MITSUBISHI ELECTRIC

Changes for the Better

Satellite Training Series PART 4

Your First AC Servo

Satellite Training Series

●Safety Precautions●

(Read all precautions before using the equipment.)

Before designing your system, make sure to read the related manuals for your products to ensure that you exercise appropriate caution with regards to safety.
Pay attention to the following precautions when training, so that you learn to use the equipment correctly.
The Mitsubishi Electric general-purpose AC servo MELSERVO-J4 is used for this training.
If the equipment in your actual environment is different, make sure to read the specific manual for each of your devices, as operation methods differ depending on the specific model of AC servos.

In this document, the safety instructions are classified into the rank of "WARNING" or "CAUTION".

⚠WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Items marked with the ⚠CAUTION symbol may even lead to serious consequences, depending on the conditions.
Both instruction levels must be followed because they are important to personal safety.

[Training precautions]

⚠WARNING

- Do not touch the terminals when the power is on to prevent electric shock.
- Before opening the safety cover, either turn off the power or ensure that it is absolutely safe to open the cover.
- Do not put your hands into any moving parts.

1. To prevent electric shock, note the following.

⚠WARNING

- Before wiring or inspection, turn off the power and wait for 15 minutes or more (20 minutes or more for converter unit) until the charge lamp turns off. Then, confirm that the voltage between P+ and N- (between L+ and L- for converter unit) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm whether the charge lamp is off or not from the front of the servo amplifier (converter unit).
- Do not operate switches with wet hands. Otherwise, it may cause an electric shock.

2. To prevent fire, note the following.

⚠CAUTION

- When you use an MR-J4 multi-axis servo amplifier, connecting an encoder for wrong axis to the CN2A, CN2B, or CN2C connector may cause a fire.

3. To prevent injury, note he following.

⚠CAUTION

- The servo amplifier (drive unit), converter unit heat sink, regenerative resistor, servo motor, etc. may become hot while power is on or for some time after power-off. Take safety measures, e.g. provide covers, to avoid accidentally touching the parts (cables, etc.) by hand.

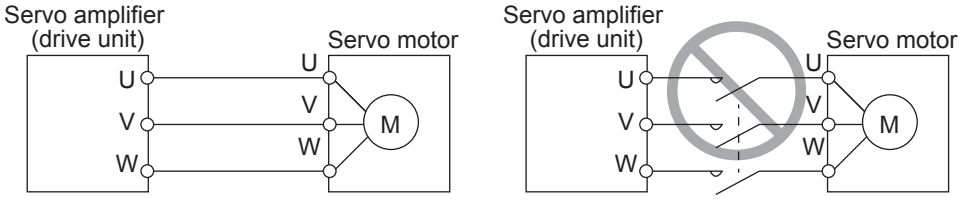
4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a malfunction, injury, electric shock, etc.

(1) Wiring

⚠CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.
- To avoid a malfunction of the servo motor, connect the wires to the correct phase terminals (U/V/W) of the servo amplifier (drive unit) and the servo motor.
- Connect the servo amplifier (drive unit) power output (U/V/W) to the servo motor power input (U/V/W) directly. Do not connect a magnetic contactor and others between them. Otherwise, it may cause a malfunction.



- Configure a circuit to turn off EM2 or EM1 when the main circuit power supply is turned off to prevent an unexpected restart of the servo amplifier (drive unit).

(2) Usage

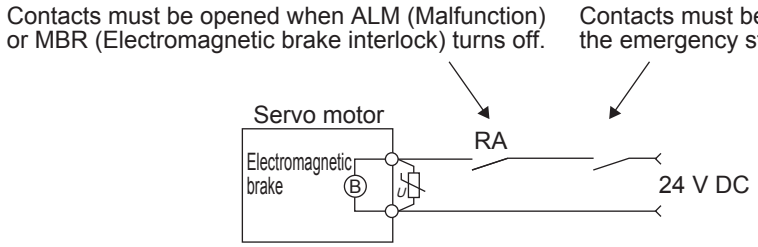
⚠CAUTION

- Before resetting an alarm, make sure that the run signal of the servo amplifier (drive unit) is off in order to prevent a sudden restart. Otherwise, it may cause an accident.
- Use the servo amplifier (drive unit) and converter unit with the specified servo motor.

(3) Corrective actions

⚠CAUTION

- Ensure safety by confirming the power off, etc. before performing corrective actions. Otherwise, it may cause an accident.
- If it is assumed that a power failure or product malfunction may result in a hazardous situation, use a servo motor with an electromagnetic brake or provide an external brake system for holding purpose to prevent such hazard.
- Configure an electromagnetic brake circuit which is interlocked with an external emergency stop switch.



- When an alarm occurs, eliminate its cause, ensure safety, and deactivate the alarm to restart operation.
- Provide an adequate protection to prevent unexpected restart after an instantaneous power failure.

Note on the icon

Point

This icon indicates useful tips for using (selecting) an AC servo.

Introduction

This document covers some fundamentals of AC servos that first-time users of AC servos should know.
This document was created on the premise that the MELSERVO-J4 series training device, a Mitsubishi Electric general-purpose AC servo, would be used.
Before wiring your AC servo, make sure to read the related manuals for your products to ensure that you exercise appropriate caution with regards to safety.

⊙ The following table lists the related manuals:

Manual title	Manual number	Description
AC Servo School Text AC Servo Practice Course (MELSERVO-J4)	SH-030146ENG	Contains an excerpt of an overview of AC servos.
SERVO AMPLIFIER INSTRUCTION MANUAL	SH(NA)030107ENG	Contains fundamentals of AC servos (MR-J4-_A_(-RJ) and MR-J4-03A6(-RJ)).
MELSERVO-J4 Servo amplifier INSTRUCTION MANUAL (TROUBLE SHOOTING)	SH(NA)030109ENG	Contains an excerpt of troubleshooting topics.

Contents

CHAPTER 1
FUNDAMENTALS OF AC SERVOS

1.1 What is an AC Servo?

The word "servo" in the AC servo is derived from a Latin word, "Servus", which means complying with commands faithfully and working loyally. Based on this, a device that works exactly as commanded is called a "servo".
Also, "AC" means an alternating current power supply, and therefore an "AC servo" controls AC motors working on an alternating current power supply.

AC servos enable an object to be moved to, or stopped at, an exact specified position, the speed of movement to be changed quickly, and the object to be moved with more or less force applied, in accordance with conditions.

Many production sites are currently trying to improve quality by installing machinery and automating processes. High-precision control through AC servos is crucial for future manufacturing.

1.2 The Role of AC Servos: Three Types of Control

AC servos provide the following three types of control:

- Position control

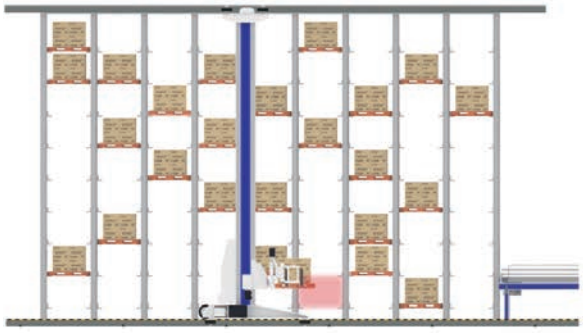
- Speed control

- Torque control

Using these types of control, AC servos can move objects to specified positions at specified speeds and levels of torque.

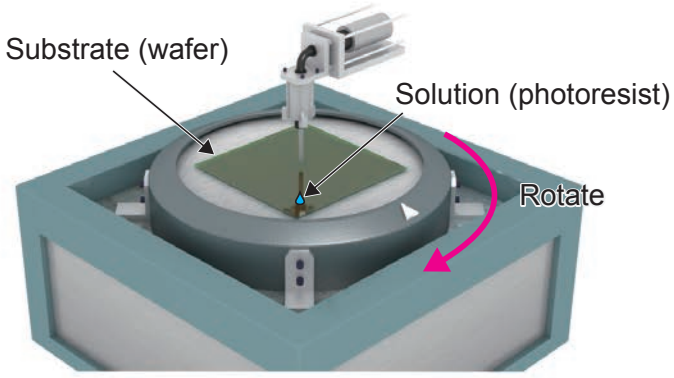
1.2.1 Position control

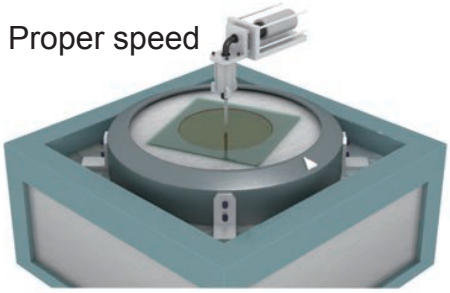
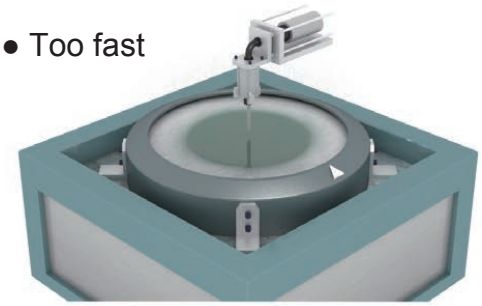
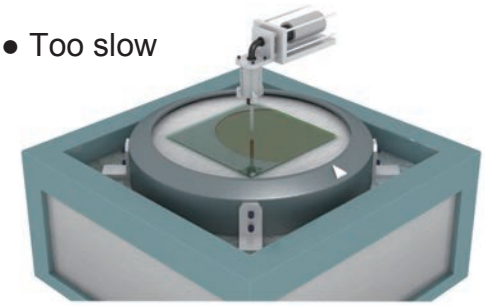
Position control is the control mode that stops an object at the desired position while controlling the motor speed. Position control is used in vertical conveyance equipment and other applications.

With AC servo 	 Enables accurate object transport to specific locations or positions.
Without AC servo	 Objects not transported to specific locations or positions, resulting in mediocre storage ability.

1.2.2 Speed control

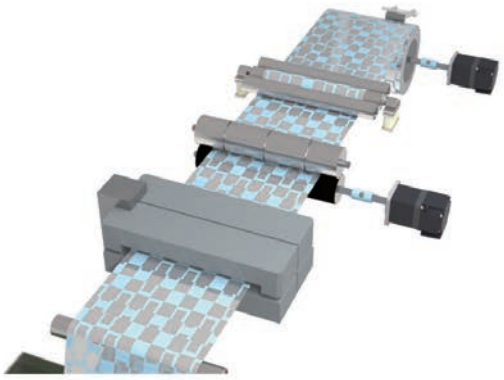
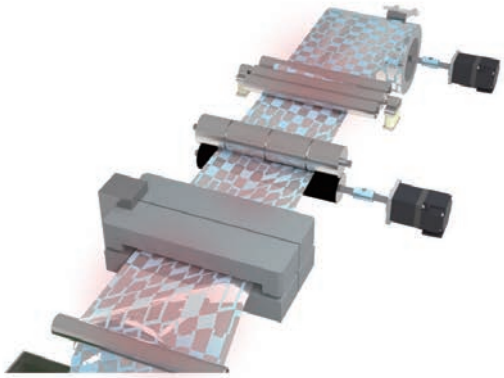
Speed control is the control mode that controls the motor's rotational speed.
Speed control is used, for example, in devices known as spin coaters, which are used to manufacture semiconductor circuits.
A spin coater drips a solution (photoresist) onto a flat substrate (wafer) and spreads the solution evenly and thinly using centrifugal force.
The AC servo can rotate the substrate stably at speeds suitable for the applicable device, enabling precise processing.



With AC servo 	● Proper speed  The photoresist is spread evenly.
Without AC servo	● Too fast  The photoresist splatters off of the substrate. ● Too slow  The photoresist is not spread evenly.

1.2.3 Torque control

Torque control is the control mode that controls the motor's torque.
Torque is the force that rotates a shaft, and torque control is used in industrial printers and other applications.
With torque control, an industrial printer can stretch paper evenly and control it so that the printing surface does not get wrinkled or slacken.

With AC servo 	 The paper can be pulled and stretched evenly.
Without AC servo	 The paper cannot be pulled evenly, resulting in wrinkles, sagging, or both.

MEMO

CHAPTER 2

THE PRINCIPLES AND CONFIGURATION OF THE AC SERVO

2.1 Device Configuration

An "AC servo" consists of two devices: the "servo amplifier", which is the control unit, and the "servo motor", the drive and detection unit. Just these two devices, however, are not enough for the AC servo to operate. It can work only when a "controller", a command unit, is used in addition to the above.
* Some AC servos can operate without a controller, but rather with the amplifier and motor alone.

Command unit Controller

(1) The controller issues a command to the servo amplifier.

Command

AC servo

Control unit Servo amplifier

(2) After receiving the command, the servo amplifier sends it to the servo motor.

Drive and detection unit Servo motor

(3) The servo motor works according to the command from the servo amplifier.

Power supply

Feedback control

Position information

(4) The servo motor detects the current position through an encoder (detector) and conveys it to the servo amplifier.
The servo amplifier compares the command value with the current value detected, and issues a command so that any errors between them will be minimized.
* This is called "feedback control".

2.2 Types of Servo Motors

Servo motors can be divided into the following three types:

- Rotary servo motor

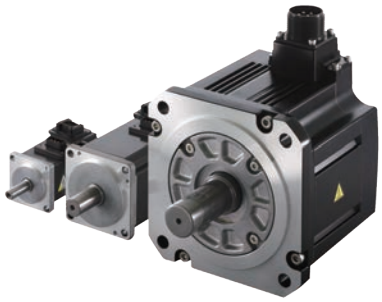
- Linear servo motor

- Direct drive motor

Point

Select the type of the servo motor based on the specifications of the device into which the AC servo will be incorporated.

- Rotary servo motor



It looks like a conventional motor. An encoder for position detection is equipped behind the shaft.
* In this learning material, a rotary servo motor is used.

- Linear servo motor

It has the shape of a rotary servo motor that was developed into a plane. The mover moves over a stator.

- Direct drive motor

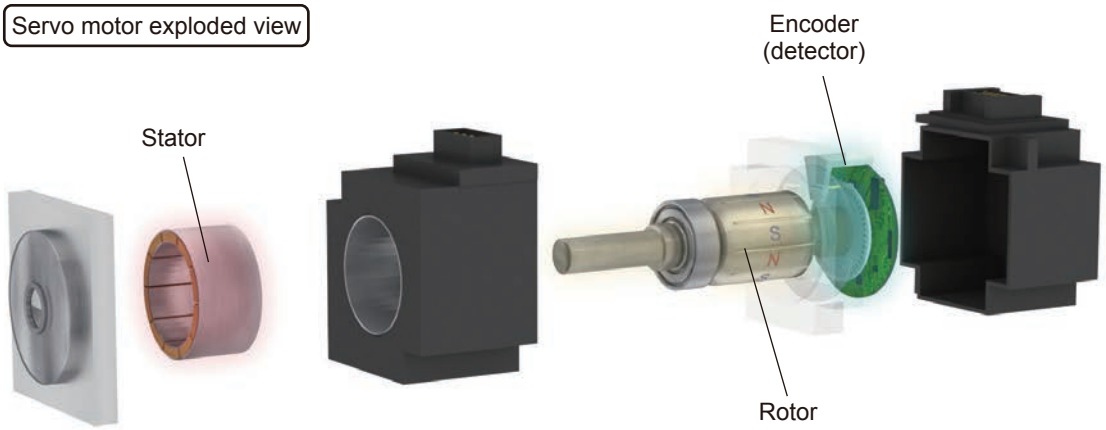
It looks similar to the rotary motor. The axis is hollow.

2.3 The Structure of the Servo Motor

This section describes the structure of the servo motor, using the rotary servo motor as an example.

Servo motor

Servo motor exploded view



A servo motor is made up mainly of three parts: stator, rotor, and encoder.

- Stator

This acts as the base. Wire is wrapped around the core to provide the force needed to rotate the rotor.

- Rotor

This is a rotational shaft. It uses a permanent magnet. It is connected to the encoder.

- Encoder (detector)

This is used to read the motor position and other values. It is a sensor that detects and converts rotation angles into electric signals and then outputs the signals.

Point

Use care when handling the encoder, because it has a glass disk and electric components.

2.4 Brakes

AC servos have three brakes to stop the movement of a motor.

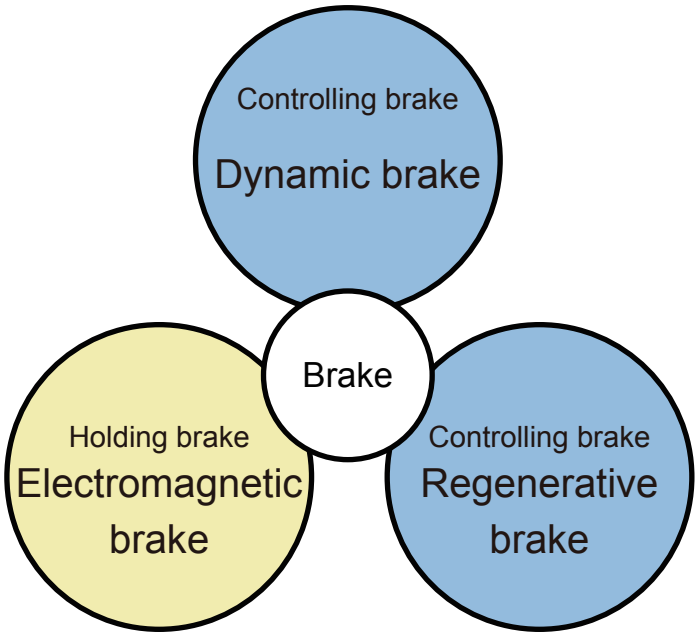
- Dynamic brake

- Electromagnetic brake

- Regenerative brake

Point

Use combinations of different brake types together or use the different brakes separately depending on the application for safe use of the AC servo.



- Dynamic brake

This brake is used to quickly stop the servo motor when a power outage or servo amplifier failure occurs.

Point

This brake cannot keep the motor in the stopped position.
To do so, use the servo motor with the electromagnetic brake, which can maintain the position.

- Electromagnetic brake

This brake is used to maintain the mechanical position of the motor upon power outages or emergency stops.

Point

The electromagnetic brake is for keeping the servo motor stopped and cannot decelerate the motor.
Some servo motors are equipped with an electromagnetic brake, while others are not. Adding an electromagnetic brake to a servo motor afterward is not possible.
You need to select a servo motor based on the device you use.

- Regenerative brake

When the motor is decelerated, this brake is used to convert the excess rotational energy into electrical energy, flow it back into the servo amplifier, and reuse it. It can also be used with different shafts as driving energy, helping save the energy used by the device.

2.5 Differences between AC Servos and Inverters

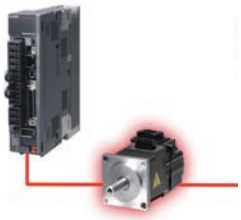
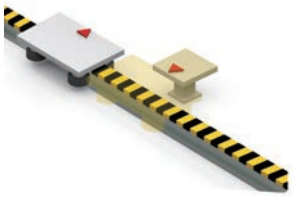
An "AC servo" can provide three types of control: position, speed, and torque control. However, an "inverter" can also provide speed control to drive a motor. (See Satellite Training Series Part 2.)
The AC servo and the inverter differ in terms of control purposes and functions.

Select an AC servo or inverter that fits the operating pattern of the device to be implemented and other conditions.

What is compared	(General-purpose) AC servo	(General-purpose) Inverter
Control application	Used in applications that require high-speed and high-precision control over transitions.	Used to control relatively lenient, steady states.
Control modes	Used for the position control, speed control, and torque control modes.	Basically targets the speed control mode.
Motor	Specified and limited, as a general rule, by the combination with the servo amplifier.	Uses a general-purpose (induction) motor.
Operation with multiple motors	Fundamentally, one servo amplifier drives only one servo motor.	One inverter can drive multiple general-purpose motors. (In V/F control mode)
Price	(Relatively) High-priced	(Relatively) Low-priced
Responsiveness (the higher the better)	High. Around 200 to 15000 rad/s	Low. 100 rad/s or lower
Whether the shaft position can be maintained	Possible (The servo lock mechanism comes standard.)	Not possible
Start/stop frequency (Number of times the machine can be started/stopped)	Around 20 to 600 rpm	Around 20 rpm or lower.
Rate of change in speed	Low. Changes in load and other factors can be canceled out because speed feedback is available.	High. Changes in load and other factors affect the rate because no speed feedback is available.
Range of continuous operation (Continuous operation at 100% load)	Wide. Around 1:1000 to 1:5000	Narrow. Around 1:10
Maximum torque (Rated torque ratio)	Around 300%	Around 150%
Output	Around 10 W to 60 kW	Around 100 W to 300 kW

2.6 Servo Lock

A "servo lock" is the state in which the servo motor maintains control over the position of an object, so that the object does not move from the stopped position.
This feature enables the motor to control the object's return to the stopped position, even when an external force changes the position of it.
The servo lock feature allows for precise positional adjustment.

With servo lock 	 The servo motor tries to return the workpiece that has been moved by an external force back into position.
Without servo lock	 An external force applied to the workpiece moves it out of position.

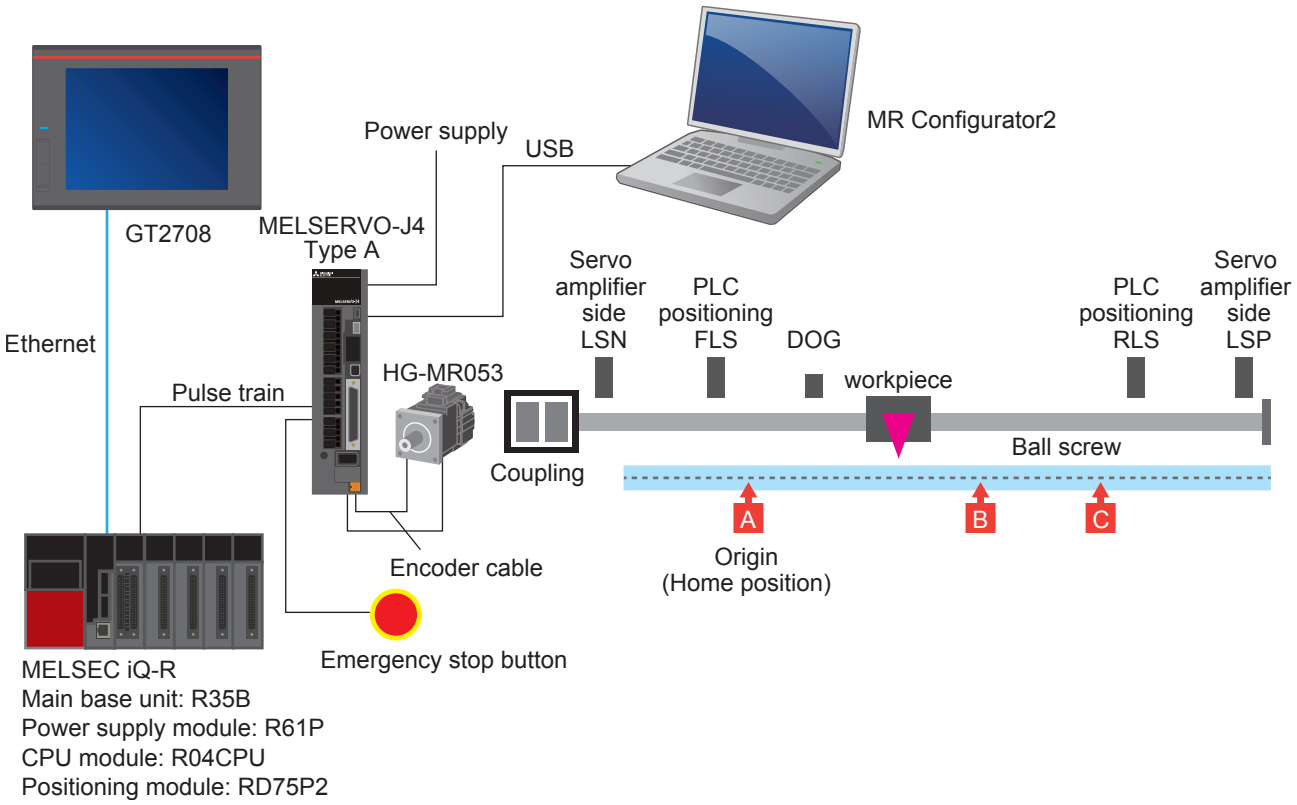
MEMO

CHAPTER 3
SERVO CONTROL IN DETAIL

3.1 Configuration of the Learning Machines

Now that you have learned about the basics, you will now operate the AC servo.
In this training series, you will use the devices shown in the following table and figure:

Mitsubishi Electric servo amplifier	MELSERVO-J4 Type A
Mitsubishi Electric programmable controller	iQ-R Series
Display screen	GT2708
Servo mechanism	Ball screw (driving part of the servo mechanism)



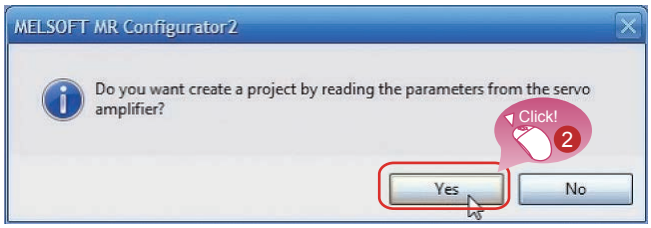
3.1.1 Before starting: Backup operation

If the device you are using already contains data, creating a backup allows you to restore the device to its initial state when a failure occurs.

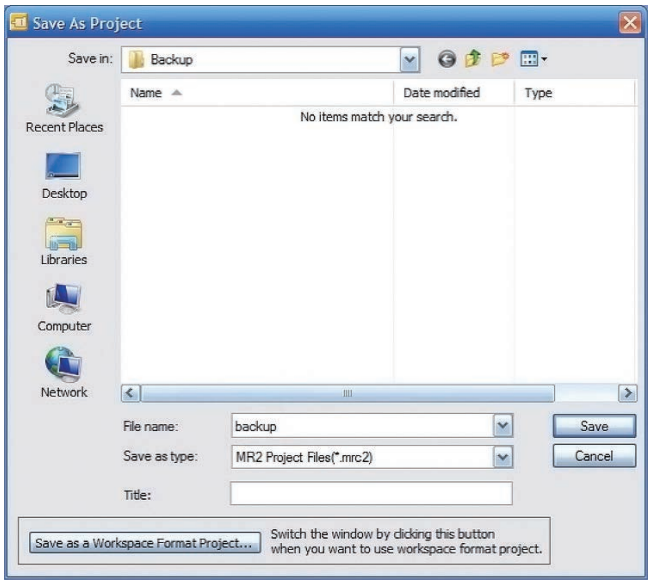
* If the device you are using does not contain any data, you can start configuration as is.

1. Connect a USB cable between the servo amplifier and a PC (MR Configurator2). Turn on the power to the servo amplifier.

2. When you see "Do you want to create a project by reading the parameters from the servo amplifier?", click [Yes].



3. Name your project and save it anywhere you want.



3.2 MR Configurator2 System Settings

3.2.1 What is MR Configurator2?

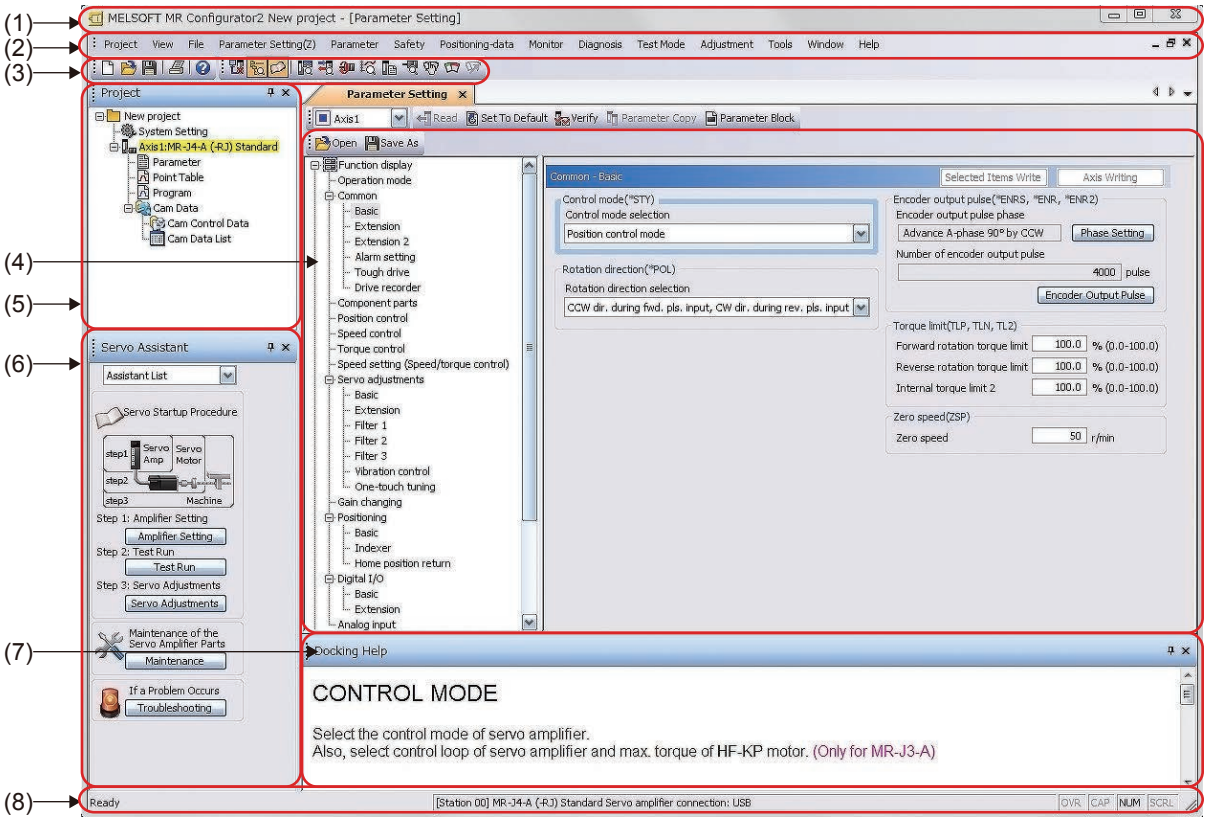
MR Configurator2 is software that provides support from startup to maintenance of a servo amplifier.
Using your PC, you can easily perform parameter settings, monitor display, diagnosis, test mode, and servo adjustments. With its servo assistant function, even beginners can operate the amplifier most appropriately following the operating procedures.

3.2.2 MR Configurator2 screen configuration

Main frame configuration

The main frame has the following screen configuration:

- Screenshot



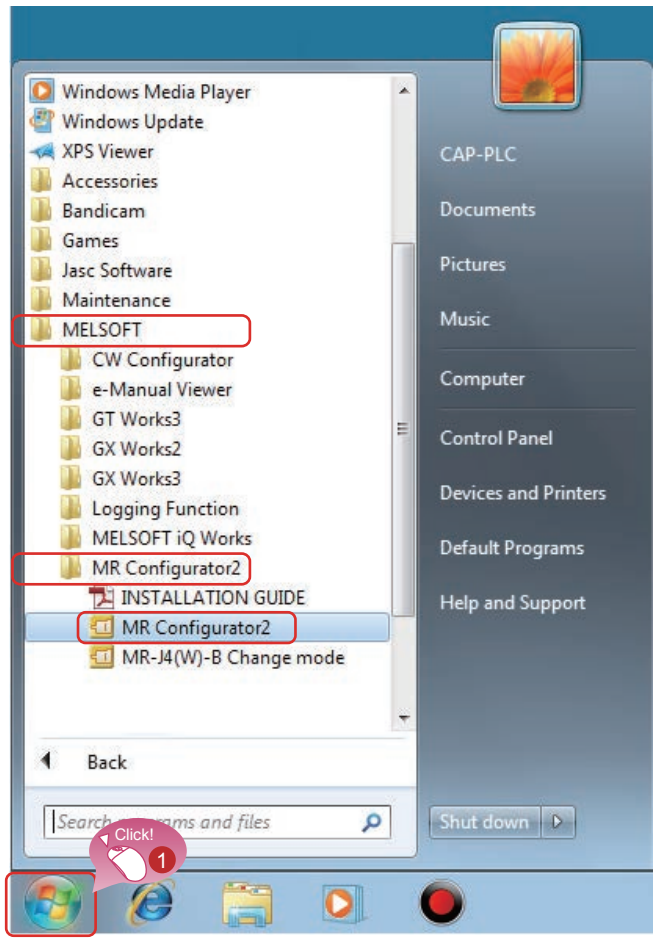
- Components

No.	Item	Display or setting contents
(1)	Title bar	Displays the name of the project and more.
(2)	Menu bar	Displays the menu for performing each function.
(3)	Tool bar	Displays the tool buttons for performing each function.
(4)	Work window	Acts as a main screen for parameter setting, monitoring, adjustment, and more.
	Docking windows	Supports tasks that are done in the work window.
(5)	Project window	Displays the contents of the project in tree format.
(6)	Servo assistant	Provides guidance from starting a function to operating it.
(7)	Docking help	Displays what the parameter is.
(8)	Status bar	Displays information about the project you are editing.

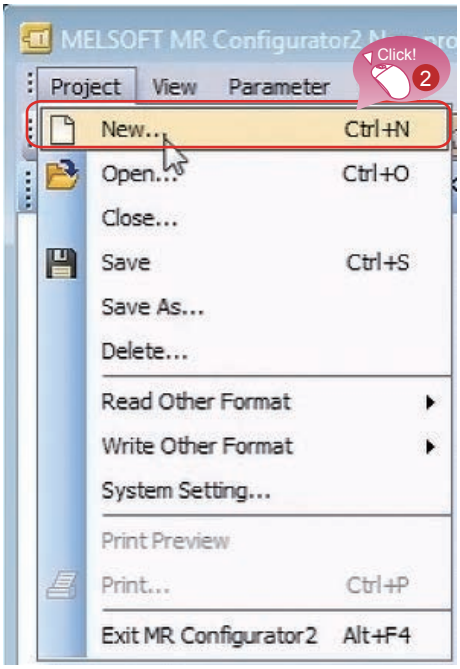
3.2.3 Creating a new project

In this training series, you will use an AC servo with no data.
You will use the software version 1.60N.

1. On your PC, start MR Configurator2.
   In the Windows® Start menu, select [MELSOFT] → [MR Configurator2] → [MR Configurator2].



2 In [Project], click [New Project].



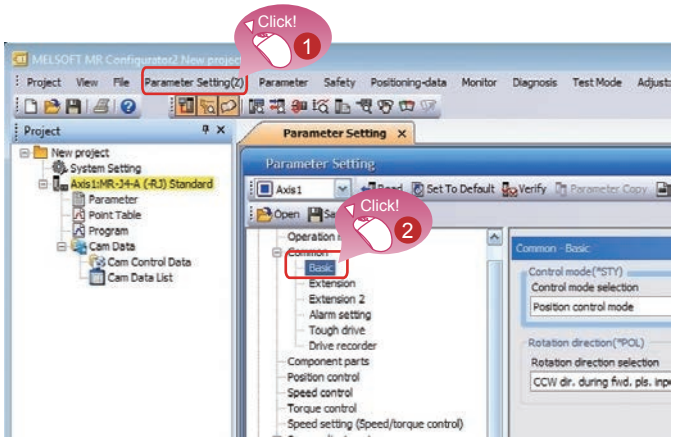
3 Select [MR-J4-A(-RJ)] for [Model] and [Standard] for [Operation mode].

4 Under [Connection setting], select [Servo amplifier connection USB].

5 Click the [OK] button.

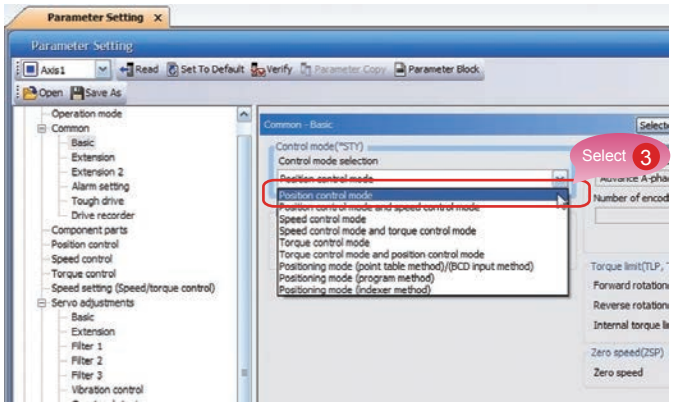
3.2.4 Parameter setting

1. From the menu bar, select [Parameter] and click [Parameter Setting].

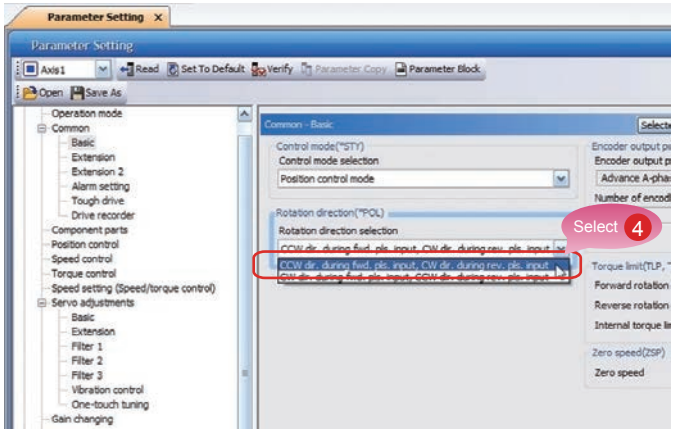


2. Click [Basic].

3. From [Control mode selection], select [Position control mode].



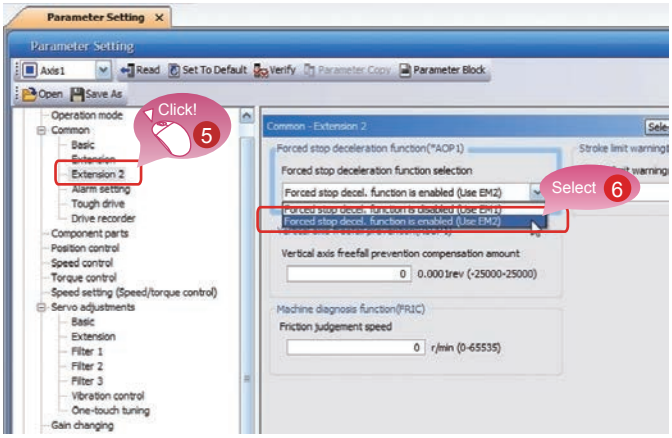
4. From [Rotation direction selection], select [CCW dir. during fwd pls. input, CW dir. during rev. pls. input].



CW, CCW	
CCW Counter-clockwise CW Clockwise	

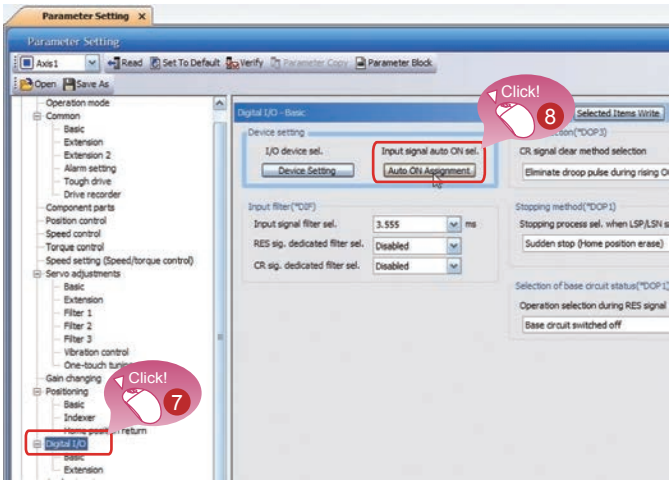
5 Click [Extension 2].

6 From [Forced stop deceleration function selection], select [Forced stop decel. function is enabled (Use EM2)].



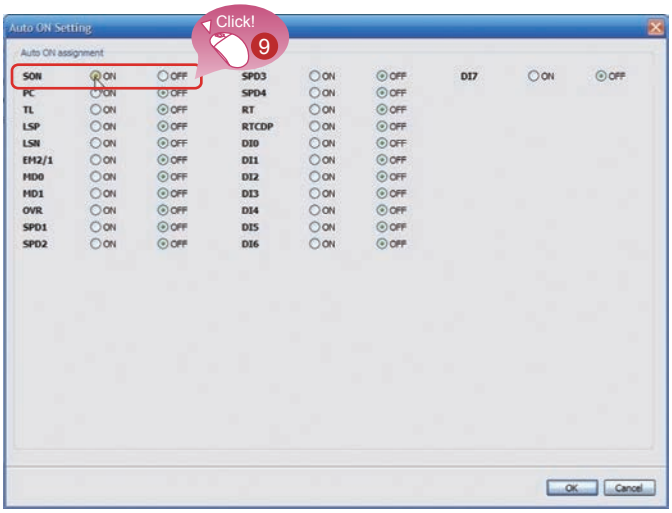
7 Click [Digital I/O].

8 Under [Input signal auto ON sel.], click [Auto ON Assigment].



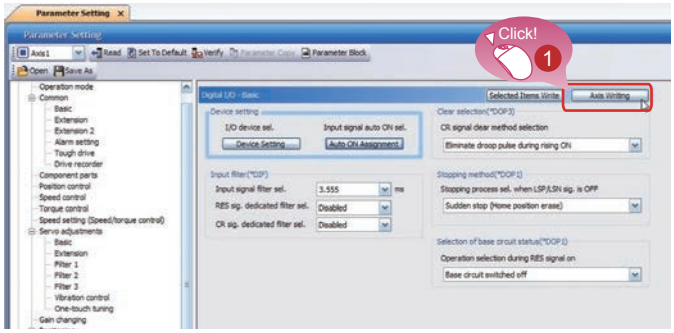
9 In the [Auto ON Setting] screen that opens, enable [SON].

SON	
SON = "Servo On" The "Servo On" signal is used to enable the main circuit. The signal must be turned on before operation. By doing so, the servo lock state will be enabled.	

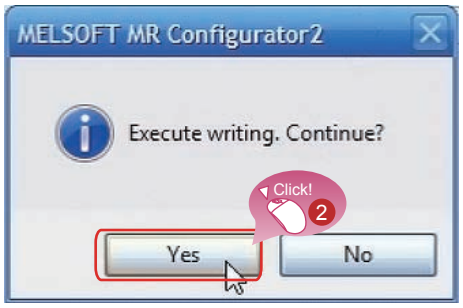


3.2.5 Writing to the servo amplifier

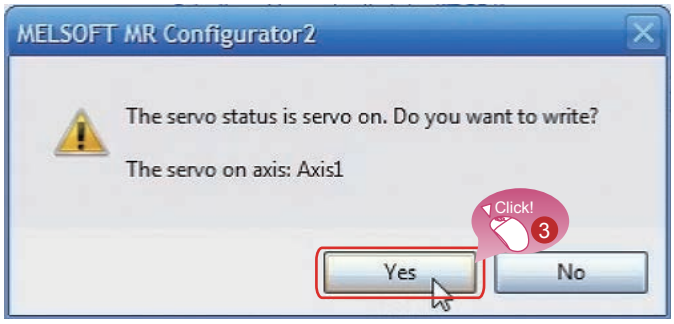
1. From the menu bar, select [Parameter] → [Parameter Setting] and then click [Axis Writing].



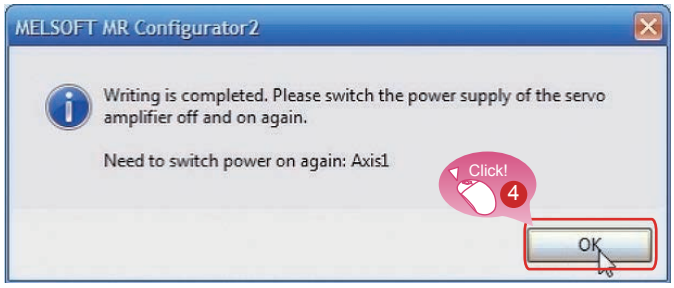
2. In the dialog box that appears, as shown to the right, click [Yes].



3. In the dialog box that appears, as shown to the right, click [Yes].



4. After the writing is complete, in the dialog box that appears, as shown to the right, click [OK].



You have now completed the configuration of the servo amplifier before operation.

Point

Changes to the configuration of the servo amplifier take effect when you turn it off and then on again after writing.

3.3 Test Mode

3.3.1 Before using test mode

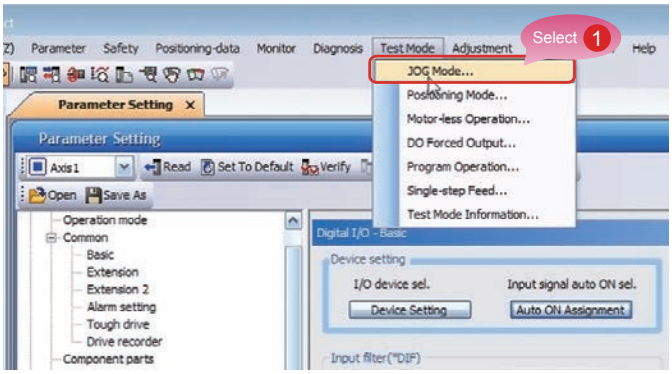
Check that the servo amplifier and servo motor operate properly.

⚠WARNING	Check that the servo motor rotates properly before connecting it to a device. Testing the motor while it is linked with the device may cause an unexpected movement, possibly leading to a serious accident due to a malfunction. Therefore, check first that the motor can operate properly without linking with a device such as a ball screw.

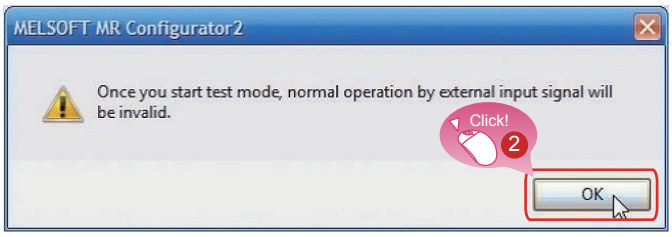
3.3.2 JOG operation

After the check in the previous subsection is complete, connect the servo motor to the ball screw and start test mode.

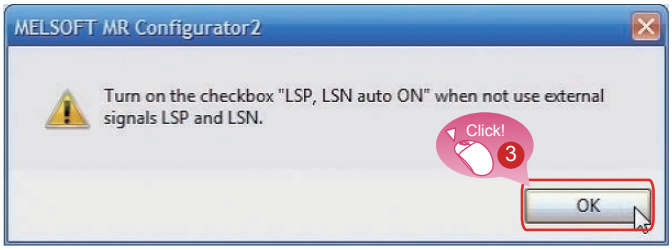
1. From the menu bar, select [Test Mode] and then [JOG Mode].



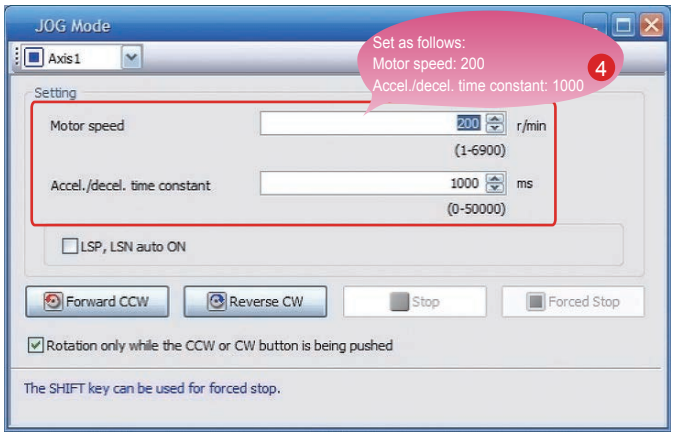
2. In the dialog box that appears, as shown to the right, click [OK].



3. In the dialog box that appears, as shown to the right, click [OK].

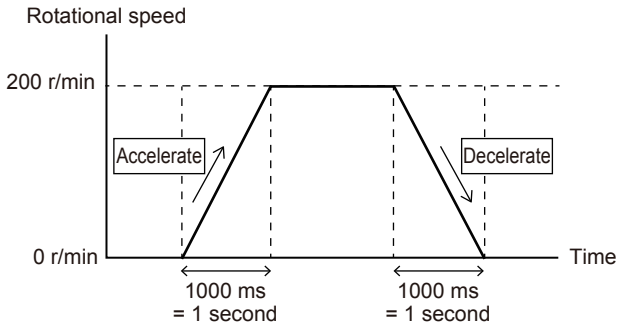


4 The [JOG Mode] screen appears.
Enter the following values:
[Motor speed]: 200
[Accel./decel. time constant]: 1000



Motor speed/Accel./decel. time constant	

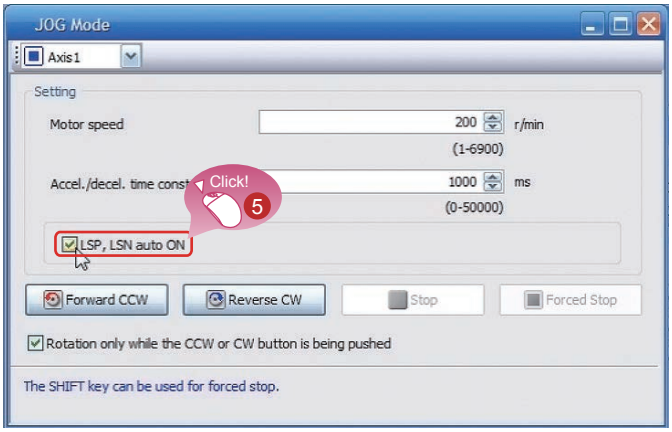
These items set the rotational speed of the servo motor.
[r/min]: rotation per minute: This unit represents how many times the motor rotates per minute.
[200 r/min]: This means that the motor rotates 200 times per minute.
[Accel./decel. time constant]: This indicates how long it takes to reach the set speed value and to stop the motor.
[ms]: 1/1000 second
[1000 ms]: It means that it takes 1000 ms, or 1 second, for the motor to reach the set speed of 200 r/min.



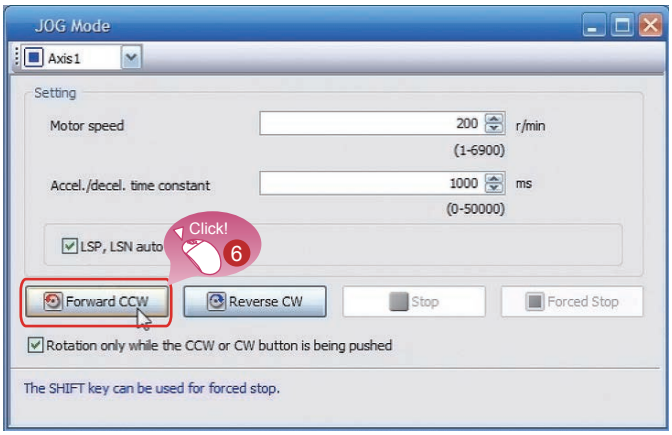
3

5 Select the [LSP, LSN auto ON] check box.

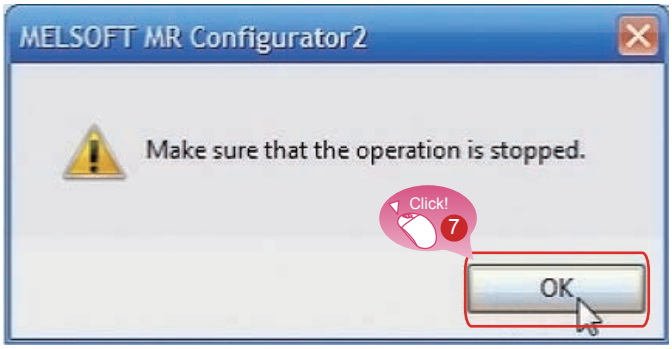
LSP, LSN	
LSP = Forward stroke end LSN = Reverse stroke end ON: State for normal operation OFF: In this state, operation stops when the limit is reached. When [LSP, LSN auto ON] is enabled, the operation can continue even when the limit is exceeded.	



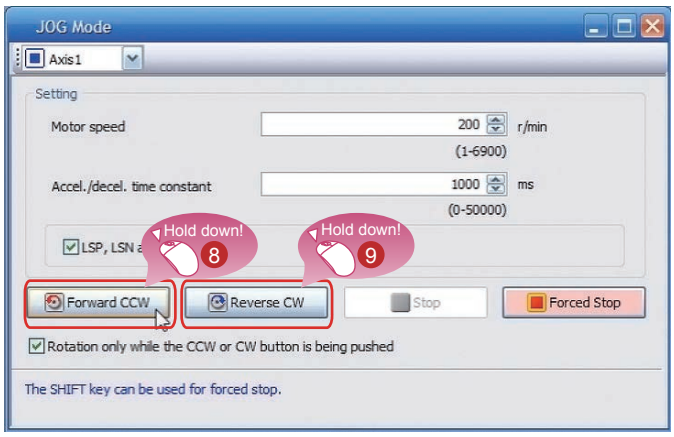
6 Click [Forward CCW].



7 In the dialog box that appears, as shown to the right, click [OK].



8 Hold [Forward CCW].
Check that the ball screw rotates.

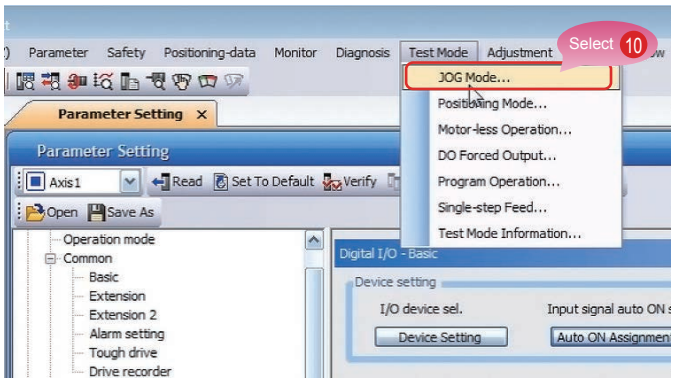


9 Hold [Reverse CW].
Check that the ball screw counter-rotates.

* If [Rotation only while the CCW or CW button is being pushed] is selected, the screw rotates only while you hold [Forward CCW] or [Reverse CW].

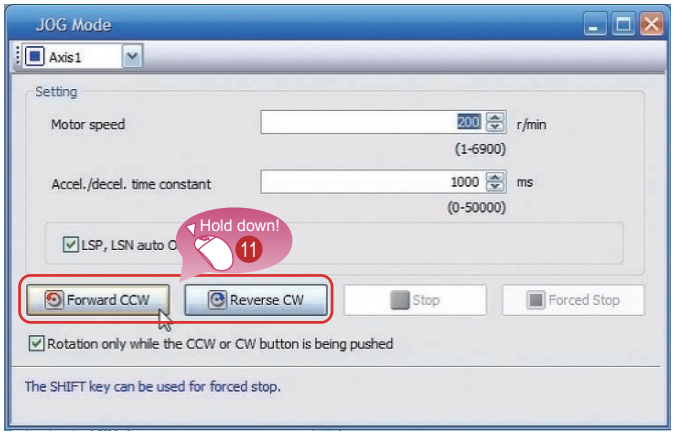
10 Move the moving part of the ball screw to point A.

Select [Test Mode] and then [JOG Mode].
[Motor speed]: 200
[Accel./decel. time constant]: 1000



11 Hold [Forward CCW] or [Reverse CW] to adjust the moving part, so that it can get closer to point A.

If the limit specified in [LSP] or [LSN] is exceeded, the servo motor stops and the error screen appears.
After the servo motor stops, it no longer moves, even if you hold [Forward CCW] or [Reverse CW].



Turn the power off and on again, and specify the values for [Motor speed] and [Accel./decel. time constant] one more time. Move the moving part in the opposite direction of the previous operation.

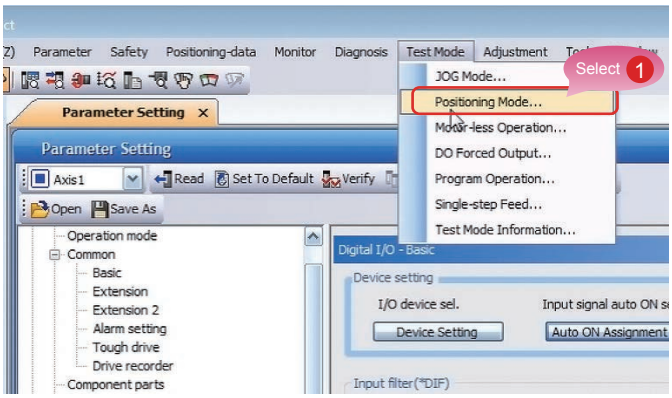
Set mechanical limits to ensure safety.

3.3.3 Positioning mode

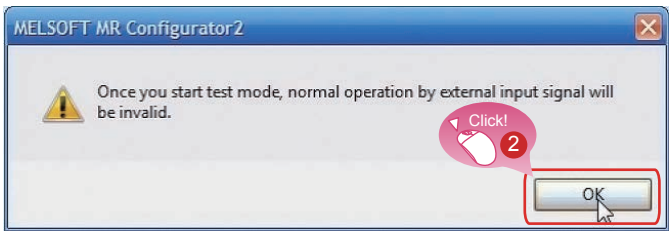
Use the positioning mode.

1. Make sure that the moving part has halted and is close to point A, and then perform the following steps:

   Select [Test Mode] and then [Positioning Mode].

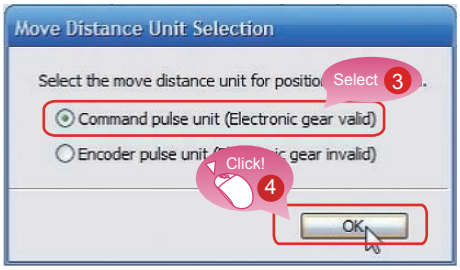


2. In the dialog box that appears, as shown to the right, click [OK].

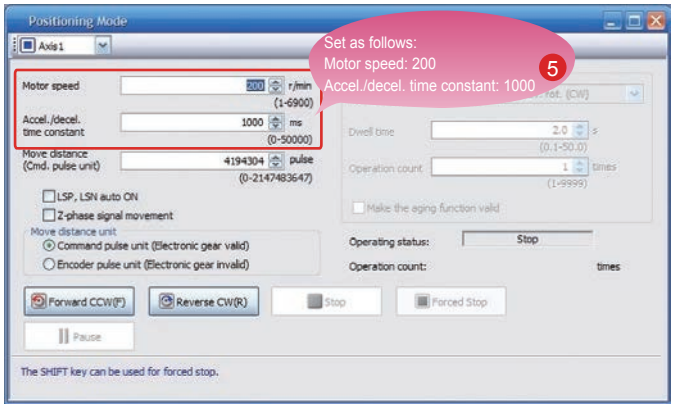


3. In the [Move Distance Unit Selection] screen that appears, select [Command pulse unit (Electronic gear valid)].

4. Click [OK].

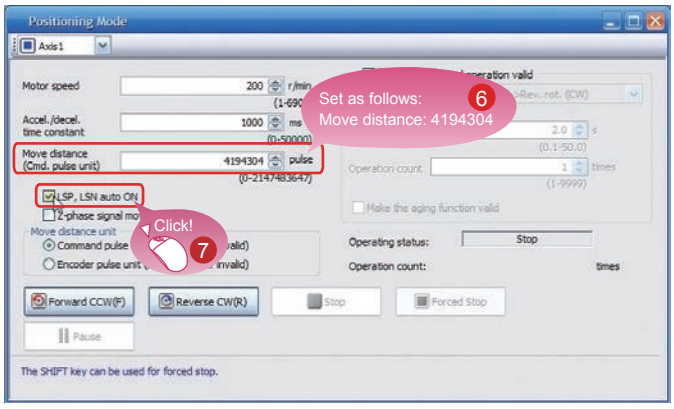


5 The [Positioning Mode] screen appears.
In [Motor speed] and [Accel./decel. time constant], enter the same numbers as the values previously entered again.
[Motor speed]: 200
[Accel./decel. time constant]: 1000



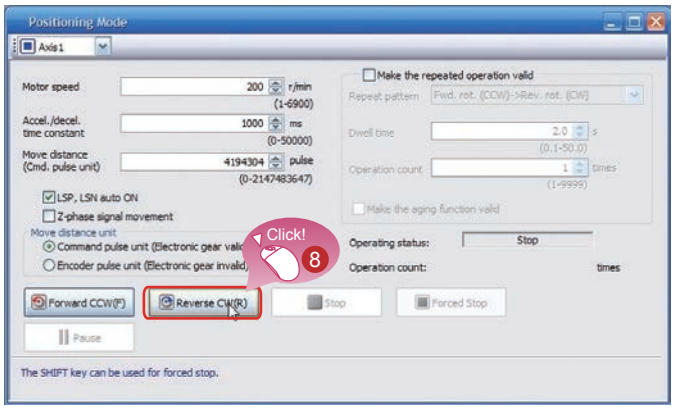
6 In [Move distance], type 4194304.

Move distance	
Move distance literally means the amount of movement. In positioning control, enter the actual distance to move.	

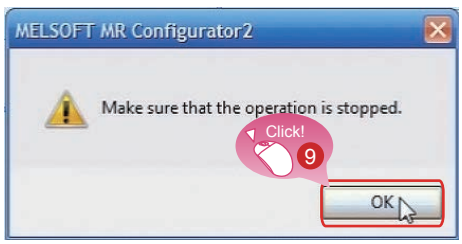


7 Select the [LSP, LSN auto ON] check box.

8 Click [Reverse CW].

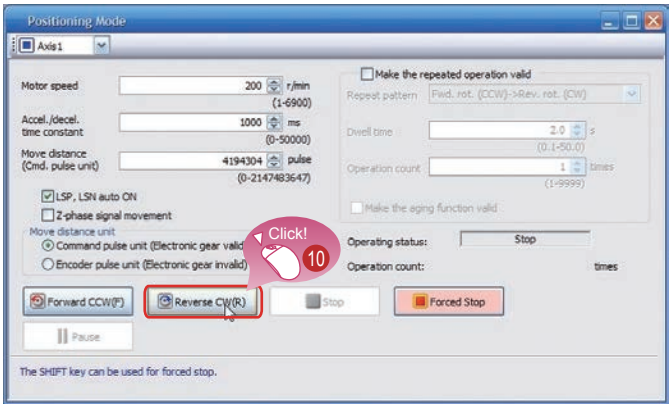


9 In the dialog box that appears, as shown to the right, click [OK].



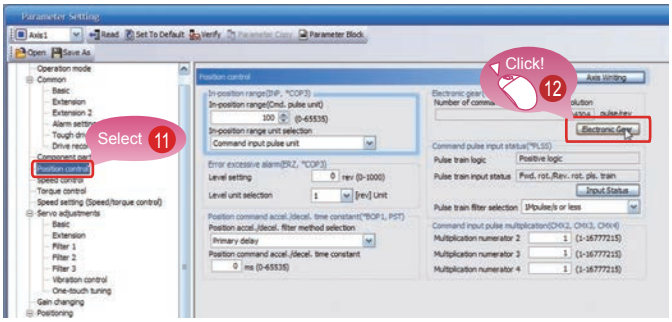
10 Click [Reverse CW] again.

The ball screw moves slightly.
This means that a command from the servo amplifier caused the screw to move 4194304 pulses in the [Reverse CW] direction.

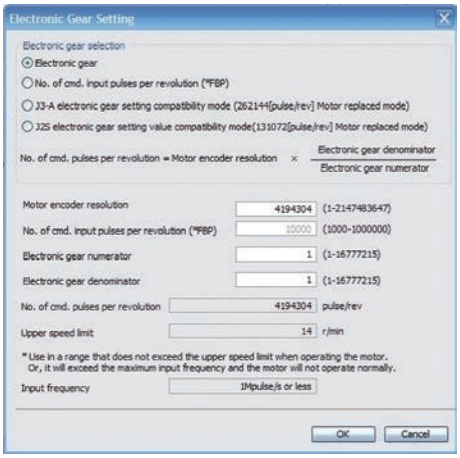


11 Configure the electronic gear setting.
Select [Parameter Setting] and then [Position control].

12 Click [Electronic Gear].



The [Electronic Gear Setting] dialog box appears.



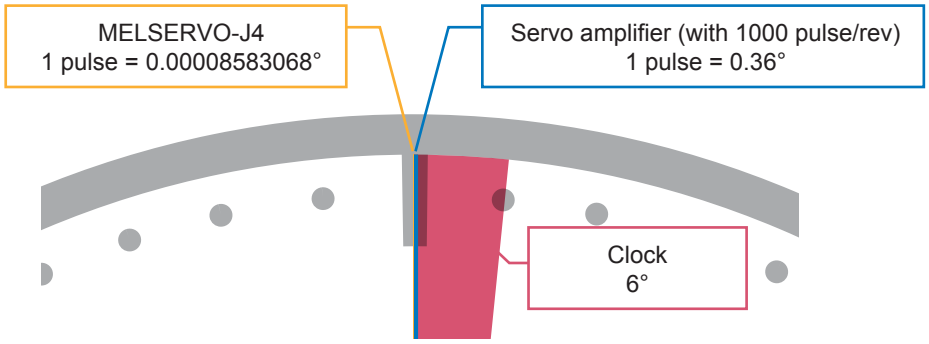
Motor encoder resolution	

The number of pulses generated for one revolution is called a resolution, which is represented in units of pulses per revolution ([pulse/rev]).

A servo amplifier can generate signals on a per pulse basis.
For example, a resolution of 1000 pulse/rev means that a single revolution of the motor, or 360°, is divided by 1000. This implies that the motor can move an object 0.36° per pulse.

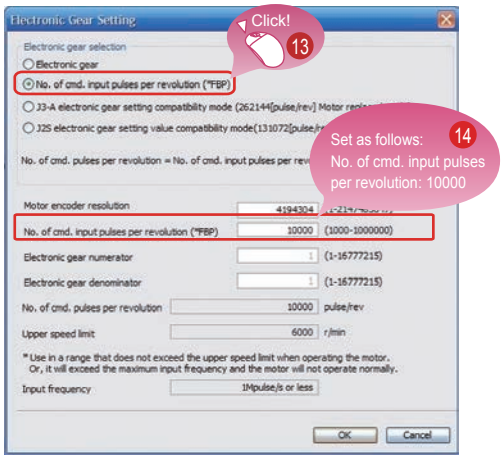
The second hand of a clock completes one revolution in 60 seconds, meaning that 360° is divided into 60 pieces and the hand moves 6° every second.

Mitsubishi Electric MELSERVO-J4 has a motor encoder resolution of 4194304 pulse/rev.
It can therefore divide 360° into 4194304 pieces and control invisibly fine movements of 0.00008583068° per pulse.

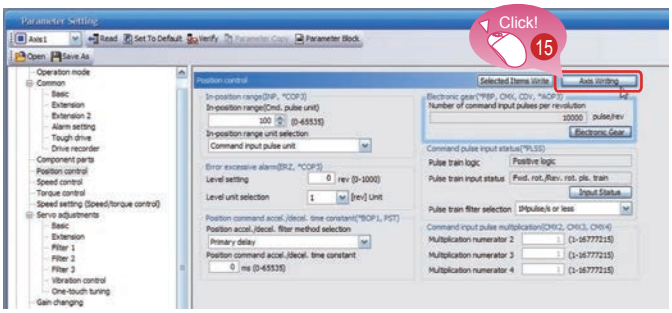


13 Select [No. of cmd. input pulses per revolution], instead of [Electronic gear].

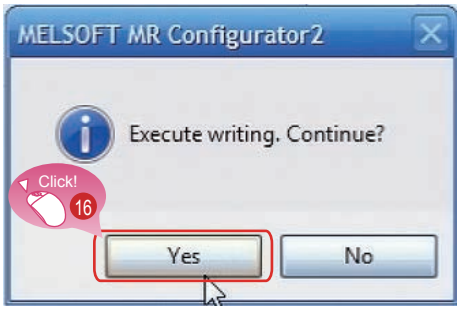
14 In [No. of cmd. input pulses per revolution], type [10000].
You can now rotate the motor one revolution with [10000] pulses.



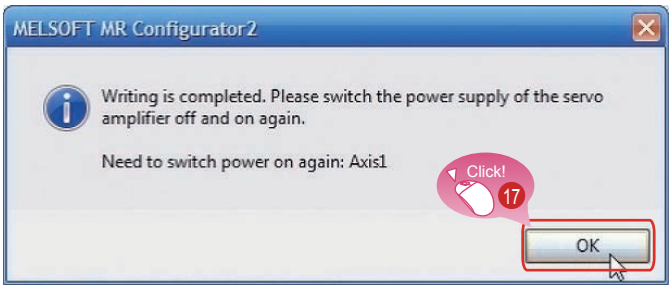
15 Perform a write operation.
Click [Axis Writing].



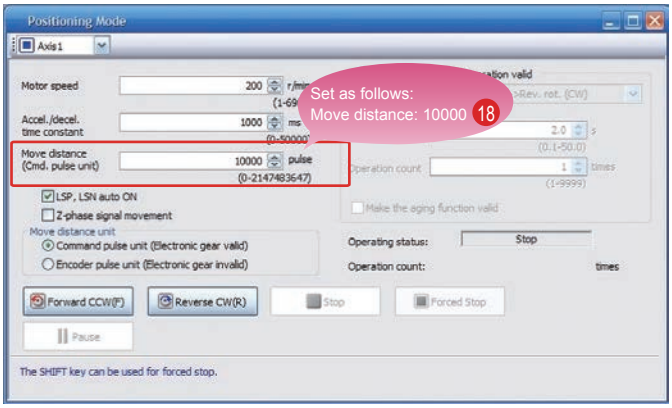
16 In the dialog box that appears, as shown to the right, click [Yes].



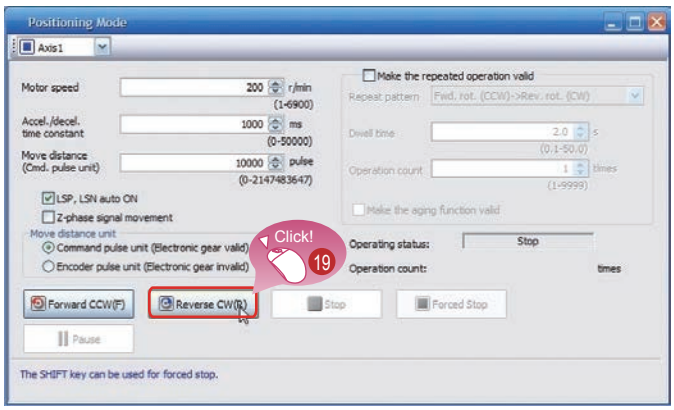
17 After the writing is completed, in the dialog box that appears saying that the servo amplifier should be turned off and on again, click [OK].
When the power is turned off and on again, the written settings take effect.



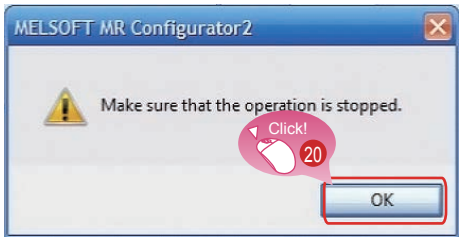
18 Go back to the [Positioning Mode] screen.
In [Move distance], type 10000.



19 Click [Reverse CW].

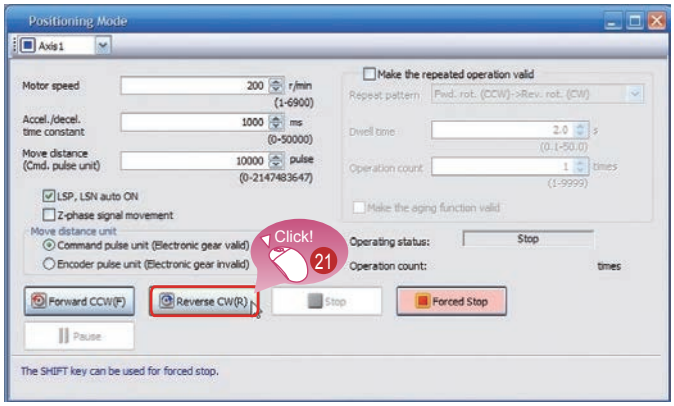


20 In the dialog box that appears, as shown to the right, click [OK].



21 Click [Reverse CW].

You can see the ball screw turn once in the direction of [Reverse CW].
This ball screw travels 5 mm per revolution of the motor and therefore moved 5 mm in the [Reverse CW] direction.



3.4 Programs

The DVD for this training material contains sample programs for positioning operations, which are demonstrated in the 3.3 Position Control video for this material.
It contains programs for MELSEC iQ-R, iQ-F, Q, L, and F Series. Use the program that is compatible with your model.
* See the manuals of each programmable controller for how to write the program.

Model configuration for the sample programs

Series	Model configuration	Sample program
iQ-R	- R35B (Main base unit) - R61P (Power supply module) - R04CPU (CPU module) - RD75D2 (Positioning module)	- Sample program_iQ-R.gx3
iQ-F*	- FX5U-32MT/ES (CPU module)	- Sample program_FX5U.gx3
Q	- Q33B (Main base unit) - Q62P (Power supply module) - Q03UDVCPU (CPU module) - QD75D1N (Positioning module)	- Sample program_Q.gxw
L	- L61P (Power supply module) - L02CPU (CPU module) - LD75D1 (Positioning module)	- Sample program_L.gxw
F*	- FX3U-32MT/ES (Main unit)	- Sample program_FX3U.gxw

* iQ-F and F Series use built-in positioning functions.

- iQ-R

(1) Program

(2) Module parameters

Changes from the initial values are as follows:

Basic parameter	Axis 1	Unit
Unit setting	0: mm	
No. of pulses per rotation (16 bits)	10000	pulse
Movement amount per rotation (16 bits)	5000	μm
No. of pulses per rotation (32 bits)	4194304	pulse
Movement amount per rotation (32 bits)	5000	μm
Basic parameter 2	Axis 1	Unit
Speed limit value	75000	mm/min
Acceleration time 0	100	ms
Deceleration time 0	100	ms
Detailed parameter 1	Axis 1	Unit
Command in-position width	10	μm
Detailed parameter 2	Axis 1	Unit
JOG speed limit value	5000	mm/min
Allowable circular interpolation error width	10	μm
OPR basic parameter	Axis 1	Unit
OPR direction	1: Negative direction (Address decrease direction)	
OPR speed	2000	mm/min
Creep speed	1000	mm/min
OPR retry	1: Perform the OPR retry with limit switches	

(3) Table data (Axis 1 positioning data)

The setting is as follows:

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
1	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
2	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
3	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
4					
5	1: Continuous positioning control	83H: LOOP Beginning of LOOP-to-LEND processing			
6	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
7	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
8	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
9	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
10	0: Positioning complete	84H: LEND End of LOOP-to-LEND processing			
11	0: Positioning complete	02H: INC1 1-axis linear control (INC)		0: Acceleration time 0	0: Deceleration time 0
12	1: Continuous positioning control	83H: LOOP Beginning of LOOP-to-LEND processing			
13	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
14	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
15	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
16	1: Continuous positioning control	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0
17	1: Continuous positioning control	84H: LEND End of LOOP-to-LEND processing			
18	0: Positioning complete	02H: INC1 1-axis linear control (INC)		0: Acceleration time 0	0: Deceleration time 0

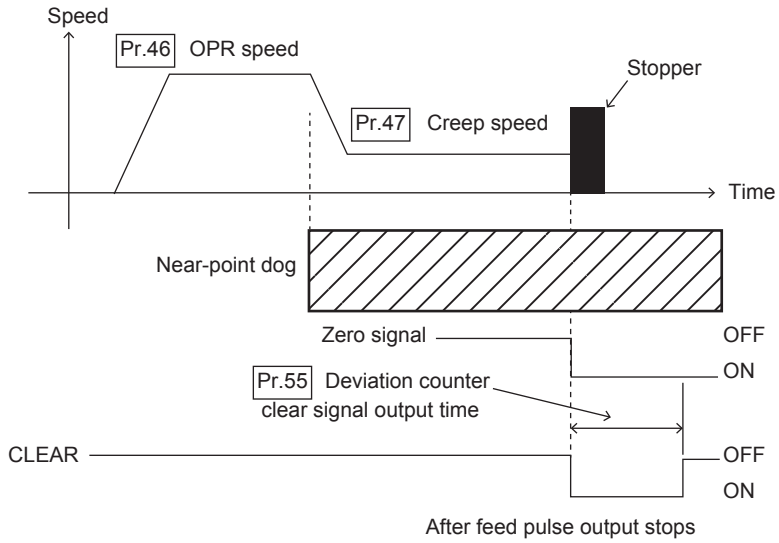
No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
1	0	0	2000	0	0			
2	80000	0	2000	0	0			
3	130000	0	2000	0	0			
4	0	0	0					
5	0	0	0		2			
6	80000	0	2000	500	0			
7	0	0	2000	500	0			
8	130000	0	2000	500	0			
9	0	0	2000	500	0			
10	0	0	0					
11	0	0	1000	0				
12	0	0	0		2			
13	80000	0	20000	500	0			
14	0	0	20000	500	0			

No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
15	130000	0	20000	500	0			
16	0	0	20000	500	0			
17	0	0	0					
18	0	0	2000	0				

(4) Signal name

The following signal names are used.

Signal name	Axis No.	Signal details (Negative logic is selected as the external I/O signal logic.)
	Axis 1	
Zero signal (+5V) (PG05)	1A9	- The zero signal is input for machine OPR. The zero signal of pulse encoder is used. - The signal is used as well when the machine OPR method is the stopper method and the OPR complete is input from an external source. - The zero signal is detected when it turns on.
Zero signal common (PG0COM)	1A10	Common for the zero signal (+5V) and zero signal (+24V)
Pulse output F (PULSE F)	1A15	The positioning pulses and pulse codes are output to the drive unit compatible with the transistor output system. (RD75P[] only)
Pulse output F common (PULSE COM)	1A16	
Pulse output R (PULSE R)	1A17	
Pulse output R common (PULSE COM)	1A18	
Upper limit signal (FLS)	1A1	- The signal is input from the limit switch installed at the upper limit position of the stroke. - Positioning stops when this signal turns off. - When the OPR retry function is enabled, this becomes the upper limit to find the near-point dog signal.
Lower limit signal (RLS)	1A2	- The signal is input from the limit switch installed at the lower limit position of the stroke. - Positioning stops when this signal turns off. - When the OPR retry function is enabled, this becomes the lower limit to find the near-point dog signal.
Near-point dog signal (DOG)	1A3	- This signal is used to detect the near-point dog for machine OPR. - The near-point dog signal is detected when it turns on.
Common (COM)	1A6 1A7	Common for the upper/lower limit signal, near-point dog signal, stop signal, and external command signal.
Drive unit READY signal (READY)	1A11	- This signal turns on when the drive unit is normal and can accept the feed pulse. - The RD75 checks the drive unit READY signal, and outputs the OPR request if the system is not in the READY state. - This signal turns off if the drive unit is inoperable, like when the control power supply of the drive unit failed. - If this signal is turned off during positioning, the system stops. The system does not start even if this signal is turned on again. - When this signal turns off, the OPR complete signal also turns off.

Signal name	Axis No.	Signal details (Negative logic is selected as the external I/O signal logic.)
	Axis 1	
Drive unit READY common (RDYCOM)	1A12	Common for the drive unit READY signal
Deviation counter clear signal (CLEAR)	1A13	This signal is output during machine OPR. (Note that the signal is not output in the count method 2.) Example: When machine OPR is carried out in the stopper method 2  - Set the output time of the deviation counter clear signal in [Pr.55] Deviation counter clear signal output time. - Use the drive unit that can reset the droop pulse amount in the deviation counter when the RD75 turns on this signal. Note: The deviation counter clear signal is output by the RD75 during machine OPR. A user cannot output the signal at will.
Deviation counter clear common (CLRCOM)	1A14	Common for the deviation counter clear signal

(5) Servo parameters (used for iQ-R, Q, and L Series in common)

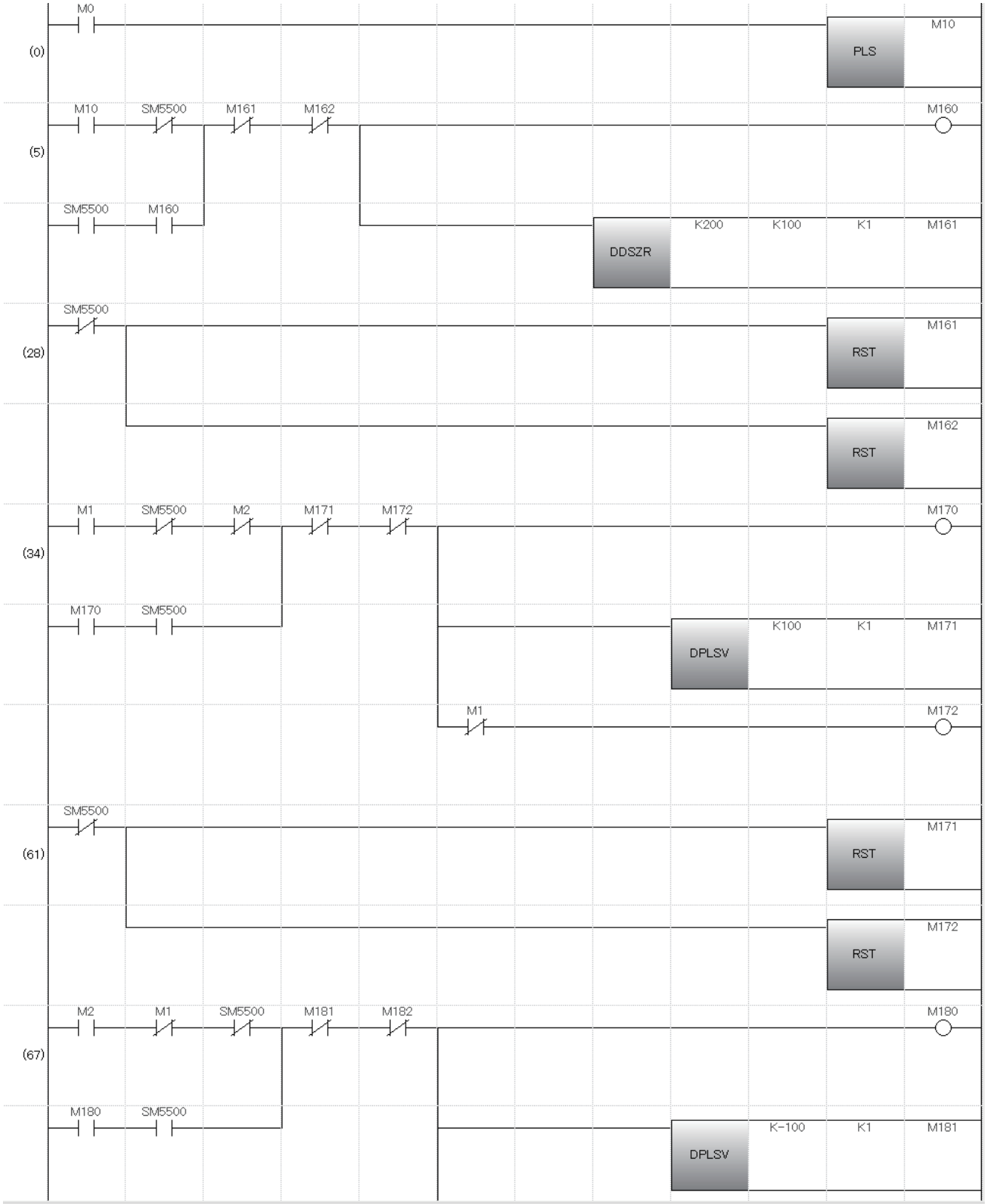
The following parameters are created by using MR Configurator2.

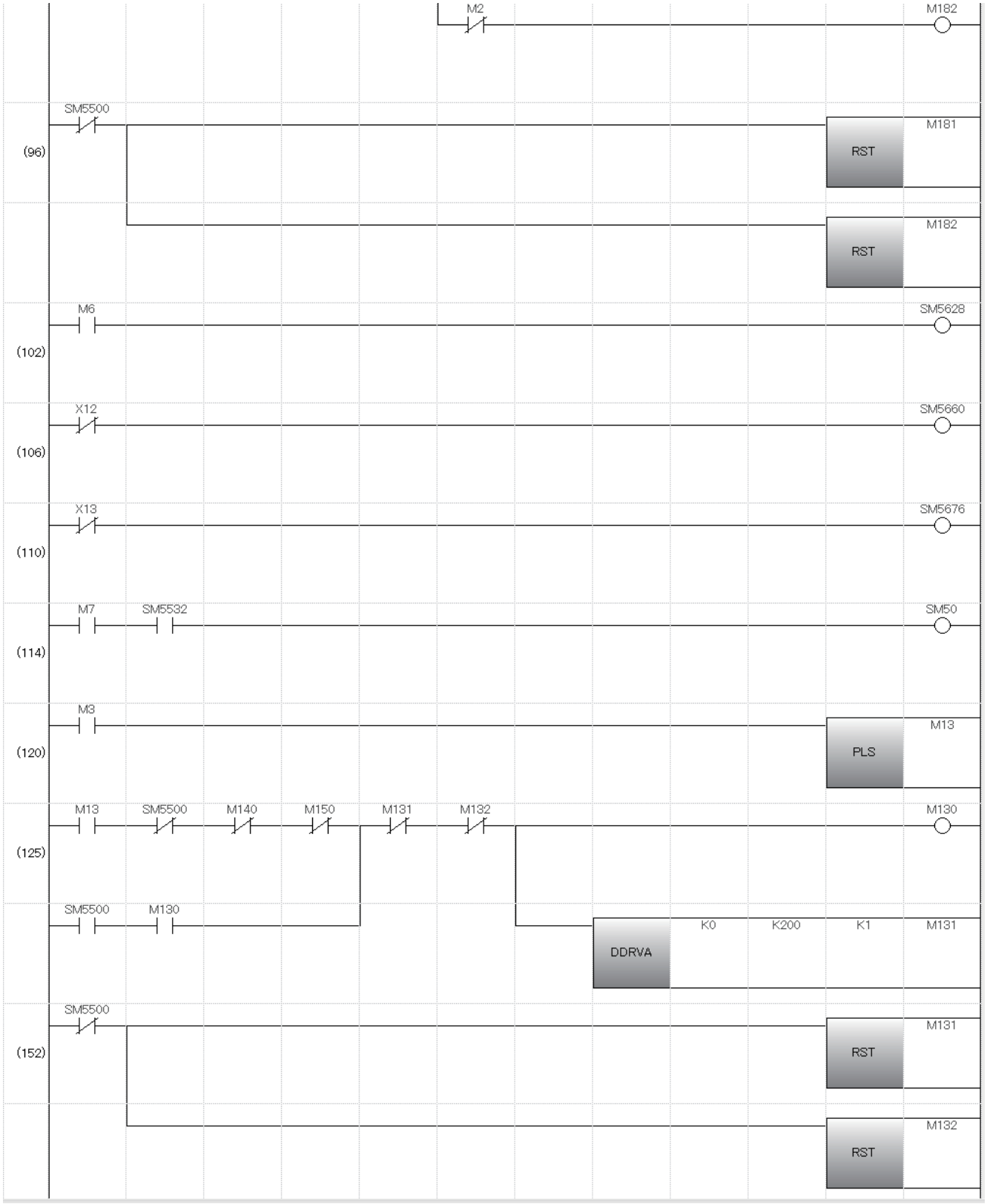
MR-J4-A(-RJ) Standard

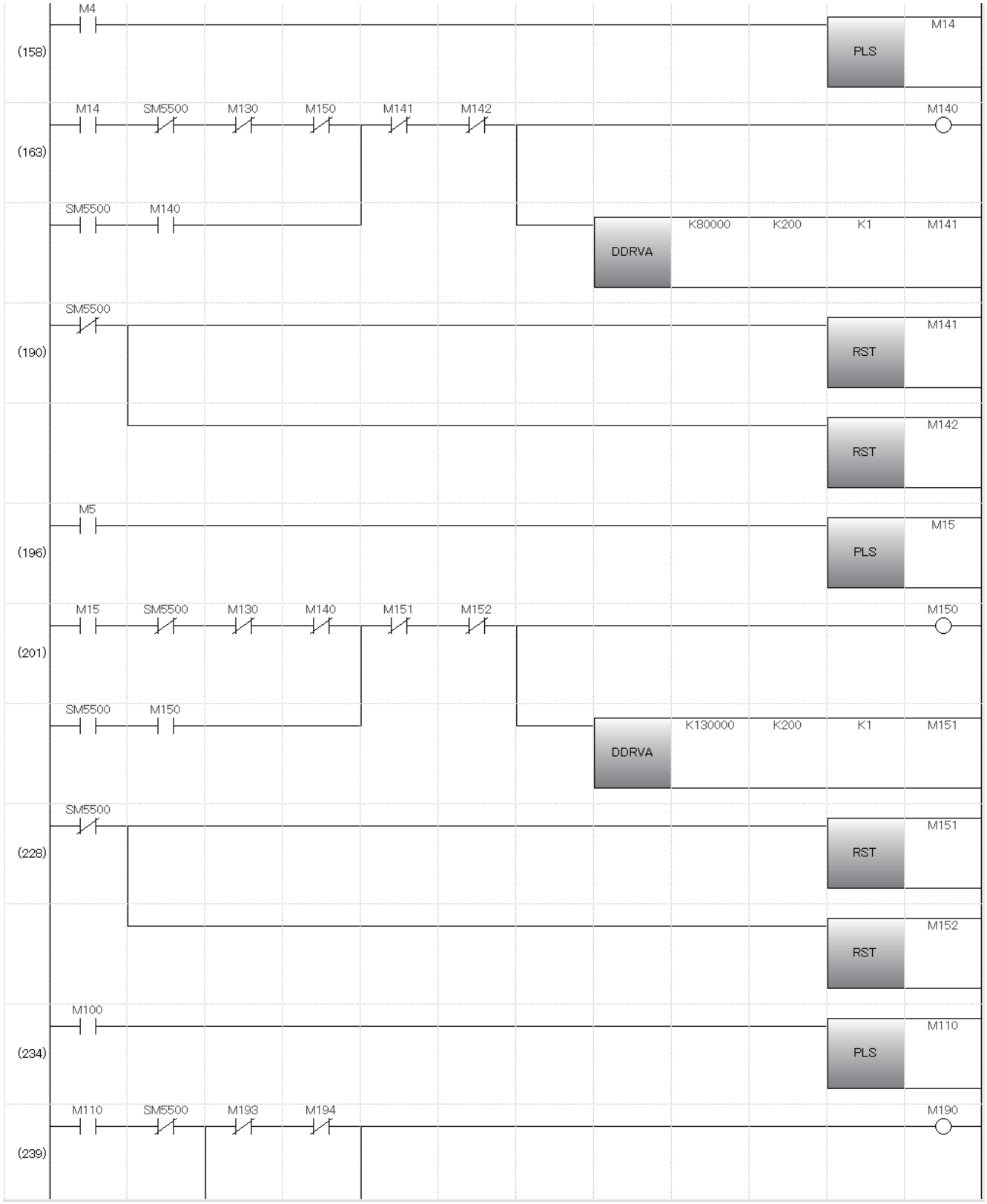
No.	Abbr.	Name	Setting value	Unit	Setting range
PA08	ATU	Auto tuning mode	4		0000-0004
PA09	RSP	Auto tuning response	32		1-40
PA13	*PLSS	Command pulse input status	211		0000-0412
PA14	*POL	Rotation direction selection	1		0-1
PA21	*AOP3	Function selection A-3	1001		0000-3001
PB06	GD2	Load inertia moment ratio	0.1	times	0.00-300.00
PB07	PG1	Model loop gain	479	rad/s	1.0-2000.0
PB08	PG2	Position loop gain	477	rad/s	1.0-2000.0
PB09	VG2	Speed loop gain	2267	rad/s	20-65535
PB10	VIC	Speed integral compensation	2.6	ms	0.1-1000.0
PB17	NHF	Shaft resonance suppression filter	102		0000-031F
PB18	LPF	Low-pass filter setting	18000	rad/s	100-18000
PB23	VFBF	Low-pass filter selection	1		0000-1022
PC37	VCO	Analog speed command offset	23	mV	-9999-9999

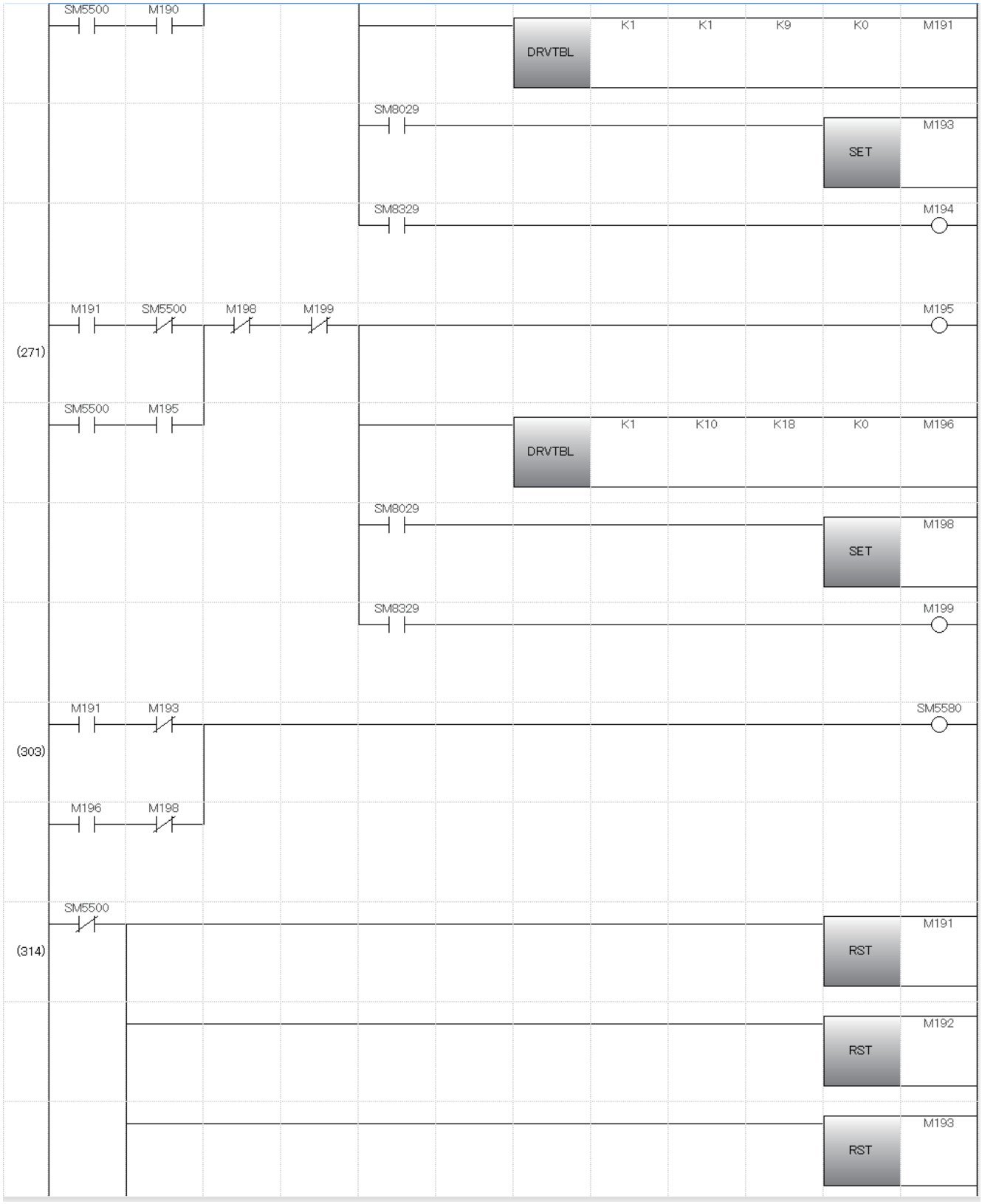
- iQ-F

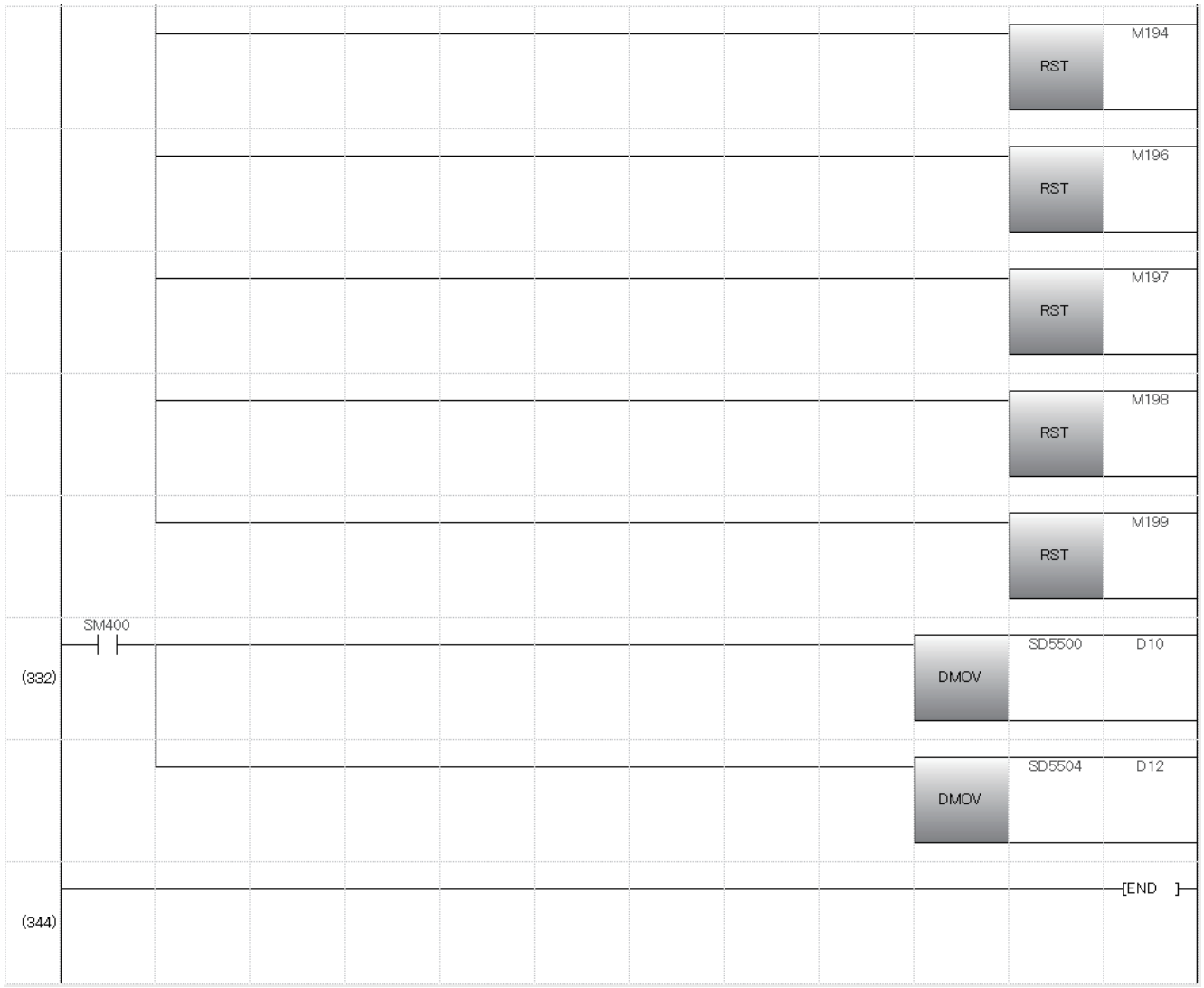
(1) Program




M2
M182
SM5500
(96)
RST
M181
RST
M182
M6
SM5628
(102)
X12
SM5660
(106)
X13
SM5676
(110)
M7
SM5532
SM50
(114)
M3
(120)
PLS
M13
M13
SM5500
M140
M150
M131
M132
M130
(125)
SM5500
M130
DDRVA
K0
K200
K1
M131
SM5500
(152)
RST
M131
RST
M132


(158)
M4
PLS
M14
(163)
M14
SM5500
M130
M150
M141
M142
M140
SM5500
M140
DDRVA
K80000
K200
K1
M141
(190)
SM5500
RST
M141
RST
M142
(196)
M5
PLS
M15
(201)
M15
SM5500
M130
M140
M151
M152
M150
SM5500
M150
DDRVA
K130000
K200
K1
M151
(228)
SM5500
RST
M151
RST
M152
(234)
M100
PLS
M110
(239)
M110
SM5500
M193
M194
M190


SM5500
M190
DRVTBL
K1
K1
K9
K0
M191
SM8029
SET
M193
SM8329
M194
(271)
M191
SM5500
M198
M199
M195
SM5500
M195
DRVTBL
K1
K10
K18
K0
M196
SM8029
SET
M198
SM8329
M199
(303)
M191
M193
SM5580
M196
M198
(314)
SM5500
RST
M191
RST
M192
RST
M193



(2) Assignment

The settings are as follows:

I/O assignment

Signal assignment	I/O No.	Connection destination
Pulse train (Pulse output destination)	Y000	Servo amplifier
Rotation (Rotation direction signal)	Y002	
Clear signal	Y001	
Zero signal	X002	
Servo ready	Not used	
Near-point signal (DOG)	X001	Sensor
LSF	X012	
LSR	X013	

Signal assignment	I/O No.	Connection destination
Immediate stop command	M6	GOT
Error reset command	M7	
OPR command	M0	
JOG+ command	M1	
JOG- command	M2	
Point A positioning operation command	M3	
Point B positioning operation command	M4	
Point C positioning operation command	M5	
Automatic operation command	M100	
Current value [μm]	D10	
	D11	
Current speed [cm/min]	D12	
	D13	

Related devices

Name	Device No.	Setting details or status
Instruction execution complete flag	SM8029	
Instruction execution abnormal end flag	SM8329	
Positioning instruction activation	SM5500	
OPR command	M10	
During OPR operation	M160	
OPR Instruction execution complete	M161	
OPR Instruction execution abnormal end	M162	
JOG+ During operation	M170	
JOG+ Instruction execution complete	M171	
JOG+ Instruction execution abnormal end	M172	
JOG- During operation	M180	
JOG- Instruction execution complete	M181	
JOG- Instruction execution abnormal end	M182	
Immediate stop command (Pulse output stop command)	SM5628	
LSF	SM5660	X12
LSR	SM5676	X13
Error reset	SM50	
Always ON	SM400	
Positioning axis 1 positioning error occur	SM5532	
Point A positioning operation command	M13	
Moving to point A	M130	
Point A positioning operation command execution complete	M131	
Point A positioning operation command execution abnormal end	M132	
Point B positioning operation command	M14	
Moving to point B	M140	

Name	Device No.	Setting details or status
Point B positioning operation command execution complete	M141	
Point B positioning operation command execution abnormal end	M142	
Point C positioning operation command	M15	
Moving to point C	M150	
Point C positioning operation command execution complete	M151	
Point C positioning operation command execution abnormal end	M152	
Automatic operation command	M110	
Automatic operation low speed operation	M190	
Automatic operation low speed operation execution complete	M191	
Automatic operation low speed operation execution abnormal end	M192	
Automatic operation low speed operation command execution complete	M193	
Automatic operation low speed operation command execution abnormal end	M194	
Automatic operation high speed operation	M195	
Automatic operation high speed operation execution complete	M196	
Automatic operation high speed operation execution abnormal end	M197	
Automatic operation high speed operation command execution complete	M198	
Automatic operation high speed operation command execution abnormal end	M199	
Table shift command	SM5580	
Current value [μm]	SD5500	
	SD5501	
Current speed [cm/min]	SD5504	
	SD5505	

(3) Module parameters

The settings are as follows:

High Speed I/O (Output Function → Positioning → Detailed Setting → Basic Settings)

Basic Parameter 1	
Pulse Output Mode	1: PULSE/SIGN
Output Device (PULSE/CW)	Y0
Output Device (SIGN/CCW)	Y2
Rotation Direction Setting	0: Current Address Increment with Forward Run Pulse Output
Unit Setting	1: Machine System (um, cm/min)
Number of Pulses per Rotation	1500 pulse
Movement Amount per Rotation	5000 μm
Positioning Data Magnification	1: X Single
Basic Parameter 2	
Interpolation Speed Specification Method	0: Composite Speed
Max. Speed	4000 cm/min
Bias Speed	0 cm/min
Acceleration Time	100 ms
Deceleration Time	100 ms
Detailed Setting Parameter	
External Start Signal Enable/Disable	0: Invalid
External Start Signal Device No.	X0
External Start Signal Logic	0: Positive Logic
Interrupt Input Signal 1 Enable/Disable	0: Invalid
Interrupt Input Signal 1 Mode	0: High Speed Mode
Interrupt Input Signal 1 Device No.	X0
Interrupt Input Signal 1 Logic	0: Positive Logic
Interrupt Input Signal 2 Logic	0: Positive Logic
OPR Parameter	
OPR Enable/Disable	1: Valid
OPR Direction	0: Negative Direction (Address Decrement Direction)
Starting Point Address	0 μm
Clear Signal Output Enable/Disable	1: Valid
Clear Signal Output Device No.	Y1
OPR Dwell Time	0 ms
Near-point Dog Signal Device No.	X1
Near-point Dog Signal Logic	0: Positive Logic
Zero Signal Device No.	X2
Zero Signal Logic	0: Positive Logic
Zero Signal OPR Zero Signal Counts	1
Zero Signal Count Start Time	0: Near-point Dog Latter Part

Input response time

Item	Setting
X1	10 μs
X2	10 μs

(4) Table data

The setting is as follows:

Axis 1 Tabel data

No.	Control Method	Axis to be Interpolated	Positioning Address	Command Speed	Dwell Time	Interrupt Counts	Interrupt Input Signal 2 Device No.	Jump Destination Table No.	M No. for Jump Condition
1	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	80000 μm	200 cm/min	500 ms	1	X0	1	0
2	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	200 cm/min	500 ms	1	X0	1	0
3	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	130000 μm	200 cm/min	500 ms	1	X0	1	0
4	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	200 cm/min	500 ms	1	X0	1	0
5	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	80000 μm	200 cm/min	500 ms	1	X0	1	0
6	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	200 cm/min	500 ms	1	X0	1	0
7	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	130000 μm	200 cm/min	500 ms	1	X0	1	0
8	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	200 cm/min	500 ms	1	X0	1	0
9	0: No Positioning	Axis 2 Specification	0 μm	1 cm/min	0 ms	1	X0	1	0
10	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	80000 μm	2000 cm/min	500 ms	1	X0	1	0
11	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	2000 cm/min	500 ms	1	X0	1	0
12	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	130000 μm	2000 cm/min	500 ms	1	X0	1	0

No.	Control Method	Axis to be Interpolated	Positioning Address	Command Speed	Dwell Time	Interrupt Counts	Interrupt Input Signal 2 Device No.	Jump Destination Table No.	M No. for Jump Condition
13	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	2000 cm/min	500 ms	1	X0	1	0
14	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	80000 μm	2000 cm/min	500 ms	1	X0	1	0
15	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	2000 cm/min	500 ms	1	X0	1	0
16	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	130000 μm	2000 cm/min	500 ms	1	X0	1	0
17	2: 1 Speed Positioning (Absolute Address Specification)	Axis 2 Specification	0 μm	2000 cm/min	500 ms	1	X0	1	0
18	0: No Positioning	Axis 2 Specification	0 μm	1 cm/min	0 ms	1	X0	1	0
19	0: No Positioning	Axis 2 Specification	0 μm	1 cm/min	0 ms	1	X0	1	0
20	0: No Positioning	Axis 2 Specification	0 μm	1 cm/min	0 ms	1	X0	1	0

(5) Servo parameters (used for iQ-F and FX Series in common)

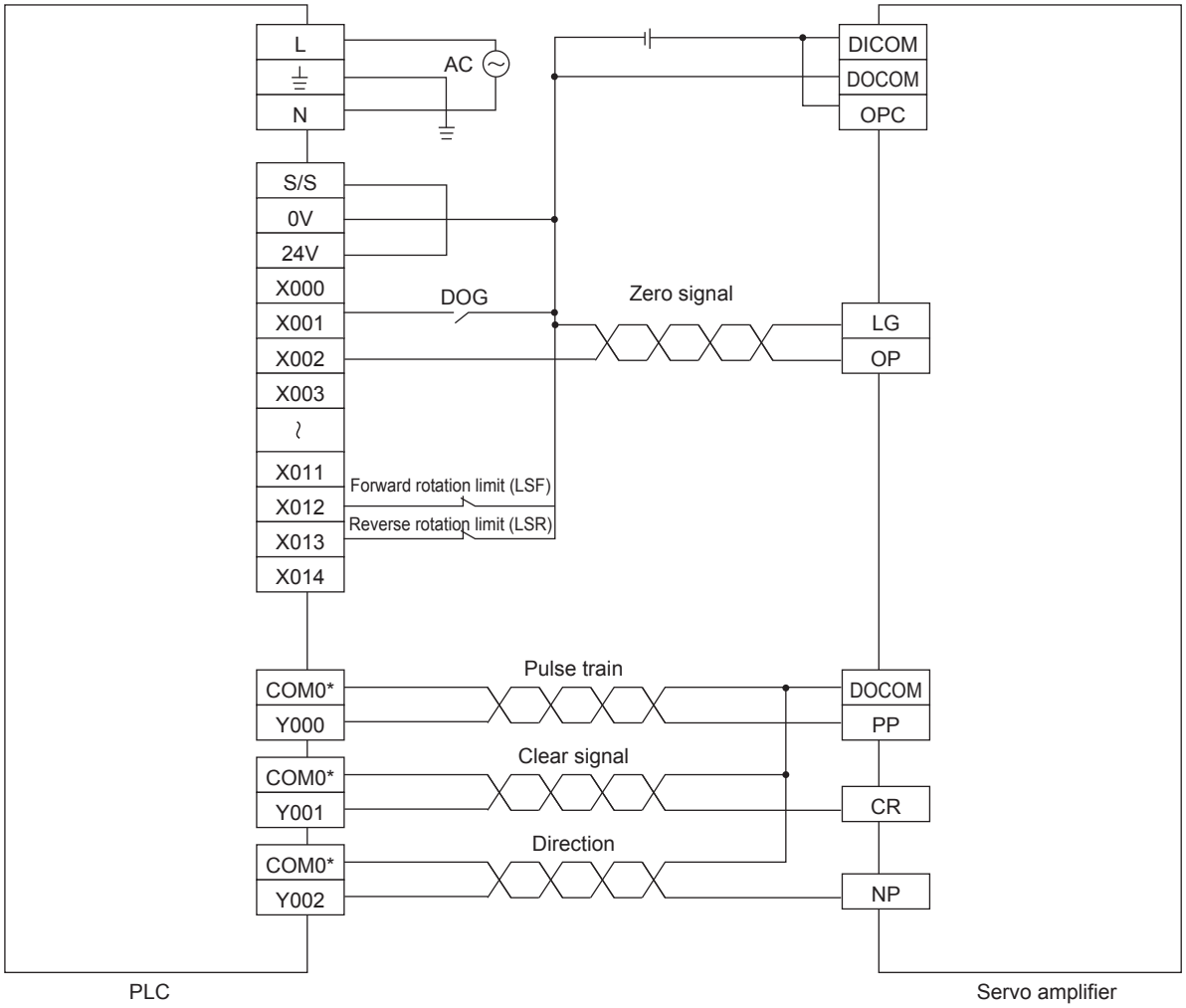
The following parameters are created by using MR Configurator2.

MR-J4-A(-RJ) Standard

No.	Abbr.	Name	Setting value	Unit	Setting range
PA05	*FBP	Number of command input pulses per revolution	1500		1000-1000000
PA08	ATU	Auto tuning mode	4		0000-0004
PA09	RSP	Auto tuning response	32		1-40
PA13	*PLSS	Command pulse input status	211		0000-0412
PA14	*POL	Rotation direction selection	1		0-1
PA21	*AOP3	Function selection A-3	1001		0000-3001
PB06	GD2	Load inertia moment ratio	0.1	times	0.00-300.00
PB07	PG1	Model loop gain	479	rad/s	1.0-2000.0
PB08	PG2	Position loop gain	477	rad/s	1.0-2000.0
PB09	VG2	Speed loop gain	2267	rad/s	20-65535
PB10	VIC	Speed integral compensation	2.6	ms	0.1-1000.0
PB17	NHF	Shaft resonance suppression filter	102		0000-031F
PB18	LPF	Low-pass filter setting	18000	rad/s	100-18000
PB23	VFBF	Low-pass filter selection	1		0000-1022
PC37	VCO	Analog speed command offset	23	mV	-9999-9999

(6) Connection diagram of I/O signals (used for iQ-F and FX Series in common)

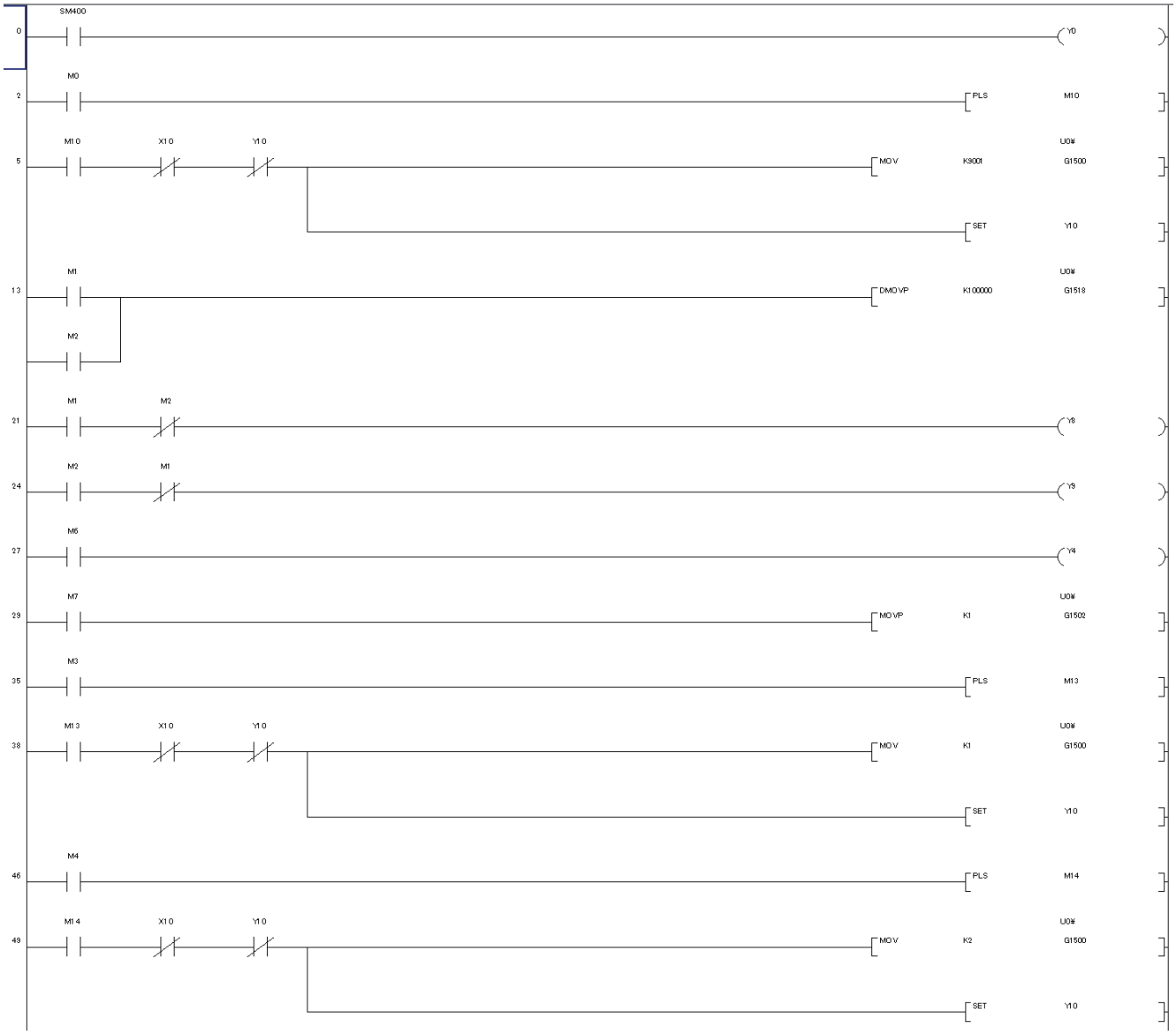
The connection is as follows:

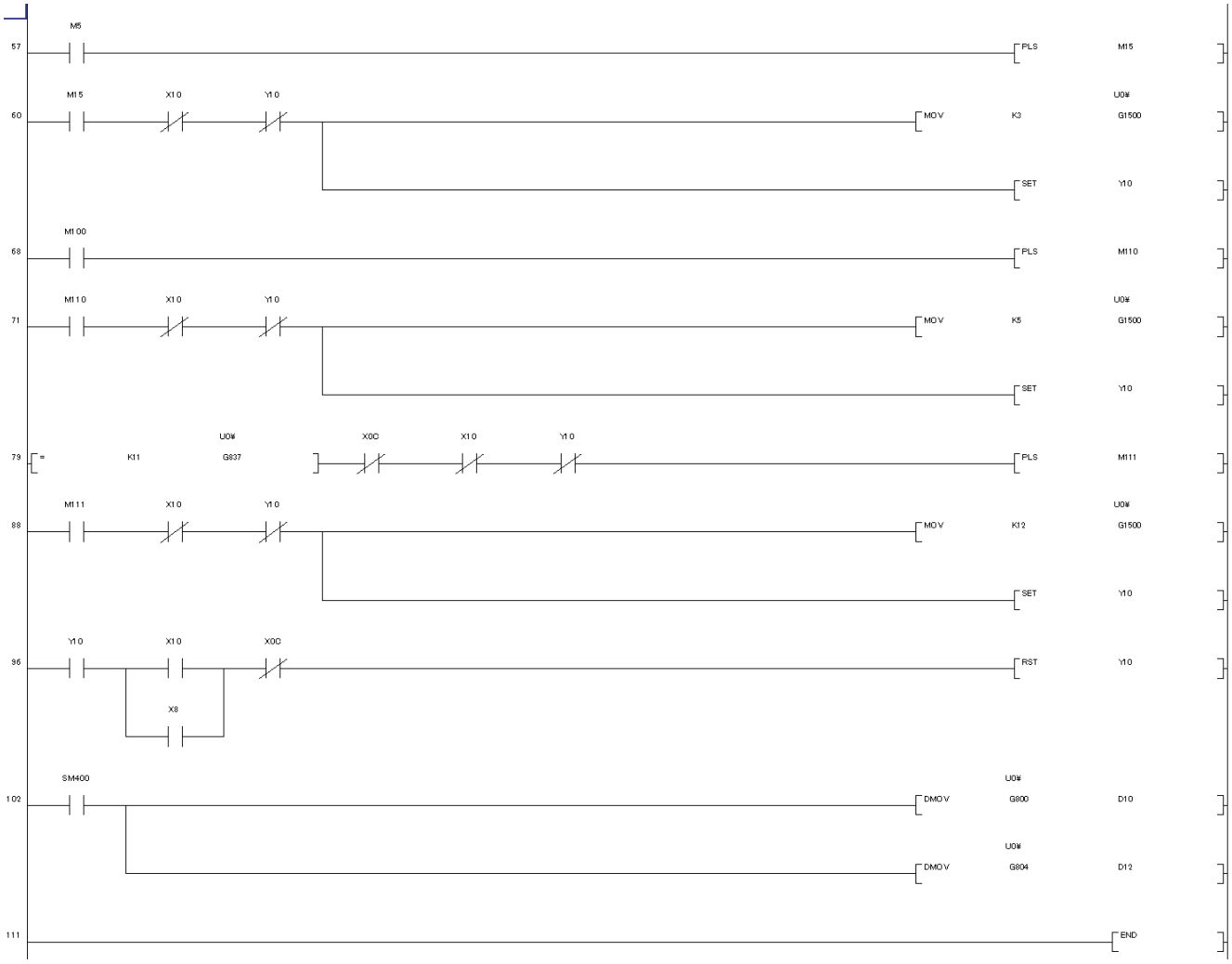


* FX5U: COM0
FX3U: COM1

- Q Series

(1) Program





(2) Assignment

The setting is as follows:

I/O assignment

Signal assignment	I/O No.	Connection destination
Error detection	X8	Servo amplifier
BUSY	XC	
Start complete	X10	
PLC READY	Y0	
Axis stop	Y4	
Forward run JOG start	Y8	
Reverse run JOG start	Y9	
Positioning start	Y10	

Signal assignment	I/O No.	Connection destination
OPR command	M0	GOT
JOG+ command	M1	
JOG- command	M2	
Point A positioning operation command	M3	
Point B positioning operation command	M4	
Point C positioning operation command	M5	
Stop command	M6	
Error reset command	M7	
Automatic operation command	M100	
Current value [mm]	D10, D11	
Current speed [mm/min]	D12, D13	

(3) Module parameters

Changes from the initial values are as follows:

Basic parameter		Unit
Unit setting	0: mm	
No. of pulses per rotation (16 bits)	10000	pulse
Movement amount per rotation (16 bits)	5000	μm
Basic parameter 2		**Unit**
Speed limit value	75000	mm/min
Acceleration time 0	100	ms
Deceleration time 0	100	ms
Detailed parameter 2		**Unit**
JOG speed limit value	5000	mm/min
OPR basic parameter		**Unit**
OPR direction	1: Negative direction (Address decrease direction)	
OPR speed	2000	mm/min
Creep speed	1000	mm/min
OPR retry	1: Perform the OPR retry with limit switches	

(4) Table data (Axis 1 positioning data)

The setting is as follows:

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
1	0: END	01h: ABS line 1	-	0: 100	0: 100
2	0: END	01h: ABS line 1	-	0: 100	0: 100
3	0: END	01h: ABS line 1	-	0: 100	0: 100
4					
5	1: CONT	83h: LOOP	-	0: 100	0: 100
6	1: CONT	01h: ABS line 1	-	0: 100	0: 100
7	1: CONT	01h: ABS line 1	-	0: 100	0: 100
8	1: CONT	01h: ABS line 1	-	0: 100	0: 100
9	1: CONT	01h: ABS line 1	-	0: 100	0: 100
10	1: CONT	84h: LEND	-	0: 100	0: 100
11	0: END	02: INC line 1	-	0: 100	0: 100
12	1: CONT	83h: LOOP	-	0: 100	0: 100
13	1: CONT	01h: ABS line 1	-	0: 100	0: 100

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
14	1: CONT	01h: ABS line 1	-	0: 100	0: 100
15	1: CONT	01h: ABS line 1	-	0: 100	0: 100
16	1: CONT	01h: ABS line 1	-	0: 100	0: 100
17	1: CONT	84h: LEND	-	0: 100	0: 100
18	0: END	02h: INC line 1	-	0: 100	0: 100

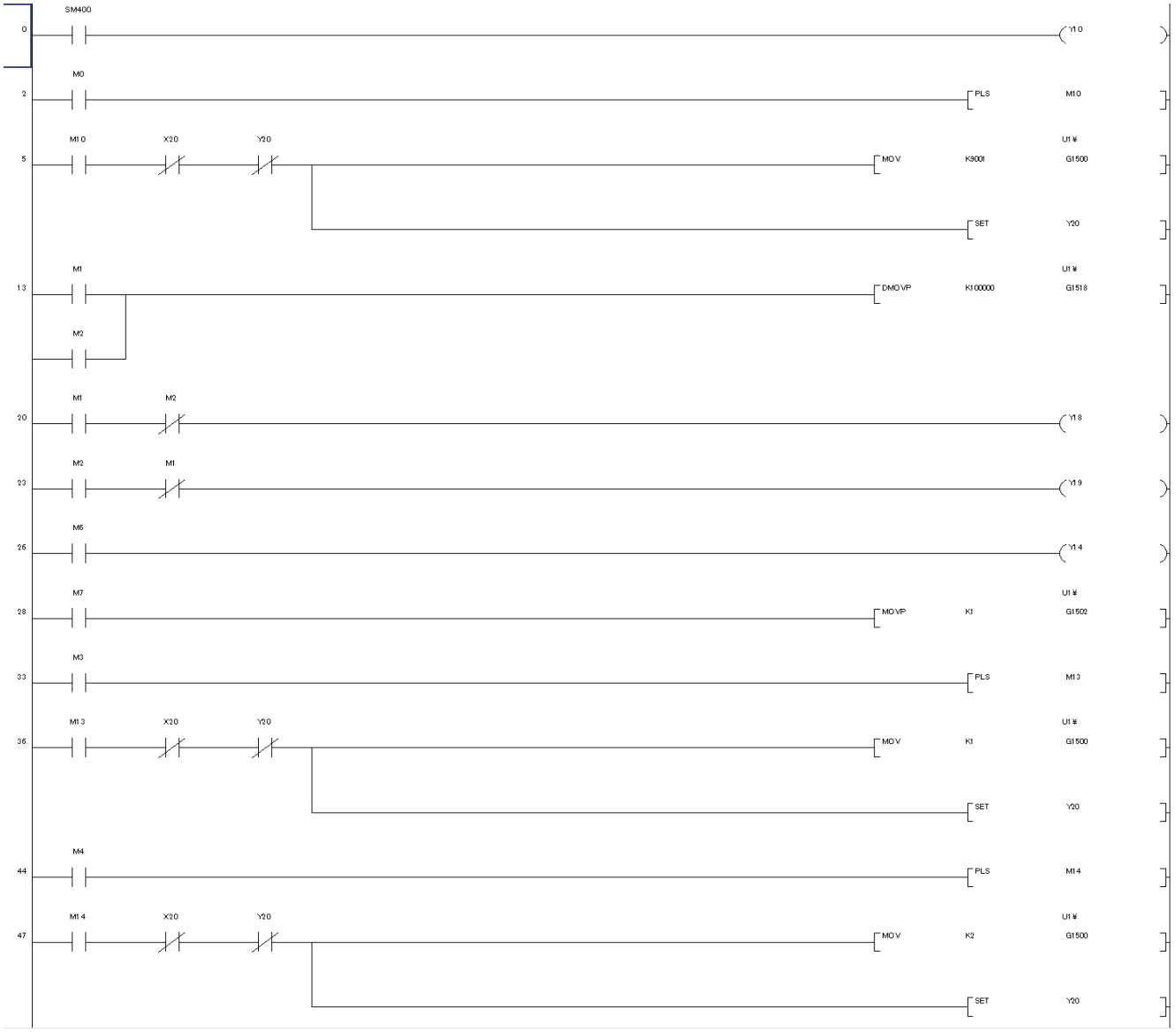
No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
1	0	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
2	80000	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
3	130000	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
4	0	0	0	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
5	0	0	0	0	2	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
6	80000	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
7	0	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
8	130000	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
9	0	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.

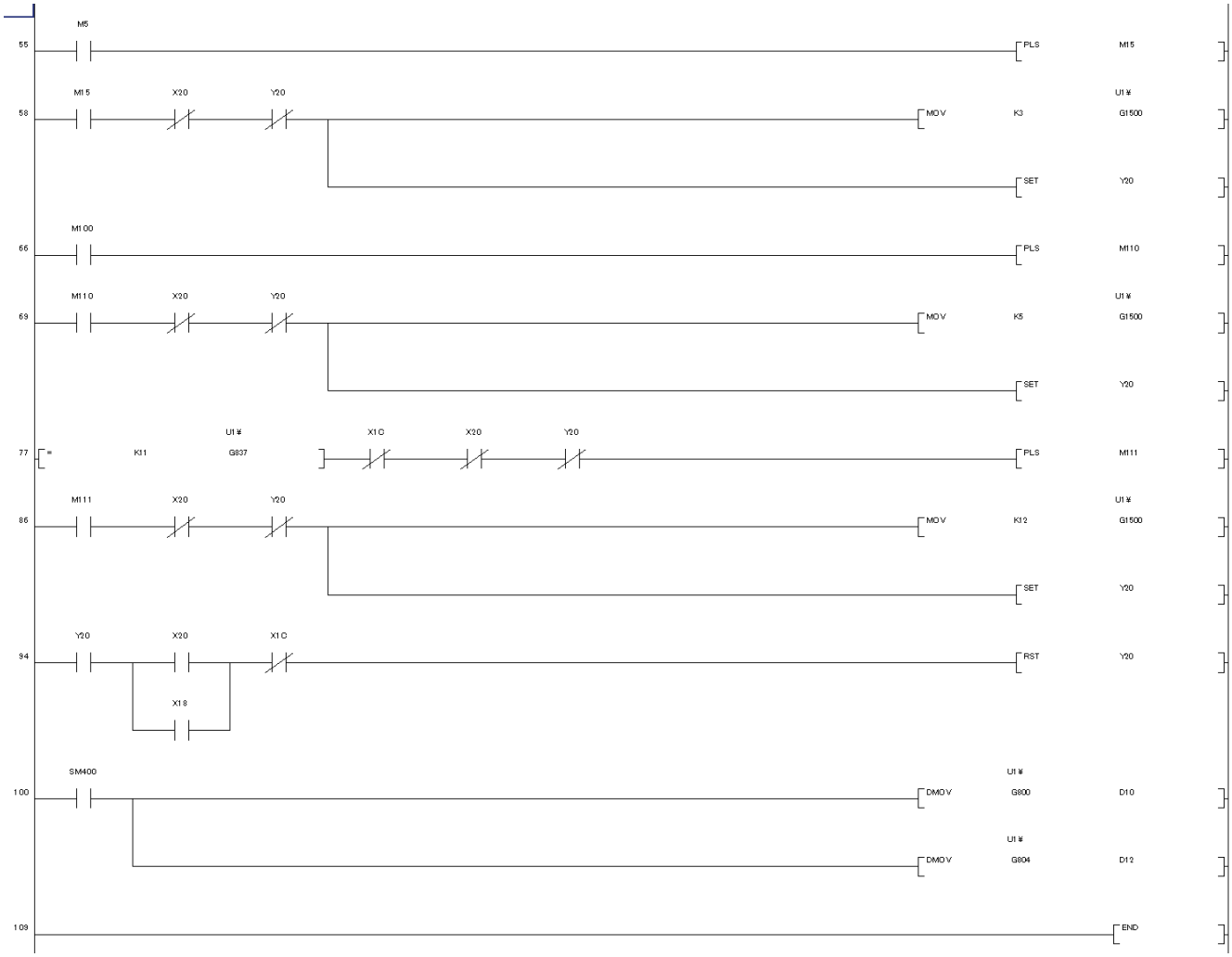
No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
10	0	0	0	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
11	0	0	1000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
12	0	0	0	0	2	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
13	80000	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
14	0	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
15	130000	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
16	0	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
17	0	0	0	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
18	0	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.

(5) Servo parameters (used for iQ-R, Q, and L Series in common) → See Page 3-25.

- L Series

(1) Program





(2) Assignment

The setting is as follows:

I/O assignment

Signal assignment	I/O No.	Connection destination
Error detection	X18	Servo amplifier
BUSY	X1C	
Start complete	X20	
PLC READY	Y10	
Axis stop	Y14	
Forward run JOG start	Y18	
Reverse run JOG start	Y19	
Positioning start	Y20	

Signal assignment	I/O No.	Connection destination
OPR command	M0	GOT
JOG+ command	M1	
JOG- command	M2	
Point A positioning operation command	M3	
Point B positioning operation command	M4	
Point C positioning operation command	M5	
Stop command	M6	
Error reset command	M7	
Automatic operation command	M100	
Current value [mm]	D10, D11	
Current speed [mm/min]	D12, D13	

(3) Module parameters

Changes from the initial values are as follows:

Basic parameter		Unit
Unit setting	0: mm	
No. of pulses per rotation (16 bits)	10000	pulse
Movement amount per rotation (16 bits)	5000	μm
Basic parameter 2		**Unit**
Speed limit value	75000	mm/min
Acceleration time 0	100	ms
Deceleration time 0	100	ms
Detailed parameter 2		**Unit**
JOG speed limit value	5000	mm/min
OPR basic parameter		**Unit**
OPR direction	1: Negative direction (Address decrease direction)	
OPR speed	2000	mm/min
Creep speed	1000	mm/min
OPR retry	1: Perform the OPR retry with limit switches	

(4) Table data (Axis 1 positioning data)

The setting is as follows:

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
1	0: END	01h: ABS line 1	-	0: 100	0: 100
2	0: END	01h: ABS line 1	-	0: 100	0: 100
3	0: END	01h: ABS line 1	-	0: 100	0: 100
4					
5	1: CONT	83h: LOOP	-	0: 100	0: 100
6	1: CONT	01h: ABS line 1	-	0: 100	0: 100
7	1: CONT	01h: ABS line 1	-	0: 100	0: 100
8	1: CONT	01h: ABS line 1	-	0: 100	0: 100
9	1: CONT	01h: ABS line 1	-	0: 100	0: 100
10	1: CONT	84h: LEND	-	0: 100	0: 100
11	0: END	02: INC line 1	-	0: 100	0: 100
12	1: CONT	83h: LOOP	-	0: 100	0: 100

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.
13	1: CONT	01h: ABS line 1	-	0: 100	0: 100
14	1: CONT	01h: ABS line 1	-	0: 100	0: 100
15	1: CONT	01h: ABS line 1	-	0: 100	0: 100
16	1: CONT	01h: ABS line 1	-	0: 100	0: 100
17	1: CONT	84h: LEND	-	0: 100	0: 100
18	0: END	02h: INC line 1	-	0: 100	0: 100

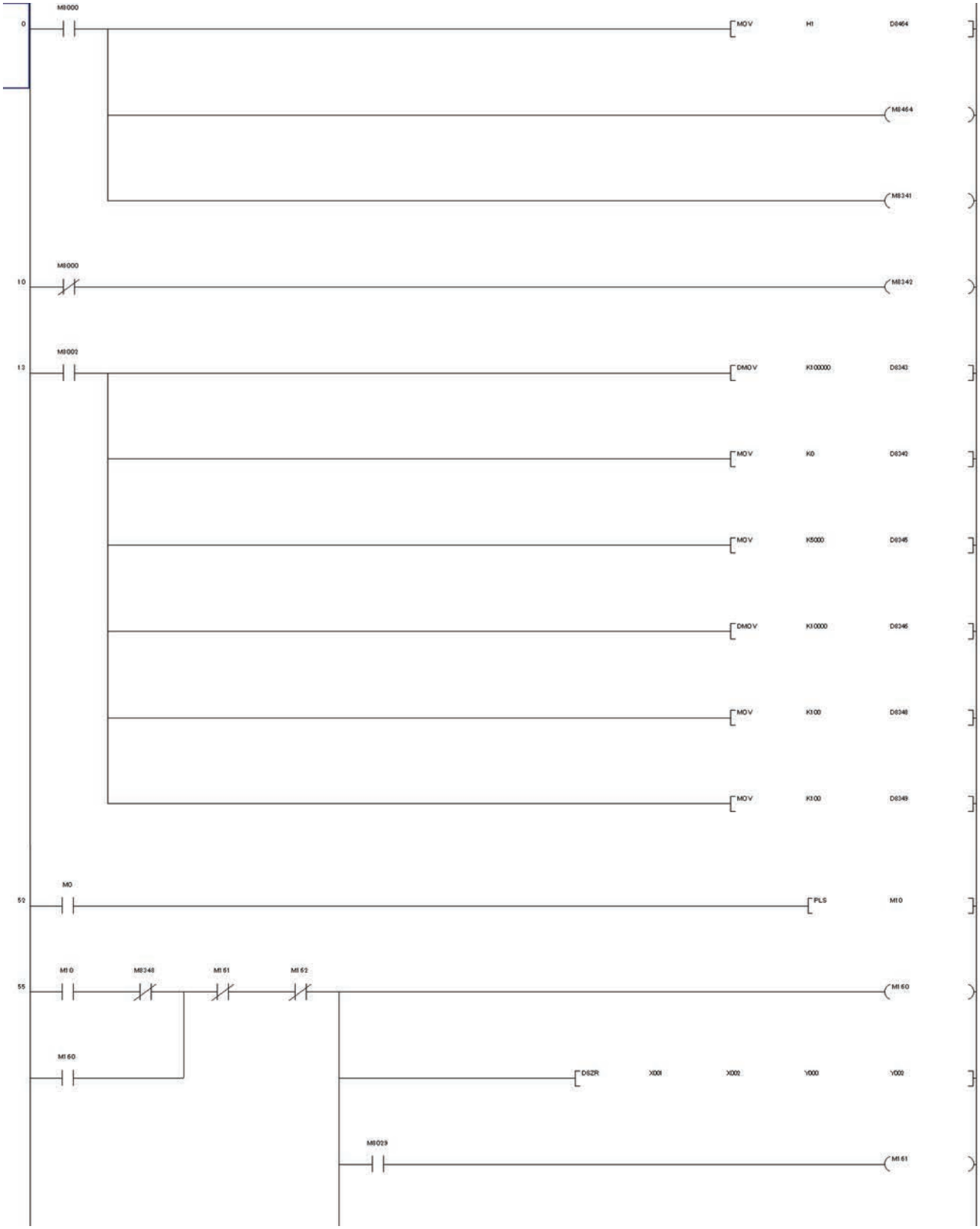
No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
1	0	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
2	80000	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
3	130000	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
4								
5	0	0	0	0	2	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
6	80000	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
7	0	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
8	130000	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
9	0	0	2000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.

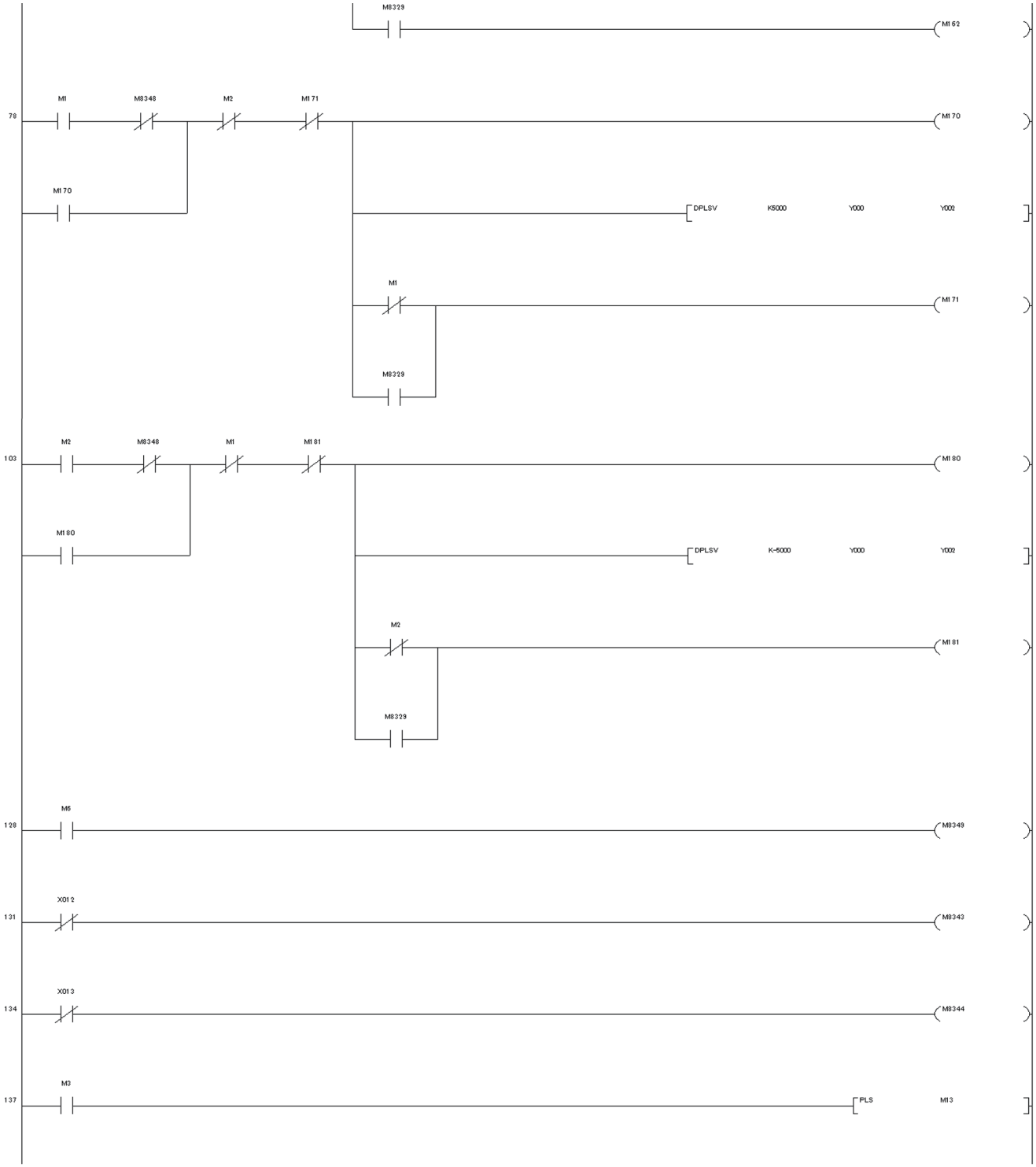
No.	Positioning address	Arc address	Command speed	Dwell time	M code	M code ON signal output timing	ABS direction in degrees	Interpolation speed specification method
10	0	0	0	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
11	0	0	1000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
12	0	0	0	0	2	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
13	80000	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
14	0	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
15	130000	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
16	0	0	20000	500	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
17	0	0	0	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.
18	0	0	2000	0	0	0: Use the set value in "M code ON signal output timing" in detailed parameters 1.	0: Use the set value in "ABS direction in unit of degree" of the axis control data.	0: Use the set value in "Interpolation speed designation method" in detailed parameters 1.

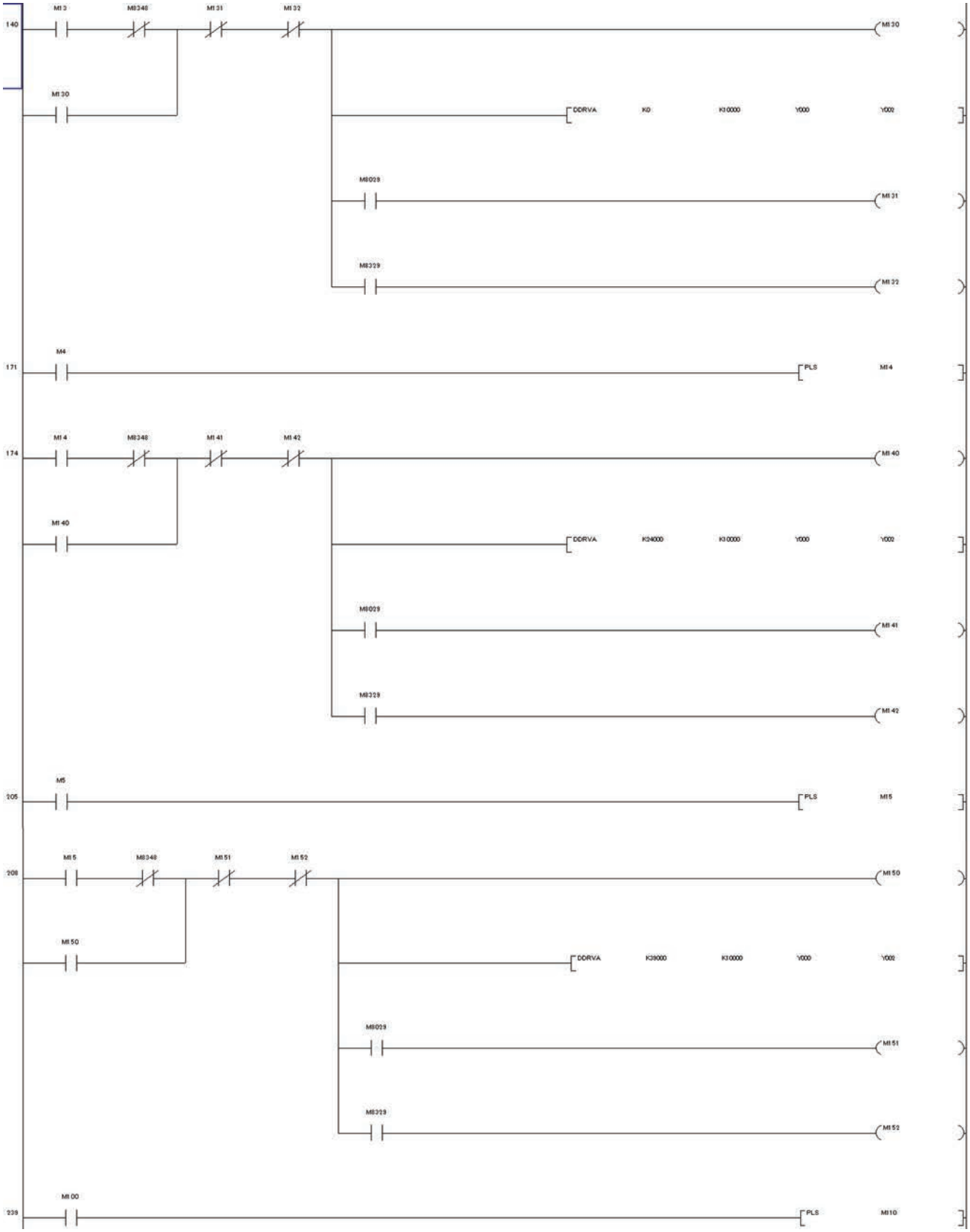
(5) Servo parameters (used for iQ-R, Q, and L Series in common) → See Page 3-25.

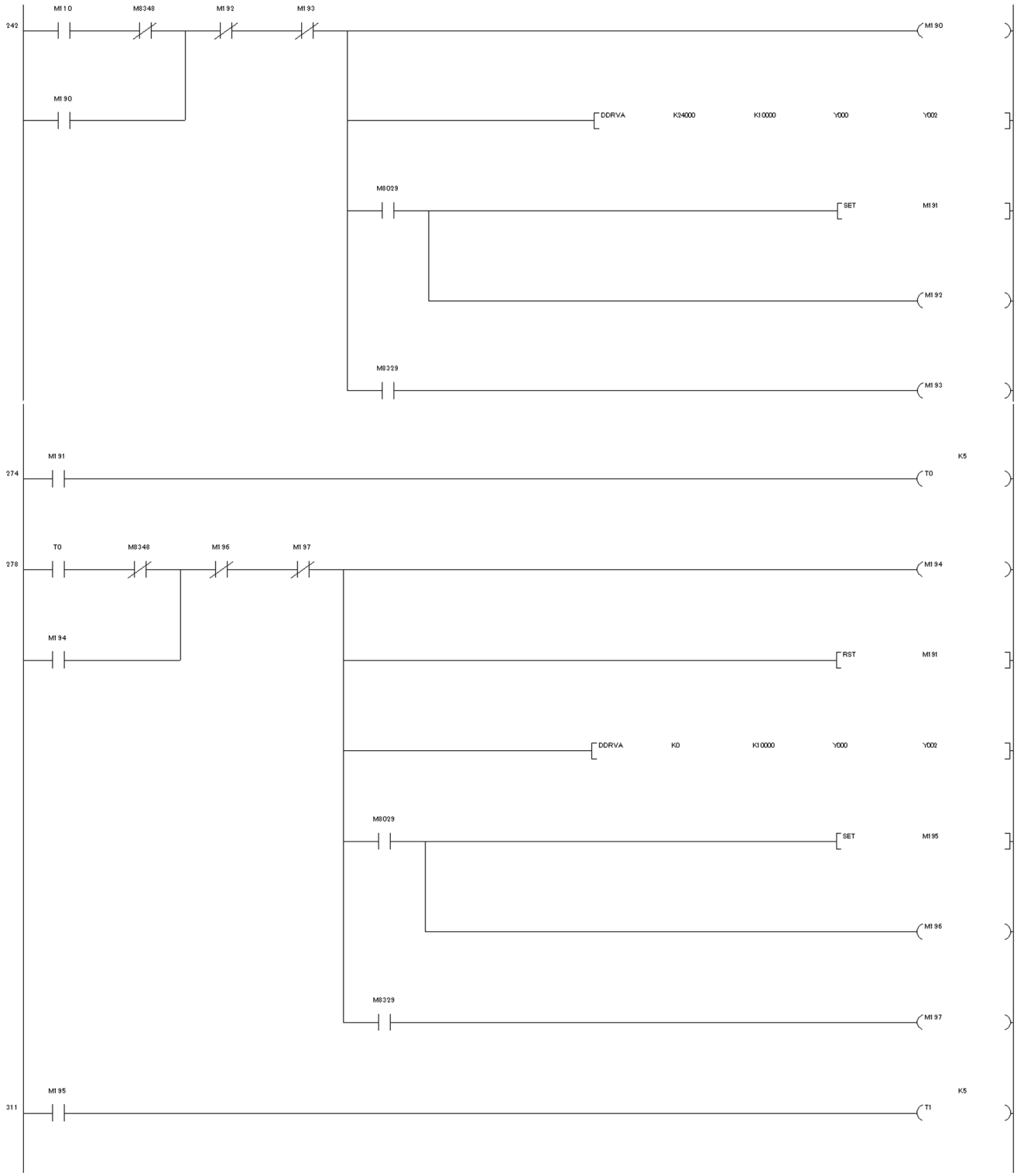
- F Series

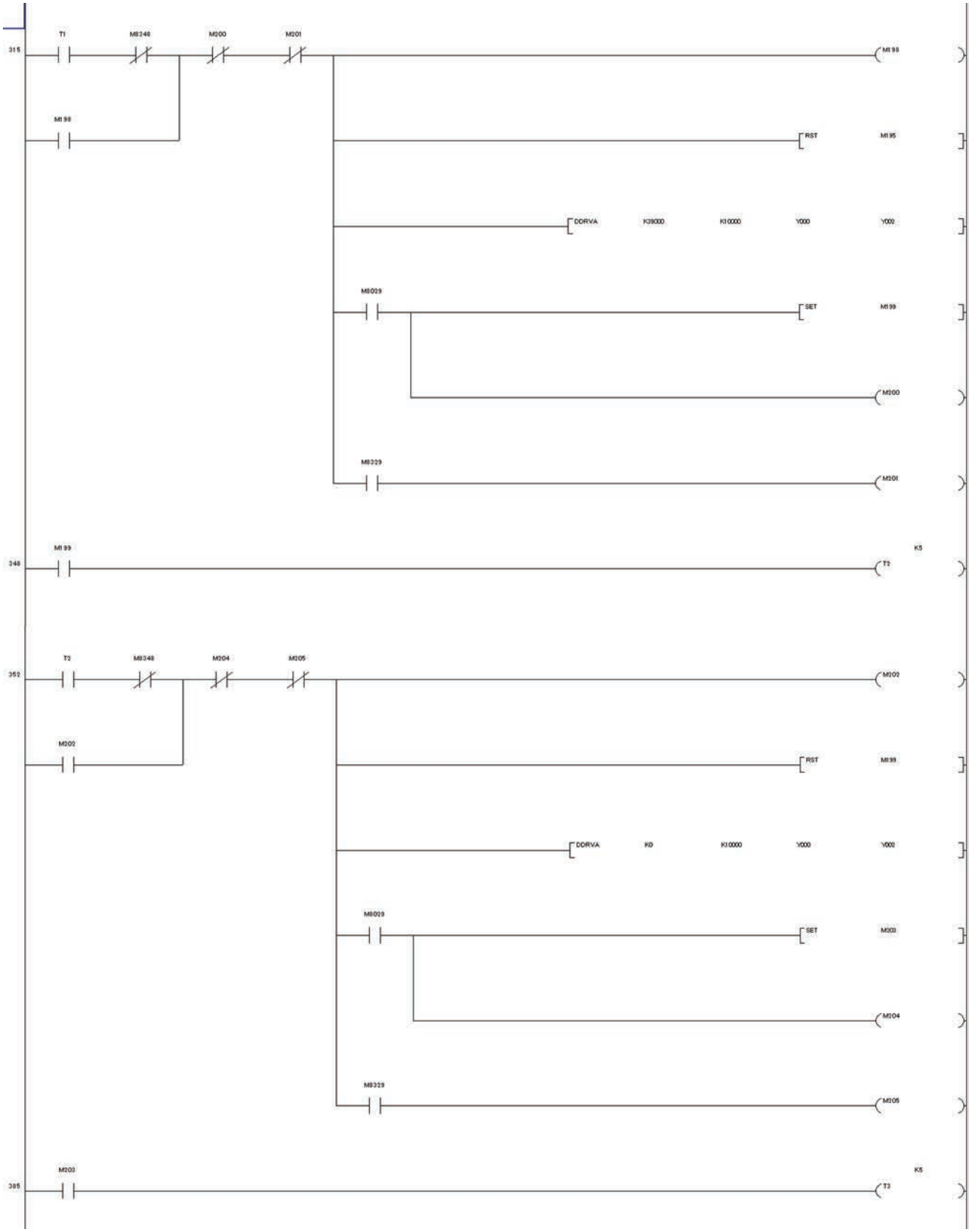
(1) Program



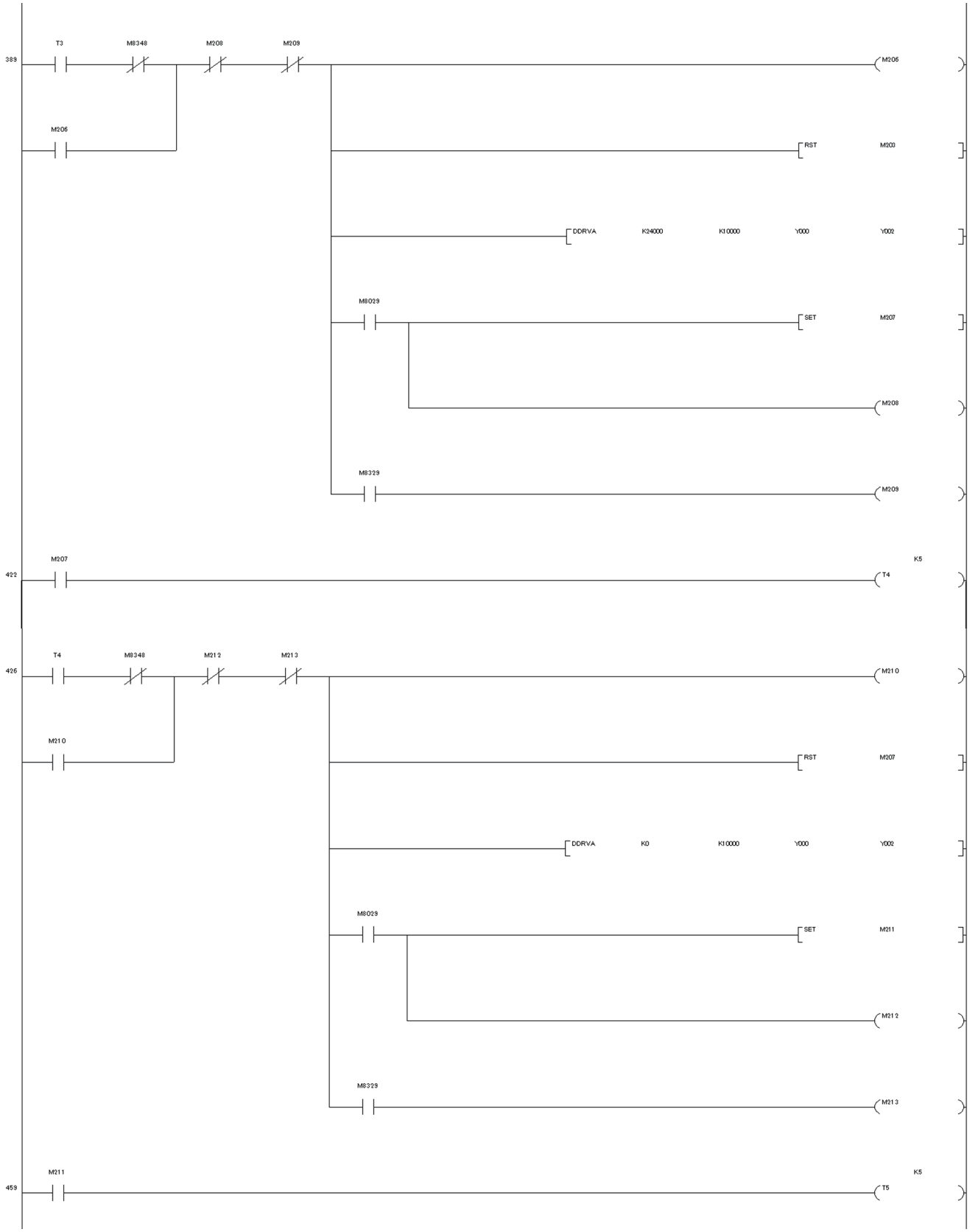

M8329
M162
78
M1
M8348
M2
M171
M170
M170
DPLSV
K5000
Y000
Y002
M1
M171
M8329
103
M2
M8348
M1
M181
M180
M180
DPLSV
K-5000
Y000
Y002
M2
M181
M8329
128
M6
M8349
131
X012
M8343
134
X013
M8344
137
M3
PLS
M13

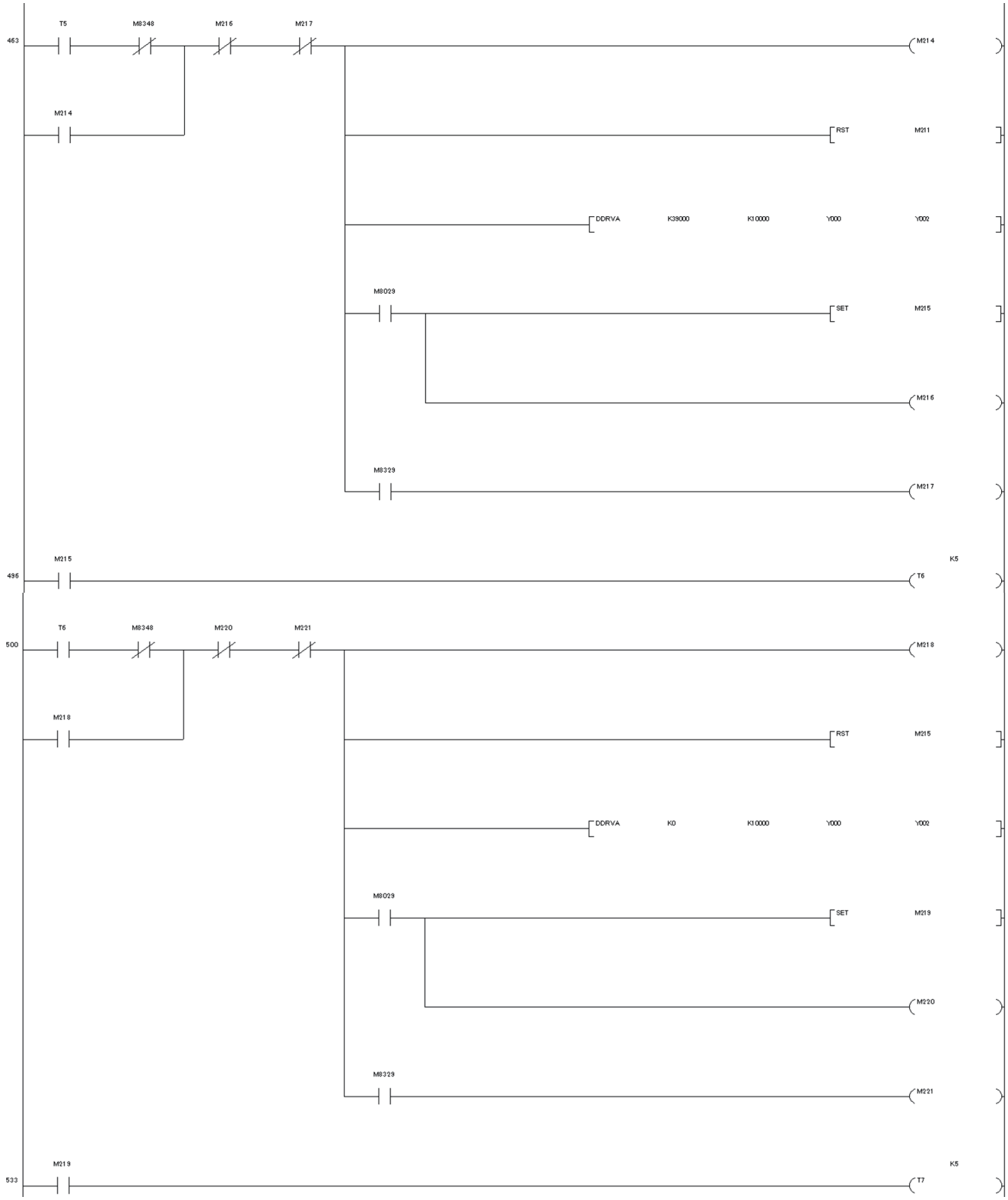

140
M13
M8348
M131
M132
M130
M130
DDRVA
K0
K10000
Y000
Y000
M8029
M131
M8329
M132
171
M4
PLS
M14
174
M14
M8348
M141
M142
M140
M140
DDRVA
K34000
K10000
Y000
Y000
M8029
M141
M8329
M142
205
M5
PLS
M15
208
M15
M8348
M151
M152
M150
M150
DDRVA
K39000
K10000
Y000
Y000
M8029
M151
M8329
M152
239
M100
PLS
M110

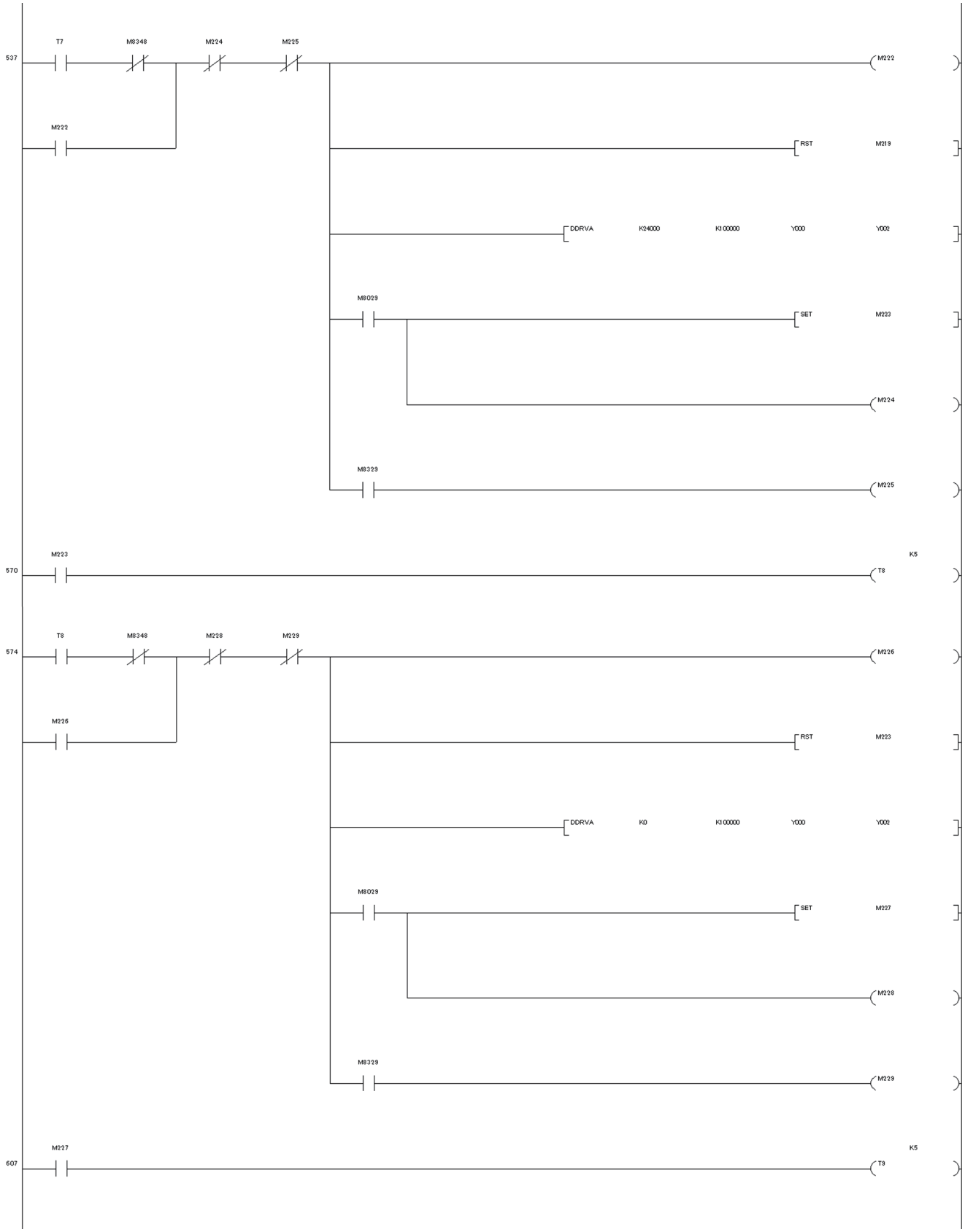

242
M110
M8348
M192
M193
M190
M190
DDRVA
K24000
K10000
Y000
Y002
M8029
SET
M191
M192
M8329
M193
274
M191
K5
T0
278
T0
M8348
M196
M197
M194
M194
RST
M191
DDRVA
K0
K10000
Y000
Y002
M8029
SET
M195
M196
M8329
M197
311
M195
K5
T1

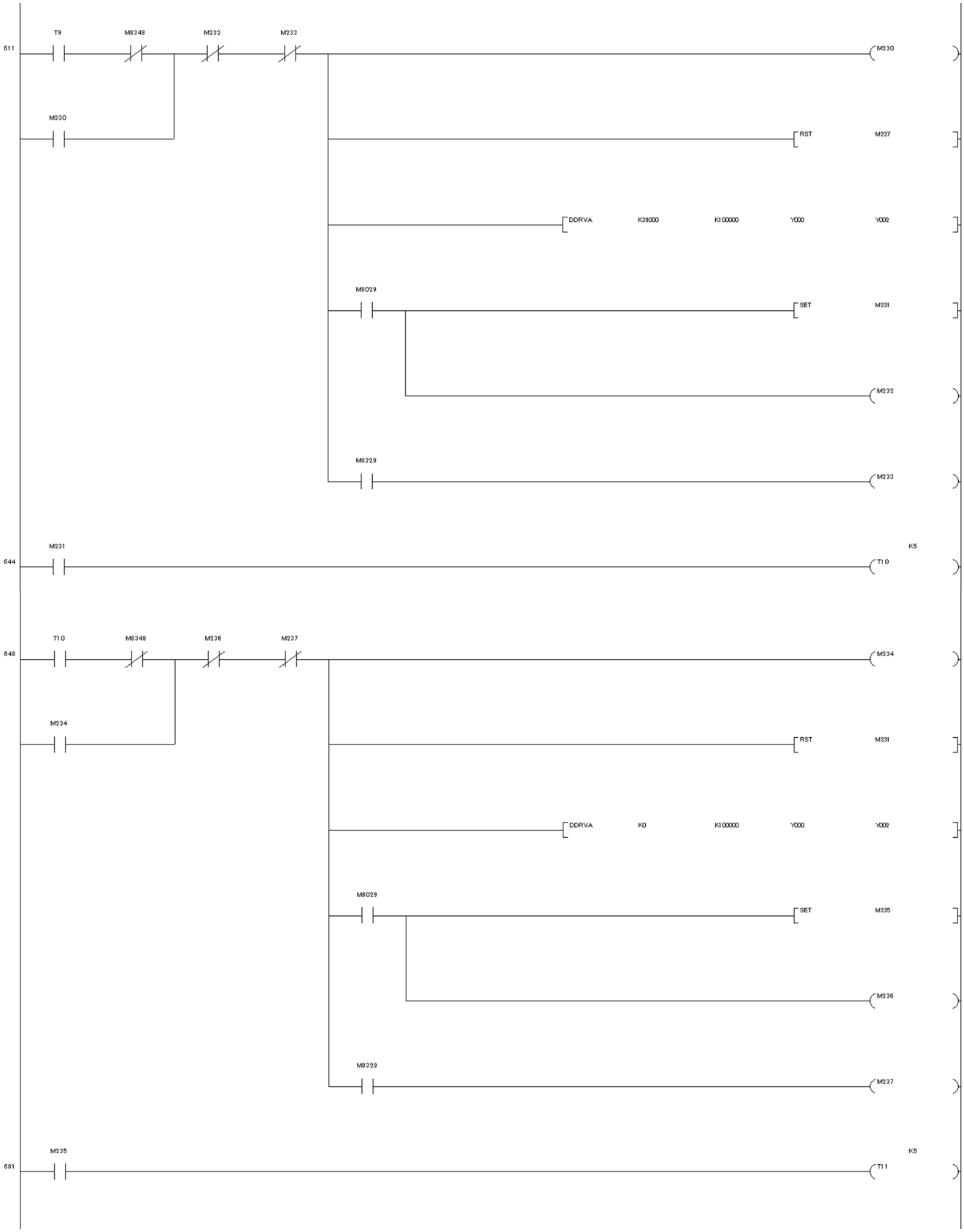

315
T1
M8348
M200
M201
M199
M199
RST
M195
DDRVA
K29000
K10000
Y000
Y002
M8029
SET
M199
M200
M8329
M201
348
M199
K5
T2
352
T2
M8348
M204
M205
M202
M202
RST
M199
DDRVA
K0
K10000
Y000
Y002
M8029
SET
M203
M204
M8329
M205
385
M203
K5
T3

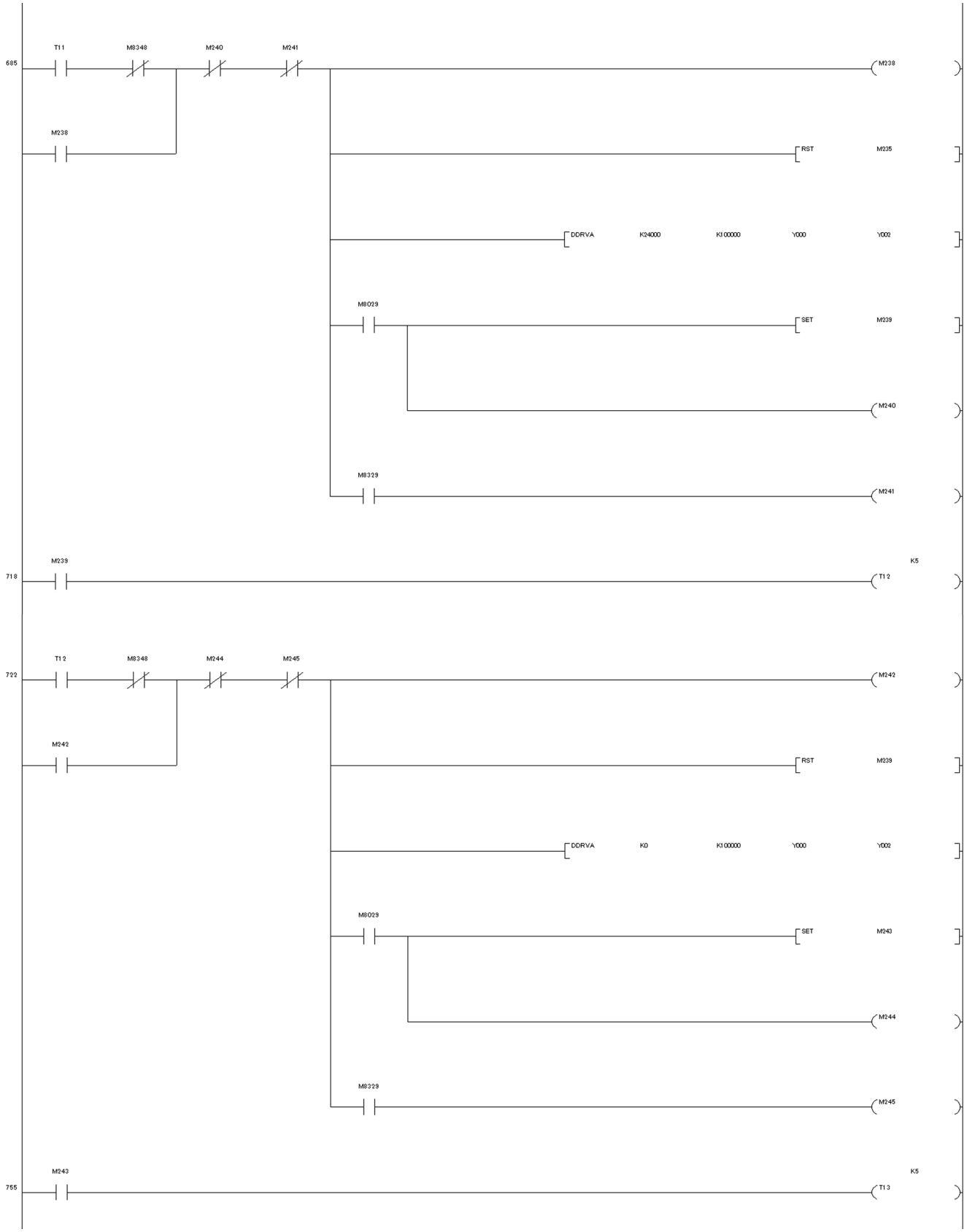
3

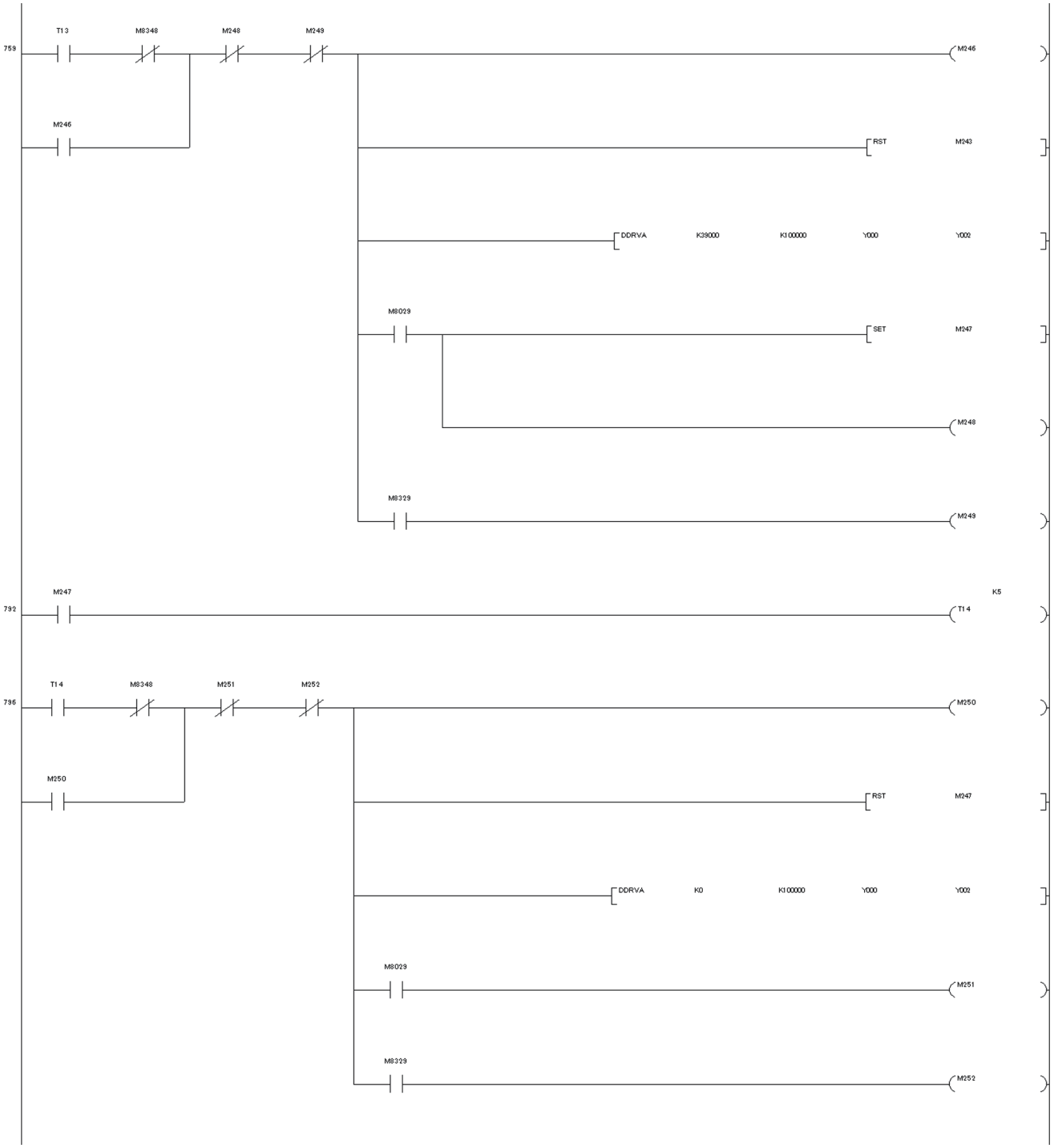

389
T3
M8348
M208
M209
M206
M205
RST
M203
DDRVA
K24000
K10000
Y000
Y002
M8029
SET
M207
M208
M8329
M209
422
M207
K5
T4
426
T4
M8348
M212
M213
M210
M210
RST
M207
DDRVA
K0
K10000
Y000
Y002
M8029
SET
M211
M212
M8329
M213
459
M211
K5
T5

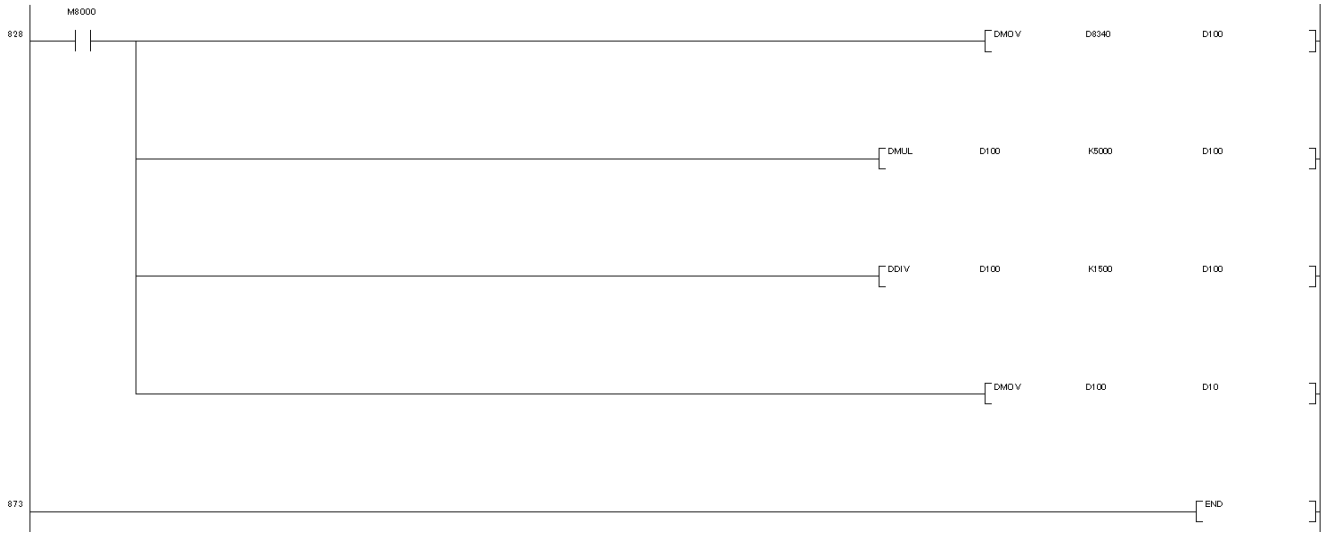

463
T5
M8348
M216
M217
M214
M214
RST
M211
DDRVA
K39000
K10000
Y000
Y002
M8029
SET
M215
M216
M8329
M217
496
M215
K5
T6
500
T6
M8348
M220
M221
M218
M218
RST
M215
DDRVA
K0
K10000
Y000
Y002
M8029
SET
M219
M220
M8329
M221
533
M219
K5
T7


537
T7
M8348
M224
M225
M222
M222
RST
M219
DDRVA
K24000
K100000
Y000
Y002
M8029
SET
M223
M224
M8329
M225
570
M223
K5
T8
574
T8
M8348
M228
M229
M226
M226
RST
M223
DDRVA
K0
K100000
Y000
Y002
M8029
SET
M227
M228
M8329
M229
607
M227
K5
T9


611
T9
M8348
M232
M233
M230
M230
RST
M227
DDRVA
K39000
K100000
Y000
Y002
M8029
SET
M231
M232
M8329
M233
644
M231
K5
T10
648
T10
M8348
M236
M237
M234
M234
RST
M231
DDRVA
K0
K100000
Y000
Y002
M8029
SET
M235
M236
M8329
M237
681
M235
K5
T11


685
T11
M8348
M240
M241
M238
M238
RST
M235
DDRVA
K24000
K100000
Y000
Y002
M8029
SET
M239
M240
M8329
M241
718
M239
K5
T12
722
T12
M8348
M244
M245
M242
M242
RST
M239
DDRVA
K0
K100000
Y000
Y002
M8029
SET
M243
M244
M8329
M245
755
M243
K5
T13


759
T13
M8348
M248
M249
M246
M246
RST
M243
DDRVA
K39000
K100000
Y000
Y002
M8029
SET
M247
M248
M8329
M249
792
M247
K5
T14
796
T14
M8348
M251
M252
M250
M250
RST
M247
DDRVA
K0
K100000
Y000
Y002
M8029
M251
M8329
M252



(2) Assignment

The settings are as follows:

I/O assignment

Signal assignment	I/O No.	Connection destination
Pulse train (Pulse output destination)	Y000	Servo amplifier
Direction (Rotation direction signal)	Y002	
Clear signal	Y001	
Zero signal	X002	
Servo ready	Not used	
Near-point signal (DOG)	X001	Sensor
LSF	X012	
LSR	X013	
Immediate stop command	M6	GOT
OPR command	M0	
JOG+ command	M1	
JOG- command	M2	
Point A positioning operation command	M3	
Point B positioning operation command	M4	
Point C positioning operation command	M5	
Automatic operation command	M100	
Current value [μm]	D10	
	D11	

Speed and target address setting

Name	Setting value
Maximum speed [Hz]	100000
Bias speed [Hz]	0
OPR speed [Hz]	10000
Creep speed [Hz]	5000
JOG speed [Hz]	5000
Acceleration time [ms]	100
Deceleration time [ms]	100

Name	Setting value
Individual operation movement speed [Hz]	10000
Automatic operation movement speed low speed [Hz]	10000
Automatic operation movement speed high speed [Hz]	100000
Point A target address [PLS]	0
Point B target address [PLS]	24000
Point C target address [PLS]	39000

Related devices

Name	Device No.	Setting details or status
Device for clear signal device specification	D8464	Y001
Clear signal device specification function valid flag	M8464	ON
Clear signal output valid flag	M8341	ON
OPR direction specification	M8342	OFF
Maximum speed [Hz]	D8343	100000
	D8344	
Bias speed [Hz]	D8342	0
Creep speed [Hz]	D8345	5000
OPR speed [Hz]	D8346	10000
	D8347	
Acceleration time [ms]	D8348	100
Deceleration time [ms]	D8349	100
Instruction execution complete flag	M8029	
Instruction execution abnormal end flag	M8329	
Positioning instruction activation	M8348	
OPR command	M10	
During OPR operation	M160	
OPR Instruction execution complete	M161	
OPR Instruction execution abnormal end	M162	
JOG+ During operation	M170	
JOG+ Instruction execution abnormal end	M171	
JOG- During operation	M180	
JOG- Instruction execution abnormal end	M181	
Immediate stop command (Pulse stop command)	M8349	
LSF	M8343	
LSR	M8344	
Point A positioning operation command	M13	
Moving to point A	M130	
Point A positioning operation command execution complete	M131	
Point A positioning operation command execution abnormal end	M132	
Point B positioning operation command	M14	
Moving to point B	M140	
Point B positioning operation command execution complete	M141	
Point B positioning operation command execution abnormal end	M142	
Point C positioning operation command	M15	
Moving to point C	M150	
Point C positioning operation command execution complete	M151	

Name	Device No.	Setting details or status
Point C positioning operation command execution abnormal end	M152	
Automatic operation command	M110	
During automatic operation point B move 1	M190	
During automatic operation point B move 1 complete	M191	
During automatic operation point B move 1 command execution complete	M192	
During automatic operation point B move 1 command execution abnormal end	M193	
During automatic operation point B move 1 dwell time	T0	5
During automatic operation point A move 1	M194	
During automatic operation point A move 1 complete	M195	
During automatic operation point A move 1 command execution complete	M196	
During automatic operation point A move 1 command execution abnormal end	M197	
During automatic operation point A move 1 dwell time	T1	5
During automatic operation point C move 1	M198	
During automatic operation point C move 1 complete	M199	
During automatic operation point C move 1 command execution complete	M200	
During automatic operation point C move 1 command execution abnormal end	M201	
During automatic operation point C move 1 dwell time	T2	5
During automatic operation point A move 2	M202	
During automatic operation point A move 2 complete	M203	
During automatic operation point A move 2 command execution complete	M204	
During automatic operation point A move 2 command execution abnormal end	M205	
During automatic operation point A move 2 dwell time	T3	5
During automatic operation point B move 2	M206	
During automatic operation point B move 2 complete	M207	
During automatic operation point B move 2 command execution complete	M208	
During automatic operation point B move 2 command execution abnormal end	M209	
During automatic operation point B move 2 dwell time	T4	5
During automatic operation point A move 3	M210	
During automatic operation point A move 3 complete	M211	
During automatic operation point A move 3 command execution complete	M212	
During automatic operation point A move 3 command execution abnormal end	M213	
During automatic operation point A move 3 dwell time	T5	5
During automatic operation point C move 2	M214	
During automatic operation point C move 2 complete	M215	
During automatic operation point C move 2 command execution complete	M216	
During automatic operation point C move 2 command execution abnormal end	M217	
During automatic operation point C move 2 dwell time	T6	5
During automatic operation point A move 4	M218	
During automatic operation point A move 4 complete	M219	
During automatic operation point A move 4 command execution complete	M220	
During automatic operation point A move 4 command execution abnormal end	M221	
During automatic operation point A move 4 dwell time	T7	5
During automatic operation point B move 3	M222	
During automatic operation point B move 3 complete	M223	
During automatic operation point B move 3 command execution complete	M224	
During automatic operation point B move 3 command execution abnormal end	M225	
During automatic operation point B move 3 dwell time	T8	5
During automatic operation point A move 5	M226	

Name	Device No.	Setting details or status
During automatic operation point A move 5 complete	M227	
During automatic operation point A move 5 command execution complete	M228	
During automatic operation point A move 5 command execution abnormal end	M229	
During automatic operation point A move 5 dwell time	T9	5
During automatic operation point C move 3	M230	
During automatic operation point C move 3 complete	M231	
During automatic operation point C move 3 command execution complete	M232	
During automatic operation point C move 3 command execution abnormal end	M233	
During automatic operation point C move 3 dwell time	T10	5
During automatic operation point A move 6	M234	
During automatic operation point A move 6 complete	M235	
During automatic operation point A move 6 command execution complete	M236	
During automatic operation point A move 6 command execution abnormal end	M237	
During automatic operation point A move 6 dwell time	T11	5
During automatic operation point B move 4	M238	
During automatic operation point B move 4 complete	M239	
During automatic operation point B move 4 command execution complete	M240	
During automatic operation point B move 4 command execution abnormal end	M241	
During automatic operation point B move 4 dwell time	T12	5
During automatic operation point A move 7	M242	
During automatic operation point A move 7 complete	M243	
During automatic operation point A move 7 command execution complete	M244	
During automatic operation point A move 7 command execution abnormal end	M245	
During automatic operation point A move 7 dwell time	T13	5
During automatic operation point C move 4	M246	
During automatic operation point C move 4 complete	M247	
During automatic operation point C move 4 command execution complete	M248	
During automatic operation point C move 4 command execution abnormal end	M249	
During automatic operation point C move 4 dwell time	T14	5
During automatic operation point A move 8	M250	
During automatic operation point A move 8 command execution complete	M251	
During automatic operation point A move 8 command execution abnormal end	M252	
Current value register [PLS]	D8340	
	D8341	
Current value register for μm conversion	D100	
	D101	
	D102	
	D103	
RUN monitor	M8000	
Initial pulse	M8002	

(3) Servo parameters (used for iQ-F and FX Series in common) → See Page 3-35.

(4) Connection diagram of the input output signal (used for iQ-F and FX Series in common) → See Page 3-36.

MEMO

CHAPTER 4

USAGE PRECAUTIONS AND MAINTENANCE

4.1 Daily and Periodic Inspections

Although AC servos are excellent devices, they may malfunction when they are affected by usage conditions such as temperature, humidity, and vibration, or due to parts aging or reaching the end of their service life. Daily and periodic inspections are essential to prevent these issues and to ensure stable use of the devices.

4.1.1 Daily inspection

In daily inspections, you verify that motors are operating as configured and check them for any operational issues, such as abnormal vibration or noise.

During operation, check that the following are working properly:

- The motor is operating as configured.
- The installation environment is suitable.
- The cooling system does not have any problems.
- Abnormal vibration and discoloration are not present.
- The voltage of the AC servo measured with a tester is correct.

The following table shows what to inspect, when, and how:

Inspection aspect	Subcategory 1	Subcategory 2	How to inspect	Criteria	Instrument
General	Ambient environment	Check the ambient temperature, humidity, dust and dirt, and more.			Thermometer, hygrometer, recorder
	Storage environment	Check the ambient temperature, humidity, dust and dirt, and more.	Measure using a thermometer, hygrometer, and other instruments.	Servo motor: -10 to +70°C (no freezing) 90% RH or less (no condensation) Servo amplifier: -20 to +65°C (no freezing) 90% RH or less (no condensation)	Thermometer, hygrometer, recorder
	Device operation	No abnormal vibrations or noise	Visual and auditory checks	No abnormal conditions	
	Power supply voltage	The voltage of the main circuit is correct	Measure the interphase voltage between terminal blocks L1, L2, and L3 of the servo amplifier.	See the standard specifications.	Tester, digital multimeter
Cooling system	Cooling fan	No abnormal vibrations or noise	Rotate the fan manually while the power is off.	It must rotate smoothly.	
Display	Display	The charge indicator lamp and the 7-segment LED illuminate properly	Indicate the lamp on the amplifier panel and the display screen.	Check that they are illuminated.	

Inspection aspect	Subcategory 1	Subcategory 2	How to inspect	Criteria	Instrument
Servo motor	General	(1) No abnormal vibrations or noise (2) No odd smells	(1) Auditory, physical, and visual checks (2) Check for bad smells due to overheating, damage, or other reasons.	(1) (2) No abnormal conditions are detected.	
	Detector	No abnormal vibrations or noise	Auditory and physical checks	No abnormal conditions are detected.	
	Cooling fan	(1) No abnormal vibrations or noise (2) No mist, foreign objects, or other buildup is attached	(1) Rotate the fan manually while the power is off. (2) Visual check	(1) It must rotate smoothly. (2) No abnormal conditions are detected.	
	Bearings	No abnormal vibrations or noise	Auditory and physical checks	No abnormal conditions are detected.	

4.1.2 Periodic inspection

In periodic inspections, you stop the equipment and perform checks that cannot be done while it is operating. Screws, bolts, and other fittings may loosen due to vibration or temperature changes. These fittings should be checked during periodic inspections and any that have become loose should be further tightened. The air filter should also be cleaned during periodic inspections.

⚠CAUTION	When you inspect internal components of the servo amplifier, they might retain an electrical charge for some time, even after the power is turned off. Wait until the charge indicator lamp turns off before inspecting them. Make sure to refer to the manuals while performing inspections.

Check the aspects that can be inspected only when the equipment is not running.

- Tightness check and further tightening
- Confirming no corrosion or damage on conductors or insulators
- Insulation resistance measurements
- Checking and replacing the cooling fan

The following table shows what to inspect, when, and how:

Inspection aspect	Subcategory 1	Subcategory 2	How to inspect	Criteria	Instrument
Main circuit	General	(1) No loose fittings (2) No traces of overheating on individual components (3) Cleaning	(1) Further tightening (2) Visual check	(1) (2) No abnormal conditions are detected.	
	Connection conductor and electrical wire	(1) No distortion on the conductors (2) No damage to the wire coating	(1) (2) Visual check	(1) (2) No abnormal conditions are detected.	
	Terminal block	No damage	Visual check	No abnormal conditions are detected.	
	Smoothing capacitor	(1) No leaking liquids (2) Safety valve not coming out or bulging (3) Capacitance measurement	(1) (2) Visual check (3) Measure it with a capacitance meter.	(1) (2) No abnormal conditions are detected. (3) 85% or more of the rated capacity	Capacitance meter
	Relay	(1) No chattering noise during operation (2) Timer operation time confirmation (3) No roughness at points of contact	(1) Auditory check (2) Time from when the power is turned on to when the relay operates (3) Visual check	(1) No abnormal conditions are detected. (2) The relay must operate within 0.1 to 0.15 seconds. (3) No abnormal conditions are detected.	Universal counter
	Resistor	(1) No cracks on the insulation of the resister (2) No broken wires	(1) Visual check. Cement resistors and wound resistors (2) Disconnect one of the connecting leads and measure using a tester.	(1) No abnormal conditions are detected. (2) Errors must be within ±10% of the indicated resistance value.	Tester, Digital multimeter
Control circuit/ protective circuit	Operational check	(1) Operate the servo amplifier alone (with no load) to check the balance between interphase output voltages. (2) Use the sequence protection operation to check that the protection and display circuit work properly.	(1) Measure the interphase voltages between the output terminals U, V, and W of the servo amplifier. (2) Simulate short-circuited protection circuit outputs on the servo amplifier.	(1) The balance of the interphase voltages must be within 4 V. (2) The sequence must work without failure.	Digital multimeter, rectifier-type voltmeter
Cooling system	Cooling fan	No loose connections	Further tightening	No abnormal conditions are detected.	

4.1.3 MELSERVO-J4 battery

Servo amplifiers include a battery to retain information on the current position, which is stored in the encoder memory, even when the power to the servo amplifier is turned off.
When the battery life ends, the amplifier loses the absolute position, which must be configured again. Make sure to replace it periodically.

Point

- Batteries typically last for 5 years from their date of manufacture.
  However, you may need to replace them before then if problems arise.
- When the battery holder is located at the bottom of the servo amplifier, it cannot be grounded while the battery is installed.
  Make sure to ground the servo amplifier before installing the battery.

⚠WARNING	- You may get an electric shock. Make sure to turn off the main circuit's power supply. - After doing so, wait for 15 minutes or more and check that the charge indicator lamp is not lit. Then, use a tester to check the voltage between the P+ and N- terminals. - Make sure you are facing the front of the servo amplifier when checking the status of the charge indicator lamp.
⚠CAUTION	The internal circuit of the servo amplifier may cause electrostatic discharge. Make sure that: - The human body and workbench are grounded. - You do not directly touch the connector pins, electrical parts, or other conductive parts with your hands.

4

- How to replace the battery in MELSERVO-J4

Turn off the main circuit power supply.

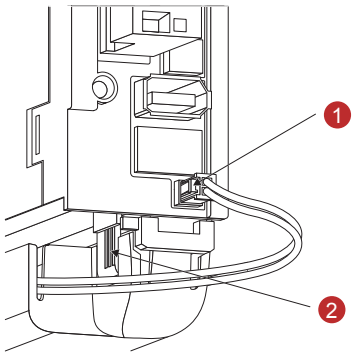
Point

The control circuit power supply must be on.
Replacing the battery while the control circuit power supply is off causes the absolute position data to be lost.

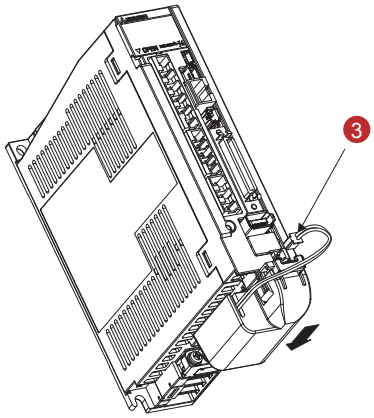
1. Remove the old battery.

   Pull out the plug while pushing the unlock lever of the plug.

2. Slide the battery case toward you while pushing the unlock lever of the battery.



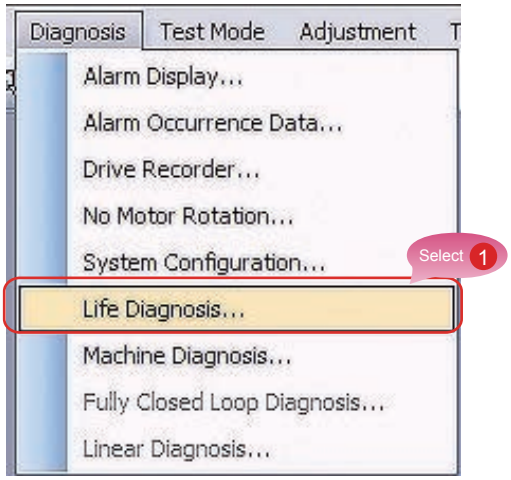
3 Slide in a new battery before inserting the plug into CN4.



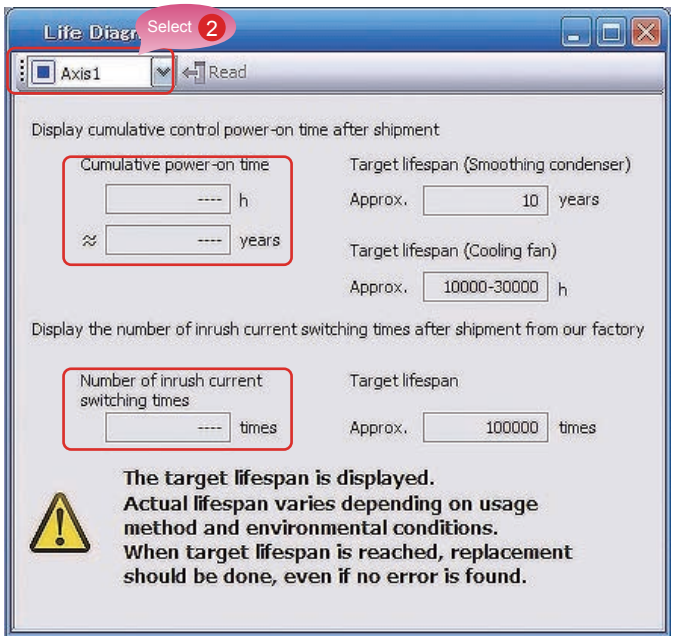
4.2 Life Diagnosis

The life diagnosis feature of MR Configurator2 enables you to see the estimated life and accumulated energization time of life-limited parts.

1. From the menu bar, select [Diagnosis] and then [Life Diagnosis].



2. Select the axis that corresponds to the servo amplifier you want to diagnose.
   - Smoothing capacitors and cooling fans use the value of Cumulative power-on time to display the Target lifespan.
   - Relays use the value of Number of inrush current switching times to display the Target lifespan.



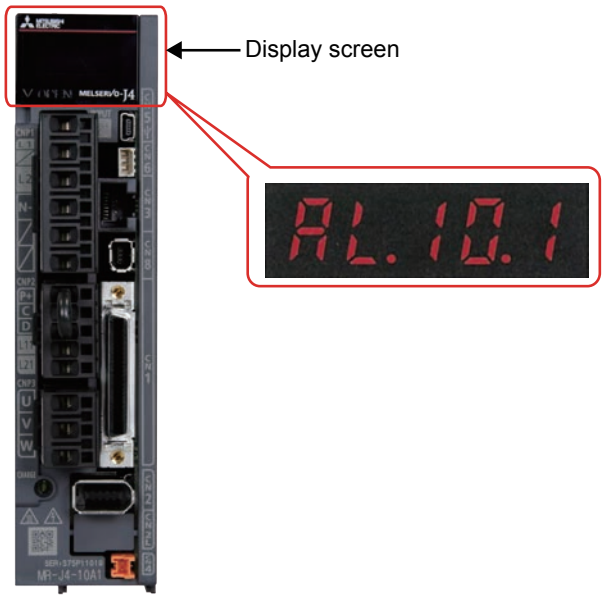
Point

The life diagnosis feature is effective for preventive maintenance on the servo amplifier.
Please make good use of the feature.

4.3 Alarms/Warnings

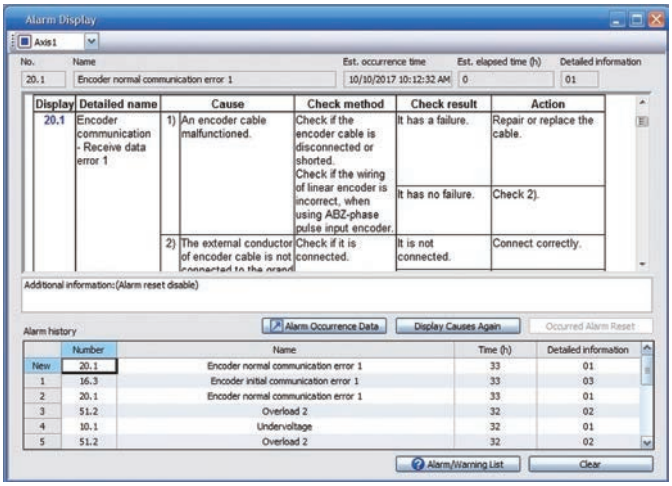
4.3.1 Display

The servo amplifiers have a "display screen" for alarms and warnings when errors occur during operation.
MR-J4 Series displays a 3-digit alarm for the AC servo, to simplify troubleshooting when an alarm occurs.
If an alarm or warning appears on the display screen, turn off the SON (Servo On) signal and shut off the power.
Then, follow the troubleshooting procedures described in the manual.



MR Configurator2 can be used to find out the causes of alarms and warnings.

To find out the details of each alarm, from the menu bar, select [Diagnosis] → [Alarm Display].
This information is also available from [MR Configurator2 HELP] under [Help].



4.3.2 Common alarms and troubleshooting procedures

This subsection describes some common alarms.

Encoder normal communication - Receive data error 1 (Alarm code "20.1")

- Error cause

The ambient environment contains noise or some other abnormality.

- Resolution

The most common noise problem is caused by bundling the servo amplifier input/output wires with the signal wires. Try running these wires separate from each other.

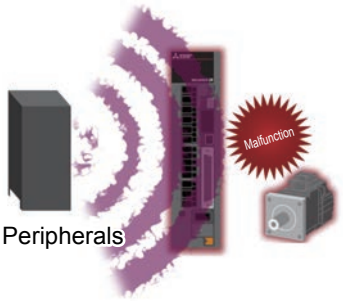
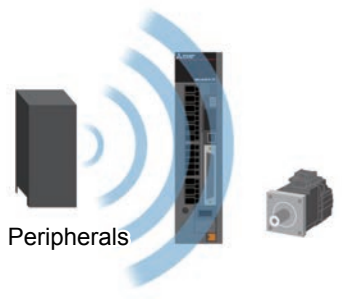
- If noise is being generated by the servo amplifier, install a noise filter onto the servo amplifier power circuit.
- If the equipment near the servo amplifier generates significant noise, try installing a surge protector on said equipment to reduce the noise generated.

Noise	

When hearing the word "noise", you may think of "unwanted sound" or "unpleasant sound".

You may have had an experience where you could not hear someone on the other end of a phone call. This is also caused by noise.

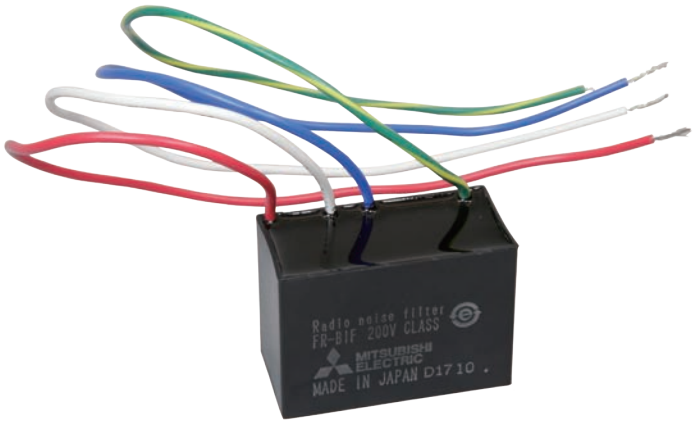
Noise can affect various electronic devices and can be generated from a wide range of sources.

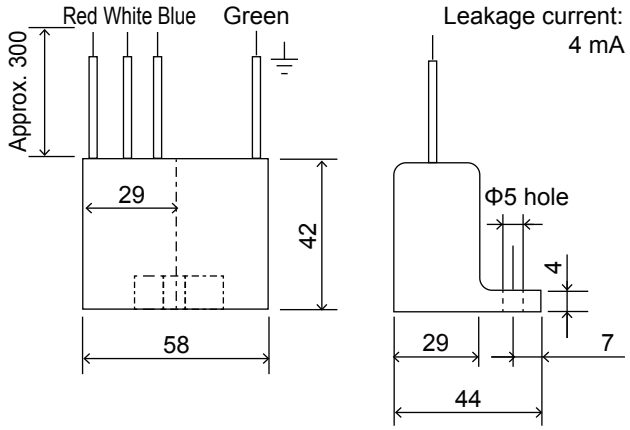
Noise from the outside causing the servo amplifier to malfunction	
Noise generated by the servo amplifier causing other equipment to malfunction	
Noise not affecting the servo amplifier	

★ How to install a noise filter

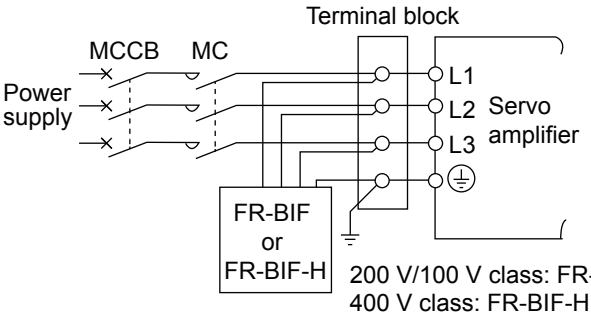
- Radio noise filter (FR-BIF, FR-BIF-H)

A radio noise filter can help reduce noise generated by the servo amplifier power supply and is especially effective for the radio frequency band of 10 MHz or less. The filter is for input only.



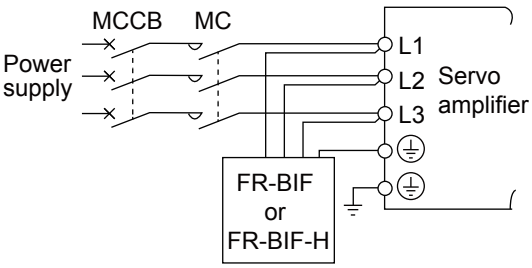
External dimensions (Unit: mm)	Connection diagram
	The filter cannot be connected to the output circuits of the servo amplifier. Wiring must be as short as possible. The filter must also be grounded. When using the FR-BIF with a single-phase power supply, make sure to properly insulate any unused wires.

Single-axis servo amplifiers of 3.5 kW or less and multi-axis servo amplifiers:



200 V/100 V class: FR-BIF
400 V class: FR-BIF-H

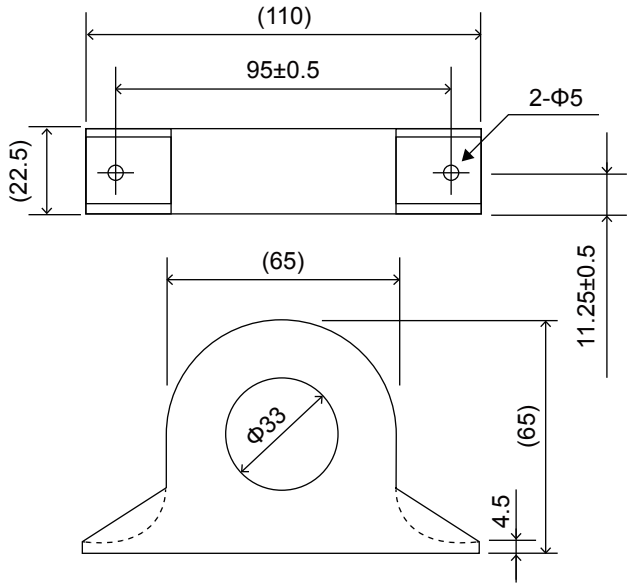
Single-axis servo amplifier of 5 kW or more:



- Line noise filter (FR-BSF01)

A line noise filter can help reduce radio noise generated from the servo amplifier power supply and output circuits, and it can effectively suppress high-frequency leakage current (zero-phase current). It works especially well for the band from 0.5 to 5 MHz.

External dimensions (Unit: mm)	Connection diagram



The line noise filter can be installed to the main circuit (L1, L2, and L3) of the servo amplifier and the wiring of the power supply (U, V, and W) of the servo motor. All wires must pass through the line noise filter in the same direction and for the same number of times.

When the filter is used on the wiring of the main circuit power supply, the more times that a wire passes through the line noise filter, the more effective it is, but four times is the usual amount.

When it is used on the wiring of the power supply of the servo motor, the number of times that it passes through the filter must be four or less.

In this case, the ground wire must not pass through the filter.

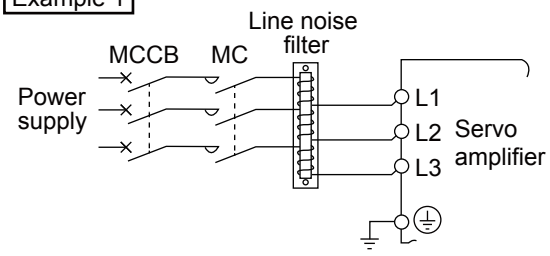
Doing so will lessen the effect.

As shown in the figure below, wind the wires around the line noise filter until they have passed through the filter for the desired number of times.

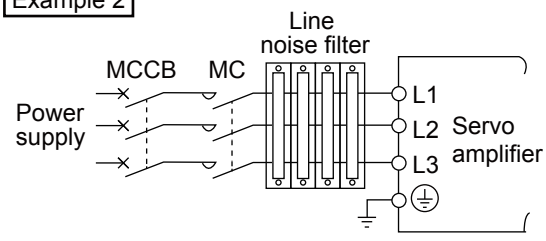
If the wire is too thick to wind it around, use two or more line noise filters to ensure that the total number of times the wire passes through them is equal to the desired number of passes.

Place line noise filters as close to the servo amplifier as possible. This can help improve the noise-reduction effect.

Example 1



Example 2



★ Other noise suppression measures

- Data line filter

Attaching a data line filter to a pulse output cable or encoder cable for the pulse train command unit can help prevent noise intrusion.

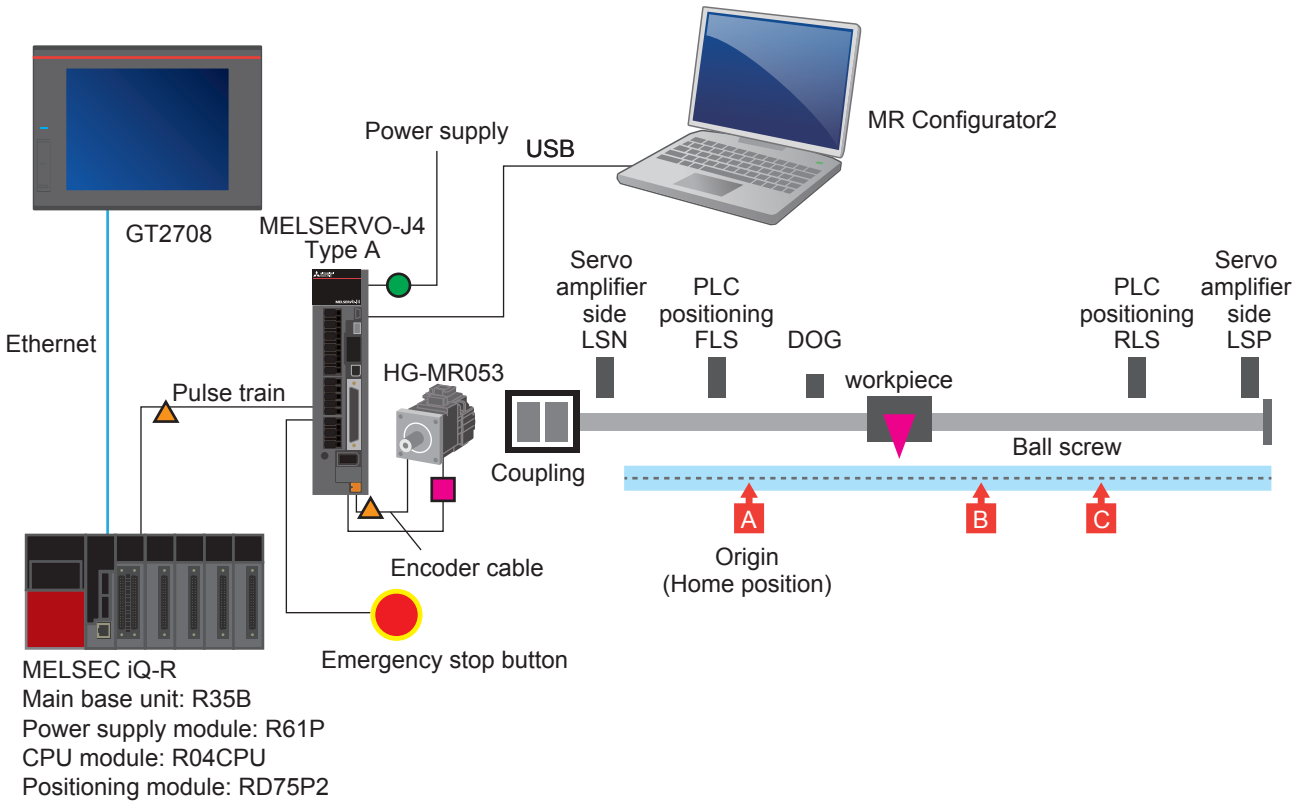
- Surge protector, diode

Attach a surge protector to the AC relay or AC bulb around the servo amplifier, and a diode to the DC relay or DC bulb.

Each of the filters should be placed as shown in the figure below:

△ Data line filter
○ Line filter*
□ Radio noise filter*

* For the line and radio noise filters, determine which filter to install based on the ambient conditions.



Servo motor encoder - Absolute position erased (Alarm code "25.1")

- Error cause

The battery has reached the end of its service life due to, for example, the battery not having been replaced periodically.

* When the battery life ends, the amplifier loses the absolute position, which must be configured again.

Point

- Batteries typically last for 5 years from their date of manufacture.
  However, you may need to replace them before then if problems arise.
- When the battery holder is located at the bottom of the servo amplifier, it cannot be grounded while the battery is installed.
  Make sure to ground the servo amplifier before installing the battery.

⚠WARNING	- You may get an electric shock. Make sure to turn off the main circuit's power supply. - After doing so, wait for 15 minutes or more and check that the charge indicator lamp is not lit. Then, use a tester to check the voltage between the P+ and N- terminals. - Make sure you are facing the front of the servo amplifier when checking the status of the charge indicator lamp.
⚠CAUTION	The internal circuit of the servo amplifier may cause electrostatic discharge. Make sure that: - The human body and workbench are grounded. - You do not directly touch the connector pins, electrical parts, or other conductive parts with your hands.

4

- Resolution (for MELSERVO-J4)

Replace the battery with a new one.

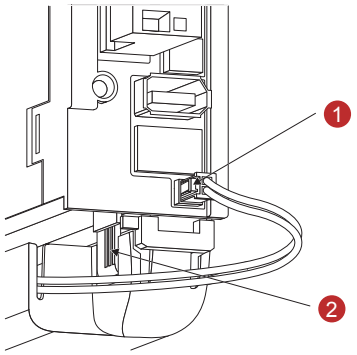
Point

The control circuit power supply must be on.
Replacing the battery while the control circuit power supply is off causes the absolute position data to be lost.

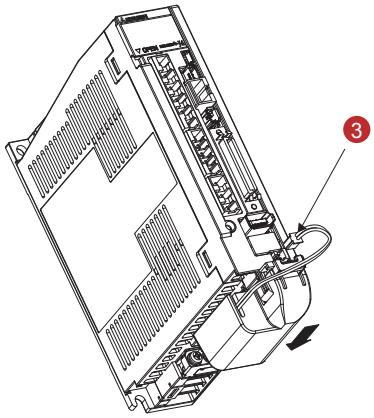
1. Remove the old battery.

   Pull out the plug while pushing the unlock lever of the plug.

2. Slide the battery case toward you while pushing the unlock lever of the battery.

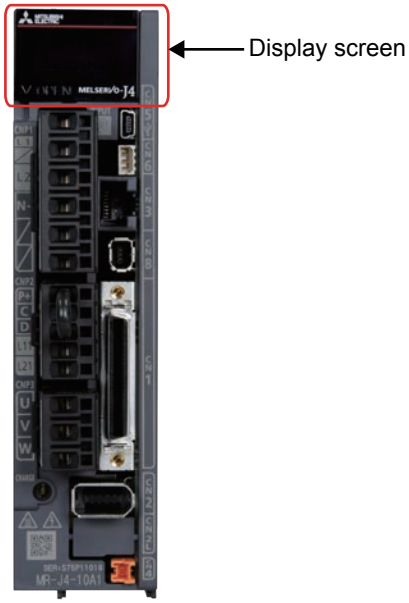


3 Slide in a new battery before inserting the plug into CN4.



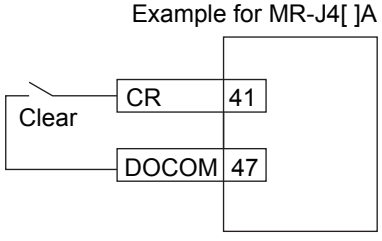
Then, perform the return-to-origin (home position) process.

1 Turn the power to the servo amplifier off and on, and check that the alarm has been cleared.



2 Use the JOG operation to move the workpiece to the origin position.
See the following subsection for the JOG operation:
→ 3.3.2 JOG operation

3 Input a clear signal into the servo amplifier. This action tells the servo amplifier that the current position is the origin (home position). Use a programmable controller output or external switch, as shown in the figure to the right, to input the clear signal.

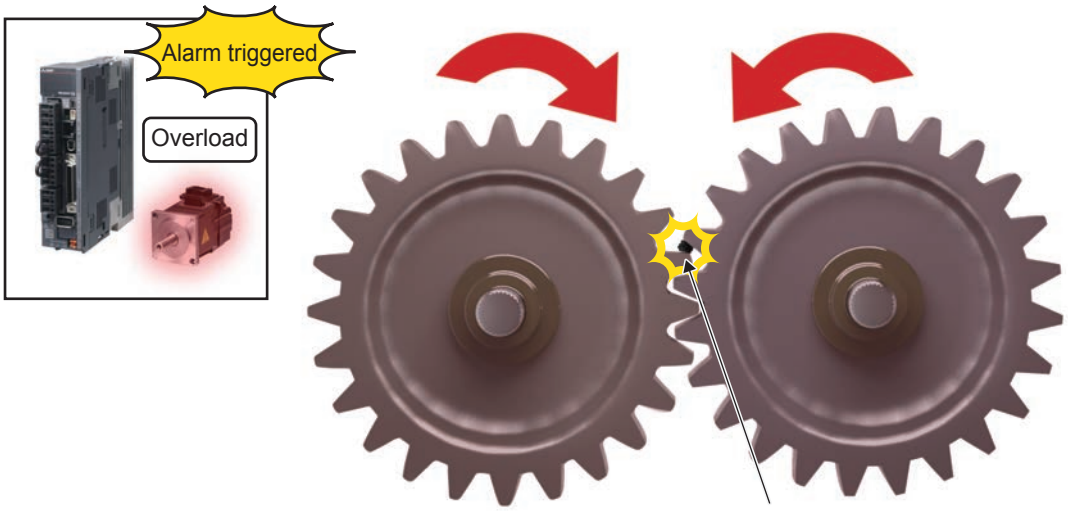


Thermal overload error 1 during operation (Alarm code "50.1")

- Error cause

Cables are disconnected or scrap material is jamming equipment.

* Foreign objects can jam the moving parts of equipment, causing them not to operate correctly.
  Excessive current then flows in an attempt to operate the parts normally, which causes an excessive load to trigger the alarm.



- Resolution

Check mechanical parts carefully.

* If this alarm occurs even when there are no mechanical issues, the wiring may be disconnected or connected incorrectly.
  Check the wiring.

4.3.3 List of alarms and warnings

- Alarm list

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
10	Undervoltage	10.1	Voltage drop in the control circuit power	✓	✓
		10.2	Voltage drop in the main circuit power	✓	✓
11	Switch setting error	11.1	Axis number setting error/station number setting error		✓
		11.2	Disabling control axis setting error		✓
12	Memory error 1 (RAM)	12.1	RAM error 1		✓
		12.2	RAM error 2		✓
		12.3	RAM error 3		✓
		12.4	RAM error 4		✓
		12.5	RAM error 5		✓
		12.6	RAM error 6		✓
13	Clock error	13.1	Clock error 1		✓
		13.2	Clock error 2		✓
14	Control process error	14.1	Control process error 1		✓
		14.2	Control process error 2		✓
		14.3	Control process error 3		✓
		14.4	Control process error 4		✓
		14.5	Control process error 5		✓
		14.6	Control process error 6		✓
		14.7	Control process error 7		✓
		14.8	Control process error 8		✓
		14.9	Control process error 9		✓
		14.A	Control process error 10		✓
		14.B	Control process error 11		✓
15	Memory error 2 (EEP-ROM)	15.1	EEP-ROM error at power on		✓
		15.2	EEP-ROM error during operation		✓
		15.4	Home position information read error		✓
16	Encoder initial communication error 1	16.1	Encoder initial communication - Receive data error 1		✓
		16.2	Encoder initial communication - Receive data error 2		✓
		16.3	Encoder initial communication - Receive data error 3		✓
		16.5	Encoder initial communication - Transmission data error 1		✓
		16.6	Encoder initial communication - Transmission data error 2		✓
		16.7	Encoder initial communication - Transmission data error 3		✓
		16.A	Encoder initial communication - Process error 1		✓
		16.B	Encoder initial communication - Process error 2		✓
		16.C	Encoder initial communication - Process error 3		✓
		16.D	Encoder initial communication - Process error 4		✓
		16.E	Encoder initial communication - Process error 5		✓
		16.F	Encoder initial communication - Process error 6		✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
17	Board error	17.1	Board error 1		✓
		17.3	Board error 2		✓
		17.4	Board error 3		✓
		17.5	Board error 4		✓
		17.6	Board error 5		✓
		17.7	Board error 7		✓
		17.8	Board error 6		✓
		17.9	Board error 8		✓
19	Memory error 3 (Flash-ROM)	19.1	Flash-ROM error 1		✓
		19.2	Flash-ROM error 2		✓
		19.3	Flash-ROM error 3		✓
1A	Servo motor combination error	1A.1	Servo motor combination error 1		✓
		1A.2	Servo motor control mode combination error		✓
		1A.4	Servo motor combination error 2		✓
1B	Converter alarm	1B.1	Converter unit error		✓
1E	Encoder initial communication error 2	1E.1	Encoder malfunction		✓
		1E.2	Load-side encoder malfunction		✓
1F	Encoder initial communication error 3	1F.1	Incompatible encoder		✓
		1F.2	Incompatible load-side encoder		✓
20	Encoder normal communication error 1	20.1	Encoder normal communication - Receive data error 1		✓
		20.2	Encoder normal communication - Receive data error 2		✓
		20.3	Encoder normal communication - Receive data error 3		✓
		20.5	Encoder normal communication - Transmission data error 1		✓
		20.6	Encoder normal communication - Transmission data error 2		✓
		20.7	Encoder normal communication - Transmission data error 3		✓
		20.9	Encoder normal communication - Receive data error 4		✓
		20.A	Encoder normal communication - Receive data error 5		✓
21	Encoder normal communication error 2	21.1	Encoder data error 1		✓
		21.2	Encoder data update error		✓
		21.3	Encoder data waveform error		✓
		21.4	Encoder non-signal error		✓
		21.5	Encoder hardware error 1		✓
		21.6	Encoder hardware error 2		✓
		21.9	Encoder data error 2		✓
24	Main circuit error	24.1	Ground fault detected at hardware detection circuit		✓
		24.2	Ground fault detected by software detection function	✓	✓
25	Absolute position erased	25.1	Servo motor encoder - Absolute position erased		✓
		25.2	Scale measurement encoder - Absolute position erased		✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
27	Initial magnetic pole detection error	27.1	Initial magnetic pole detection - Abnormal termination	✓	✓
		27.2	Initial magnetic pole detection - Time out error	✓	✓
		27.3	Initial magnetic pole detection - Limit switch error	✓	✓
		27.4	Initial magnetic pole detection - Estimated error	✓	✓
		27.5	Initial magnetic pole detection - Position deviation error	✓	✓
		27.6	Initial magnetic pole detection - Speed deviation error	✓	✓
		27.7	Initial magnetic pole detection - Current error	✓	✓
28	Linear encoder error 2	28.1	Linear encoder - Environment error		✓
2A	Linear encoder error 1	2A.1	Linear encoder error 1-1		✓
		2A.2	Linear encoder error 1-2		✓
		2A.3	Linear encoder error 1-3		✓
		2A.4	Linear encoder error 1-4		✓
		2A.5	Linear encoder error 1-5		✓
		2A.6	Linear encoder error 1-6		✓
		2A.7	Linear encoder error 1-7		✓
		2A.8	Linear encoder error 1-8		✓
2B	Encoder counter error	2B.1	Encoder counter error 1		✓
		2B.2	Encoder counter error 2		✓
30	Regenerative error	30.1	Regeneration heat error	✓*1	✓*1
		30.2	Regeneration signal error	✓*1	✓*1
		30.3	Regeneration feedback signal error	✓*1	✓*1
31	Overspeed	31.1	Abnormal motor speed	✓	✓
32	Overcurrent	32.1	Overcurrent detected at hardware detection circuit (during operation)		✓
		32.2	Overcurrent detected at software detection function (during operation)	✓	✓
		32.3	Overcurrent detected at hardware detection circuit (during a stop)		✓
		32.4	Overcurrent detected at software detection function (during a stop)	✓	✓
33	Overvoltage	33.1	Main circuit voltage error	✓	✓
34	SSCNET receive error 1	34.1	SSCNET receive data error	✓	✓
		34.2	SSCNET connector connection error	✓	✓
		34.3	SSCNET communication data error	✓	✓
		34.4	Hardware error signal detection	✓	✓
		34.5	SSCNET receive data error (safety observation function)	✓	✓
		34.6	SSCNET communication data error (safety observation function)	✓	✓
35	Command frequency error	35.1	Command frequency error	✓	✓
36	SSCNET receive error 2	36.1	Continuous communication data error	✓	✓
		36.2	Continuous communication data error (safety observation function)	✓	✓
37	Parameter error	37.1	Parameter setting range error		✓
		37.2	Parameter combination error		✓
		37.3	Point table setting error		✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
39	Program error	39.1	Program error		✓
		39.2	Instruction argument external error		✓
		39.3	Register No. error		✓
		39.4	Non-correspondence instruction error		✓
3A	Inrush current suppression circuit error	3A.1	Inrush current suppression circuit error		✓
3D	Parameter setting error for driver communication	3D.1	Parameter combination error for driver communication on slave		✓
		3D.2	Parameter combination error for driver communication on master		✓
3E	Operation mode error	3E.1	Operation mode error		✓
		3E.6	Operation mode switch error		✓
42	Servo control error (for linear servo motor and direct drive motor)	42.1	Servo control error by position deviation	*3	✓
		42.2	Servo control error by speed deviation	*3	✓
		42.3	Servo control error by torque/thrust deviation	*3	✓
	Fully closed loop control error (for fully closed loop control)	42.8	Fully closed loop control error by position deviation	*3	✓
		42.9	Fully closed loop control error by speed deviation	*3	✓
		42.A	Fully closed loop control error by position deviation during command stop	*3	✓
45	Main circuit device overheat	45.1	Main circuit device overheat error 1	✓*1	✓*1
		45.2	Main circuit device overheat error 2	✓*1	✓*1
46	Servo motor overheat	46.1	Abnormal temperature of servo motor 1	✓*1	✓*1
		46.2	Abnormal temperature of servo motor 2	✓*1	✓*1
		46.3	Thermistor disconnected error	✓*1	✓*1
		46.4	Thermistor circuit error	✓*1	✓*1
		46.5	Abnormal temperature of servo motor 3	✓*1	✓*1
		46.6	Abnormal temperature of servo motor 4	✓*1	✓*1
47	Cooling fan error	47.1	Cooling fan stop error		✓
		47.2	Cooling fan speed reduction error		✓
50	Overload 1	50.1	Thermal overload error 1 during operation	✓*1	✓*1
		50.2	Thermal overload error 2 during operation	✓*1	✓*1
		50.3	Thermal overload error 4 during operation	✓*1	✓*1
		50.4	Thermal overload error 1 during a stop	✓*1	✓*1
		50.5	Thermal overload error 2 during a stop	✓*1	✓*1
		50.6	Thermal overload error 4 during a stop	✓*1	✓*1
51	Overload 2	51.1	Thermal overload error 3 during operation	✓*1	✓*1
		51.2	Thermal overload error 3 during a stop	✓*1	✓*1
52	Error excessive	52.1	Excess droop pulse 1	✓	✓
		52.3	Excess droop pulse 2	✓	✓
		52.4	Error excessive during 0 torque limit	✓	✓
		52.5	Excess droop pulse 3	✓	✓
54	Oscillation detection	54.1	Oscillation detection error	✓	✓
56	Forced stop error	56.2	Over speed during forced stop	✓	✓
		56.3	Estimated distance over during forced stop	✓	✓
61	Operation error	61.1	Point table setting error	✓	✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
63	STO timing error	63.1	STO1 off	✓	✓
		63.2	STO2 off	✓	✓
		63.5	STO by functional safety unit	✓	✓
64	Functional safety unit setting error	64.1	STO input error		✓
		64.2	Compatibility mode setting error		✓
		64.3	Operation mode setting error		✓
65	Functional safety unit connection error	65.1	Functional safety unit communication error 1		✓
		65.2	Functional safety unit communication error 2		✓
		65.3	Functional safety unit communication error 3		✓
		65.4	Functional safety unit communication error 4		✓
		65.5	Functional safety unit communication error 5		✓
		65.6	Functional safety unit communication error 6		✓
		65.7	Functional safety unit communication error 7		✓
		65.8	Functional safety unit shut-off signal error 1		✓
		65.9	Functional safety unit shut-off signal error 2		✓
66	Encoder initial communication error (safety observation function)	66.1	Encoder initial communication - Receive data error 1 (safety observation function)		✓
		66.2	Encoder initial communication - Receive data error 2 (safety observation function)		✓
		66.3	Encoder initial communication - Receive data error 3 (safety observation function)		✓
		66.7	Encoder initial communication - Transmission data error 1 (safety observation function)		✓
		66.9	Encoder initial communication - Process error 1 (safety observation function)		✓
67	Encoder normal communication error 1 (safety observation function)	67.1	Encoder normal communication - Receive data error 1 (safety observation function)		✓
		67.2	Encoder normal communication - Receive data error 2 (safety observation function)		✓
		67.3	Encoder normal communication - Receive data error 3 (safety observation function)		✓
		67.4	Encoder normal communication - Receive data error 4 (safety observation function)		✓
		67.7	Encoder normal communication - Transmission data error 1 (safety observation function)		✓
68	STO diagnosis error	68.1	Mismatched STO signal error		✓
69	Command error	69.1	Forward rotation-side software limit detection - Command excess error	✓	✓
		69.2	Reverse rotation-side software limit detection - Command excess error	✓	✓
		69.3	Forward rotation stroke end detection - Command excess error	✓	✓
		69.4	Reverse rotation stroke end detection - Command excess error	✓	✓
		69.5	Upper stroke limit detection - Command excess error	✓	✓
		69.6	Lower stroke limit detection - Command excess error	✓	✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
70	Load-side encoder initial communication error 1	70.1	Load-side encoder initial communication - Receive data error 1		✓
		70.2	Load-side encoder initial communication - Receive data error 2		✓
		70.3	Load-side encoder initial communication - Receive data error 3		✓
		70.5	Load-side encoder initial communication - Transmission data error 1		✓
		70.6	Load-side encoder initial communication - Transmission data error 2		✓
		70.7	Load-side encoder initial communication - Transmission data error 3		✓
		70.A	Load-side encoder initial communication - Process error 1		✓
		70.B	Load-side encoder initial communication - Process error 2		✓
		70.C	Load-side encoder initial communication - Process error 3		✓
		70.D	Load-side encoder initial communication - Process error 4		✓
		70.E	Load-side encoder initial communication - Process error 5		✓
		70.F	Load-side encoder initial communication - Process error 6		✓
71	Load-side encoder normal communication error 1	71.1	Load-side encoder normal communication - Receive data error 1		✓
		71.2	Load-side encoder normal communication - Receive data error 2		✓
		71.3	Load-side encoder normal communication - Receive data error 3		✓
		71.5	Load-side encoder normal communication - Transmission data error 1		✓
		71.6	Load-side encoder normal communication - Transmission data error 2		✓
		71.7	Load-side encoder normal communication - Transmission data error 3		✓
		71.9	Load-side encoder normal communication - Receive data error 4		✓
		71.A	Load-side encoder normal communication - Receive data error 5		✓
72	Load-side encoder normal communication error 2	72.1	Load-side encoder data error 1		✓
		72.2	Load-side encoder data update error		✓
		72.3	Load-side encoder data waveform error		✓
		72.4	Load-side encoder non-signal error		✓
		72.5	Load-side encoder hardware error 1		✓
		72.6	Load-side encoder hardware error 2		✓
		72.9	Load-side encoder data error 2		✓
74	Option card error 1	74.1	Option card error 1		✓
		74.2	Option card error 2		✓
		74.3	Option card error 3		✓
		74.4	Option card error 4		✓
		74.5	Option card error 5		✓
75	Option card error 2	75.3	Option card connection error		✓
		75.4	Option card disconnected		✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
79	Functional safety unit diagnosis error	79.1	Functional safety unit power voltage error	✓*4	✓
		79.2	Functional safety unit internal error		✓
		79.3	Abnormal temperature of functional safety unit	✓*4	✓
		79.4	Servo amplifier error		✓
		79.5	Input device error		✓
		79.6	Output device error		✓
		79.7	Mismatched input signal error		✓
		79.8	Position feedback fixing error		✓
7A	Parameter setting error (safety observation function)	7A.1	Parameter verification error (safety observation function)		✓
		7A.2	Parameter setting range error (safety observation function)		✓
		7A.3	Parameter combination error (safety observation function)		✓
		7A.4	Functional safety unit combination error (safety observation function)		✓
7B	Encoder diagnosis error (safety observation function)	7B.1	Encoder diagnosis error 1 (safety observation function)		✓
		7B.2	Encoder diagnosis error 2 (safety observation function)		✓
		7B.3	Encoder diagnosis error 3 (safety observation function)		✓
		7B.4	Encoder diagnosis error 4 (safety observation function)		✓
7C	Functional safety unit communication diagnosis error (safety observation function)	7C.1	Functional safety unit communication setting error (safety observation function)	✓*4	✓
		7C.2	Functional safety unit communication data error (safety observation function)	✓*4	✓
7D	Safety observation error	7D.1	Stop observation error	✓*2	✓
		7D.2	Speed observation error	✓*4	✓
82	Master-slave operation error 1	82.1	Master-slave operation error 1	✓	✓
84	Network module initialization error	84.1	Network module undetected error		✓
		84.2	Network module initialization error 1		✓
		84.3	Network module initialization error 2		✓
85	Network module error	85.1	Network module error 1		✓
		85.2	Network module error 2		✓
		85.3	Network module error 3		✓
86	Network communication error	86.1	Network communication error 1	✓	✓
		86.2	Network communication error 2	✓	✓
		86.3	Network communication error 3	✓	✓
8A	USB communication time-out error/serial communication time-out error/MODBUS-RTU communication time-out error	8A.1	USB communication time-out error/Serial communication time-out error	✓	✓
		8A.2	MODBUS-RTU communication time-out error	✓	✓

No.	Name	Detail No.	Detail name	Alarm deactivation	
				Alarm reset	Cycling the power
8D	CC-Link IE communication error	8D.1	CC-Link IE communication error 1	✓	✓
		8D.2	CC-Link IE communication error 2	✓	✓
		8D.3	Master station setting error 1	✓	✓
		8D.5	Master station setting error 2		✓
		8D.6	CC-Link IE communication error 3	✓	✓
		8D.7	CC-Link IE communication error 4	✓	✓
		8D.8	CC-Link IE communication error 5	✓	✓
		8D.9	Synchronization error 1		✓
		8D.A	Synchronization error 2		✓
8E	USB communication error/serial communication error/ MODBUS-RTU communication error	8E.1	USB communication receive error/Serial communication receive error	✓	✓
		8E.2	USB communication checksum error/Serial communication checksum error	✓	✓
		8E.3	USB communication character error/serial communication character error	✓	✓
		8E.4	USB communication command error/Serial communication command error	✓	✓
		8E.5	USB communication data number error/Serial communication data number error	✓	✓
		8E.6	MODBUS-RTU communication receive error	✓	✓
		8E.7	MODBUS-RTU communication message frame error	✓	✓
		8E.8	MODBUS-RTU communication CRC error	✓	✓
88888	Watchdog	8888._	Watchdog		✓

*1 Leave for about 30 minutes of cooling time after removing the cause of occurrence.

*2 This is applicable when [Pr. PA04] is set to the initial value. The stop system of SD can be changed to DB using [Pr. PA04].

*3 The alarm can be canceled by setting as follows:

For the fully closed loop control: set [Pr. PE03] to "1 _ _ _".

When a linear servo motor or direct drive motor is used: set [Pr. PL04] to "1 _ _ _".

*4 Reset this while all the safety observation functions are stopped.

- Warning list

No.	Name	Detail No.	Detail name
90	Home position return incomplete warning	90.1	Home position return incomplete
		90.2	Home position return abnormal termination
		90.5	Z-phase unpassed
91	Servo amplifier overheat warning*	91.1	Main circuit device overheat warning
92	Battery cable disconnection warning	92.1	Encoder battery cable disconnection warning
		92.3	Battery degradation
93	ABS data transfer warning	93.1	Magnetic pole detection incomplete warning at ABS data transfer request
95	STO warning	95.1	STO1 off detection
		95.2	STO2 off detection
		95.3	STO warning 1 (safety observation function)
		95.4	STO warning 2 (safety observation function)
		95.5	STO warning 3 (safety observation function)
96	Home position setting warning	96.1	In-position warning at home positioning
		96.2	Command input warning at home positioning
		96.3	Servo off warning at home positioning
		96.4	Magnetic pole detection incomplete warning at home positioning
97	Positioning specification warning	97.1	Program operation disabled warning
		97.2	Next station position warning
98	Software limit warning	98.1	Forward rotation-side software stroke limit reached
		98.2	Reverse rotation-side software stroke limit reached
99	Stroke limit warning	99.1	Forward rotation stroke end off
		99.2	Reverse rotation stroke end off
		99.4	Upper stroke limit off
		99.5	Lower stroke limit off
9A	Optional unit input data error warning	9A.1	Optional unit input data sign error
		9A.2	Optional unit BCD input data error
9B	Error excessive warning	9B.1	Excess droop pulse 1 warning
		9B.3	Excess droop pulse 2 warning
		9B.4	Error excessive warning during 0 torque limit
9C	Converter warning	9C.1	Converter unit warning
9D	CC-Link IE warning 1	9D.1	Station number switch change warning
		9D.2	Master station setting warning
		9D.3	Overlapping station number warning
		9D.4	Mismatched station number warning
9E	CC-Link IE warning 2	9E.1	CC-Link IE communication warning
9F	Battery warning	9F.1	Low battery
		9F.2	Battery degradation warning
E0	Excessive regeneration warning	E0.1	Excessive regeneration warning
E1	Overload warning 1	E1.1	Thermal overload warning 1 during operation
		E1.2	Thermal overload warning 2 during operation
		E1.3	Thermal overload warning 3 during operation
		E1.4	Thermal overload warning 4 during operation
		E1.5	Thermal overload warning 1 during a stop
		E1.6	Thermal overload warning 2 during a stop
		E1.7	Thermal overload warning 3 during a stop
		E1.8	Thermal overload warning 4 during a stop
E2	Servo motor overheat warning	E2.1	Servo motor temperature warning
E3	Absolute position counter warning	E3.1	Multi-revolution counter travel distance excess warning
		E3.2	Absolute position counter warning
		E3.4	Absolute positioning counter EEP-ROM writing frequency warning
		E3.5	Encoder absolute positioning counter warning
E4	Parameter warning	E4.1	Parameter setting range error warning
E5	ABS time-out warning	E5.1	Time-out during ABS data transfer
		E5.2	ABSM off during ABS data transfer
		E5.3	SON off during ABS data transfer

No.	Name	Detail No.	Detail name
E6	Servo forced stop warning	E6.1	Forced stop warning
		E6.2	SS1 forced stop warning 1 (safety observation function)
		E6.3	SS1 forced stop warning 2 (safety observation function)
E7	Controller forced stop warning	E7.1	Controller forced stop input warning
E8	Cooling fan speed reduction warning	E8.1	Decreased cooling fan speed warning
		E8.2	Cooling fan stop
E9	Main circuit off warning	E9.1	Servo-on signal on during main circuit off
		E9.2	Bus voltage drop during low speed operation
		E9.3	Ready-on signal on during main circuit off
		E9.4	Converter unit forced stop
EA	ABS servo-on warning	EA.1	ABS servo-on warning
EB	The other axis error warning	EB.1	The other axis error warning
EC	Overload warning 2	EC.1	Overload warning 2
ED	Output watt excess warning	ED.1	Output watt excess warning
F0	Tough drive warning	F0.1	Instantaneous power failure tough drive warning
		F0.3	Vibration tough drive warning
F2	Drive recorder - Miswriting warning	F2.1	Drive recorder - Area writing time-out warning
		F2.2	Drive recorder - Data miswriting warning
F3	Oscillation detection warning	F3.1	Oscillation detection warning
F4	Positioning warning	F4.4	Target position setting range error warning
		F4.6	Acceleration time constant setting range error warning
		F4.7	Deceleration time constant setting range error warning
		F4.9	Home position return type error warning
F5	Simple cam function - Cam data miswriting warning	F5.1	Cam data - Area writing time-out warning
		F5.2	Cam data - Area miswriting warning
		F5.3	Cam data checksum error
F6	Simple cam function - Cam control warning	F6.1	Cam axis one cycle current value restoration failed
		F6.2	Cam axis feed current value restoration failed
		F6.3	Cam unregistered error
		F6.4	Cam control data setting range error
		F6.5	Cam No. external error
		F6.6	Cam control inactive
F7	Machine diagnosis warning	F7.1	Vibration failure prediction warning
		F7.2	Friction failure prediction warning
		F7.3	Total travel distance failure prediction warning

* Leave for about 30 minutes of cooling time after removing the cause of occurrence.

4.4 Other Factors Impacting the Servo System

4.4.1 Harmonics

Harmonics have higher frequencies than fundamental waves. Servo amplifiers also produce several harmonic waves.

Because harmonics cause abnormal rotation and vibration with adverse effects on electronic equipment, you may need to take measures to prevent harmonics, such as adding a reactor to a servo amplifier.

4.4.2 Leakage current

Leakage current literally refers to the "current that is leaking".

Although it theoretically should not flow, this is what we call the current that flows outside of the electric circuit.

It may cause noise in electronic equipment, or an electric shock depending on the amount of current. You must take measures to ensure that servo amplifiers and servo motors are grounded, so that leakage current can be minimized.

Furthermore, leakage current can cause an earth-leakage circuit breaker to react excessively and get tripped. This may cause trouble if, for example, the equipment cannot operate properly. Refer to the manual to select a circuit breaker with an appropriate capacity.

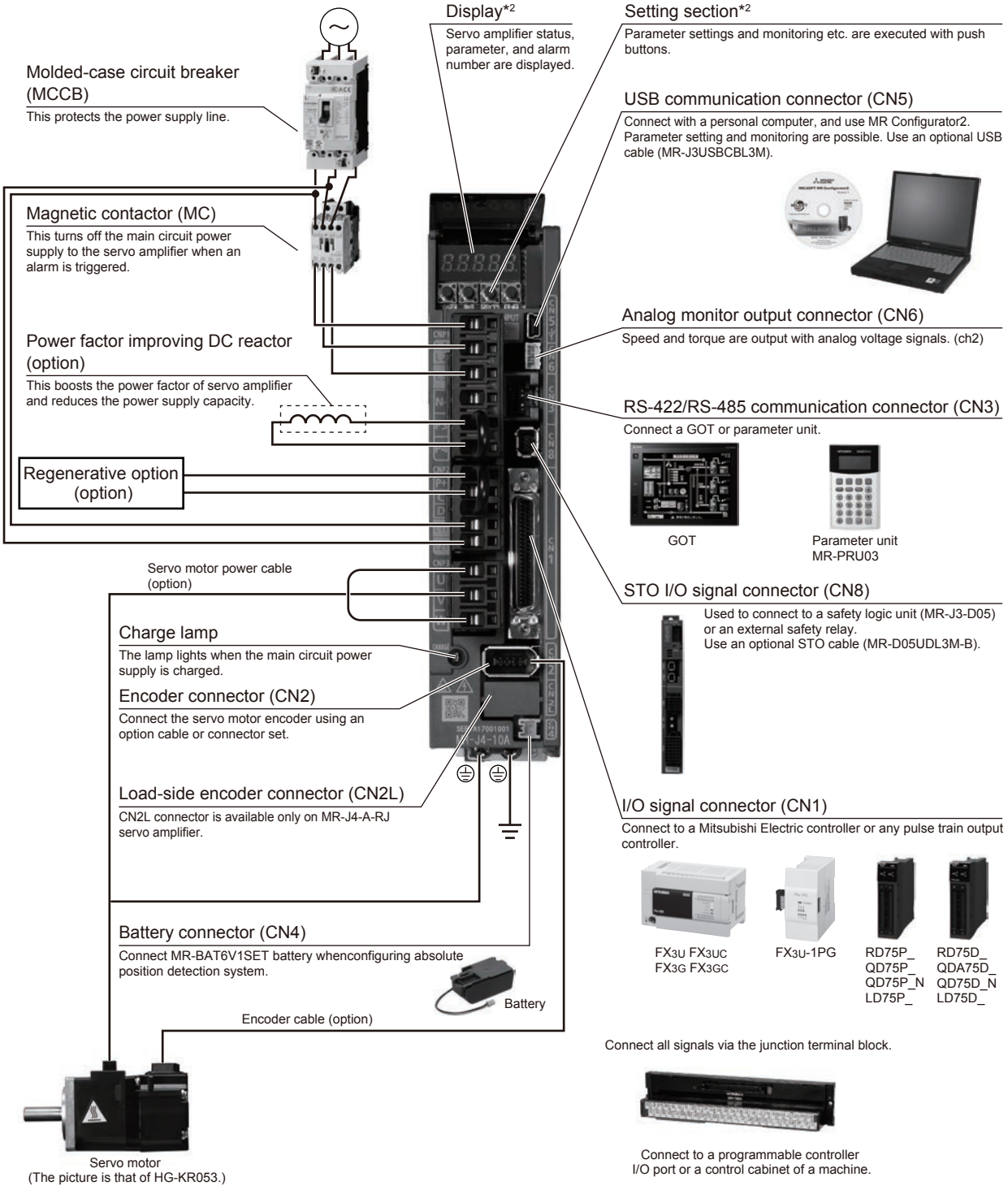
In addition, you must pay attention to the precautions to operate equipment properly. Refer to the relevant manuals for details and take appropriate measures.

CHAPTER 5
INTRODUCTION TO MELSERVO-J4

5.1 Appearance and Interfaces

MR-J4-A/MR-J4-A-RJ Connections with Peripheral Equipment*1

Peripheral equipment is connected to MR-J4-A/MR-J4-A-RJ as described below. Connectors, cables, options, and other necessary equipment are available so that users can set up the servo amplifier easily and start using it right away.



*1 The connection with the peripheral equipment is an example for MR-J4-350A/MR-J4-350A-RJ or smaller servo amplifiers. Refer to "MR-J4-_A_(-RJ) MR-J4-03A6(-RJ) Servo Amplifier Instruction Manual" for the actual connections.

*2 This picture shows when the display cover is open.

5.2 Types of Servo Amplifiers

MELSERVO-J4 servo amplifiers come in three different models, each with its own characteristics.
Use a different model depending on the environment and equipment that the amplifier connects to.

- Type A

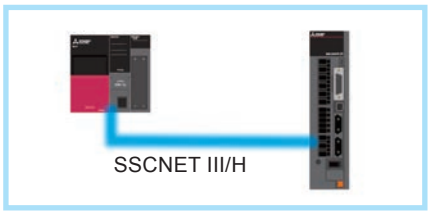
This servo amplifier supports generic interfaces.
The Type A model is used in this training material.

MR-J4-A

- Type B

This servo amplifier supports the servo system control network (SSCNET III/H), a dedicated servo network.
- Allows building a complete synchronous system through high-speed serial optical communication.
- Combined with a servo system controller, provides the maximum functionality and performance of the servo system.
- Supports high-speed, high-precision, and multi-axis control.
- Excellent noise resistance

MR-J4-B



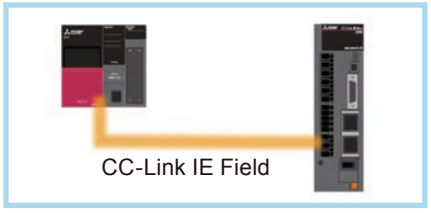
MR-J4W2-B

MR-J4W3-B

- Type GF

This servo amplifier supports the CC-Link IE field network.
When combined with a simple motion module, it can provide positioning and synchronous control of multiple axes.
- You can build a system that is synchronous with things such as a remote I/O over an Ethernet-based open network.

MR-J4-GF

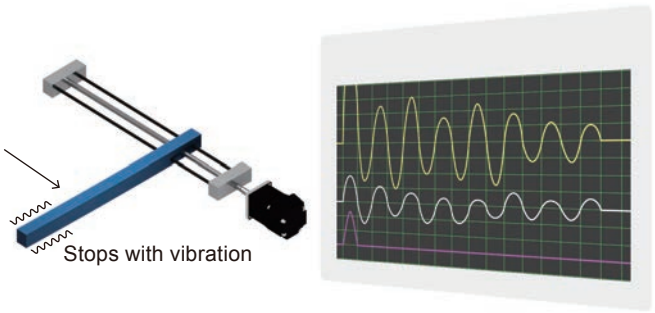


5.3 Key Features of the Mitsubishi Electric MELSERVO-J4 Series

5.3.1 Advanced vibration suppression control II

This feature suppresses the vibration at the end of an arm or residual vibration.
A servo motor operation that causes equipment to move also generates vibration at the device's main unit and the end of the arm, both of which have a relatively low frequency of about 100 Hz or less.

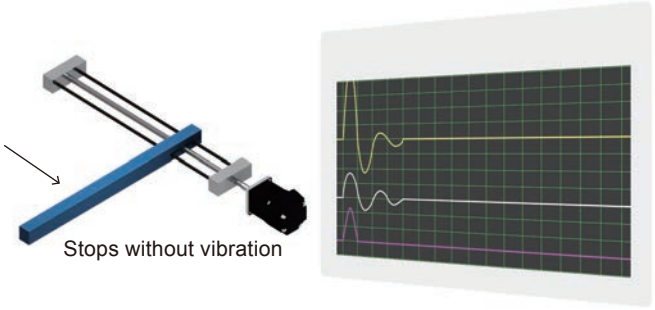
Without vibration suppression control



Two types of vibrations exist.

These vibrations prevent the servo motor from moving most accurately.
The "Advanced vibration suppression control II" feature reduces both types of vibration simultaneously.

Advanced vibration suppression control II

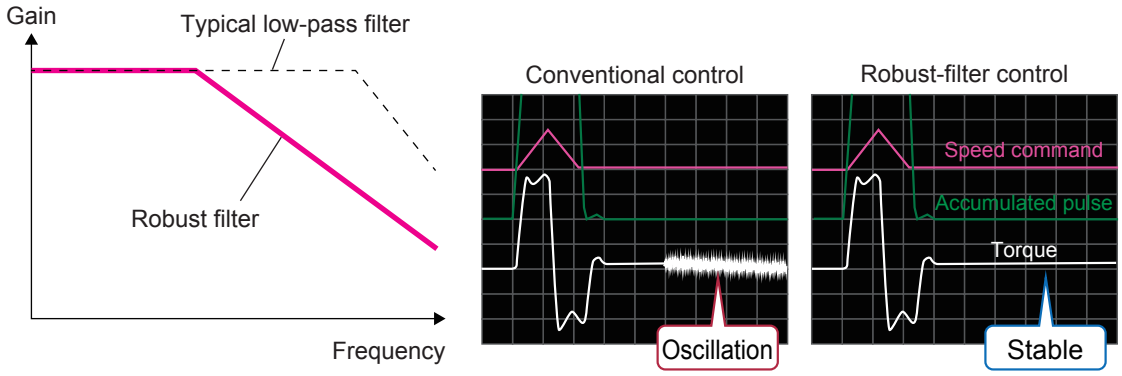


Both vibrations are suppressed.

You can adjust the feature easily with MR Configurator2.
Suppressing vibration with this feature can reduce the settling time.

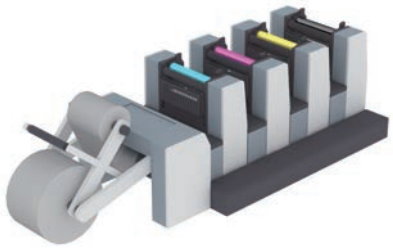
5.3.2 Robust filter

A robust filter is used with high-inertia equipment driven by belts and gears, such as industrial printers and packing equipment. It facilitates both high responsiveness and stability. Additional tuning is unnecessary.
Compared to conventional filters, it can bring much greater stability by gently reducing the torque with a wide range of frequencies.

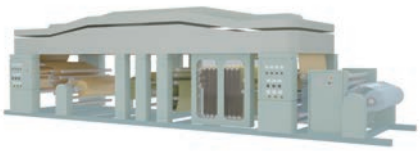


Application examples

[Industrial printer]



[Packaging equipment]

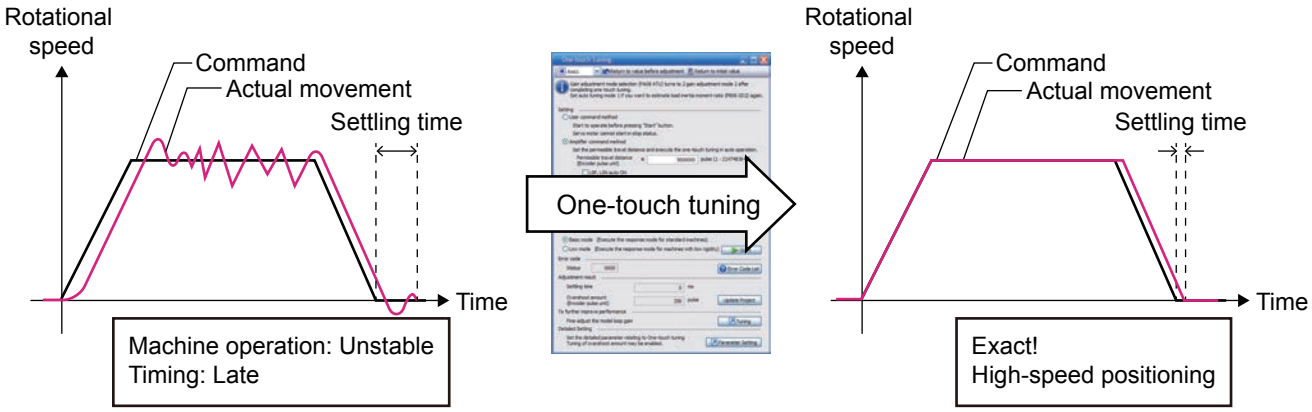


5.3.3 One-touch tuning

The one-touch tuning feature, as suggested by its name, enables users to quickly and easily set devices for maximum performance with a single button press.

Just turning on the one-touch tuning feature completes comprehensive tuning, including the "advanced vibration suppression control II" and "robust filter" features.

* You can also use this feature from MR Configurator2.



Revision History

Date of creation	Version	Description
March 2018	A	First edition

MEMO

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

KK018-T1803-EN H-1803(MEE)

March 2018