MITSUBISHI ELECTRIC
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Servo

MOTION CONTROLLER Basics (Hardware)

This course is a training system for those who establish the motion control system using the motion CPU module of Mitsubishi motion controller Q series for the first time.

L(NA)00127ENG

Introduction Purpose of the Course

This course is for those who are going to establish the motion control system using the motion CPU module for the first time to learn system design, installation, wiring, and wiring check.

The main contents of this course are for hardware designer.
The contents for software designer, such as system setting and programming, are prepared in the "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.

For this course, you are required to have knowledge about MELSEC-Q series PLC, AC servo and positioning control.
For those who take this course for the first time, we recommend to take
"MELSEC-Q SERIES BASICS" course,
"MELSERVO (MR-J4) BASICS" course,
"YOUR FIRST FACTORY AUTOMATION (POSITIONING CONTROL)" course.

Introduction Course Structure

The contents of this course are as follows.
We recommend that you start from Chapter 1.

Chapter 1 - BASICS OF MOTION CONTROL

You will learn the basics of the motion control system and motion CPU module.

Chapter 2 - SYSTEM DESIGN

You will clarify the control details of the system to be established and learn how to design systems and to select products.

Chapter 3 - INSTALLATION AND WIRING

You will learn how to install and wire motion control systems.

Chapter 4 - WIRING CHECK

You will learn how to check for correct wiring.

Final Test

Passing grade: 60% or higher.

Introduction How to Use This e-Learning Tool

Go to the next page		Go to the next page.
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Move to the desired page		"Table of Contents" will be displayed, enabling you to navigate to the desired page.
Exit the learning		Exit the learning. Window such as "Contents" screen and the learning will be closed.

Introduction How to Use This e-Learning Tool

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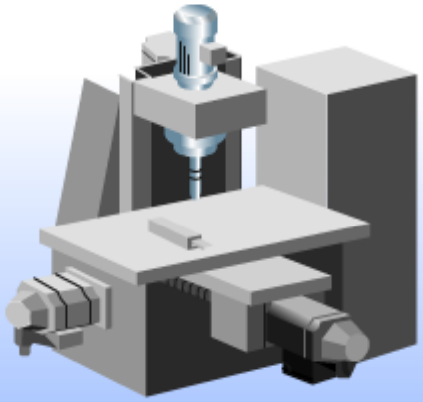
Chapter 1 BASICS OF MOTION CONTROL

The motion control controls the multiple axes (servo motors) for a conveyor assembly, a processing machine etc. and performs the high-precision positioning control and speed control.
This course provides hardware designer with information on how to configure motion control systems using the motion CPU module (Q172DCPU)

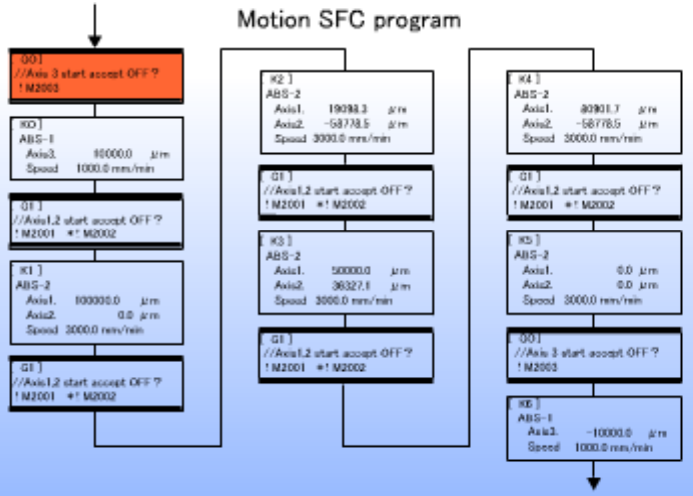
The application examples of the motion control are introduced in the following.
Click the button of the application example which you would like to see.

X-Y table | Sealing | Spinner | Filling machine

X-Y table



Motion SFC program



1.1 Features of Motion CPU Modules

Use a motion CPU module of the Mitsubishi motion controller Q series for motion control. The following shows the features of motion CPU modules.

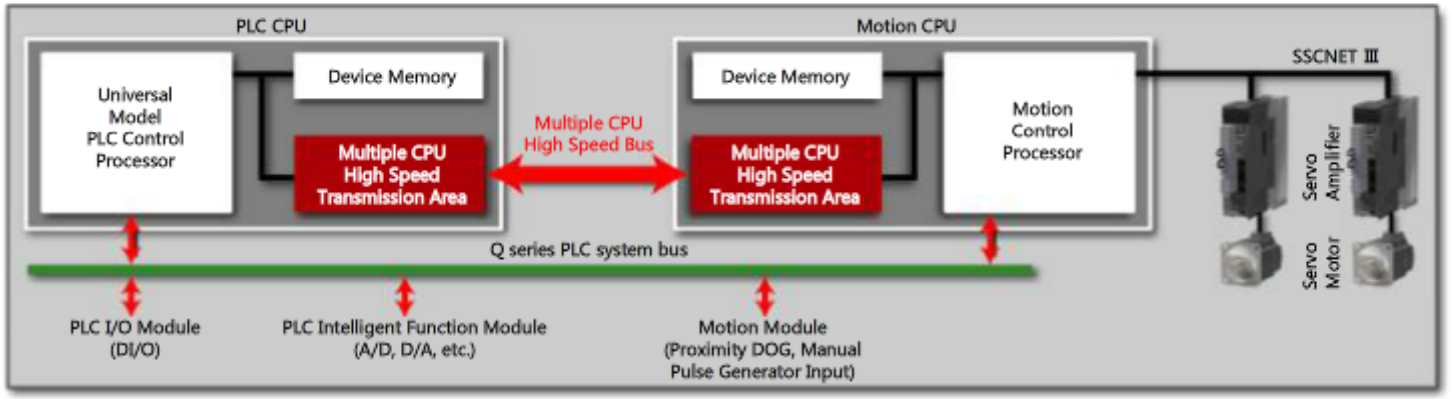
Operating system software can be selected to suit each application

You can select suitable operating system software (control software) for applications such as conveyor assembly or processing machine.

Operating system software SW8DNC-SV□□Q□ (CD-ROM)	Conveyor assembly use Motion SFC compatible SV13	Automatic machinery use Motion SFC compatible SV22	Machine tool peripheral use SV43
	Dedicated language	Mechanical support language	EIA language (G code)
	Electronic component assembly, Inserter, Feeder, Molder, Conveying equipment, Paint applicator, Chip mounting, Wafer slicer, Loader and Unloader, Bonding machine, X-Y table	Press feeder, Food processing, Food packaging, Winding machine, Spinning machine, Textile machine, Printing machine, Book binder, Tire molder, Paper-making machine	Grinding machine Transfer machine Machine tool Woodworker Loader and unloader
	Linear interpolation (1 to 4 axes), Circular interpolation, Constant-speed, Fixed-pitch feed, Speed control with fixed position stop, Speed switching, Speed control, Speed and position switching	Synchronous control, Electronic shaft, Electronic clutch, Electronic cam, Draw control	Linear interpolation (1 to 4 axes) Circular interpolation Helical interpolation Constant-speed positioning

Multiple CPU configuration reduces the load of CPU processing

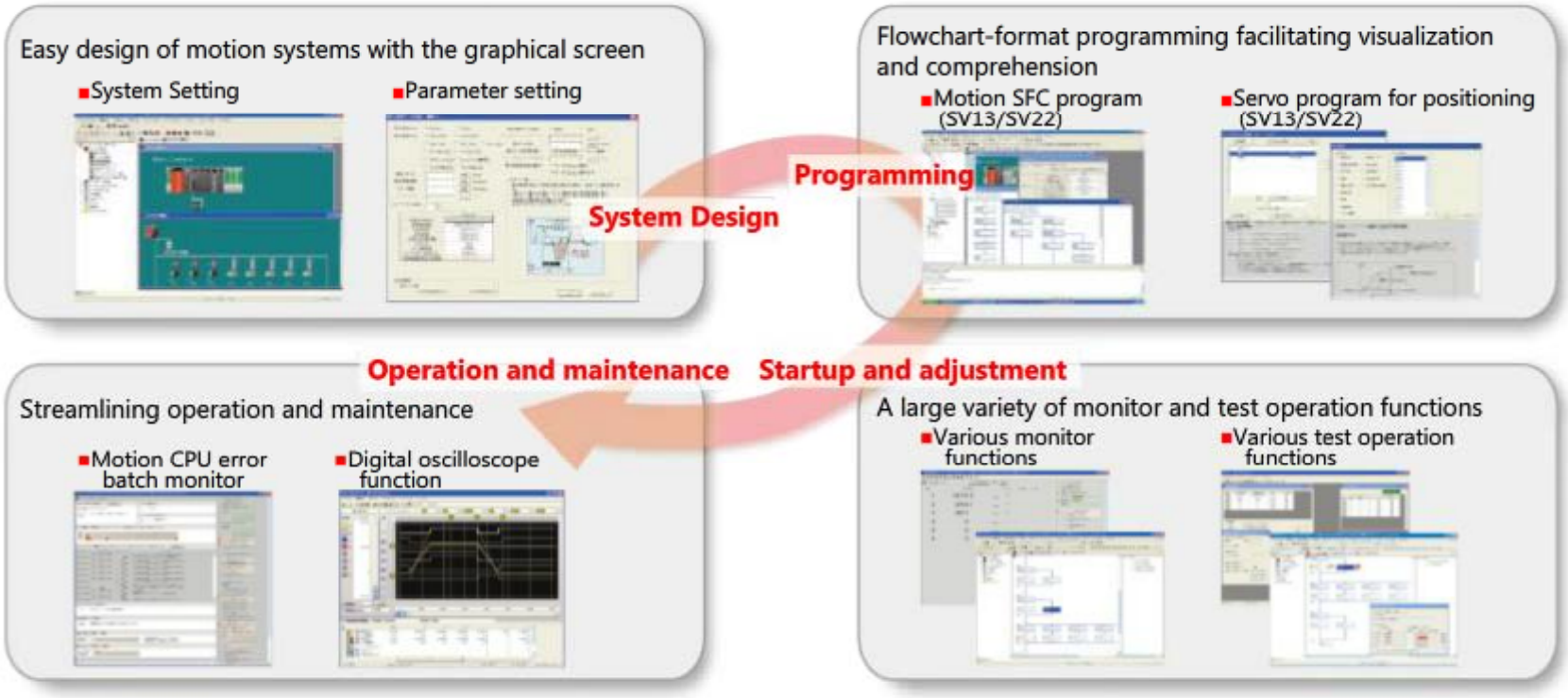
A motion CPU module needs to be used in conjunction with a PLC CPU module. This is referred to as multiple CPU configuration, in which sequence control and motion control are processed in each CPU module, reducing the processing load on each CPU module and speeding up processing. (A motion CPU module cannot be used alone.)



1.1 Features of Motion CPU Modules

Easy-to-use development and maintenance environment are provided

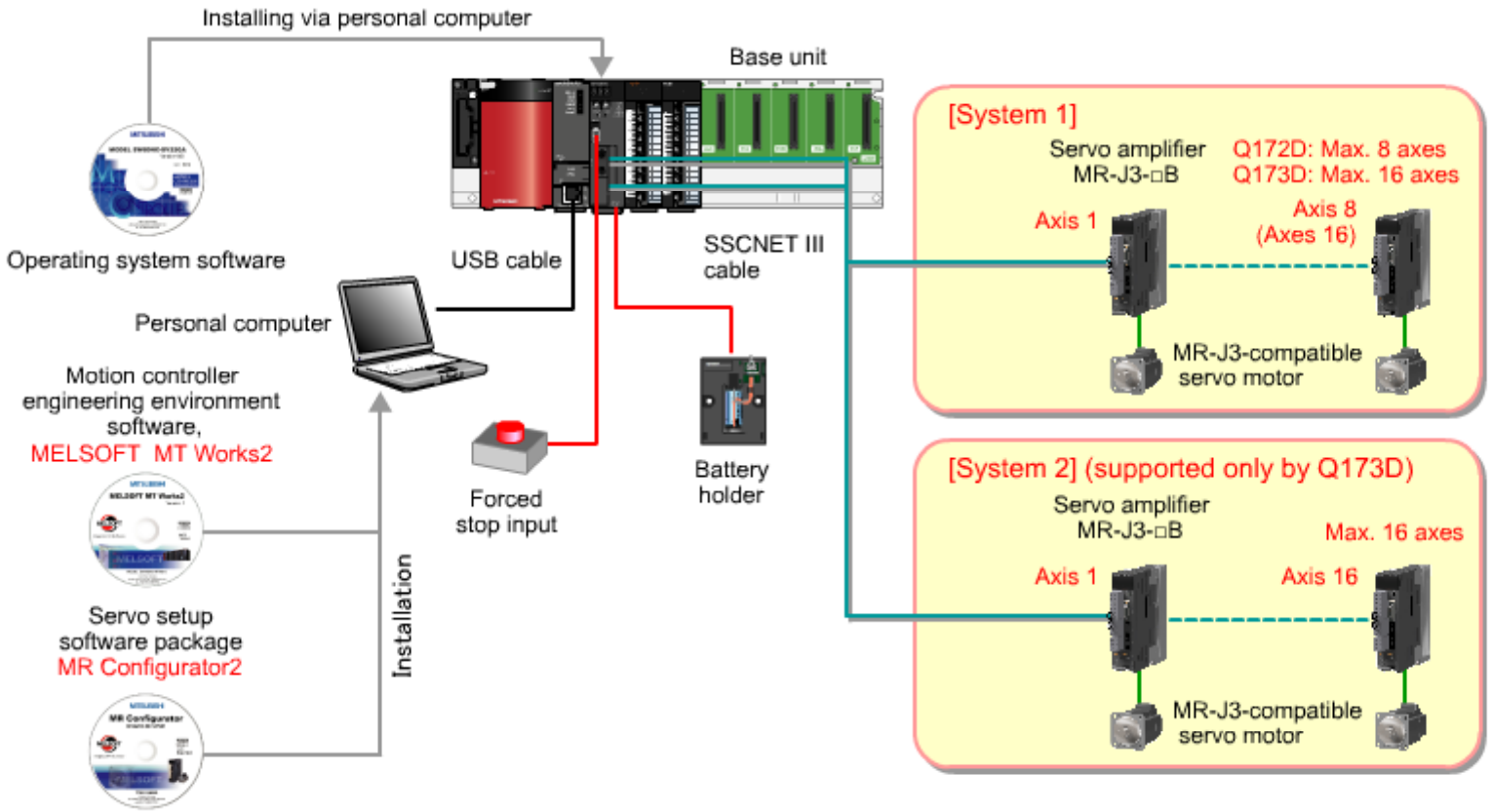
A motion controller engineering environment, MELSOFT MT Works2, provides development and maintenance environment that enables system setting, parameter setting "programming and debugging", simulation, and "operation and maintenance" in an integrated way from a personal computer.
This streamlines the development, operation, and maintenance of motion control systems.



1.2 Requirements for Establishing Motion Control Systems

The following shows basic configuration (including hardware and software) required for establishing a motion control system.

Pointing the mouse cursor on each device displays the details of the device.



1.3 Names of Each Section of a Motion CPU Module

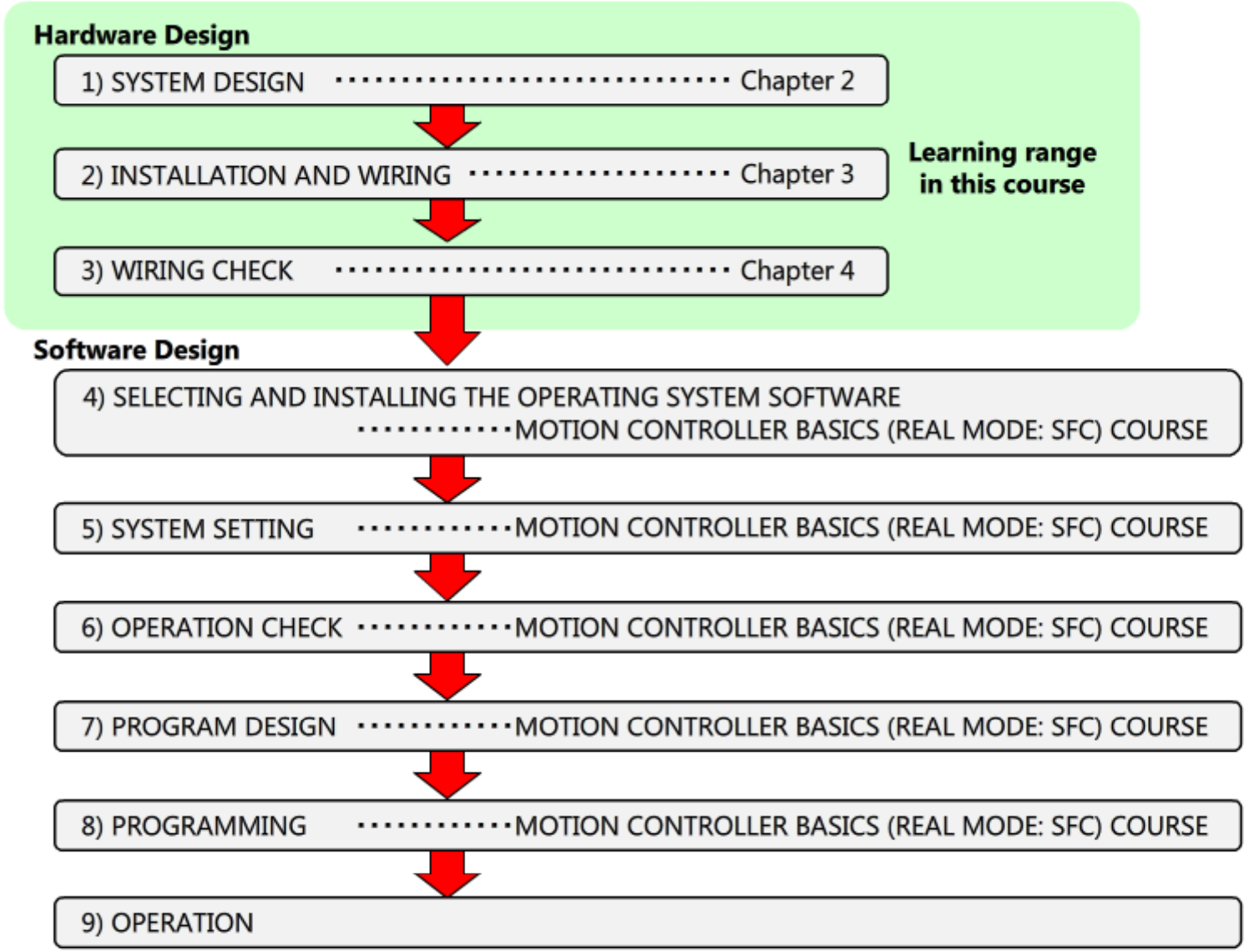
The following table lists the names and applications of each section of a motion CPU module. (In this course, Q172DCPU is used as the example.)

Pointing the mouse cursor on each item in the table highlights the corresponding section of the motion CPU module, and vice versa.

Name	Application
7-segment LED display	Indicates the operation status and error information of the CPU module.
Rotary function select 1 switch (SW1)	Used to set the operation mode (normal operation mode, installation mode, etc.).
Rotary function select 2 switch (SW2)	Used to set the operation mode (normal operation mode, installation mode, etc.).
RUN/STOP switch	Used to control the CPU module (to execute or stop programs).
Forced stop input connector	Terminal for inputting a forced stop input (24VDC).
SSCNET III CN1 connector	Connector for connection with servo amplifiers (up to 16 axes) Connect a SSCNET III cable.

1.4 Procedures to Establish the Motion Control System

The following shows the procedure to establish the motion control system.
In this course, you will learn the process of the hardware design along with the establishment procedure.



1.5 Summary

The following lists the contents you learned in Chapter 1.
The following points are very important, so please check them again.

Basics of Motion control	The motion control controls the multiple axes (servo motor) for a conveyor assembly, a processing machine etc. and performs the high-precision positioning control and speed control.
Features of motion CPU modules	• You can select suitable operating system software (control software) for applications such as conveyor assembly or processing machine. • A motion CPU module needs to be used in conjunction with a PLC CPU module. This is referred to as multiple CPU configuration, in which sequence control and motion control are processed in each CPU module, reducing the processing load on each CPU module and speeding up processing. • A motion controller engineering environment, MELSOFT MT Works2, provides development and maintenance environment that enables system setting, parameter setting, "programming and debugging", simulation, and "operation and maintenance" in an integrated way from a Windows personal computer. • This streamlines the development, operation, and maintenance of motion control systems.

Chapter 2 SYSTEM DESIGN

In Chapter 2, you will learn how to design a system and to select products.

SYSTEM DESIGN ····· Chapter 2

↓

INSTALLATION AND WIRING ····· Chapter 3

↓

WIRING CHECK ····· Chapter 4

Learning procedure of Chapter 2

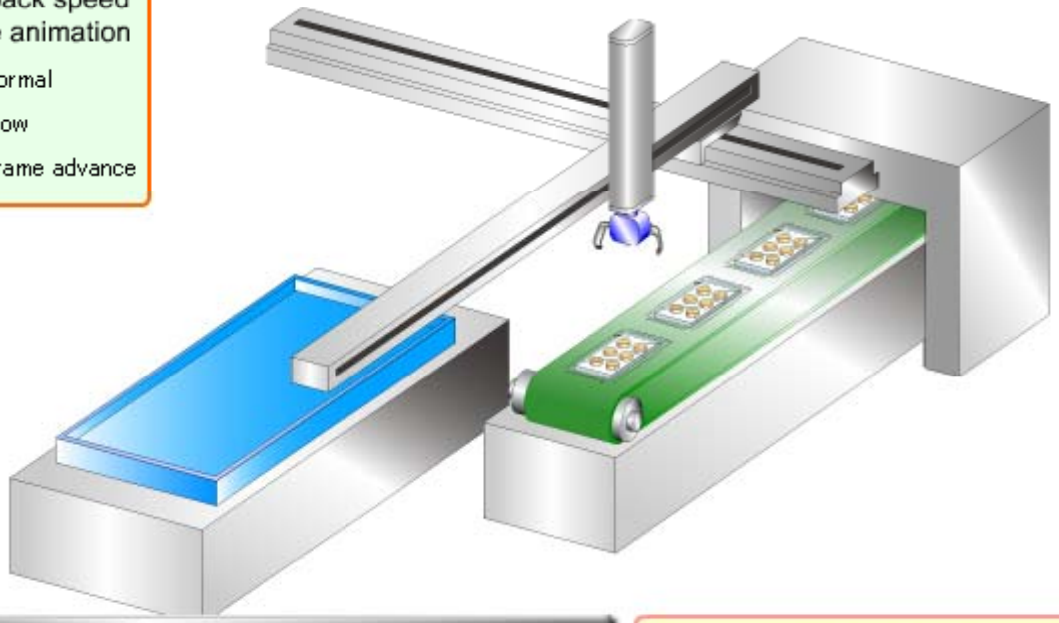
2.1 Clarifying the Control Mode
  2.1.1 Equipment configuration of the sample system for this course
2.2 Evaluating a Servo System
2.3 Evaluating Necessary I/O Specifications and Points
2.4 Evaluating Safety Design
2.5 Selecting Products
2.6 Summary of this Chapter

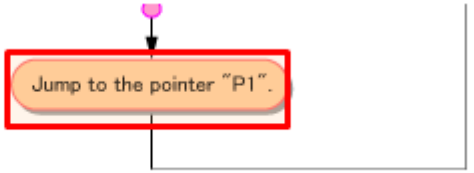
2.1 Clarifying the Control Mode

Check the control mode (control flow) in the sample system for this course by using the animation.

Operate the animation in the following sample system by a mouse according to the instruction of Click .

Playback speed of the animation
- (•) Normal
- ( ) Slow
- ( ) Frame advance

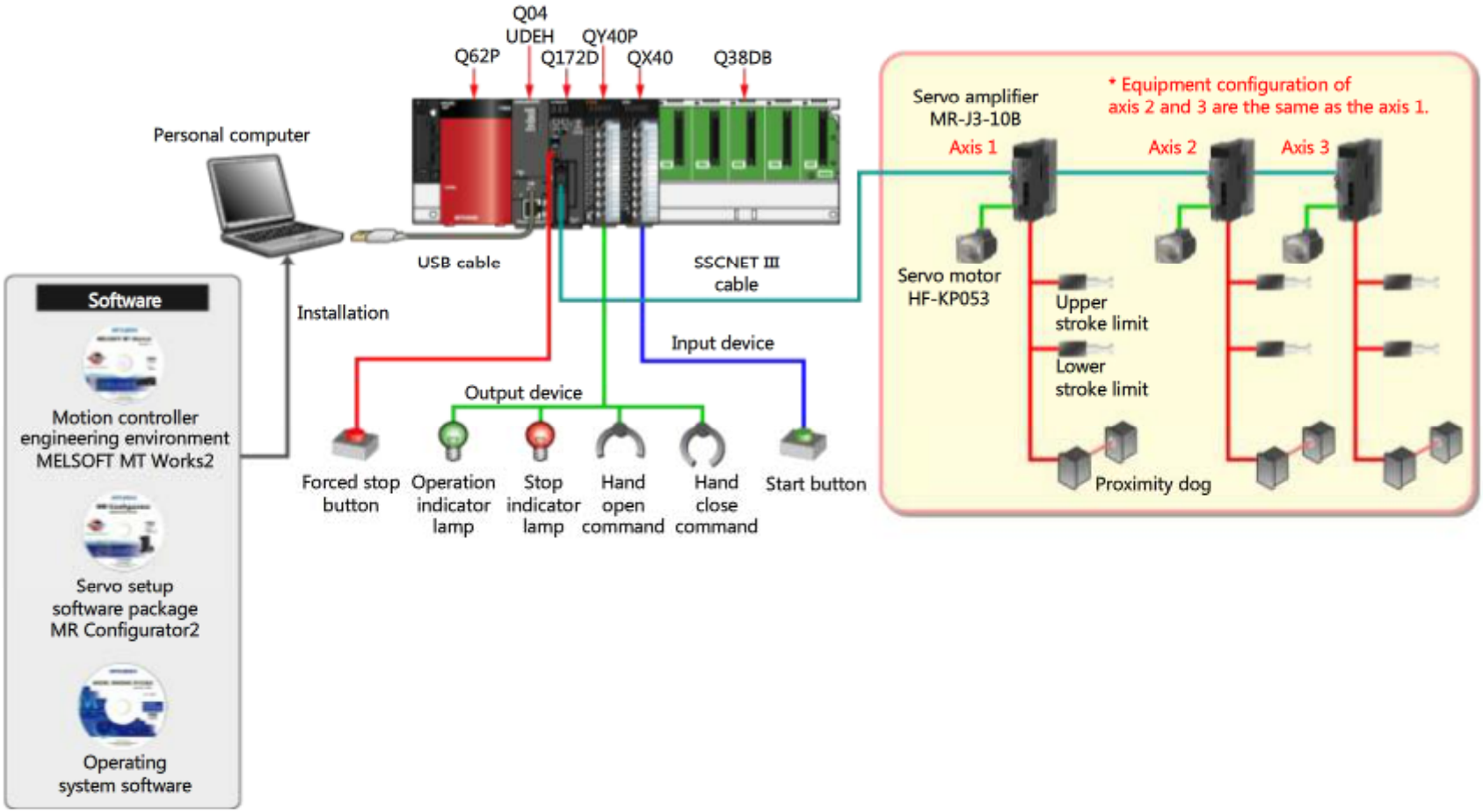




To arrange the next goods onto the pallet,
the control flow returns back to the pointer (P1).

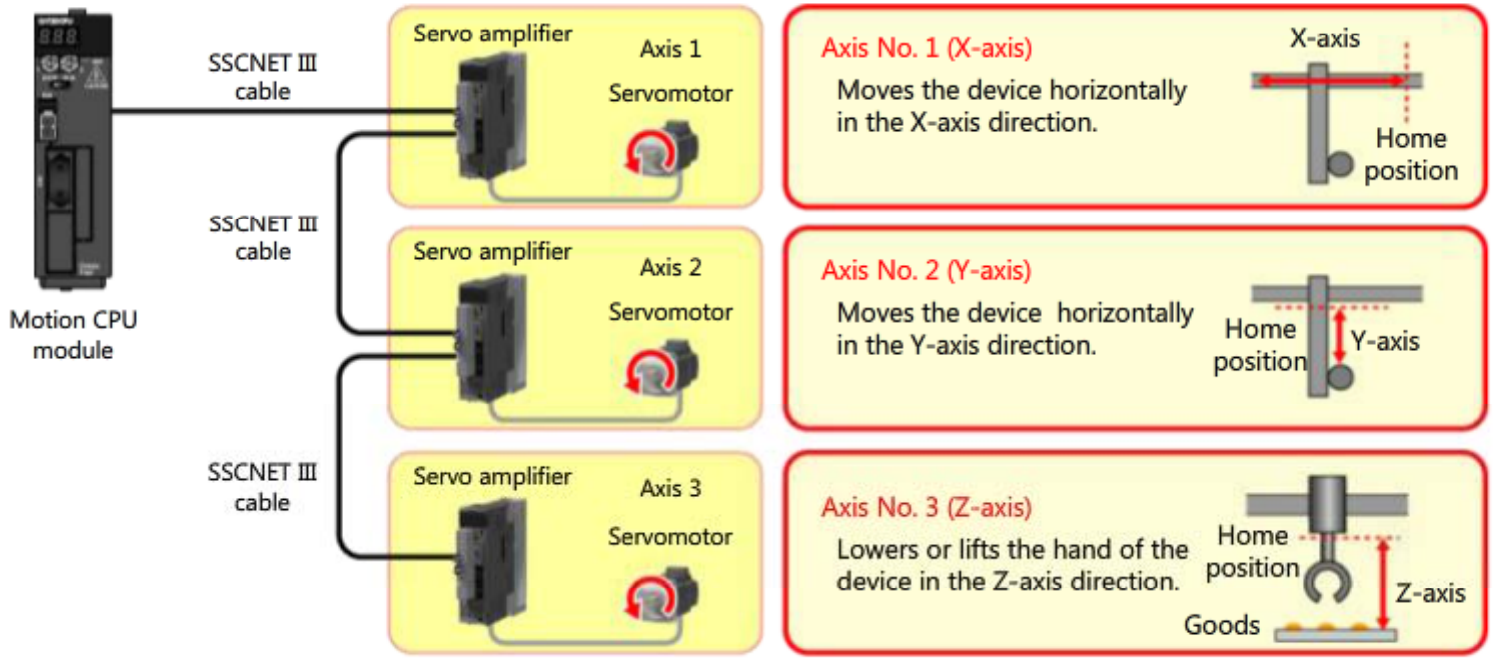
2.1.1 Equipment configuration of the sample system for this course

The following shows the equipment configuration of the sample system for this course.



2.2 Evaluating a Servo System

Next, evaluate servo system configuration according to machine specifications of the system (number of axes, axis No., rotation direction, etc.).
For the sample system, the servo system configuration below is selected according to the control details shown in section 2.1.



Servomotor rotation direction

Evaluate the servo motor rotation direction for moving the machine in the forward rotation direction, based on the machine specifications.
The rotation direction is counterclockwise (CCW) or clockwise (CW) from load-side view (the side where the motor is installed to the machine).
In the sample system, an axis rotates counterclockwise with the forward rotation command.

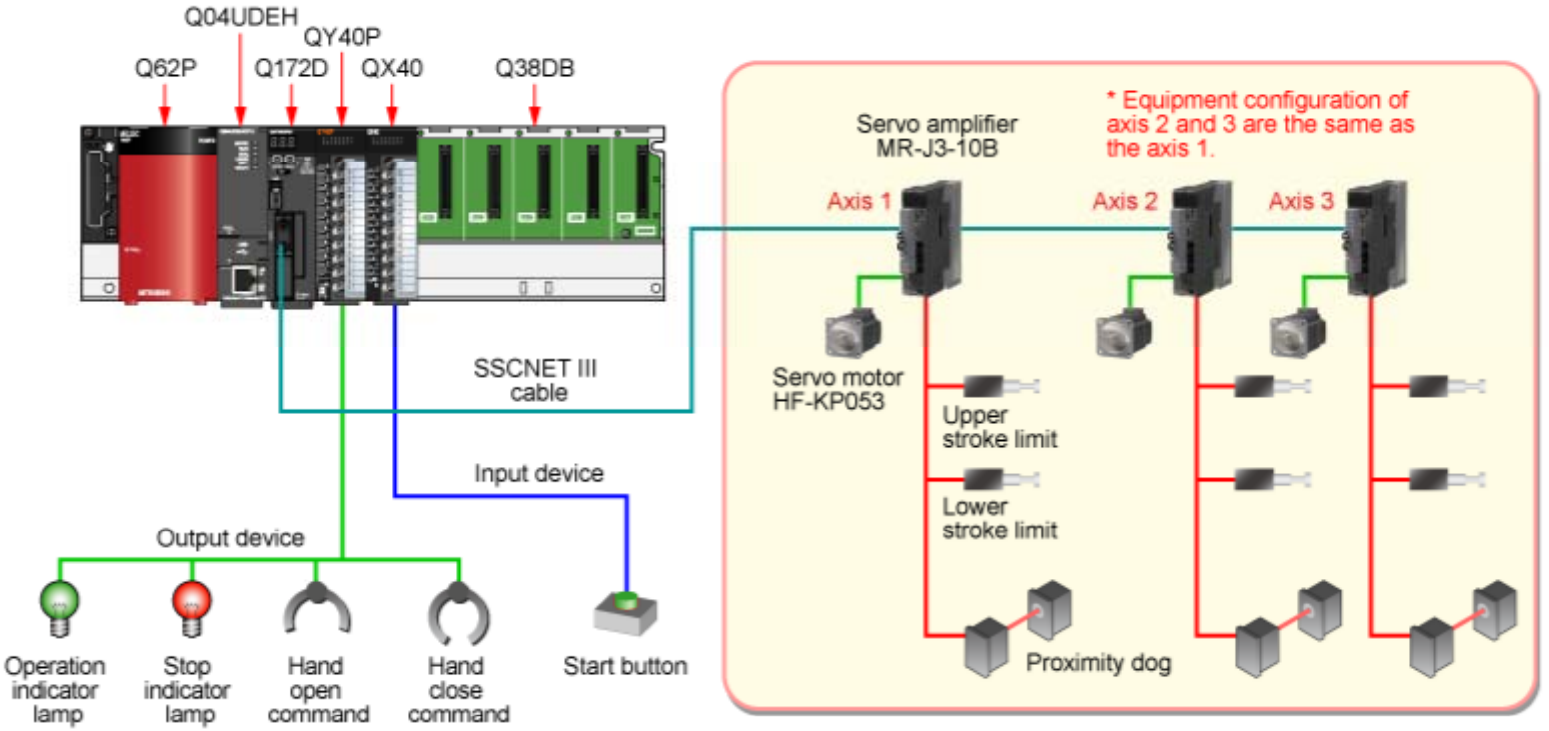
Evaluating home position return method

To remove an error of stop positions, perform the home position return for each axis.
Several methods are prepared for the home position return. Select a suitable method for machine specifications of the system.
For the sample system, perform the home position return of the proximity dog type for each axis.

2.3 Evaluating Necessary I/O Specifications and Points

Next, evaluate the I/O specifications and points of the motion controller and the servo amplifier.
Select the I/O specifications and points according to the control details shown in section 2.1.

Pointing the mouse cursor to a device connected to the motion controller or the servo amplifier displays the corresponding I/O specifications.

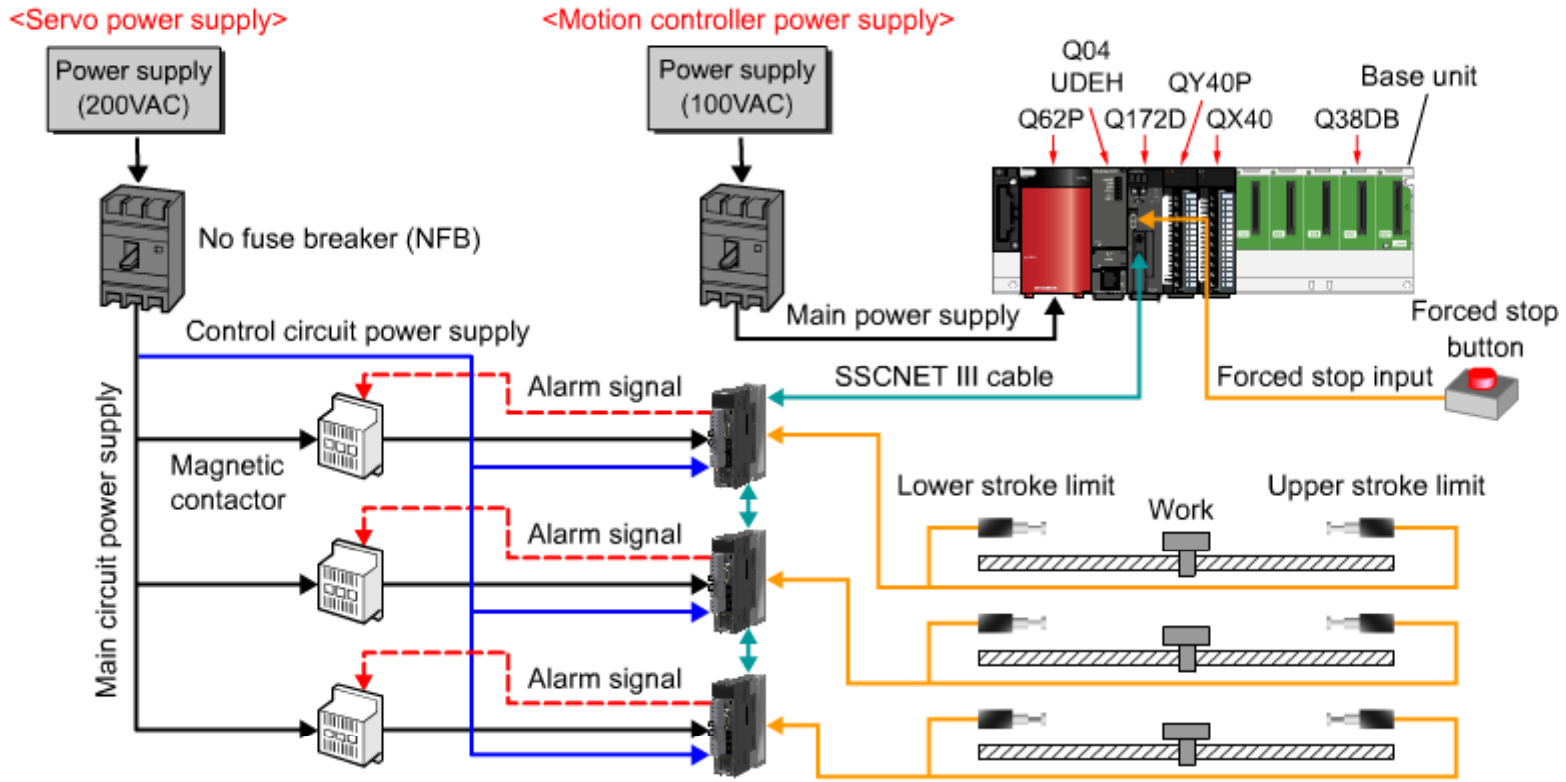


2.4 Evaluating Safety Design

Next, evaluate the safety design of the motion control system.
To prevent damage and failure of devices and other accidents in case of system malfunction, evaluate a mechanism for assuring a system to stop in case of emergency.
For the sample system in this course, the following three safety measures are taken.

Click the button of the safety measure which you would like to see. (Click the "Display entire circuit" button to check the entire circuit.)

Emergency stop circuit | Forced stop circuit | Limited movable range of work | Display entire circuit

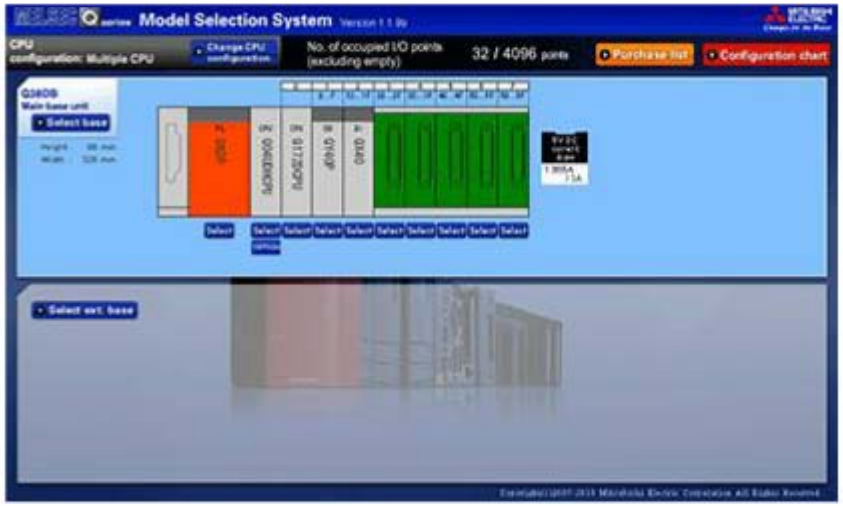


2.5 Selecting Products

Select products for purchase based on the evaluated system configuration.
Select products with the aid of the selection tools.

For motion controllers: MELSEC-Q series model selection system

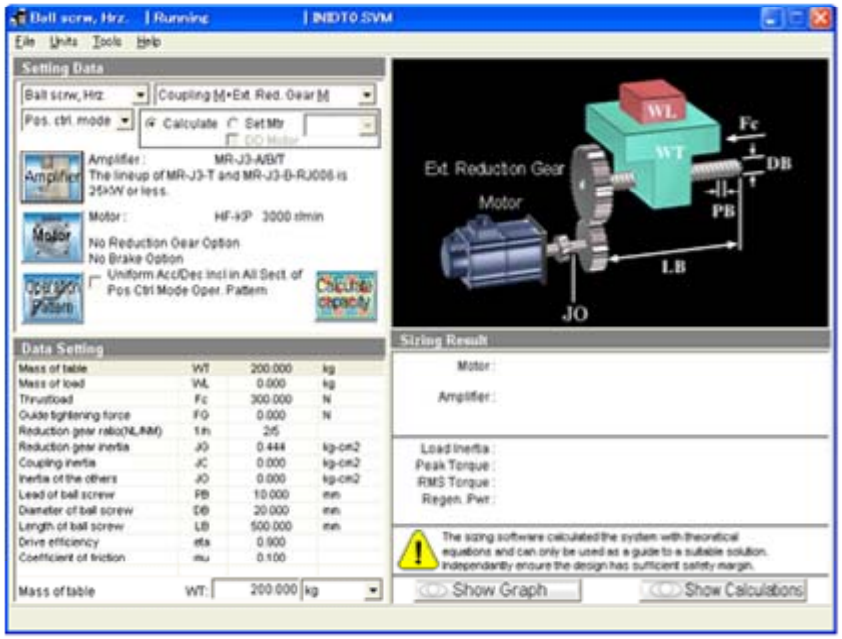
This tool helps you to select MELSEC-Q series products, including motion CPU modules in our Web site for industrial automation products.
You can use this tool at no charge.



* This tool works on the Web page. Downloading and installing is not required.

For servos: AC servo capacity selection tool

This tool helps you to select a suitable combination of servo amplifiers and servo motors according to the machine specifications of the system. You can download this tool from our Web site for industrial automation products.



*This tool requires installation to your personal computer after downloading.

2.5 Selecting Products

Select devices to be used in the sample system according to the evaluated system configuration.
In the next, the following table lists the selected equipment configuration of the sample system.

Item	Configuration component	Quantity	Model name	Description
Motion controller system	Base unit	1	Q38DB	a base unit which has 8 slots for mounting each module and supports multiple CPU.
	Power supply module	1	Q62P	Supplies power to each module.
	PLC CPU module	1	Q04UDECPU	A CPU module which performs the sequence control. * The battery (Q6BAT) is enclosed with the CPU module.
	Motion CPU module	1	Q172DCPU	A CPU module which performs the motion control. * The battery (Q6BAT) and the battery holder (Q170DBATC) are enclosed with the CPU module.
	Input module	1	QX40	Inputs the ON/OFF signal from the start button. (16 points)
	Output module	1	QY40P	Outputs the ON/OFF signal to the indicator lamp and the device (the hand part). (16 points)
	External power supply	1	–	Supplies 24VDC power to the I/O devices and the forced stop input.
External I/O device	Start button	1	–	A push button switch to start the sample system.
	Forced stop button	1	–	A push button switch to stop the servo motors of all the axes at an emergency.
	Cable for forced stop input	1	Q170EMICBL□M	Used for wiring the forced stop input to the motion CPU module.
	Hand part of the device	1	–	The hand part of the device for catching the goods.
	Indicator lamp	2	–	The indicator lamps to inform if the system is in operation or stops.
Servo system	Servo amplifier	3	MR-J3-10B	A servo amplifiers for 3 axes.
	Servo motor	2	HF-KP053	Servo motors for the axis 1 (X-axis) and the axis 2 (Y-axis).
		1	HF-KP053B	A servo motor with a brake for the axis 3 (Z-axis).
	Stroke limit	6	–	Sensors to detect the upper limit and the lower limit in the movable range of the device.
	Proximity dog	3	–	Sensors to detect the starting position of deceleration at the home position return.
	Motor power supply cable	3	MR-PWS1CBL2M-A1-L	A cable to conduct the power from the servo amplifier to the servo motor. (Length: 2m)
	Encoder cable	3	MR-J3ENCBL2M-A1-L	A cable to connect the servo amplifier and the encoder of the servo motor. (Length: 2m)

2.5 Selecting Products

	Encoder cable	3	MR-J3ENCBL2M-A1-L	A cable to connect the servo amplifier and the encoder of the servo motor. (Length: 2m)
	SSCNET III cable	3	MR-J3BUS□M	A communication cable between the motion CPU module and the servo amplifier.
Development environment	Personal computer	1	–	A personal computer to run the engineering environment software.
	Engineering environment software	1	MELSOFT MT Works2	Software to set the motion CPU module, to program and so on.
		1	MELSOFT GX Works2	Software to set the PLC CPU module, to program and so on.
		1	MELSOFT MR Configurator2	Setup software to set the servo amplifier and the servo motor.
	Operating system software	1	SW8DNC-SV13QD	Software to be installed to the motion CPU module.
	USB cable	1	MR-J3USBCBL3M	Connects the personal computer where MELSOFT MT Works2 is installed and the CPU module.

2.6 Summary

The following lists the contents you learned in Chapter 2.
The following points are very important, so please check them again.

Clarifying the control mode	Clarify the control details and machine specifications before designing systems.
Evaluating a servo system	Evaluate servo system configuration according to machine specifications of the system (number of axes, axis No., rotation direction, etc.). ・Servo motor rotation direction Evaluate the servo motor rotation direction for moving the machine in the forward rotation direction, based on the machine specifications. Rotation direction is counterclockwise (CCW) or clockwise (CW) from load-side view (the side where the motor is connected to the machine). ・Evaluating home position return method To remove an error of stop positions, perform the home position return for each axis. Several methods are prepared for the home position return. Select a suitable method for machine specifications of the system.
Evaluating I/O specifications and points	Evaluate necessary I/O specifications and points according to control details and machine specifications.
Evaluating safety design	To prevent damage and failure of devices and other accidents in case of system malfunction, evaluate a mechanism for assuring a system to stop in case of emergency. ・Emergency stop circuit Configure the circuit so that a magnetic contactor is turned off to shut down the main circuit power supply to a servo amplifier where an alarm (failure) has occurred, and the electromagnetic brake of the servo motor is activated to enable an emergency stop. ・Evaluating home position return method To remove an error of stop positions, perform the home position return for each axis. Several methods are prepared for the home position return. Select a suitable method for machine specifications of the system. ・Limited movable range of work Install stroke limits at the both ends of each axis. Configure the circuit so that the servo motor comes to a rapid stop when a work exceeding the movable range contacts the stroke limit.
Selecting products	Select products for purchase based on the evaluated system configuration. Mitsubishi Electric provides tools that assist product selection at no charge. ・For motion controllers MELSEC-Q series model selection system ・For servos AC servo capacity selection tool

Chapter 3 INSTALLATION AND WIRING

In Chapter 3, you will learn how to install and wire motion control systems.

SYSTEM DESIGN ····· Chapter 2

↓

INSTALLATION AND WIRING ····· Chapter 3

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WIRING CHECK ····· Chapter 4

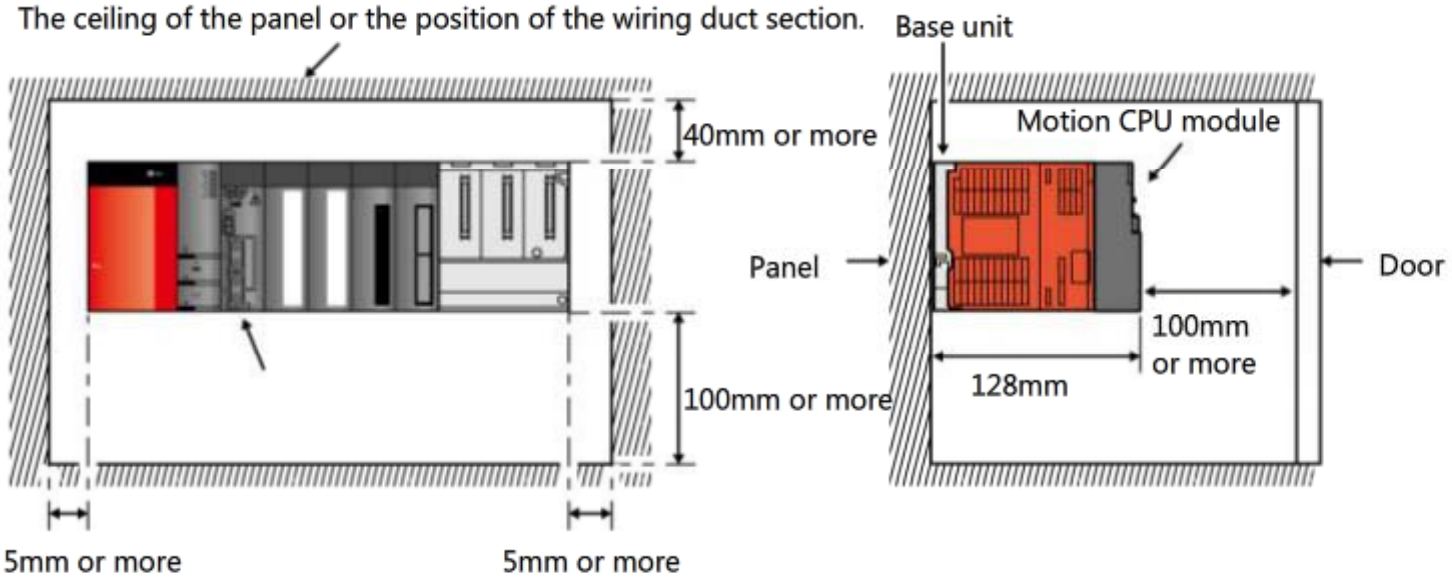
Learning procedure of Chapter 3

3.1 Installation
3.2 Mounting Modules
  3.2.1 Setting a battery to a motion CPU module
3.3 Grounding
3.4 Wiring for Power Supply and I/O Devices
  3.4.1 Wiring for power supply module
  3.4.2 Wiring for I/O devices
  3.4.3 Connecting the power supply to servo amplifiers
  3.4.4 Connecting external I/O devices to the servo amplifier
  3.4.5 Connecting a motor power supply cable
  3.4.6 Connecting a encoder cable
  3.4.7 Connecting servo amplifiers
  3.4.8 Setting a battery for the absolute position detection system
3.5 Setting Control Axis Numbers of Servo Amplifiers
3.6 Initialization of PLC CPU Module
  3.6.1 Connecting a PLC CPU module and a personal computer
  3.6.2 Setting the connection between GX Works2 and the PLC
  3.6.3 Formatting the memory

3.1 Installation

Install a motion controller and servo amplifiers.
To provide good ventilation for heat dissipation and to replace modules easily, give the clearances between the upper and lower sections of the module and the components or parts.
Depending on your system configuration, wider clearances are required.

Motion controller installation

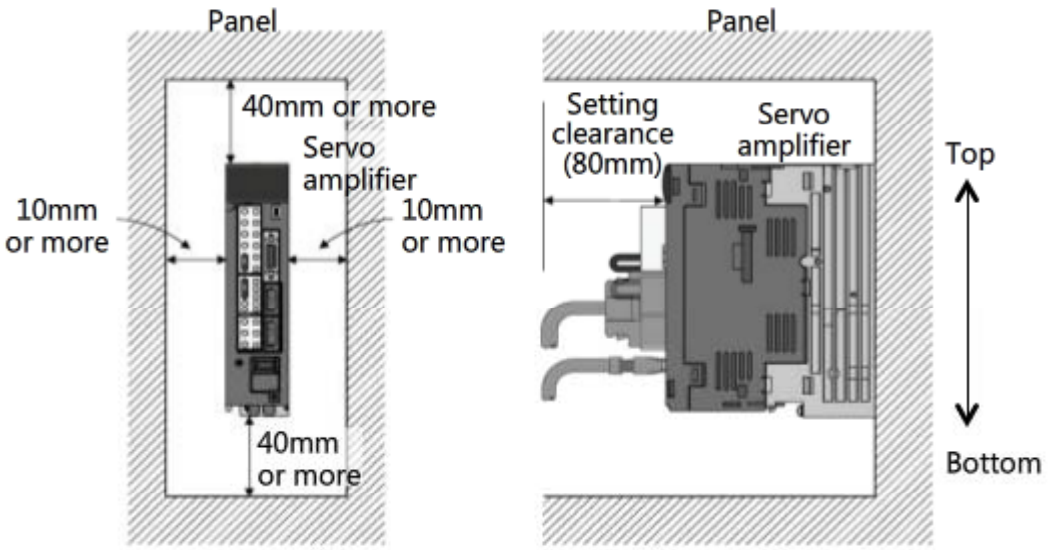


Precautions

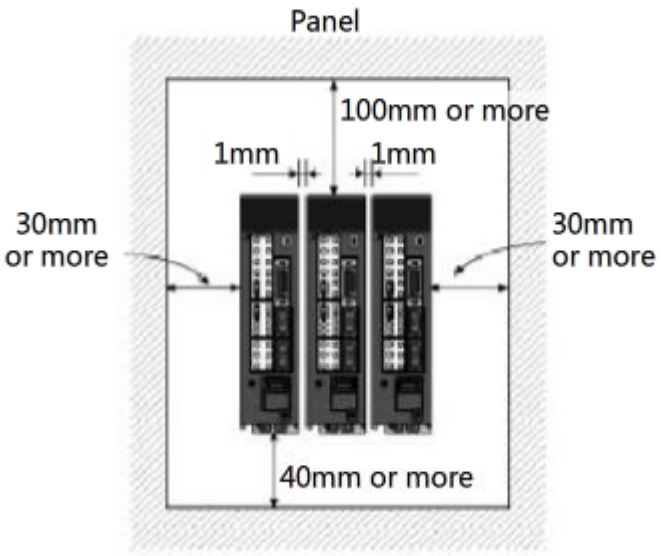
- Fix the base unit on the flat surface of the panel with screws (M4 × 14).
- Do not install a motion controller near an oscillating source such as a large-size magnetic contactor or a no fuse breaker. Instead, provide other panel or separate them.
- To reduce the effects of radiant noise and heat, provide the clearances shown below between a motion CPU module and devices (contactors, relays, etc.).
    - Front section of a motion CPU module: 100mm or more
    - Right and left directions of a motion CPU module: 50mm or more

3.1 Installation

Servo amplifier installation



For close installation of 2 or more amplifiers



Precautions

(1)Install a servo amplifier on the vertical wall with the right side up.
(2)Keep the ambient temperature within the range of 0 to 55°C.
(3)Install a cooling fan for heat dissipation.
(4)Use care with foreign matters, which are generated in assembly or may enter from a cooling fan.
(5)When installing a servo amplifier in a place with much toxic gas or dust, provide air purging.

Precautions

(1)For 200V-class, 3.5kW or less servo amplifiers and 100V-class, 400W or less servo amplifiers, close installation is available.
(2)When closely installing two or more servo amplifiers, provide clearances of 1mm between the amplifiers, considering the installation tolerance.
(3)Keep the ambient temperature for close installation within the range of 0 to 45°C.

3.2 Mounting Modules

Mount the power supply module, PLC CPU module, motion CPU module, and I/O module to the base unit.
Before mounting the PLC CPU module to the base unit, set a battery to the PLC CPU module.

①Setting a battery to the PLC CPU module

① Open the cover at the bottom of the CPU module

↓

② Insert the battery-side connector to the CPU module-side connector, making sure the right direction

↓

③ Close the cover at the bottom of the CPU module

↓

Completed

(Duration: 00:26)

3.2 Mounting Modules

②Mounting each module to the base unit

① Insert the module fixing protrusion into the module fixing recess of the base unit

↓

② Using the module fixing recess as the fulcrum, push the module until it clicks

↓

③ Make sure the module is securely mounted to the base unit

↓

④ Screw the module to the base unit

↓

Completed

(Duration: 00:18)

Point to note when mounting modules
Make sure to screw the modules mounted to the base unit.

3.2.1 Setting a battery to a motion CPU module

Set a battery to a motion CPU module. The battery is an external type.
Using the battery holder unit, install the battery to the panel, etc. in the right direction.

① Install the battery holder unit to the panel in the right direction.

↓

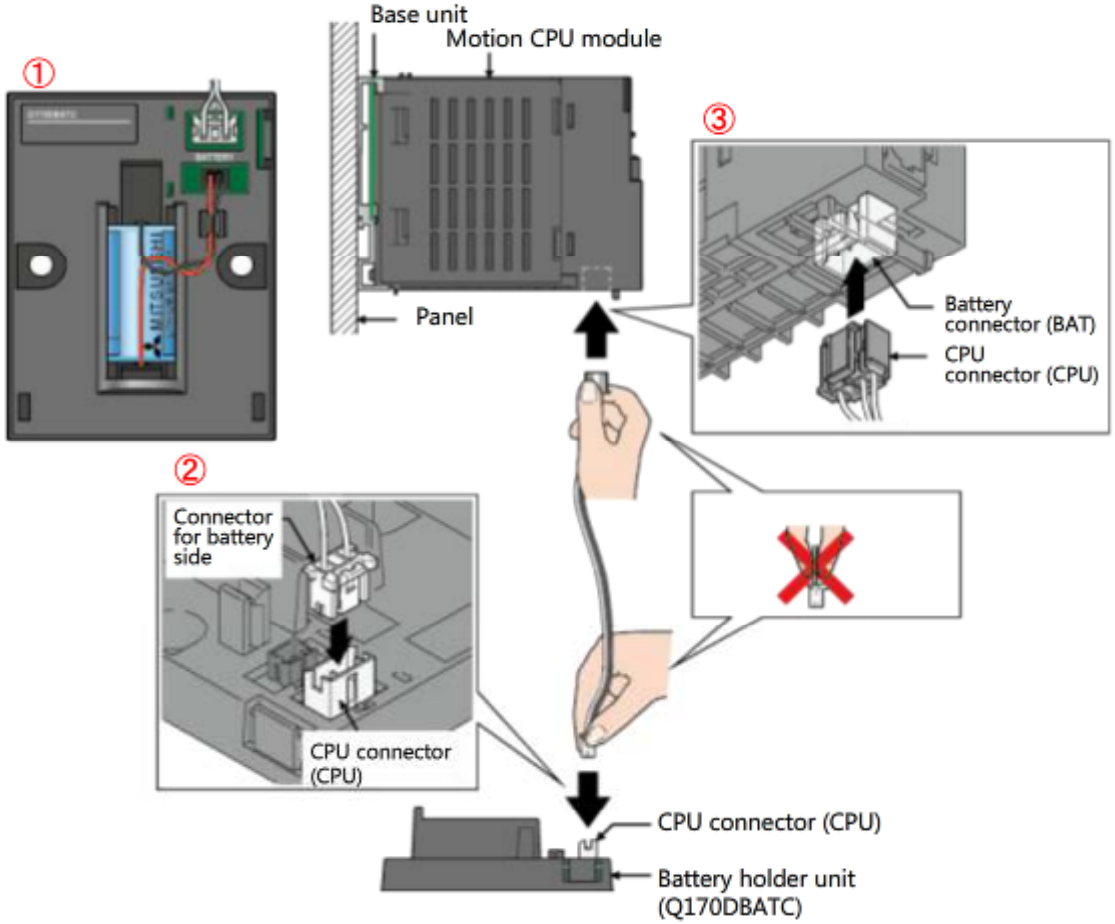
② Insert the battery connector of the battery cable to the CPU connector of the battery holder unit.

↓

③ Insert the connector for CPU side of the battery cable to the battery connector of the battery holder unit.

↓

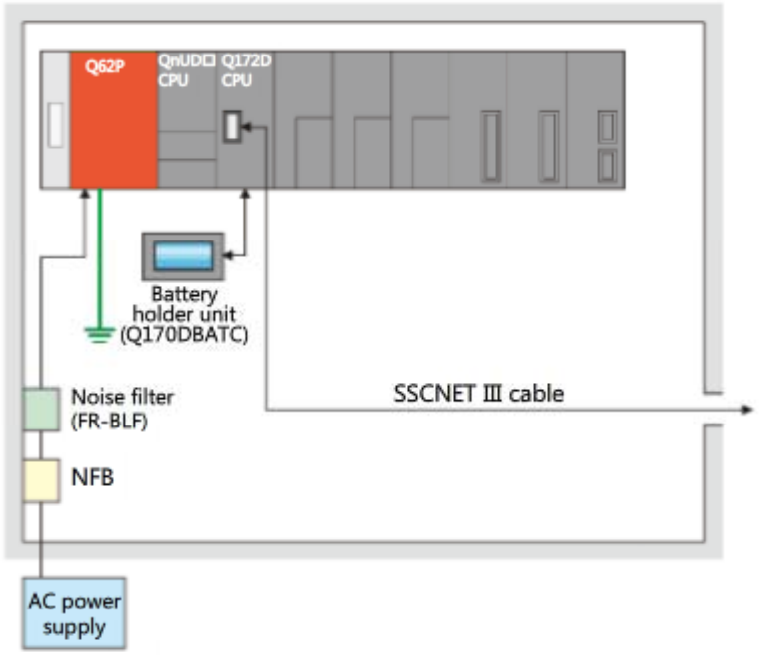
Completed



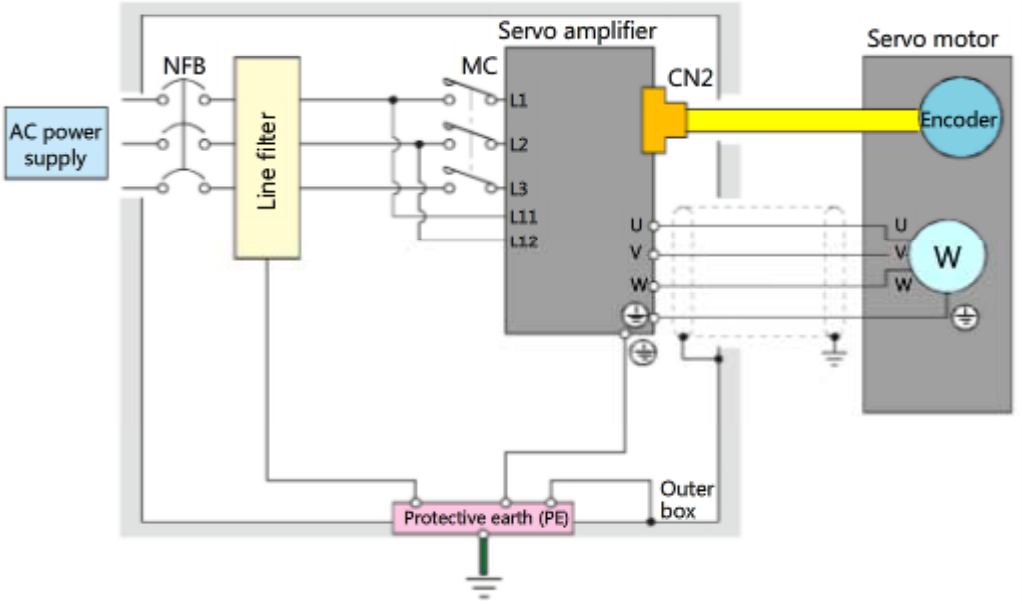
3.3 Grounding

Before wiring the power supply, ground the motion controller and the servo amplifier.
To prevent electric shock and malfunction due to noise, make sure to perform grounding works according to the figure below.

For motion controllers

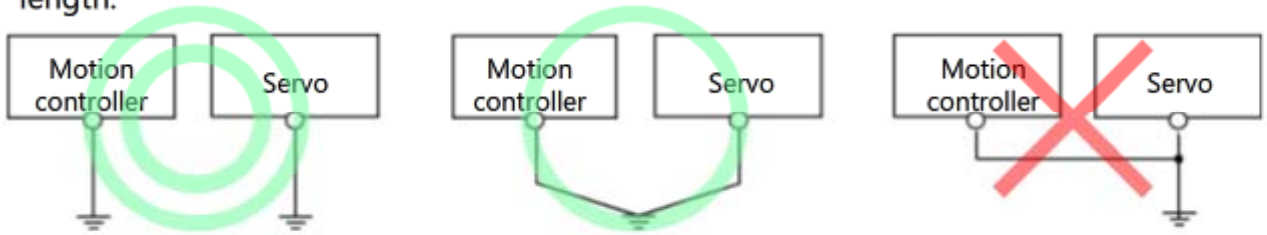


For servos



Precautions

- To prevent electric shock, make sure to connect the protective earth terminal of the servo amplifier to the protective earth of the panel.
- As far as possible, adopt independent grounding to avoid a possible effect of noise from other devices.
  When independent grounding is impossible, adopt common grounding, where all the grounding wires must be the same in length.



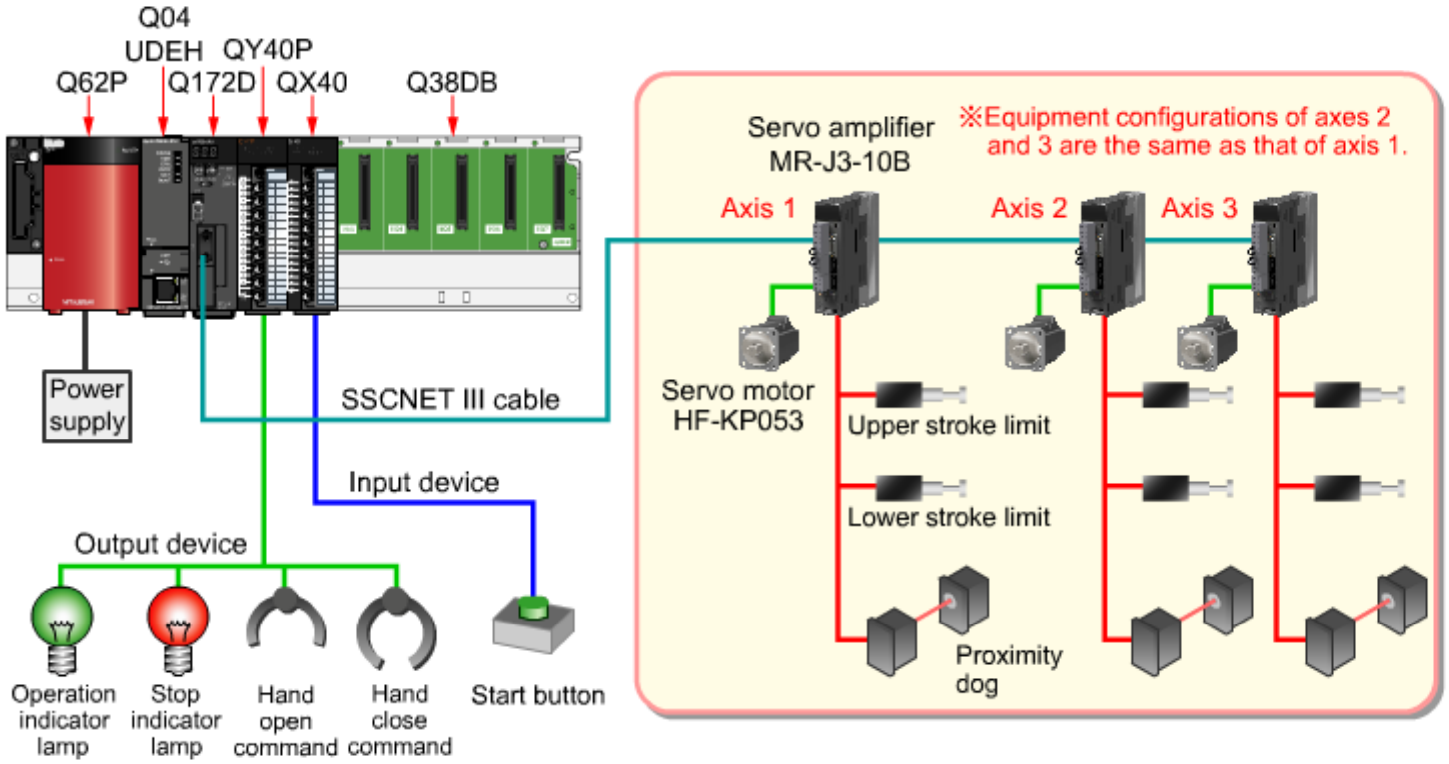
(1) Independent grounding: Best
(2) Common grounding: Good
(3) Joint grounding: Not allowed

3.4 Wiring for Power Supply and I/O modules

Wire the PLC, servo amplifiers and servomotors.
The following shows the devices to be wired in the sample system.

Click the button of the wiring which you would like to see. (Click the "Display entire circuit" button to check the entire circuit.)

Wiring for Power Supply and I/O modules | Connection of a servo amplifier with I/O modules | Connection of servo amplifier with servomotor | Connection of a motion CPU module with servo amplifiers | Display entire circuit

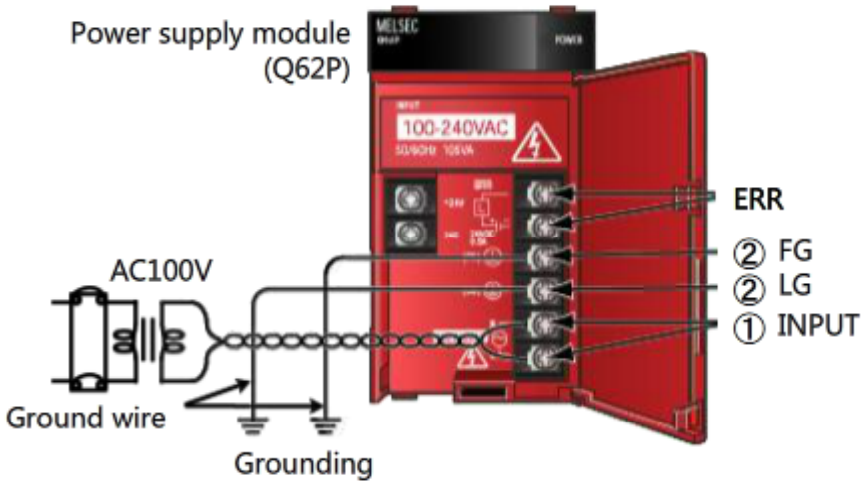


3.4.1 Wiring for power supply module

Arrange the power cable and the ground wire according to the following procedure.
Grounding is a wiring for prevention of electric shock and malfunction.

① Connect the power supply of 100VAC to the power input terminal via a breaker and an isolation transformer

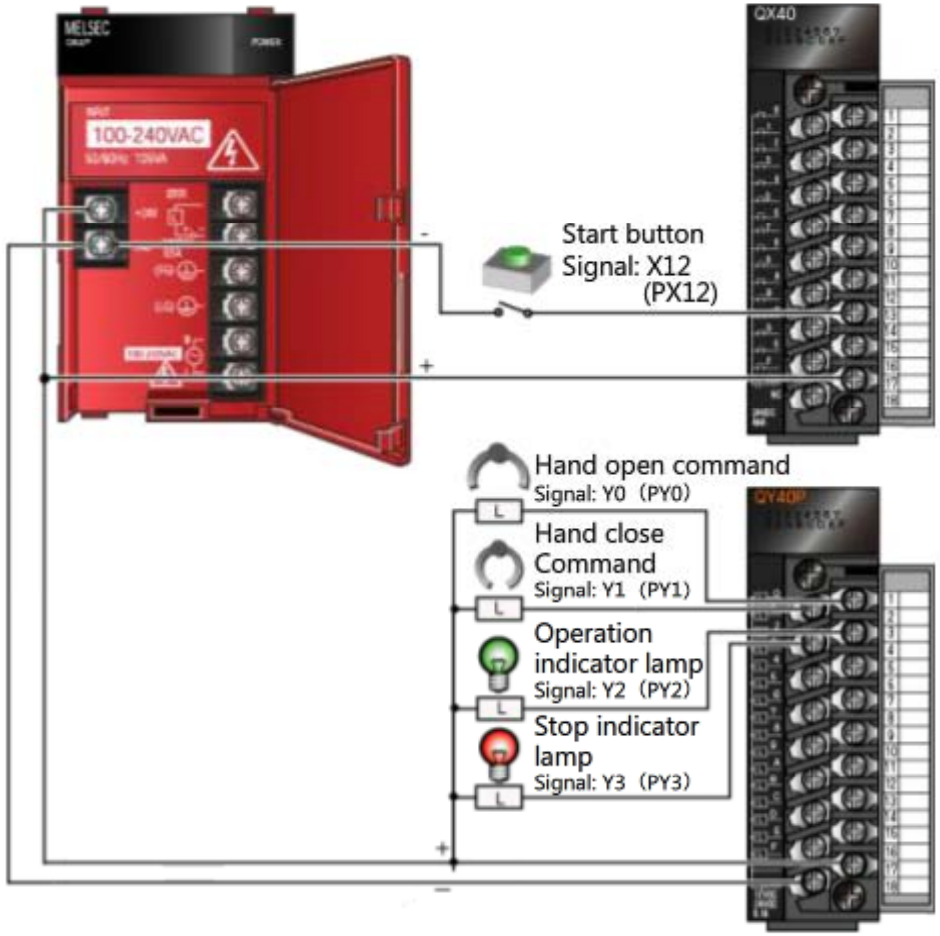
② Ground the LG and FG terminals



※ In the sample system, the power supply of 100VAC is used.
The power supply module Q62P is compatible with the power supply of 100 to 240VAC.

3.4.2 Wiring for I/O devices

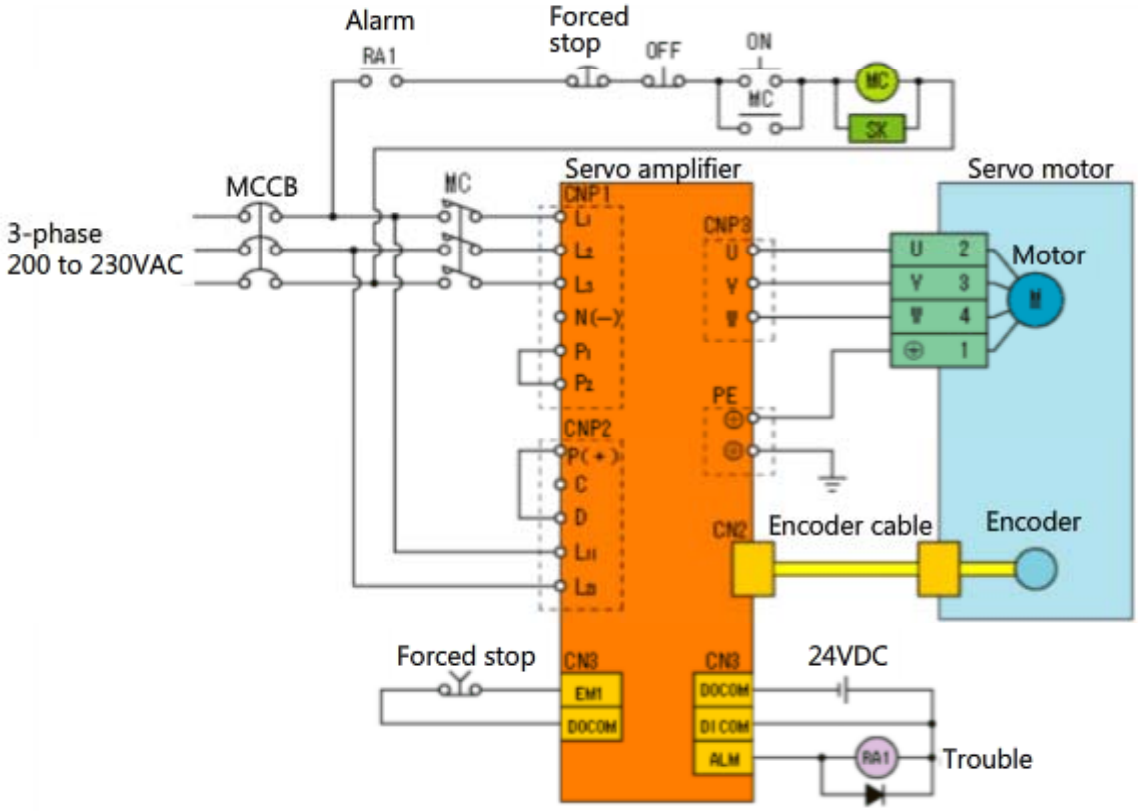
Perform the wiring for the input module (QX40) and the output module (QY40P) as shown below.
Wire the start button (X12), hand open command (Y0), hand close command (Y1), operation indicator lamp (Y2), and stop indicator lamp (Y3) as shown below.



3.4.3 Connecting the power supply to servo amplifiers

Connect the power supply to the two parts: main circuit power supply and the control circuit power supply of a servo amplifier.
Always use a Molded case circuit breaker (MCCB) for the input lines of the power supply.
Also, always connect a magnetic contactor (MC) between the main circuit power supply and the L1, L2, and L3 terminals of a servo amplifier so that the magnetic contactor is turned off to turn off the main circuit power supply when an alarm signal or a forced stop input signal is in the non-conductive status.

The following shows the wiring diagram for MR-J3-10B to MR-J3-350B with 3-phase power supply of 200 to 230VAC.



3.4.3 Connecting the power supply to servo amplifiers

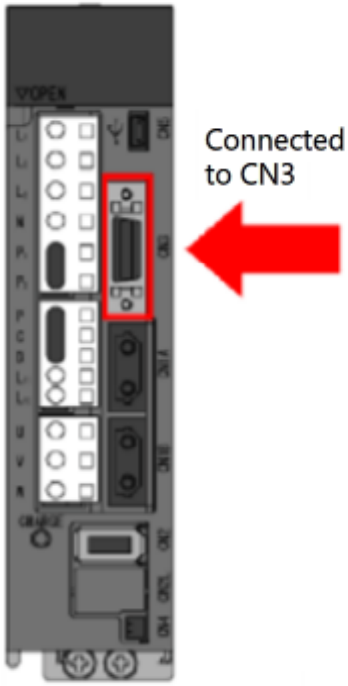
You will learn how to connect a main circuit power supply and a control circuit power supply with the aid of the animation below.
In the sample system, connect 3-phase power supply of 200VAC to MR-J3-10B.
For information on how to select power supply cables and connect them to connectors, refer to the manuals.

1. Connect the connector for CNP1, which is an accessory of a servo amplifier, to the main circuit power supply cable.
   Make sure wiring for L1, L2 and L3 is correct.
2. Connect the connector for CNP2, which is an accessory of a servo amplifier, with the control circuit power supply cable.
   Make sure wiring for L11 and L12 is correct.
3. Connect the main circuit power supply cable to the CNP1 connector of the servo amplifier.
4. Connect the control circuit power supply cable to the CNP2 connector of the servo amplifier.

3.4.4 Connecting external I/O devices to the servo amplifier

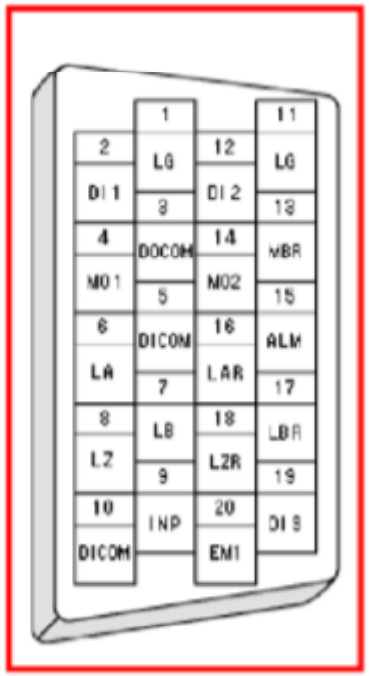
Connect external I/O devices to an I/O signal connector (model name: MR-CCN1).
Connect the wired I/O signal connector to the CN3 connector of the servo amplifier.

The following shows the signal wiring diagram of an I/O signal connector.
The table below lists the external I/O devices used in the sample system.
For the connection of other devices, refer to the manuals.



Connected to CN3

Pin configuration of an I/O signal connector

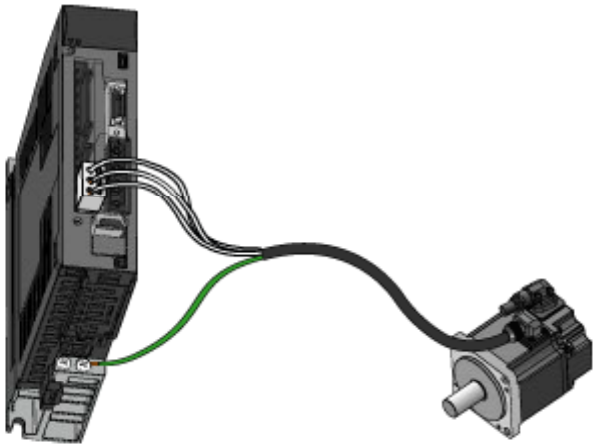


The diagram above is as viewed from the connector wiring section.

Pin No.	Symbol	Function and application
2	DI1	Connect an upper stroke limit.
12	DI2	Connect a lower stroke limit.
19	DI3	Connect a proximity dog.
13	MBR	Connect an electromagnetic brake interlock. When using this signal, set the operation delay time of the electromagnetic brake. A servo-off status or an alarm turns off MBR.
15	ALM	Outputs alarm signals. Connected to an external sequence that turns on or off magnetic contactors (MC) by alarm signals.
5	DICOM	Input 24VDC for the I/O interface (24VDC±10%, 150mA). The power supply capacity differs depending on the points of the I/O interface used. Connect (+) of the 24VDC external power supply.
10		
3	DOCOM	Common terminal for input signals such as the EM1 signal.

3.4.5 Connecting a motor power supply cable

You will learn how to connect a motor power supply cable with the aid of the animation below.
The motor power supply cable is necessary to transmit electric power from a servo amplifier to a servo motor.
In this course, a power supply cable for HF-KP series motors, "MR-PWS1CBL2M-A1-L (Length: 2m)" is used.
For information on how to select motor power supply cables, refer to the manuals.



1. Ground the ground wire from the servo motor to the protective earth (PE) terminal of the servo amplifier.
   For details of grounding, refer to section 3.3.
2. Connect the connector for CNP3, which is an accessory of a servo amplifier, to the power supply cable.
   Make sure wiring for U, V and W is correct.
3. Connect the connector for CNP3 of the power supply cable to the CNP3 connector of the servo amplifier.
4. Connect the power supply cable from the servo amplifier to the power supply connector of the servo motor.

- Make sure wiring for U, V and W of the motor power supply cable is correct.
  If wiring is wrong, an alarm occurs and the servo motor does not operate.
- Use dedicated cables to connect servo amplifiers and servo motors.
  Do not install a power capacitor, surge absorber, filter, or magnetic contactor (MC) between them.

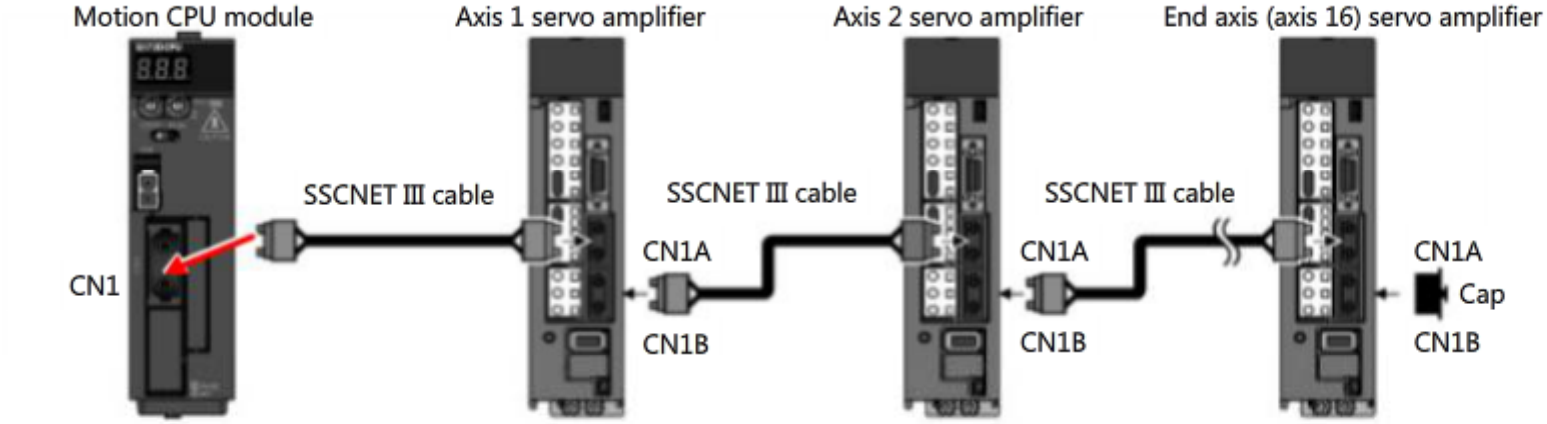
3.4.6 Connecting a encoder cable

You will learn how to connect a encoder cable with the aid of the animation below.
A encoder cable is necessary to give feedback of the position data detected by encoders in servo motors to servo amplifiers.
In this course, a encoder cable for HF-KP series motors, "MR-J3ENCBL2M-A1-L (Length: 2m)" is used.
For information on how to select encoder cables, refer to the manuals.

1. Connect the encoder cable connector to the servo amplifier CN2 connector.
2. Connect the encoder cable connector to the motor encoder connector.

3.4.7 Connecting servo amplifiers

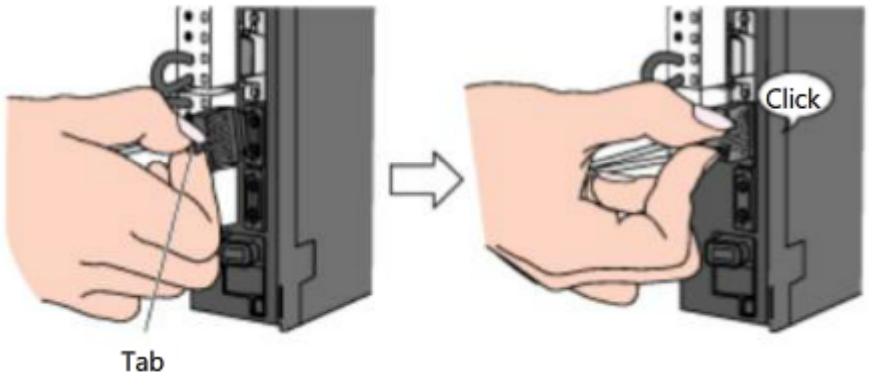
You will learn how to connect a motion CPU module and servo amplifiers.
MR-J3-□B servo amplifiers employ SSCNET Ⅲ interfaces.
SSCNET Ⅲ, which employs optical communication system, is highly noise-resistant and suitable for high-speed interactive communication.
Use dedicated cables for connection. The cables with the connector are easily connected and removed.



Handle SSCNET Ⅲ cables with attention to the following.

- The inside of the cable may be distorted or broken by force such as high impact, lateral pressure, extreme tension or torsion, which makes optical transmission unavailable.
- Since optical fibers are made from synthetic resin, fire or high temperature distorts the fibers and makes optical transmission unavailable.
- Contamination on the end face of an optical cord inhibits optical transmission and can be a cause of malfunction.
- Do not look directly at the light output from the ends of connectors or cables.
- Mount an accessory cap on the reserved connector (CN1B) of the end axis servo amplifier for safety and protection.

How to connect

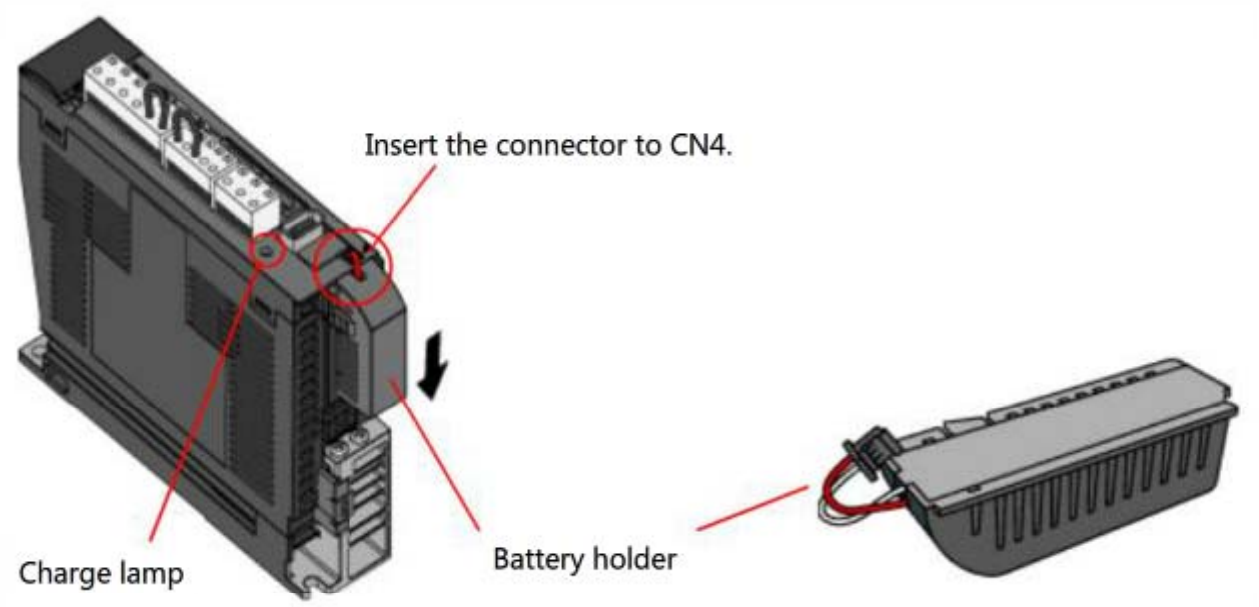


3.4.8 Setting a battery for the absolute position detection system

When the absolute position system is used, a battery needs to be set to store absolute position data.
When setting a battery to the servo amplifier (or when replacing the battery), make sure the following to prevent electric shock or loss of the absolute position data.

- To prevent electric shock, turn off the main circuit power supply and then wait for 15 minutes or more.
  After confirming the charge lamp is turned off, check the voltage between P (+) and N (-) with a tester, etc., and then connect a battery.
- Replace the battery only when the control circuit power supply turns on.
  If the battery is replaced when the control circuit power supply is off, absolute position data is lost.
- For some servomotors, removing the encoder cable causes the lost of absolute position data.
  After removing the encoder cable, make sure to perform the home position return.

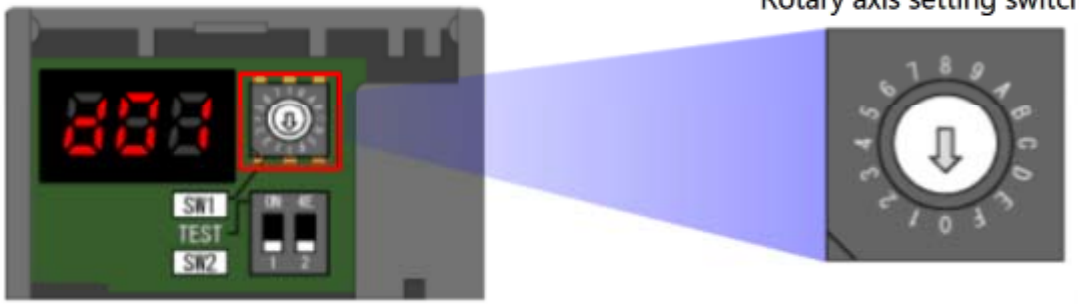
How to set a battery to MR-J3-10B



3.5 Setting Control Axis Numbers of Servo Amplifiers

Set control axis numbers of servo amplifiers.
Control axis numbers are the numbers are assigned to each servo amplifier for identification of control axes, which can be set up to 16 axes.
The system does not operate normally when the control axis number is duplicated.

Set control axis numbers with the rotary axis setting switch (SW1) inside the front cover of a servo amplifier.



Set control axis numbers of each servo amplifier, using the setting table below as a reference.

Rotary axis setting switch (SW1)	Control axis No.	Display
0	Axis 1	d01
1	Axis 2	d02
2	Axis 3	d03
3	Axis 4	d04
4	Axis 5	d05
5	Axis 6	d06
6	Axis 7	d07
7	Axis 8	d08

Rotary axis setting switch (SW1)	Control axis No.	Display
8	Axis 9	d09
9	Axis 10	d10
A	Axis 11	d11
B	Axis 12	d12
C	Axis 13	d13
D	Axis 14	d14
E	Axis 15	d15
F	Axis 16	d16

3.6 Initialization of PLC CPU Module

Sequence programs and parameters are written to the memory in a PLC CPU module.
However, the memory is not set up for use when purchased.
Thus, an operation referred to as "Format" is required to initialize the memory and make it available for use.

Formatting is performed with PLC engineering software, GX Works2.
Also, the CPU module needs to be connected with a personal computer by a USB cable.
Before formatting, prepare a personal computer where GX Works2 is installed and a USB cable.

Format the memory according to the following procedure.

① Connecting a PLC CPU module and a personal computer

↓

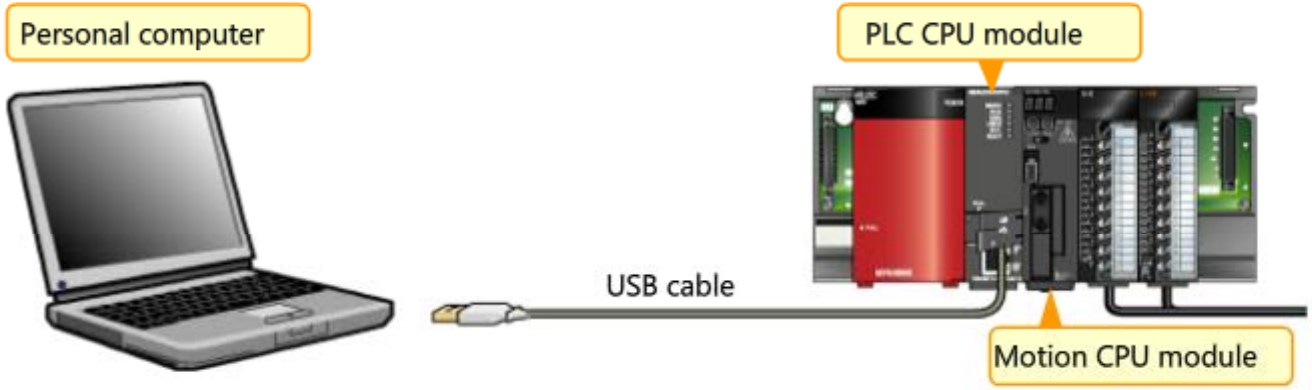
② Setting the connection between GX Works2 and the PLC

↓

③ Formatting the memory

3.6.1 Connecting a PLC CPU module and a personal computer

Connect the USB ports of the PLC CPU module and the personal computer with a USB cable.

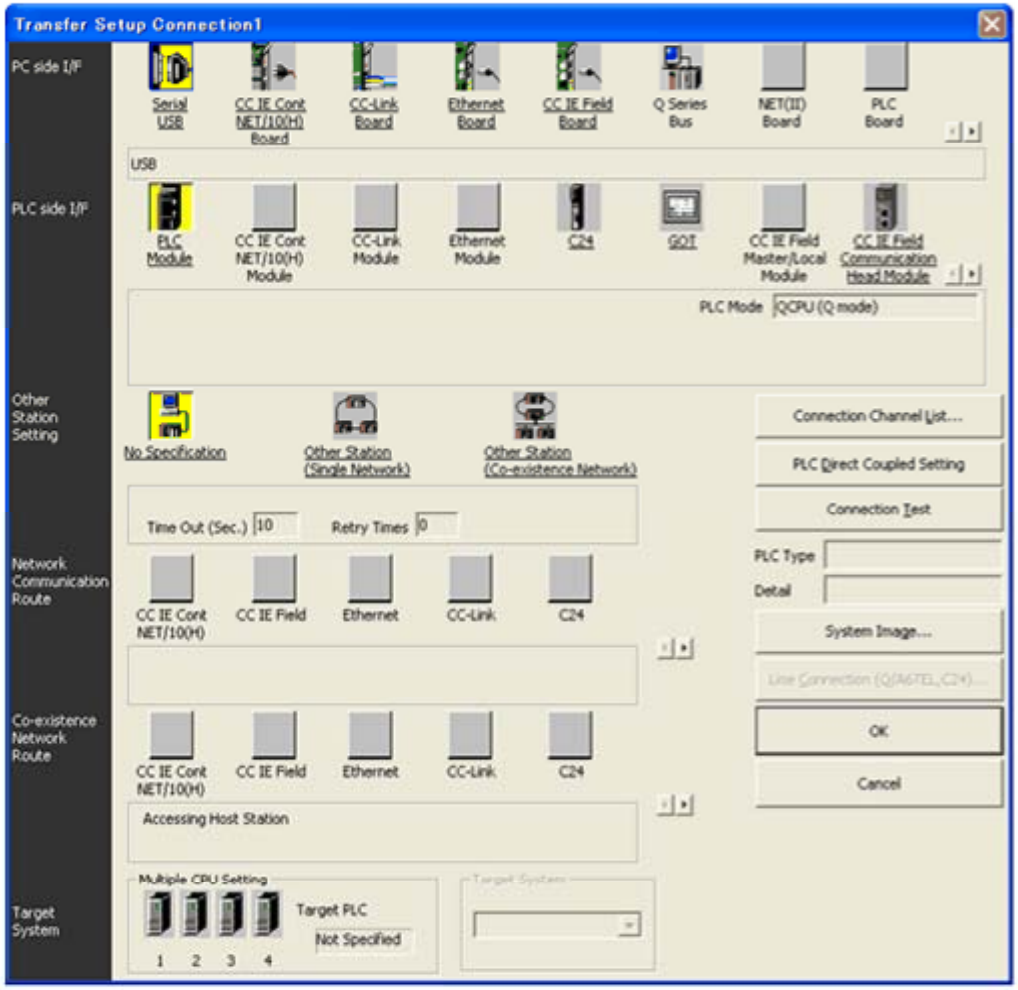


3.6.2 Setting the connection between GX Works2 and the PLC

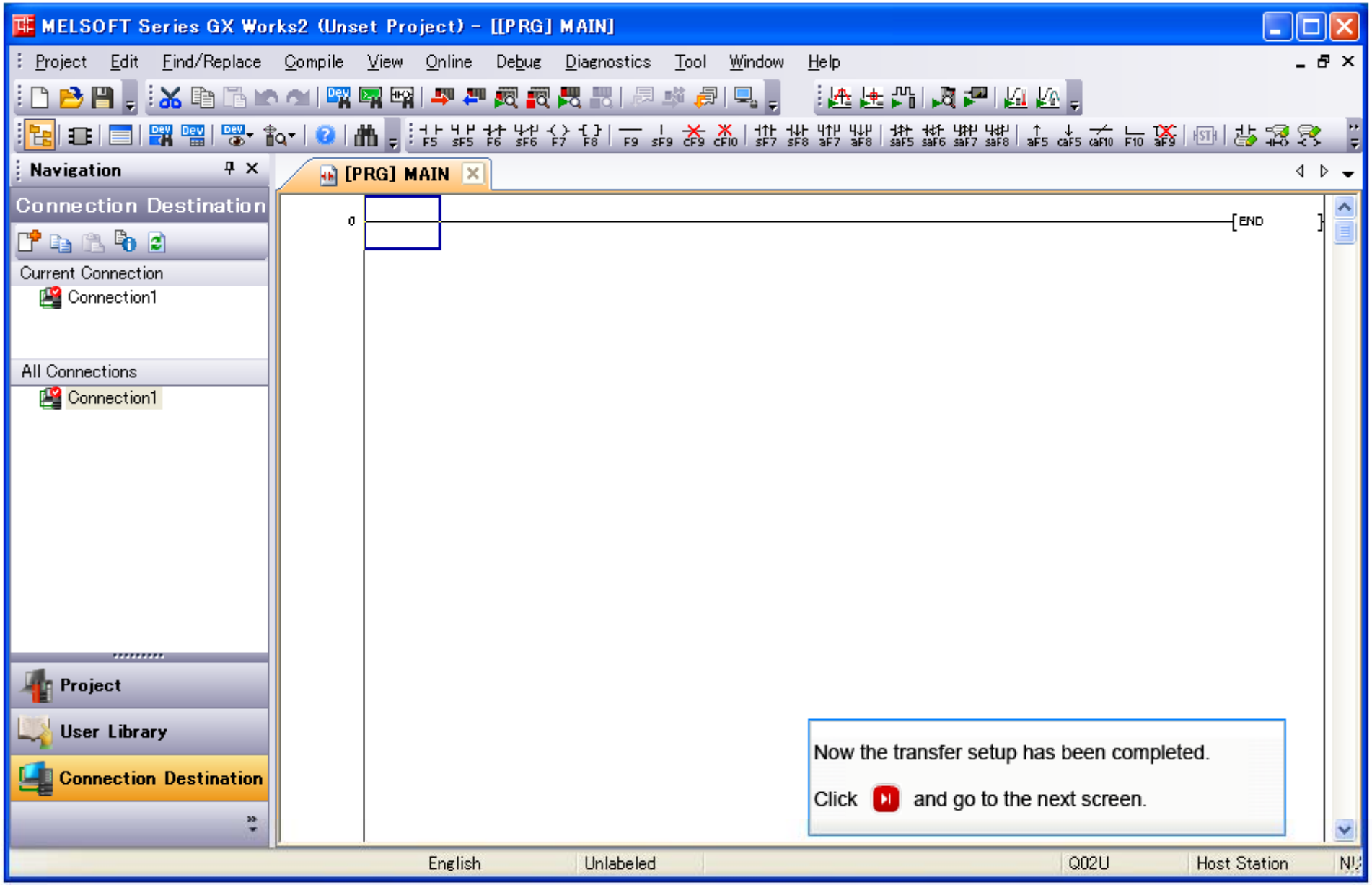
After connecting the personal computer and the PLC CPU module, connect GX Works2 and the PLC.
The USB cable connection by itself does not establish communication between them.

Set the connection on the Transfer Setup screen.
Let's set the transfer setup in the next screen.

The following shows an example of the transfer setup screen.



3.6.2 Setting the connection between GX Works2 and the PLC

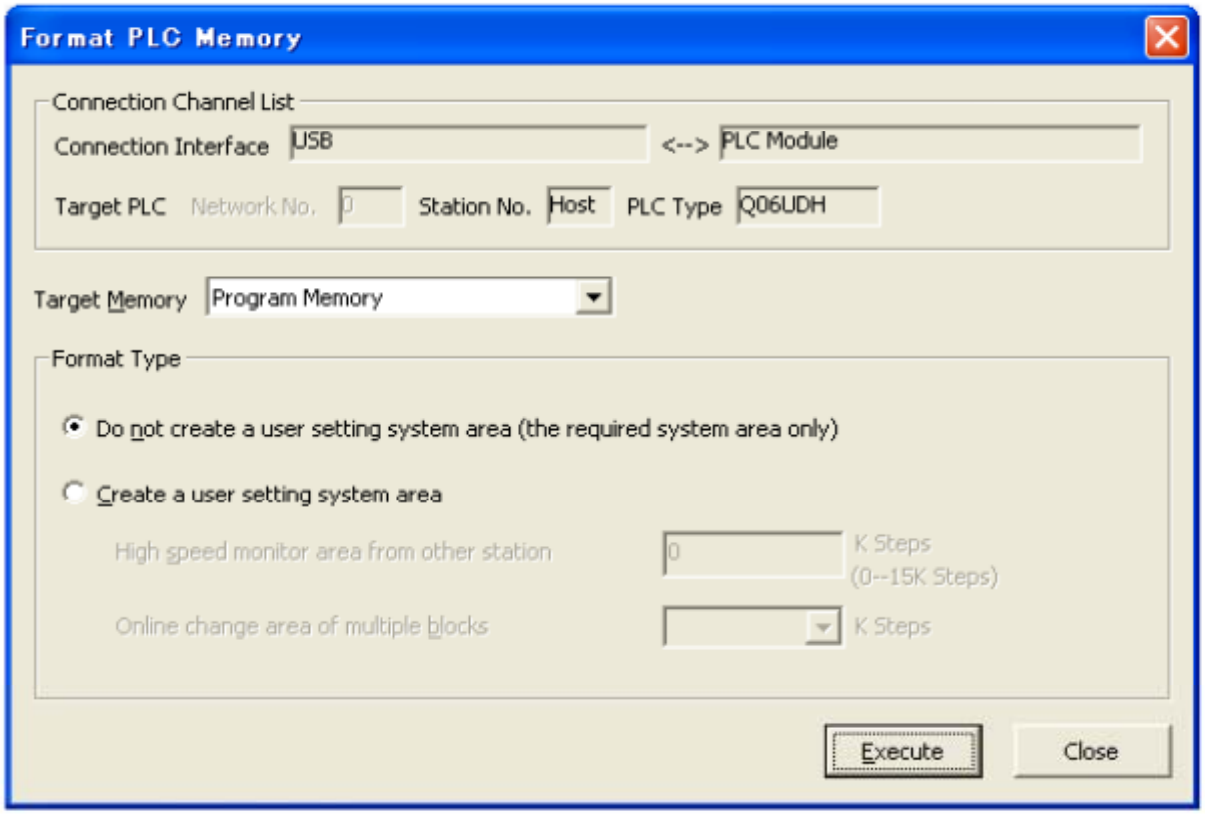


3.6.3 Formatting the memory

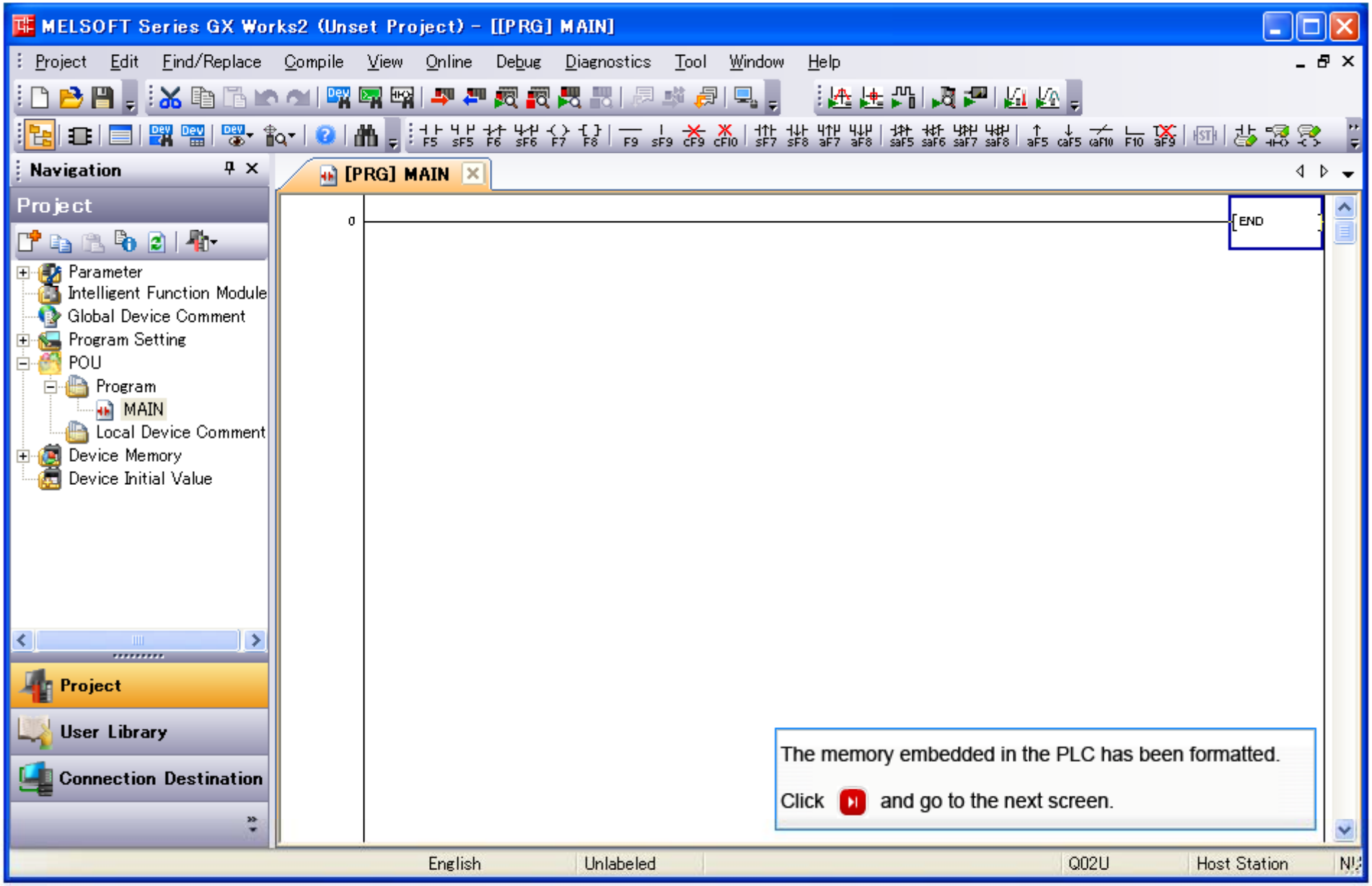
After the transfer setup is completed, communication is established between the memory and the PLC CPU module. Then, format it with Format PLC Memory of GX Works2 to set the memory of the PLC CPU module to the initial status.

Let's format the PLC memory in the next screen.

The following shows an example of the Format PLC Memory screen.



3.6.3 Formatting the memory



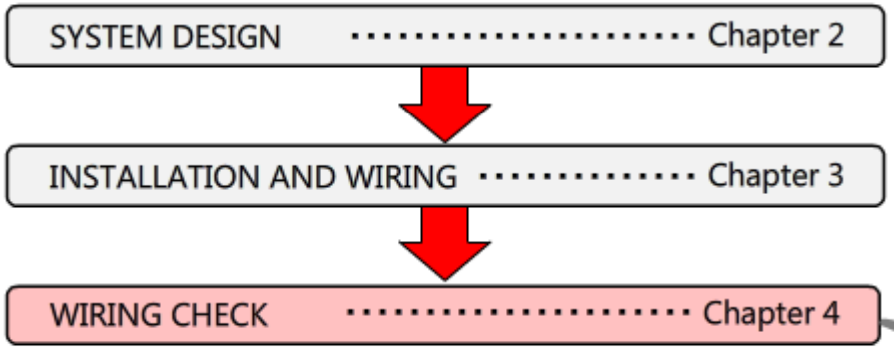
3.7 Summary

The following lists the contents you learned in Chapter 3.
The following points are very important, so please check them again.

Motion controller installation	• To provide good ventilation for heat dissipation and to replace modules easily, give the clearances between the upper and lower sections of the module and the components or parts. • Fix the base unit on the flat surface of the panel with screws (M4 × 14). • Do not install a motion controller near an oscillating source such as a large-size magnetic contactor or a no fuse breaker. Instead, provide other panel or separate them. • To reduce the effects of radiant noise and heat, provide the clearances between a motion CPU module and devices (contactors, relays, etc.).
Servo amplifier installation	• Install a servo amplifier on the vertical rightly. • Keep the ambient temperature within the range of 0 to 55℃. (For close installation: 0 to 45℃) • Install a cooling fan for heat dissipation. • Use care with foreign matters, which are generated in assembly or may enter from a cooling fan. • When installing a servo amplifier in a place with much toxic gas or dust, provide air purging. • For 200V-class, 3.5kW or less servo amplifiers and 100V-class, 400W or less servo amplifiers, close installation is available. When closely installing two or more servo amplifiers, provide clearances of 1mm between the amplifiers, considering the installation tolerance.
Mounting modules	• Before mounting the PLC CPU module to the base unit, set a battery to the PLC CPU module. • Make sure to screw the modules mounted to the base unit. • Using the battery holder unit, install the battery to the panel, etc. in the right direction.
Grounding	• Before wiring the power supply, ground the motion controller and the servo. To prevent electric shock and malfunction due to noise, make sure to perform grounding works. • To prevent electric shock, make sure to connect the protective earth terminal of the servo amplifier to the protective earth of the panel. • As far as possible, adopt independent grounding to avoid a possible effect of noise from other devices. When independent grounding is impossible, adopt common grounding, where all the grounding wires must be the same in length.
Connecting servo amplifiers	• A motion CPU module and servo amplifiers are connected by SSCNET Ⅲ cables. • SSCNET Ⅲ, which employs optical communication system, is highly noise-resistant and suitable for high-speed interactive communication.
Control axis Nos. of servo amplifiers	• Nos. are assigned to each servo amplifier for identification of control axes, which can be set up to 16 axes. • Note that duplicated control axis Nos. set in a servo system cause abnormal operation. • Set control axis Nos. with the rotary switch (SW1) inside the front cover of a servo amplifier.

Chapter 4 WIRING CHECK

In Chapter 4, you will learn how to check correct wiring.



Learning procedure of Chapter 4

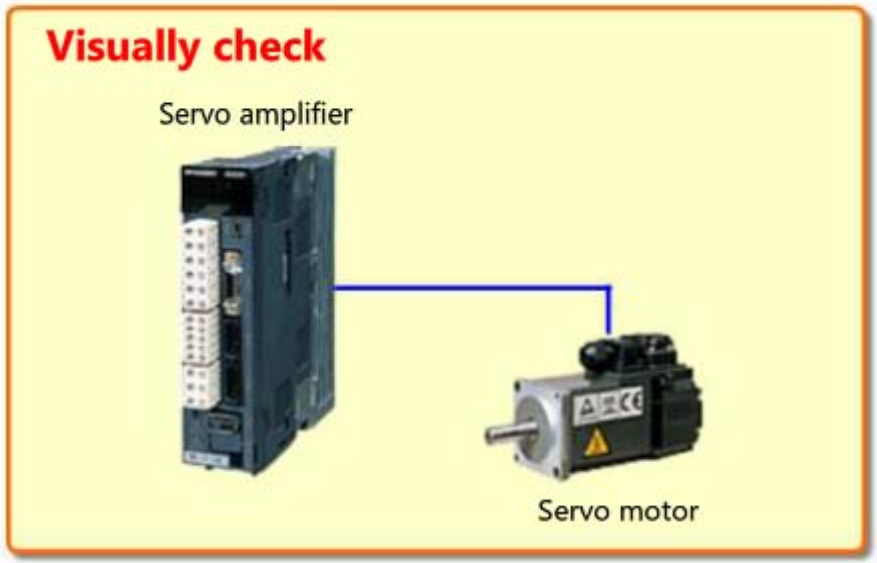
4.1 Visual Check
4.2 Checking Correct Power Input
4.3 Checking I/O Signals

4.1 Visual Check

Before turning on the power supply, visually check the wiring of the motion controller and the servo for errors.
Check for wrong wiring and a disconnected, loose, or damaged cable or connector.
Also check for the cable routing and for the ambient environment such as wire scraps, metal powders, etc.

When wiring is incorrect

- Modify wrong wiring or an omitted one.
- Reconnect a disconnected connector or a loose one.
- Replace a corroded cable or a damaged cable with a new one.
- For short-circuited wiring, modify the insulation and wiring.



4.2 Checking Correct Power Input

After the visual check on wiring, turn on the power supply according to the following procedure.
Check the LED displays of the PLC CPU module, motion CPU module, and servo amplifiers for errors.

① Before turning on the power supply, check:
- Wiring for the power supply
- Power supply voltage

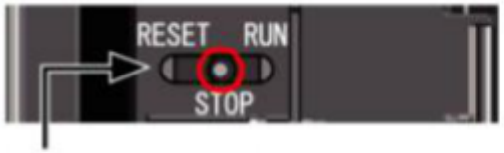
② Check the switches of the PLC CPU module and the motion CPU module are in the STOP position

③ Turn on the power supply module

④ Check that the power supply is correct
(1) The "POWER" LED of the power supply module illuminates in green
(2) The "ERR." LED of the CPU module blinks in red (Although the error displays appear since parameters are not yet written, this does not mean any problem at this stage.)

⑤ Check the 7-segment LED displays of the motion CPU module and servo amplifiers of each axis
- For the motion CPU module:
"AL" (Motion error)
- For the servo amplifier:
"b□□" (□□ is an axis No.)

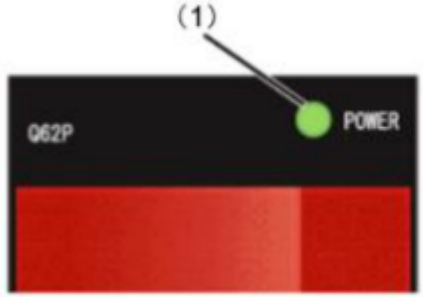
PLC CPU module



RESET/STOP/RUN

Motion CPU module

Turn on the power supply



Power supply module

PLC CPU module

Motion CPU module

Servo amplifier

4.3 Checking I/O Signals

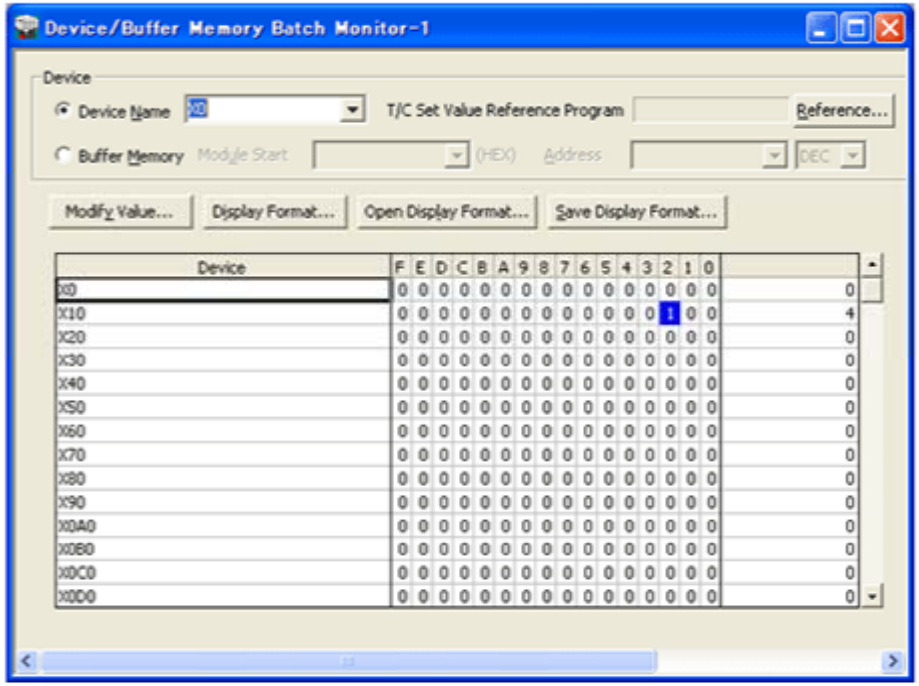
After the power supply is turned on, check I/O signals with GX Works2 and MR Configurator2.
Check I/O signals to make sure correct wiring on signal basis.

Checking the motion controller

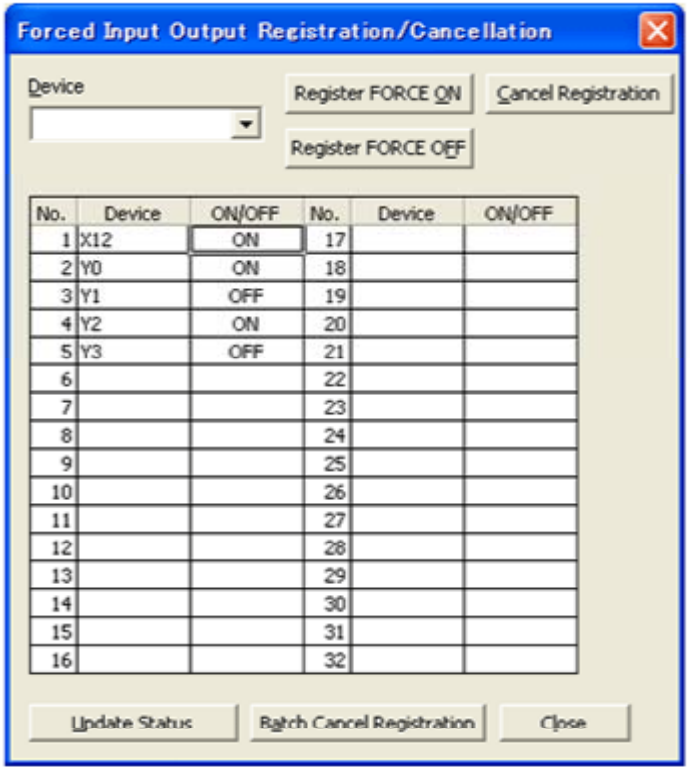
Check I/O signals of the external I/O devices connected to the I/O module.
Use the following functions of GX Works2 for the check.

- Input signal: Device/buffer memory batch monitor function
- Output signal: Forced I/O registration/cancellation function

Device/buffer batch monitor function



Forced I/O registration/cancellation function



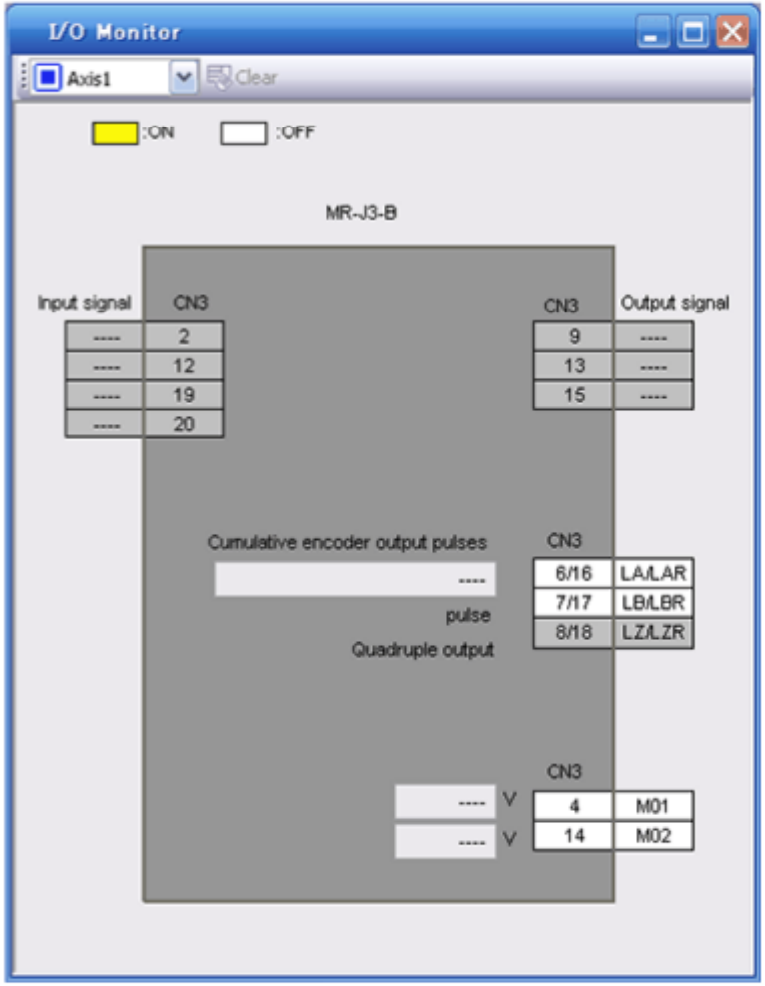
4.3 Checking I/O Signals

Checking the servo amplifier

Check I/O signals of the external I/O devices connected to the servo amplifier.
Use the following function of MR Configrator2 for the check.

- Input signal: I/O monitor display function

I/O monitor display function



4.4 Summary

The following lists the contents you learned in Chapter 4.
The following points are very important, so please check them again.

Visually checking wiring	Before turning on the power supply, visually check for errors in wiring for the motion controller and the servo. Check for wrong wiring and a disconnected, loose, or damaged cable or connector. Also check for the cable routing and for the ambient environment such as wire scraps, metal powders, etc.
Checking power input	Turn on the power supply and check the LED displays of the PLC CPU module, motion CPU module, and servo amplifiers for errors.
Checking I/O signals	Check I/O signals with GX Works2 and MR Configurator2. Check I/O signals to make sure correct wiring on signal basis. ・Checking the motion controller Check I/O signals of the external I/O devices connected to the I/O module. Use the following functions of GX Works2 for the check. - Input signal: Device/buffer memory batch monitor function - Output signal: Forced I/O registration/cancellation function ・Checking the servo amplifier Check I/O signals of the external I/O devices connected to the servo amplifier. Use the following function of MR Configrator2 for the check. - Input signal: I/O monitor display function

Test Final Test

Now that you have completed all of the lessons of the MOTION CONTROLLER Basics (Hardware) Course, you are ready to take the final test.
If you are unclear on any of the topics covered, please take this opportunity to review those topics.
There are a total of 5 questions (23 items) in this Final Test.
You can take the final test as many times as you like.

How to score the test

After selecting the answer, make sure to click the **Answer** button. Your answer will be lost if you proceed without clicking the Answer button. (Regarded as unanswered question.)

Score results

The number of correct answers, the number of questions, the percentage of correct answers, and the pass/fail result will appear on the score page.

Correct Answers : 2

Total Questions : 9

Percentage : 22%

To pass the test, you have to answer **60%** of the questions correct.

Proceed | Review | Retry

- Click the **Proceed** button to exit the test.
- Click the **Review** button to review the test. (Correct answer check)
- Click the **Retry** button to retake the test again.

Test Final Test 1

Select the servo amplifier series that is connected with a motion CPU module by SSCNETIII cables.

- MR-J3-☐A
- MR-J3-☐B
- MR-J3-☐T

Answer Back

Test Final Test 2

Select the correct descriptions of safety measures required for motion control systems. (Select three items.)

- [ ] The circuit must be configured so that only the control circuit power supply of the servo amplifier is turned off when the alarm signal of the servo amplifier is turned off.
- [x] The circuit must be configured so that only the main circuit power supply of the servo amplifier is turned off when the alarm signal of the servo amplifier is turned off.
- [ ] The circuit must be configured so that 24VDC power supply is input to the forced stop input terminal of the motion CPU module, and all the axes come to a forced stop when the power input is turned off by a forced stop switch, etc.
- [ ] A power supply of 100VAC must be input to the forced stop input terminal of the motion CPU module. The circuit must be configured so that all the axes can be forcibly stopped.
- [ ] Stroke limits must be installed to the both ends of each axis to bring the machine exceeding the movable range to a rapid stop in order to prevent failure and accident due to an overrun.
- [ ] Upper and lower stroke limits are input from I/O modules.

Answer Back

Test Final Test 3

Select minimum devices required for configuring a motion controller system. (Select four items.)

- [ ] Main base unit
- [ ] Extension base unit
- [ ] PLC CPU module
- [ ] Motion CPU module
- [ ] Positioning module
- [ ] Motion controller module
- [ ] I/O module
- [ ] Battery holder unit

Answer Back

Test Final Test 4

Select the correct features of motion CPU modules that support multiple CPU configuration. (Select two items.)

- [ ] Systems can be established with a single motion CPU module or with a motion CPU module and a PLC CPU module.
- [ ] Sequence control and motion control are processed in each CPU module, reducing the processing load on each CPU module and speeding up processing.
- [ ] Operation can be continued even when either of the PLC CPU or the motion CPU has failed.
- [ ] Using multiple CPU high speed transmission memory enables high speed data transmission between a PLC CPU and a motion CPU.

Answer Back

Test Final Test 5

Select correct descriptions of motion controllers. (Select three items.)

- [ ] There is no problem in mounting a motion CPU module to an extension base.
- [ ] SSCNETIII cables must be used to connect Q172DCPU and servo amplifiers.
- [ ] SSCNET cables must be used to connect Q172DCPU and servo amplifiers.
- [ ] Motion CPU module always need to be equipped with batter y .
- [ ] Parameters and programs are not lost even when a motion CPU module is not equipped with a battery.
- [ ] A motion CPU module needs to be screwed to a base unit.
- [ ] A motion CPU module does not need to be screwed to a base unit.

Answer Back

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Test Score

You have completed the Final Test. You results area as follows.
To end the Final Test, proceed to the next page.

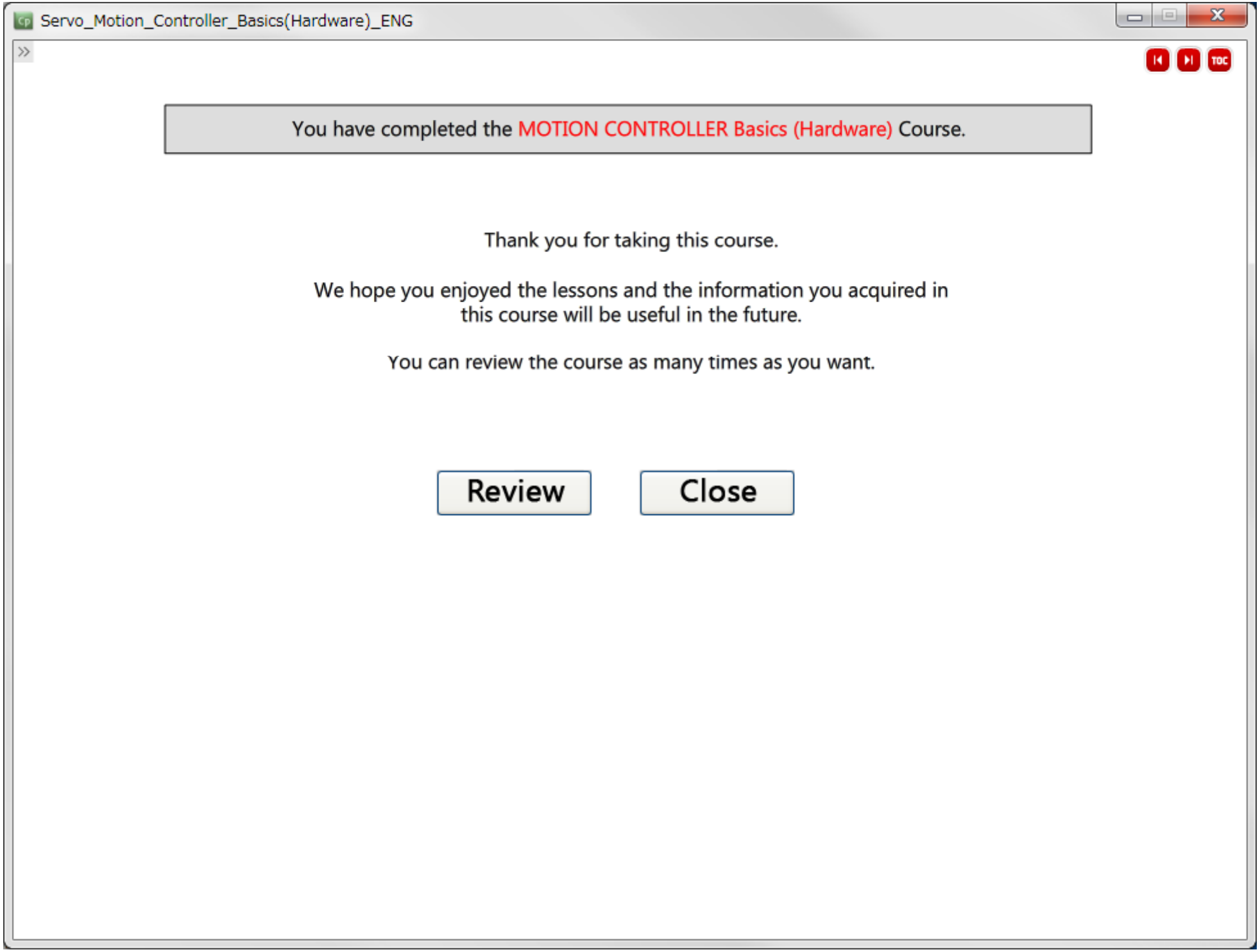
Correct answers : 0

Total questions : 5

Percentage : 0%

Proceed Review Retry

You failed the test.


Servo_Motion_Controller_Basics(Hardware)_ENG
TOC
You have completed the MOTION CONTROLLER Basics (Hardware) Course.
Thank you for taking this course.
We hope you enjoyed the lessons and the information you acquired in this course will be useful in the future.
You can review the course as many times as you want.
Review
Close