Servo System Controller

MELSEC iQ-F Series Simple Motion Module

This course is for participants who will establish a motion control system using the MELSEC iQ-F series Simple Motion module for the first time.
Introduction

Purpose of the Course

This course targets those who establish a motion control system using the MELSEC iQ-F series Simple Motion module for the first time. This course describes the procedures for system design, installation, wiring, and the operations required before operating the Simple Motion module with MELSOFT GX Works3, the PLC engineering software.

Learn about module installation, wiring, and power-on of the MELSEC iQ-F series Simple Motion module.

Synchronous Control Startup

Module Startup

Positioning Control Startup

The basic knowledge of MELSEC iQ-F series PLCs, AC servos, and positioning control is required to take this course.

For beginners, taking the following courses are recommended.

- "MELSEC iQ-F Series Basic" course
- "PLC Engineering Software MELSOFT GX Works3 (Ladder)" course
- "MELSERVO Basics (MR-J4)" course
- "FA Equipment for Beginners (Positioning)" course
Introduction

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

- Chapter 1 - Module Startup
  Learn about module installation, wiring, and power-on of the MELSEC iQ-F series Simple Motion module.

- Chapter 2 - Positioning Control Startup
  Learn about how to perform the positioning control with the MELSEC iQ-F series Simple Motion module.

- Chapter 3 - Synchronous Control Startup
  Learn about how to perform the synchronous control with the MELSEC iQ-F series Simple Motion module.

- Final Test
  5 sections in total (7 questions)  Passing grade: 60% or higher.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
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<tbody>
<tr>
<td>Go to the next page</td>
<td>Go to the next page.</td>
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<tr>
<td>Back to the previous page</td>
<td>Back to the previous page.</td>
</tr>
<tr>
<td>Move to the desired page</td>
<td>“Table of Contents” will be displayed, enabling you to navigate to the desired page.</td>
</tr>
<tr>
<td>Exit the learning</td>
<td>Exit the learning. Window such as &quot;Contents&quot; screen and the learning will be closed.</td>
</tr>
</tbody>
</table>
Safety precautions

When you learn by using actual products, please fully read "Safety Instructions" in the corresponding manuals and use them correctly.

Precautions in this course

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

The following shows the software used in this course and each software version.

For the latest version of each software, check the Mitsubishi Electric FA Website.

- MELSOFT GX Works3 Ver.1.011M

Reference materials

The following is the reference related to the learning. (You can learn without it.) Click the reference name to download.

<table>
<thead>
<tr>
<th>Name of reference</th>
<th>File format</th>
<th>File size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recording paper</td>
<td>Compressed file</td>
<td>7.06 kB</td>
</tr>
</tbody>
</table>
Chapter 1  Module Startup

This chapter explains a 1-axis system using ball screws as the system used in this course. Please check the following PDF file for the operation pattern diagram and the machine specifications.

Sample system details <PDF>
1.1 System Configuration

The following shows the configuration of the sample system used in this course.

(Note) The 24VDC service power supply for FX5U-32MT/ES can also be used. (The 24VDC service power supply for FX5U-32MT/ES supplies power to one Simple Motion module.)
1.2 Startup Procedure

The following shows the establishment procedure of a servo system with the MELSEC iQ-F series Simple Motion module. This course explains module installation, wiring, and cable wiring following the establishment procedure.

1. Mounting
   - Installing a Simple Motion module

2. Wiring and cable connection
   - Wiring of the PLC and Simple Motion module power supply
   - Wiring for servo amplifier power supply and servo motor power cables
   - Axis Number Settings
   - SSCNET III/H Connection
   - Power-on of the system
   - Power-on of servo amplifier
1.3 Mounting

Install a Simple Motion module.

1. Remove the extension connector cover (A in the figure below) on the right side on the surface of the FX5U PLC.
2. Connect the extension cable (B in the figure below) from the Simple Motion module to the extension connector of the PLC. Push the pull tab (C in the figure below) of the extension cable inside the extension connector cover.
3. Attach the extension connector cover.
1.4 Wiring and Cable Connection

This section explains the wiring and cable connection example for the Simple Motion module and servo amplifiers. The system in this course uses the cables for MR-J4-10B. If the capacity of the servo amplifier is different, refer to SERVO AMPLIFIER INSTRUCTION MANUAL for each model.

1.4.1 Wiring of the PLC and Simple Motion module power supply

The following shows an example when a power wire and a grounding wire are connected to the FX5U PLC and Simple Motion module. At wiring, open the terminal block cover on the top of the PLC and wire cables. Connect an isolation transformer when noise often enters in the power supply system.

<table>
<thead>
<tr>
<th>Terminal screw size</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>0.5〜0.8 N・m</td>
</tr>
</tbody>
</table>
1.4.2 Wiring for Servo Amplifier Power Supply and Servo Motor Power Cables

Wire the control circuit power supply (L11, L21) and the main circuit power supply (L1, L2, L3) of the servo amplifier, and the servo motor power cable.

<table>
<thead>
<tr>
<th>Item</th>
<th>Applicable wire size</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control circuit power supply (L11, L21)</td>
<td>1.25mm² to 2mm² (AWG16 to 14)</td>
<td>-</td>
</tr>
<tr>
<td>Main circuit power supply (L1, L2, L3)</td>
<td>2mm² (AWG14)</td>
<td>-</td>
</tr>
<tr>
<td>Grounding wire</td>
<td>1.25mm² (AWG16)</td>
<td>1.2N•m</td>
</tr>
</tbody>
</table>
### 1.4.3 Axis Number Settings

Set a control axis number to the servo amplifier. A control axis number is assigned to each servo amplifier to identify control axes. Up to 4 axis numbers can be set regardless of the order of connection. Note that the operation may not be performed properly if the set control axis numbers overlap in one servo system.

Select the control axis number of the servo amplifier with the axis selection rotary switch (SW1). Refer to the following table for the relation between each setting value of the axis selection rotary switch and axis number. Turn "off (down)" all auxiliary axis number setting switches (SW2).

<table>
<thead>
<tr>
<th>Axis selection rotary switch (SW1)</th>
<th>Control axis number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Axis 1</td>
</tr>
<tr>
<td>1</td>
<td>Axis 2</td>
</tr>
<tr>
<td>2</td>
<td>Axis 3</td>
</tr>
<tr>
<td>3</td>
<td>Axis 4</td>
</tr>
</tbody>
</table>
1.4.4 SSCNET III/H Connection

Connect the servo amplifier with a controller. The MR-J4-B servo amplifier has an SSCNET III/H interface. Using the optical communication method, SSCNET III/H achieves high noise tolerance and high-speed, full-duplex communication.

Use a dedicated cable to connect the servo amplifier with the controller. The cable with connectors allows easy connection and disconnection. The following figure shows a 2-axis system as an example.

Servo system controller FX5-40SSC-S

MR-J4-10B

MR-J4-10B

CN1A

CN1B

CN1A

Cap

CN1B

Note the following points when using SSCNET III cables:

- If any power such as a great shock or lateral pressure is applied to the cable, or the cable is pulled, suddenly bent, or twisted, inside parts are distorted or damaged, and optical transmission will not be available.
- As the optical fibers are made of synthetic resin, it will be thermally deformed if exposed to a fire or high temperature.
- If the end face of an optical cord tip is dirty, optical transmission is interrupted and it may cause malfunctions.
- Do not look directly at the light output from the connector or the end of the cable.
- For your safety and protection of the connector, put a supplied cap in the unused connector (CN1B) on the final-axis servo amplifier.

How to connect

Knob

Click
1.4.5 Power-on of the Programmable Controller

Check that the wiring to the power supply of the PLC is correct and the PLC CPU module is in the STOP status. After that, power on the PLC.

PLC operation status

LED status after power-ON

PWR LED (green light) turns ON.

Check that the RUN/STOP/RESET switch of the PLC is in the STOP status.

When parameters and programs are not written to the PLC, the ERR LED (red light) flashes, but no immediate error occurring. After writing parameters and programs and turning the power OFF to ON, the ERR LED will be OFF.
1.4.6 Power-on of Servo Amplifier

Turn on the control circuit power supply and the main circuit power supply of the servo amplifier. “AA” (Initializing standby) or “Ab” (Initializing) is displayed in the display of the servo amplifier. No servo system controller is connected in this sample system. Thus, configure required settings and start up the system with the “Ab” state.

Power on the servo amplifier.

"AA" or "Ab" is displayed in the display.

When parameters are not written to the Simple Motion module, the LED displays "AA" or "Ab", but no immediate error is occurring.
1.5 Summary of This Chapter

In this chapter, you have learned:

- System Configuration
- Startup Procedure
- Mounting
- Wiring and Cable Connection

Important points

<table>
<thead>
<tr>
<th>System Configuration</th>
<th>Configure a system using MELSEC iQ-F series PLCs including a Simple Motion module and MELSERVO J4 series servo amplifiers and servo motors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup Procedure</td>
<td>After wiring of the programmable controller, wiring of the power supplies of the servo amplifiers and the power cables of the servo motors, setting of axis numbers, and connecting to SSCNET are completed, turn on the power supplies of the PLC and the servo amplifiers.</td>
</tr>
<tr>
<td>Mounting</td>
<td>Connect the Simple Motion module to the extension connector of the PLC.</td>
</tr>
</tbody>
</table>
| Wiring and Cable Connection | Wire the power supplies of the PLC and Simple Motion module, wire the power supplies of servo amplifiers and the power cables of servo motors, set the control axis numbers of servo amplifiers, and connect to SSCNETIII/H.  
                              | After all the wiring and cable connection operations are completed, power on the PLC and the servo amplifiers to check that these module have been properly connected. |
Chapter 2  Positioning Control Startup

Positioning control startup is performed in chapter 2.

2.1  Creating a New Project

Use MELSOFT GX Works3 to create a project and sequence program. The contents in this course require MELSOFT GX Works3 of version 1.011M or later.

How to check the version of MELSOFT GX Works3
Start MELSOFT GX Works3, and select [Help] - [Version Information].
2.1.1 Creating a New Project

Start MELSOFT GX Works3, and create a new project. Select [Project] - [New] in the menu, set the items as follows, and click [OK].

<table>
<thead>
<tr>
<th>Item</th>
<th>Setting</th>
</tr>
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<tbody>
<tr>
<td>Series</td>
<td>FX5CPU</td>
</tr>
<tr>
<td>Model</td>
<td>FX5U</td>
</tr>
<tr>
<td>Program language</td>
<td>Ladder</td>
</tr>
</tbody>
</table>

The window asking you to add a module appears. Click the [Setting Change] button and change the setting of [Use Module Label] to [Yes].

Click the [OK] button to create a project.
2.1.1 Creating a New Project

Click the [OK] button to create a project.
2.1.2 Connecting the PLC to a Personal Computer

Confirm the connection between a personal computer and the PLC. Connect the PLC to a personal computer with an Ethernet cable. Select [Online] - [Specify Connection Destination] in the menu to display the "Specify Connection Destination Connection" window, and select [CPU Module Direct Coupled Setting]. Select [Ethernet] as the method of connecting with the CPU module.
2.1.3 Initializing the PLC CPU

Initialize a memory of the PLC CPU. Select [Online] - [CPU Memory Operation] in the menu, and click [Initialization] in the Memory Management window.

- Select the memory to initialize.
- Click the Initialization button.
- Confirm the initialization process.
- Click Yes to proceed with initialization.
- The initialization process will be completed.
2.1.4 Creating a Module Configuration

Create a module configuration diagram and fix the parameter. Double-click [Module Configuration] in the Navigation tree to open the module configuration diagram. Select a Simple Motion module from the Element Selection window, and drag and drop it into the configuration diagram.

After creating the module configuration diagram, select [Edit] - [Parameter] - [Fix] from the menu. The window asking about module label addition appears for the selected modules. Click [Yes].
2.2 Sequence Program Creation

Create a sequence program.

2.2.1 New Sequence Programs Creation

The use of label and function block (FB) removes the need to remember devices when programming.
2.2.2 Multiple Comments Display Setting

Check the "Enable Multiple Comments Display" box and "Target" boxes for each language to switch the language for comments in sequence programs.

Select [View] - [Multiple Comments Display Setting] in the menu to open the setting screen.
2.2.3 Registration of Global Labels

Labels are variable elements that allow you to put arbitrary names or data types to programs, etc. The use of labels allows you to create a program without worries about devices and buffer memory, enabling a different model/product to be used with the same program.

Select [Label] - [Global] in the menu to display the screen for registering global labels.

For registered contents, refer to the following PDF file.

Global label setting examples <PDF>
2.2.4 Element Selection Window

Display the Element Selection window.
2.2.5 Sequence Program Creation with Module Labels

Create a sequence program using module labels. Drag and drop the module label to be used from the Element Selection window, change it to an arbitrary contact or coil, and convert it. For sequence program examples, refer to the following link.

Sequence program for positioning control <PDF>

1. Select a label from the module label list.
2. Drag & drop the module label.
3. Double-click.
4. Change the contact to an arbitrary contact or coil.
5. Click [OK] to create a circuit.
2.2.5 Sequence Program Creation with Module Labels

(1) Select a label from the module label list.

(6) Select [Convert] - [Convert] in the menu and convert it.
2.2.6 Sequence Program Creation with Module FB

Create a sequence program using module FBs.

On the next page, operate the actual screen and create a sequence program using module FBs.
### 2.2.6 Sequence Program Creation with Module FB

The sequence program creation using module FBs is completed.

Click [ ] to proceed to the next screen.

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</tbody>
</table>

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**Module Label**
- FX5UCPU
- 1[U1]:FX5-40SSC-S
- FX5SSC_1

**Nodes**
- uIO
- Parameter
- Axis monitor data
- System monitor data
- Axis control data 1
- System control data 3
2.2.7 Saving a Project

Save a created project.
Select [Project]-[Save as] in the menu, and click [Save] after entering the file name.

![Image of saving a project process]

- Select [Save As...]
- Enter the file name: FX5-40SSC-S_sample
- Select save as type: GX Works3 Project (*.gx3)
- Click [Save]
2.2.8 Writing to the Programmable Controller

Write the set parameters and created program into the PLC.
Select [Online] - [Write to PLC] in the menu to display the Online Data Operation window.
Select System Parameter/CPU Parameter, Module Parameter, and program files and click [Execute] to start writing to the PLC.
Click [Close] to complete the writing to the Programmable Controller.
2.3 Parameter Settings for Simple Motion Module

Set parameters of the Simple Motion module.
For parameter setting examples, refer to the following link.

Parameter setting example <PDF>

2.3.1 Start of Simple Motion Module Setting Function

Double click [Simple Motion Module Setting] in the menu of MELSOFT GX Works3 to open the Simple Motion Module Setting Function window.
2.3.2 System Settings

Configure the system setting.

1. Double-click.

2. Set the servo amplifiers according to the machine. (Double-click)

3. Set the details of servo amplifiers.

4. Click [OK], then the set servo amplifier is colored.
2.3.3 Parameter Settings

Set parameters.

On the next page, operate the actual screen and set parameters.
Setting parameters is completed.
Click 🔄 to proceed to the next screen.
1. **Rotation direction selection**
   - The rotation direction is either counterclockwise (CCW) or clockwise (CW) as seen from the load side (side attached to the machine).
   - **Function Explanation**: Use this option to set the rotation direction of the servo motor when being moved by forward rotation commands. The rotation direction is either counterclockwise (CCW) or clockwise (CW) as seen from the load side (side attached to the machine).
   - **Initial values**: CCW for forward rotation command, CW for reverse command.
   - **Setting for the Sample System**: CCW for forward rotation command, CW for reverse command.
### 2.3.4 Servo Parameter Settings (Basic)

| Servo forced stop selection | Turn this option ON to enable use of the forced stop input (EM2 or EM1) signal. The initial value is set to [Enabled] for safety reasons. In the sample system, the servo forced stop signal is not used. Thus, set this option to [Disabled]. | Enabled (Either forced stop input EM2 or EM1 is used.) | Disabled (Neither forced stop input EM2 nor EM1 is used.) |
2.3.4 Servo Parameter Settings (Component Parts)

Set Component parts of Servo Parameter.

<table>
<thead>
<tr>
<th>Parameter item</th>
<th>Function Explanation</th>
<th>Initial values</th>
<th>Setting for the Sample System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute position detection system/Incremental system selection</td>
<td>Select Used in incremental system or Used in ABS pos. detect system.</td>
<td>Disabled (Used in incremental system)</td>
<td>Disabled (Used in incremental system)</td>
</tr>
<tr>
<td>home position setting condition select</td>
<td>When &quot;Z-phase must not be passed&quot; is selected, the home position return can be executed without waiting for the motor to rotate one time or more.</td>
<td>Z-phase must be passed</td>
<td>Z-phase must not be passed</td>
</tr>
<tr>
<td>System Selection</td>
<td>Home position setting condition select</td>
<td>Z-phase must be passed</td>
<td>Z-phase must not be passed</td>
</tr>
<tr>
<td>------------------</td>
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</tr>
<tr>
<td></td>
<td>When &quot;Z-phase must not be passed&quot; is selected, the home position return can be executed without waiting for the motor to rotate one time or more.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.3.5 Positioning Data Setting

Set positioning data based on the operation pattern of the system used in this course.

On the next page, operate the actual screen and configure the positioning data setting.
2.3.5 Positioning Data Setting

Setting positioning data is completed. Click to proceed to the next screen.
2.3.6 Writing to the Simple Motion Module

Write the set parameters and positioning data into the Simple Motion module. Before writing them, save the project. (Refer to Section 2.2.7.)

1) Select [Online] - [Write to PLC] in the menu to display the Online Data Operation window.
2) Select Simple Motion Module Setting.
3) Click [Execute] to start writing the selected items to the Simple Motion module.
4) Click [Close] after completion of the writing.

Power on the PLC after completion of the writing.

The confirmation message window for flash ROM overwriting appears. Click [Yes].
2.4 Operation Check

Check the operation of the system in this course. Before the operation check, set some items so that the buffer memory can be monitored on the monitor window of GX Works3.

1) Select [Tool] → [Options] from the menu to display the following window.
2) Select [Monitor] → [Ladder Editor].
3) Set [Monitor Buffer Memory and Link Memory] of "Operational Setting" to [Yes].
4) Click the [OK] button.
2.4.1 JOG Operation

Check the operation with the JOG operation.

On the next page, operate the actual screen and check the operation with the JOG operation.
2.4.1 JOG Operation

ROTATION DIRECTION/MOVING DIRECTION

Select the rotation direction/moving direction of the command input pulse.

The JOG operation check is completed. Click to proceed to the next screen.
2.4.2 Home Position Return

Perform the home position return.
Perform the data set type home position return in this course.

On the next page, operate the actual screen and perform the home position return.
2.4.2 Home Position Return

Md.31: Status: HPR request flag turns OFF.
Md.31: Status: HPR complete flag turns ON.

The home position return operation check is completed.
Click to proceed to the next screen.
2.4.3 Positioning Control

Check the operation with the positioning control.

On the next page, operate the actual screen and check the operation with the positioning control.
Md.31: Status: HPR complete flag turns OFF.

The positioning control operation check is completed. Click \( \rightarrow \) to proceed to the next screen.
2.5 Summary of This Chapter

In this chapter, you have learned:

- Creating a New Project
- Sequence Program Creation
- Parameter Settings for Simple Motion Module
- Operation Check

Important points

| Creating a New Project | Use MELSOFT GX Works3 to create a project and sequence program.  
<table>
<thead>
<tr>
<th></th>
<th>The contents in this course require MELSOFT GX Works3 of version 1.011M or later.</th>
</tr>
</thead>
</table>
| Sequence Program Creation | The use of label and function block (FB) removes the need to remember devices  
|                         | when programming.  
|                         | Check the "Enable Multiple Comments Display" box and "Target" boxes for each language to switch the language for comments in sequence programs. |
| Parameter Settings for Simple Motion Module | Double-click [Simple Motion Module Setting] in the menu of MELSOFT GX Works3  
|                                            | to open the Simple Motion Module Setting Function window. |
| Operation Check | Double-clicking a device while pressing the SHIFT key changes the status of the device from OFF to ON, and vice versa. |
Chapter 3  SYNCHRONOUS CONTROL STARTUP

This chapter describes synchronous control, mainly about the synchronous control parameter, positioning data for synchronous control, and operation check for synchronous control. Axis 1 operation is the same as that described in Chapter 1. Refer to Chapter 1 to 2 for details of the parameters and servo parameters. For the operation pattern diagram and machine specifications, check the following PDF file.

Sample system details (Synchronous control) <PDF>
3.1 System Configuration

The following shows the configuration of the sample system used in this chapter.
3.1 System Configuration

- Molded-case circuit breaker (MCCB)
- Magnetic contactor (MC)
- SSCNET III cable (MR-J3BUS_M)
- Molded-case circuit breaker (MCCB)
- Magnetic contactor (MC)

Connections:
- Servo motor power cable
- Encoder cable

Units:
- HG-KR13
The following shows the synchronous control startup procedure.

1. System Configuration Settings  
   Section 3.3.1

2. Parameters and Servo Parameters Settings  
   Section 3.3.2

3. Positioning Data Settings  
   Section 3.3.3

4. Synchronous Control Parameter Settings
   - Synchronous parameter settings
   - Input axis parameter settings
   - Transition of synchronous control parameter window  
   Section 3.3.4

5. Cam Data Creation
   - Creating a new cam data
   - Cam curve creation  
   Section 3.3.5

6. Writing to the Simple Motion Module  
   Section 3.3.6
3.3 Parameter Creation for Synchronous Control

Create parameters for synchronous control.

3.3.1 System Configuration Settings

Configure a 2-axis system.
Add an axis in the System Configuration window.

(Note) Turn "off (down)" all auxiliary axis number setting switches (SW2).
3.3.2 Parameters and Servo Parameters Settings

Set parameters and servo parameters for axis 2. The following shows the setting details of the electronic gear setting for the belt conveyor.

[Input]

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Components</td>
<td>Conveyor</td>
</tr>
<tr>
<td>Unit Setting</td>
<td>0:mm</td>
</tr>
<tr>
<td>Outer diameter of Roll (DR)</td>
<td>50000.0 [μm]</td>
</tr>
<tr>
<td>Reduction Gear Ratio (NL/NM)</td>
<td></td>
</tr>
<tr>
<td>Load side [NL]</td>
<td>1</td>
</tr>
<tr>
<td>Motor side [NM]</td>
<td>1</td>
</tr>
<tr>
<td>Encoder resolution</td>
<td>4194304 [pulse/rev]</td>
</tr>
</tbody>
</table>

[Calculation Result]

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Setting</td>
<td>0:mm</td>
</tr>
<tr>
<td>Number of Pulses per Rotation</td>
<td>172985333 pulse</td>
</tr>
<tr>
<td>Movement Amount per Rotation</td>
<td>6478422.3 μm</td>
</tr>
<tr>
<td>Unit Magnification</td>
<td>1: x1 times</td>
</tr>
</tbody>
</table>
3.3.3 Positioning Data Settings

Set Axis #2 Positioning Data.

[Axis 2 positioning data]

<table>
<thead>
<tr>
<th>No.</th>
<th>Operation pattern</th>
<th>Control method</th>
<th>Axis to be interpolated</th>
<th>Acceleration time No.</th>
<th>Deceleration time No.</th>
<th>Positioning address</th>
<th>Arc address</th>
<th>Command speed</th>
<th>Dwell time</th>
<th>Mcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0: END</td>
<td>INC linear 1</td>
<td>-</td>
<td>1:1000</td>
<td>1:1000</td>
<td>157079.6 μm</td>
<td>0.0 μm</td>
<td>2000.00 mm/min</td>
<td>0 ms</td>
<td>0</td>
</tr>
</tbody>
</table>
# Synchronous Control Parameter Settings

Set parameters for axis 1 which synchronizes to the input axis (axis 2) feed current value in cam operation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input axis parameter</td>
<td>Set the servo input axis type for the main shaft.</td>
</tr>
<tr>
<td></td>
<td>(Set &quot;1: Feed current value &quot; for axis 2)</td>
</tr>
<tr>
<td>Axis 1 synchronous control</td>
<td>Set the axis 1 synchronous control parameter.</td>
</tr>
<tr>
<td>Synchronous control image</td>
<td>The configuration of output axes connected to the main shaft is displayed.</td>
</tr>
<tr>
<td></td>
<td>The configuration of input/output axes can be checked at a glance.</td>
</tr>
</tbody>
</table>
3.3.4 Synchronous Parameter Settings

The following explains the settings that synchronize the axis 1 to the axis 2 feed current value. Select [Axis #1 Synchronous Parameter] in the Navigation menu, and select [Main shaft (Main)] to display the parameters of the main shaft.

Change the following parameters. Use the default values for the synchronous parameters other than the following.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main shaft</td>
<td></td>
</tr>
<tr>
<td>Main input axis No.</td>
<td>Pr.400: Type</td>
</tr>
<tr>
<td></td>
<td>1: Servo input axis</td>
</tr>
<tr>
<td></td>
<td>Pr.400: Axis No.</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Output axis</td>
<td>Cam axis cycle unit setting</td>
</tr>
<tr>
<td></td>
<td>Pr.438: Unit</td>
</tr>
<tr>
<td></td>
<td>0:mm</td>
</tr>
<tr>
<td></td>
<td>Pr.438: Number of decimal places</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pr.439: Can axis length per cycle</td>
</tr>
<tr>
<td></td>
<td>157.0796 mm</td>
</tr>
<tr>
<td></td>
<td>Pr.441: Cam stroke amount</td>
</tr>
<tr>
<td></td>
<td>1000000.0 μm</td>
</tr>
<tr>
<td></td>
<td>Pr.440: Cam No.</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
3.3.4 Input Axis Parameter Settings

The following explains the settings that synchronize the axis 1 to the axis 2 feed current value. Select [Input Axis Parameter] in the Navigation menu to display the Input Axis Parameter window.

Change the following parameters. Use the default values for the I/O axis parameters other than the following.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo input axis</td>
<td>Pr.300: Servo input axis type</td>
</tr>
<tr>
<td></td>
<td>1: Feed current value</td>
</tr>
</tbody>
</table>
### 3.3.4 Transition of Synchronous Control Parameter Window

The following shows the synchronous parameter window transition.

**[Synchronous parameter]**

1. Select [Axis # 1 Synchronous Parameter] in the menu. Then, the axis 1 synchronous parameter can be changed.

2. Click [Synchronous Control Image] to open the image screen.

3. Select the main shaft to open the input axis parameter. Parameters related to the input axis (axis 2) can be set.
Cam Data Creation

Create cam data.

On the next page, operate the actual screen and create cam data.
Cam data creation is completed.
Click to proceed to the next screen.
3.4 Operation Check for Synchronous Control

Check the operation of synchronous control.

Save the project first. (Refer to Section 2.2.7.)

After saving the project, write the synchronous control parameters and cam data into the Simple Motion module. (Refer to Section 2.3.6.)
3.4.1 Starting the Synchronous Control and Checking the Operation

Start the synchronous control and check the operation.

On the next page, operate the actual screen and start the synchronous control and check the operation.
### 3.4.1 Starting the Synchronous Control and Checking the Operation

**Axis Monitor**

<table>
<thead>
<tr>
<th>Monitor Type</th>
<th>Axis #1</th>
<th>Axis #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Md.20: Feed current value</td>
<td>0.0 μm</td>
<td>157079.6 μm</td>
</tr>
<tr>
<td>Md.21: Machine feed value</td>
<td>0.0 μm</td>
<td>157079.6 μm</td>
</tr>
<tr>
<td>Md.23: Axis error No.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Md.24: Axis warning No.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Md.26: Axis operation status</td>
<td>Synchronous Control</td>
<td>Waiting</td>
</tr>
<tr>
<td>Md.28: Axis feed speed</td>
<td>0.00 mm/min</td>
<td>0.00 mm/min</td>
</tr>
<tr>
<td>Md.44: Positioning data No. being executed</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Md.47: Positioning data being executed: Operation pattern</td>
<td>Positioning Complete</td>
<td>Positioning Complete</td>
</tr>
</tbody>
</table>

**Module Information List**

- PLC READY (U1#G5950)
- READY (U1#G31500.0)
- Synchronization flag (U1#G31500.1)
- All axes servo ON (U1#G5951)
- Md.108: Servo status 1 : READY ON
  - Axis Nos.: 1 2 3 4
- Md.108: Servo status 1 : Servo ON
  - Axis Nos.: 1 2 3 4
- Md.50: Forced stop input (U1#G4231)
  - BUSY
    - Axis Nos.: 1 2 3 4
- Md.31: Status : Error detection
  - Axis Nos.: 1 2 3 4
- Md.31: Status : Axis warning detection
  - Axis Nos.: 1 2 3 4
- Md.51: AMP-less operation mode (U1#G4232)
- Md.133: Operation cycle over flag (U1#G4239)
- Md.134: Operation time (U1#G4208)

**Operation Image**

Starting the synchronous control and checking the operation are completed.

Click ⏩ to proceed to the next screen.
3.4.2 Operation Check with Digital Oscilloscope

Check the operation with a digital oscilloscope.

On the next page, operate the actual screen and check the operation with a digital oscilloscope.
Check that the waveform of the created cam data matches that of axis 1 feed current value in digital oscilloscope. (The display of the graph varies depending on the timing to stop sampling.)

Checking the operation with a digital oscilloscope is completed. Click to proceed to the next screen.
## Summary of This Chapter

In this chapter, you have learned:

- System Configuration
- Startup Procedure for Synchronous Control
- Parameter Creation for Synchronous Control
- Operation Check for Synchronous Control

**Important points**

<table>
<thead>
<tr>
<th>System Configuration</th>
<th>To add an axis, set servo amplifiers and control axis numbers with the SSCNETIII connection, add and wire servo motors, and configure the setting with MELSOFT GX Works3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup Procedure for Synchronous Control</td>
<td>As the establishment procedure of a servo system with the MELSEC iQ-F series Simple Motion module, set the system configuration, parameters, servo parameters, positioning data, and synchronous control parameters, create cam data, and write the set items to the Simple Motion module.</td>
</tr>
<tr>
<td>Parameter Creation for Synchronous Control</td>
<td>Parameters for synchronous control include synchronous parameters, input axis parameters, and cam data (cam curve).</td>
</tr>
<tr>
<td>Operation Check for Synchronous Control</td>
<td>On the Axis Monitor window, it's possible to check the synchronous control status. Use a digital oscilloscope to check the synchronous control status in a graph.</td>
</tr>
</tbody>
</table>
Now that you have completed all of the lessons of the MELSEC iQ-F Series Simple Motion Module Course, you are ready to take the final test.

If you are unclear on any of the topics covered, please take this opportunity to review those topics.

There are a total of 5 questions (7 items) in this Final Test. You can take the final test as many times as you like.

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

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

- Correct answers: 5
- Total questions: 5
- Percentage: 100%

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

- Click the Proceed button to exit the test.
- Click the Review button to review the test. (Correct answer check)
- Click the Retry button to retake the test again.
Please select the software required for performing the positioning control with the MELSEC iQ-F series Simple Motion module.

- MELSOFT GX Works2
- MELSOFT GX Works3
- MELSOFT MT Works2
- MELSOFT GT Works3
- RT ToolBox2
Please select the correct control axis number of the servo amplifier for Axis 1.
Please select the correct method of turning on or off an arbitrary device in the sequence program during monitoring with MELSOFT GX Works3.

- Double-click a device.
- Double-click a device while pressing the Alt key.
- Double-click a device while pressing the SHIFT key.
Please select the appropriate synchronous control startup procedure.

- A → E → C → D → B → F
- E → D → C → B → A → F
- B → F → E → A → D → C

A: Cam data creation
B: Synchronous parameter settings
C: Positioning data settings
D: Parameters and servo parameters settings
E: System configuration settings
F: Writing to the Simple Motion module

Answer  Back
Please select the correct explanation of each item of digital oscilloscope from the term box.

- Sampling target data can be set.
- A sampling cycle and sampling rate before and after a trigger can be set.
- Conditions to start sampling can be set.

Term

1: Sampling condition
2: Trigger setting
3: Probe selection

Answer  Back
You have completed the Final Test. Your results are as follows.
To end the Final Test, proceed to the next page.

Correct answers: 5
Total questions: 5
Percentage: 100%

Proceed Review

Congratulations. You passed the test.
You have completed the MELSEC iQ-F Series Simple Motion Module Course.

Thank you for taking this course.

We hope you enjoyed the lessons and the information you acquired in this course will be useful in the future.

You can review the course as many times as you want.

Review  Close