Industrial Robot

MELFA Basic Operations and Maintenance (FR Series D Type)

This course gives you the opportunity to learn how to carry out basic and maintenance operations on the industrial robot MELFA FR series D type.
Click the Next button at the upper right of the screen.

Introduction Purpose of the Course

This course targets first-time users of the MITSUBISHI industrial robot MELFA and describes the procedures for setup, operations, and maintenance.

Introduction Course Structure

Chapters of this course are made up as follows.
We recommend that you start from Chapter 1.

Chapter 1 - Configuration of Mitsubishi Industrial Robot MELFA

This chapter covers the configuration of the MITSUBISHI industrial robot MELFA.

Chapter 2 - Setup

This chapter covers setup procedures, such as connecting devices and setting an origin.

Chapter 3 - Programming

This chapter covers programming methods.

Chapter 4 - Robot Operation

This chapter covers robot operations with a teaching pendant.

Chapter 5 - Automatic Operation

This chapter covers the methods of carrying out automatic robot operation.

Chapter 6 - Maintenance

This chapter covers the methods of carrying out maintenance and inspection.

Final Test

This chapter checks your understanding of the contents of chapter 1 to 6.

Introduction How to Use This e-Learning Tool

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

Introduction Cautions for Use

■Safety precautions

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

Chapter 1 Configuration of Mitsubishi Industrial Robot MELFA

This course describes basic and maintenance operations on the MITSUBISHI industrial robot MELFA.
The MITSUBISHI industrial robot MELFA is used to assemble and check electric components and electronic components and transfer automobile parts, liquid crystal display boards, and semiconductor wafers, for example. The MELFA can automate production equipment and will add a high value.

Electric components and electronic components

Transfer automobile parts

Liquid crystal display boards

Semiconductor wafers

1.1 Types of Robots and Controllers

[Robot]

The MITSUBISHI industrial robot MELFA has two types: the vertical, multiple-joint type and the horizontal, multiple-joint type.

Vertical multiple-joint type: RV-FR series

Load capacity of 2 kg

RV-2FR-D
RV-2FR-R
RV-2FR-Q

Load capacity of 4 kg

RV-4FR-D
RV-4FR-R
RV-4FR-Q

Long arm with load capacity of 4 kg

RV-4FRL-D
RV-4FRL-R
RV-4FRL-Q

Load capacity of 7 kg

RV-7FR-D
RV-7FR-R
RV-7FR-Q

Long arm with load capacity of 7 kg

RV-7FRL-D
RV-7FRL-R
RV-7FRL-Q

Ultra-long arm with load capacity of 7 kg

RV-7FRLL-D
RV-7FRLL-R
RV-7FRLL-Q

Load capacity of 2 kg

RV-13FR-D
RV-13FR-R
RV-13FR-Q

Long arm with load capacity of 13 kg

RV-13FRL-D
RV-13FRL-R
RV-13FRL-Q

Load capacity of 20 kg

RV-20FR-D
RV-20FR-R
RV-20FR-Q

Horizontal multiple joint type: RH-FRH series

Load capacity of 3 kg

Load capacity of 6 kg

Load capacity of 12 kg

Load capacity of 20 kg

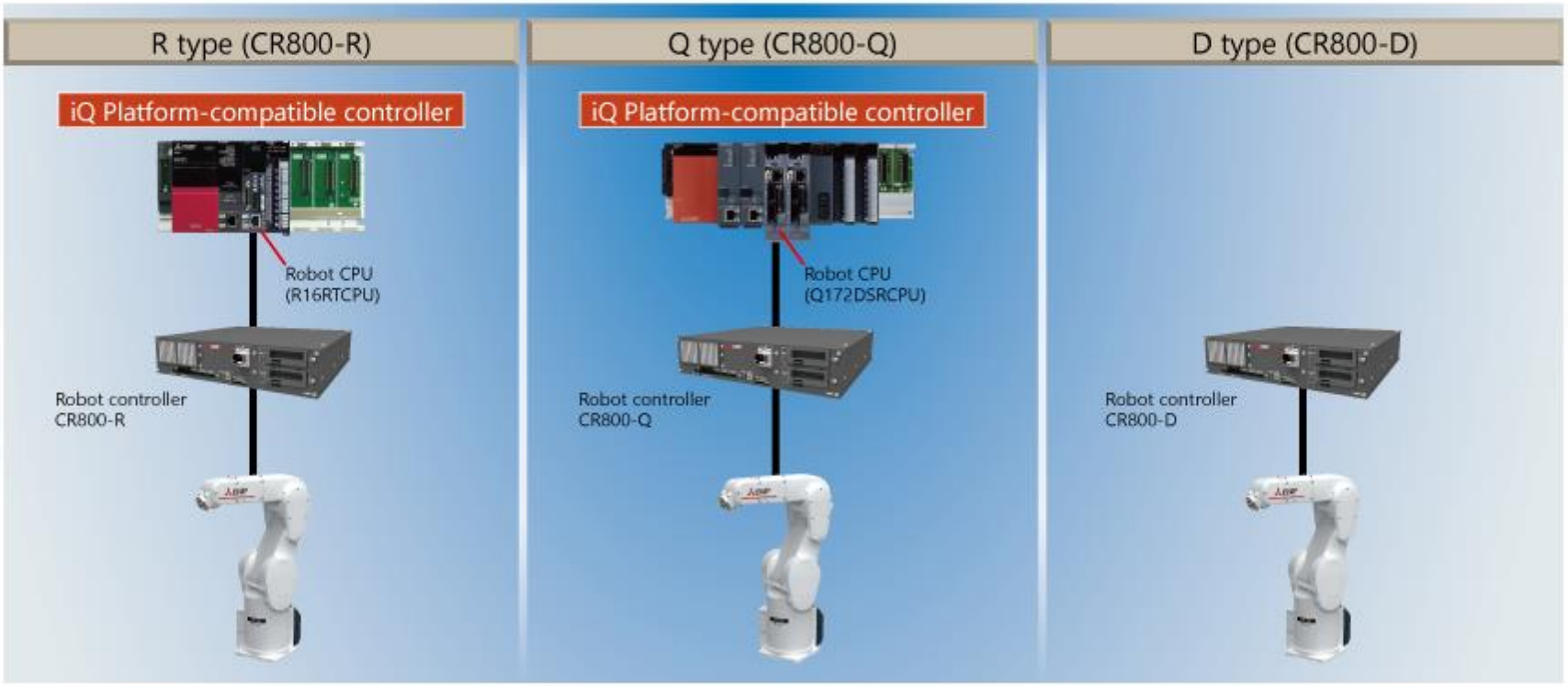
1.1 Types of Robots and Controllers

Load capacity of 3 kg	Load capacity of 6 kg	Load capacity of 12 kg	Load capacity of 20 kg
RH-3FRH-D	RH-6FRH-D	RH-12FRH-D	RH-20FRH-D
RH-3FRH-R	RH-6FRH-R	RH-12FRH-R	RH-20FRH-R
RH-3FRH-Q	RH-6FRH-Q	RH-12FRH-Q	RH-20FRH-Q

1.1 Types of Robots and Controllers

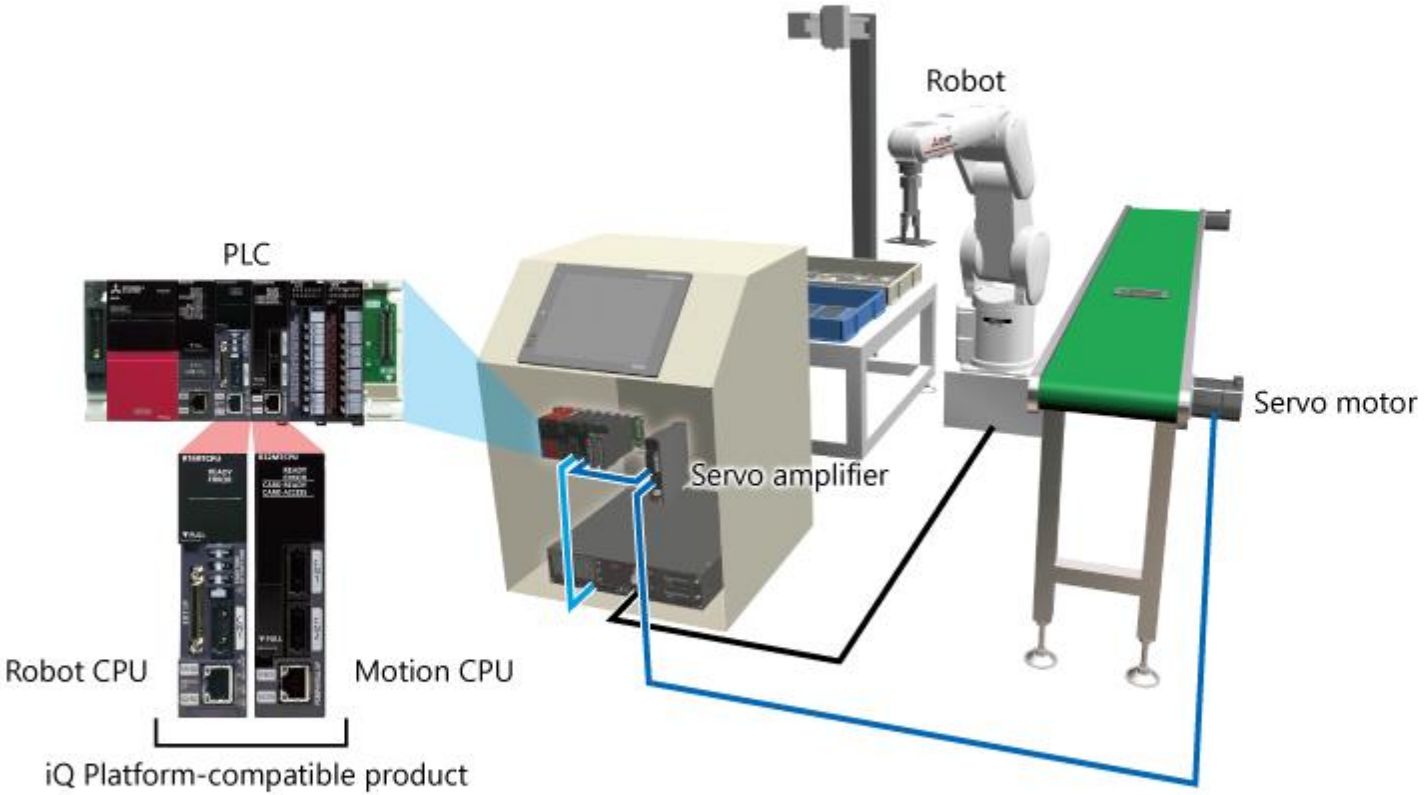
[Controller]

Three types of the robot controller are available: D type (standalone robot controller), R type, and Q type (iQ Platform-compatible controller). The robot CPU is built in the D type controller. For linkage with a programmable controller, the robot CPU is separated from the R type and Q type controller, and mounted on a slot on the programmable controller base.



1.2 iQ Platform

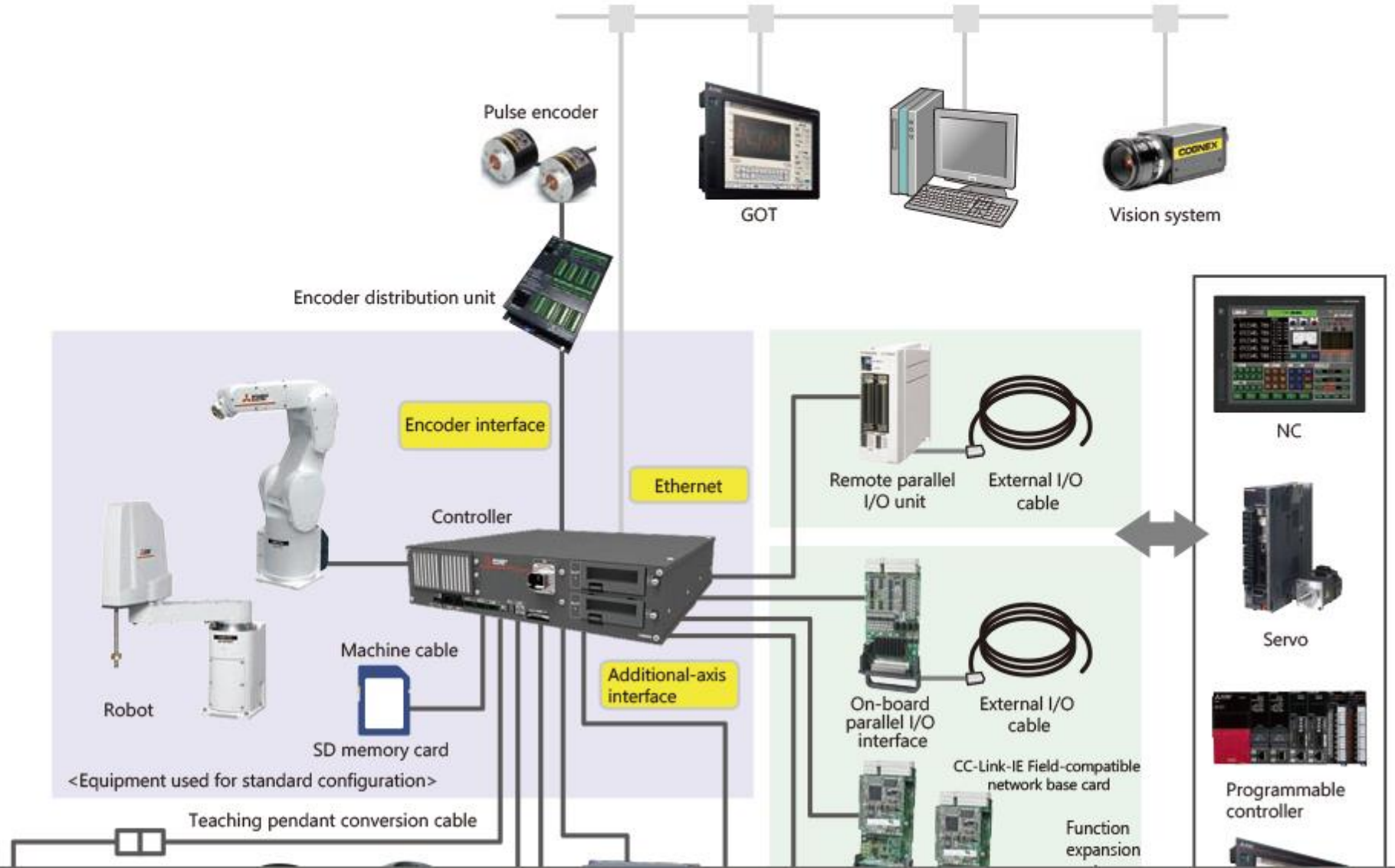
iQ Platform enables integrated control of peripheral FA devices including the robots, and reduces cost in all phases of design, startup, operation, and maintenance. With the multi-CPU configuration, the compatibility with FA equipment is drastically improved and high-accuracy control and information management can be performed easily at high speed.



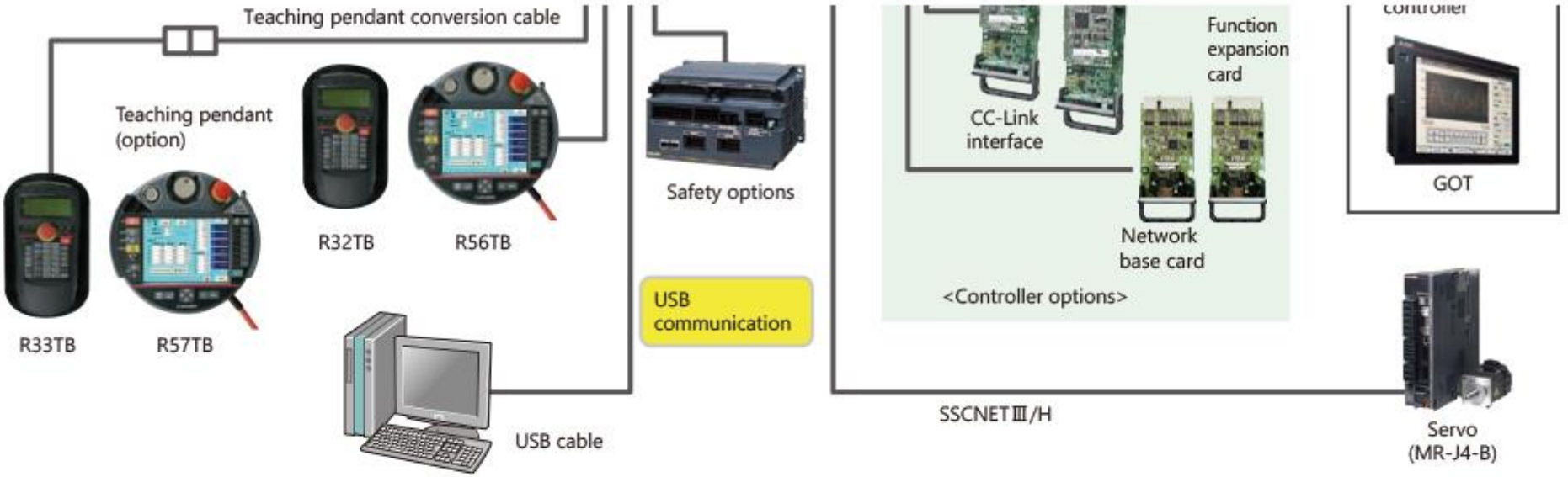
1.3 Equipment (Option and Peripheral) Configuration

The following shows the equipment (option and peripheral) configuration of the D type robot system.

Putting the mouse cursor over a piece of equipment displays the description of the function.

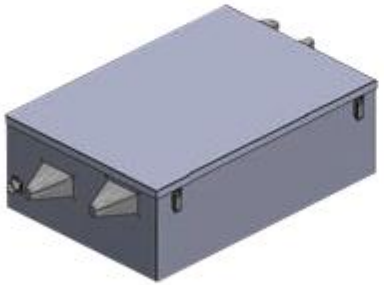


1.3 Equipment (Option and Peripheral) Configuration



<Software options>

RT ToolBox3 mini
RT ToolBox3
RT ToolBox3 Pro



Controller protection box

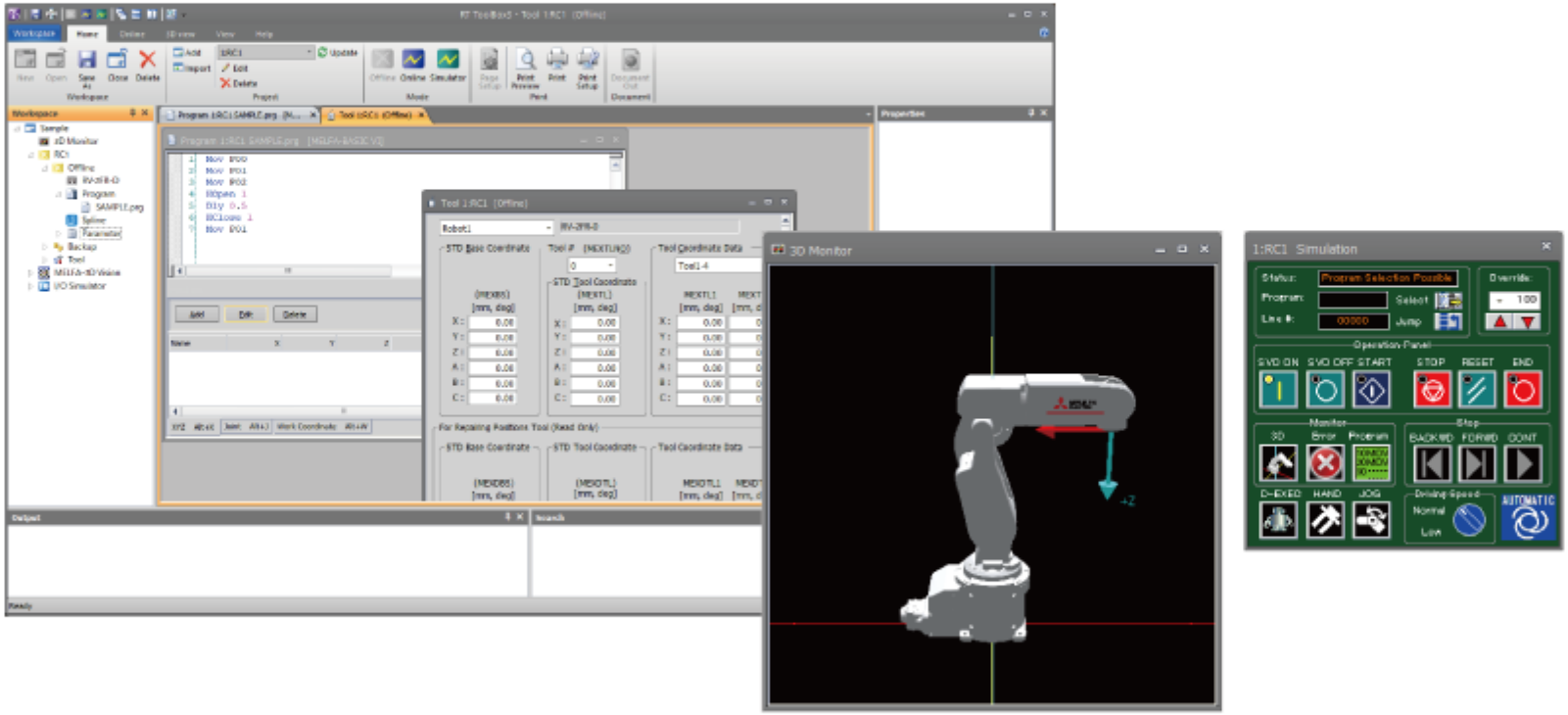
<Feature options>

Force sensor set

MELFA-3D Vision

1.3.1 Options (RT ToolBox3)

RT ToolBox3 is the software for a personal computer and supports the phases including system setup, debug, and operation. The software enables you to create and edit programs, check the operational range before the introduction of a robot, estimate the tact time, perform debug operations at the activation of the robot, and monitor the status and errors during operations. Simulation that includes features such as robot dynamics and servo responses as well as robot controller emulation allows realistic simulations that include motor loading, tracking, and positioning times.

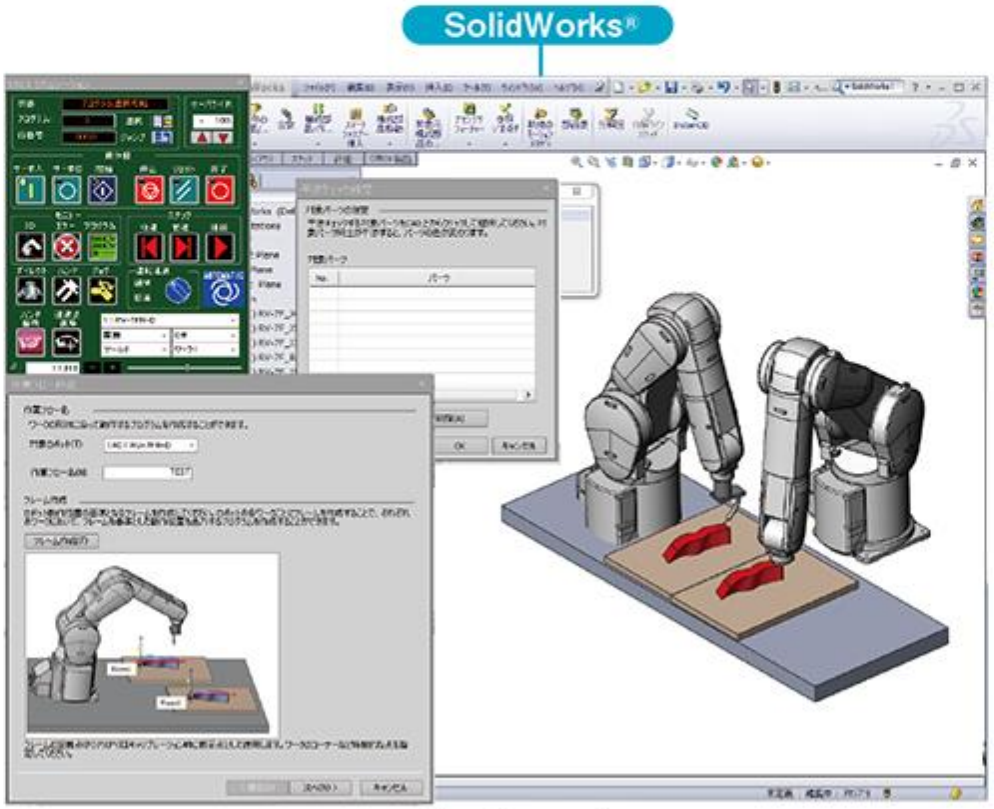


Operation windows of RT ToolBox3

1.3.2 Options (RT ToolBox3 Pro)

In RT ToolBox3 Pro, the teaching position data and robot operation program required for operating the robot can be automatically generated by reading the 3D CAD data (*1) of the workpiece to SolidWorks®, and setting the machining condition and machining area.
For the workpiece with complex shape, the operation of the system that requires multiple position teaching data can be automated.

*1) Format readable by SolidWorks®



Calibration tool

1.3.3 Options (R56TB)

The R56TB is a new type of teaching pendant for enhanced robot operations. With monitor functions equivalent to the personal computer support software, program editing, parameter setting, and I/O status display can be performed easily.
In addition to the teaching operation of the robot, LCD is used and the monitor function is enhanced to perform greatly in operations such as debugging.

TFT color LCD

- Adopted a VGA (640×480) full-color touch panel for user-friendly screen layout.
- Realized simple operations by visual menu screen.

USB connection interface

By connecting the USB memory, the controller data can be backed up without a personal computer at work site.
The same content as the personal computer such as program information, parameter information, and system information can be backed up.

1.3.4 Options (MELFA-3D Vision)

MELFA-3D Vision is a 3-dimensional vision sensor dedicated for small robots which is small and realizes high-speed and high-accuracy measurement.
It is optimum as a replacement of a parts feeder.
High-speed picking is available with original model-less identification processing.

Connection compatibility unique to robot manufacturer

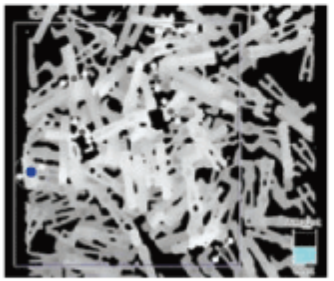
It can be connected directly through LAN that is equipped on the controller as a standard feature. The sensor setting and operation can be checked easily with the personal computer for setting. A personal computer is not required during operation. The coordinate calibration function of the robot and vision sensor is standardly installed, and it can be controlled easily by using a dedicated command added to MELFA-BASIC.

MELFA-3D Vision

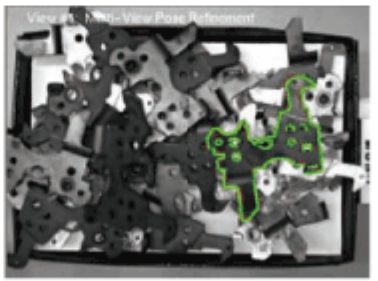
Supporting multiple identification method

The identification methods of model-less and model matching can be used according to the application.

- Model-less recognition:
  Identify the position without registering the model of the target workpiece
- Model matching recognition:
  Identify the posture using the 3D-CAD model



Model-less recognition



Model matching recognition

1.3.5 Options (Force sensor set)

By using the force applied to the hand, the force sensor assembles and processes in the same way as human.
It realizes operation that requires minute pressure and force detection.

Improves the production stability

By absorbing position deviations due to parts variation and following the minute external force, parts are installed and assembled without damaging the parts. It improves the position latch at operation failure and operation stability by retry processing. The quality can be managed and the cause of the operation failure can be analyzed with the log data.

Realizes complex assembly and processing

By following the minute external force, parts are installed and assembled without damaging the parts. With the force detection at contact, the operation direction and force can be changed, and the interruption processing can be executed with the trigger condition that is the combination of position information and force information.

1.3.6 Options (MELSENSOR)

MELSENSOR is a small vision sensor that can be operated with the network connection and as a stand-alone. It is applicable for automatic inspection, measurement, identification, or others at the work site.

VS80 series

Small and reduced-wire stand-alone type

- PatMax Redline (*1) is implemented, which enables high-speed workpiece identification.
- For compact size (31×31×75 mm), installation to narrow spaces, unreachable places, and robot hand becomes possible.
- PoE implemented wireless stand-alone vision sensor.

VS70 series

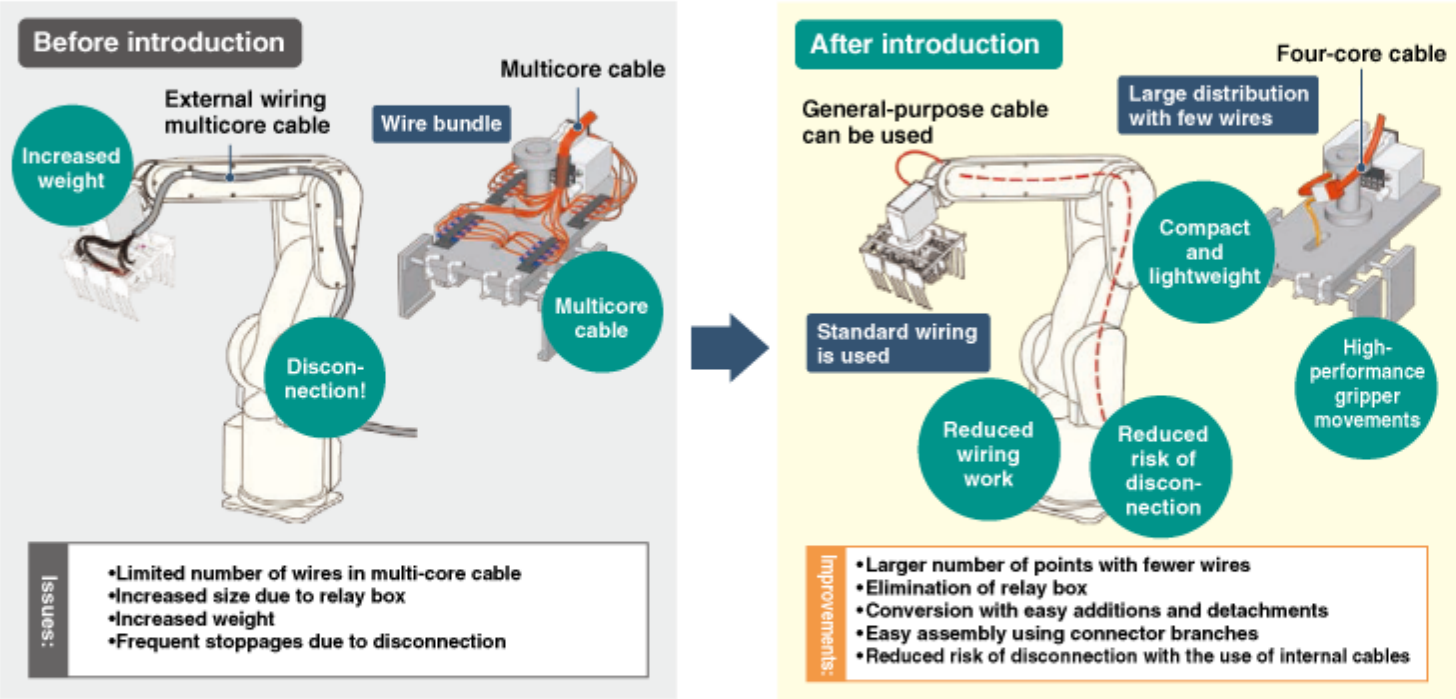
Light integrated compact size

- With PatMax Redline (*1), high-speed workpiece identification becomes possible.
- Lights, lens, and filters can be selected from various optional products, and freely customized according to user applications.
- Conforming to IP67 standard, it is resistant to dust and water.

*1: High-speed and high-accuracy pattern matching algorithm

1.3.7 Options (ASLINK)

By using the AnyWireASLINK wiring system for reducing wires to MELFA robots, the hand wiring issues can be solved.
By connecting the AnyWire dedicated cable unit to the internal wiring of the conventional robot, each I/O input of 256 points can be used for the hand without laying the external wiring in the robot arm.



1.3.8 Options (Multi-functional electrical hand)

With the high-accuracy gripping, position, and speed control with various functions and lineups, the electrical hand can be used in various applications.

High-performance operation control impossible with air cylinder

Setting the grip force and speed for each workpiece

The grip pattern according to the gripping targets, such as soft workpieces and heavy workpieces, can be set by the torque specification and grip speed setting.

Optimum setting of operation stroke for each workpiece shape

The optimum stroke can be specified for different workpieces in multiple sizes with the operation position specification.

Easy application for handling and inspection

It can be used for product inspections such as success/failure of gripping and judgment by workpiece dimension measurement with the hand torque and position feedback.

Simple control

The operation stroke and grip force according to the workpiece shape can be set easily in the robot program.

Simple operation

It can be operated freely with the teaching pendant.

1.4 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Lineup of MITSUBISHI industrial robot MELFA.
- Equipment (option and peripheral) configuration

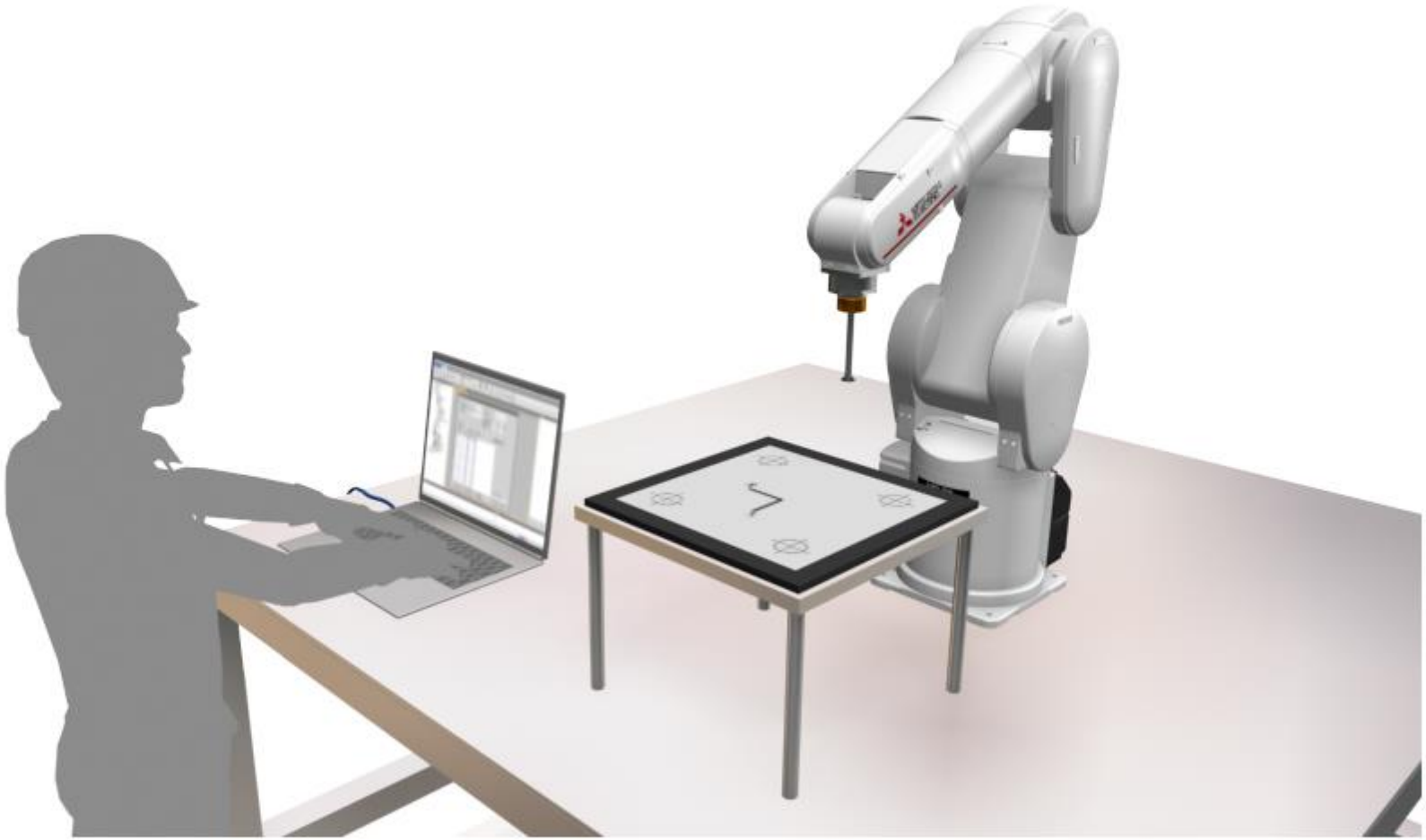
[Points]

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

D type robot	• Standalone robots with a robot controller central to the control system
R type, Q type robot	• New-concept robots with the robot CPU built in the programmable controller
Controller	• A controller controls robots. Three types are available: D type, R type, and Q type.

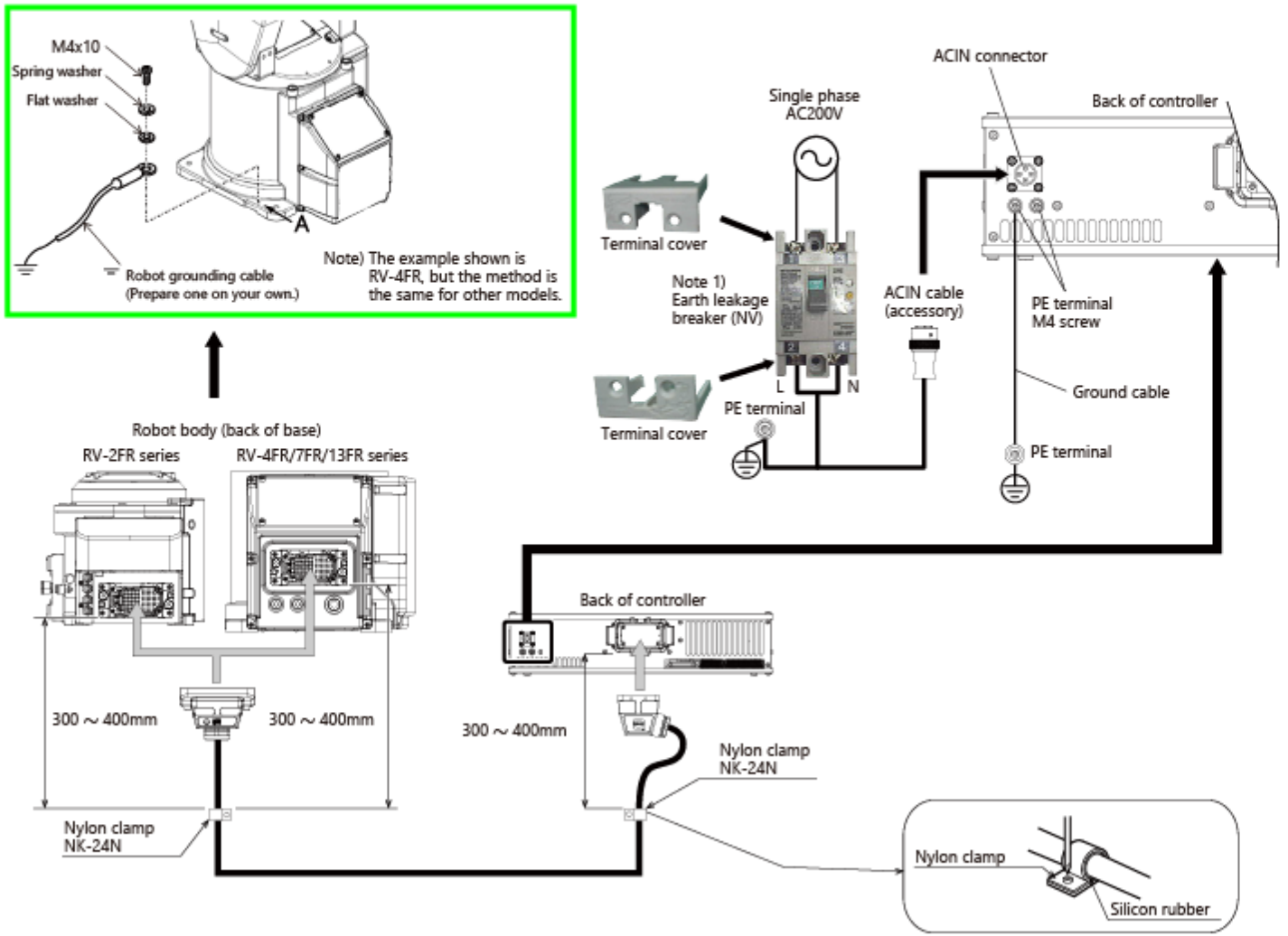
Chapter 2 Setup

Chapter 2 covers the procedures for setting the MITSUBISHI industrial robot MELFA.
Chapter 2 introduces the preparations to use a robot, such as connecting devices and setting an origin with a teaching pendant.



2.1 Connecting Devices

The following shows how to connect a robot to a robot controller, and how to connect power cables and a ground cable to the robot controller.



Note 1) Always install the terminal cover on the earth leakage breaker.

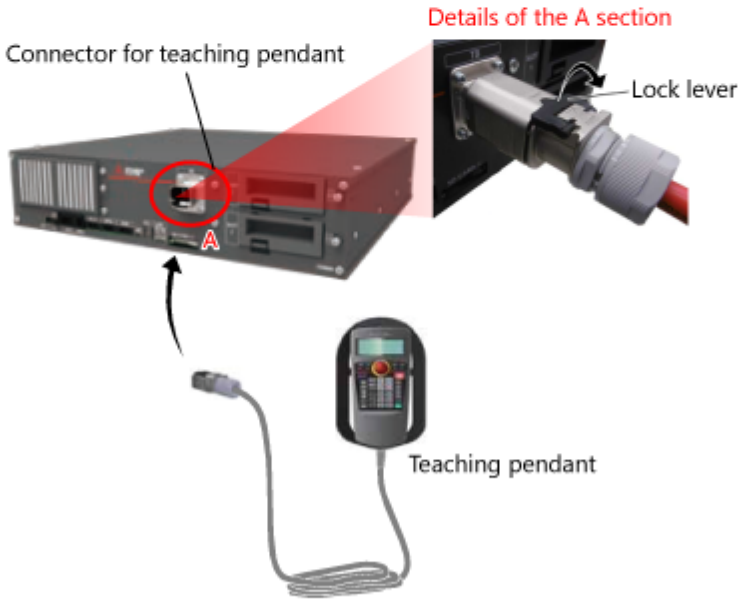
2.2 Connecting a Teaching Pendant

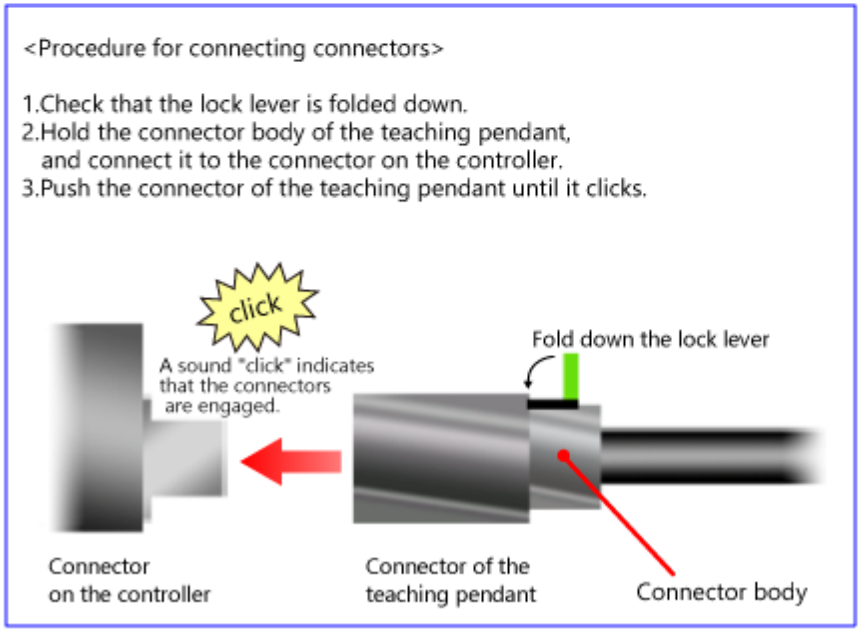
The teaching pendant must be connected or disconnected with the control power OFF. If the teaching pendant is connected or disconnected while the control power is ON, an emergency stop alarm occurs.
By pulling the teaching box connector within five seconds after switching the [Enable] switch from position 3 to position 2 (hold it lightly) during AUTOMATIC mode, the teaching pendant can be disconnected from the controller without the emergency stop alarm.

The following shows the procedure for connecting a teaching pendant.

1. Check that the POWER (power supply) switch of the robot controller is OFF.

2. Connect the connector of the teaching pendant to the connector for the teaching pendant on the robot controller.





2.3 Teaching Pendant Language Setting

This section covers the procedure for setting a language for the teaching pendant.
The standard teaching pendant (R32TB) is used to show how to set a language.
The default language is English.

Displaying configuration screen
▼
Language setting
▼
Saving settings

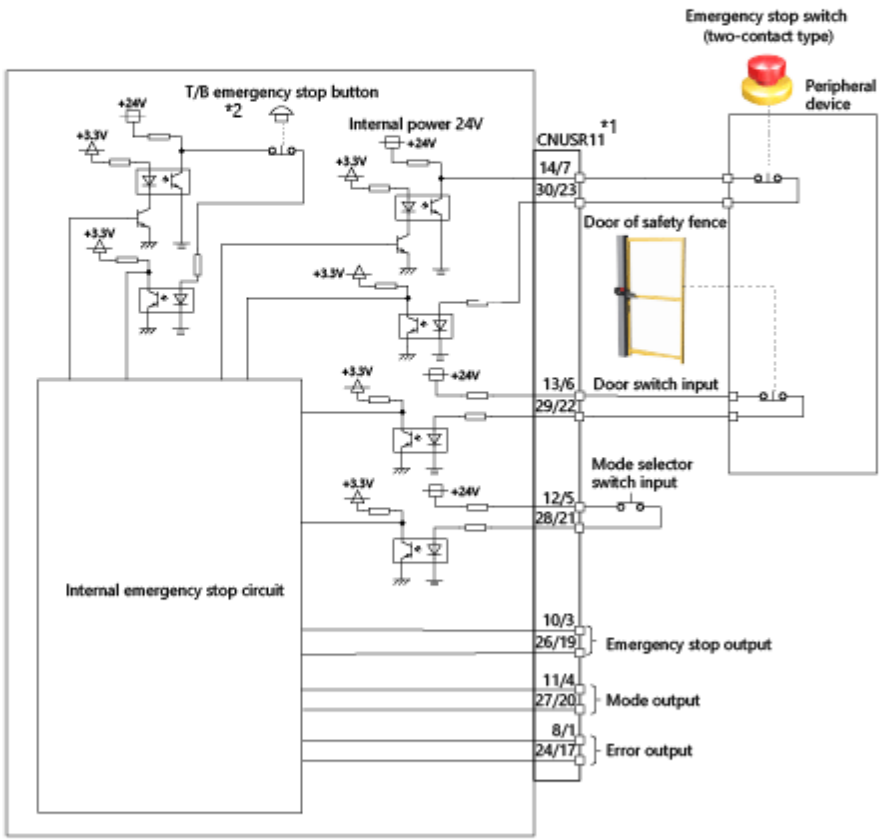
1.Configuration
2.Com.Information

<1> <2> Rset

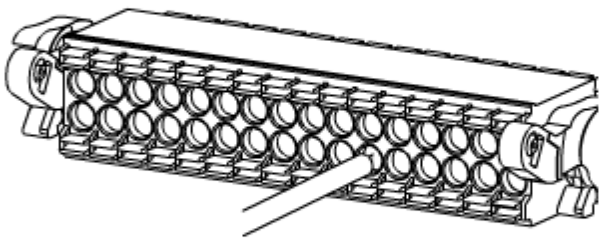
You have completed the language setting for the teaching pendant.
Proceed to the next page.

2.4 Example of Safety Measures

To use a robot, safety measures are absolutely necessary.
The robot controller has two emergency-stop input circuits on the user wiring terminal block, which implements safety measures.
Create a circuit as shown below for safety measures.



*1) Shows that CNUSR11 is two-system and has two terminals for each input and output.
The two-system connection is necessary.
*2) Shows the emergency stop button of the T/B connected to the controller.



- For more details, refer to the specifications of the model in use.
- Do not carry out wiring that is not shown in specifications or manuals. Otherwise, a malfunction or failure occurs.
- Part of the internal circuit is simplified.
- The circuit is duplicated.

2.5 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Connecting devices
- Connecting a teaching pendant
- Teaching pendant language setting
- Example of safety measures

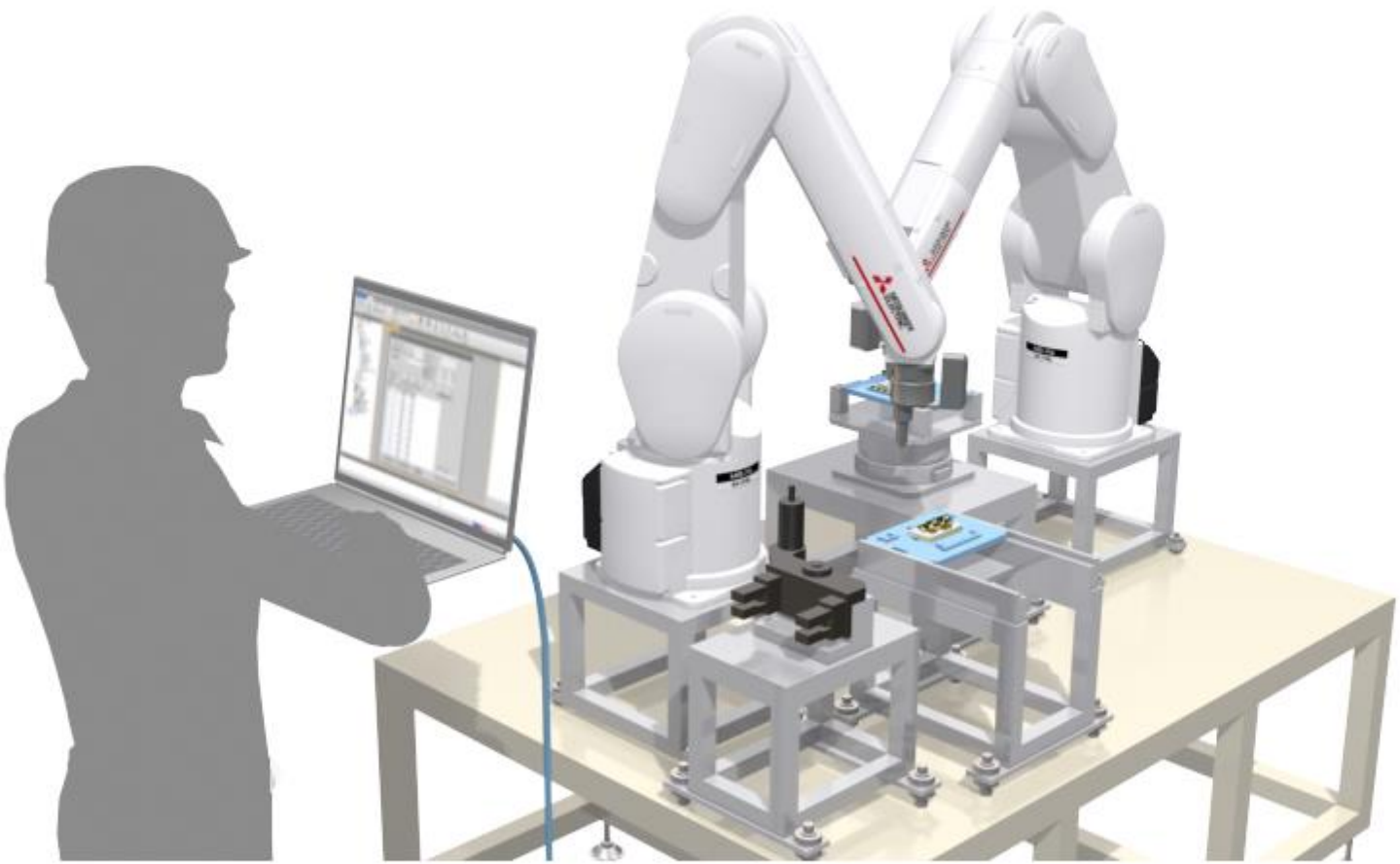
[Points]

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

Connecting devices	• You have learned to connect devices.
Connecting a teaching pendant	• Connect or disconnect a teaching pendant when the robot controller is OFF.
Teaching pendant language setting	• You have learned to switch languages of the teaching pendant.
Safety measures	• To use a robot, safety measures are absolutely necessary.

Chapter 3 Programming

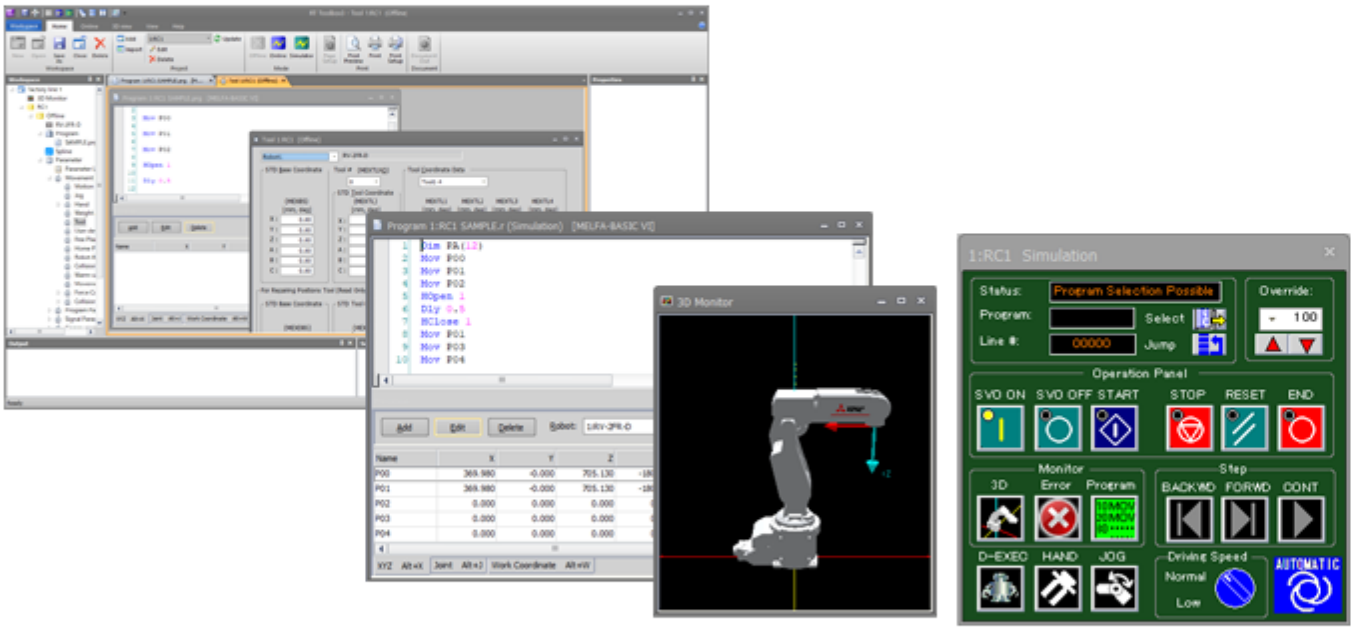
Chapter 3 covers the procedure for creating a program for the MITSUBISHI industrial robot MELFA.



3.1 Introduction of RT ToolBox3

Use the program creation and total engineering support software "RT ToolBox3" to develop programs for the MITSUBISHI industrial robot MELFA.

RT ToolBox3 is software for a personal computer and supports the phases including system setup, debug, and operation. The software enables you to create and edit programs, check the operational range before the introduction of a robot, estimate the tact time, perform debug operations at the activation of the robot, and monitor the status and errors during operations.

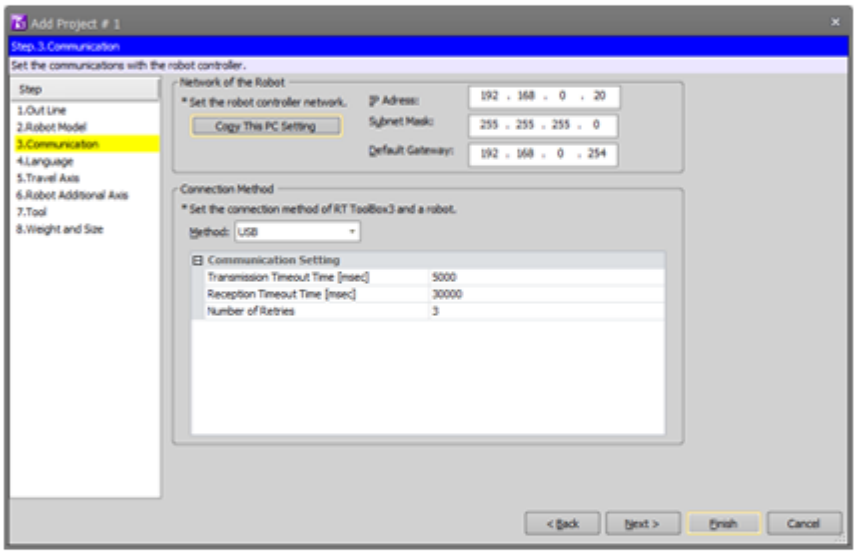


Operation windows of RT ToolBox3

3.2 Workspace Creation, Communication Setting (USB), and Connection

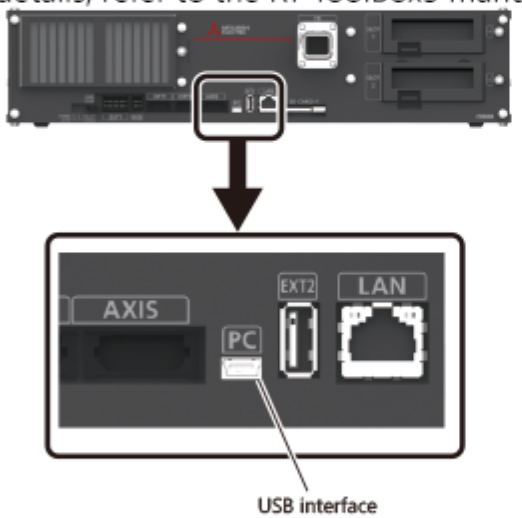
Workspace creation and communication settings are required to use RT ToolBox3.

This course describes the communication setting with a USB connection.

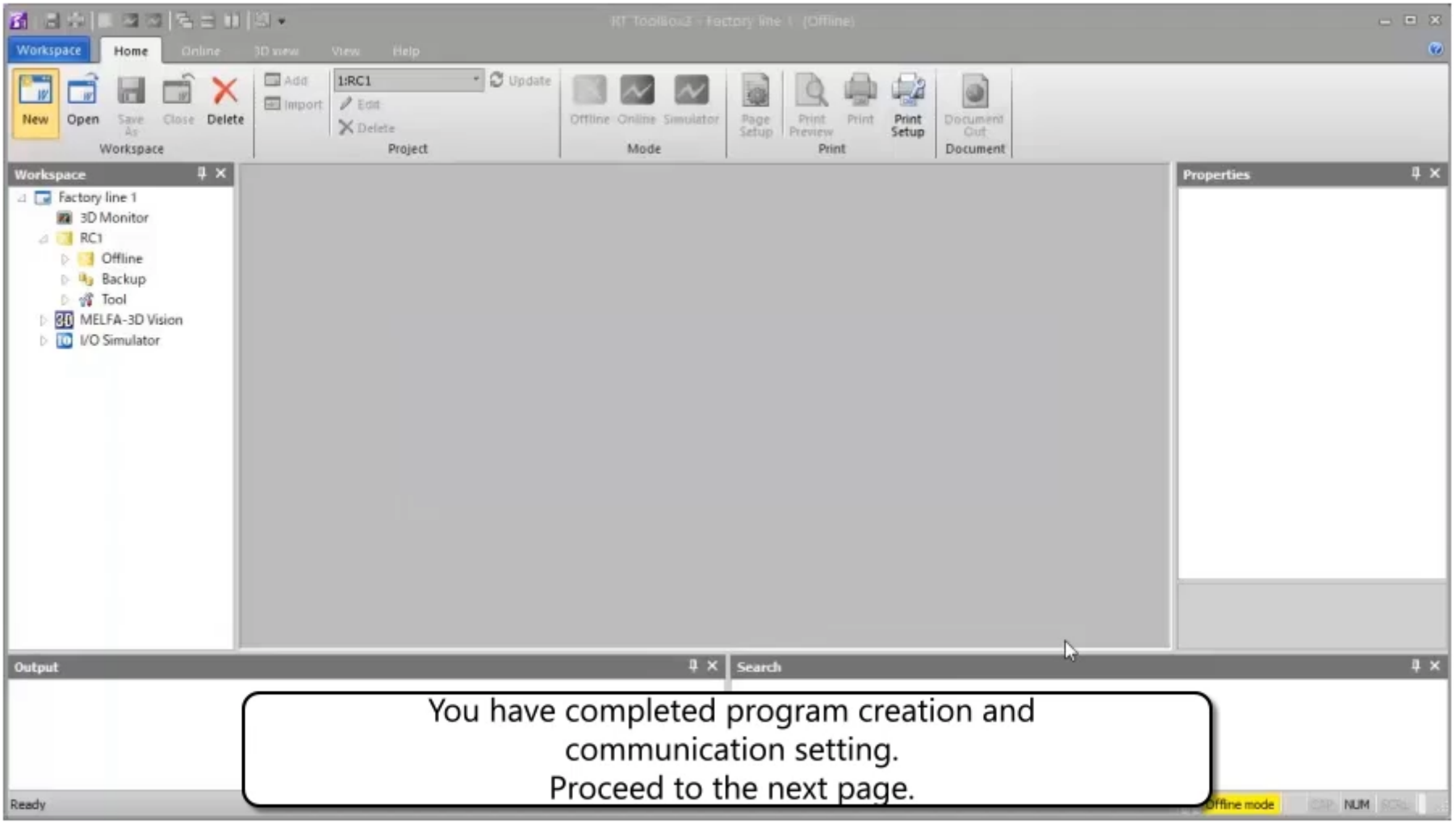


A USB driver is required to be installed before a robot controller and personal computer is connected through the USB.

For details, refer to the RT ToolBox3 manual.



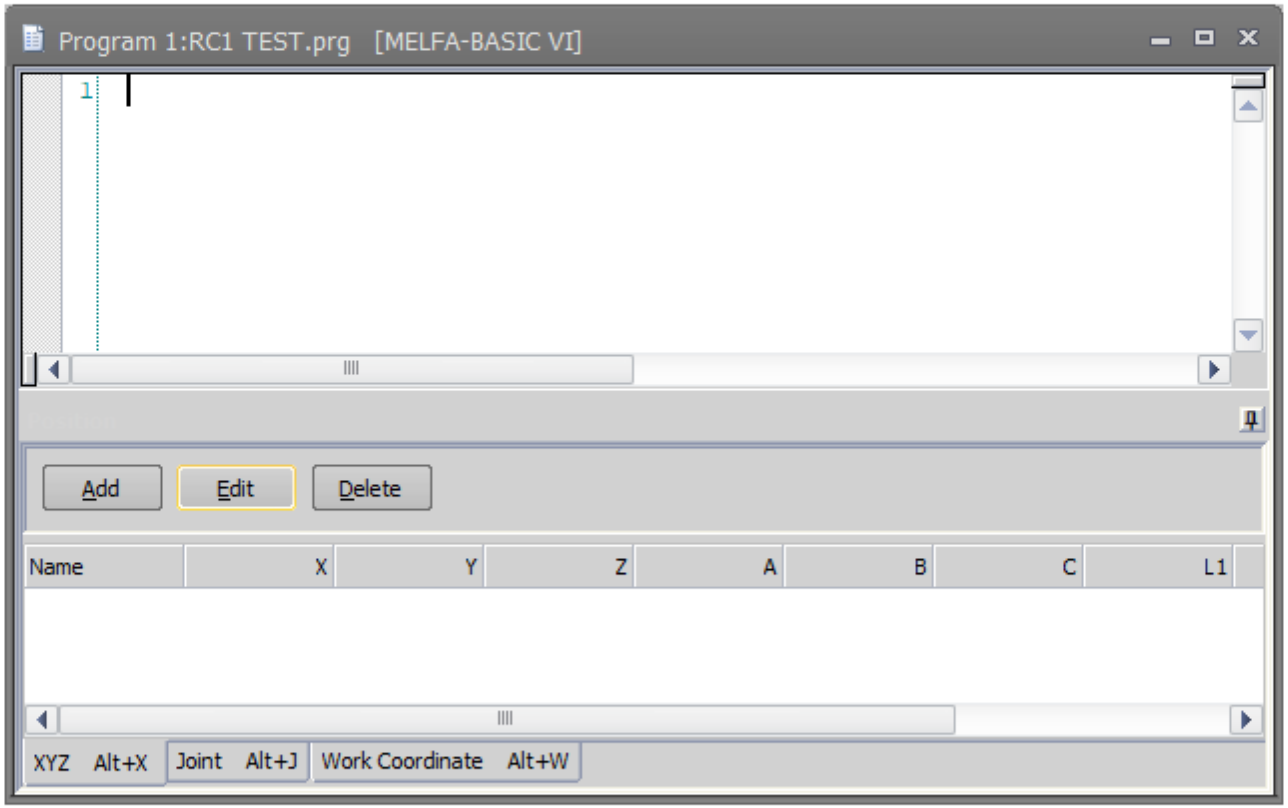
3.2 Workspace Creation, Communication Setting (USB), and Connection



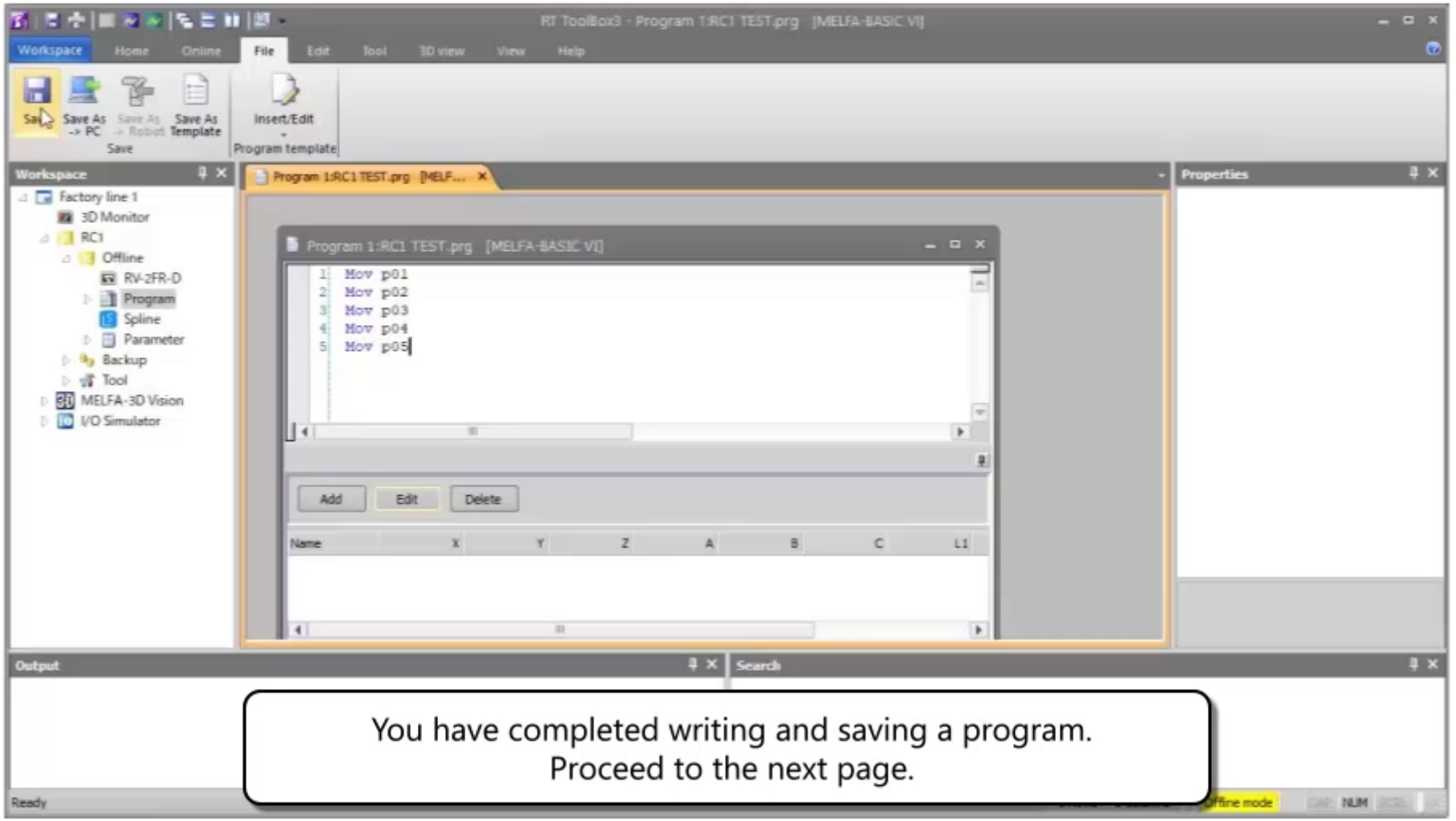
3.3 Writing and Saving Programs

Programs are written and saved with RT ToolBox3.

In this section, create a new robot program in a personal computer.



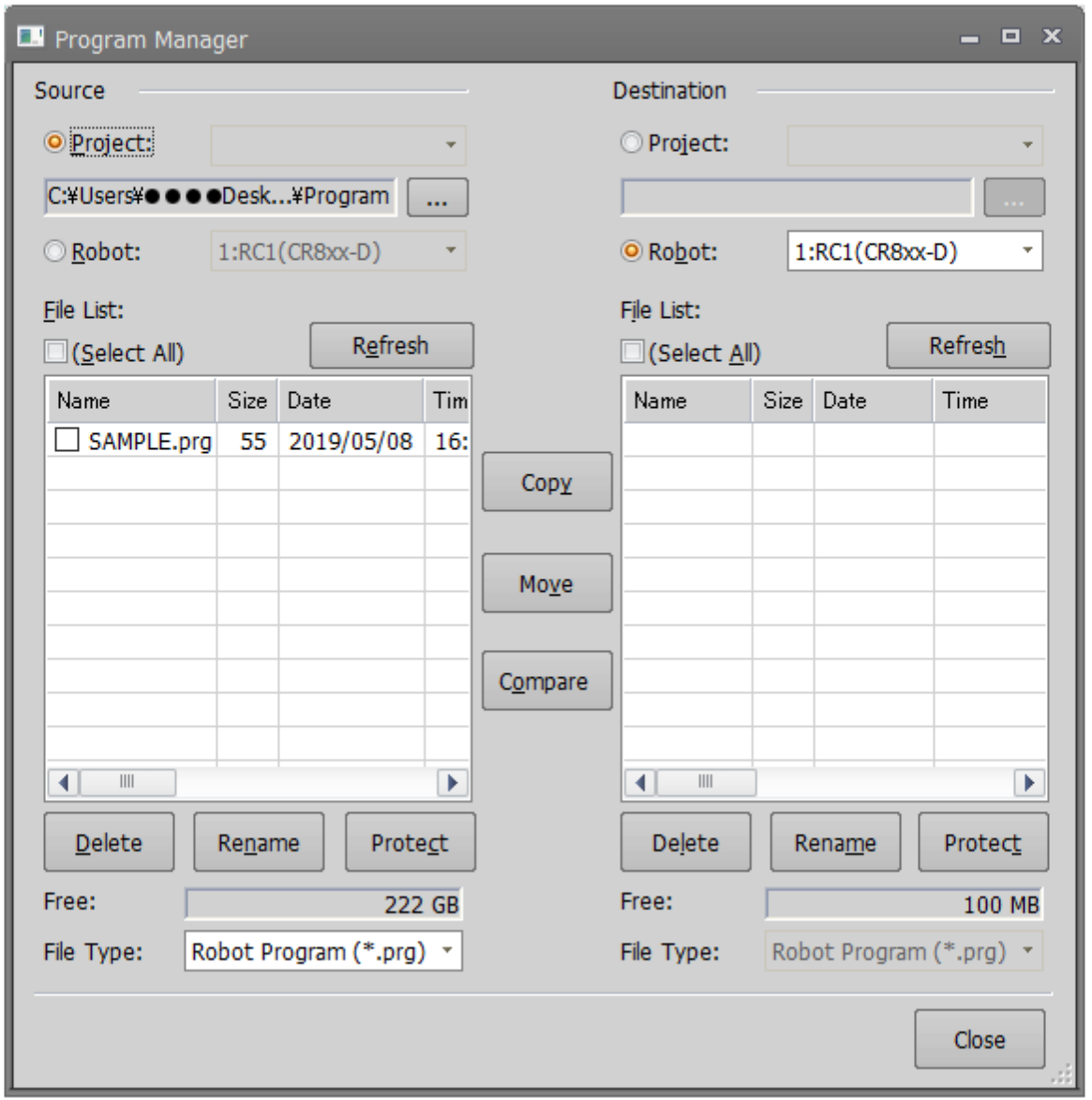
3.3 Writing and Saving Programs



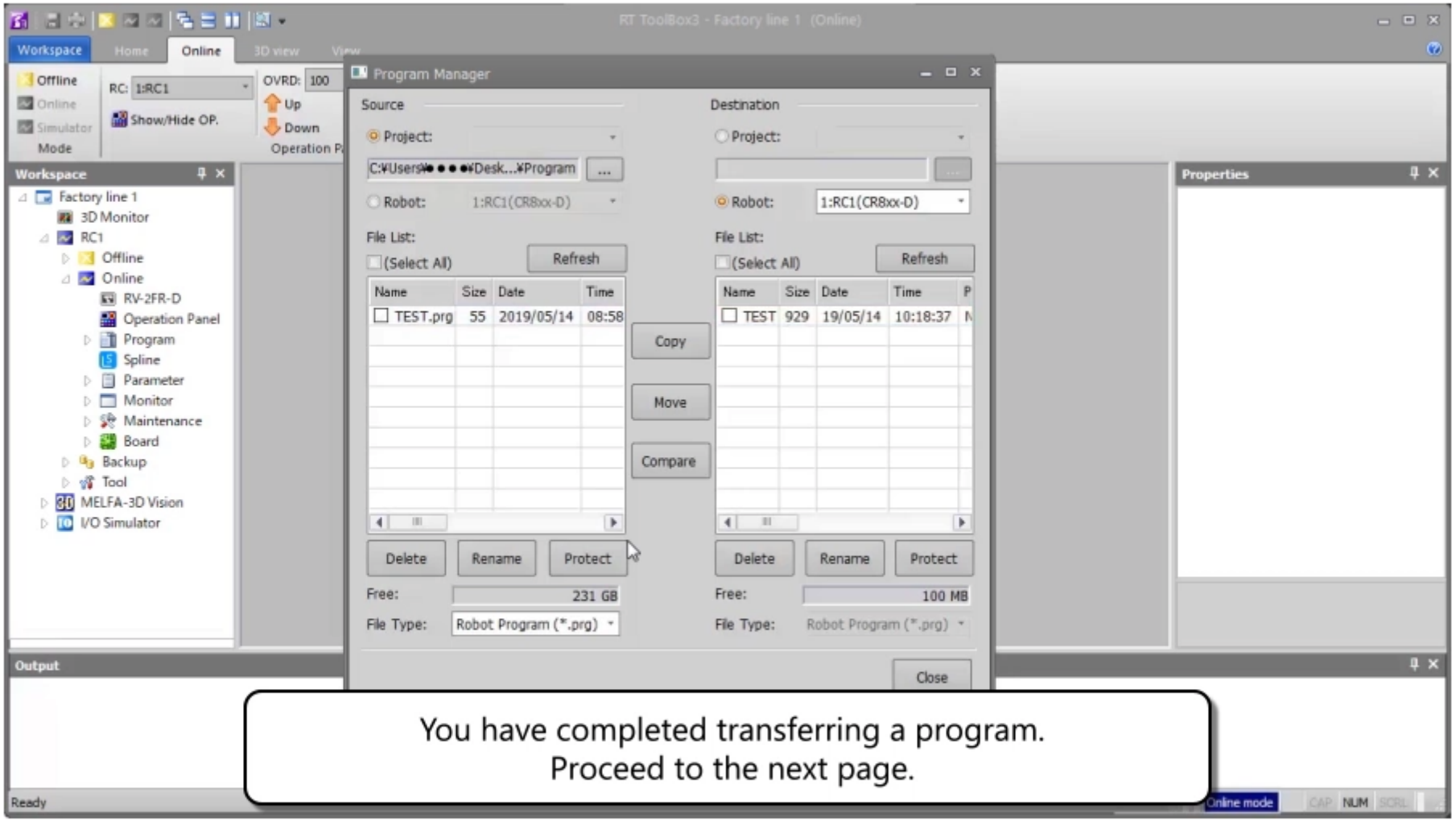
You have completed writing and saving a program.
Proceed to the next page.

3.4 Transferring Programs to a Controller

To operate a robot, a created program needs to be saved in the robot controller.
You will learn to transfer a program file from a personal computer to a robot controller using RT ToolBox3.



3.4 Transferring Programs to a Controller



You have completed transferring a program.
Proceed to the next page.

3.5 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Introduction of RT ToolBox3
- Workspace creation, communication setting (USB), and connection
- Writing and saving programs
- Transferring programs to a controller

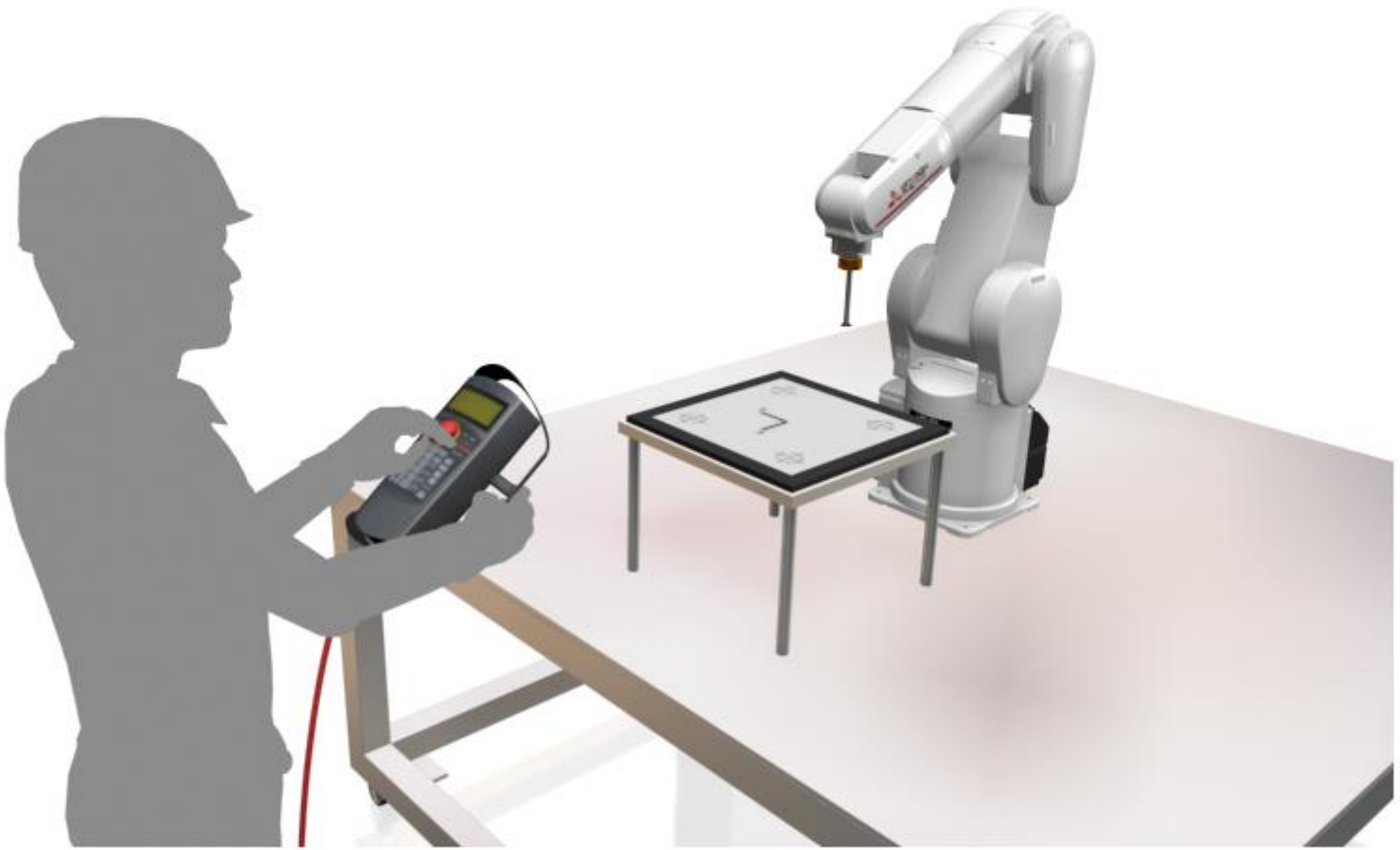
[Points]

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

Introduction of RT ToolBox3	• This software supports all the phases including system setup, debug, and operation.
Workspace creation, communication setting (USB), and connection	• You have learned about workspace creation and communication setting.
Writing and saving programs	• You have learned about writing and saving programs.
Transferring programs to a controller	• You have learned to transfer a program from a personal computer to a robot controller.

Chapter 4 Robot Operation

Chapter 4 covers robot operations with a teaching pendant.



4.1 Names and Functions of Parts of the Teaching Pendant

This section describes the names and functions of parts of the teaching pendant (R32TB/R33TB).

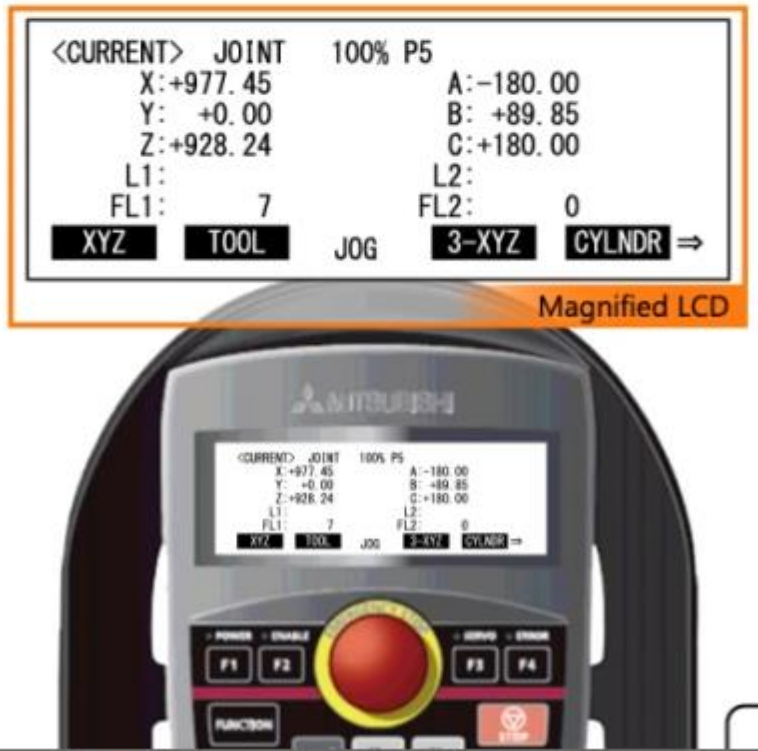
[Names and functions of parts]

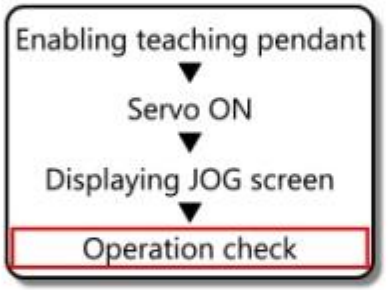
Putting the mouse cursor over each part in the table or on the figure of the teaching pendant highlights the corresponding part or description.

No	Name	Description
①	[Emergency stop] switch	The robot servo turns OFF and the operation stops immediately.
②	[Enable/Disable] switch	This switch enables or disables the robot operations with the teaching pendant.
③	Enable switch (3-position switch)	When the [Enable/Disable] switch is enabled, and this key is released or pressed with force, the servo will turn OFF, and the operating robot will stop immediately.
④	LCD display panel	The robot status and various menus are displayed.
⑤	Status display lamp	Display the state of the robot or T/B.
⑥	[F1], [F2], [F3], [F4] key	Execute the function corresponding to each function currently displayed on LCD.
⑦	[FUNCTION] key	This key switches the function display, and changes the functions assigned to [F1], [F2], [F3], and [F4] keys.
⑧	[STOP] key	This stops the program and decelerates the robot to a stop.
⑨	[OVRD↑][OVRD↓] key	These keys change the speed override of the robot.
⑩	[JOG operation] key (12 keys from [-X(J1) to [+C(J6)])	Move the robot according to jog mode. And, input the numerical value.
⑪	[SERVO] key	Pressing this key while the [Enable] switch is lightly held turns ON the robot servo.
⑫	[MONITOR] key	It becomes monitor mode and display the monitor menu.
⑬	[JOG] key	It becomes jog mode and display the jog operation.
⑭	[HAND] key	It becomes hand mode and display the hand operation.
⑮	[CHARCTER] key	This changes the edit screen, and changes between numbers and alphabetic characters.
⑯	[RESET] key	This resets the error. The program reset will execute, if this key and the [EXE] key are pressed.
⑰	[↑][↓][←][→] key	Moves the cursor each direction.
⑱	[CLEAR] key	Erase the one character on the cursor position.
⑲	[EXE] key	Input operation is fixed. And, while pressing this key, the robot moves when direct mode.
⑳	Number/Character key	Pressing this key while numerical input or character input is enabled displays a number or character.

4.2 Jog Operation on the Teaching Pendant

In this section, move the robot manually using the teaching pendant to check that the robot properly operates.
The manual operation on a robot is called "jog operation". This operation includes the JOINT jog, which moves each axis, the XYZ jog, which moves the robot along the base coordinate system, the TOOL jog, which moves the robot along the tool coordinate system, and the CYLINDER jog, which moves the robot along the circular arc.
When actually operating a robot manually, hold the 3-position [Enable] switch, which is located on the back of the teaching pendant.
(Releasing or strongly pressing this switch turns OFF the robot servo. When performing jog operation, always hold this switch lightly.)





Pressing the [Y(J2)] key moves the

4.2 Jog Operation on the Teaching Pendant

Enabling teaching pendant
▼
Servo ON
▼
Displaying JOG screen
▼
Operation check

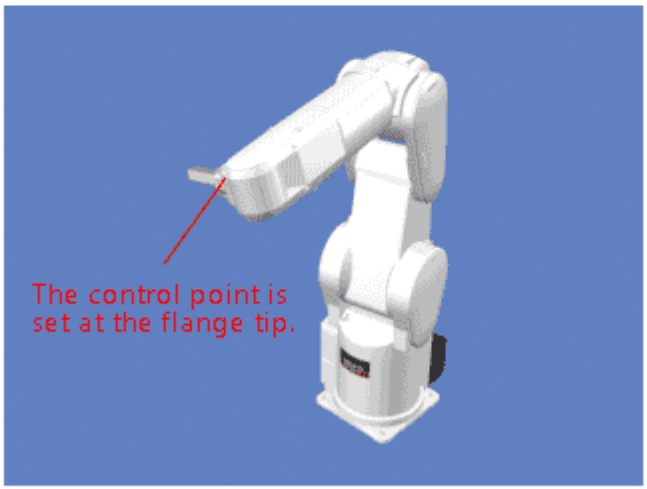
Pressing the [-Y(J2)] key moves the arm in the negative direction. Check the operation, and proceed to the next page.

4.3 Tool Setting Procedure

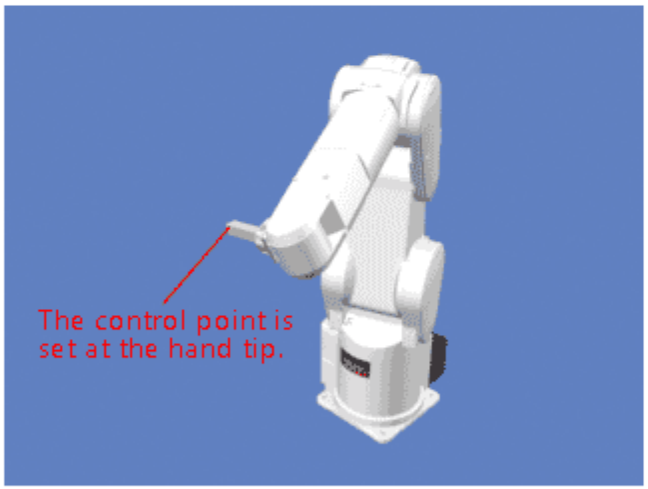
When a hand is attached to the robot, setting the hand tip as a control point of the robot may facilitate the operation.
In such a case, setting tool data for the robot is necessary.
There are three methods of setting the data.

- MEXTL parameter
- Tool instruction in the robot program
- Setting a tool number for the M_Tool variable (The values in the parameters from MEXTL1 to MEXTL4 are the tool data.)

[Operations before and after the tool setting]



Before the tool setting



After the tool setting

4.3 Tool Setting Procedure (Setting with Parameter MEXTL)

In this section, simulate the tool setting.

Enabling teaching pendant
▼
Displaying parameter screen
▼
Parameter setting

<PARAMETER> NAME(MEXTL)
DATA ELE(3)
(100)

DATA Prev 123 Next CLOSE

Magnified LCD

You have completed the tool setting.
Proceed to the next page.

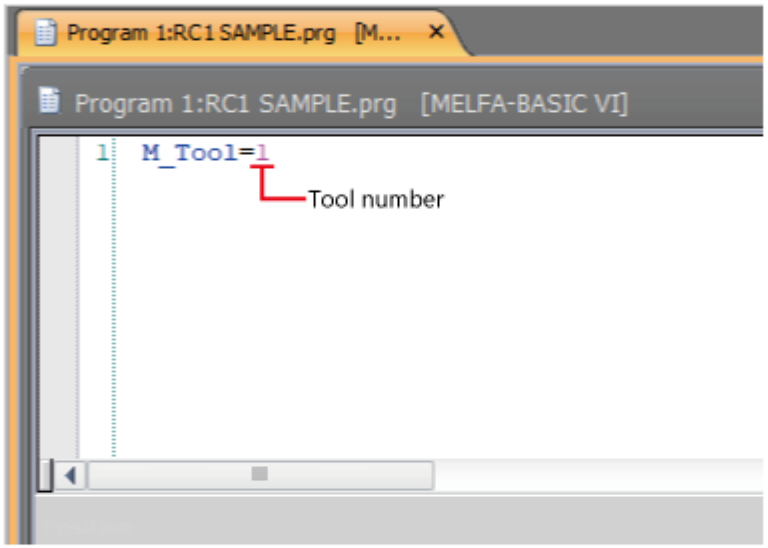
4.3 Tool Setting Procedure (Setting with Tool Instruction in Robot Program)

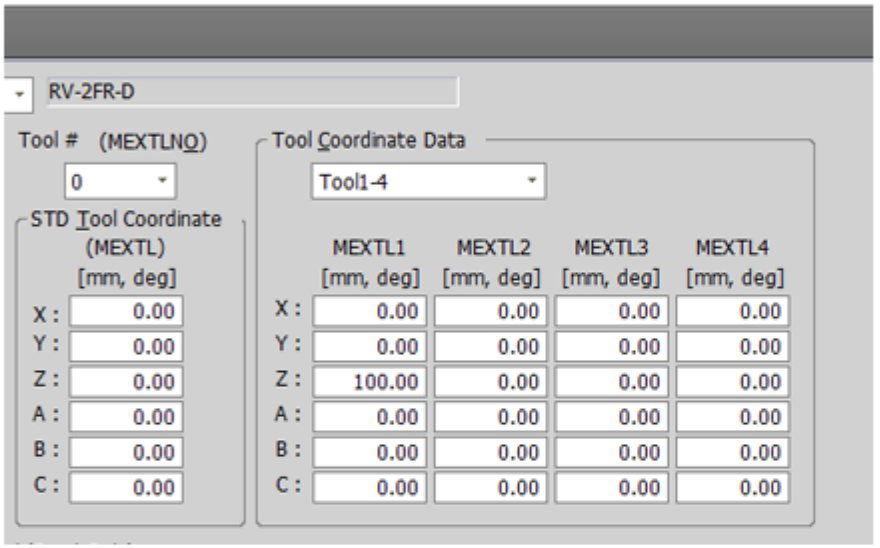
This section describes the setting procedure with the Tool instruction in the robot program.
The following figure shows the setting when the setting value of Z-axis is changed from 0 to 100 mm.

Symbol	Description
X	Travel distance to X-axis direction (unit: mm)
Y	Travel distance to Y-axis direction (unit: mm)
Z	Travel distance to Z-axis direction (unit: mm)
A	Rotation centering on X-axis (unit: deg)
B	Rotation centering on Y-axis (unit: deg)
C	Rotation centering on Z-axis (unit: deg)

4.3 Tool Setting Procedure (Setting Tool Number for M_Tool Variable)

This section describes the procedure to set the tool number for the M_Tool variable.
The following figure shows the setting when the setting value of Z-axis is changed from 0 to 100 mm.
In the following figure, the tool data is changed by verifying the value of tool number 1 (MEXTL1).





4.4 Hand Open/Close

This section describes the open/close operations on the hand attached to a robot.
The teaching pendant can open/close four hands with the standard setting. Hand 1 is assigned to the C-axis, hand 2 to the B-axis, hand 3 to the A-axis, and hand 4 to the Z-axis. Pressing the [+] key opens the hands and the [-] key closes them.

Enabling teaching pendant
▼
Display hand screen
▼
Operation check

Check the operation, and proceed to the next page.

4.5 Hand Alignment

The posture of the hand attached to the robot can be aligned in units of 90 degrees.
This feature moves the robot to the position where the A, B, and C components of the current position are set at the closest values in units of 90 degrees.

Enabling teaching pendant
▼
Servo ON
▼
Displaying hand screen
▼
Hand alignment

You have completed hand alignment.
Proceed to the next page.

4.6 Teaching

After a robot is moved to a position with jog operation or other methods, the position can be taught to a position variable in the program. The position is overwritten (corrected) if teaching has already been carried out. There are two methods of teaching: command edit screen and position edit screen.

Displaying step number input screen
▼
Displaying confirmation screen
▼
Registering current position

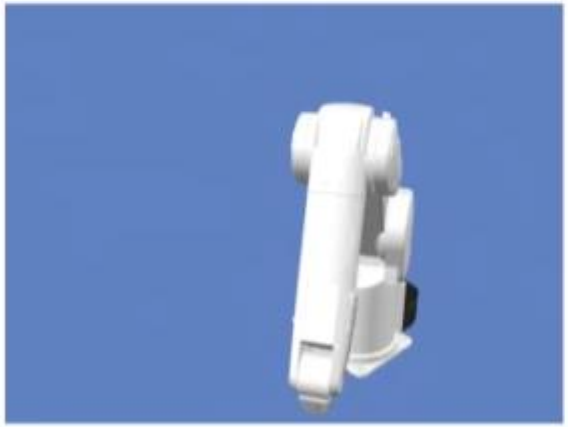
<PROGRAM> 1 100%
4 Mov P4
5 Mov P5
6 END
EDIT DELETE 123 INSERT TEACH ⇒

You have completed the teaching operation.
Proceed to the next page.

4.7 Operation Check (Step Feed)

Before starting automatic operation on a robot, check the operation by executing each step of the program (step feed).

Enabling teaching pendant
▼
Servo ON
▼
Step feed



You have completed the operation check (step feed).
Proceed to the next page.

4.8 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Names and functions of parts of the teaching pendant
- Jog operation on the teaching pendant
- Tool setting procedure
- Hand open/close, hand alignment
- Operation check (step feed)

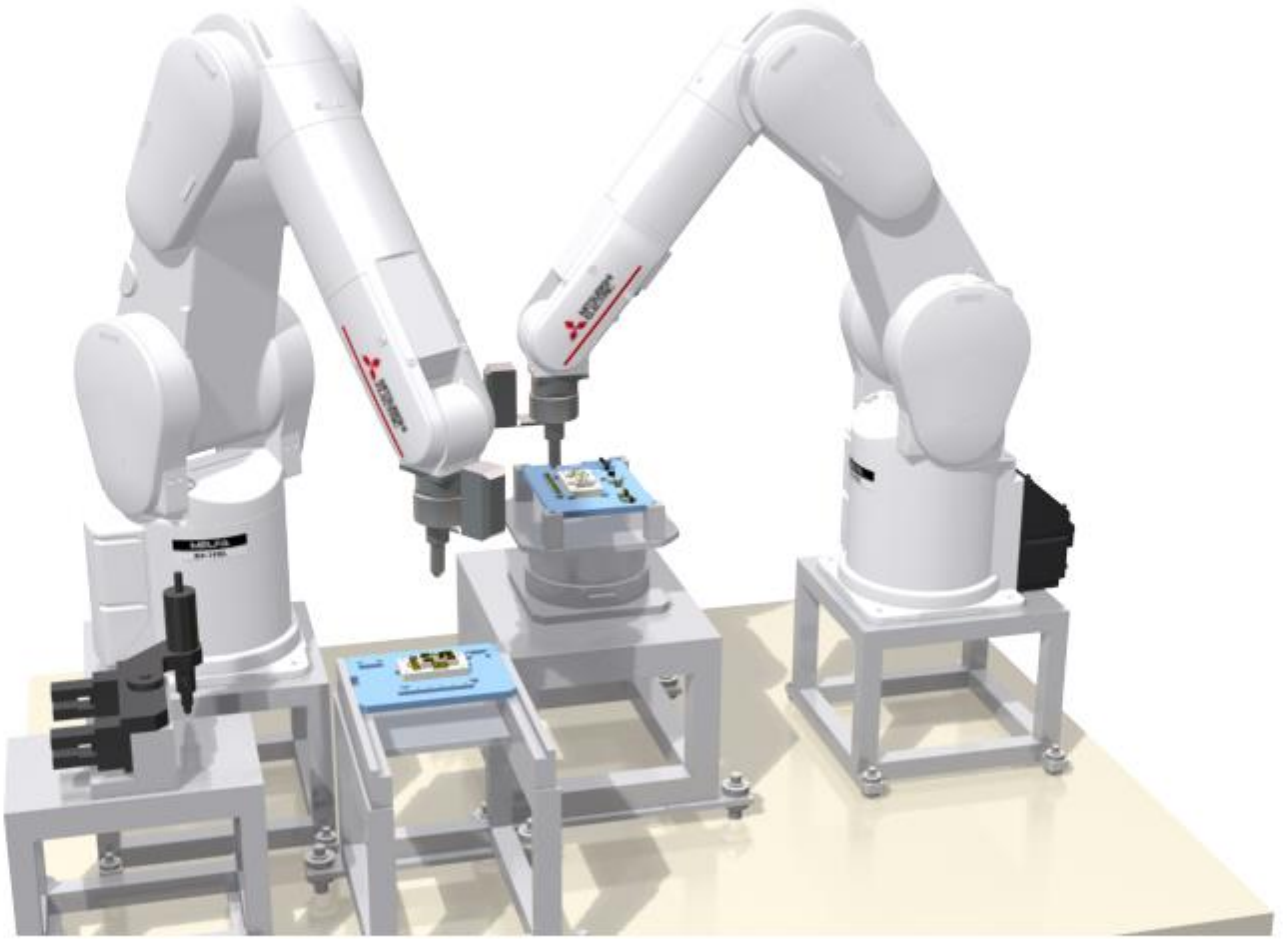
[Points]

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

Names and functions of parts of the teaching pendant	• You have learned about the names and functions of parts of the teaching pendant.
Jog operation on the teaching pendant	• You have learned about the jog operation and movement with the teaching pendant.
Tool setting procedure	• You have learned about the tool setting procedure.
Hand open/close, hand alignment	• You have learned to open/close and align a hand.
Operation check (step feed)	• You have learned to check the operation by step feed.

Chapter 5 Automatic Operation

Chapter 5 covers robot automatic operation.

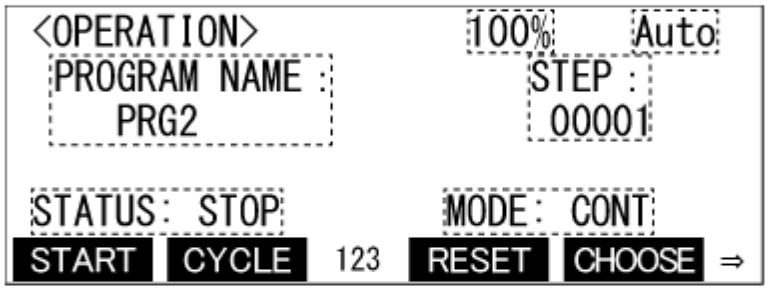


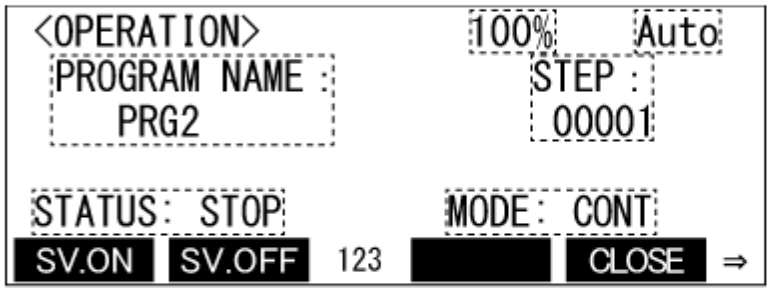
5.1 Function of Operation Panel Screen

This section describes the names and functions in the operation screen of the teaching pendant (R32TB/R33TB).

[Names and functions of parts]

Putting the mouse cursor over each part in the table or on the figure of the operation panel screen highlights the corresponding part or description.





Name	Description
Setting speed	Displays the setting speed.
Mode of controller	Displays the mode of controller.
Program name	Displays the selected program name.
Program execution state	Displays the program execution state.
Line number in execution	Displays the line number being executed.
Operation mode	Displays the operation mode.
START	Switches the screen from start of program execution or during program stop, to restart <STARTING PROGRAM> screen.
CONT. / CYCLE.	Switches the operation mode.

5.1 Function of Operation Panel Screen

RESET	Cancels the program pause, and releases the alarm with program reset when there is an alarm.
CHOOSE	Select the program to be started. Switches to the <PROGRAM CHOICE> screen.
SV.ON / SV.OFF	Turns ON/OFF the servo power.
CLOSE	Ends (ends the starting operation from the T/B) the <OPERATION> screen.

5.2 Operations on the Operation Panel

This section describes operations on the operation panel. This section shows an example of how the operating speed setting is changed and the program is started.

Displaying program selection screen
▼
Changing override
▼
Selecting program
▼
Servo ON
▼
Starting automatic operation
▼
Changing mode

You have learned about operations on the operation panel.
Proceed to the next page.

5.3 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Function of operation screen
- Operations on the operation screen

[Points]

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

Function of operation screen	• You have learned the functions of the operation screen.
Operations on the operation screen	• You have learned the operations on the operation screen.

Chapter 6 Maintenance

Chapter 6 covers maintenance and inspection required for long trouble-free service of robots.

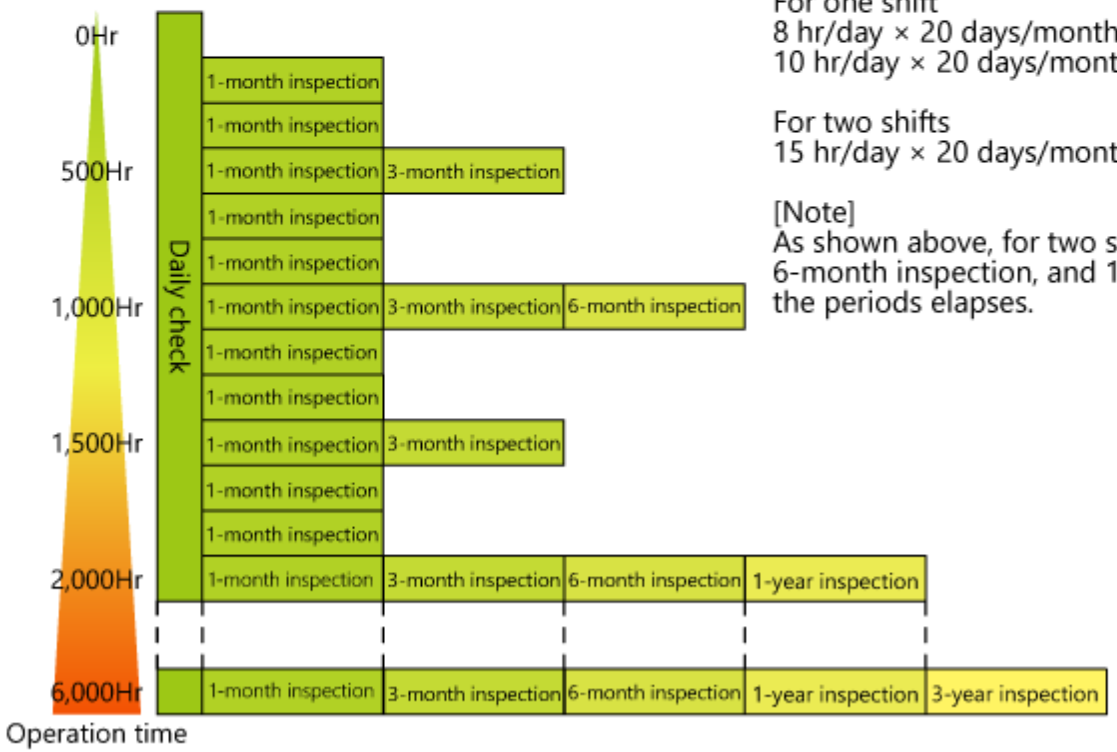
6.1 Maintenance and Inspection

Maintenance and inspection include daily checks and periodic checks. The checks are necessary to prevent failures for safety and prolonged use.

The maintenance and inspection cycles and the check list are shown below.

[Maintenance and inspection cycle] (For RV-2FR-R/D)

<Inspection schedule>



<Estimation of inspection cycle>

For one shift
8 hr/day × 20 days/month × 3 months = approx. 500 hr
10 hr/day × 20 days/month × 3 months = approx. 600 hr

For two shifts
15 hr/day × 20 days/month × 3 months = approx. 1,000 hr

[Note]
As shown above, for two shifts, carry out 3-month inspection, 6-month inspection, and 1-year inspection when half the periods elapses.

6.1 Maintenance and Inspection

[Check item] (For RV-2FR-R/D)

<Daily check item>

Step	Check item (detail)	Remedy
Before power-ON (Check the following items before power-ON.)		
1	Check the robot for loose installation bolts. (Visual check)	Tighten the bolts securely.
2	Check the cover for loose fixing screws. (Visual check)	Tighten the screws securely.
3	Check the hand for loose fixing bolts. (Visual check)	Tighten the bolts securely.
4	Check that the power cable is securely connected. (Visual check)	Connect the cable securely.
5	Check that the cables between the robot and controller are securely connected. (Visual check)	Connect the cable securely.
6	Check that there are no cracks and foreign substances on the robot and no objects that cause interference with the robot.	Replace parts with new ones, or take temporal measures.
7	Check that no leakage of grease is found from the robot body. (Visual check)	Clean the robot, and fill grease.
8	Check that the air pressure system is in a normal condition. Check that air is not leaked, water is not collected in the drain, the hoses are not folded, and the air source is in a normal condition. (Visual check)	Take measures against water collection and air leakage (or replace parts).
After power-ON (Watch the robot when turning it ON.)		
1	Check that powering ON the robot does not cause to abnormal operation or sound.	Refer to troubleshooting.
During operation (Use your own program.)		
1	Check that the point of operation is not deviated from alignment. Check the following if a deviation occurs. 1)Check that the installation bolts are secure	Refer to troubleshooting.

	1:Check that the installation bolts are secure. 2:Check that the hand fixing bolts are secure. 3:Check that the jigs around the robot are not displaced. 4:If the position is not corrected, refer to "Troubleshooting" and carry out checking and take measures.	
2	Check abnormal operation or noise. (Visual check)	Refer to troubleshooting.

6.1 Maintenance and Inspection

[Check item] (For RV-2FR-R/D)

<Periodic check list>

Step	Check item (detail)	Remedy
1-month check item		
1	Check that the bolts and screws used for the robot body are secure.	Tighten the bolts securely.
2	Check that the connector fixing screws and terminal screws on the terminal block are secure.	Tighten the screws securely.
3	Remove all covers, and check that no scratches by rubbing and foreign substances are on the cables.	Examine the cause and eliminate. If a cable is considerably damaged, contact MITSUBISHI service sector.
3-month check item		
1	Check that the tension in the timing belt is proper.	Adjust the tension if the belt is too stretched or too loosened.
6-month check item		
1	Check that the tooth part of the timing belt is not too worn out.	If the teeth are considerably chipped or worn out, replace the belt.
1-year check item		
1	Replace the backup batteries in the robot.	Refer to "Section 6.4 Battery Replacement Procedure" to replace the batteries.
3-year check item		
1	Lubricate the grease at the reduction gears for each axis.	Refer to "Section 6.3 Greasing Procedure" to carry out greasing.

6.2 Filter Inspection/Cleaning/Replacement Procedure

A filter is installed in the controller.

You have completed filter inspection and cleaning.
Proceed to the next page.

6.3 Greasing Procedure

The following shows the locations of greasing and the replacement procedure.
(The procedure may differ depending on the model. For details, refer to the manual for the model in use.)

6.4 Battery Replacement Procedure

[Robot arm]
An absolute encoder is installed into the robot to detect the position on each axis.
While the power is shut OFF, the position data in the encoder is backed up by backup batteries.
The batteries are installed at production shipments. Replace these consumables approximately once a year.

If the batteries are replaced after running out, the ABS origin setting described in section 6.5 is necessary.

For the battery replacement procedure, watch the video below.
(The procedure may differ depending on the model. For details, refer to the manual for the model in use.)

6.5 Resetting the Origin (ABS Origin Setting)

When the origin setting of the robot is performed for the first time, the MITSUBISHI industrial robot MELFA records the angular position of the origin within one rotation of the encoder as the offset value. If the origin setting is performed using the ABS origin method, this value is used to suppress variations in the origin setting operations and to reproduce the initial origin position accurately.

If the battery goes dead and the origin data at shipment is erased, it is necessary to set the origin again. This section introduces the ABS method that is necessary for the reset.

Displaying ORIGIN/BRK screen
▼
Selecting ABS method
▼
Inputting origin
▼
Setting origin

<ORIGIN> ABS COMPLETED

J1:(1) J2:(1) J3:(1)
J4:(1) J5:(1) J6:(1)
J7:( ) J8:( )

123 CLOSE

You have completed the origin setting with the ABS method. Proceed to the next page.

6.5 Resetting the Origin (ABS Origin Setting)

Displaying ORIGIN/BRK screen
▼
Selecting ABS method
▼
Inputting origin
▼
Setting origin

<ORIGIN> ABS COMPLETED

J1:(1) J2:(1) J3:(1)
J4:(1) J5:(1) J6:(1)
J7:( ) J8:( )

123 CLOSE

You have completed the origin setting with the ABS method.
Proceed to the next page.

6.6 Jig-method Origin Setting

This section introduces the procedure for setting an origin using jigs.
When the motor is replaced or the robot position is misaligned, the origin needs to be set again. This section introduces the jig method that is necessary for the reset.

For the details of the origin setting with the jig method, watch the video below.
(The procedure may differ depending on the model. For details, refer to the manual for the model in use.)

6.7 Summary of This Chapter

Below is a list of the topics that you studied in this chapter.

- Maintenance and inspection
- Filter inspection/cleaning/replacement procedure
- Greasing procedure
- Battery replacement procedure
- ABS origin setting
- Jig-method origin setting

After-sales service
Mitsubishi Electric System & Service Co., Ltd. will be the contact for maintenance service including repairs and inspection. Please consult your local Mitsubishi Electric System & Service Co., Ltd.

[Points]

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

Maintenance and inspection	• You have learned about the maintenance and inspection cycles and the check items.
Filter inspection/cleaning/replacement procedure	• You have learned about the filter inspection, cleaning, and replacement procedures.
Greasing procedure	• You have learned to grease the robot.
Battery replacement procedure	• You have learned to replace batteries in the robot and robot controller.

6.7 Summary of This Chapter

ABS origin setting	• You have learned about the origin setting with the ABS method.
Jig-method Origin Setting	• You have learned about the origin setting with the jig method.

Test Final Test

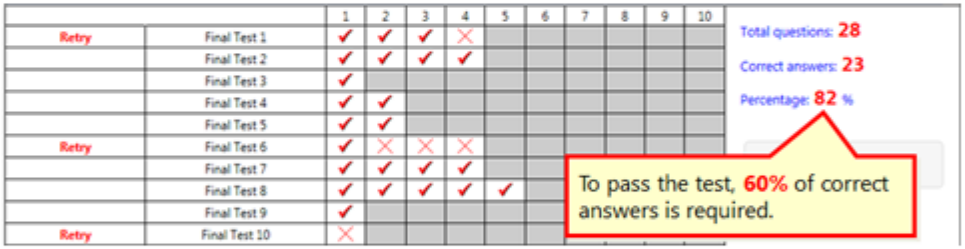
Now that you have completed all of the lessons of the **MELFA Basic Operations and Maintenance (FR Series D Type)** Course, you are ready to take the final test. If you are unclear on any of the topics covered, please take this opportunity to review those topics.

There are a total of 12 questions (57 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**

The following text describes the configuration of the MITSUBISHI industrial robot MELFA. Fill in each gap with an appropriate option.

- The MITSUBISHI industrial robot MELFA has two types: (Q1), which is the vertical, multiple-joint type, and (Q2), which is the horizontal, multiple-joint type.
- Three types of the robot controller are available: (Q3), which is the standalone robot controller, and (Q4), which is the iQ Platform-compatible controller.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Test **Final Test 2**

Select model names that match each specification.

Robot specifications	Model name
Vertical, multiple-joint type, D type, load capacity of 7 kg	(Q1)
Horizontal, multiple-joint type, D type, load capacity of 6 kg	(Q2)
Vertical, multiple-joint type, R type, load capacity of 7 kg, long arm	(Q3)
Horizontal, multiple-joint type, Q type, load capacity of 12 kg	(Q4)

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Test **Final Test 3**

The following text describes connection of the teaching pendant and the origin setting with the teaching pendant.
Fill in each gap with an appropriate option.

- The teaching pendant must be connected during power (Q1) . If the power is (Q2) and no teaching pendant is connected to the controller, an emergency stop alarm occurs.
- In the AUTOMATIC mode, the teaching pendant can be removed from the controller without generating an emergency stop alarm by pulling out the teaching pendant connector within five seconds after holding (Q3) of the teaching pendant lightly (as shown in

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Test **Final Test 4**

The following text describes the language setting for the teaching pendant. Select an appropriate option for each gap.

1. Turn on the teaching pendant with both the [F1] key and (Q1) on the teaching pendant held.
2. On the initial setting screen, press the [F1] key to select "1. Configuration".
3. On the screen displayed, select " (Q2) " by pressing the [F1] key to display the language setting screen.
4. To select Japanese, press the [F1] or (Q3). This displays " (Q4) " on the screen.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Q5 Select the appropriate word or phrase

Q6 Select the appropriate word or phrase

Test **Final Test 5**

The following table lists the functions of RT ToolBox3.
Select ○ for correct descriptions and × for incorrect ones.

Function	Answer
Creating robot programs	(Q1)
Jog operation on robot	(Q2)
Checking robot operational range	(Q3)
Estimating tact time of robots	(Q4)
Switching robot operation modes between manual and automatic	(Q5)

Q1 Choose

Q2 Choose

Q3 Choose

Q4 Choose

Q5 Choose

Test **Final Test 6**

The following text describes the procedure for creating a program with RT ToolBox3 and transferring the program to the robot controller. Select an appropriate option for each gap.

1. Activate (Q1) .
2. Create a new (Q2) .
3. In the project setting window, configure the communication setting to communicate with the robot controller.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Q5 Select the appropriate word or phrase

Test **Final Test 7**

Select the names of parts of the teaching pendant that are required to use in the operations below.

Operation	Name
Switch that turns OFF the robot servo and immediately stops the robot regardless of whether the teaching pendant is enabled or disabled	(Q1)
Switch that enables or disables the robot operations with the teaching pendant.	(Q2)
"Releasing or strongly pressing this switch in the manual mode turns OFF the robot servo. To carry out operations that can be performed while the robot servo is ON, such as jog, this switch must be lightly held."	(Q3)
These keys change the speed override of the robot.	(Q4)

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Test **Final Test 8**

The following text describes the procedure for checking a program with a teaching pendant.
Select an appropriate option for each gap.

1. Open the (Q1) for the program.
2. Press the (Q2) key to display "FWD" and "BWD" on the function menu at the bottom of the screen.
3. Hold the (Q3) lightly and press the [SERVO] key to turn ON the robot servo.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Test **Final Test 9**

Select the names in the operation panel screen of the teaching pendant that are required to use in the operations below.

Operation	Name
Restart from start of program execution or during program stop.	(Q1)
Switch the operation mode.	(Q2)
Cancel program pause and reset the program. During alarm occurrence, the alarm is released.	(Q3)
Turn ON/OFF the servo power.	(Q4)

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Test **Final Test 10**

Automatic operation procedure
The following text describes the procedure for automatic operation of a robot program. Select an appropriate option for each gap.

1) Set the [MODE] switch of the mode selector switch to (Q1) .
2) Press the (Q2) to reduce the operating speed.
3) Press the function key [F4] assigned to (Q3) in the operation screen to display the Program choice screen.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Q5 Select the appropriate word or phrase

Q6 Select the appropriate word or phrase

Q7 Select the appropriate word or phrase

Test **Final Test 11**

Select the inspection cycles for the check items below.

Check item	Inspection timing
Tension of the timing belt	(Q1)
Leakage of grease from the robot body	(Q2)
Replacement of backup batteries	(Q3)
Cracks and foreign substances on the robot and objects that cause interference	(Q4)
Greasing the reduction gear of each axis	(Q5)

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Q5 Select the appropriate word or phrase

Test **Final Test 12**

The following texts describe the procedure for replacing the batteries in a robot. Select correct step numbers.

(Q1) Replace the old backup batteries with new ones one by one.
Replace all batteries at one time.
(Q2) Turn OFF the power.
(Q3) Install the battery cover.

Q1 Select the appropriate word or phrase

Q2 Select the appropriate word or phrase

Q3 Select the appropriate word or phrase

Q4 Select the appropriate word or phrase

Q5 Select the appropriate word or phrase

Test Score

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

		1	2	3	4	5	6	7	8	9	10	11	12
	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	✓	✓	✓	✓								
	Final Test 10	✓	✓	✓	✓	✓	✓	✓					
	Final Test 11	✓	✓	✓	✓	✓							
	Final Test 12	✓	✓	✓	✓	✓							

Total questions: **55**

Correct answers: **55**

Percentage: **100** %

Clear

You have completed the "Industrial Robot MELFA Basic Operations and Maintenance (FR Series D Type)" Course.

Thank you for taking this course.

We hope you enjoyed the lessons and the information you acquired in this course is useful for configuring systems in the future.

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

Review

Close