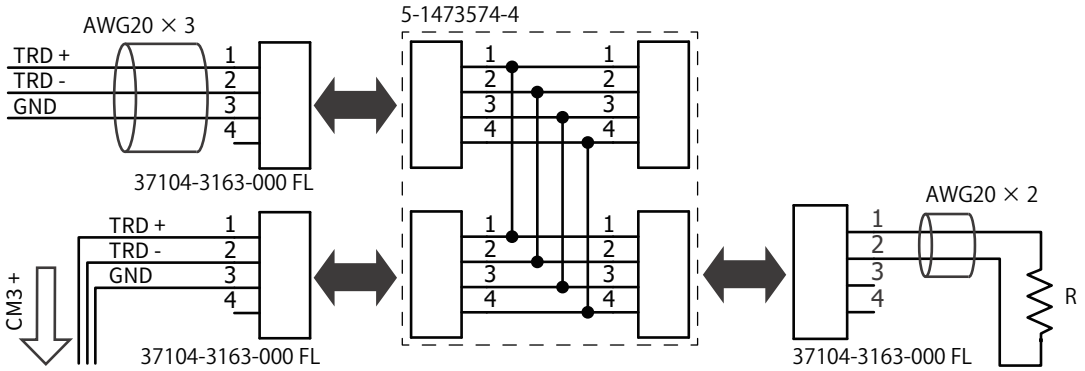
- Branch Connector

  Recommended model: 5-1473574-4 (Junction Box 4D: TE)

  37104-3163-000 FL（Mini clamp wire mount plug: 3M）

  Recommended wire: AWG20

☐ Example of final motor connection

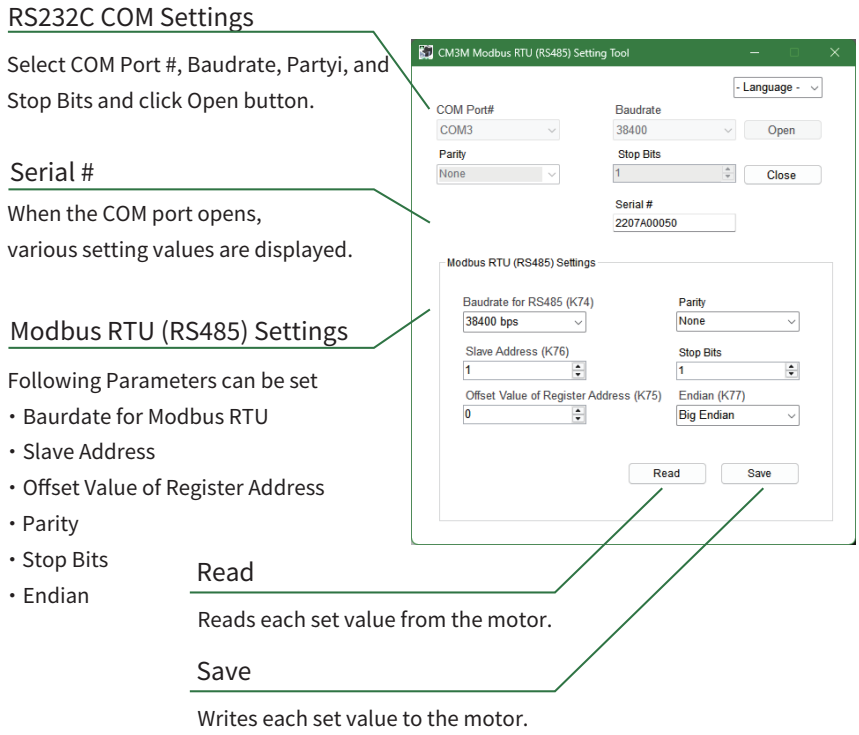


✳ Install a terminal resistor at the terminal end.

✳ The resistance value of the terminal resistor should be the same value as the impedance of the communication cable or the same value or the PLC side. (Reference value: 100 to 120 Ω 1/2W)

6.4 Communication Setup (RS485)

Set communication parameters for Modbus RTU (RS485) via RS-232C communication using configuration software on a PC. All other parameters and operation commands should be set from a host controller that supports Modbus RTU.



6.4.1 Setting Procedure

Connect the PC to the CM3M Modbus RTU (RS485) via RS-232C and open the serial port. Set the following parameters along with the master

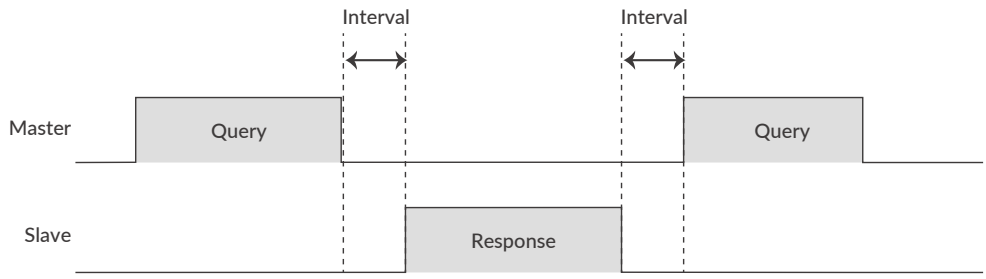
- Parity / Stop Bits（K72）
  The parity (None / Even / Odd) and the stop bits (1 / 2) can be set.
- Baudrate (K74)
  Baudrate can be selected from 9.6, 19.2, 38.4, 57.6, and 115.2 kbps.
- Offset value for register address (K75)
  The register address can be offset up to 32767.
- Slave address (K76)
  Slave addresses can be selected from 1 to 32.
- Endian (K77)
  Endian can be selected from big endian and small endian.

6.5 Setting Software "COOL WORKS"

Motion data settings, parameter settings, and trial runs are available.

6.6 Communication Timing

The communication timing of the query from the master and the response from CM3M is as follows.



There must be an interval of at least 3.5 characters between query and response.

Baudrate [kbps]	Interval [msec]
9.6	3.65
19.2	1.82
38.4	0.91
57.6	0.61
115.2	0.30

6.7 Message Frame

6.7.1 Query

A message sent by the master is called a query. The message composition of a query is as follows

Slave Address	Function Code	Register Start Address	Data	CRC Check
1 byte	1 byte	2 byte	2 byte	2 byte

☐ Slave Address (0x01 —0xFF)

Slave address of CM3M, set by K76.

☐ Function Code

The supported function codes are as follows.

Code	Name
0x03	Read Holding Resister
0x05	Force Single Coil
0x10	Preset Multiple Resister

☐ Data

Sets the number of holding registers and data to be operated. The data length varies depending on the function code.

☐ CRC Check

CRC check by the CRC-16. The slave calculates the received data using the CRC-16 method and compares it with the CRC check value in the message if the data was received correctly.

6.7.2 Response

The slave responds to the query.
The message structure of the response is the same as for a query as follows

Slave Address	Function Code	Register Start Address	Data	CRC Check
1 byte	1 byte	2 byte	2 byte	2 byte

☐ Normal Response

The slave receives the query from the master, executes the process successfully, and returns the query corresponding to the function code.

☐ No Response

Sometimes when a query is received from the master, it cannot be processed properly and the query is not returned. The following are possible causes of no response.

- Communication Error: Please make sure that the communication settings are correct.
- Wrong slave address: If a non-existent slave address is specified, there will be no response.
- Wrong function code: CM3M does not respond to function codes other than 0x03, 0x05, 0x08, and 0x10.
- 0x00 is specified for the slave address: No response is returned for the broadcast function.

☐ Exception Response

The following exception response is returned when an error occurs in the message frame of a query from the master.

Slave Address	Function Code	Register Start Address	Data	CRC Check
1 byte	1 byte	2 byte	2 byte	2 byte

＊ When responding to an exception, everything after 6 bytes is set to 1.

Causes of exception responses include the following

- Data error is occurring in the message frame of the query from the master.
- Function code 0x03, 0x05, 0x08, 0x10 is incorrectly set or register address is incorrect.

Chapter 7 Function Code

This section describes the supported function codes. Function codes not listed in this section cannot be executed.

7.1 Read Holding Resister (Function Code 0x03)

Reads 2 bytes of registers, such as Motor information, K parameter, and Motion data. Data must be read by specifying the upper and lower addresses at the same time. Otherwise, the value will not be read correctly.

☐ Example: When reading the current position and speed of slave address 1

Contents	Register Address	Value	Dicimal
Current Position (Upper)	0x0102	0x0012	1234567
Current Position (Lower)	0x0103	0xD687	
Current Speed (Upper)	0x0104	0x0000	100
Current Speed (Lower)	0x0105	0x0064	

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 1 (Set by K76)
Function Code		0x03	Read holding register
Data	Starting Address (Upper)	0x01	Starting address 0x0102
	Starting Address (Lower)	0x02	
	Register Number (Upper)	0x00	Number of registers to be read 0x0004
	Register Number (Lower)	0x04	
Error Check (Lower)		0xE4	Calculation result for CRC-16
Error Check (Upper)		0x35	

- Response

Field Name		Data	Contents	
Slave Address		0x01	Same value as query	
Function Code		0x03	Same value as query	
Data	Data Byte	0x08	Twice of the number of addresses to be read	
	Read value of register address (Upper)	0x00	Value of Register Address 0x0102	The current position 1234567 is 0x0012D687 in hex
	Read value of register address (Lower)	0x12		
	Read value of register address + 1 (Upper)	0xD6	Value of Register Address 0x0103	
	Read value of register address + 1 (Lower)	0x87		
	Read value of register address + 2 (Upper)	0x00	Value of Register Address 0x0104	The current speed 100 is 0x00000064 in hex.
	Read value of register address + 2 (Lower)	0x00		
	Read value of register address + 3 (Upper)	0x00	Value of Register Address 0x0105	
	Read value of register address + 3 (Lower)	0x64		
Error Check (Lower)		0x01	Calculation result for CRC-16	
Error Check (Upper)		0xD5		

7.2 Force Single Coil (Function Code 0x05)

Function code 0x05 can be written to a 1-byte register to issue an execution command.
Refer to "8.4 Execution Command" for a list of commands.
To turn on the coil, write 0xFF00; to turn off the coil, write 0x0000.

☐ Example: When executing motion data 5 at slave address 2

Contents	Register Address	Detail
Execution of Motion Data 5	0x058B	Initail: 0x0000 Execution: 0xFF00

- Query

Field Name		Data	Contents
Slave Address		0x02	Slave Address 2 (Set by K76)
Function Code		0x05	Force Single Coil
Data	Starting Address (Upper)	0x05	Register Address 0x058B
	Starting Address (Lower)	0x8B	
	Write value to Register Address (Upper)	0xFF	Change the value to 0xFF00 to start Motion Data 5
	Write value to Register Address (Lower)	0x00	
Error Check (Lower)		0xFC	Calculation result for CRC-16
Error Check (Upper)		0xEF	

To execute next motion data next, reset 0x058B to its initial value before executing the next motion.

- Response
  The same content as the query is returned.

7.2.1 About coil readout

To read the coil status, use function code 0x03 to read the switch status.
Refer to "8.1.5 Switch Status" for details.

- Switch 1 status (0x0116, 0x0117)
- Switch 2 status (0x0118, 0x0119)

7.3 Diagnosis (Function Code 0x08)

You can check the connection of RS485 communication. If you send a query with 8 as the function code, it will return a response with the same contents as the query.

☐ Example: To check the connection of slave address 1

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 1 (Set by K76)
Function Code		0x08	Diagnosis
Data	Subfunction code (Upper)	0x00	00: reply query data
	Subfunction code (Lower)	0x00	
	Write value to Register Address (Upper)	0xAB	Send arbitrary data (0xABCD)
	Write value to Register Address (Lower)	0xCD	
Error Check (Lower)		0x5E	Calculation result for CRC-16
Error Check (Upper)		0xAE	

- Response

Field Name		Data	Contents
Slave Address		0x01	Same Value as Query
Function Code		0x08	Same Value as Query
Data	Subfunction code (Upper)	0x00	Same Value as Query
	Subfunction code (Lower)	0x00	
	Write value to Register Address (Upper)	0xAB	Same Value as Query
	Write value to Register Address (Lower)	0xCD	
Error Check (Lower)		0x5E	Same Value as Query
Error Check (Upper)		0xAE	

If a sub-function code other than 00 is received, exception response 01 is returned.

- Response

Field Name		Data	Contents
Slave Address		0x01	Same Value as Query
Function Code		0x88	Exception response
Data	Subfunction code (Upper)	0x00	Exception response
	Subfunction code (Lower)	0x10	
Error Check (Lower)		0x87	Calculation result for CRC-16
Error Check (Upper)		0xC0	

7.4 Preset Multiple Resister (Function Code 0x10)

Up to 20 contiguous registers can be written to, allowing setting of K parameters and motion data. Data must be written by specifying the upper and lower address levels at the same time. If data is not written at the same time, it will not be reflected correctly. If a value outside the settable range is set, the contents of the holding register will not be changed. At that time, a normal response will be returned; see "8.2 K Parameters" for K parameters and "8.3 Motion Data" for motion data.

☐ Example: When writing the following data to Acceleration data 2 of Slave address 3.

Contents	Regi	Value	Decimal
Acceleration Data 2 (Upper)	0x0298	0x0000	100
Acceleration Data 2 (Lower)	0x0299	0x0064	

- Query

Field Name		Data	Contents	
Slave Address		0x03	Slave Address 3 (Set by K76)	
Function Code		0x10	Preset Multiple Resister	
Data	Starting Address (Upper)	0x02	Starting Address 0x0298	
	Starting Address (Lower)	0x98		
	Number of registers (Upper)	0x00	Number of registers to be written 2 = 0x0002	
	Number of registers (Lower)	0x02		
	Number of data bytes	0x04	Twice the number of addresses to be read.	
	Write value of register address (Upper)	0x00	Value of Register Address 0x0298	Acceleration 100 is 0x00000064 in hex
	Write value of register address (Lower)	0x00		
	Write value of register address + 1 (Upper)	0x00	Value of Register Address 0x0298	
	Write value of register address + 1 (Lower)	0x64		
Error Check (Lower)		0xE8	Calculation result for CRC-16	
Error Check (Upper)		0x56		

- Response

Field Name		Data	Contents
Slave Address		0x03	Same value as query
Function Code		0x10	Same value as query
Data	Starting Address (Upper)	0x02	Same value as query
	Starting Address (Lower)	0x98	
	Number of registers (Upper)	0x00	Same value as query
	Number of registers (Lower)	0x02	
Error Check (Lower)		0xC0	Calculation result for CRC-16
Error Check (Upper)		0x7D	

Chapter 8 Holding Register List

All data consists of 4 bytes. In the Modbus RTU protocol, registers consist of 2 bytes, so one data is represented by two registers. Addresses are arranged in big-endian format and are listed in order of upper and lower bytes. Up to 18 addresses (36 bytes) of continuous data can be read.

8.1 Motor Information

Information such as the current position can be read out with Function Code 0x03.

Register Address (DEC)	Register Address (HEX)	Name	Descripstion
256	0100	Position deviation (Upper)	Displays deviation between current position and target position
257	0101	Position deviation (Lower)	
258	0102	Current position (Upper)	Displays current position in pulses
259	0103	Current position (Lower)	
260	0104	Current speed (Upper)	Displays current speed in set units
261	0105	Current speed (Lower)	
262	0106	Current torque (Upper)	Displays current torque as a percentage of maximum torque
263	0107	Current torque (Lower)	
264	0108	Motor status (Upper)	Displays motor status Ref: "8.1.1 Motor Status (0x0108, 0x0109)"
265	0109	Motor status (Lower)	
266	010A	Warning status (Upper)	Displays warning status Ref: "8.1.2 Warning (0x010A, 0x010B)"
267	010B	Warning status (Lower)	
268	010C	Output status (Upper)	Displays output status
269	010D	Output status (Lower)	
270	010E	Input status (Upper)	Displays input status
271	010F	Input status (Lower)	
272	0110	Power voltage (Upper)	Displays power supply voltage in 0.1V increments
273	0111	Power voltage (Lower)	
274	0112	Case temperature (Upper)	Displays case temperature in 1°C increments
275	0113	Case temperature (Lower)	
276	0114	Load factor (Upper)	Displays motor load factor as % of rated torque
277	0115	Load factor (Lower)	
278	0116	Switch 1 status (Upper)	Displays the status of holding registers 0x0580 to 0x0597 at once
279	0117	Switch 1 status (Lower)	
280	0118	Switch 2 status (Upper)	Displays the status of holding registers 0x0598 to 0x05B7 at once
281	0119	Switch 2 status (Lower)	
282	011A	Origin (default: -1) (Upper)	Encoder phase information for home detection is displayed in 0 to 999
283	011B	Origin (default: -1) (Lower)	

8.1.1 Motor Status (0x0108, 0x0109)

Various statuses including motor errors are as follows.

Value	Name	Detail	Category
null	Motor is running	Motion Data in running	-
B0	Position Error Overflow	Position deviation exceeds the set value by K63	Alarm
B1	Overvoltage Alarm	Input voltage exceeds 30V	Alarm
B2	Overload Alarm	Current torque exceeds the maximum torque for the time set by K64	Alarm
B3	In-position	Motion is stopped and in-position range	-
B4	Servo off	Servo off	-
B5	Push Motion	During Push Motion	-
B6	Over current Alarm	Excessive current flowed	Alarm
B7	Temperature Alarm	Internal temperature exceeded 110°C	Alarm
B8	Operation Warning	Refer to "8.1.2 Warning (0x010A, 0x010B)"	Warning
B9	Low Voltage Alarm	Main power supply has fallen below 18V.	Alarm
B10	STO Activated	STO signal is turned off	Alarm
B11	Status Warning	Refer to "8.1.2 Warning (0x010A, 0x010B)".	Warning
B12	ABS Alarm	Origin detection is not completed when single-turn ABS is set.	Alarm

☐ About Alarm

When an alarm occurs, the bit of the motor status corresponding to the contents of the alarm stands, the alarm output turns ON, and the servo turns OFF. When the cause of the alarm is removed and the alarm is cleared (0x0582), servo-ON (0x0580) can be accepted. Refer to "11.2 Sequence to Reset Alarm".

8.1.2 Warning (0x010A, 0x010B)

The warnings and possible factors are as follows

Value	Name	Detail	Classification
B0	Push Motion Warning	Reach the target position during Push Motion	Operation Warning
B1	Software Limit Warning	Execution command to the target position set over the software limit is sent	Operation Warning
B2	Limit Sensor Warning	Limit sensor is on	Operation Warning
B3	Manual Mode Warning	Execution Command is sent in Manual Mode	Operation Warning
B4	Origin Detection Incomplete Warning	An execution command is sent while the origin detection operation was not completed when the origin detection completion (K30) was enabled	Operation Warning
B5	Execution Warning	An operation command is sent when operation cannot be performed	Operation Warning
B6	Temperature Warning	Temperature inside of driver case exceeds the set value of K61	Status Warning
B7	Over Load Warning	The load exceeds the set value of K62	Status Warning

∗ The motor axis does not servo off even in a warning state.

☐ Classification of warnings

- Operation Warning
  Operation Warning indicates an inoperable condition. Please check the cause of the operation warning.
  To reset the warning, please send a stop command.

- Status Warning
  This is a warning that the temperature or load factor has exceeded a threshold value.
  The status warning function is useful for preventive maintenance of equipment..

8.1.3 Output Status (0x010C, 0x010D)

The output status displays the state of the output signal in hexadecimal.
If “0: General output” is selected with the output function selection, this shows the status when the output signal (0x05A8 to 0x05AA) is turned on with function code 0x05. If a function other than “general output” is selected, the output status is not reflected.

Contents		Description
B0	Output 1	0: OFF / 1: ON Ex: When Output 2 and 4 are ON 2+8=10 → 0x0A
B1	Output 2	
B2	Output 3	
B3	Output 4	

8.1.4 Input Status (0x010E, 0x010F)

The input status displays the input signal status, STO signal, and overcurrent detection signal in hexadecimal.

Contents		Description
B0	Input 1	0: OFF / 1: ON Example: When Input 3 and 4 are ON 4+8=12 → 0x0C If B7 occurs frequently, please reduce acceleration.
B1	Input 2	
B2	Input 3	
B3	Input 4	
B4	N/A	
B5	N/A	
B6	STO	
B7	Overcurrent alarm	

8.1.5 Switch Status

The state of multiple holding registers can be read out at once.

☐ Switch 1 Status (0x0116, 0x0117)

Motion data can be executed only when the conditions match those in the table below.

Bit	Contents	Conditions for initiating motion
B0	Servo ON/OFF	1
B1	STOP	0
B2	Alarm Reset	0
B3	Origin detection operation starts	0
B4	Move to position 0	0
B5	Set current position to position 0	0
B6	Position deviation reset	—
B7	Software reset	—
B8	Sets the current position to the origin	0
B9	Save	—
B10	Execute motion data 1	0
～	～	0
B25	Execute motion data 16	0
B26	Resume motion	0

☐ Switch 2 Status (0x0118, 0x0119)

Bit	Contents
B0	Output 1
B1	Output 2
B2	Output 3
B3 ～ B15	N/A
B16	Set current position to position 1
～	～
B31	Set current position to position 16

8.2 K Parameters

Set parameters such as Resolution, communication settings, and protection function.
Details of various functions and usage examples are described in Chapter 10.

✳ Note

- Please change parameters while CM3M is stopped.
- Unless the Data Save command is executed, the value saved previously will remain when the power is turned on again.
- For safety reasons, there are some settings that require a power off and on (Restart).
- No error is returned even if a value outside the settable range is set. After writing with function code 0x10, be sure to read back with function code 0x03 to verify that the setting was made correctly.

☐ Numbers for Parameter Setting

If B0 to B# is written in the Setting/Range in the next Parameter List, the setting is made in bit units.

Bit	B7	B6	B5	B4	B3	B2	B1	B0
Binary	0	1	0	0	1	1	0	0

The contents set to 1 are valid, and the contents set to 0 are invalid.

8.2.1 Motion Environmental Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
296	0128	K1	Resolution	0	300 ppr	✓	Set the pulse count per revolution. Ref: 10.1
				1	600 ppr		
				2	1000 ppr		
				3	1200 ppr		
				4	2000 ppr		
297	0129			5	3000 ppr		
				6	5000 ppr		
				7	6000 ppr		
				8	10000 ppr		
				9	12000 ppr		
298	012A	K2	Speed Unit	0	100 pps	✓	Set the speed unit for S command.
299	012B			1	10 pps		
				2	1 pps		
300	012C	K3	Servo ON/OFF Setting	0	Servo Off		Set either CM3M starts with Servo on or Servo off when powered on.
301	012D			1	Servo On		
302	012E	K4	Coordinate Direction	0	Positive in CW	✓	Set the coordinate direction. Ref: 10.2
303	012F			1	Positive in CCW		
304	0130	K5	In-position Range	1 - 500 Pulse			Set the range for In-position. Ref: 10.3
305	0131						
306	0132	K6	Speed Override	1 - 100 %			Limit the speed by the set proportion. Ref: 10.4
307	0133						
308	0134	K7	Software Limit Setting	0	Disabled		Set the enable / disable of the software limit function and the operation when the function is enabled. Ref: 10.5
309	0135			1	Detect before moving		
				2	Detect after moving		
310	0136	K8	Software Limit（+）	0 - Depends on ResolutionPulse (Set by K10)			Set the operating limit boundary in the positive direction (Unit set by K10) Ref: 10.5
311	0137						
312	0138	K9	Software Limit（—）	Depends on Resolution - 0 Pulse (Set by K10)			Set the operating limit boundary in the negative direction (Unit set by K10) Ref: 10.5
313	0139						
314	013A	K10	Unit of Software Limit	0	100 Pulse	✓	Set the unit for Software Limit. Ref: 10.5
315	013B			1	10 Pulse		
				2	1 Pulse		
316	013C	K11	Push Motion Operation Mode	0	Continuous (One direction)		Set the direction and time for Push Motion ( ): Direction to limit torque. One direction: Torque is limited only in operation direction. Both direction: Torque is limited in both directions.
				1	Set time (One direction)		
317	013D			2	Continuous (Both direction)		
				3	Set time (Both direction)		
320	0140	K13	Push Motion Holding Time	1 - 30000 msec			Set Push Motion Holding Time. Ref: 11.4
321	0141						
322	0142	K14	Open Loop Holding Angle	0	Disabled		Set the angle to switch back to closed loop from Open Loop Holding. Ref: 10.6
323	0143			1 to 72 (± 0.1°)			
324	0144	K15	Switch Time for Open Loop Holding Mode	10 - 1000 msec			Set the time to switch to Open Loop Holding after positioning is completed. Ref: 10.6
325	0145						
326	0146	K16	Deceleration ratio	1 - 500 %			Set the deceleration in % of the Acceleration
327	0147						
328	0148	K17	Creeping Speed	0 - 1000 pps (Set by K2)			Set the creeping speed Ref: 10.7
329	0149						
330	014A	K18	Deceleration ratio at limit sensor stop	0 ~ 10000		%	Sets the deceleration by the limit sensor as a % of acceleration. Ref; 11.6.4
331	014B						

8.2.2 Origin Detection Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
338	0152	K22	Origin Signal Source	0	Stopper Detection	✓	Set the origin detection signal source and detection method. The origin sensor can be assigned only to input point 1. (Auto): Automatic origin detection operation starts when the power is turned on. Ref: 11.5
				1	Stopper Detection (Auto)		
339	0153			2	Origin Sensor		
				3	Origin Sensor (Auto)		
340	0154	K23	Origin Detection Speed	1 ～ 32767 pps (K2 設定値)			Set the speed for Origin Detection.
341	0155						
342	0156	K24	Origin Detection Acceleration	1 ～ 32767 kpps²			Set the acceleration for Origin Detection.
343	0157						
344	0158	K25	Origin Detection Direction	0	CW	✓	Set the direction for Origin Detection.
345	0159			1	CCW		
346	015A	K26	Origin Offset Distance	± 32767 パルス			Set offset amount from detected origin to coordinate origin.
347	015B						
348	015C	K27	Unit of Origin Offset Distance	0	100 Pulse	✓	Set the unit when Offset is set.
349	015D			1	10 Pulse		
				2	1 Pulse		
350	015E	K28	Stopper Detection Torque	10 ～ 150%			Set the torque to detect a stopper for Origin Detection by percentage to rated torque. Ref: 11.5.1
351	015F						
352	0160	K29	Single-turn ABS Function	0	Disabled	✓	Set Enable/Disable of the single-turn ABS function Ref: 10.8
353	0161			1	Enabled		
354	0162	K30	Origin Detection Completion	0	Disabled	✓	Set to accept only home detection after power-on Ref: 10.9
355	0163			1	Enabled		

8.2.3 Gain Adjustment Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
356	0164	K31	Tuning	0	PPI		Set CM3M Tuning method. Ref: 11.8
357	0165			1	Tuningless		
358	0166	K32	Servo Stiffness	10 - 200			Set Servo Stiffness when Tuningless is selected. Ref: 11.8.1
359	0167						
360	0168	K33	Position P Gain	1 - 5000			Set 3 types of gains when PPI is selected. Ref: 11.8.2
361	0169						
362	016A	K34	Speed P Gain	50 - 5000			
363	016B						
364	016C	K35	Speed I Gain	0 - 5000			
365	016D						
366	016E	K36	S-Curve Gain	0 - 1024			Set S-Curve Gain for positioning operation. Ref: 11.8.3
367	016F						

8.2.4 Input Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
378	017A	K42	Input Filter	1 - 50 msec		✓	Set the filtering time for input signal. Ref: 11.6.1
379	017B						
380	017C	K43	Input Logic	1st digit	IN 1	✓	Set the input logic. Ref: 5.1.2 0: Active High 1: Active Low Ex: IN1, IN3, and IN5 as Active Low K43=010101
				2nd digit	IN 2		
381	017D			3rd digit	IN 3		
				4th digit	IN 4		
382	017E	K44	Input 1 Function	0	No Action	✓	Select the function to be assigned to IN1 to IN4. Origin sensor can be assigned only to IN1. Inching / jog can be assigned only to IN3 and IN4. Ref: 11.6
383	017F			1	Origin Sensor		
384	0180	K45	Input 2 Function	2	CCW Limit Sensor		
385	0181			3	CW Limit Sensor		
386	0182	K46	Input 3 Function	4	Manual Mode		
387	0183			5	Servo on・off		
388	0184	K47	Input 4 Function	6	Inching・Jog (CCW)		
389	0185			7	Inching・Jog (CW)		
				8	Start Motion Data #1		
				9	Start Motion Data #2		
				10	Start Motion Data #3		
				11	Stop		
394	018A	K50	Inching・Jog Speed	1 - 32767 pps (Set by K2)			Set the speed for the Inching and Jog operation. Ref: 11.6.2
395	018B						
396	018C	K51	Inching Distance	1 - 100 Pulse			Set the Inching distance. Ref: 11.6.2
397	018D						
398	018E	K52	Inching・Jog Shift Time	0	No Inching Motion		Set the time to switch Jog from Inching completion. Ref: 11.6.2
399	018F			1 - 30000 msec			

8.2.5 Output Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
400	0190	K53	Output Logic	1st digit	OUT 1	✓	Set the output logic Ref: 5.2.2 0: Active High 1: Active Low Ex: OUT3 and OUT1 as Active Low K53=101
401	0191			2nd digit	OUT 2		
				3rd digit	OUT3		
404	0194	K55	Output 1 Function	0	General Output		Assign functions to Output 1 to 3 Ref: 11.7.2
405	0195			1	In-position Output		
				2	Warning Output		
406	0196	K56	Output 2 Function	3	General Output		
407	0197			4	ZONE Output		
				5	MOVE Output		
408	0198	K57	Output 3 Function	6	BUSY Output		
409	0199			7	END Output		
				8	Servo On Output		
				9	Push Motion Output		
				10	Origin Set Completion		
410	019A	K58	MOVE Output Threshold	0 - 2147483647 pps (Set by K2)			Set the speed threshold to output MOVE Output signal. Ref: 11.7.2
411	019B						
412	019C	K59	ZONE (—)	± 2147483647 Pulse			Set boundary of ZONE Output in the negative direction. Ref: 11.7.2
413	019D						
414	019E	K60	ZONE (+)	± 2147483647 Pulse			Set boundary of ZONE Output in the positive direction. Ref: 11.7.2
415	019F						

8.2.6 Status Parameters

Register DEC	Register HEX	#	Name	Setting/Range		Restart	Reference/Remarks
416	01A0	K61	Temperature Warning Threshold	0 - 100 °C			Set the threshold to output a temperature warning.
417	01A1						
418	01A2	K62	Load Warning Threshold	1 - 100 %			Set a threshold to output a load warning as a percentage of the maximum torque.
419	01A3						
420	01A4	K63	Position Error Overflow Threshold	1 - 32767 [1000 pulse]			Set Position Error Overflow Threshold between current and target position. Ref: 10.10
421	01A5						
422	01A6	K64	Overload Detection Time	100 - 10000 msec			Set the time to output Overload alarm. Ref: 10.11
423	01A7						
424	01A8	K65	Status LED	0	Enabled		Set enable / disable of the status LED Ref: 11.10
425	01A9			1	Disabled		

8.2.7 Communication Parameters

Register		#	Name	Setting/Range		Restart	Reference/Remarks
DEC	HEX						
436	01B4	K71	Baud Rate RS-232C	0	38.4 kbps	✓	Set the baud rate for RS-232C communication for setting.
				1	9.6 kbps		
				2	19.2 kbps		
437	01B5			3	57.6 kbps		
				4	115.2 kbps		
438	01B6	K72	Parity RS-232C	0	None	✓	Set the parity when transferring data for RS-232C
				1	Even		
439	01B7			2	Odd		
440	01B8	K73	Delimiter RS-232C	0	CR	✓	Set the delimiter type at the end of replied data from CM3M for RS-232C
441	01B9			1	CRLF		
442	01BA	K74	Baud Rate for Modbus RTU RS485	0	38.4 kbps	✓	Set the baud rate for RS485 communication
				1	9.6 kbps		
				2	19.2 kbps		
443	01BB			3	57.6 kbps		
				4	115.2 kbps		
444	01BC	K75	Holding Register Offset Value RS485	0 - 32767		✓	Set register address offset value of Modbus RTU
445	01BD						
446	01BE	K76	Slave Address RS485	1 - 32		✓	Set the slave address of Modbus RTU
447	01BF						
448	01C0	K77	Endian RS485	0	Big Endian	✓	Set the Endian of Modbus RTU
449	01C1			1	Little Endian		
450	01C2	K78	Group Setting	0~247			Set the Group. 10.12 参照
451	01C3						

8.3 Motion Data

Motion data can be read with function code 0x03 and written with 0x10. Motion data consists of operation mode, position data, speed data, acceleration data, torque limit data, push torque data, jump data, repetition data, and timer data. After setting these data, the motion can be started by the execution command. A total of 16 types of motion data can be stored.

☐ Motion data type and address

Motion Data #	Operation Mode	Position Data	Speed Data	Acceleration Data	Torque Limit Data	Push Torque Data	Jump Data	Repitation Data	Timer Data
1	0x0280 0x0281	0x0282 0x0283	0x0284 0x0285	0x0286 0x0287	0x0288 0x0289	0x028A 0x028B	0x028C 0x028D	0x028E 0x028F	0x0290 0x0291
2	0x0292 0x0293	0x0294 0x0295	0x0296 0x0297	0x0298 0x0299	0x029A 0x029B	0x029C 0x029D	0x029E 0x029F	0x02A0 0x02A1	0x02A2 0x02A3
3	0x02A4 0x02A5	0x02A6 0x02A7	0x02A8 0x02A9	0x02AA 0x02AB	0x02AC 0x02AD	0x02AE 0x02AF	0x02B0 0x02B1	0x02B2 0x02B3	0x02B4 0x02B5
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
15	0x037C 0x037D	0x037E 0x037F	0x0380 0x0381	0x0382 0x0383	0x0384 0x0385	0x0386 0x0387	0x0388 0x0389	0x038A 0x038B	0x038C 0x038D
16	0x038E 0x038F	0x03A0 0x03A1	0x03A2 0x03A3	0x03A4 0x03A5	0x03A6 0x03A7	0x03A8 0x03A9	0x03AA 0x03AB	0x03AC 0x03AD	0x03AE 0x03AF

Motion data can be saved in the CM3M's internal memory by turning the coil of the save command (0x0589) on and off. Saved motion data will not be lost even if the power is turned off.

☐ List of Motion Data

Name	No.	Setting/Range		Unit
Position Data	1 ~ 16	Depends on Resolution (Ref: 10.1)		pulse
Speed Data		± 200000 (Ref: 10.1)		Set by K2
Acceleration Data		1 - 32767		kpps²
Push Torque Data		10 - 80		% of Rated Torque
Torque Limit Data		0 - 100		% of Max. Torque
Motion Mode		0	PTP Motion	
		1	INC Motion	
		2	PTP Push Motion	
		3	INC Push Motion	

8.3.1 Motion Data Details

☐ Operation Mode

Vallue	Content	Description
0	PTP Motion	Absolute positioning motion to the target position set by position data with respect to the origin
1	INC Motion	Incremental positioning motion with the target distance set by position data with respect to the current position
2	PTP Push Motion	Push motion to the absolute position set by position data with the torque of push torque data.
3	INC Push Motion	Push motion with the incremental distance set by position data with the torque of push torque data.

☐ Position Data

Set the target position with respect to the origin for PTP Motion, and set the relative motion distance from the current position for INC Motion.

∗ When 10^9 is set to the target position (1000000000), the motion will be the continuous motion. For continuous motion, rotation direction is set only by Speed Data. Regardless of the coordinate direction (K4) setting, when the Speed Data has a positive value, the output shaft rotates in the CW direction, and when it has a negative value, it rotates in the CCW direction.

∗ The settable range of position data depends on the Resolution.
Please refer to "10.1 Resolution（K1）(0x0128, 0x0129)" for details.

∗ If the current position exceeds the settable range of coordinates due to INC Motion or continuous operation, executing PTP Motion from that position may move in an unexpected direction. Be sure to reset the current position if the coordinate range is exceeded.

☐ Speed Data

Set the target speed of the motion as a positive value. If the acceleration is small with respect to the distance traveled, deceleration will start before the set value is reached. The unit is selected from 100pps, 10pps, and 1pps according to the speed unit parameter (K2).

Example: When K2=0（100pps）and S=100
S.1 = 100 × 100pps = 10000 [pps]

- Unit Conversion to rpm

Speed[rpm] = S Data × Speed Unit [pps] × 60 [sec/min] / Resolution [ppr]

Example: S Data 100（S=100）
Speed Unit 100pps（K2=0）
Resolution 1000ppr（K1=2）

Speed[rpm] = 100 × 100[pps] × 60[sec/min] / 1000[ppr]
= 600 [rpm]

☐ Acceleration Data

Sets the acceleration of motion.

The rate of increase in velocity per second is defined as acceleration. The unit is pps^2 [pulse / sec^2].
The unit of acceleration data is $kpps^2$ (kilo-pulse/sec^2) = 1000 [pps^2]

Example: Speed Unit: 100pps（K2=0）
Speed Data: 500
Acceleration Data: 100）
Acceleration time to reach target speed is:
Acceleration Time [sec] = 500 × 100 [pps] / (100 × 1000 pps2) = 0.5 [sec]

☐ Push Torque Data

Set the torque for the push motion as a ration to the rated torque when push motion is set by the Motion Mode. Please refer to "11.4 Push Motion" for details.

☐ Torque Limit Data

The output torque during motion can be limited by the ratio to the maximum torque.

☐ Jump Data

Motion data number to be executed next can be specified; if 0 is specified, no jump is made.

☐ Repitation Data

The motion is repeated the number of times specified by the repeat data.
When set to 0, the motion data is not executed. When -1 is set, the motion is repeated indefinitely.

☐ Timer Data

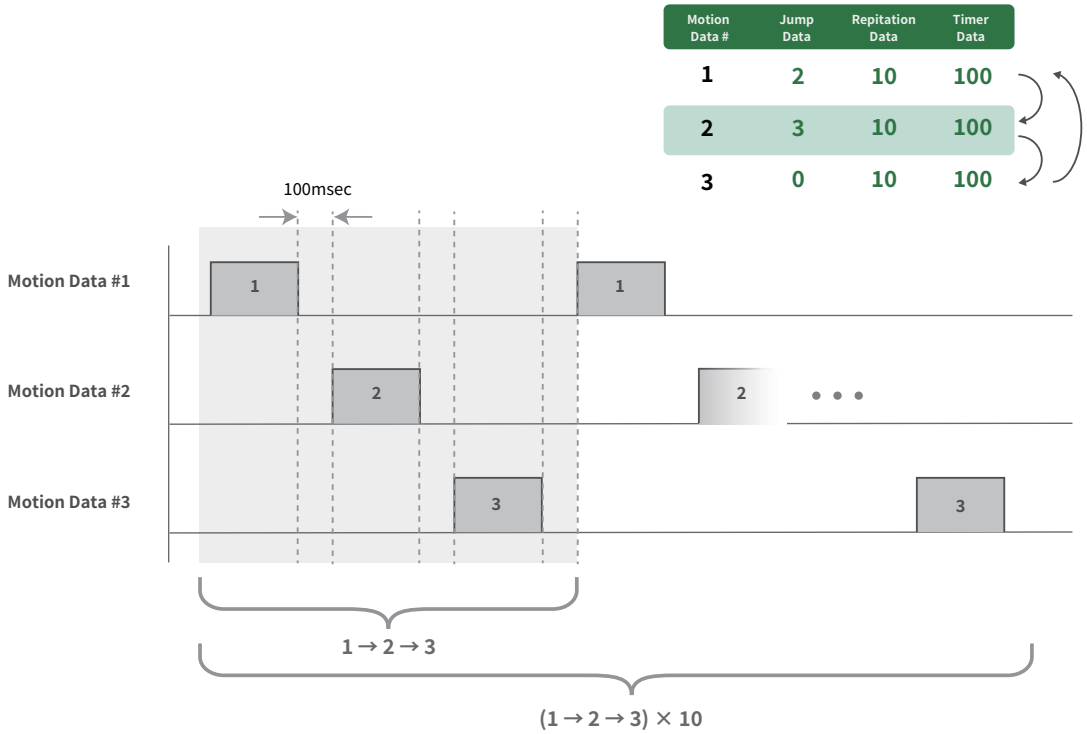
If other motion data is specified in the jump data, wait time is generated for the time specified in the timer data.

8.3.2 Example of jump, repeat, and timer

The following is an example of jump, repetition, and timer data settings for operation under the following conditions.

- Motion data 1, 2, 3 executed in order
- Each timer is 500 msec.
- Repeat the above motion 10 times.

☐ Motion Sequences



8.3.3 Motion Data Holding Register List

Motion data is structured as shown in the figure below. Function code 0x03 for reading, 0x10 for writing. Up to 18 consecutive data can be read and up to 20 can be written.
Once set, the data is stored until the power is turned off, so it is not necessary to write all motion data each time. Motion data can be saved in EEPROM by turning the coil of the save command (0x0589) on and off. Saved motion data will not disappear when the power is turned off.

☐ Motion data type and address diagram

Motion Data #	Operation Mode	Position Data	Speed Data	Acceleration Data	Torque Limit Data	Push Torque Data	Jump Data	Repitation Data	Timer Data
1	0x0280 0x0281	0x0282 0x0283	0x0284 0x0285	0x0286 0x0287	0x0288 0x0289	0x028A 0x028B	0x028C 0x028D	0x028E 0x028F	0x0290 0x0291
2	0x0292 0x0293	0x0294 0x0295	0x0296 0x0297	0x0298 0x0299	0x029A 0x029B	0x029C 0x029D	0x029E 0x029F	0x02A0 0x02A1	0x02A2 0x02A3
3	0x02A4 0x02A5	0x02A6 0x02A7	0x02A8 0x02A9	0x02AA 0x02AB	0x02AC 0x02AD	0x02AE 0x02AF	0x02B0 0x02B1	0x02B2 0x02B3	0x02B4 0x02B5
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
15	0x037C 0x037D	0x037E 0x037F	0x0380 0x0381	0x0382 0x0383	0x0384 0x0385	0x0386 0x0387	0x0388 0x0389	0x038A 0x038B	0x038C 0x038D
16	0x038E 0x038F	0x03A0 0x03A1	0x03A2 0x03A3	0x03A4 0x03A5	0x03A6 0x03A7	0x03A8 0x03A9	0x03AA 0x03AB	0x03AC 0x03AD	0x03AE 0x03AF

The holding registers for each data are as follows

☐ Motion Data Holding Register

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
640	280	Operation Mode 1 (High)	658	292	Operation Mode 2 (High)
641	281	Operation Mode 1 (Low)	659	293	Operation Mode 2 (Low)
642	282	Position Data 1 (High)	660	294	Position Data 2 (High)
643	283	Position Data 1 (Low)	661	295	Position Data 2 (Low)
644	284	Speed Data 1 (High)	662	296	Speed Data 2 (High)
645	285	Speed Data 1 (Low)	663	297	Speed Data 2 (Low)
646	286	Acceleration Data 1 (High)	664	298	Acceleration Data 2 (High)
647	287	Acceleration Data 1 (Low)	665	299	Acceleration Data 2 (Low)
648	288	Torque Limit Data 1 (High)	666	29A	Torque Limit Data 2 (High)
649	289	Torque Limit Data 1 (Low)	667	29B	Torque Limit Data 2 (Low)
650	28A	Push Torque Data 1 (High	668	29C	Push Torque Data 2 (High
651	28B	Push Torque Data 1 (Low)	669	29D	Push Torque Data 2 (Low)
652	28C	Jump Data 1 (High)	670	29E	Jump Data 2 (High)
653	28D	Jump Data 1 (Low)	671	29F	Jump Data 2 (Low)
654	28E	Repetition Data 1 (High)	672	2A0	Repetition Data 2 (High)
655	28F	Repetition Data 1 (Low)	673	2A1	Repetition Data 2 (Low)
656	290	Timer Data 1 (High)	674	2A2	Timer Data 2 (High)
657	291	Timer Data 1 (Low)	675	2A3	Timer Data 2 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
676	2A4	Operation Mode 3 (High)	694	2B6	Operation Mode 4 (High)
677	2A5	Operation Mode 3 (Low)	695	2B7	Operation Mode 4 (Low)
678	2A6	Position Data 3 (High)	696	2B8	Position Data 4 (High)
679	2A7	Position Data 3 (Low)	697	2B9	Position Data 4 (Low)
680	2A8	Speed Data 3 (High)	698	2BA	Speed Data 4 (High)
681	2A9	Speed Data 3 (Low)	699	2BB	Speed Data 4 (Low)
682	2AA	Acceleration Data 3 (High)	700	2BC	Acceleration Data 4 (High)
683	2AB	Acceleration Data 3 (Low)	701	2BD	Acceleration Data 4 (Low)
684	2AC	Torque Limit Data 3 (High)	702	2BE	Torque Limit Data 4 (High)
685	2AD	Torque Limit Data 3 (Low)	703	2BF	Torque Limit Data 4 (Low)
686	2AE	Push Torque Data 3 (High	704	2C0	Push Torque Data 4 (High
687	2AF	Push Torque Data 3 (Low)	705	2C1	Push Torque Data 4 (Low)
688	2B0	Jump Data 3 (High)	706	2C2	Jump Data 4 (High)
689	2B1	Jump Data 3 (Low)	707	2C3	Jump Data 4 (Low)
690	2B2	Repetition Data 3 (High)	708	2C4	Repetition Data 4 (High)
691	2B3	Repetition Data 3 (Low)	709	2C5	Repetition Data 4 (Low)
692	2B4	Timer Data 3 (High)	710	2C6	Timer Data 4 (High)
693	2B5	Timer Data 3 (Low)	711	2C7	Timer Data 4 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
712	2C8	Operation Mode 5 (High)	730	2DA	Operation Mode 6 (High)
713	2C9	Operation Mode 5 (Low)	731	2DB	Operation Mode 6 (Low)
714	2CA	Position Data 5 (High)	732	2DC	Position Data 6 (High)
715	2CB	Position Data 5 (Low)	733	2DD	Position Data 6 (Low)
716	2CC	Speed Data 5 (High)	734	2DE	Speed Data 6 (High)
717	2CD	Speed Data 5 (Low)	735	2DF	Speed Data 6 (Low)
718	2CE	Acceleration Data 5 (High)	736	2E0	Acceleration Data 6 (High)
719	2CF	Acceleration Data 5 (Low)	737	2E1	Acceleration Data 6 (Low)
720	2D0	Torque Limit Data 5 (High)	738	2E2	Torque Limit Data 6 (High)
721	2D1	Torque Limit Data 5 (Low)	739	2E3	Torque Limit Data 6 (Low)
722	2D2	Push Torque Data 5 (High	740	2E4	Push Torque Data 6 (High
723	2D3	Push Torque Data 5 (Low)	741	2E5	Push Torque Data 6 (Low)
724	2D4	Jump Data 5 (High)	742	2E6	Jump Data 6 (High)
725	2D5	Jump Data 5 (Low)	743	2E7	Jump Data 6 (Low)
726	2D6	Repetition Data 5 (High)	744	2E8	Repetition Data 6 (High)
727	2D7	Repetition Data 5 (Low)	745	2E9	Repetition Data 6 (Low)
728	2D8	Timer Data 5 (High)	746	2EA	Timer Data 6 (High)
729	2D9	Timer Data 5 (Low)	747	2EB	Timer Data 6 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
748	2EC	Operation Mode 7 (High)	766	2FE	Operation Mode 8 (High)
749	2ED	Operation Mode 7 (Low)	767	2FF	Operation Mode 8 (Low)
750	2EE	Position Data 7 (High)	768	300	Position Data 8 (High)
751	2EF	Position Data 7 (Low)	769	301	Position Data 8 (Low)
752	2F0	Speed Data 7 (High)	770	302	Speed Data 8 (High)
753	2F1	Speed Data 7 (Low)	771	303	Speed Data 8 (Low)
754	2F2	Acceleration Data 7 (High)	772	304	Acceleration Data 8 (High)
755	2F3	Acceleration Data 7 (Low)	773	305	Acceleration Data 8 (Low)
756	2F4	Torque Limit Data 7 (High)	774	306	Torque Limit Data 8 (High)
757	2F5	Torque Limit Data 7 (Low)	775	307	Torque Limit Data 8 (Low)
758	2F6	Push Torque Data 7 (High	776	308	Push Torque Data 8 (High
759	2F7	Push Torque Data 7 (Low)	777	309	Push Torque Data 8 (Low)
760	2F8	Jump Data 7 (High)	778	30A	Jump Data 8 (High)
761	2F9	Jump Data 7 (Low)	779	30B	Jump Data 8 (Low)
762	2FA	Repetition Data 7 (High)	780	30C	Repetition Data 8 (High)
763	2FB	Repetition Data 7 (Low)	781	30D	Repetition Data 8 (Low)
764	2FC	Timer Data 7 (High)	782	30E	Timer Data 8 (High)
765	2FD	Timer Data 7 (Low)	783	30F	Timer Data 8 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
784	310	Operation Mode 9 (High)	802	322	Operation Mode 10 (High)
785	311	Operation Mode 9 (Low)	803	323	Operation Mode 10 (Low)
786	312	Position Data 9 (High)	804	324	Position Data 10 (High)
787	313	Position Data 9 (Low)	805	325	Position Data 10 (Low)
788	314	Speed Data 9 (High)	806	326	Speed Data 10 (High)
789	315	Speed Data 9 (Low)	807	327	Speed Data 10 (Low)
790	316	Acceleration Data 9 (High)	808	328	Acceleration Data 10 (High)
791	317	Acceleration Data 9 (Low)	809	329	Acceleration Data 10 (Low)
792	318	Torque Limit Data 9 (High)	810	32A	Torque Limit Data 10 (High)
793	319	Torque Limit Data 9 (Low)	811	32B	Torque Limit Data 10 (Low)
794	31A	Push Torque Data 9 (High	812	32C	Push Torque Data 10 (High
795	31B	Push Torque Data 9 (Low)	813	32D	Push Torque Data 10 (Low)
796	31C	Jump Data 9 (High)	814	32E	Jump Data 10 (High)
797	31D	Jump Data 9 (Low)	815	32F	Jump Data 10 (Low)
798	31E	Repetition Data 9 (High)	816	330	Repetition Data 10 (High)
799	31F	Repetition Data 9 (Low)	817	331	Repetition Data 10 (Low)
800	320	Timer Data 9 (High)	818	332	Timer Data 10 (High)
801	321	Timer Data 9 (Low)	819	333	Timer Data 10 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
820	334	Operation Mode 11 (High)	838	346	Operation Mode 12 (High)
821	335	Operation Mode 11 (Low)	839	347	Operation Mode 12 (Low)
822	336	Position Data 11 (High)	840	348	Position Data 12 (High)
823	337	Position Data 11 (Low)	841	349	Position Data 12 (Low)
824	338	Speed Data 11 (High)	842	34A	Speed Data 12 (High)
825	339	Speed Data 11 (Low)	843	34B	Speed Data 12 (Low)
826	33A	Acceleration Data 11 (High)	844	34C	Acceleration Data 12 (High)
827	33B	Acceleration Data 11 (Low)	845	34D	Acceleration Data 12 (Low)
828	33C	Torque Limit Data 11 (High)	846	34E	Torque Limit Data 12 (High)
829	33D	Torque Limit Data 11 (Low)	847	34F	Torque Limit Data 12 (Low)
830	33E	Push Torque Data 11 (High	848	350	Push Torque Data 12 (High
831	33F	Push Torque Data 11 (Low)	849	351	Push Torque Data 12 (Low)
832	340	Jump Data 11 (High)	850	352	Jump Data 12 (High)
833	341	Jump Data 11 (Low)	851	353	Jump Data 12 (Low)
834	342	Repetition Data 11 (High)	852	354	Repetition Data 12 (High)
835	343	Repetition Data 11 (Low)	853	355	Repetition Data 12 (Low)
836	344	Timer Data 11 (High)	854	356	Timer Data 12 (High)
837	345	Timer Data 11 (Low)	855	357	Timer Data 12 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
856	358	Operation Mode 13 (High)	874	36A	Operation Mode 14 (High)
857	359	Operation Mode 13 (Low)	875	36B	Operation Mode 14 (Low)
858	35A	Position Data 13 (High)	876	36C	Position Data 14 (High)
859	35B	Position Data 13 (Low)	877	36D	Position Data 14 (Low)
860	35C	Speed Data 13 (High)	878	36E	Speed Data 14 (High)
861	35D	Speed Data 13 (Low)	879	36F	Speed Data 14 (Low)
862	35E	Acceleration Data 13 (High)	880	370	Acceleration Data 14 (High)
863	35F	Acceleration Data 13 (Low)	881	371	Acceleration Data 14 (Low)
864	360	Torque Limit Data 13 (High)	882	372	Torque Limit Data 14 (High)
865	361	Torque Limit Data 13 (Low)	883	373	Torque Limit Data 14 (Low)
866	362	Push Torque Data 13 (High	884	374	Push Torque Data 14 (High
867	363	Push Torque Data 13 (Low)	885	375	Push Torque Data 14 (Low)
868	364	Jump Data 13 (High)	886	376	Jump Data 14 (High)
869	365	Jump Data 13 (Low)	887	377	Jump Data 14 (Low)
870	366	Repetition Data 13 (High)	888	378	Repetition Data 14 (High)
871	367	Repetition Data 13 (Low)	889	379	Repetition Data 14 (Low)
872	368	Timer Data 13 (High)	890	37A	Timer Data 14 (High)
873	369	Timer Data 13 (Low)	891	37B	Timer Data 14 (Low)

Register Address		Name	Register Address		Name
DEC	HEX		DEC	HEX	
892	37C	Operation Mode 15 (High)	910	38E	Operation Mode 16 (High)
893	37D	Operation Mode 15 (Low)	911	38F	Operation Mode 16 (Low)
894	37E	Position Data 15 (High)	912	390	Position Data 16 (High)
895	37F	Position Data 15 (Low)	913	391	Position Data 16 (Low)
896	380	Speed Data 15 (High)	914	392	Speed Data 16 (High)
897	381	Speed Data 15 (Low)	915	393	Speed Data 16 (Low)
898	382	Acceleration Data 15 (High)	916	394	Acceleration Data 16 (High)
899	383	Acceleration Data 15 (Low)	917	395	Acceleration Data 16 (Low)
900	384	Torque Limit Data 15 (High)	918	396	Torque Limit Data 16 (High)
901	385	Torque Limit Data 15 (Low)	919	397	Torque Limit Data 16 (Low)
902	386	Push Torque Data 15 (High	920	398	Push Torque Data 16 (High
903	387	Push Torque Data 15 (Low)	921	399	Push Torque Data 16 (Low)
904	388	Jump Data 15 (High)	922	39A	Jump Data 16 (High)
905	389	Jump Data 15 (Low)	923	39B	Jump Data 16 (Low)
906	38A	Repetition Data 15 (High)	924	39C	Repetition Data 16 (High)
907	38B	Repetition Data 15 (Low)	925	39D	Repetition Data 16 (Low)
908	38C	Timer Data 15 (High)	926	39E	Timer Data 16 (High)
909	38D	Timer Data 15 (Low)	927	39F	Timer Data 16 (Low)

8.4 Execution Command

Rewrite a 1 byte register with function code 0x05.
To turn on the coil, write 0xFF00; to turn off the coil, write 0x0000.

To read back the coil status, read the switch status with function code 0x03.

- Switch 1 status (0x0116, 0x0117)
- Switch 2 status (0x0118, 0x0119)
  See "8.1.5 Switch Status" for details.

Register Address (DEC)	Register Address (HEX)	Name	Description
1408	0580	Servo ON/OFF	Switches servo ON/OFF
1409	0581	Stop	Stops motion. Turning this bit off and on twice will cause the operation to stop completely.
1410	0582	Alarm Reset	Resets an alarm
1411	0583	Origin detection operation starts	Starts origin detection.
1412	0584	Move to position 0	Moves to the 0-pulse position.
1413	0585	Set current position to position 0*	Resets the current position to 0 pulse.
1414	0586	Position deviation reset*	Clear the position deviation
1415	0587	Software reset*	Reset the motor
1416	0588	Set the current position to the origin*	Sets the current position as the origin.
1417	0589	Save*	Saves changes in motion data.

Register Address (DEC)	Register Address (HEX)	Name	Description
1418	058A	Execute Motion Data 1	Execute Motion Data 1 to 16
1419	058B	Execute Motion Data 2	
1420	058C	Execute Motion Data 3	
1421	058D	Execute Motion Data 4	
1422	058E	Execute Motion Data 5	
1423	058F	Execute Motion Data 6	
1424	0590	Execute Motion Data 7	
1425	0591	Execute Motion Data 8	
1426	0592	Execute Motion Data 9	
1427	0593	Execute Motion Data 10	
1428	0594	Execute Motion Data 11	
1429	0595	Execute Motion Data 12	
1430	0596	Execute Motion Data 13	
1431	0597	Execute Motion Data 14	
1432	0598	Execute Motion Data 15	
1433	0599	Execute Motion Data 16	
1434	059A	Resume Motion	Resume halted operation
1448	05A8	Output 1	Switches outputs 1 to 3 ON/OFF
1449	05A9	Output 2	
1450	05AA	Output 3	
1451	05AB	Capture Position Data 1	Sets the current position to position data
1452	05AC	Capture Position Data 2	
1453	05AD	Capture Position Data 3	
1454	05AE	Capture Position Data 4	
1455	05AF	Capture Position Data 5	
1456	05B0	Capture Position Data 6	
1457	05B1	Capture Position Data 7	
1458	05B2	Capture Position Data 8	
1459	05B3	Capture Position Data 9	
1460	05B4	Capture Position Data 10	
1461	05B5	Capture Position Data 11	
1462	05B6	Capture Position Data 12	
1463	05B7	Capture Position Data 13	
1464	05B8	Capture Position Data 14	
1465	05B9	Capture Position Data 15	
1466	05BA	Capture Position Data 16	

＊ Be sure to do this when operation is stopped. After sending a command, wait at least 10 msec before sending the next command.

Chapter 9 Setting Example

9.1 Checking I/O Connection

The CM3M has 4 inputs, 3 outputs and 1 STO input. Use CML to check the wiring then check the electrical specifications by measuring devices. Refer to "4.5 Circuit Connection" for connection example.

☐ Confirmation Procedure

1. Turn off the servo

   If the servo is on, lower the flag at register address 0x0580 to set the servo-off state.Check the motor status with function code 0x05 at register address 0x0108 (Upper) and 0x0109 (Lower) and confirm that B4 is lowered.

2. Parameter Setting

   Set 0 to K44 (0x017E, 0x017F) to assign the "General Input" function to IN1.
   Set 0 to K45 (0x0180, 0x0181) to assign the "General Input" function to IN2.
   Set 0 to K46 (0x0182, 0x0183) to assign the "General Input" function to IN3.
   Set 0 to K47 (0x0184, 0x0185) to assign the "General Input" function to IN4.

   Set 0 to K55 (0x0194, 0x0195) to assign the "General Output" to OUT1.
   Set 0 to K56 (0x0196, 0x0197) to assign the "General Output" to OUT1.
   Set 0 to K57 (0x0198, 0x0199) to assign the "General Output" to OUT1.

3. Check the Input Signal

   Turn off all input signals 1 to 4 and the STO signal to check the input status.
   Turn on all input signals 1 to 4 and, STO signal to send input signal query.

Register Address (DEC)	Register Address (HEX)	Name	Description
270	010E	Input Status (Upper)	Display Input Status
271	010F	Input Status (Lower)	

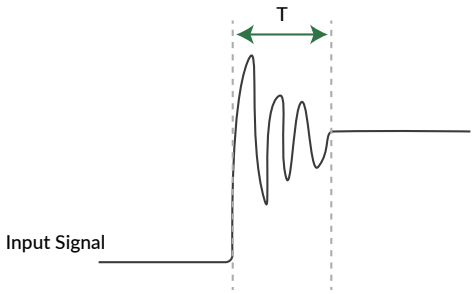
If you can see the change in the status of input signals, the connection is done correctly.

＊ Depending on the connection, the status logic of the input signal may be reversed.

4. Confirmation of Electrical Specifications of Input Signals

Measure the voltage at the high and low levels of the input signal by measuring devices. Make sure that the specifications in "13.2 Electrical Specifications" are met. Be careful especially when the wiring is long.

When using switches with mechanical contacts, check chattering and adjust the input filter (K42).



A signal without chattering is ideal, but if it cannot be removed chattering, measure the chattering period T then set the input filter time as K42 setting value > T [msec].

5. Check the output signal

To check the wiring of the output, use the CML execution commands below.
Use this command to check responds from the connected devices.
Connect not exceeding the maximum rated current.

Register Address (DEC)	Register Address (HEX)	Name	Description
1448	05A8	Output 1	Switches outputs 1 to 3 ON/OFF
1449	05A9	Output 2	
1450	05AA	Output 3	

9.2 Origin Setting

Since the position coordinates of CM3M are incremental, it is necessary to set the origin (coordinates 0) every time CM3M is turned on. There are two types of origin signal sources as Stopper and Origin Sensor (* Refer to "11.5 Origin Detection" for origin signal sources).

☐ Related command (function code 0x05)

Register Address (DEC)	Register Address (HEX)	Name	Details
1411	0583	Origin detection operation starts	Starts origin detection
1412	0584	Move to position 0	Moves to the 0-pulse position.
1413	0585	Set current position to position 0*	Resets the current position to 0 pulse.
1416	0588	Position deviation reset*	Clear the position deviation

9.3 Checking Range of Motion

Check the coordinates of the target position by interfering with the machine with other axes, routing the wiring, and so on. CM3M sets the target position in pulse units. There are two ways to check, one is to use the motion data for direct execution, and the other is to use the jog function of the input function. From here, it becomes the actual operation. Since the area is checked on the hardware side, check with the set speed slowed down as much as possible. Here, the confirmation method using the jog function is shown.

1. Calculate the range of motion (Related Parameter K1: Resolution)

   Calculate the maximum operating area from the machine specifications.

2. Parameter Setting

Register Adddress（DEC）		Value	Details
Upper	Lower		
382	383	5	Input 1 function: Servo ON/OFF
384	385	4	Input 2 function: Manual mode
386	387	6	Input 3 function: Inching CCW
388	389	7	Input 4 function: Inching CW
390	391	10	Jog speed: 1000 ppr
392	393	0	Inching operation: None

   ＊ Please refer to "11.6.2 Manual Mode" for Inching / Jog operation.

3. Origin Detection

   When using an origin sensor as the origin signal source, set Origin Sensor to the Input 1 by K44.
   Use the execution command to turn the servo on and off.

4. Check the Range of Operating

   Operate by Jog operation and check the below 3 points.

- The current position at the maximum point. Does it match the data calculated in the procedure 1?
  How to check your current position:

Register Address (DEC)	Register Address (HEX)	Name	Description
258	0102	Current position (Upper)	Displays current position in pulses
259	0103	Current position (Lower)	

- Check for interference with other axes
- Check the routing of wirings
  Make sure that there is no interference with wiring or machinery, the bending radius of the cable, or the main connector of CM3M is not under load.

  After confirming the maximum operating area, you can carry the test run more safely by using the Software Limit function by K8 and K9.

9.4 PTP Motion

This section describes an example setting for positioning motion. Refer to "8.3 Motion Data" for details on the motion data to be set.

☐ Data Setting

Set the following data for slave address 1

Register Address (HEX)	Settings		Value	Details
0x0280	Operation Mode 1	Upper	0x0000	1: PTP Motion
0x0281		Lower	0x0001	
0x0282	Position Data 1	Upper	0x0000	10000 [pulse]
0x0283		Lower	0x2710	
0x0284	Speed Data 1	Upper	0x0000	300 [100 ppr]
0x0285		Lower	0x012C	
0x0286	Accel. Data 1	Upper	0x0000	150 [kpps^2]
0x0287		Lower	0x0096	
0x0288	Torque Limit Data 1	Upper	0x0000	100 [%]
0x0289		Lower	0x0064	
0x028A	Push Torque Data 1	Upper	0x0000	10[%]*
0x028B		Lower	0x000A	
0x028C	Jump Data 1	Upper	0x0000	0 (No Jumping)
0x028D		Lower	0x0000	
0x028E	Repetition Data 1	Upper	0x0000	1: Execute only once
0x028F		Lower	0x0001	
0x0290	Timer Data 1	Upper	0x0000	0*
0x0291		Lower	0x0000	

∗ Push Torque data doesn't affect for PTP motion

∗ Timer data is not refferred for No Jumping.

1. Send Data for Motion Data #1

- Query

Field Name		Data	Contents	
Slave Address		01	Slave Address 01 (Set by K76)	
Function Code		10	Preset Multiple Resister	
Data	Starting Address (Upper)	02	Starting Address 0x0280	
	Starting Address (Lower)	80		
	Number of registers (Upper)	00	Number of registers to be written 0x12=18	
	Number of registers (Lower)	12		
	Number of data bytes	24	Twice the number of addresses to be read. 0x24 = 36	
	Write value of register address (Upper)	00	Value of Register Address 0x0280	Operation Mode 1: 1 (PTP) 0x0000 0001
	Write value of register address (Lower)	00		
	Write value of register address + 1 (Upper)	00	Value of Register Address 0x0281	
	Write value of register address + 1 (Lower)	01		

Field Name		Data	Contents	
Data	Write value of register address + 2 (Upper)	00	Value of register address 0x0282	Position Data 1 10000 [Pulse] 0x0000 2710
	Write value of register address + 2 (Lower)	00		
	Write value of register address + 3 (Upper)	27	Value of register address 0x0283	
	Write value of register address + 3 (Lower)	10		
	Write value of register address + 4 (Upper)	00	Value of register address 0x0284	Speed Data 1 300 [100 ppr] 0x0000 012C
	Write value of register address + 4 (Lower)	00		
	Write value of register address + 5 (Upper)	01	Value of register address 0x0285	
	Write value of register address + 5 (Lower)	2c		
	Write value of register address + 6 (Upper)	00	Value of register address 0x0286	Acceleration Data 1 150 [kpps^2] 0x0000 0096
	Write value of register address + 6 (Lower)	00		
	Write value of register address + 7 (Upper)	00	Value of register address 0x0287	
	Write value of register address + 7 (Lower)	96		
	Write value of register address + 8 (Upper)	00	Value of register address 0x0288	Torque Limit Data 1 100 [%] 0x0000 0064
	Write value of register address + 8 (Lower)	00		
	Write value of register address + 9 (Upper)	00	Value of register address 0x0289	
	Write value of register address + 9 (Lower)	64		
	Write value of register address + 10 (Upper)	00	Value of register address 0x028A	Push Torque Data 1 10[%] 0x0000 000A
	Write value of register address + 10 (Lower)	00		
	Write value of register address + 11 (Upper)	00	Value of register address 0x028B	
	Write value of register address + 11 (Lower)	0A		
	Write value of register address + 12 (Upper)	00	Value of register address 0x028C	Jump Data 1 0 (No Jumping) 0x0000 0000
	Write value of register address + 12 (Lower)	00		
	Write value of register address + 13 (Upper)	00	Value of register address 0x028D	
	Write value of register address + 13 (Lower)	00		
	Write value of register address + 14 (Upper)	00	Value of register address 0x028E	繰返しデータ 1 1：1 度だけ実行 0x0000 0001
	Write value of register address + 14 (Lower)	00		
	Write value of register address + 15 (Upper)	00	Value of register address 0x028F	
	Write value of register address + 15 (Lower)	01		
	Write value of register address + 16 (Upper)	00	Value of register address 0x0290	Timer Data 1 0 msec 0x0000 0000
	Write value of register address + 16 (Lower)	00		
	Write value of register address + 17 (Upper)	00	Value of register address 0x0291	
	Write value of register address + 17 (Lower)	00		
Error Check (Lower)		0xEF	Calculation result for CRC-16	
Error Check (Upper)		0xE3		

- Response

Field Name		Data	Contents
Slave Address		0x01	Same value as query
Function Code		0x10	Same value as query
Data	Starting Address (Upper)	0x02	Same value as query
	Starting Address (Lower)	0x80	
	Number of registers (Upper)	0x00	Same value as query
	Number of registers (Lower)	0x12	
Error Check (Lower)		0x40	Calculation result for CRC-16
Error Check (Upper)		0x54	

2. Make sure that the data is set correctly with function code 0x03

   If a value outside the settable range is transmitted, the response is normal, but the value remains unchanged from before the query was sent. Be sure to verify that the value has been changed to the intended value by reading out the holding register.

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 01 (Set by K76)
Function Code		0x03	Read holding register
Data	Starting Address (Upper)	0x02	Starting Address 0x0102
	Starting Address (Lower)	0x80	
	Number of registers (Upper)	0x00	Number of registers to be read 0x0012 = 18
	Number of registers (Lower)	0x12	
Error Check (Lower)		0xC5	Calculation result of CRC-16
Error Check (Upper)		0x97	

- Response

  (omitted)

3. If the servo state is set to 'servo-off' at power-on, the next query is sent to turn the servo on.

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 01 (Set by K76)
Function Code		0x05	Force Single Coil
Data	Starting Address (Upper)	0x05	Register Address 0x0580
	Starting Address (Lower)	0x80	
	Write value to Register Address (Upper)	0xFF	Write 0xFF00 to servo on
	Write value to Register Address (Lower)	0x00	
Error Check (Lower)		0x8D	Calculation result for CRC-16
Error Check (Upper)		0x1E	

- Response

  The same content as the query is returned.

4. Send following query to execute Motion Data #1

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 01 (Set by K76)
Function Code		0x05	Force Single Coil
Data	Starting Address (Upper)	0x05	Register Address 0x058A
	Starting Address (Lower)	0x8A	
	Write value to Register Address (Upper)	0xFF	Write 0xFF00 to execite Motion Data #1
	Write value to Register Address (Lower)	0x00	
Error Check (Lower)		0xAD	Calculation result for CRC-16
Error Check (Upper)		0x1C	

- Response

  The same content as the query is returned.

5. To execute next motion data, bit of motion data execution must be turned off.

- Query

Field Name		Data	Contents
Slave Address		0x01	Slave Address 01 (Set by K76)
Function Code		0x05	Force Single Coil
Data	Starting Address (Upper)	0x05	Register Address 0x058A
	Starting Address (Lower)	0x8A	
	Write value to Register Address (Upper)	0x00	Write 0xFF00 to execite Motion Data #1
	Write value to Register Address (Lower)	0x00	
Error Check (Lower)		0xEC	Calculation result for CRC-16
Error Check (Upper)		0xEC	

- Response

  The same content as the query is returned.

☐ When motion data is not executed

If motion does not start, the following are possible causes

- Motion data is not set correctly.
  - The same value as the current position is set for the target position.
  - A small value is set for the torque limit and it cannot be driven.
  - The operation mode is not set.
- Switch 1 status does not meet the operation conditions at the start of motion

  Refer to "8.1.5 Switch Status"
  - The servo is in the servo-off state.
  - Motion data execution flag is still up.

Chapter 10 Detail of Various Settings

10.1 Resolution（K1）（0x0128, 0x0129)

Set the Resolution of the motor in pulse per rotation. The maximum and minimum value of the position (P command) for each Resolution is as shown in the below table.

Value	Resolution	Maximum value in the negative direction	Maximum value in the positive direction	Speed data value at 5000 rpm for 100 pps speed unit
0	300	-12,884,901	12,884,901	250
1	600	-25,769,803	25,769,803	500
2	1000	-42,949,672	42,949,672	833
3	1200	-51,539,607	51,539,607	1000
4	2000	-85,899,345	85,899,345	1667
5	3000	-128,849,018	128,849,018	2500
6	5000	-214,748,364	214,748,364	4167
7	6000	-257,698,037	257,698,037	5000
8	10000	-429,496,729	429,496,729	8333
9	12000	-515,396,075	515,396,075	10000

＊ Continuous position (P=1000000000) is available for all Resolution

10.2 Coordinate Direction（K4）（0x012E, 0x012F)

Set which of the CW / CCW directions is positive.

Coordinate Direction	
0: Set CW direction as the positive	1: Set CCW direction as the positive
P=100: 100 pulses in CW	P=100: 100 pulses in CCW
P=-100: 100 pulses in CCW	P=-100: 100 pulses in CW

-100（CCW）0 （CW）100 -100（CW） 0 （CCW）100

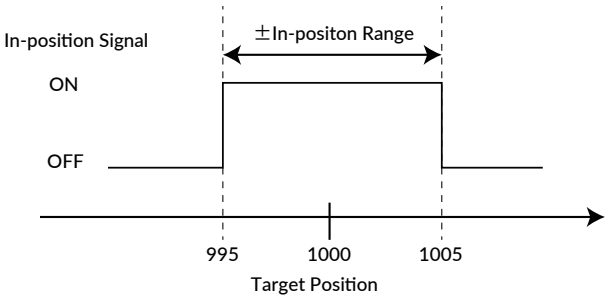
Example: K4=1 // Set CCW direction as the positive direction

＊ When 10’ is set to the target position (P=1000000000), the motion will be the continuous motion. For continuous motion, rotation direction is set only by Speed Data. Regardless of the coordinate direction (K4) setting, when the Speed Data has a positive value, the output shaft rotates in the CW direction, and when it has a negative value, it rotates in the CCW direction.

10.3 In-position（K5）(0x0130, 0x0131)

This parameter sets the range for In-position in the pulse unit. In-position is detected when the current position is within the set range against the target position. When stopping the motor by a stop command, the stopped position is recognized as the target position, therefore In-position is detected within the set range against the current position. When recognized as In-position, In-position signal is ON and the motor status goes in Ux.1=8. In-position signal can be output by assigning an output function (Ref: "11.7.2 Other Output Functions").

In-position signals will be sent out between 995 and 1005, when the target position is 1000.



10.4 Speed Override（K6）(0x0132,0x0133)

The speed override can change the actual operating speed uniformly to the ratio to the set speed. In order to ensure the safety of the device, please set the speed override before trying the required speed. Without changing the value of the S command, you can test the motion at the speed that the speed override is applied. Gradually increase the ratio and check if there is any problem with the set S command data.

Operation Speed ＝ Speed × Speed Override (K6) / 100

10.5 Software Limit（K7- K10）(0x0134 - 0x013B)

Please use the software limit function to prevent accidents when executing a set Motion Data. This function sets enable/disable of the limit of motion range, and how motor behaves when the function is enabled.

☐ Software Limit Setting（K7）

0	Disable	Disable the Software Limit
1	Enable (no motion)	Enable the Software Limit. If the motion to the outside of the Software Limit range is executed, the motor won't start moving, and Operation Warning (Ux.1=256) will be output.
2	Enable (move to software limit)	Enable the Software Limit. If the motion to the outside of the Software Limit range is executed, the motor moves to the boundary of the Software Limit range, and Operation Warning (Ux.1=256) will be output.

※ Software Limit does not work for Continuous Motion.

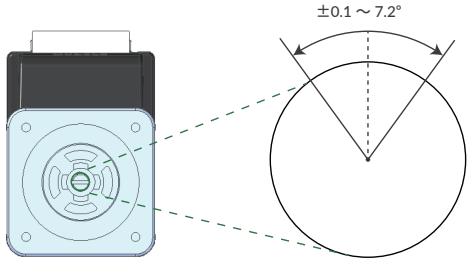
【Software Limit Setting Range and Unit】

From 0 position, set the positive operation boundary value to K8 Software Limit（+）and negative operation boundary value to K9 Software Limit（—）with the set unit by K10. The set ranges are different by the unit as shown in the below table.

Software Limit Setting Range		Unit (K10)	
Positive (K8)	Negative (K9)		
0 to 9,999,999	-9,999,999 to 0	0	100 pulse
0 to 99,999,999	-99,999,999 to 0	1	10 pulse
0 to 999,999,999	-999,999,999 to 0	2	1 pulse

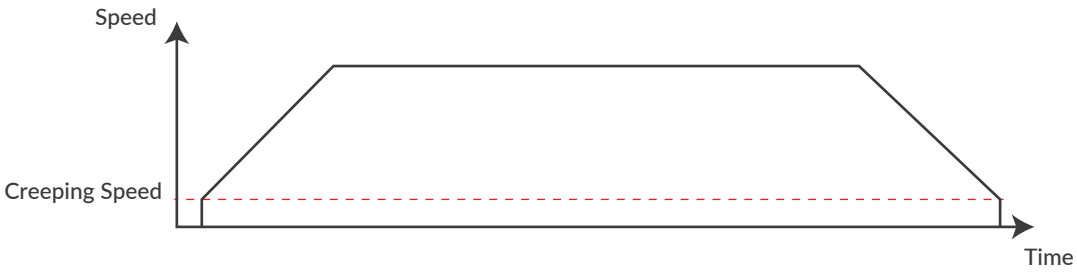
10.6 Open Loop Holding（K14・K15）(0x0142-0x0145)

The Open Loop Holding is a function to automatically switch from closed loop control to open loop control if there is no operation command for the set time by K15 parameter after positioning is completed. In Open Loop Holding mode, hunting inherent to the servo motor can be suppressed. If the difference between the current position and the target position becomes larger than the K14 set value (± 0.1 to 7.2 degree) due to external force, the motor goes back in closed loop and returns to the previous target position.



10.7 Creeping Speed（K17）(0x0148, 0x0149)

Set the creeping speed at the start and completion of the operation from 0 to 1000 (unit: K2 setting value). The creeping speed is the initial speed at which the operation actually starts and the final speed at the end of the operation. By changing the creeping speed, you can adjust the response time of the motor and increase the tact time, but if you increase the set value too much, vibration may occur or operation may not be possible.



10.8 Single Turn ABS Function（K29）

The single-turn ABS function allows the position (angle) to be held between ± 180° with reference to the origin, even after the power is switched off. In mechanisms such as turntables, this function can omit the time required to return to the origin. If the stop position after power off is near the machine angle 180 ° from the origin, the machine will be in an undefined area.

☐ Procedures to enable the single turn ABS function

1. Set K29 (0x0160, 0x0161) as 1 to enbale the single turn ABS function
2. Turn off and on the power
3. ABS Alarm will be published

   Bit 12 of motor status (0x0108, 0x0109) will be ON.

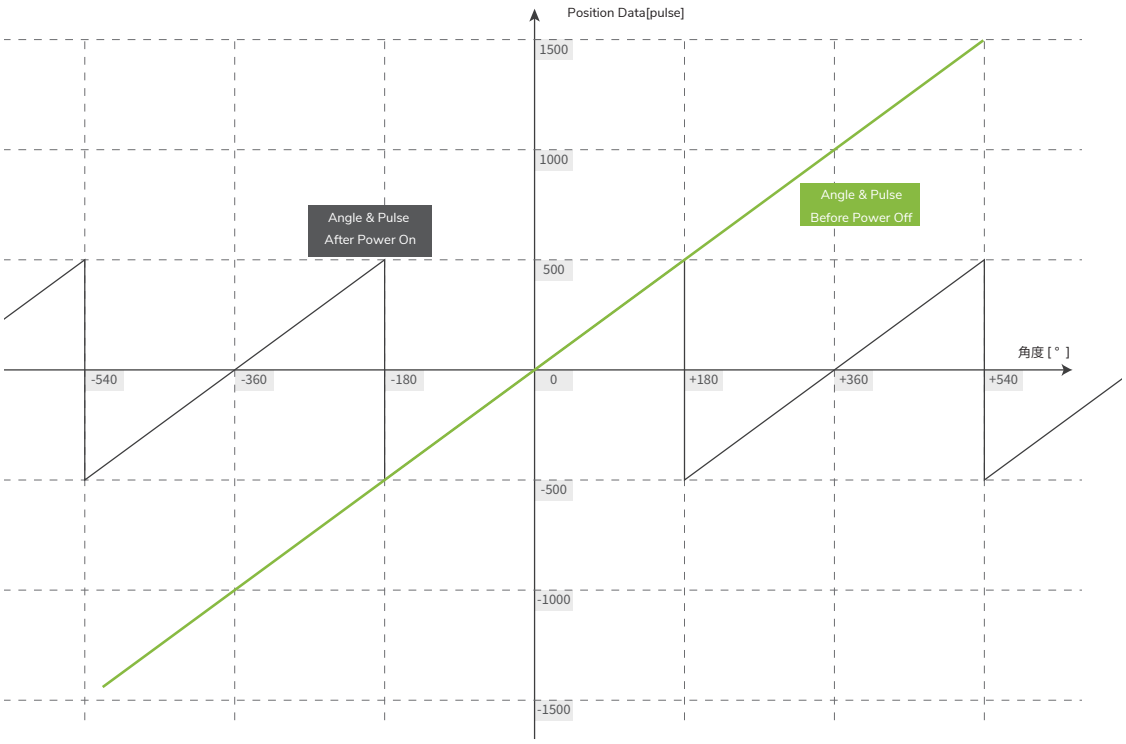
4. Turn ON and OFF the coil of alarm reset (0x0582)
5. Turn ON the coil of servo ON (0x0580)
6. Turn ON and OFF the coild of origin detection* (0x0583)

   ∗ Turning ON the coil of 0x0588 make the current position as origin.

   ∗ Origin will be clreared once origin searhch settings.
   Please set the origin again by following the above procedures. (Refer "11.5 Origin Detection")

☐ Position coordinates displayed after power on again

When the power is reconnected, the display always shows the position from -180° to +180° with reference to the origin. For example, for 1000 resolution (K1=3), the current position is displayed as a value from -500 to +500 after the power is recycled.



10.9 Origin Detection Completion （K30）(0x0162, 0x0163)

When the origin detection completion confirmation is enabled (K30=1) and the power is turned on again, only the origin detection operation is accepted until the origin detection is completed. If the execution command is issued when the origin detection is not completed, CM3M will not operate and motor status will be both In-position and Operation warning.

10.10 Position Error Overflow Threshold (K63)（0x01A4, 0x01A5)

Settable range: 1 to 32767

Unit: 1000 pulses

If the deviation between the target position and the current position exceeds the K63 setting, a position error overflow alarm occurs and the servo turns off and stops.

10.11 Overload Detection Time (K64) (0x01A6, 0x01A7)

Settable range: 100 to 10000

Unit: msec

Set the time until the overload alarm is output. If the overload state continues for the set time (msec), an overload alarm is output, and the servo is turned off.

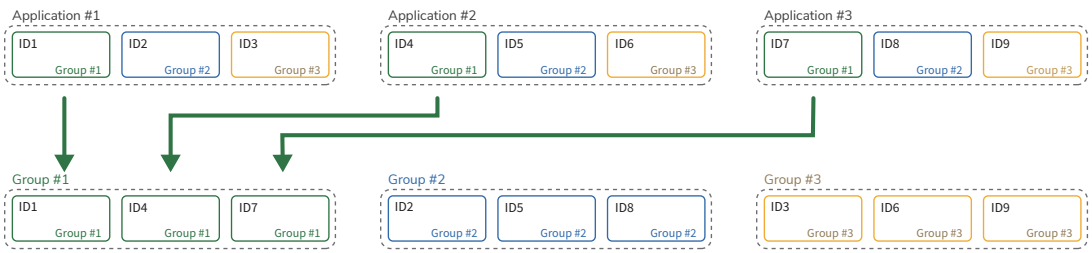
10.12 Group Setting (K78) (0x01C2, 0x01C3)

If the K78 is set to a value other than 0, it will respond to queries not only for its own slave ID, but also for other slave addresses set in the group. Function codes 0x05 and 0x10 are supported. This makes it possible to control several devices in the same system simultaneously. No response is returned for queries to addresses set in the group ID.

☐ Example: when there are three devices and they are allocated to groups 1-3

Slave addresses 1 to 3, which are the parent, are set to group 0. Slave addresses 4 and 7 are set to group 1, slave addresses 5 and 8 to group 2 and slave addresses 6 and 9 to group 3. Slave addresses 4 and 7 can then be controlled at the same time by simply sending a query from the higher master to slave address 1.

Slave Address	1	2	3	4	5	6	7	8	9
Group ID	0	0	0	1	2	3	1	2	3



Chapter 11 Various Functions

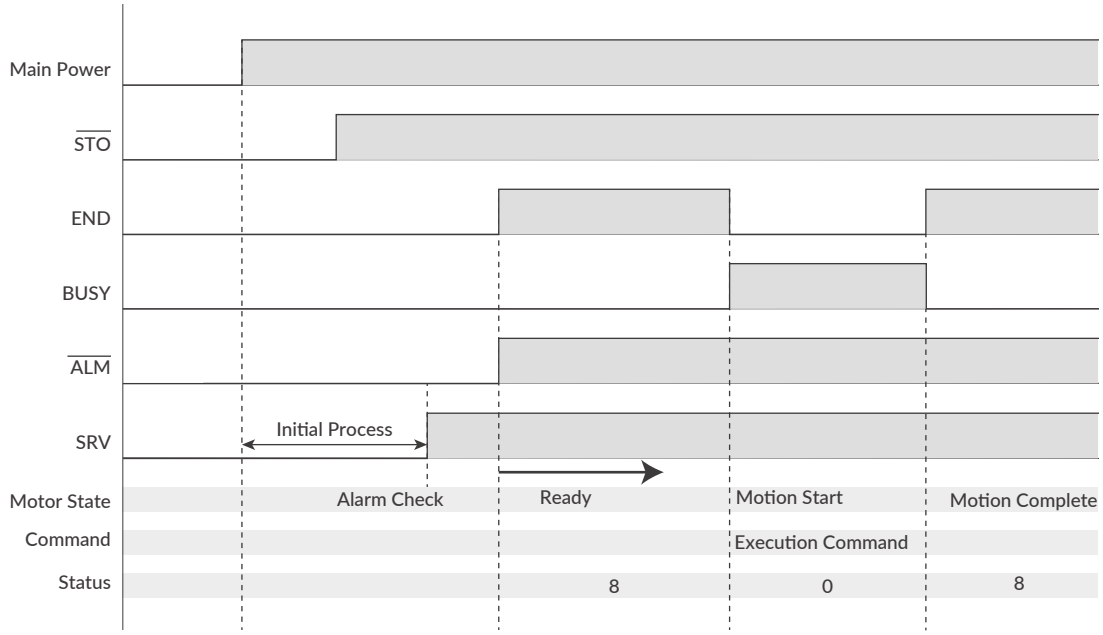
See the legend below for the sequences in Chapter 8.

INPOS ：In-position
ALM ：Alarm output
BUSY ：During operation
STO ：STO
SRV ：Servo status

END ：End

11.1 Sequence When Power is On

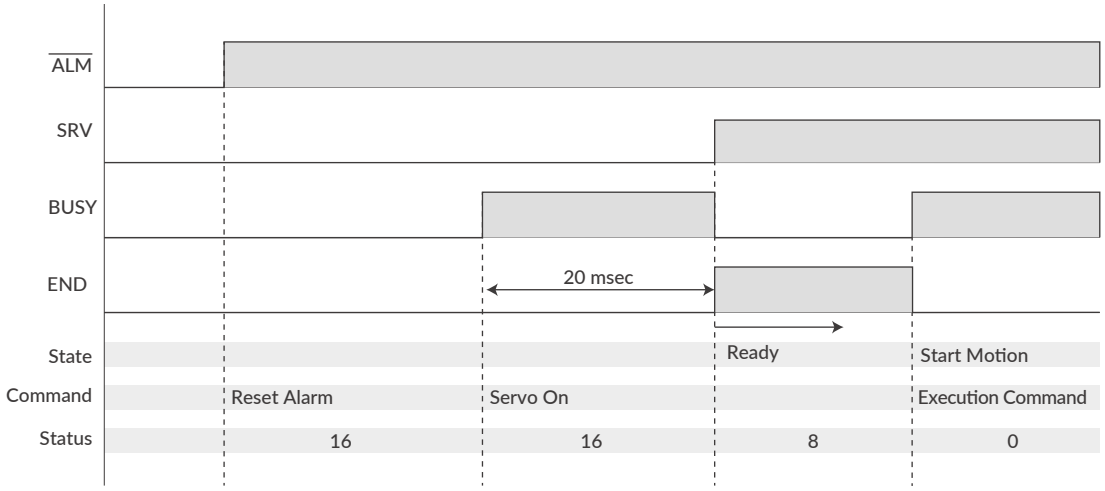
The sequence below describes from when the main power is turned on until CM3 is ready to accept commands. This sequence is only for initial servo state is "Servo on".



When the main power is turned on, the system check that the STO function is off, then the servo is on. Next, the system checks the alarm status. When their are no alarm, the ALM and END output are turned off. Finally, CM3 is ready to accept the execution command.

11.2 Sequence to Reset Alarm

The sequences shown below is for resetting alarm.



In case of alarm status, remove the cause of alarm and reset alarm. Then send Servo On command after alarm reset and checking status. 20msec after Servo on, CM3 will be ready to accept execution commands.

∗ If using an external brake, release the brake within this 20 msec.

11.3 Positioning Operation

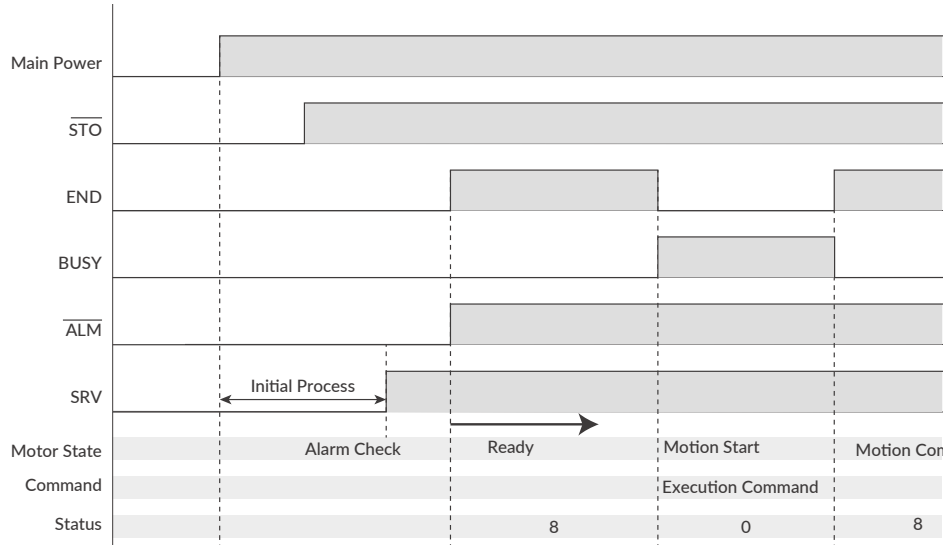
Motion Data is composed of elements necessary for operation, such as speed, acceleration, target position, and torque. Motion Data can be registered and saved, and positioning operation can be performed by specifying the Motion Data number and sending an execution command. Absolute positioning (PTP Motion), relative positioning (INC Motion), and push motion are available.

∗ PTP Motion means PTP (ABS directive), and INC Motion means PTP (INC directive).

11.3.1 PTP Motion

☐ PTP Motion Sequence

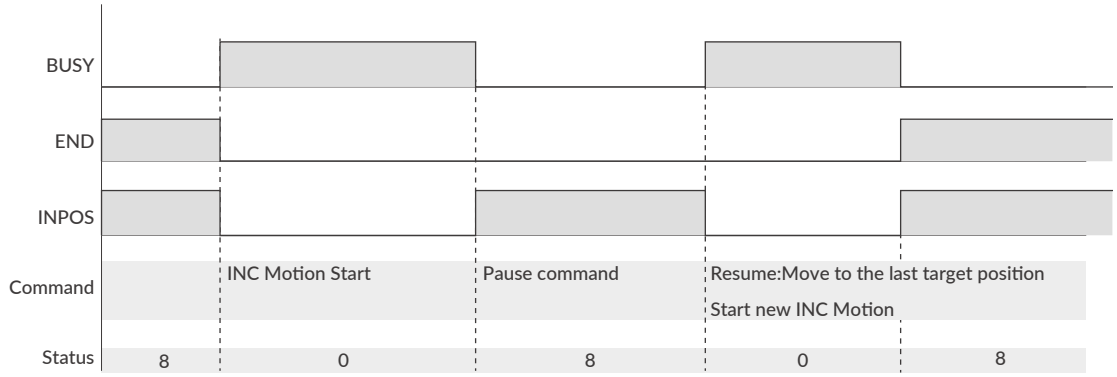
When 1 is set for the motion mode, motion will be PTP motion.



☐ INC Motion Example

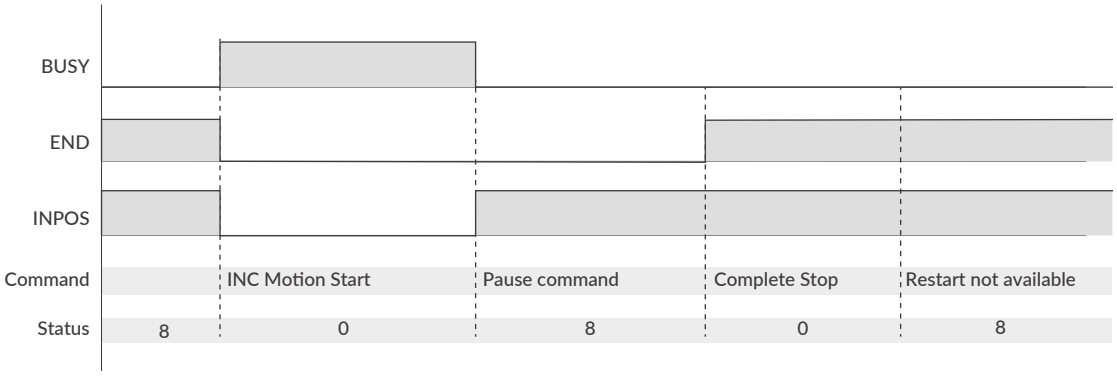
When 2 is set for the motion mode, motion will be INC motion.

- Sequence when Pause command is sent during INC Motion



When Pause command is sent during INC Motion, motion will be stop and In-position will be detected. With re-start command, CM3M goes to the former target position and the motion will be completed.

- Sequence when stop command is sent during INC Motion



When Pause command is sent during INC Motion, CM3M stops and In-position is detected. CM3M becomes stop = END status by sending Pause command again and will not move even if restart command is sent.

11.4 Push Motion

The Push Motion is an operation that limits the output torque with the set torque for the set time. It can be used for gripping and press-fitting workpieces. To execute the Push Motion, set Motion Mode to 2 or 3, and set the Push Motion Operation Mode (K11) and Push Motion Holding Time (K13).

☐ PTP / INC Push Motion

PTP (absolute position) Push Motion and INC (relative position) Push Motion are available for Push Motion.

PTP Push Motion: Starts the Push Motion from the current position toward the set absolute position. Set 2 for Motion Mode.

INC Push Motion: Starts the Push Motion with the target position at the distance from the current position. Set 3 for Motion Mode..

In either case, set the target position so that it is several revolutions ahead of the object to be pushed. If the target position is too small, positioning may be completed before the workpiece is detected, or sufficient torque may not be generated. If the object to be pushed cannot be detected during the Push Motion and reach the set target position, Operation Warning , Push Motion, and in-position will be output. Warning Status will be the Push Motion Waring.

☐ Push Motion Operation Mode（K11）

Select the direction to limit Torque and the finite (set time) / continuous Push Motion Holding time.

K11	Push Torque Direction	Push Motion Time
0	One direction	Continuous
1	One direction	Set Time
2	Both direction	Continuous
3	Both direction	Set Time

- Push Torque Direction

One direction: The Push Torque is effective only in the operation direction. This can be used to grip a rigid workpiece.

Both direction: The Push Torque is effective in both directions. This can be used to grip an elastic workpiece or only detect a workpiece.

- Push Motion Time

Continuous: Regardless of the Push Motion Holding Time (K13), the Push Motion does not stop until the stop command is sent.

Set Time: When the total Push Time reaches the Push Motion Holding Time (K13), the Push Motion is completed.

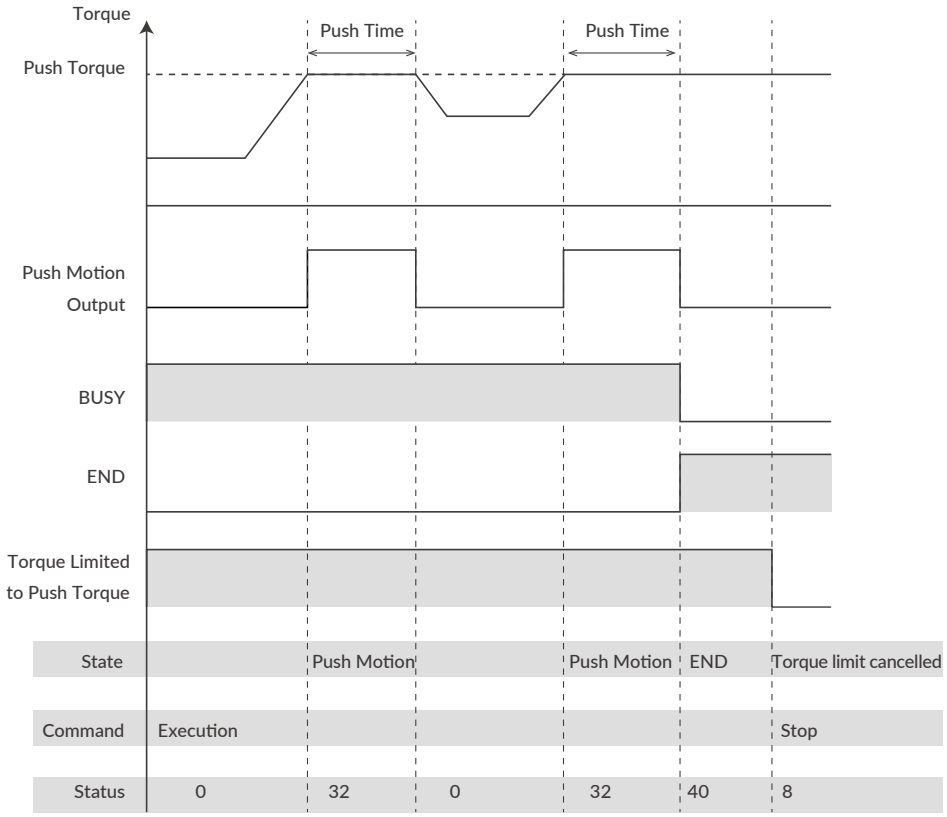
☐ Push Torque Data

Set the torque for the Push Motion. (Unit: percentage of rated torque)

☐ Push Motion Holding Time（K13）

Set the time to continue the Push Motion. (Unit: msec)

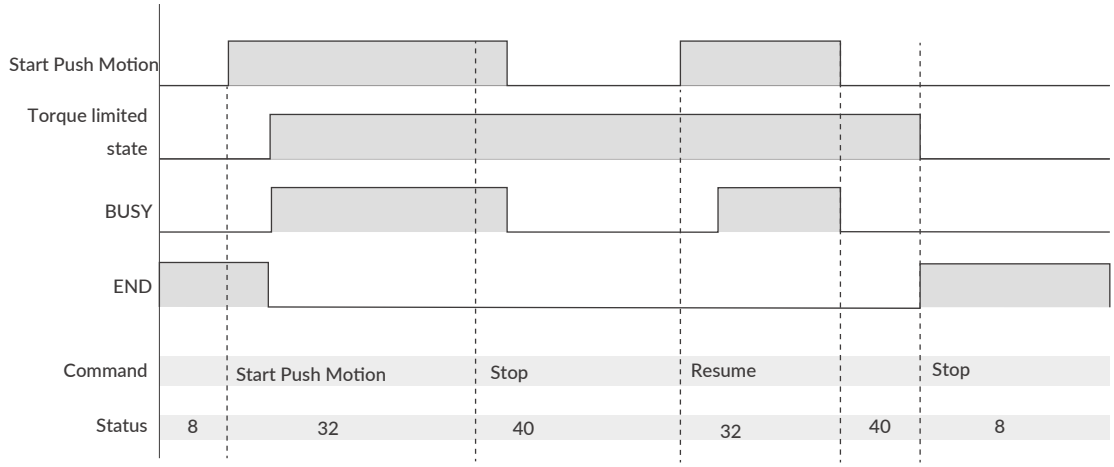
☐ Sequence for Push Motion



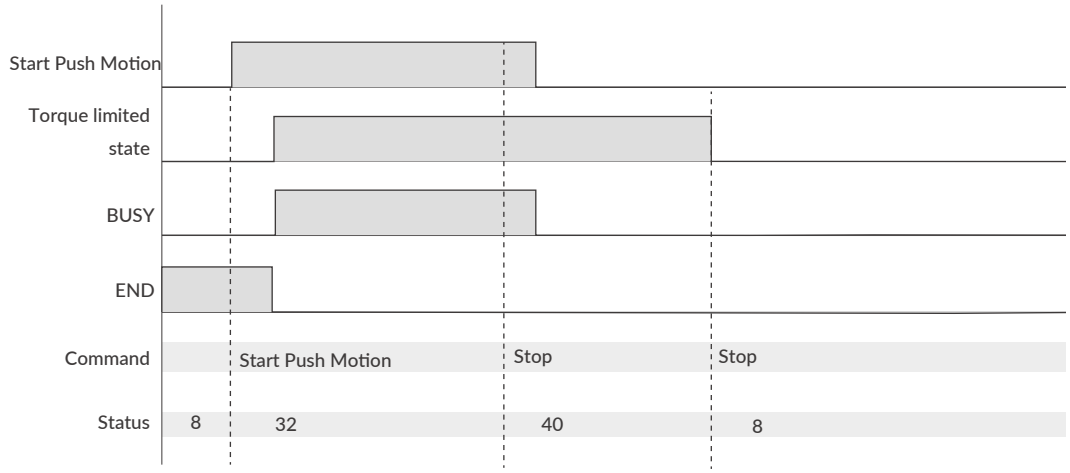
If the object to be pushed cannot be detected during the Push Motion and reach the set target position, motor status will be the Operation Warning, Push Motion, and in-position. Warning status will be Push Motion Waring.

☐ Sequence when Pause command is sent during INC Motion

When Pause command is sent during INC Motion, CM3M stops and In-position is detected. With re-start command, CM3M goes to the former target position and the motion will be completed.



☐ Sequence when stop command is sent during INC Motion



When Pause command is sent during INC Motion, CM3M stops and In-position is detected. CM3M becomes stop = END status by sending Pause command again and will not move even if restart command is sent.

11.5 Origin Detection

Origin Detection can be selected from Stopper Detection Origin Sensor, and combination as shown in the below table

K22	Content
0	Stopper Detection
1	Stopper Detection (Auto)
2	Origin Sensor *
3	Origin Sensor (Auto) *

* Valid only when origin sensor is assigned to Input 1

☐ Category of Origin Detection

Stopper Detection : Origin Detection using a mechanical stopper
Origin Sensor : Origin Detection using a origin sensor
Auto : Origin Detection starts automatically when the power is turned on.

Set the following parameters as needed to perform origin detection:

☐ Settings for Origin Detection Motion

- Origin Detection Speed（K23）
- Origin Detection Acceleration（K24）
- Origin Detection Direction（K25）

☐ Settings for Offset

- Origin Offset Distance（K26）
- Origin Offset Distance Unit（K27）

☐ Settings for Stopper Detection

- Stopper Detection Torque（K28）

☐ Setting for Origin Sensor

- Input 1 Function（K44）

☐ Settings for Origin Detection Completion

- Origin Detection Completion（K30）
- Origin Set Completion Output（K55、K56、K57）

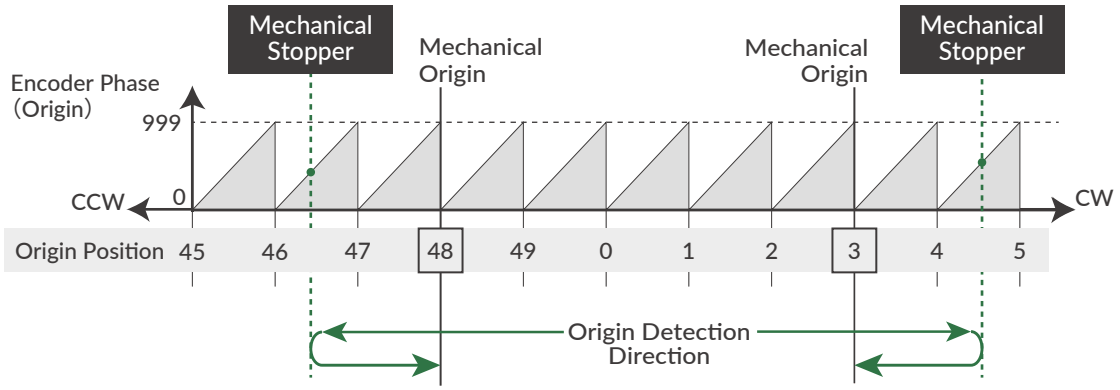
11.5.1 Stopper Detection

If the device to which the CM3M is installed has a mechanical stopper, the origin search is available using the stopper as the origin signal source.

There are 50 origin positions (mechanical origins) per rotation when using Origin Detection Stopper Detection. Encoder phase shifts from 0 to 999 linearly between each origin position.

When Origin Detection is started, CM3M starts rotating in the set direction to detect stopper. A stopper detection will be completed when the motor torque reaches the Stopper Detection Torque and the speed becomes 1/16 of the Origin Detection Speed.
Then displays the encoder phase information (Origin=0 to 999).

After stopper detection, Origin Detection is completed at the encoder phase 0 point that is 1 cycle before detected phase by stopper.



- Set the threshold of the torque to detect a stopper for Origin Detection by percentage to Max. Torque.
- When the Stopper Detection Torque is set too low, Origin is mis-detected by detecting torque reaching the threshold.
- When Origin Offset is set, the position moves the set offset distance from the detected mechanical origin is the coordinate origin.
- For the stable origin search, adjust an attachment as a coupling for the encoder phase value indicated in “Origin=***” to be between 200 to 800.

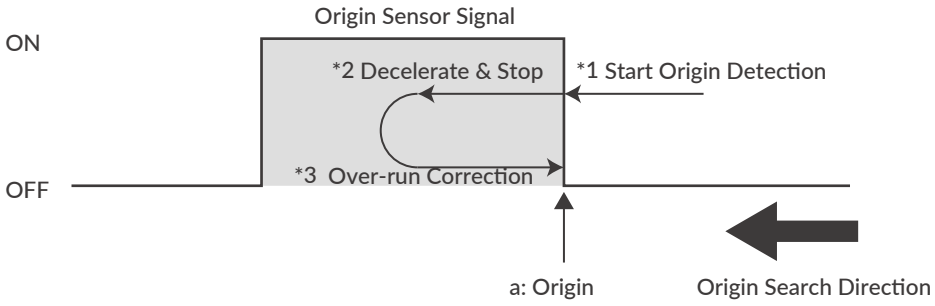
11.5.2 Origin Sensor

Origin Sensor signal can be assigned only to IN1. Sensor signal detection circuit is hysteresis circuit to minimize the noise influence. Rising edge of origin sensor in Origin Detection Direction is detected as mechanical origin.

✳ If the origin detection is executed when the origin sensor is not assigned to Input 1, Ux.1=264 which is the total of the operation warning Ux.1 = 256 and in-position Ux.1 = 8 is output, and WARN.1=32 (operation warning) is output when the warning Query command ?199 is sent. When selecting the Input 1 function of K44, be sure to select the origin sensor (K44=1) or the limit sensor in the origin detection direction (K44=2: CCW limit sensor, K44=3: CW limit sensor).

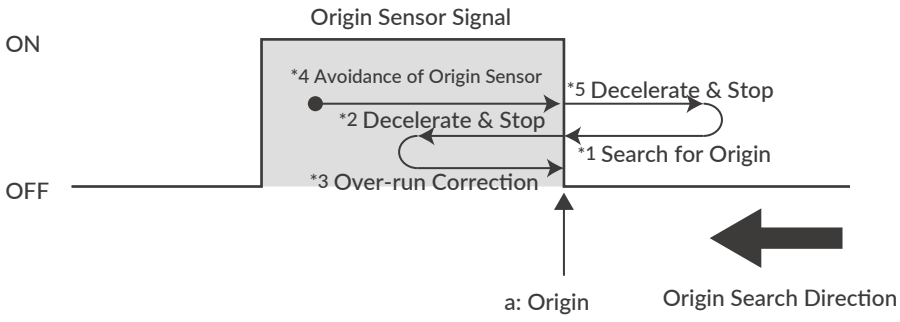
Depending on the status of origin sensor signal when Origin Detection starts, there are following differences in the Origin Detection operation.

☐ When an origin sensor signal is OFF when Origin Detection is executed



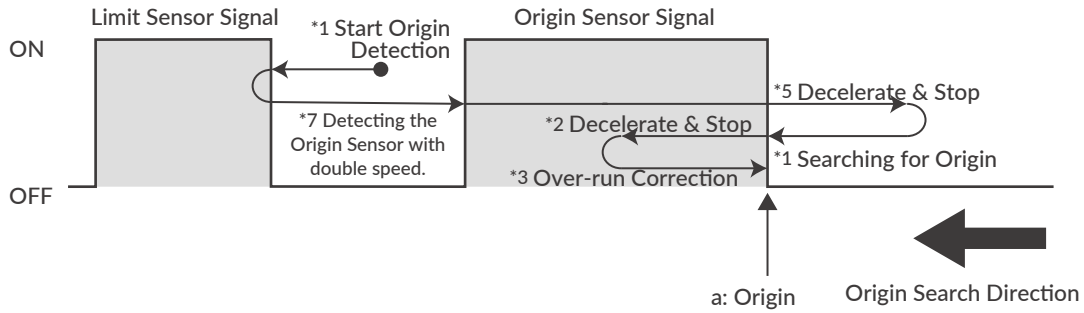
① Start origin detection
② Decelerate from rising edge (a) of origin sensor (Point a) (*2)
③ Move to Point a again (*3)
Complete origin detection

☐ When an origin sensor signal is ON when Origin Detection is executed



① Running in the opposite to the origin detection direction to get out from the origin sensor
② After passing the point a and detecting a sensor signal off in the figure, start to decelerate (*5).
③ The same motion as “When an origin sensor signal is OFF” in the previous paragraph will be executed.
④ Starting origin detection
⑤ Decelerate from rising edge of origin sensor (point a) (*2)
⑥ Move to Point a again （*3）
Complete origin detection

☐ Simultaneous use of limit sensor and origin sensor



① Start Origin Detection.
② When the limit sensor signal in the origin detection direction is detected, start moving in the opposite direction at twice the origin detection speed.
③ Detect the origin sensor signal (*7).
④ After detecting the origin sensor signal, then the same motion as "When an origin sensor signal is ON" in the previous paragraph will be executed.
⑤ To move out of sensor signal, move in the opposite direction from origin detection direction.
⑥ After passing the point a in the figure, start to decelerate after detecting a sensor signal off (*5)
⑦ The same motion as “When an origin sensor signal is OFF” in the previous paragraph will be executed.
⑧ After starting origin detection, decelerate from rising edge of origin sensor (Point a) (*2)
⑨ Move to Point a again (*3)
Complete origin detection

11.6 Input Functions

CM3M has 4 inputs, and the functions of inputs 1 to 4 are set with K44 to K47.

- Function and description of each inputs

K44/K45/ K46/K47	Function	Description
0	General Input	Set when using the I command
1	Origin Sensor	Available for IN1 only
2	Limit Sensor (CCW)	Limit Sensor in CCW direction
3	Limit Sensor (CW)	Limit Sensor in CW direction
4	Manual Mode	Switch to Manual Mode.
5	Servo ON/OFF	Toggle Servo on / Servo off. Alarm can be reset when the servo is turned on.
6	CCW Inching・Jog	Only available for IN3 and IN4. Inching/Jog in the CCW direction in Manual Mode.
7	CW Inching・Jog	Only available for IN3 and IN4. Inching/Jog in the CW direction in Manual Mode.
8	Execute Motion Data #1	Execute Motion Data #1
9	Execute Motion Data #1	Execute Motion Data #2
10	Execute Motion Data #1	Execute Motion Data #3
11	Stop	Stop motion

11.6.1 Input Filter

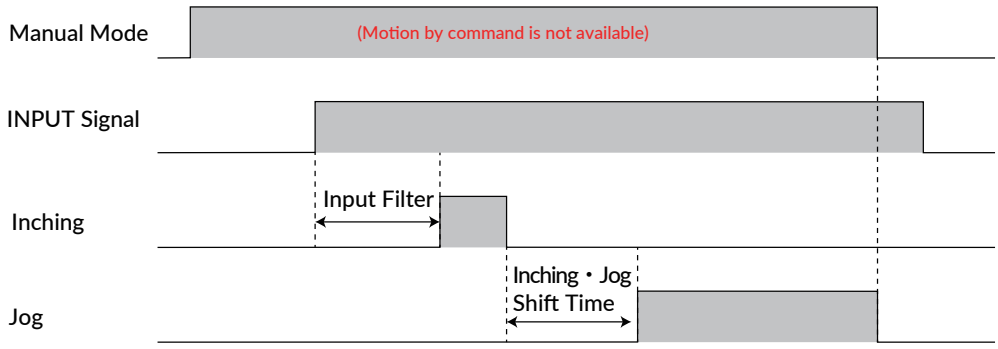
Set the filter time for the input signal with K42 between 1 and 50 msec. The higher the number, the longer the filter time and the slower the response to the input. Signals shorter than the set value will not be recognized as input signals.

11.6.2 Manual Mode

When the INPUT assigned to manual mode is turned on, it switches to manual mode, enabling inching and jogging operations by input signals and not accepting operations by commands.

☐ Inching・Jog

Inching and jog functions can be assigned to inputs 3 and 4. When an input signal coming in, CM3M move the Inching Distance of K51 (1 to 100 pulses) at the speed set by K50 (1 to 32767 [unit: K2]). After that, the motion will switch to the Jog after the Inching・Jog Shift Time set by K52 (1 to 3000 msec). If the applied input signal is shorter than K52, only Inching motion will be executed.



- Setting Example

Register Address (DEC)		K	Value	Contents
Upper	Lower			
298	299	K2	0	Set speed unit as 100 pps
386	387	K46	6	Assign Inching / Jog (CCW) to Input 3
388	389	K47	7	Assign Inching / Jog (CW) to Input 4
394	395	K50	50	Set Inching / Jog Speed as 50 x [100 pps]=5000 pps
396	397	K51	100	Set Inching Distance as 100 pulses
398	399	K52	1000	Set Inching Shifting time as 1000 msec

When IN3 (IN4) is turned on, CM3+ move 100 pulses in the CW (CCW) direction as Inching. If IN3 (IN4) is continuously turned on for 1000 [msec] or more even after the operation is completed, the motion will switch to the Jog operation and continue rotating at a speed of 5000 [pps].

☐ Jog

The inching/jog speed parameter sets the speed of movement when a jog signal is input. The acceleration is common to the home detection acceleration (K24)..

- Setting Example

Register Address (DEC)		K	Value	Contents
Upper	Lower			
298	299	K2	0	Set Speed Unit as 100 pps
394	395	K50	100	Set Inching • Jog Speed as 10000 pps
398	399	K52	0	No Inching

Jog motion is executed in the direction of CCW by a signal to IN5 and to CW by a signal to IN6. CM3+ keep rotating at a speed of 10000pps while the input is ON.

∗ If K52=0 is set, only Jog operation is enabled.
Refer to "Inching • Jog Shift Time" for details.

11.6.3 Servo On/Servo Off

IN3 can toggles the Servo on (alarm reset) and Servo off. When the signal is turned on, the alarm is reset and the servo is turned on at the same time, and the status of in position is replied. When the signal turns off, the servo turns off, and CM3M replies the status of Servo off.

11.6.4 Limit Sensor

The function of the limit sensor can be set for Input 1 and Input 2.

Example: Set 2 to K44 (0x017E, 0x017F) (CCW direction limit sensor set to input 1)
Set 3 for K45 (0x0180, 0x0181) (CW direction limit sensor set for input 2)

The deceleration ratio at stop by the limit sensor can be set with K18.

Parameter	Name	Range	Unit	Detail
K18	Deceleration ratio at stop by limit sensor	1 ～ 10000	%	Sets the deceleration to stop when the limit sensor is turned on as a percentage of acceleration.

Example: Set 500 to K18 (0x014A, 0x014B) (stop at 500% deceleration of acceleration)

When the limit sensor is switched on, a motion warning is issued and the CM3M stops at the deceleration set in K18. The warning status is indicated by the limit sensor warning bit being switched on. After stopping, the CM3M can only move in the opposite direction to the limit sensor.

11.7 Output Functions

CM3M has 4 outputs. Functions can be assigned to Output 1 -3 though Output 4 is fixed to ALARM output.

This section explains about each output functions. Refer to timing chart for the timings.

11.7.1 Alarm Output

Alarm output function is assigned to Output 4. CM3M goes in Servo Off when an alarm occurs to protect CM3M. Alarm information can be confirmed by "11.10 Status LED" or "8.1.1 Motor Status (0x0108, 0x0109)".

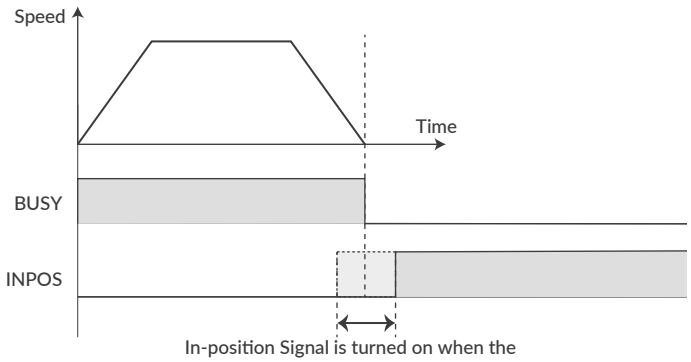
11.7.2 Other Output Functions

3 out of 11 kinds of output function can be assigned to output 1, 2, and 3. Select the function of output 1 by K55, output 2 by K56, and output 3 by K57.

K55/K56/K57	Function	Output Contents
0	General Output	Turn outputs on / off by command
1	In-position Output	Output in the In-position range
2	Warning Output	Output in the Operation and Status Warning state
3	N/A	N/A
4	ZONE Output	Output in the ZONE set by parameters
5	MOVE Output	Output when speed exceeds MOVE Output Threshold
6	BUSY Output	Output during motion
7	END Output	Output when operation is completed
8	Servo On	Output when Servo On
9	Push Motion Output	Output when torque exceeds the set value during Push Motion
10	Origin Set Completion Output	Output when origin is set

☐ Positioning Status Output (In-position, BUSY, END)

CM3M goes into In-position status and output signal from Output that In-position Output is assigned when the current position goes into the In-position range (±) set by In-position Range parameter (K5).
When END Output is assigned, turn output on when the operation set in Motion Data is completed. When the operation is paused, In-position Output is turned on but END Output is not turned on.



☐ ZONE / MOVE Output

- ZONE Output
  Output is turned on when CM3M' s current position goes in the set zone. ZONE Output range is set by ZONE（—）（K59）and ZONE（＋）（K60）and this function is valid for all operation.

- MOVE Output
  The output turns on when the speed set by the MOVE Output Threshold (K58) is exceeded.

  All output signals are valid only when the output function is assigned to the output point.

11.8 Tuning

The servo Tuning method can be selected from Tuningless or PPI control with the Tuning parameter (K31).

11.8.1 Tuningless（K31=1）

When selecting Tuningless by Tuning parameter, CM3M is automatically optimized by the changes of load, motion and etc. from low to high speed range. When some adjustment of trackability is necessary, it can be adjusted by Servo Stiffness parameter. The higher the Servo Stiffness value, the higher the trackability but setting it too high will cause the motor's vibration.

11.8.2 PPI（K31=0）

In case of fixed load and operation, PPI Control can be selected by Tuning parameter. When selecting PPI Control, the Position P gain, Speed P gain, and Speed I gain are valid. These gains can be separately set by parameters and are to match your machinery and CM3M servo motor. Without the gain adjustment, it may cause CM3M a vibration, too sensitive condition and some noise.

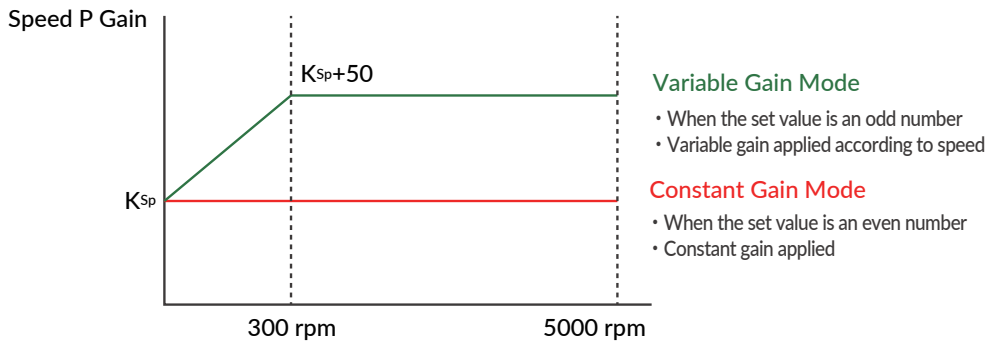
Follow the steps below to adjust CM3M's Position P gain, Speed P gain, and Speed I gain values. An adjustment with CM3M mounted in a machine and running a motor is necessary to find the optimum values. Adjustment steps are as it shown in below.

① Initial Setting
Set parameters as it follows.

Position P gain=100
Speed P gain=150
Speed I gain=1

② Speed P Gain（K34）

First, in order to optimize the Speed P Gain, increase the K34 value so that high-frequency vibration does not occur during CM3M operation. If the value of this parameter is too large, high frequency vibration may occur, but it is more stable to set K34 as high as possible.

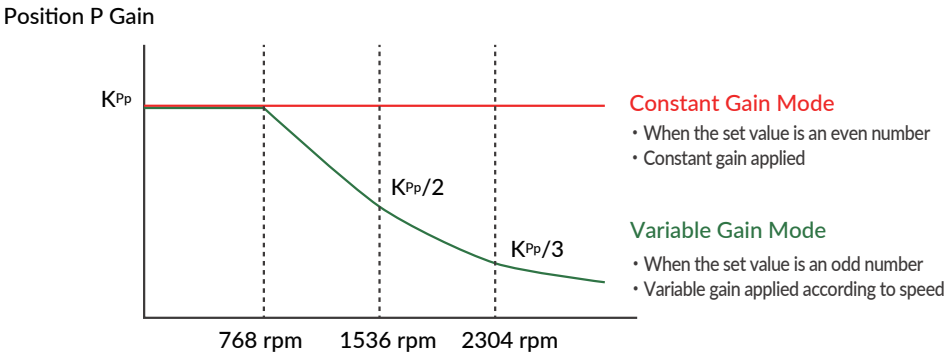


For variable gain mode, this gain setting value applies to when the speed is 0 rpm. When Speed is between 0rpm and 300rpm, Speed P gain value increases in proportion. The conclusive gain value is setting gain value plus 50.

∗ If the gain value is even, the Constant Gain Mode is set, and if the gain value is odd, the Variable Gain Mode will be set.

③ Position P Gain（K33）

After setting the optimum value of Speed P Gain, search for the optimum value of Position P Gain while operating CM3M. Increasing the value of Position P Gain will reduce the position error. In other words, the positioning time will be shorter, but if the value of Position P Gain is too large, vibrations may occur. The higher the value as much as possible, the more stable the motion will be.

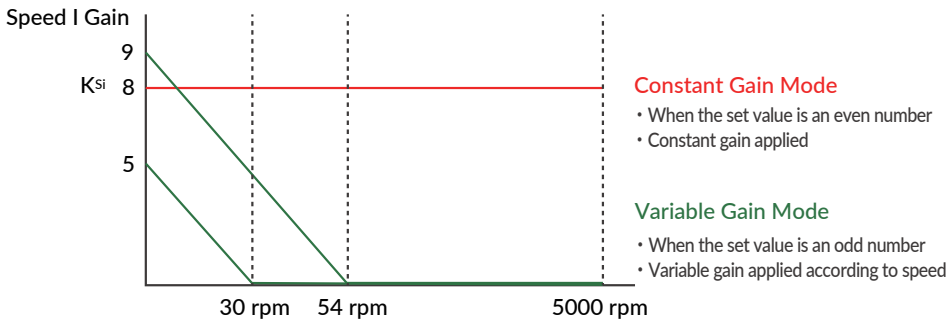


In the variable gain mode, the set value is the gain applied during low speed operation. The gain starts de-creasing after the speed exceeds 768 rpm, and at 2304 rpm it becomes one-third of the set value.
For example, if you set K33=101, 100 will be applied at speeds below 768 rpm, then at 3000 rpm, 25 will be applied.

∗ If the gain value is even, the Constant Gain Mode is set, and if the gain value is odd, the Variable Gain Mode will be set.

④ Speed I Gain（K35）

After setting the optimum value of Position P Gain, increase the value of Speed I Gain. Find the optimum value while operating CM3M. Speed I Gain is a parameter for slowly correcting the position error when the position error is not sufficiently reduced even if the Position P Gain is adjusted. If the value of Speed I Gain is excessively high, a large vibration might occur.



In variable gain mode, Speed I Gain decreases with increasing speed. When K35 = 5, Speed I Gain becomes 0 above 30 rpm, and when K35 = 9, it becomes 0 above 54 rpm.

∗ If the gain value is even, the Constant Gain Mode is set, and if the gain value is odd, the Variable Gain Mode will be set.

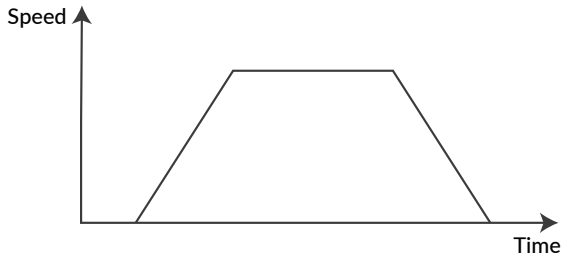
The optimal values can be set by following the above steps.

11.8.3 S-Curve Gain

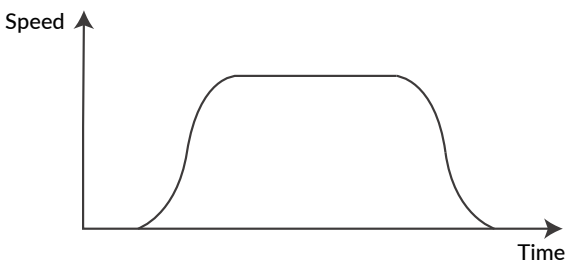
The s-curve gain (K36) is the parameter to change the trapezoidal motion to S-shape. K36 can be set from 0 to 1024, and the higher the K36, the more the motion is S-shape. By enabling the S-curve gain, it helps to soften the impact when starting and stopping, and to reduce overshoot.

Example:

K36=0 //Trapezoidal Motion



K36=1024 //S-Curve Motion



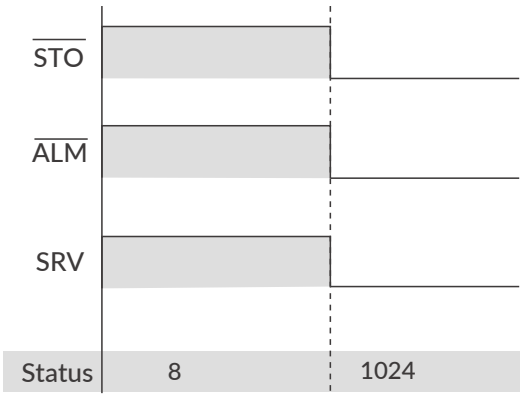
11.9 STO Function

CM3M is equipped with the STO (Safe Torque Off) function, which is one of the safety functions defined in the international standard IEC61800-5-2. STO is a function that cuts off only the power supply to the motor. When the STO function is activated, the stopped state of the motor is not controlled and the servo is turned off.

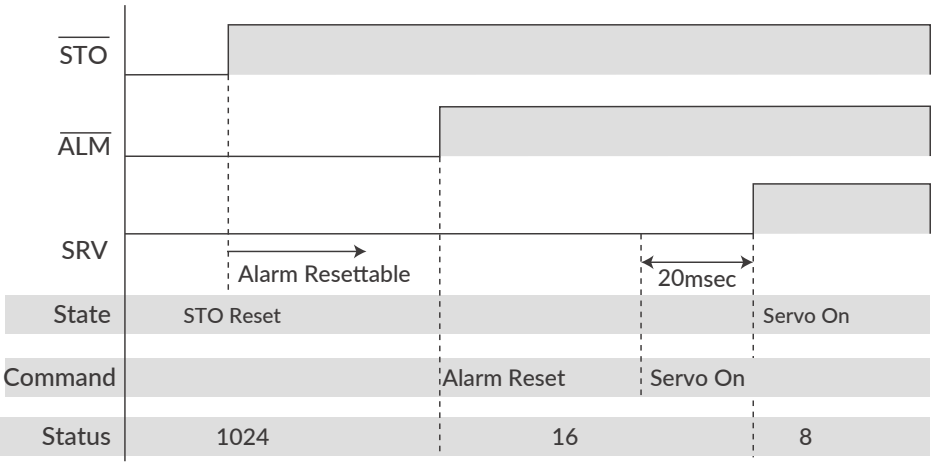
* Not certified by a third party organaization

If a voltage is applied between STO + and STO-, the STO stays disabled and CM3M is ready to operate. When the voltage is cut off, the STO is activated and goes in an STO (Ux.1=1024) status. When voltage is applied again between STO + and STO-, STO is canceled and the alarm can be canceled.

☐ Sequence for STO



☐ Recovery sequence from STO state



11.10 Status LED

The status of CM3M is indicated by the status LED of 7 colors (blue, green, red, magenta, cyan, yellow, white). The flashing pattern of the status LED for each status is as follows. If multiple statuses occur at the same time, the status of the first row of the table has a higher priority.

Status	Pattern	Red	Magenta	Green	Cyan	Blue	White	Yellow
STO	Lighting							
Overload Alarm	Alternate							
Over Current Alarm	Alternate							
Over Temperature Alarm	Alternate							
Over Voltage Alarm	Alternate							
Low Voltage Alarm	Alternate							
Position Error Overflow Alarm	Flashing							
ABS Alarm	Alternate							
Servo Off	Lighting							
Push Motion Warning	Flashing							
Limit Sensor	Alternate							
Software Limit	Alternate							
Manual Mode Warning	Lighting							
Operation Warning	Alternate							
Overload Warning	Alternate							
Temperature Warning	Alternate							
Servo On	Lighting							
BUSY*	Lighting							
Push Motion	Flashing							
Push Complete (Torque Limited)	Flashing							
Manual Mode	Alternate							

* LED lighting for BUSY means motion is being executed. It may not match the BUSY output during operation. Please confirm the exact status by communication. See "8.1.1 Motor Status (0x0108, 0x0109)" for details

Chapter 12 Maintenance and Inspection

12.1 Maintenance

It is important to have regular maintenance for CM3M to ensure it is operating safely.

☐ Check Up Items

Type	Cycles	Inspection items
Daily inspection	Daily	• Are there dust, foreign objects around the motor? • Is there any abnormal vibration, noise or smell? • Are the cables not damaged? • Is there any loose connection or misalignment with other devices? • Is the main circuit voltage normal?
Periodical inspection	Annually	• Is there any loose point at tighten points? • Are terminals intact not damaged?

12.2 Troubleshooting

Please check the following items before inquiring.

12.2.1 Communications

Symptom	Check	How to solve
Communication cannot be established with controller such as PLC	Is the cabling between devices connected properly?	Please see "Chapter 4 Wiring and Connection"and make sure all cables are connected properly. Confirm the state of the contact of the connector pins and the state of the harnesses. (Has not the disconnection occurred?)
	Are the communication settings correct?	Check that the motor settings and PLC settings are correct. Check the baud rate, stop bit, parity, offset value of the holding register, slave address and endian setting.

12.2.2 Motion

Symptom	Check	How to solve
Motion data does not work when executed.	Check switch 1 status.	Refer to Section "8.1.5 Switch Status" to check whether the operability conditions are met.

12.2.3 Motor

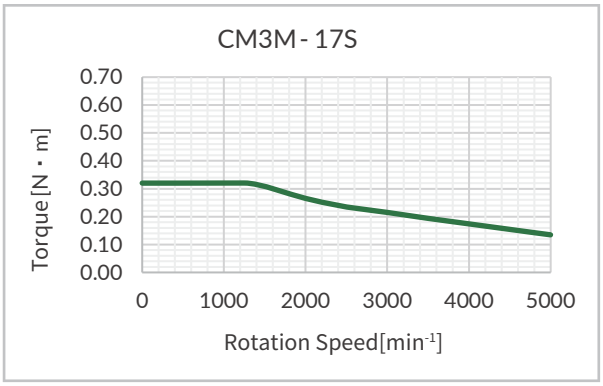
Symptom	Check	How to solve
Noise and vibrations	Are the machine and the motor resonating?	Adjust the gain or speed of CM3M.
Overheat	Is operating temperature within specification?	Do not use outside the specification.
	Check the mounting part on the machine.	Make sure there are no loose or slippery places in the machine.
	Is the load inertia within the allowable range.	Make sure that it is within the specification.
	Is bearing not damaged?	Turn the power off and rotate the shaft. If there is a noise, then replacement or repair is required.
Does not rotate	Is the power ON?	Turn the power ON.
	Check cable connection	Connect the cables properly. Confirm whether the state of the contact of the connector pins and the state of the harnesses.
	Is the load within the allowable range?	Use it within the allowable load.
	Is the CM3M Servo off?	Servo on the CM3M.
	Is the motor in an alarm state?	Remove the cause of alarm and reset an alarm.
	Has the STO been activated?	When STO is activated, CM3M power circuit is cut off. Apply the voltage to STO input.

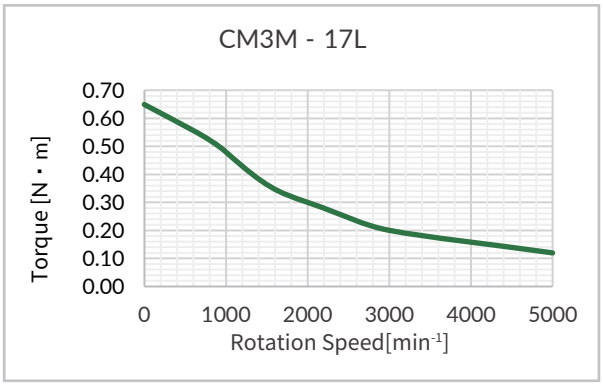
Chapter 13 Specifications

13.1 Basic Specifications

☐ CM3M-17S/L

Items		CM3M-17S50*	CM3M-17L50*
Input voltage		+24Vdc ± 10%	
Input current / peak current		3.5 [A] / 4.8 [A]	4 [A] / 5 [A]
CM3M output		60 [W]	60 [W]
Maximum rotation speed		5000 [min^{-1}]	
Rated torque		0.25 [N・m]	0.52 [N・m]
Maximum torque		0.32 [N・m]	0.65 [N・m]
Rotor moment of inertia		0.036 × 10^{-4} [kg・m^2]	0.074 × 10^{-4} [kg・m^2]
Allowable load moment of inertia		Less than 10 times the Rotor Inertia	
Allowable radial load (shaft end)		37 [N]	32 [N]
Allowable thrust load		10 [N]	10 [N]
Speed / position detector		Incremental Magnetic Encoder	
Resolution		Selectable from 300 to 12000 [pulse/rotation]	
Control method		Closed-loop vector control	
Heat resistant class		B	
Insulation resistance		100 MΩ 500Vdc	
Insulation Strength	Coil-Frame	500V (1mA leak current)	
	Coils	500V (1mA leak current)	
I/O	Input	Digital Input：4	
	Output	Digital Output: 4 (Including 1 error output)	
	STO	1	
Communication port		RS485 (Modbus RTU): 1 Port, RS-232C: 1 Port	
Cooling method		Natural cooling	
Mass		295 [g]	435 [g]
Operation / storage temperature		0°C to 40°C（No freezing）/ -20°C to 60°C（No freezing）	
Operation / storage humidity		5 to 95%RH（No condensation）/ 20 to 90%RH（No condensation）	
Atmosphere		Do not use in explosive, flammable gas, corrosive atmosphere, dust, water, oil fumes, water vapor, radiation, or direct sunlight.	
Vibration resistance / shock		JIS Z0232 Level 2 / JIS Z0202 Level 3	

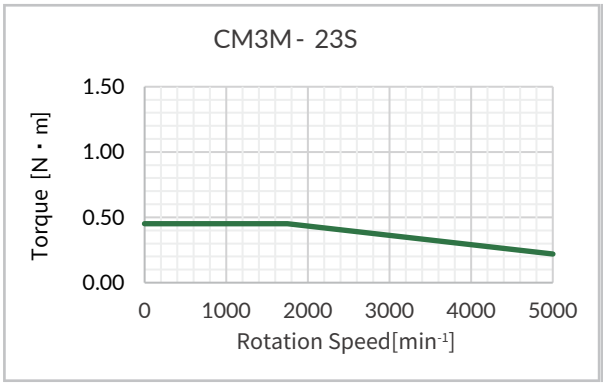


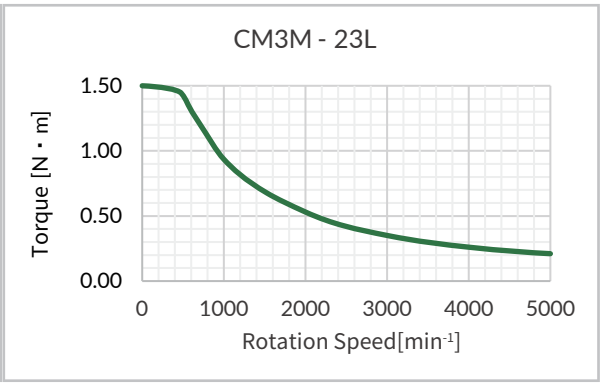


＊ Specifications are subject to change without notice.

☐ CM3M-23S/L

Items		CM3M-23S50*	CM3M-23L50*
Input voltage		+24Vdc ± 10%	
Input current / peak current		4[A] / 5[A]	5[A] / 6[A]
CM3M output		80 [W]	100 [W]
Maximum rotation speed		5000 [min-1]	
Rated torque		0.30 [N・m]	1.05 [N・m]
Maximum torque		0.45 [N・m]	1.50 [N・m]
Rotor moment of inertia		0.1 × 10-4 [kg・m2]	0.36 × 10-4 [kg・m2]
Allowable load moment of inertia		Less than 10 times the Rotor Inertia	
Allowable radial load (shaft end)		77[N]	70[N]
Allowable thrust load		15[N]	15[N]
Speed / position detector		Incremental Magnetic Encoder	
Resolution		Selectable from 300 to 12000 [pulse/rotation]	
Control method		Closed-loop vector control	
Heat resistant class		B	
Insulation resistance		100 MΩ 500Vdc	
Insulation Strength	Coil-Frame	500V (1mA leak current)	
	Coils	500V (1mA leak current)	
I/O	Input	Digital Input：4	
	Output	Digital Output: 4 (Including 1 error output)	
	STO	1	
Communication port		RS485 (Modbus RTU): 1 Port, RS-232C: 1 Port	
Cooling method		Natural cooling	
Mass		525 [g]	1050 [g]
Operation / storage temperature		0°C to 40°C（No freezing）/ -20°C to 60°C（No freezing）	
Operation / storage humidity		5 to 95%RH（No condensation）/ 20 to 90%RH（No condensation）	
Atmosphere		Do not use in explosive, flammable gas, corrosive atmosphere, dust, water, oil fumes, water vapor, radiation, or direct sunlight.	
Vibration resistance / shock		JIS Z0232 Level 2 / JIS Z0202 Level 3	





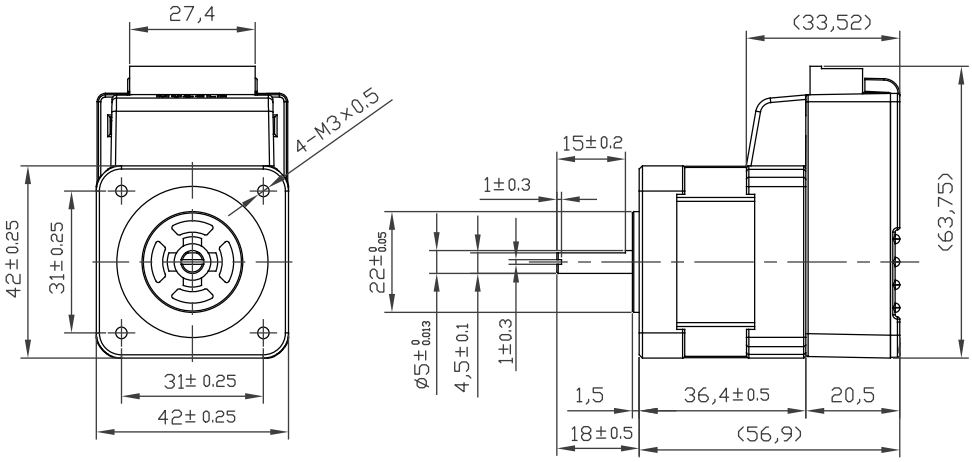
＊ Specifications are subject to change without notice.

13.2 Electrical Specifications

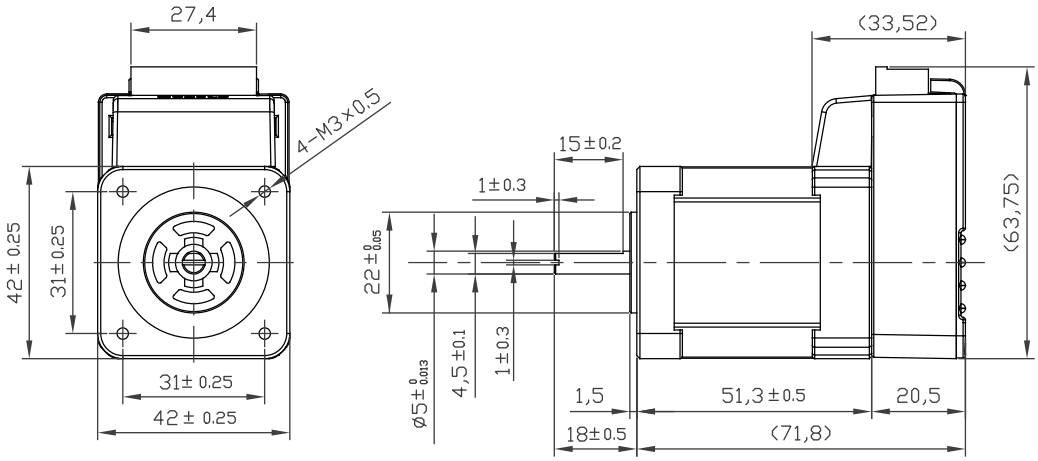
Item		Value
Digital Input	Applied Voltage	0 - 26 [V]
	Low Level Voltage	0.8 [V]
	High Level Voltage	4.2 [V]
Digital Output	Withstanding Voltage	26 [V]
	Max. Continuous Load Current	10mA
Communication	Baud Rate	9.6 - 115.2 [kbps]

13.3 Dimensions

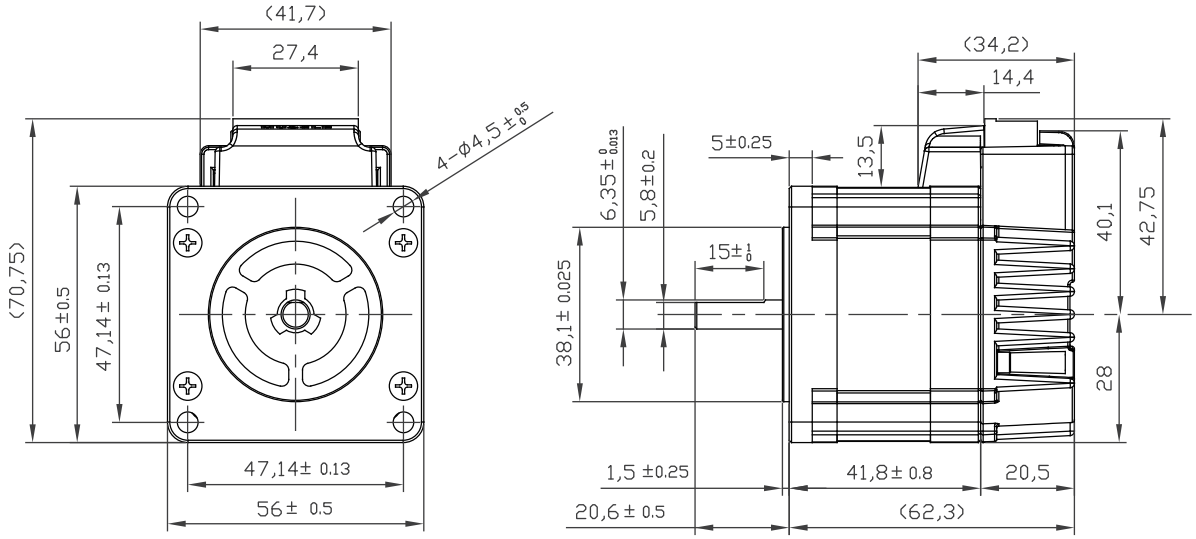
☐ CM3M-17S



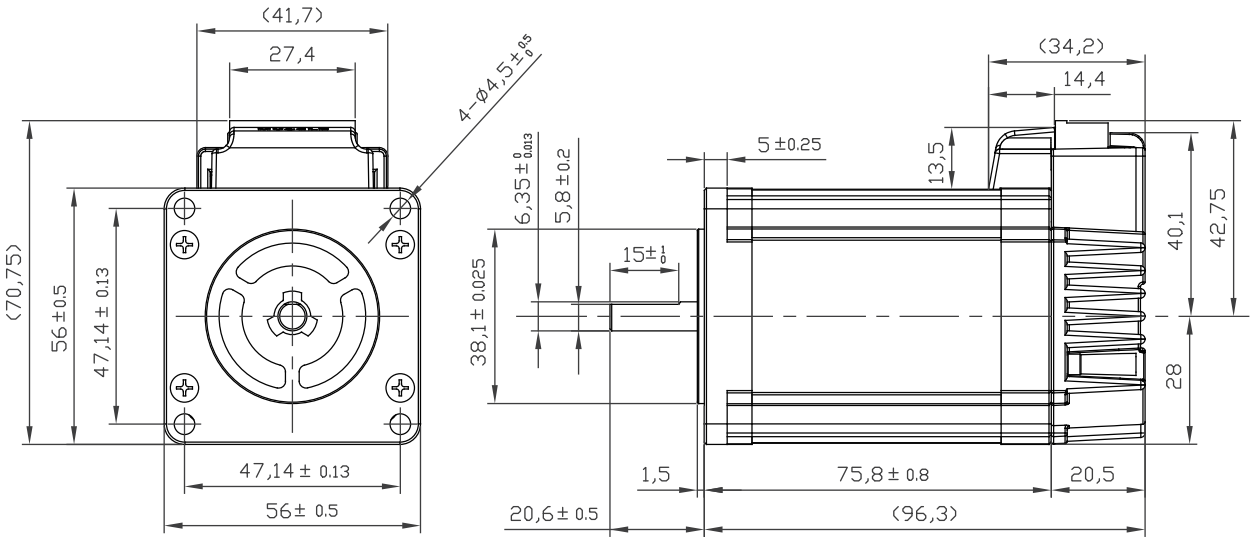
☐ CM3M-17L



☐ CM3M-23S



☐ CM3M-23L



Appendix Conformance

CE Marking

CM3M is a component that is intended to be incorporated into machines and equipment for industrial use. When CM3M is built into machines or equipment, it must be established that the machine or equipment fulfills the requirements of the EU Directives.

RoHS Directive

CM3M is conformed to RoHS directive.

EMC Directive

The EMC Directive applies not to CM3M alone but to machines and equipment incorporating CM3M. CM3M is conformed to EMC directive.

The conditions of installation, wiring and grounding may be different to the above example, when CM3M is incorporated in machinery or equipment. Therefore, the conformity assessment is required to the machinery or equipment, with CM3M is incorporated, as a whole, in order to meet the EMC Directive.
(The whole machinery or equipment, incorporating CM3M, is subjected to the EMC Directive, rather than CM3M alone.)

Revision History

※ User's Guide No. is described in the cover of this manual.

Revised Data	User's Guide No.	Page	Object	Revised Item
Jan 2025	MDUG-CM3M/25101E-01			New Document