



Servo

# MOTION CONTROLLER Application (Virtual Mode)

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

## Introduction Purpose of the Course

This course is for those who are going to establish the motion control system using the motion CPU module of MITSUBISHI motion controller for the first time.

To establish the system, you need to learn the synchronous control in the SV22 virtual mode by using the motion controller engineering environment MELSOFT MT Works 2.

This course mainly consists of the contents intended for a person in charge of software who understands the programming basics and designs synchronous control. The contents for a person in charge of hardware, such as the system design, installation, wiring and so on are prepared in the "SERVO MOTION CONTROLLER BASICS (HARDWARE)" course. The basic contents for a person in charge of software, such as programming are prepared in the "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.

For this course, you are required to have knowledge about MELSEC-Q series PLC, AC servo and positioning control.

For those who take this course for the first time, we recommend you to take

- "MELSEC-Q SERIES BASICS" course
- "MELSERVO BASICS (MR-J3)" course
- "YOUR FIRST FACTORY AUTOMATION (POSITIONING CONTROL)" course
- "SERVO MOTION CONTROLLER BASICS (HARDWARE)" course
- "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.

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Introduction Course Structure

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

**Chapter 12 - REAL MODE AND VIRTUAL MODE**

You will learn differences between the real mode and virtual mode.

**Chapter 13 - MECHANICAL SYSTEM PROGRAM**

You will learn about the mechanical system program and mechanical module used for control under the virtual mode.

**Chapter 14 - CREATING CAM DATA**

You will learn how to create cam data used with the mechanical module "CAM".

**Chapter 15 - EXERCISE**

You will learn about the mechanical system and how to create cam data using the sample system.

**Chapter 16 - APPLICATION**

You will learn about the limit switch output function, address clutch, and digital oscilloscope.

**Final Test**

Passing grade: 60% or higher.

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» **Introduction How to Use This e-Learning Tool**

Navigation icons: Back, Forward, Table of Contents.

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

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## Introduction Cautions for Use

### Safety precautions

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

### Precautions in this course

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

This course is for the following software version:

- MT Developer2 Version 1.18U

### Reference

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

Reference name	File type	Size
<a href="#">Sample program</a>	Compressed file	53,651 bytes
<a href="#">Recording paper</a>	Compressed file	43.5 kB

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## Chapter 12 REAL MODE AND VIRTUAL MODE

In this chapter, you will learn the differences between the real mode (SV13/SV22) and virtual mode (SV22).  
The real mode is used to directly control a system using the servomotor(s) with a servo program.  
For details of the real mode, refer to the "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.

The diagram illustrates a servo motion controller application. It features two main sections: 'Real' and 'Virtual'. In the 'Real' section (green base), a black servo motor is connected to a green circular load via a shaft. A spring is attached to the load. In the 'Virtual' section (orange base), a black servo motor is connected to a black circular load via a shaft. A small blue component is also present. The word 'Virtual' is written diagonally across the orange base. The entire setup is mounted on a white surface.

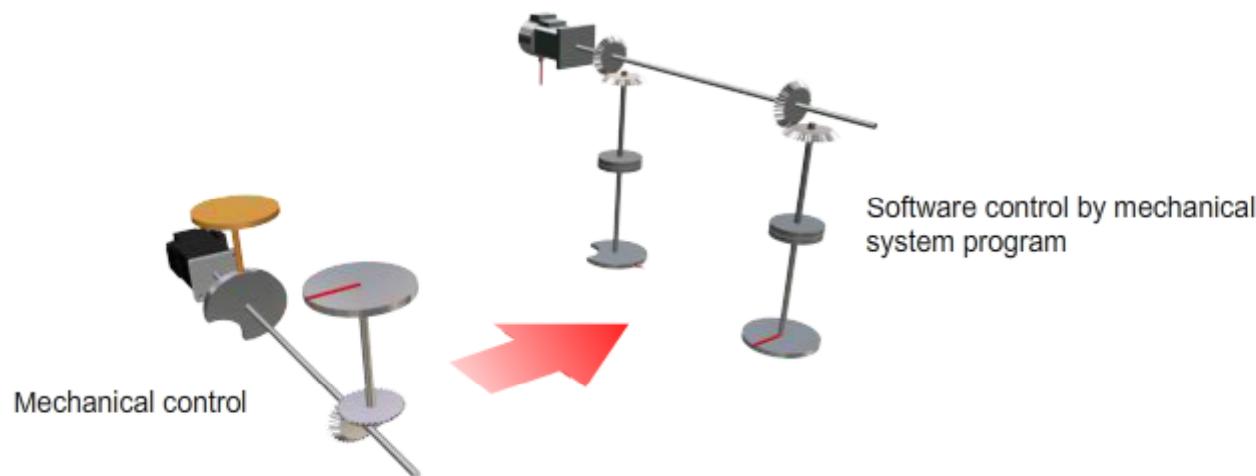
**12.1****Virtual Mode**

Conventionally, a machine was controlled by mechanically linking shafts, gears, and clutches from each motor. The virtual mode replaces this mechanical operation by synchronizing the motors on the machine using the mechanical system program.

By giving commands to the virtual servomotor, the motors on the machine are controlled in accordance with the settings of the mechanical system program.

The virtual mode provides the following advantages over mechanically building the system:

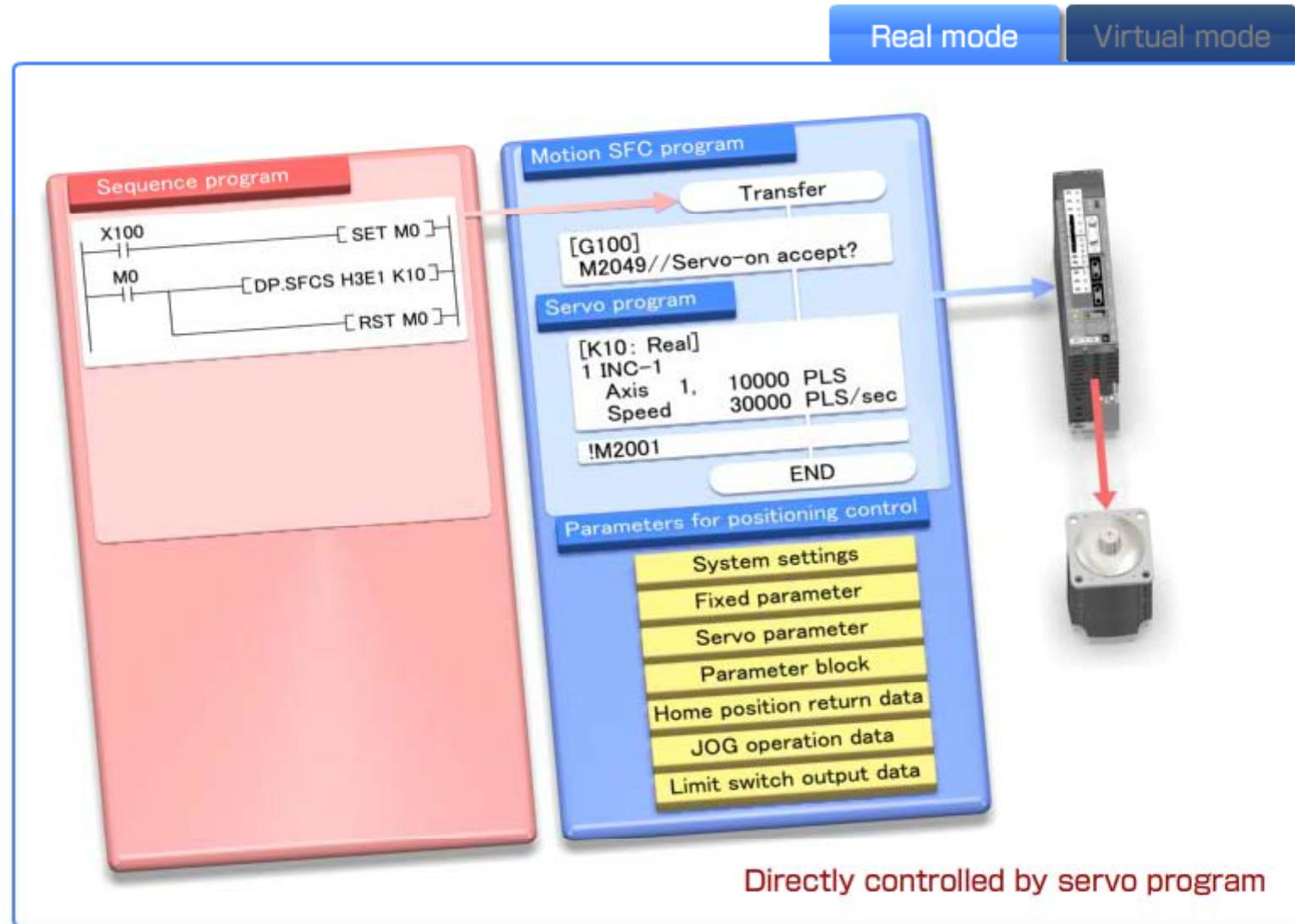
- Smaller and lower-cost machines can be manufactured.
- Wear and life of each part (main shaft, gear, and clutch) do not need to be considered.
- Tasks such as stage replacement become easier.
- System performance improves because errors due to mechanical precision do not exist.



**12.2****Differences between Real Mode and Virtual Mode**

The differences between the real mode and virtual mode on the motion controller are as follows:

Click [Real mode] and [Virtual mode] on the right to confirm differences between the real mode and virtual mode.

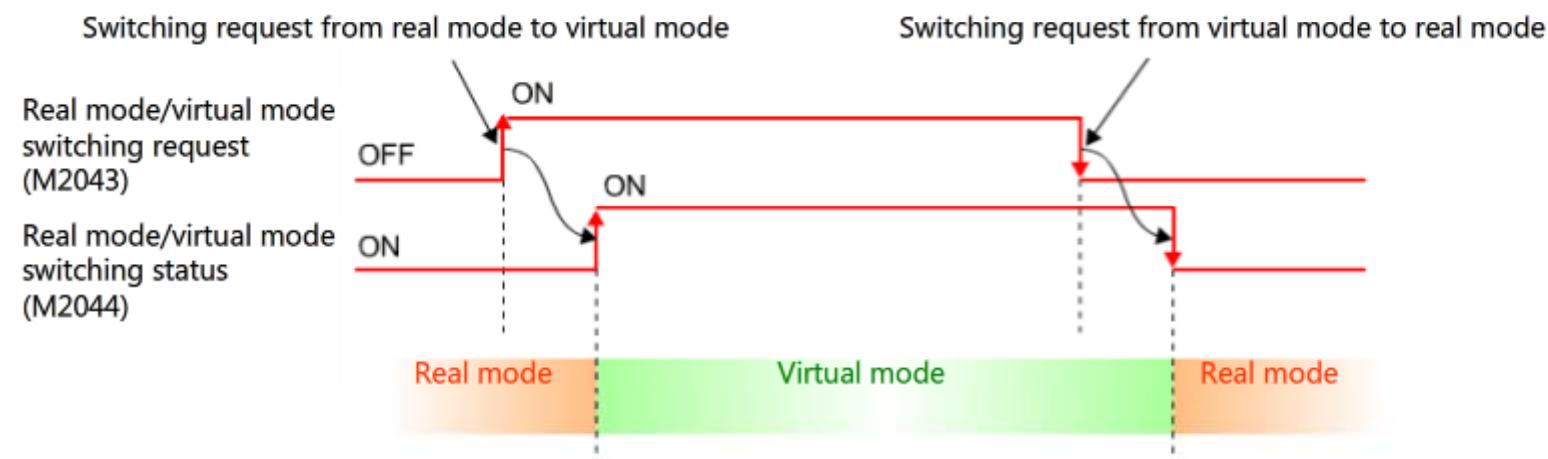


**12.3****Procedure for Switching to Virtual Mode**

In order to use the virtual mode functionality, the mode is to be switched to the virtual mode. To change the mode, turn on and off the real mode/virtual mode switching request (M2043). When switching from the real mode to the virtual mode, check the following to judge if switching is possible:

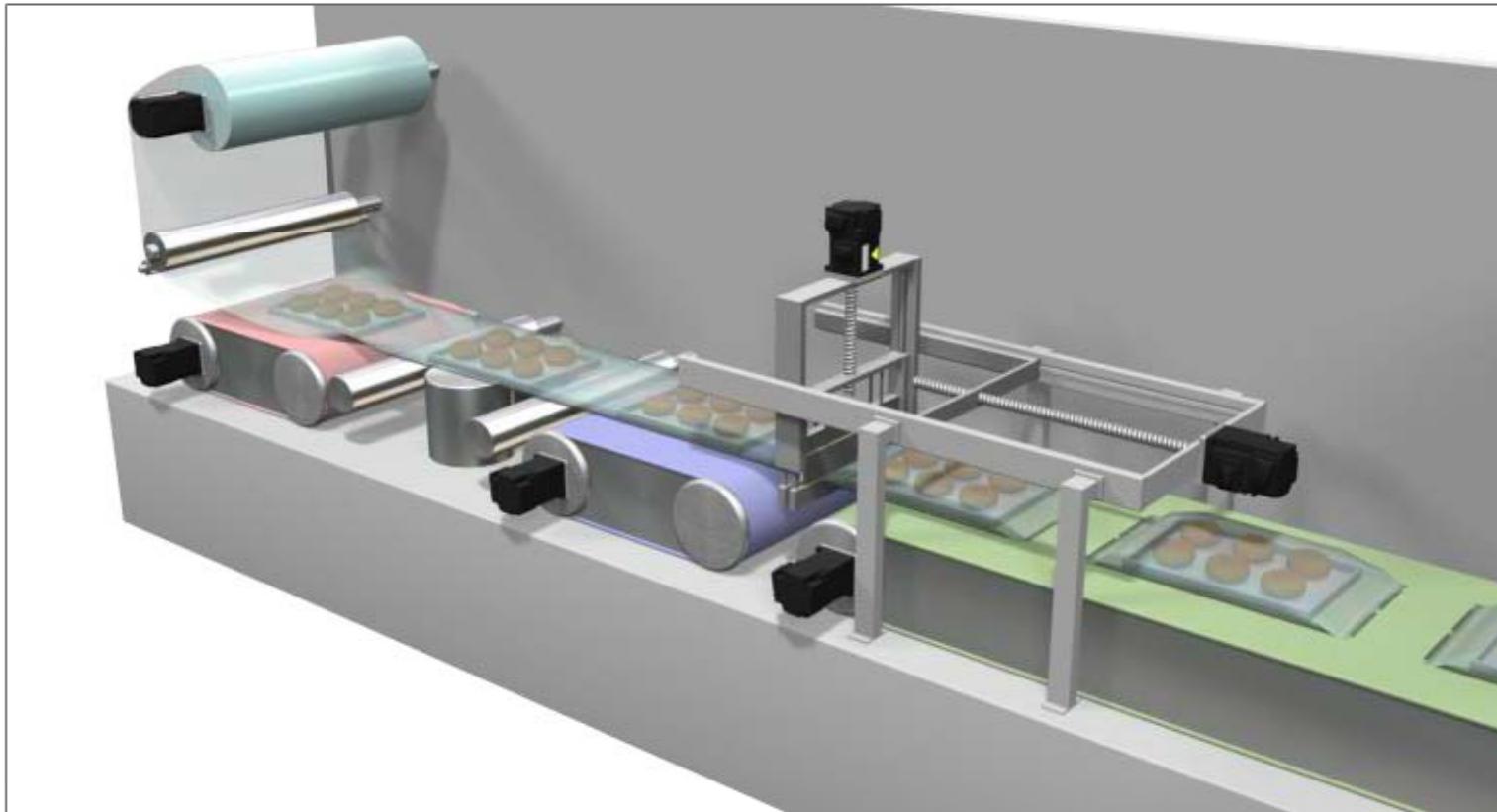
- Mechanical system program is registered.
- All axes servo-on command is turned on.
- All axes are stopped.
- No servo error exists with any of the axes.
- Home position return requests for all axes except for the roller axis are off.

Timing chart



**12.4****Clarifying the Operation Mode**

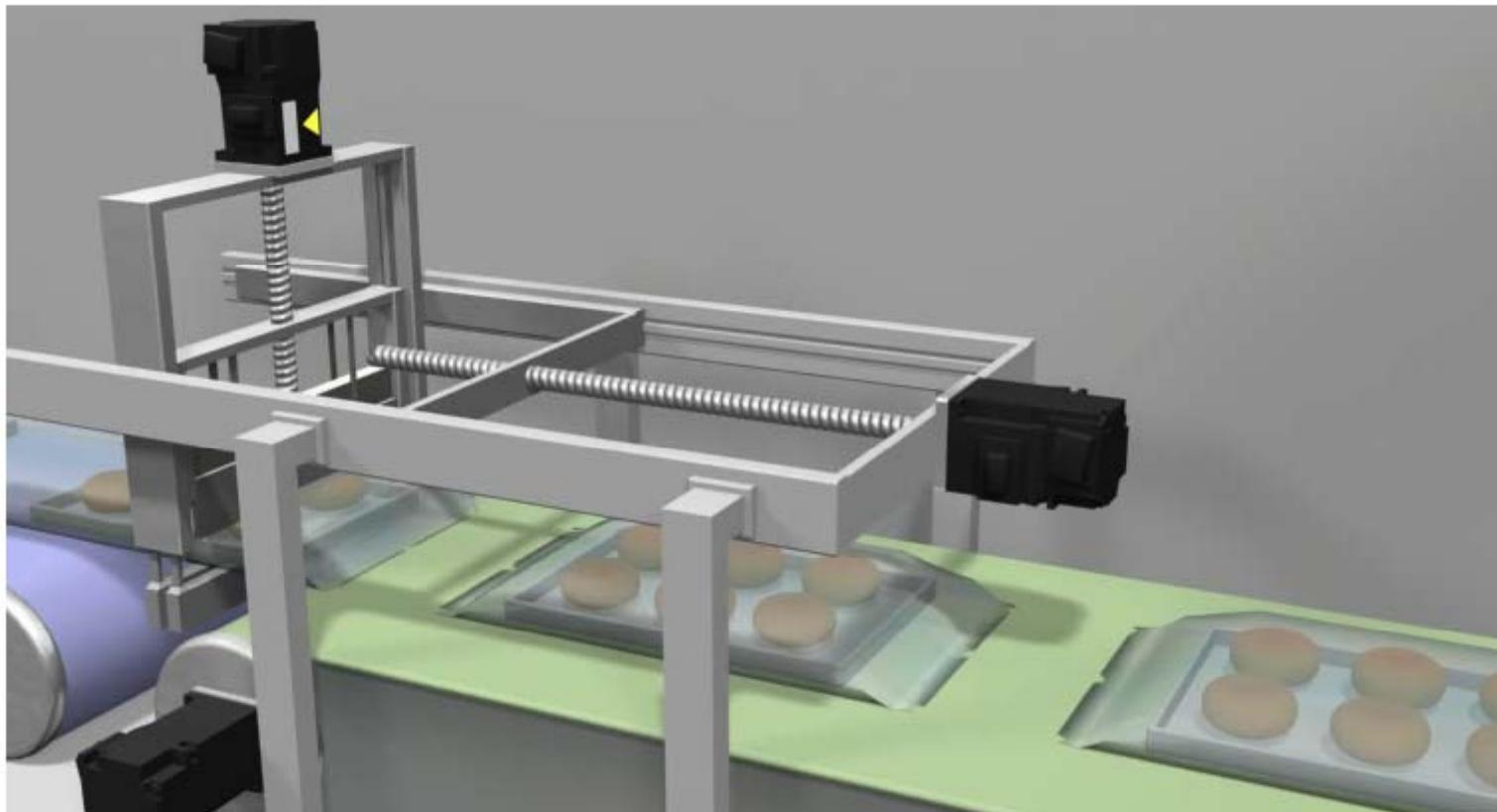
The sample system used in this course is the packaging machine of the sample system used in the "SERVO MOTION CONTROLLER BASICS (HARDWARE)" course and the "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.



(Duration: 00:05)

## 12.4.1 Packing machine control

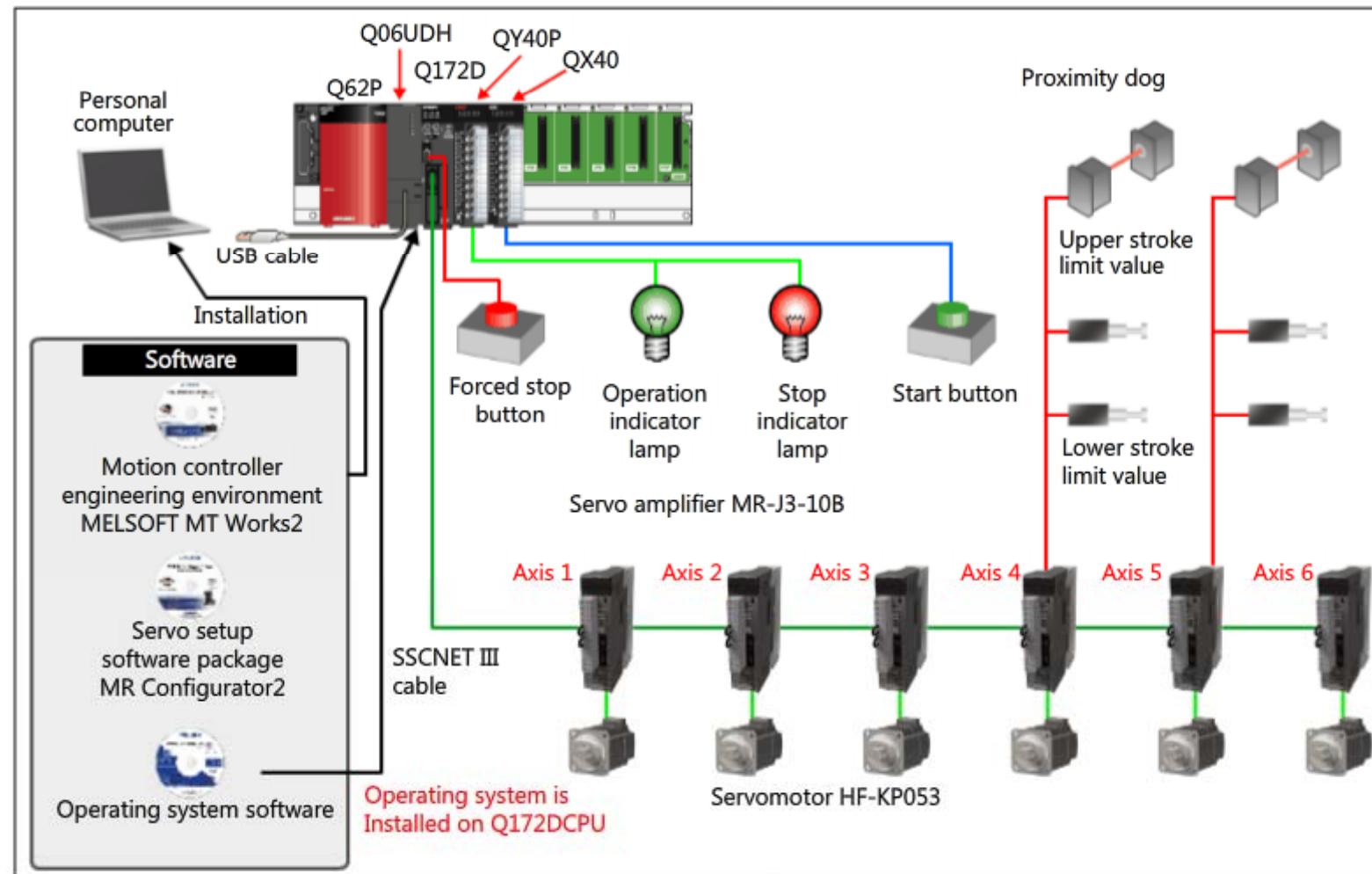
The operation mode (control flow) in the sample system for this course is as shown below.

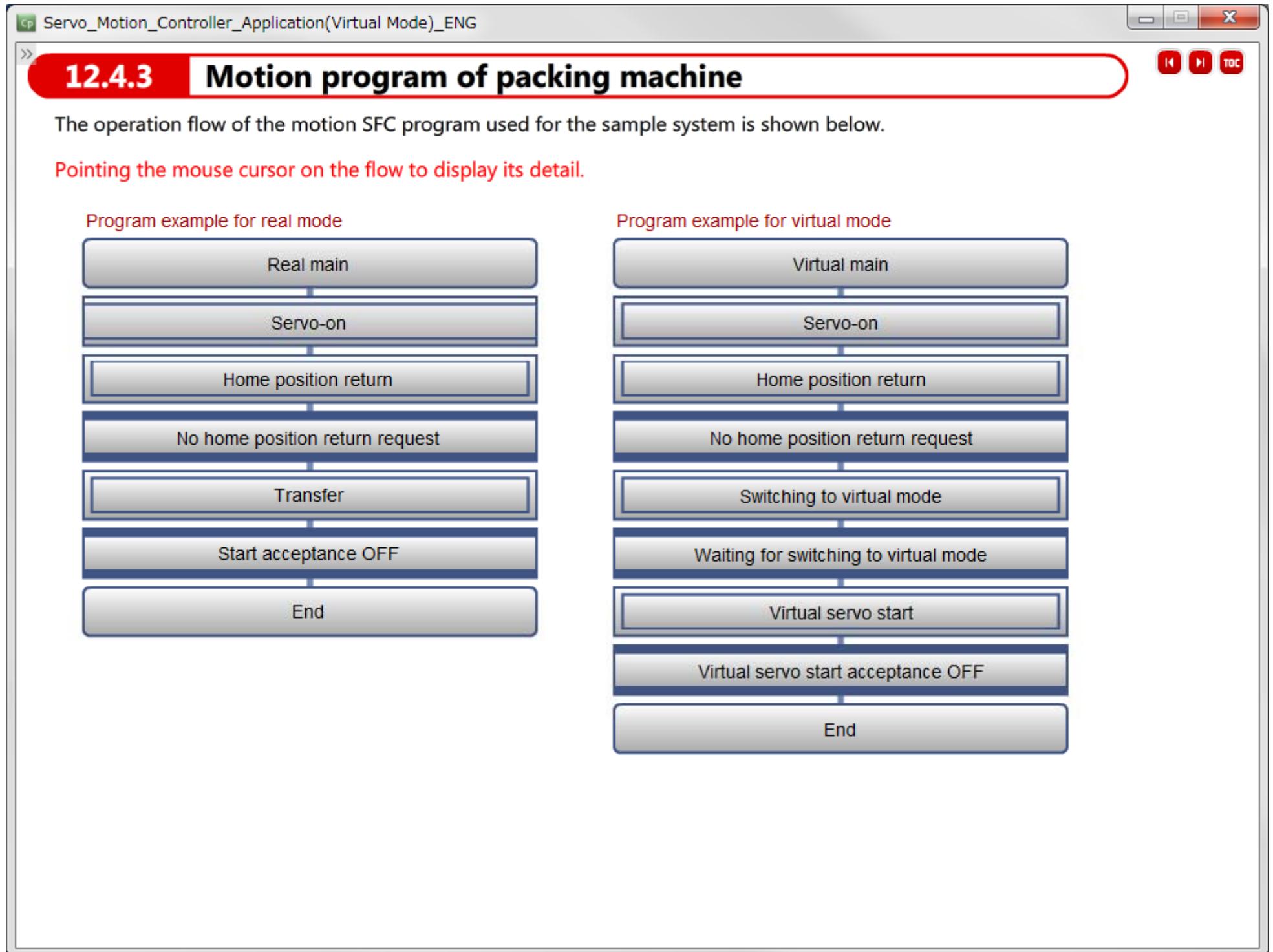


(Duration: 00:19)

## 12.4.2 Equipment configuration of the sample system for this course

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





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## 12.5 Summary

In this chapter, you have learned:

- Virtual mode
- Differences between real mode and virtual mode

### Important points

The contents you learned in this chapter are listed below.

Virtual mode	The virtual mode synchronizes the motors that were conventionally controlled mechanically, by the mechanical system program.
Procedure for switching to virtual mode	When switching from the real mode to the virtual mode, check if switching is possible.
Differences between real mode and virtual mode	The real mode directly controls individual axes. The virtual mode gives commands to the virtual servomotor and controls the axes by synchronizing them using the mechanical system program.

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## Chapter 13 MECHANICAL SYSTEM PROGRAM

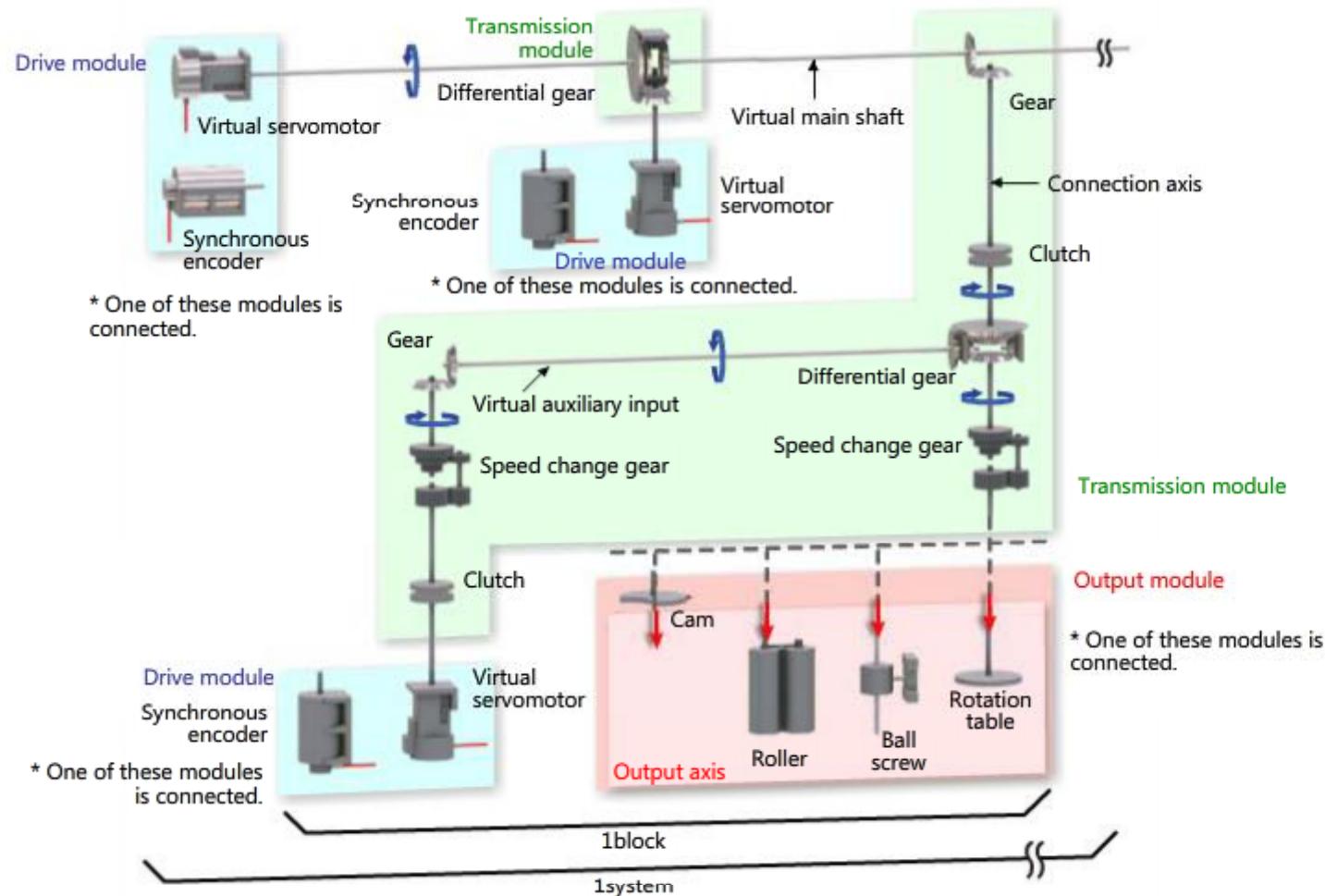
In this chapter, you will learn about the mechanical system program.

The mechanical system program uses mechanical modules including the virtual servomotor, synchronous encoder, gear, clutch, roller, and cam to perform synchronization control by software.

The diagram illustrates a mechanical system setup. At the top, a grey base structure contains several circular components highlighted with colored circles: orange, blue, green, purple, and red. These likely represent different types of sensors or actuators. Below the base, a network of shafts and couplings connects to a complex gear train. The gear train consists of multiple shafts with various gears, some featuring star patterns, indicating different rotational speeds or directions. The entire assembly is designed for synchronized motion control, as mentioned in the chapter title.

**13.1****Mechanical Module Connection Diagram**

The mechanical module connection diagram is a virtual system diagram in which the mechanical modules are arranged. The mechanical module connection diagram is shown below.



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## 13.2 Sample Window of Mechanical System

A sample window of mechanical system program used on the sample system in this course is shown below.

Pointing the mouse cursor on the module icon to display its explanation.

MELSOFT Series MT Developer2 C:\YMLSEC\le-learning\Packing Equipment - [Mechanical System page 01]

Project

- Packing Equipment (SV22)
  - System Setting
  - Servo Data Setting
  - Motion SFC Program
  - Servo Program
  - Mechanical System
  - Cam Data
  - Labels
  - Structured Data Types
  - Device Memory
  - Device Comment

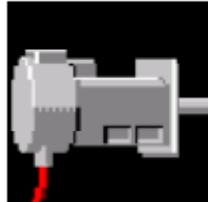
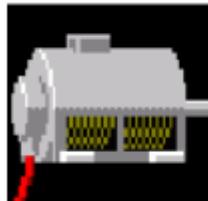
Mechanical System page ... Parameter Block System Structure Motion SFC 18:Addr data Motion SFC 15:Virtual cr

V.1 P1 Axis 1 Axis 2 Axis 3 V.2 Axis 4 Axis 5 Axis 6

Axis	Axis detail
1	Roller for the belt conveyor below the packing film roll
2	Rotary table for the packaging film roller
3	Rotary table for the belt conveyor before the cutting device
4	Ball screw for adjusting the cutting position
5	Cam which controls the operation of the cutting device
6	Roller for the belt conveyor after the cutting device

**13.3****Drive Module**

The drive modules are the driving power source of the virtual axes (virtual main shaft and virtual auxiliary input axis). The following two types of drive modules are available.

Mechanical module		Function	Refer to
Appearance	Name		
	Virtual servomotor	Used when driving the virtual axis of the mechanical system program by input pulse from the servo program and the JOG operation.	13.3.1
	Synchronous encoder	Used when driving the virtual axis by input pulses from an external synchronous encoder.	13.3.2

### 13.3.1 Virtual servomotor

The virtual servomotor is used when the virtual axis is driven by the servo program and the JOG operation.

When the virtual servomotor starts, it transmits pulses to the virtual axis according to the start condition (command speed and travel value).



\* The parameter values shown below are used for the sample system.

**Virtual servomotor**

Transmission module

Output module

Parameter item	Sample value
Virtual axis	1
Command in-position range	100[PLS]
Operation mode at error occurrence	Continue
Upper stroke limit value	0[PLS]
Lower stroke limit value	0[PLS]
JOG Operation-time Parameter	
Parameter block No.	2
JOG speed limit value	15000[PLS/s]

**<Setting details>**

Set the axis number specified by the servo program in the virtual mode.

**<Setting range>**

When using Q173DCPU: 1 to 32      When using Q172DCPU: 1 to 8

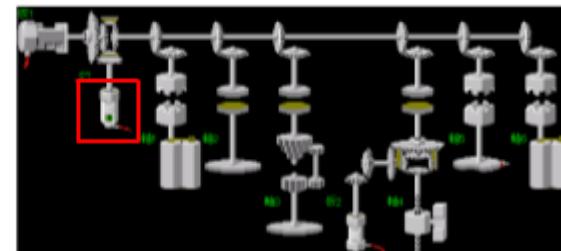
**<Setting example>**

Set this parameter item to "1" because the sample system uses the virtual axis 1.

## 13.3.2 Synchronous encoder

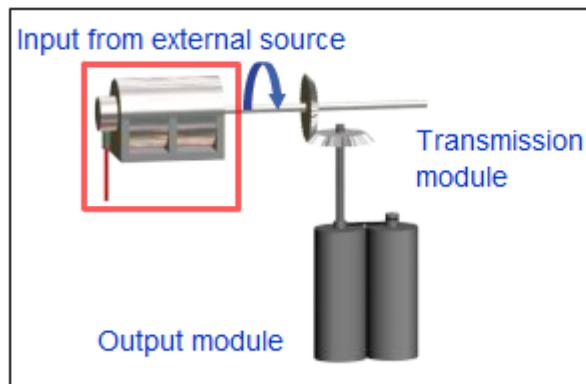
A synchronous encoder is used when driving the virtual axis by the input pulses from an external source.

\* Q172DEX or Q173DPX is required to use the synchronous encoder.



\* The parameter values shown below are used for the sample system.

Click each parameter item in the table to see its explanation.



Parameter item	Sample value
Synchronous encoder number	1
Using the existing encoder	No
Error-time operation mode	Continue

### <Setting details>

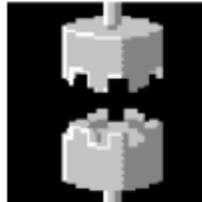
Set the synchronous encoder number defined on the system setting window.

### <Setting range>

### <Setting example>

## 13.4 Transmission Module

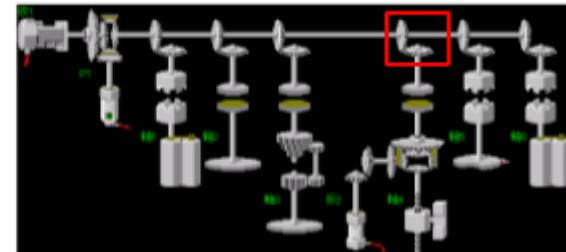
A transmission module transmits pulses from the drive module to the output module.  
The following four types of transmission modules are available.

Mechanical module		Function	Refer to
Appearance	Name		
	Gear	Used to change the rotation ratio or direction for the travel value (pulse) input from the drive module.	13.4.1
	Clutch	Used to transmit the rotation of the drive module to the output module and separate it from the output module.	13.4.2
	Speed change gear	Used to change the speed of the output module during operation.	13.4.3
	Differential gear	Used to shift the output module phase or to adjust the operation start position.	13.4.4

## 13.4.1 Gear

The gears are used to transmit the number of pulses, obtained by multiplying the number of pulses from the input axis by the gear ratio, to the output axis.

The gear ratio is calculated by dividing "Gear ratio input axis side tooth count" by "Gear ratio output axis side tooth count".



$$\text{Number of output axis pulses} = (\text{Number of input axis pulses}) \times (\text{Gear ratio) [PLS]})$$

Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample system.

Virtual servomotor

Input axis

Gear (gear ratio)

Output axis

**Input axis:**  
100[PLS]

**Output axis:**  
3000[PLS]

<Setting details>

Set the gear input axis side tooth count.

<Setting range>

1 to 65535

<Setting example>

Set this parameter to "30" because the axis 4 of the sample system multiplies the number of input pulses from the virtual servomotor by 30.

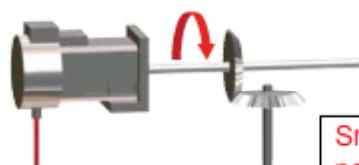
Parameter item	Sample value
Gear ratio input axis side tooth count	30
Gear ratio output axis side tooth count	1
Rotation direction	Forward

## 13.4.2 Clutch

A clutch transmits the command pulses from the input axis to the output module and cut them, and is used to control start and stop operations of the servomotor.

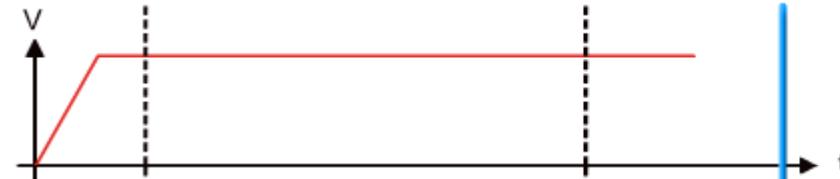
The two types of clutches, smoothing and direct clutches, are available. Either of them is used depending on whether or not acceleration/deceleration is required.

Acceleration/deceleration: required

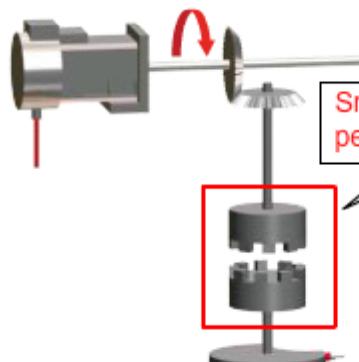


Virtual servomotor

Smoothing process:  
performed



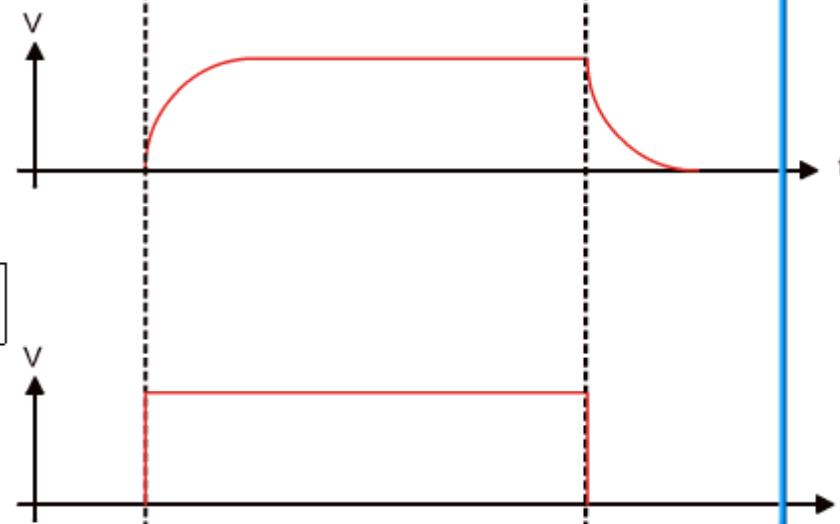
Acceleration/deceleration: not required



Smoothing clutch

Smoothing process:  
not performed

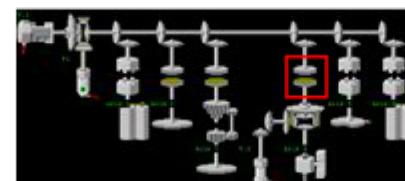
Direct clutch



## 13.4.2 Clutch

The clutch has the five different modes as below.

Operation mode	Description
ON/OFF mode	The clutch turns on when the clutch ON/OFF command device switches from OFF to ON. The clutch turns off when the clutch ON/OFF command device switches from ON to OFF.
Address mode	The clutch turns on when the clutch ON/OFF command device is ON and the clutch ON address is reached. The clutch turns off when the clutch ON/OFF command device is OFF and the clutch OFF address is reached.
Address mode 2	While the clutch ON/OFF command device is ON, the clutch turns on and off according to the clutch ON/OFF address. The clutch turns off when the clutch ON/OFF command device switches from ON to OFF.
One-shot mode	When the clutch ON/OFF command device switches from OFF to ON, the clutch turns on after moving for a specified travel amount, and then it turns off after moving for a specified travel amount.
External input mode	This mode is used only for the axis set the incremental synchronous encoder (manual pulse generator) as the drive module. The clutch turns on/off according to the clutch ON/OFF command device and external input (TREN signal: Synchronous encoder start signal).



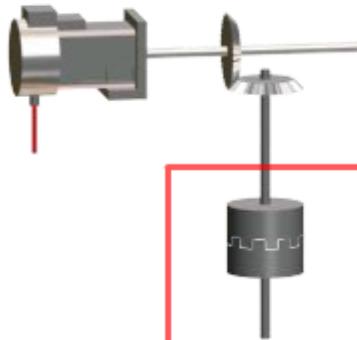
Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample



Parameter item	Sample value
Clutch ON/OFF command device	M7004
Clutch status device	M7014

## 13.4.2 Clutch



Parameter item	Sample value
Clutch ON/OFF command device	M7004
Clutch status device	M7014
Clutch type	Smoothing clutch
Smoothing clutch method	Time-constant system
Smoothing time constant	30[ms]
Slippage setting device	
Slippage in-position range setting device	
Slippage system	Exponential function
Smoothing clutch complete signal device	
Operation mode	ON/OFF mode, address mode and one-shot
Mode setting device	D7040
ON address setting device	D7042
OFF address setting device	D7044
Address mode clutch control system	Current value within 1

### <Setting details>

Specify the device for clutch on/off command.

### <Setting range>

X0000 to X1FFF  
Y0000 to Y1FFF  
M0 to M8191 (\*1)  
F0 to F2047

## 13.4.2 Clutch

U3E0G10000.0 to U3E0G17167.F (\*2)

U3E1G10000.0 to U3E1G17167.F (\*2)

Label and structure name registered as bit device

(\*1) The device area of the virtual servomotor axis status and command signal not used in mechanical system program be used by the user.

(\*2) The available multiple CPU sharing device range varies depending on the multiple CPU high speed transmission area setting.

### <Setting example>

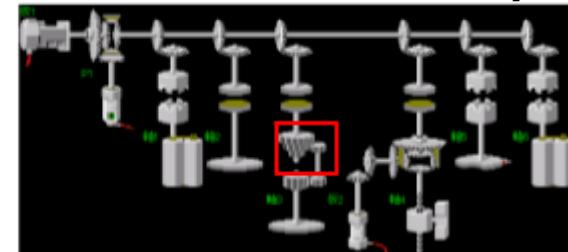
Set this parameter to "M7004" for the sample system.

### 13.4.3 Speed change gear

A speed change gear is used to change the rotation speed and travel value for the output module during operation.

The speed transmitted to output axis is calculated by multiplying the speed at input axis by a speed change ratio set to the speed change ratio setting device.

$$\text{Output axis speed} = (\text{Input axis speed}) \times \frac{(\text{Speed change ratio}) *}{1000} \quad [\text{PLS/s}]$$

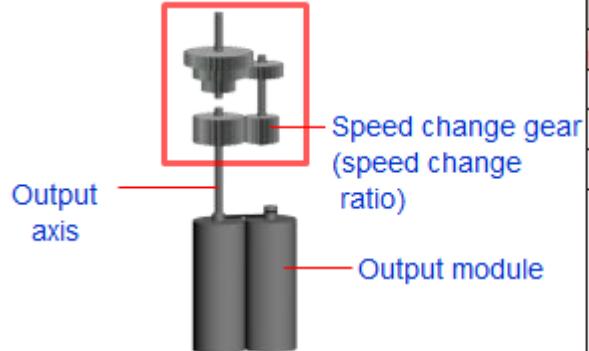


\* 0 to 65535

Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample system.

	Parameter item	Sample value
Speed change ratio upper limit value	65535	
Speed change ratio lower limit value	1	
Speed change ratio setting device	D7036	
Smoothing time constant	0[ms]	



#### <Setting details>

Set the upper limit of the speed change ratio.

When the value from the speed change ratio setting device exceeds this limit, the speed change gear is controlled by the limit value.

#### <Setting range>

Set this value by multiplying 0.00 to 655.35[%] by 100 (0 to 65535).

### 13.4.3 Speed change gear

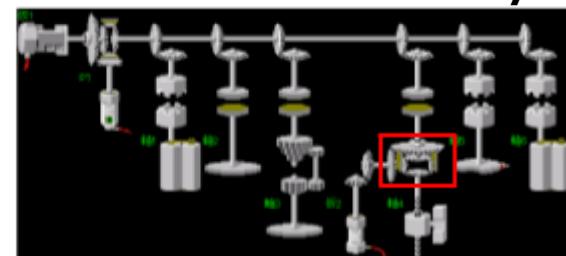
<Setting example>

Set this parameter to "65535" for the sample system.

## 13.4.4 Differential gear

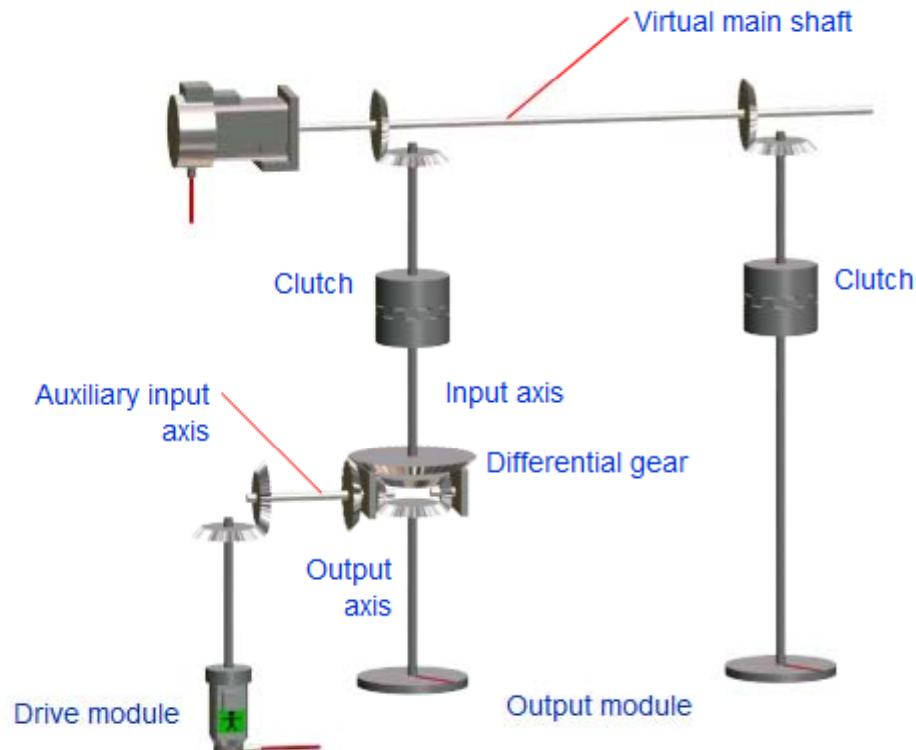
A differential gear subtracts the travel value of the auxiliary input axis from the travel value of the input axis and then transmits the result to the output axis.

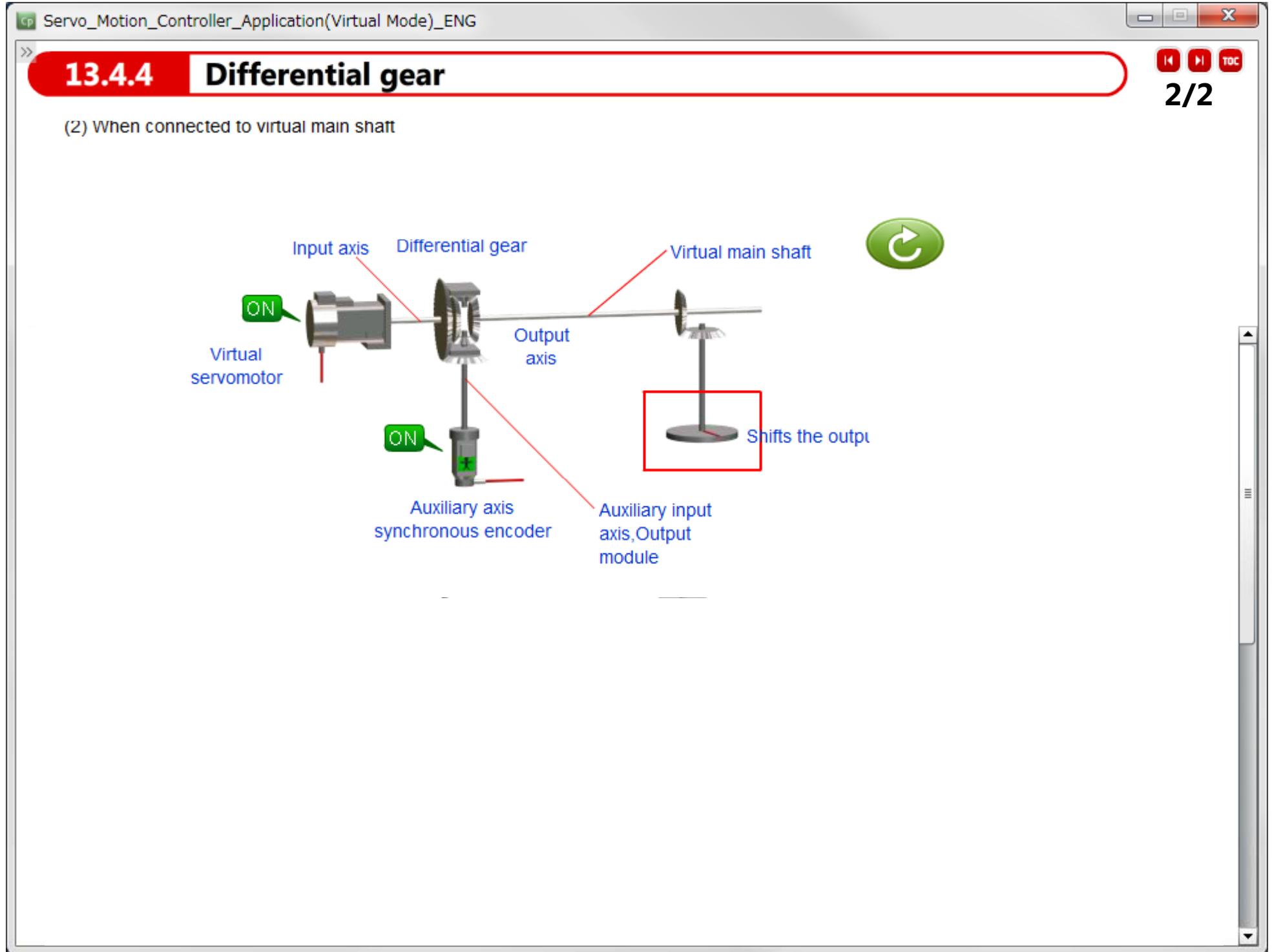
The auxiliary axis of the differential gear has the rotation direction, and it is set to reverse direction by default.



$$\text{Output axis travel value} = (\text{Input axis travel value}) - (\text{Auxiliary input axis travel value}) \text{ [PLS/s]}$$

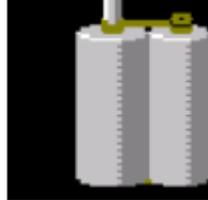
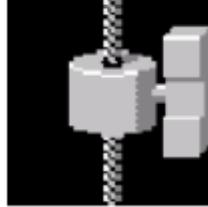
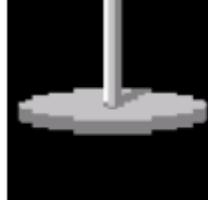
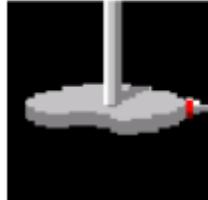
(1) When shifting the output module phase or adjusting the operation start position





## 13.5 Output Module

An output module controls machines. There are four types of output modules listed as below.

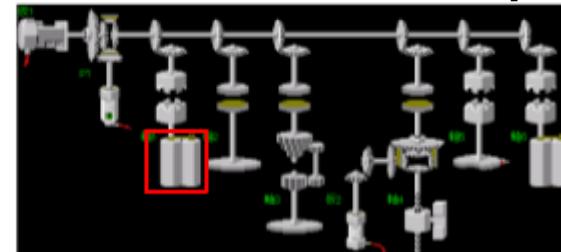
Mechanical module		Function	Refer to
Appearance	Name		
	Roller	Used to control the speed of a machine connected to the servomotor.	13.5.1
	Ball screw	Used to linearly move a machine connected to the servomotor.	13.5.2
	Rotary table	Used to rotationally move a machine connected to the servomotor.	13.5.3
	Cam	Used to move a machine connected to the servomotor according to a defined cam pattern.	13.5.4

## 13.5.1 Roller

A roller is used in the following cases:

- To continuously operate a machine connected to the servomotor
- To use a system which does not require position control

The roller is controlled by the speed and the travel value calculated as below.

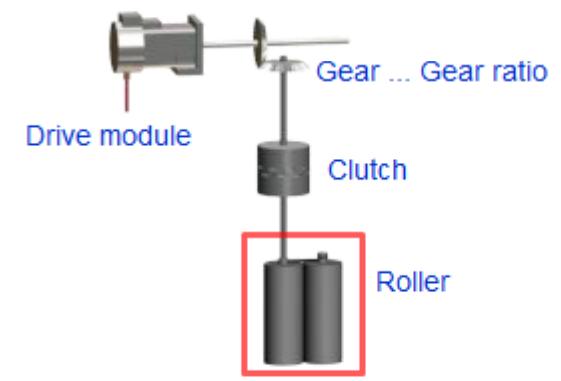


$$\text{Roller speed} = (\text{Drive module speed [PLS/s]} \times (\text{Gear ratio}) \times (\text{Speed change ratio}) [\text{PLS/s}])$$

$$\text{Roller travel value} = (\text{Drive travel value [PLS]} \times (\text{Gear ratio}) \times (\text{Speed change ratio}) [\text{PLS}])$$

Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample system.



Drive module      Gear ... Gear ratio  
Clutch      Roller

	Sample value
Output axis No.	1
Comment	
Roller diameter	95493.0[μm]
Number of pulses per revolution	262144[PLS]
Travel value per pulse	1.1[μm]
Permissible droop pulse value	6553500[PLS]
Converted value	7499888.2[μm]
Speed limit value	1800000.00[mm/min]
Unit of output	mm
Torque limit	300%
Phase compensation	Not set

**<Setting details>**  
Specify the axis number defined on the system setting screen.

**<Setting range>**  
When using Q173DCPU: 1 to 32    When using Q172DCPU: 1 to 8

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13.5.1 **Roller**

>>

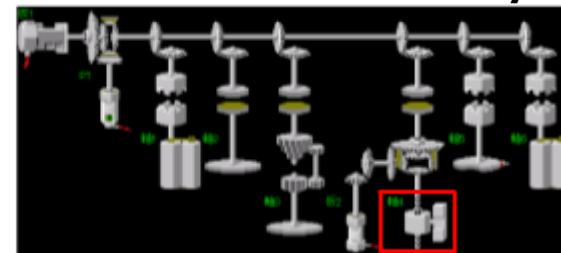
**2/2**

[\*\*<Setting example>\*\*](#)

Set this parameter to "1" because the sample system uses No. 1.

## 13.5.2 Ball screw

A ball screw is used to linearly move a machine connected to the servomotor. The ball screw is controlled at the speed calculated by multiplying the speed and travel value from the drive module by the gear ratio from the transfer module, and the resulting travel value is output.



$$\text{Ball screw speed} = (\text{Drive module speed [PLS/s]} \times \text{Gear ratio}) \times [\text{PLS/s}]$$

$$\text{Ball screw travel value} = (\text{Drive travel value [PLS]} \times \text{Gear ratio}) [\text{PLS}]$$

Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample system.

Parameter item	Sample value
Output axis No.	4
Comment	
Ball screw pitch	10000.0[μm]
Number of pulses per revolution	262144[PLS]
Travel value per pulse	0.0[μm]
Permissible droop pulse value	6553500[PLS]
Converted value	249996.1[μm]
Speed limit value	60000.00[mm/min]
Unit of output	mm
Torque limit	300%
Upper stroke limit value	214748364.7[μm]
Lower stroke limit value	-214748364.8[μm]
Phase compensation	Not set

**<Setting details>**  
Specify the axis number defined on the system setting screen.

**<Setting range>**

## 13.5.2 Ball screw

### <Setting range>

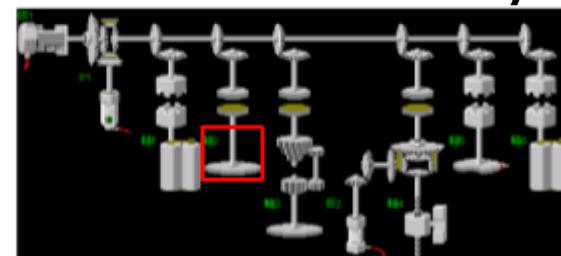
When using Q173DCPU: 1 to 32    When using Q172DCPU: 1 to 8

### <Setting example>

Set this parameter to "4" because the sample system uses No. 4.

### 13.5.3 Rotary table

The rotary table is controlled by the speed and the travel value calculated as below.



$$\text{Rotary table speed} = (\text{Drive module speed [PLS/s]} \times (\text{Gear ratio}) \times [\text{PLS/s}])$$

$$\text{Rotary table travel value} = (\text{Drive travel value}) \times (\text{Gear ratio}) [\text{PLS}]$$

Click each parameter item in the table to see its explanation.

\* The parameter values shown below are used for the sample system.

Parameter item	Sample value
Output axis No.	2
Comment	
Number of pulses per revolution	26214[PLS]
Travel value per pulse	0.01373[deree]
Permissible droop pulse value	6553500[PLS]
Converted value	90000.00000[degree]
Speed limit value	1080000.000
Torque limit	300%
Upper stroke limit value	0.00000[degree]
Lower stroke limit value	0.00000[degree]
Current value within 1 virtual axis revolution storage	
Main shaft side	D7020
Auxiliary input axis side	
Phase compensation	Not set

**<Setting details>**  
Specify the axis number defined on the system setting screen.

### 13.5.3 Rotary table

2/2

<Setting range>

When using Q173DCPU: 1 to 32      When using Q172DCPU: 1 to 8

<Setting example>

Set this parameter to "2" because the sample system uses No. 2.

## 13.5.4 Cam

1/2

A cam is used to move a machine connected to the servomotor according to a defined cam pattern.

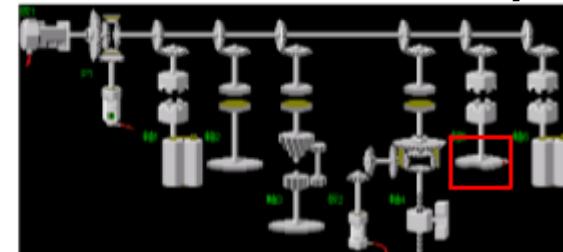
The cam makes one revolution with the number of pulses per one cam axis revolution.

For an axis with the cam specified as the output module, the ball screw can also be used to perform the same operation as the cam does, as animated below.

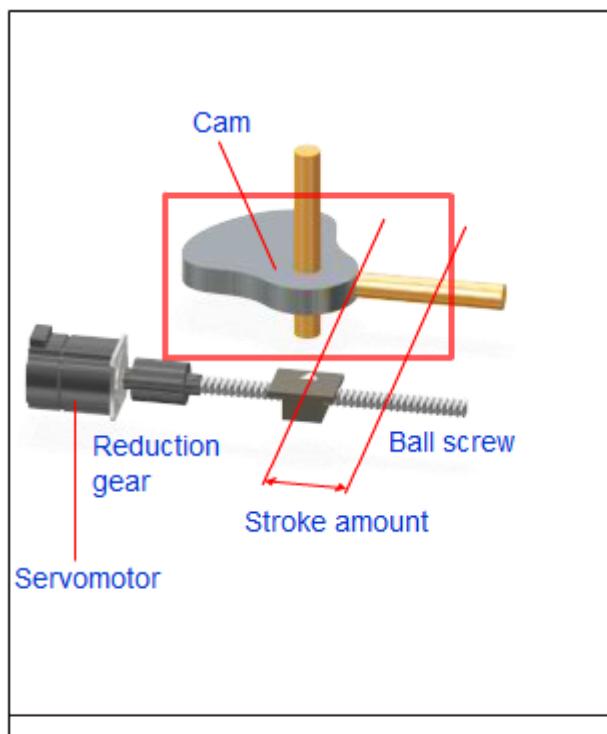
The following two types of data are required to use the cam:

- Cam data (refer to Chapter 14 for details.)
- Output module parameters

Click each parameter item in the table to see its explanation.



\* The parameter values shown below are used for the sample system.



Parameter item	Sample value
Output axis No.	5
Comment	
Cam number setting device	D7056
Number of pulses per revolution	2621440[PLS]
Permissible droop pulse value	6553500[PLS]
Stroke amount setting device	D7058
Lower stroke limit value storage device	D7060
Cam or ball screw switching device	
Unit of output	mm
Torque limit	300%
Current value within 1 virtual axis revolution storage device	
Main shaft side	D7062
Auxiliary input axis side	
Phase compensation	Not set

<Setting details>

Specify the axis number defined on the system setting screen.

## 13.5.4 Cam

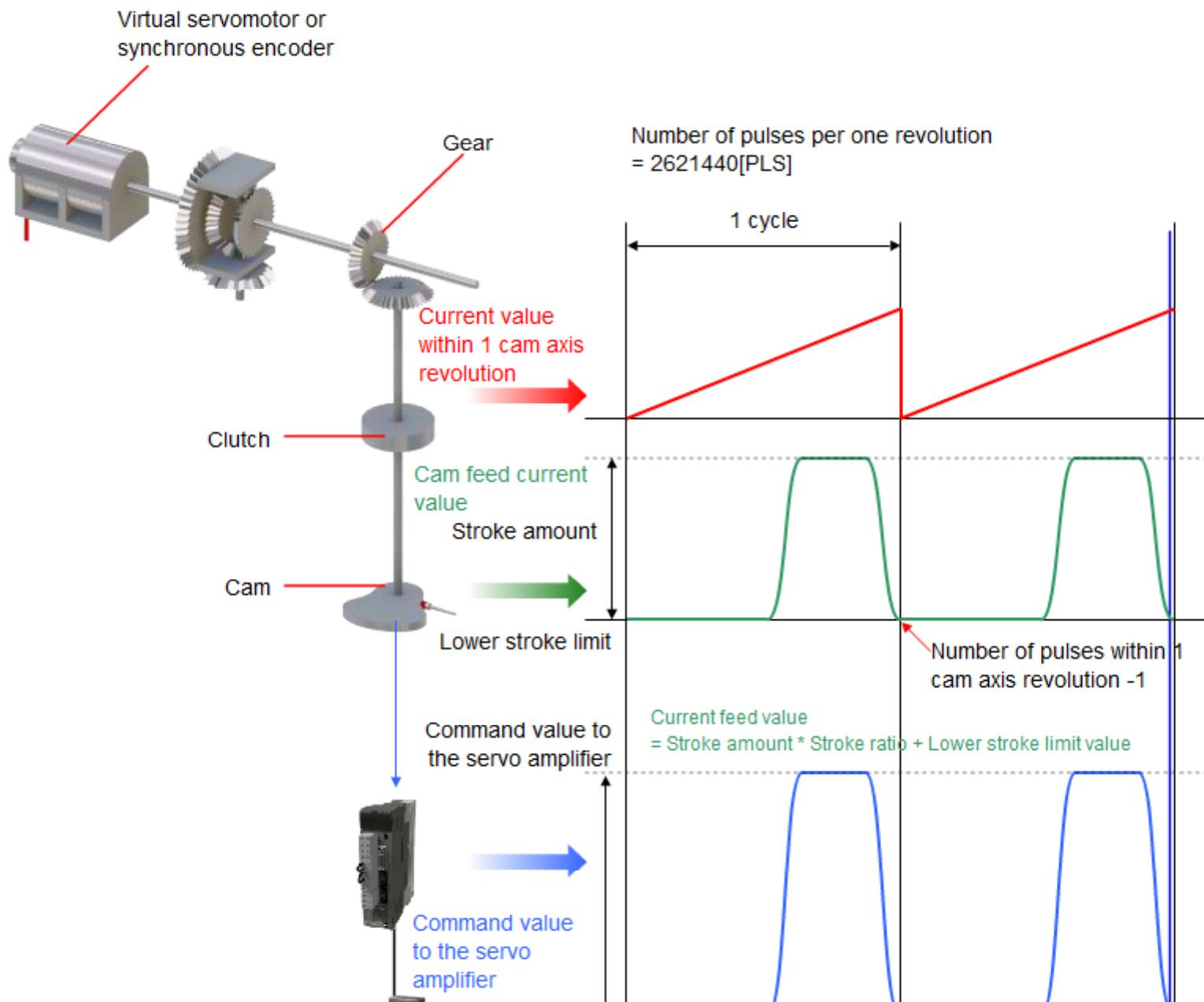
2/2

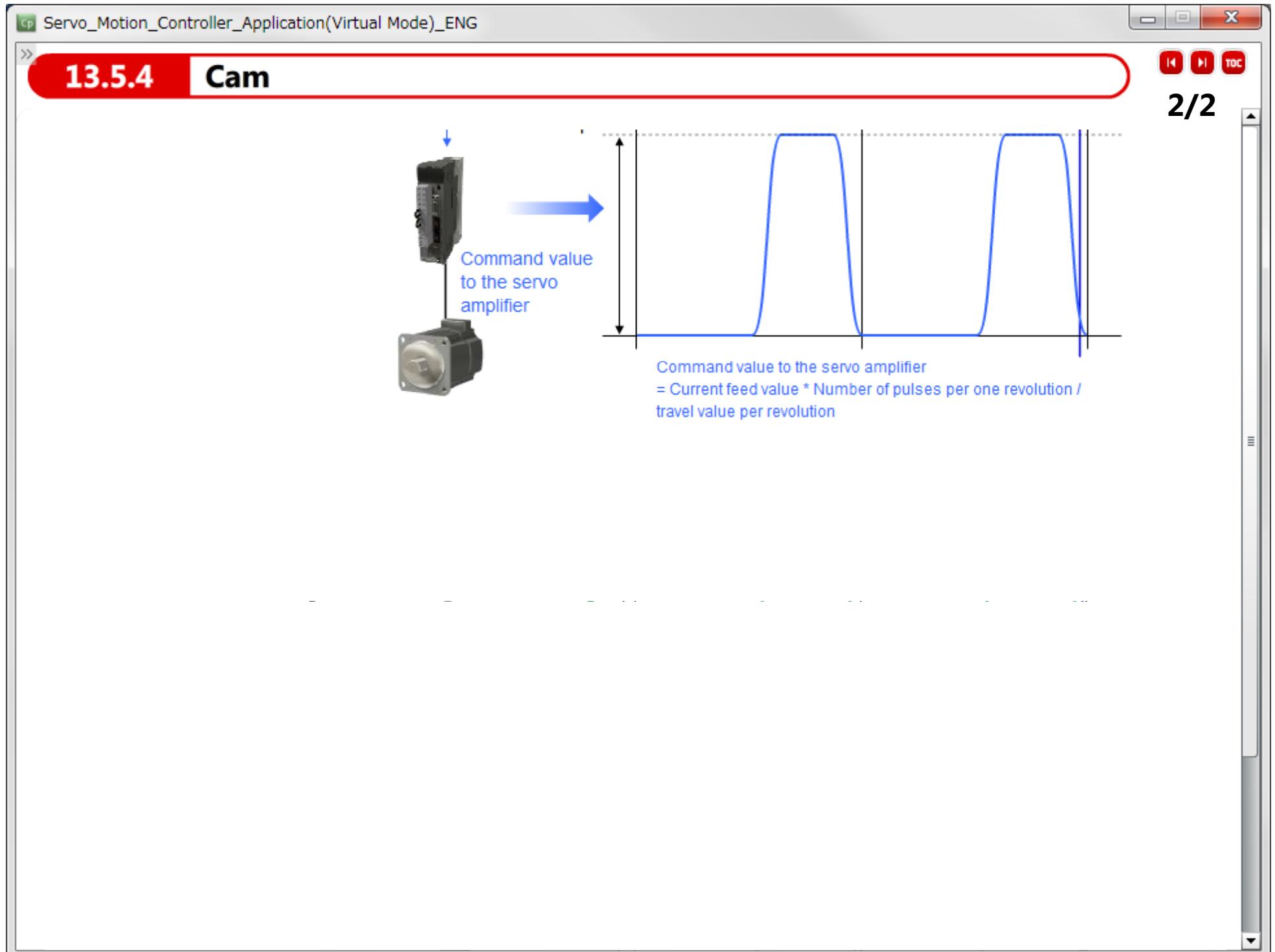
<Setting range>

When using Q173DCPU: 1 to 32    When using Q172DCPU: 1 to 8

<Setting example>

Set this parameter to "5" because the sample system uses No. 5.

**13.5.4 Cam**



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## 13.6 Summary

In this chapter, you have learned:

- Mechanical module connection diagram
- Mechanical system program
- Mechanical module
- Drive module
- Transmission module
- Output module

**Important points**

The contents you learned in this chapter are listed below.

Mechanical module connection diagram	A virtual system diagram with the mechanical modules arranged properly
Mechanical system program	A program that performs synchronization control by software in the same way as by hardware
Mechanical module	A functional module illustrated in the mechanical module connection diagram
Drive module	The driving power source of the virtual axes (virtual main shaft and virtual auxiliary input axis)
Transmission module	transmits pulses from the drive module to the output module.
Output module	The travel value of the servomotor is controlled by the command pulse from the output module.

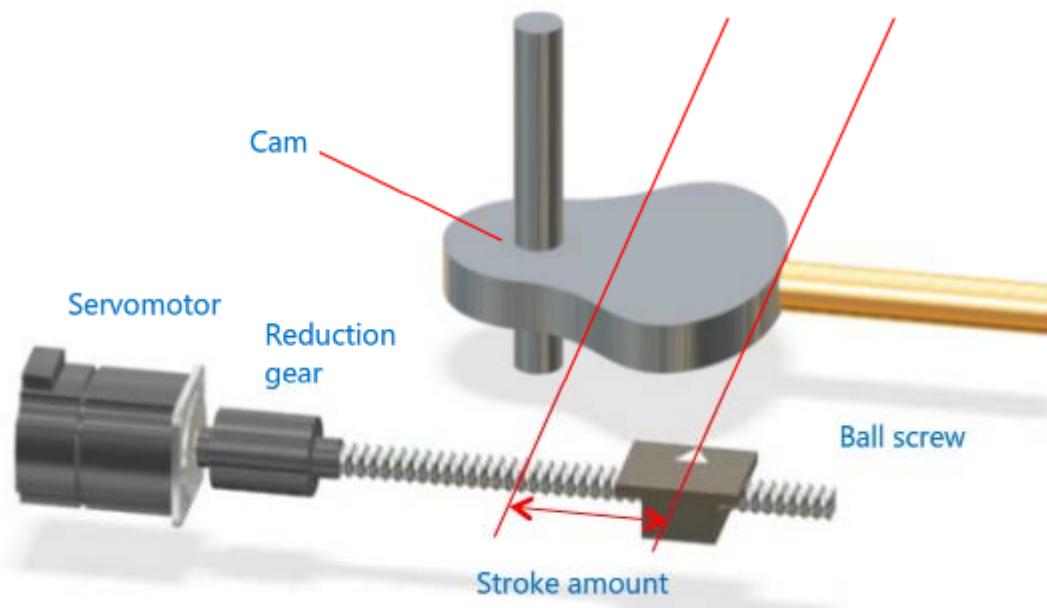
## Chapter 14 CAM DATA CREATION

In this chapter, you will learn how to create cam data.

Cam data is used by the cam, an output module of the mechanical module.

The items to be set for creating cam data are listed below.

Items to be set	Initial value	Setting range
Cam No.	-	Refer to the next section.
Resolution	256	256, 512, 1024, 2048
Stroke amount switching position	0	0 to (resolution -1)
Operation mode	Two-way cam mode	<ul style="list-style-type: none"><li>• Two-way cam mode</li><li>• Feed cam mode</li></ul>
Cam data table	0	0 ~ 32767



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## 14.1 Cam No.

The cam number is the number assigned to the created cam data.

Assign a number from 1 to 64 for each machine name.

The cam data number is determined according to the order in which the machine names are registered during conversion by the mechanical system program, and is used with an offset value as shown below.

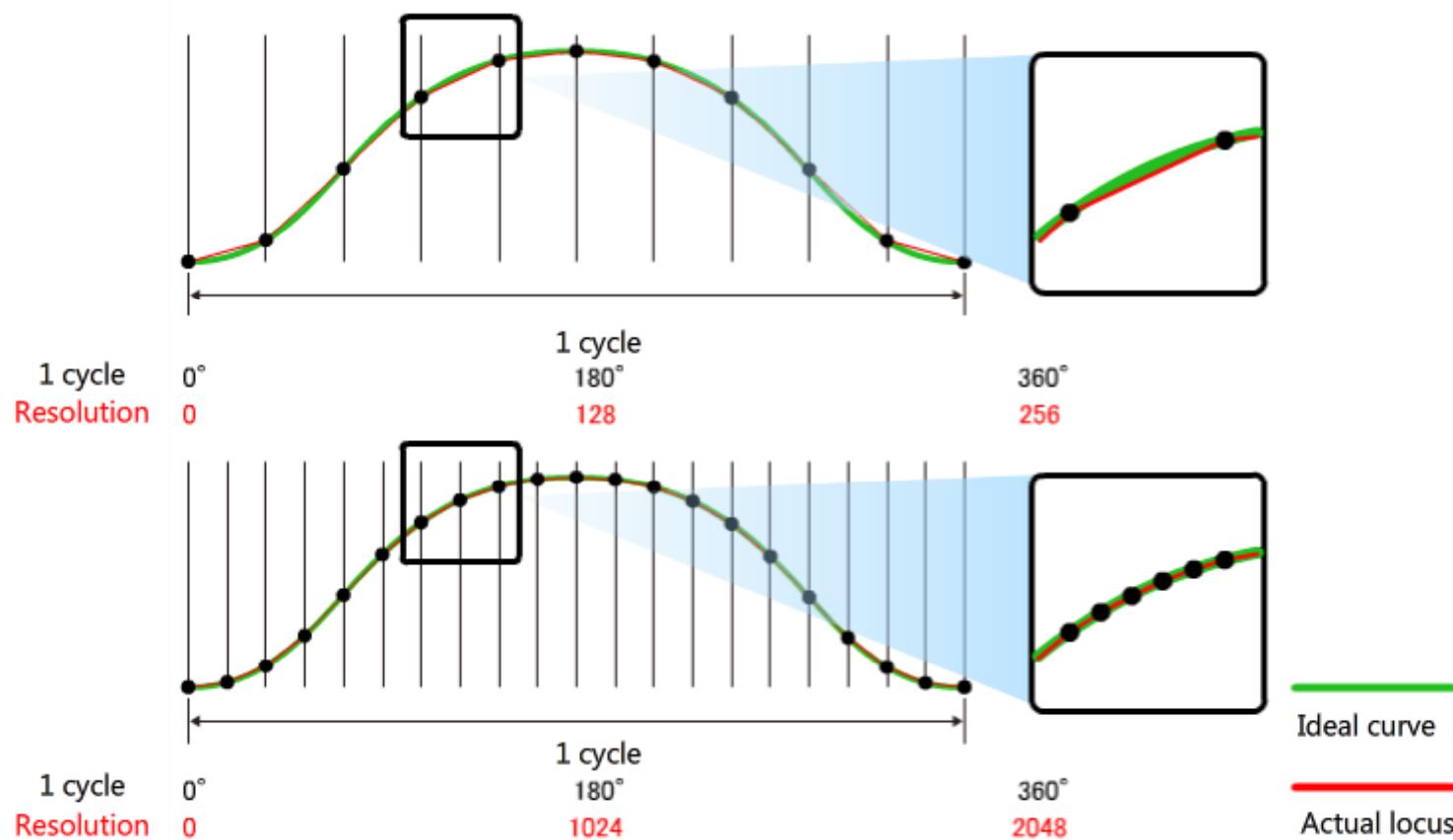
When setting the cam number of cam data used for the cam number setting device in the motion SFC program, use the number with this offset value.

The screenshot shows a 'Cam Data Setting' dialog box on the left and a table on the right. The dialog box has a title bar 'Cam Data Setting', a text input field 'Enter the machine name for Cam Data Setting.', and four dropdown menus. The first dropdown contains 'CUTTER-CAM'. Below the dialog are two buttons: 'OK' and 'Cancel'. Red arrows point from each of the four dropdown menus in the dialog to the corresponding row in the table. The table has two columns: 'Order of machine names' and 'Cam No. setting'. The rows are:

Order of machine names	Cam No. setting
1	1 ~ 26
2	101 ~ 164
3	201 ~ 264
4	301 ~ 364

**14.2****Resolution**

Resolution is the number of segments into which a cam curve for a single cycle is divided for control. A higher resolution acquires more sampling data to allow for control closer to the cam curve.



The following conditions shall be satisfied to make sure that all the points data of resolution are output.

- Number of pulses per cam revolution ( $N_c$ )  $\geq$  Resolution
- Time required per cam revolution  $\geq$  Operation cycle  $\times$  Resolution

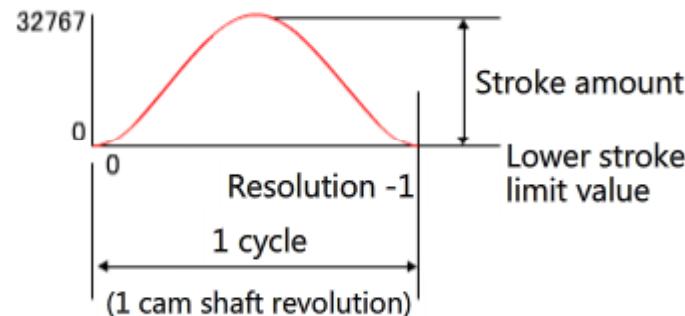
**14.3****Operation Modes**

Two-way cam mode and feed cam mode are available for control cam data.

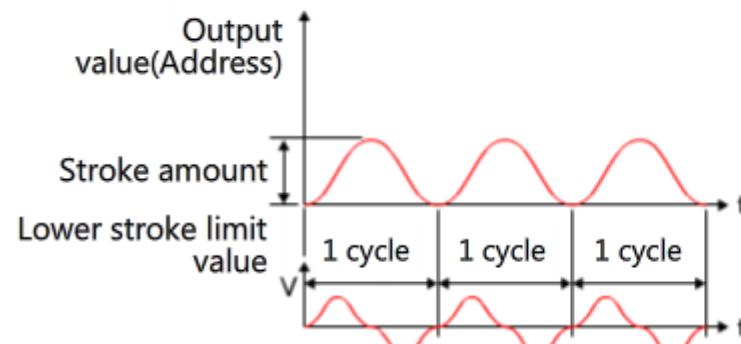
### Two-way cam mode

A two-way operation is repeated within the range of the stroke amount.

#### Cam pattern



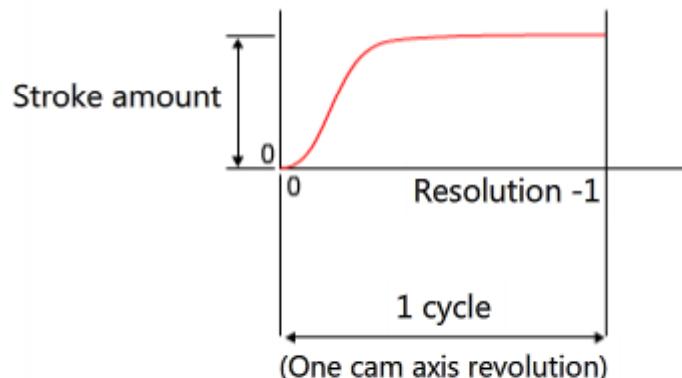
#### Sample operation



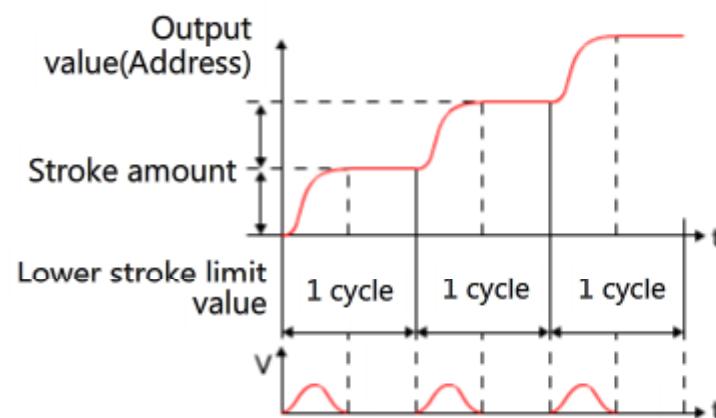
### Feed cam mode

Feeds for the specified stroke amount in a single cycle in a single direction for positioning starting from the lower stroke limit value.

#### Cam pattern



#### Sample operation



Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 14.4 Cam Data Table

The cam data table defines the stroke ratio for each point of the defined resolution. The stroke ratio is the value represented with the maximum value of the cam curve as 100%.

MT Developer2 automatically generates the cam data table when the cam curve is created.

A graph illustrating a cam curve. The vertical axis is labeled "Output value(Address)" with markings at 0, 100%, and 0%. The horizontal axis is labeled "t" and has a marking at 0%. A red curve starts at the origin (0,0), rises to a peak labeled "Cam curve", falls, and then drops sharply towards the x-axis. A dashed horizontal line extends from the peak of the curve to the x-axis, defining the "Stroke amount". A dashed vertical line extends from the peak of the curve to the y-axis, defining the "Stroke ratio". The minimum value on the y-axis is labeled "Lower stroke limit value (lower dead point)". The time interval from the start to the end of one full cycle is labeled "1 cycle".

Based on the current value within one cam axis revolution, a value calculated using the stroke ratio in the cam data table is output.

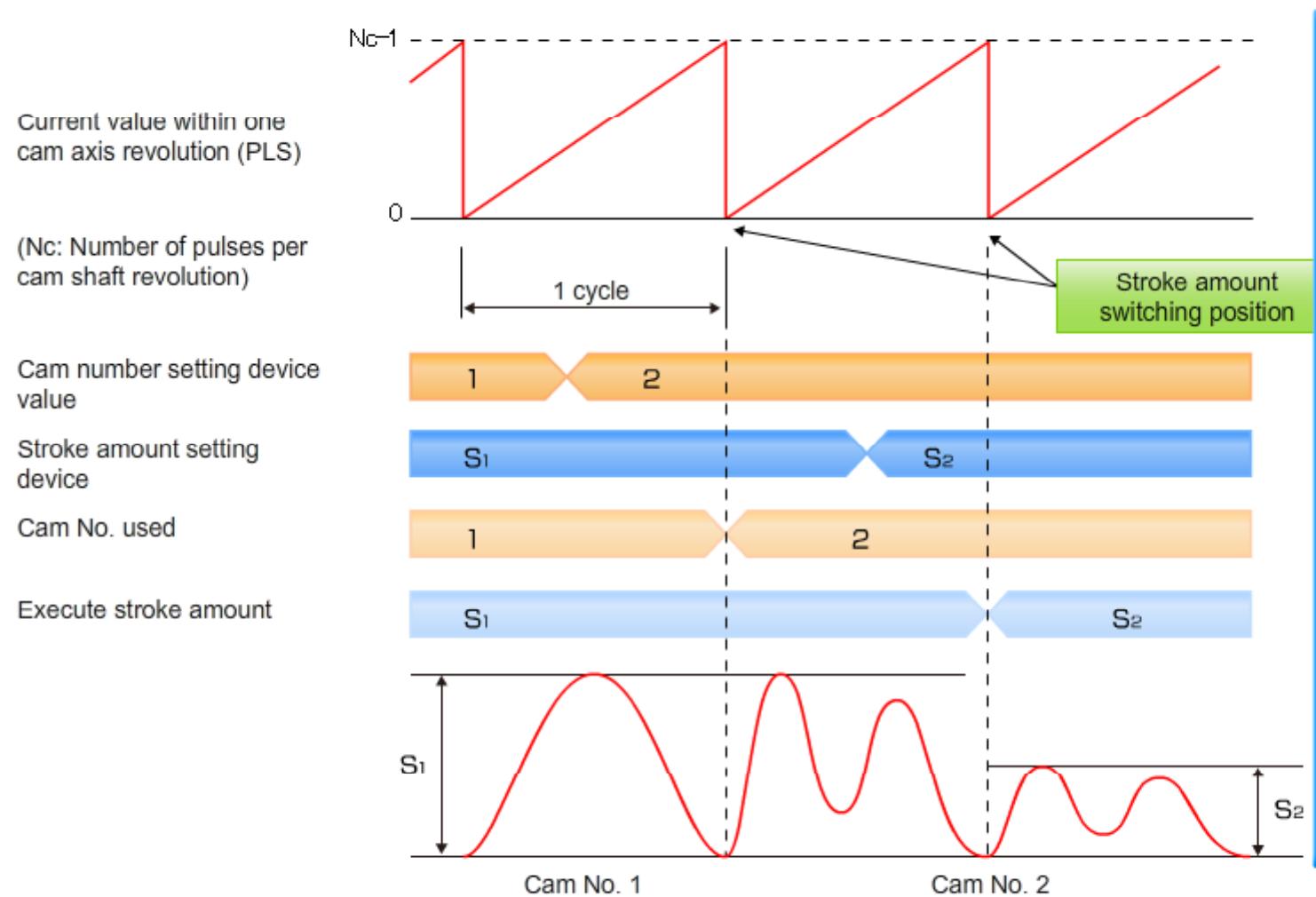
$$\text{Current feed value} = \text{Lower stroke limit value} + \text{Stroke amount} \times \text{Stroke ratio}$$

**14.5****Stroke Amount Switching Position**

This setting is used to switch the cam number and stroke amount during operation.

When the specified switching position [0 to (resolution -1)] is passed, if the stroke amount and cam number are correct, the program switches to the specified cam number and stroke amount.

(Example) When the stroke amount switching position is set to 0, cam No. 1 and No. 2, and stroke amounts S1 and S2 are switched as shown below.<sup>11</sup>



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## 14.6 Summary

In this chapter, you have learned:

- Cam data
- Cam No.
- Resolution
- Stroke amount switching position
- Operation mode
- Cam data table

**Important points**

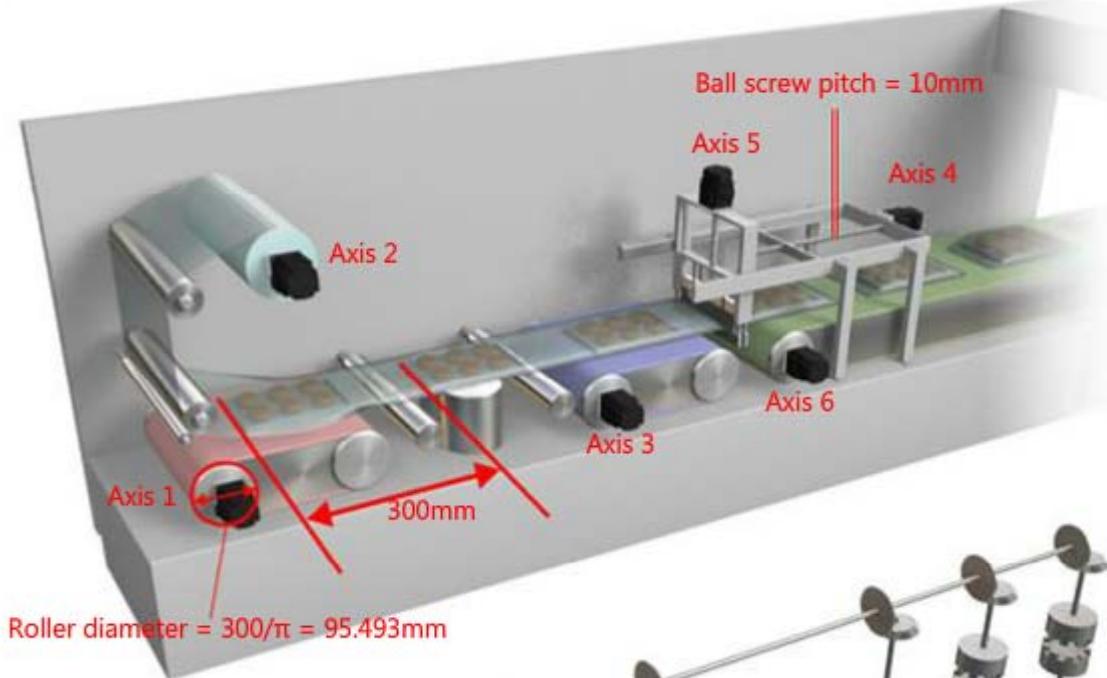
The contents you learned in this chapter are listed below.

Cam data	Settings used for the cam of the mechanical module.
Cam No.	Number assigned to the cam data.
Resolution	Number of segments into which a cam curve for a single cycle is divided for control.
Stroke amount switching position	Setting used to switch the cam number and stroke amount during operation.
Operation mode	Two-way cam mode and feed cam mode are available for control cam data.
Cam data table	Setting of the stroke ratio for each point of defined resolution.

## Chapter 15 Exercise

In this chapter, you will learn about the creation of the mechanical system program and cam data, and also about monitoring the program operation.

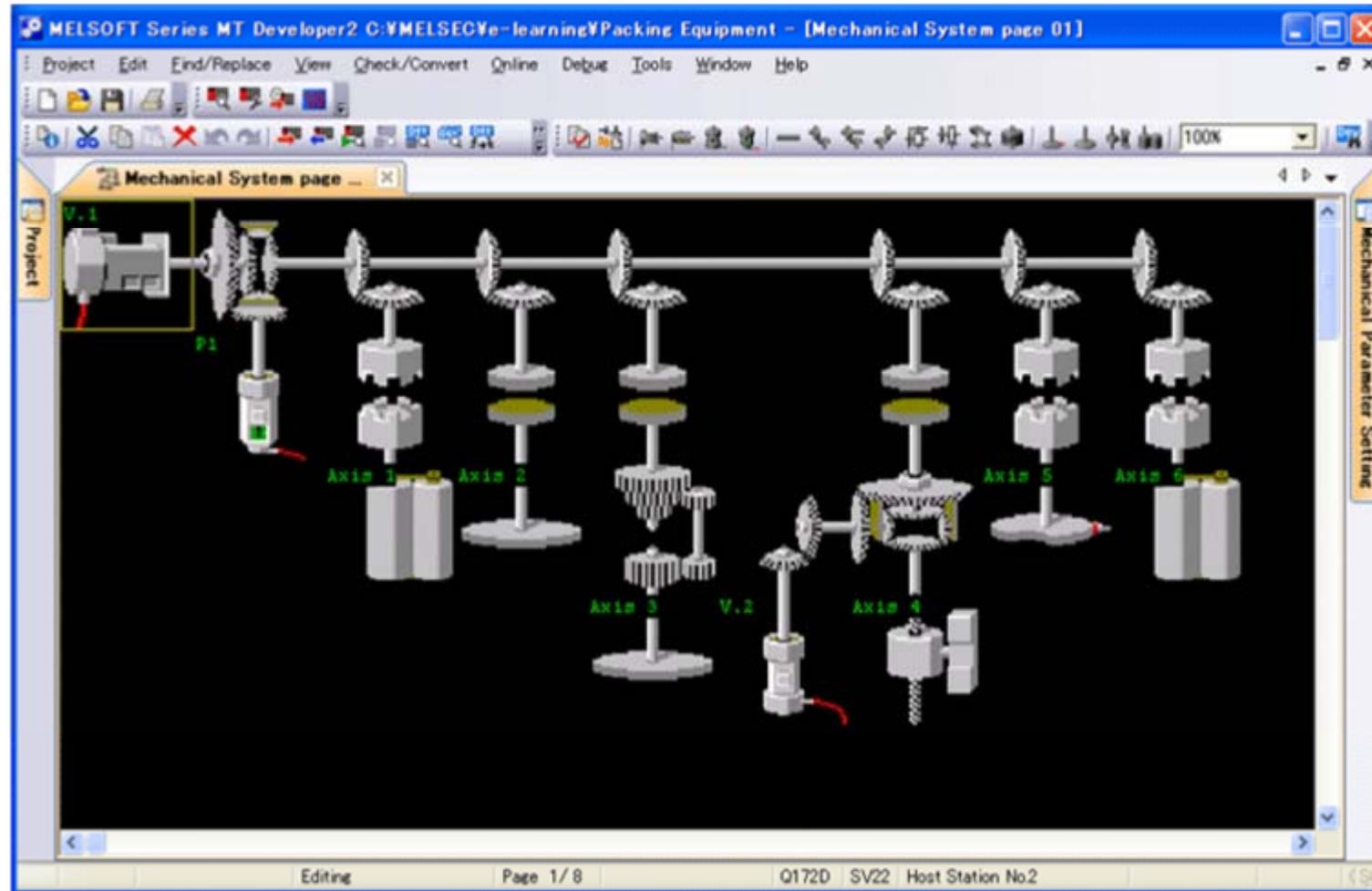
The sample system handles the packaging machine of the system used in the "SERVO MOTION CONTROLLER BASICS (HARDWARE)" course and the "SERVO MOTION CONTROLLER BASICS (REAL MODE: SFC)" course.



**15.1****Mechanical System Program**

Learn how to create the mechanical system program using the system for the exercise.

Let's set a system configuration in the next screen.



Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 15.1 Mechanical System Program

MELSOFT Series MT Developer2 C:\MELSEC\learning\Packing Equipment - [Mechanical System page 01]

Project Edit Find/Replace View Check/Convert Online Debug Tools Window Help

Mechanical System page ...

Mechanical Parameter Setting

Roller

Parameter Item	Setting Value
Output Axis No.	6
Comment	
Roller Diameter	95493.0[μm]
Number of Pulses per Revolution	262144[PLS]
Number of Pulses per Revolution	1.1[μm]
Permissible Droop Pulse	6553500[PLS]
Converted Value	7499888.2[μm]
Speed Limit Value	60000.00[mm/min]
Output Unit	mm
+ Torque Limit	300%
+ Phase Compensation	Not Set

Speed Limit Value

Set other parameters in the same procedure.

Click and go to the next screen.

0.01 to 0000000.00

Editing Page 1 / 8 Q172D SV22 Host Station No.2

The screenshot shows the MELSOFT Series MT Developer2 software interface for configuring a mechanical system. The main window displays a 3D model of a mechanical assembly with six axes labeled Axis 1 through Axis 6. The assembly consists of various shafts, couplings, and pulleys. A virtual axis is also present. On the right side of the screen, a 'Mechanical Parameter Setting' dialog box is open for the 'Roller' component. This dialog lists several parameters with their current values: Output Axis No. (6), Roller Diameter (95493.0[μm]), Number of Pulses per Revolution (262144[PLS]), Permissible Droop Pulse (6553500[PLS]), Converted Value (7499888.2[μm]), Speed Limit Value (60000.00[mm/min]), and Output Unit (mm). The Speed Limit Value is highlighted with a yellow box. Below the dialog, a message prompts the user to set other parameters in the same procedure and provides instructions for navigating to the next screen. The bottom status bar shows the page number (1 / 8), host station information (Q172D SV22 Host Station No.2), and a date/time stamp (0.01 to 0000000.00).

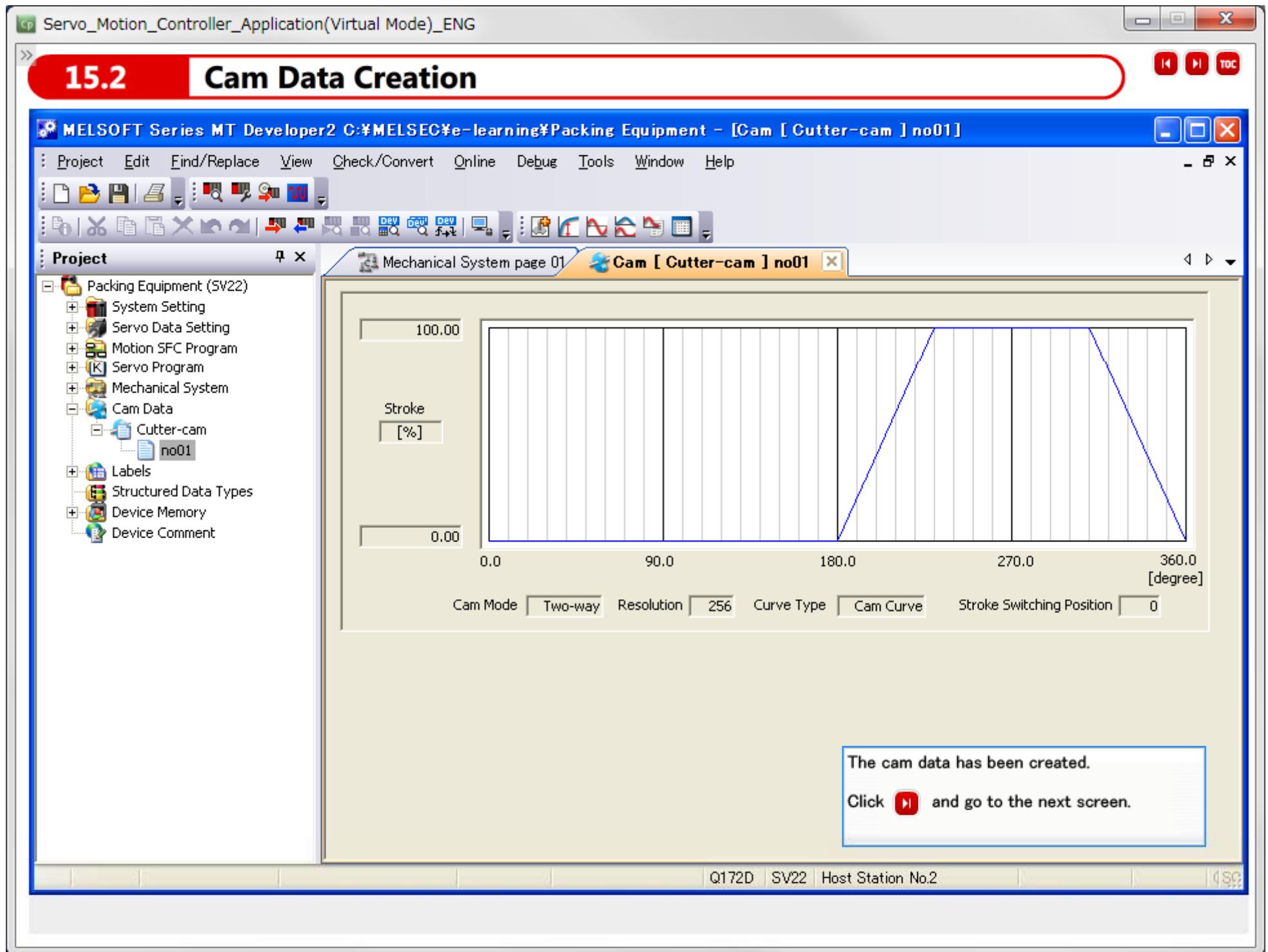
Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 15.2 Cam Data Creation

Now we learn how to create cam data using the cam of the mechanical system program created in the section 15.1.2.

Create the cam data in the next page using the actual window.

The screenshot shows the MELSOFT Series MT Developer software interface. The title bar reads "MELSOFT Series MT Developer2 C:\MELSEC\le-learning\Packing Equipment - [Cam [Cutter-cam] no01]". The menu bar includes Project, Edit, Find/Replace, View, Check/Convert, Online, Debug, Tools, Window, and Help. The toolbar has various icons for file operations. The left sidebar is titled "Project" and lists "Packing Equipment (SV22)" with sub-items: System Setting, Servo Data Setting, Motion SFC Program, Servo Program, Mechanical System, Cam Data (selected), Labels, VARIABLE, Structured Data Types, Device Memory, and Device Comment. The main workspace is titled "Mechanical System page 01" and contains a sub-tab "Cam [Cutter-cam] no01". This tab displays a graph of a cam curve. The vertical axis is labeled "Stroke [%]" with values 0.00 and 100.00. The horizontal axis is labeled "0.0 90.0 180.0 270.0 360.0 [degree]". A blue line represents the cam curve, which is constant at 0% until 180 degrees, then rises linearly to 100% at 270 degrees, and returns to 0% at 360 degrees. Below the graph are buttons for "Cam Mode" (set to "Two-way"), "Resolution" (set to 256), "Curve Type" (set to "Cam Curve"), and "Stroke Switching Position" (set to 0). At the bottom of the workspace, status bars show "Q172D SV22 Host Station No.2" and "(SC)".

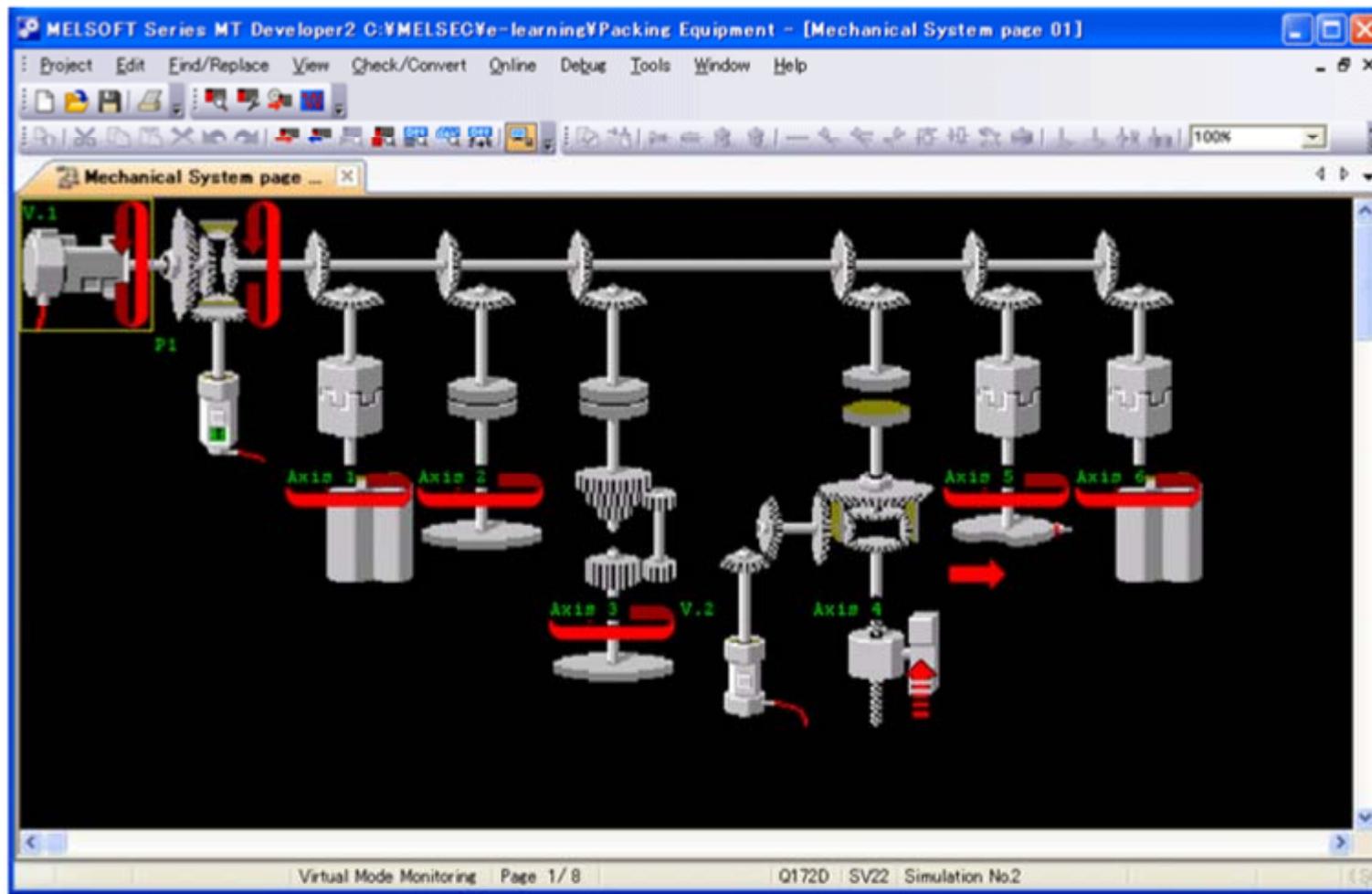


**15.3****Monitoring**

You can monitor operation of the created mechanical system program.

Monitor the program in the next page using MT Simulator2.

MT Simulator2: This tool allows for various monitoring tasks including motion SFC program monitoring without connecting to an actual system by starting simulation from MT Developer2.



Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 15.3 Monitoring

MELSOFT Series MT Developer2 C:\MELSEC\learning\Packing Equipment - [Mechanical System page 01]

Project Edit Find/Replace View Check/Convert Online Debug Tools Window Help

Mechanical System page ...

**Mechanical Detailed Monitor**

Parameter Name	Monitor Value	Unit
Cam		
Output Axis No.	20000.0	A...
Feed Current Value	20000.0	μm
Real Current Value	0	μm
Deviation Counter Value	300	PLS
Torque Limit Value	1	%
Execute Cam No.	0.0	
Lower Stroke Limit	20000.0	μm
Execute Stroke	1875030	μm
Cam Axis 1 Rev.Curr.Val.	267210	PLS
Current Value within 1 Virtual Axis Revolu...		
Main Shaft Side		PLS
	D7062,D706	3
Auxiliary Input Axis Side		PLS
Error Code		
Minor Error	0	
Major Error	0	

Monitoring of the mechanical system program operation starts.

Click  and go to the next screen.

MT Simulator2

Tools

LED: 0.0.0

Switch:  RESET  STOP  RUN

virtual Mode Monitoring | Page 1 / 8 | Q172D | UV22 | Command No.2

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 15.4 Summary

In this chapter, you have learned:

- Mechanical system program creation
- Cam data creation
- Monitoring

Important points

The contents you learned in this chapter are listed below.

Mechanical system program creation	Arrange and configure the mechanical modules to configure a system.
Cam data creation	Create a necessary cam curve in accordance with control details.
Monitoring	You can check the virtual mode operation via simulation.

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## Chapter 16 APPLICATION

In this chapter, you will learn the following as applications of the virtual mode in the motion controller.

\* You can also use the limit switch output function and digital oscilloscope in the real mode, as well as in the virtual mode.

- Limit switch output function
- Clutch operation mode (Address mode)
- Digital oscilloscope



Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 16.1 Limit Switch Output Function

The limit switch output function uses the motion control data or arbitrary word device data as watch data and turns on the output device while the watch data is within the ON output block defined by the ON and OFF values. Settings can be made by selecting [Servo Data Setting] -> [Limit Output Data] in the project window.

Advantages of using the limit switch output function

- The cost can be reduced because the sensor switch and related hardware are not necessary.
- Switch cabling is not necessary.
- Position data can be monitored accurately.

Application

- Used for monitoring the rotary cutter address
- Used for the marking switch

The screenshot shows the MELSOFT Series MT Developer2 software interface. The title bar reads "MELSOFT Series MT Developer2 C:\VMELSEC\Ye-learning\Packing Equipment - [Limit Output Data]". The main window is titled "Limit Output Data". The left sidebar shows a project tree with nodes like "Project", "System Setting", "Servo Data Setting", "Servo Data", "Servo Parameter", "Parallel Block", "Limit Output Data" (which is selected and highlighted in red), "Motion SFC Program", "Servo Program", "Mechanical System", "Can Data", "Labels", "VARIABLE", "Structured Data Types", "Device Memory", and "Device Comment". The right pane contains several configuration tabs: "Add New Data", "Limit Pattern Display", "Item", "Output Device", "Watch Data", "Data Type", "ON section setting", "Output Enable/Disable Bit Setting", and "Forced Output Bit Setting". Each tab has associated descriptive text and input fields. At the bottom, there is a "Data Type" section with options for "1:16-bit Integer Type Data", "2:32-bit Integer Type Data", and "4:64-bit Floating-Point Type Data". The status bar at the bottom of the window displays "Q1720 SV22 Host Station No2 CAP NUM SCR".

## 16.1.1 Operation of the limit switch output function

Limit switch output control is enabled during PCPU Ready Complete flag (SM500: ON) by turning on the PLC ready flag (M2000) from off.

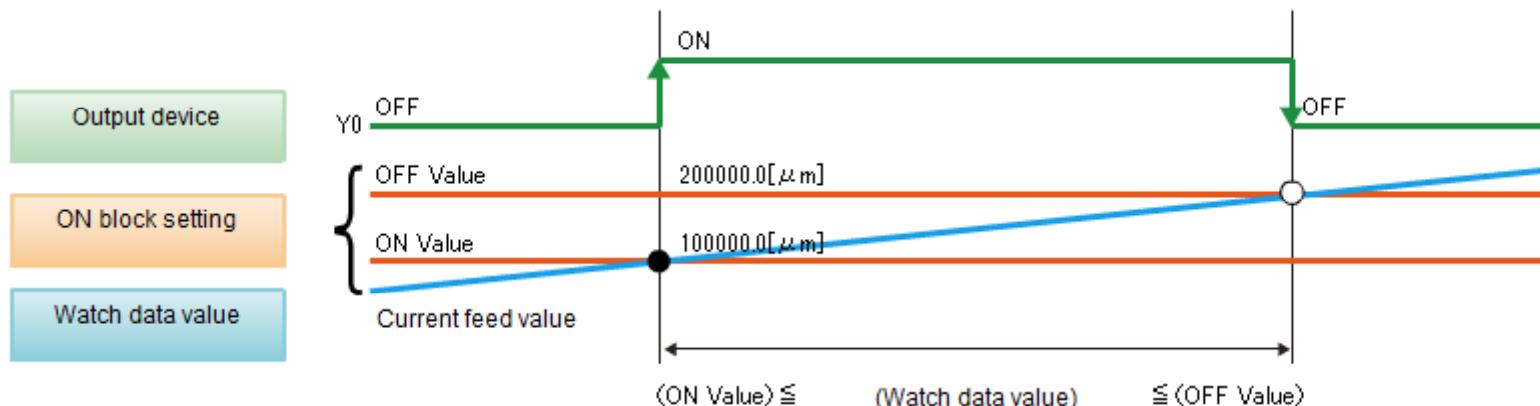
All points are disabled when the PCPU Ready Complete flag (SM500) is turned off by turning off the PLC READY flag (M2000) from on.

The limit switch output can be enabled or disabled individually for each point by setting the enable/disable output bit. By setting the forced output bit, the limit switch output can be turned on for each point.

When (ON value) < (OFF value)

100000.0 [μm] ≤ Current feed value < 200000.0 [μm]

Y0 turns on when the current feed value is 100[mm] or higher and lower than 200[mm].



Parameter item	Sample value
Limit output data	
Output device	Y0000
Watch data	
Watch data specification	0: Motion control data
Axis	Axis 1
Name	0: Current feed value
ON block setting	
ON Value	100000.0 [μm]

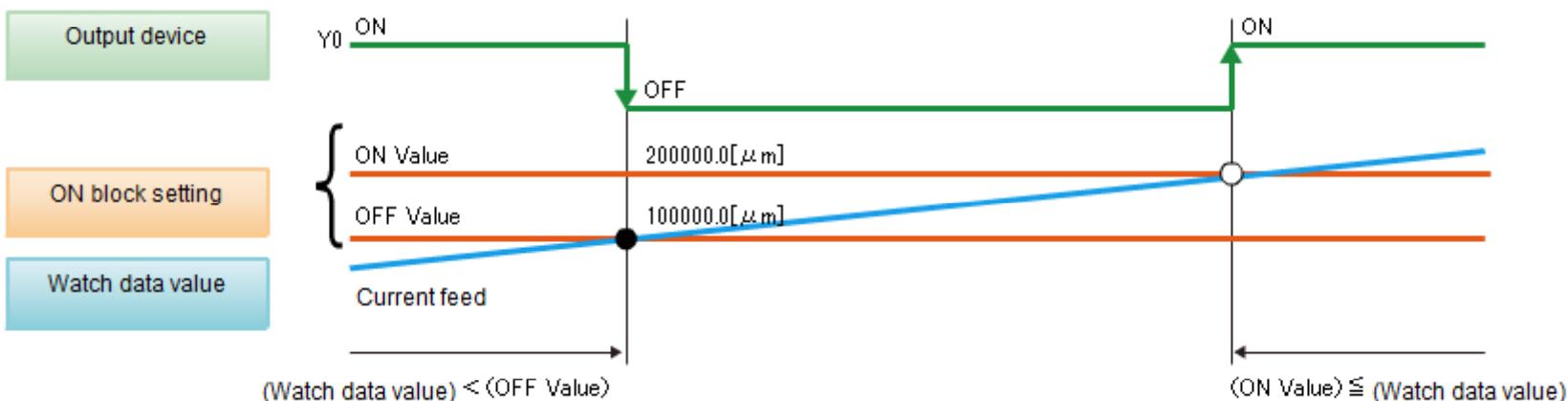
## 16.1.1 Operation of the limit switch output function

ON Value	K100000.0L[μm]
OFF Value	K200000.0L[μm]
Enable/disable output bit setting	
Enable/disable output bit	0: Invalid
Forced output bit setting	
Forced output bit	0: Invalid

When (ON value) > (OFF value)

Current feed value  $\leq$  100000.0[μm],  
 200000.0[μm]  $<$  Current feed value

Y0 turns on when the current feed value is 100[mm] or lower or higher than 200[mm].

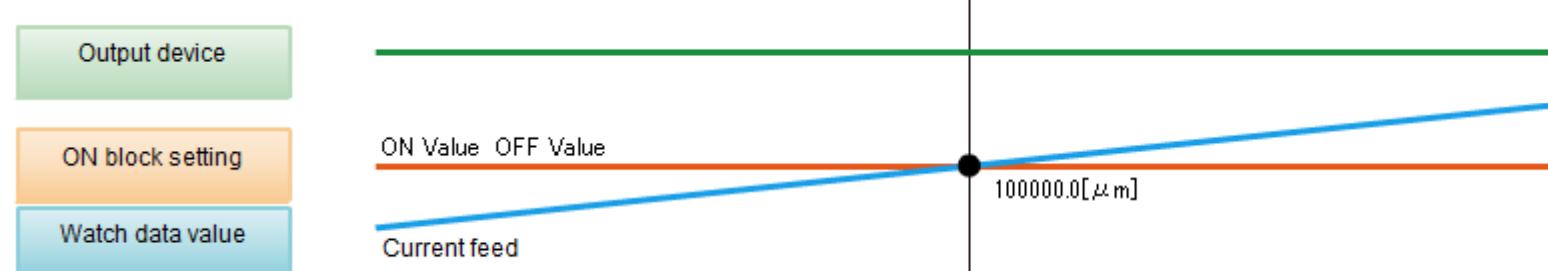


Parameter item	Sample value
Limit output data	
Output device	Y0000
Watch data	
Watch data specification	0: Motion control data
Axis	Axis 1
Name	0: Current feed value
ON block setting	
ON Value	K200000.0L[μm]
OFF Value	K100000.0L[μm]
Enable/disable output bit setting	
Enable/disable output bit	0: Invalid
Forced output bit setting	
Forced output bit	0: Invalid

When (ON value) = (OFF value)

$$\text{Current feed value} = 100000.0[\mu\text{m}]$$

Y0 is constantly turned off regardless of the current feed value.



Parameter item	Sample value
Limit output data	
Output device	Y0000
Watch data	
Watch data specification	0: Motion control data
Axis	Axis 1
Name	0: Current feed value
ON block setting	
ON Value	K100000.0L[μm]
OFF Value	K100000.0L[μm]
Enable/disable output bit setting	
Enable/disable output bit	0: Invalid
Forced output bit setting	
Forced output bit	0: Invalid

### Logical sum of output results

When the multiple watch data, ON region, output enable/disable bit and forced output bit are set to the same output device, the logical add of output results of the settings is output.



## 1) Without output enable/disable bit/forced output settings

## 2) With output enable/disable bit/forced output settings

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 16.1.2 Limit output setting data

The limit output setting data items to be set for the limit switch output function are listed below.  
Up to 32 limit output setting data can be created.

Item	Setting range	Description
Output device	Bit device (X, Y, M, B, U□ \ G)	This device outputs the ON/OFF signals for the set watch data.
Watch data	Motion control data, Word device (D, W, #, U□ \ G) (16-bit integer, 32-bit integer, 64-bit floating-point)	Target data for the limit switch output function
ON block ON Value OFF Value	Word device (D, W, #, U□ \ G), constant (K, H)	The output device is turned on within this block for the watch data.
Enable/disable output bit	Bit device (X, Y, M, B, F, SM, U□ \ G), None: Invalid (default)	The limit switch output is turned off regardless of the watch data value while the setting device is turned off.
Forced output bit	Bit device (X, Y, M, B, F, SM, U□ \ G), None: Invalid (default)	The limit switch output is turned on regardless of the watch data value while the setting device is turned on.

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 16.2 Address mode clutch

The address mode clutch provides modes to turn on/off the clutch depending on the current address value of the virtual axis (input axis). Address mode and address mode 2 are available depending on the clutch operation method. (Refer to the section 13.4.2 for the clutch.)

**Advantage of address mode**

- Suitable for the clutch of a device requiring high precision
- Suitable for a device repeatedly turning on/off the clutch

**Application**

- Clutch used with the axis for the running cutter of the sample system (axis repeatedly turning on/off the clutch)

Operation mode	Clutch operation
Address mode	The clutch turns on when the clutch ON/OFF command device is ON and the clutch ON address is reached. The clutch turns on when the clutch ON/OFF command device is OFF and the clutch OFF address is reached.
Address mode 2	While the clutch ON/OFF command device is ON, the clutch turns on and off according to the clutch ON/OFF address. The clutch turns off when the clutch ON/OFF command device switches from ON to OFF.

The value of the clutch ON/OFF address setting device is the current value of the virtual axis or the current value within one virtual axis revolution, depending on the output module.

Ball screw or roller	Differential gear
<ul style="list-style-type: none"><li>• Current value of virtual axis When the differential gear is connected to the main shaft, the current value of the main shaft is after the differential gear</li></ul>	<ul style="list-style-type: none"><li>• Current value within one virtual axis revolution (Drive module travel value x Gear ratio % NC) %: Multiplication and division operator, NC: Number of pulses per one cam axis revolution</li></ul>

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

## 16.2.1 Address mode

An example of the address mode operation is shown below.  
This example uses the cam as the output module.

The timing diagram illustrates the relationship between the Clutch ON/OFF command device and the Clutch status. The Clutch ON/OFF command device (green line) has an OFF state followed by an ON state, which then returns to OFF. The Clutch status (purple line) shows a series of pulses where the clutch is ON for a period and then OFF. The current value within one virtual axis revolution is represented by a blue sawtooth wave that oscillates between the OFF address (top dashed line) and the ON address (bottom dashed line). The mechanical diagram shows a drive module connected to a virtual servomotor or synchronous encoder. A gear ratio is applied to the drive module travel value. A clutch is shown as a red box, with a callout indicating it is controlled by the Drive module travel value x Gear ratio. A cam is also present in the system.

Clutch ON/OFF command device

OFF      ON      OFF

OFF address

Current value within one virtual axis revolution

ON address

Clutch status

ON      OFF

Differential gear

Virtual servomotor or synchronous encoder

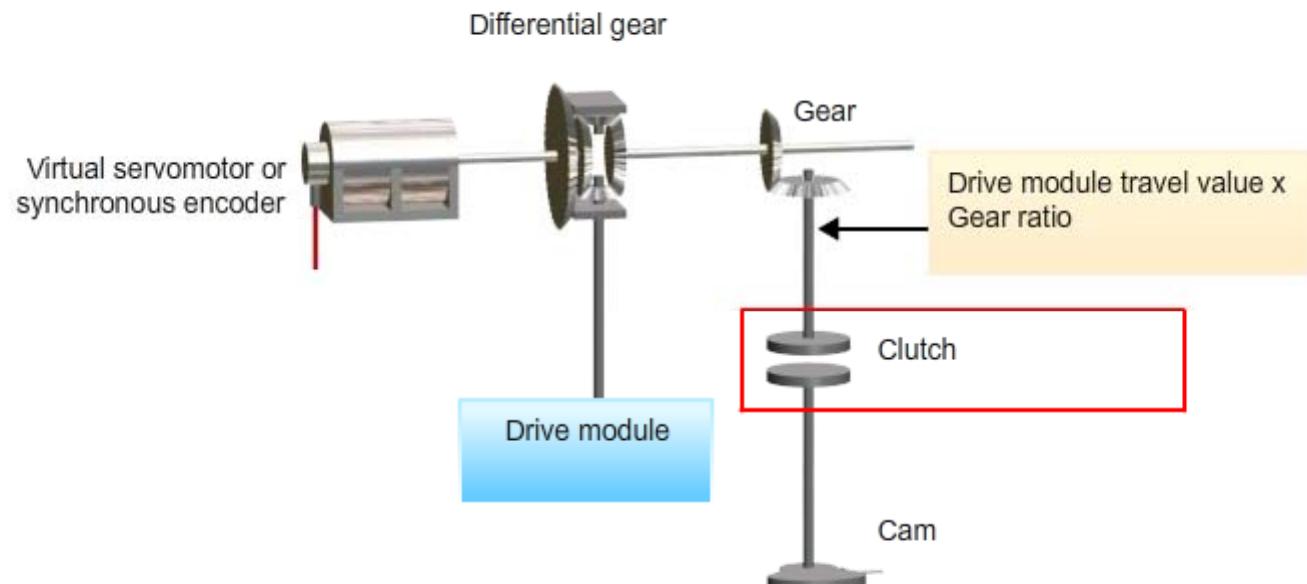
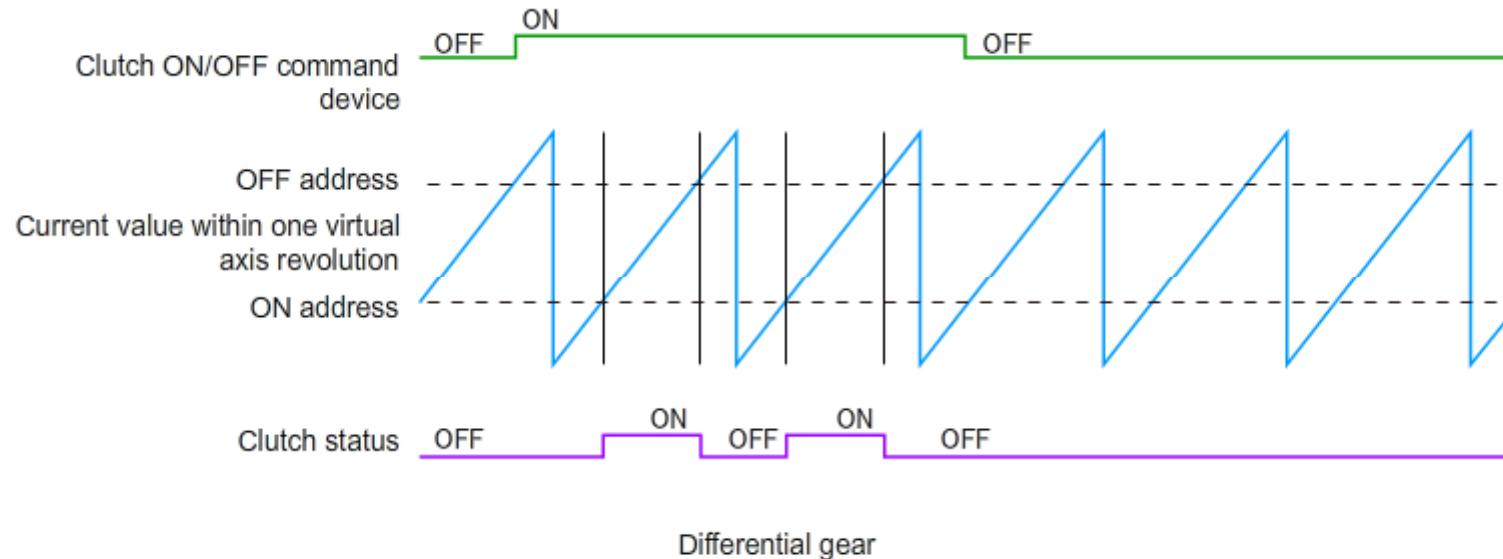
Drive module travel value x Gear ratio

Clutch

Cam

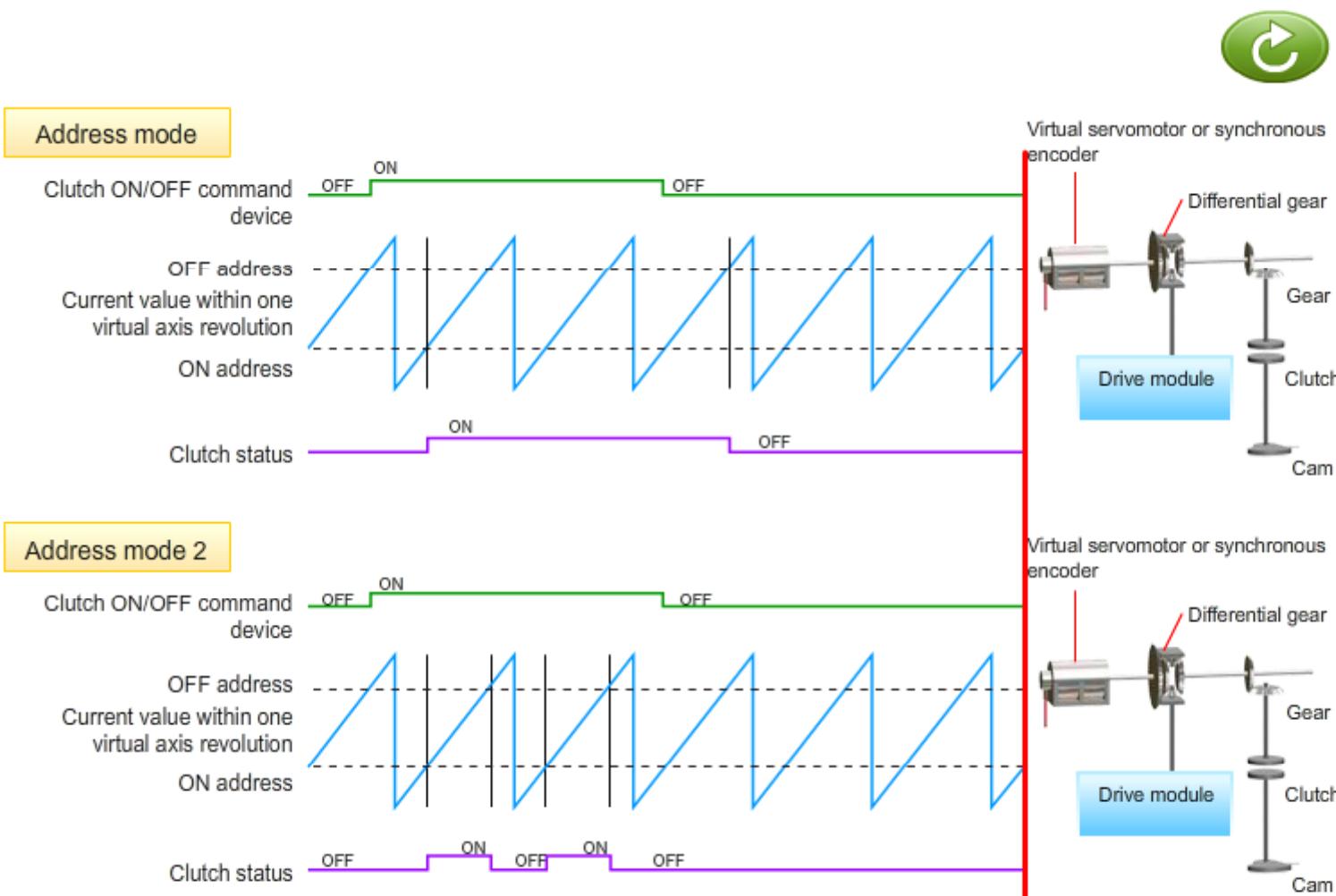
## 16.2.2 Address mode 2

An example of the address mode 2 operation is shown below.  
This example uses the cam as the output module.



## 16.2.3 Comparison between address mode and address mode 2

The figure below compares the address mode and address mode 2.



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## 16.3 Digital Oscilloscope

The digital oscilloscope emulates the oscilloscope functionality on software and is used to adjust and analyze the status of the motion controller system.

This function allows for using the oscilloscope functionality without preparing a physical oscilloscope.

It is ideal for analysis upon startup of a system or during the occurrence of a failure because it displays the control status of the motion system by waveforms.

The screenshot shows the MT Developer2 application window titled "Digital Oscilloscope". The main menu bar includes File, Edit, View, Action, Online, Tools, and Help. A toolbar with various icons is visible above the main workspace. On the left, there's a vertical toolbar with buttons for "Assistant", "wORP", "Scale", and "Status". The "Status" tab is selected, showing "STOP" and "Continuous Mode" buttons. The main workspace is a graph area with a black background and a vertical dashed grid line. An "Assistant" dialog box is overlaid on the screen. It has a blue header bar with the word "Assistant". The main content area is divided into several sections: "Communicate with the controller and sample the data.", "Analyze the sampled data.", "Print the sampled data.", "Refer to the help.", and "Check the previously saved sampling data.". Each section contains a small icon and a brief description. At the bottom of the dialog, there is a checked checkbox for "Display at Start-up" with the note "To display the screen again, select [View] -> [Display Assistant Screen] menu." and a "Close" button.

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## 16.3.1 How to use the digital oscilloscope

The digital oscilloscope is a function of MT Developer2.  
Now we confirm how to use the digital oscilloscope.

Go to the next page.

You will configure the digital oscilloscope using MT Developer2.  
(You can simulate the software.)

The screenshot shows the MT Developer2 interface with a floating 'Assistant' dialog box. The dialog box is titled 'Select the work item.' and contains several sections:

- Communicate with the controller and sample the data.**
  - 1) Perform the communication setting to connect the controller and personal computer.
  - 2) Select the probe item to be sampled.
  - 3) Set the sampling condition.
  - 4) Start the sampling.
  - 5) Save the sampling condition and sampled data to the file as a sampling data.
- Analyze the sampled data.**
  - The sampled data is displayed in the numeric data. The operation can be executed for the sampled data.
- Print the sampled data.**
  - Print out the sampling data.
- Refer to the help.**
  - Display the help for the digital oscilloscope function and its operation method.

Below the main sections, there is a note: **Check the previously saved sampling data.** with a link to **Read the sampling data saved in the file.** There is also a checked checkbox for **Display at Start-up** with the sub-note: **To display the screen again, select [View] -> [Display Assistant Screen] menu.**

The background of the application shows a waveform on the oscilloscope screen and various toolbars and menus.

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## 16.3.1 How to use the digital oscilloscope

**Digital Oscilloscope - MT Developer2**

File Edit View Action Online Tools Help

Ax. 5-Speed command Ax. 5-Servo error detection

	Unit	A	B	A - B	1	2	2 - 1
<input checked="" type="checkbox"/> Ax. 5-Speed command	PLS/s	4000000	-4000000	8000000	0	0	0
<input checked="" type="checkbox"/> Ax. 5-Cam Axis 1 Re...	PLS	2100000	900000	1200000	1085100	2205920	1120820
<input checked="" type="checkbox"/> Ax. 5-Motor speed	x0.1r/min	0	0	0	0	0	0
<input checked="" type="checkbox"/> Ax. 5-Motor current	x0.1%	0	0	0	0	0	0
<input checked="" type="checkbox"/> Ax. 5-Servo error de...					0	0	0
<input checked="" type="checkbox"/> Ax. 5-Error detection					0	0	0

< >

Assistant Screen

WORD PLS/s 10000000 0 -10000000

BIT

1 2 3 4 5 6 7 8

A B T 1 2

Using the check boxes in the CURSOR window, you can filter waveforms to those you want to view.

Click  and go to the next screen.

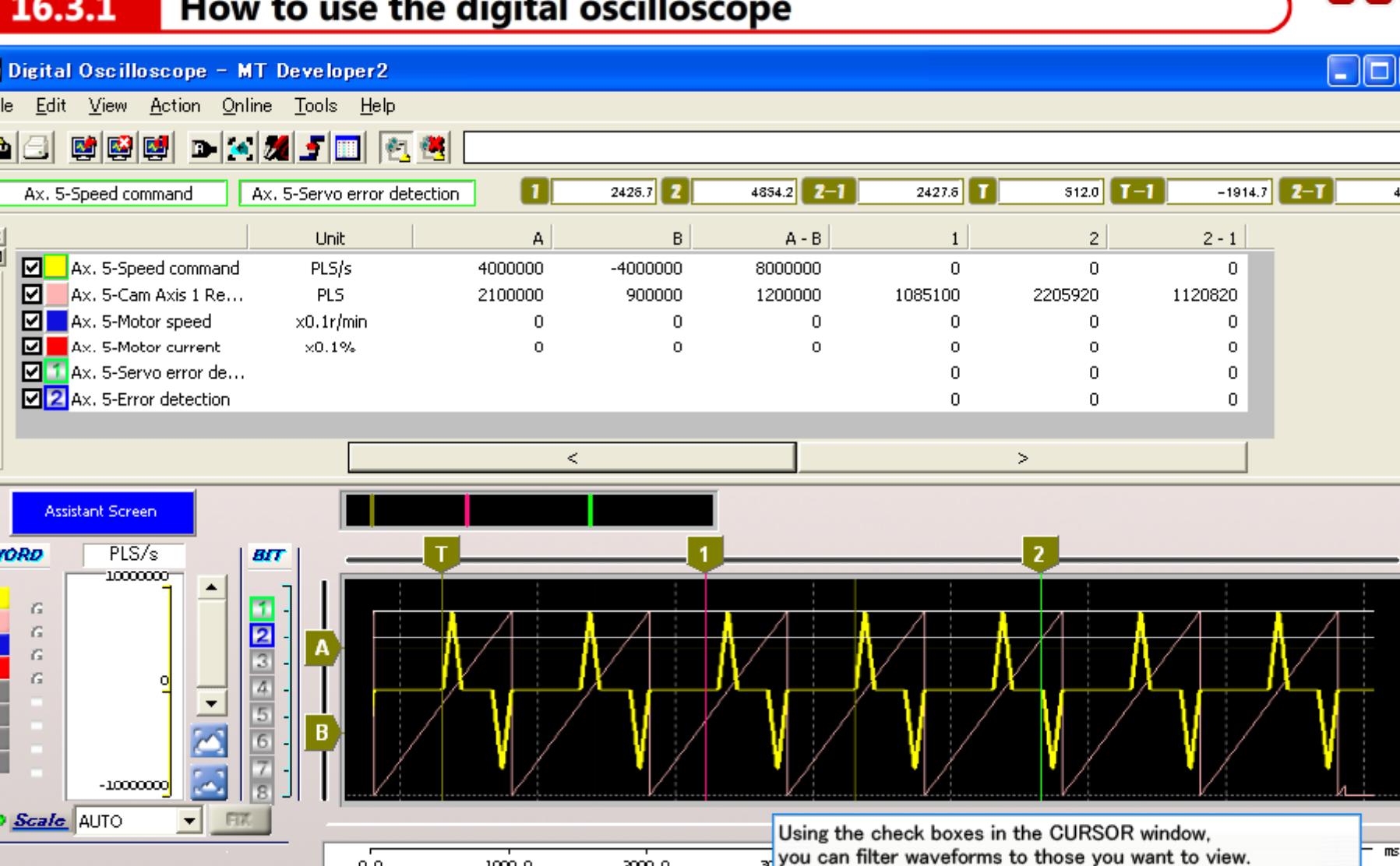
Scale AUTO FIX

0.0 1000.0 2000.0 ms

Status TRIGGER STOP

Continual Mode Trigger Counts Finish Time

Simulation No.2 MODE Digital OSC



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## 16.4 Summary

In this chapter, you have learned:

- Limit switch output function
- Clutch operation mode (Address mode)
- Digital oscilloscope

### Important points

The contents you learned in this chapter are listed below.

Limit switch output function	This function turns on the output device while the watch data value is within the ON output block.
Clutch operation mode (Address mode)	This mode turns on/off the clutch according to the current value of the virtual axis or the current value within one virtual axis revolution.
Digital oscilloscope	This software emulates a physical oscilloscope.

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## Test Final Test

Now that you have completed all of the lessons of the **MOTION CONTROLLER Application (Virtual Mode)** 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 10 questions (32 items) in this Final Test.**

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

**How to score the test**

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

**Score results**

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

Correct Answers : 2

Total Questions : 9

Percentage : 22%

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

Proceed   Review   Retry

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

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Test Final Test 1

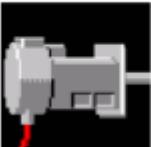
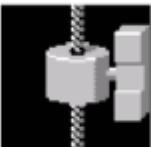
Select the motion OS software that supports the virtual mode.

- Conveyor assembly use (SV13)
- Automatic machinery use (SV22)
- Machine tool peripheral use (SV43)

Answer Back

**Test****Final Test 2**

Select the functions of the configuration components (such as step, transition) used in a motion SFC program.

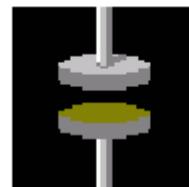
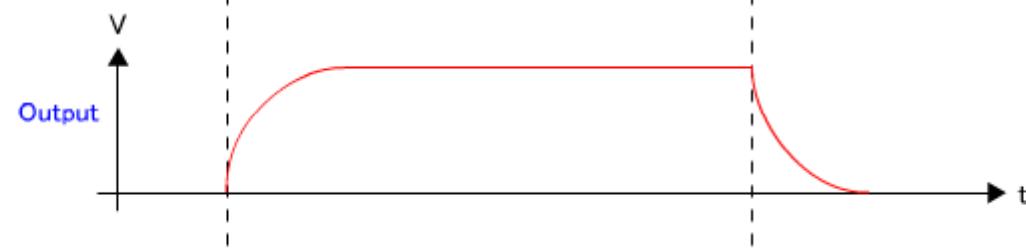
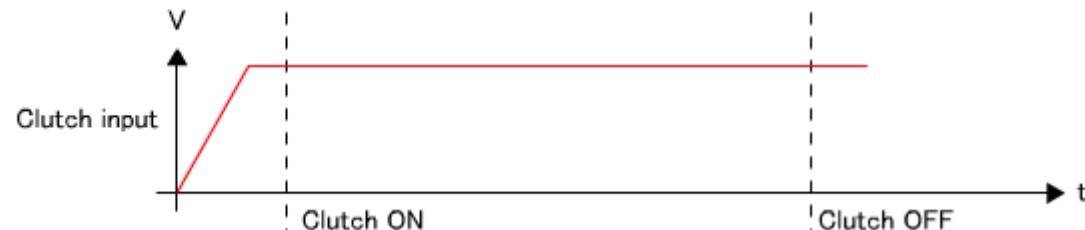
Mechanical module		Function description
Appearance	Name	
	<input type="button" value="▼"/>	Used to drive the mechanical system program's virtual axis by servo program or JOG operation.
	<input type="button" value="▼"/>	Used to adjust the rotation ratio and direction according to the travel value (pulse) input from the drive module.
	<input type="button" value="▼"/>	Used to change the speed of the output module during operation.
	<input type="button" value="▼"/>	Used to carry out linear positioning control of the machine connected to the servomotor.

**Name**

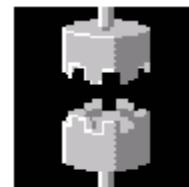
1. Virtual servomotor
2. Synchronous encoder
3. Gear
4. Clutch
5. Speed change gear
6. Roller
7. Ball screw
8. Cam

**Test****Final Test 3**

The graphs below shows the relationship between clutch input and output. Select the clutch suitable for this type of control.



Smoothing clutch



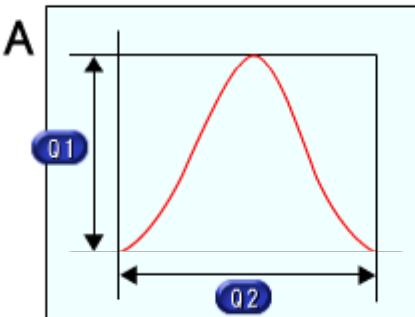
Direct clutch

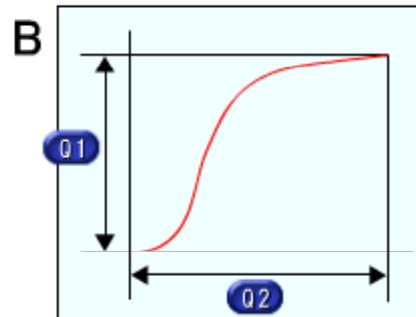
**Answer****Back**

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## Test Final Test 4

Select the 3 processes which should be executed before the positioning control when designing a motion SFC program.

A 

B 

● A cam patterns are indicated in the above graphs. Select the correct term to fill Q1 and Q2 in the graph.

Q1  Q2

● Select the correct cam pattern set in the feed cam mode from the above graph A and B.

Q3

[Answer](#) [Back](#)

**Test****Final Test 5**

Answer the questions below.

- Select the correct term to fill Q1to Q4 in the following descriptions from 1 to 7 in the lower box.

Present feed value = Lower stroke limit value + [Q1] \* Stroke ratio

The number of pulses required to rotate the cam through one cycle is [Q2]

[Q3] is the setting determines the number of index divisions in one cycle.

[Q4] and stroke amount are set, and turn a REAL/VIRTUAL mode switching request flag (M2043) ON.

**Terms**

- |  |                   |
|--|-------------------|
| 1. Stroke amount                             | 5. Cam No.        |
| 2. Number of pulses per cam shaft revolution | 6. Operation mode |
| 3. Cam resolution                            | 7. Feed cam mode  |
| 4. Stroke ratio                              |                   |

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## Test Final Test 6

When the address mode 2 is set to the address mode clutch, select the correct clutch status with the following clutch ON/OFF command device, virtual axis present value, and the clutch ON/OFF address.

Clutch ON/OFF command device

The diagram shows a blue line labeled "Clutch ON/OFF command device" with a pulse from OFF to ON and back to OFF. Below it is a green line labeled "Current value of virtual axis" with a sawtooth-like waveform. Vertical dashed lines indicate the clutch ON/OFF addresses. The green line starts at a low level, goes up during the first pulse, stays high during the second pulse, and then goes down during the third pulse.

\* Dashed lines represent the clutch ON/OFF addresses.

Clutch status A

A red line starting at OFF, going to ON during the first pulse, staying high during the second pulse, and then going to OFF during the third pulse.

Clutch status B

A red line starting at OFF, going to ON during the second pulse, staying high during the third pulse, and then going to OFF during the fourth pulse.

Clutch status C

A red line starting at OFF, going to ON during the third pulse, staying high during the fourth pulse, and then going to OFF during the fifth pulse.

Clutch status D

A red line starting at OFF, going to ON during the first pulse, going to OFF during the second pulse, going to ON during the third pulse, and then going to OFF during the fourth pulse.

Answer Back

Servo\_Motion\_Controller\_Application(Virtual Mode)\_ENG

Test Score

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

Correct answers : 0

Total questions : 6

Percentage : 0%

Proceed      Review      Retry

**You failed the test.**



You have completed the **MOTION CONTROLLER Application (Virtual Mode)** 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**