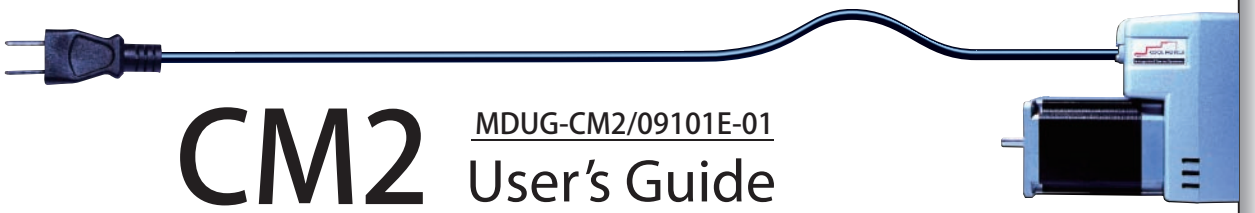
Integrated AC Servo System
COOL MUSCLE 2



CM2 User's Guide

MDUG-CM2/09101E-01

Motor
•
Encoder
•
Driver
•
Controller
•
PLC
•
Power supply

All in **ONE** Solution

MUSCLE CORPORATION

☐ 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 dose 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.
- Please notify our sales representative if you have some questions or comments with the contents of this User's Guide.
- The contents of this User's Guide do not guarantee or grant rights to patents, copyright, or any other rights to the intellectual property of Muscle Corporation or any third party. Muscle Corporation is not responsible for any problems that may occur concerning the intellectual property rights of third parties resulting from the application of information provided in this User's Guide.
- Cool Muscle is a registered trademark of Muscle Corporation.
- Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and other countries.
- Other company names and product names described in this User's Guide are trademarks or registered trademarks of their respective holders. The trademark notices (TM, ®) are not necessarily appended to company, system, and product names described in this User's Guide.

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 equipments or systems which have an affect on 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 dameges 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 explaind 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.

Note that some items described as Cautions may result in more serious damage under certain conditions. Please observe the precautions of both levels because they are important to personnel safety.

“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 the motor while operating.
The failure could result in injuries.

- Take a measure for safety to keep away contact by personel.

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.

- Ambient temperature / Working : 0 to 40℃, Storage : -20 to 60℃ (non freezing)
- Ambient humidity : Below 90%RH (non condensing)
- Vibration / Shock resistance : Below 9.8ms^{-2} (1G) / Below 98ms^{-2} (10G)
- 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..

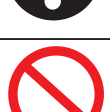
Be sure to fix the product on the machine firmly.
- If fixation is not tight enough, the product may come off while operating.

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.

Do not block up a venting hole in the enclosure of driver.
- The failure could result in abnormal temperature.



Caution (wiring)

Wiring must always be performed properly and reliably.

- Ensure that terminal connection or porarity (+, -) 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 burst.

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

- The failure could result in damages or burst.

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

- The failure could result in damages or burst.

Caution (usage)

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

- When a trouble occurs, shutoff 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 actions)

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

- The failure could result in damages or burst.

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, shutoff the power immediately and do not turn on the power.

- The failure could result in damages or burst.

Caution (maintenance, 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.

INDEX

Chapter 1

Chapter 2

Chapter 3

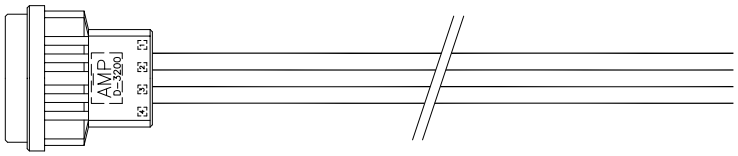
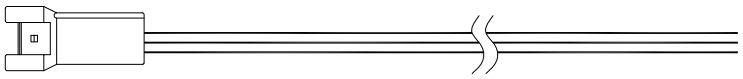
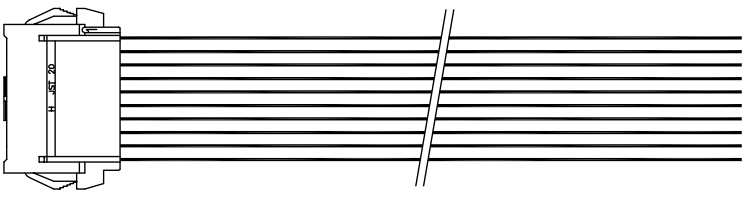
Explanation of icon

Icons used in this User's Guide.

	Warnings and notices
	Important points
	Supplemental explanations

Bundled Items

CM2 package includes CM2 and following cables.(ⓐ～ⓒ: Refer to 3.1)

#	Cable	Application
ⓐ	accessory power supply cable	500mm one side connector 
ⓑ	accessory communication cable	500mm one side connector 
ⓒ	accessory I/O cable	500mm one side connector 

Chapter 1

Functions and Structure

1.1. Overview

The COOL MUSCLE 2 (CM2) is the world smallest integrated AC servo system that combines motor, encoder, driver, controller, PLC and power supply. The use of its own program language " CML " (COOL MUSCLE Language) allows easy creation and control of motion. CML is a powerful motion programming language that simplifies and supports PTP motion, interpolation function* and torque control. CM2 provides the highest system solution. (*optional)

Features of CM2

■ Motor

CM2 is based on an AC servo motor allowing for high speed, Max.8000min.

100W, 200W and 400W models are available.

■ Encoder

Muscle's unique magnetic encoder gives CM2 a Max. 50,000 ppr, and realizes the smooth motion and high-accuracy positioning.

■ Driver

An ultra compact driver incorporates closed loop vector control.

Muscle's unique control technology eliminates the servo tuning.

■ Controller

Various kinds of motion as PTP motion, interpolation function (optional) and torque control are supported.

Muscle's original OS is built in.

■ Integrated PLC Function

CM2 has 6 inputs and 4 outputs.

A totally new integrated AC servo system incorporates PLC function as arithmetic / logical operation and more.

■ Integrated Power Supply

Motor control/drive power supply is built in!

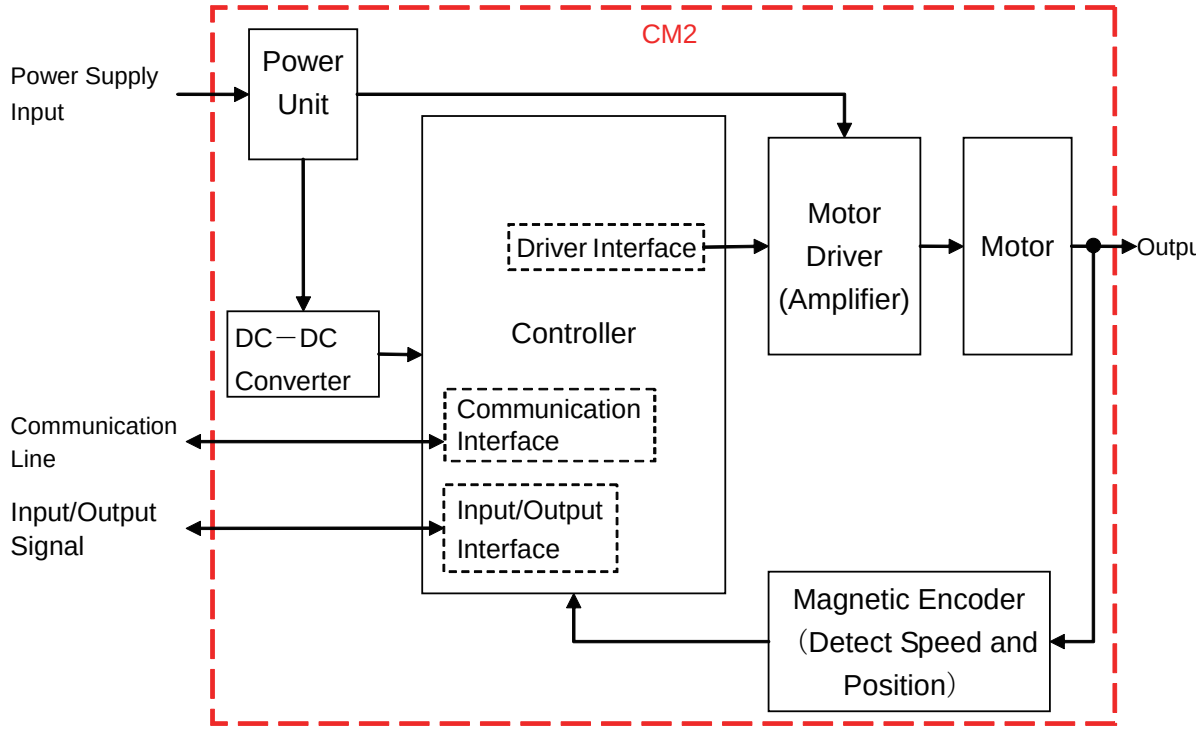
CM2 can be connected directly to AC100V-240V power source without conversion.

■ Communication

Two RS-232C ports.

Multi-axis network can be easily created by the daisy chain connection.

1.2. Block Diagram



1.3. Product Code Scheme

Product code scheme is described as below.

CM2-C-56B10A-R

Control Type
- P Pulse
- C Computer
- R Interpolation

Motor size
- 56 56mm
- 60 60mm

Motor Series

Motor Output
- 10 100W
- 20 200W
- 40 400W

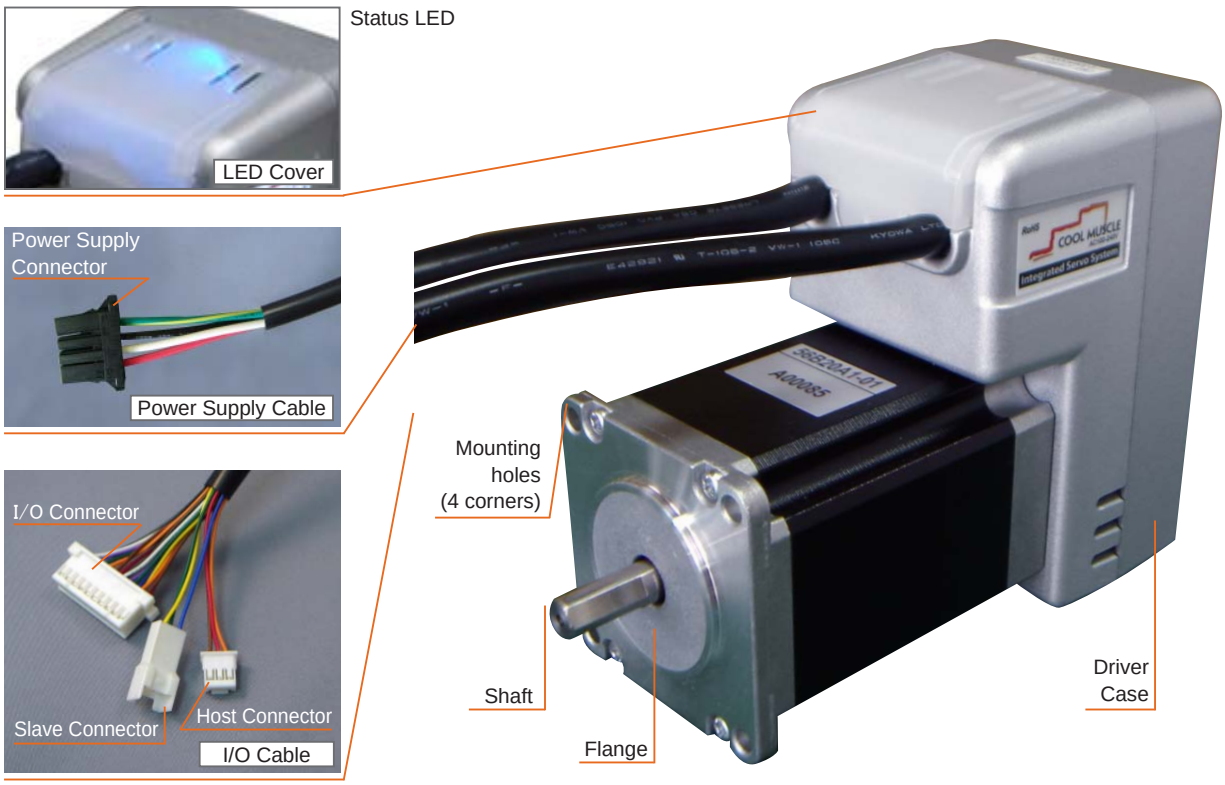
Shaft end (*Option)
- R Round shaft
- K Keyway *
- D D-cut *
- W Double D-cut *

CM2 Model numbers are as below.

Cool Muscle 2 names	Model #
COOLMUSCLE2 CM2 56□ 100W ⋆Type	CM2-⋆-56B10A-⋆
COOLMUSCLE2 CM2 56□ 200W ⋆Type	CM2-⋆-56B20A-⋆
COOLMUSCLE2 CM2 60□ 100W ⋆Type	CM2-⋆-60A10A-⋆
COOLMUSCLE2 CM2 60□ 400W ⋆Type	CM2-⋆-60A40A-⋆

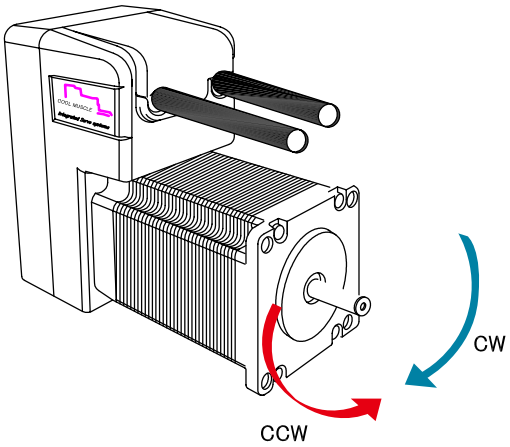
1.4. Parts Description

Each part of CM2 is as below.



1.5. Motor's Rotating Direction

The rotationg direction means as drawn in right.



CW (Clockwise) :

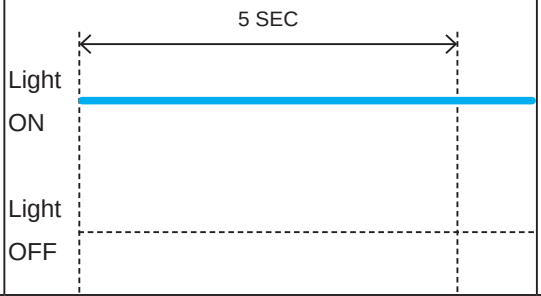
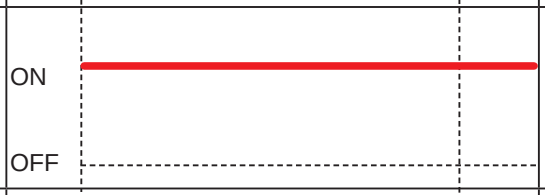
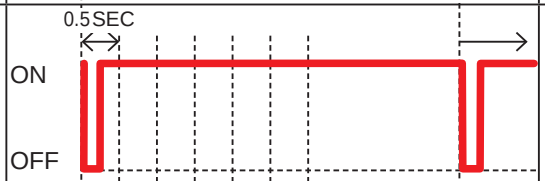
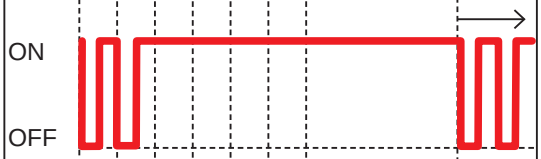
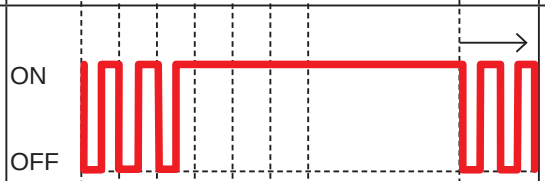
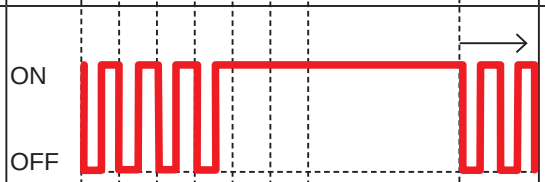
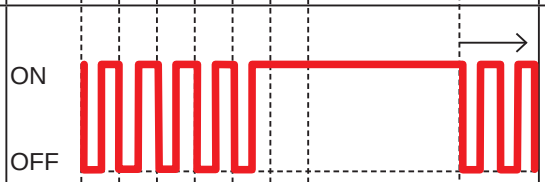
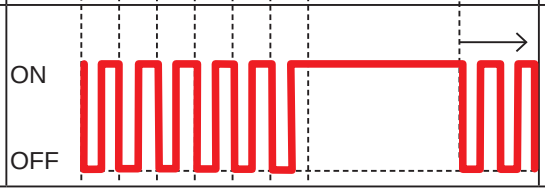
Facing to the output shaft, the motor shaft rotates in Clockwise direction.

CCW (Counterclockwise) :

Facing to the output shaft, the motor shaft rotates in Counterclockwise direction.

1.6. Status LED

Status LED lights as follows by the status of CM2. (Status LED can be inactivated by parameter setting)

Status LED		Pattern of lighting / blinking	Status of CM2
Blue 	Lighting		Servo ON
Red 	Lighting		Motor free by CML command or input function
	Blinking once		Overflow of position error
	Blinking twice		Over voltage
	Blinking 3times		Overload
	Blinking 4times		Temperature error of driver
	Blinking 5times		Push motion error
	Blinking 6times		Emergency stop

1.7. Control Type

Control types of CM2 include Computer, Pulse and Interpolation allowing you to choose the appropriate type for your application.

1.7.1. Pulse Type (P Type)

Pulse type CM2 can replace the existing pulse controll unit.
Input methods for Pulse type include CW/CCW pulses and Pulse/ Direction style. This input method can be selected by parameter K36. Please refer to the CML User's Guide for more information.

1.7.2. Computer Type (C Type)

The operation controlled by a command or a program are possible. C type CM2 can be operated in the following methods.

【Direct Mode】
If your application requires complicated motion or arbitrary motion, you can send CML commands directly to CM2 via PC or embedded computers as needed. Immediate motion of CM2 is triggered and executed every time CML commands are sent from computer.
This mode is useful for debugging the programs or test runs. Please refer to the CML User's Guide for more information.

【Program Mode】
CM2 operates in accordance with a pre-defined program using CML. For the application which requires repetitive motion, it is realized by executing pre-programmed positioning program stored in CM2, eliminating the need for an external controll unit. Pre-loaded programs in CM2 can be set to run using a switch connected to input, PC or PLC.
Please refer to the CML User's Guide for more information.

1.7.3. Interpolation Type (R Type)

R type CM2 has the function of Circular/Linear Interpolation in addition to the function of Computer Type.
Circular Interpolation function can easily generate an arc trajectory only by specifying radius or center point of circle without a complex hand calculation and describing the calculating formula.

Chapter 2

Installation

Installing in an improper location or mounting to machinary incorrectly, CM2 could result in abnormal behavior or an unpredictable accident. Please read the following cautions to ensure safe and proper use of CM2.

2.1. Operating Condition

Please refer to Section 9.1 for operating and storage conditions.

The following instructions should also be fully noted.

- Indoor where there is not direct sunlight on the product.
- Cooling ventilation is properly considered.
- No dust, metal particles, corrosive gas, flammable gas, oil mist.
- No drop of water and cutting oil.

  Please note that CM2 is not environmentally sealed. Using CM2 in a place where water or oil gets into it may cause insulation failure or short-circuit.
- Use in a place where inspection and cleaning are easy to do.

＊ Please contact us when the motor is required for more demanding conditions.

2.2. Mounting to Machinery

2.2.1. General Notes

【 Mounting Direction 】

CM2 can be mounted horizontally or vertically.

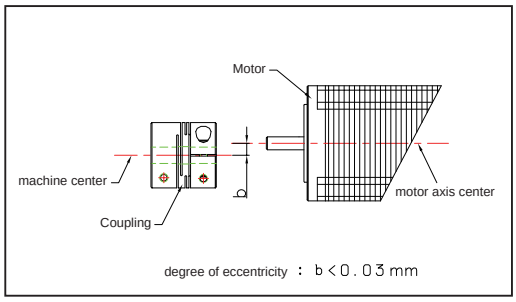
【 Impact / Vibration 】

Please avoid mounting CM2 where excessive impact and vibrations occur.

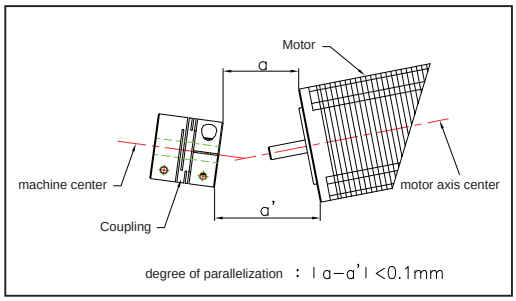
Protect CM2 from impact such as hammering during mouting. Never apply any direct impact to the motor shaft.

2.2.2. Coupling / Centering

Use a coupling when connecting the motor to a machine to avoid unnecessary load. Make sure that the motor shaft and the machine center are properly aligned.
Use a flexible coupling with high torsional stiffness. Use of a flexible coupling with low torsional stiffness may cause unstable motion.



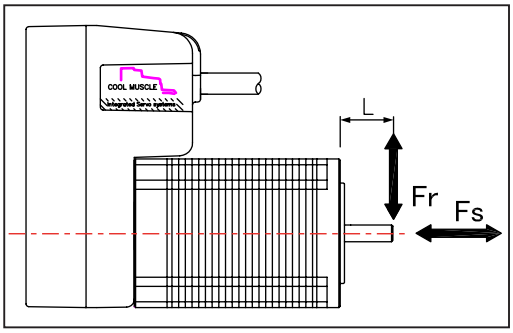
When the machine center and the motor shaft are not properly aligned, vibration may occur, resulting in damage to the motor bearings. Please make sure to align the motor shaft with the mashine center within the error tolerance as the diagram in the right. Do not apply impact or force to the motor shaft during mounting a coupling.



2.2.3. Allowable Shaft Load

Allowable Radial Load and Thrust Load onto the motor shaft are described in 9.1, Specification. Design the machinery to ensure that shaft load does not exceed the allowable values.

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



2.2.4. Notes for Shaft Load

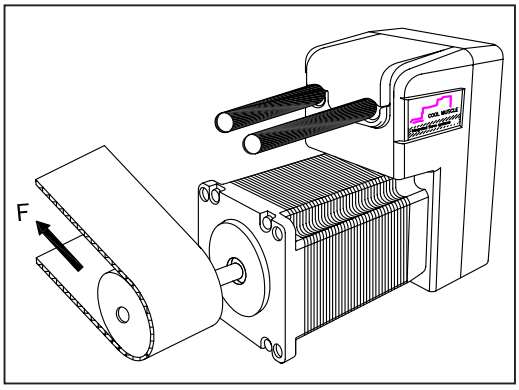
【Radial Load】

Excessive radial load could damage the motor bearings.

● Belt Drive

When a pulley is directly mounted onto the shaft, take note of radial load caused by belt tension.

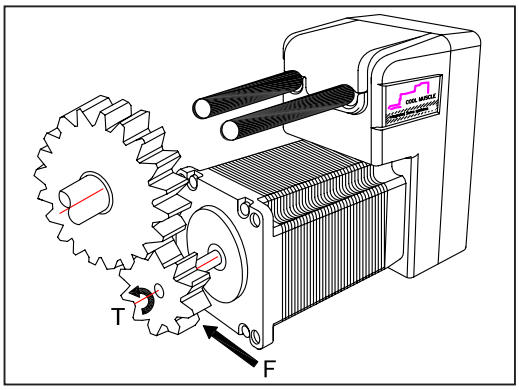
To prevent slipping and respond to overload, a wide belt with strong tension tends to be used for design on the safe side. Moreover, this tendency may be increased by the adjustment not using a measurement tool.



● Gear drive

When a gear is directly mounted onto a motor shaft, radial load is occurred.

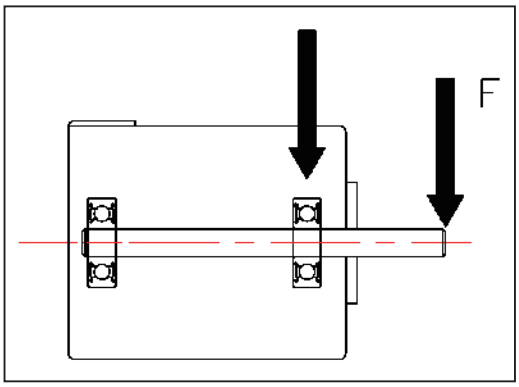
The larger radial load is caused by using smaller gears to obtain high reduction ratio. Please make sure that the axial load is within the values of specifications.



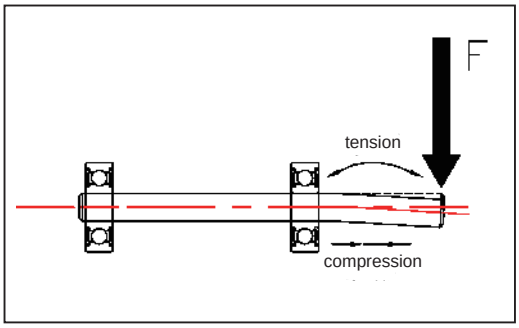
● Overhang load

When the motor shaft is overhung, a vertical force onto the overhung part has a big influence on the motor shaft.

Overhang load is multiplied by the leverage effect, stressing the motor shaft bearing. The longer the overhung length, the larger the overhang load.

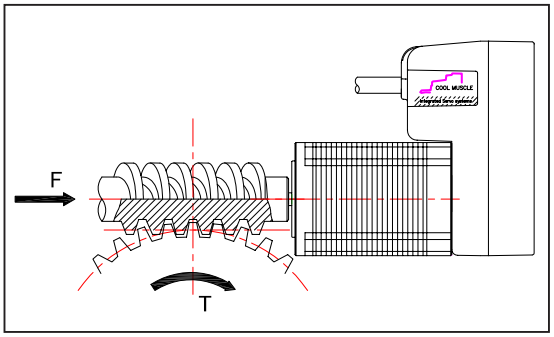


Moment load is applied (see the illustration in the right) to the motor shaft that is overhung. A tension force is applied to the top half of the shaft and compression forced is applied to the bottom half of the shaft. During the shaft rotation, these opposite forces alternate and stress the shaft, and continued rotation over the long term could result in break.



【Thrust Load】

Large thrust load could damage the motor shaft bearings. A large thrust load could even move the shaft , damaging an encoder that is mounted at the other end of the shaft. When mounting a worm gear directly onto the motor shaft, a large thrust load occurs. Make sure that a thrust load is not applied to the motor shaft when mounting or taking off a gear, pulley or coupling.

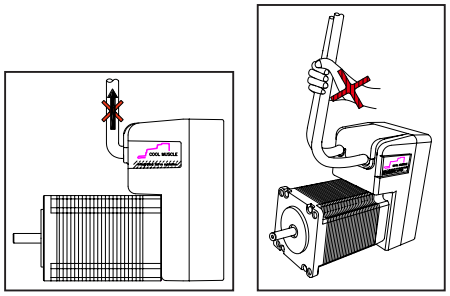


2.3. Notes for Cabling

● Make sure that bending stress or tension force is not applied to the cable.

● Do not connect or disconnect connectors when the motor is powered. Make sure that the power is OFF before connecting or disconnecting the connector.

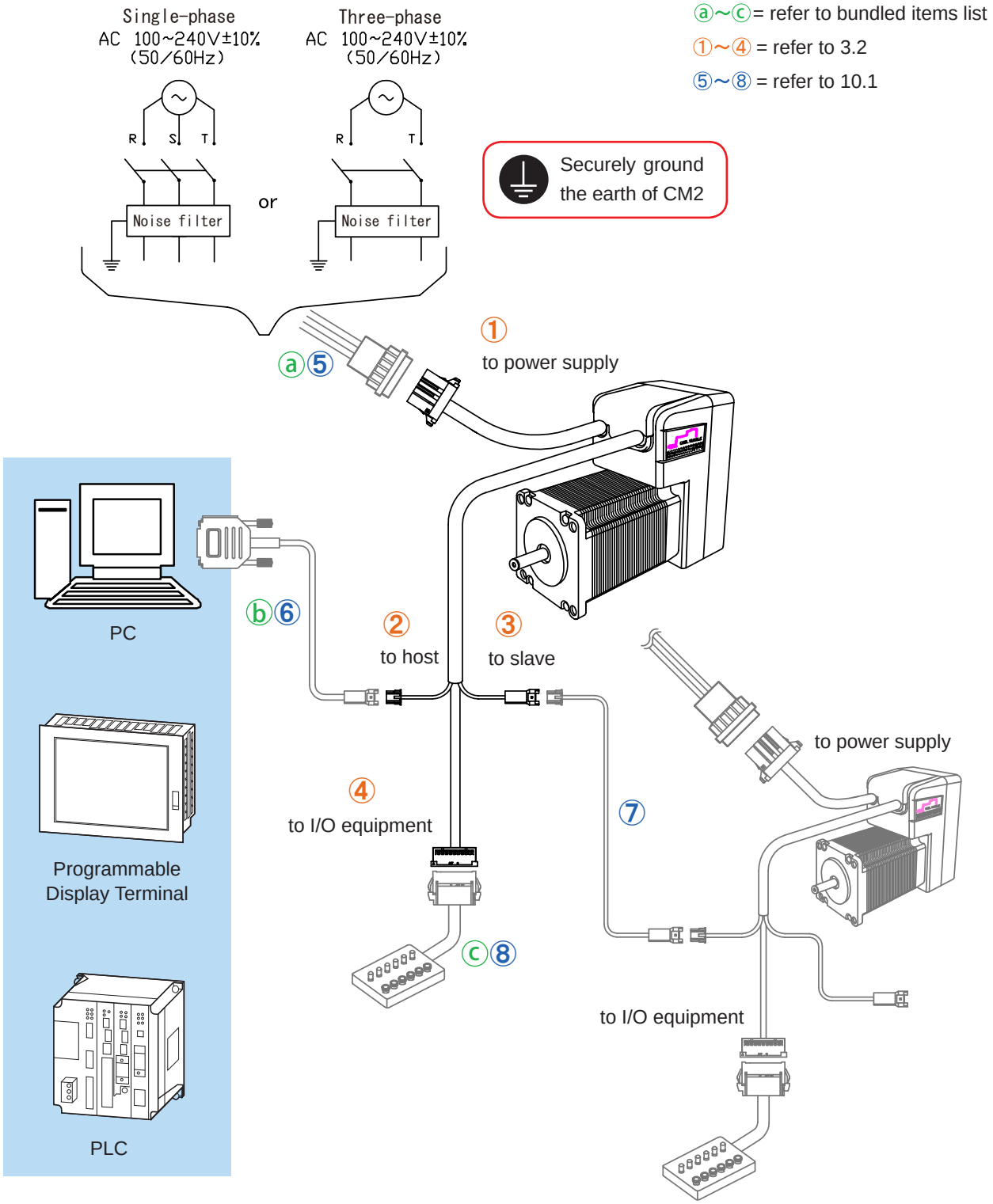
● Do not pull the cable forcefully or use the cable to carry or hang CM2. This may damage the connectors.



Chapter 3

Wiring and Connections

3.1. Typical Connection Example

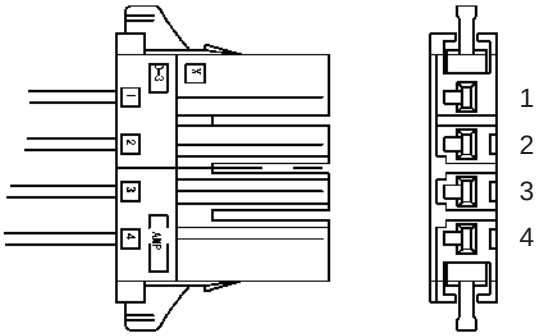


3.2. Connector Pin Layout and Functions

Connector Pin layout for each CM2 cable is as below.

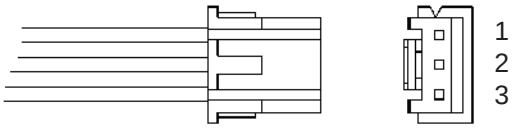
【Pin layout】

① Power supply Connector 1-178128-4 (Tyco Electronics AMP)



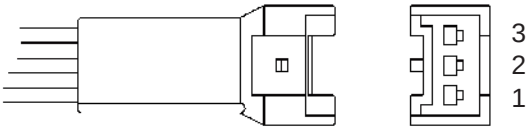
No.	Color
1	Red
2	White
3	Black
4	Green-Yellow

② Host Connector XAP-03V-1 (JST)



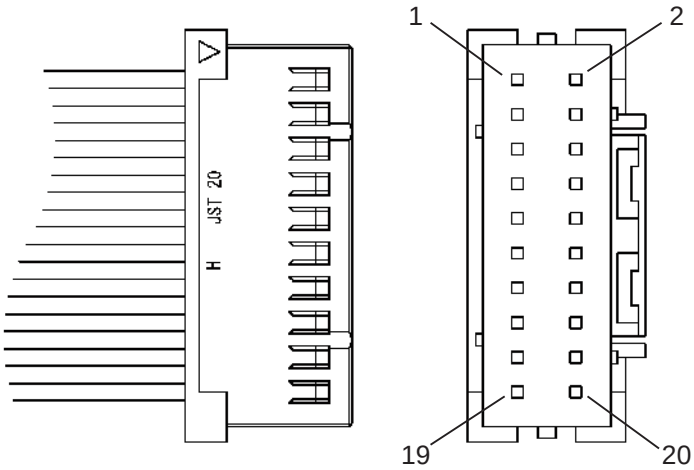
No.	Color
1	Brown
2	Red
3	Orange

③ Slave Connector XARR-03VF (JST)



No.	Color
1	Yellow
2	Green
3	Blue

④ I/O Connector XADRP-20V (JST)



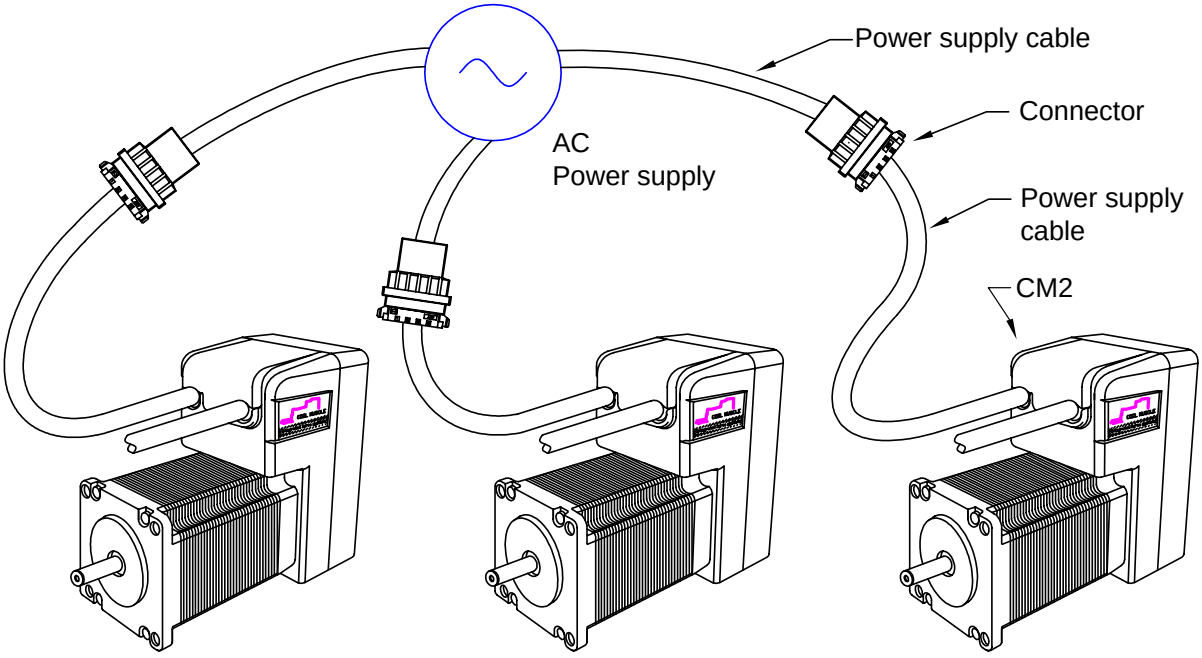
No.	Color	No.	Color
1	Brown	11	Brown
2	Red	12	Red
3	Orange	13	Orange
4	Yellow	14	Yellow
5	Green	15	Green
6	Blue	16	Blue
7	Purple	17	Purple
8	Gray	18	Gray
9	White	19	White
10	Black	20	Black

【Connector Pin Function List】

Cable	Connector					
	Name	No.	Pin name	Functions		
Power supply Cable	① Power supply Connector	1	R / L1	3 phase / Single phase AC input		
		2	S	3 phase AC input		
		3	T / L2	3 phase AC / Single phase AC input		
		4	E	Earth		
I/O Cable	② Host Connector	1	RXD0	RS-232C, Receive data from host		
		2	TXD0	RS-232C, Transmit data to host		
		3	GND	Communication GND		
	③Slave Connector	1	TXD1	RS-232C, Transmit data to slave		
		2	RXD1	RS-232C, Receive data from slave		
		3	GND	Communication GND		
	④ I/O Connector	1	+5V	+5V Output (0.2A max)		
		2	INPUT1+	Digital Input 1+	CW+	Pulse+
		3	INPUT1-	Digital Input 1-	CW-	Pulse-
		4	INPUT2+	Digital Input 2+	CCW+	Direction+
		5	INPUT2-	Digital Input 2-	CCW-	Direction-
		6	INPUT3	Digital Input 3		
		7	INPUT4	Digital Input 4		
		8	INPUT5	Digital Input 5		
		9	INPUT6	Digital Input 6		
		10	INPUT COM	Common for digital input3~6		
		11	OUTPUT1	Digital Output 1		
		12	OUTPUT2	Digital Output 2		
		13	OUTPUT3	Digital Output 3		
		14	OUTPUT4	Digital Output 4		
		15	OUTPUT COM	Common for digital output1~4		
		16	ANALOG IN	Analog Input		
		17	ANALOG OUT	Analog Output		
		18	N.C.	-		
		19	GND	Signal Ground		
		20	GND	Signal Ground		

3.3. Connecting to Power Supply

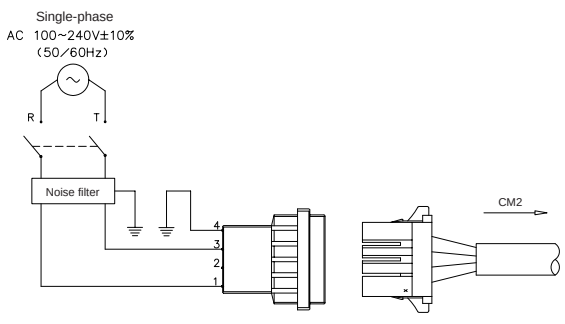
Connect CM2 Power Supply cable to AC power supply.



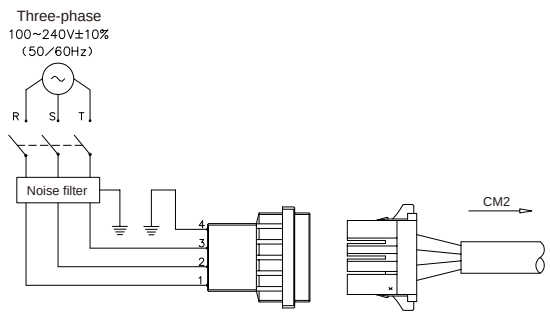
Make sure that the power is OFF while connecting the cables.
Power ON after confirming the wiring is thoroughly correct.

Securely ground the earth of CM2.

【 Single-phase 】

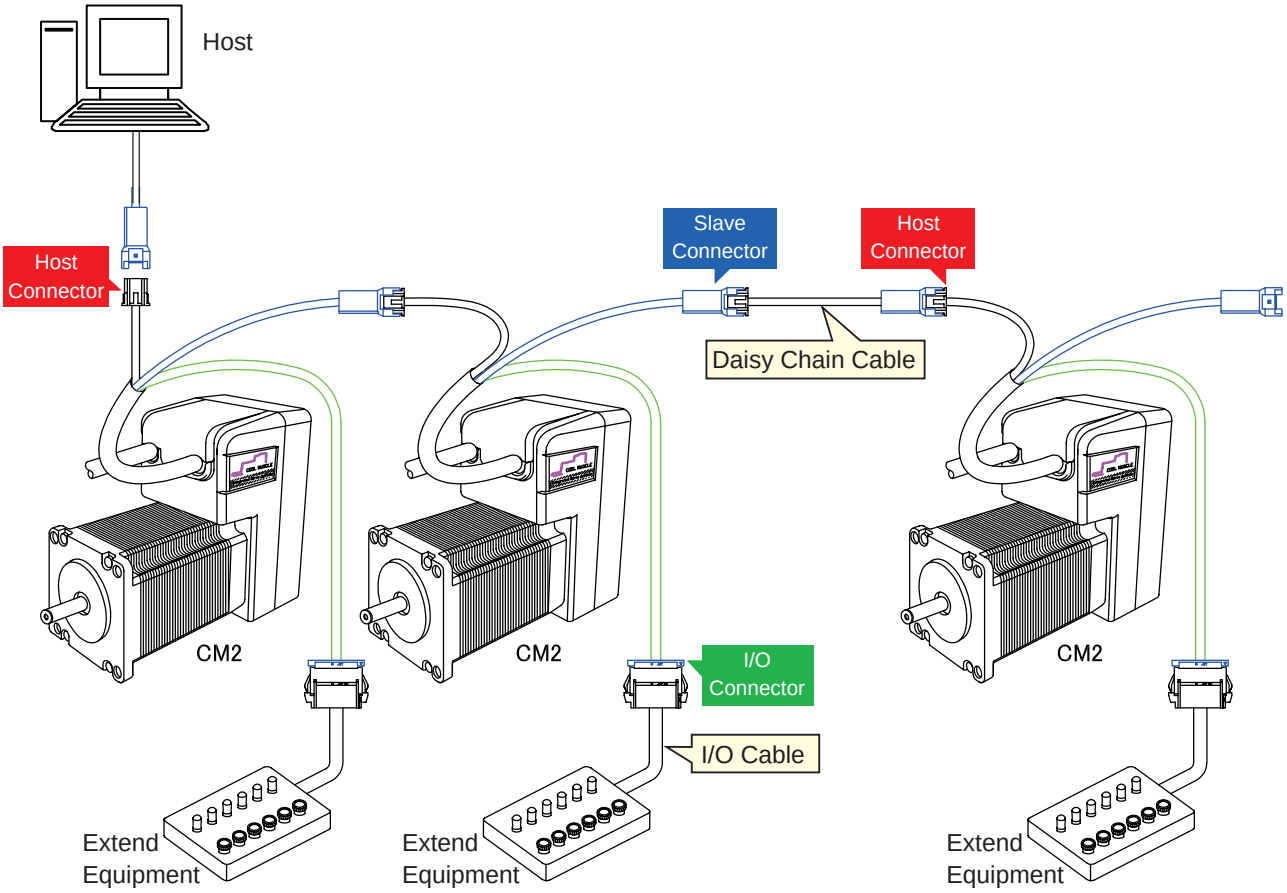


【 Three-phase 】



3.4. Connecting to Equipments

Up to 15 CM2s can be daisy-chained by connecting the host connector to the slave connector of each CM2. Use of a daisy chain cable (option) allows a longer distance communication between CM2s. Among plural CM2s, only the host connector of the 1st Axis (CM2) must be connected to a host such as a PC. And if necessary, connect the I/O connector with each external equipment by using an I/O cable.

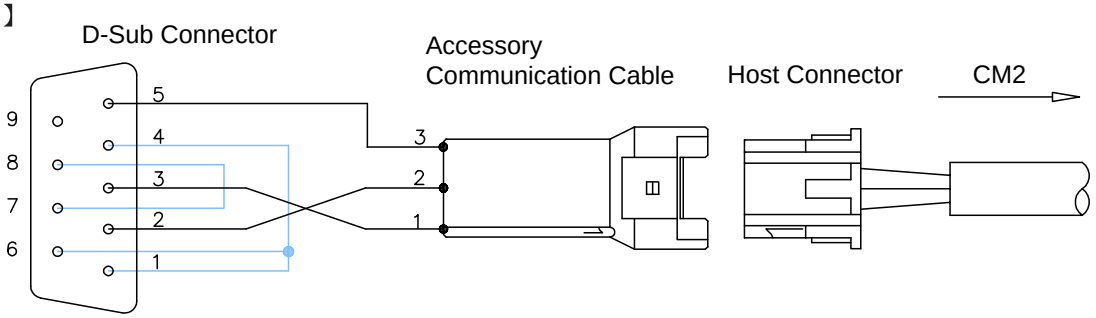


Make sure that the power is OFF while connecting the cables.
Power ON after confirming the wiring is thoroughly correct.

3.4.1. Connection for Host Communication

The connecting diagram of an attached communication cable and a D-Sub connector linked to the host is as follows.

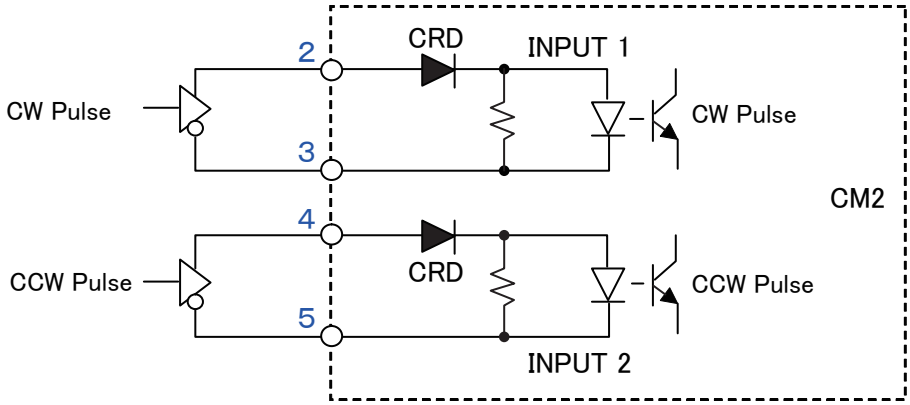
【 9 Pin 】



3.4.2. Connection for Pulse Input

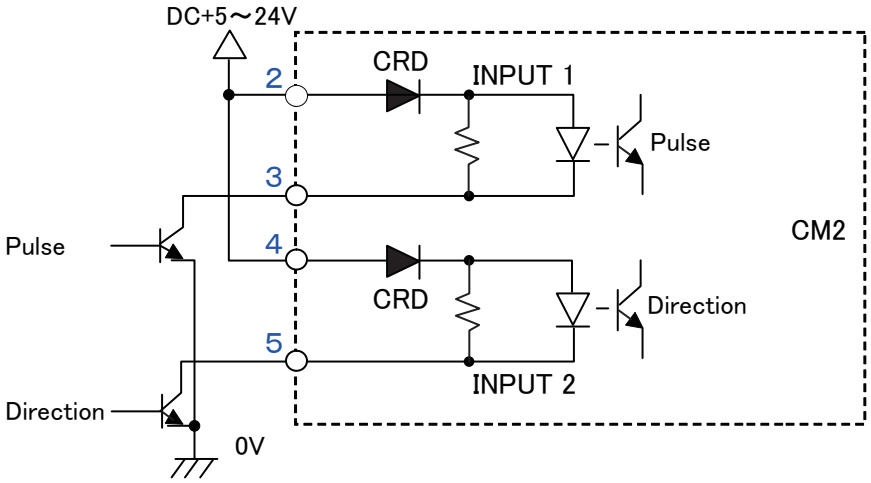
For Pulse type CM2, Input 1 and Input 2 are assigned to CW/CCW pulse Input or Pulse/Direction command Input. Each signal should be input between Input 1+ and Input 1-, and between Input 2+ and Input 2-.

【Connecting to Line Driver (Differential type) Output】



(example of CW/CCW pulse input)

【Connecting to Open Collector Output】



(example of Pulse/Direction command input)

- The polarity of input voltage for Input 1+ (Input 2+) is plus(+) to Input 1- (Input2-).
- As each input (Input 1, Input 2) is equipped with current regulative diode (CRD), the input current can be 8-12mA.

Interface using Line Driver Circuit is strongly recommended.

As Open Collector interface is highly influenced by noise, deviation in position could occur. Moreover, caution should be exercised in case of long distance wiring.

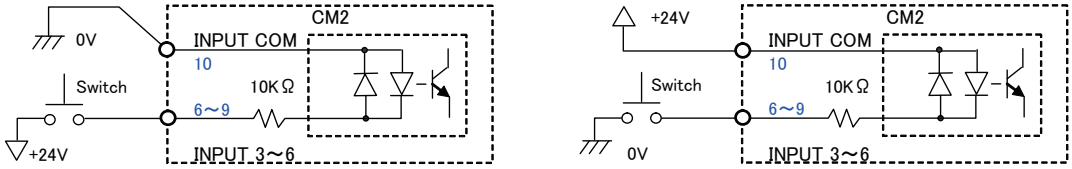
3.4.3. Digital Input/Output

【INPUT 1, 2】

Input 1 and Input 2 can be used as digital except for Pulse type. Please refer to 4.4.2 for connection.

【INPUT 3, 4, 5, 6】

An optical coupler device is used for Input 3-6 circuitry shown below. Each signal should be input between Input 3,4,5,6 and Input COM.

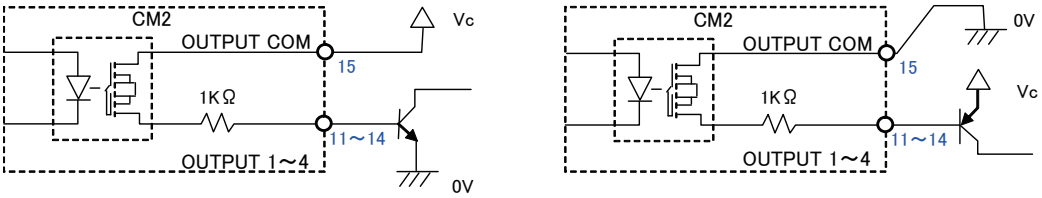


- Plus or minus polarity is acceptable for the input voltage between Input 3, 4, 5, 6 and Input COM.
- Each input (Input 3, 4, 5, 6) is equipped with resistor 10KΩ in series.

【OUTPUT 1, 2, 3, 4】

A FET device is used for Output 1-4 circuitry shown below.

Each FET output is between Output 1,2,3,4 and Output COM.



- Plus or minus polarity is acceptable for the applied voltage between Output 1, 2, 3, 4 and Output COM.
- Each output (Output 1, 2, 3, 4) is equipped with resistor 1KΩ in series.
- Allowable load current for each output (Output 1, 2, 3, 4) is 20mA.

3.4.4. Connection for Analog Input/Output

【ANALOG IN】

Apply analog voltage 0-5V between ANALOG IN (16pin) and GND (19, 20pin) of CM2.

【ANALOG OUT】

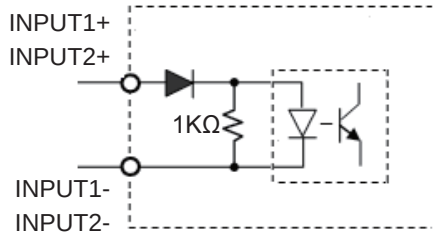
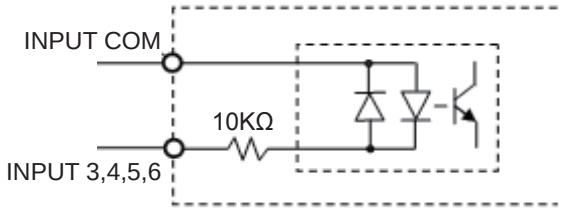
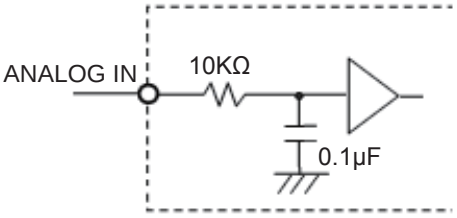
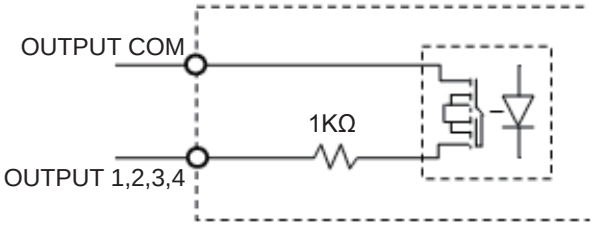
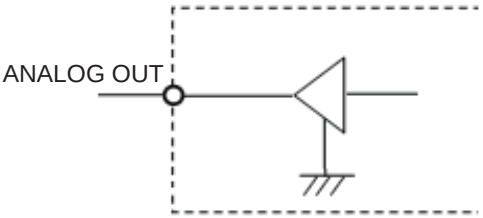
Analog voltage will be output between ANALOG OUT (17pin) and control GND (19, 20pin) of CM2. You can monitor the analog voltage by Oscilloscope.

3.4.5. +5V Output

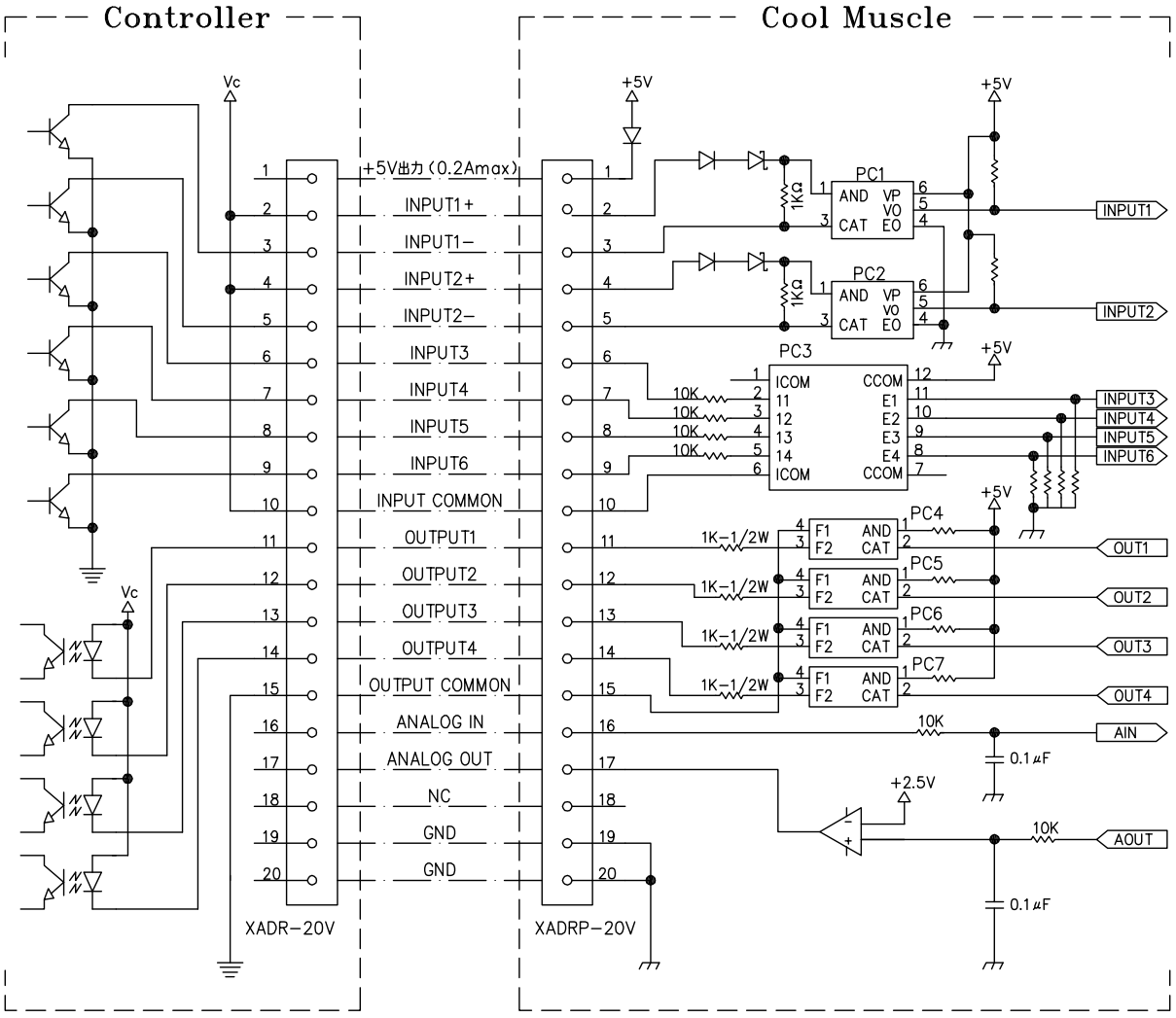
【+5V】

Regulated DC +4.8V (typ.) is output between +5V (1 pin) and GND (19, 20pin). Maximum output current is 200mA.

3.5. I/O Circuit

<table>
<tr><td rowspan="3">Input</td><td>INPUT1,2
Polarity Fixed</td><td> 
</td></tr>
<tr><td>INPUT3,4,5,6
No Polarity</td><td> 
</td></tr>
<tr><td>ANALOG IN
Polarity Fixed</td><td> 
</td></tr>
<tr><td rowspan="2">Output</td><td>OUTPUT 1,2,3,4
No Polarity</td><td> 
</td></tr>
<tr><td>ANALOG OUT
Polarity Fixed</td><td> 
</td></tr>
</table>

3.6. Connection Example



Chapter 4

Communication Functions

Command transmission via serial communication is possible between CM2 and a host such as PC.
It allows you to set parameters, create motion programs, save the data into CM2's integrated memory, execute motion commands, and also monitor motor status. CML is available for parameter settings, creation of motion programs or command input.

4.1. Communication Software Overview

With following software, communication between CM2 and PC is possible.

【Hyper Terminal】
Hyper Terminal is the communication software attached to Windows OS and you can input the text-based commands.

【CoolWorks Lite】
CoolWorks Lite (hereafter CWL) is CML compatible utility software, has user-friendly interface and assists easy operation of CM2.
With CWL, you can modify parameters and data, save them, jog the motor, plot the motor data on a graph easily.
The latest CWL can be downloaded for free from the following web site: http://www.musclecorp.com/.
Please refer to CWL User Manual for more information.
*CWL would be updated without notice.

4.2. Confirming Communication

According to the following procedures, please confirm that the communication between PC and CM2 is established. In this section, the communication method of HyperTerminal is introduced.

1) Start up PC

2) Start up HyperTerminal
Click [Start] in Windows,
select [All Programs]→
[Accessories]→
[Communication]→
[Hyper Terminal].

3) Set connection settings for Hyper Terminal

In the [Connection Description] Window.

[Name] … Use a name that is easy to understand.
ex. Cool Muscle

[Icon] … Choose an Icon of your choice.

Click [OK].

[Connect To] … Choose a COM port that CM2 is connected to.

Click [OK].

Open the Control panel, click [Performance and Maintenance] and then [System].
Choose [Hardware] Tab on the opened window and then click [Device Manager].
The available COM ports are displayed in the tree selection [Ports (COM & LPT)] .

In the [COM ☐ Properties] window, set each item as below.

[Bits per second] … 38400

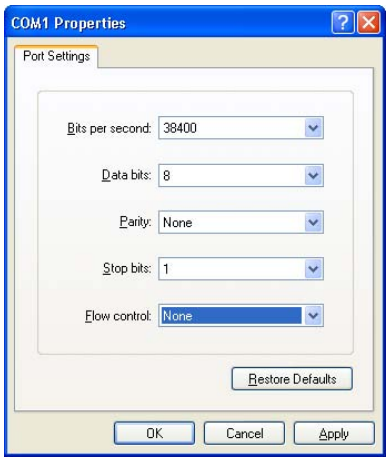
[Date bits] … 8

[Parity] … None

[Stop bits] … 1

[Flow control] … None

Click [OK].

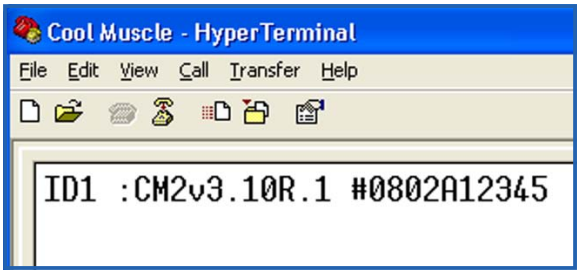


Default value of CM2's communication baud rate is 38400.

4) Power-ON CM2 and confirm communication between PC and CM2.

CM2's version information appears when there is communication between CM2 and PC is established.

It might take a few minutes to establish communication when CM2 is connected to PC for the first time.



5) Save communication settings.

Power-OFF CM2, and click the ☒ at the top right corner of Hyper Terminal Window. Dialog box will appear and ask if you want to save the settings as the name you entered in step 3. Click [Yes] to save the settings.

4.3. Communication Method

In this section, communication method with Hyper Terminal is introduced. Please refer to CoolWorls Lite User Manual for CWL instructions.

1) Start up Hyper Terminal.

Go to [Start] in Windows [All Programs]→[Accessories]→[Communications]→[HyperTerminal].

Select the connect settings for CM2, named in the Connection Discription and saved before.

2) Send commands and programs.

Enter CML commands in the terminal window and press "Enter↵" key to send commands to CM2.

CM2 executes motion or reacts to commands.

To transfer a text file that is created in editor application such as Word, click [Transfer] in the Menu Bar → [Send file]. Select a file that you want to transfer.

Please refer to CML User's Guide for CML commands and programs.

3) Save and print communication log.

To save communication log, click [Transfer] in the Menu Bar → [Text Capture].

To print communication log, click [Transfer] in the Menu Bar → [Capture and Print].

4.4. Communication Time

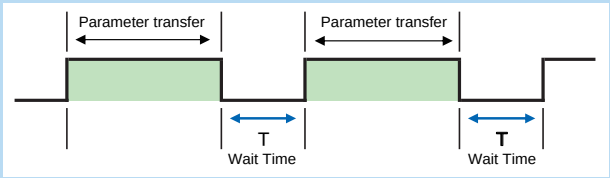
4.4.1. Transmission Time

【Parameter】

When the change of parameters is performed with a host such as PC, the data shall be sent to CM2 and written into the internal memory (EEPROM) with predefined timing. The communication data processing is sometimes delayed because the writing time will take longer in proportion to the number of parameters to be changed.

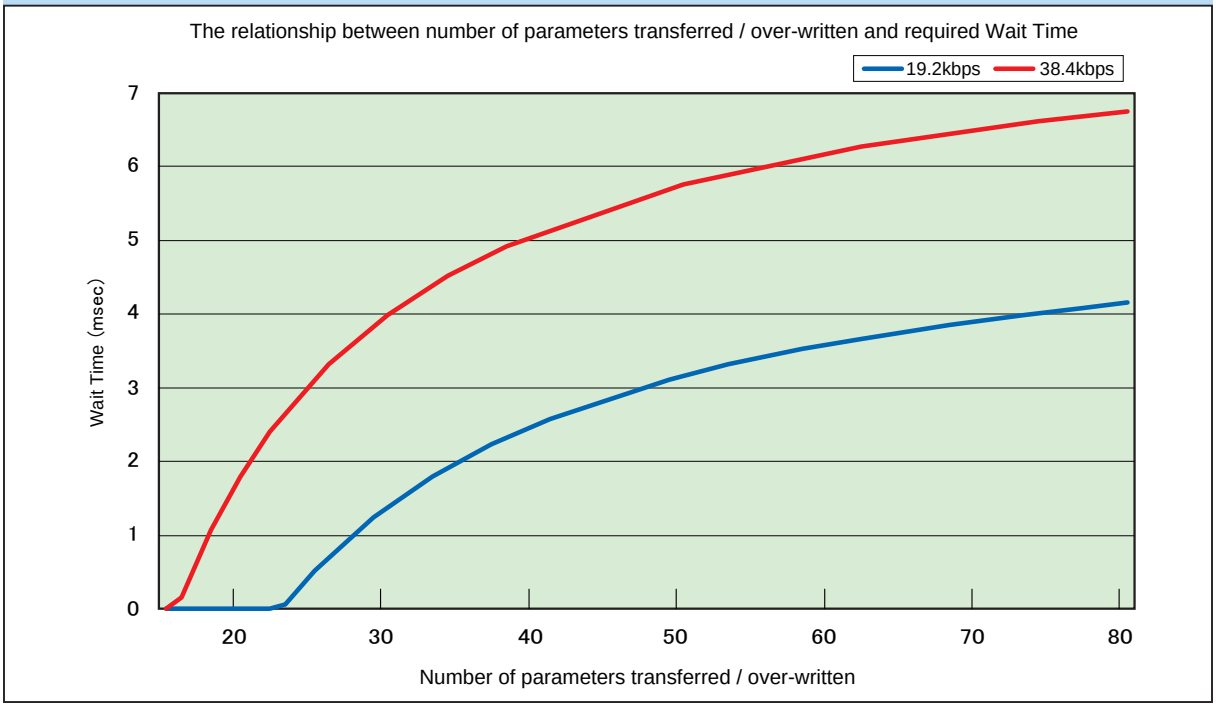
Set the appropriate Wait Time between parameter transfer, and you can get the stable communication and over-writing new data without fail. The Wait Time can be set according to the communication speed (baud rate) and number of parameters to be changed as shown in the following graph.

The graph shows only a rough indication by simple calculation. Set the affordable Wait Time.



Wait Time T

The time between a delimiter(, or CR) and the first character of the next parameter transferred.



* Wait Time will not be required in 9600 bps. But the communication will be more stable if 1msec time interval is set between each transferred parameter.

CM2's communication buffer could be overflowed by a delay of communication data processing when a lot of parameters are transferred to CM2 and over-written at a time with high communication speed.

【Command】

Set more than 1msec time interval between the commands transferred.

【Query】

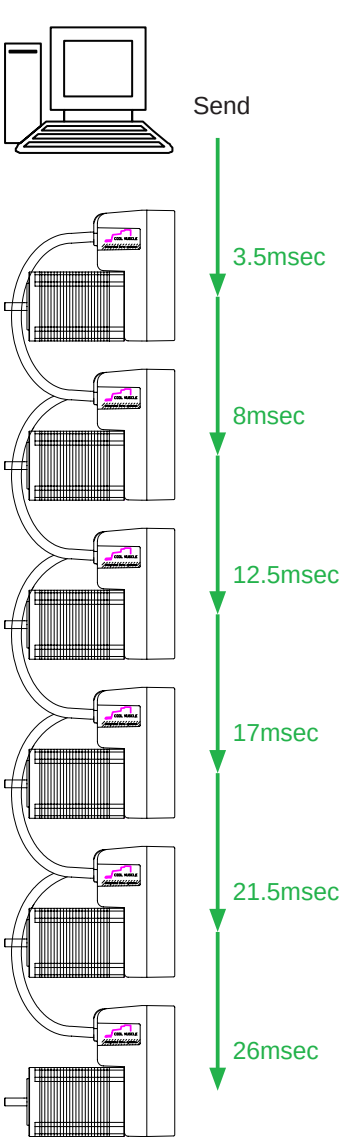
Send another query after receiving the response for the query before.

4.4.2. Response Time

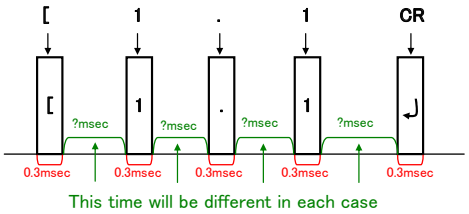
When more CM2 are used in daisy-chained network, more time will be needed for transmission of data. Higher communication speed can realize higher response.

Ex.: When the following Program Bank is executed with 38400bps in the configuration of 6 CM2s, the response time goes as follows.

```
B1.1
A1.1, S1.1, P1.1, A1.2, S1.2, P1.2, A1.3, S1.3, P1.3, A1.4, S1.4, P1.4, A1.5, S1.5, P1.5, A1.6, S1.6, P1.6
END
$.1,$.2,$.3,$.4,$.5,$.6
[1.1
```



Execute



1st CM2

[1.1CR → "[", "1", ".", "1", "CR" 5 characters. It will take 10bit / 38400 (bit/sec) = 0.00026…≒0.3msec for 1 character, 0.3×5=1.5msec in total. The internal processing time after receiving "CR" shall be Max. 2msec. After sending data, it theoretically takes Max. 3.5msec before motion starts.

2nd CM2

A1.2,S1.2,P1.2, (15 characters)

0.3×15=4.5, the 2nd CM2 starts the motion Max. 4.5msec after the 1st CM2.

3rd CM2

A1.2,S1.2,P1.2,A1.3,S1.3,P1.3, (30 characters)

0.3×30=9, the 3rd CM2 starts the motion Max. 9msec after the 1st CM2.

4th CM2

A1.2,S1.2,P1.2,A1.3,S1.3,P1.3,A1.4,S1.4,P1.4, (45 characters)

0.3×45=13.5, the 4th CM2 starts the motion Max. 13.5msec after the 1st CM2.

5th CM2

A1.2,S1.2,P1.2,A1.3,S1.3,P1.3,A1.4,S1.4,P1.4,A1.5,S1.5,P1.5, (60 characters)

0.3×60=18, the 5th CM2 starts the motion Max. 18msec after the 1st CM2.

6th CM2

A1.2,S1.2,P1.2,A1.3,S1.3,P1.3,A1.4,S1.4,P1.4,A1.5,S1.5,P1.5,A1.6,S1.6, P1.6, CR (75 characters)

0.3×75=22.5, the 6th CM2 starts the motion Max. 22.5msec after the 1st CM2.

* By defining only the “A” and “S” data for ID1 ~ 6 in the first line and “P” data for ID1 ~ 6 in the second line, the time delay between each motor shall be shorten to approximately 1.5msec.

Chapter 5

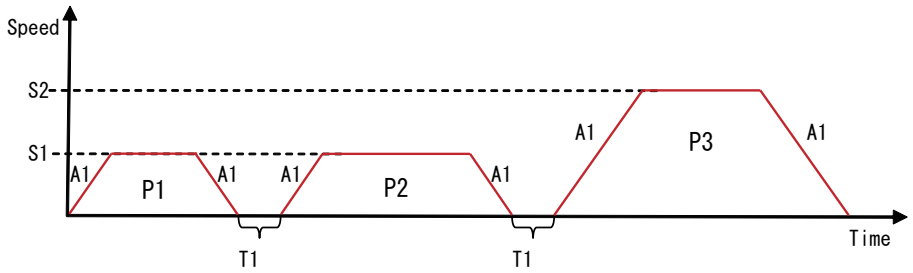
Operating the Motor

5.1. Basic Motion

All of CM2's motion is operated by our unique CML Command. Please refer to CML User Manual for more information.

【PTP Positioning】

CM2 moves to P1, P2, and P3, pausing for the time set by T1 at each point.



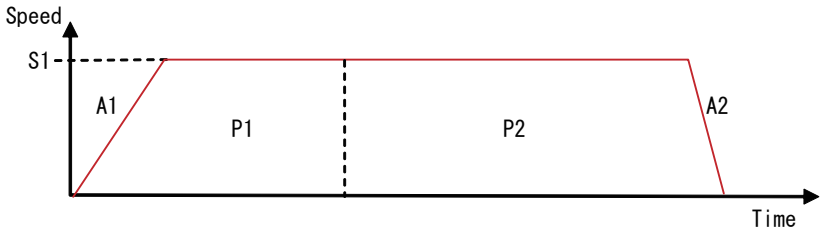
【Speed setting】

Speeds can be defined as shown in the diagram above to make a stable speed at each position or to change speed at specified positions.

【Accelerations and Decelerations setting】

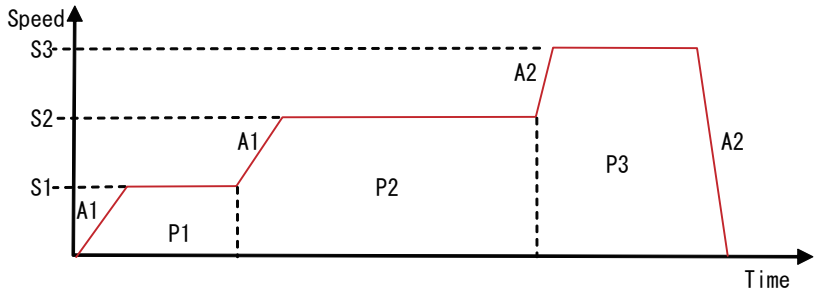
Unless set by parameters, acceleration and deceleration are the same.

Acceleration (A1) and Deceleration (A2) can be set separately as shown in the diagram below.



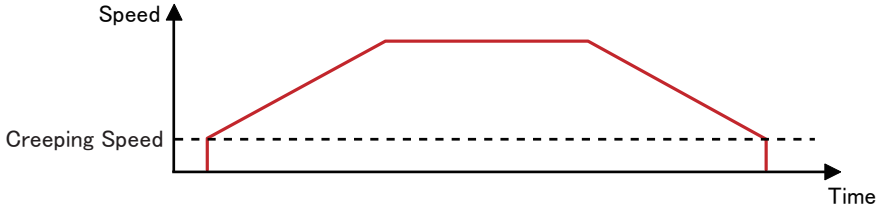
【Merged Motion】

Merged Motion is possible as CM2 passes each point without stopping and move to the final position (Merged Motion). You can change the speeds and accelerations can be changed at each passing point.



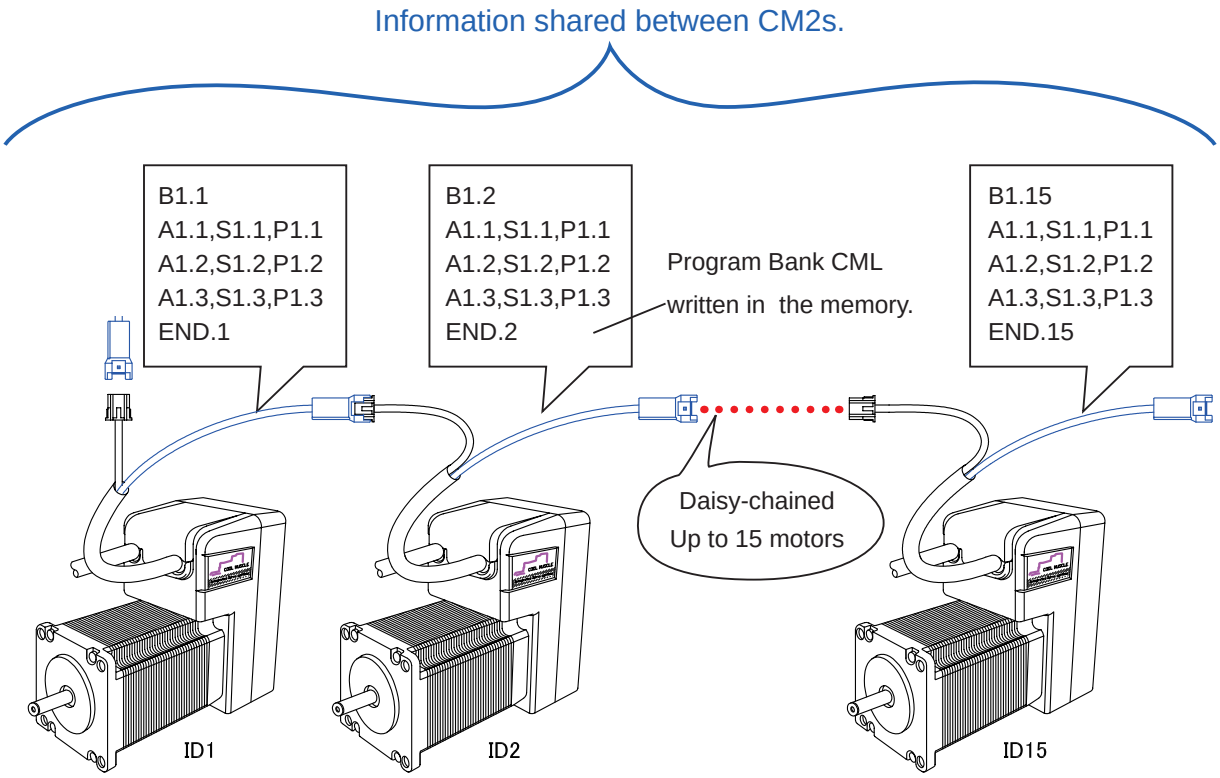
【Creeping Speed】

Creeping speed is the initial speed with which the motor initiates motion and also the speed at which the motor approaches the target position. By changing the creeping speeds, response time can be adjusted and tact time will be faster. When the creeping speed is set too high, vibrations may occur and the motor may not move.



5.2. Multiple Axes Control Motion

Parameters, Program Banks, and Ladder Logic Banks can be set to each CM2 on the daisy-chain network. Since all the status and I/O information can be shared between motors, CM2 realizes the high performance multiple axes control.



Chapter 6

Input/Output Functions

6.1. Input / Output Functions

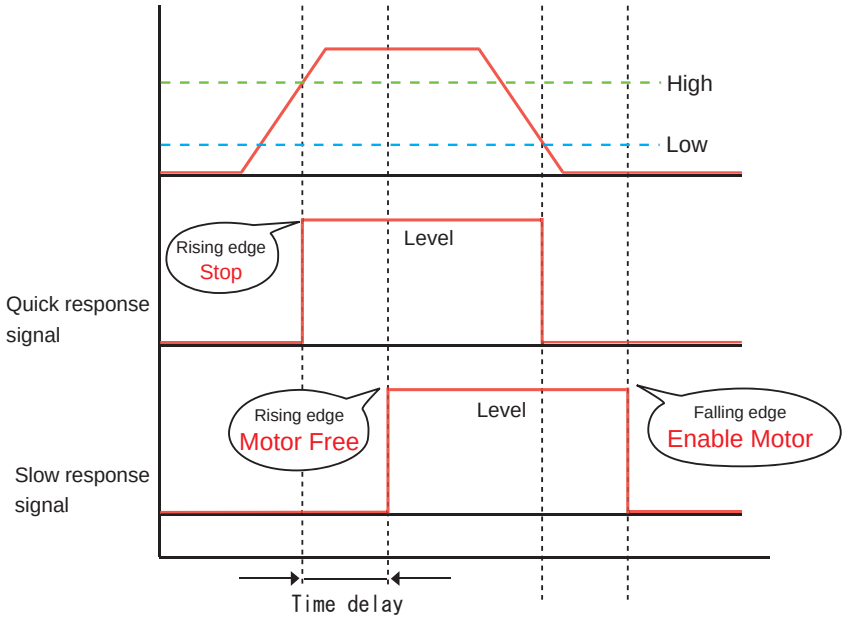
The CM2 has 6 Digital Inputs, 4 Digital Outputs, 1 analog input and 1 analog output (Monitoring). Various functions can be assigned to these inputs and outputs by parameters.

6.1.1. Digital Input

Signal classification	Functions	Description
at Level	General Use	General Use for I command
	Origin sensor	Origin sensor signal
	Manual feed CW	ON: continuous CW direction motion
	Manual feed CCW	ON: continuous CCW direction motion
	Stop Ladder Logic Bank	Stop the Ladder Logic Bank in operation
	CW direction limit sensor	Used for the limit sensor in CW direction
	Emergency stop	Emergency stop when the input signal is ON
	Stop Program Bank	Stop motion and Program Bank execution
	CCW direction limit sensor	Used for the limit sensor in CCW direction
at rising or falling edges	Alarm Reset / Pause	Alarm reset or pause motor
	Motor Free	Disable motor (rising edge)
	Enable Motor	Enable motor(falling edge) (Servo ON)
	Position counter reset	Set the current position to 0. (reset position counter)
	Execute next line	Execute next program line
	Execute previous line	Execute previous program line
	Execute Program Bank 1	Execute Program Bank 1
	Origin Search	Start origin search
	Manual jog CW	Jog motion in CW direction.
	Manual jog CCW	Jog motion in CCW direction.

Use of virtual signals allows to assign more functions to each input.
The CM2 generates 2 input signals with a time delay based on the actual signal. Functions can be assigned to rising edge / falling edge / target voltage level of a signal.

For example, assign "stop" to a quick response signal's rising edge, "motor free" / "enable motor" to slow response signal's rising / falling edges.



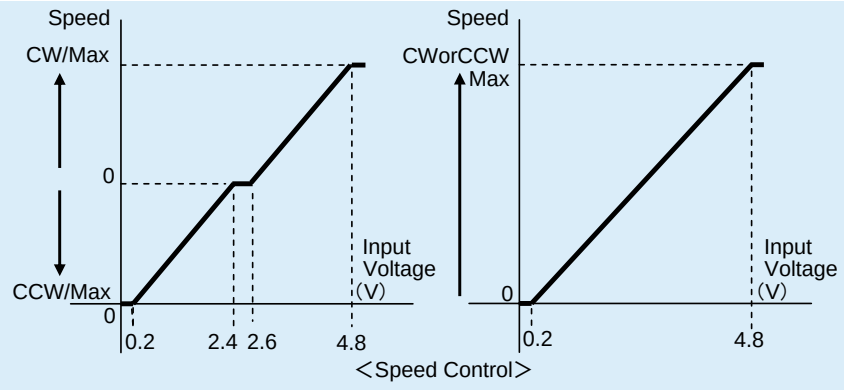
6.1.2. Digital Output

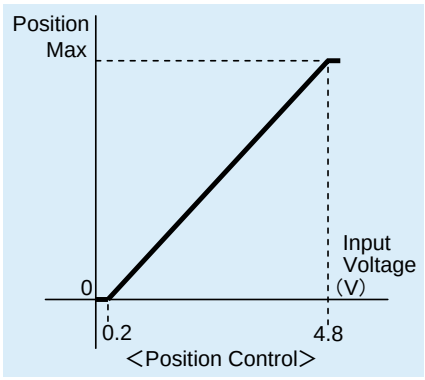
Signal	Functions	Description
Output signal	In-Position	In-position signal
	Alarm	Alarm signal
	General Output	General output; Command O/ Command F turn output signal ON / OFF.
	Completion of origin search	Output In-position signal only when the origin search is completed.
	In-position signal in Merge motion	In-position signal at each point in merge motion.
	Position Mark Output	Turns the output On/OFF at a set interval.
	Motor Free Signal	Outputs signal during motor free
	Push Motion	Outputs signal during push motion

6.1.3. Analog Input

Analog input/output functions are an ideal solution for feed systems and valves.

If the analog input voltage is applied when CM2 is powered ON, it interferes with the threshold on either 0V or 5V. Therefore make sure to apply the analog voltage that adapts the motion before powered ON.

<table>
<tr><th>Signal</th><th>Functions</th><th>Description</th></tr>
<tr><td rowspan="2">Input Voltage</td><td>Speed Control (Rotation Direction / Speed)</td><td>The speed control in proportion to input voltage level from 0.2V to 4.8V.
• Input voltage 2.6V to 4.8V : Increase speed in CW direction
Input voltage 2.4V to 0.2V : Increase speed in CCW direction
• Input voltage 0.2V to 4.8V : Increase speed either in CW or CCW direction
The maximum rotation speed is set by a parameter.
 

＜Speed Control＞</td></tr>
<tr><td>Position Control (Rotation Angle or Distance)</td><td>The position control in proportion to input voltage level from 0.2V to 4.8V.
The maximum travel range is set by a parameter.
 

＜Position Control＞</td></tr>
</table>

6.1.4. Analog Output

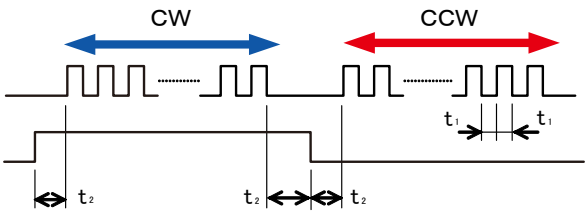
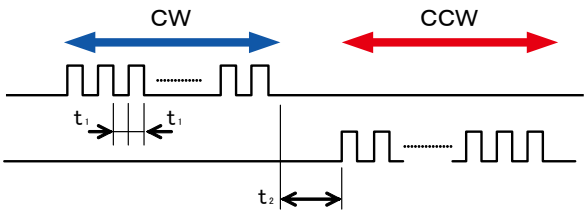
OP Amp usage is recommended

Signal	Functions	Description
Analog Output (Monitoring)	Target position	Target position (pulses)
	Target position magnified by 8	Target position data magnified by 8
	Current position	Current position (pulses)
	Current position magnified by 8	Current position data magnified by 8
	Position error	Position error (pulses)
	Position error magnified by 8	Position error data magnified by 8
	Current speed	Current speed(rpm)
	Current speed magnified by 8	Current speed data magnified by 8
	Current torque	Current torque (kgfcm)
	Current torque magnified by 8	Current torque data magnified by 8

6.2. I/O Signal according to Control Type

6.2.1. Pulse Input

INPUT 1 and INPUT 2 are used for Pulse Input. The rotation of motor is controlled through the command pulse signal. The motor angle is proportional to a number of pulses and the motor speed is proportional to the pulse frequency.

Method	Symbol	Function	Pattern of Signal and Motion
Pulse / Direction	Pulse	Command pulse	
	Direction	Rotation direction	
CW / CCW	CW Pulse	CW direction command pulse	
	CCW Pulse	CCW direction command pulse	

* Pulse frequency : Max. 500Kpps
* The width of pulse : Min. 0.8 μsec (t1>=0.8 μsec)
* Pulse rise / fall time of input signal should be set to no more than 0.1 μsec
* The time between a direction pulse and command pulse : More than 5 μsec (t2>=5 μsec)

Chapter 7

Various Other Functions

7.1. Origin Search

There are two origin search methods as using stopper and origin sensor.

【Using Stopper】

The origin search method using stopper function eliminates the need for origin sensor.

The origin search is completed by detecting the set torque when pushing a stopper.

The torque, speed, acceleration and direction for the origin search can be set by parameters.

【Using Origin sensor】

The origin search with an external origin sensor.

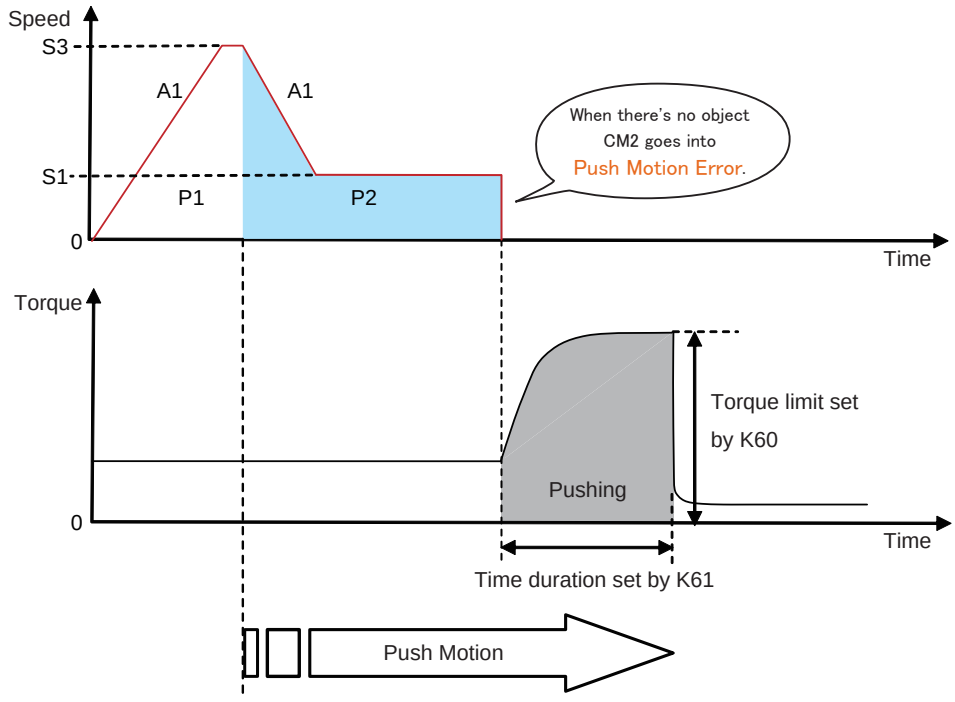
The speed, acceleration and direction for origin search can be set by parameters.

7.2. Push Motion

CM2 can perform push motion within the set torque limit.

The diagram below shows the push motion towards P2 with S1 after passing P1 with S3.

The torque limit and time duration for push motion need to be defined by parameters K60 and K61.

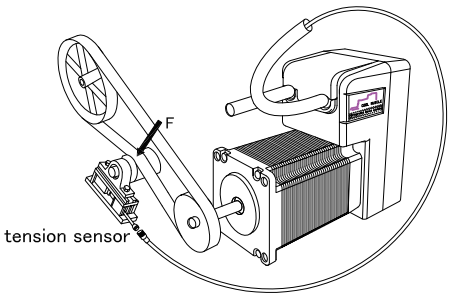


7.3. Manual Jog and Feed

Manual jog makes the motor move incrementally by numbers of pulses set by parameter for an one-shot signal input. This is useful for fine adjustments. Manual feed makes the motor move in a specified direction continuously while the signal is ON. The motor stops when the signal is OFF. Speed and direction can be set by parameters.

7.4. Torque Control

This feature allows an output torque control or feedback control by connecting CM2 to an external torque sensor.
Various torque controls such as push control common in pneumatic sliders and constant tension control are possible.



7.5. Arithmetic/Logical Operation Function

Arithmeticl/logical operations can be executed in Program Banks, using information such as defined data in the memory, current position, speed, torque of motor and I/O status.
It is possible to operate the complex control, using arithmetic/logical operations for position, speed and torque of motor, that is adaptable to a nonlinear application too.
Furthermore, the range of motion control can be expanded with using arithmetic/logical operations such as comparison of defined values and conditional branching by logical operation.

7.6. PLC Function

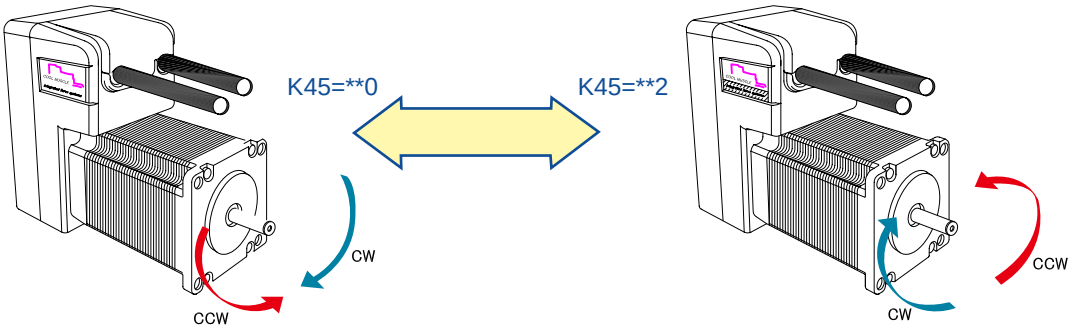
CM2 has software PLC function, and the sequential logic can be defined by CML.
The processing of PLC function runs in the background along with the operation of motor and makes it possible to execute various processes in conjunction with motor status, I/O status and etc.
PLC function implemented in CM2 supports complex motion without equipping external PLC as a host controller.

7.7. Reversal of Coordinate

Reversing the direction of motor rotation can be realized by changing the parameter.

It is available with just setting a parameter instead of changing signs of all position data, in such case where the motor mounting side is restricted because of the difficulty related to installation space, or the application for a symmetrical machine is required.

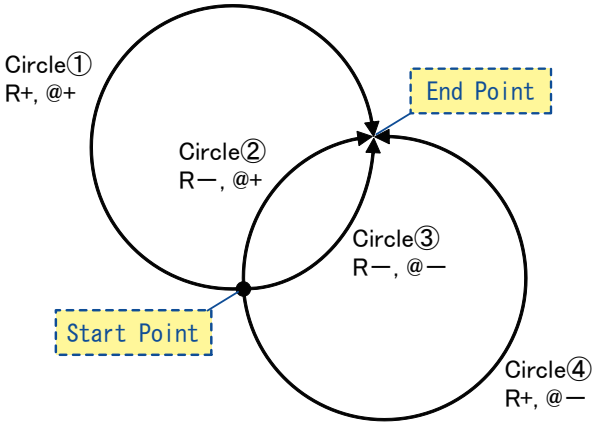
	Normal	Reversal of Coordinate
Forward	CW	CCW
Reverse	CCW	CW



7.8. Circular / Linear Interpolation (optional)

Simple 3 CML commands support Circular / Linear Interpolation without a special controller.

Command	Function
R	Set radius
N	Set center point
@	Execution



7.9. Protection/Safety Features

When an alarm is triggered, the motor automatically goes into a motor free status (servo OFF), preventing the motor or equipment from being damaged. Following are the alarm and protection functions in CM2.

● Protection Function

- Position error over flow alarm
- Over voltage alarm
- Overload alarm
- Temperature alarm
- Power module over current alarm

● Safety Function

- Push motion error
- Limit sensor input
- Emergency stop

Chapter 8

Maintenance and Inspection

8.1. Maintenance

It is important to have regular maintenance for CM2 to ensure it is operating safely.

Following maintenance and checks are based on the assumption that the motor is operating under the condition of average operating temperature of 30 degrees, load % of 80%, under operation time of 18 hours per day.

【Before Inspection】

- Leave CM2 for five minutes after powered OFF because circuit boards are charged with high voltage.
- For resistance isolation measurement testing, please disconnect all external devices.
  When resistance isolation testing is done with devices connected to CM2, damages could occur.

【Checkup items】

Type	Cycles	Inspection items
Daily inspection	Cycles	• Are there dust, foreign objects around the motor and air vent? • Is there any abnormal vibration, noise or smell? • Is the cabling OK? No damage? • Is there any loose connection or misalignment at each connecting point to other devices? • Is the main circuit voltage normal?
Periodical inspection	Every year	• Is there any loose point at tighten (pressed) points? • Are terminals intact, not damaged?

【CM2 Parts life time】

The life time of each part depends on the actual operating conditions and how it has been used. Defective parts should be replaced or repaired immediately.

Do not disassemble CM2.

Part	Part Name	Average Life	Remarks
Driver	Aluminum electrolytic condenser	5 years	
	EEPROM	rewrite 100 thousand times	Parameter setting is counted as one rewrite.
Motor	Bearings	4-6 years (20-30 thousand hours)	

8.2. Troubleshooting

Please confirm the below things before a inquiry.

8.2.1. Communications

Symptom	Check	How to solve
There is no response from CM2 in the software window or it is not possible to operate it when powered ON.	Is the cabling between devices connected properly?	Please see sections 4.3, 4.4. Make sure all the cabling is 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 Hyper Terminal?	Once set the Hyper Terminal setting, it can not be changed. Read Sections 4.2 and create a new communication connection from the beginning.
	Is a set value corresponding to the rewritten baud rate?	Please match the baud rate of the communication software to the value of CM2.
	Are there multiple HyperTerminal applications or other terminal applications running?	If there is other software using COM ports, it may cause interference. Please close the applications.
	Did you wait for a few minutes?	It may take a few minutes to establish communication between CM2 and PC for the first time.

8.2.2. Motor

Symptom	Check	How to solve
Noise and vibrations	Are the machine and the motor resonating?	Adjust the speed of motor.
	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.
	Check load inertia.	Make sure that it is within the specification.
	Damaged bearing?	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. (Has not the disconnection occurred?)
	Is it within the load limit?	Use it within the load limit.
	Is the motor in a motor free state?	Enable the motor.
	Check alarms	Get rid of a cause, and reset the alarm.

8.2.3. Motion

Symptom	Check	How to solve
Inaccurate origin	Is the origin search speed too high?	Decrease the Origin search speed at the point close to origin.
Inaccurate in-positioning (Pulse type)	Are the pulse style and width complying to specifications? Is the signal line influenced by noise?	Make sure the pulse style and width are in the specifications. When positional accuracy is not improved because of the noise, measures against the noise should be taken.

Chapter 9

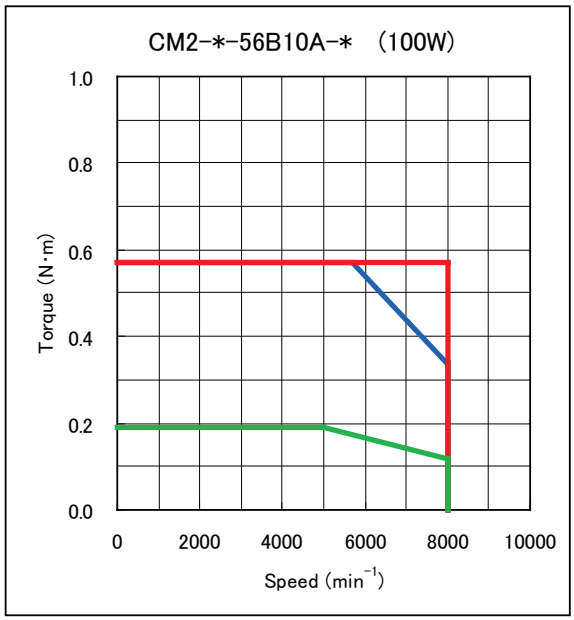
Characteristics

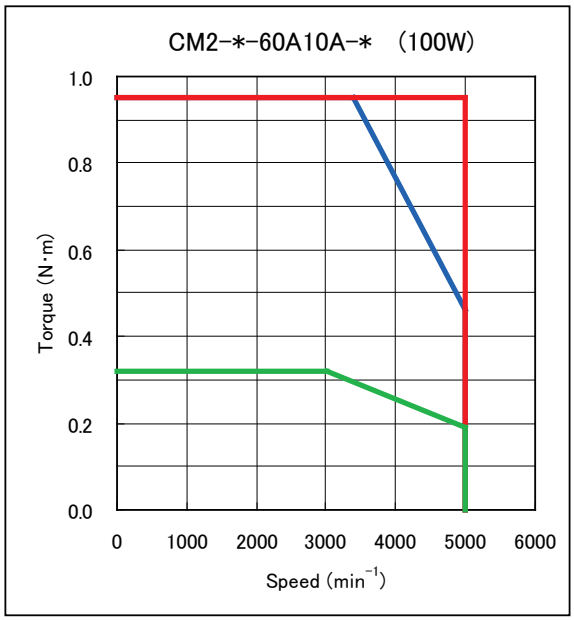
9.1. Basic Specifications

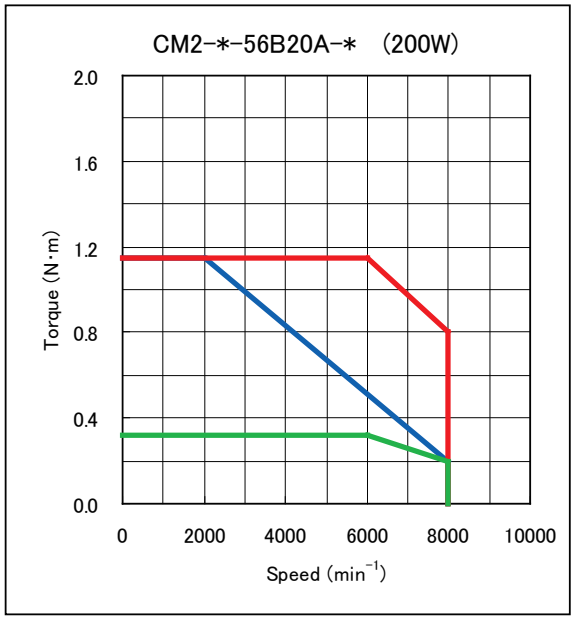
MODEL		CM2-*-56B10A-*	CM2-*-60A10A-*	CM2-*-56B20A-*	CM2-*-60A40A-*
Input AC Supply [V]		Single-phase or Three-phase 100~240 ±10% (Frequency :50/60Hz±5%)			Single-phase or Three-phase 200~240 ±10% (Frequency :50/60Hz±5%)
Rated Current [Arms] reference values are measured with Single-phase 200V		1.2	2.2	1.4	4.0
Motor Output [W]		100	100	200	400
Rated Speed [min^{-1}] *		5,000	3,000	6,000	3,500
Max. Speed [min^{-1}]		8,000	5,000	8,000	5,000
Rated Torque [N• m](kgf • cm) *		0.19 (1.95)	0.32(3.25)	0.32(3.25)	1.09 (11.1)
Max. Torque [N • m](kgf • cm)		0.57 (5.85)	0.95 (9.7)	1.15 (11.7)	3.82 (39)
Rotor Inertia (kg • m^2)		0.091×10^{-4}	0.09×10^{-4}	0.18×10^{-4}	0.34×10^{-4}
Allowable Load of Inertia		Less than 10 times the Rotor Inertia			
Allowable Radial Load [N](kgf) at the point 20mm off from the surface		58.8 (6)	78.4 (8)	58.8 (6)	196 (20)
Allowable Thrust Load [N](kgf)		29.4 (3)	39.2 (4)	29.4 (3)	68.6 (7)
Shaft End Play [mm]		0.1	0.2	0.1	0.2
Static Friction Torque [N • m](kgf• cm)		0.02 (0.2)	0.02 (0.2)	0.02 (0.2)	0.04 (0.4)
Applicable Encoder		Incremental Magnetic Encoder			
Resolution (ppr)		From 200 to 50,000 set by parameter			
Control Method		Closed-Loop Vector Control			
Insulation Class		Class B	Class F	Class B	Class F
Insulation Resistance [MΩ]		100 at DC500V			
Insulation Strength		AC1500V – 60sec			
Memory Capacity		Number of Program / Ladder Logic Banks : Each up to 30 Number of Commands : Up to 1000 Number of data : Position 200/ Speed 15/ Acceleration 8/ Timer 8/ Torque limit 8/ Variable 15			
Indicator LED		Blue Lighting …Servo ON Red Lighting… Motor free by CML Red Blinking…Alarm (once: position erorr overflow, twice: overvoltage, 3 times: overload, 4 times: temperature error, 5 times: push mode error, 6 times: emergency stop)			
I/O	Controls Input	Digital Input: 6 (including pulse Input 2), Analog Input: 1			
	Controls Output	Digital Output: 4, Analog Output: 1			
	Communication port	Host and Slave communication 2ports. Conforming to RS-232C.			
Cooling Method		Natural cooling			
Mass [kg]		1.2	1.1	1.7	2.0
Environment	Operating Temperature	0 ~ +40℃ (non-freezing)			
	Storage Temperature	-20 ~ +60℃ (non-freezing)			
	Operating/ Storage Humidity	90%RH or less (non-condensing)			
	Atmosphere	In-door use only (no direct sunlight) No corrosive or combustible gas, oil mist, and dust.			
	Altitude	Less than 1,000m above sea level			
	Impact	10G (98m/s^2) or less			
	Vibration	1G (9.8m/s^2) or less			

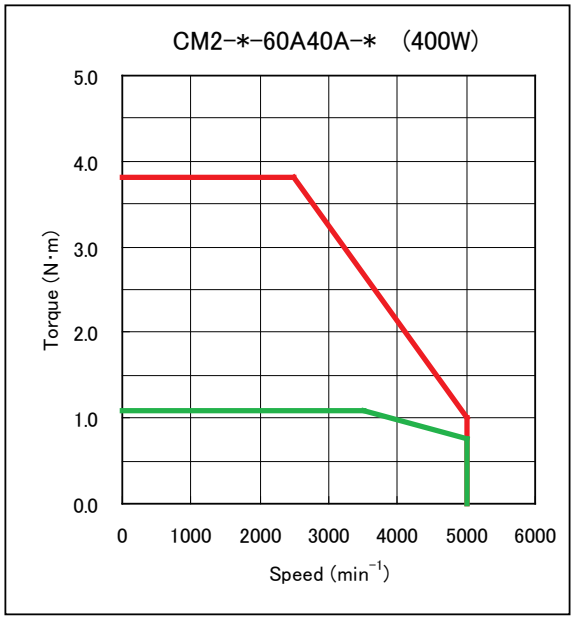
* values are measured with Aluminum Plate of 305 x 305 x t12 mm

【Torque-Rotational speed characteristic】 red line : AC200V, blue line : AC100V, green line : CONT. ZONE









* Input Voltage is AC200-240V

9.2. Electric Specifications

Operating free-air temperature Ta is 25℃ (unless otherwise noted)

ITEMS		CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage	AC input voltage	3 phase (R,S,T) ▪ Single phase (L1,L2) / 50,60Hz	90	-	264	V
Digital Input 1 (INPUT1+~INPUT1- / INPUT2+~INPUT2-)*1	Applied voltage	INPUT1+ ~ INPUT1-, INPUT2+ ~ INPUT2-	0	-	24	V
	Low-level input voltage		0	-	0.8	
	High-level input voltage		3	-	24	
	Pulse input frequency		-	-	500	KHz
	Input pulse width		0.8	-	-	μs
	Input pulse rise/fall time		-	-	0.1	μs
Digital Input 2 (INPUT3,4,5,6 / INPUT COM)*2	Applied voltage	INPUT3,4,5,6 ~ INPUT COM	0	-	24	V
	Low-level input voltage		0	-	0.8	
	High-level input voltage		3	-	24	
Analog Input (ANALOG IN)	Input voltage	ANALOG IN ~ GND	0	-	5	V
	Operating voltage	Position control Speed control (one direction) Torque control Torque feedback control	0.2	-	4.8	V
		Speed control (CW direction)	2.6	-	4.8	V
		Speed control (CCW direction)	0.2	-	2.4	V
Digital Output (OUTPUT1,2,3,4 / OUTPUT COM)*3	Applied voltage	OUTPUT1,2,3,4 ~ OUTPUT COM	-	-	30	V
	Continuous load current		-	-	20	mA
	OFF ▪ Leak current		-	0.1	1	nA
Analog Output (ANALOG OUT)	Output voltage	ANALOG OUT ~ GND	1	-	4	V
	Output current		-	-	7	mA
+5V Output (+5V)	Output voltage	+5V ~ GND	4.5	5	5.5	V
	Output current		-	-	200	mA
Communication Line (RXD0 / TXD0) (RXD1 / TXD1)	Baud rate		9.6	-	230.4	Kbps
	Input voltage	RXD0,RXD1 ~ GND	-25	-	25	V
	Positive-going input threshold voltage		-	1.8	2.4	
	Negative-going input threshold voltage		0.8	1.5	-	
	Input resistance		3	5	7	KΩ
	Output voltage (MAX)	TXD0,TXD1 ~ GND	-13.2	-	13.2	V
	Output voltage swing range		±5	±5.4	-	

*1 The polarity of input voltage for INPUT1+ (INPUT2+) is plus(+) to INPUT1- (INPUT2-).
As each input (INPUT1-,INPUT2-) is equipped with current regulative diode, the input current can be 8~12mA.

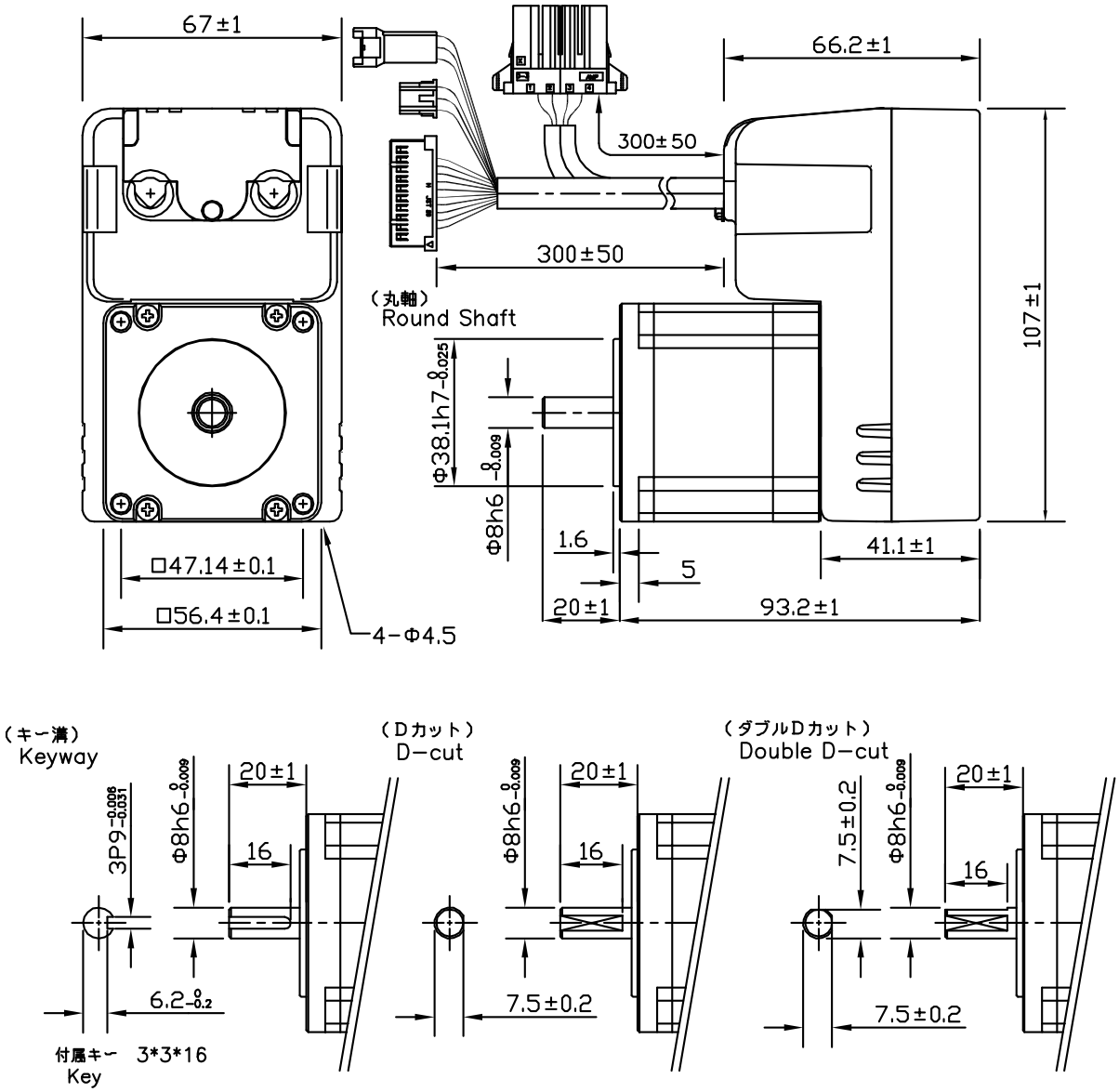
*2 Plus or minus polarity is acceptable for the input voltage between INPUT3, 4, 5, 6 and INPUT COM.
Each input (INPUT3,4,5,6) is equipped with resistor 10KΩ in series.

*3 Plus or minus polarity is acceptable for the applied voltage between OUTPUT1,2,3,4 and OUTPUT COM.
Each output (OUTPUT1,2,3,4) is equipped with resistor 1KΩ in series.

9.3. Dimensions

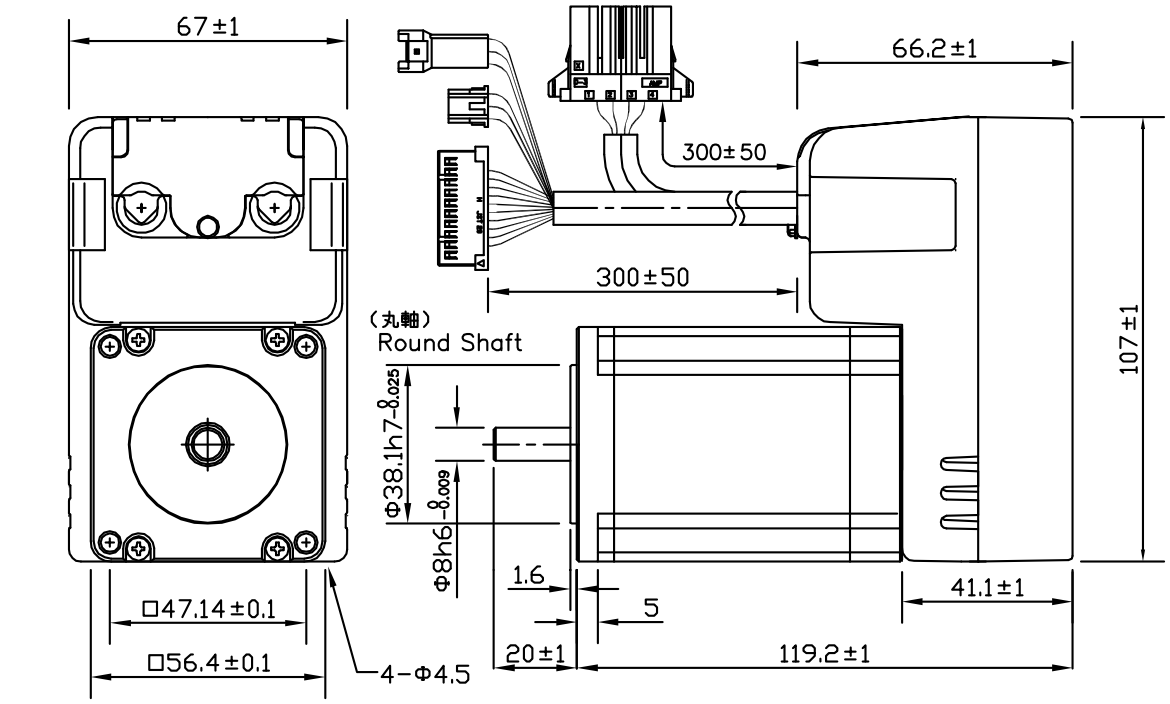
【CM2-∗-56B10A-∗】

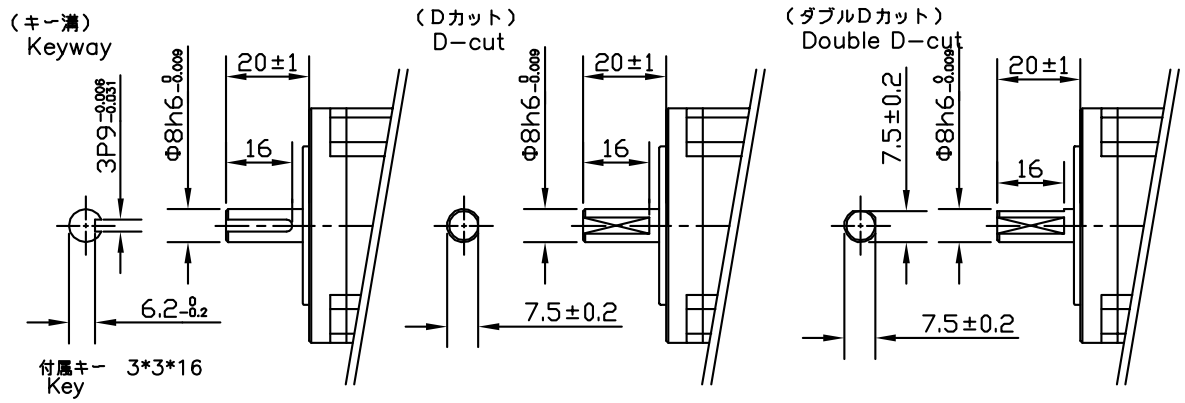
[Unit : mm]



【CM2-∗-56B20A-∗】

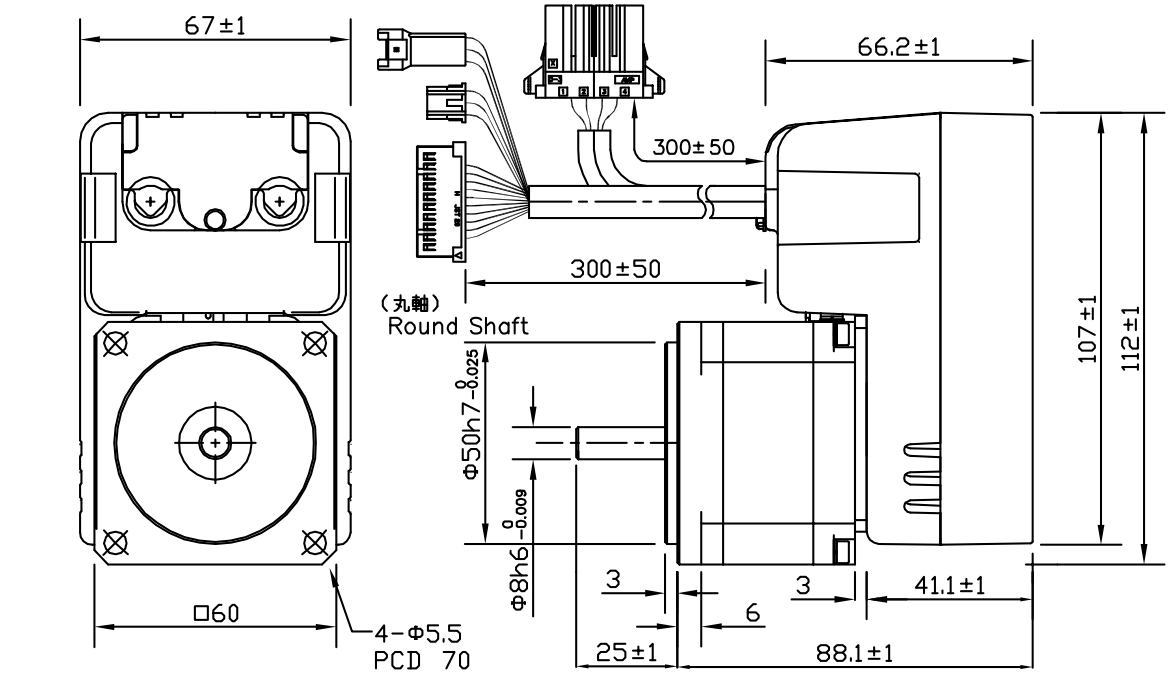
[Unit : mm]

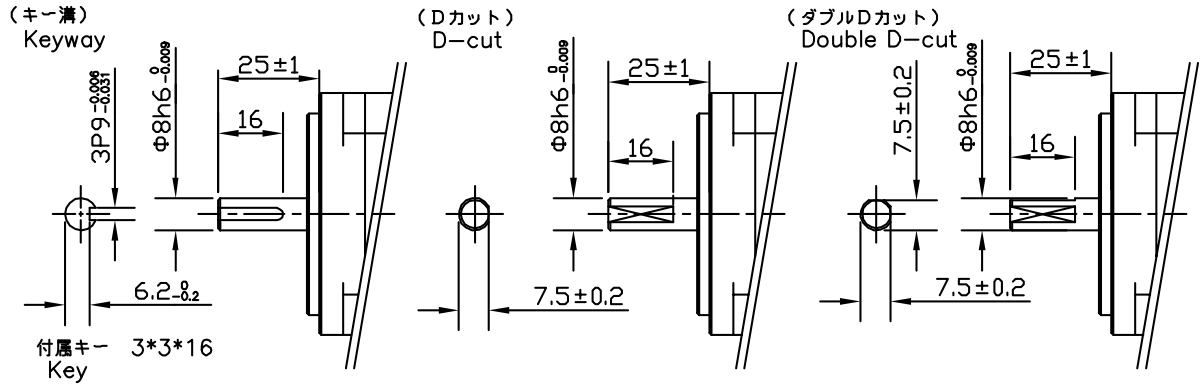




【CM2-∗-60A10A-∗】

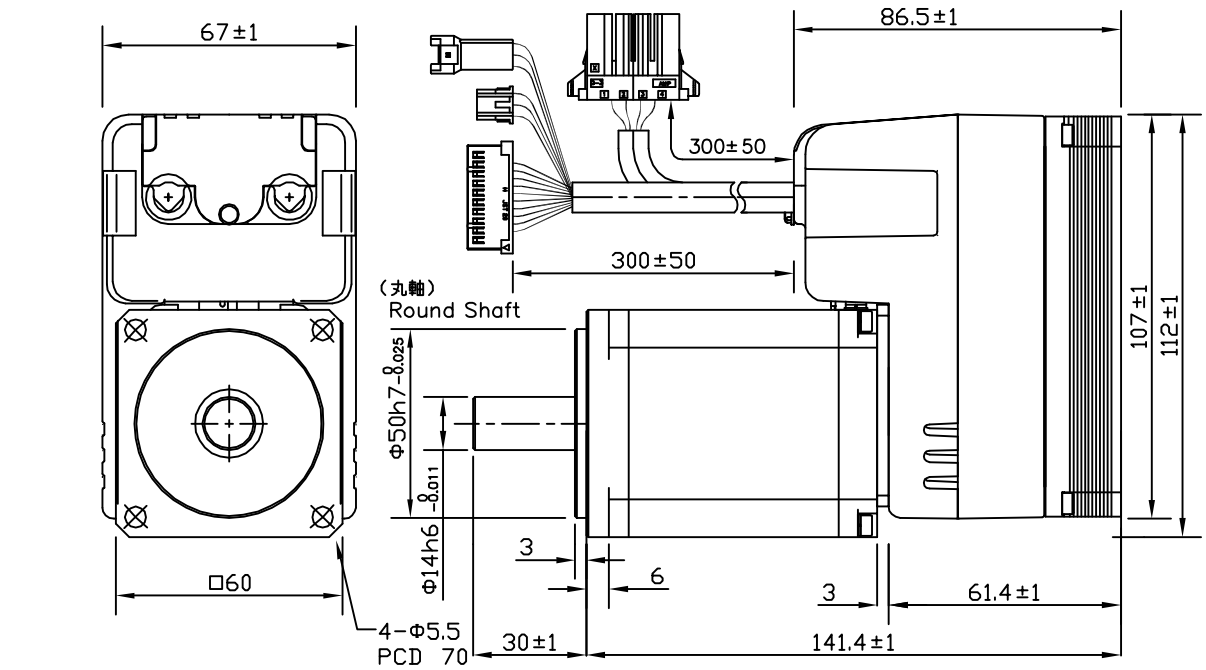
[Unit : mm]

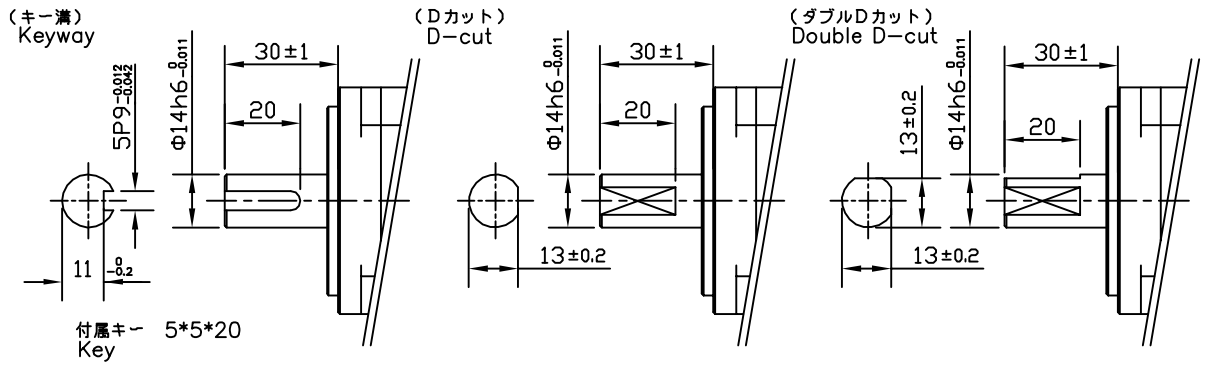




【CM2-∗-60A40A-∗】 * with radiation fin

[Unit : mm]





Chapter 10

Peripherals

10.1. Cables

Naming scheme for CM2 cables are as bellow.

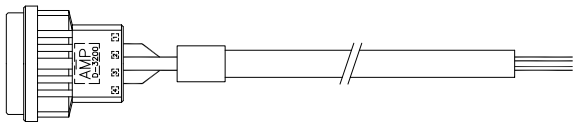
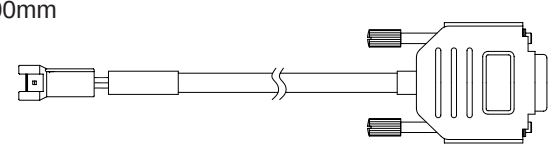
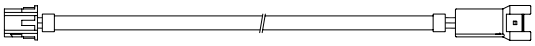
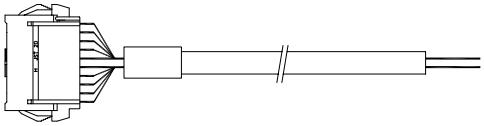
CM2-RS2-2000W

Application
- RS Communication
- DC Daisy Chain
- PW Power
- IO I/O

Cable length
- 0500 500mm
- 1000 1000mm
- 2000 2000mm

Connector
- S Single ended
- W Double ended

Model numbers for cables are as below. (Refer to Page 11 for # ⑤ ~ ⑧)

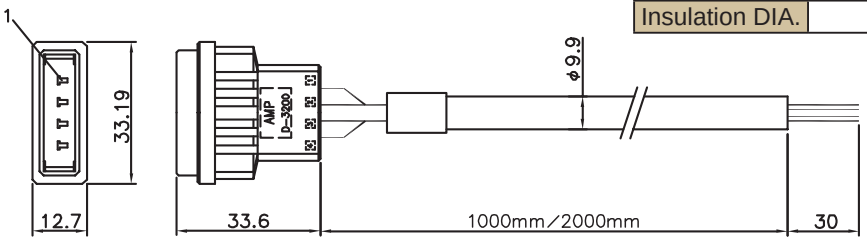
#	Cable	Model Number	Description
⑤	Power supply cable	CM2PW2-****S	1000mm/2000mm 
⑥	Host communication cable	CM2RS2-2000W	2000mm 
⑦	Daisy Chain cable	CM2DC2-****W	500mm/1000mm/2000mm 
⑧	I/O cable	CM2IO2-****S	1000mm/2000mm 

Details of cables

⑤ Power supply cable

Cable spec. (SUMITOMO EIWC)

WIRE	H VCT 4C
SIZE (AWG)	18
Insulation DIA.	ϕ Max 2.8



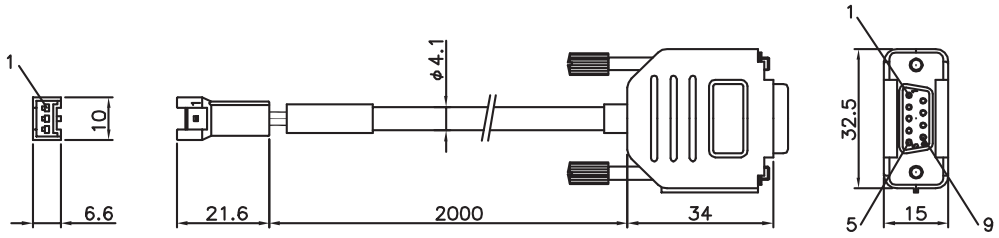
Connector 1-179552-4 (AMP)

No.	SIGNAL	COLOR	
1	R/L1		Red
2	S		White
3	T/L2		Black
4	E		Green

⑥ Host communication cable

Cable spec. (TAIYO EWC)

WIRE	2464-1061/ⅡA 3C
SIZE (AWG)	26



Connector XARR-03VF (JST)

No.	SIGNAL	COLOR		
1	RXD0		Orange	Black dot ・1 point
2	TXD0		Gray	
3	GND		White	

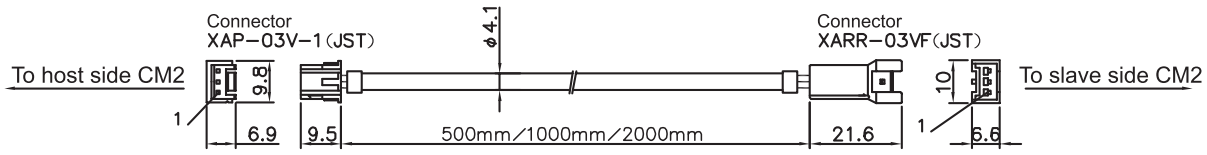
Connector D-Sub Female (MH connectors)

No.	SIGNAL	COLOR		
2	RXD		Gray	Black dot ・1 point
3	TXD		Orange	
5	GND		White	

⑦ Daisy Chain cable

Cable spec. (TAIYO EWC)

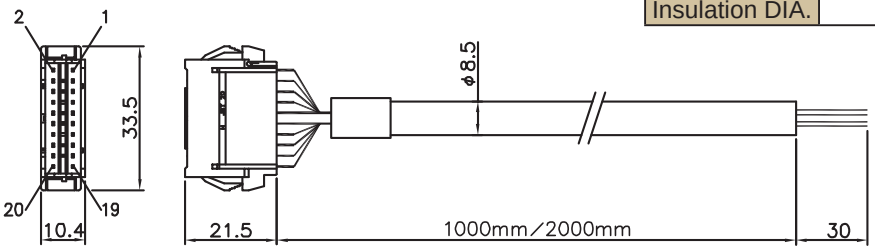
WIRE	2464-1061/ⅡA 3C
SIZE (AWG)	26



⑧ I/O cable

Cable spec. (TAIYO EWC)

WIRE	2464-1061/ⅡA 10P
SIZE (AWG)	26
Insulation DIA.	φ 1.0



Connector XADR-20V (JST)

No.	SIGNAL	COLOR			No.	SIGNAL	COLOR		
1	+5V		Orange	Black dot • 1 point	11	OUTPUT1		Orange	Red dot • 1 point
2	INPUT1+		Gray		12	OUTPUT2		Gray	
3	INPUT1-		White		13	OUTPUT3		White	
4	INPUT2+		Yellow		14	OUTPUT4		Yellow	
5	INPUT2-		Pink		15	OUTPUT COM		Pink	
6	INPUT3		Orange	Black dot • 2 points	16	ANALOG IN		Orange	Red dot • 2 points
7	INPUT4		Gray		17	ANALOG OUT		Gray	
8	INPUT5		White		18	N.C.		White	
9	INPUT6		Yellow		19	GND		Yellow	
10	INPUT COM		Pink		20	GND		Pink	

Revision History

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

Revised Date	User's Guide No.	Page	Revised Item
May, 2007	MDUG-CM2/07515J-01		New Draft
Feb., 2008	MDUG-CM2/08215J-01	CH 1- 2	Shaft end is added to Model #.
		CH 3-14	Figure of【 9 Pin 】is changed.
		CH 3-16	Figure of【 OUTPUT 1, 2, 3, 4 】is changed.
		CH 3-18	Connection Example is changed.
		CH 4-20	Figure of No.4 is changed.
		CH 7-32	"7.7. Reversal of Coordinate" is changed.
		CH 8-33	Average Life of Motor in chart of【CM2 Parts life time】is changed.
		CH 9-35	Model # "-∗" is added.
			Single-phase or Three-phase in chart of "Input AC Supply [V] of 60A40A" is added.
		CH 9-36	Model # "-∗" in chart of【Torque-Rotational speed characteristic】is added.
		CH 9-38～41	Shaft end is added.
		CH 10-43, 44	Details of option cables are added.
Jan., 2009	MDUG-CM2/09101J-01	IN - 004	Length of each bundled cables is changed.
		CH 9-35	Rated Current (reference value) is changed.
		CH 9-36	" * **Input Voltage is AC200-240V** " is added.