

COOL MUSCLE 3

Pulse Type User's Guide



MDUG-CM3/20831E-01
CM3 Firmware Version v1.01



CM3 has three sorts of control types: **Direct type, I/O type, and Pulse type.**

This user's guide is for the CM3 **Pulse type** only.

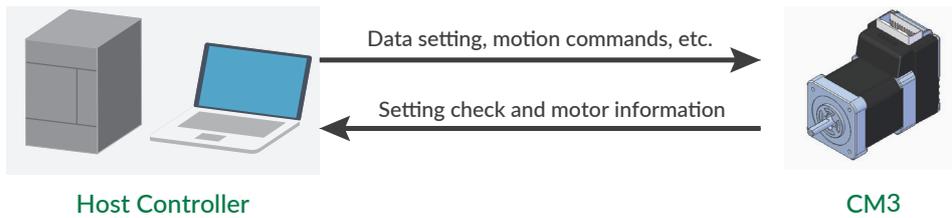
The control type of CM3 can be changed according to the control method.

Type can be changed from the dedicated software "COOL WORKS QUICK" .

- Direct type (Communication type)

Direct type lets you operate CM3 by sending and receiving commands via RS-232C serial communication. Positioning can be done by simple settings as position, speed, acceleration and etc.

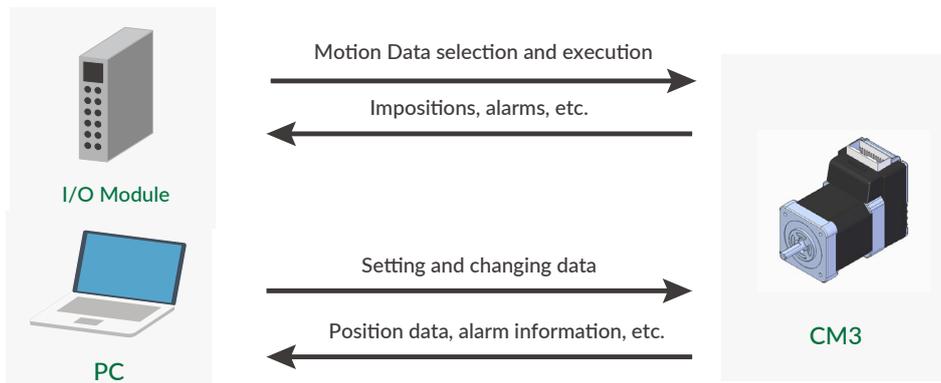
Max 32 point Motion Data can be set and executed.



- I/O type

Max 8 point Motion Data can be set and they can be selected and executed by input signals.

Output signal from I/O port on PLC executes a motion set in CM3' s Motion Data.



- Pulse type

CM3 is controlled by a pulse signal from the PLC.

The ABZ output function allows you to replace an existing system with the CM3.

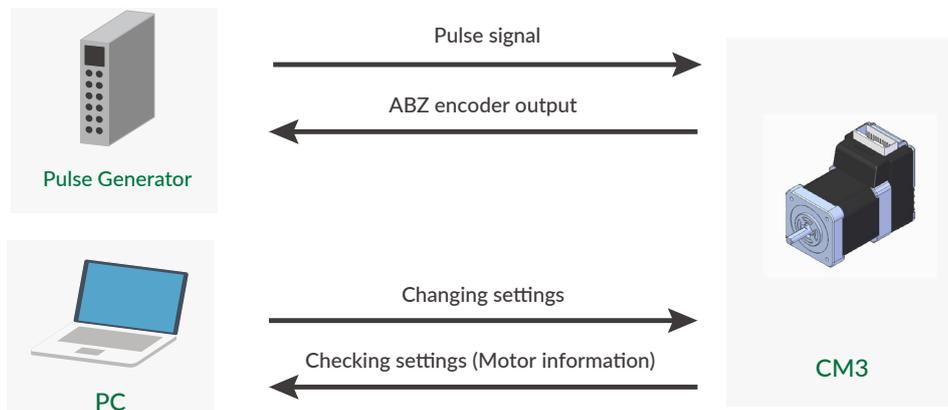


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Before Use

- 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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- Please refer to the related manuals "COOL WORKS QUICK USER'S MANUAL" for the usage of COOL WORKS QUICK, a communication software for COOL MUSCLE operation.

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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

Instructions for Safety

Warning

Never touch the rotating part of the motor while operating.

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



Do not touch the motor 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 motor 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 motor 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 motor 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 the motor 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, etc., on the end of the cable. 

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 apply a load exceeding the tolerable load onto the motor 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 (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, the motor 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 (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.

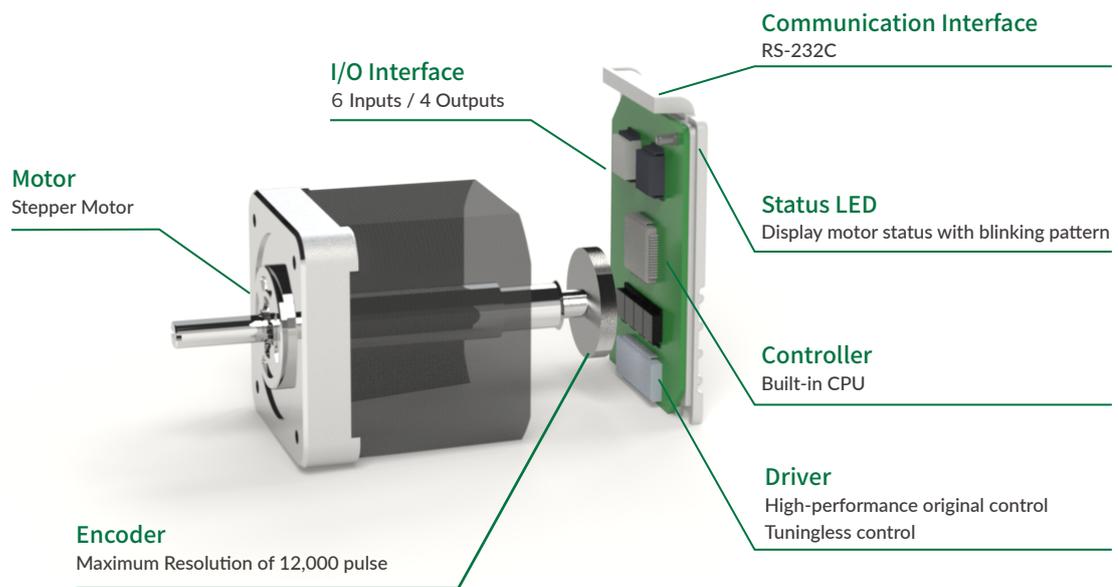
About processing of waste

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

Chapter 1 Functions and Structure

1.1 Overview

The "CM3" is an integrated AC servo system with a built-in, encoder, driver and controller. The higher torque and speed have been achieved by MUSCLE' s own control technology. Various conditions can be set using the original programming language "CML" (COOL MUSCLE Language), and operations can be executed by pulse signals. CM3 provides the highest solution.

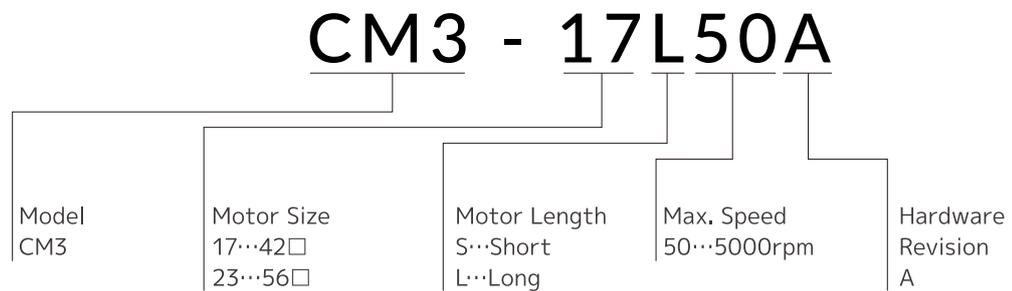


Main Functions of CM3

- PTP Motion by Pulse Input Signal
- Torque Limit Function
- STO Function
- Tuningless Function
- ABZ-phase output and other output functions

1.2 Product Code Scheme

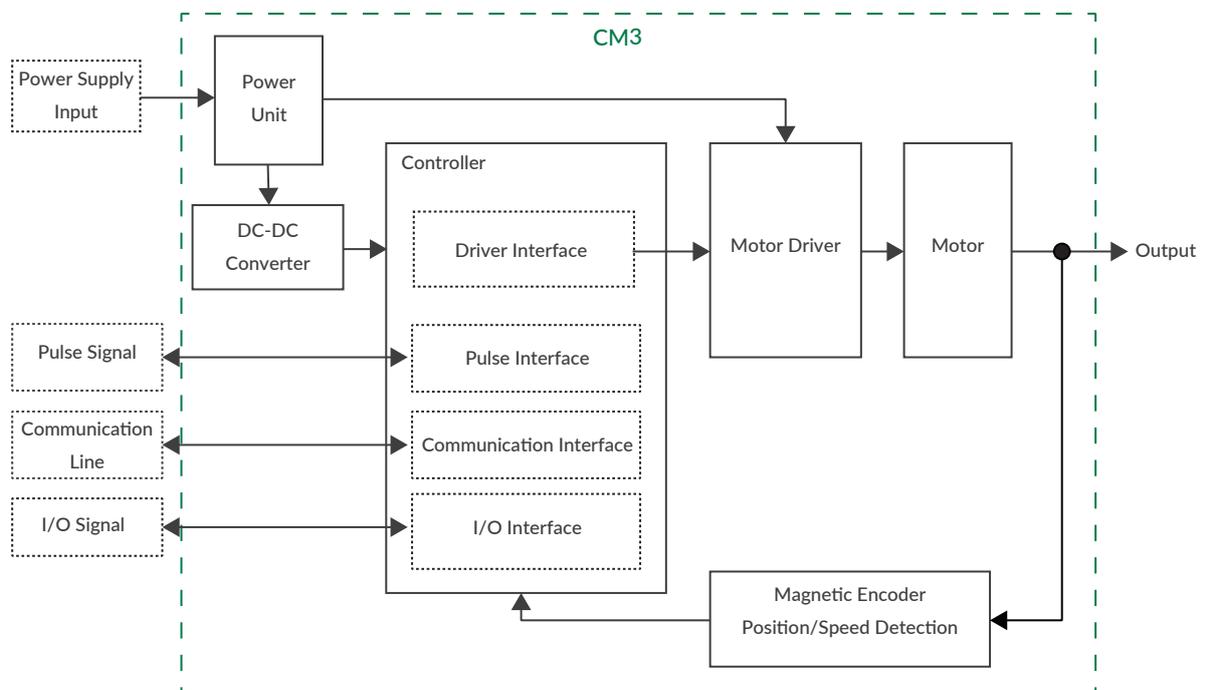
CM3's product code scheme is described as below.



□ Product Name

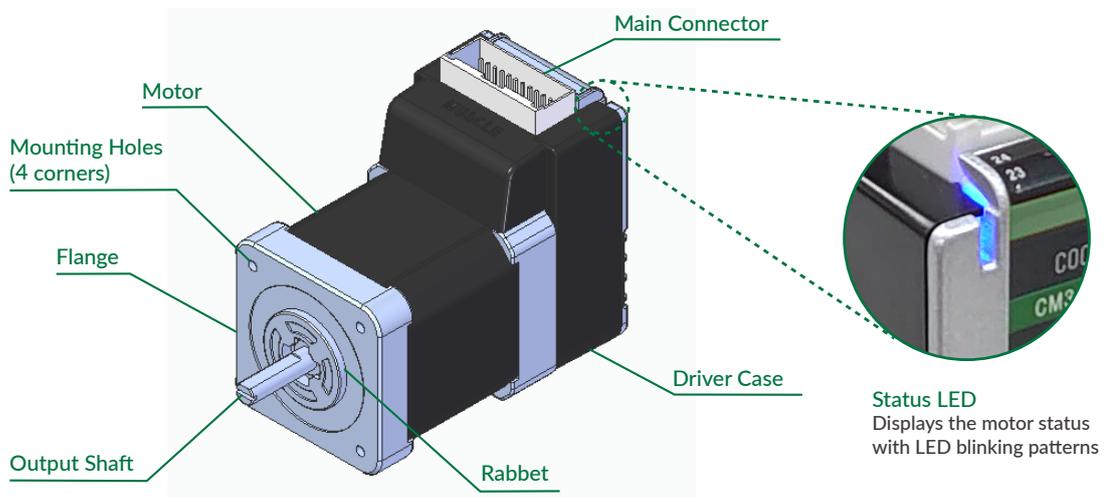
Product Name	Product Code
CM3 42mm Short	CM3-17S50A
CM3 42mm Long	CM3-17L50A
CM3 56mm Short	CM3-23S50A
CM3 56mm Long	CM3-23L50A

1.3 Function Block Diagram



1.4 Parts Description

The names of parts of CM3 are as shown below.



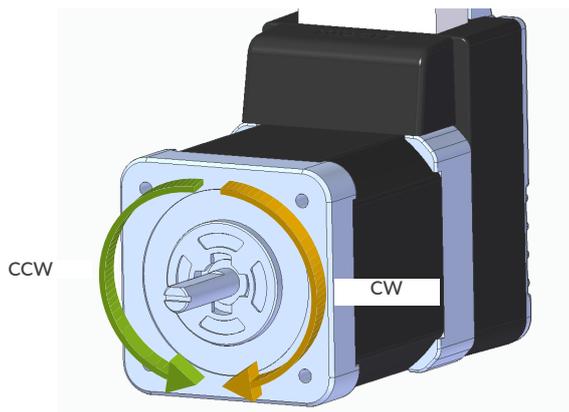
* Please refer to "8.9 Status LED" for the status LED blinking pattern.

1.5 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

CW direction is positive direction and CCW direction is negative direction in coordinate.

1.6 Control

The pulse type CM3 operates by receiving pulse signals from a pulse generator such as PLC. The pulse signal supports CW/CCW, step/direction, and AB phase, and its input method can be connected to either the line driver method or open collector method.

Refer to "8.3 Positioning Operation" for details.

1.7 Program Language, COOL MUSCLE Language "CML"

CML is an abbreviation for "COOL MUSCLE Language" (hereafter, CML) for setting and checking the status of CM3. CML consists of the following items.

Parameters

Parameters set the system conditions such as CM3's communication setting, alarm conditions and etc.

Execution Commands

Execution commands are commands to save data and turn on / off general output..

Query Commands

Query commands read CM3's current status such as current position and speed.

CM3 Status

Current status (In-position, alarm, warning and etc) of CM3.

Please refer to "Appendix 1 Execution / Query Command" for Query commands and CM3 status. ".Motor ID" follows all CML but ".Motor ID" is not described in this document due to that CM3 is a single axis controlled device. ".Motor ID" is not necessary when sending CML to CM3 but ".Motor ID" is added in replied data.



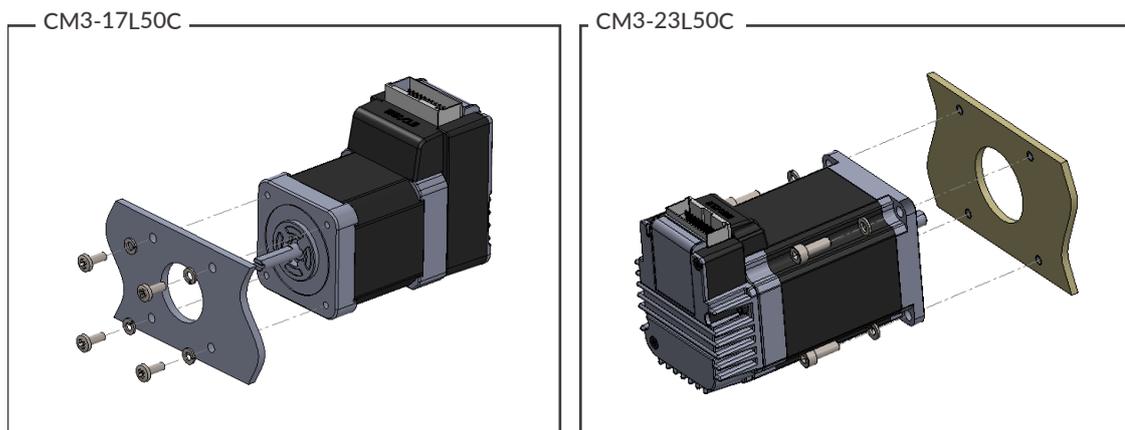
Please use 1 byte character only. CML is not case sensitive.

Chapter 2 Installation

2.1 Mounting to Machinery

CM3 can be mounted either horizontally or vertically. Mount CM3 on the smooth and rigid surface of a metal plate. When installing CM3, 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 CM3's installing surface leaving no gaps between the surface and metal plate.

(Tolerance of rabbet is on "Chapter 10 Specifications".)



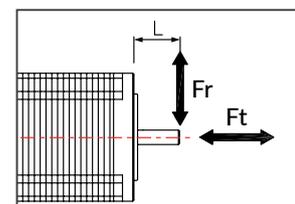
The sizes of mounting bolts are as follows.

Model	Bolt Size	Depth
CM3-17S50 / CM3-17L50	M3	5.0 mm
CM3-23S50 / CM3-23L50	M4	-

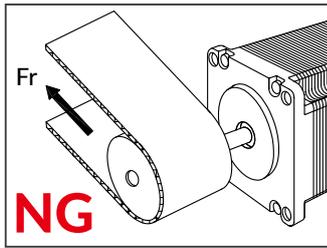
2.2 Mounting to Load

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 load and thrust load on motor shaft do not exceed the allowable values. (Allowable radial load and thrust load of each CM3 motor size are stated in "Chapter 10 Specifications".)

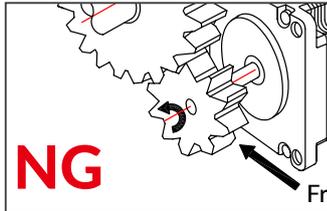
Radial Load (F_r): Perpendicular force applied to the shaft end.
 Thrust Load (F_t): Parallel force applied to the shaft end.



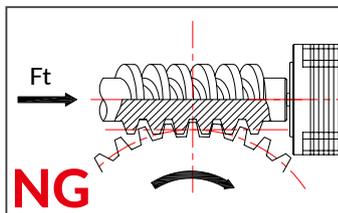
Mounting a load directly to the output shaft would increase the force and damage the motor.
 Consider reviewing the mechanical system so that excessive load is not applied to the output shaft.



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.



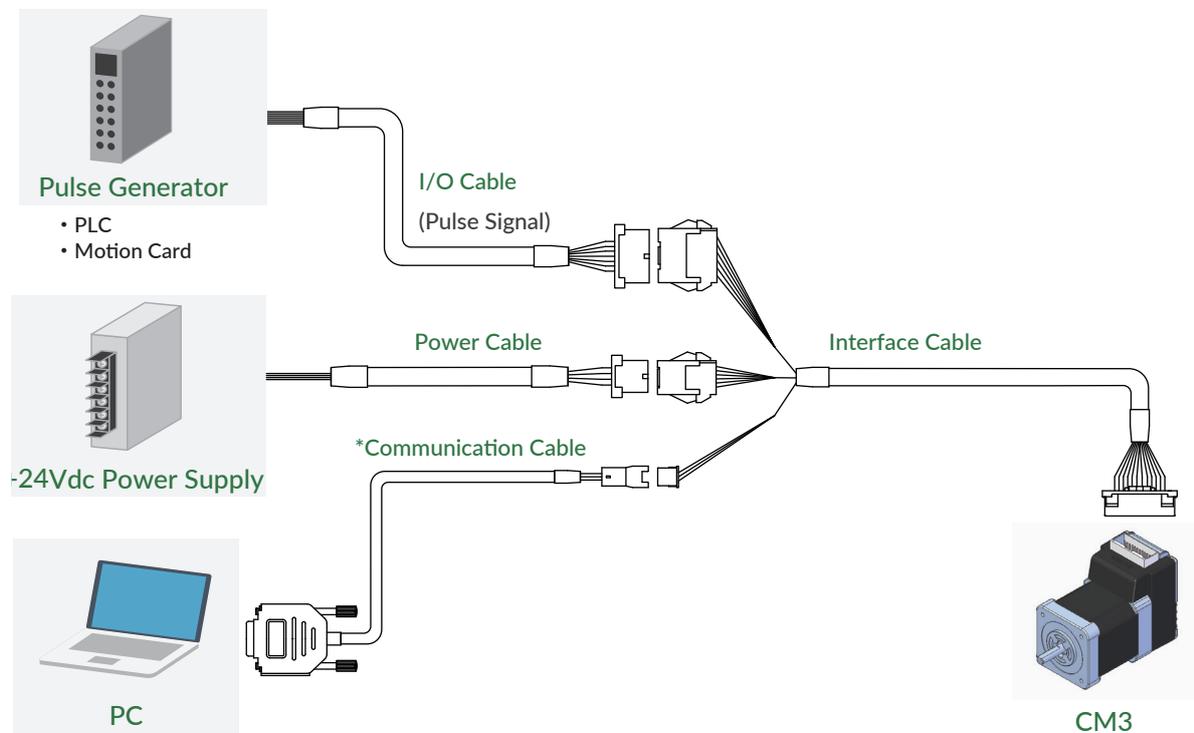
When a worm gear is directly mounted onto output shaft, thrust load (Fr) will be produced and forced to motor shaft. Motor shaft will be moved, and it may result in damaging the inside of motor.

Chapter 3 Wiring and Connection

3.1 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 CM3 by holding cables. It may result in damaging connectors.



*Required when changing the CM3 settings from a PC

3.2 Connector Pin Layout and Functions

Pin layout and functions of CM3 cables are described below.

Main Connector

CM3 has a 24-pin connector on the top. The pin layout, names and functions are as follows.

No.	Name	Function	No.	Name	Function
2	D_GND	Digital Ground	1	FG	Frame Ground
4	ALARM	Alarm Output	3	D_GND	Digital Ground
6	OUT3	Output 3 / Z-phase	5	RXD0	RS232C Receive Data
8	OUT2	Output 2 / B-phase	7	TXD0	RS232C Transmit Data
10	OUT1	Output 1 / A-phase	9	STO_IN-	STO Input -
12	STO_IN+	STO Input +	11	IN6+	CW / Step / B-Phase Pulse +
14	IN6-	CW / Step / B-Phase Pulse -	13	IN5+	CCW / Dir / A-Phase Pulse +
16	IN5-	CCW / Dir / A-Phase Pulse -	15	IN_COM	IN1 to 4 Common
18	IN4	Torque Limit	17	IN3	Servo on/off
20	IN2	CW Limit Sensor	19	IN1	CCW Limit Sensor
22	P-GND	Power Ground	21	P-GND	Power Ground
24	POWER	+24Vdc	23	POWER	+24Vdc

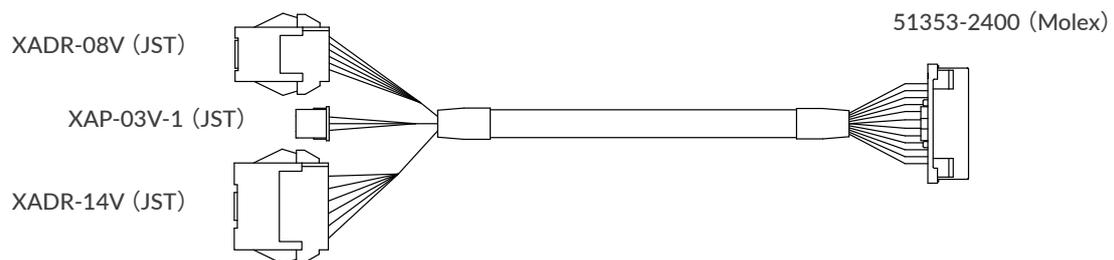
Connector: 55959-2430 (Molex)

Interface Cable A (400mm, 1000mm, 2000mm, 3000mm, 5000mm)

Product Number: CMIFA1-****WR (****: Cable Length)

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

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

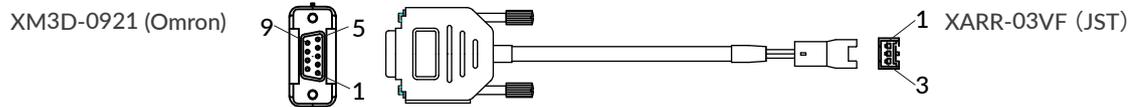


Chapter 3 Wiring and Connection

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
ORG	2	RXD	RS232C Receive Data from PC
GRY	3	TXD	RS232C Transmit Data from PC
WHT	5	D_GND	Digital Ground

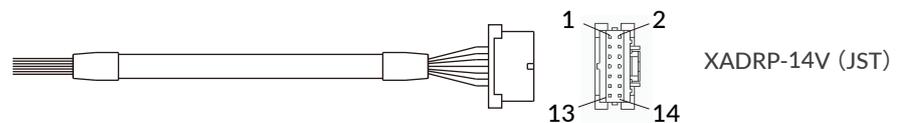
CM3 side

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

I/O Cable A (1000mm, 3000mm, 5000mm)

Product Number: CMIOA1-****S (****: Cable Length)

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



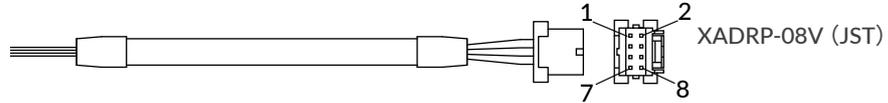
Color	Dot	No.	Name	Function	Color	Dot	No.	Name	Function
PPL	/	1	IN1	CCW Limit Sensor	BLU	/	2	IN2	CW Limit Sensor
GRN	/	3	IN3	Servo on / off	YLW	/	4	IN4	Torque Limit
ORG	/	5	IN5 +	CCW / Dir / A-Phase Pulse +	RED	/	6	IN5 -	CCW / Dir / A-Phase Pulse -
BLK	/	7	IN6 +	CW / Step / B-Phase Pulse +	BRW	/	8	IN6 -	CW / Step / B-Phase Pulse -
WHT	/	9	IN_COM	Input 1 to 4 Common	GRY	/	10	OUT1	Output 1 / A-phase
WHT	-	11	OUT2	Output 2 / B-phase	WHT	--	12	OUT3	Output 3 / Z-phase
WHT	---	13	ALARM	Alarm Output	WHT	----	14	D_GND	Digital Ground

Chapter 3 Wiring and Connection

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

Product Number: CM3PWA1-****S (****: Cable Length)

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



Color	No.	Name	Function	Color	No.	Name	Function
RED	1	POWER	+24Vdc	GRN	2	POWER	+24Vdc
BLK	3	P-GND	Power Ground	WHT	4	P-GND	Power Ground
GRY	5	STO_IN+	STO Input +	BLU	6	STO_IN-	STO Input -
BRW	7	FG	Frame Ground	-	8	N/A	N/A

3.3 Electrical Specifications

Item		Value
Digital Input	Applied Voltage	0 - 26 [V]
	Low Level Voltage	0.8 [V]
	High Level Voltage	4.2 [V]
Pulse Input	Max. Input Pulse Frequency	1 [MHz]
	Duty	50 ± 10%
Digital Output	Withstanding Voltage	26 [V]
	Max. Continuous Load Current	10 [mA]

3.4 Input/Output Circuit

Input	<p>IN1, 2, 3, 4 No Polarity</p>	
	<p>IN5 (CCW/Dir/A-Phase) IN6 (CW/Step/B-Phase) With Polarity</p>	
	<p>STO No Polarity</p>	
Output	<p>OUT1, 2, 3 ALARM Open-drain</p>	

* When not using the STO function, apply a voltage of 5 to 24V between STO+ and STO-.

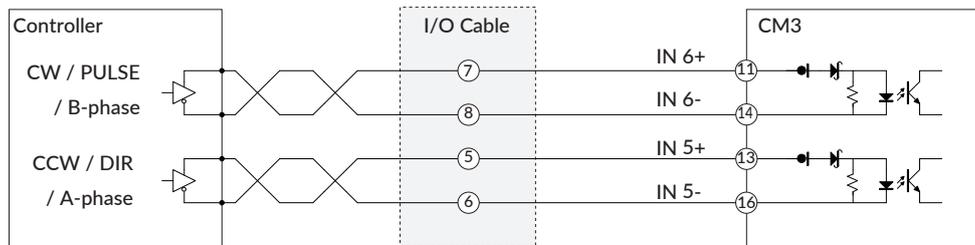
3.5 Circuit Connection

Pulse Input

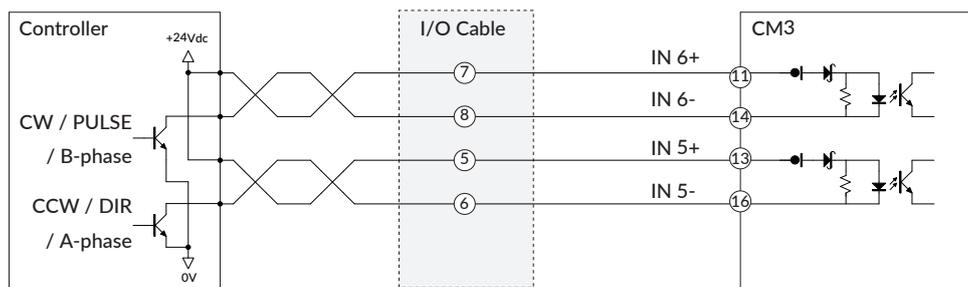
CM3 supports line driver output or open collector output pulse signals.

Input Pulse Maximum Frequency: 1 [MHz]

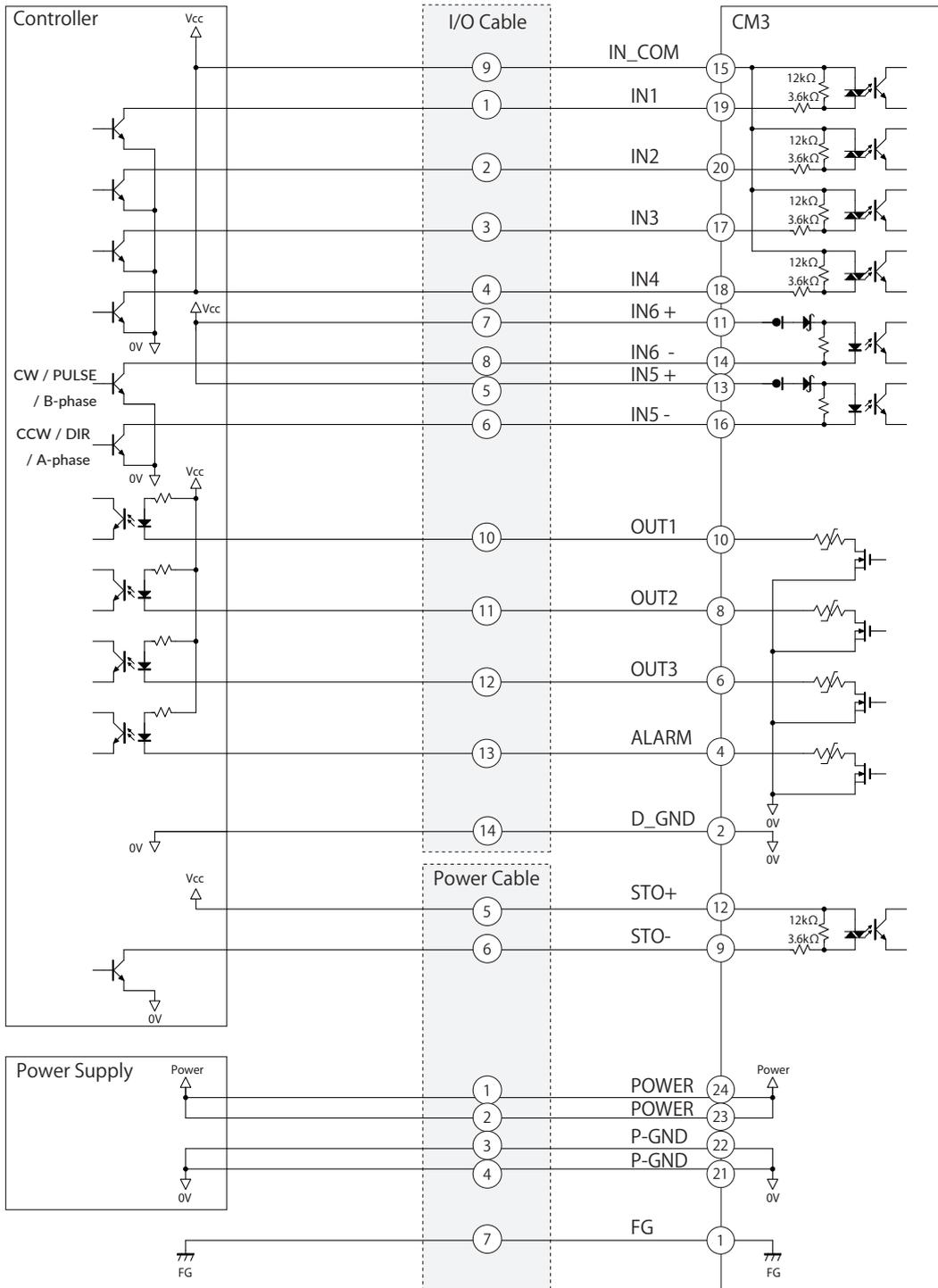
• Line Driver Output



• Open Collector Output



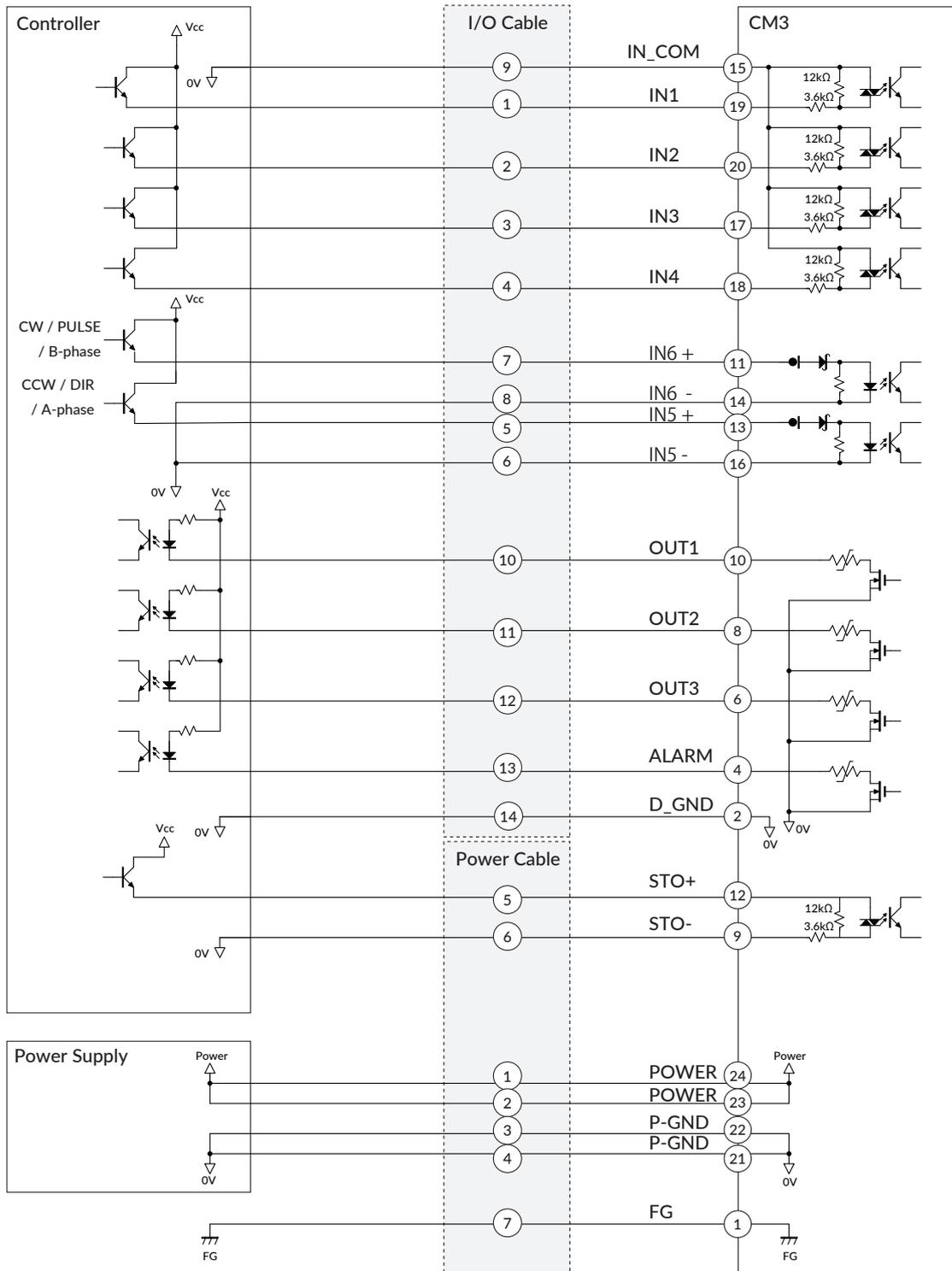
□ Connection Example with Sink Output Circuit



 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

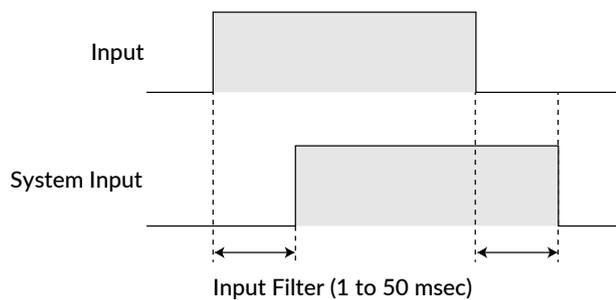
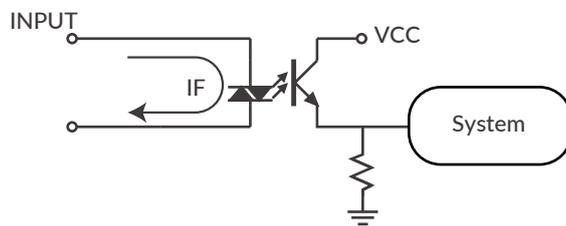
Chapter 4 Input/Output

4.1 Input Signal

4.1.1 Input Filter

CM3 is equipped with 4 digital inputs with no polarity (IN1 to IN4) and 2 pulse signal inputs with polarity (IN5 and IN6), totaling 6 points. The input signal to Input 1 to Input 4 has a filter function (1msec to 50msec) by software. The filter function of this software cannot be removed. The minimum filtering time is 1msec and the detection sequence is shown in the below diagram.

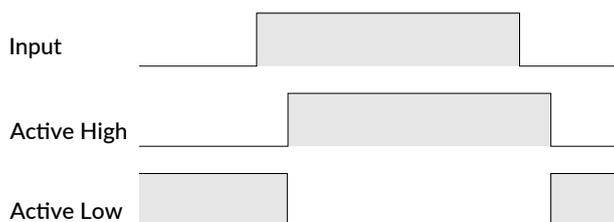
* The input filter function cannot be used for the pulse inputs.



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

4.1.2 Input Logic

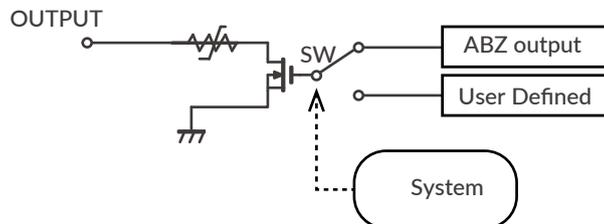
Input signal logic can be set by a parameter. Active High and Active Low settings are as shown in the below diagram. Set it to suit the logic on the controller side.



4.2 Output Signal

4.2.1 Output Function

CM3 has 4 outputs that are an open-drain circuit. OUT4 is fixed for Alarm Output and other Outputs (OUT1 to OUT3) can be set as ABZ Output or General Output by parameters.



4.2.2 Output Logic

The logic for Output 1 to Output 3 can be switched by setting Parameter.

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

Active High: Gate in open-drain circuit is ON when output condition is true

Active Low: Gate in open-drain circuit is ON when output condition is false

Refer to "[8.6 Output Functions](#)" for further information.

Chapter 5 Communication Function

5.1 Default Setting

The default settings for Resolution and pulse input method are as follows.

	Default	Values that can be set		
Resolution	1000 ppr	300 to 12000ppr		
Pulse Input Method	CW/CCW	CW/CCW	Step/Direction	A-phase/B-phase

- When no change required:
Input the pulse signal from the controller and operate the motor.
- When changing settings:
Connect PC and CM3, then follow the steps below to change the settings.

5.2 Communication Software Overview

COOL WORKS QUICK

COOL WORKS QUICK (hereafter CWQ) is CML compatible utility software, has user-friendly interface and assists easy operation of CM3. With CWQ, you can easily set and save parameters and data, stream data in graph and etc. The latest version of CWQ and its manual are available for free on MUSCLE CORPORATION's website. (<https://musclecorp.com/motion-en>)

Establish communication with CM3

If the following information is displayed when powered on, communication between PC and CM3 is established. If communication is not succeeded, please review the communication conditions.

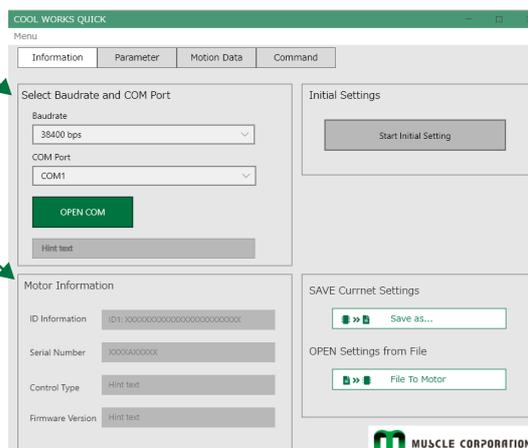
Open COM Port

Start communication with CM3

Motor Information

Once the communication is established, the information below will be shown.

- Motor ID
- Serial Number
- Control Type
- Firmware Version



*The screen is under development

Chapter 5 Communication Functions

- Settings for host devices such as PLC and HMI, and Windows terminal software such as Tera Term.

Communication conditions must be set as follows.

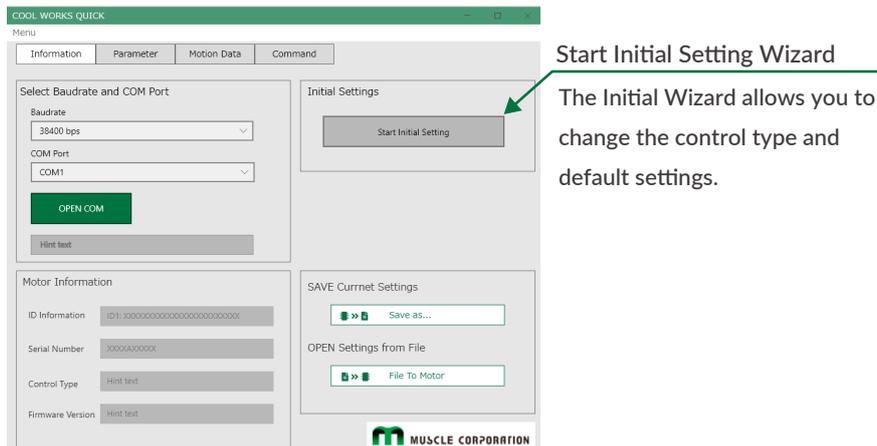
Baud rate	38400
Data	8
Parity	NONE
Stop	1
Flow Control	NONE

5.2.1 Select Control Type

Once communication is established, then select the control type.

The control type can be selected from the initial setup wizard.

1. Click the button below to open the Initial Setup Wizard.

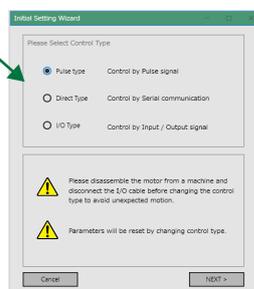


2. When the Initialization Wizard opens, select a control type. The pulse type is selected as default. Please select the "Direct type".

Select Control Type

Choose the control type from below items

- Pulse Type
- Direct Type
- I/O Type



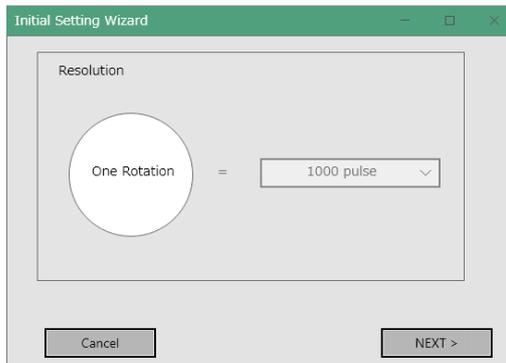
*The screen is under development

5.3 Change Basic Settings

After selecting the control type, please select the Resolution and pulse input type.

5.3.1 Resolution Setting

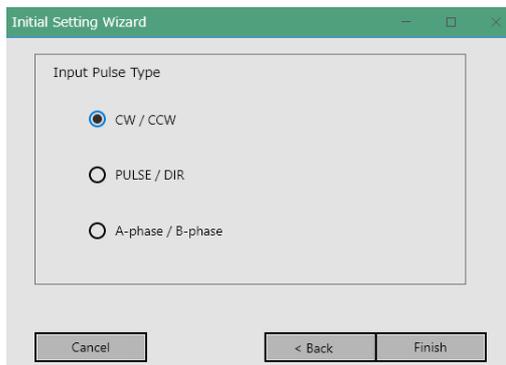
Select the number of pulses per revolution. For details on Resolution, refer to "".



5.3.2 Pulse Input Type Setting

Select the pulse method to be input to CM3.

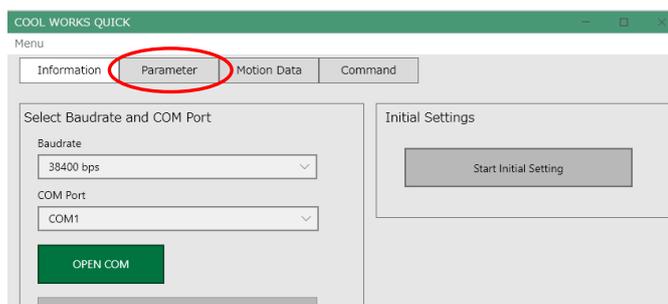
For details on the pulse input method, refer to "8.3 Positioning Operation".



- Other Settings

You can display all the setting items by clicking the button below.

The setting items will be explained in the next section.



*The screen is under development

Chapter 6 Other Setting Items

CM3 has setting parameters for various settings, execution commands and Query commands that are convenient when starting up the device. A list of each commands is shown below.

分類	内容
Parameters	Motion Environmental Parameters
	Gain Adjustment Parameters
	I/O Parameters
	Status Parameters
	Monitoring Parameters
Execution Commands	Save Parameters, Output Signal On/Off
Query Command	Query commands read the set data and current status of CM3.

As the flow to the operation, set the operation conditions by parameters then operation can be executed by applying pulse signal. You can easily create a system by creating a sequence that of signals including execution, output signals from CM3 on your host controller.

6.1 Parameter Settings

The list of parameters will be displayed by clicking "ALL" in "Parameter" window. Please set up CM3 following the details of each function and examples stated "[Chapter 7 Detail of Various Settings](#)".

* Note

- Please change parameters while CM3 is stopped.
- The changed parameter value is saved by executing the Data Save command (\$).
- For safety reasons, there are some settings that require a power off and on (Restart).

6.1.1 Motion Environmental Parameters

K	Name	Setting/Range		Unit	Restart	Reference/Remarks
1	Resolution	0	300	ppr	✓	Set the pulse count per revolution. The Resolution of ABZ encoder is Max. 3000ppr and the same Resolution as Resolution parameter is applied. When Resolution is set higher than 3000ppr, the Max. 3000ppr is applied to ABZ encoder Resolution. Ref: 7.1
		1	600			
		2	1000			
		3	1200			
		4	2000			
		5	3000			
		6	5000			
		7	6000			
		8	10000			
		9	12000			
3	Servo ON/OFF Setting	0	Servo Off			Set either CM3 starts with servo on or servo off when powered on.
		1	Servo On			
5	In-position Range	1 - 500		Pulse		Set the range for In-position. Ref: 7.3
12	Torque Limit	0 - 100		msec		Set the limit to output torque by a signal to Input 4 by the ration to the maximum torque. Ref: 8.5.4

6.1.2 Gain Adjustment Parameters

K	Name	Setting/Range		Unit	Restart	Reference/Remarks
31	Tuning	0	PPI	—		Set CM3's Tuning method. Ref: 8.7
		1	Tuningless			
32	Servo Stiffness	30 - 150				Set Servo Stiffness when Tuningless is selected. Ref: 8.7.1
33	Position P Gain	1 - 5000				Set 3 types of gains when PPI is selected. Ref: 8.7.2
34	Speed P Gain	50 - 5000				
35	Speed I Gain	0 - 5000				

6.1.3 I/O Parameters

K	Name	Setting/Range		Unit	Restart	Reference/Remarks
41	Pulse Input Method	0	CW/CCW		✓	Select Pulse Input Method from CW/CCW, Step/Direction or A Phase/B Phase Ref: 8.5.1
		1	Step/Direction			
		2	A Phase/B Phase			
42	Input Filter	1 - 50		msec	✓	Set the filtering time for input signal. Ref: 8.5.1
43	Input Logic	1st digit	IN 1	0: Active High 1: Active Low	✓	Set the input logic. Ref: 4.1.2 Ex: IN1, IN3, and IN5 as Active Low K43=010101
		2nd digit	IN 2			
		3rd digit	IN 3			
		4th digit	IN 4			
		5th digit	IN 5			
		6th digit	IN 6			
53	Output Logic	1st digit	OUT 1	0: Active High 1: Active Low	✓	Set the output logic Ref: 4.2.2 Ex: OUT3 and OUT1 as Active Low K53=101
		2nd digit	OUT 2			
		3rd digit	OUT3			
54	Output Function	0	ABZ Encoder Output		✓	Select the function to be assigned to outputs 1 to 3 from "ABZ Encoder Output" and "User Defined". Ref: 8.6
		1	User Defined			
55	Output 1 Function	0	General Output			Assign functions to Output 1 to 3 when "User Defined" is selected. Ref: 8.6.3
		1	In-position Output			
		2	Warning Output			
		3	Individual ZONE Output			
56	Output 2 Function	4	ZONE Output			
		5	MOVE Output			
		6	BUSY Output			
		7	END Output			
57	Output 3 Function	8	Servo On Output			
		9	Push Motion Output			
		10	Origin Set Completion Output			
58	MOVE Output Threshold	0 to 2147483648		pps Set by K2		Set the speed threshold to output MOVE Output signal. Ref: 8.6.3

6.1.4 Status Parameters

K	Name	Setting/Range		Unit	Restart	Reference/Remarks
61	Temperature Warning Threshold	0 to 100		°C		Set the threshold to output a temperature warning.
62	Load Warning Threshold	0 to 100		%		Set a threshold to output a load warning as a percentage of the maximum torque.
63	Position Error Overflow Threshold	1 to 32767		1000 pulse		Set Position Error Overflow Threshold between current and target position. Ref: 7.4
64	Overload Detection Time	100 to 10000		msec		Set the time to output Overload alarm. Ref: 7.5
65	Status LED	0	Enabled			Set enable / disable of the status LED Ref: 8.9
		1	Disabled			
66	Status Report	B0	In-position/Alarm	Ux.1		Set the conditions to automatically report to a host controller. Ref: 7.6
		B1	Input Status	IN.1		
		B2	Output Status	OUT.1		
		B3	No Local Echo	-		
		B4	Comment	-		
		B5	Warning	Ux.1		
		B6	N/A			
B7	N/A					

6.2 Execution/Query Commands

By clicking "Command" tab, Execution and Query commands can be sent from the window, CM3 status can be checked. Please refer to "Appendix 1 Execution / Query Command" for the details.

Chapter 7 Detail of Various Settings

7.1 Resolution (K1)

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

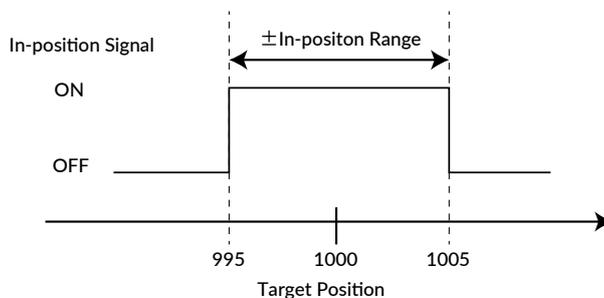
Ex: K1=2 // Set 1000 to the Resolution per rotation

7.2 In-position (K5)

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: 8.6.3).

Ex: K5=5 // Set in-position range as ± 5 pulses

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



7.3 Pulse Input Method (K41)

The following Pulse Input Method is available for CM3

- CW/CCW
- Step/Direction
- A Phase/B Phase

Please refer to "8.3 Positioning Operation" for details.

7.4 Position Error Overflow Threshold (K63)

Settable range: 1 to 32767

Unit: 1000 pulses

An error (Ux=1) is output when the deviation between the current position and the target position exceeds the set value then stop with servo off.

Ex: K63=50 // Set threshold as 50000 pulses

7.5 Overload Detection Time (K64)

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) or longer, an overload alarm (Ux.1 = 4) is output, and the servo is turned off.

Ex:

K64=3000 //When overload condition continues more than 3000msec,
the motor goes into an overload alarm status and stops with servo off

7.6 Status Report (K66)

Set the conditions to automatically report to a host controller.

When combining each condition, set the total value of each numerical value.

Ex 1: K66=13

$2^0 = 1$: Automatically report to a host when in-position and alarm occur.

$2^2 = 4$: Automatically report to a host when output status changes.

$2^3 = 8$: No local echo

When 3 functions are combined, the value of K66 shall be $1+4+8=13$ by addition.

Ex 2: K66=38

$2^1 = 2$: Automatically report to a host when input status changes.

$2^2 = 4$: Automatically report to a host when output status changes.

$2^5 = 32$: Automatically report to a host when warning occur.

When 3 functions are combined, the value of K66 shall be $2+4+32=38$ by addition.

Status Report	Bit	Ex1	Ex2
No Report	0		
In-position / Alarm	B0	$2^0 = 1$	
Input Status	B1		$2^1 = 2$
Output Status	B2	$2^2 = 4$	$2^2 = 4$
No Local Echo	B3	$2^3 = 8$	
Comment	B4		
Warning	B5		$2^5 = 32$
K66 Value		13	38

- Comment example

error.01.1: Value Out of Range!!

When a value outside the Motion Data setting range is entered

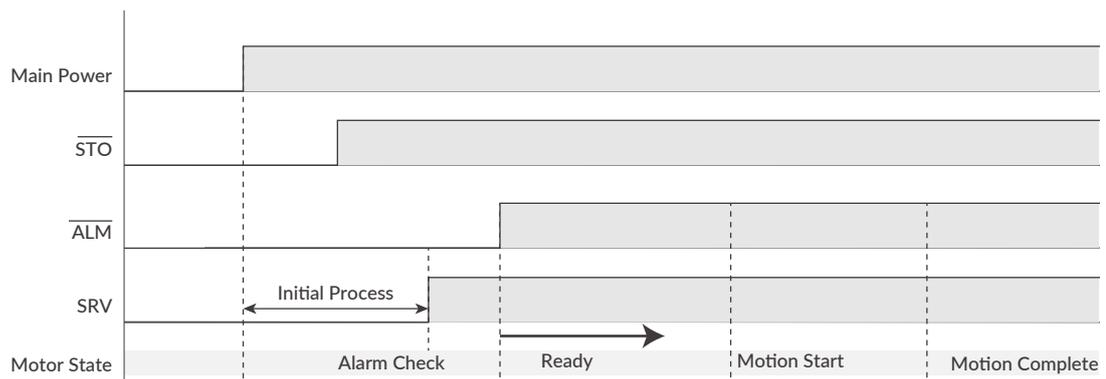
Chapter 8 Various Functions

See the legend below for the sequences in Chapter 8.

INPOS	: In-position	Ux=8	} Access via communication or Output by signal
ALM	: Alarm output	Ux=Alarm No.	
STO	: STO	Ux=1024	
SRV	: Servo status	Ux=16	

8.1 Sequence When Power is On

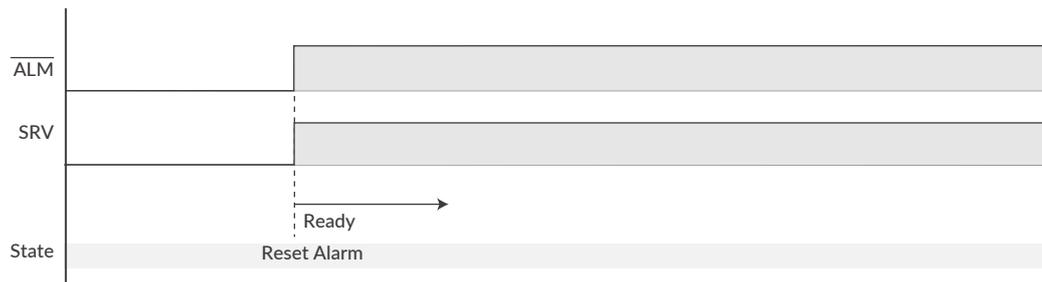
The sequence below describes from when the main power is turned on until CM3 is ready to accept commands. This sequence is only for initial servo state is "servo on".



When the main power is turned on, the system checks that the STO function is off, then the servo is on. Next, the system checks the alarm status. When there is no alarm, the ALM and END output are turned off then CM3 is ready for operation by pulse signal.

8.2 Sequence to Reset Alarm

The sequences shown below is for resetting alarm.

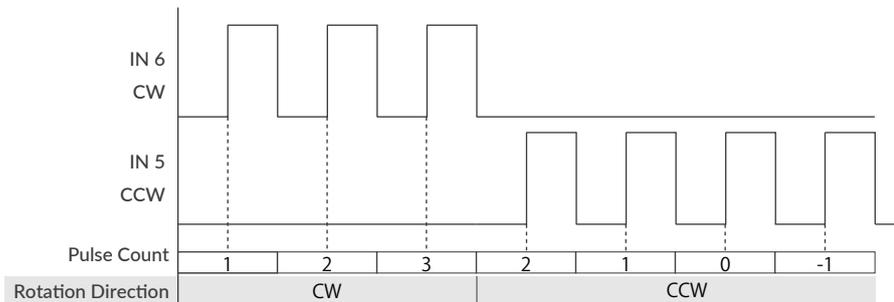


In case of alarm status, remove the cause of alarm then Servo On/Reset Alarm by a signal to Input 3. When an alarm is reset, CM3 becomes servo on and operation by pulse signal is possible.

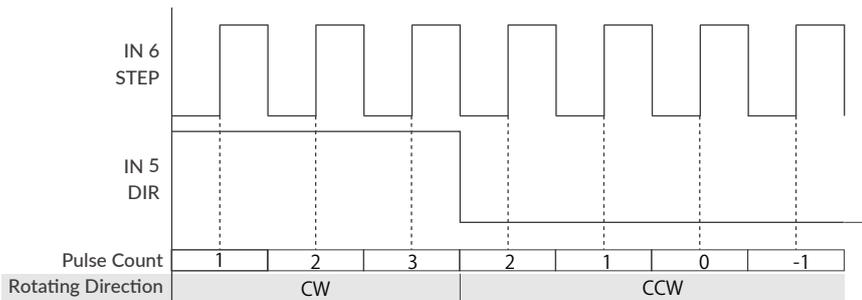
8.3 Positioning Operation

The below Pulse Input Method is available for CM3.

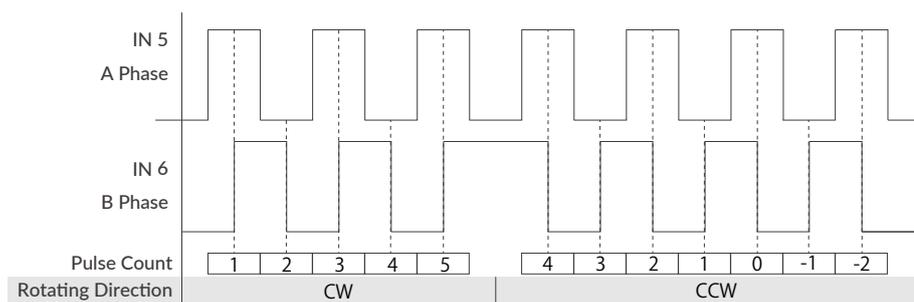
- CW/CCW (K41=0)



- Step/Direction (K41=1)



- A Phase/B Phase (K41=2)



8.4 Push Motion by Torque Limit Function

CM3 can continuously push or grip an object by this function. By turning on input 4, the output torque can be limited to the torque set by K12. The limitation is off when Input 4 is off. Apply pulse signal not to overflow Position Error Overflow Threshold when using this function. When disabling this function, send pulse signal to an opposite direction and make it sure that CM3 has moved away from an object.

8.5 Input Functions

The functions of Inputs 1 to 4, are as shown below.

Input	Function	Description
1	CCW Limit Sensor	Stop CM3 from moving in CCW direction.
2	CW Limit Sensor	Stop CM3 from moving in CW direction
3	Servo On/Alarm Reset	Turn Servo On/Off. Alarm will be reset after Servo On.
4	Torque Limit On/Off	Limit the maximum torque at the value set by K12

8.5.1 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.

Ex:

```
K42=5           //Set the filtering time for the input signal to 5 msec
```

8.5.2 Servo On/Servo Off

CM3 can be Servo On (Alarm Reset)/Off by turning Input 3 on/off by a signal.

When Input 3 is on, Reset Alarm and Servo On are executed at the same time then send the state Ux.1=8 (In-position). When Input 3 is off, CM3 sends the state ux.1=16 (Servo Off).

8.5.3 Limit Sensor

The function of the limit sensor are set to Input 1 and Input 2.

When a limit sensor is on, Operation Warning (Ux.1=256) is sent then CM3 slows down by the deceleration set in Motion Data and stops. Limit Sensor Warning (WARN.1=4) is replied to a Query command (?199). After stopping by limit sensor, operation only in an opposite direction to a limit sensor is possible.

8.5.4 Torque Limit

By turning on IN4, the torque limiting function is enabled. During torque limitation, the maximum torque is limited to the torque set by K12 and the Torque Limit Output is turned on. Turning IN4 off removes the maximum torque limit.

* The Torque Limit Output is available only when the output function is assigned..

8.6 Output Functions

CM3 has 4 outputs. Functions can be assigned to Output 1 -3 though Output 4 is fixed to ALARM output.

Either ABZ Encoder Output or User Defined can be selected as functions for Output 1-3. It is recommended that ABZ Encoder Output is selected for a host controller to control CM3 and User Defined is selected for CM3 to output its status.

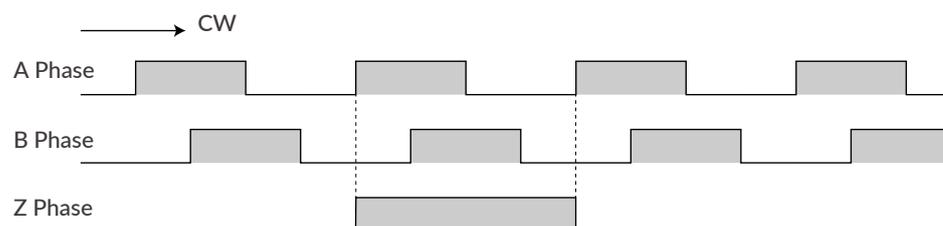
Each output function can be set by Output Function parameter. This section explains about each output functions. Refer to timing chart for the timings.

8.6.1 Alarm Output

Alarm output function is assigned to Output 4. CM3 goes in Servo Off when an alarm occurs to protect CM3. Alarm information can be confirmed by "8.9 Status LED" or reply ("Appendix 1 Execution / Query Command") to Query command (?99). Refer to "8.2 Sequence to Reset Alarm" for the sequence to cancel an alarm.

8.6.2 ABZ Encoder Output

When the output function is set to "ABZ encoder output" (K54=0), OUT1 to 3 are assigned to the ABZ phase encoder output function. The Z phase is output once per rotation, and the relationship between the AB phase and the Z phase is as follows.



Related parameters: Resolution (K1), Output Function (K54)

The Resolution of the ABZ output is fixed at 3000 ppr when the Resolution parameter is set to 3000 ppr or higher. If the Resolution parameter is less than 3000 ppr, the Resolution of the ABZ encoder output will be the same as the Resolution parameter.

8.6.3 Other Output Functions

By selecting "User setting" for output function (K54 = 1), 3 out of 11 kinds of output function can be assigned to output 1, 2, and 3. Select the function of output 1 with K55, output 2 with K56, and output 3 with 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	N/A	N/A
5	MOVE Output	Output when speed exceeds MOVE Output Threshold
6	N/A	N/A
7	N/A	N/A
8	Servo On	Output when Servo On
9	Torque Limit Output	Output when Torque Limit is active by a signal to Input 4
10	N/A	N/A

Positioning Status Output (In-position)

CM3 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 (\pm) set by In-position Range parameter (K5).

The in-position signal is turned off when the deviation between the input pulse and the current position is greater than the in-position range.

MOVE Output

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

This output signal can be used as operating signal.

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

8.7 Tuning

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

8.7.1 Tuningless (K31=1)

When selecting Tuningless by Tuning parameter, CM3 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.

8.7.2 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 CM3 servo motor. Without the gain adjustment, it may cause CM3 a vibration, too sensitive condition and some noise.

Follow the steps below to adjust CM3's position P gain, speed P gain, and speed I gain values. An adjustment with CM3 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.

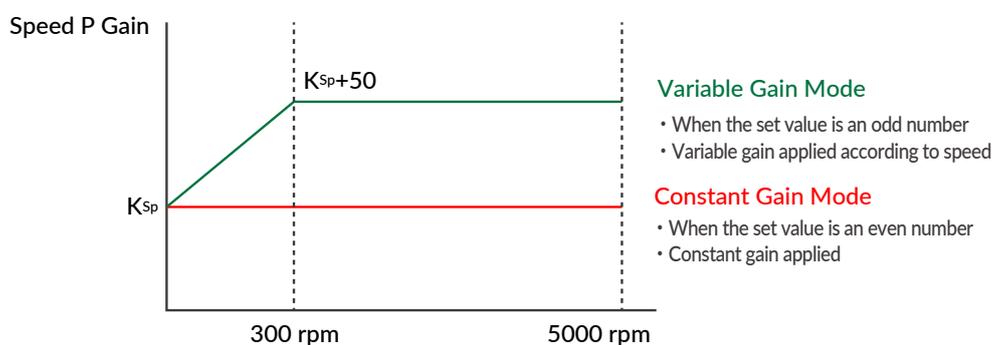
Position P gain=100

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 CM3 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.



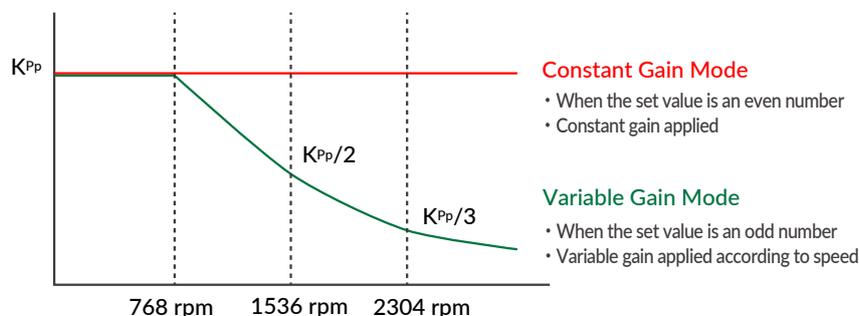
For variable gain mode, this gain setting value applies to when the speed is 0 rpm. When Speed is between 0rpm and 300rpm, Speed P gain value increases in proportion. The conclusive gain value is setting gain value plus 50.

* 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 CM3. 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.

Position P Gain



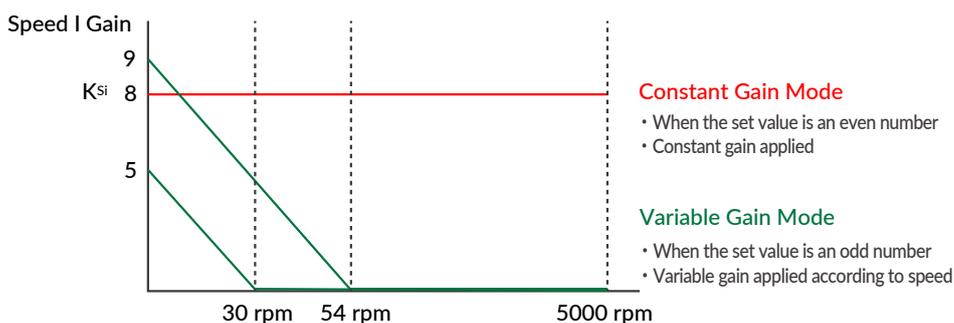
In the variable gain mode, the set value is the gain applied during low speed operation. The gain starts decreasing after the speed exceeds 768 rpm, and at 2304 rpm it becomes one-third of the set value.

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 CM3. 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.

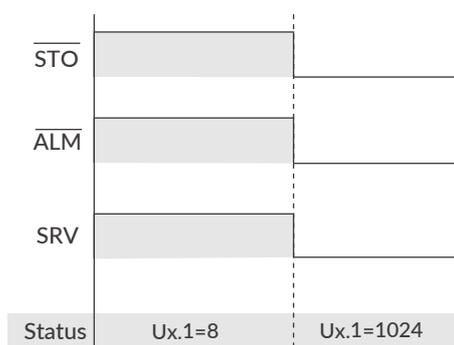
The optimal values can be set by following the above steps.

8.8 STO Function

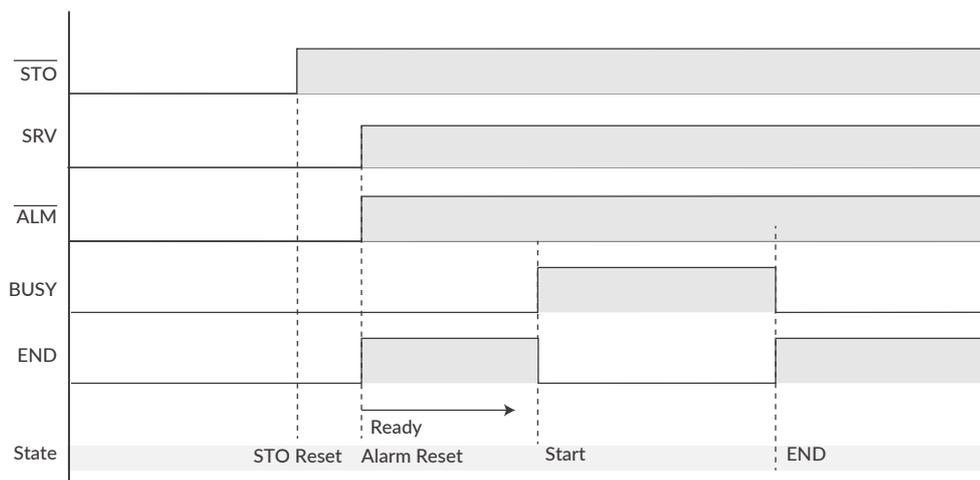
CM3 is equipped with the STO (Safe Torque Off) function, which is one of the safety functions defined in the international standard IEC61800-5-2. STO is a function that cuts off only the power supply to the motor. When the STO function is activated, the stopped state of the motor is not controlled and the servo is turned off.

If a voltage is applied between STO + and STO-, the STO will not function and CM3 is ready to operate. When the voltage is cut off, the STO works and issues an STO (Ux=1024) status. When the voltage is applied again between STO + and STO-, the STO is canceled, the alarm is canceled, and the servo is turned on at the same time.

Sequence for STO



Recovery sequence from STO state



8.9 Status LED

The status of CM3 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	Red						
Overload Alarm	Alternate	Red	Magenta					
Over Current Alarm	Alternate	Red		Green				
Over Temperature Alarm	Alternate	Red			Cyan			
Over Voltage Alarm	Alternate	Red				Blue		
Low Voltage Alarm	Alternate	Red					White	
Position Error Overflow Alarm	Flashing	Red						
Servo Off	Lighting		Magenta					
Limit Sensor	Alternate			Green				Yellow
Operation Warning	Alternate						White	Yellow
Overload Warning	Alternate		Magenta					Yellow
Temperature Warning	Alternate				Cyan			Yellow
Servo On	Lighting					Blue		
Torque Limit	Flashing					Blue		

Chapter 9 Maintenance and Inspection

9.1 Maintenance

It is important to have regular maintenance for CM3 to ensure it is operating safely.

Check Up Items

Type	Cycles	Inspection items
Daily inspection	Daily	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Is there any loose point at tighten points? • Are terminals intact not damaged?

9.2 Troubleshooting

Please check the following items before inquiring.

9.2.1 Communications

Symptom	Check	How to solve
There is no response in the software window or can not operate a motor	Is the cabling between devices connected properly?	Please see " Chapter 3 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 set correctly when using communication software?	Once change CM3 baud rate, baud rate of communication software must be changed. Read " Chapter 5 Communication Function " and create a new communication connection from the beginning.
	Is a set value corresponding to the rewritten baud rate?	Please set the same baud rate of the communication software to the value of CM3.
	Are there multiple communication software running?	If there is other software using COM ports, it may cause interference. Please close the software.

9.2.2 Motor

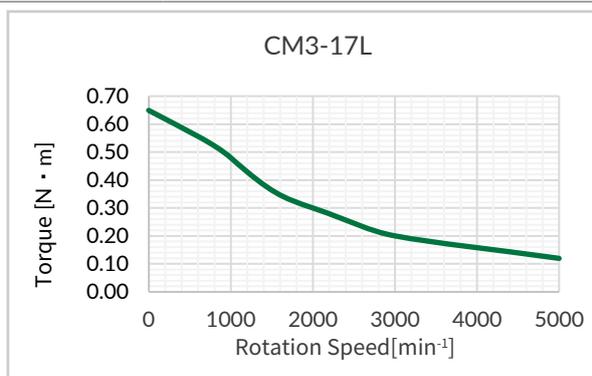
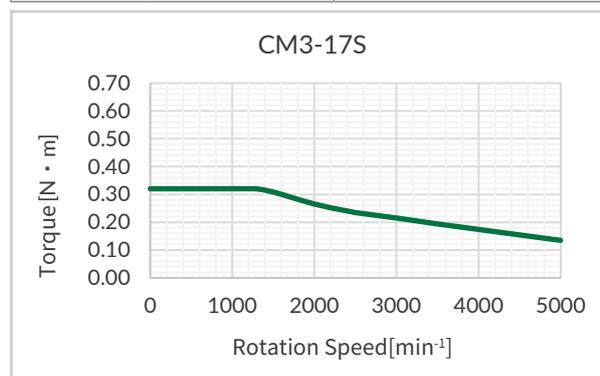
Symptom	Check	How to solve
Noise and vibrations	Are the machine and the motor resonating?	Adjust the gain or speed of CM3.
	Damage to bearing?	Check the noise and vibrations with no load applied to the motor. If there is noise and vibrations, replacement or repair is required.
Overheat	Is operating temperature 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 CM3 servo off?	Servo on the CM3.
	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, CM3 power circuit is cut off. Apply the voltage to STO input.

Chapter 10 Specifications

10.1 Basic Specifications

CM3-17S/L

Items		CM3-17S50*	CM3-17L50*
Input voltage		+24Vdc \pm 10%	
Input current / peak current		3.5 [A] / 4.8 [A]	4 [A] / 5 [A]
CM3 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 M Ω 500Vdc	
Insulation Strength	Coil-Frame	500V (1mA leak current)	
	Coils	500V (1mA leak current)	
I/O	Input	Digital Input : 6	
	Output	Digital Output: 4 (Including 1 error output)	
	STO	1	
Communication port		RS-232C	
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	

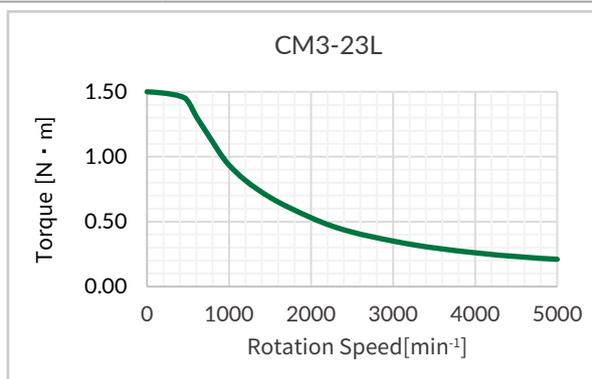
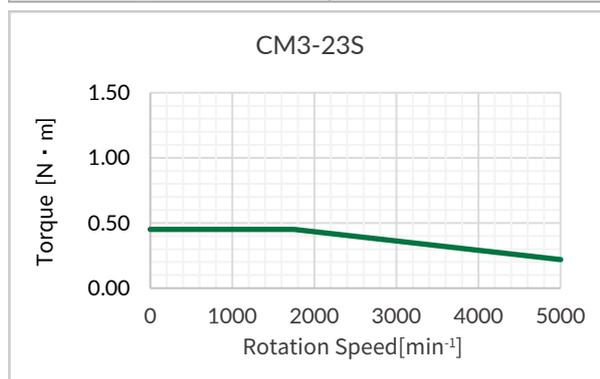


* Specifications are subject to change without notice.

Chapter 10 Specifications

□ CM3-23S/L

項目		CM3-23S50*	CM3-23L50*
Input voltage		+24Vdc ± 10%	
Input current / peak current		4[A] / 5[A]	5[A] / 6[A]
CM3 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 · m ²]	0.36×10^{-4} [kg · m ²]
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 : 6	
	Output	Digital Output: 4 (Including 1 error output)	
	STO	1	
Communication port		RS-232C	
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	



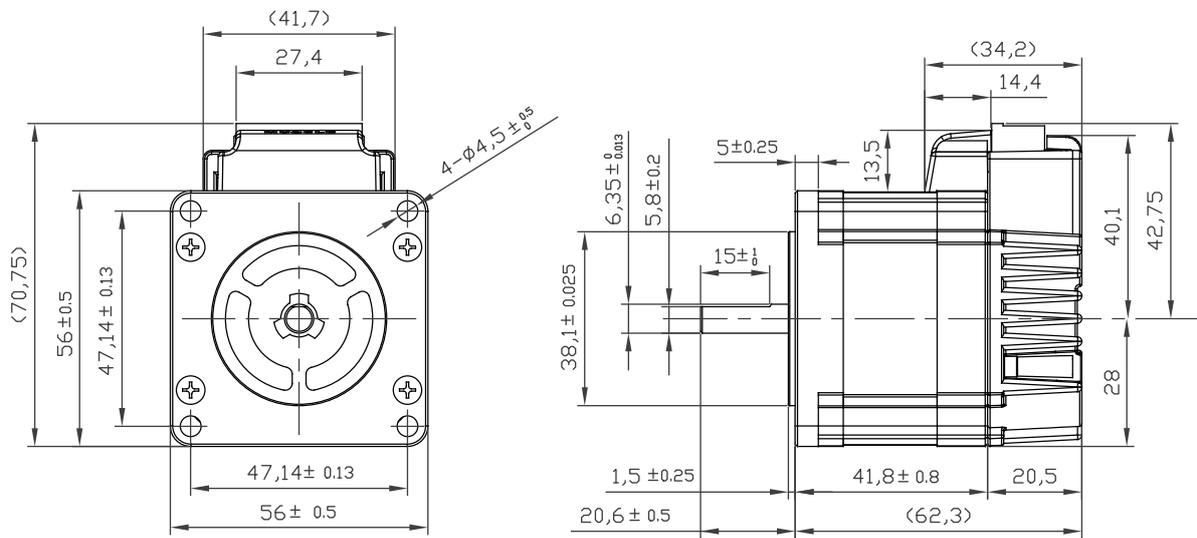
* Specifications are subject to change without notice.

10.2 Electrical Specifications

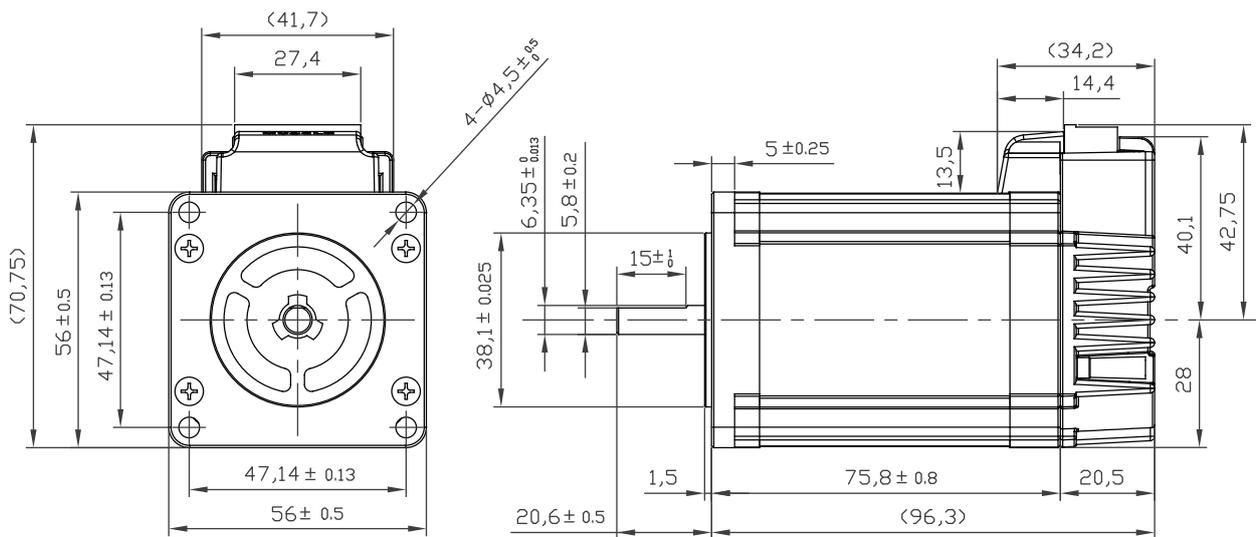
Item		Value
Digital Input	Applied Voltage	0 to 26 [V]
	Low Level Voltage	0.8 [V]
	High Level Voltage	4.2 [V]
Pulse Input	Max. Input Pulse Frequency	1 [MHz]
	Duty	50 ± 10%
Digital Output	Withstanding Voltage	50 [V]
	Max. Continuous Load Current	10mA

Chapter 10 Specifications

□ CM3-23S



□ CM3-23L



Appendix 1 Execution / Query Command

Query Command

Data set in CM3 and CM3's current status can be confirmed.

- Status Query Command

The replied data is shown as B0 to B# are set by bit.

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

CML	Name	Unit	Replied Contents		
?50	Output Status	N/A	B0	Output 1	Display output status in hexadecimal OUT.1 = Hex value 0: Off / 1: On Not available when set to ABZ encoder output.
			B1	Output 2	
			B2	Output 3	
			B3	Output 4	
?70	Input Status	N/A	B0	Input 1	Display input status in hexadecimal IN.1=Hex value 0: Off / 1: On Please reduce the acceleration for B7.
			B1	Input 2	
			B2	Input 3	
			B3	Input 4	
			B4	Input 5	
			B5	Input 6	
			B6	STO Signal	
			B7	Over Current Signal	
			B8	N/A	
B9	N/A				
?71	Temperature in Driver Case	°C	Temp.1=Value		
?72	Power Voltage	0.1V	CVSEN.1=Value		
?79	Load Factor	%	PWR.1=Value	Display percentage of rated torque	
?85	Version Information	N/A	Display CM3 Version Information		
?90	List of Parameters	N/A	Display the list of all K parameters		
?95	Position Deviation	Pulse	Pe.1=Value		
?96	Current Position	Pulse	Px.1=Value		
?97	Current Speed	Set by K2	Sx.1=Value		
?98	Current Torque	%	Ix.1=Value	Display percentage of the Max. torque	
?99	Motor Status	N/A	B0	Position Error Overflow	Display Motor Status in decimal Ux.1=Decimal Value The contents of the operation warning and status warning can be checked by "?199."
			B1	Overvoltage Alarm	
			B2	Overload Alarm	
			B3	In-position	
			B4	Servo off	
			B5	Torque Limit	
			B6	Overcurrent Alarm	
			B7	Temperature Alarm	
			B8	Operation Warning	
			B9	Low Voltage Alarm	
			B10	STO Activated	
			B11	Status Warning	
B12	N/A				

Appendix 1 Execution / Query Command

Warning Query Command

Warning information can be checked with the Warning Query Command. Since the warning is a state before the alarm, the motor will not be servo off. Utilizing warnings will help preventive maintenance of CM3.

CML	Name	Unit	Contents		Category	Cause
?199	Warning WARN.1=Value	N/A	B0	N/A	N/A	N/A
			B1	N/A	N/A	N/A
			B2	Limit Sensor Warning	Operation	Limit sensor is on
			B3	N/A	N/A	N/A
			B4	N/A	N/A	N/A
			B5	Execution Warning	Operation	An operation command is sent when operation cannot be performed
			B6	Temperature Warning	Status	Temperature inside of driver case exceeds the set value of K61
			B7	Over Load Warning	Status	The load exceeds the set value of K62

The replied data is shown as B0 to B# are set by bit.

Ex. When B6、 B3、 B2 are ON

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

Binary : 0100 1100

Decimal : $2^6 + 2^3 + 2^2 = 64 + 8 + 4 = 76$

Hex : $76 = 16 \times 4 + 12 = 4C$

Execution Format

"CML command" No

*Number can be omitted when it is not required

Example: \$

// Save all the Parameters and Motion Data.

CML	Name	No	Contents
\$	Data Save	—	Save data *Make sure the motor is not running before sending the command.
O	Output Signal On	1 - 3	Turn on the specified output Ref: 8.6.3
F	Output Signal Off	1 - 3	Turn off the specified output Ref: 8.6.3

Appendix 2 ASCII Code Chart

The programming language CML via RS-232C serial communication can control CM3.

MUSCLE developed CML based on ASCII code that is the most modern character-encoding schemes used for computer and communication devices. ASCII code chart is as shown in the below table.

ASCII Code Chart

		Upper 4-bit (Hex)							
		0	1	2	3	4	5	6	7
Lower 4-bit (Hex)	0	NUL	DLE	(SP)	0	@	P	`	p
	1	SOH	DC1	!	1	A	Q	a	q
	2	STX	DC2	“	2	B	E	b	r
	3	ETX	DC3	#	3	C	S	c	s
	4	EOT	DC4	\$	4	D	T	d	t
	5	ENQ	NAC	%	5	E	U	e	u
	6	ACK	SYN	&	6	F	V	f	v
	7	BEL	ETB	‘	7	G	W	g	w
	8	BS	CAN	(	8	H	X	h	x
	9	HT	EM	)	9	I	Y	i	y
	A	LF	SUB	*	:	J	Z	j	z
	B	VT	ESC	+	;	K	[	k	{
	C	FF	FS	,	<	L	\	l	|
	D	CR	GS	-	=	M	]	m	}
	E	SO	RS	.	>	N	^	n	to
	F	SI	US	/	?	O	_	o	DEL

CML is composed of the combination of the character code above.

Appendix 3 Conformance

CE Marking

CM3 is a component that is intended to be incorporated into machines and equipment for industrial use. When CM3 is built into machines or equipment, it must be established that the machine or equipment fulfills the requirements of the EU Directives.

RoHS Directive

CM3 is conformed to RoHS directive.

EMC Directive

The EMC Directive applies not to CM3 alone but to machines and equipment incorporating CM3. CM3 is conformed to EMC directive.

The conditions of installation, wiring and grounding may be different to the above example, when CM3 is incorporated in machinery or equipment. Therefore, the conformity assessment is required to the machinery or equipment, with CM3 is incorporated, as a whole, in order to meet the EMC Directive. (The whole machinery or equipment, incorporating CM3, is subjected to the EMC Directive, rather than CM3 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
August 2020	MDUG-CM3/20831E-01			New Document