MITSUBISHI ELECTRIC
Changes for the Better

Servo
MELSERVO Basics (MR-J4)

This course is available as part of an online training (e−Learning) system for enabling you to learn how to construct a Servo system using the MELSERVO−J4 series.

L(NA)00131ENG

Introduction Purpose of the Course

This course is intended for those working to construct a Servo system using the MELSERVO−J4 series for the first time so that they can learn about Installation and Wiring of such a system and perform other procedures up to Test operation and monitoring.

A basic knowledge of AC Servos is required to take this course.

Beginners are recommended to take the following course:
•"FA Equipment for Beginners (Servos)" Course

Introduction Course Structure

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

Chapter 1 - Learning About the MELSERVO−J4 Series

This chapter describes the features, basic configuration and product lineup of the MELSERVO−J4 series.

Chapter 2 - Sample System and Equipment Configuration

This chapter describes how to select a Servo system and learn the names of parts and their functions.

Chapter 3 - Installation/Wiring of Servo Amplifier and Servo Motor

This chapter describes Installation and Wiring of a Servo amplifier and Servo motor.

Chapter 4 - Setting Up/Starting the Servo Amplifier

This chapter describes how to set up parameters and perform Test operation using MR Configurator2.

Chapter 3 - Adjusting/Maintaining the Servo Amplifier

This chapter describes how to check the operation in a sample system with the servo motors installed.

Chapter 4 - Safety Observation Functions and Energy Saving

This chapter introduces the safety observation functions and energy saving performance of the MELSERVO−J4 series.

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.
Back to the previous page		Back to the previous page.
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 Cautions for Use

Safety precautions

When you learn by using actual products, please carefully read the safety precautions in the corresponding manuals.

Precautions in this course

- The displayed screens of the software version that you use may differ from those in this course.

This course is for the following software version:

- MR Configurator2 Ver.1.12N
- MRZJW3-MOTSZ111E Ver.C5

Reference materials

Below is a list of references related to the topics in this course. (Please note that these reference materials are not absolutely necessary as you can still complete this course without using them.)
Click on the name of the reference file to download.

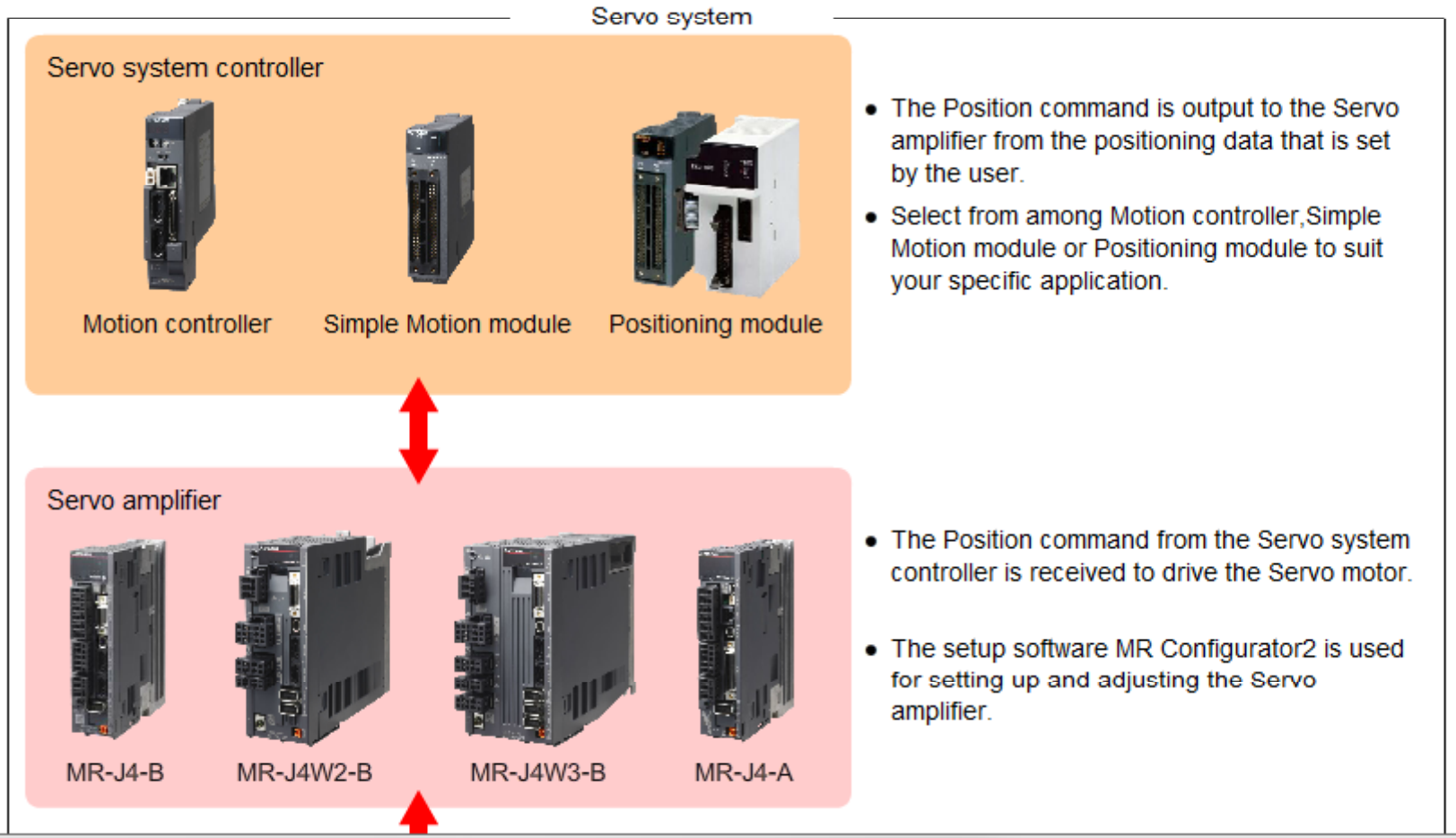
Name of reference	File format	File size
Recording paper	Compressed file	9kB

Chapter 1 Learning About the MELSERVO-J4 Series

In this course, you will learn how to construct a Servo system using the Mitsubishi general-purpose AC servo MELSERVO-J4 (simply referred to as "MR-J4" from here on).
Chapter 1 provides an overview of a Servo system and application examples, and you will learn about MR-J4 series Servo amplifiers and Servo motors.

1.1 Overview of a Servo System

A Servo system comprises a Servo system controller, Servo amplifier and Servo motor.



- The Position command is output to the Servo amplifier from the positioning data that is set by the user.
- Select from among Motion controller,Simple Motion module or Positioning module to suit your specific application.

- The Position command from the Servo system controller is received to drive the Servo motor.
- The setup software MR Configurator2 is used for setting up and adjusting the Servo amplifier.

Servo motor

Rotary servo motor

Linear servo motor

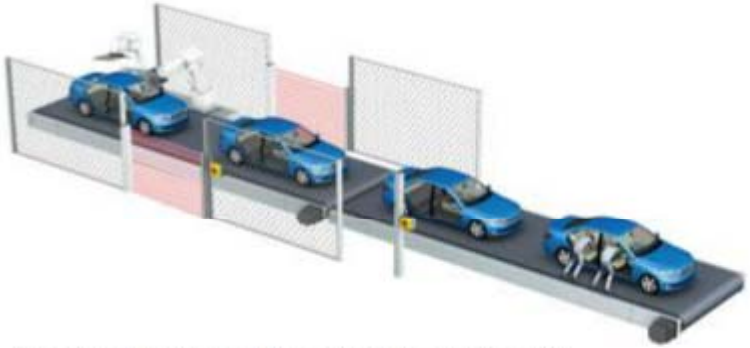
Direct drive motor

- Power from the Servo amplifier is received to drive the servo motor shaft. And, the position data that is detected by the Encoder in the motor is fed back to the Servo amplifier.
- Select the Servo motor that is best suited to your specific application.

1.2 Application Examples of a Servo System

Application Examples of a Servo System
Servo systems can be applied in various systems that require position, speed or other types of control.

●Vehicle assembly lines

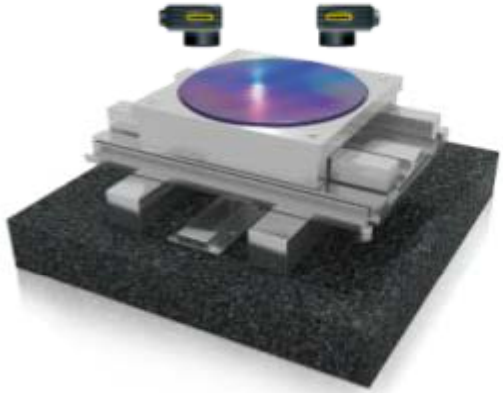


Safety observation functions ensure safety and security

●Material handling systems

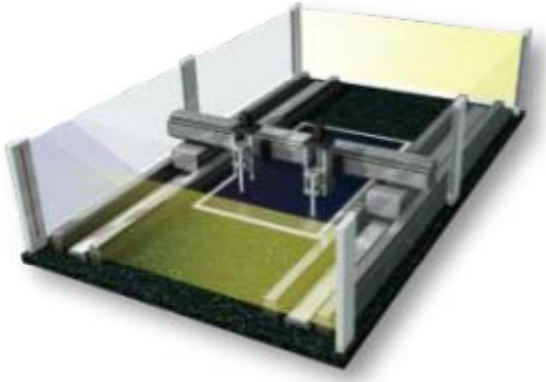
Conveyor lines are easily achieved

●Semiconductor manufacturing devices



Vision sensors are used for accurate positioning

●Liquid crystal manufacturing devices



Linear servos achieve a multi-head configuration

1.3 Servo Amplifier

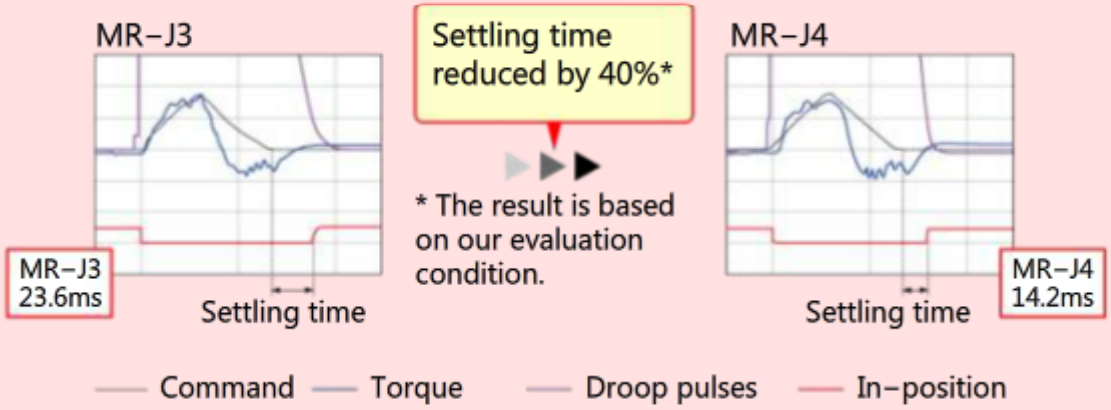
MR−J4 Servo amplifiers are among the fastest and highest precision servos in the industry. They support a wide range of motors from Rotary servo motors through Linear servo motors and Direct drive motors.

1.3.1 MELSERVO−J4 Features

The features of the MR−J4 are as follows.

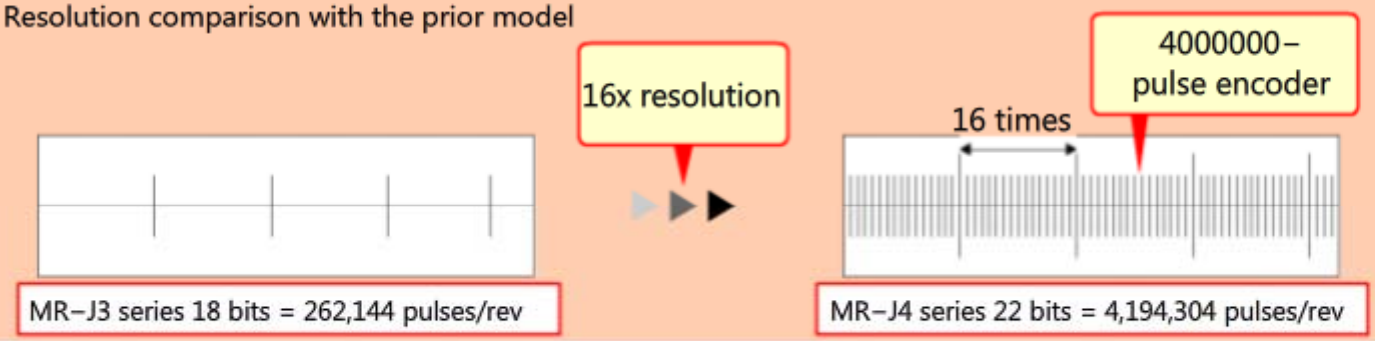
- High response is achieved by a servo control engine based on proprietary architecture. This helps reduce device tact time and improve precision.

Settling time comparison with the prior model



- They are equipped with a high−resolution absolute encoder as standard. This enables high−precision positioning and smooth rotation.

Resolution comparison with the prior model



1.3.2 MELSERVO-J4 Features

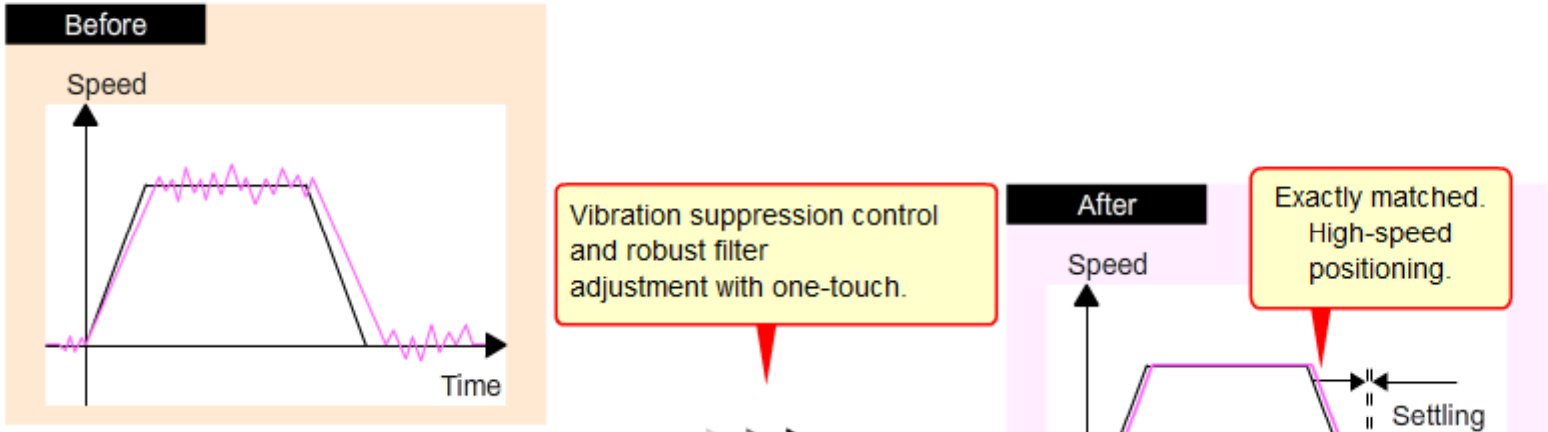
- Advanced one-touch tuning function

Servo gains including machine resonance suppression filter, advanced vibration suppression control II*, and robust filter are adjusted just by turning on the one-touch tuning function. Machine performance is utilized to the fullest using the advanced vibration suppression control function.
Click the button to check the repeating movement.

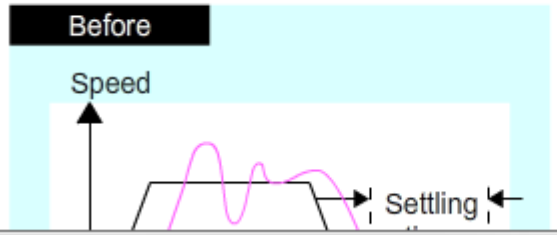
* The advanced vibration suppression control II automatically adjusts one frequency.

—: Command —: Actual operation

When machine movement is unstable



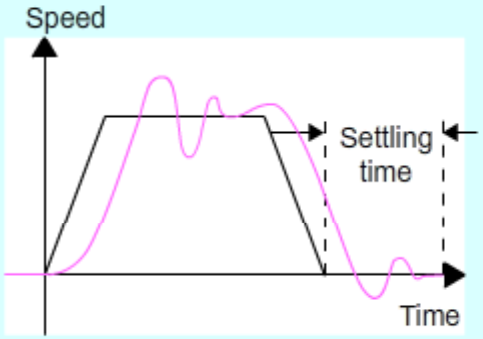
When timing of movement is delayed

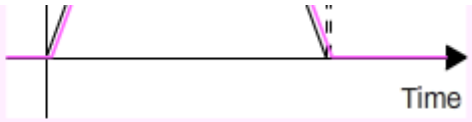


1.3.2 MELSERVO-J4 Features

When timing of movement is delayed

Before

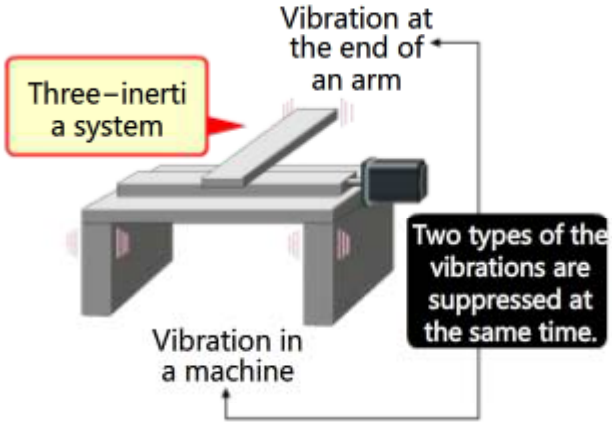


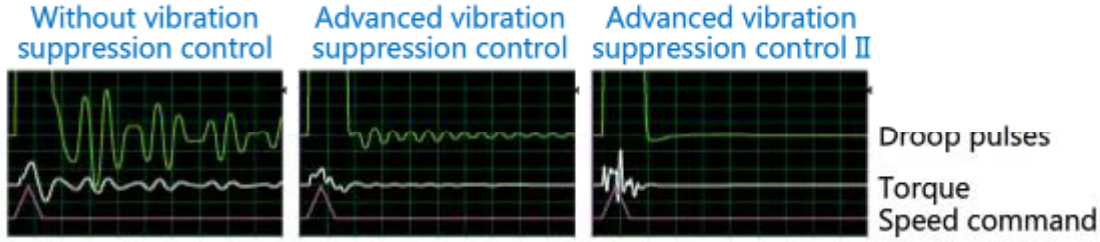


1.3.3 MELSERVO-J4 Features

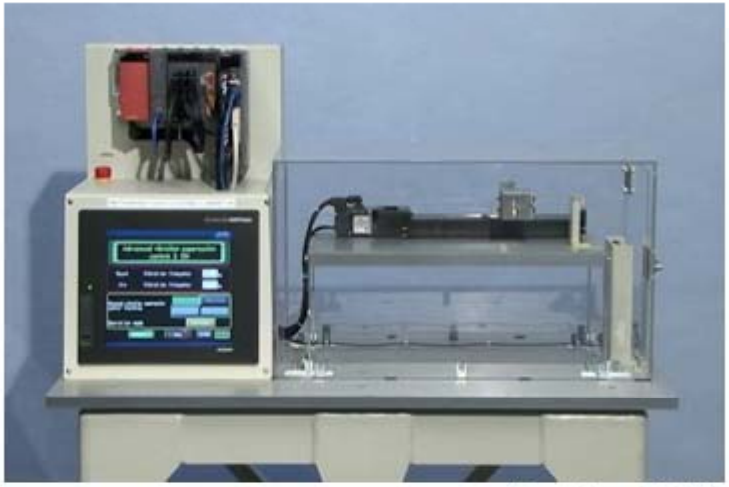
- Advanced vibration suppression control Ⅱ

Two low-frequency vibrations can be suppressed simultaneously by a vibration suppression algorithm supported on three-inertial system machines. Adjustments also can be performed simply by one-touch operation.
The effectiveness of this can be demonstrated in suppressing residual vibration on arm ends or equipment bodies.





The following video shows an instance where residual vibration, that occurs when a motor is driven to position a three-inertial system unit with two different machine resonances on a frame and arm, is suppressed by Advanced vibration suppression control Ⅱ.

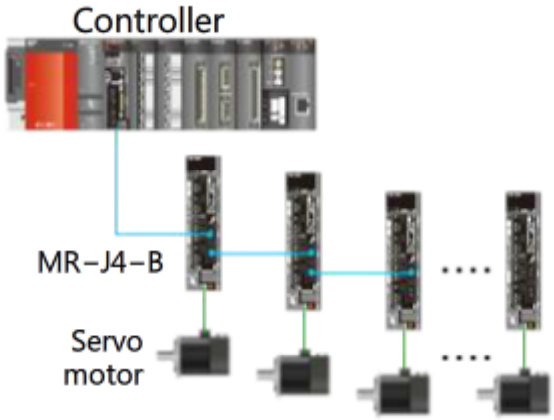
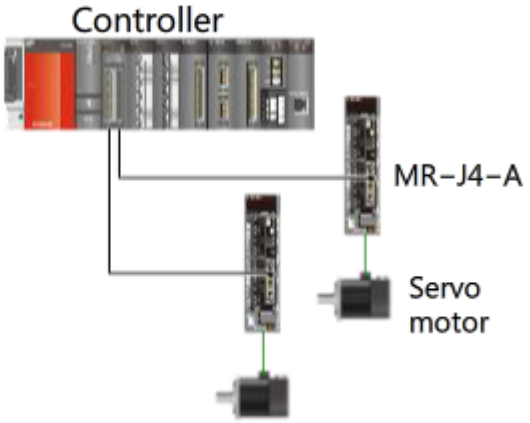


(Duration: 01:14)

1.4 Types of Servo Amplifiers

There are two types of MR−J4 Servo amplifiers as follows depending on the Command interface.

- MR−J4−B・・・Servo system high−speed synchronized network "SSCNETⅢ/H" compatible Servo amplifier
- MR−J4−A・・・General−purpose interface compatible Servo amplifier (e.g. for Pulse train or analog input)

	Feature	System configuration
SSCNET Ⅲ/H compatible MR−J4−B	• Can be connected to a Motion controller, Simple Motion module, etc. that is suited to multi−axis synchronous control. • The data transmission/reception speed has been increased 3−fold over conventional methods to 150Mbps full duplex (equivalent to 300Mbps half duplex) This drastically increases the response of the system. • Complete synchronous communication achieves increased equipment performance. • Optical communication drastically improves noise immunity. • Wiring up to 1600m is possible per system. • Wiring can be saved considerably.	
General−purpose interface compatible MR−J4−A	• Can be connected to a pulse generator, positioning controller, etc. • Maximum command pulse frequency of 4Mpps supported. • Analog voltage commands also are supported. Speed control or torque control is also enabled by analog voltage commands.	

The 2−axis servo amplifier MR−J4W2−B and 3−axis servo amplifier MR−J4W3−B are also available for operating two and three servo motors, respectively.

1.4.1 Lineup of Servo Amplifiers

Here, we will introduce the lineup of MR-J4 Servo amplifiers.

● : Compatible ○: Available in the future –: Not compatible

Servo amplifier		Number of axes	Power supply specifications	Command interface: SSCNET III/H	Command interface: Pulse train	Command interface: Analog voltage	Command interface: RS-422 multi-drop	Control mode: Position	Control mode: Speed	Control mode: Torque	Control mode: Fully closed loop control	Capacity
SSCNET III/H interface	MR-J4-B	1	1-phase 100 V AC	○	–	–	–	○	○	○	○	0.1 – 0.4 (Released in the future)
			3-phase 200 V AC	●	–	–	–	●	●	●	●	0.1 – 22
			3-phase 400 V AC	●	–	–	–	●	●	●	●	0.6 – 22
	MR-J4W2-B	2	3-phase 200 V AC	●	–	–	–	●	●	●	●	0.2 – 1.0
	MR-J4W3-B	3	3-phase 200 V AC	●	–	–	–	●	●	●	–	0.2 – 0.4
General-purpose interface	MR-J4-A	1	1-phase 100 V AC	–	○	○	○	○	○	○	○	0.1 – 0.4 (Released in the future)
			3-phase 200 V AC	–	●	●	●	●	●	●	●	0.1 – 22
			3-phase 400 V AC	–	●	●	●	●	●	●	●	0.6 – 22

Capacity scale: 0.1kW, 1kW, 10kW, 100kW

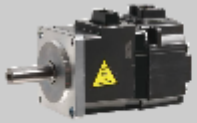
(as of June, 2013)

1.5 Servo Motor

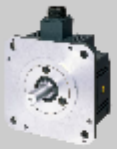
There are two other types of Servo motors in addition to Rotary servo motors, Linear servo motors that are capable of high-speed, high-precision positioning, and Direct drive motors that are ideal for use under low-speed, high-torque conditions.

1.5.1 Lineup of Rotary Servo Motors

Here, we will introduce the lineup of Rotary servo motors.

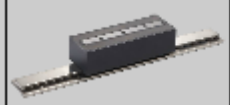
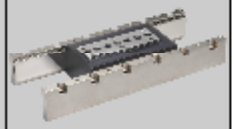
Rotary servo motor series		Rated speed (maximum speed) [r/min]	Power supply specifications	Features	Rated output (0.1kW / 1kW / 10kW / 100kW)	Application examples
Small capacity	HG-KR series 	3000 (6000)	3-phase 200 V AC	Low inertia Perfect for general industrial machines.	0.05 – 0.75	•Belt drives •Robots •Mounters •Sewing machines •X-Y tables •Food processing machines •Semiconductor manufacturing equipment •Knitting and embroidery
	HG-MR series 	3000 (6000)	3-phase 200 V AC	Ultra-low inertia Well suited for high-throughput operations.	0.05 – 0.75	•Inserters •Mounters
Medium capa	HG-SR series 	1000 (1500)	3-phase 200 V AC	Medium inertia This series is available with two rated speeds.	0.5 – 4.2	•Material handling systems •Robots •X-Y tables
		2000 (3000)	3-phase 200 V AC		0.5 – 7.0	

1.5 Servo Motor

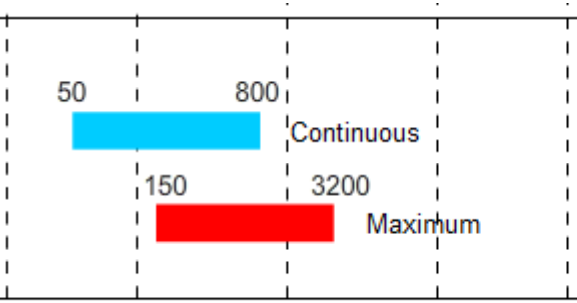
Medium capacity	HG-SR series 	1000 (1500)	3-phase 200 V AC	Medium inertia This series is available with two rated speeds.	0.5 4.2	•Material handling systems •Robots •X-Y tables
		2000 (3000)	3-phase 200 V AC 3-phase		0.5 7.0	
Medium/large capacity	HG-JR series 	3000 (6000: 0.5 to 5 kW 5000: 7, 9 kW)	3-phase 200 V AC 3-phase 400 V AC	Low inertia Well suited for high-throughput and high-acceleration/ deceleration	0.5 9.0	•Food packaging machines •Printing machines
		1500 (3000: 11, 15 kW 2500: 22 kW)			11 22	•Injection molding machines •Press machines
Medium capacity	HG-RR series 	3000 (4500)	3-phase 200 V AC	Ultra-low inertia Well suited for high-throughput operations.	1.0 5.0	•Ultra-high-throughput material handling systems
Medium capacity, flat type	HG-UR series 	2000 (3000: 0.75 to 2 kW 2500: 3.5, 5 kW)	3-phase 200 V AC	Flat type The flat design makes this unit well suited for situations where the installation space is limited.	0.75 5.0	•Robots •Food processing machines

1.5.2 Lineup of Linear Servo Motors

Here, we will introduce the lineup of Linear servo motors.

	Linear servo motor series	Maximum speed	Cooling method	Features	Thrust	Application examples
Core type	LM-H3 series 	3.0	Natural cooling	Suitable for space-saving. Compact size and high thrust.	70 960 Continuous 175 2400 Maximum	•Semiconductor mounting systems •Wafer cleaning systems •LCD assembly machines •Material handlings
	LM-F series 	2.0	Natural cooling	Compact size. The integrated liquid-cooling system doubles the continuous thrust.	300 3000 Continuous 1800 18000 Maximum	•Press feeders •NC machine tools •Material handlings
		2.0	Liquid cooling		600 6000 Continuous 1800 18000 Maximum	
	LM-K2 series 	2.0	Natural cooling	High thrust density. Magnetic attraction counter-force structure enables longer life of the linear guides and lower audible noise.	120 2400 Continuous 300 6000 Maximum	•Semiconductor mounting systems •Wafer cleaning systems •LCD assembly machines

1.5.2 Lineup of Linear Servo Motors

Coreless type	LM-U2 series 	2.0	Natural cooling	No cogging and small speed fluctuation. No magnetic attraction force structure extends life of the linear guides.		•Screen printing systems •Scanning exposure systems •Inspection systems •Material handlings

1.5.3 Lineup of Direct Drive Motors

Here, we will introduce the lineup of Direct drive motors.

Direct drive motor series	Rated speed (maximum speed) [r/min]	Motor outer diameter [mm]	Features	Torque (1N·m / 10N·m / 100N·m / 1000N·m)	Application examples
TM-RFM series 	200 (500)	φ130	• Suitable for low-speed and high-torque operations. • Smooth operation with less audible noise. • The motor's low profile design contributes to compact construction and a low center of gravity for enhanced machine stability. • Clean room compatible.	2 6 Rated 6 18 Maximum	• Semiconductor manufacturing devices • Liquid crystal manufacturing devices • Machine tools
	200 (500)	φ180		6 18 Rated 6 54 Maximum	
	200 (500)	φ230		12 72 Rated 36 216 Maximum	
	100 (200)	φ330		40 240 Rated 120 720 Maximum	

1.6 Servo Amplifier / Servo Motor Combinations

Here, we will introduce combinations of MR-J4 Servo amplifiers and Servo motors.

●: Compatible ○: Available in the future –: Not compatible

Servo amplifier		Power supply specifications	Rotary servo motor						Linear servo motor				Direct drive motor
			HG-KR	HG-MR	HG-SR	HG-JR	HG-RR	HG-UR	LM-H3	LM-F	LM-K2	LM-U2	TM-RFM
SSCNET III/H interface	MR-J4-B	1-phase 100 V AC	○	○	–	–	–	–	–	–	–	–	–
		3-phase 200 V AC	●	●	●	●	●	●	●	●	●	●	●
		3-phase 400 V AC	–	–	●	●	–	–	–	●	–	–	–
	MR-J4W2-B	3-phase 200 V AC	●	●	●	●	–	●	●	–	●	●	●
	MR-J4W3-B	3-phase 200 V AC	●	●	–	–	–	–	●	–	●	●	●
General-purpose interface	MR-J4-A	1-phase 100 V AC	○	○	–	–	–	–	–	–	–	–	–
		3-phase 200 V AC	●	●	●	●	●	●	●	●	●	●	●
		3-phase 400 V AC	–	–	●	●	–	–	–	●	–	–	–

(as of June, 2013)

1.7 Absolute Position Detection System

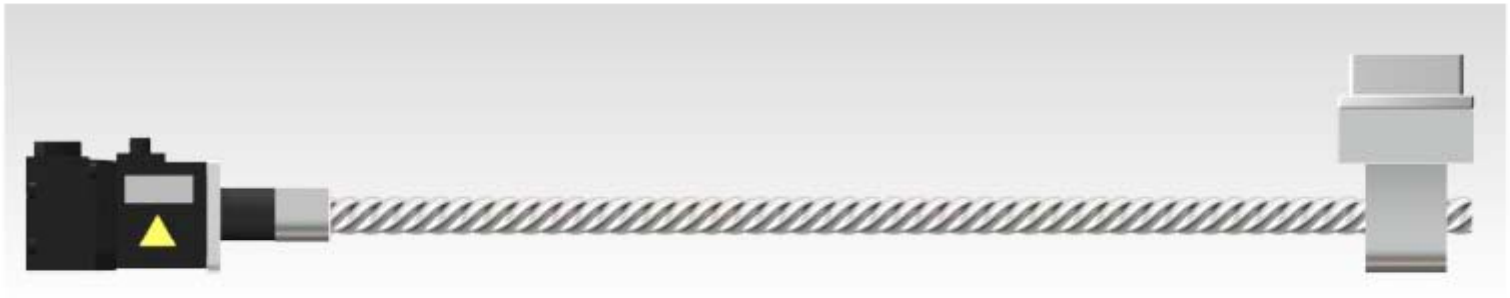
The MR−J4 series uses an absolute encoder so that an Absolute position detection system can be easily constructed.

With conventional Incremental systems, the rotation position and speed could not be detected and stored in memory when the power was turned OFF. So, whenever the Servo system power was turned ON, for example, when the system was started up or at a recovery from a malfunction or power interruption, the task of aligning the home position (home position return) was required.

With Absolute position detection system, however, the rotation position and speed can be detected and stored in memory when the power is turned OFF. So, if the home position is set at the initial operation, operation can be resumed without having to perform a home position return. As a result, the recovery time from a malfunction and power interruption can be shortened.
When constructing Absolute position detection system with the MR−J4 series, a battery unit is required to hold the absolute position data.
You can check how each of these "Absolute position detection system" and "Incremental system" works by clicking the respective button below to start an animation.

Absolute position detection system

Power ON



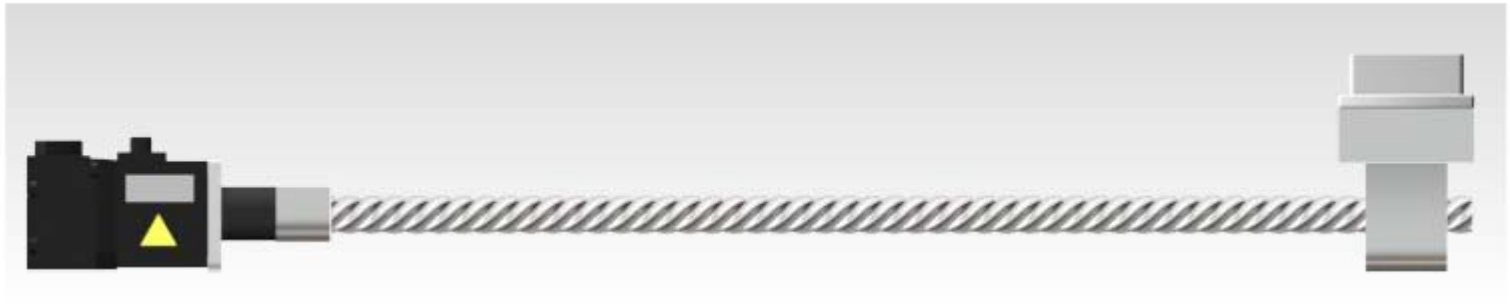
Incremental system

Power ON

1.7 Absolute Position Detection System

Incremental system

Power ON



1.8 Procedure for Constructing a Servo System

The following shows the procedure for constructing a Servo system.
In this course, you will learn the procedure from "(1) Selection" through to "(5) Adjustment".

(1) Selection of Servo amplifier/Servo motor ····· Chap.2

↓

(2) Installation/Wiring of Servo amplifier/Servo motor ····· Chap.3

↓

(3) Setting up/Starting the Servo amplifier ····· Chap.4
- Parameter settings
- Checking Servo amplifier/Servo motor Wiring
- Test operation

↓

(4) Motor-less operation connected to controller ····· Chap.4

↓

(5) Adjustment of Servo amplifier mounted on machine ····· Chap.5

1.9 Summary

In this chapter, you have learned:

- MELSERVO-J4 Features
- Lineup of Servo Amplifiers
- Lineup of Servo Motors
- Absolute position detection system
- Procedure for Constructing a Servo System

Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

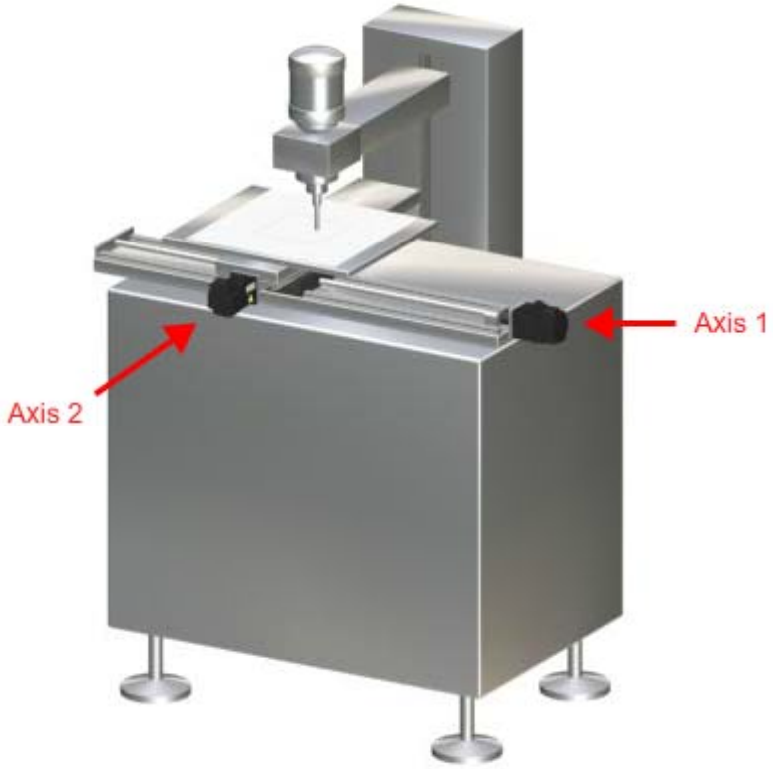
MELSERVO-J4 Features	• A servo control engine based on a proprietary architecture is used to achieve the fastest and highest precision in the industry. • The Rotary servo motor is equipped with a 4,194,304p/rev (22bit) absolute encoder, which enables high-precision positioning and smooth rotation.
Absolute position detection system	• With Absolute position detection system, if the home position is set when the equipment is initially started up, the system compensates for a position shift. Therefore, a home position return after the power is turned back ON is not required.

Chapter 2 Sample System and Equipment Configuration

2.1 Sample System

In this course, you will learn about the X−Y table as the sample system.
Check the operation pattern diagram and machine specifications from the following PDF file.

Sample system details <PDF>



2.2 Selecting the Servo Motor Capacity

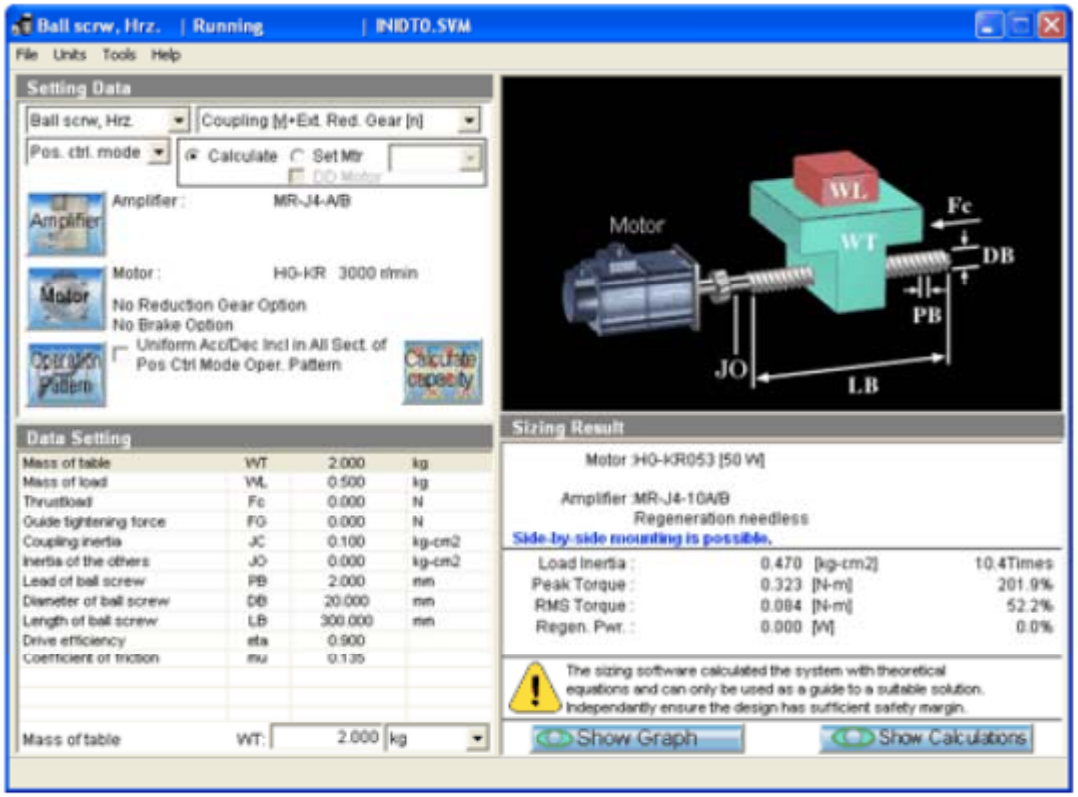
First, you must select the optimum capacity of Servo amplifier/Servo motor to be used on the sample system. The AC Servo Capacity Selection Software (freeware) is used for selecting capacity.

AC Servo Capacity Selection Software

- When the machine specifications and operation pattern are set, the optimum Servo amplifier, Servo motor and Regenerative energy option can be selected.
- A menu for selecting Linear servo motors and Direct drive motors is also provided.
- Ten types of equipment configurations, such as horizontal ball screw, vertical ball screw, rack and pinion, and roll field, are supported.

Let's try selecting using the AC Servo Capacity Selection Software on the next screen.

Capacity Selection Software MRZJW3-MOTSZ111E Ver.C5



*The capacity selection software is available for free download. Contact your local sales office for more details.

Servo_MELSERVO_Basics(MR-J4)_ENG

2.2 Selecting the Servo Motor Capacity

Ball scrw, Hrz. | Running | INIDTO.SVM

File Units Tools Help

Setting Data

Ball scrw, Hrz. | Coupling [γ]+Ext. Red. Gear [η]

Pos. ctrl. mode | Calculate | Set Mtr | DD Motor

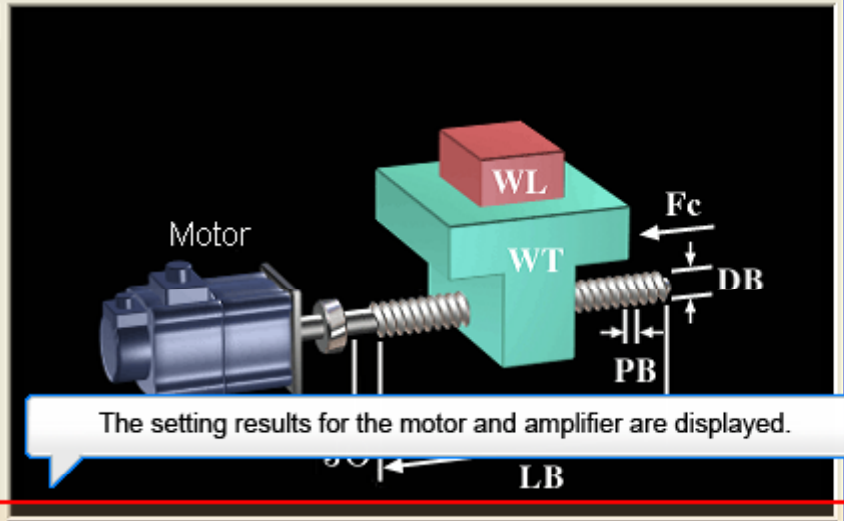
Amplifier : MR-J4-A/B

Motor : HG-KR 3000 r/min

No Reduction Gear Option
No Brake Option

Uniform Acc/Dec Incl in All Sect. of Pos Ctrl Mode Oper. Pattern

Amplifier | Motor | Operation Pattern | Calculate capacity



The setting results for the motor and amplifier are displayed.

Data Setting

Mass of table	WT	2.000	kg
Mass of load	WL	0.500	kg
Thrustload	Fc	0.000	N
Guide tightening force	FG	0.000	N
Coupling inertia	JC	0.100	kg-cm2
Inertia of the others	JO	0.000	kg-cm2
Lead of ball screw	PB	2.000	mm
Diameter of ball screw	DB	20.000	mm
Length of ball screw	LB	300.000	mm
Drive efficiency	eta	0.900	
Coefficient of friction	mu	0.135	

Mass of table WT: 2.000 kg

Sizing Result

Motor :HG-KR053 [50 W]

Amplifier :MR-J4-10A/B
Regeneration needless

Side-by-side mounting is possible.

Load Inertia :	0.470 [kg-cm2]	10.4Times
Peak Torque :	0.323 [N-m]	201.9%
RMS Torque :	0.084 [N-m]	52.2%
Regen. Pwr. :	0.000 [W]	0.0%

The sizing software calculated the syst... equations and can only be used as a gu... Independantly ensure the design has su...

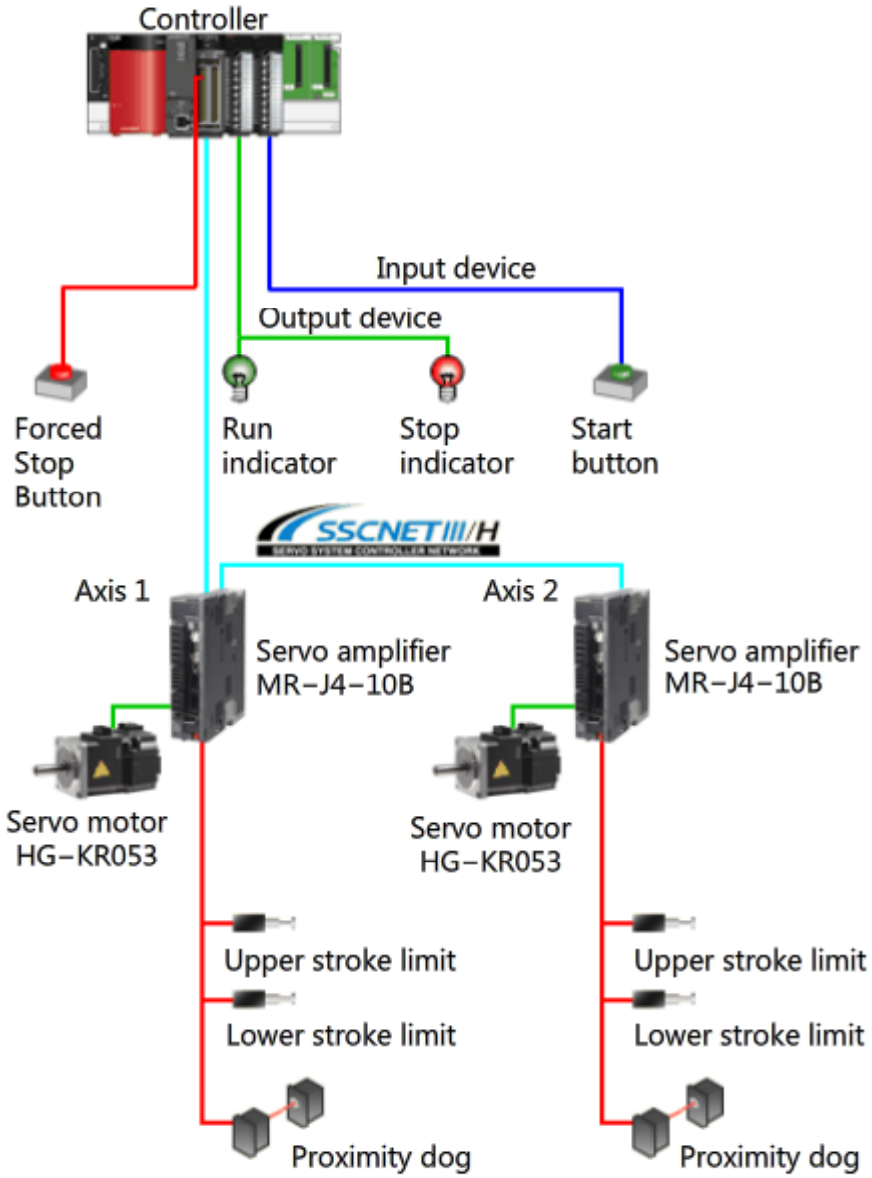
Show Graph

The calculation result is displayed.

Click ▶| to proceed to the next screen.

2.3 Equipment Configuration

Construct the sample system according to the following procedure. The following shows an equipment configuration diagram and list for the sample system.



Model		Model Name	Q'ty
Controller			
	PLC CPU	Q04UDEHCPU	1
	Power supply module	Q62P	1
	Main base unit	Q35DB	1
	Input module	QX40	1
	Output module	QY41P	1
	Servo system controller (Simple Motion module)	QD77MS2	1
Servo amplifier		MR-J4-10B	2
Servo motor		HG-KR053	2
Servo motor power cable		MR-PWS1CBL2M-A2-L	2
Encoder cable		MR-J3ENCBL2M-A2-L	2
SSCNET III cable		MR-J3BUS1M	2
Connector set		MR-CCN1	2
Battery		MR-BAT6V1SET	2
Personal computer communication cable (USB cable)		MR-J3USBCBL3M	1
Setup software		MR Configurator2	1

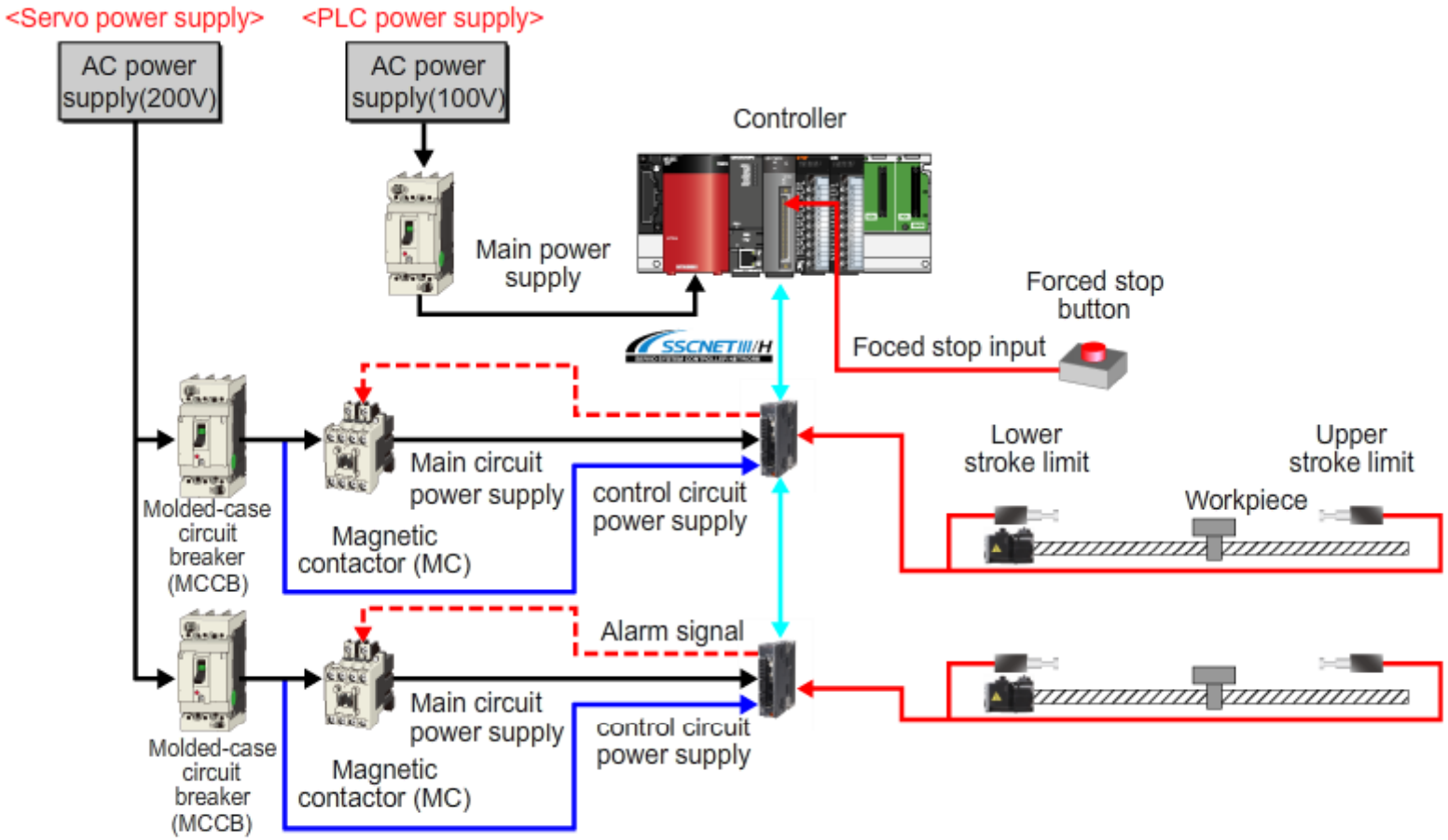
*A molded-case circuit breaker (MCCB) and Magnetic contactor (MC) are required separately.

2.4 Safe Design of a Sample System

We will review safety measures in place that are designed to unfailingly stop the system in emergencies to prevent device damage and malfunction and accidents from occurring when problems arise in the system.

Click the button that you would like to learn more about. (Click "Display all circuits" button to check out safety measure devices for all circuits.)

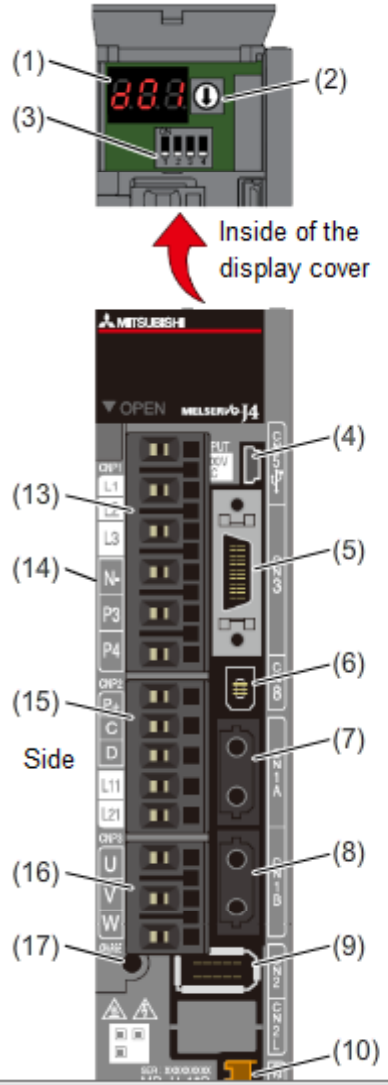
Emergency stop circuit | Forced stop circuit | Workpiece moveable range | Display all circuits



2.5 Servo Amplifier

2.5.1 Introduction to Names and Functions of Servo Amplifier Parts

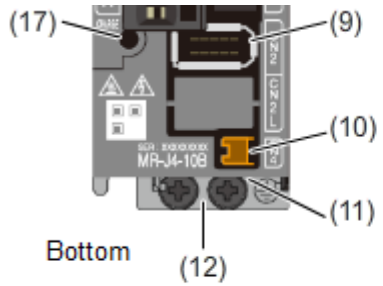
By way of example, you will learn the names and functions of the "MR−J4−10B" Servo amplifier.



No.	Name/Application
(1)	Display The 3-digit, seven-segment LED shows the servo status and the alarm number.
(2)	Axis selection rotary switch (SW1) Used to set the axis No. of servo amplifier.
(3)	Control axis setting switch (SW2) The test operation switch, the control axis deactivation setting switch, and the auxiliary axis number setting switch are available.
(4)	USB communication connector (CN5) Connect with the personal computer.
(5)	I/O signal connector (CN3) Used to connect digital I/O signals.
(6)	STO input signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.
(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis servo amplifier.

No.	Name/Application
(9)	Encoder connector (CN2) mConnects to the servo motor encoder.
(10)	Battery connector (CN4) Used to connect the battery for absolute position data backup.
(11)	Battery holder Install the battery for absolute position data backup.
(12)	Protective earth (PE) terminal Grounding terminal
(13)	Main circuit power supply connector (CNP1) Connect the input power supply.
(14)	Rating plate
(15)	Control circuit power supply connector (CNP2) Connect the control circuit power supply and regenerative option.
(16)	Servo motor power output connector (CNP3) Connect the servo motor.

2.5 Servo Amplifier

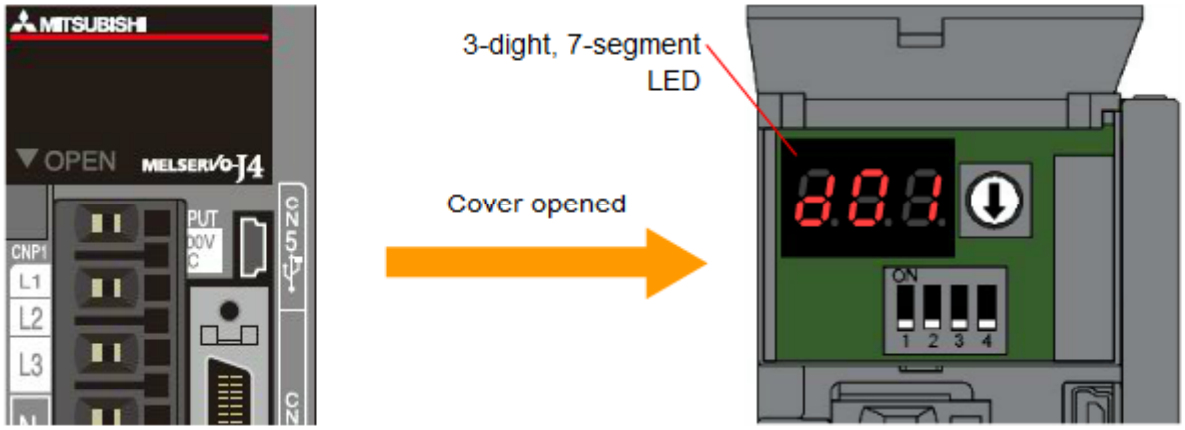


(7)	SSCNET III cable connector (CN1A) Used to connect the servo system controller or the previous axis servo amplifier.
(8)	SSCNET III cable connector (CN1B) Used to connect the next axis servo amplifier. For the final axis, put a cap.

(16)	Servo motor power output connector (CNP3) Connect the servo motor.
(17)	Charge lamp When the main circuit is charged, this will light. While this lamp is lit, do not reconnect the cables.

2.5.2 Display Unit for the Servo Amplifier

The display for the servo amplifier is shown below. (For the MR−J4−B model servo amplifier)
The display uses a seven−segment display to indicate axis servo conditions and provide alarm notifications.



(1) Normal display

When there is no alarm,the axis No. and blank are displayed in turns.

Status (1 digit) Axis No. (2 digits)

(2) Alarm display

When an alarm occurs, the alarm number (two digits) and the alarm detail (one digit) are displayed in turns with the status display. For example, the following shows when [AL. 32 Overcurrent] is occurring.

Status (1 digit) Axis No. (2 digits) Alarm No. (2 digits) Alarm detail (1 digit)

2.5.2 Display Unit for the Servo Amplifier

Status (1 digit) | Axis No. (2 digits)

"b": Indicates ready-off and servo-off status.
"C": Indicates ready-on and servo-off status.
"d": Indicates ready-on and servo-on status.

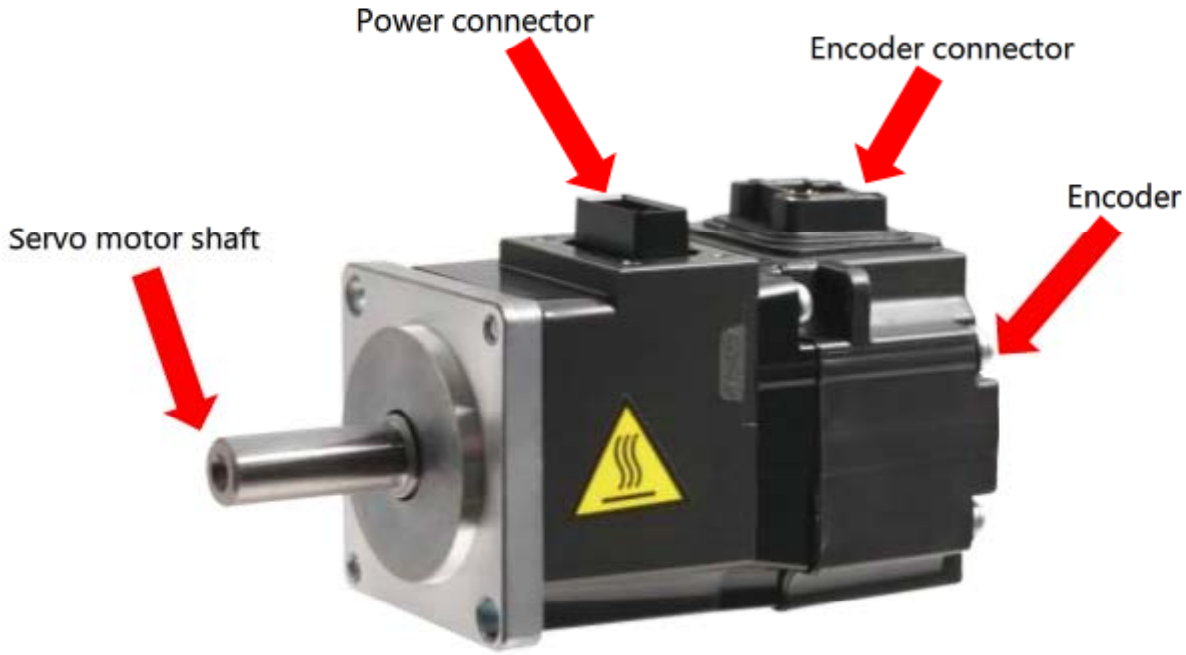
Status (1 digit) | Axis No. (2 digits)

"n": Indicates that an alarm is occurring.

Alarm No. (2 digits) | Alarm detail (1 digit)

2.6 Introduction to Names of Servo Motor Parts

By way of example, you will learn the names of the "HG-KR053" Servo motor.



2.7 Summary

In this chapter, you have learned:

- Selecting the Servo System Capacity
- Equipment Configuration of Servo System
- Safe Design of a Sample System
- Introduction to Names and Functions of Servo Amplifier Parts
- Introduction to Names of Servo Motor Parts

Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

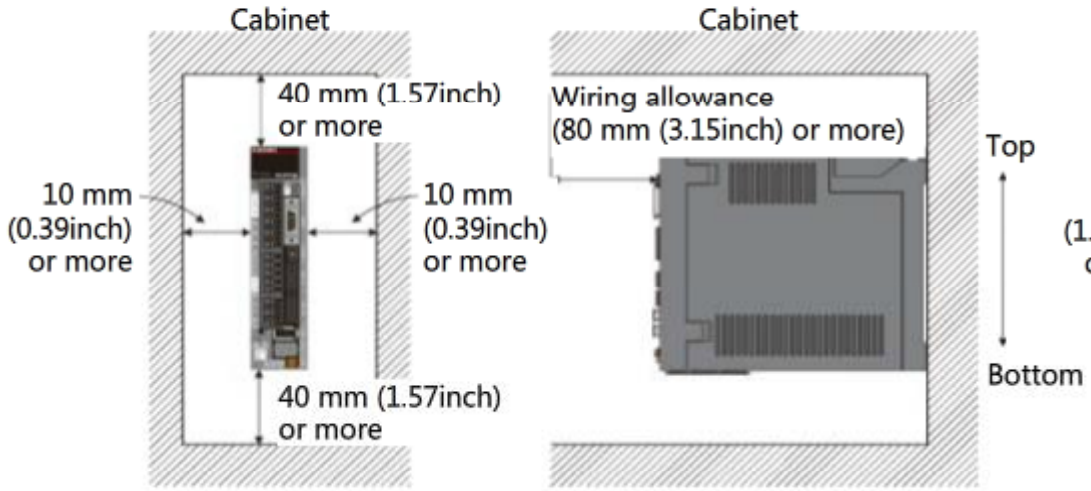
Selecting the Servo System Capacity	• Select a combination of Servo amplifier and Servo motor that is within the appropriate capacity range.
Equipment Configuration of Servo System	• Select a controller, Servo amplifier, Servo Motor, cables, etc. according to the specifications of the system to be constructed and comprise the Servo system.
Safe Design of a Sample System	• We will implement safety measures in place that are designed to unfailingly stop the system in emergencies to prevent device damage and malfunction and accidents from occurring
Introduction to Names and Functions of Servo Amplifier Parts	• Servo amplifiers comprise a Display, axis setting part, interface, Battery holder, and Charge lamp
Introduction to Names of Servo Motor Parts	• Servo motors comprise a power supply connector, Servo motor shaft, Encoder connector, and Encoder.

Chapter 3 Installation/Wiring

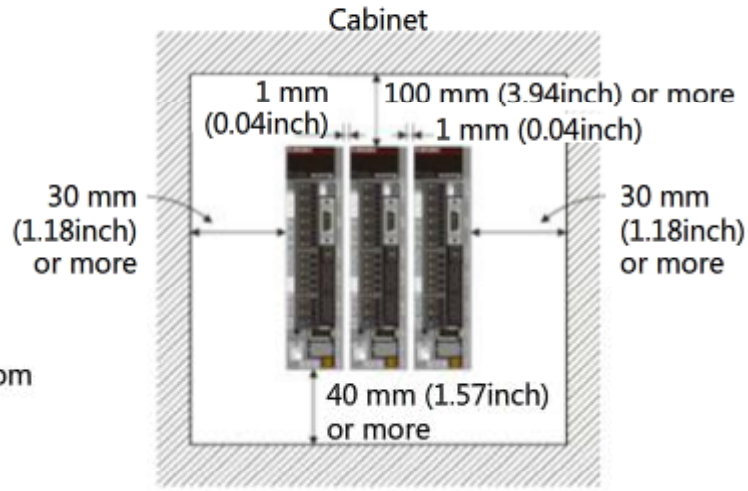
3.1 Installation of Servo Amplifiers

Check the installation direction and space around the MR-J4-10B.

- Installation of one servo amplifier



- Installation of two or more servo amplifiers



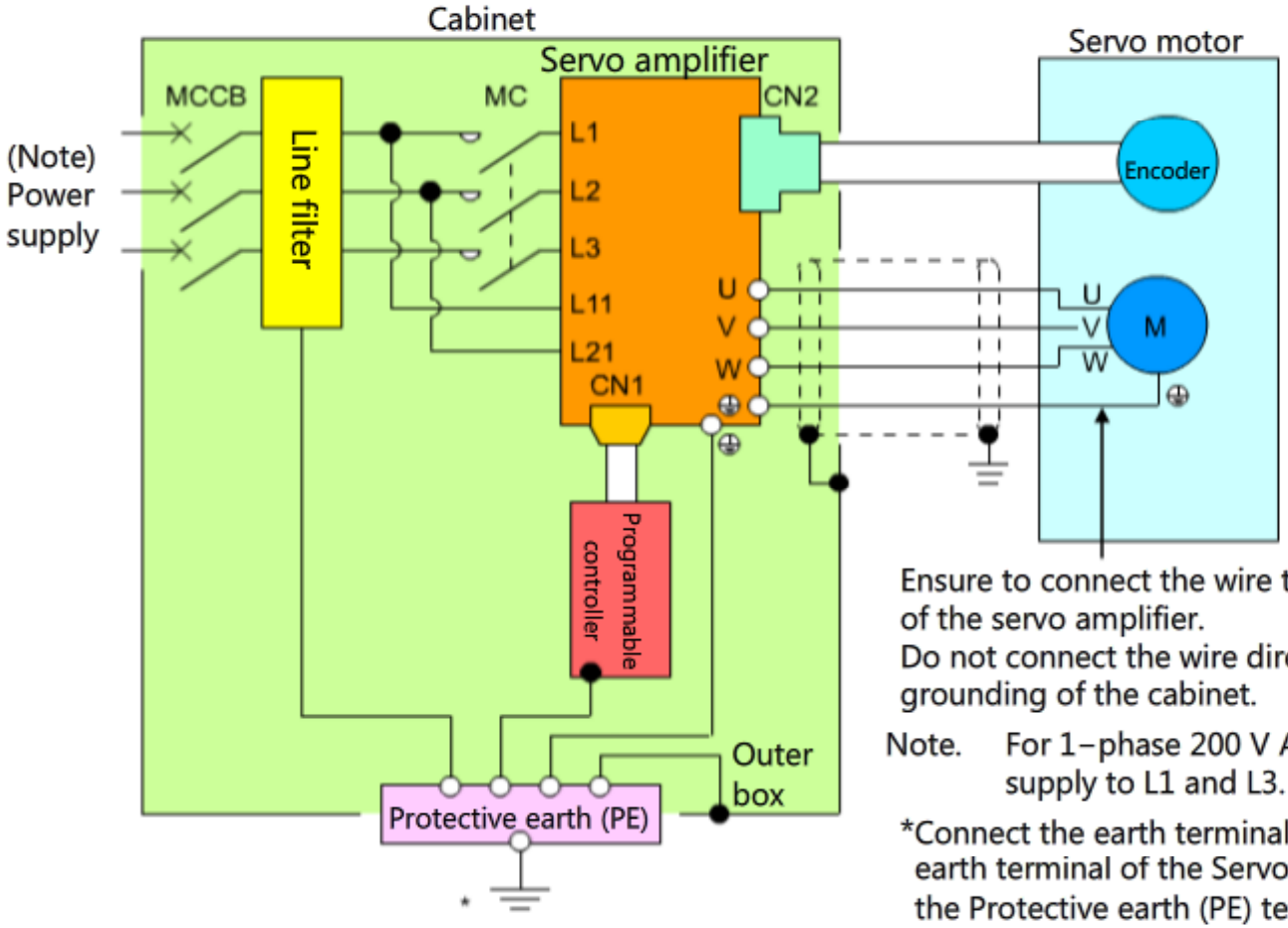
Cautions
- Mount the servo amplifier to a vertical wall making sure to orient it correctly with the top facing up and the bottom facing down.
- Use it in an environment with a room temperature ranging from 0°C to 55°C (32°F to 131°F).
- Use a cooling fan to prevent system overheating.
- Be careful not to allow any foreign objects or material to enter the servo amplifier during assembly or from the cooling fan.
- Use an air purge system if installing servo amplifiers in locations with toxic gas fumes or high in dust (force clean air into the cabinet from outside to make the internal pressure higher than the external pressure).

Cautions
- When mounting the servo amplifiers closely, leave a clearance of 1 mm between the adjacent servo amplifiers in consideration of mounting tolerances. In this case, keep the ambient temperature within 0 °C to 45 °C (32°F to 113°F) or use the servo amplifier with 75% or less of the effective load ratio.

3.2 Grounding the Servo Amplifier

Before wiring the power supply, ground the Servo amplifier and Servo motor.
As a measure to prevent electric shock and noise, reliably ground the Servo amplifier and Servo motor.

- To prevent electric shock, be sure to connect the Protective earth terminal of the amplifier to the protective earth of the Cabinet.
- Servo amplifiers are influenced by switching noise from transistors depending on how wiring is routed and how the ground is made. So, when grounding, refer to the diagram below.



Ensure to connect the wire to the PE terminal of the servo amplifier.
Do not connect the wire directly to the grounding of the cabinet.

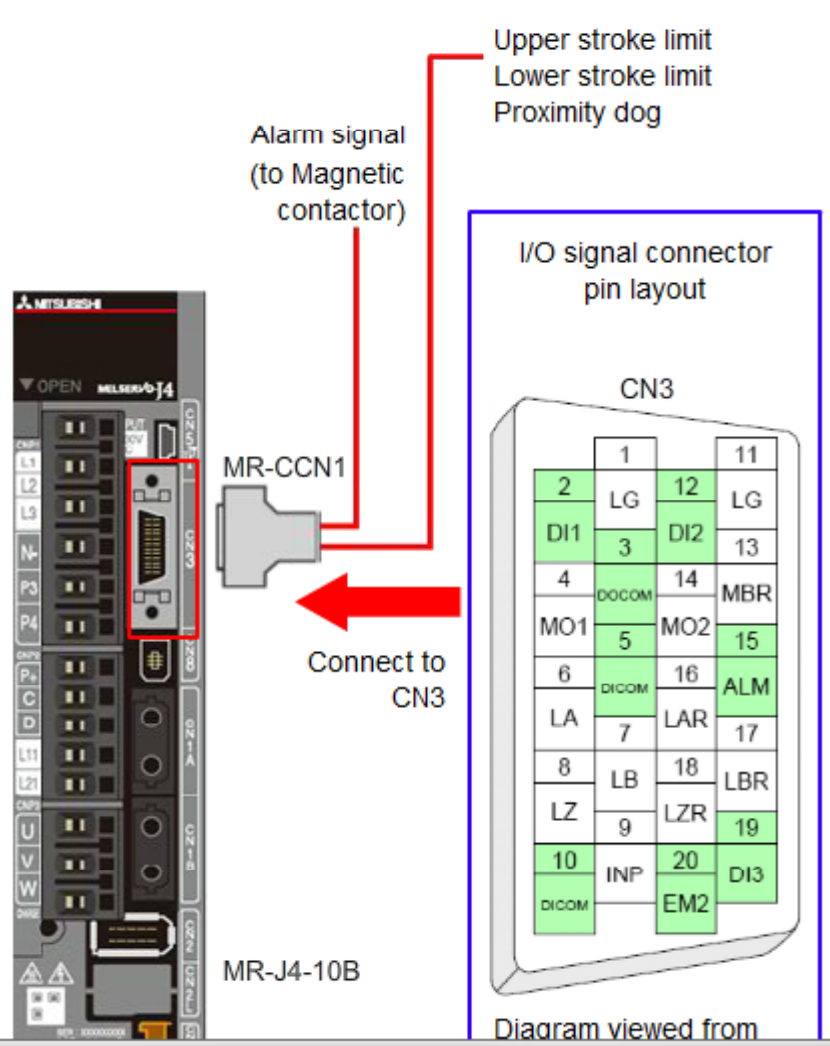
Note. For 1-phase 200 V AC to 240 V AC, connect the power supply to L1 and L3. Leave L2 open.

*Connect the earth terminal of the Servo motor to the Protective earth terminal of the Servo amplifier. Ground by connecting the Protective earth (PE) terminal of the Servo amplifier to the Protective earth (PE) of the Cabinet.

3.3 Wiring External I/O Signals to the Servo Amplifier

Wire external I/O devices to the I/O signal connector (model: MR−CCN1).
Connect the already wired I/O signal connector to the CN3 connector on the Servo amplifier.

A signal wiring diagram for the I/O signal connector is shown below.
The following introduces only the external I/O device used in this course.
For details on other devices, refer to the respective manual.



I/O device

Pin No.	Symbol	Function/application
20	EM2	Wires the forced stop switch.
2	DI1	Wires the hardware upper stroke limit switch.
12	DI2	Wires the hardware lower stroke limit switch.
19	DI3	Wires the proximity dog.
15	ALM	Outputs the Alarm signal. Connects to an external sequence to switch the magnetic contactor (MC) ON/OFF with the alarm signal.
5	DICOM	Input 24VDC (24VDC±10% 0.3A) for the I/O interface. The power supply capacity varies according to the number of points on the I/O interface to be used. Connect the 24VDC external power supply (+).
10		

3.3 Wiring External I/O Signals to the Servo Amplifier

MR-J4-10B

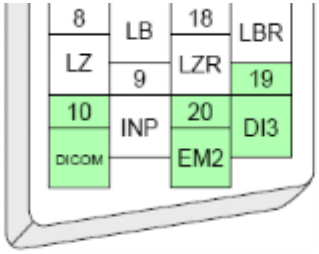


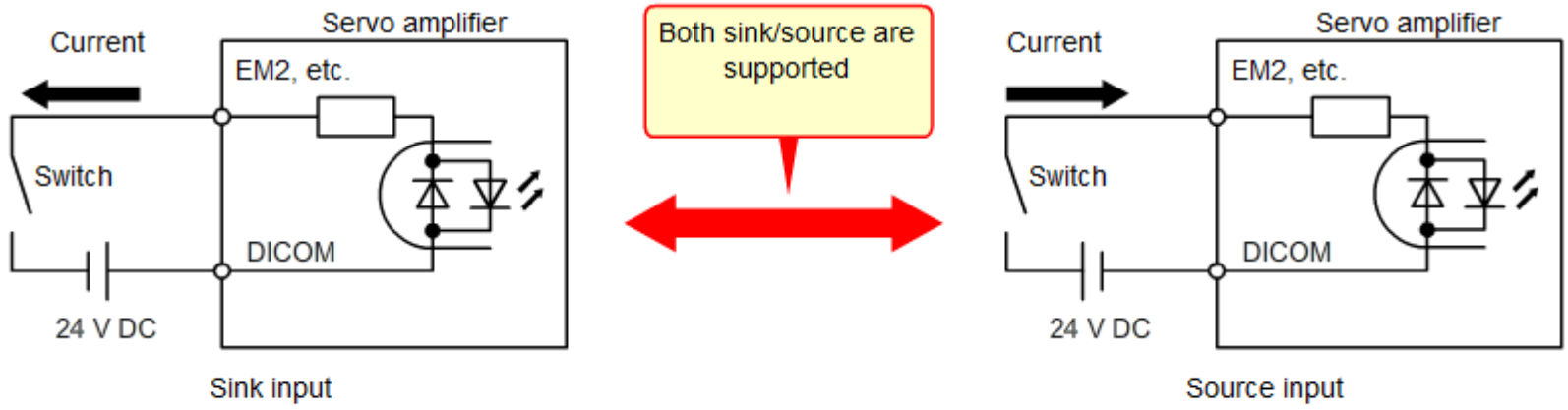
Diagram viewed from connector wiring section

5	DICOM	Input 24VDC (24VDC±10% 0.3A) for the I/O interface. The power supply capacity varies according to the number of points on the I/O interface to be used. Connect the 24VDC external power supply (+).
10		
3	DOCOM	Common terminal for EM1 and other input signals

Sink/Source Wiring Compatibility

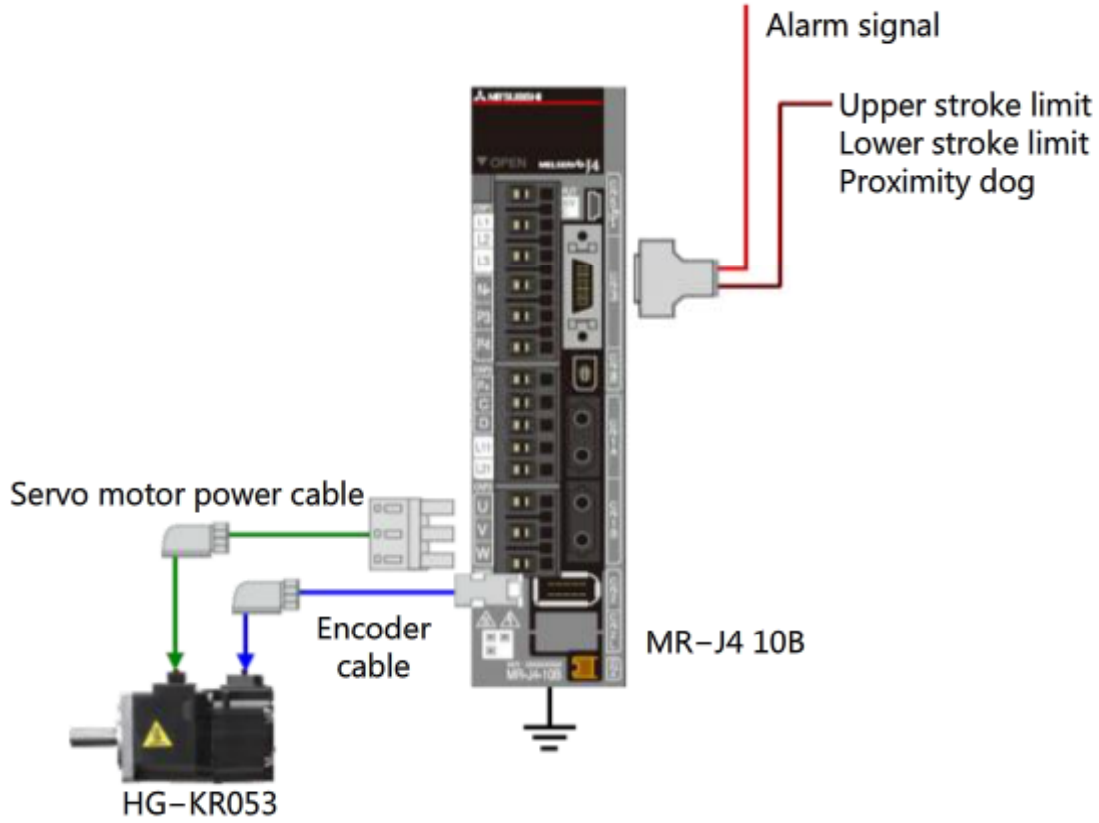
Both sink and source wiring of digital inputs and outputs are supported

■Example of digital input



3.4 Wiring the Servo Amplifier to the Servo Motor

By way of example, you will learn how to connect the Servo motor power cable and Encoder cable to the "MR−J4−10B" and "HG−KR053".
For details on how to select each cable, refer to the respective manual.



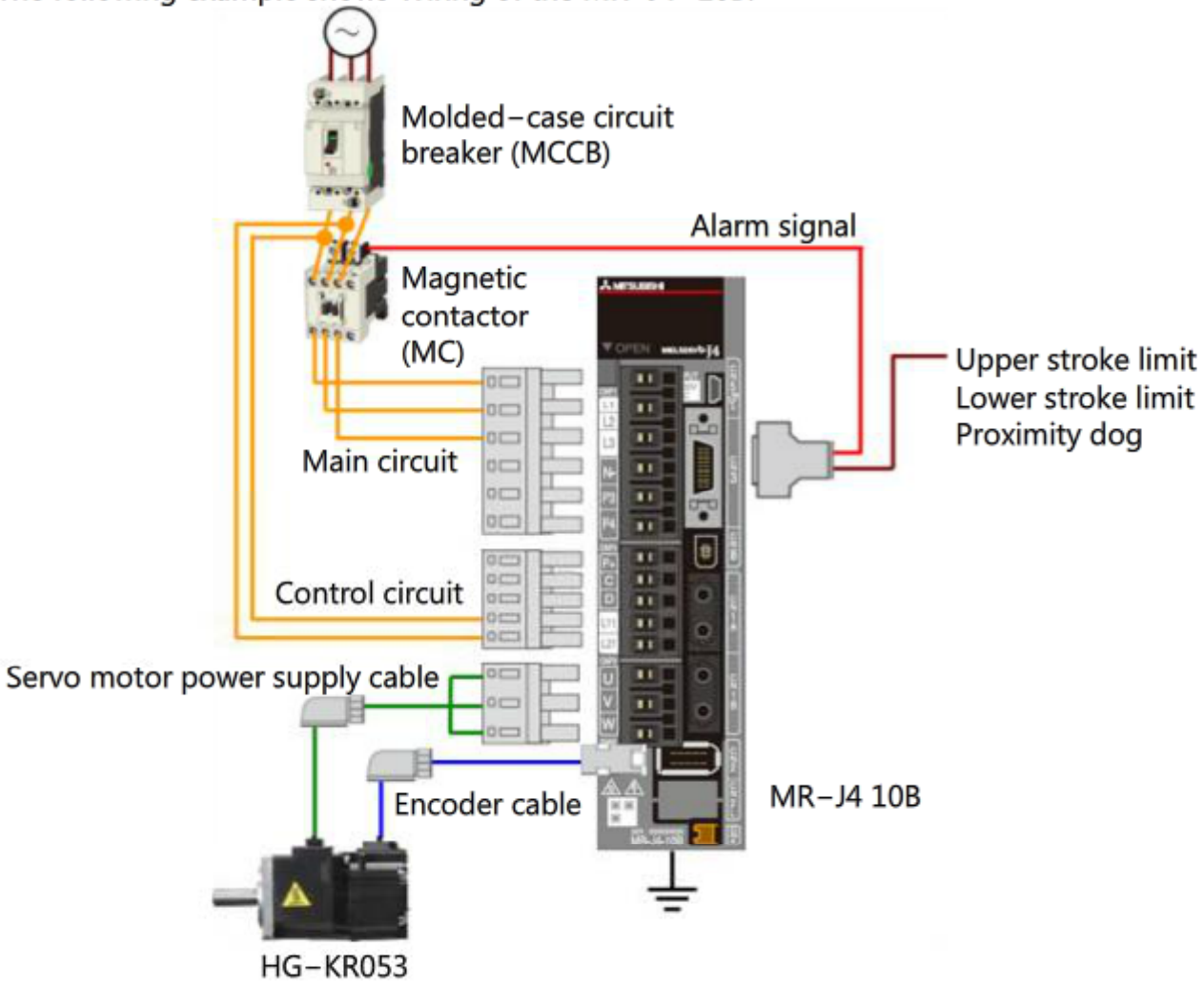
Cautions

- Correctly connect the phases (U/V/W) of the Servo amplifier and Servo motor power supply. Incorrectly connecting the phases will make the Servo motor malfunction.
- Wire the Servo amplifier to the Servo motor using the dedicated cable.
  Also, do not attach a power capacitor, surge absorber, filter, Magnetic contactor (MC), etc. between the amplifier and motor.
- Connect the grounding wire from the Servo motor to the Protective earth (PE) terminal of the Servo amplifier.
  For details on grounding, see item 3.2.

3.5 Wiring the Servo Amplifier Power Supply

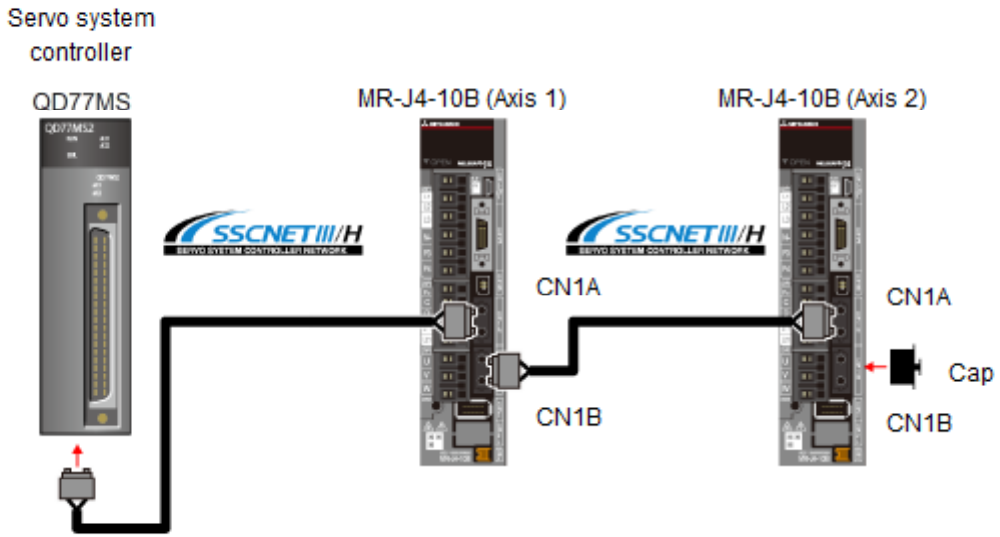
Connect the power supply to the Servo amplifier in two places, for the main circuit and the control circuit.
Be sure to connect a molded−case circuit breaker (MCCB) to the input line of the power supply.
Also, be sure to connect a Magnetic contactor (MC) between the main circuit power supply and terminals L1, L2 and L3 of the Servo amplifier, and wire it so that the Magnetic contactor is turned OFF to turn the main circuit power supply OFF when the Alarm signal or forced stop input signal is non−conductive.

The following example shows Wiring of the MR−J4−10B.



3.6 SSCNET III/H Connection

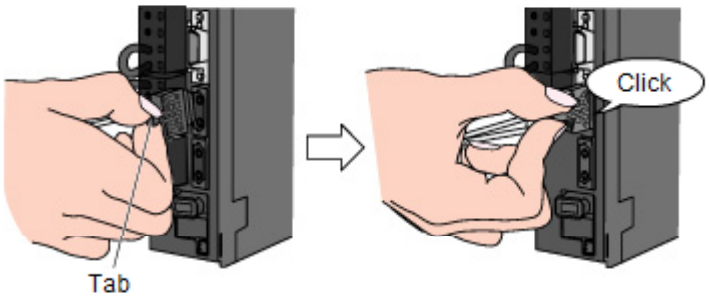
Here, you will learn how to connect Servo amplifiers together.
The MR−J4−B Servo amplifier is equipped with an SSCNET III/H interface.
The SSCNET III/H interface provides high−speed, Full duplex communications with excellent noise tolerance using an optical communications system.
Dedicated cables are used for this connection. Cables are provided with connectors so that they can be easily connected and disconnected.



Be sure to carefully observe the below precautions when handling the SSCNET III cable.

- Do not apply tension or lateral pressure on the cable, or do not bend sharply, twist, or pull the cable. Otherwise, the internal optical fiber will be deformed or broken, causing the optical transmission to fail.
- Do not to use the fiber optic cable near fire or at high temperatures as it is made of a synthetic resin that could become deformed if heated, which could cause optical communications to fail.
- Do not to let dirt and other foreign matter collect on either end of the fiber optic cable as it could block the transmission of light and cause devices to malfunction.
- Do not attempt to look directly into the light emitted from the connector or cable terminal ends.

Connecting method



3.6 SSCNET III/H Connection

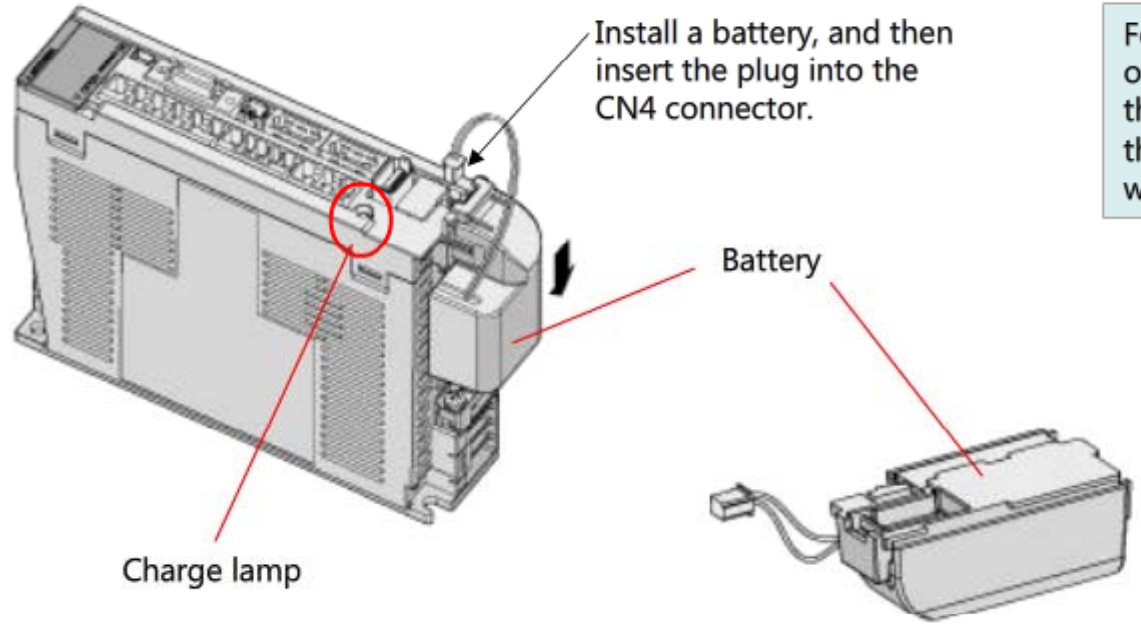
- Do not attempt to look directly into the light emitted from the connector or cable terminal ends.
- For safety and protective reasons, place the accompanying caps on unused connectors (CN1B) on the servo amplifier of the final axis to block emitted light.

3.7 Attaching the Battery Unit for the Absolute Position Detection System

When using an Absolute position detection system, a battery is required to hold the absolute position data.
Pay attention to the following to prevent electric shock or loss of absolute position data when attaching (or replacing) the battery to the Servo amplifier.

- To prevent electric shock, leave the Servo amplifier for at least 15 minutes after turning the main circuit power supply OFF, then check that the Charge lamp is out and check the voltage between the P(+) and N(−) terminals with a voltage tester or other tool before connecting the battery.
- Replace the battery with only the control circuit power supply ON.
  If the battery is replaced with the control circuit power supply OFF, the absolute position data will be lost.
- Disconnecting the encoder cable deletes the absolute position data. After disconnecting the encoder cable, be sure to perform a home position return.

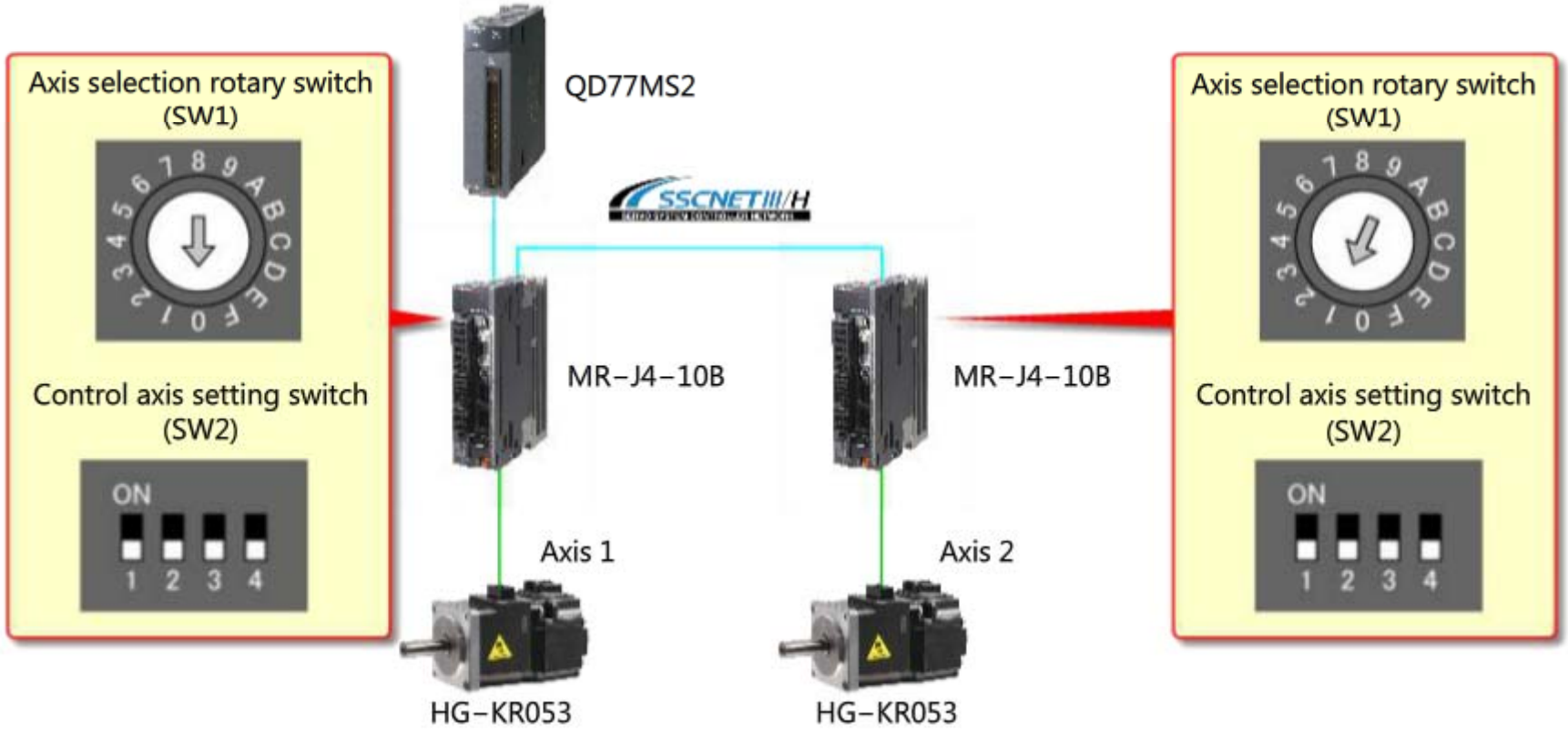
In this example, connect to the MR−J4−10B.



For the servo amplifier with a battery holder on the bottom, it is not possible to wire for the ground with the battery installed. Insert the battery after executing the ground wiring of the servo amplifier.

3.8 Axis No. Settings

Set the control axis No. to the Servo amplifier. Control axis numbers are assigned separately for each Servo amplifier in order to identify the control axis to use. Any number of axes up to 16 can be used regardless of the order of connection. Be careful not to assign the same control axis No. to multiple Servo amplifiers within the same Servo system as this could cause system operation to fail.
With the Servo amplifier, set the servo control axis No. using a combination of the settings for the Axis selection rotary switch (SW1) and the Control axis setting switch (SW2), which are located inside the display cover on the servo amplifier.



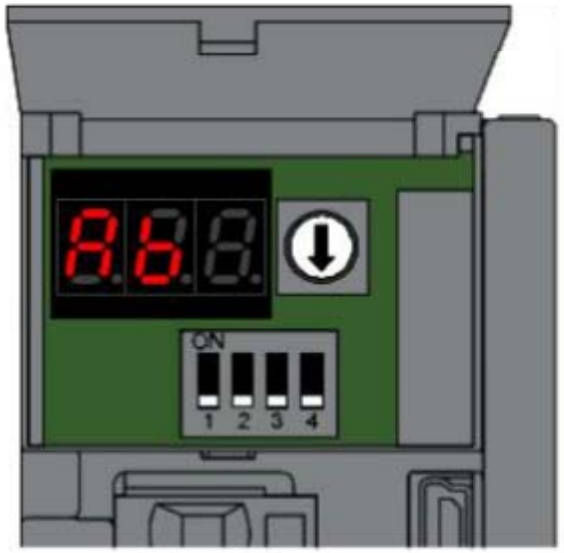
*Be sure to restart the main circuit power and control circuit power of the servo amplifier after making any changes to the axis selection rotary switch (SW1) and the Control axis setting switch (SW2).

3.9 Turning the Servo Amplifier Power ON

Turn the main circuit power supply and control circuit power supply of the Servo amplifier ON. When the Servo amplifier starts up, "Ab" (Servo system controller power ON standby) appears on the Display.
Set up and start up the Servo amplifier in this state since the Servo system controller power is not turned ON.

Turn the Servo amplifier power ON.

"Ab" appears on the Display



3.10 Summary

In this chapter, you have learned:

- Installing the Servo Amplifier
- Grounding the Servo Amplifier
- Wiring External I/O Signals to the Servo Amplifier
- Wiring the Servo Amplifier to the Servo Motor
- Wiring the Servo Amplifier Power Supply
- SSCNET Ⅲ/H Connection
- Attaching the Battery Unit for the Absolute Position Detection System
- Setting the Axis No.
- Turning the Servo Amplifier Power ON

Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

Installing the Servo Amplifier	・Attach the Servo amplifier to a vertical wall making sure to orient it correctly with the top facing up and the bottom facing down. ・Use it in an environment with a room temperature ranging from 0°C to 55°C (32°F to 131°F). (Ranging from 0°C to 45°C (32°F to 113°F) if using Servo amplifiers are closely mounted together.) ・Use a cooling fan to prevent system overheating. ・Be careful not to allow any foreign objects or material to enter the servo amplifier during assembly or from the cooling fan. ・Use an air purge system if installing Servo amplifiers in locations with toxic gas fumes or high in dust. ・If using two or more Servo amplifiers stacked together, leave open a gap of 1 mm between amplifiers to provide some leeway for installation.
Grounding the Servo Amplifier	・As a measure to prevent electric shock and noise, reliably ground the Servo amplifier and Servo motor. ・To prevent electric shock, be sure to connect the Protective earth terminal of the amplifier to the protective earth of the Cabinet

3.10 Summary

Grounding the Servo Amplifier	・As a measure to prevent electric shock and noise, reliably ground the Servo amplifier and Servo motor. ・To prevent electric shock, be sure to connect the Protective earth terminal of the amplifier to the protective earth of the Cabinet.
Wiring the Servo Amplifier Power Supply	A power supply is connected to the servo amplifier with the connectors for the main circuit power and the control circuit power. Make sure to connect a molded-case circuit breaker (MCCB) to the input line of the power supply.
SSCNET III/H Connection	・This connection provides high-speed, full-duplex communications with excellent noise tolerence using an optical communications system. ・Dedicated cables are used for this connection.
Attaching the Battery for the Absolute Position Detection System	・A battery is required to hold the absolute position data. Pay attention to the precautions in 3.7 to prevent electric shock or loss of absolute position data when attaching (or replacing) the battery to the Servo amplifier.
Axis No. settings	・Up to 16 axes can be set as the Servo amplifier axis No. using a combination of the settings for the Axis selection rotary switch and the Control axis setting switch, which are located inside the display cover on the servo amplifier. ・Be careful not to assign the same control axis No. to multiple Servo amplifiers within the same Servo system as it could cause system operation to fail.

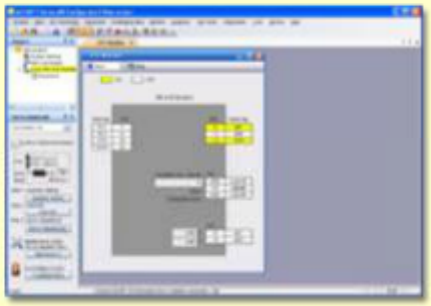
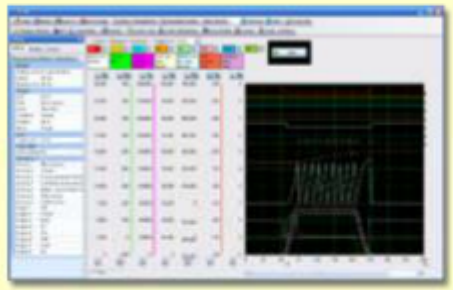
Chapter 4 Setting Up/Starting the Servo Amplifier

In this chapter, you will learn about setting up and starting a Servo amplifier using the setup software "MR Configurator2".

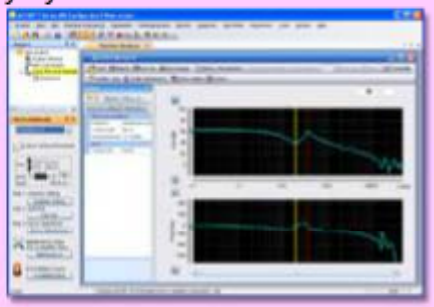
4.1 Setup Software "MR Configurator2"

Here, we will introduce the functions and applications of the setup software "MR Configurator2" (SW1DNC-MRC2-E).
You can perform adjustments and diagnosis, display monitors, read/write parameters, and execute Test operation simply from MR Configurator2 running on a personal computer.

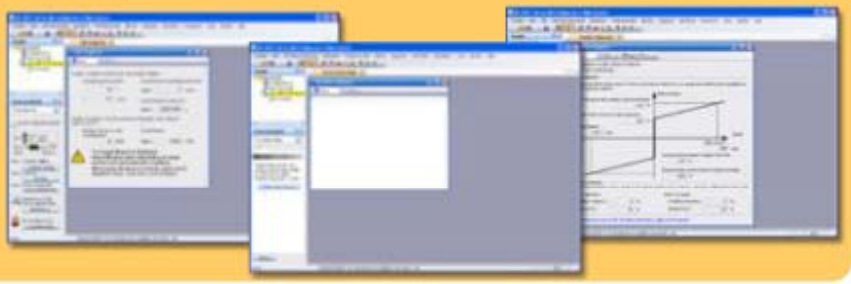
Startup Setting various parameters required for running the Servo system and writing the parameters to the servo amplifier are possible. Operation status can be monitored in a graph, etc.

Adjustment All gains are automatically adjusted, and servo performance can be demonstrated to its maximum merely by the click of a button.

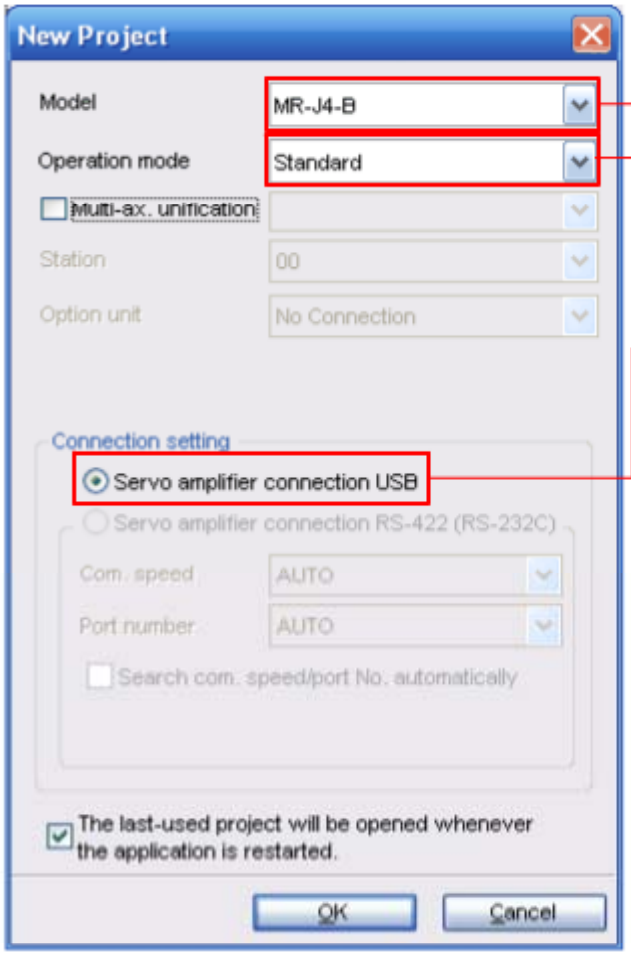



Maintenance The status of the Servo system and causes of malfunctions can be looked into and diagnosed, and parts life can be displayed in an easy-to-understand format.



4.2 Creating New Projects

In this section, we will create a new project.
Start up MR Configurator2 and select [Project] –> [New].
The [Create New] dialog box appears. Make the settings for communicating with the Servo amplifier.
In this course, you will make the settings for communicating with the Servo amplifier MR–J4–B via a USB connection.



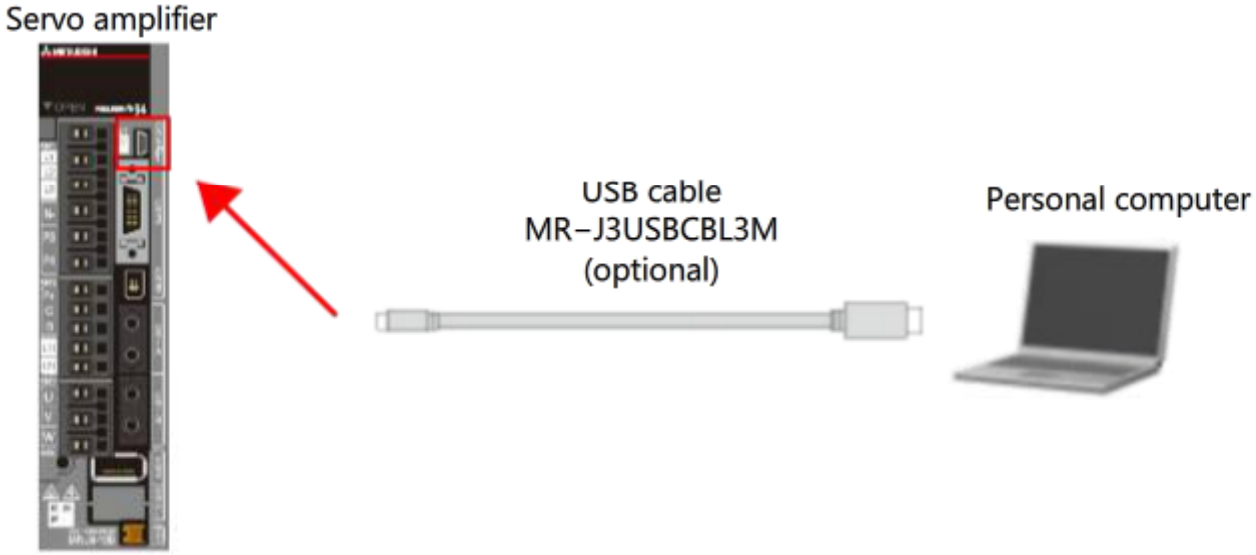
System Settings

Setting item	Set content	Setting in this Course
Model Setting	Use to select the model of Servo amplifier to be connected.	MR–J4–B
Operation mode	Use to select the operation mode.	Standard
Peer Destination	Use to select the peer to communicate with.	Servo amplifier connection USB

4.3 Connecting the Servo Amplifier to a Personal Computer

Connect the Servo amplifier to a computer using a USB cable.
Use the "MR−J3USBCBL3M" (length: 3 m) for the USB cable.

Connection with servo amplifier



Precautions when connecting by USB cable

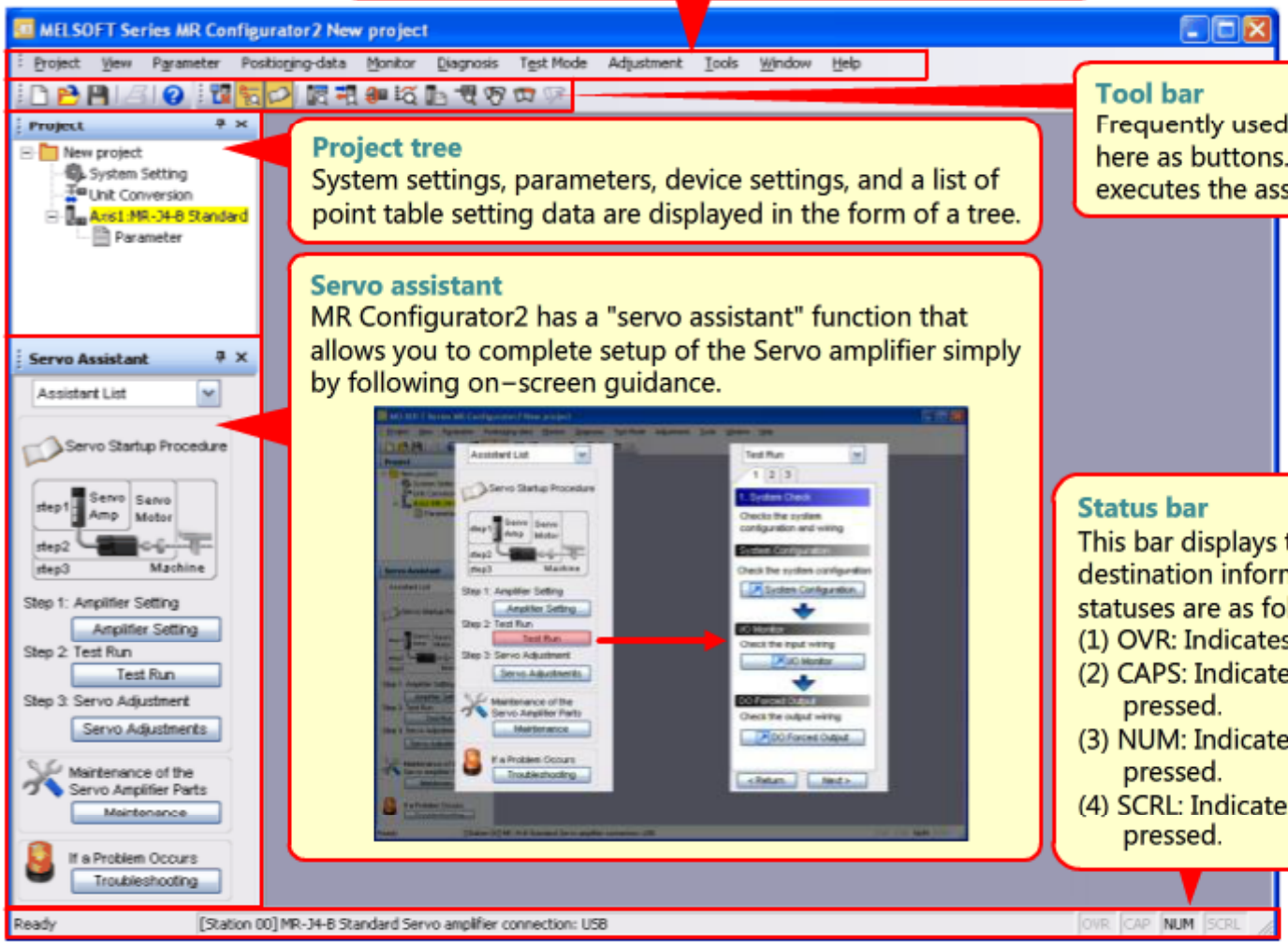
When the Servo amplifier is connected for the first time to a personal computer running Windows XP, the Add New Hardware wizard will be displayed.
With a personal computer running Windows 2000, Windows Vista and Windows 7, the Servo amplifier will automatically be detected.
However, on personal computers running Windows 2000 and Windows XP, a driver must be installed for each individual USB port. When connecting the Servo amplifier to a different USB port for the first time, the drive installation screen will be displayed.
For details on how to install the USB driver, refer to the respective manual.

4.4 Explanation of MR Configurator2 Screen and Servo Assistant

Here, we will explain the names of parts and functions on the MR Configurator2 screen.

MR Configurator2 has "Servo assistant" function that allows you to complete setup of the Servo amplifier simply by following on-screen guidance. In the following pages onwards, the servo assistant will be used to set up the Servo amplifier.

Menu bar
Use to select items to be performed on MR Configurator2.



Tool bar
Frequently used functions are grouped here as buttons. Clicking a button executes the assigned function.

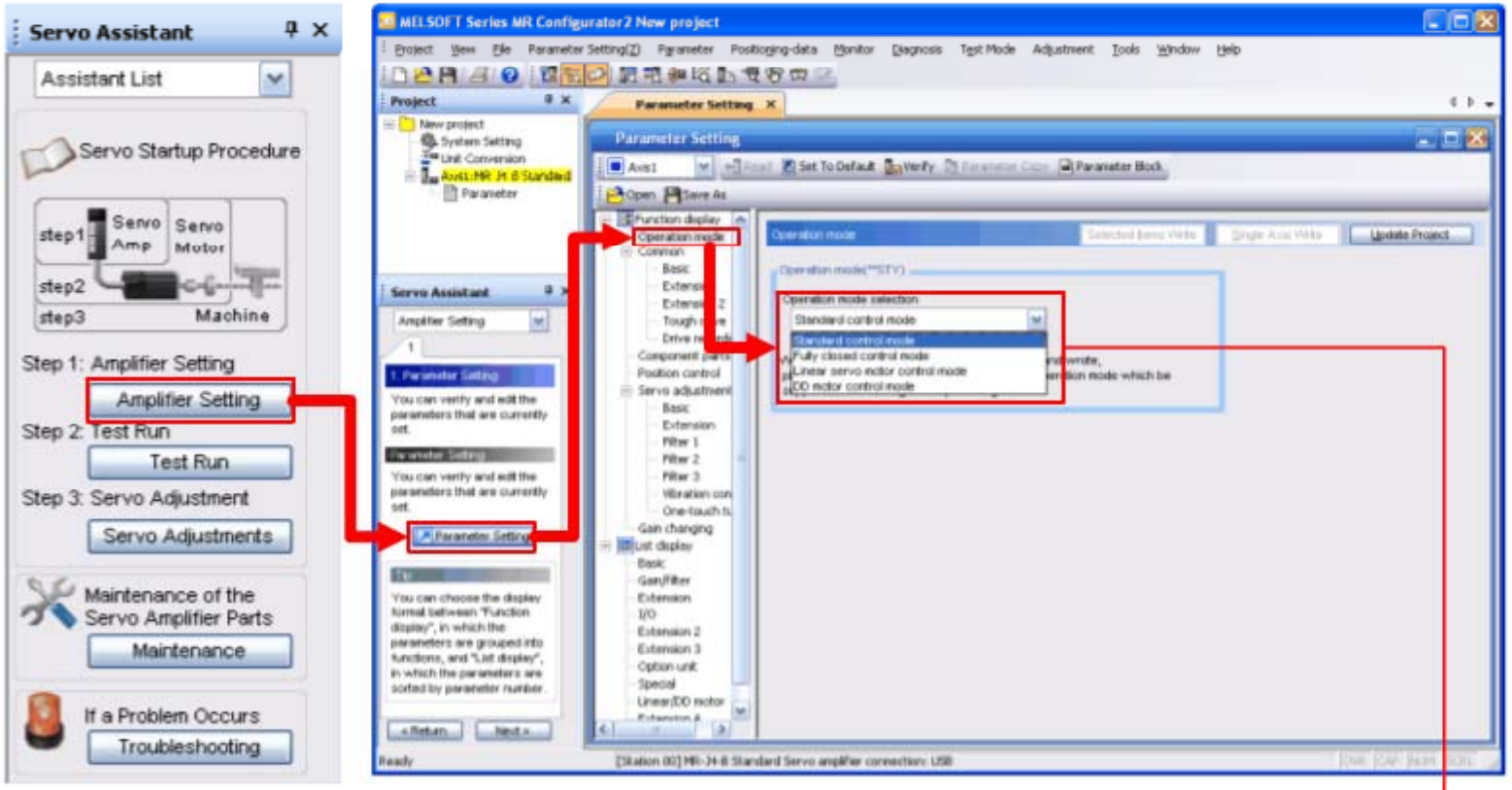
Project tree
System settings, parameters, device settings, and a list of point table setting data are displayed in the form of a tree.

Servo assistant
MR Configurator2 has a "servo assistant" function that allows you to complete setup of the Servo amplifier simply by following on-screen guidance.

Status bar
This bar displays the window status, connection destination information and key statuses. Key statuses are as follows:
(1) OVR: Indicates that the Insert key is pressed.
(2) CAPS: Indicates that the Caps Lock key is pressed.
(3) NUM: Indicates that the Num Lock key is pressed.
(4) SCRL: Indicates that the Scroll Lock key is pressed.

4.4.1 Step1 Amplifier Setting – Parameter Setting (Operation mode)

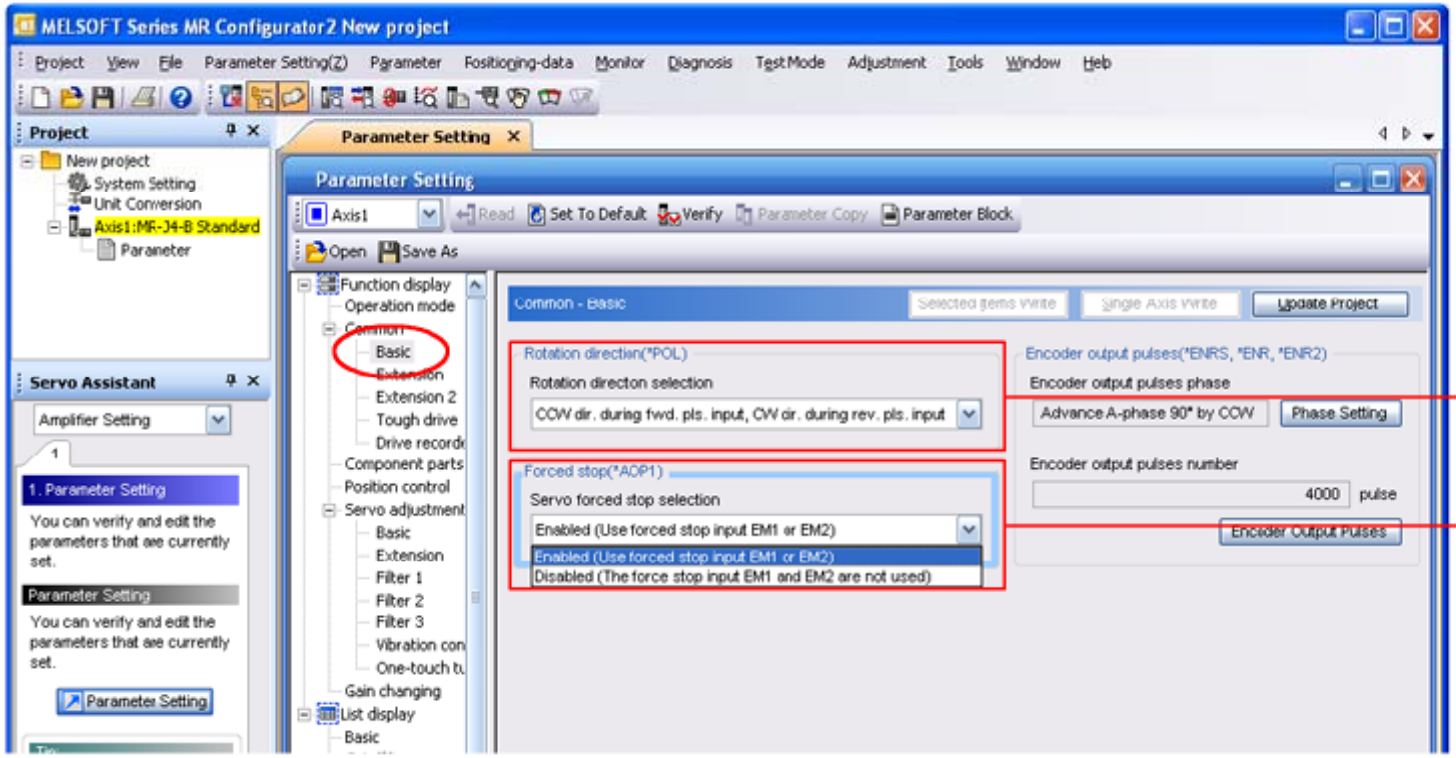
Select the operation mode.
In the servo assistant, select [Amplifier Setting] –> [Parameter Setting], then select [Operation mode] at [Function display], and set the operation mode.



Parameter item	Function Explanation	Initial values	Setting for the Sample System
Operation mode selection	Select an operation mode.	Standard control mode	Standard control mode

4.4.2 Step1 Amplifier Setting – Parameter Setting (Basic)

Make the basic settings.
Continuing from the previous page, select [Function display]–[Common]–[Basic], and set the rotation direction and forced stop.



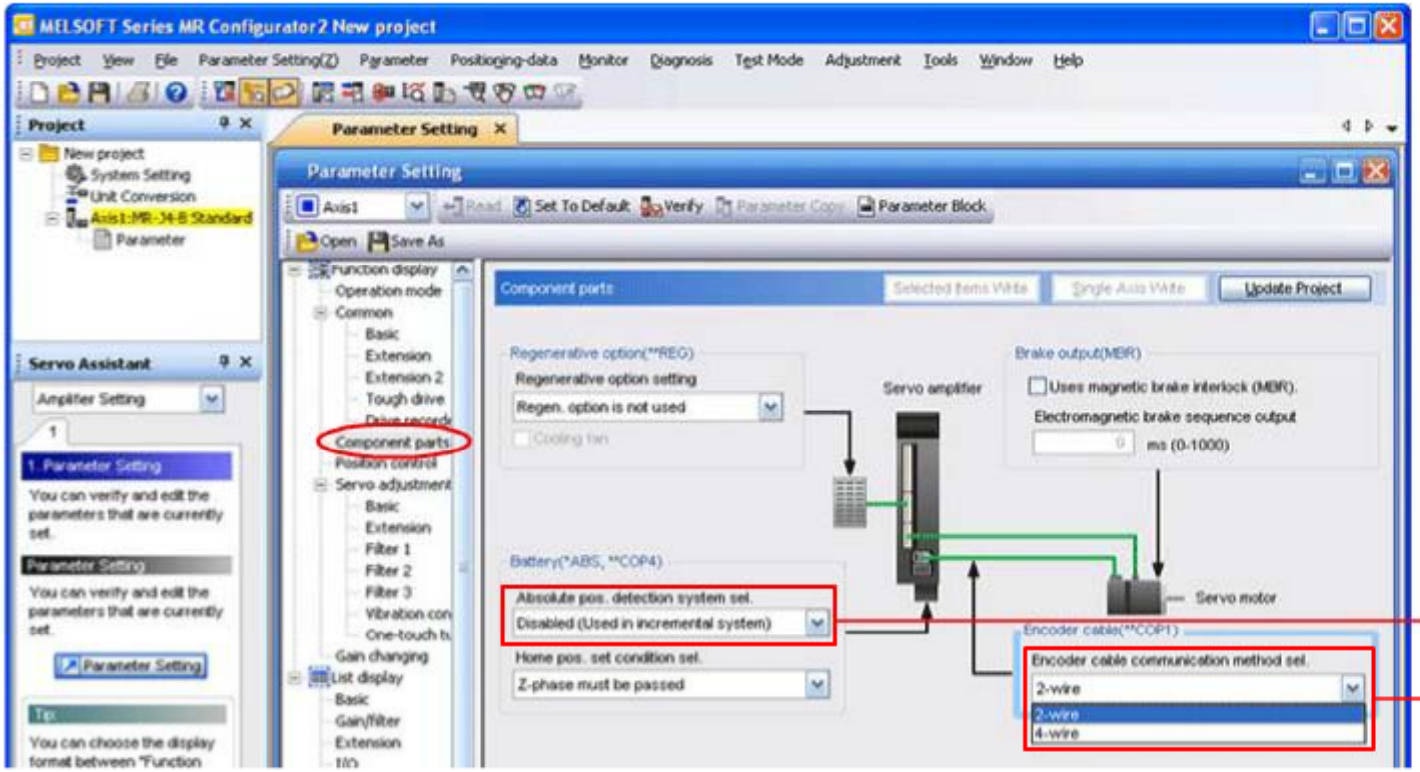
Parameter item	Function Explanation	Initial values	Setting for the Sample System
Rotation direction	Use this option to set the rotation direction of the servo motor when being moved by forward rotation commands. The rotation direction is either counter-clockwise (CCW) or clockwise (CW) as seen from the load side (side attached to the machine).	CCW for forward	CCW for forward

4.4.2 Step1 Amplifier Setting – Parameter Setting (Basic)

Rotation direction selection	Use this option to set the rotation direction of the servo motor when being moved by forward rotation commands. The rotation direction is either counter-clockwise (CCW) or clockwise (CW) as seen from the load side (side attached to the machine).  Counter-clockwise (CCW) Clockwise (CW) Set the rotation direction considering the machine specifications. In the sample system, the servo motor in each axis is set to rotate in the counter-clockwise direction (CCW) for the forward rotation command.	CCW for forward rotation command, CW for reverse command	CCW for forward rotation command, CW for reverse command
Servo forced stop selection	Turn this option ON to enable use of the forced stop input (EM2 or EM1) signal. The initial value is set to [Enabled] for safety reasons. In the sample system, the controller's forced stop signal is used and the servo forced stop signal is not used. Thus, set this option to [Disabled].	Enabled (Either forced stop input EM2 or EM1 is used.)	Disabled (Neither forced stop input EM2 nor EM1 is used.)

4.4.3 Step1 Amplifier Setting – Parameter Setting (Component parts)

Set components.
Continuing from the previous page, select [Function display]–[Common]–[Component parts], and select the Absolute position detection system and Encoder cables communications system.

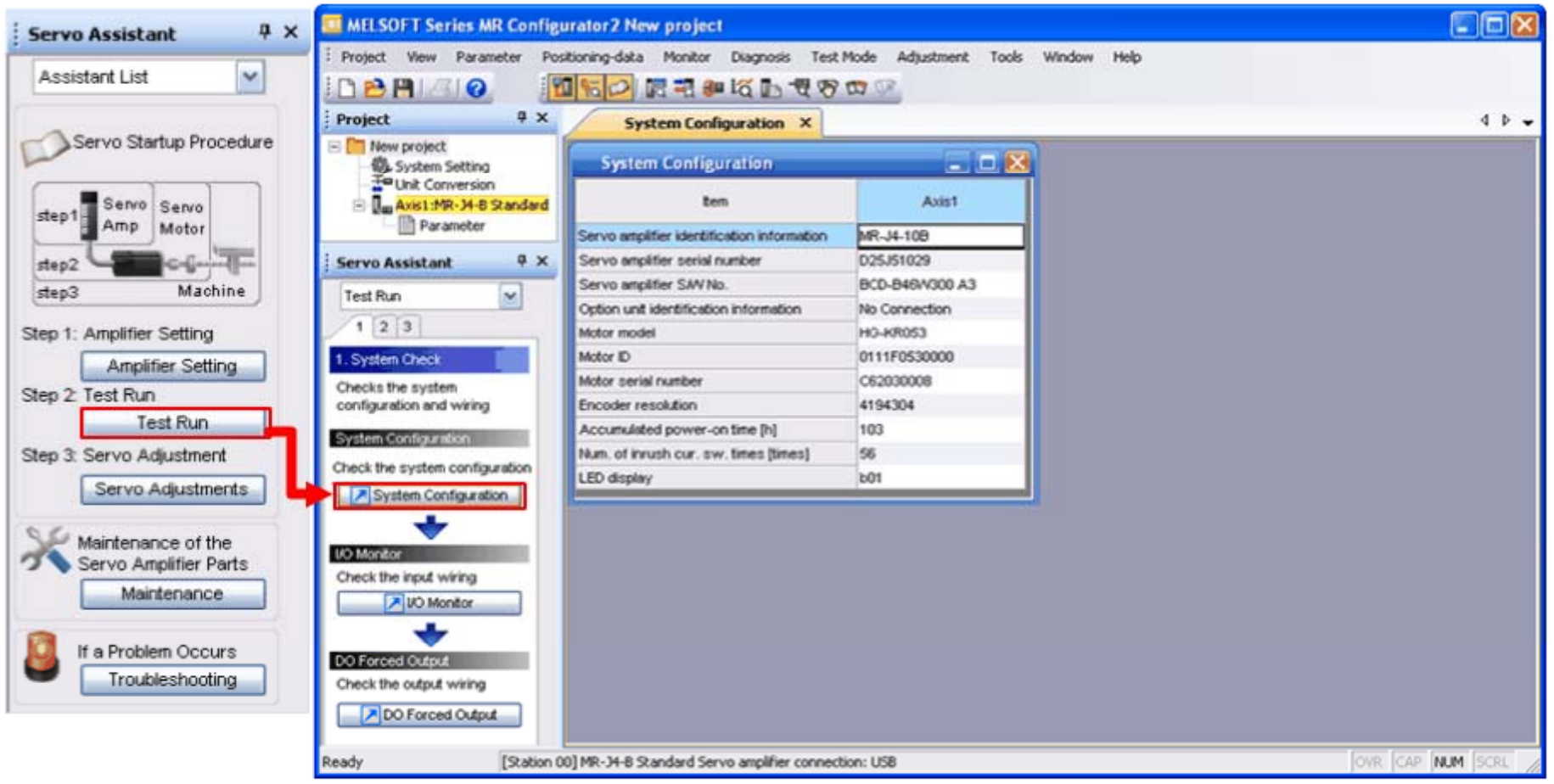


Parameter item	Function Explanation	Initial values	Setting for the Sample System
Encoder cable communication method selection	Set according to the Encoder cable communication method.	Two-wire type	Two-wire type
Selection of Absolute position detection system	When selection is enabled, a home position return is no longer needed after the power is turned back ON again because machine position data is stored and held in the Servo amplifier.	Disabled	Enabled

4.5 Adjustment

4.5.1 Step2 Test Run − System Check (System Configuration)

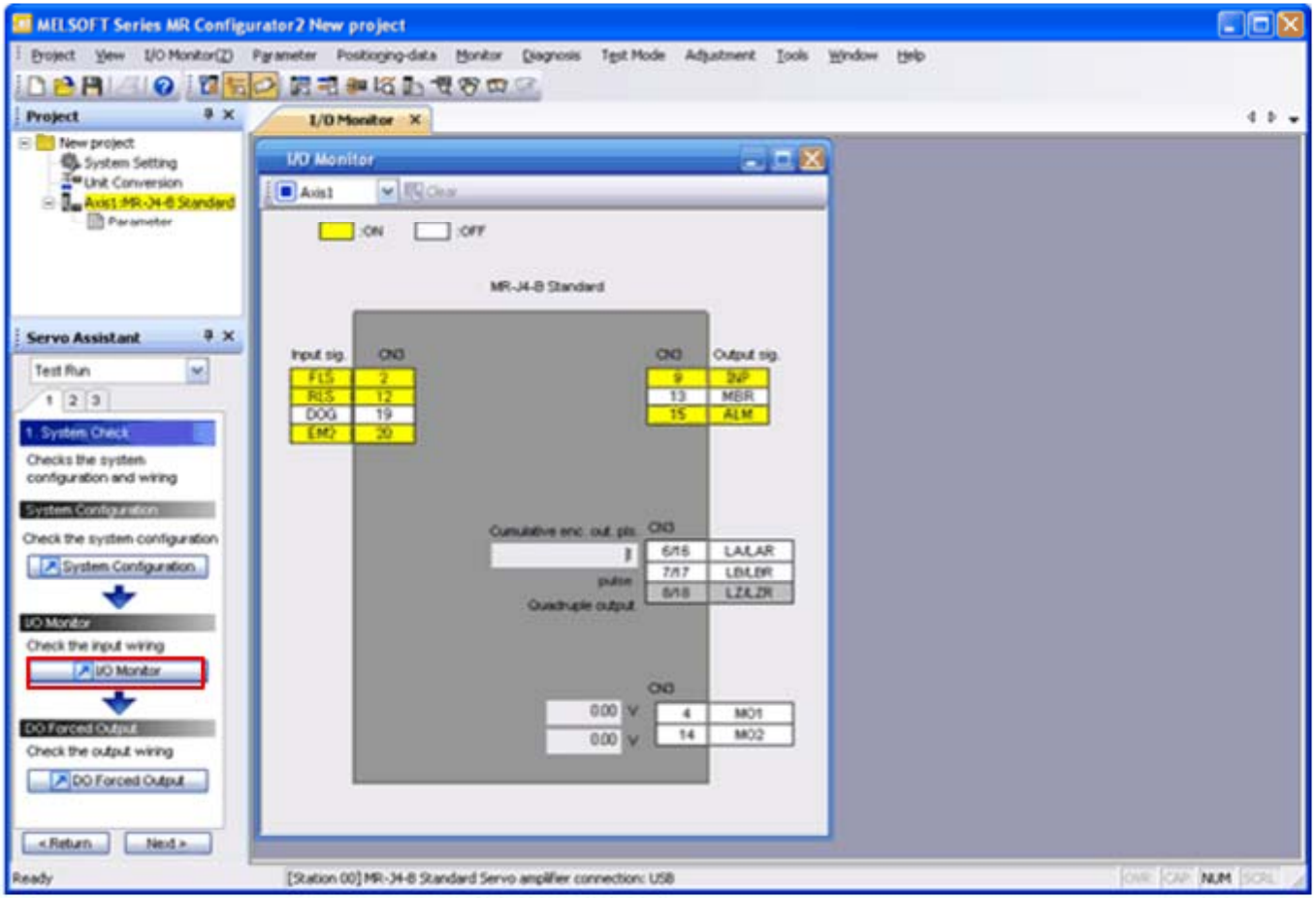
Check the system configuration.
In the servo assistant, select [Test Run]−>[System Configuration], and check the motor model, etc.



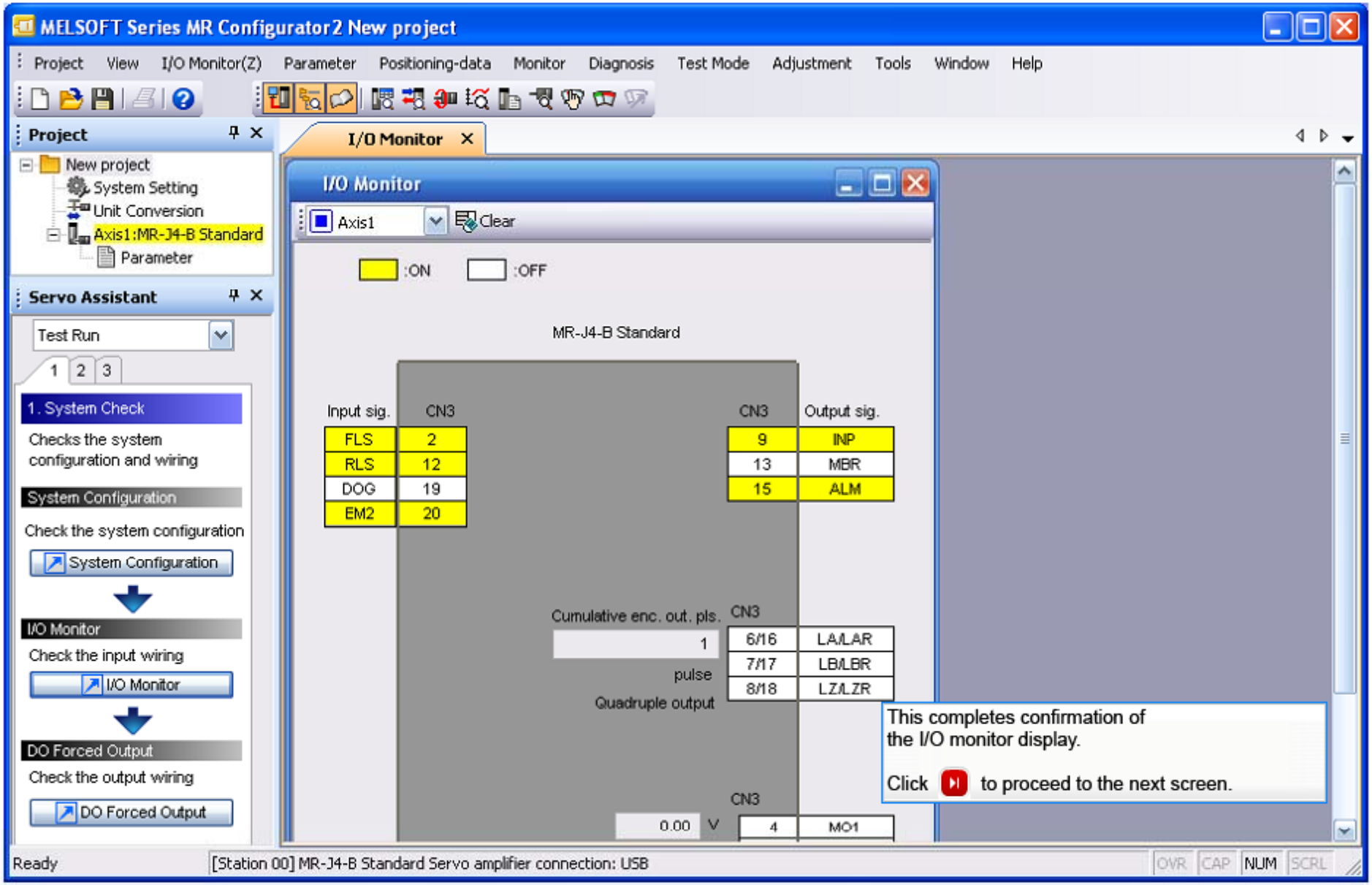
4.5.2 Step2 Test Run – System Check (I/O Monitor)

I/O signal assignments and ON/OFF status can be monitored in the I/O monitor display.

Let's try to display the I/O monitor display on the next screen.



4.5.2 Step2 Test Run – System Check (I/O Monitor)



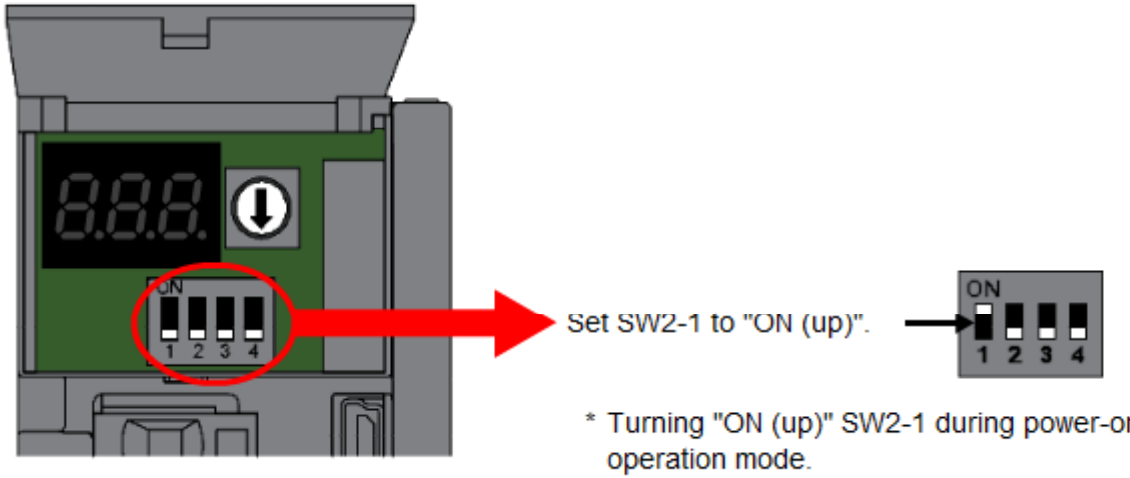
4.5.3 Test Operation Mode

Here, we will introduce the Test operation modes that are available on MR Configurator2.
This course will use "DO Forced Output" for checking wiring and "JOG Mode" and "Positioning Mode" for checking operation.

Name of Mode	Function/Role
DO (output signal) Forced Output	Output signals can be forcibly turned ON/OFF regardless of the status of the Servo motor. This mode is useful for checking signal wiring.
JOG Mode	The Servo motor can be operated in the forward and reverse directions at the desired rotation speed. This mode is suited to checking Servo motor operation and rotation direction.
Positioning Mode	The Servo motor rotates for the specified move distance at the desired rotation speed and comes to a stop. This mode is suited to checking the operation and stop precision in positioning control.

Procedure for using the Test operation mode

(1) Turn off the power.
(2) Set the Test operation select switch (SW2-1) to "ON (up)".



Set SW2-1 to "ON (up)".

* Turning "ON (up)" SW2-1 during power-on will not start the test operation mode.

4.5.3 Test Operation Mode

(3) Turn the Servo amplifier power ON.

← The decimal point flickers.

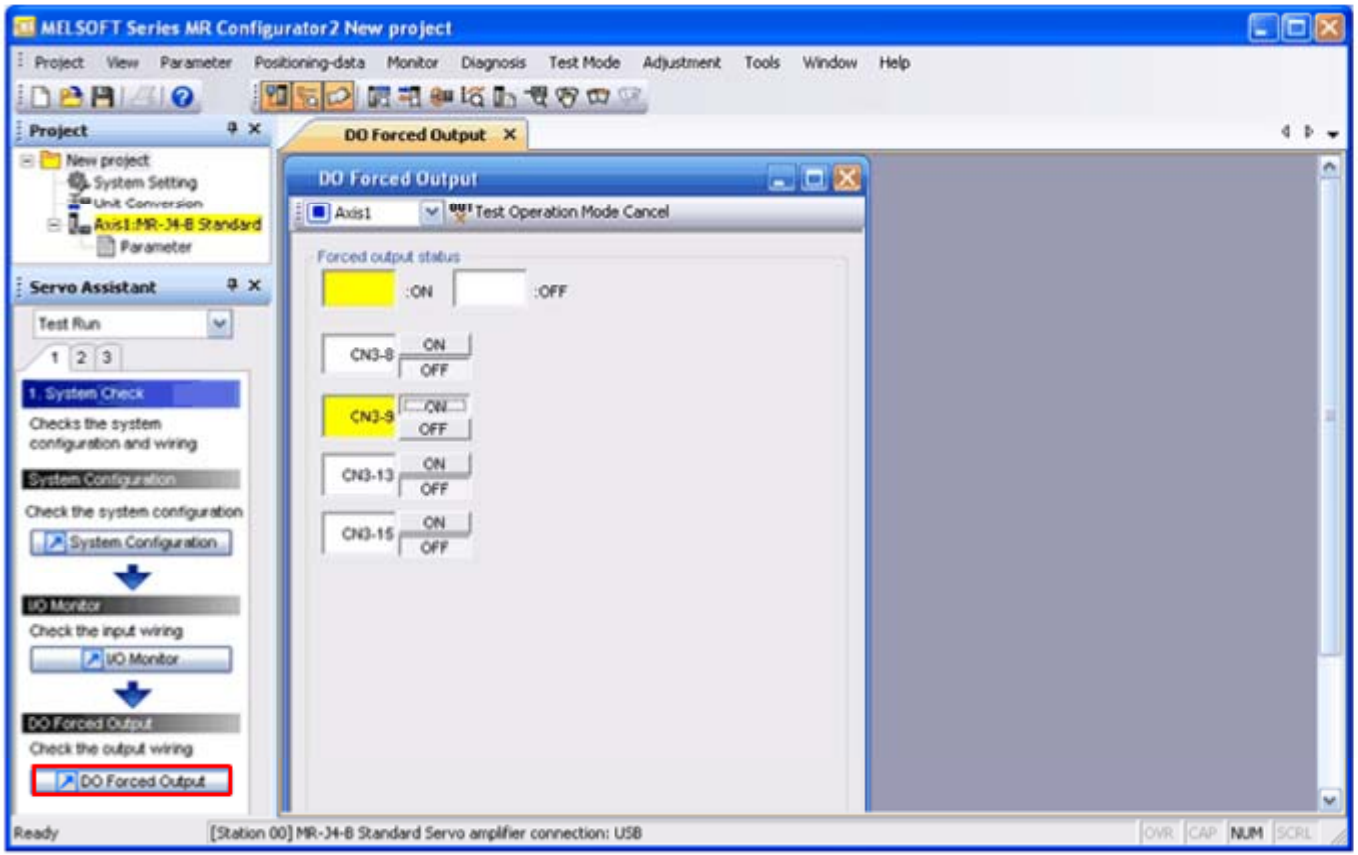
When an alarm or warning has occurred during Test operation

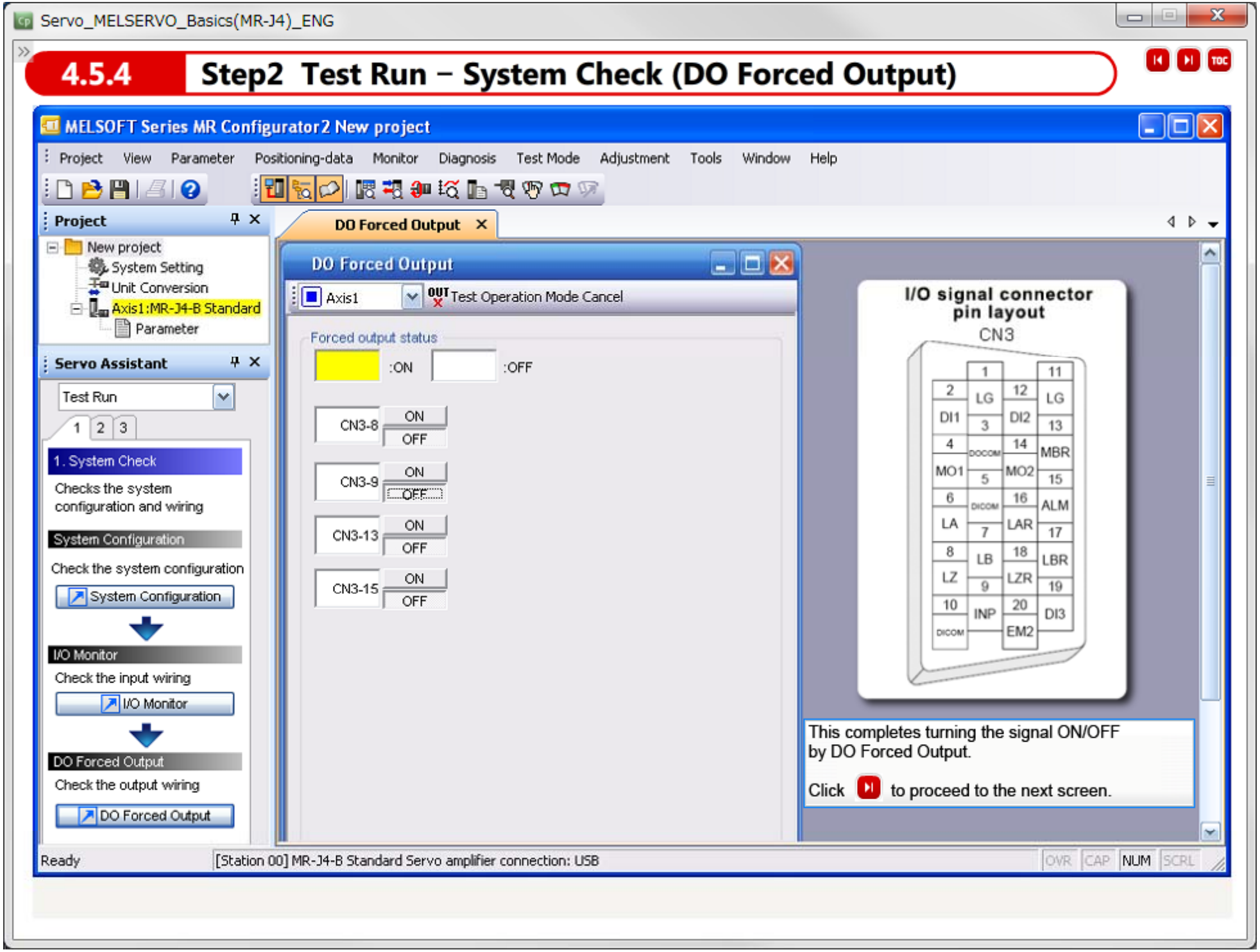
← The decimal point flickers.

4.5.4 Step2 Test Run – System Check (DO Forced Output)

Output signals can be forcibly turned ON/OFF by DO Forced Output regardless of the servo status.
This is used, for example, to check the wiring of the output signal.

Let's try to operate DO Forced Output on the next screen.




Servo_MELSERVO_Basics(MR-J4)_ENG
4.5.4 Step2 Test Run – System Check (DO Forced Output)
MELSOFT Series MR Configurator2 New project
Project View Parameter Positioning-data Monitor Diagnosis Test Mode Adjustment Tools Window Help
Project
New project
System Setting
Unit Conversion
Axis1:MR-J4-B Standard
Parameter
Servo Assistant
Test Run
1 2 3
1. System Check
Checks the system configuration and wiring
System Configuration
Check the system configuration
System Configuration
I/O Monitor
Check the input wiring
I/O Monitor
DO Forced Output
Check the output wiring
DO Forced Output
DO Forced Output
DO Forced Output
Axis1
Test Operation Mode Cancel
Forced output status
:ON
:OFF
CN3-8 ON OFF
CN3-9 ON OFF
CN3-13 ON OFF
CN3-15 ON OFF
I/O signal connector pin layout
CN3
1 11
2 LG 12 LG
DI1 3 DI2 13
4 DOCOM 14 MBR
MO1 5 MO2 15
6 DICOM 16 ALM
LA 7 LAR 17
8 LB 18 LBR
LZ 9 LZR 19
10 INP 20 DI3
DICOM EM2
This completes turning the signal ON/OFF by DO Forced Output.
Click to proceed to the next screen.
Ready
[Station 00] MR-J4-B Standard Servo amplifier connection: USB
OVR CAP NUM SCRL

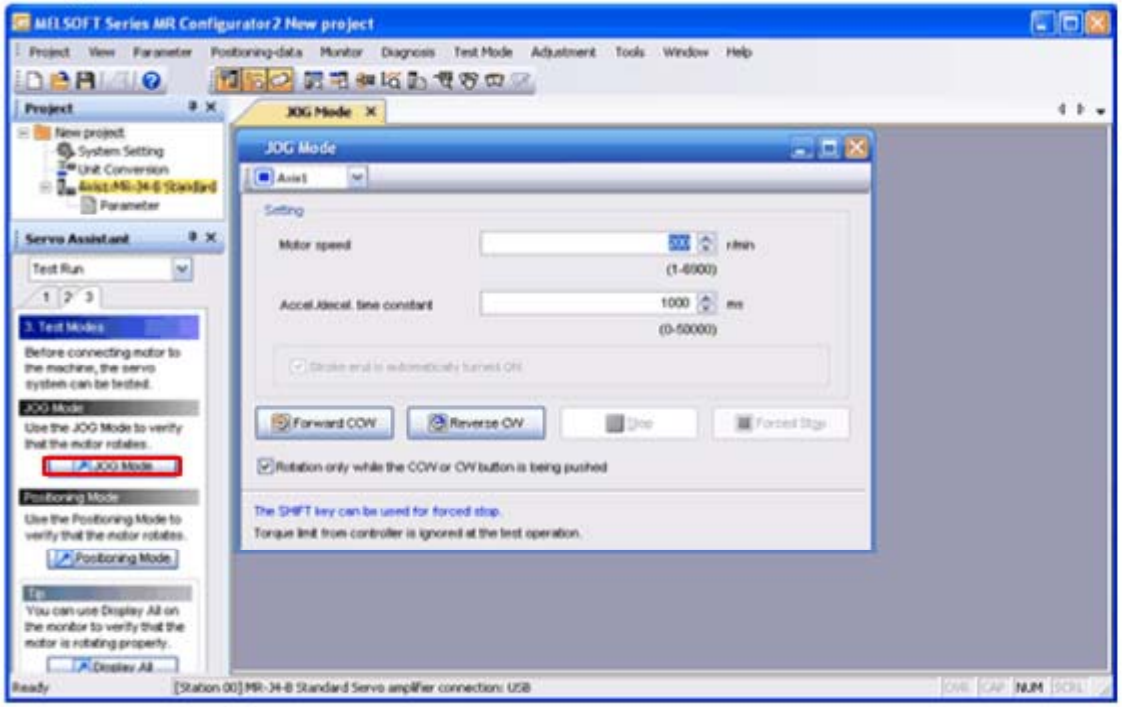
4.5.5 Step2 Test Run – Test Modes (JOG Mode)

After making sure that there are no problems in the wiring, check operation (forward rotation/reverse rotation) of the Servo system in the "JOG Mode" of the test modes.
By forward rotation, the Servo motor rotates counterclockwise, and by reverse rotation, it rotates clockwise.
* The rotation direction is as seen from the shaft side of the Servo motor.

In JOG Mode, set the following items.

Setting item	Set content	Setting Values in this Course
Motor speed	Specify the rotation speed of the Servo motor. When specifying, start with a slow speed until normal operation can be confirmed.	50 r/min
Acceleration/deceleration time constant	Specify the acceleration time until the rated rotation speed is reached from a stationary state and the deceleration time until the rotation speed comes to a stop from the rated rotation speed.	1000 ms

Let's try to perform "JOG Mode" on the next screen.



4.5.5 Step2 Test Run – Test Modes (JOG Mode)

MELSOFT Series MR Configurator2 New project

Project View Parameter Positioning-data Monitor Diagnosis Test Mode Adjustment Tools

Project
- New project
  - System Setting
  - Unit Conversion
  - Axis1:MR-J4-B Standard
    - Parameter

Servo Assistant

Test Run

1 2 3

3. Test Modes

Before connecting motor to the machine, the servo system can be tested.

JOG Mode

Use the JOG Mode to verify that the motor rotates.

JOG Mode

Positioning Mode

Use the Positioning Mode to verify that the motor rotates.

Positioning Mode

Tip:

You can use Display All on the monitor to verify that the motor is rotating properly.

Display All

JOG Mode

JOG Mode

Axis1

Setting

Motor speed

Accel./decel. time constant

Stroke end is automatically turned ON.

Forward CCW | Reverse CW | Stop | Forced Stop

Rotation only while the CCW or CW button is being pushed

The SHIFT key can be used for forced stop.

Torque limit from controller is ignored at the test operation.

<Operation image>

Jog operation is now completed.

Click to proceed to the next screen.

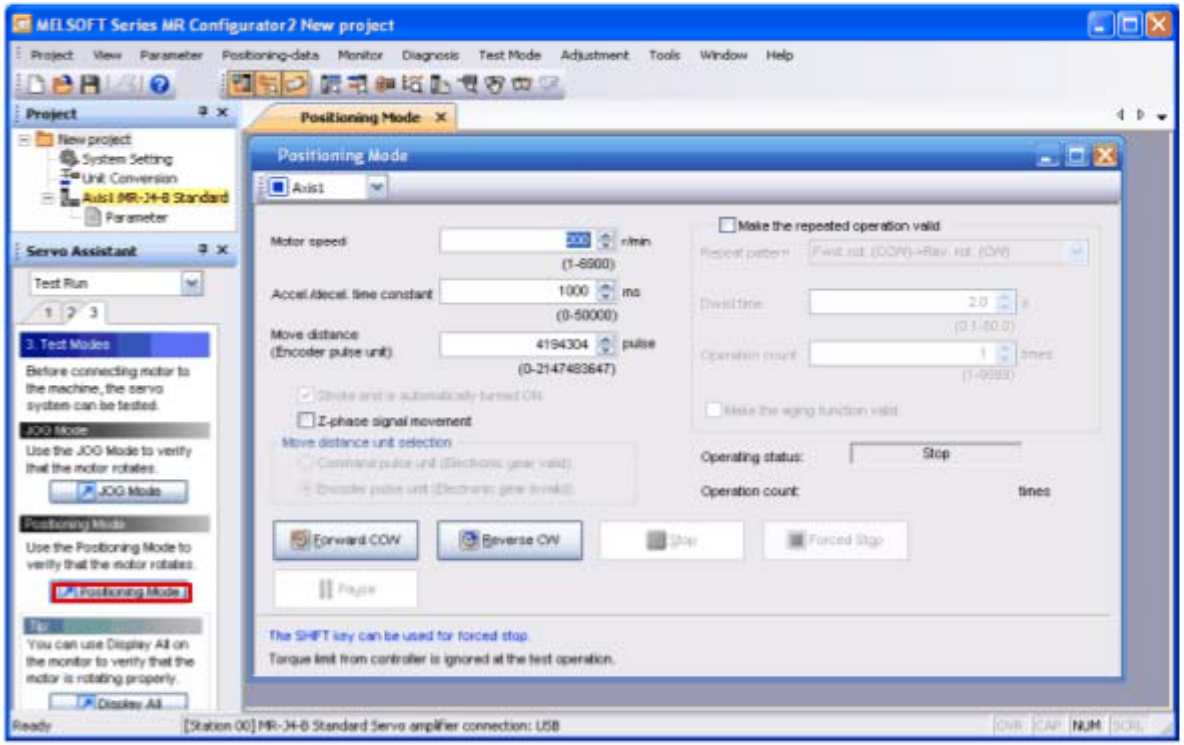
Ready [Station 00] MR-J4-B Standard Servo amplifier connection: USB OVR CAP NUM SCRL

4.5.6 Step2 Test Run – Test Modes (Positioning Mode)

Next, you check operation by "Positioning Mode".
By "Positioning Mode", you check if operation is being performed correctly at the specified speed and move distance.

Setting item	Set content	Setting Values in this Course
Motor speed	Specify the rotation speed of the Servo motor. When specifying, start with a slow speed until normal operation can be confirmed.	1000 r/min
Acceleration/deceleration time constant	Specify the acceleration time until the rated rotation speed is reached from a stationary state and the deceleration time until the rotation speed comes to a stop from the rated rotation speed.	1000 ms
Move distance	Specify the travel distance of the Servo motor.	4194304 pulse

Let's try to perform "Positioning Mode" on the next screen.



Servo_MELSERVO_Basics(MR-J4)_ENG

4.5.6 Step2 Test Run – Test Modes (Positioning Mode)

MELSOFT Series MR Configurator2 New project

Project View Parameter Positioning-data Monitor Diagnosis Test Mode Adjustment Tools

Project
- New project
  - System Setting
  - Unit Conversion
  - Axis1:MR-J4-B Standard
    - Parameter

Servo Assistant

Test Run

1 2 3

3. Test Modes

Before connecting motor to the machine, the servo system can be tested.

JOG Mode

Use the JOG Mode to verify that the motor rotates.

JOG Mode

Positioning Mode

Use the Positioning Mode to verify that the motor rotates.

Positioning Mode

Tip:
You can use Display All on the monitor to verify that the motor is rotating properly.

Display All

Positioning Mode

Positioning Mode

Axis1

Motor speed 1000 r/min (1-6900)

Accel./decel. time constant 1000 ms (0-50000)

Move distance (Encoder pulse unit) 4194304 pulse (0-2147483647)

Stroke end is automatically turned ON.

Z-phase signal movement

Move distance unit selection

Command pulse unit (Electronic gear valid)

Encoder pulse unit (Electronic gear invalid)

(1-9999)

Make the aging function valid

Operating status: Stop

Operation count: times

Forward CCW | Reverse CW | Stop | Forced Stop

Pause

The SHIFT key can be used for forced stop.

Torque limit from controller is ignored at the test operation.

Positioning operation is now completed.

Click to proceed to the next screen.

<Operation image>

Ready [Station 00] MR-J4-B Standard Servo amplifier connection: USB OVR CAP NUM SCRL

4.5.7 Remedies When Problems Are Found in Test Operation

The following shows remedies when problems are found in Test operation.

Problems in wiring

- Checking for wrong wiring or failure to wire.
- Connect or reconnect any disconnected or loose connectors.
- Replace any corroded or damaged cables with new ones.
- Redo insulation or wiring if wiring is short-circuited.

Problems in operation

- Make sure that the main circuit power supply and control circuit power supply are ON.
- If the forced stop input switch is pressed (EM1 is non-conductive), release the switch (set EM1 to a conductive state).
- If the motor does not rotate with JOG operation, check the cause by the "Reason for not operating" function under "Diagnosis", and adopt the appropriate remedy.

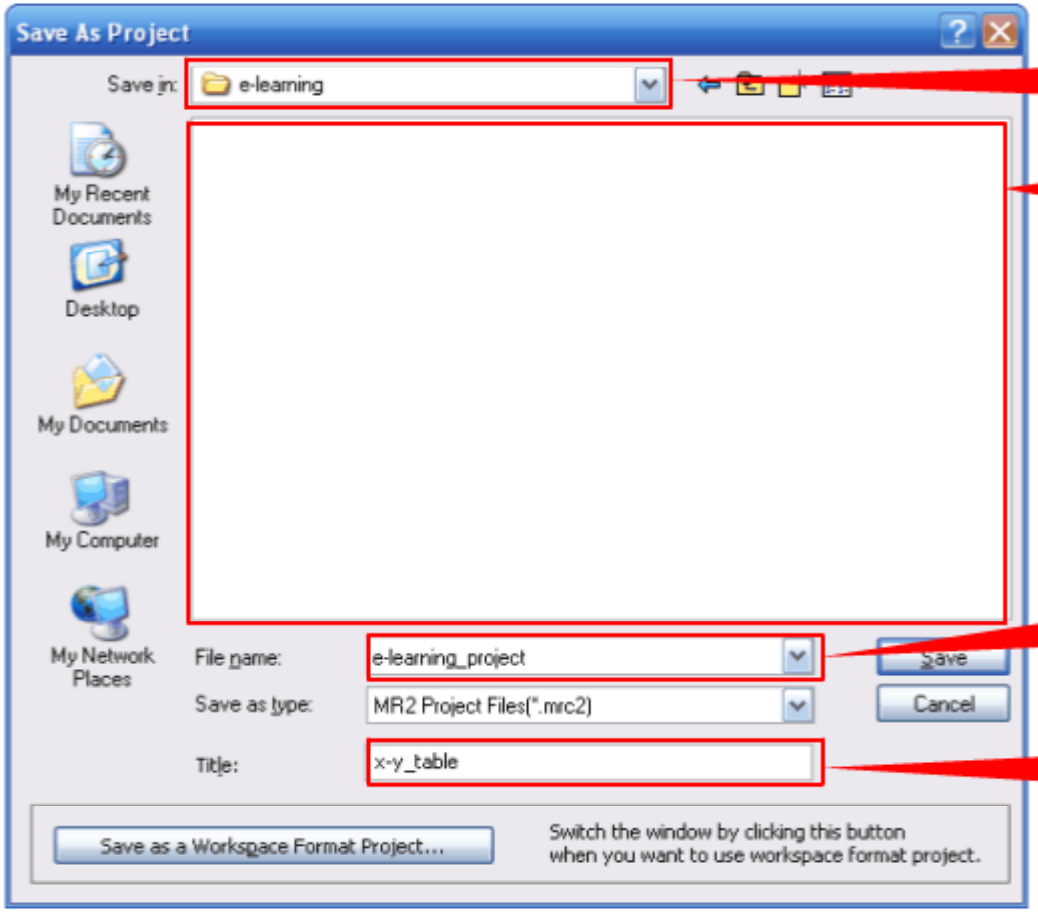
Additional info.

If the JOG operation is performed when the main power supply is OFF, the servo motor does not rotate, but it may not be displayed in the "Reason for not rotating". Additionally, in this case, the servo system ends the JOG mode with a warning. However, as this is not an alarm, it will not be stored in the alarm history.

4.6 Saving Projects

Setup is now completed.
Click the "Save" icon to save the project file.
If you exit the setup without saving the settings, the settings cannot be read when the Servo system starts up next time.

If you want to save a new project, set the file name.
It is recommended that you select a name that can be used to identify the content of the project (using the control details, system name, or other easily recognizable text).
Files are saved with the ".mrc2" file extension. (*Ver.1.19V or later)



Save folder path *Required
Specify a folder in which to create a workspace.

List of Files
If there are one or more files in the same save folder path, they are given in list form.

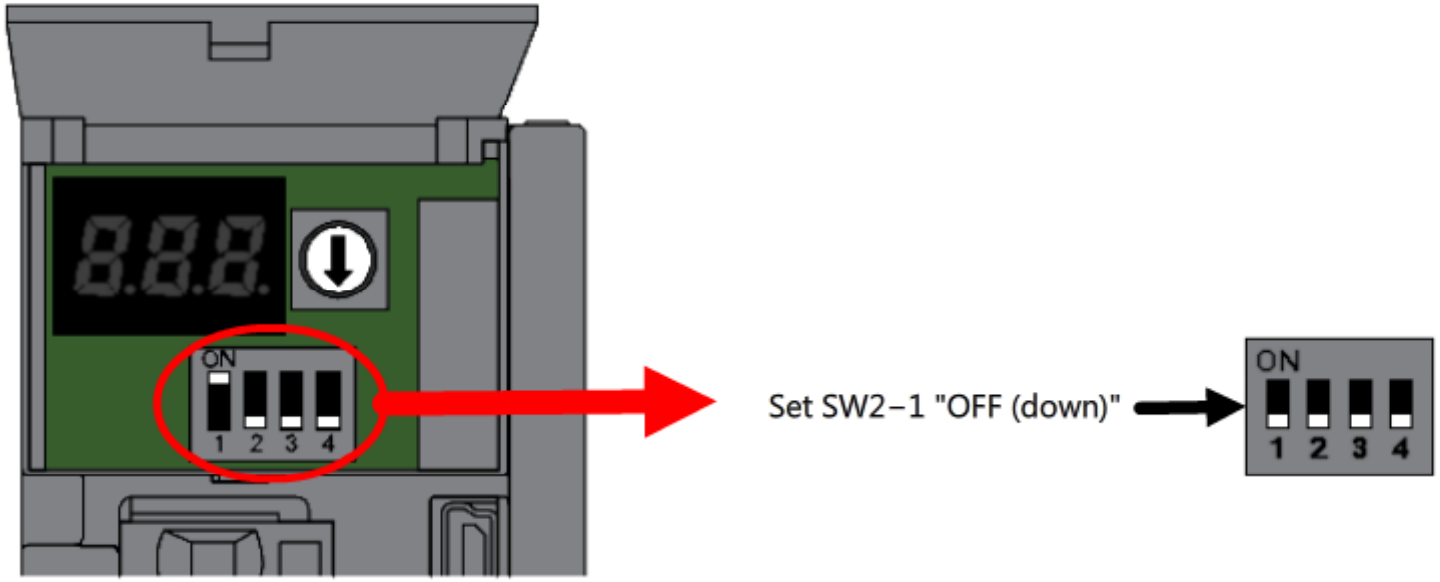
File Name *Required
Specify a file name.

Title
Specify a title.
This is useful if you would like to put a name that does not fit in the file name. (You can skip the title if you wish as it is not necessary.)

4.7 Ending Test Operation Mode

End Test operation mode.
End Test operation mode by the following procedure.

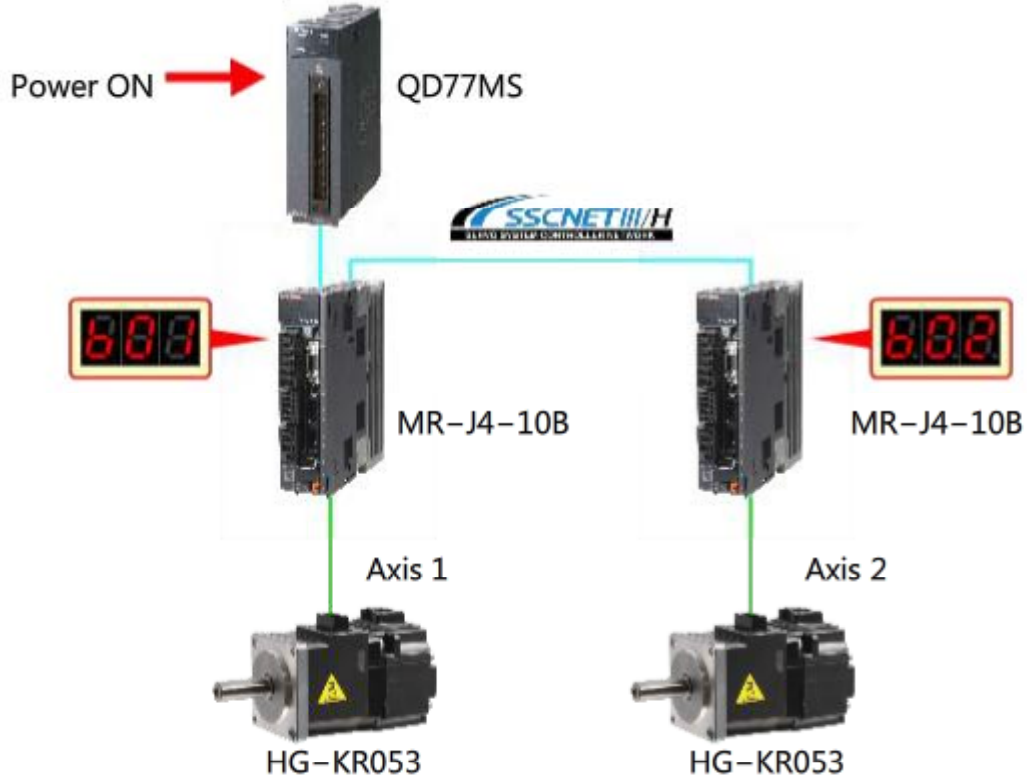
Procedure for exiting the Test operation mode
(1) Turn the Servo amplifier power OFF.
(2) Turn "OFF (down)" the Test operation select switch (SW2−1) .



(3) Turn the power ON again.

4.8 Turning the Controller Power ON

When setup and startup of the Servo amplifier are completed, connect the Servo amplifier to the controller and turn the controller power ON.
Start SSCNETIII/H communications between the controller and Servo amplifier as Initialize communication.
When Initialize communication ends normally, the "b#" (ready OFF, servo OFF) status is displayed.



To achieve a sample system, create a positioning control program for the Servo system controller.
How to use a Servo system controller can be learned by the following e-Learning course.

- "SIMPLE MOTION MODULE" course
- "SERVO MOTION CONTROLLER BASICS (HARDWARE)" course
- "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.
- "SERVO MOTION CONTROLLER APPLICATION (VIRTUAL MODE)" course.

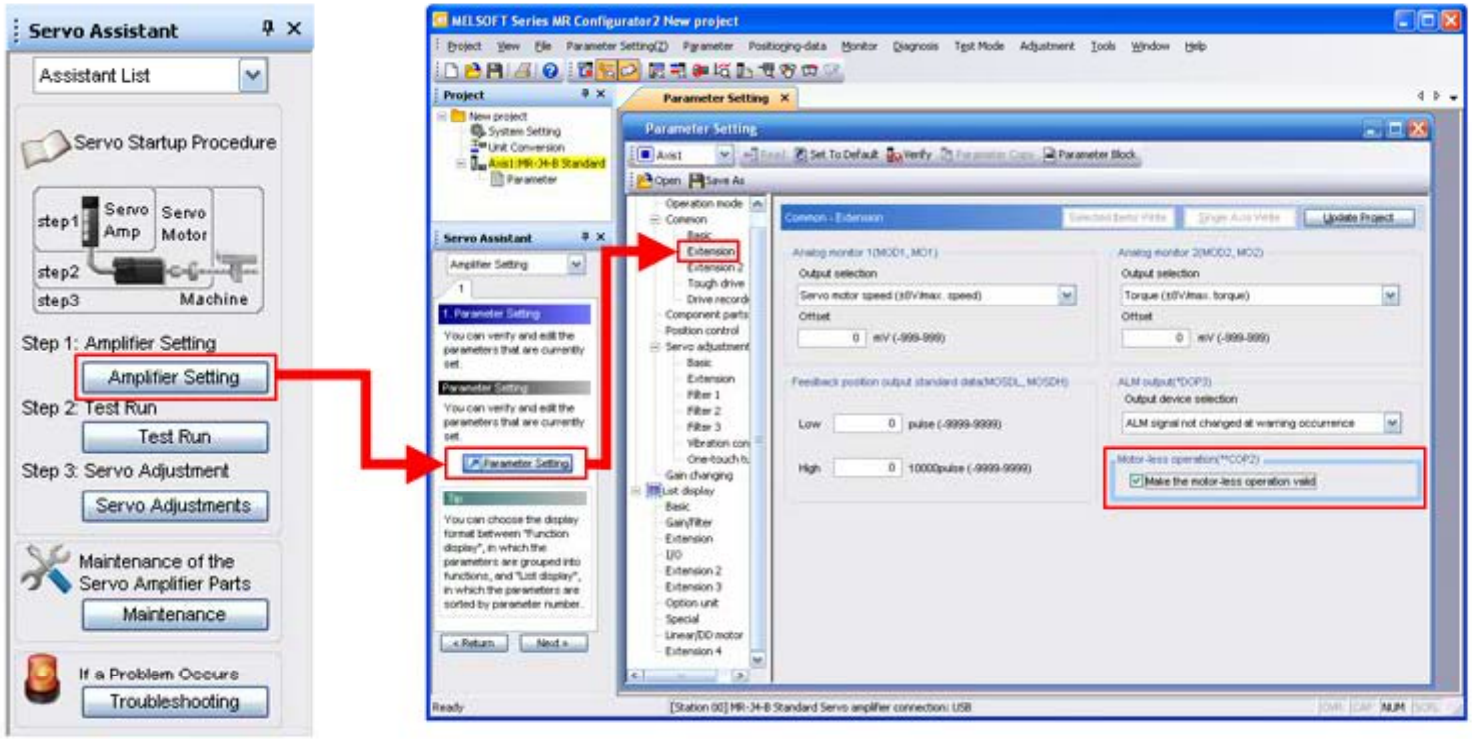
4.9 Motor-less Operation

Before installing a Servo system controller on an actual system, check that the positioning control program for the controller runs normally.
Check operation of the positioning control program by motor-less operation.
With motor-less operation, though the Servo motor is not connected, output signals can be output as if the Servo motor is running in response to commands from the Servo system controller and the Status can be displayed.

Procedure for motor-less operation

(1)Set the servo amplifier to the servo-off status.

(2)Select the "Enable motor-less operation" checkbox at the servo parameter settings for the Servo system controller, and turn the power back ON.
(When setting the Simple Motion module, use MELSOFT GX Works2.)



(3)The display shows the following screen.

4.9 Motor-less Operation

(3)The display shows the following screen.

← The decimal point flickers.

4.10 Summary

In this chapter, you have learned:

- Servo Amplifier Setup
- Creating New Projects
- Connecting the Servo Amplifier to a Personal Computer
- Amplifier Settings – Parameter Settings
- Test run – System Check
- Test run – Test Operation
- Remedies When Problems Are Found in Test Operation
- Saving Projects
- Connecting the Controller to the Servo Amplifier

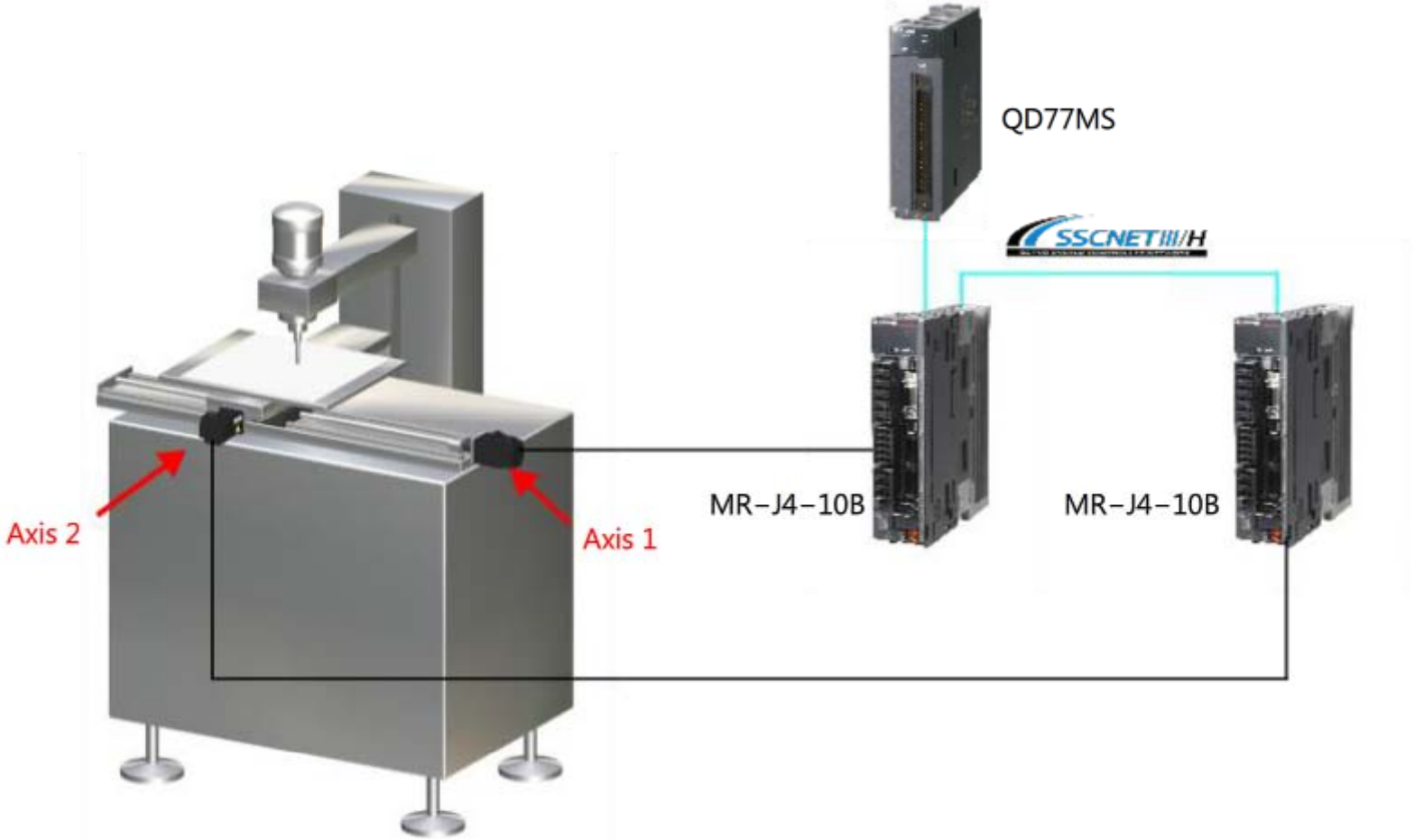
Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

Servo Amplifier Setup	• On MR Configurator2, the parameter, Test operation, advanced functions, diagnosis, monitoring and alarm functions can be operated within the GUI screens on the personal computer.
Connecting the Servo Amplifier to a Personal Computer	• Connect the Servo amplifier to a personal computer using a USB cable. • Use the "MR-J3USBCBL3M" (length: 3 m) for the USB cable.
Amplifier Settings – Parameter Settings	• Select "Operation mode", "Basic" and "Component parts" in MR Configurator2, and set the rotation direction, forced stop, and Encoder cable communication method.
Test run – System Check	• Using the "JOG Mode" and "Positioning Mode" functions of MR Configurator2, check if the motor is running normally.
Remedies When Problems Are Found in Test Operation	• When problems are found in Test operation, check the wiring and power supply, and when an alarm occurs, check the details indicated by the alarm and how to remedy the alarm in the manual, and take the appropriate remedy.
Connecting the Controller to the Servo Amplifier	• Before installing on an actual system, check for any problems in the program by motor-less operation with the Servo amplifier combined with the controller. • Use the motor-less operation with forced stop released.

Chapter 5 Adjusting/Maintaining the Servo Amplifier

In this chapter, you will learn how to check the operation in a sample system wiht the servo motors installed.



5.1 Servo Adjustment

To operate a Servo system in an optimum state, gain must be adjusted to match machine characteristics (load inertia moment ratio) and the response of the Servo system must be kept at the appropriate level.
If gain is not optimum, the following problems will occur. Try clicking the button to check operation.

Servo adjustment optimum

Response too low (gain = small):
Servo characteristics (agility) are lost

Response too high (gain = large):
Vibration, abnormal noise and overrun occur

5.1.1 Introducing One-touch Adjustment

The Advanced one-touch tuning function (simply called "one-touch tuning" from here on) allows you to easily adjust servos. With one-touch tuning, parameters for gain are automatically adjusted.

The one-touch tuning is available in three modes according to the rigidity of the machine.
The default response mode is "Basic mode (AT.)". First, make adjustments in the Basic mode (AT.).
If satisfactory results cannot be obtained by the Basic mode (AT.), adjust by either the Low or High mode to match the response and machine rigidity.
The table below shows the response and machine rigidity suited to each mode.

Response mode	Explanation
High mode	For machines with high rigidity
Basic mode	For standard machines
Low mode	For machines with low rigidity

After adjustment, the adjustment result can be verified by Settling time or overshoot amount.
If the adjustment result by one-touch adjustment is unsatisfactory, adjustment can also be performed manually using tuning functions.

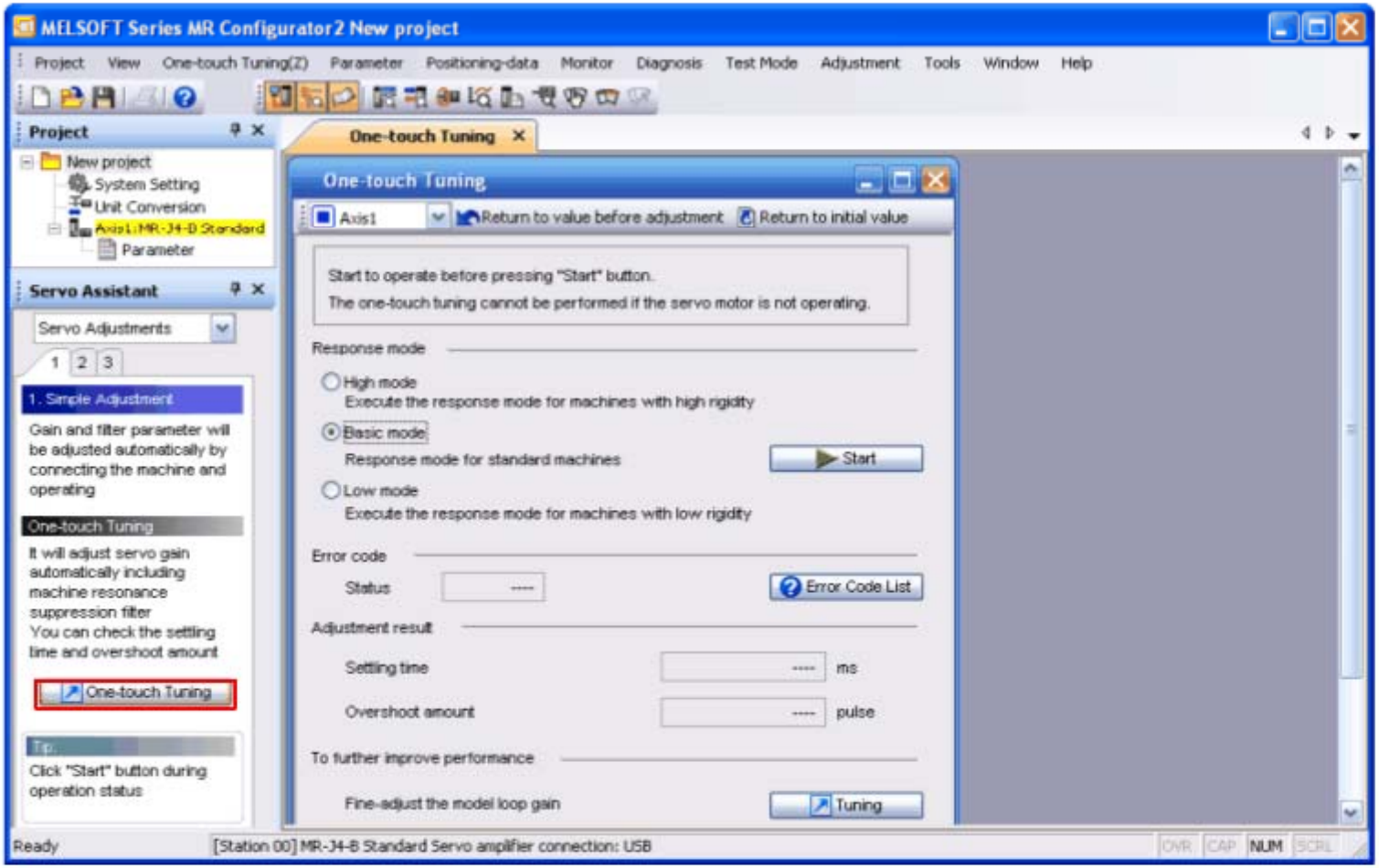
What is "Settling time?"
Settling time is the time interval from when the command pulse is outputted to when the in-position signal (INP) turns on after the servo amplifier outputs the droop pulses.
The shorter the Settling time, the higher the response of the Servo system becomes.

Cautions
(1) The one-touch tuning is not available in the torque control mode.
(2) The one-touch tuning is not available during an alarm or a warning which does not allow the operation to continue.
(3) The one-touch tuning is not available during the following test operation mode.
    (a) Output signal (DO) forced output
    (b) Motor-less operation

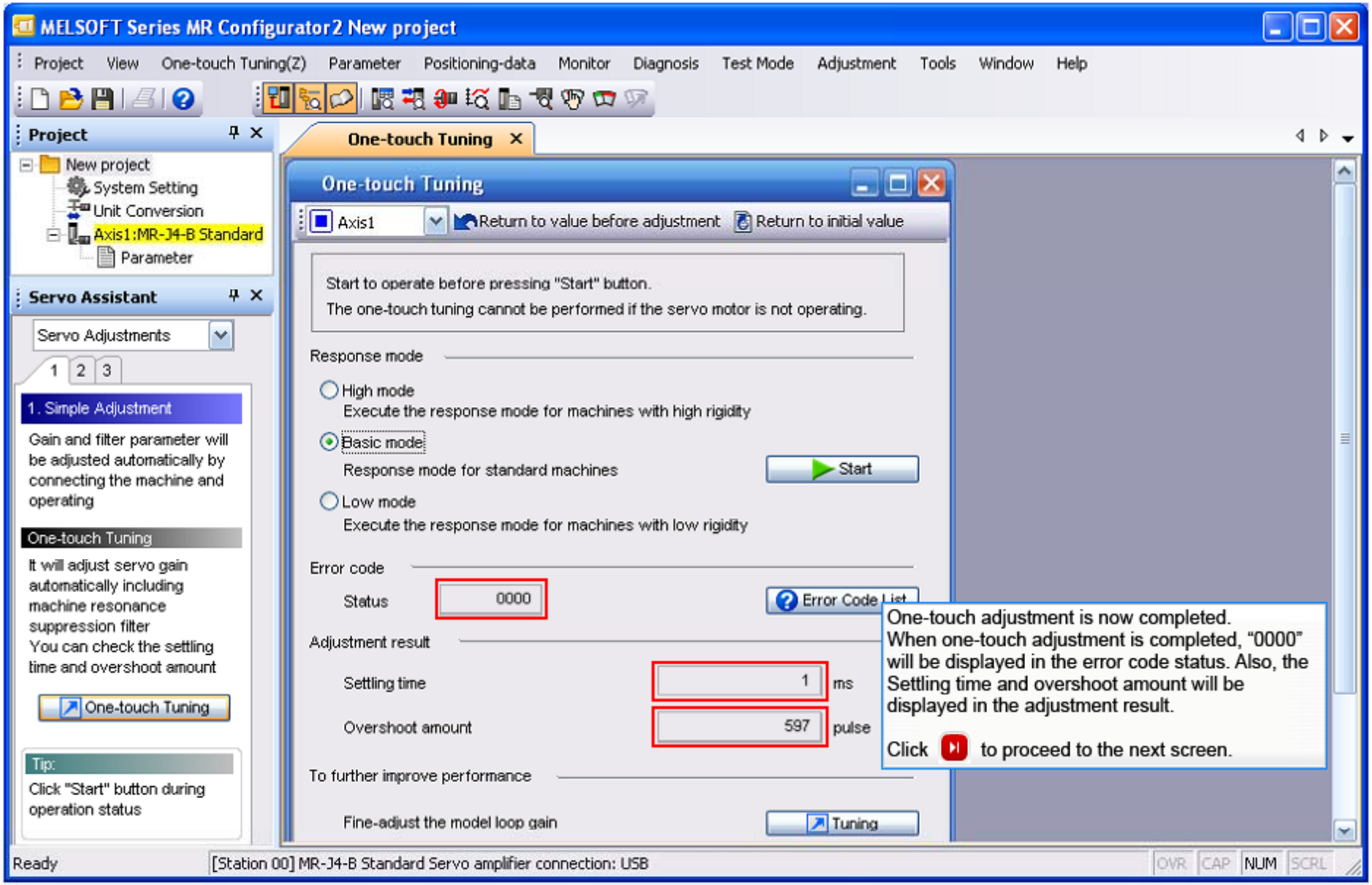
5.1.2 One-touch tuning on the Sample System

Perform one-touch tuning on the sample system.

Let's try to perform one-touch tuning of the sample system on the next screen.



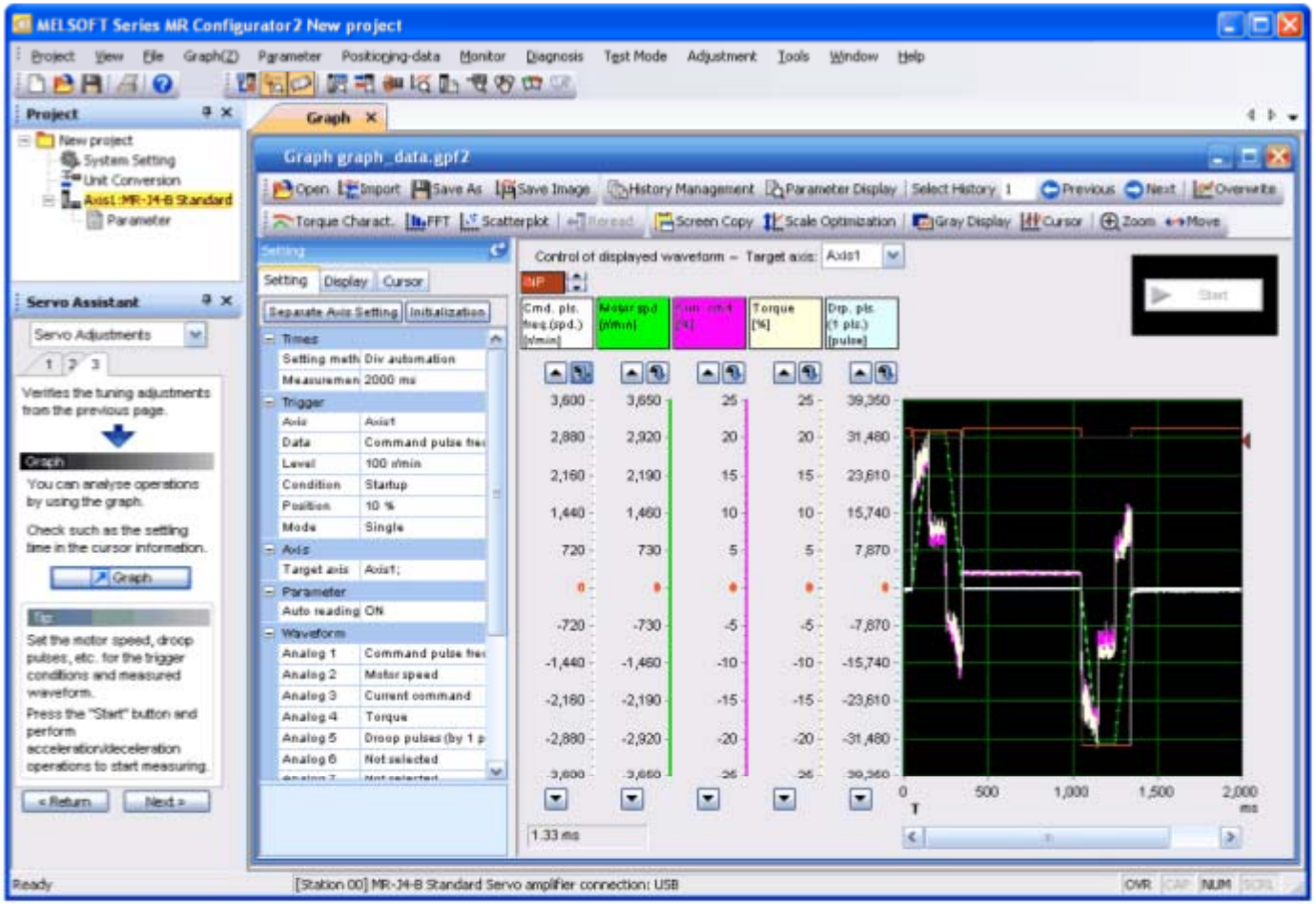
5.1.2 One-touch tuning on the Sample System



5.2 Graph Function

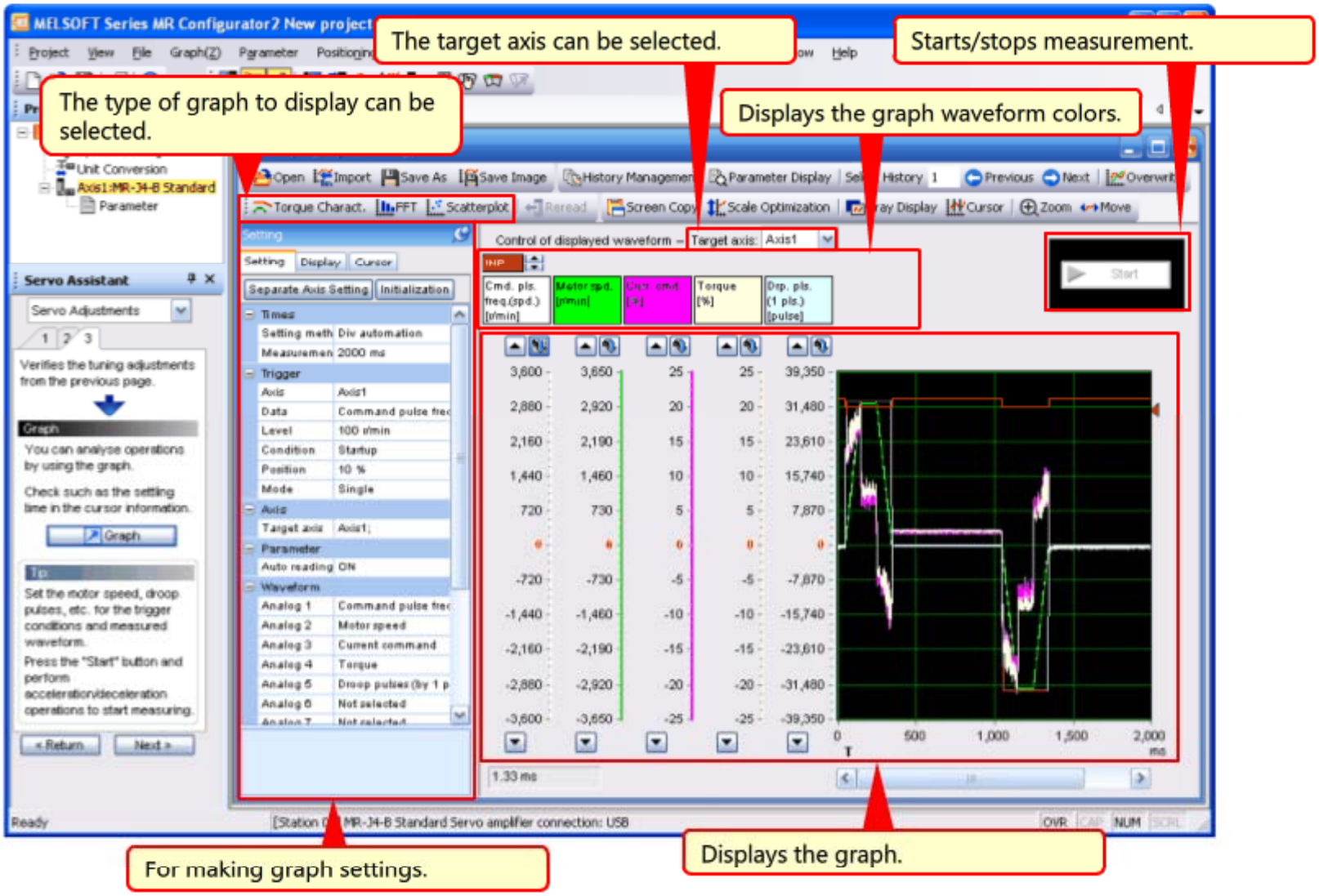
The graph function enables the waveforms of analog and digital servo data to be easily measured.
The MR Configurator2 graph function has the following features:

- Measurement channels can be expanded to 7 analog channels and 8 digital channels.
- "Select History" for displaying a history of past data as a graph
- "Overwrite" of graph data
- Torque characteristic diagram (ST characteristics)
- FFT display/scatter diagram, etc.



5.2.1 Explanation of Graph Function Screen

The following describes the various elements of the graph function screen.



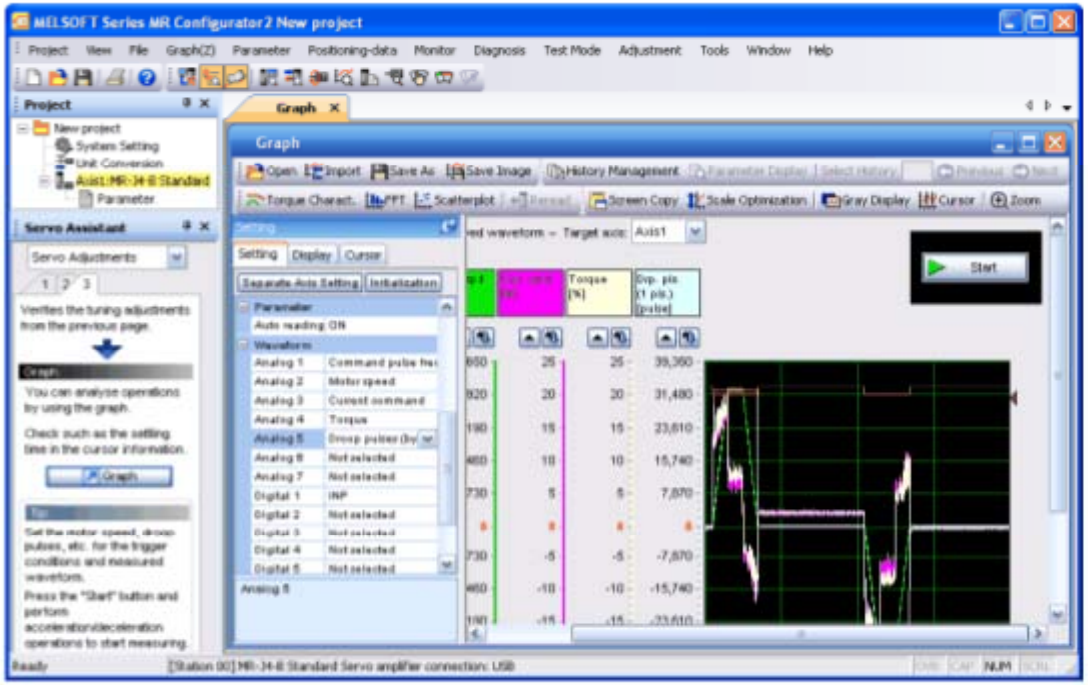
5.2.2 Graph Functions in the Sample System

Graph functions are used for performing measurement on the sample system. The following items are measured.

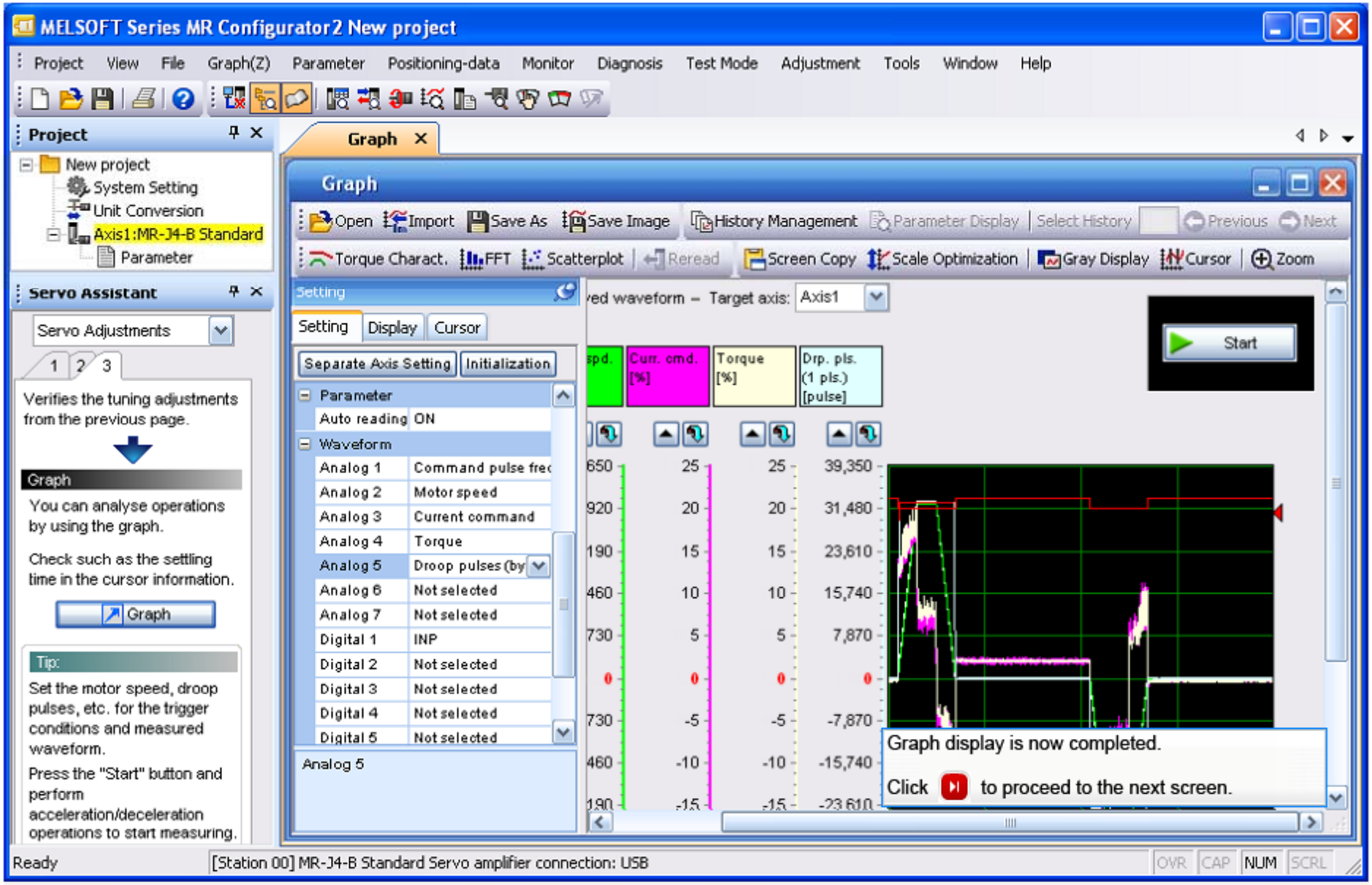
Item to measure

Times	Setting method	Div automation
	Measurement time	2000 ms
Trigger	Data	Command pulse frequency (by speed)
Waveform	Analog 1	Command pulse frequency (by speed)
	Analog 2	Motor speed
	Analog 3	Current command
	Analog 4	Torque
	Analog 5	Droop pulses (by 1 pulse)

Let's try to perform graph functions on the next screen.



5.2.2 Graph Functions in the Sample System



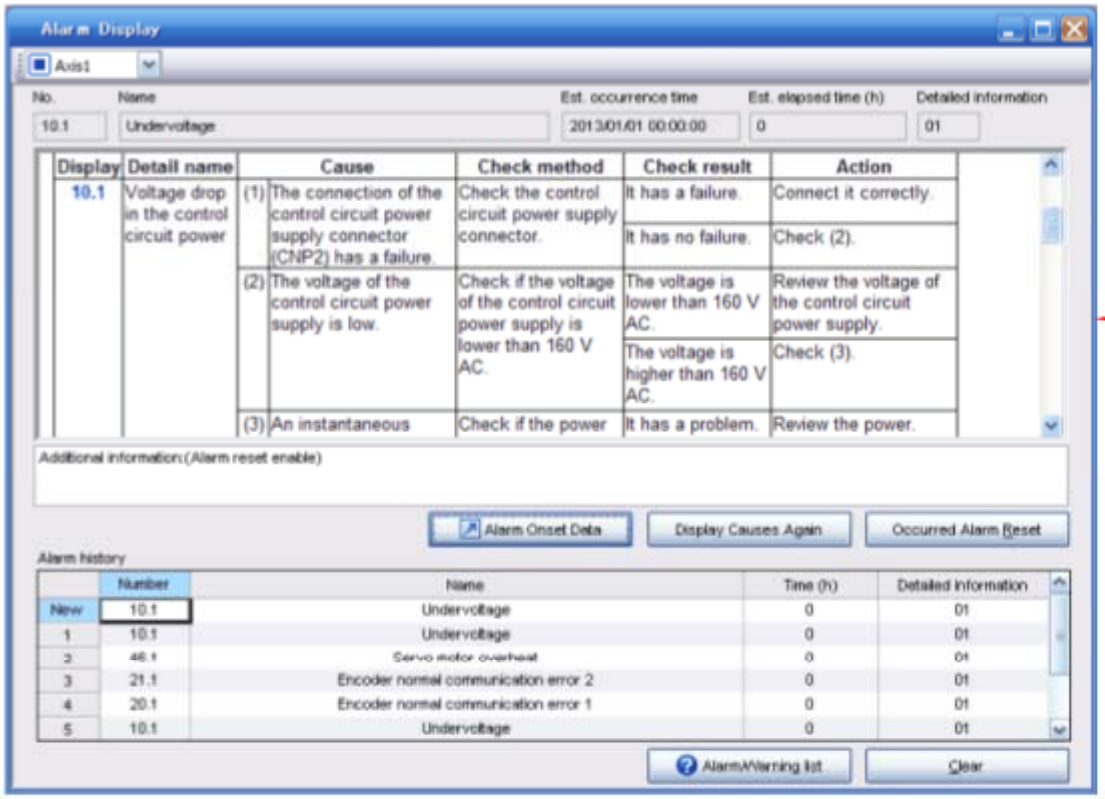
5.3 Troubleshooting – Alarm Display

In MR-J4 series, servo alarms are displayed in 3 digits.
Troubleshooting at alarm occurrence is easy.

Alarm No. (2 digits) Alarm detail (1 digit)

When an alarm occurs, the alarm number (two digits) and the alarm detail (one digit) are displayed in turns with the status display.

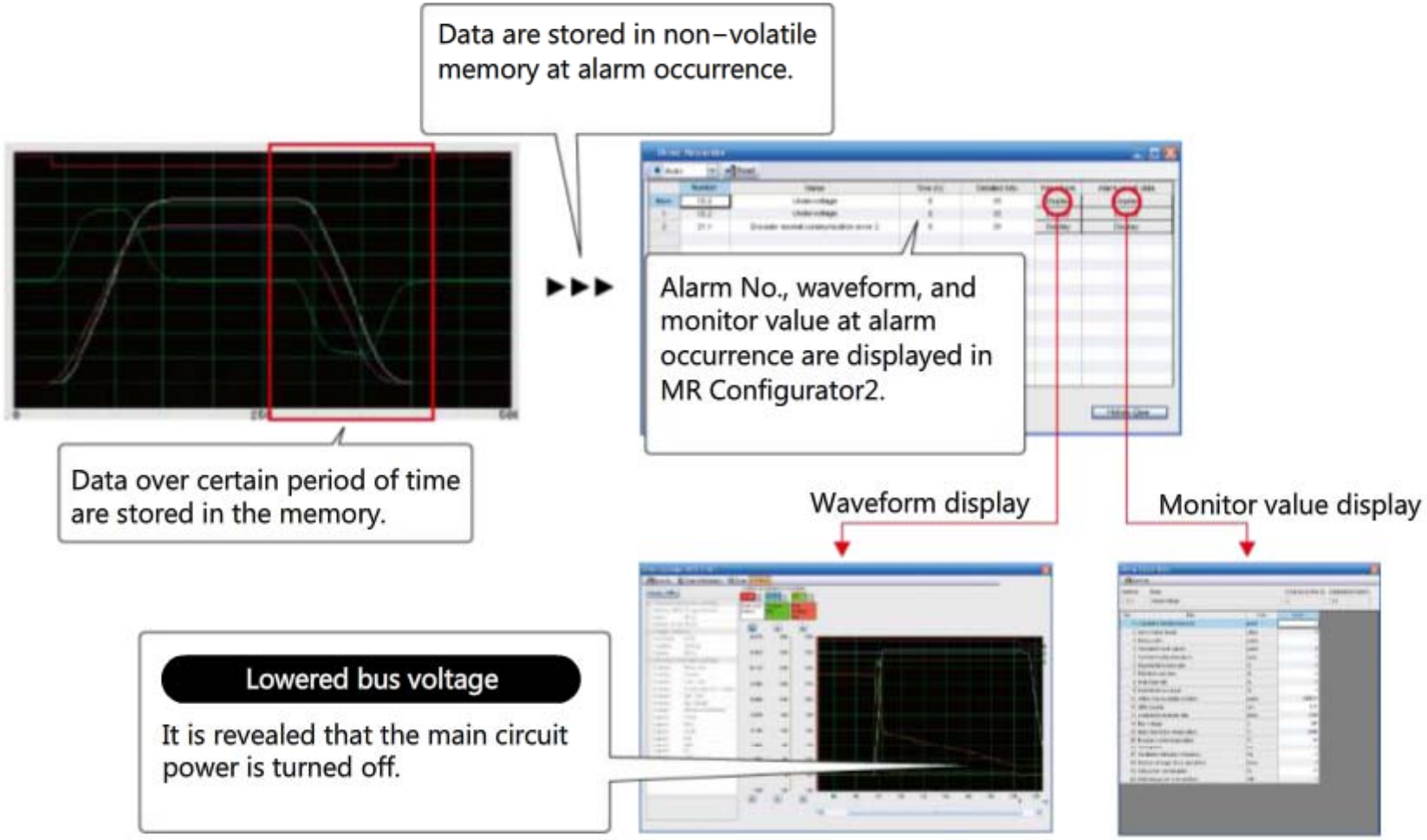
Example of an alarm window



For the undervoltage alarm, whether the alarm occurred in the main or the control circuit is identified by the alarm No.

5.4 Troubleshooting − Large Capacity Drive Recorder

The cause of errors that occur can be investigated quickly and reliably by the Large capacity drive recorder.
The Large capacity drive recorder saves servo data (e.g. Motor current, Position commands) before and after alarm occurrence to non−volatile memory on the Servo amplifier.
At recovery from an alarm, the data can be used for analyzing the cause of the alarm by reading the data on MR Configurator2.
Check the waveform ((analog 16 bits × 7 channels + digital 8 channels) × 256 points) of 16 alarms in the alarm history and the monitor value.

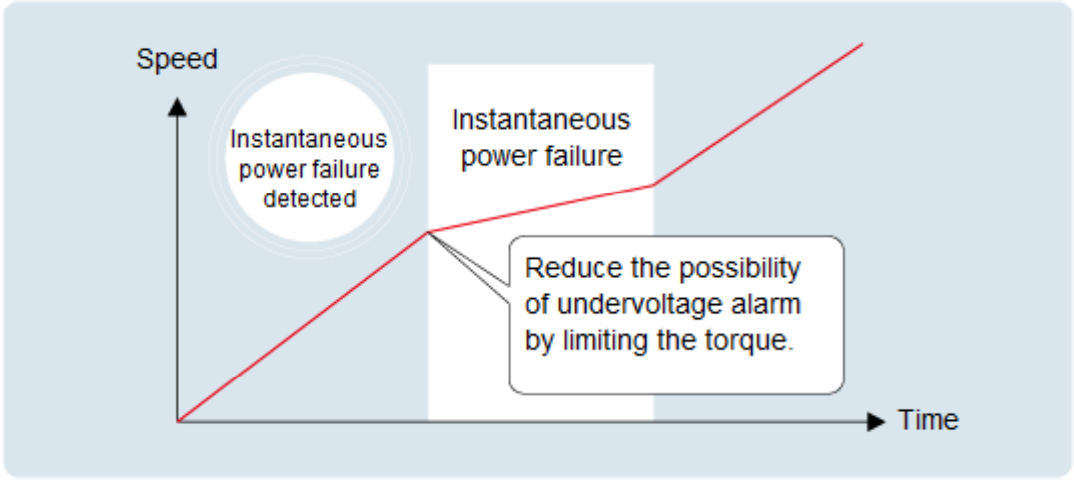


5.5 Tough Drive Function

The tough drive function detects fluctuations in the operating environment to automatically adjust the control state of the servos so that losses caused by line stoppage can be reduced.
The tough drive function has two modes, "Instantaneous power failure tough drive" and "Vibration tough drive."

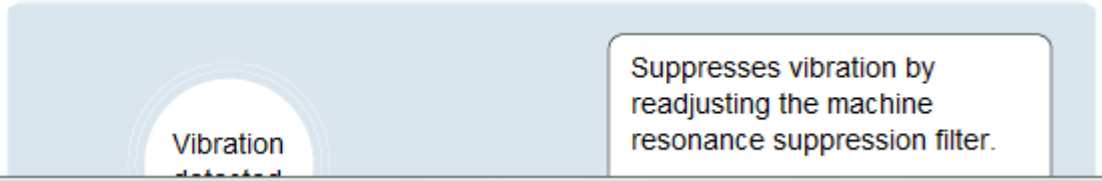
Instantaneous power failure tough drive

The possibility of undervoltage alarm is reduced by limiting the torque when instantaneous power failure is detected in the main circuit power supply.
(During an instantaneous power failure, the power charged to the main circuit capacitor is used.)

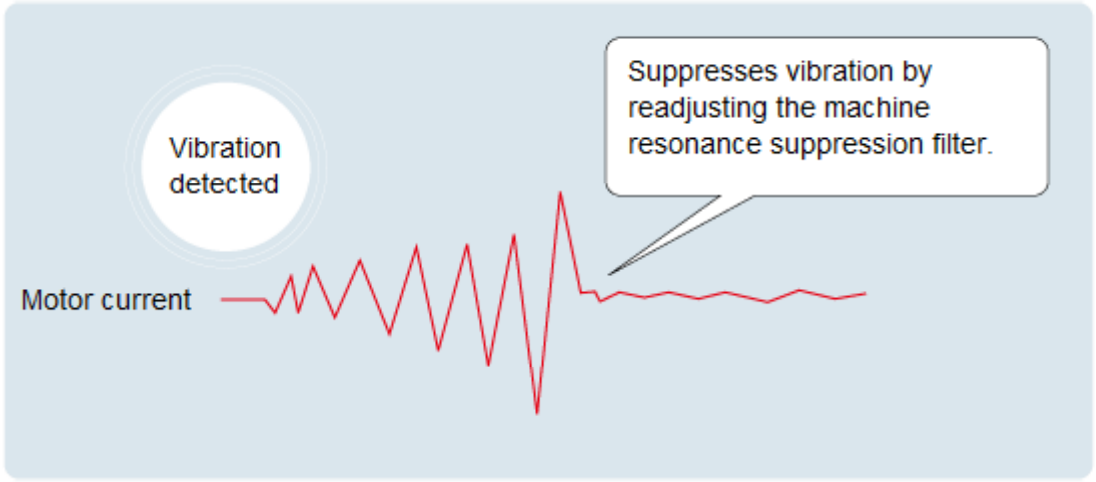


Vibration tough drive

Machine resonance suppression filter is readjusted when vibration caused by a change in machine resonance frequency is detected by the current command inside the servo amplifier. Losses from the machine stop due to age-related deterioration is reduced.



5.5 Tough Drive Function



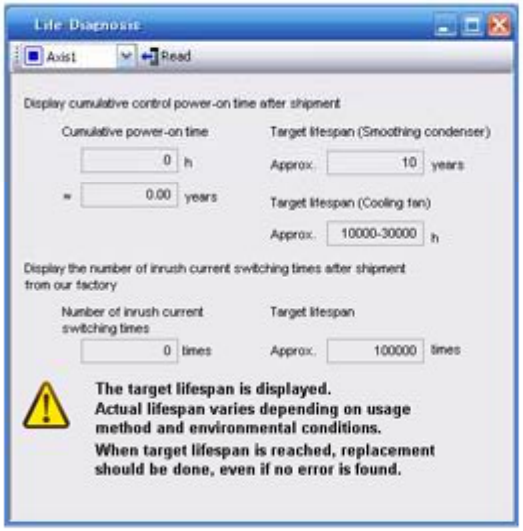
5.6 Maintenance

Diagnosis functions of MR Configurator2 allow maintenance to be performed at an early stage.
"Life Diagnosis" and "Machine Diagnosis" are available.

Life diagnosis function

Check cumulative operation time and on/off times of inrush relay.
This function provides an indication of replacement time for servo amplifier parts such as capacitor and relays.

- For the capacitor and fan, the energization time is displayed as a guideline for replacement.
- For relays, the ON/OFF counts are displayed as a guideline for replacement.

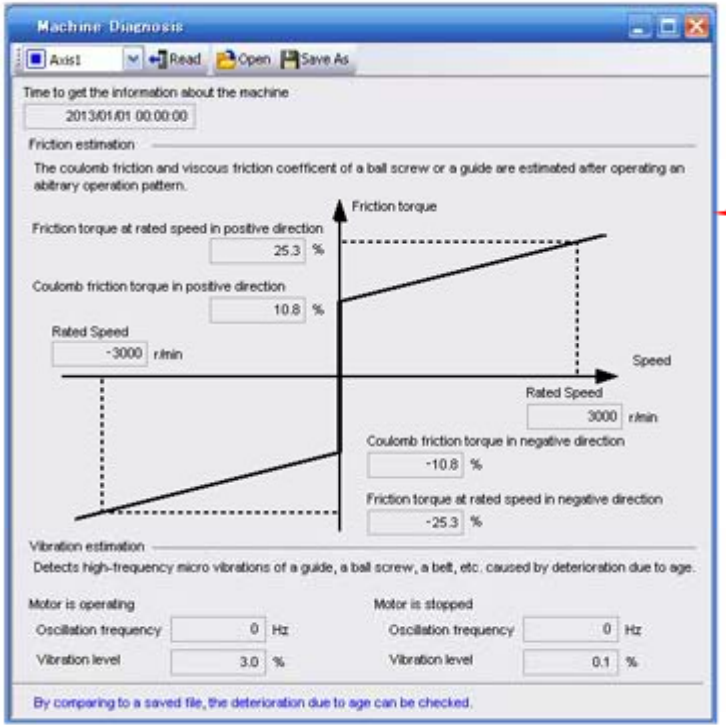


Support the preventive maintenance of the servo amplifier.

Machine diagnosis

Equipment friction, load inertia moment, unbalanced torque, and change in vibration components are analyzed from the internal data on the Servo amplifier
so that changes in machine components (e.g. ballscrews, guides, bearing, belts) can be detected. This helps the timely maintenance of drives.
Comparing the data of the first operation and after years of operation helps to find out the aging deterioration of a machine and is beneficial for preventive maintenance. This function estimates and displays machine friction and vibration in normal operation without any special measurement.

5.6 Maintenance



Prevent machine failure with advanced preventive maintenance beforehand.

5.7 Summary

In this chapter, you have learned:

- Servo adjustment
- One-touch Adjustment
- Graph function
- Troubleshooting
- Tough drive function
- Maintenance

Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

One-touch Adjustment	• Servos can be adjusted easily in three response modes: "High mode," "Basic mode" and "Low mode."
Graph function	• Servo operation can be verified by history management, overwrite, torque characteristic diagram (ST characteristics), FFT display, scatterplot, and other functions.
Troubleshooting	• Quickly and reliably investigating the cause of alarms when they occur, and displaying the servo alarm as three digits makes troubleshooting easier when an alarm occurs.
Tough drive function	• Fluctuations in the operating environment are detected to automatically adjust the control state of the servo. • Losses caused by line stoppage are reduced.

Chapter 6 Safety Observation Functions and Energy Saving

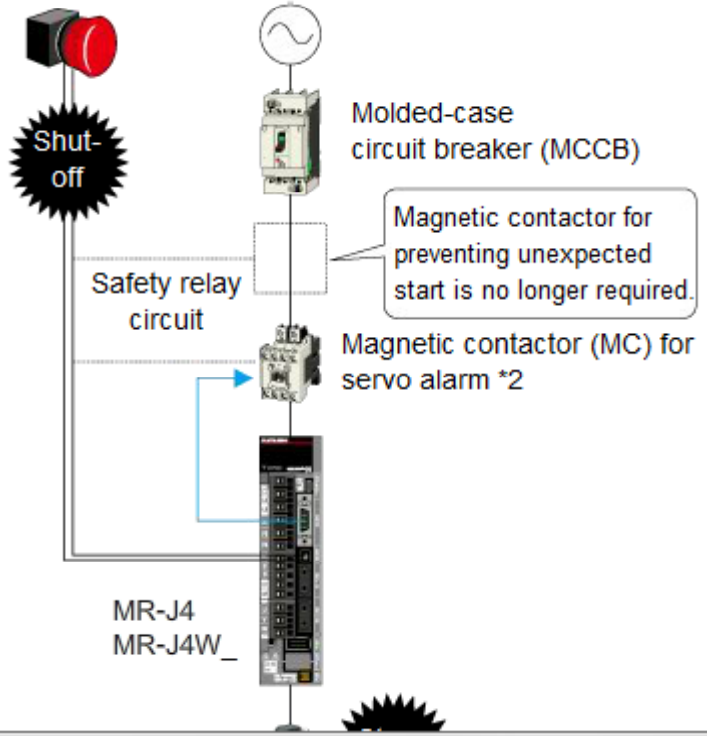
The MR−J4 series is equipped with Safety observation functions.
It also minimizes waste such as energy consumption, installation space and wiring.

6.1 STO/SS1 Compatibility

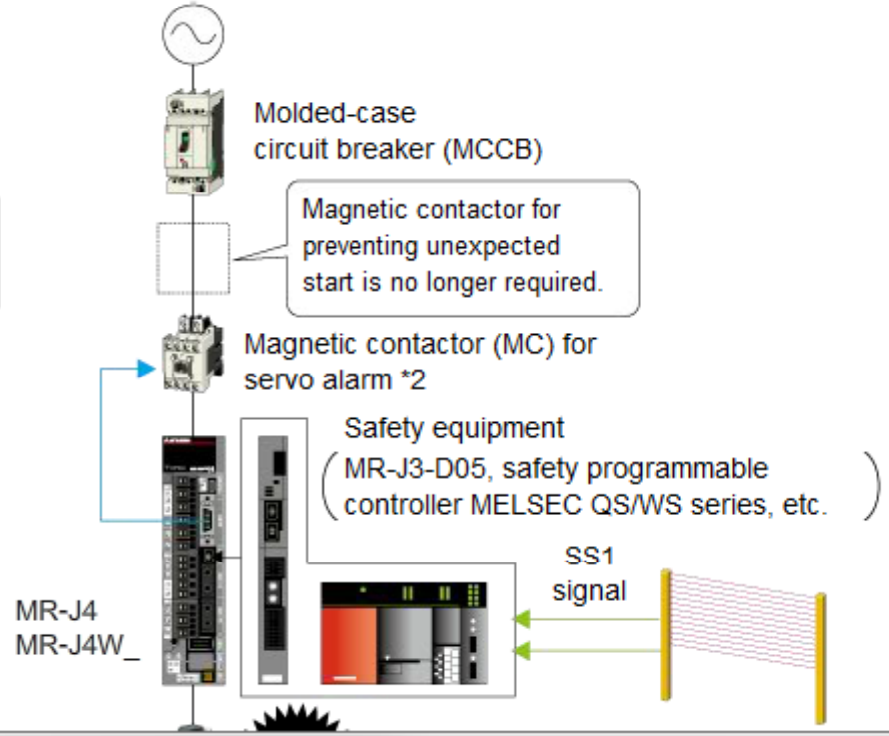
The MR−J4 series supports STO (Safe torque off) and SS1*1 (Safe stop 1) as standard, which allows a safety system of equipment to be easily configured. (SIL 2)

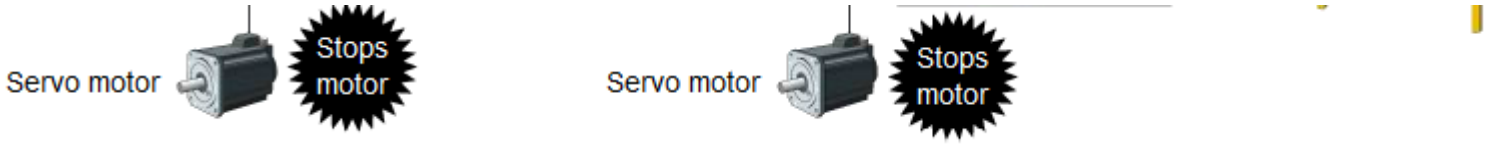
- The restart time can be shortened since the Servo amplifier power does not need to be turned OFF.
- Magnetic contactor for preventing unexpected motor start is not required.*2

[Shut-off by STO function]



[Shut-off by STO and SS1 functions]





*1. Safety equipment (MR-J3-D05, etc.) is required.

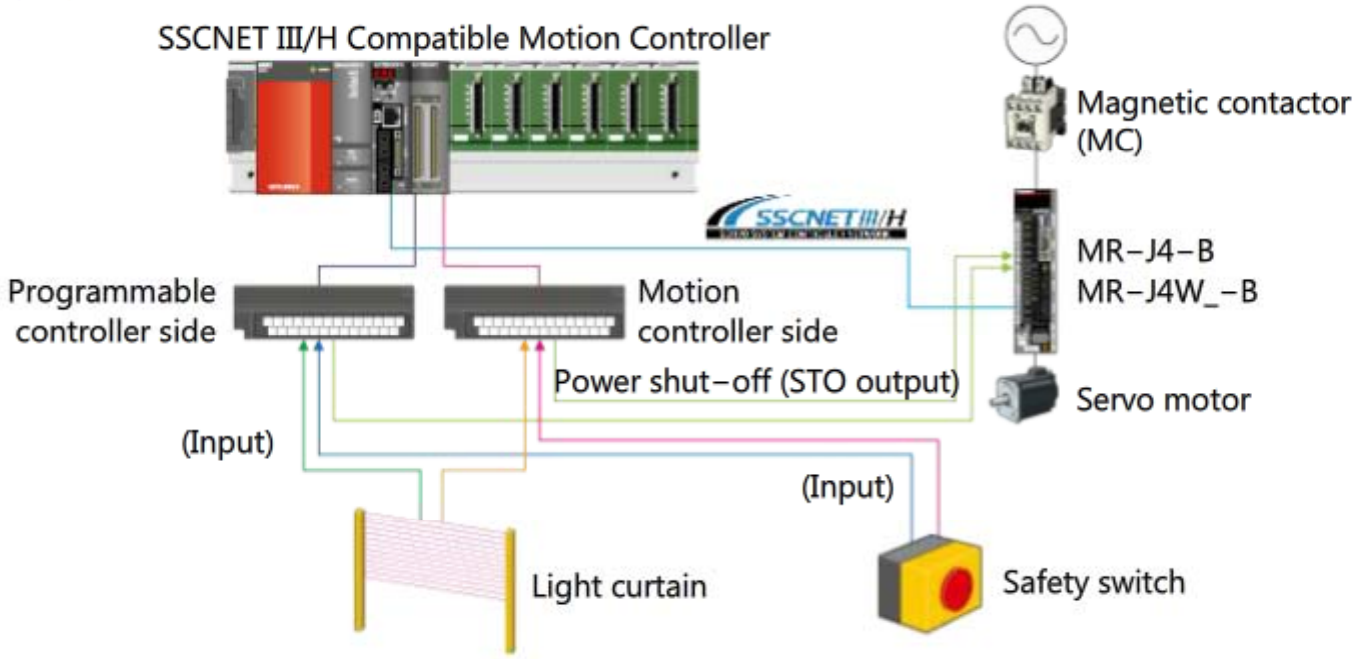
*2. STO is not the electrical safety protection function but the function to turn off the output torque by shutting off the power supply inside the servo amplifier. For MR-J4 series servo amplifier, magnetic contactors are not required to meet the STO requirements. However, install a magnetic contactor to prevent the short circuit of servo amplifier or electric shock.

6.2 Combination with a Motion Controller

Combination with the Q17nDSCPU Motion controller is compliant with the following functions defined as "power drive system functions" in IEC/EN 61800-5-2.

IEC/EN 61800-5-2:2007 function
STO (Safe torque off)
ST1 (Safe stop 1)
ST2 (Safe stop 2)
SOS (Safe operating stop)
SLS (Safely-limited speed)
SBC (Safe brake control)
SSM (Safe speed monitor)

Safety signal monitor function



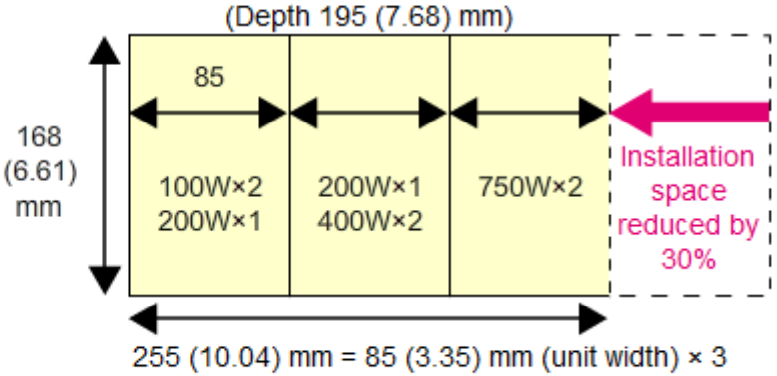
6.3 Multi-Axis Servo Amplifier

6.3.1 Multi-Axis Servo Amplifier - Space-saving

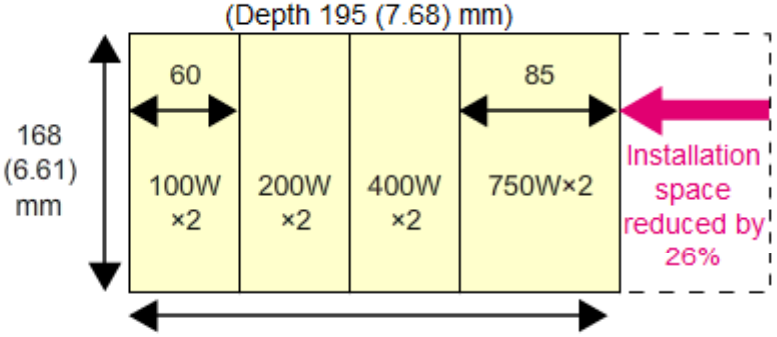
Energy can be saved, equipment can be made compact and costs can be reduced if a 2-axis or 3-axis type Servo amplifier is used.
The MR-J4W2-B 2-axis type Servo amplifier has an installation footprint 26% smaller than when two MR-J4-B's are used.
The MR-J4W3-B 3-axis type Servo amplifier has an installation footprint 30% smaller than when three MR-J4-B's are used.

[Installation space]

MR-J4W3-B
(3-axis type)



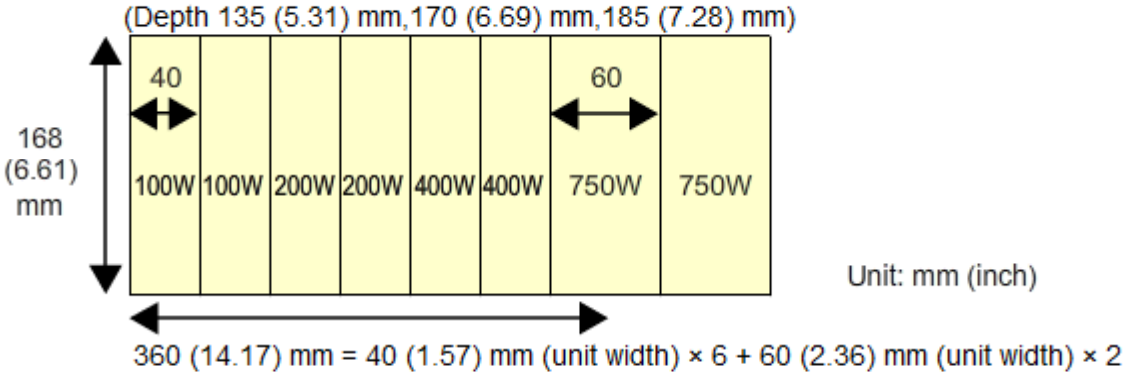
MR-J4W2-B
(2-axis type)



MR-J4-B

6.3 Multi-Axis Servo Amplifier

MR-J4-B



Unit: mm (inch)

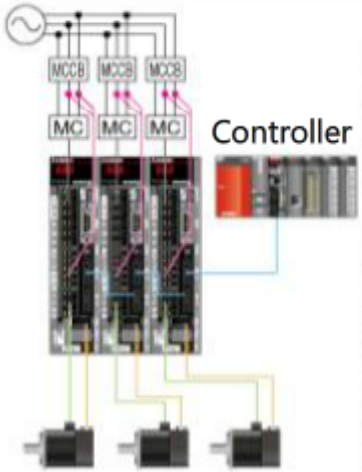
360 (14.17) mm = 40 (1.57) mm (unit width) × 6 + 60 (2.36) mm (unit width) × 2

6.3.2 Multi-Axis Servo Amplifier – Reduced-wiring

In 3-axis servo amplifier MR-J4W3-B, the three axes use the same connections for main and control circuit power, peripheral equipment, control signal wire, etc. Thus, the number of wirings and devices is greatly reduced.

Comparison of the number of wirings

MR-J4-B × 3 units

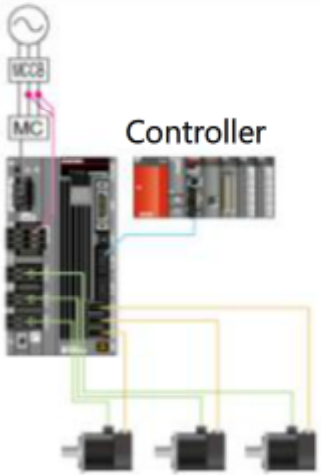


Number of wirings

SSCNET Ⅲ/H	× 3 (number of units)
Main circuit power supply	× 3 (number of units)
Control circuit power supply	× 3 (number of units)
Magnetic contactor connection	× 3 (number of units)
Magnetic contactor control	× 3 (number of units)
Encoder	× 3 (number of axes)
Motor power input	× 3 (number of axes)
Total	21

Reduced wiring by 50%

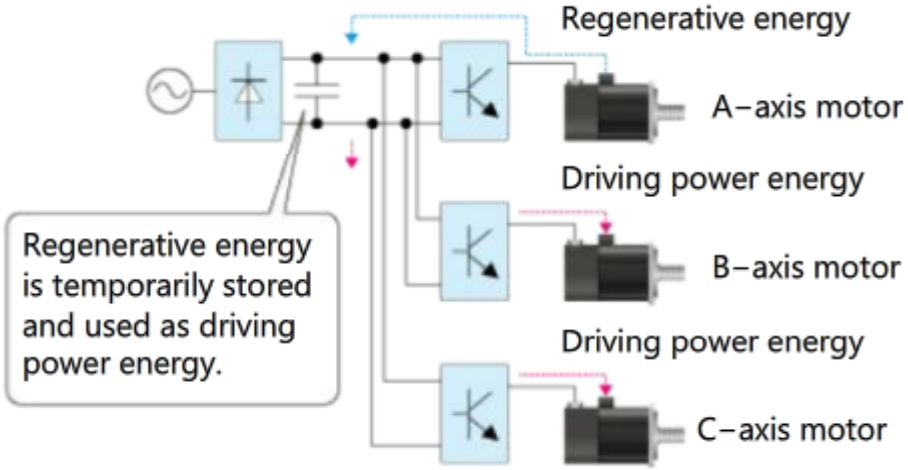
MR-J4W3-B (3-axis type) × 1 unit

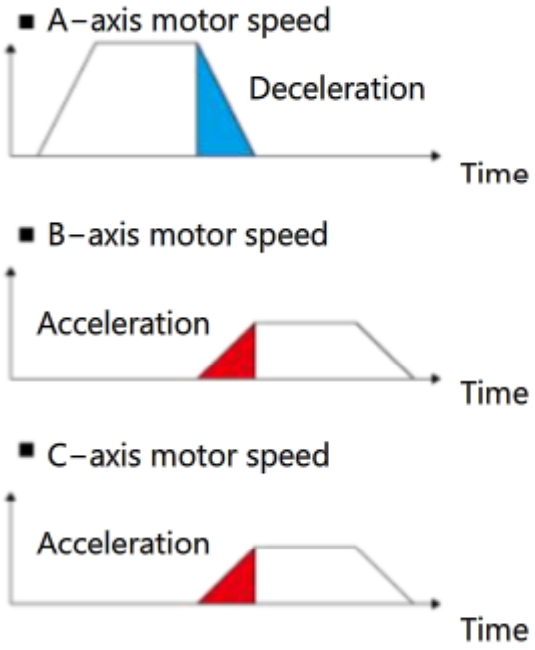


SSCNET Ⅲ/H	× 1
Main circuit power supply	× 1
Control circuit power supply	× 1
Magnetic contactor connection	× 1
Magnetic contactor control	× 1
Encoder	× 3
Motor power input	× 3
Total	11

6.3.3 Multi−Axis Servo Amplifier − Improved Energy Savings

Multi−axis type Servo amplifiers are capable of using the regenerative energy of a specified axis as the motor drive energy for other axes, which helps save equipment energy.
Reusable regenerative energy stored in the capacitor is increased for MR−J4W_ as compared to the prior model.
Regenerative option is no longer required.





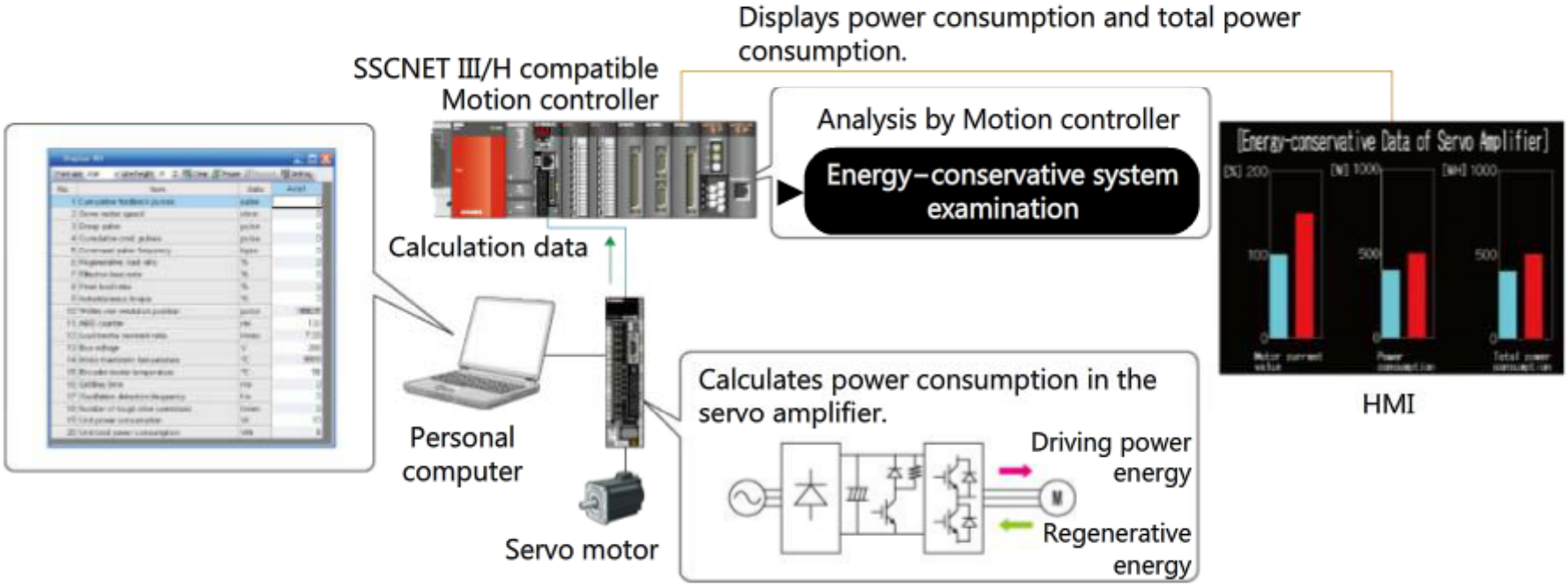
Reusable energy

	MR−J4W3	MR−J3
200W	21 J	9 J
400W	30 J	11 J

Regenerative resistor may be required depending on the conditions.

6.4 Power Monitoring

The power monitor function provided on the MR−J4 series calculates the Driving power energy and Regenerative energy from the speed, current and other data held internally by the Servo amplifier. Power consumption, etc. can be monitored on MR Configurator2.
On a SSCNET III/H system, data is sent to the Motion controller so that power consumption can be analyzed or displayed on the HMI.



6.5 Summary

In this chapter, you have learned:

- STO/SS1 Compatibility
- Multi−Axis Servo Amplifier
- Power monitoring

Important points

The following points are very important, so please review them again to ensure that you have familiarized yourself with their content.

STO/SS1 Compatibility	• IEC/EN 61800−5−2 functions are supported as standard. • The level of safety can be improved by combining with a Motion controller.
Multi−Axis Servo Amplifier	• The 3−axis servo amplifier MR−J4W3−B requires 30% less installation space and approximately 50% less wiring as compared to three units of 1−axis servo amplifier. • Regenerative energy is utilized to increase equipment energy savings.
Power monitoring	• The power monitor function provided as standard calculates the Driving power energy and Regenerative energy from the speed, current and other data held internally by the Servo amplifier so that power consumption can be analyzed or displayed on the HMI.

Servo_MELSERVO_Basics(MR-J4)_ENG

Test Final Test

Now that you have completed all of the lessons of the Servo MELSERVO Basics (MR-J4) 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 (13 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

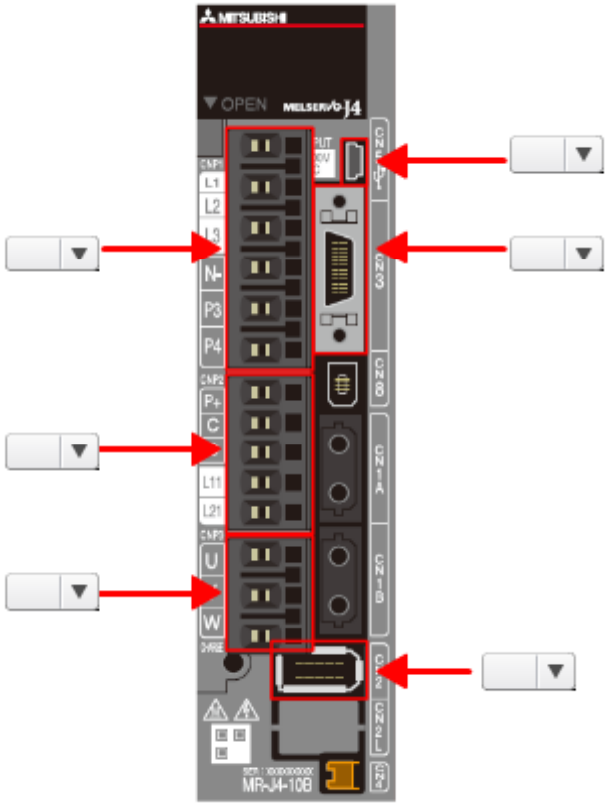
From the following, select the system that can detect and store the rotation position and speed in the memory when the power supply is turned OFF and can resume operation without having to perform a home position return if the home position is set at the initial operation.

- ○ Absolute position detection system
- ○ Incremental system

Answer Back

Test Final Test 2

Select the correct names for the component parts of the Servo amplifier below.



Answer Back

Terms to select

1. USB communication connector
2. Encoder connector
3. Main circuit power supply connector
4. Servo motor power connector
5. I/O signal connector
6. Control circuit power supply connector

Test Final Test 3

Select the correct sentence regarding installation of the battery for an Absolute position detection system.

Switch the main circuit power supply as follows when the battery for an Absolute position detection system is installed.

Q1 --Select--

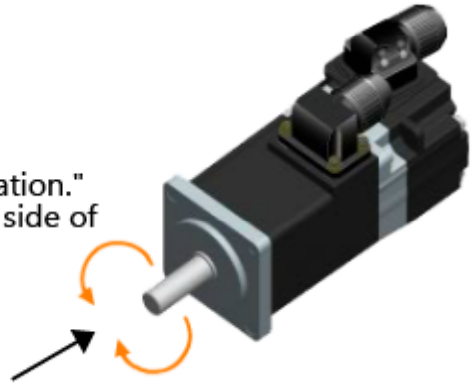
Then, 15 minutes later, check that the Charge lamp is out and check the voltage between the P(+) and N(-) terminals with a voltage tester or other tool before connecting the battery unit.

Q2 --Select--

Answer Back

Test Final Test 4

Please answer the questions below regarding operation of the Servo system.



- Check operation (forward rotation/reverse rotation) of the Servo system by "Jog operation." When the Servo motor rotates forward, which way does it turn as seen from the shaft side of the Servo motor?

Q1 --Select--

- From which speed should you specify for the motor speed until normal operation is confirmed?

Q2 --Select--

Answer Back

Test Final Test 5

Please answer the questions below regarding one-touch adjustment using MR Configurator2.

- Select the response mode suitable for equipment having high machine rigidity.

01 --Select--

- Select the Test operation mode that does not support one-touch adjustment.

02 --Select--

Answer Back

Servo_MELSERVO_Basics(MR-J4)_ENG

Test

Test Score

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

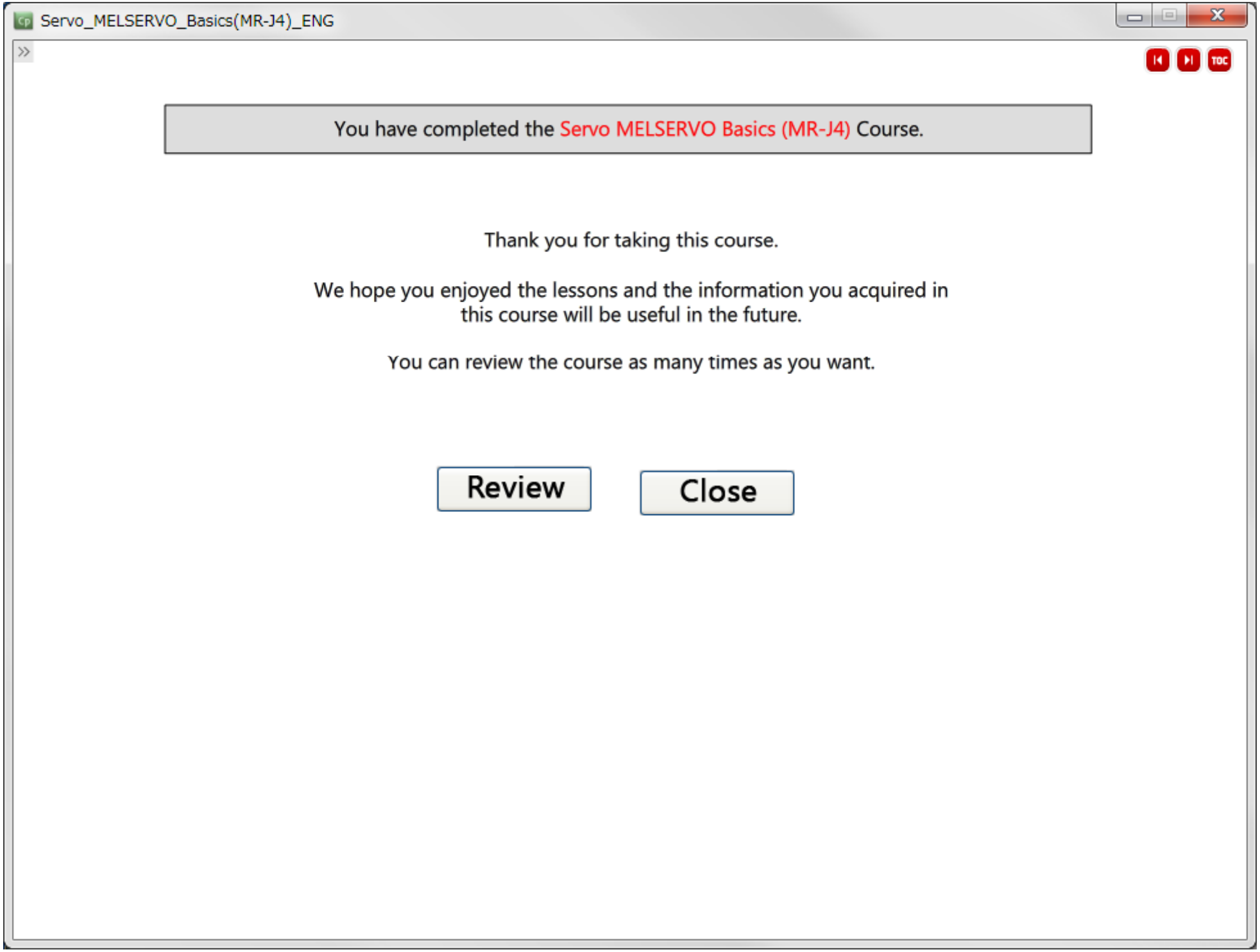
Correct answers : 0

Total questions : 5

Percentage : 0%

Proceed | Review | Retry

You failed the test.


Servo_MELSERVO_Basics(MR-J4)_ENG
TOC
You have completed the Servo MELSERVO Basics (MR-J4) 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