PLC

Positioning Control (MELSEC iQ-R Series)

This course is intended for users who will configure a positioning control system for the first time.

L(NA)08828ENG

Purpose of the course

This course is intended for users who will configure a positioning control system for the first time.
By taking this course, a participant will learn the basics of the MELSEC iQ-R series positioning module and will obtain the necessary knowledge to configure a simple positioning control system.

As prerequisites for this course, you should have already completed the following courses or possess the equivalent knowledge in:

- FA Equipment for Beginners (Industrial Network)
- MELSEC iQ-R Series Basic
- Programming Basics
- Engineering Software MELSOFT GX Works3 (Ladder)
- Intelligent Function Module (MELSEC iQ-R Series)

Course structure

The contents of this course are as follows.

Chapter 1 - Understanding the Positioning Module "RD75"

The basics of the positioning module "RD75" and terms and knowledge that you will need to use the positioning module.

Chapter 2 - System Configuration

The typical system configuration procedure, control method and machine specifications of the sample system

Chapter 3 - Preparation for Positioning Parameters

How to set positioning parameters

Chapter 4 - Positioning Data Preparation

How to set positioning data

Chapter 5 - Sequence Program Preparation

How to execute positioning data using a sequence program

Chapter 6 - Test Operation of System

Test operation performed before actual operation

Chapter 7 - Bringing System into Service

Troubleshooting and operation confirmation methods using monitors

Final Test

Pass grade: 60% or higher

How to use this e-Learning tool

Go to the next page	>	Go to the next page.
Back to the previous page	<	Back to the previous page.
Move to the desired page	TOC	"Table of Contents" will be displayed, enabling you to navigate to the desired page.
Exit the learning	X	Exit the learning.

Cautions for use

Safety precautions

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

Precautions in this course

The displayed screens of the software version that you use may differ from those in this course.
This course uses the following software version:

- GX Works3 Version 1.057K

Chapter 1 Understanding the Positioning Module "RD75"

This course explains how to configure a positioning control system based on the MELSEC iQ-R series programmable controller positioning module.

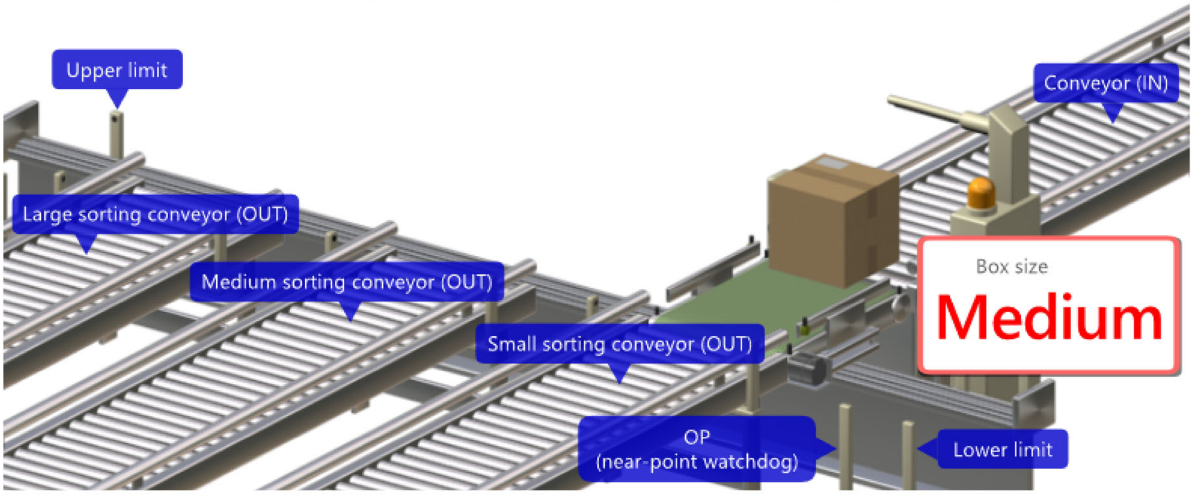
Chapter 1 explains about the features and functionality of the RD75 positioning module.
The basic terms and knowledge required for handling the positioning module are also given in this chapter.

1.1 "RD75" Features and Functionality

Suppose you built a system which incorporates the positioning control function. For that system, in most cases, more than a simple positioning control will be required.

Look at the material handling system shown in the diagram below.
This system categorizes the boxes proportional to its size and distributes them to the correct conveyor.
This type of system cannot be easily realized just by using a standard control system. A dedicated positioning system which synchronizes the proximity sensor inputs and determines the box sizes is required, in addition to the central control system.

The positioning module "RD75" used in this course is an intelligent function module which is part of programmable controller system.
It has special features to ensure synchronization between the sequence program and positioning.



1.2 "RD75" Lineup

The table below shows the positioning module "RD75" series lineup.

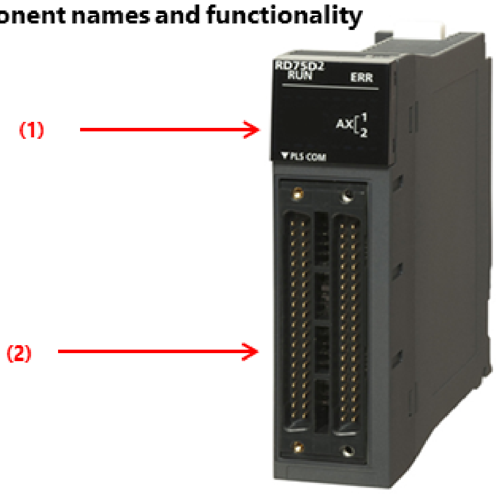
	RD75P	RD75D
Interface	Open collector output	Differential driver
Distance between servo and RD75	2m	10m
Noise immunity	Standard	Good

Mitsubishi Electric positioning modules include RD75, which is equipped with the standard functions, and RD77 and RD78, which perform high-degree of motion control.
This course uses "RD75D" with a differential driver interface, which is versatile enough to be connected to 3rd party servo amplifier, as well as has good immunity to noise.

1.3 "RD75"

The "RD75D", which is explained in this course, is an intelligent function module that controls a servo amplifier.
The "RD75D" is equipped with not only control signals for the servo amplifier, but also other signals for a connected system.

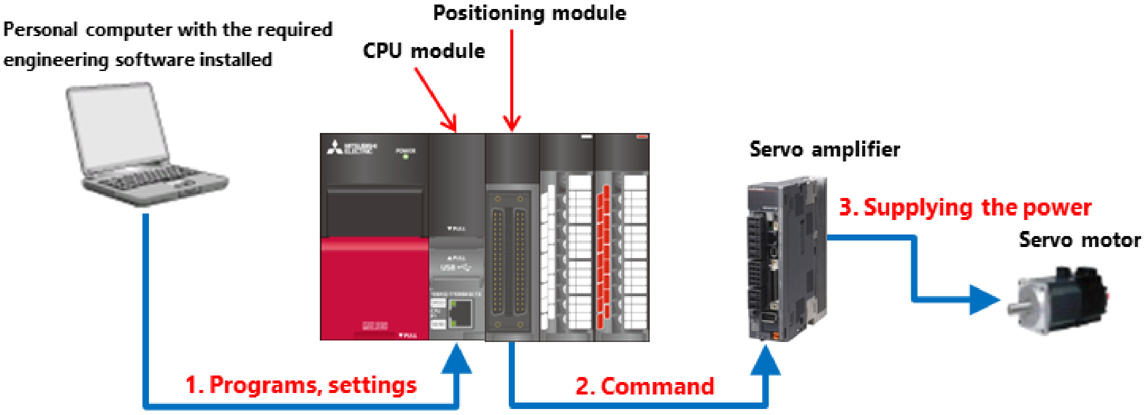
■ Component names and functionality



No.	Name	Function
(1)	LED indicator	The operating state of the positioning module is displayed.
(2)	External connector	Connector for establishing a connection with a servo amplifier, mechanical-system input, or manual pulse generator.

1.4 Positioning Control System Basic Configuration

Shown here is the basic configuration of a positioning control system using the positioning module and a servo control system (amplifier + motor), and the roles of the devices.



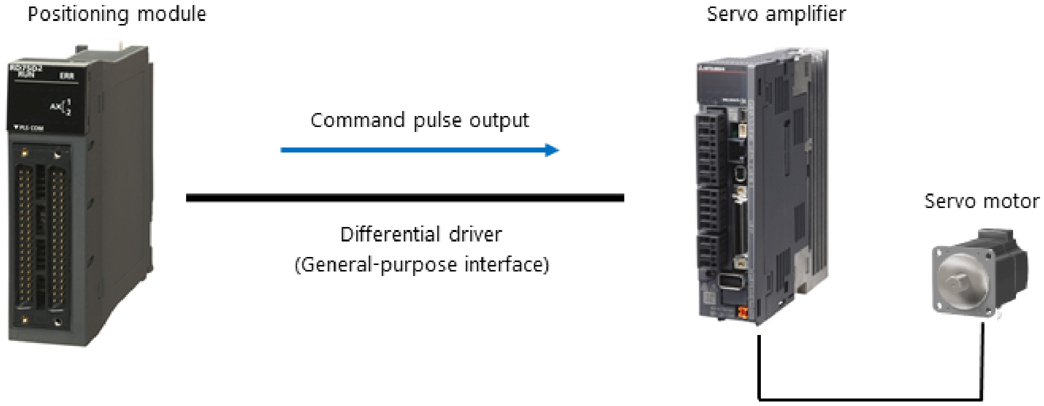
1. Programs and settings are written to the CPU module using the personal computer.
2. The positioning module sends a positioning command to the servo amplifier.
3. The servo amplifier supplies the power to a servo motor to drive it.

1.5 Connecting the "RD75" to a Servo Amplifier

In this course, the positioning module "RD75D" is connected to a servo amplifier via the differential driver interface.
The differential driver is versatile enough to be connected to 3rd party servo amplifiers.
It also has the advantage of being immune to noise, compared with an open collector output that is versatile as well.

For more information about the connecting method, check the corresponding manuals of the positioning module and servo amplifier.

■ Connection between the positioning module "RD75D" and servo amplifier

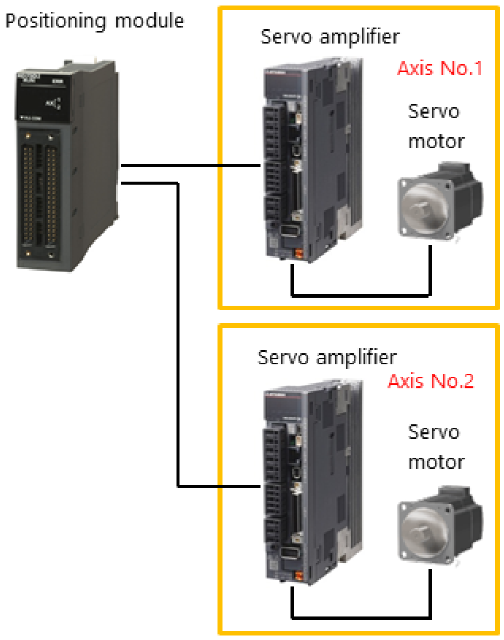


1.6 Number of Controlled Axes

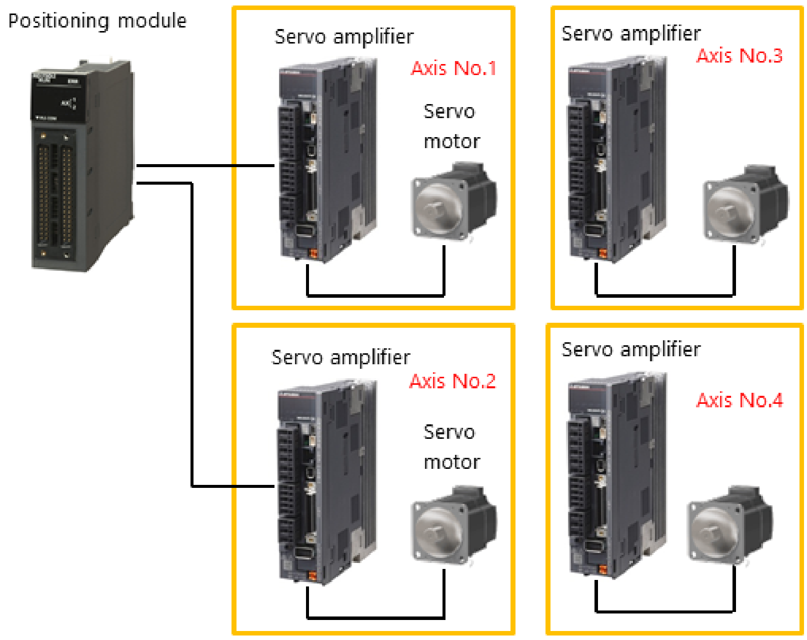
Number of controlled axes represents the number of servo motors that can be driven by the positioning module. It is expressed in axes per module.

In this course, "RD75D2", which controls up to "two axes", is used.
The "RD75D" lineup consists of modules which are capable of controlling 2 axes or 4 axes.

■ **RD75D2: 2-axes control (2 serve motors)**



RD75D4: 4-axes control (4 serve motors)



1.7 "RD75" Setting Method

To perform a positioning control, it is necessary to set a variety of parameters/data in the positioning module.

Module settings can be made from the following:

- From the positioning parameters in the engineering software "GX Works3".
- Directly from the sequence program using a positioning module-dedicated instruction.

This course explains the module settings from the positioning parameters, with which users can set the module by simply entering values in the forms.

Item	Axis 1
Basic parameter 1	**Set the basic parameter 1.**
Unit setting	0:mm
Electronic gear selection	1:32bit
No. of pulses per rotation (16 bits)	20000 pulse
Movement amount per rotation (16 bits)	2000.0 μm
No. of pulses per rotation (32 bits)	4194304 pulse
Movement amount per rotation (32 bits)	250000.0 μm
Unit magnification	1: ×1
Pulse output mode	1: CW/CCW mode
Rotation direction setting	0: Current value increment with forward run pulse output
Bias speed at start	0.00 mm/min
Basic parameter 2	**Set the basic parameter 2.**
Speed limit value	2000.00 mm/min

Positioning parameter setting area

1.8 Summary

In this chapter, you have learned:

- "RD75" features and functionality
- "RD75" lineup
- "RD75"
- Positioning control system basic configuration
- Connecting the "RD75" to a servo amplifier
- Number of controlled axes
- "RD75" setting method

Important points

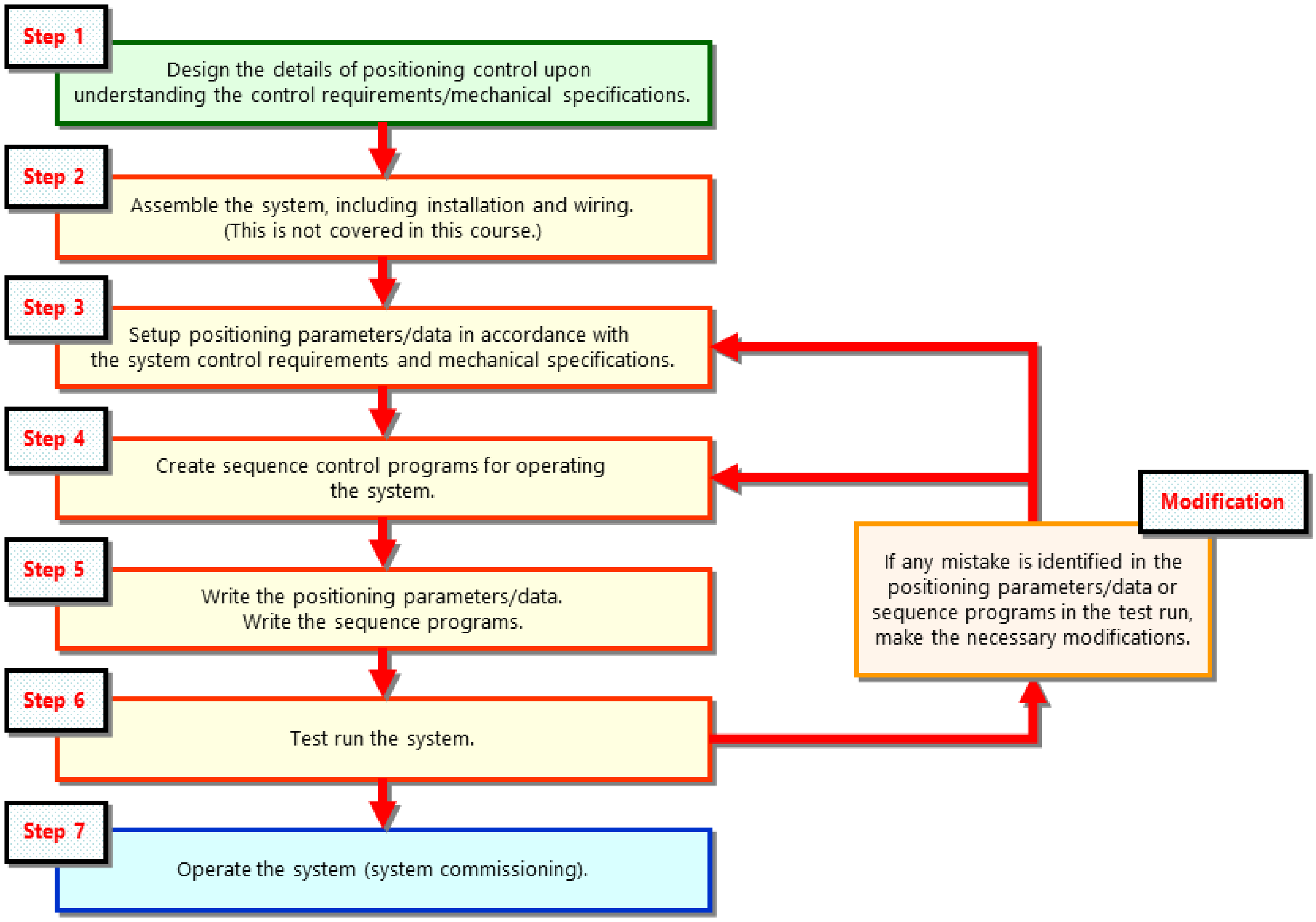
The roles and functions of the positioning module	You have learned the important points in choosing a programmable controller's positioning module and relationship between a programmable controller and the positioning module.
The lineup and specifications/functions of the positioning module	You have learned the basic system configuration and the role of each component.
The principal terms of the positioning control	You have learned the principal terms relating to the positioning control.

Chapter 2 System Configuration

Chapter 2 explains how to configure an example system (the procedure from designing the system to placing it in operation).

2.1 System Configuration Procedure

The following figure shows the steps used to configure an example system.

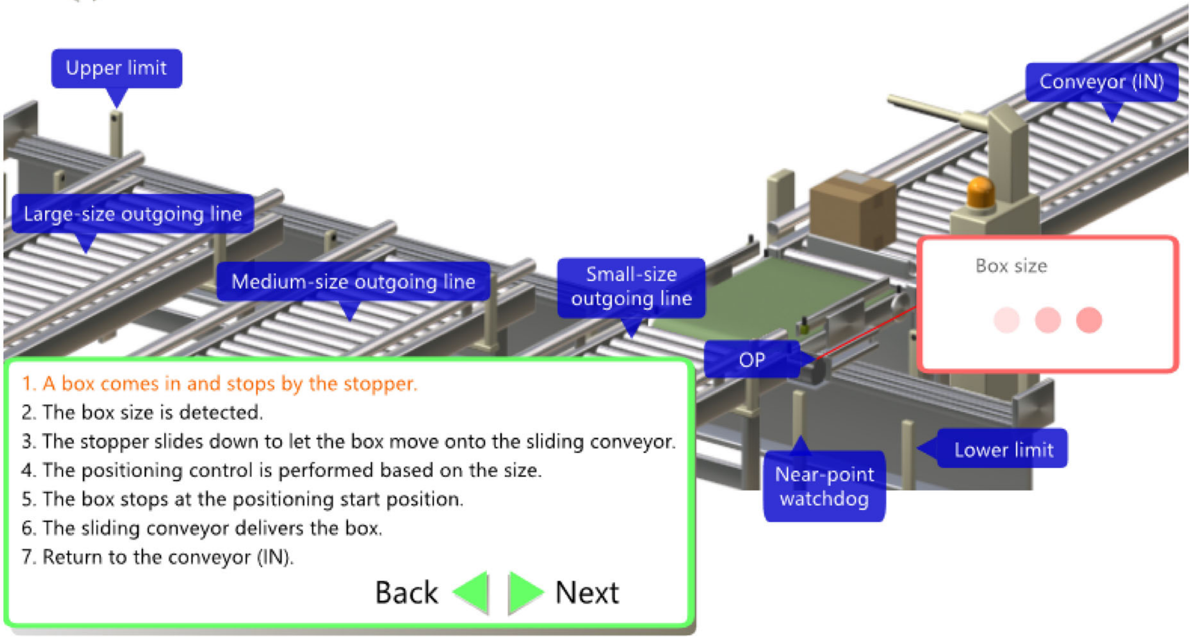


2.2 System Configuration

In this course, a material handling system is used to understand positioning control via the positioning module.
The example material handling system is a system which: 1) classifies boxes received along a conveyor into three group sizes - large, medium, small, and 2) uses a sliding conveyor to distribute the boxes according to their size to the specific outgoing lanes.
In the system, positioning control is used to control the speed and insure movement accuracy (start/stop) of the sliding conveyor.

See the animation below and understand how the control is exercised in the example material handling system.

Click the "Back" or "Next" button to have the control proceed forward or backward while checking each action.



2.3 Mechanical Specifications/Performance of Sample System

Prior to designing the positioning control, it is imperative to understand the mechanical specifications/performance of the system.
Shown below are the mechanical specifications of the example material handling system and the specifications/performance of each device.

■ Mechanical specifications of the material handling system

Device name	Mechanical specifications		Description
Transfer conveyors	Machine's original position (OP)	0 mm (0 μm)	Reference position for positioning control
	Position of incoming line	500 mm (500,000 μm)	All values are distances from the machine's OP.
	Position of small-size outgoing line	500 mm (500,000 μm)	
	Position of medium-size outgoing line	1,500 mm (1,500,000 μm)	
	Position of large-size outgoing line	2,500 mm (2,500,000 μm)	
Sliding conveyor (workpiece)	Servo motor Movement amount per rotation	250 mm (250,000 μm)	—
	Speed limit	60,000 mm/min	Applicable to all types of positioning control
	Moving speed	60,000 mm/min	
	Acceleration/deceleration time	1,000 ms	

■ Specifications/Performance of devices used in the material handling system

Device name	Type name	Description
Positioning module	RD75D2	Number of controlled axes: 2 Connection with servo amplifier: Differential driver output
Servo amplifier	MR-J4-10A	MR-J4-A series
Servo motor	HG-KR053	Rated output capacity: 50 W Rated speed of rotation: 3,000 r/min Encoder resolution: 4,194,304 pulses/rev

2.4 Summary

In this chapter, you have learned:

- System configuration procedure
- System configuration
- Mechanical specifications/performance of sample system

Important points

Procedure for configuring a system	You have learned a generally-applicable procedure for configuring a system.
How control is exercised in the system	You have learned how the example material handling system works.
Mechanical specifications of the system, specifications/performance of the system's devices	You have learned the mechanical specifications of the sample system and the specifications/performance of the devices.

Chapter 3 Preparation for Positioning Parameters

Chapter 3 explains how to make parameter settings which are required to operate the positioning module.

3.1 Setup of Positioning Parameters

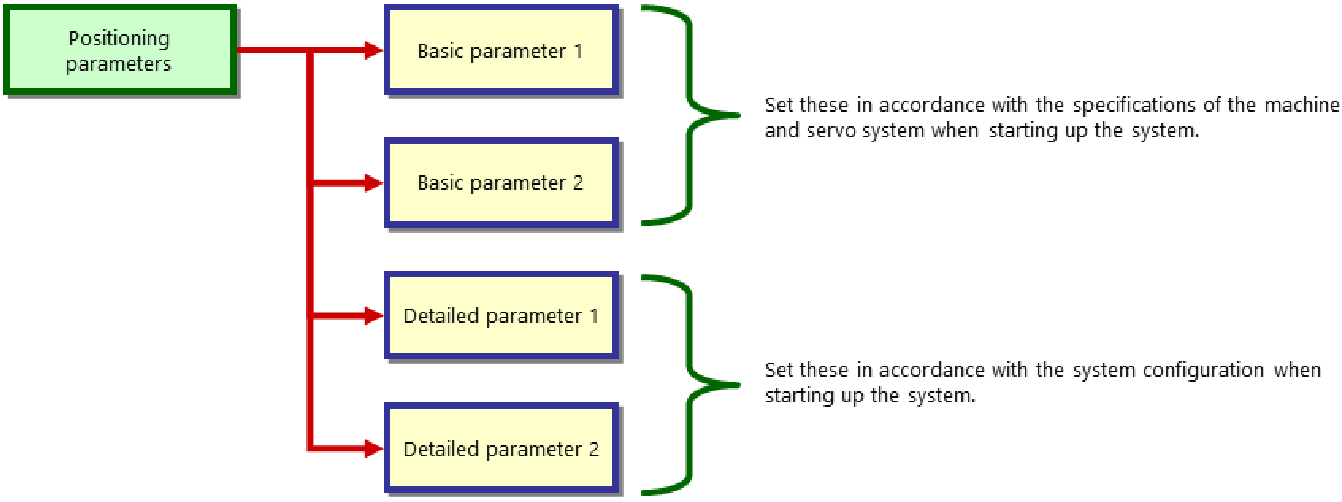
3.2 Setup of the Servo Amplifier

Type of parameters		Parameters used for the sample system
Positioning parameters	Basic parameter 1	• Unit settings • Number of pulses per rotation • Movement amount per rotation • Unit magnification • Pulse output mode • Rotating direction settings
	Basic parameter 2	• Speed limit • Acceleration time: 0 • Deceleration time: 0
	Detailed parameter 1	• Software stroke limit, upper limit • Software stroke limit, lower limit • Software stroke limit selection • Software stroke limit, valid/invalid settings • Output signal logic selection

3.1 Setup of Positioning Parameters

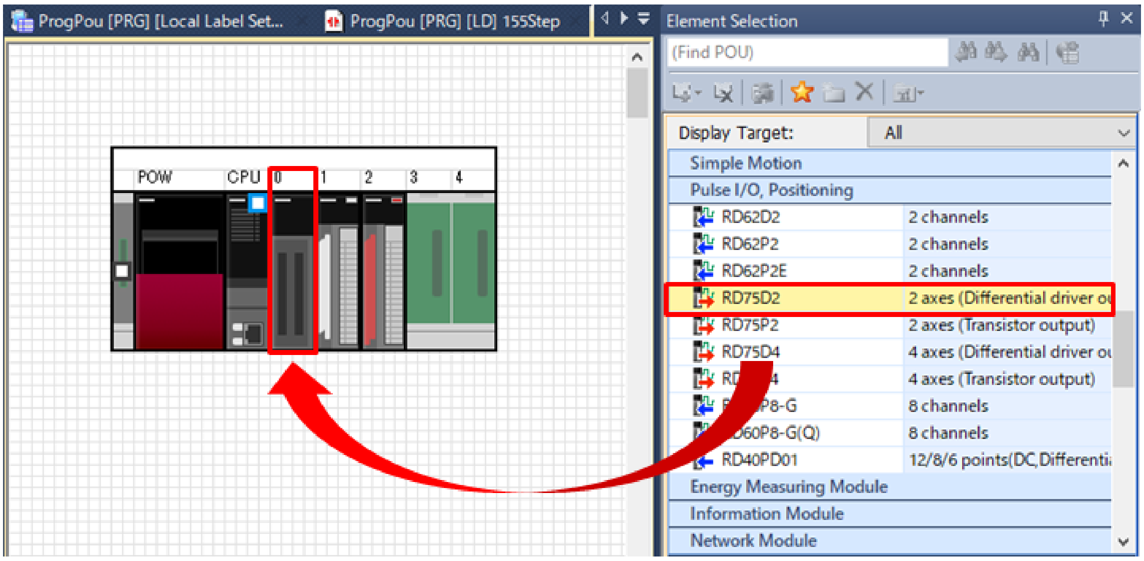
The positioning parameters are required for the operation of the positioning module.
Any mistakes can result in the controlled equipment to behave out of scope, or for the actual module to become inoperative.

■ Positioning parameters structure



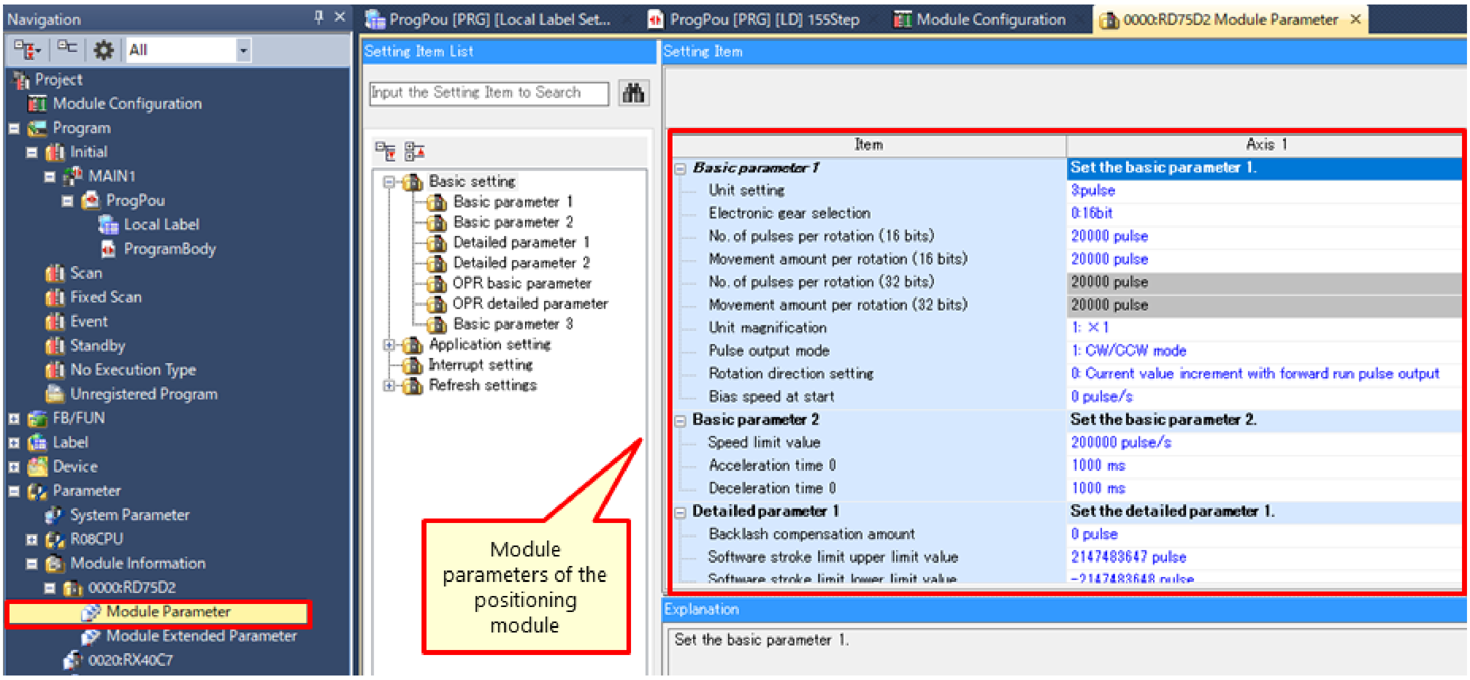
3.1.1 Positioning parameter setting

To set the module parameters for positioning, add the positioning module to the module map in GX Works3.



3.1.1 Positioning parameter setting

Open the setting window by selecting the module parameter of the positioning module in the navigation window.



3.1.2 Setting command unit for positioning module

To specify a position or the movement amount from current position to destination, an address is used.
For the operation of the positioning module, set here the unit of measurement for the positioning address (movement amount), speed, and time.

Select a unit of measurement from among mm, inch, degree, and pulse (PLS) according to the machine specifications.
In general, mm or inch is used for linear or circular control while degree is used for rotary control.
The parameter input unit and input range vary with the unit settings.

Item	Axis 1
Basic parameter 1	**Set the basic parameter 1.**
Unit setting	0:mm
Electronic gear selection	1:32bit
No. of pulses per rotation (16 bits)	20000 pulse
Movement amount per rotation (16 bits)	2000.0 μm
No. of pulses per rotation (32 bits)	4194304 pulse
Movement amount per rotation (32 bits)	250000.0 μm
Unit magnification	1: ×1

Positioning parameter setting area

For the sample material handling system, the unit "mm" is used (used since the system's mechanical design stage).
Selecting "mm" changes the units to the following set values as shown below.

Item	Set value unit
Address (movement amount)	µm (micrometer)
Time	ms (millisecond)
Speed	mm/min (millimeter/minute)

When the unit setting is "mm", the unit for address input (movement amount) is "µm".
If "mm" was being used in the design stage, the value must be converted into "µm" (1 mm = 1,000 µm).

3.1.3 Electronic gear function settings for positioning module

The electronic gear function converts address (movement amount) and speed settings made in mm, inch, etc. into a number of command pulses or command pulse frequency to the servo amplifier.

The electronic gear function eliminates the need for the user to convert the value to a number of pulses before delivering a command.
This function also corrects errors in the stop position, adjusts the unit in which the movement amount is expressed, etc.

To ensure correct operation of the electronic gear function, enter appropriate values in the following:

- Number of pulses per rotation
- Movement amount per rotation
- Unit magnification

The relationship between setting items and the electronic gear is given by the following equation:

Electronic gear = number of pulses per rotation / (movement amount per rotation x unit magnification)

NOTE:

The servo amplifier is equipped with an electronic gear.
An electronic gear in the servo amplifier operates differently from the one in the positioning module. Therefore, it is important not to be confused between the two technologies.
Further information of the electronic gear in the servo amplifier is contained in the "FA Equipment for Beginners (Positioning) Course".

3.1.3 Electronic gear function settings for positioning module

This section explains about parameters for the electronic gear function.

(1) Number of pulses per rotation

Set the number of command pulses required for the servo motor to complete one rotation.
Normally, set a resolution value of the encoder contained within the servo motor.
For the sample material handling system, set the maximum selectable value ("65,535 pulses/rev") of RD75D2 since RD75D2 cannot output the encoder resolution of the servo motor.

(2) Movement amount per rotation

Set the amount by which the workpiece moves by one rotation of the servo motor.
The amount varies depending on the mechanical linkage (cam, belt, chain, ball screw, etc) between the servo motor and the workpiece.
In the sample material handling system, the sliding conveyor moves "250,000 µm (250 mm)" in one rotation of the servo motor.
However, the maximum movement amount selectable for RD75D2 is "6,553.5 µm (6.5535 mm)" with the unit ("mm").
If movement amount exceeds the maximum selectable value, just like this sample system, adjust using the unit magnification as explained below.

(3) Unit magnification

Use the unit magnification if the movement amount per rotation exceeds the maximum selectable value. The value is converted by the following equation before it is sent to the servo amplifier.

> Actual movement amount of the workpiece per motor rotation =
> "specified movement amount" x "unit magnification (1 time, 10 times, 100 times, or 1000 times)"

Because the movement amount for the sample material handling system is "250,000 µm (250 mm)" and exceeds the maximum selectable value, set "2,500 µm", which is equal to one-hundredth of the actual movement amount, and specify "× 100 (100 times)" as the unit magnification.

	Item	Axis 1
	Basic parameter 1	**Set the basic parameter 1.**
	Unit setting	0:mm
	Electronic gear selection	0:16bit
(1)	No. of pulses per rotation (16 bits)	65535 pulse
(2)	Movement amount per rotation (16 bits)	2500.0 µm
	No. of pulses per rotation (32 bits)	4194304 pulse
	Movement amount per rotation (32 bits)	250000.0 µm
(3)	Unit magnification	100: × 100

Positioning parameter setting area

3.1.4 Making settings conforming to servo system specifications

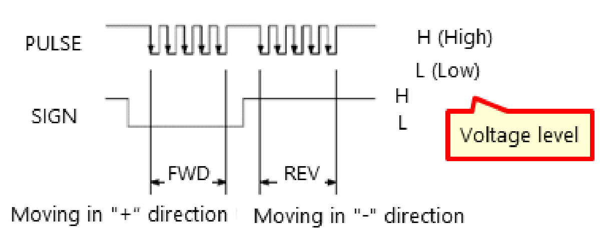
This section explains about parameters to be set in accordance with the specifications of the servo system.

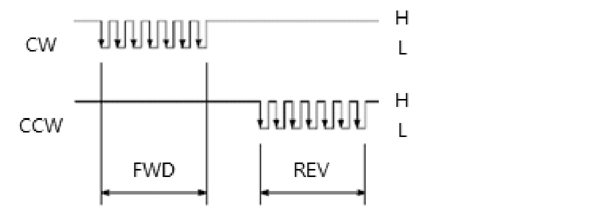
(1) Pulse output mode

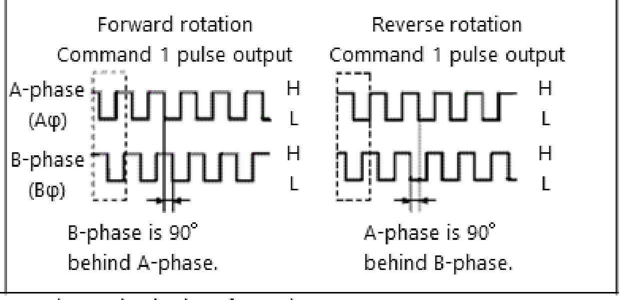
Set a signaling method for command pulse and rotation direction so that they correspond to the connected servo amplifier.
For the sample system, "CW/CCW Mode" is used.

(1)	Pulse output mode	1: CW/CCW mode
	Rotation direction setting	0: Current value increment with forward run pulse output
	Bias speed at start	0.00 mm/min

Positioning parameter setting area

<table>
<tr><th>Mode</th><th>Characteristic</th><th>Pulse (with negative logic* being used)</th></tr>
<tr><td>PULSE/SIGN</td><td>On- or Off-state of direction sign (SIGN), independently of command pulse (PULSE), controls the direction of rotation.</td><td>


</td></tr>
<tr><td>CW/CCW</td><td>Command pulse is outputted for each direction of rotation.
FWD
Output feed pulse (PULSE F) for forward rotation.
REV
Output feed pulse (PULSE R) for reverse rotation.</td><td>


</td></tr>
<tr><td>A Phase/
B Phase
(4 Multiply)</td><td rowspan="2">Rotation direction is controlled by a phase difference between A-phase (Aφ) and B-phase (Bφ).
Forward rotation when B-phase is 90° behind A-phase.
Reverse rotation when B-phase is 90° ahead of A-phase.
Multiple setting (4 Multiply/1 Multiply)
4 Multiply : When the command 1 pulse output is 1 pulse/s, the pulse rises and falls 4 times per second.
1 Multiply : When the command 1 pulse output is 1 pulse/s, the pulse rises and falls each second.</td><td rowspan="2">


</td></tr>
<tr><td>A Phase/
B Phase
(1 Multiply)</td></tr>
</table>

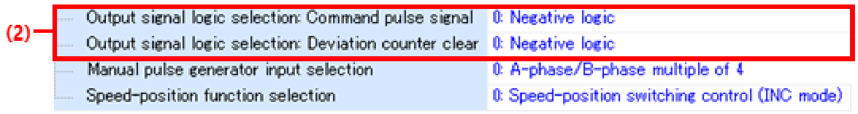
* Positive or negative logic can be set for output signals. For details of the positive and negative logic, refer to the next page.

3.1.4 Making settings conforming to servo system specifications

(2) Output signal logic selection

Set the output signal logic according to the connected servo amplifier.
With or without the command depends on the voltage level of the output signal.

Logic	Voltage level and command
Positive logic	L: Without command H: With command
Negative logic	H: Without command L: With command

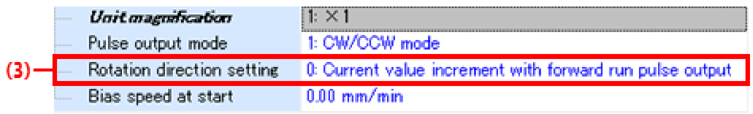


Positioning parameter setting area

For the sample system, set "Negative logic" for both the command pulse signal and the deviation counter clear signal.

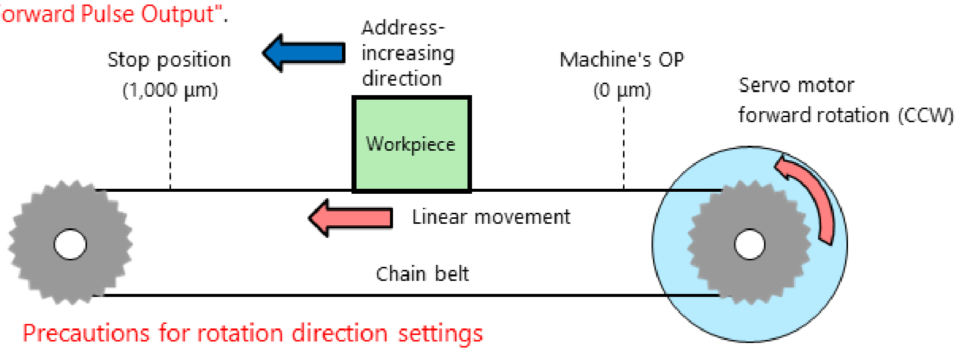
(3) Rotation direction setting

Set the address-increasing direction.



Positioning parameter setting area

In the sample system, the workpiece moves in a forward rotation (positive address increments) upon receiving a forward run pulse signal from the servo amplifier.
To make this movement, select "Increase Present Value by Forward Pulse Output".



Precautions for rotation direction settings

If the rotation direction is wrongly specified, the workpiece would move in the direction opposite to the one indicated by the command. Test run should always be performed to check beforehand that the workpiece moves as indicated by the command. More details on the test run will be given in Chapter 6.

3.1.5 Workpiece acceleration rate settings

The acceleration/deceleration rate of the workpiece determines the positioning speed, but the rate also affects the stopping accuracy. To determine a proper acceleration rate, take into account the mechanical specifications, inertia acting on the workpiece, performance of the servo motor, etc.

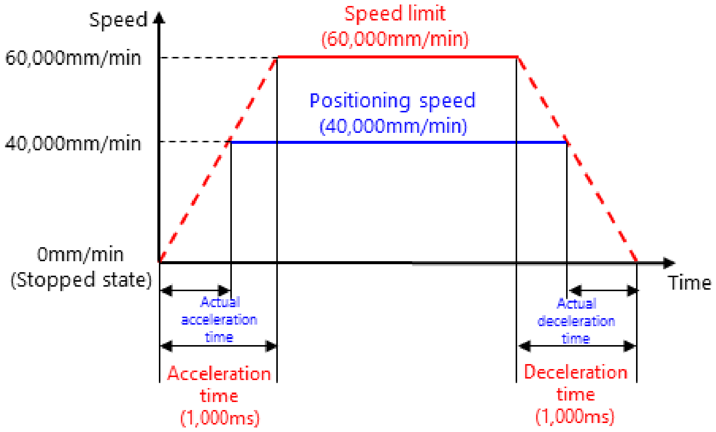
Rapid acceleration/deceleration of the workpiece can cause a workpiece deviation from its stop position or overrun, as well as vibration. In contrast, slow acceleration/deceleration can cause a reduced positioning speed.

(1) Speed limit value

Set a maximum speed permitted in positioning control. If a speed exceeding the limit is commanded, the specified speed limit is applied.
To determine a proper speed limit, take into account the rated rotation speed of the servo motor and the moving speed of the workpiece.
For the sample material handling system, set "60,000 mm/min" as the speed limit.

(2) Acceleration time 0, Deceleration time 0

- Acceleration time
  Time taken for the workpiece in stopped state to accelerate to the set speed limit
- Deceleration time
  Time taken for the workpiece travelling at the speed limit to decelerate to a stop



The diagram on the right shows the relationship between the respective parameters.
If the positioning speed lower than the speed limit is specified, the actual acceleration time and deceleration time will be shorter than the values that have been specified.

For the sample material handling system, set the acceleration and deceleration time to "1,000 ms (1 second)".

	Item	Axis 1
	Basic parameter 2	Set the basic parameter 2.
(1)	Speed limit value	60000.00 mm/min
(2)	Acceleration time 0	1000 ms
	Deceleration time 0	1000 ms

Positioning parameter setting area

3.1.6 Workpiece movable range settings

If the workpiece overruns (moves to an unexpected position) during the operation of the system, a system breakdown or other accidents may occur.
To prevent this, limit the movable range of the workpiece by setting upper/lower limit addresses.

The following table lists addresses to use for limiting the movement of workpiece.

Machine feed value	An address which indicates the workpiece position using an OP address established by "machine original position return (machine OPR)" as the reference. This value cannot be changed by performing the current value change.
Current feed value	Although this value indicates the workpiece position in the same way as the machine feed value does, it can be changed by performing the current value change.

***Machine OPR:** Operation to establish the OP address. Further details will be explained in Section 6.3.
***Current value change:** Function with which users can change a current value to a new value

3.1.6 Workpiece movable range settings

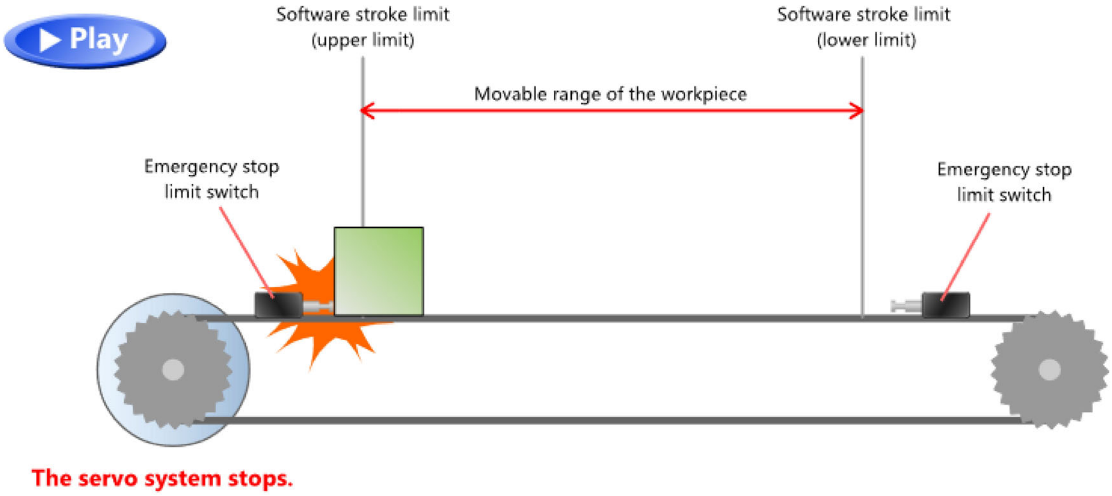
■ **Limit the movable range by using the software stroke limit function**

To the positioning module, set the movable range's upper/lower limit address, which will be processed by the software.
If the "current feed value" or "machine feed value" exceeds the upper-/lower-limit address, the workpiece will be decelerated to a stop.
Also, if an over-the-range positioning command is given, this will be ignored.

■ **Limit the movable range by using the hardware stroke limit function**

Physically limit the workpiece movement by installing emergency stop limit switches at the upper and lower limits of the movable range.
If either of the emergency stop limit switches is triggered by an approaching workpiece, the positioning module decelerates the workpiece to a controlled stop.
For further information regarding the connection between the emergency stop limit switch and the positioning module, please refer to the corresponding positioning module manual.

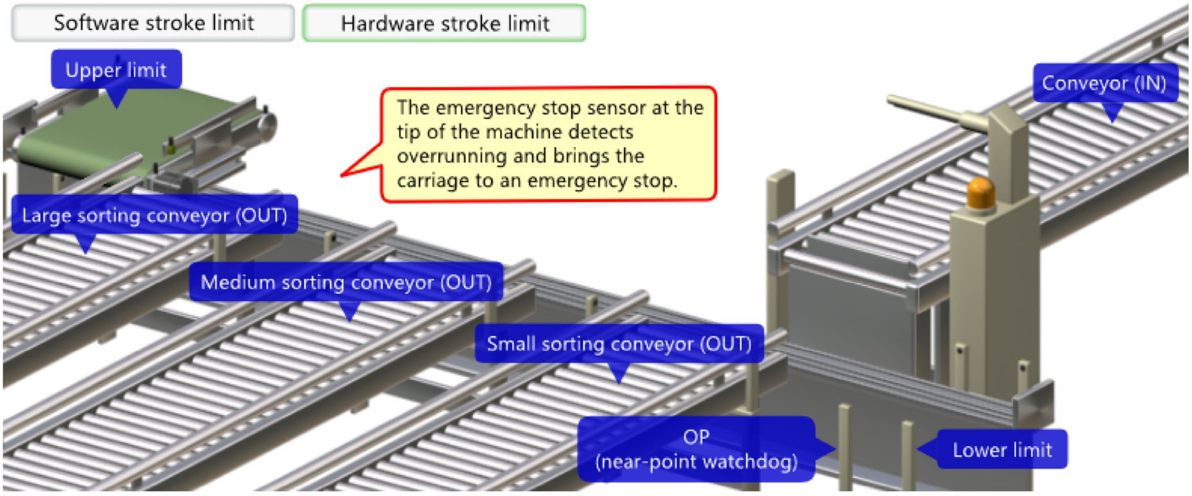
Click the "Play" button shown below to visualize the operation of the software/hardware stroke limit function.



3.1.6 Workpiece movable range settings

In the sample material handling system, both the software and hardware stroke limit functions are used.
The software stroke limit function may not operate properly if the current value retained in the positioning module differs from the workpiece's current value.
Thus, install emergency stop limit switches at both ends of the movable range as well, to ensure a physical means to stop the workpiece even when the software's stroke limit function fails.

Refer to the animation below to check the movements of the workpiece with the software/hardware stroke limit function(s) applied to the sample system.



3.1.6 Workpiece movable range settings

This section explains about parameters related to the software stroke limit function.

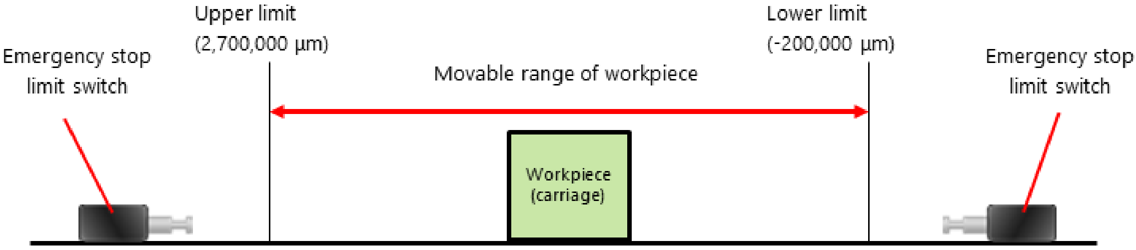
(1) Software stroke limit upper/lower limit values

Set the upper/lower limit address of the movable range.
In general, the machine OP is set at the upper or lower limit of the software stroke limit.

For the sample material handling system, set the upper and lower limits to "2,700,000 µm" and "-200,000 µm", respectively.

	Detailed parameter 1	Set the detailed parameter 1.
	Backlash compensation amount	0.0 µm
(1)	Software stroke limit upper limit value	2700000.0 µm
(1)	Software stroke limit lower limit value	-200000.0 µm
	Software stroke limit selection	1: Apply software limit for machine feed value
	Software stroke limit valid/invalid setting	1: Disable
	Command in-position width	10.0 µm
	Torque limit setting value	300 %

Positioning parameter setting area



3.1.6 Workpiece movable range settings

(2) Software stroke limit selection

The sample material handling system has its movable range limited by the machine feed value.

(3) Software stroke limit valid/invalid setting

The software stoke limit function can be disabled during manual operation.
Even if the software stroke limit function is disabled with this setting, it still operates (enabled) for normal positioning control.

For the sample material handling system, select "Invalid" to prevent the software stroke limit function from being activated while manually performing an operation test on the hardware stroke limit function (emergency-stop sensors).

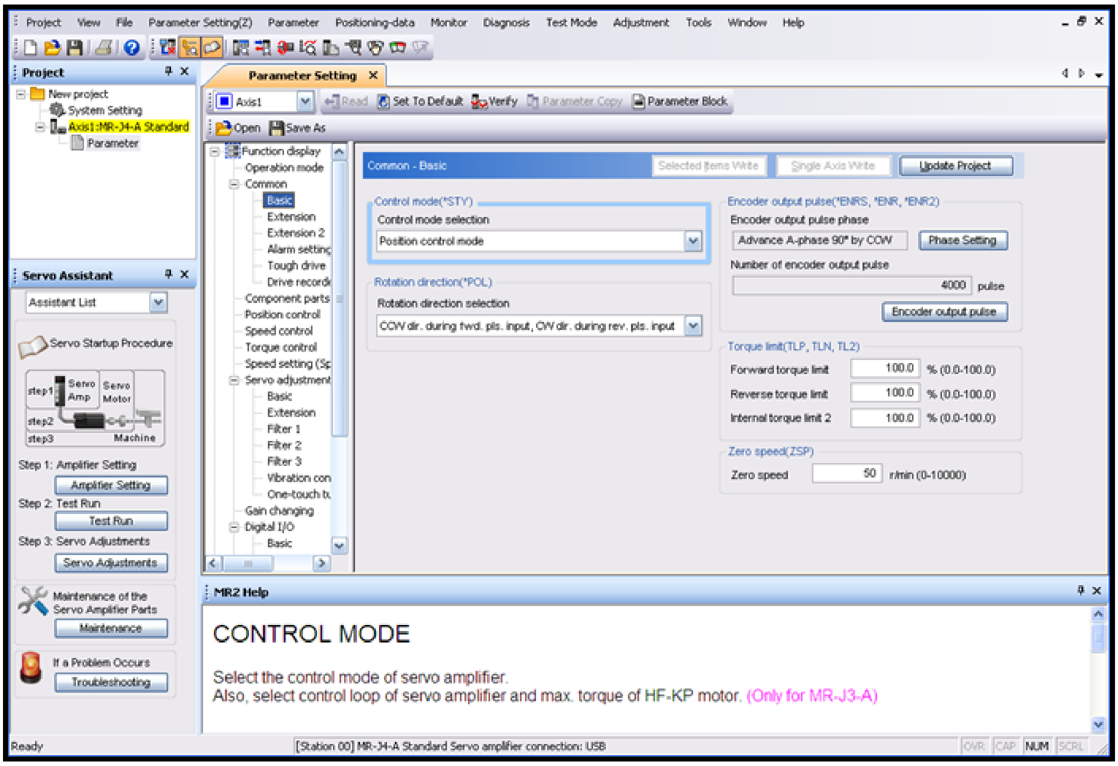
	Detailed parameter 1	Set the detailed parameter 1.
	Backlash compensation amount	0.0 μm
	Software stroke limit upper limit value	2700000.0 μm
	Software stroke limit lower limit value	-200000.0 μm
(2)	Software stroke limit selection	1: Apply software limit for machine feed value
(3)	Software stroke limit valid/invalid setting	1: Disable
	Command in-position width	10.0 μm
	Torque limit setting value	300 %

Positioning parameter setting area

3.2 Setup of the Servo Amplifier

Set the servo amplifier's operation.
The sample system uses the Mitsubishi Electric "MR-J4" series servo amplifier, which is setup by the dedicated software, "MR Configurator2". This software is also capable of checking the servo motor operation alone and anti-vibration tuning.

When connecting the positioning module to a 3rd party servo amplifier, please refer to the corresponding servo amplifier manual.



MR Configurator2

3.3 Summary

In this chapter, you have learned:

- Setup of positioning parameters
- Setup of the servo amplifier

Important points

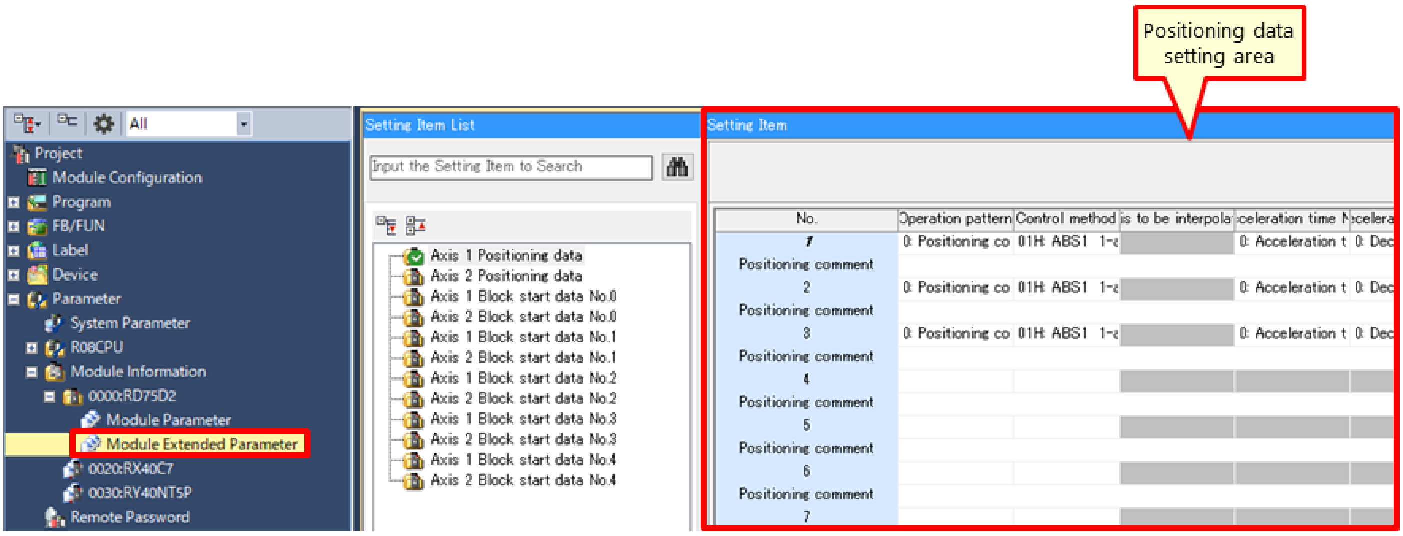
Positioning parameter settings	• Setup of positioning parameters (divided by functions). • The units of the setting values may differ from the units in use and may require conversion. • Roles of positioning module's electronic gear. • Acceleration/deceleration speed is set as time. • Types and concept behind stroke limits which are a safety measure.
Servo amplifier settings	The connected servo amplifier must be set. Use "MR Configurator2" to set Mitsubishi Electric "MR-J4" series servo amplifier.

Chapter 4 Positioning Data Preparation

Chapter 4 explains how to create positioning control commands by using GX Works3.
Set positioning data from the **module extension parameter**.

The positioning command can be setup as positioning data. Up to 600 pieces of data can be set.
The set positioning data is identified by the "data No." .

A single positioning data can be executed individually, several positioning data can be executed in sequence.



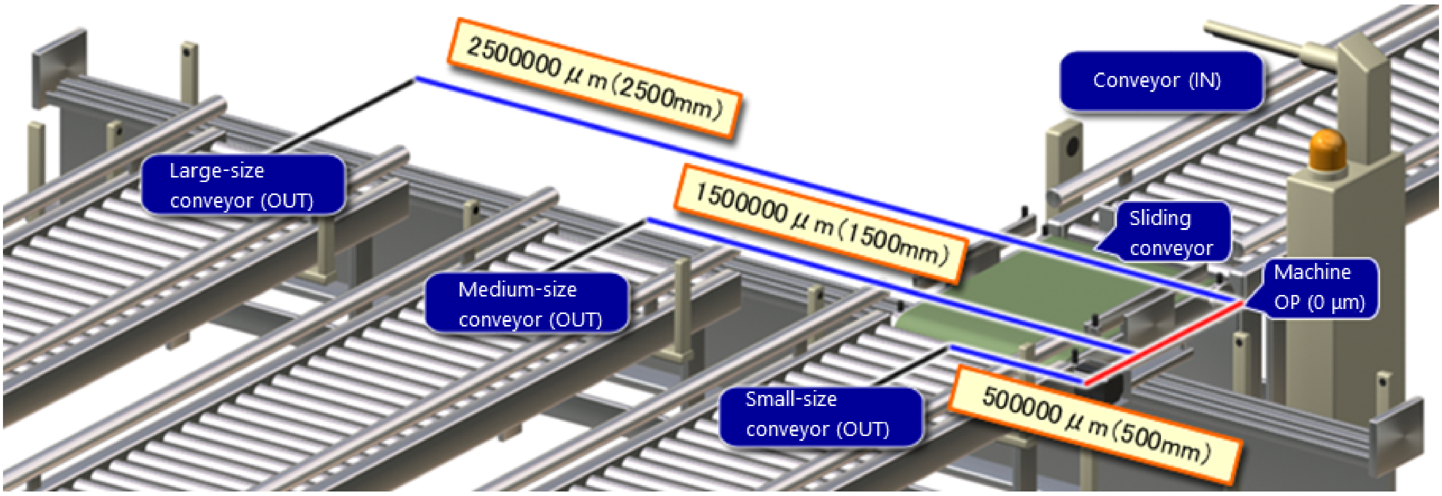
4.1 Positioning Data Settings

4.2 Writing Positioning Parameters/Data

4.1 Positioning Data Settings

The sample material handling system requires three types of positioning control commands. These are set as No.1 through No.3 positioning data, respectively.
The table below shows positioning control commands required for the material handling system.

No.	Positioning start address	Positioning stop address	Positioning speed	Description of control
1	Conveyor (IN) (500,000 µm)	Medium-size conveyor (OUT) (1,500,000 µm)	60,000 mm/min	Positioning control for the movement from the incoming line to the medium-size outgoing line
2	Conveyor (IN) (500,000 µm)	Large-size conveyor (OUT) (2,500,000 µm)		Positioning control for the movement from the incoming line to the large-size outgoing line
3	Medium-/large-size conveyor (OUT) stop position	Conveyor (IN) (500,000 µm)		Positioning control for the movement from the individual outgoing line to the incoming line



4.1 Positioning Data Settings

This section explains the items to be set as positioning data.

(1) Positioning data No.

This is a number which identifies the positioning data.
When executing positioning by using a dedicated instruction or when performing a test operation, specify the specific data number.

(2) Operation pattern

Set the operation pattern for each positioning data.
The sample material handling system executes No.1 through No.3 positioning data by using "0: Positioning complete" operation pattern.

Operation pattern	Feature
0: Positioning complete	Only the positioning data of the specified number will be executed, and complete the positioning.
1: Continuous positioning control	The positioning data of the specified number will be executed. After that, the system decelerates and stops the workpiece once, then executes the next positioning data, up to the number specified for "Independent positioning control".
3: Continuous path control	The positioning data of the specified number will be executed. After that, the system executes the next positioning data without decelerating, up to the number specified for "Independent positioning control". The workpiece's moving speed is directly changed to the speed set in the next positioning data, allowing several positioning control commands to be executed smoothly.

(1) (2)

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed
1	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	1500000.0 μm		60000.00 mm/min
Positioning comment								
2	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	2500000.0 μm		60000.00 mm/min
Positioning comment								
3	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	500000.0 μm		60000.00 mm/min

Positioning data setting area

(3) Control system

Set the positioning control method.
Each method consists of the number of controlled axes, path of workpiece, and the addressing method (ABS or INC).

Control system (path of workpiece)	Number of controlled axes				Addressing method		Feature of control
	1 axis	2 axes	3 axes	4 axes	ABS	INC	
Linear control (linear interpolation control)	O	O	O	O	O	O	This method, by using 1 to 4 servo motor axes, controls the movement of the workpiece in a simple one-dimensional linear control or in a more complex 2-dimensional or 3-dimensional linear control.
Circular interpolation control		O			O	O	This method, by using 2 servo motor axes, controls the movement of the workpiece through a circular path.
Constant-feed control	O	O	O	O		O	A positioning control which has the workpiece move a fixed distance repeatedly.

In the sample material handling system, the workpiece travels to the address specified by the ABS method (absolute addressing method) using 1-axis linear control.
Therefore, set "1-axis linear control (ABS)" in No.1 through No.3 positioning data.

(3)

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed
1	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	1500000.0 μm		60000.00 mm/min
Positioning comment								
2	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	2500000.0 μm		60000.00 mm/min
Positioning comment								
3	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	500000.0 μm		60000.00 mm/min

Positioning data setting area

4.1 Positioning Data Settings

(4) Acceleration time No. and Deceleration time No.

Select the acceleration time and deceleration time from among four patterns, No.0 through No.3.
For the sample material handling system, select "0: Acceleration time 0" and "0: Deceleration time 0" for No.1 through No.3 positioning data.

(5) Positioning address

Set either a positioning address (ABS method) or a movement amount (INC or constant-feed method).
For the sample material handling system, set a positioning address since the system uses the ABS addressing method.

No.	Positioning destination	Positioning address	Description of control
1	Medium-size conveyor (out)	1,500,000µm (1,500mm)	Used for positioning from the incoming conveyor to the medium-size outgoing conveyor
2	Large-size conveyor (out)	2,500,000µm (2,500mm)	Used for positioning from the incoming conveyor to the large-size outgoing conveyor
3	Conveyor (in)	500,000µm (500mm)	Used for returning from the large-/medium-size outgoing conveyor to the incoming conveyor

(6) Command speed

Set a positioning speed (speed at constant-speed movement).
Any speed exceeding the speed limit (Section 3.1.4) cannot be set.
For the sample material handling system, set "60,000 mm/min" in No.1 through No.3 positioning data.

No.	Operation pattern	Control method	Axis to be interpolated	Acceleration time No. (4)	Deceleration time No. (4)	Positioning address (5)	Arc address	Command speed (6)
1	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	1500000.0 µm		60000.00 mm/min
Positioning comment								
2	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	2500000.0 µm		60000.00 mm/min
Positioning comment								
3	0: Positioning complete	01H: ABS1 1-axis linear control (ABS)		0: Acceleration time 0	0: Deceleration time 0	500000.0 µm		60000.00 mm/min

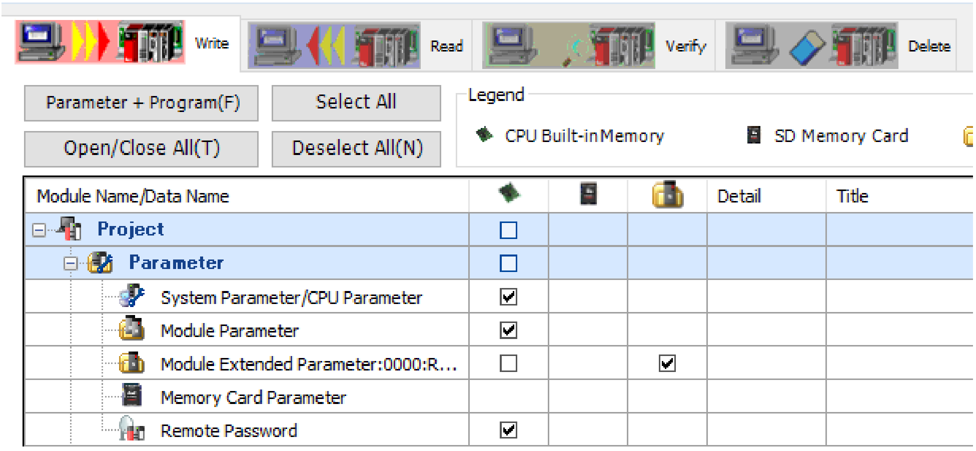
Positioning data setting area

4.2 Writing Positioning Parameters/Data

Write the parameters and data, which are set in GX Works3, into the CPU module.

Connect the CPU module with the personal computer, on which GX Works3 is operating, by a USB cable.
After connecting, make connection settings in "Transfer Setup" of GX Works3.

Upon establishing the connection successfully, write parameter data into the CPU module from "Write to PLC" of GX Works3.
On "Online Data Operation" window, select "Intelligent Function Module" for the module extension parameter before writing.



■ Writing parameters/data into flash ROM

For the sample material handling system, write parameters/data into a CPU module's flash ROM as well.
The information held in the buffer memory of the positioning module is cleared when the power to the module is turned off.
However, the information written into the CPU module's flash ROM is held even after the power to the module is turned off and will be copied to the positioning module's buffer memory when the power is turned on again. For this reason, the flash ROM can be used as a backup for the buffer memory.

■ Initializing the positioning module

If you want to reset the positioning module to the factory setting, initialize the module.
For details on this process, please refer to the GX Works3 manual.

4.3 Summary

In this chapter, you have learned:

- Positioning data settings
- Writing positioning parameters/data

Important points

Designing and setting positioning data	You have learned about necessary positioning data conforming to the machine specifications and how to perform settings.
Specifying a connection destination and performing a communication test	You have learned how to check whether the connection is established or not between the positioning module and GX Works3.
Writing positioning parameters/data	You have learned how to write the positioning parameters/data settings into the CPU module.

Chapter 5 Sequence Program Preparation

Chapter 5 explains how to execute positioning data of the number specified from a sequence program.

When you configure a system, you will notice that not so many systems can function only with positioning control. This is because a control system fundamentally requires synchronization of I/O signals by the programmable controller.

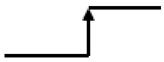
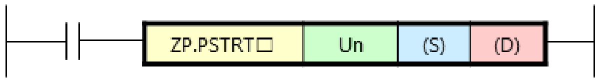
To meet such a requirement, the positioning module is designed to handle dedicated instructions, which are used to execute specific positioning data in a sequence program.
For example, positioning data is used as below in the material handling system: 1) The size of a box is classified by a sensor (small, medium, or large) and the information is sent to the programmable controller, 2) The programmable controller executes the positioning data with the No. corresponding to the information received, and 3) The sliding conveyor delivers the box according to the executed positioning data.

5.1 Executing Positioning Data from the Sequence Program

5.1 Executing Positioning Data from the Sequence Program

"ZP.PSTRT☐" instruction is dedicated to executing positioning data of the number specified in a sequence program.

■ Positioning control start instruction

Instruction symbol	Condition for execution	Circuit
ZP.PSTRT☐		

Enter the number of the axis (axes) (1 through 4) into "☐" part of the instruction. (ZP.PSTRT1 to ZP.PSTRT4)

■ Data setting

Data setting	Setting details	Data type
Un	Start I/O number for RD75D (00 to FE: The first 2 digits where the I/O number is expressed in 3 digits)	BIN16 bit
(S)	Start number for a device in which control data* is stored.	Device
(D)	Start number for a bit device which is turned on for one scan cycle upon the completion of the instruction. In the case of abnormal completion, ((D) +1) turns on as well.	Bit

* Control data will be explained on the next page.

The sample material handling system uses "ZP.PSTRT1" instruction.

5.1 Executing Positioning Data from the Sequence Program

■ **Control data**

Set the parameters used in the ZP.PSTRT☐ instruction to the sequential devices shown below. The set data are used as control data. The results of instruction execution are also written into the devices by the system.

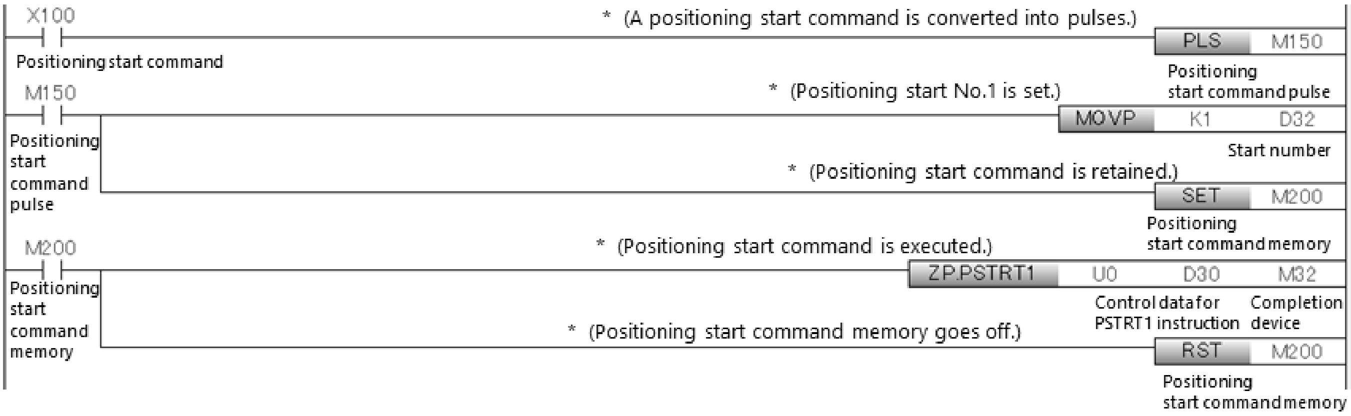
For the control data "Start number", set the number of the positioning data to be executed.

Device	Item	Data to be set or stored	Range of setting
(S) +0	System area	—	—
(S) +1	Ending status	Status at completion of instruction is stored. • 0: Normal end • Other than 0: Abnormal end (error code)	—
(S) +2	Start number	Set the data No. to be executed by the ZP.PSTRT☐ instruction: • Number of positioning data: 1 to 600 • Block start: 7000 to 7004 • Machine OPR: 9001 • High-speed OPR: 9002 • Current value change: 9003 • Simultaneous execution at plural axes: 9004	1 to 600 7000 to 7004 9000 to 9004

5.1 Executing Positioning Data from the Sequence Program

The following diagram shows an example of sequence program that uses the dedicated instruction.
In this program, positioning data No.1 is executed when X100 turns on.
Devices D30 to D32 are used for control data, and devices M32 and M33 are used for completing the positioning data execution (completion device).
(Note that the following example program is different from a sequence program applied to the sample material handling system.)

■ **Positioning start program**



5.2 Summary

In this chapter, you have learned:

- Executing positioning data from the sequence program

Important point

How to use the dedicated instruction "ZP.PSTRT□"	You have learned how to use the dedicated instruction "ZP.PSTRT□" which allows you to execute any given positioning data in a sequence program.

Chapter 6 Test Operation of System

Chapter 6 explains how to check the system by performing a test operation before bringing it into service.
Mistakes made in the design, poor assembly of the equipment, or incorrect parameter/data settings may cause the system to fail, which could result in an accident.
Therefore, make sure to check the operation of the system by performing a test operation before bringing it into service.

The following points should be checked in the test operation:

- The machine design is appropriate for positioning control system.
- A positioning control system is properly assembled (installation and connection included).
- Workpiece (sliding conveyor) moves correctly in a correct direction.
- Software/hardware stroke limits operate normally.
- Execution of positioning data results in an operation consistent with the design.

■ Positioning test

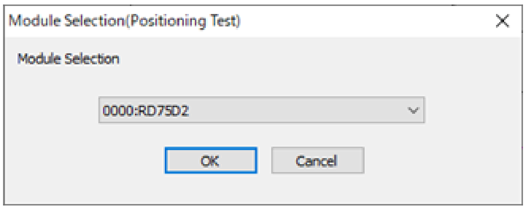
For a test operation, use the positioning test function of GX Works3.
The positioning test is a useful function that allows you to perform a manual operation, machine OPR, and positioning data execution using GX Works3 while monitoring the operation status. For the test, no input device or sequence program is required.

■ Operation procedure

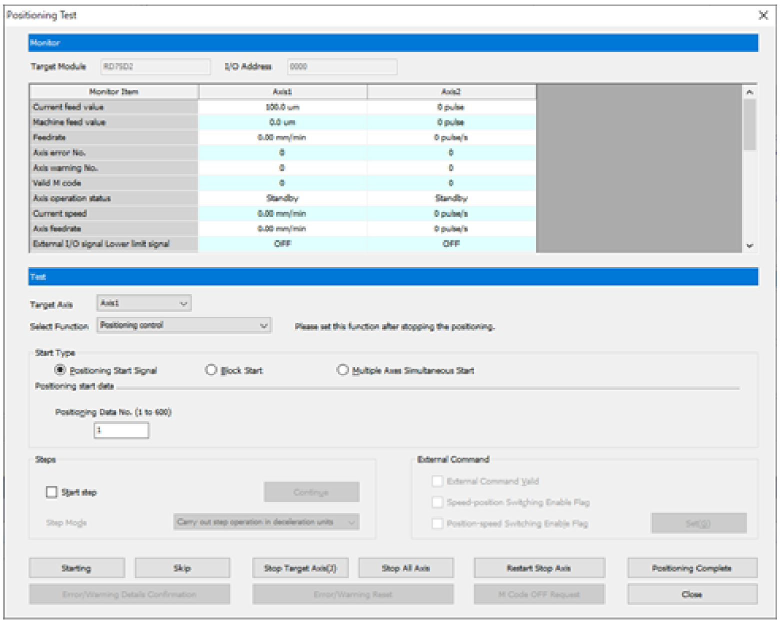
(1) On the GX Works3 menu, select "Tool" - "Module Tool List" - "Pulse I/O/Positioning" -"Positioning test".

(2) Select a positioning module to be tested.

(3) "Positioning Test" window appears.



Module Selection (Positioning Test) window



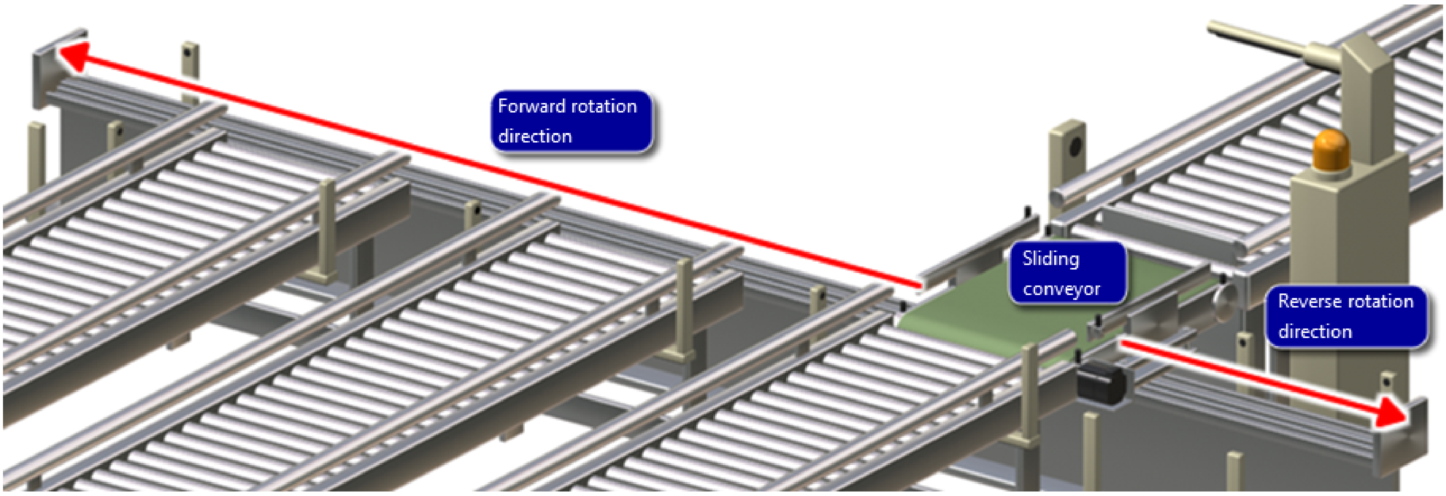
Positioning Test window

6.2 Manual Test Operation for Workpiece

Perform a test operation on the workpiece.
In the sample material handling system, 1) check the operation of the "carriage" (workpiece), 2) check the moving direction (rotation direction of the motor), and
3) check the operation of hardware stroke limits manually.

Be sure to manually check the operation before performing automatic operation using sequence programs and positioning data.
An assembly fault of a system or incorrectly set parameters may be left unnoticed, and cause the workpiece to move in an unexpected way, resulting in a system fault or an accident.

For the sample material handling system, use "JOG operation" to test the operation of the carriage.
The JOG operation is a manual operation that rotates a servo motor in the forward/reverse direction at a fixed speed.



6.2.1 Parameter setting for JOG operation

This section explains the parameter settings required for JOG operation.

(1) JOG speed limit value

Set the maximum speed during JOG operation.
JOG operation speed will be limited to the set value.

For the sample material handling system, set "3000 mm/min".

(2) JOG operation acceleration time selection / JOG operation deceleration time selection

Select the acceleration time and deceleration time during JOG operation from among four patterns, No.0 through No.3.

For the sample material handling system, set "0: Acceleration time 0" and "0: Deceleration time 0".

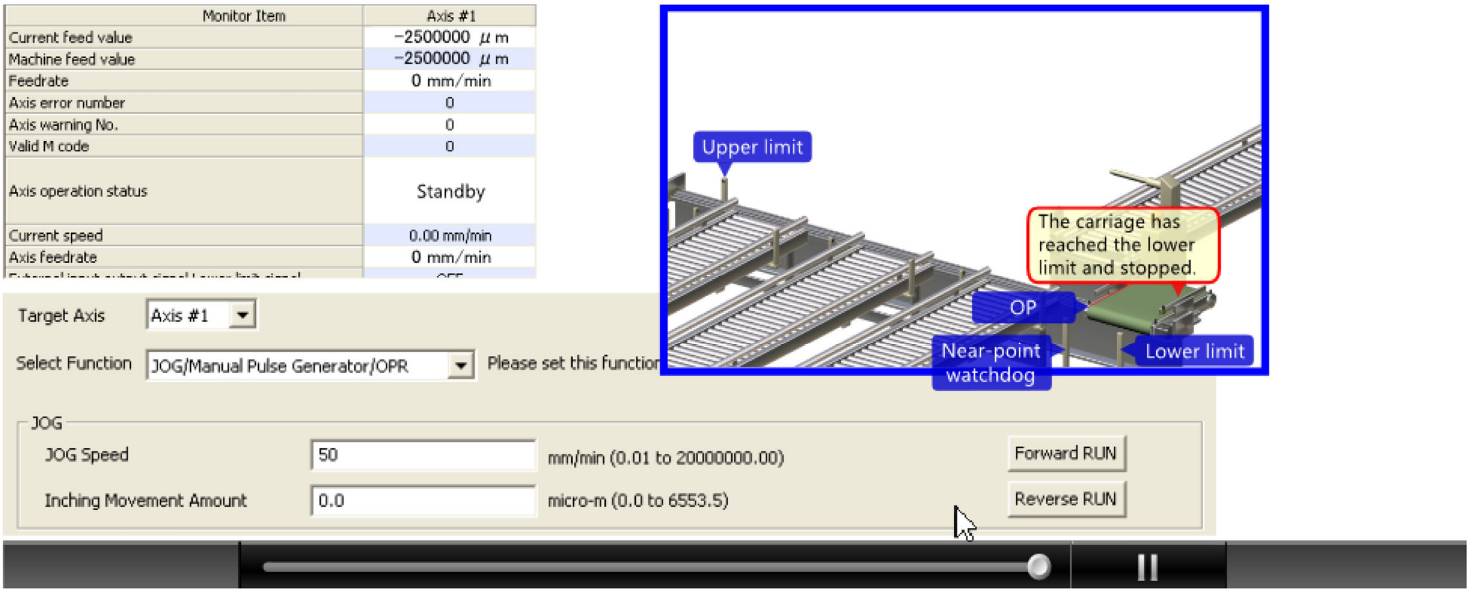
	Item	Axis 1
	Detailed parameter 2	**Set the detailed parameter 2.**
	Acceleration time 1	1000 ms
	Acceleration time 2	1000 ms
	Acceleration time 3	1000 ms
	Deceleration time 1	1000 ms
	Deceleration time 2	1000 ms
	Deceleration time 3	1000 ms
(1)	JOG speed limit value	3000.00 mm/min
(2)	JOG operation acceleration time selection	0: Acceleration time 0
	JOG operation deceleration time selection	0: Deceleration time 0
	Acceleration/deceleration processing selection	0: Trapezoidal acceleration/deceleration processing
	S-curve ratio	100 %
	Sudden stop deceleration time	1000 ms

Positioning parameter setting area

6.2.2 Test operation by JOG operation

The JOG operation moves the workpiece at a speed specified in "JOG Speed" while the corresponding button is being pressed.
It is used for test operation.
To execute a JOG operation, go to "Positioning Test" and select "JOG/Manual Pulse Generator/OPR" at Select Function.

Click the "Play" button (▷) and see how to check the operation of carriage and hardware stroke limit by using the JOG operation.



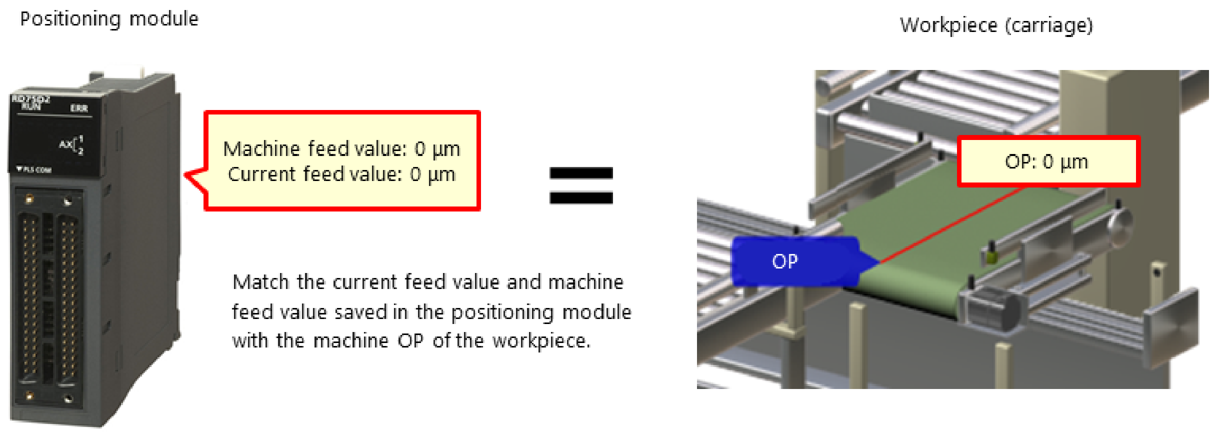
6.3 Initialization of Positioning Start Position

The positioning start position must be initialized (OPR must be performed) before checking the operation of positioning control.

By initializing the positioning start position, the machine OP saved in the positioning module, and the machine OP of the actual workpiece are synchronized.
If they are not synchronized, a workpiece deviation from its stop position may occur.
This initialization process is called "machine OPR".

Machine OPR should always be performed at every start because a stop position may have been shifted due to an external pressure, disturbance, etc. while the system is in stop.
If such a situation is likely to occur, create a sequence program that performs machine OPR after the power is supplied to the system (after startup).

To perform a machine OPR by a sequence program, use the "ZP.PSTRT□" instruction explained in Chapter 5.
A machine OPR can be performed by setting "9001" to the start number of control data.
For details, please refer to the corresponding positioning module manual.



6.3.1 OPR parameter settings

This section explains the parameter settings required for execution of machine OPR.

(1) OPR method

Select a machine OPR method.

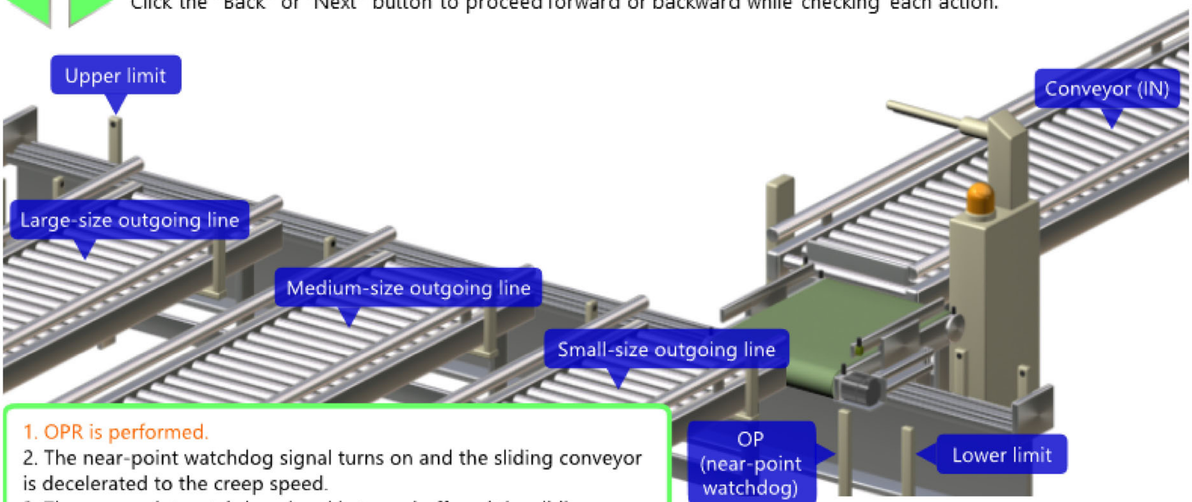
For the sample material handling system, select "Near-point Dog Method".
In the "Near-point Dog Method", when a workpiece near the original position (near point) is detected by a sensor, the movement of the workpiece is decelerated to a speed level called "creep speed", in order to improve its stop accuracy.
The accuracy of OPR is increased and at the same time the impact on the machine is reduced in this method.

Item	Axis 1
OPR basic parameter	Set the OPR basic parameter.
(1) OPR method	0: Near-point dog method
OPR direction	1: Negative direction (Address decrease direction)
OP address	0.0 μm
OPR speed	3000.00 mm/min
Creep speed	300.00 mm/min
OPR retry	0: Do not perform the OPR retry with limit switches

Positioning parameter setting area

See the animation below to understand how the OPR is performed by the "Near-point Dog Method".

Click the "Back" or "Next" button to proceed forward or backward while checking each action.



1. OPR is performed.
2. The near-point watchdog signal turns on and the sliding conveyor is decelerated to the creep speed.
3. The near-point watchdog signal is turned off, and the sliding conveyor is stopped at reception of the first zero signal*.

* Zero signal: Output at the original point of one rotation. It is output once per motor rotation.

Back Next

6.3.1 OPR parameter settings

(2) OP address

Set the machine OP address.
In an OPR, the "machine feed value" and "current feed value", which are saved in the positioning module, are initialized to the OP address.

For the sample material handling system, set "0 µm", which is easy to remember.

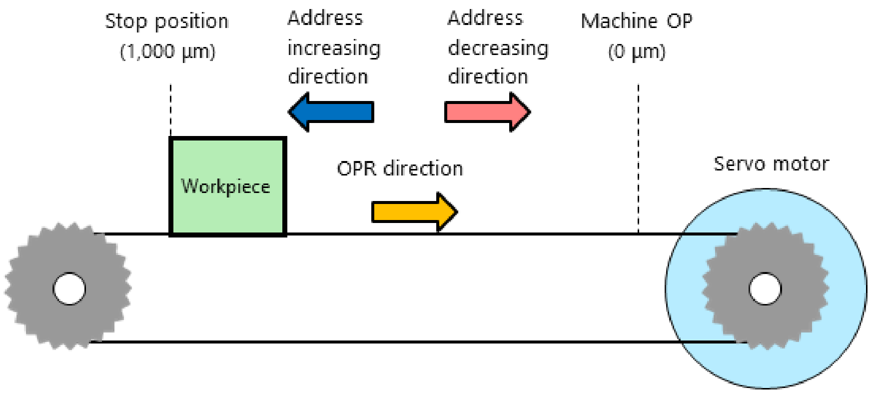
Item	Axis 1
OPR basic parameter	**Set the OPR basic parameter.**
OPR method	0: Near-point dog method
(3) OPR direction	1: Negative direction (Address decrease direction)
(2) OP address	0.0 µm
OPR speed	3000.00 mm/min
Creep speed	300.00 mm/min
OPR retry	0: Do not perform the OPR retry with limit switches

Positioning parameter setting area

(3) OPR direction

Set the direction in which the workpiece moves during OPR.
The direction is determined by the system machine structures, and specifications and settings of the servo system, etc.

In the material handling system, the sliding conveyor moves away from the machine OP, increasing its address.
If it were to return to its original position, it has to be moved to the opposite direction, decreasing its address. Therefore, set "Reverse Direction (Address Decrease Direction)" to OPR direction.



6.3.1 OPR parameter settings

(4) OPR speed

Set the moving speed during OPR.
The workpiece moves at the set speed from the OPR start until the input signal of near-point watchdog turns on.

For the sample material handling system, set "3000 mm/min" to OPR speed.

Item	Axis 1
OPR basic parameter	**Set the OPR basic parameter.**
OPR method	0: Near-point dog method
OPR direction	1: Negative direction (Address decrease direction)
OP address	0.0 μm
(4) OPR speed	3000.00 mm/min
(5) Creep speed	300.00 mm/min
OPR retry	0: Do not perform the OPR retry with limit switches
OPR detailed parameter	**Set the OPR detailed parameter.**
OPR dwell time	0 ms
Setting for the movement amount after near-point dog ON	0.0 μm
(6) OPR acceleration time selection	0: Acceleration time 0
OPR deceleration time selection	0: Deceleration time 0

Positioning parameter setting area

(5) Creep speed

Set a speed slower than OPR speed.
Since OP serves as a reference position of positioning control, high stopping accuracy is required.
If the input signal of near-point watchdog turns on, OPR speed is lowered to the creep speed, reducing the moving speed.

For the sample material handling system, set "300 mm/min" (1/10 of OPR speed).

(6) OPR acceleration time selection / OPR deceleration time selection

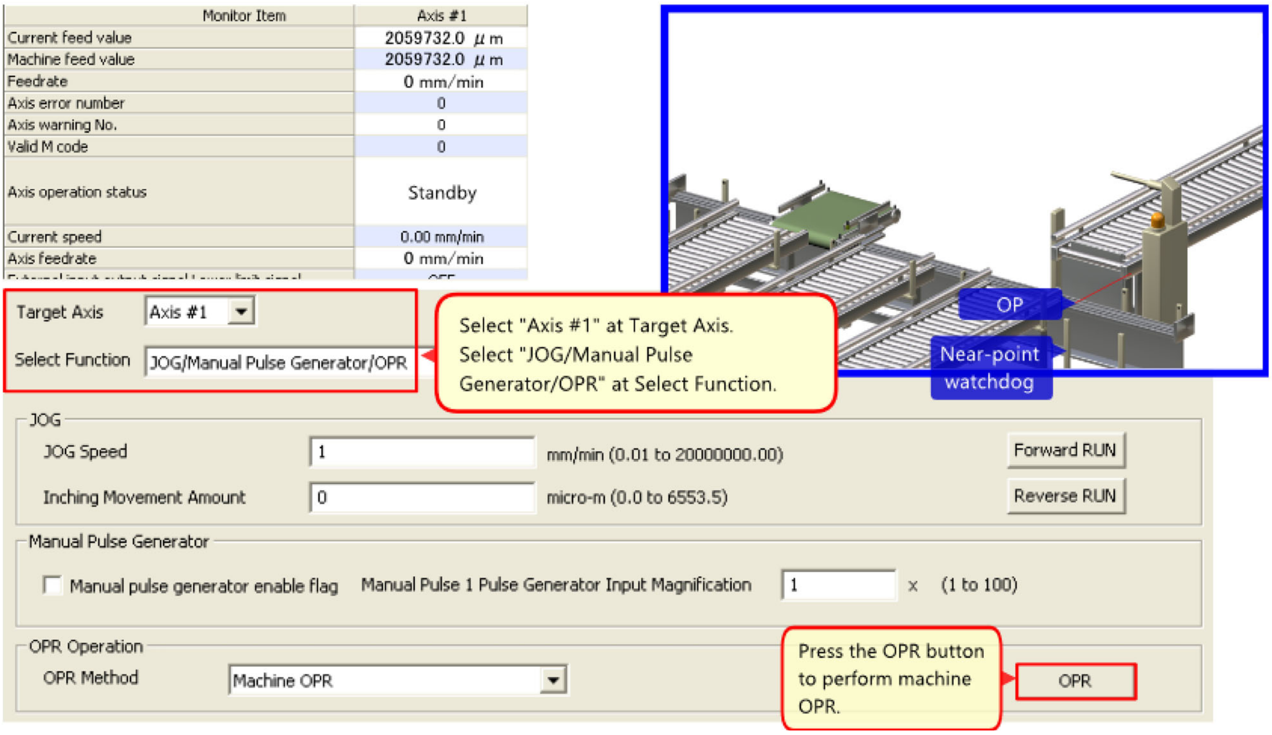
Select the acceleration time and deceleration time during OPR from among four patterns, No.0 through No.3.

For the sample material handling system, select "0: Acceleration time 0" and "0: Deceleration time 0".

6.3.2 Execution of machine OPR

Use GX Works3 to perform machine OPR without using a sequence program.

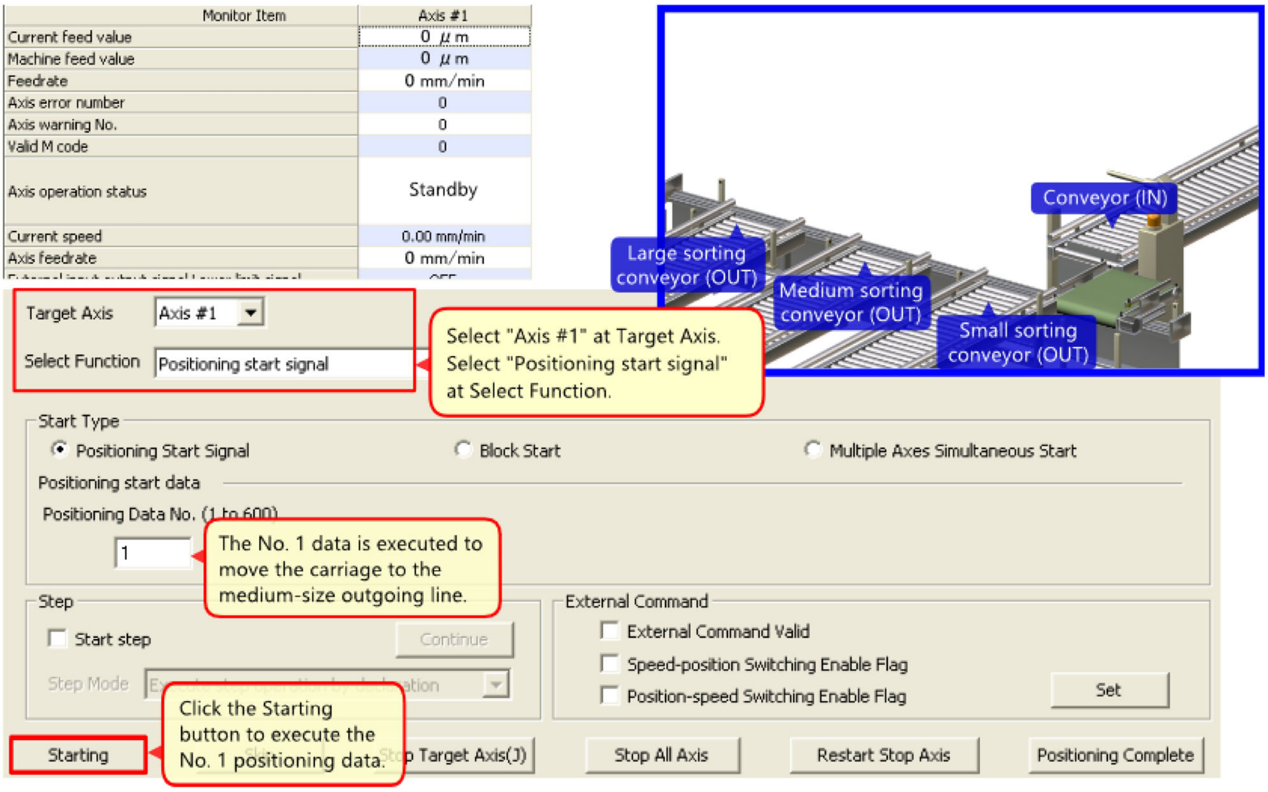
To execute an OPR operation, go to "Positioning Test" and select "JOG/Manual Pulse Generator/OPR" at Select Function.



6.4 Operation Check of Positioning Data

Use "Positioning Test" to confirm that execution of positioning data results in an operation consistent with the design. Any positioning data can be executed, without using a sequence program.

To execute a positioning test, go to "Positioning Test" and select "Positioning control" at Select Function.



6.5 Summary

In this chapter, you have learned:

- Test operation of system
- Manual test operation for workpiece
- Initialization of positioning start position
- Operation check of positioning data

Important points

Importance of test operation	You have learned that a test operation must be performed before bringing the system into service.
Roles and procedure of manual operation	You have learned about JOG operation, which is a test operation that can be performed using GX Works3.
Roles and procedure of machine OPR	You have learned the importance and the procedure of machine OPR and OPR parameters.
Roles and procedure of positioning data operation test	You have learned how to check the positioning operation by using the specified data.

Chapter 7 Bringing System into Service

Chapter 7 explains how to control the system under operation.
The chapter refers to how to check the operating status and troubleshooting using GX Works3.

7.1 Troubleshooting Using Operation Monitors

Various troubles (warning and error) may occur during operation of a system.

In order to investigate the cause of a trouble, the warning code / error code must be checked.
An operation monitor provides the operating state of each axis and the operating status at the time of a failure while showing the warning/error codes.

The following shows what the operation monitor displays.

	Axis1
Current feed value	100.0 um
Axis feedrate	0.00 mm/min
Axis operation status	Standby
Positioning data No. being executed	0
Operation pattern of Positioning data being executed	Positioning Completed
Control method of Positioning data being executed	-
Axis to be interpolated of Positioning data being executed	Axis #1 Specification
Acceleration time No. of Positioning data being executed	Acceleration time 0
Deceleration time No. of Positioning data being executed	Deceleration time 0
Axis error No. ...	0
Axis warning No. ...	0
Valid M code	0

Setting status (Current feed value, Axis feedrate)

Operating status (Axis operation status through Deceleration time No. of Positioning data being executed)

Error code, warning code (Axis error No., Axis warning No.)

Operation monitor area

7.2 Safety Measures of System (Accident Prevention)

Positioning control moves machines and materials, and can introduce a safety risk into the manufacturing site.
To prevent any danger, system failure or an accident, thorough safety measures must be implemented prior to using such a control system.

■ Use of emergency stop function

An emergency stop function stops all the servo motor axes by an emergency stop input from an input device connected to a positioning module.
Be sure to install an emergency stop button or similar devices so that the system can be stopped at any time when a trouble occurs.
For the connection method of input devices, refer to the corresponding positioning module manual.

An emergency stop input can be connected to the servo amplifier as well.
By connecting the input to the servo amplifier, an emergency stop function can be used from the servo amplifier, even if the positioning module fails.
For the connection method, refer to the corresponding servo amplifier manual.

Caution

> When wiring an emergency stop input, always wire by the negative logic and use "normally closed contact".
>
> When performing an emergency stop, do not directly turn off the servo motor power supply.

■ Measures to prevent workers' approaching the system under operation

Installation of a safety fence can prevent a worker from accidentally approaching the system under operation.
A safety fence not only prevents workers from approaching the system, but also protects workers from the scattered debris of broken system, etc.
In addition, opening/closing operation of the safety fence door and the signals from the motion sensor, which is interlocked with the emergency stop input, can be used as another measure. With this mechanism, when a worker approaches the system under operation, the system can be shut down automatically.

7.3 Summary

In this chapter, you have learned:

- Troubleshooting using operation monitors
- Safety measures of system (accident prevention)

Important points

Troubleshooting using operation monitors	You have learned how to use the monitoring function of GX Works3 to perform primary diagnostic of the system not preforming the expected operation.
Safety measures	You have learned the importance of thorough safety measure in the control involving motions.

Test Final Test

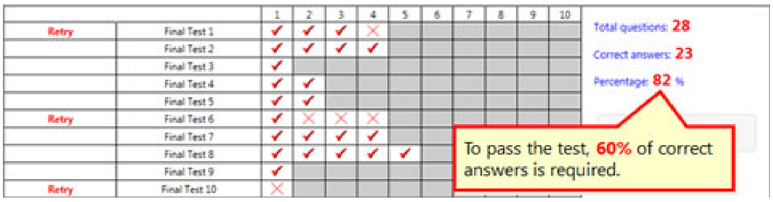
Now that you have completed all of the lessons of the **Positioning Control (MELSEC iQ-R Series)** Course, you are ready to take the final test. If you are unclear on any of the topics covered, please take this opportunity to review those topics.

There are a total of 9 questions (19 items) in this Final Test.

You can take the final test as many times as you like.

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.



Test **Final Test 1**

"RD75" positioning module features

Please select the appropriate sentences that correctly describe the RD75 positioning module features (Multiple answers).

Q1

- [x] **The complicated positioning control interlocked with the programmable controller can be built.**
- [ ] **The "RD75" positioning modules are dedicated to a Mitsubishi Electric servo amplifiers.**
- [ ] **Positioning module settings are performed using machine switches.**
- [x] **The amount of sequence programs can be reduced by using positioning data, compared with the case not using them.**
- [x] **A dedicated instruction is used in a sequence program to execute positioning data.**

Test | **Final Test 2**

Positioning control functionality

Please select the correct function corresponding to each description contained on the left.

Matches the machine OP of the workpiece and that of the positioning module. **(Q1)**
Physically limits the movable range of the workpiece using a switch, sensor, etc. installed at both ends of the system.

Q1 Machine OPR

Q2 Hardware stroke limit

Q3 Software stroke limit

Q4 Electronic gear

Q5 JOG operation / inching operation

Test

Final Test 3

Electronic gear function setting

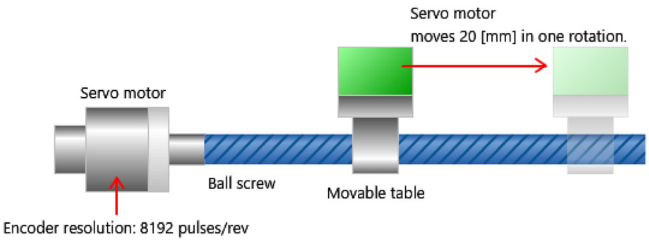
Please select the appropriate settings below.

If an electronic gear is required to operate a sliding table for 20mm in one motor rotation with an encoder resolution of 8192 pulses/rev.

Q1 8192 pulse/rev

Q2 20000μm

Q3 1 time



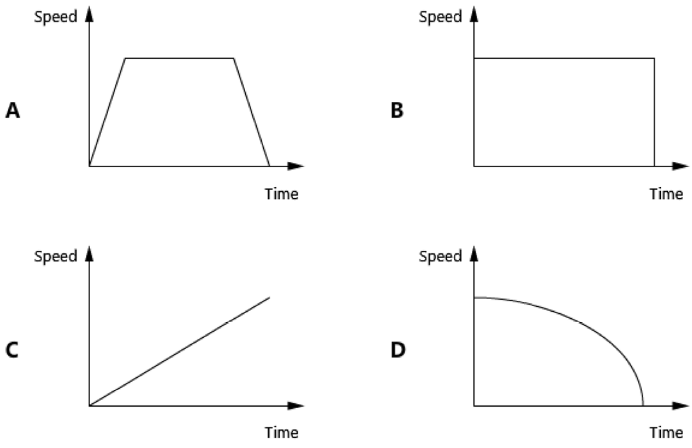
[+]

Relationship of speed and time

Select a graph that shows the correct relationship between speed and time during positioning control.

Q1

- (selected) A
- B
- C
- D



[+]

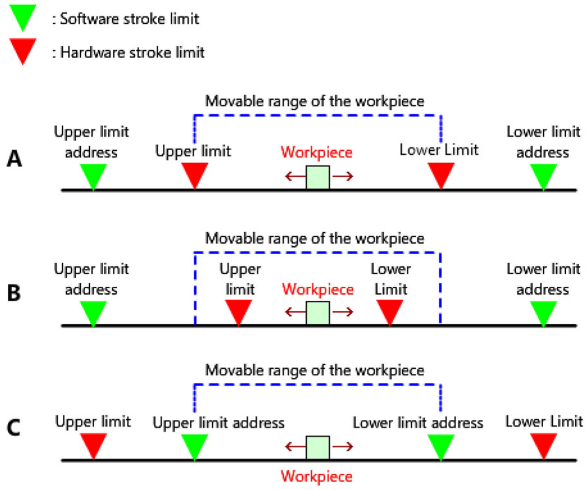
Test | **Final Test 5**

Limiting the movable range of workpiece

Select the figure that correctly shows the positions of the software stroke limits and the hardware stroke limits.

Q1

- A
- B
- C (selected)



[+]

Test | **Final Test 6**

Positioning data execution using a sequence program

The following figure shows a sequence program that executes the positioning data No. 2 when X1 is on.

Select the correct value to complete the program below. Use devices D33 to D35 to store control data of the positioning data No. 2, and use devices M34 and M35 as completion devices.The number of control axis is "1 axis".

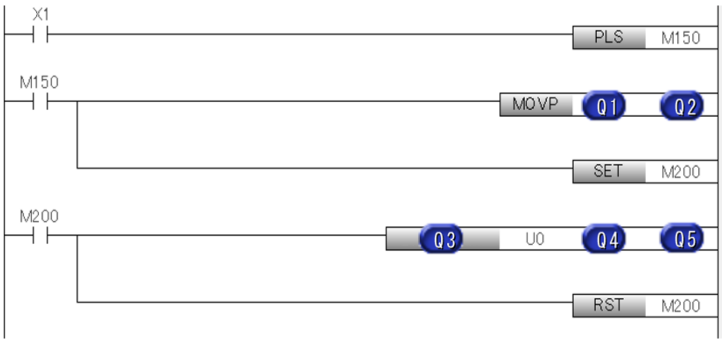
Q1 K3

Q2 D35

Q3 ZP.PSTRT1

Q4 D33

Q5 M34



[+]

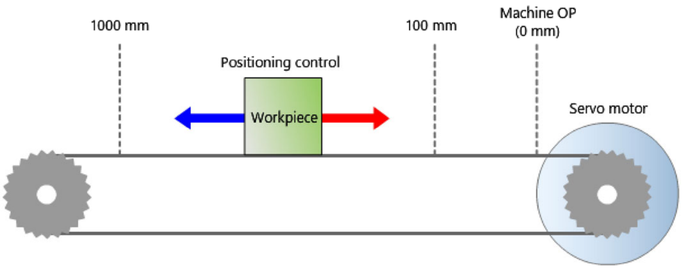
Test **Final Test 7**

OPR direction of machine OPR

Select the correct "OPR direction" for the workpiece, which always moves between the work address 100 mm and 1000 mm in the positioning control.The machine OP address is "0 mm".

Q1

- Forward Direction (Address Increase Direction)
- Reverse Direction (Address Decrease Direction)



[+]

System test operation

What can be tested by performing the "positioning start" of GX Works3's test function? Select the most suitable answer.

Q1

- ○ **Operation and travel (rotation) direction of the workpiece.**
- ○ **Operation of the hardware/software stroke limits.**
- ◉ **Operation of positioning data**
- ○ **Operation of positioning parameters**
- ○ **Operation of sequence programs**

Test | **Final Test 9**

System safety measures

Select the correct description for system safety measures.

Q1

- ○ **As an emergency stop method, it is safer to turn off the servo motor power supply directly rather than turning off the positioning module and servo amplifier.**
- ○ **For the emergency stop wiring, it is safer for to use a "normally open contact" rather than a "normally closed contact".**
- ◉ **A safety fence interlocked with the emergency stop can be installed around the system to provide safety.**
- ○ **An emergency stop gives a sudden impact to the system (workpiece), and therefore is safer if it is not used.**
- ○ **Software stroke limits provide enough safety by limiting the movable range of a workpiece.**

Test | **Test Score**

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

		1	2	3	4	5	6	7	8	9	10
	Final Test 1	✓									
	Final Test 2	✓	✓	✓	✓	✓					
	Final Test 3	✓	✓	✓							
	Final Test 4	✓									
	Final Test 5	✓									
	Final Test 6	✓	✓	✓	✓	✓					
	Final Test 7	✓									
	Final Test 8	✓									
	Final Test 9	✓									

Total questions: **19**

Correct answers: **19**

Percentage: **100** %

Clear

You have completed the **Positioning Control (MELSEC iQ-R Series)** 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