



CFD CONTROLLER INSTRUCTION MANUAL BASIC OPERATIONS MANUAL

2nd edition

- Before attempting to operate the robot, please read through this operating manual carefully, and comply with all the safety-related items and instructions in the text.
- The installation, operation and maintenance of this robot should be undertaken only by those individuals who have attended one of our robot course.
- When using this robot, observe the law related with industrial robot and with safety issues in each country.
- This operating manual must be given without fail to the individual who will be actually operating the robot.
- Please direct any queries about parts of this operating manual which may not be completely clear or any inquiries concerning the after-sale service of this robot to any of the service centers listed on the back cover.

NACHI-FUJIKOSHI CORP.

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NOTE

Chapter 1 Introduction

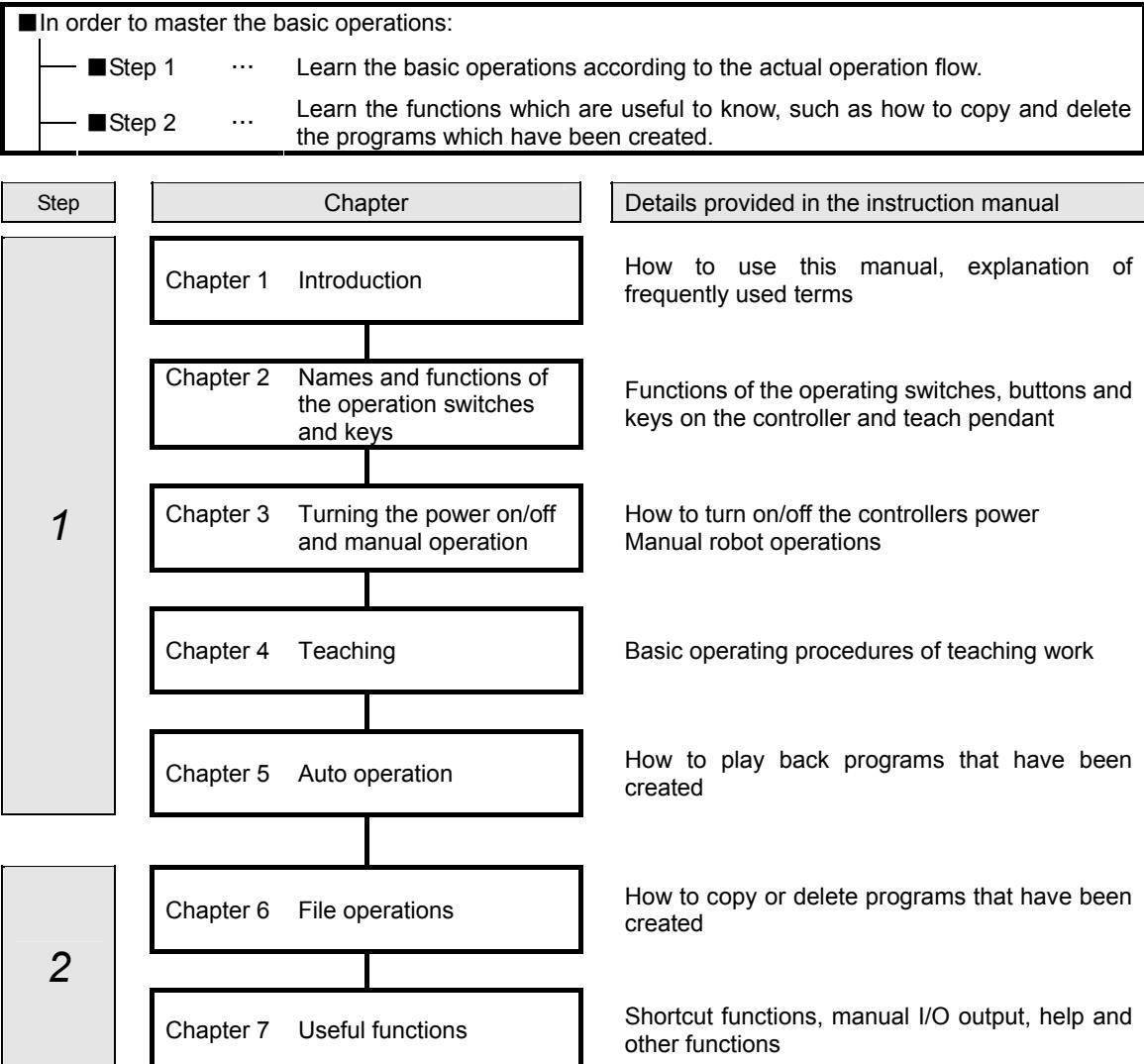
This chapter provides a guide to reading this manual, and it explains the frequently used terms and the basic concepts applying to the robot.

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1.1 Configuration of manual

This “Basic Operation Manual” explains the basic knowledge and operations required in order to use this controller.

Please read through this manual, and master the basic operation.

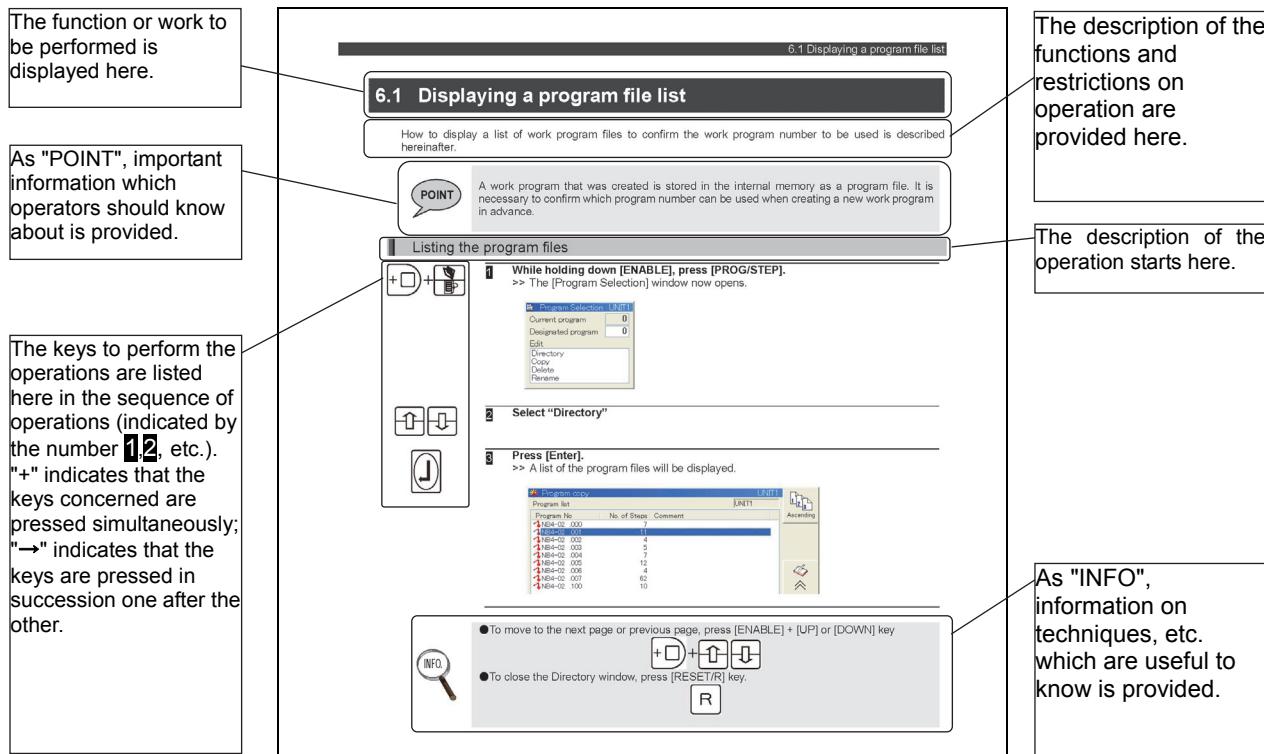


“Chapter 8 Mini teach pendant” explains about the operation of the mini teach pendant.

1.2 How to read the instruction manual

How to use the instruction manual

The basic operations of the controller are described using the following formats in this manual.



Screen displays on the teach pendant

Not all the screen displays on the teach pendant may be provided in every case.
The screen displays are provided as examples. They may differ depending on the robot used.

Displays relating to descriptions of operations

Descriptions of operations are displayed as follows.

Descriptions	Details
Press [Enter].	The keys of the teach pendant are enclosed in square brackets [], and the exteriors of the actual keys are positioned on the left of the descriptions of their operations. Example:  1 Press [Enter].
Press f4 <File>.	When functions are selected using the 12 icons (f keys) indicated at both sides of the display screen, the initial assignment of the icon names and f keys are enclosed in angular brackets < >. Example:  5 Press f4 <File>. ※ In the actual operation, touch the icon on the screen.
Align the cursor with "Directory."	When an item displayed on the teach pendant is to be indicated in cases, for instance, where a candidate is to be selected, the item concerned is enclosed in quotation marks ("").

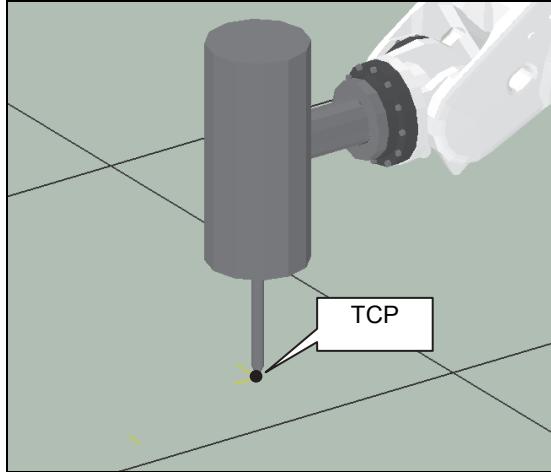
1.3 Frequently used terms

Explained below, for the benefit of those individuals who will be operating the robot for the first time, are the basic terms which are frequently used in this manual.

Table 1.3.1 Frequently used terms

Terms	Explanation
Teach pendant	This is used to perform the manual robot operations, teaching, etc.
Enable switch	This is a safety device for ensuring that the robot will not operate unexpectedly due to incorrect operations. The Enable switch is located on the rear panel of the teach pendant. Manual robot operations and check go/back operations are only permitted when the Enable switch is held down.
Teach mode	This mode is mainly used for creating programs.
Playback mode	This mode is used to automatically execute the created programs.
Motor Power	This denotes the status of power to the robot, that is to say, whether it is on or off. At motor power ON, power is supplied to the robot, and at motor power OFF, the robot is set to emergency stop.
Teaching	This refers to teaching the robot how to move and how to do welding work. What is taught is successively recorded in the programs.
Program	This is a file in which the robot movements, welding work and other execution procedures are recorded.
Movement Command	These commands cause the robot to move. This commands includes various conditions (e.g. speed, interpolation type, etc.) and the position information that stands for the teach point.
Function Command	These commands are used to perform auxiliary jobs during robot operations, such as welding, program branching, and external I/O control.
Step	When movement or function commands are taught, their successive numbers are written in the program. These numbers are known as steps.
Accuracy	The robot reproduces the taught positions accurately but in some cases these positions need not be accurate. The "accuracy" function specifies how precisely the robot is to operate.
Coordinate System	The robot has coordinates. Normally, they are known as robot coordinates. As viewed from the front of the robot, the back and forth movement is represented by X, the left and right movement by Y and the up and down movement by Z, thus forming three orthogonal coordinates. These coordinates serve as a reference for calculating operations such as manual operations or shift operations etc. In addition, there are tool coordinates which are referenced to the tool installation surface (flange surface).
Axis	The robot is controlled by a multiple number of motors. The parts controlled by these motors are called axes. A robot which is controlled by six motors is called a 6-axis robot.
AUX. Axis	Axes other than those of the robot (such as positioners or sliders) are generally called auxiliary axes. An alternative term is "external axes."
Check go/check back	This function slowly runs the created programs on a step by step basis to check the teach positions. It operates in two directions, step forward (check go) and step backward (check back).
Start	Start refers to the playback of a program which has been created.
Automatic operation / Playback	Both "automatic operation" and "playback" mean the playback of a program in the playback mode.
Stop	Stop refers to stopping the robot in the start status (playback).
Emergency stop	Emergency stop refers to stopping the robot (or system) in an emergency. Generally, a multiple number of buttons for initiating emergency stop are provided in the system, and emergency stop can be applied to the system immediately by

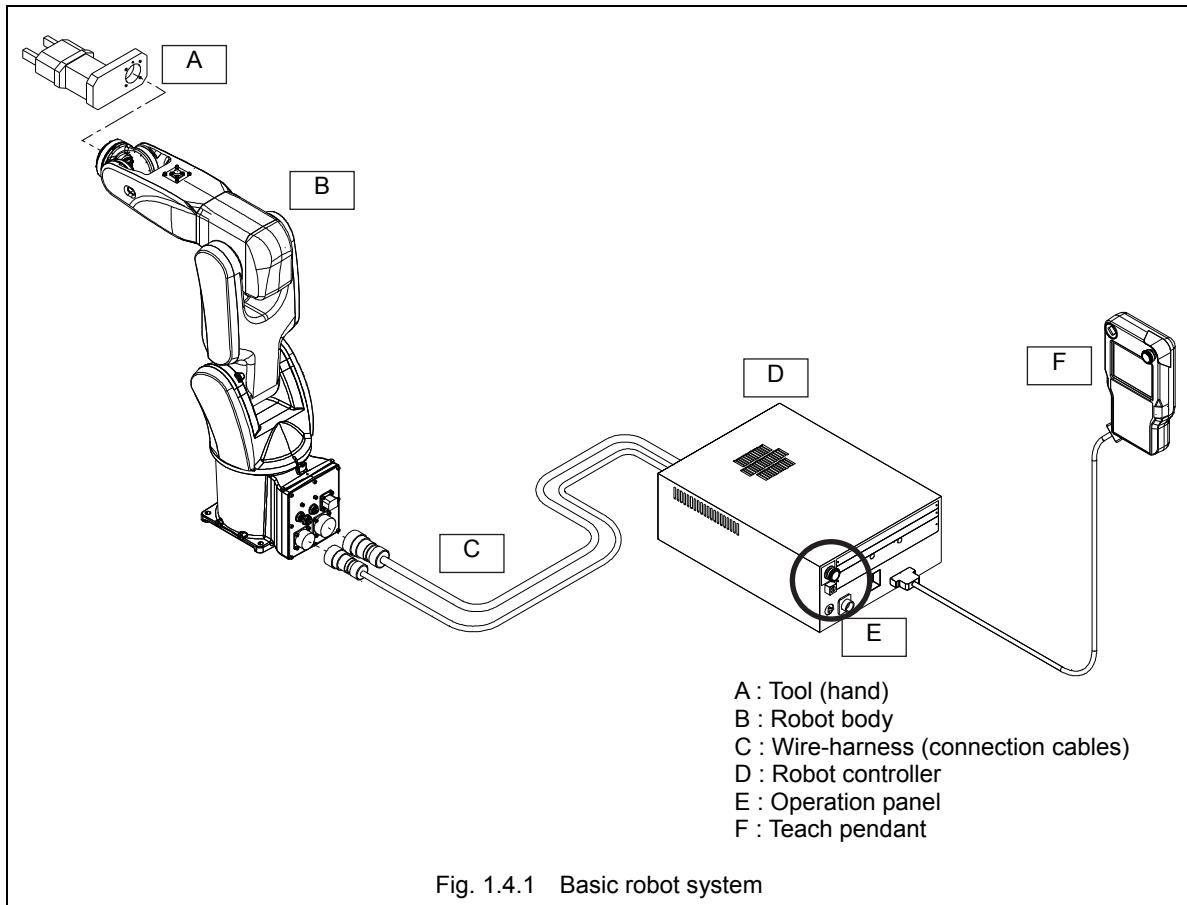
Table 1.3.1 Frequently used terms

Terms	Explanation	
	pressing one of these buttons.	
Error	If an error in operation or teaching or trouble in the robot itself has been detected during a teaching or playback operation, the operator is alerted to the error or trouble concerned.	If an error occurs during a playback operation, the robot is set to the stop status, and the servo power (motor power) is turned off immediately.
Alarm		If an alarm occurs during a playback operation, the robot is set to the stop status. The servo power (motor power) is not turned off. This type of trouble is less serious than an error.
Information		If information occurs, the robot remains in the start status even during a playback operation. It includes alarms or errors that have the potential to develop in the future.
Mechanism	<p>A mechanism refers to a unit such as a “manipulator”, “positioner”, “servo gun” or “servo travel” device that configures a control group and cannot be broken down any further.</p> <p>A “multi-mechanism” refers to a configuration where, for instance, a servo gun has been added to a manipulator. For the multi-mechanism, it is necessary to select which mechanism will be manually operated.</p>	
Unit	<p>This refers to the increments in which a program is created.</p> <p>On some occasions, only one mechanism configures the unit; on other occasions, multiple mechanisms (multi-mechanism) are involved.</p> <p>When the “Multi-unit” option is set, multiple units can be operated at the same time. In other cases, only 1 unit is used overall, so there is no need to be concerned with the unit.</p>	
TCP	<p>Tool Center Point. This is the tool tip of the robot hand.</p> <p>To move the tool tip along an accurate locus using LIN or CIR interpolation type, it is necessary to setup the TCP position accurately.</p>	
<p>(An example of the TCP)</p> 		

1.4 Basic concepts applying to the robot

This section describes an overview of operations that you should know before reading chapter 2 and subsequent chapters.

1.4.1 Robot system

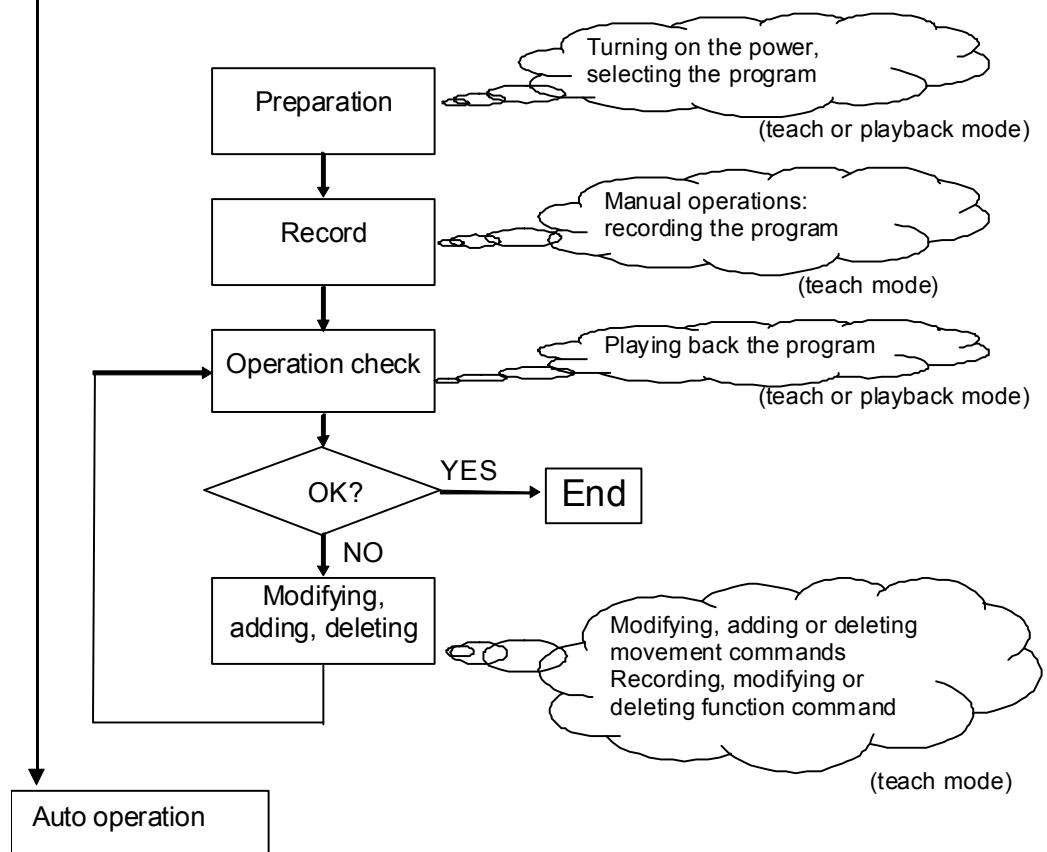


1.4.2 Overview: from teaching to auto operation

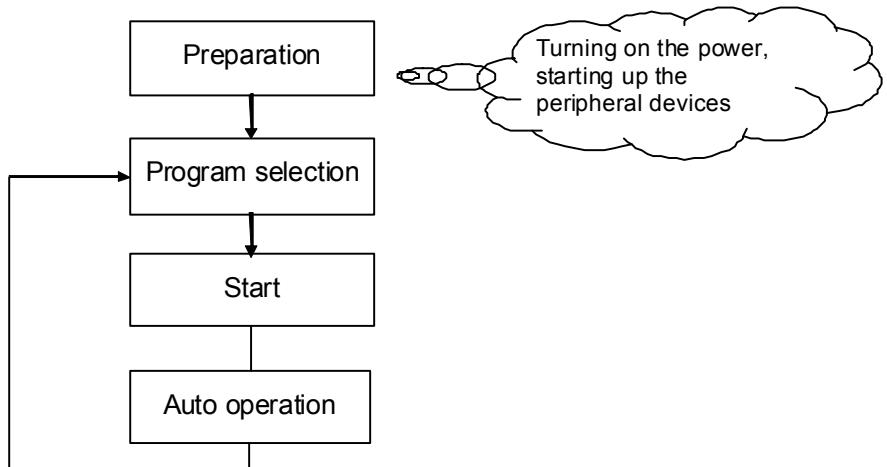
Proceed as follows to continuously operate the robot.

Creating the program (teaching)

The program is created in the sequence shown below. The entire process is known as the "teaching work." It refers to creating the program and modifying it into the optimal form.



After the creation of the program has been completed, automatic operation is performed. When automatic operation is performed, the selected program is repeatedly played back.



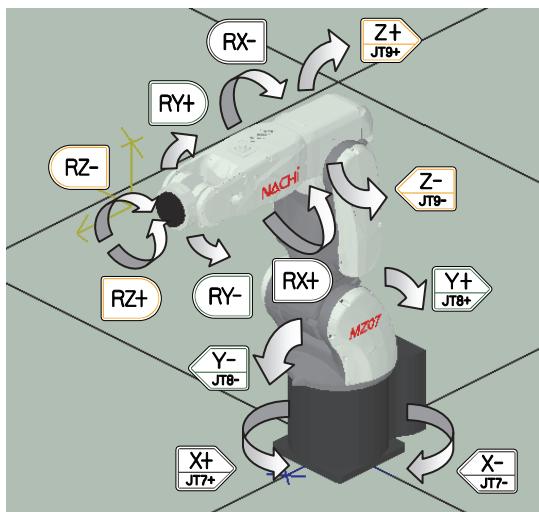
1.4.3 Manual operation

“Manual operation” refers to moving the robot with the use of the teach pendant.

Joint coordinate system



Each joint of the robot body rotates individually by the axis operation keys on the teach pendant.

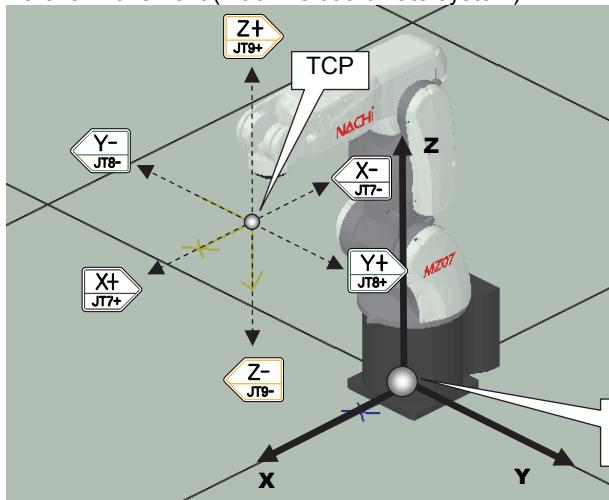


Robot coordinate system (Machine coordinate system)

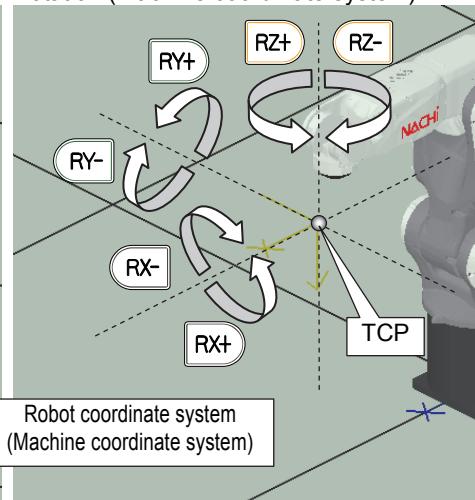


The tool tip of the robot (TCP : Tool Center Point) moves along the **“Robot coordinate system (Machine coordinate system)”**. In case of rotational operation, the TCP position is fixed and the tool direction rotates around the TCP. At this time, the rotational axis is X, Y, and Z axis of the robot coordinate system.

Parallel movement (Machine coordinate system)



Rotation (Machine coordinate system)

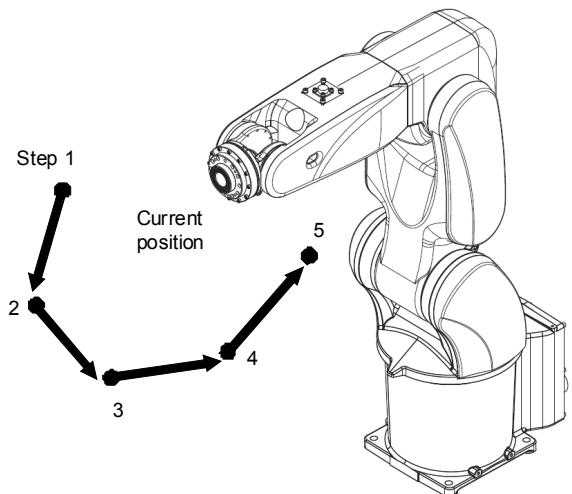


Robot coordinate system
(Machine coordinate system)

1.4.4 Teaching

Teach the robot positions to which it is to be moved and the numerical sequence of these positions ahead of time.

This job is called “teaching,” and it is performed in the following sequence.

1	Select the teach mode. Teaching is performed in the teach mode.
2	Select the program number. Select the number of the program to be used.
3	Successively record the operation positions to which the robot is to move and the robot's postures. <ul style="list-style-type: none"> •Move the robot to the recorded position and posture using manual operation. •Press [O.WRITE/REC] key to record the step. •Repeatedly press this key to record the steps in succession. 
4	If necessary, record the function commands. Record the function commands in the appropriate steps. When the function commands are recorded, signals can be output to an external source or the robot can be placed in the standby mode, for instance. See 1-9 "1.4.5 Function Command (Function)".
5	Record the end command (function command END) that indicates the end of operation. Record the END command (function command END) in the step that ends the movement.
6	Check what has been taught and modify it if necessary.

This completes the sequence of the teaching session, and a program is created as a result.

The teaching system outlined above is called the “teaching playback system.”

Alternative systems include the “robot language system” and “off-line teaching system.”

The robot supports all of these systems but only the “teaching playback system” is explained in this instruction manual.

1.4.5 Function Command (Function)

In order to operate the hand or gun attached to the robot wrist or capture signals that check the work, function commands (functions) are recorded at the appropriate positions in the program.

Furthermore, in order to perform complicated work, other programs may be called or, depending on the status of the external signals, operation may jump to other programs. These are also recorded as function commands.

Typical function commands

The function commands are expressed using a format based on SLIM (Standard Language for Industrial Manipulators) that is a robot language.

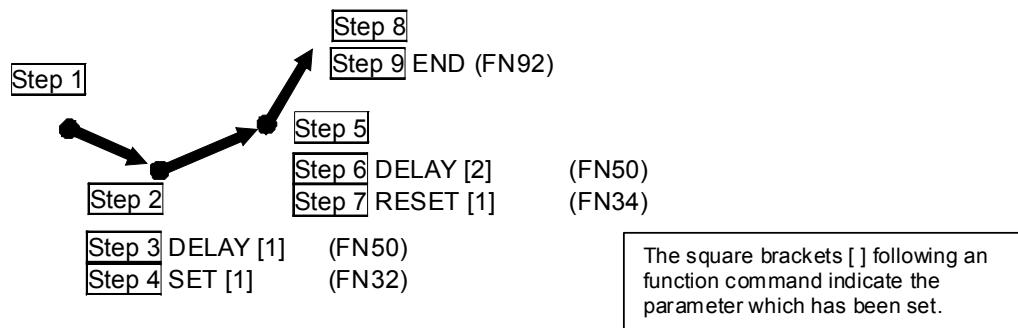
Alternatively, function commands can be specified using the “FN***” format where a 1 to 3 digit number is input into the *** part (which is called a function number).

Some typical function commands are listed below.

Table 1.4.1 Typical function commands

Function Command (SLIM)	Function number	Title	Description of function
SET	FN32	Output signal ON	The specified output signal is set to ON.
RESET	FN34	Output signal OFF	The specified output signal is set to OFF.
DELAY	FN50	Timer	Operation stands by for the specified time.
CALLP	FN80	Program call	Another program which has been specified is called.
CALLPI	FN81	Conditional program call	When the specified signal is ON, another program is called.
END	FN92	END	The execution of the program is ended.

Teaching example

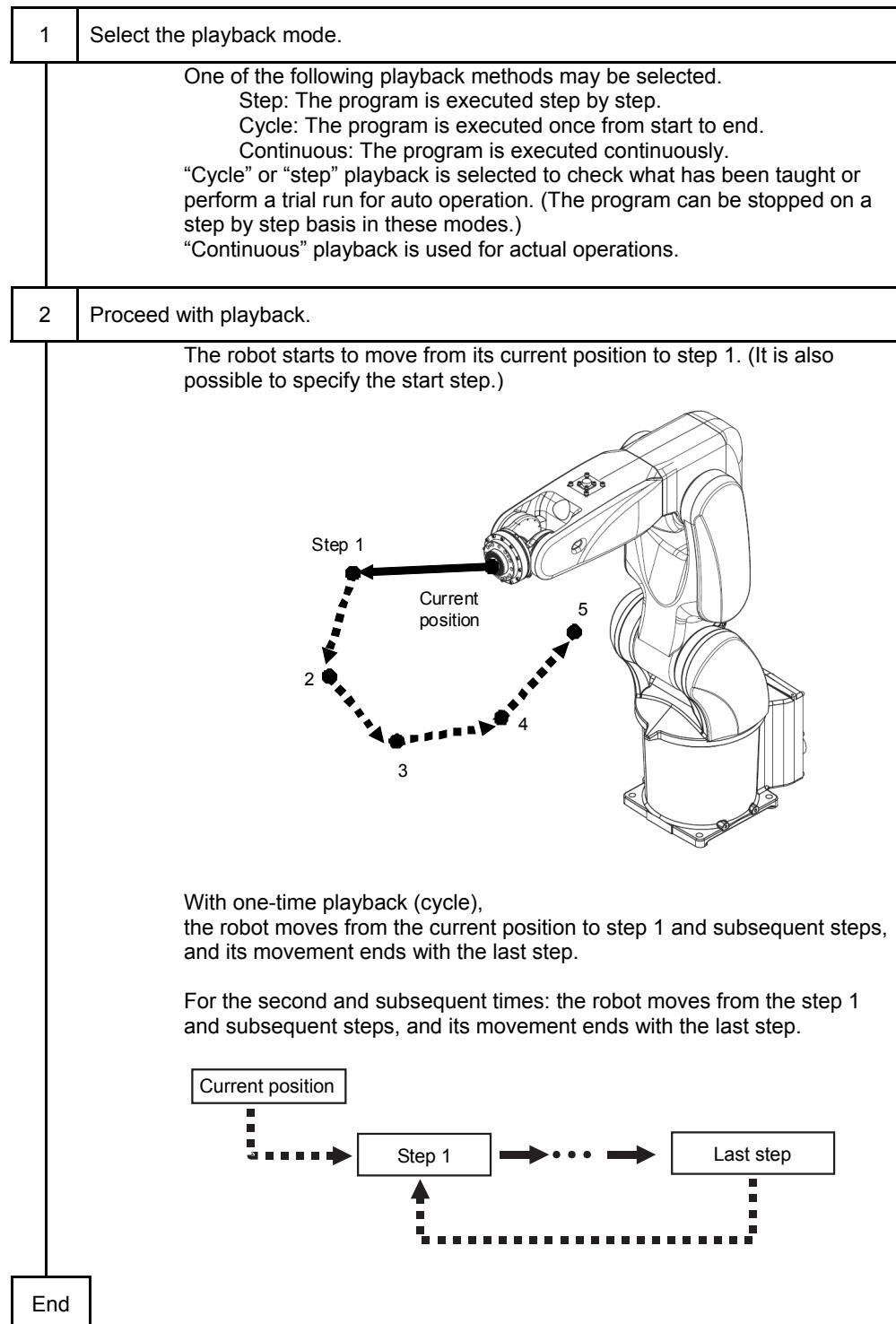


In the case of the teaching example above, the robot operates in the following way.

- (1) After the robot has moved to the position in step 2
 Step 3 DELAY [1] (FN50) Operation stands by for 1 second.
 Step 4 SET [1] (FN32) Output signal “1” is set to ON.
- (2) After the robot has moved to the position in step 5
 Step 6 DELAY [2] (FN50) Operation stands by for 2 second.
 Step 7 RESET [1] (FN34) Output signal “1” is set to OFF.

1.4.6 Auto operation

The following steps are taken to automatically run the program which has been created.



Chapter 2 Names and functions of the operation switches and keys

In this chapter, the functions of the operation switches and keys provided on the robot controller will be described.

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2.1 Controller

2.1.1 Equipments

The circuit breaker and operation panel are provided on the front side of the CFD controller, and the teach pendant is connected here as well.

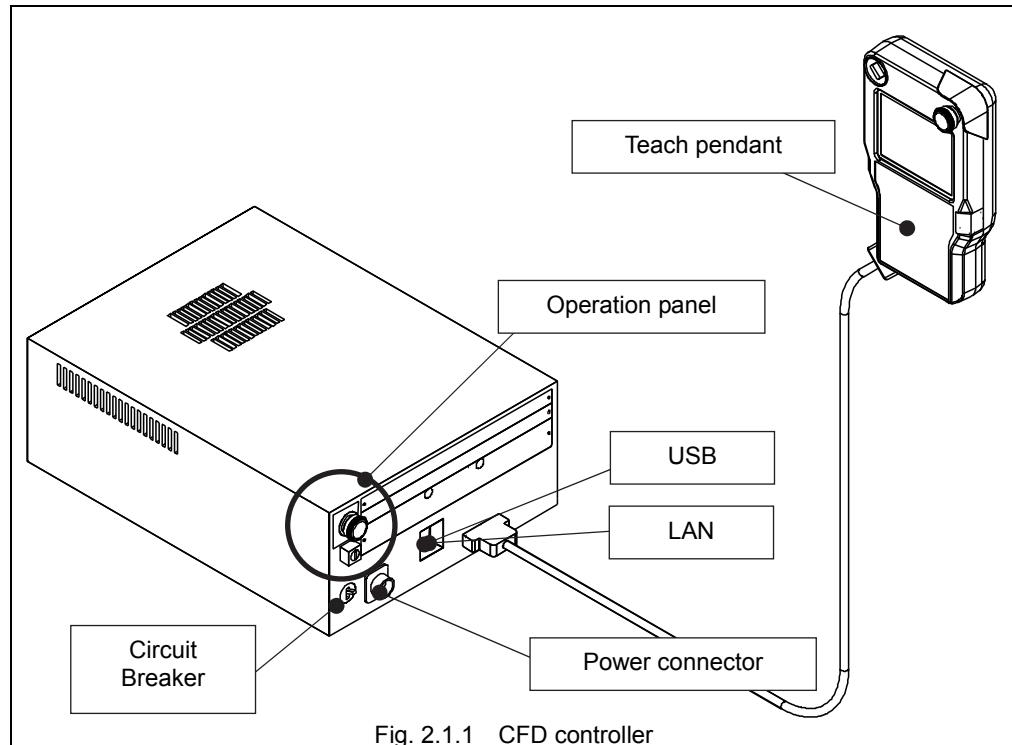


Fig. 2.1.1 CFD controller

Circuit breaker

This turns the power of the controller ON and OFF.

Teach pendant

The teach pendant has the keys and buttons to perform teaching, file operation, various condition settings, etc.

This picture shows the smart teach pendant.

In some cases, the compact teach pendant may be connected.

Operation Panel

Buttons for performing the minimum required operations such as motor power ON, automatic operation start and stop, emergency stop, and switching between the teach and playback modes are provided.

USB

This is a connector for an USB memory.

LAN

This is a connector for Ethernet connection.

Power connector

This is for power source connection.



The “Motors ON” operation and the “Playback start” operation can be done using the teach pendant.

2.2 Operation panel

The operation panel is provided with an emergency stop button and a selector switch for Teach mode / Playback mode.

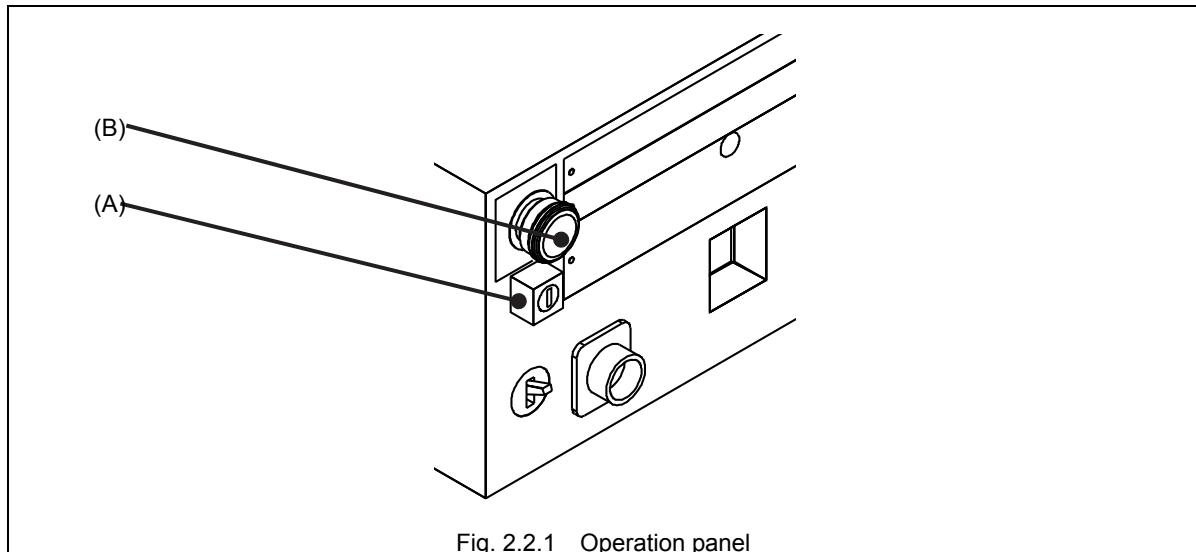


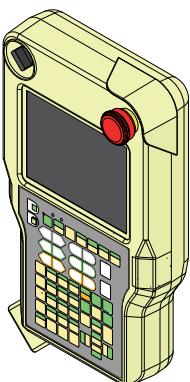
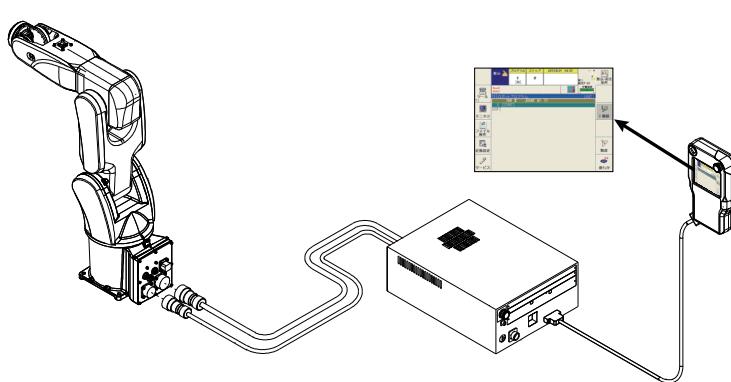
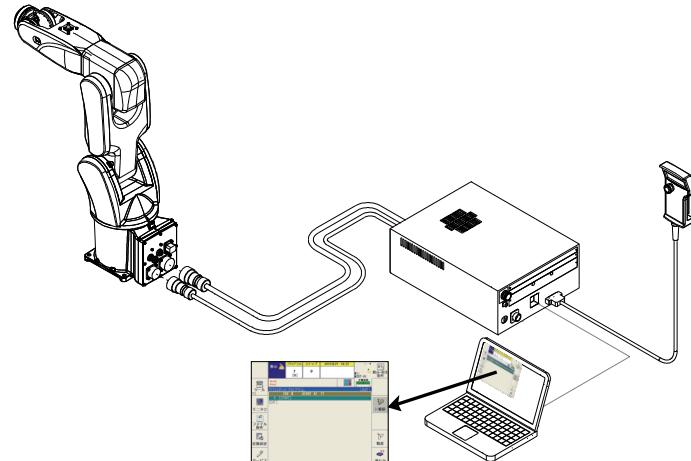
Table 2.2.1 Functions of buttons and switches on the operation panel

Indication used in this manual	Description of function
(A) [MODE SELECT SWITCH] 	<p>This is used to select the mode. The TEACH or PLAYBACK mode can be selected. This switch is used in combination with the teach pendant "TP selector switch".</p> <p>The key can be removed only in case of the TEACH mode.</p>
(B) [EMERGENCY STOP BUTTON] 	<p>When this is pressed, the robot is set to emergency stop. Emergency stop is performed by pressing the switch on the operation panel or on the teach pendant.</p> <p>To release emergency stop, turn the button clockwise. (The button will then return to its original position.)</p>

2.3 Teach pendant

2.3.1 2 types of teach pendant

For this robot controller, two teach pendants (**Smart teach pendant** and the **Compact teach pendant**) are available as an option and only either 1 of them can be connected (selectable option). (These 2 teach pendants cannot be used at the same time.)

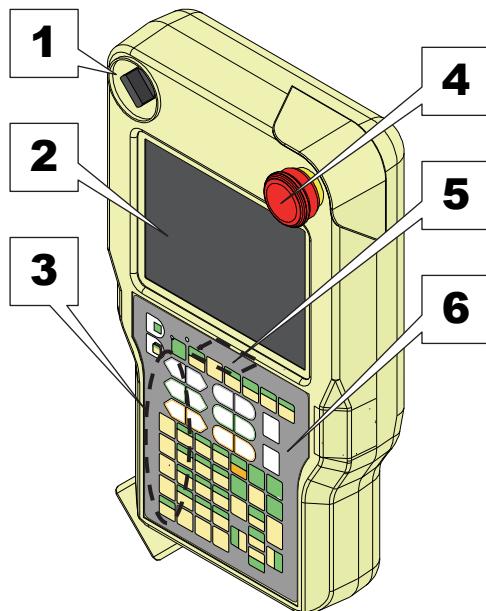
External view	Characteristics
Smart TP 	<p>The "Smart TP" can use the all functions of this robot controller. (NOTE: The teach pendant of the FD controller and the Smart TP are not the same completely.)</p> 
Compact TP 	<p>The "Compact TP" can perform the basic operation from the teaching to the playback (automatic operation). However, there are some functions that are not available on this teach pendant. (e.g. Software PLC edit function etc.) And, this pendant does not support a part of mandatory operations like initial setting operations etc. For those operations, please use the PC software "FD on DESK Light"(for free) instead. If the PC(FD on DESK Light) is connected to this robot controller, a screen that is the same with that of the Smart TP is displayed on the PC and it becomes possible to perform the same operations with Smart TP using the PC.</p> 
	<p>For details of the "FD on DESK Light", refer to its instruction manual.</p> <p>This is a "TP shorting plug". If a teach pendant is not connected to this robot controller, this shorting plug must be connected instead of that.</p>



- To connect a PC to this robot controller using the Ethernet, it is necessary to make a setting of TCP/IP.
- When a "TP shorting plug" is connected to this controller, the manual operation is not possible. And, in the playback mode, to perform the motors ON operation, the program selecting operation, and the program start operation etc., the external input signal must be used.

2.3.2 External appearance of smart teach pendant

The smart teach pendant is provided with operation keys, buttons, switches etc. for creating programs and performing various settings.

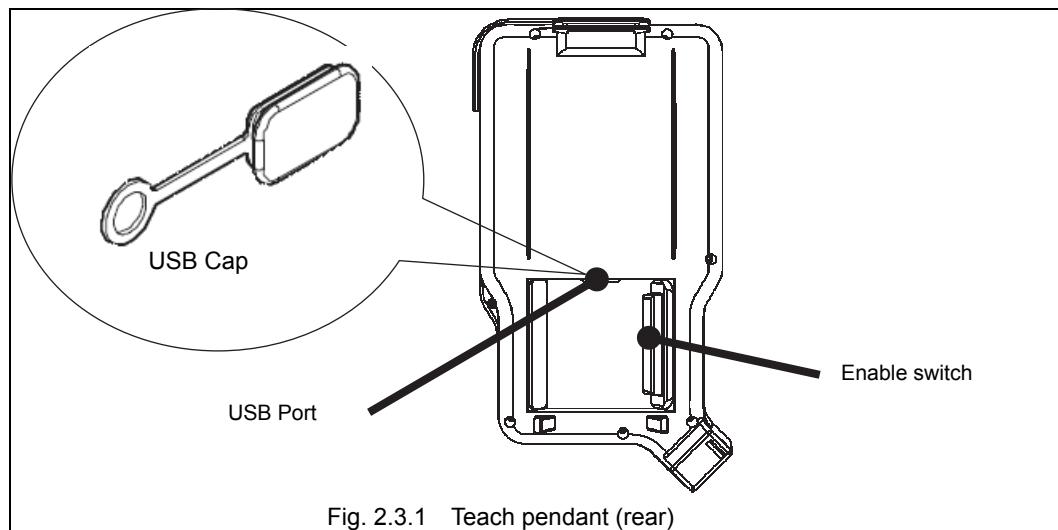


No.	Name	Description
1	TP selector switch	This switch is used with the [MODE SELECT SWITCH] of the CFD controller to permit / prohibit the Motors ON operation.
2	Touch screen color LCD	A touch screen type color LCD
3	(Back side) Enable switch	This switch enables the servo power to turn ON in the teach mode.
4	Emergency stop button	This button can stop the robot forcibly. The same button is equipped with the operation panel of the CFD controller
5	(Back side) USB port	An USB memory can be connected here as "Teach Pendant External memory". (NOTE) This port can be used only for file copy operation. Backup operation cannot be used.
6	Operation keys	Operation keys for manual operation of the robot, or various setting operations, etc.

Be sure to follow the cautions below for the USB port (see fig. 2.3.1).



- Only connect USB memory while operating files.
- When file operations have finished, always remove the USB memory and close the USB cap.
- Continuing use with the USB memory connected, or failing to close the USB cap may hinder the dust protection, waterproofing, and anti-spatter properties, which may lead to failure.
- The USB cap is a consumable part. If the USB cap becomes loose, or is damaged or lost, quickly replace it with a new one. In the time until a new one is procured, use tape etc. to block up the USB port.



2.3.3 LED Functions

LEDs are arranged above each operation key of the smart teach pendant, and operate as shown below.

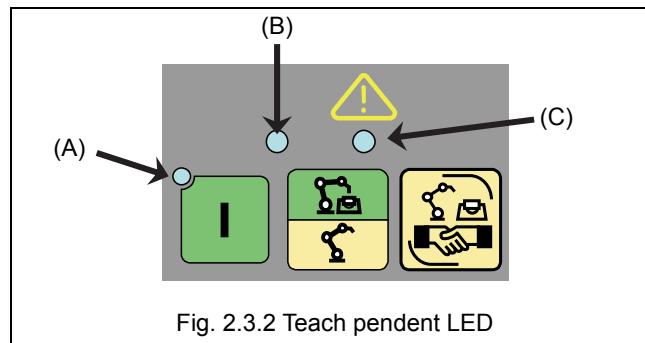


Table 2.3.1 LED Functions

	LED Color	Functions
(A)	Green	Flashes during preparation of motor power ON, and lights when motor power is ON (servo ON). It is the same as the green "Motor power ON button" lamp on the operation panel and control box.
(B)	Orange	Flashes after the power to the controller is switched on, and lights when the teach pendant system starts. At all other times it remains lit.
(C)	Red	Lights when a hardware malfunction occurs in the teach pendant. Normally this remains off.

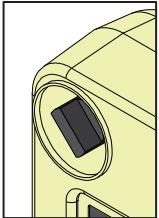
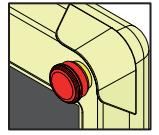
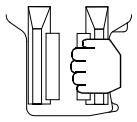


Directly after power to the controller is switched on, all of the LEDs light for approximately 0.5 seconds to check they are operating normally, and then switch off. After this, they operate as shown in Table 2.3.1.

2.3.4 Functions of buttons and switches

The buttons and switches on the teach pendant have the following functions.

Table 2.3.2 Functions of buttons and switches

External appearance	Indication used in this manual	Function
	[TP SELECTOR SWITCH]	<p>This is used in combination with the [MODE SELECT SWITCH] on the operation panel. For further details, refer to "3.2 Mode selection" in Chapter 3.</p> <p>Manual operation (Teach mode)</p>  <p>"Motors ON" is allowed in the Teach mode</p> <p>Automatic operation (Playback)</p>  <p>"Motors ON" is allowed in the playback mode</p>
	[EMERGENCY STOP BUTTON]	 <p>When this is pressed, the robot is set to emergency stop. To release emergency stop, turn the button in the direction of the arrow.</p>
	[Enable switch] (Dead-man switch)	<ul style="list-style-type: none"> - Used to manually operate the robot in TEACH mode. <u>This switch is not used in the PLAYBACK mode.</u> - When the enable switch is grasped, power is supplied to the robot (Servo ON). The robot can be operated manually only while the switch is grasped. - When this switch is released or grasped tightly until a clicking sound is heard, the robot is set to emergency stop. <p>For details on how to operate the enable switch, refer to "3.3 Turning the motor power to ON" in Chapter 3.</p>

2.3.5 Functions of operation keys

The operation keys provided on the teach pendant have the following functions.

Table 2.3.3 Functions of operation keys

External appearance	Indication used in this manual	Function
	[ENABLE]	The functions are executed by pressing this key together with other keys. Basically, the green keys will work with this key.
	[SHIFT]	The functions are executed by pressing this key together with other keys.
	[MOTOR POWER ON] (NOTE 1)	 The motor power is set to ON by pressing this key together with the [ENABLE] key. This key is available in both of Teach mode and Playback mode.
	[UNIT / MECHANISM]	<p>PRESSED ON ITS OWN MECHANISM SELECTION</p> <p>M1: MZ07-01 -> M2: PH001</p> <p>When a multiple number of mechanisms are connected to the system, the mechanism to be operated manually is selected.</p> <p>WITH [ENABLE] UNIT SELECTION</p> <p>When a multiple number of units are defined in the system, the unit to be operated is selected.</p>
	[SYNCHRONIZE] (NOTE 2)	<p>This key is used by a system in which a multiple number of mechanisms are connected, and it has the following functions.</p> <p>PRESSED ON ITS OWN SYNCHRO MOTION ON/OFF</p> <p>It selects or releases synchronized (cooperative) manual operation.</p> <p>WITH [ENABLE] SYNCHRO MOTION ON/OFF</p> <p>When synchronized (cooperative) operation is specified for a move command, "H" appears before the step number.</p>

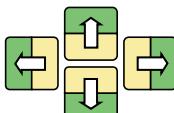
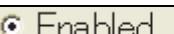
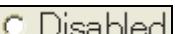
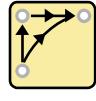
(NOTE 1) This key can be used only in case of "Internal start mode". For details, refer to the chapter 5.

(NOTE 2) This key can be used only in case of "Synchromotion" setting.

External appearance	Indication used in this manual	Function								
	[INTERP / COORD]	<p>PRESSED ON ITS OWN COORDINATE SYSTEM SELECTION</p> <p>Every time this key is pressed, the manual operation coordinate system will change.</p> <p>(NOTE)</p> <ul style="list-style-type: none"> - To select the user coordinate system or the world coordinate system (absolute coordinate system), please use the following menu to make the settings. <Constant settings> - [5 Operation Constants] [5 Coordinate registration] - Some mechanisms can use only "Joint" coordinate system. <p>WITH [ENABLE] INTERPOLATION TYPE SELECTION</p> <table border="1"> <tr> <td>100 %</td> <td>JOINT</td> <td>A1</td> <td>T1</td> </tr> <tr> <td>1200 mm/s</td> <td>LIN</td> <td>A1</td> <td>T1</td> </tr> </table> <p>This switches the interpolation type (joint interpolation, linear interpolation or circular interpolation) of the recording status.</p>	100 %	JOINT	A1	T1	1200 mm/s	LIN	A1	T1
100 %	JOINT	A1	T1							
1200 mm/s	LIN	A1	T1							
	[CHECK SPD / TEACH SPEED]	<p>PRESSED ON ITS OWN MANUAL SPEED CHANGE</p> <p>The operating speed of the robot during manual operation is selected. Each time it is pressed, one of the 1 to 5 operating speeds is selected (the higher the number, the faster the speed). Furthermore, the following function is provided as well.</p> <p>The playback speed recorded in the steps is also determined by the manual speed which has been selected by this key.</p> <p> This function is set by selecting [Constant Setting] → [5 Operation Constants] → [4 Record speed] → [Value of recording method — Decision method].</p> <p>WITH [ENABLE] CHECK SPEED CHANGE</p> <p>The maximum speed during a check go or check back operation is selected. Each time it is pressed, one of the 1 to 5 operating speeds is selected (the higher the number, the faster the speed).</p>								
	[STOP / CONTINUOUS]	<p>PRESSED ON ITS OWN CONTINUOUS / NON-CONTINUOUS</p> <p>Single Continuous</p> <p>Continuous or non-continuous (single check go) during a check go or check back operation is selected. When continuous operation is selected, the operation of the robot does not stop at each step.</p> <p>WITH [ENABLE] PLAYBACK STOP</p> <p>The program being played back is stopped. (This has the same function as the stop button.)</p>								

External appearance	Indication used in this manual	Function
	[CLOSE / SELECT SCREEN]	<p>PRESSED ON ITS OWN</p> <p>If a multiple number of monitor screens are displayed, the screen targeted for operation is selected.</p> <p>WITH [ENABLE]</p> <p>The selected monitor screen is closed.</p>
	[Axis operating keys]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE SWITCH] AXIS OPERATION</p> <p>The robot is moved manually. If an auxiliary axis to be moved, the operation target is selected ahead of time using [UNIT/MECHANISM].</p>
	[CHECK GO] [CHECK BACK]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE SWITCH] CHECK GO / BACK</p> <p>When these are pressed together with the [ENABLE SWITCH], the check go or check back operation is performed. Normally, the robot is stopped at each recorded position (step). It is also possible to move the robot continuously. Use [STOP/CONTINUOUS] to select step or continuous.</p>
	[O.WRITE / REC]	<p>PRESSED ON ITS OWN RECORDING A MOVEMENT COMMAND</p> <p>During teaching, the movement command is recorded. This can be used only when the last step in the task program has been selected.</p> <p>WITH [ENABLE] OVERWRITING THE MOVEMENT COMMAND</p> <p>The already recorded movement command is overwritten by the current recording statuses (position, speed, interpolation type, and accuracy). However, the command can be overwritten only when changes are made to what is recorded for the movement commands. A movement command cannot be overwritten by a function command; neither can a function command be overwritten by another function command.</p> <p>The recording position, speed and accuracy of a recorded movement command can each be revised using [MOD Position], [SPEED] and [ACC], respectively.</p> <p> The [SPEED] and [ACC] key functions are set by selecting [Constant Setting] → [5 Operation Constants] → [1 Operation condition] → [5 Usage of SPD key] or [6 Usage of ACC key].</p>
	[INS]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE] INSERTION OF A MOVEMENT COMMAND</p> <p>The movement command is inserted "Before" the current step.</p> <p> "Before" can be changed to "After" or vice versa by selecting [Constant Setting] → [5 Operation Constants] → [1 Operation condition] → [7 Step insertion position].</p>

External appearance	Indication used in this manual	Function
	[CLAMP ARC]	Other functions can also be allocated. For details, see "4.13 Clamp/Arc Key Settings" in the instruction manual "SETUP MANUAL".
	[MOD Position]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE] STEP POSITION MODIFICATION The position stored in the movement command now selected is changed to the current robot position.</p>
	[HELP]	Press this for help concerning an operation or function. The built-in tutorial function (help function) is called. See the chapter 7 also.
	[DEL]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE] STEP DELETION The step now selected (movement command or function command) is deleted.</p>
	[RESET / R]	This is a cancel key. This clears the input or returns the setting screen to its original status. It also enables R codes (short-cut codes) to be input. The function that is to be used can be called immediately by inputting an R code. See the chapter 7 also.
	[PROG / STEP]	<p>PRESSED ON ITS OWN STEP SELECTION</p> <p>This is used to call a step specified in the program.</p> <p>WITH [ENABLE] PROGRAM SELECTION</p> <p>The specified program is called.</p>
	[Enter]	<p>This enters the menu or numerical input contents.</p> <p>Determination operation of numerical input can also be performed with arrow keys by <Constant Setting> - [7F-key] – [7 Numerical input] and switching to "Cursol" under [Decision method of numerical input].</p>

External appearance	Indication used in this manual	Function
	Cursor keys	<p>PRESSED ON ITS OWN CURSOR MOVEMENT When these keys are pressed on their own, the cursor moves.</p> <p>WITH [ENABLE] PAGE UP/DOWN, SETTING MODIFICATION</p> <ul style="list-style-type: none"> On a screen where the settings are configured on a multiple number of pages, the page is moved. Horizontal scroll bar operation Lines are moved in units of multiple lines in the work program editing screen etc. On a service or constant setting screen, for instance, the selection items arranged horizontally (radio buttons) are selected. <p> Enabled  Disabled</p> <ul style="list-style-type: none"> On a teach or playback mode screen, the number of the current step is changed. (This function can be enabled in the menu of <Constant Setting> - [5 Operation Constants] [1 Operation condition] [8 Step selection with E+up/down keys].)
	[OUT]	<p>PRESSED ON ITS OWN SHORTCUT FOR SETM function During teaching, this short-cut calls the output signal command (SETM <FN105> function command).</p> <p>WITH [ENABLE] MANUAL SIGNAL OUTPUT The external signals are set to ON or OFF manually.</p>
	[IN]	During teaching, this short-cut calls the input signal wait "positive logic" command (WAITI <FN525> function command).
	[SPD]	<p>This is used to revise the speed of recorded movement commands or the recording status.</p> <p></p> <p>This function is set by selecting [Constant Setting] →[5 Operation Constants] → [1 Operation condition] →[5 Usage of SPD key].</p>
	[ACC]	<p>PRESSED ON ITS OWN ACCURACY SETTING This is used to revise the accuracy of a recorded movement command or the recording status.</p> <p></p> <p>This function is set by selecting [Constant Setting] →[5 Operation Constants] → [1 Operation condition] →[6 Usage of ACC key].</p> <p>WITH [ENABLE] Positioning ON/OFF (P mark) The "P" mark of the step will turn ON / OFF. (0 is OFF / 1 is ON)</p>
	[END/TIMER]	<p>PRESSED ON ITS OWN SHORTCUT FOR DELAY function During teaching, this short-cut records the timer command (DELAY <FN50> function command)</p> <p>WITH [ENABLE] SHORTCUT FOR END function During teaching, this short-cut records the end command (END <FN92> function command).</p>

External appearance	Indication used in this manual	Function
	[BS]	<p>PRESSED ON ITS OWN Deletion of a number or character -> </p> <p>The number or character before the cursor position is deleted. The key is also used to release a selection during file operations.</p> <p>WITH [ENABLE] UNDO The operation performed immediately before is cleared, and the status prior to the change is restored. It is effective only while creating a new or editing an existing program.</p>
	[FN] (Function)	This is used when selecting the function commands.
	[EDIT]	<p>Opens the program editing screen. In the program editing screen, mainly function commands are changed, added or deleted, and the parameters of move commands are changed.</p>
	[I/F] (Interface)	<p>Opens the interface panel window. For details, refer to the instruction manual "INTERFACE PANEL" (TFDEN-015)</p>

External appearance	Indication used in this manual	Function
	Numeric keys/ [0] to [9] / [.]	<p>PRESSED ON ITS OWN Numerical input Numbers (0 to 9, decimal point) are input.</p> <p>WITH [ENABLE] JOINT INTERPOLATION (with [7]) A shortcut for a "JOINT" move command</p> <p>WITH [ENABLE] LINEAR INTERPOLATION (with [8]) A shortcut for a "LIN" move command</p> <p>WITH [ENABLE] CIRCULAR INTERPOLATION (with [9]) A shortcut for a "CIR" move command</p> <p>For arc welding uses</p> <p>WITH [ENABLE] APPLICATION FUNCTION 1 (with [4]) During teaching, commands for arc welding are displayed on the f keys (f1~f12).</p> <p>WITH [ENABLE] APPLICATION FUNCTION 2 (with [5]) During teaching, commands for weaving are displayed on the f keys (f1~f12).</p> <p>WITH [ENABLE] APPLICATION FUNCTION 3 (with [6]) During teaching, commands for sensors are displayed on the f keys (f1~f12).</p> <p>For uses other than arc welding</p> <p>WITH [ENABLE] APPLICATION FUNCTION 1 (with [4]) APPLICATION FUNCTION 2 (with [5]) APPLICATION FUNCTION 3 (with [6]) Application functions 1~3 can be allocated to the desired functions. For details, see "7.7 Customizing Hard Keys".</p> <p>WITH [ENABLE] "ON" (with [1]) <input checked="" type="checkbox"/> On a setting screen, for instance, a check mark is placed inside the check box.</p> <p>WITH [ENABLE] "OFF" (with [2]) <input type="checkbox"/> On a setting screen, for instance, the check mark inside the check box is removed.</p> <p>WITH [ENABLE] "REDO" (with [3]) This re-does the operation which was restored by clearing (undo) the operation immediately before. It is effective only while creating a new or editing an existing program.</p> <p>WITH [ENABLE] "+" (with [0]) "+" is input.</p> <p>WITH [ENABLE] "-" (with [.]) "-" is input.</p>

2.3.6 Configuration of display screen

Indicated on the display screens are the program and settings used for the current operation and the icons (f keys) for selecting the various functions.

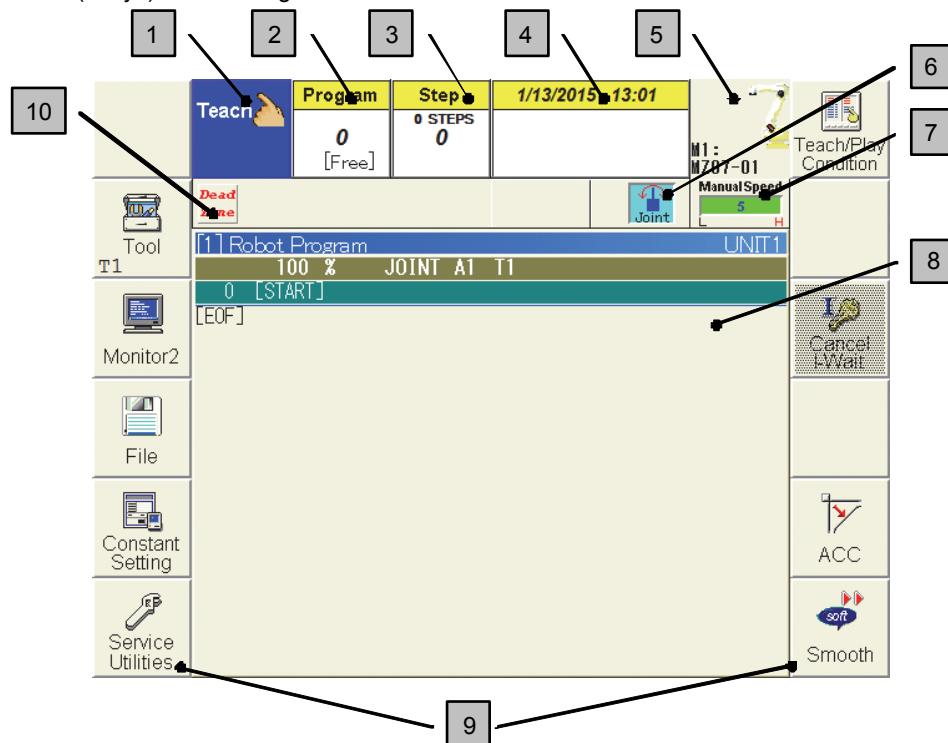


Fig. 2.3.3 Configuration of display screen

1 Mode display area

The selected mode (teach, playback or high-speed teach) is displayed here. (The highspeed teach mode is optional.)

The motor power, operation underway and emergency stopped statuses are also displayed.

Table 2.3.4 Status display

Status	Teach mode	Playback mode
Motor power OFF		
Motor power ON, servo power OFF, now saving energy (playback mode)		-
Motor power ON, servo power ON		
Motors energized, check GO/BACK operation underway (teach mode), now operating (playback mode)		
Emergency stopped		

2 Program number display area

The number of the selected program is displayed.

3 Step number display area

The number of the step selected in the program is displayed here.

The total number of steps is displayed on a step number.

4 Date & time display area

The current date and time are displayed here.

5 Mechanism display area

The mechanism targeted for manual operation is displayed here.

With a multi-unit specifications robot, the numbers of the units involved in the teaching are also displayed.

6 Coordinate system display area

The selected coordinate is displayed here.

Table 2.3.5 Coordinate system display

Types of coordinate systems	Display
Axis coordinate system	
Machine coordinate system	
Tool coordinate system (The number on the left of the icon is the tool number.)	
Absolute coordinate system (world coordinate system)	
User coordinate system (The number on the left of the icon is the coordinate number.)	

7 Speed display area



The manual operation speed is displayed here. When [ENABLE] is pressed, the check speed is displayed.

Table 2.3.6 Speed display

Speed	Display
Manual speed	
Check speed	

8 Monitor display area

The contents of the program are displayed here (in the case of the initial settings).

9 f key display area

By touching a display area, called f key, selectable functions are displayed. The six keys on the left correspond to f1 to f6; the six keys on the right correspond to f7 to f12. See 2-17 "2.3.7 Concerning the operation of the f keys".

10 Variable status display area

Various status displays such as "Input wait (I wait)" and "External start selected" appear as the icons shown in Table 2.3.7 in this area. When this status ends, the icon is cleared.

Table 2.3.7 Status icon display

Status	Icon	Status	Icon
External signal input waiting (I waiting)		Robot in the start enable area	
"Start selection: External" or "Program selection: Internal" now selected		Now Log in (The 3 digit number signifies the user ID)	
"Start selection: Internal" or "Program selection: External" now selected		J5 axis in singular point status	
"Start selection: External" or "Program selection: External" now selected		The touch panel is locked. (Press cursor keys etc. to unlock)	
Software PLC now operating			
Software PLC now stopped			
Machine lock now set			
Dry run now set			
Now connected with external PC via Ethernet			
Automatic backup proceeding (The extent to which the operation has been completed is indicated as a percentage.)			
Temporarily stopped (with station startup only)			
Holding or now paused * This is displayed only when the hold signal or pause signal is input during playback.			
Mechanism now disconnected			
I/O simulation mode now selected			

Not all of the optional functions are listed in the above table.

For details on any of the icons not described in the table, refer to the operating instructions for the optional functions concerned.

2.3.7 Concerning the operation of the f keys

A number of icons are assigned to the f key display area.

The allocation of icons differs according to the application (use), such as arc welding or spot welding etc. It is also switched in accordance with the selected mode or operating conditions.

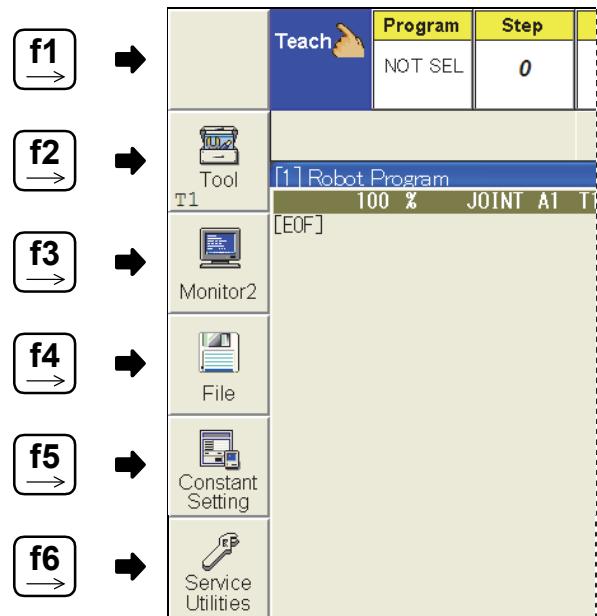


The initial allocation of the f keys differs according to the application. For details on the initial allocation, see the sections in chapter 8 and beyond in this instruction manual that correspond to the application that will be used.

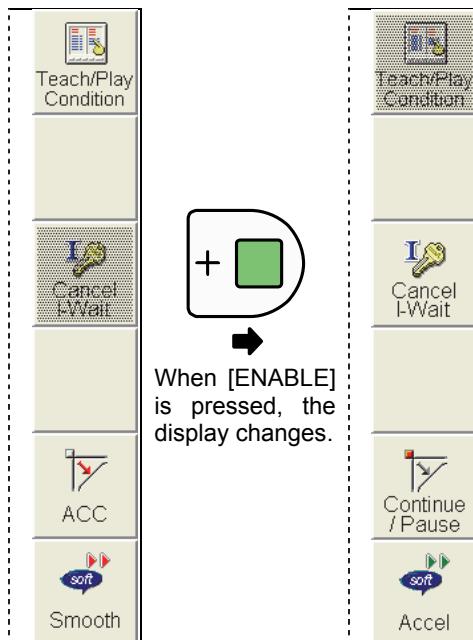
Enter the f key from the touch panel

To select the function allocated to an icon, touch the f key display area icon directly.

Each function can be selected by touching the icon directly.



Normally, a function is selected by pressing one of the f1-f12 icons on its own. However, in some cases the key must be pressed together with [ENABLE].



← An icon displayed with the mesh display can be selected by pressing [ENABLE].

← An icon displayed with the mesh display can be selected by pressing [ENABLE].

← Some icons are only displayed when [ENABLE] is pressed.

Enter the f key from the operation key

Inputting using only the f keys, without using the touch panel (this is known as "f key substitute operation"). There are 2 types of operating method. See Table 2.3.8. In the default settings, "f Key substitute operation" is disabled (no key input method).

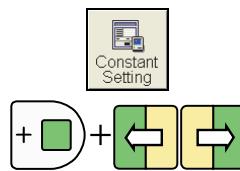
Table 2.3.8 Key allocation in f key substitute operation

Operation Key		For operations in this table, hold down the  [SHIFT] key and press the appropriate operation key.		Operation Key	
Pattern 1	Pattern 2			Pattern 2	Pattern 1
	ON				
	OFF				
					
					
					
					

The description below shows how to enable "f key substitute operation."

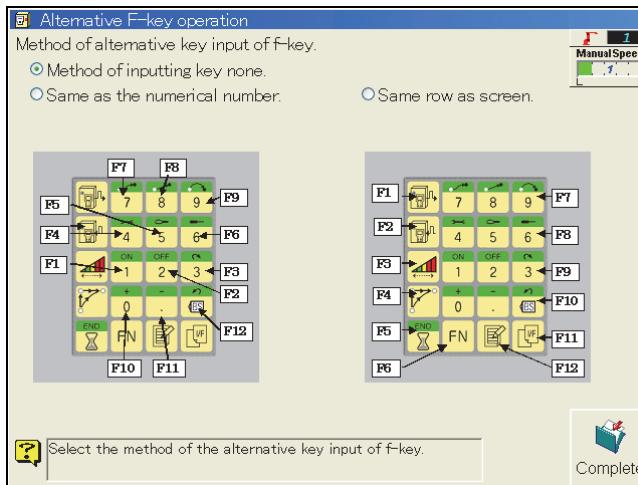
1 Change the operator qualification to **EXPERT** or higher.

2 Select <Constant Setting> - [7 f-Keys] – [9 Alternative F-key operation].



3 Hold down [ENABLE] and press [Left/Right] to select the item.

>> Correspondences between the f keys and operation keys for each setting are shown in Table 2.3.8.



4 After selecting the item, press f12 <Complete>.

>> This completes the settings.



Settings can also be changed from the shortcut R971.
For details on shortcut operations, see “Chapter 7 Useful Functions”.
Correspondence between shortcuts and constant settings when constant settings are configured are shown in Table 2.3.9.

POINT

Table 2.3.9 Correspondence with Constant Settings

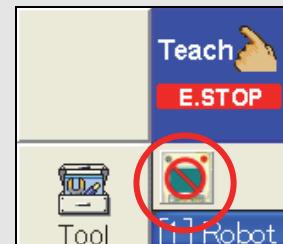
Shortcut	Constant settings
0 (None)	No key input method
1 (Pattern 1)	Same as the numerical figure
2 (Pattern 2)	Same as the screen arrangement

2.3.8 Touch Panel

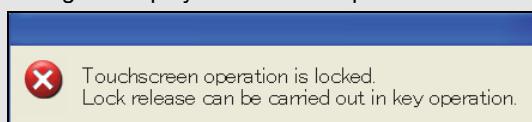
The touch panel is equipped as standard to the teach pendant, and the touch panel is set to be operable by default. Operations using the touch panel can be enabled or disabled by changing the setting.

The touch panel can be set to temporarily lock (be inoperable) even when enabled if the teach pendant is not operated for a set period of time. This is called the “touch panel lock” function, and prevents unwanted entries being caused by unintentional touching of the touch panel. The touch panel lock function is enabled by default.

The icon shown below is displayed in the status icon display if the touch panel is locked by the touch panel lock function.

POINT


The following message is displayed if the touch panel is touched in this case.



The touch panel is automatically unlocked if the operation keys are used.

This section explains how to change the touch panel settings.

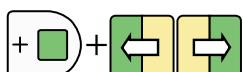
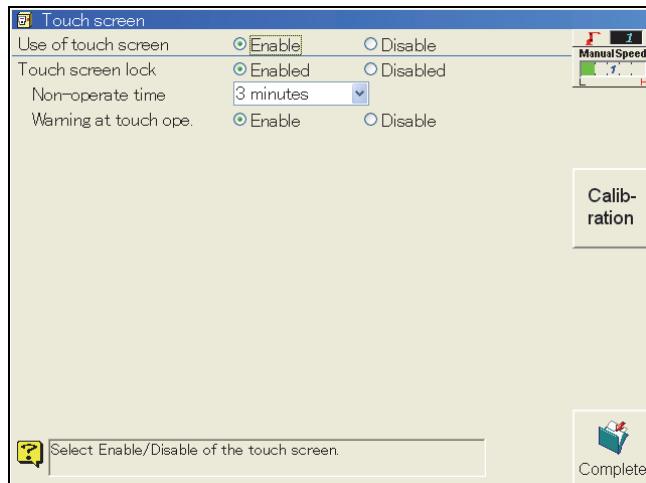
Changing the Touch Panel Settings

1 Change the operator qualification to **EXPERT or higher.**



2 Select <Constant Setting> - [7 f-Keys] - [10 Touch screen].

>>The following setting screen is displayed.



3 Select the item using [ENABLE] + [Left/Right] to enable or disable touch panel operation.

>> To change other settings items, use [Up/Down] to move the cursor to the item you want to change. Settings are as follows.

Item	Details
Use of touch screen	Select “Enable” to enable use of the touch panel or “Disable” to disable use.
Touch screen lock	Select “Enabled” to use the touch panel lock function or “Disabled” not to use it.
Non-operate time	Set the period of non-use after which the touch panel is locked.
Warning at touch ope.	Select “Enable” to display a message if the touch panel is touched while locked. Select “Disabled” not to display this message.



Touch panel operation cannot be disabled if the “Method of alternative key input of F-key.” in <Constant Setting> - [7 f-keys] – [9 Alternative F-key operation] is set to “Method of inputting key none.”



4 After selecting the item, press f12 <Complete>.

>>This completes the settings.



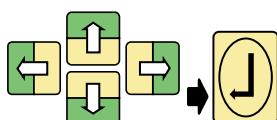
The touch panel can also be enabled/disabled from the shortcut R970. For details on shortcut operations, see “Chapter 7 Useful Functions.”

2.4 To input characters

The method used to input characters is described here.

Functions of soft keyboard

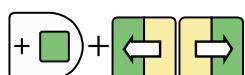
- 1 When the status in which characters can be input is established, the soft keyboard starts up.**



To select characters

Select characters using one of the following methods.

- Select the characters using the up, down, left and right keys, and press [Enter] or f11 <Enter>.
- Touch the characters that you want to enter on the screen.



To move the cursor in the character input field

Press the left or right key while holding down [ENABLE].



To input a space

Press f4 or f10 <Blank>.



To delete a character

Move the cursor to the right of the character to be deleted, and press f5 <BS>. The character to the left of the cursor is now deleted.

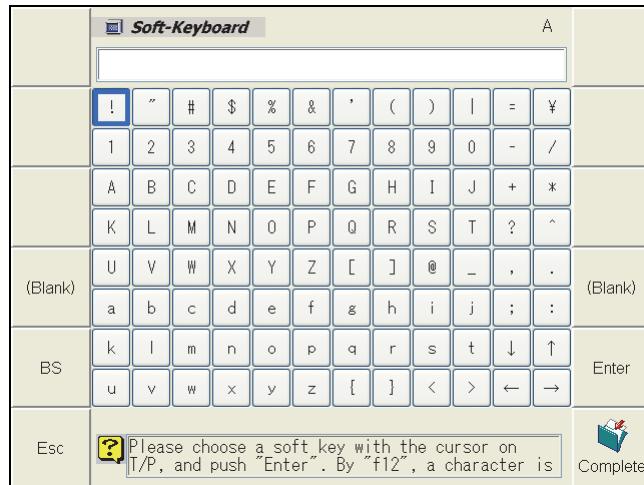


- 2 To record the characters which have been input, press f12 <Complete>.**

>> The characters are recorded, and operation returns to the original screen.

To input letters of the alphabet or symbols

- 1 Alphanumerics and half-size symbols can be input in the initial start status of the soft keyboard.**



- 2 Input the characters by following the steps on the previous page.**

Chapter 3 Turning the power on/off and manual operation

This chapter describes how to turn the power on/off and how to operate the robot manually.

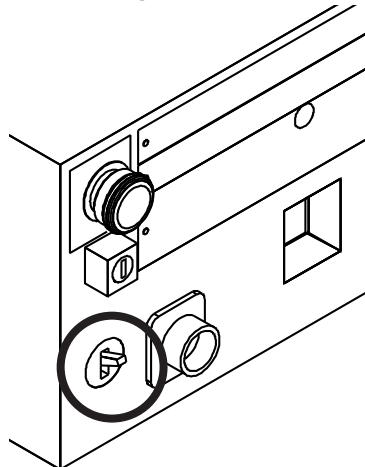
3.1	Turning the control power to ON	3-1
3.2	Mode selection (Teach / Playback).....	3-2
3.3	Turning the motor power to ON	3-3
3.4	Moving the robot manually	3-5
3.4.1	Outline.....	3-5
3.4.2	Selecting the coordinate system for the manual operation	3-6
3.4.3	Selecting the manual operation speed	3-13
3.4.4	Setting the manual operation speed	3-13
3.4.5	Switching the mechanism	3-14
3.4.6	Moving the robot manually	3-15
3.4.7	How to stop the robot using axis operation keys.....	3-16
3.4.8	How to stop the robot using ENABLE SWITCH	3-16
3.4.9	How to stop the robot using EMERGENCY STOP BUTTON	3-16
3.5	Turning the motor power to OFF	3-17
3.6	Turning the control power to OFF.....	3-18

3.1 Turning the control power to ON

In order to use robot, first turn the controller's power (control power) to ON.

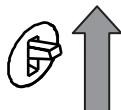
Turning the control power to ON

- 1** First, check the position of the circuit breaker (power switch). (This position differs depending on the series and the specifications.)

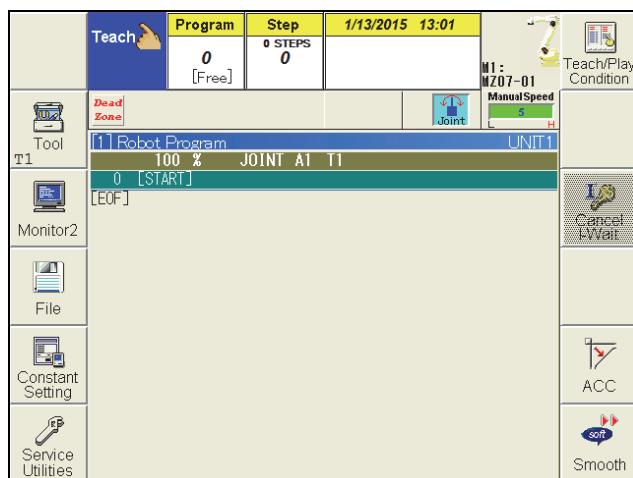


- 2** Turn the circuit breaker to the ON position.

>> The system starts up automatically, and self-diagnosis is commenced.



- 3** If self-diagnosis is completed without any problems detected, a screen such as the one shown below is displayed on the teach pendant.



The robot is now ready to operate.

3.2 Mode selection (Teach / Playback)

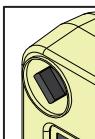
The controller features a teach mode that is mainly used for creating programs, and a playback mode that is for automatically running programs.

Mode selection



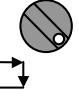
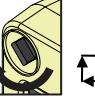
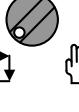
- 1** Turn the [MODE SELECT SWITCH] on the operation panel to the TEACH mode position or the PLAYBACK mode position.

MODE SELECT SWITCH	MODE
 left	TEACH 
 right	PLAYBACK 



- 2** Then turn the [TP SELECTOR SWITCH] on the teach pendant to the TEACH mode position or the PLAYBACK mode position.

Only when one of the following combinations is used, the robot can be operated manually or automatically.

Mode	MODE SELECT SWITCH	TP SELECTOR SWITCH
TEACH 	TEACH 	  (Manual)
PLAYBACK 	PLAYBACK 	  (Automatic)



If the [MODE SELECT SWITCH] and the [TP SELECTOR SWITCH] do not match, one of the following messages is displayed.

- "E0967 Teach pendant selector switch is set to manual."
- "A2006 Teach pendant selector switch is set to automatic."

3.3 Turning the motor power to ON

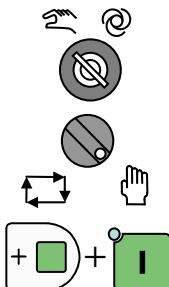
To move the robot, turn the motor power to ON.



Before turning the motor power to ON, be absolutely sure to check that no one is near the robot. If the robot should move without warning and come into contact or sandwich a person, death or serious injury may result.

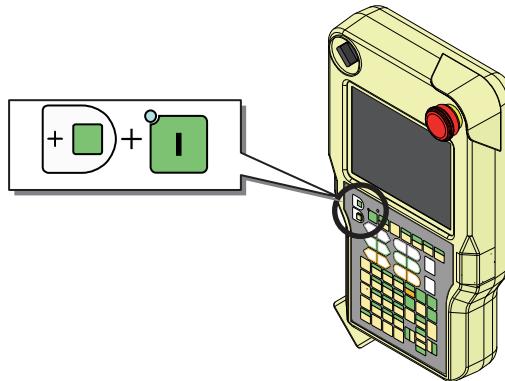
Turning the motor power to ON (in the teach mode)

Take the following steps to turn the motor power to ON in the teach mode.



- 1 Select the TEACH mode.**
 - (1) Turn the [MODE SELECT SWITCH] to the TEACH position (Left side).
 - (2) Turn the [TP SELECTOR SWITCH] to the MANUAL side (Right side)
 - (3) Release the lock of the emergency stop button on the teach pendant and the operation panel by turning the button to the right side. (If the button is locked, the "Motors ON" operation is not permitted.)

- 2 Press [ENABLE] and [MOTOR ON] keys on the teach pendant.**



>>The "Motors ON" is executed and the "Motors ON" indicator is displayed on the teach pendant screen.



But still now it is not possible to move the robot. See the next section.

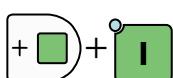
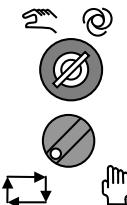


When the "Motors ON" operation cannot be executed

- Has the [EMERGENCY STOP BUTTON] on the teach pendant been pressed?
→ Turn the [EMERGENCY STOP BUTTON] clockwise to release it.
- When executing the Motors ON operation, release the [ENABLE SWITCH].
→ Grasp the switch after the Motors ON operation.
- Check the condition of the "**External Emergency Stop Input**" terminals (Pin 1-2 and 3-4) in the TBEX1 of the sequence board.
→ The terminals are NC (Normal Close) signal. To turn the Motors ON, these terminals must be ON (=closed). So the preparation of the devices (e.g. an external PLC or emergency stop buttons, etc.) connected here must have been finished and the signal must be ON (=closed).
- Are the [TP SELECTOR SWITCH] on the teach pendant and the [MODE SELECT SWITCH] on the operation panel both at the "teach" position and the "manual" position ?
→ Set both switches to the "teach" position.

Turning on the motor power (in the playback mode)

Proceed as follows to turn on the motor power in the playback mode.



- 1 Select the PLAYBACK mode.**
 (1) Turn the [MODE SELECT SWITCH] to the PLAYBACK position (Right side).
 (2) Turn the [TP SELECTOR SWITCH] to the Automatic side (Left side)
 (3) Release the lock of the emergency stop button on the teach pendant and the operation panel by turning the button to the right side. (If the button is locked, the “Motors ON” operation is not permitted.)

- 2 Press [ENABLE] and [MOTOR ON] keys on the teach pendant.**
 >>The “Motors ON” is executed and the “Motors ON” indicator is displayed on the teach pendant screen.



Now it is possible to playback the program.

[ENABLE SWITCH] need not be operated

In playback mode, the motor power is turned ON (servo ON) when the [MOTOR ON BUTTON] is pressed. The [ENABLE SWITCH] is not used.

POINT

“Internal Motors ON” and “External Motors ON”

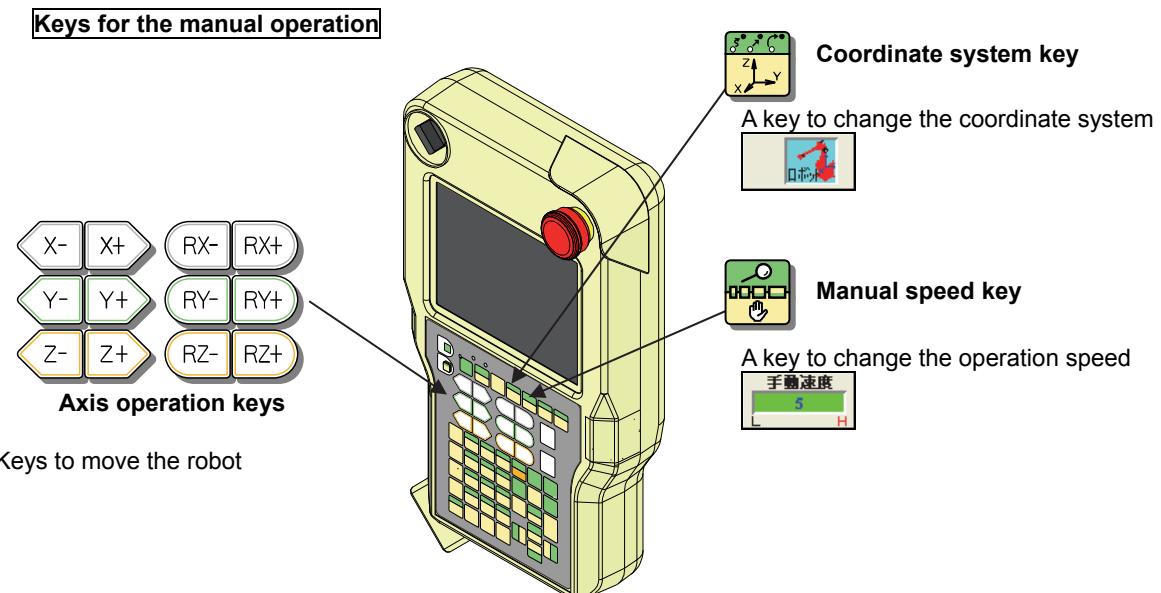
The operation described here is “Internal Motors ON”.

For the detailed operations to turn the Motors ON using external input signals (=External Motors ON operation), see the Chapter 5.

3.4 Moving the robot manually

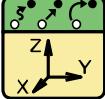
3.4.1 Outline

“Manual operation” is the operation to move the robot in the TEACH mode using the teach pendant. The operation direction of the robot (manual operation coordinate system) can be selected from several different types.



3.4.2 Selecting the coordinate system for the manual operation

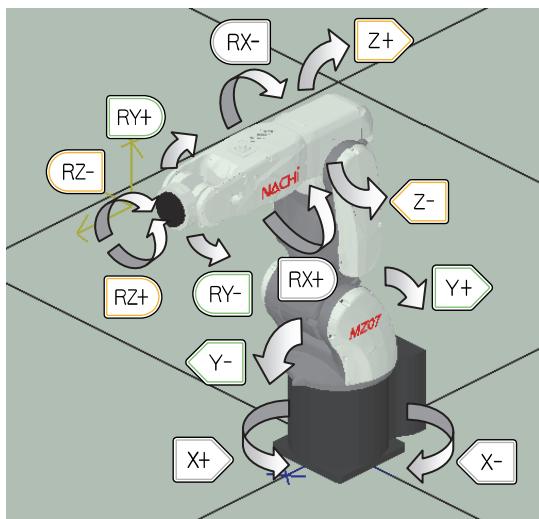
The coordinate system for the manual operation can be changed by the following operations.

	Press the [INTERPOLATION / COORDINATE] key on the teach pendant.
	Touch the icon on the screen.

Joint coordinate system



In this “**Joint coordinate system**”, each joint rotates individually by the axis operation keys.

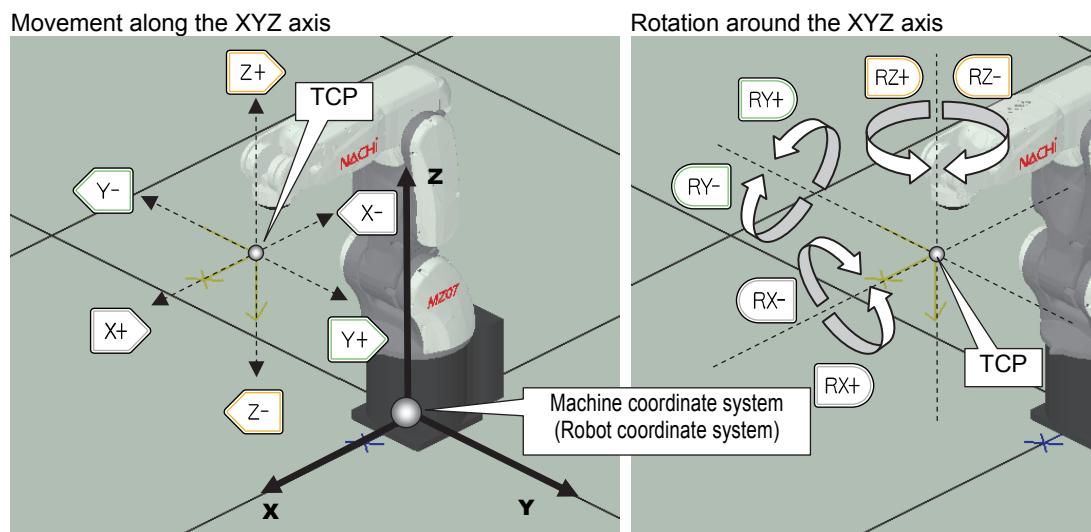
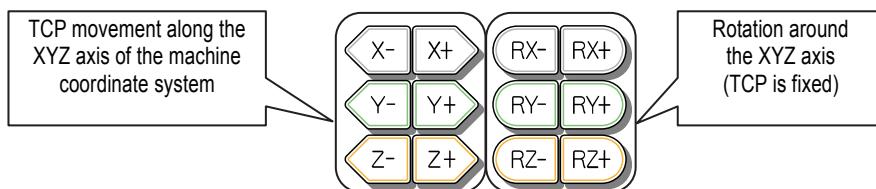


Some specific mechanisms can use only this coordinate system because of their structure.
(E.g. Traverse axis (slider unit), servo hand, 1 axis positioner etc.)

Machine coordinate system (=Robot coordinate system)



In this “**Machine coordinate system (Robot coordinate system)**”, the robot’s tool tip (TCP: Tool Center Point) moves along the “Machine coordinate system (Robot coordinate system)” that is fixed on the ground. In case of rotational operation with RX,RY,RZ keys, the TCP position (X,Y,Z) is fixed and the tool rotates around the TCP. (The rotational direction is based on the XYZ axis of the machine coordinate system).



- The tool tip position (tool length) and the tool angle can be set in the following menu.
<Constant Setting> - [3 Machine Constants] [1 Tool setting]



(Up to 32 tools (tool constants) can be defined at maximum.)

- In the default setting (factory setting), the machine coordinate system is the same with the world coordinate system. To move the machine coordinate system, change the setting in the following menu.

<Constant Setting> - [12 Format and Configuration] [5 Installation Angle]



<"Singular point" and "Dead zone">

Generally, a 6-axis articulated robot structure has a point in which the robot cannot move smoothly. This point is called as "**Singular point**". Around this point, the following problems happen. Please pay enough attention to these facts and avoid this singular point as much as possible

1. The TCP speed gets very slow when trying to go through this point
2. Accurate interpolation calculation (posture control of the robot) gets impossible
3. The wrist angle changes to unexpected direction

(Examples of singular point)

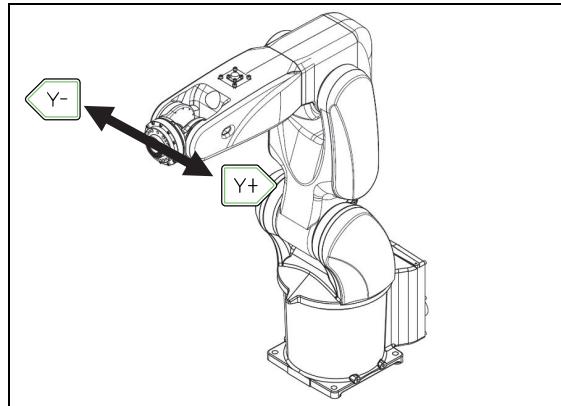
- Ex1. A posture in which the J4 axis and the J6 axis are parallel (=J5 is 0 degree)
 Ex2. The point A (Cross point of J4,J5,J6 axis) is on the J1 axis

(Supplement)

**Dead
Zone**

In this robot controller, the area around the singular point is called as "Dead Zone". The range of the Dead Zone is ± 10 degrees. If the robot gets into this area, the interpolation accuracy is not guaranteed and the robot posture control gets inaccurate.

<Constant Setting> [3 Machine Constants] [8 Posture Control] "Wrist singularity zone"
 (If the TCP setting is accurate, the TCP will go along the linear path even in the Dead Zone but tool angle gets inaccurate.)

An example of singular point

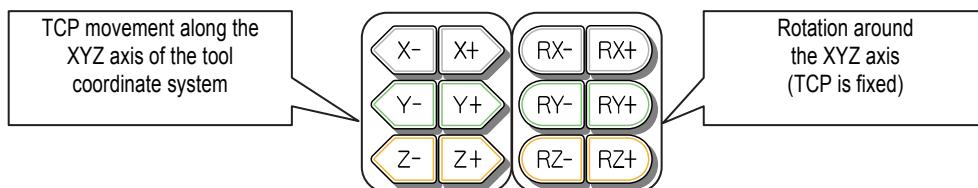
In this posture, when trying to move the robot along the Y axis, the 4th axis and the 6th axis will try to rotate in very large amount but the TCP speed of the robot gets very slow. And, in this situation, the tool posture is not kept.

Tool coordinate system

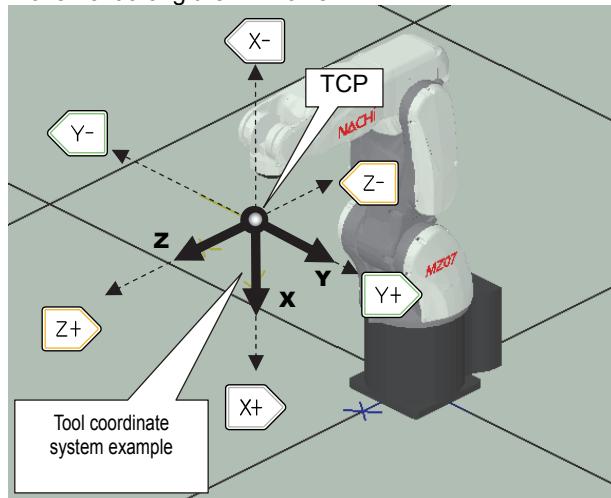


(The number shows the tool number that is being used)

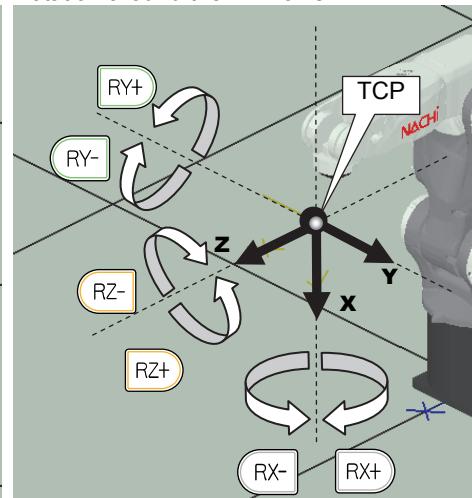
In this “**Tool coordinate system**”, the robot’s tool tip (TCP: Tool Center Point) moves along the “Tool coordinate system” that is fixed on the tool flange of the robot wrist. In case of rotational operation with RX,RY,RZ keys, the TCP position (X,Y,Z) is fixed and the tool rotates around the TCP. (The rotational direction is based on the XYZ axis of the tool coordinate system).



Movement along the XYZ axis



Rotation around the XYZ axis



(NOTE) This is just an example. The tool coordinate system's direction depends on the tool installation angle setting.

- The tool coordinate system is defined based on the tool flange center of the robot. When the direction of the tool flange (robot wrist) rotates, the tool coordinate system direction will rotate also.

- The tool tip position (tool length) and the tool angle can be set in the following menu.
<Constant Setting> - [3 Machine Constants] [1 Tool setting]



(Up to 32 tools (tool constants) can be defined at maximum.)

- To change the tool number (1-32) to be used for the manual operation, please use the Shortcut command R29 or the software-key “<Tool>”.

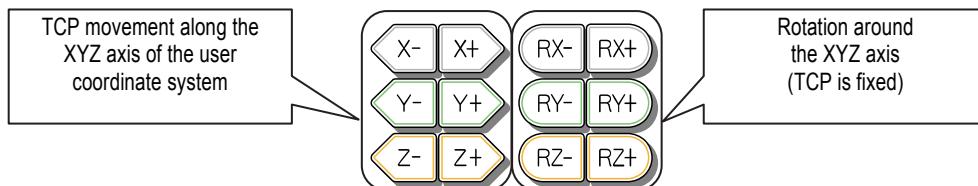


User coordinate system

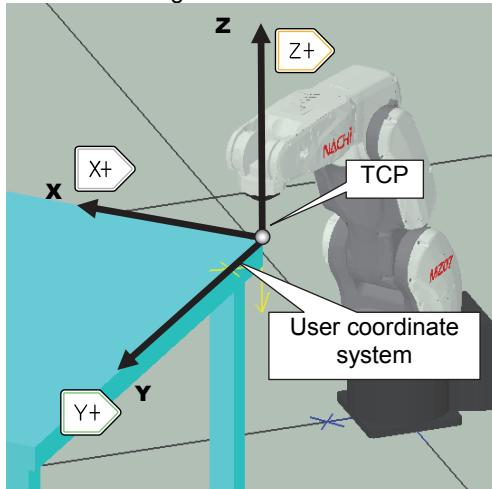


(The number shows the user coordinate system number that is being used)

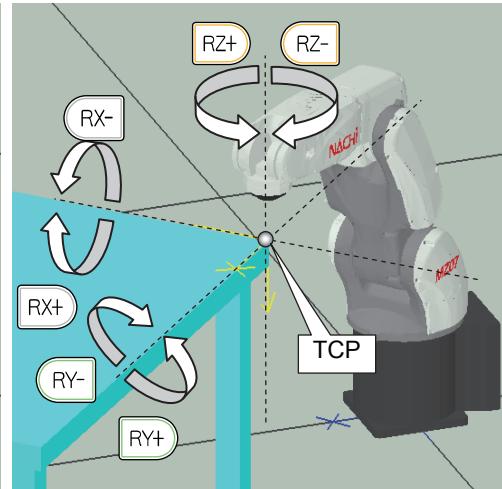
In this “**User coordinate system**”, the robot’s tool tip (TCP: Tool Center Point) moves along the “User coordinate system” that is defined in advance. In case of rotational operation with RX,RY,RZ keys, the TCP position (X,Y,Z) is fixed and the tool rotates around the TCP. (The rotational direction is based on the XYZ axis of the user coordinate system).



Movement along the XYZ axis



Rotation around the XYZ axis



- Normally, user coordinate systems are created on a work-table or a pallet. Even if the work-table is placed in slanted direction against the robot coordinate system, it is possible to move the robot horizontally and vertically on the work-table by defining a user coordinate system on the work-table in advance.

- The user coordinate system can be created in the following menu.

<Service Utilities> - [10 User Coord. Definition].



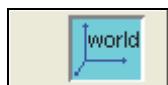
(Up to 100 user coordinate systems can be defined at maximum.)

- To use the defined user coordinate system, please make a setup in the following menu.

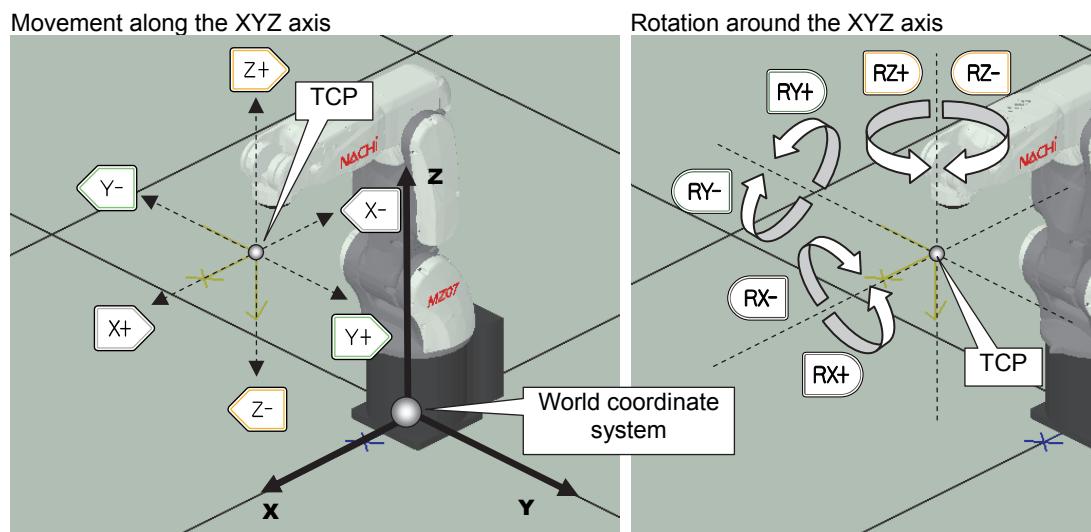
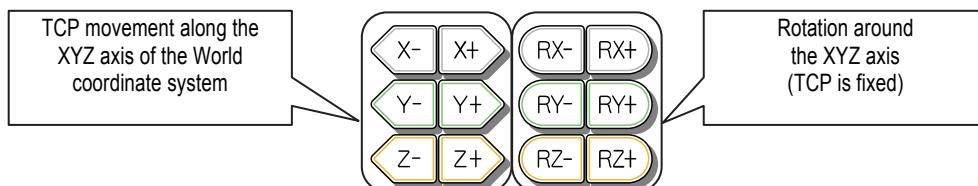
<Constant Setting> - [5 Operation Constants] [Coordinate registration]



World coordinate system (Absolute coordinate system)



In this **“World coordinate system (Absolute coordinate system)”,** the robot’s tool tip (TCP: Tool Center Point) moves along the “World coordinate system” that is fixed on the ground. In case of rotational operation with RX,RY,RZ keys, the TCP position (X,Y,Z) is fixed and the tool rotates around the TCP. (The rotational direction is based on the XYZ axis of the world coordinate system).

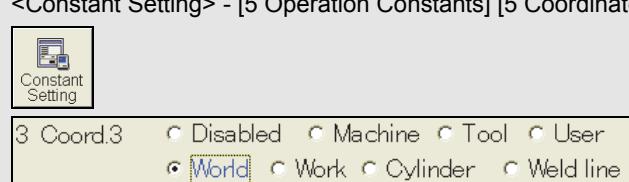


- In case of factory setting (floor mount), the machine coordinate system and the world coordinate system is the same. But in case of wall mount, slanted mount, or ceiling mount, it is necessary to change the direction of the machine coordinate system. Please change the setting in the following menu.

<Constant Setting> - [12 Format and Configuration] [5 Installation Angle]



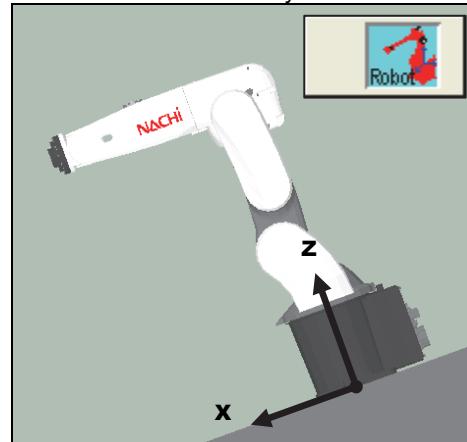
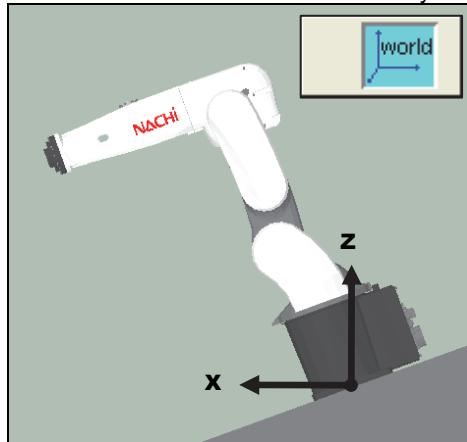
- To use the World coordinate system, please make the setting in the following menu.
- <Constant Setting> - [5 Operation Constants] [5 Coordinate registration]



Set “World” for the “Coord.3”. By this setting, it becomes possible to use “World coordinate system” as the 3rd manual operation coordinate system.

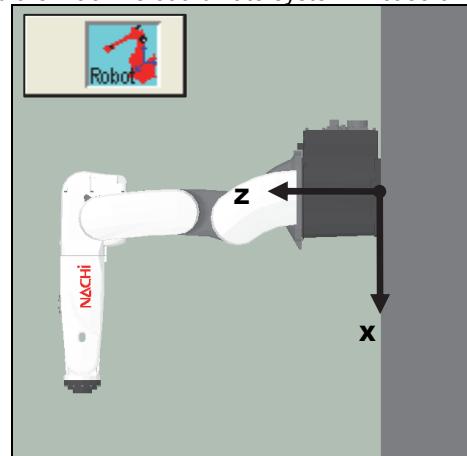
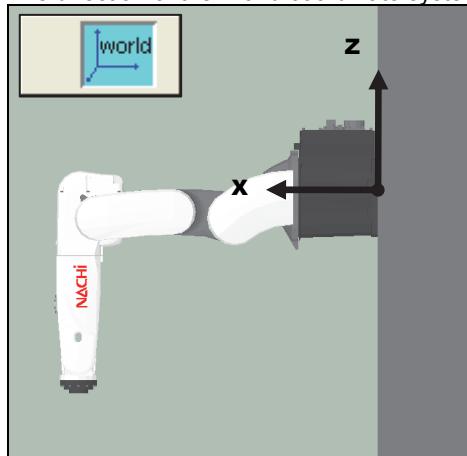
(Example 1)

The direction of the World coordinate system and the Machine coordinate system in case of slanted mount



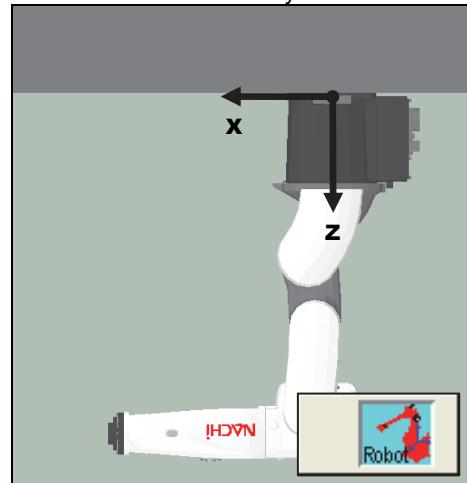
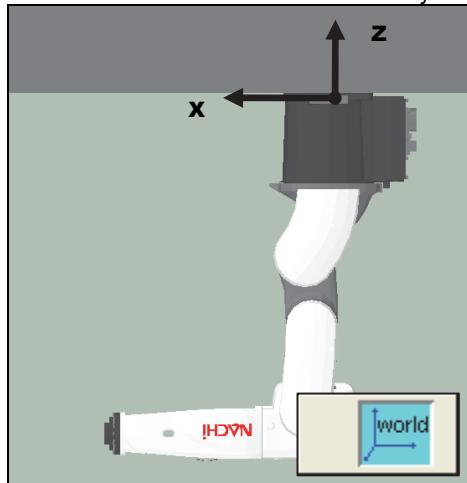
(Example 2)

The direction of the World coordinate system and the Machine coordinate system in case of wall mount



(Example 3)

The direction of the World coordinate system and the Machine coordinate system in case of ceiling mount



These pictures are just examples for the explanation. Concerning the available mounting methods, refer to the respective standard specifications of the robots.

3.4.3 Selecting the manual operation speed

The manual operation speed can be changed by the following operations.

	Press the [CHECK SPEED / TEACH SPEED] key on the teach pendant.
	Touch the icon on the screen.

3.4.4 Setting the manual operation speed

To change the settings of manual speeds 1 to 5, edit them in the following setting screen.

An operator qualification of **EXPERT** or above is required. Select the operator qualification before operation.



- 1 Select f5 <Constant setting> - [5 Operation Constants] - [2 Manual Speed].**
 >> The following setting screen is displayed.

Manual speed	Speed
1	0.5 mm/inching
2	5 mm/sec.
3	50 mm/sec.
4	100 mm/sec.
5	250 mm/sec.

Sets the manual speed.
[0.0 to 1.0mm]

Complete

Number



- 2 Move the cursor to the item you want to set, enter the setting, and press [Enter].**



- 3 After configuring the setting, press f12 <Complete>.**
 >> The setting is saved and the display returns to the original screen.



For manual speed 1 (inching), set the movement distance instead of the speed.
 In manual operation with manual speed 1, the robot automatically stops after moving the set distance.
 To continue moving, press the axis operating keys again.

3.4.5 Switching the mechanism

This procedure is used to select the mechanism to be manually operated when a multiple number of mechanisms have been connected. This operation can be performed irrespective of whether motor power is ON or OFF.

- 1 The mechanism selected for manual operation is displayed on the teach pendant.
(Example)**

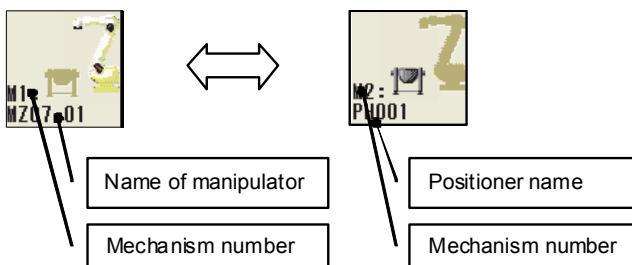


- The mechanism that does not move is gray color.
- In case of single mechanism system, this operation is not possible.

- 2 To switch the mechanism, press [UNIT/MECHANISM].**



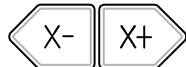
>> The selected mechanism changes (and the display of the teach pendant changes.) Given below is an example where a mechanism is switched in a configuration consisting of a manipulator and positioner.



- 3 After switching the mechanism, manual operation using the newly selected mechanism is possible.**

While holding the [ENABLE SWITCH], press the axis keys to operate the mechanism.

(Supplement) Normally, 1 axis mechanism like "Servo hand" or "Slider unit" can be operated using "X-" and "X+" keys.



- The CFD controller has an option that provides 1 servo axis. When this option is installed, the CFD controller becomes "Multi-mechanism" specification. For details of this option, please refer to the instruction manual

"CFD CONTROLLER TECHNICAL DOCUMENT 1" (TCFEN-155).



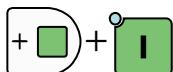
- In case of "1-axis mechanism" like a slider unit (traverse axis) or a servo hand, etc., only "**Joint coordinate system**" can be selected. So if it is not possible to select other coordinate system, please check if the present mechanism type.



3.4.6 Moving the robot manually



- 1** Check that the TEACH mode is selected.



- 2** Press [Enable] + [Motors ON].

>>The motors turn ON and the “Motors” indicator is displayed.



or



- 3** To change the manual operation coordinate system, press [INTERPOLATION / COORDINATE] key.

>>Every time this key is pressed, the coordinate system changes.



(It is also possible to change the coordinate system by touching the icon on the screen.)

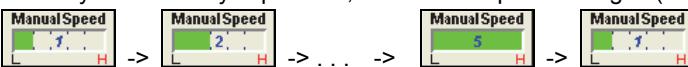


or

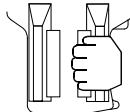


- 4** To change the manual operation speed, press [CHECK SPEED / TEACH SPEED] key.

>>Every time this key is pressed, the manual speed changes.(From 1 to 5)

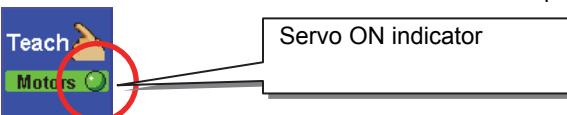


(It is also possible to change the manual speed by touching the icon on the screen.)

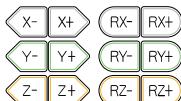


- 5** Grasp the [ENABLE SWITCH] softly.

>>The motor brakes of the current mechanism are released and the robot will make the Servo ON status. The Servo ON indicator is displayed.

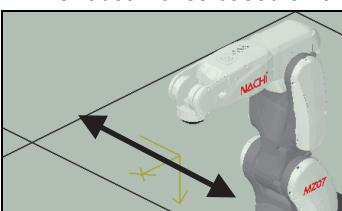


Now it is ready to operate the robot. While the [ENABLE SWITCH] is softly grasped, the power is supplied to the motors and the robot can move by pressing the axis operation keys of the teach pendant.



- 6** Press the axis operation keys.

>>The robot moves based on the current manual operation coordinate system.

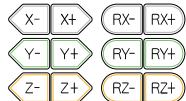


Concerning the operation of the [ENABLE SWITCH]

- To operate the robot in the TEACH mode, the robot must be operated while the [ENABLE SWITCH] is grasped. (This switch is not used in the PLAYBACK mode.)
- If the [ENABLE SWITCH] is released, the servo is turned off, and the robot stops immediately. When the [ENABLE SWITCH] is grasped again, the servo comes back ON.
- Grasping the [ENABLE SWITCH] tightly until a clicking sound is heard also causes the servo power to be turned OFF and the robot to stop immediately.
- When the [EMERGENCY STOP BUTTON] has been pressed or the emergency stop command has been input from an external source during operation, the servo power can no longer be turned on or off by operating the [ENABLE SWITCH]. In cases like this, perform steps **2** to **3** above.
- If the ON/OFF operation of the [ENABLE SWITCH] is repeated in short time, “Inconsist (un-match)” error may happen and the motors are turned OFF forcibly. In this case, please try to turn the Motors ON again.(In some cases, primary power OFF and ON may be required)

POINT

3.4.7 How to stop the robot using axis operation keys



If the axis operation keys are released, the robot will smoothly slow down and stop.

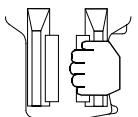
Normally, please stop the robot with this method.

After the robot stops, release the [ENABLE SWITCH].

3.4.8 How to stop the robot using ENABLE SWITCH



(Servo ON) ->



(Release) ->



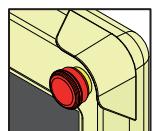
(Servo OFF)

When the robot takes unexpected dangerous motion in the TEACH mode, release the ENABLE SWITCH or grasp the switch tightly. This operation turns the Servo OFF, and the robot will stop immediately. At this time, the brake units in the motors are activated forcibly. But the Motors ON status will be kept so it is possible to turn the Servo ON by grasping the ENABLE SWITCH softly again after releasing it.



- Basically, this method is only for emergency situation. If the robot is stopped by this operation while it is moving, the motor brakes may be damaged slightly.
- When the robot is stopped by this operation, it will fall down a little. Therefore, it is recommended to stop the robot softly by following the method shown in "3.4.7 How to stop the robot using axis operation keys" to keep the accurate position.

3.4.9 How to stop the robot using EMERGENCY STOP BUTTON



It is possible to stop the robot forcibly by pressing the EMERGENCY STOP BUTTON. Both in the TEACH and PLAYBCK mode, this button is available. When pressing this button, the Motor power is shut off and the robot will stop immediately. At this time, the brake units in the motors will be activated forcibly to stop the motor rotation.



- Basically, this method is only for emergency situation. If the robot is stopped by this operation while it is moving, the motor brakes may be damaged slightly.
- When the robot is stopped by this operation, it will fall down a little. Therefore, it is recommended to stop the robot softly by following the method shown in "3.4.7 How to stop the robot using axis operation keys" to keep the accurate position.

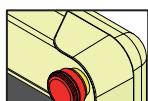
3.5 Turning the motor power to OFF

For both the TEACH mode and PLAYBACK mode, to turn the motor power OFF (servo OFF), press the [EMERGENCY STOP BUTTON]. If it is not necessary to operate the robot, always lock the [EMERGENCY STOP BUTTON] for safety.

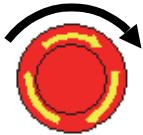
Turning the motor power to OFF

- After confirming that the robot is stopping, press the [EMERGENCY STOP BUTTON] of the teach pendant or the operation panel.

>> The motor power is now turned off (servo off).
If the robot is moving, it will stop immediately.



- To turn the motor power back on, the lock must be released.
To release the lock, turn the button in the direction of the arrow.



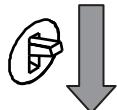
While the [EMERGENCY STOP BUTTON] is locked, the "Motors ON" operation is prohibited. This lock operation can be used before performing an inspection work etc. around the robot in safe.

3.6 Turning the control power to OFF

To suspend the robot operation, turn off the control power.

Turning the control power to OFF

- 1 Confirm that the robot is stopping.**



- 2 Turn the circuit breaker to the OFF position.**

>>The system will shutdown.



To restart, disconnect the primary power supply, and then wait for approximately 5 seconds before reconnecting the power supply.

Chapter 4 Teaching

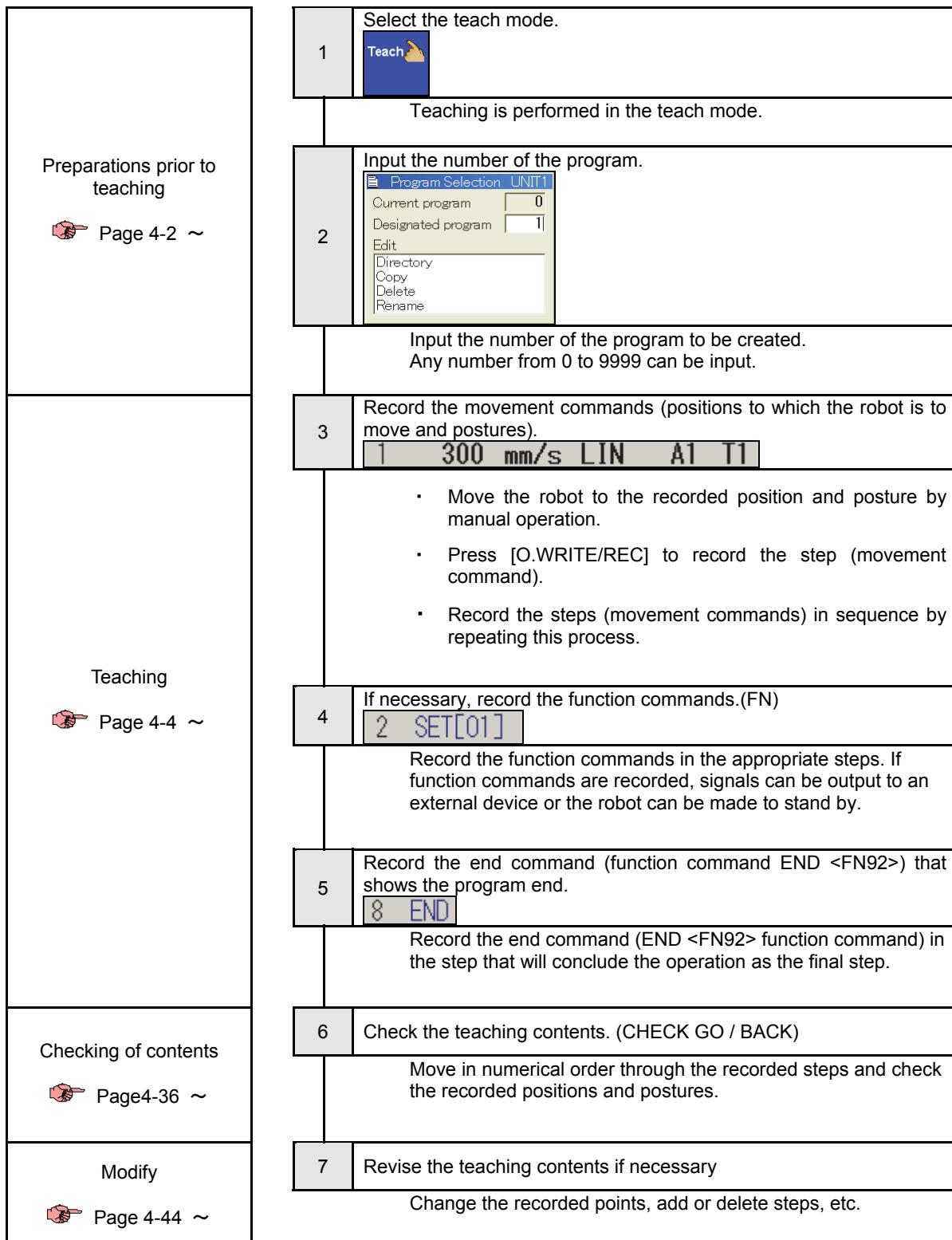
This chapter describes the teaching work.

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4.1 Teaching procedure

Proceed with teaching by following the steps below.

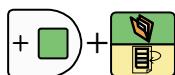


4.2 Preparations prior to teaching

4.2.1 Input the number of the program

When teaching the robot new movements, provide a number to the program which will now be created. Any number from 0 to 9999 can be input.

Input the number of the program.



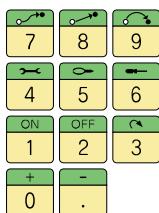
Or
Program
1 [EX]

1 Select the teach mode.



2 While holding down [ENABLE], press [PROG/STEP].

>> The [Program Selection] window now opens.



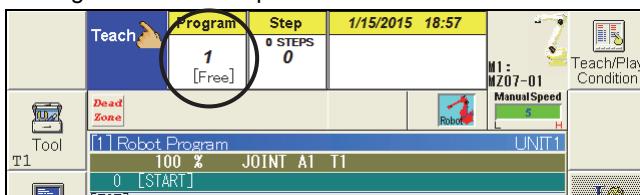
3 Input the number of the program in the “Designated program” field, and press [Enter].

When “1” is to be specified as the program number, for instance, press the [1] numeric key.



4 Press [Enter].

>> Program “1” is now opened.



At this point, the teaching can now begin.

If you do not know which numbers are not yet used

If you do not know which numbers are not yet used, check the programs already created by listing them on the display.

See page 4-3 “4.2.2 Listing the programs on the display”.



There is no specific operation for “Create new program”. After opening an unused program number and recording commands, a new program file is automatically created in the internal memory of the controller.

4.2.2 Listing the programs on the display

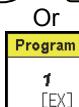
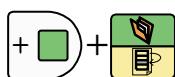
A convenient way to open an already created program is to list the programs on the display and then make the selection.

The number can also be directly specified as described in “4.2.1 Input the number of the program”.

Listing the programs on the display

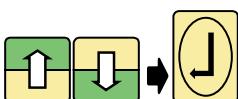


- 1 Select the teach mode.**



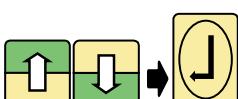
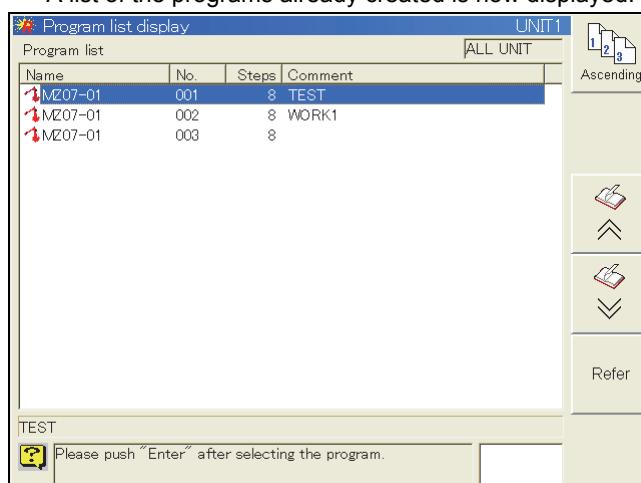
- 2 While holding down [ENABLE], press [PROG/STEP].**

>> The [Program Selection] window now opens.



- 3 Align the cursor with “Directory”, and press [Enter].**

>> A list of the programs already created is now displayed.



- 4 Align the cursor with the program to be opened, and press [Enter].**

>> The selected program is now opened.

Concerning the contents displayed when programs are listed

The contents displayed are as follows.



Name	No.	Steps	Comment
MZ07-01	001	8	TEST
MZ07-01	002	8	WORK1
MZ07-01	003	8	

[1] : The program filenames are displayed in this column. The filenames are indicated using the “robot name.xxxx” format. “xxxx” denotes the number of the program.
(Example: MZ07-01.9999)

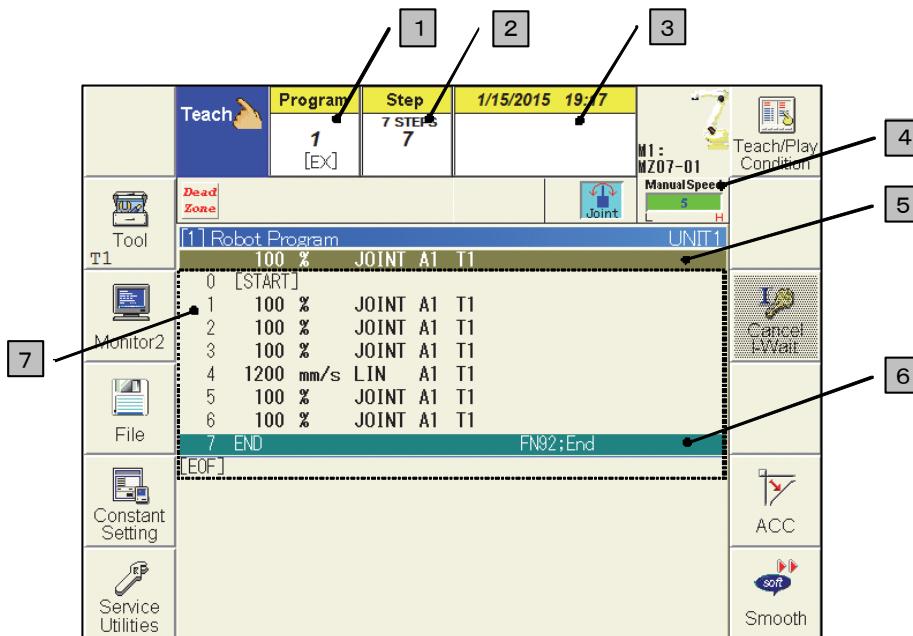
[2] : The number of recorded steps is displayed in this column.

[3] : If comments have been registered, they are displayed in this column.

4.3 Teaching

4.3.1 Concerning the screen displays during teaching

Various information is displayed on the screen during teaching as shown below. Before proceeding with teaching, remember this information as background knowledge.



1 Program No. (Program number selection key)

The number of the currently selected program is displayed.

If not even one step has been recorded, "Free" is displayed; if one or more steps have been recorded, "EX" is displayed.

2 Step No. (Step number selection key)

The number of the currently selected step is displayed.

3 Comment

The contents of the comment (REM <FN99> function command) recorded at step 1 in the program are displayed as the comment of the program itself. The maximum number of characters which can be used for the REM function command is 199. However, the comment which consists of the first 38 of these characters appears in this area.

4 Manual Speed (Manual speed selection key)

The speed set here is reflected as the movement command of the robot set in <>Operating mode S>>.

Each time [CHECK SPD/TEACH SPEED] is pressed, the speed of the recording status is switched.

5 Recording status (See "4.3.2 Setting the "Recording status""))

The currently set speed, interpolation method, etc. are displayed here. The movement commands are recorded under the conditions displayed in recording status by pressing [O.WRITE/REC].

6 Cursor

This cursor indicates operation target. It is displayed as a green bar.

7 Program contents

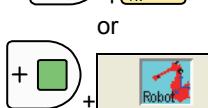
The recorded steps are displayed here.

The step numbers are provided for both the movement commands and function commands.

4.3.2 Setting the “Recording status”

How to set the “Recording status”

Before recording a move command in the program, please set the “Recording status” in advance by following the operations in this section. It is also possible to modify the parameters using the “Screen editor” function later. (See “4.7 Using the screen editor function to modify commands”)



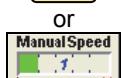
- 1 Select the interpolation type with [Enable] + [INTERP / COORD] key.**

>>The interpolation type for the move command is set. (LIN or JOINT)

1200	mm/s	LIN	A1	T1
------	------	-----	----	----

100	%	JOINT	A1	T1
-----	---	-------	----	----

See “4.3.7 Interpolation type” also.



- 2 Select the recording speed using the [CHECK SPEED / TEACH SPEED] key.**

>>Every time this key is pressed, the speed for the move command will change.

LIN : 10 → 100 → 300 → 500 → 1200 [mm/s]

1200	mm/s	LIN	A1	T1
------	------	-----	----	----

JOINT : 5 → 10 → 20 → 50 → 100 [%]

100	%	JOINT	A1	T1
-----	---	-------	----	----

See “4.3.6 Speed and its unit” also.

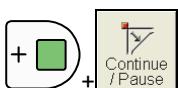


- 3 Select the Accuracy level using the [ACC] key. (A1 to A8)**

>>The accuracy level for the move command is determined.

1200	mm/s	LIN	A1	T1
------	------	-----	----	----

See “4.3.8 Accuracy (A)” also.



- 4 Set “Continue (without P)” or “Pause (with P)” by pressing [Enable] + <Continue / Pause> key.**

1200	mm/s	LIN	A1	T1	P
------	------	-----	----	----	---

See “4.3.8 Accuracy (A)” also.

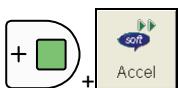


- 5 Set “Smooth (S0 to S3)” by pressing <Smooth> key.**

1200	mm/s	LIN	A1	T1	S1
------	------	-----	----	----	----

(In case of “0”, the display of “S” will disappear.)

See “4.3.12 Smoothness (S)” also.



- 6 Set “Acceleration (D0 to D3)” by pressing [Enable] + <Accel> key.**

1200	mm/s	LIN	A1	T1	D1
------	------	-----	----	----	----

(In case of “0”, the display of “D” will disappear.)

See “4.3.11 Acceleration (D)” also.

Concerning the parameters for the move command

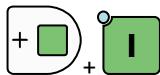
The parameters of the move command determined by the “Recording status” in advance can be modified after recording the move command. Therefore, until you get accustomed to the robot operation, it is recommended to concentrate about only how to record the position of the robot. And then modify the respective parameters later using the “Screen editor” screen”.



See “4.6 Modifying the program”.

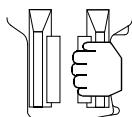
4.3.3 Recording a move command

Move the robot to the teach point and record a move command

**1**

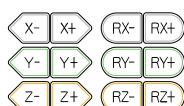
Press [MOTOR ON] key with pressing the [ENABLE] key.

>>The Motors turn ON and the “Motors ON indicator” will be displayed.

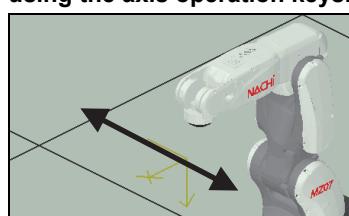
**2**

Grasp the [ENABLE SWITCH] softly to turn the Servo ON.

>>The brakes for each motor of the current mechanism will be released and the “Servo ON” condition will be made. At this time, the “Servo ON indicator” will be displayed.

**3**

With holding the [ENABLE SWITCH], move the robot to the desired position using the axis operation keys.



(NOTE) Concerning the manual operation speed or the coordinate system, see the chapter 3.

**4**

Press [OVER WRITE / RECORD] key.

>>A move command is recorded at the bottom line of the work-program.

1	300 mm/s LIN A1 T1
---	--------------------

When recording a move command, the conditions in the “Recording status” will be copied.

Recording status

1200 mm/s LIN A1P T1 D1S1

POINT

A move command that was created based on the setting of the “Recording status”

9 1200 mm/s LIN A1P T1 D1S1

A step where a new move command can be recorded

The move command recording operation using the [OVER WRITE / RECORD] key is allowed only when the last step of the work-program is selected. In short, normally, a new move command should be recorded as a last step. If you want to record a new move command at a step except for the last step, please use [ENABLE] + [INSERT] key. (See “4.6.4 Adding (inserting) movement commands”)

POINT



[OVER WRITE / RECORD] key can “record” a new move command at the last step



[ENABLE] + [INSERT] key can “insert” a new move command in the halfway of the program

4.3.4 Move command (conditions)

A move command has the following “Conditions (parameters)” as its data.

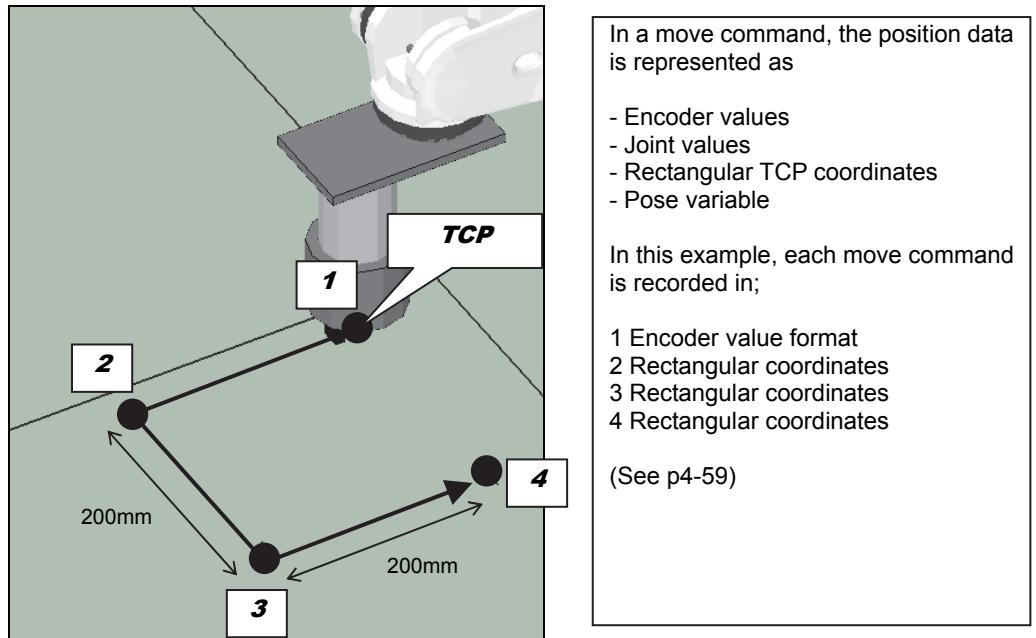
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	10.0	%	JOINT	A1P	T1	D3S3	F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

No.	Name	Descriptions
1	Step No.	This is the number of the step.
2	Speed	This is the speed that is used for the movement towards the teach point. (See “4.3.6 Speed and its unit”)
3	Speed unit	This is the unit for the speed. (See “4.3.6 Speed and its unit”)
4	Interpolation type	This is the interpolation type to determine the shape of the TCP locus. (See “4.3.7 Interpolation type”)
5	Accuracy and Continue / Pause	“Accuracy” is the shortcut distance level for a cornering motion. “Continue / Pause” (P mark) is the ON/OFF switch of the positioning motion. (See “4.3.8 Accuracy (A)”) (See “4.3.9 Continue / pause (P)”)
6	Tool No.	This is the tool number that is used for the movement towards the teach point. (The “tool constant” is used for the locus calculation etc.) (See “4.3.10 Tool number”)
7	Acceleration and Smoothness	These parameters change the “Acceleration (D)” and the “Smoothness (S)” of the speed curve. (See “4.3.11 Acceleration (D)”) (See “4.3.12 Smoothness (S)”)
8	Fine motion	This is a function to improve the path accuracy of the step temporarily. (See “4.3.13 Fine motion (F)”)
9	Step comment	It is possible to put a comment for every step. (See “4.3.14 Step comment”)

4.3.5 Move command (position data)

A move command has not only conditions explained in the previous section but also robot's position information as data. And, the respective move commands are called as “**Teach point**” or “**Recorded point**”. The tool tip of the robot (=TCP : Tool Center Point) will draw 3 dimensional trajectory connecting those points based on the “Interpolation type”.

(Example) The robot TCP will move by connecting the “Move commands (=Teach points)”.



(Display example in the “Screen editor”)

	J1/X	J2/Y	J3/Z	J4/Roll	J5/Pitch	J6/Yaw
1	V ANG	0.00	107.22	-14.72	0.00	-92.50
2	V MEC	555.0	0.0	457.0	0.00	0.00
3	V MEC	555.0	200.0	457.0	0.00	0.00
4	V MEC	355.0	200.0	457.0	0.00	0.00

The position data for each move command is displayed when moving the cursor to the right side screen in the “Screen editor”.

1st screen (conditions)

2nd screen (position data)

If the [OVER WRITE / RECORD] keys is used to make a move command, the move command will be recorded with the “**Encoder value style**” as the position data format (See “4.8.2 Encoder values format”).

And, it is also possible to select the other different position data format. For details, refer to “4.8 A movement command recorded using FN645 MOVEX (for expert)”

4.3.6 Speed and its unit

1	10.0 %	JOINT A1P T1 D3S3 F COMMENT
2	100 mm/s	LIN A1 T1
3	100 mm/s	S-LIN A1 T1

This is the speed value for the robot motion.

Unit	Name	Description
mm/s	Linear speed	<p>This is the linear speed of the TCP. (1.0 [mm/s] ~ 5000 [mm/s])</p> <p>(NOTE)</p> <ul style="list-style-type: none"> - If the distance between 2 points is too short, the TCP speed may not able to reach the designated speed. - When "The TCP position of 2 continuous teach points are almost the same" and "The tool angles of those 2 points are different", the robot wrist may move very fast unexpectedly when using this style speed setting. In a case like this, it is recommended to use the speed setting like "10%"(capacity setting) for example.
sec	Motion time	<p>This is a time that is taken to move to the teach point. (0.01 [sec] ~ 100 [s])</p> <p>(NOTE)</p> <ul style="list-style-type: none"> - If short time is set (e.g. "0.01 [sec]"), the robot will move fast. But, if it is necessary to specify the maximum speed of the robot, please use "100%" as the robot speed setting.
%	Capacity	<p>It is possible to specify the speed as the percentage [%] for the robot's maximum capacity (=100%). (1.0 [%] ~ 100 [%])</p>
deg/s	Angle change speed	<p>It is possible to specify the speed by the tool angle change speed. (1 ~ 500 [deg/s])</p>



The following units are the default units.

Basically, [mm/s] is used for LIN.

Basically, [%] is used for JOINT.

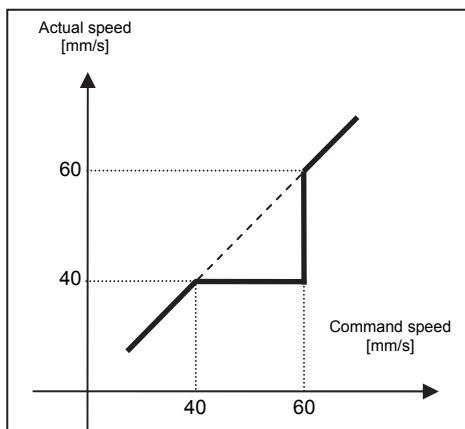
Precautions for MZ04E/MZ04DE

- If the command speed (after the Playback speed Override process) enters the range shown as below, the command speed is automatically set to 40[mm/s].

40[mm/s] ~ 59[mm/s]

(Example)

40[mm/s] → 40[mm/s]
 41[mm/s] → 40[mm/s]
 59[mm/s] → 40[mm/s]
 60[mm/s] → 60[mm/s]



- When vibration occurs, please perform the following 2 items.

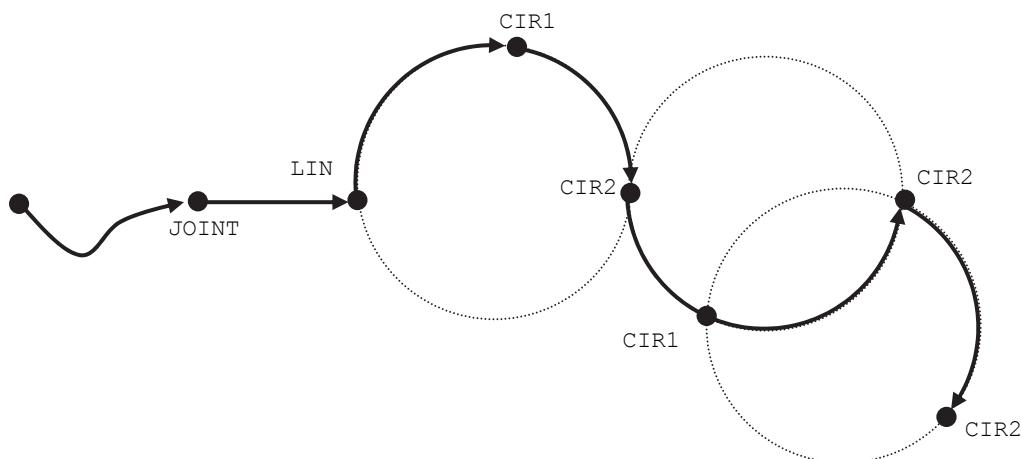
- If possible, try to change the posture of the wrist unit or the work-piece so that the inertia gets small.
- Try to change the recorded speed (larger or smaller) in the movement command. (Until the vibration disappears)

4.3.7 Interpolation type

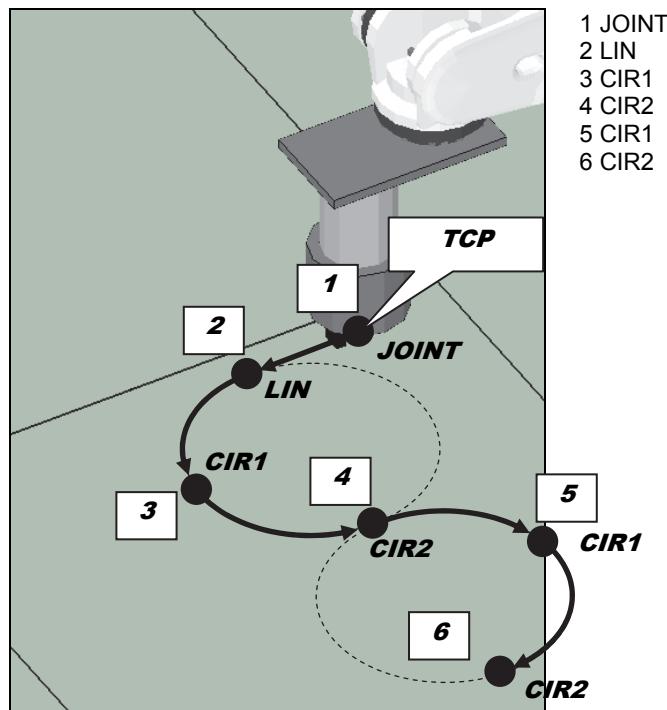
1	10.0	%	JOINT	A1P T1	D3S3	F	COMMENT
2	100	mm/s	LIN	A1	T1		
3	100	mm/s	S-LIN	A1	T1		

This is the “**Interpolation type**” that is used while the robot TCP (Tool Center Point) is moving between 2 teach points. The following 7 types are available.

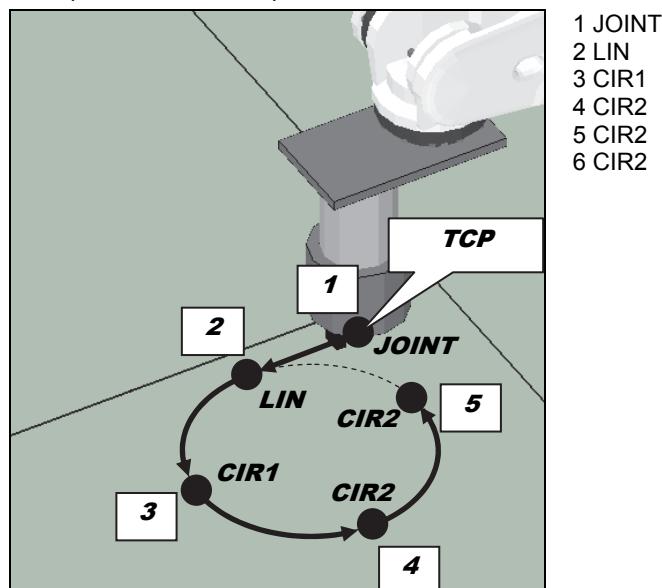
Notation	Name	Description
JOINT	Joint interpolation (Interpolation OFF)	Each joint moves independently. So the TCP path will not draw a linear line. Generally, JOINT can move faster than LIN.
LIN	Linear interpolation	Each joint synchronize each other to make the TCP draw a linear path. Generally, LIN cannot move faster than JOINT.
CIR1	Circular interpolation (middle point)	An imaginary 3D circle is generated in the memory by referring to 3 teach points (N-1, N, and N+1) and the TCP will draw an arc from N-1 to N. N-1 : The previous teach point (Step N-1) N : The teach point itself that has “CIR1” as its interpolation type N+1 : The next teach point (Step N+1)
CIR2	Circular interpolation (end point)	An imaginary 3D circle is generated in the memory by referring to 3 teach points (N-2, N-1, and N) and the TCP will draw an arc from N-1 to N. N-2 : The previous teach point (Step N-2) N-1 : The previous teach point (Step N-1) N : The teach point itself that has “CIR2” as its interpolation type
S-LIN	Stationary tool linear interpolation	In case of stationary tool interpolation (S-LIN, S-CIR1, and S-CIR2), the interpolation motion will be made by referring to the origin and the angle of the pre-defined user coordinate system. Concerning the stationary tool, refer to the online help for the “FN67 STOOL” and the <Service Utilities> [10 User Coordinate Definition] menu.
S-CIR1	Stationary tool Circular interpolation (middle point)	
S-CIR2	Stationary tool Circular interpolation (end point)	



Example 1: Circular interpolation



Example 2: Circular interpolation



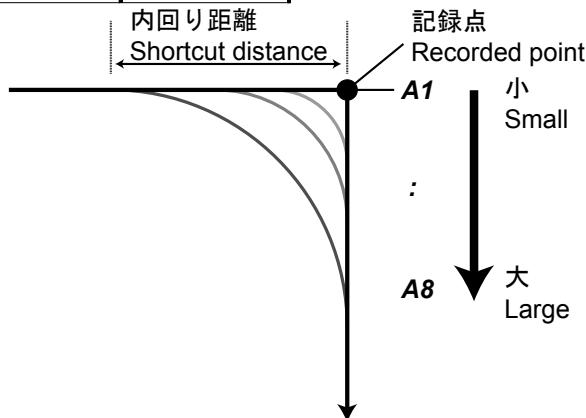
Depending on the teach point's position, the robot may draw unexpected locus.
Please pay enough attention to the interference to the peripheral devices etc.

4.3.8 Accuracy (A)

1	10.0	%	JOINT	A1	P T1	D3S3	F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

“Accuracy (A)” refers to the degree of shortcut motion for a teach point. There are 8 levels for this setting.

Level	Shortcut
A1	0 mm
A2	5 mm
A3	10 mm
A4	25 mm
A5	50 mm
A6	100 mm
A7	200 mm
A8	500 mm



- In case of A1, the TCP will go through the teach point accurately.
(Shortcut distance is 0 mm)

- If the accuracy is A2 or more, the TCP will make shortcut motion. So the time that is taken to the next teach point will get shorter. Although it is possible to shorten the tact time when using large accuracy level, it is necessary to pay enough attention not to hit the peripheral devices.

- Even if the interpolation type is changed beyond the continuous steps, the shortcut motion will be executed.

- If the accuracy level remains the same, the path of the robot is not affected even when the recording speed is changed.

- Similarly, even when the playback speed changes, there is hardly any effect on the path of the robot. (The “playback speed” is the speed resulting from a change made by speed override, the low safety speed or other actual speed during playback.)

- If the distance between 2 points is shorter than the short cut distance, the shortcut motion will start at the half point of the path.

- The shortcut distance can be changed in the following menu. But if the distance setting is changed after completing teaching operation, the motion path will change also. Please be sure that it is necessary to check the all programs' path again in a case like that.

<Constant Setting> [4 Accuracy and Smoothness]

POINT

4.3.9 Continue / pause (P)

1	10.0	%	JOINT	A1P	T1	D3S3	F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

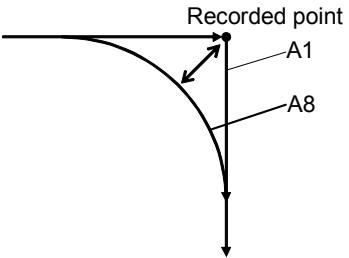
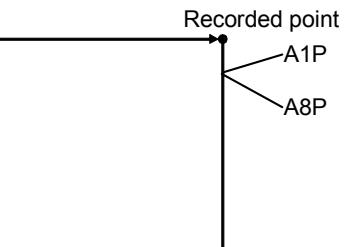
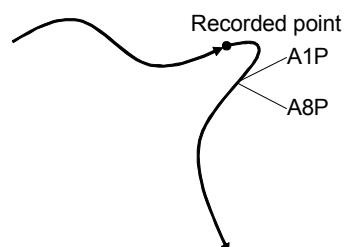
When "P" is attached to the accuracy number, the robot will make "**Pause**" motion at the teach point. If the P mark is not attached, the robot will "**Pass through (continue)**" the teach point.

Continue (without "P" mark)

The robot does not execute the in-position check and the TCP will draw the shortcut locus smoothly.

Pause (with "P" mark)

Enough deceleration & stop control is executed at the position and the in-position check (a process to check that the "Servo command position" and the "Servo current position" match each other) is executed. Please use this setting for steps where accurate positioning is necessary.

	LIN	JOINT
Continue without P		
	<p>The robot tool does not continue through the recorded points but passes smoothly along the inside of the tool path with no reduction in its speed. Exactly how far inside the tool path the robot tool moves depends on the accuracy level setting.</p>	
Pause with P		
	<p>Both A1P and A8P tool tip continue through the recorded points. However, the positioning accuracy differs according to the accuracy level. The lower the figure used for the accuracy level, the greater the deceleration at the recorded points and the higher the positioning accuracy which is achieved. Record the accuracy level for those steps requiring positioning accuracy.</p>	

POINT

Although it is possible to set "A8P", it is recommended to use "A1P" to get high positioning accuracy.

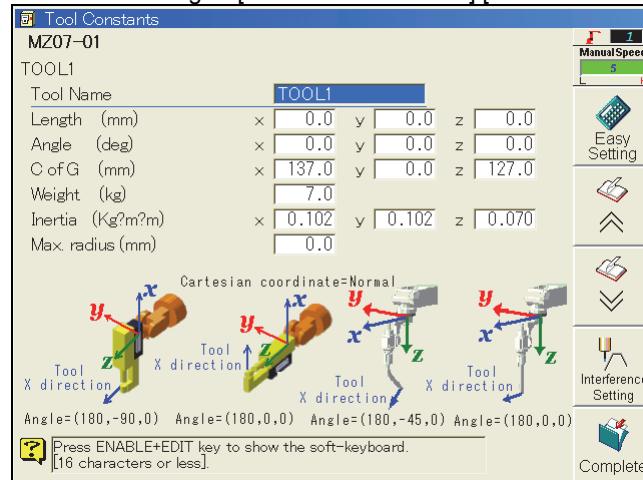
4.3.10 Tool number (T)

1	10.0	%	JOINT	A1P	T1	D3S3	F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

When using LIN, CIR1, or CIR2 as interpolation type, the setting of the “Tool Constant” is necessary. The tool constant to be used for those controls can be selected by the “Tool No.” (from T1 to T32) recorded in every move command data. And, the parameters of “Weight”, “C of G”, etc. are used for the acceleration / deceleration control of the robot.

The tool constants can be set in the following menu.
The tool constants can be defined up to 32.

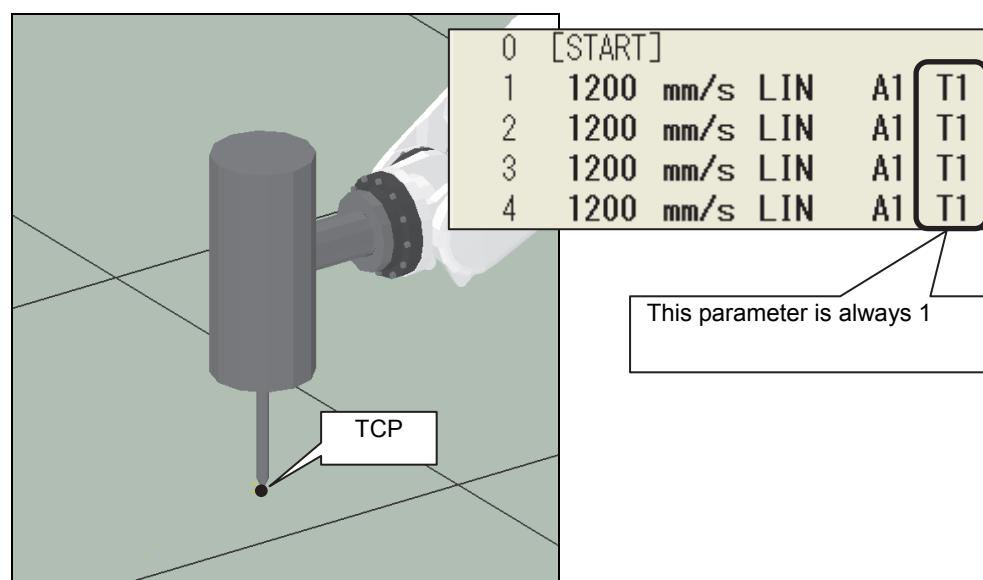
<Constant Setting> - [3 Machine Constants] [1 Tool Constants]



(Example1) If only 1 tool device is used always throughout the program

If both of the “Tool length” or the “Weight” does not change, please use T1 for all the move commands.

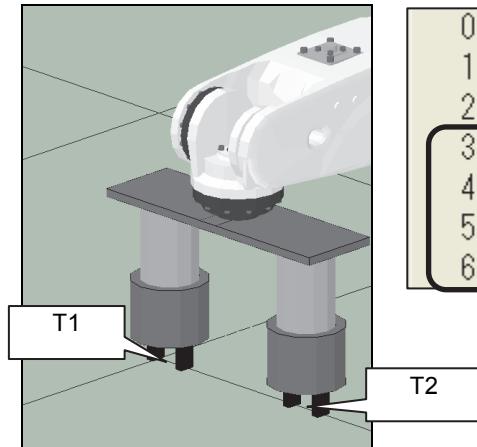
For example, if a tool like this picture is used for a de-burring application, please set the parameter of “Length” so that the TCP (tool tip 3D position) is located on the tip of the tool.



(Example2) If the tool device has 2 TCPs

In case of a double gripper like the following picture, it is recommended to define 2 tool constants. (T1 and T2)

T1 Gripper 1
T2 Gripper 2



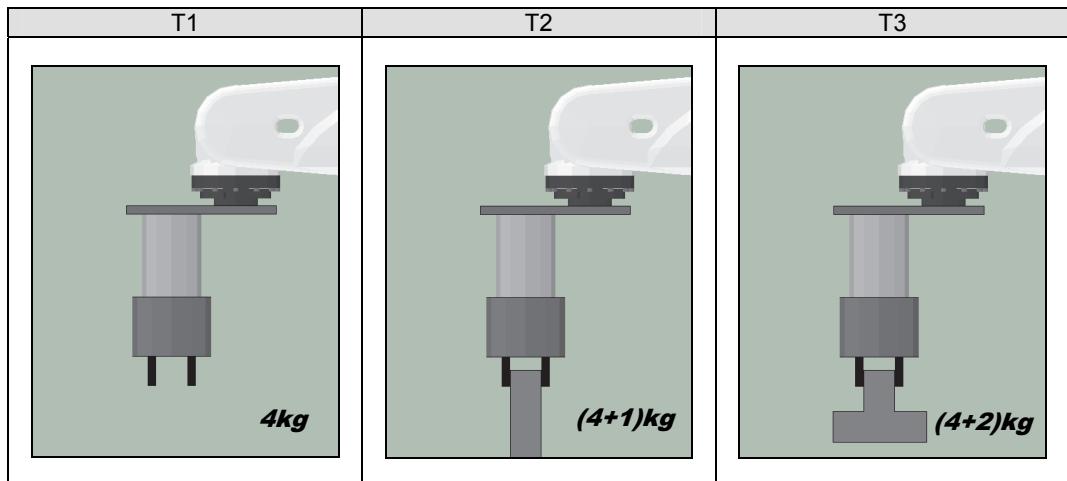
0	[START]				
1	100	mm/s	LIN	A1	T1
2	50.0	mm/s	LIN	A1	T1
3	SET[01](CLAMP)				
4	WAITI[I1](CLAMP CHECK)				
5	50.0	mm/s	LIN	A1	T2
6	100	mm/s	LIN	A1	T2

While the 2nd gripper is holding the work-piece, the robot will move using the setting of T2.

(Example3) If the total weight of the wrist load changes depending on the work-piece

If plural tool constants that have different setting of "Mass", "COG" and "Inertia" are made and the tool number is switched for the work-piece that is being held by the gripper, it is possible to use the robot's maximum performance.

T1	Gripper itself	4kg
T2	Gripper + work-piece1	(4+1) kg
T3	Gripper + work-piece2	(4+2) kg



If the tool number and the robot's condition do not match, the lifespan of the robot may be remarkably affected. To avoid this, (if possible) it is recommended to use the tool setting that has the heaviest weight setting always. (In this example, use T3 only)

4.3.11 Acceleration (D)

1	10.0	%	JOINT	A1P	T1	D3\$3	F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

The “Acceleration (D)” is a function which adjusts the smoothness by adjusting the acceleration of the robot operation. When vibration arises due to a factor such as the rigidity of the tool or work, the robot can be moved gently by using the function in the movement command concerned.

As a result, the amount of vibration is reduced. Unlike the “accuracy level” which expresses the positioning roughness when the tool passes through the recorded points, “acceleration” functions even when there is one movement command.

“Acceleration (D)” can be specified for each movement command, and one of four different settings (0, 1, 2 or 3) can be selected. At an acceleration setting of 0 (D0), the robot accelerates or decelerates at its maximum capacity, and the higher the setting used, the more smoothly (that is to say, the lower the acceleration) the robot moves. (Factory setting)

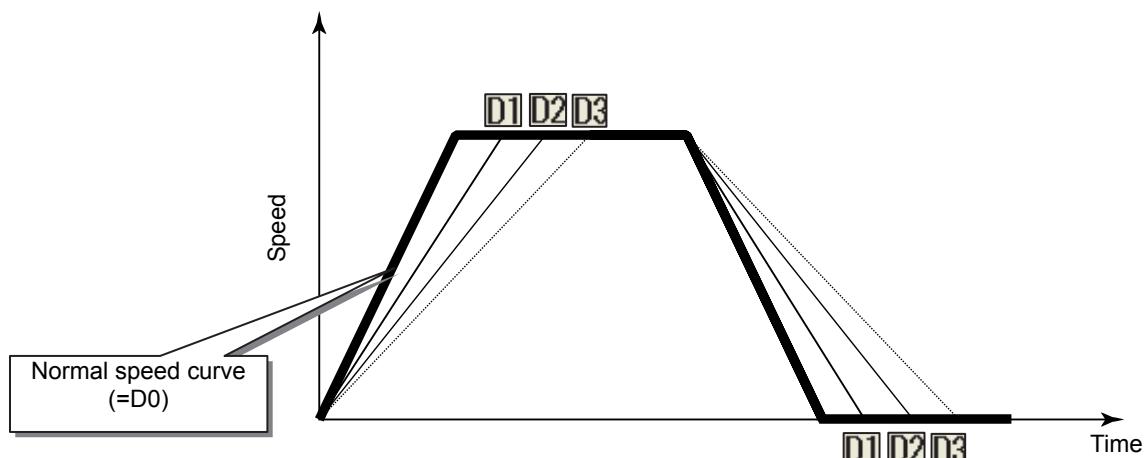


Fig. 4.3.1 “Acceleration”



When “Acceleration (D)”(1 to 3) is set, it always takes longer for the robot to move. Since this will adversely affect the cycle (tact) time, do not record the function in movement commands unnecessarily.



Both “Acceleration (D)” and “Smoothness (S)” can be recorded at the same time. Both will function simultaneously.

4.3.12 Smoothness (S)

1	10.0	%	JOINT	A1P	T1	D	S3	F	COMMENT
2	100	mm/s	LIN	A1	T1				
3	100	mm/s	S-LIN	A1	T1				

The “Smoothness(S)” is a function that adjusts the smoothness by changing the acceleration speed of the robot axes. When vibration arises due to a factor such as the rigidity of the tool or work, the robot can be moved gently by using the function in the movement command concerned.

As a result, the amount of vibration is reduced. Unlike the “accuracy level” which expresses the positioning roughness when the tool passes through the recorded points, “smoothness” functions even when there is one movement command.

“Smoothness (S)” can be specified for each movement command, and one of four different settings (0, 1, 2 or 3) can be selected. At a smoothness setting of 0 (S0), the robot accelerates or decelerates at its maximum capacity, and the higher the setting used, the more smoothly (that is to say, the lower the acceleration speed) the robot moves. (Factory setting)

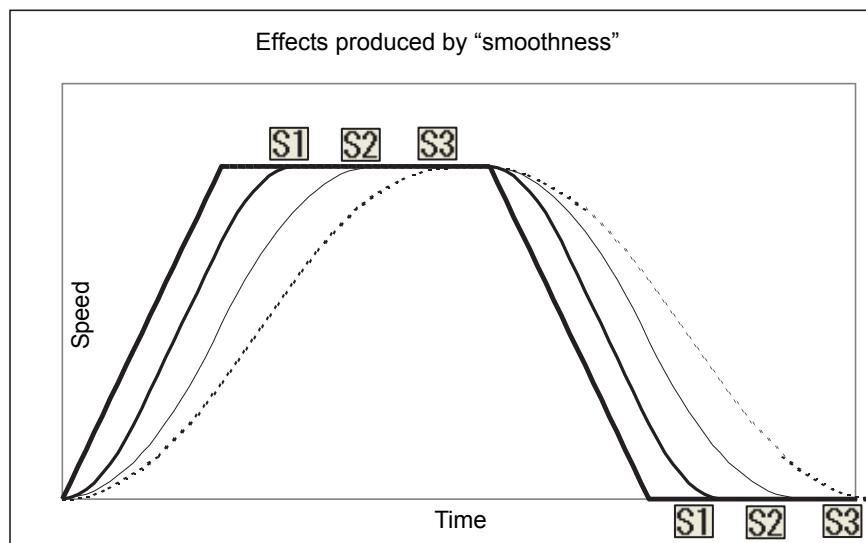


Fig. 4.3.2 “Smoothness”



When “Smoothness (S)” (1 to 3) is set, it always takes longer for the robot to move. Since this will adversely affect the cycle (tact) time, do not record the function in movement commands unnecessarily.



Both “Acceleration (D)” and “Smoothness (S)” can be recorded at the same time. Both will function simultaneously.

4.3.13 Fine motion (F)

1	10.0	%	JOINT	A1P	T1	D3S3	<input type="checkbox"/> F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

“Fine motion (F)” is a function to improve the linear path accuracy based on the following 3 methods.

1. The servo parameter optimization
2. The acceleration / deceleration optimization
3. The compensation for the robot joint's bend amount caused by the motion torque

There are 2 methods to use this “Fine motion” function.

Method 1



- (1) Open the “Screen editor” pressing [EDIT] key.
(2) Set the cursor to the position of “F” function.



- (3) Press [1] [1] and [ENTER] to turn ON the “F” mark.

1	10.0	%	JOINT	A1P	T1	D3S3	<input type="checkbox"/> F	COMMENT
2	100	mm/s	LIN	A1	T1			
3	100	mm/s	S-LIN	A1	T1			

(To turn OFF the “F” mark, input [0] and [ENTER].)

Method 2

Assign the “Fine motion select (code: 2018)” to the software key. After turning ON “F” mark in the recording status, record a move comment.

1200	mm/s	LIN	A1	T1	<input type="checkbox"/> F
------	------	-----	----	----	----------------------------



Turn ON “F” mark by pressing this software key.

1200	mm/s	LIN	A1	T1	<input type="checkbox"/> F
------	------	-----	----	----	----------------------------



Record a move command.

1200	mm/s	LIN	A1	T1	<input type="checkbox"/> F
0	[START]				
1	1200	mm/s	LIN	A1	T1
					<input type="checkbox"/> F

[EOF]



When “F” is set, the move command always takes longer for the robot to move. Since this will adversely affect the cycle (tact) time, do not record this “F” function in movement commands unnecessarily.

4.3.14 Step comment

Comments can be added to each step of the program. This comment is called a step comment. Adding step comments makes the meaning of steps easier to understand.

Step comments can be added and edited in the screen edit.

Inputting step comments



- 1 Set the robot program monitor to the operable state, and press [Edit].**
 >> The [Screen edit] screen is displayed.

Teach	Program	Step	Date/Time	Unit	Function
Step Keep Complete	1 [EX]	0	7/29/2011 14:33	U1	Find Function
Search Direction				1:NB4-02 Manual Speed	Cut
Order Direction				Robot	Copy
Screen Separation					Paste
					Cancel
					Complete

1 Robot Program UNIT1

```

1:NB4-02
0: [START]
1 100 % JOINT A1 T1
2 100 % JOINT A1 T1
3 100 % JOINT A1 T1
4 100 % JOINT A1 T1
5 100 % JOINT A1 T1
6 CALLP[I101] FN80;Program call
7 100 % JOINT A1 T1
8 100 % JOINT A1 T1
9 100 % JOINT A1 T1
10 WAITI[I101] FN525;Wait Input cond
11 100 % JOINT A1 T1
12 END FN92;End
[EOF]
The function can be inserted with the "FN" key.
  
```

For details of the basic operations for screen edit, see “Chapter 4 Teaching.”



- 2 Align the cursor with the step you want to add a step comment to, and press [Right].**

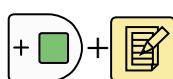
>> Align the cursor to the position in the figure.

Teach	Program	Step	Date/Time	Unit	Function
Step Keep Complete	1 [EX]	0	7/29/2011 14:35	U1	Find Function
Search Direction				1:NB4-02 Manual Speed	Cut
Order Direction				Robot	Copy
Screen Separation					Paste
					Cancel
					Complete

1 Robot Program UNIT1

```

% JOINT A1 T1
[I101] FN80;Program call
% JOINT A1 T1
% JOINT A1 T1
% JOINT A1 T1
[I101] FN525;Wait Input cond
% JOINT A1 T1
FN92;End
Push [ENABLE+EDIT] key to display soft keyboard.
  
```



- 3 Hold [ENABLE] and press [Edit].**

>> The soft keyboard is displayed.



4 Enter the step comment using the soft keyboard, and press f12 <Complete>.

>> The step comment entered at the cursor position is displayed.

Teach	Program	Step	Date/Time	Unit	Function
Step needs Complete	1 [EX]	0	7/29/2011 14:48	U1	Find Function
Search Direction	1 Robot Program			UNIT1	Cut
Order Direction					Copy
Screen Separation					Paste
					Cancel
					Complete

1:NB4-02
ManualSpeed
5 H

Robot

101] % JOINT A1 T1 pos
% JOINT A1 T1
% JOINT A1 T1
% JOINT A1 T1
% JOINT A1 T1
[101] % JOINT A1 T1 FN80;Program call
% JOINT A1 T1
% JOINT A1 T1
[101] % JOINT A1 T1 FN525;Wait Input cond Move to pos
% JOINT A1 T1 FN92;End

Push [ENABLE+EDIT] key to display soft keyboard.



5 Press f12 <Complete>, and the step comment is written to the program.



If a step comment is already input, it can be edited using the same procedure.



Programs which step comments are written to require data space enough to save them. For this reason, the number of steps that can be registered to one program is smaller compared to programs that do not have step comments. If step comments are added to a program that has many steps, "A2150: Too many steps" may be displayed. As explained in "4.3.15 Number of recordable steps", use the program call etc. to divide the program so that the number of steps does not exceed approx. 300 per program.

The maximum number of steps that can be assigned differs depending on the number of characters in the step comment etc.

4.3.15 Number of recordable steps

The recommended maximum number of steps that should be recorded in a program is approximately 300.

If the number of steps exceeds 300, divide the steps into multiple programs, and then call the programs divided from the parent program using the program call command (FN80).

By dividing, the programs can be reused, and management and maintenance also become easier.

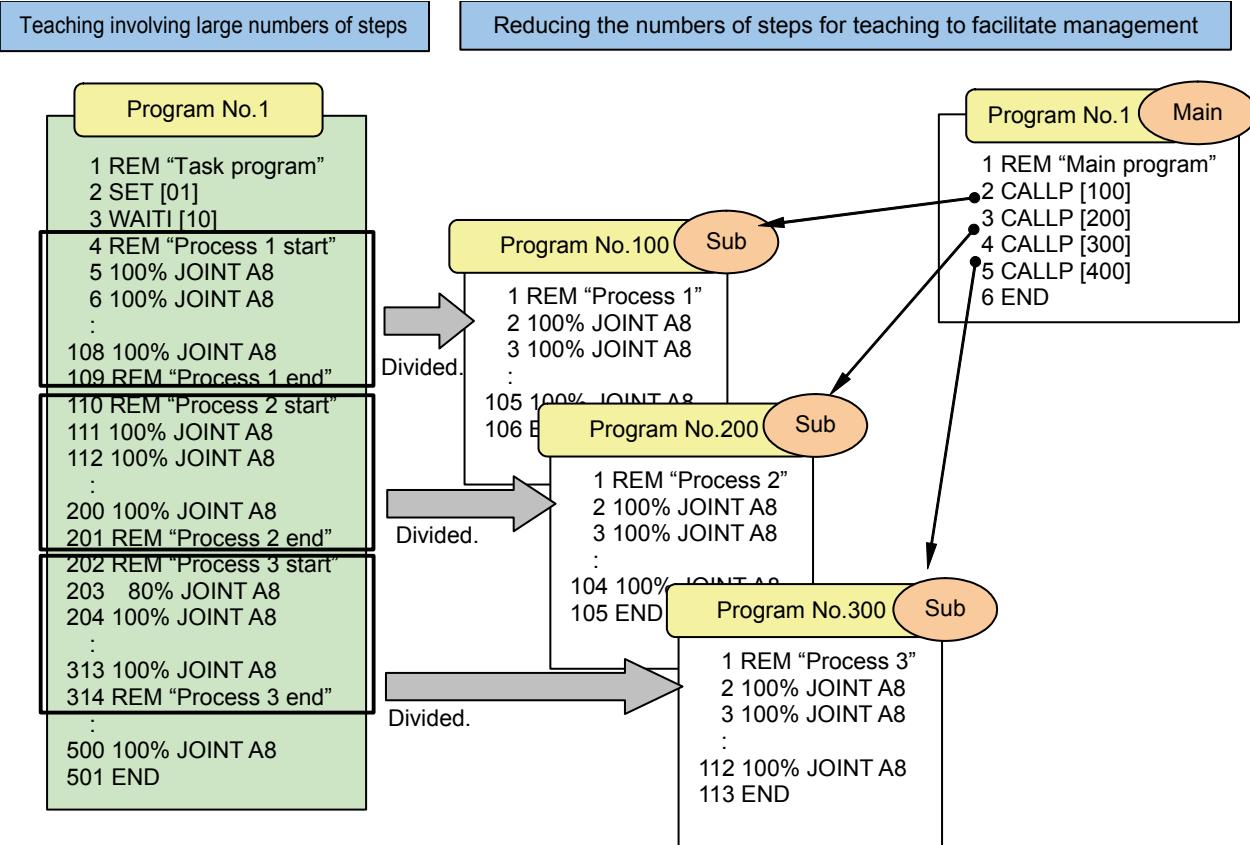


Fig. 4.3.3 Example of teaching with reduced numbers of steps



IMPORTANT

If the “A2150: Program is too large” error message appears during teaching or screen editing, it means that the number of steps stored in a task program is too high. This error occurs when the file size exceeds 64Kb.

In a case like this, divide the task program in the manner shown in the example above.

When dividing an existing task program, press the [PROG./STEP] key, select “Copy,” and copy the steps into a new task program. (Step copy function) The step copy function can also be selected by selecting <Service utilities> - [9 Program Conversion] - [2 Step copy].

The “A3084: Media device is full” error message sometimes appears during teaching, screen editing, file editing or a file operation. This error is caused by insufficient memory as defined in the cases described below.



IMPORTANT

- There is not enough space or no space at all in the internal memory device to record new data.
- There is not enough space in the internal memory to edit or operate the specified file.

In such a case, make more space in the internal memory by “deleting unused files” or “saving files which have not been used recently onto a USB memory and deleting them.”

4.3.16 Recording the function commands (FN)

In order to operate the gripper attached to the robot wrist or capture signals that check the work, function commands (functions) are recorded at the appropriate positions in the program.

Furthermore, in order to perform complicated work, other programs may be called or, depending on the status of the external signals, operation may jump to other programs. These are also recorded as function commands.

The basic function commands are expressed using a format based on SLIM (Standard Language for Industrial Manipulators) which is a robot language.

Alternatively, function commands can be specified using the “FN***” format where a 1- to 3-digit number is input into the “***” part (which is called a function number).

Some typical function commands are shown below.

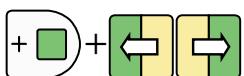
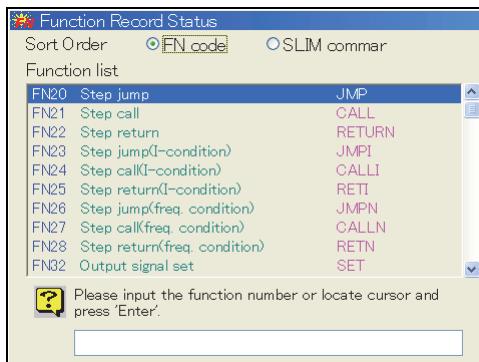
Table 4.3.1 Typical function commands

Function Command (SLIM)	Function number	Title	Description of function
SET	FN32	Output signal ON	The specified output signal is set to ON.
RESET	FN34	Output signal OFF	The specified output signal is set to OFF.
DELAY	FN50	Timer	This causes the robot to stand by for the specified time.
CALLP	FN80	Program call	Another program which has been specified is called.
CALLPI	FN81	Conditional program call	When the specified signal is ON, another program is called.
END	FN92	END	The execution of the program is ended.
REM	FN99	Comment	This attaches a descriptive comment in the program.
WAITI	FN525	Input signal wait (positive logic)	This causes the robot to stand by until the specified signal is set to ON.
WAITJ	FN526	Input signal wait (negative logic)	This causes the robot to stand by until the specified signal is set to OFF.

Selecting function commands (How to directly select a command with the function numbers)



- 1 Press [FN] at the position where the function command is to be recorded.**
 >> The list of function commands is now displayed.



- 2** The function commands can be rearranged in the order of function number or in alphabetical order using expressions in the SLIM format.
To select the sorting sequence, press [left or right] while holding down [ENABLE].

“FN code” : in the order of the FN code number

“SLIM command” : in the order of the SLIM command name (alphabetic order)

- 3 Either select the function command from the list or input its function number, and press [Enter].**

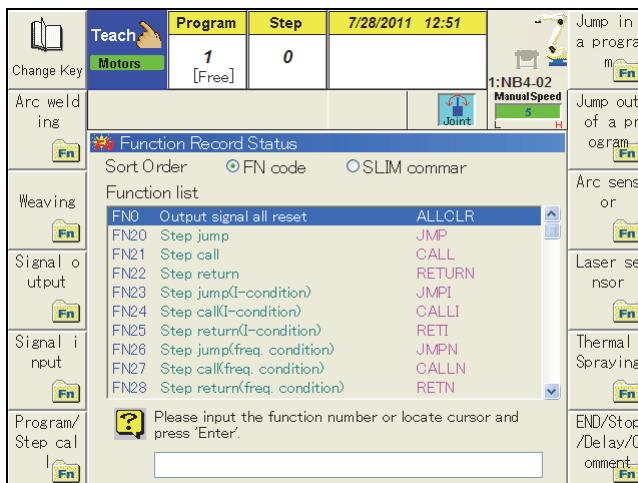
Selecting function commands (When selecting from categorized groups)

This section explains how to select function commands from categorized groups. This method is useful since it allows you to find the command you want to record from among categorized groups, even if you don't remember the function number.

To make a selection by group, it is necessary to have [Constant Setting] — [5 Operation Constants] — [1 Operation condition] — [11 Selection of a function] set to “Group”.



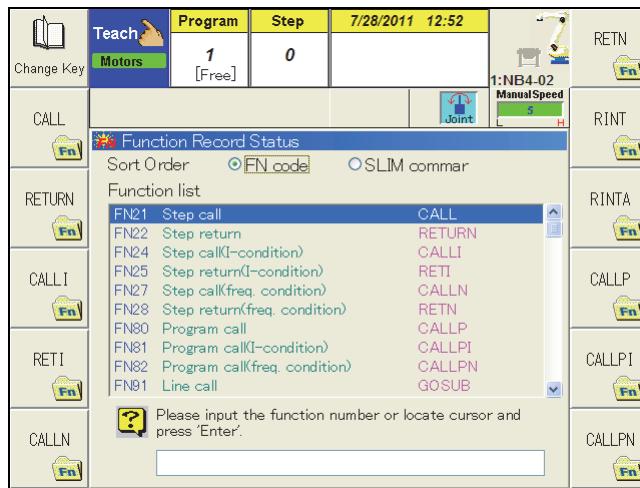
- 1 Press [FN] at the position where the function command is to be recorded.**
 >> The function groups will be displayed on the f keys.



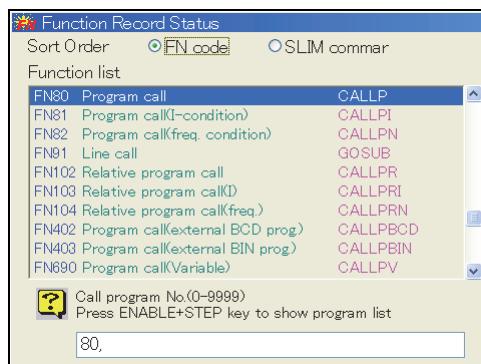


2 Selecting a program call (CALLP) is given here as an example.
Press f6 <Program/Step call>.

>> The function commands related to program calls and step calls will be displayed on the f keys. At the same time, the function commands being displayed in "Function Record Status" in the center of the screen will be narrowed down.



3 Press f10 <CALLP>.
>> The program call command is now selected.



It can also be selected using the following methods.

- Select from the list in the center of the screen using [Up/Down] [Enter].
- Input its function number, and press [Enter].

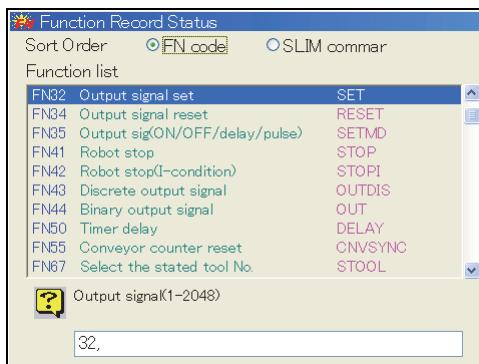
Setting and recording function command parameters (conditions)

This section describes how to input and record parameters (conditions) after the function commands have been selected.

Recording the output signal ON command (SET <FN32> function command) will be used here as an example.

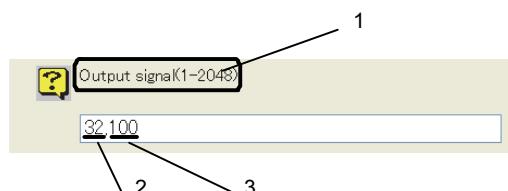
- 1 Either select the output signal ON command (SET) from the list or input its function number (FN32), and press [Enter].**

>> The output signal ON command is now selected.



- 2 Input the number of the output signal using the [Number input keys].**

The parameters which are to be set and their input ranges are displayed on the screen.



1 Name of parameter and its input range

2 Function number

3 Setting (in this case, 100 is set as the output number)



To correct input errors

To delete the wrong setting which has been input for a parameter, press [BS].



When there are 2 or more parameters

In the case of an function command with 2 or more parameters, input the first parameter, and then press [Enter]. Proceed to input the second and subsequent parameters.



- 3 Upon completion of the parameter settings, press [Enter].**

>> The output signal ON command is now recorded.

4.3.17 How to revise the input miss

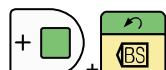
If you select wrong functions, commands, menus, screens, etc, press [R] key to cancel the operation.



To delete the inputted number etc, press [BS] key.



"UnDo" operation (cancel operation) is executed when [ENABLE] + [BS] key.



The following operations can be canceled only one time with the UnDo operation.

	Recording operation using the [FN] key
	Modifying operation for the movement speed using the [SPEED] key
	Modifying operation for the accuracy using the [ACC] key
	DELAY function recording operation using [END / TIMER] key
	END function recording operation using [ENABLE] + [END / TIMER] key
	Recording operation using the [OVER WRITE / RECORD] key
	Overwriting operation using the [OVER WRITE / RECORD] key
	Deleting operation of a move command or a function command
	Inserting operation of a move command
	Modifying operation of a move command (position data)

"ReDo" operation (cancel operation) is executed when [ENABLE] + [3] key.



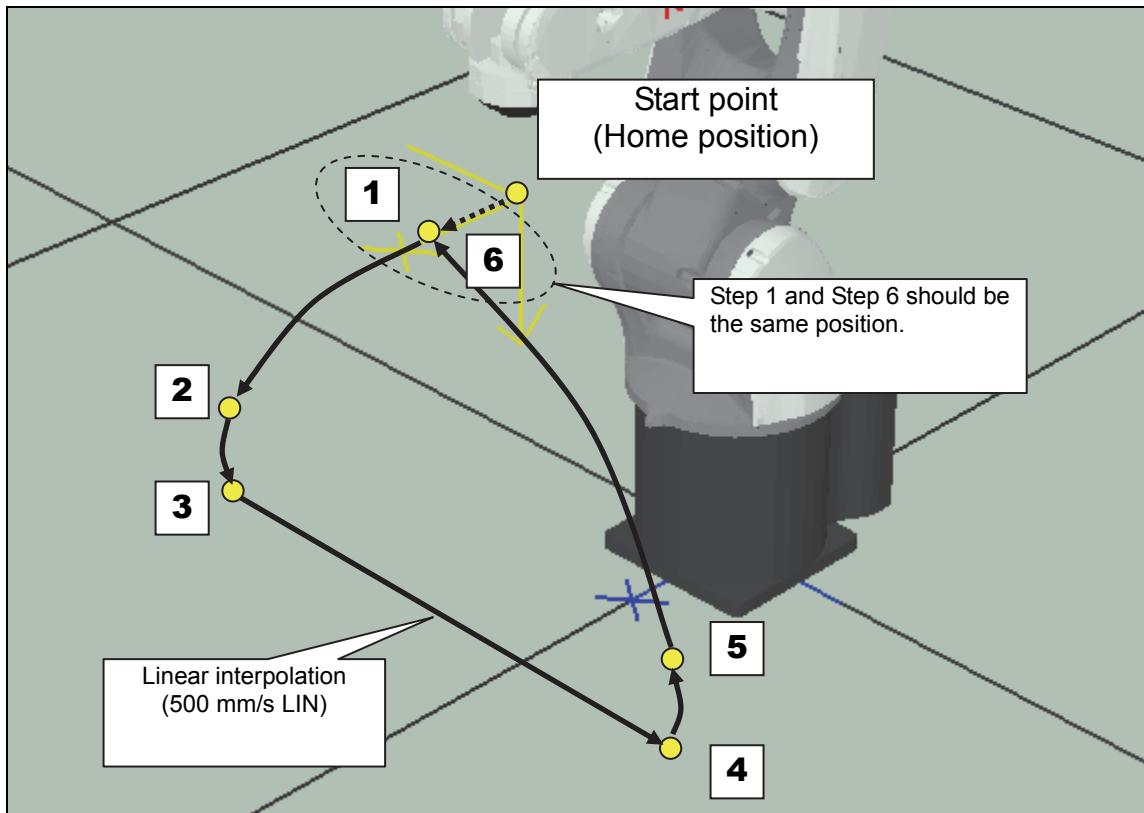
4.4 A practice teaching session

Upon completion of the preparations, try a practice session in teaching.

4.4.1 Outline of the program

In this section, the program shown below will be created.

Move the robot from step 1 to step 5, and record the positions as move commands. The recording position for step 6 should be the same with step 1. This is done in order to ensure that the robot operation will move directly from step 5 to the step 1 position with smooth motion.



Program

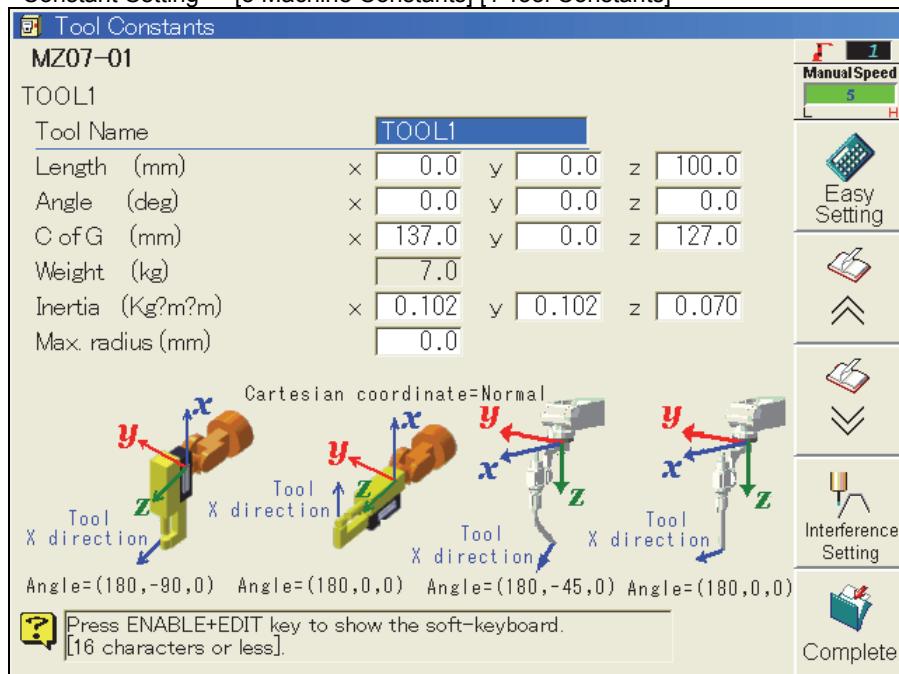
[1] Robot Program		UNIT1	
	100 %	JOINT	A1 T1
0	[START]		
1	100 %	JOINT	A1 T1
2	100 %	JOINT	A1 T1
3	100 %	JOINT	A1 T1
4	500 mm/s	LIN	A1 T1
5	100 %	JOINT	A1 T1
6	100 %	JOINT	A1 T1
7	END	FN92;End	
[EOF]			

The coordinates of each teach point (move command)

- 1 (X, Y, Z, r, p, y) = (400, 0, 500, 0, 0, -180)
- 2 (X, Y, Z, r, p, y) = (400, -300, 200, 0, 0, -180)
- 3 (X, Y, Z, r, p, y) = (400, -300, 100, 0, 0, -180)
- 4 (X, Y, Z, r, p, y) = (400, 300, 100, 0, 0, -180)
- 5 (X, Y, Z, r, p, y) = (400, 300, 200, 0, 0, -180)
- 6 (X, Y, Z, r, p, y) = (400, 0, 500, 0, 0, -180) (This is the same with Step1)

Tool constant setting

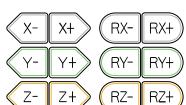
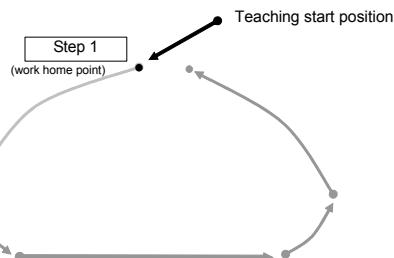
<Constant Setting> - [3 Machine Constants] [1 Tool Constants]



4.4.2 Teaching operations

Recording step 1 (work home point)

Record the “Step1” as the home position (starting point).

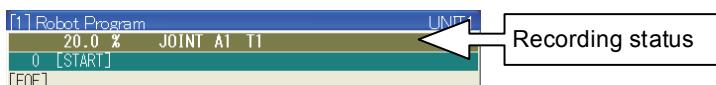


1 Use the [Axis operation keys] to move the robot to step 1 coordinates.

As step 1, set the robot to the position which will serve as the work home point.

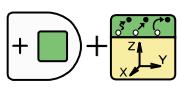
- To avoid the “**singular point**”, please set the 5th axis to -90 degrees using joint coordinate system in advance of this teaching operation.
- This is just an operation practice. It is not necessary to move the robot to the accurate position shown in the previous page.

2 In the recording status, movement commands have already been selected.

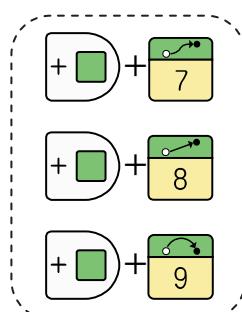


From this state, specify the method, the speed and the accuracy level of the movement up to step 1.

For step 1, try setting “joint interpolation” for the movement method, “100%” for the speed and “1” for the accuracy level.

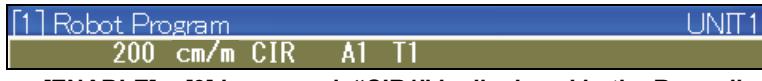


or



3 While holding down [ENABLE], press [INTERP/COORD], and set the interpolation specification of the recording status to “JOINT.”

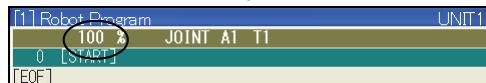
>> Each time this is pressed, the interpolation type of the recording status is switched in the following sequence: “JOINT” → “LIN” → “JOINT”, etc.



(When [ENABLE] + [9] is pressed, “CIR1” is displayed in the Recording status)



4 Press [CHECK SPD/TEACH SPEED], and set the manual speed to “5” (the recording status speed also changes along with the manual speed. When “5” is set, “100%” is displayed).



5 To specify the accuracy level, press [ACC].

>> Each time it is pressed, the accuracy changes in sequence by one level from A1 to A8.





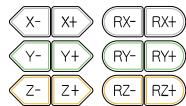
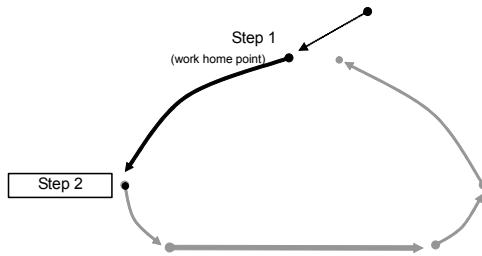
6 Press [O.WRITE/REC].

>> Step 1 is now recorded.

[1] Robot Program		UNIT1
100 %	JOINT A1 T1	
0 [START]		
1 100 %	JOINT A1 T1	
[EOF]		

Recording step 2 (just before the actual work start position)

Record step 2 near the actual work start position. The actual work start position denotes the position where the actual welding or other work will be performed.



1 Use the [Axis operation keys] to move the robot to step 2.

As step 2, set the robot to just before the start position of the work. In terms of the posture, set the robot to the posture which is close to the one in which the robot will actually perform the work in step 3.

2 Set the movement method and speed up to step 2.

In the same way as for step 1, try setting “joint interpolation” for the movement method and “100%” for the speed.



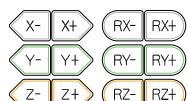
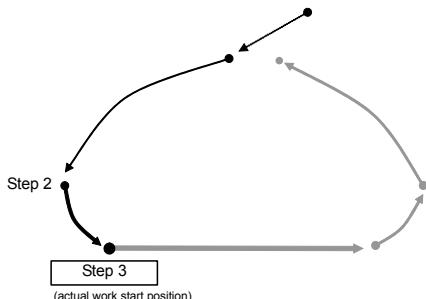
The movement command stored last is left for the recording status. To use the previous condition as is, press [O.WRITE/REC] without changing the value.

>> Step 2 is now recorded.

[1] Robot Program		UNIT1
100 %	JOINT A1 T1	
0 [START]		
1 100 %	JOINT A1 T1	
2 100 %	JOINT A1 T1	
[EOF]		

Recording step 3 (actual work start position)

Record the position where the actual welding or other work is to start as step 3.



1 Use the [Axis operation keys] to move the robot to step 3.

Since step 3 is the position where the actual welding and other work are to start, manually operate the robot until its posture is optimal for the work to be performed.

2 Set the movement method and speed up to step 3.



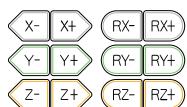
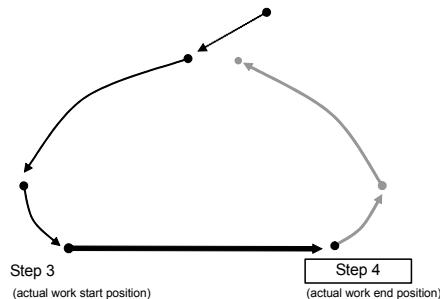
3 Press [O.WRITE/REC].

>> Step 3 is now recorded.

[1] Robot Program		UNIT1
100	%	JOINT A1 T1
0	[START]	
1	100	% JOINT A1 T1
2	100	% JOINT A1 T1
3	100	% JOINT A1 T1
[EOF]		

Recording step 4 (actual work end position)

Record the position where the actual welding or other work is to end as step 4.

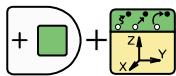


1 Use the [Axis operation keys] to move the robot to step 4.

The movements of the robot by manual operations up to step 4 need not be in a straight line. A detour may be taken but operate the robot manually in such a way that it does not make contact with the work piece.

2 Set the move method and speed up to step 4.

Set the move method to "Interpolation on (linear)," and the speed to "500mm/s."



While pressing [ENABLE], press [INTERP/COORD] and set the interpolation specification for the recorded status to linear interpolation ("LIN" is displayed in the recorded status).



Press [CHECK SPD/TEACH SPEED], and set the speed to "500mm/s."

[f1] Robot Program		UNIT1
500	mm/s	LIN A1 T1
0	[START]	



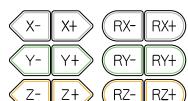
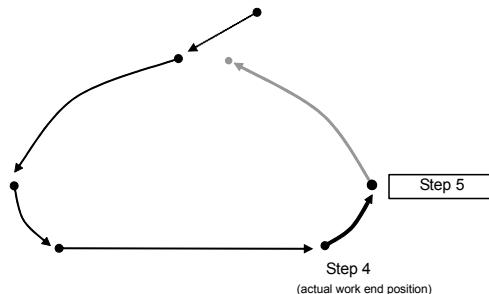
3 Press [O.WRITE/REC].

>> Step 4 is now recorded.

[f1] Robot Program		UNIT1
500	mm/s	LIN A1 T1
0	[START]	
1	100	% JOINT A1 T1
2	100	% JOINT A1 T1
3	100	% JOINT A1 T1
4	500	mm/s LIN A1 T1
		[EOF]

Recording step 5 (position away from the work piece)

Record the position away from the work piece as step 5.

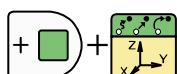


1 Use the [Axis operation keys] to move the robot to step 5.

As step 5, set the robot in the appropriate position at some distance from the work piece.

2 Set the move method and speed up to step 5.

Set the move method for step 5 to "Joint interpolation", and speed to "100%."



While pressing [ENABLE], press [INTERP/COORD] and set the interpolation specification for the recorded status to "JOINT."

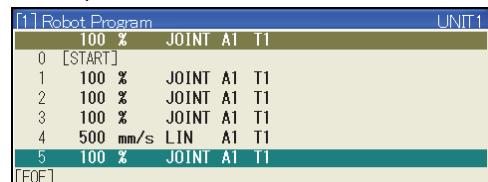


Also, press [CHECK SPD/TEACH SPEED], and set the speed to "100%."



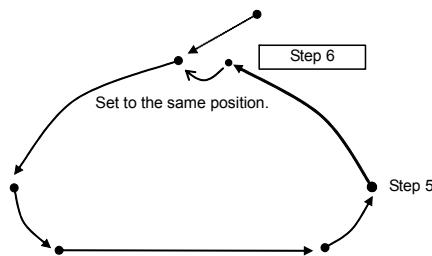
3 Press [O.WRITE/REC].

>> Step 5 is now recorded.

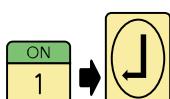


Recording step 6 (same position as for step 1)

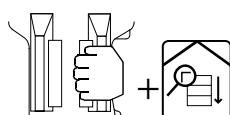
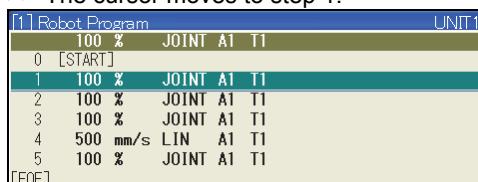
Record the same position as for step 1 as step 6.



- 1 Press [PROG/STEP].**
 >> The [Step Selection] screen now appears.



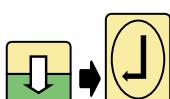
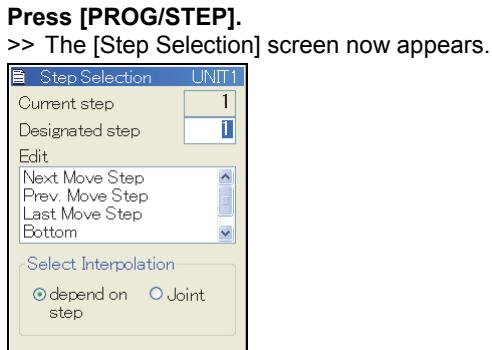
- 2 Input "1" in "Designated step", and press [Enter].**
 >> The cursor moves to step 1.



- 3 While grasping the [Enable switch] press [CHECK GO]. (Keep pressing it until the robot stops.)**
 >> The robot moves to the position recorded in step 1.



- 4 To record the position where the robot stopped (position in step 1) as step 6, call step 5.**



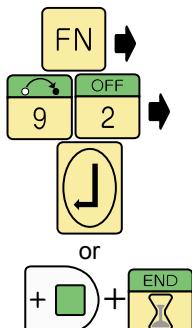
- 5 Select "Bottom" and press [Enter].**
 >> The cursor moves to the last step (step 5).
 This is now the state in which step 6 can be recorded.



- 6 The conditions in step 5 will be used as is, so press [O.WRITE/REC].**
 >> Step 6 is now recorded.

Recording the end command (End function command)

Since all the steps have now been recorded, record the end command at the end of the program. The end command can be recorded either by specifying function number FN92 or by selecting the END function command from the list of commands. (The end command must be recorded without fail.)



- 1 Press [FN], then press [9] → [2] → [Enter].**
Alternatively, hold [ENABLE] and press [END/TIMER].

>> The end command is now recorded.

[1] Robot Program		UNIT1
100 %	JOINT	A1 T1
0	[START]	
1	100 %	JOINT A1 T1
2	100 %	JOINT A1 T1
3	100 %	JOINT A1 T1
4	500 mm/s	LIN A1 T1
5	100 %	JOINT A1 T1
6	100 %	JOINT A1 T1
7	END	FN92:End
	[EOF]	

This now completes the creation of the program.
 Next, check the robot operations, postures, etc.

4.5 Checking what has been taught

4.5.1 Outline

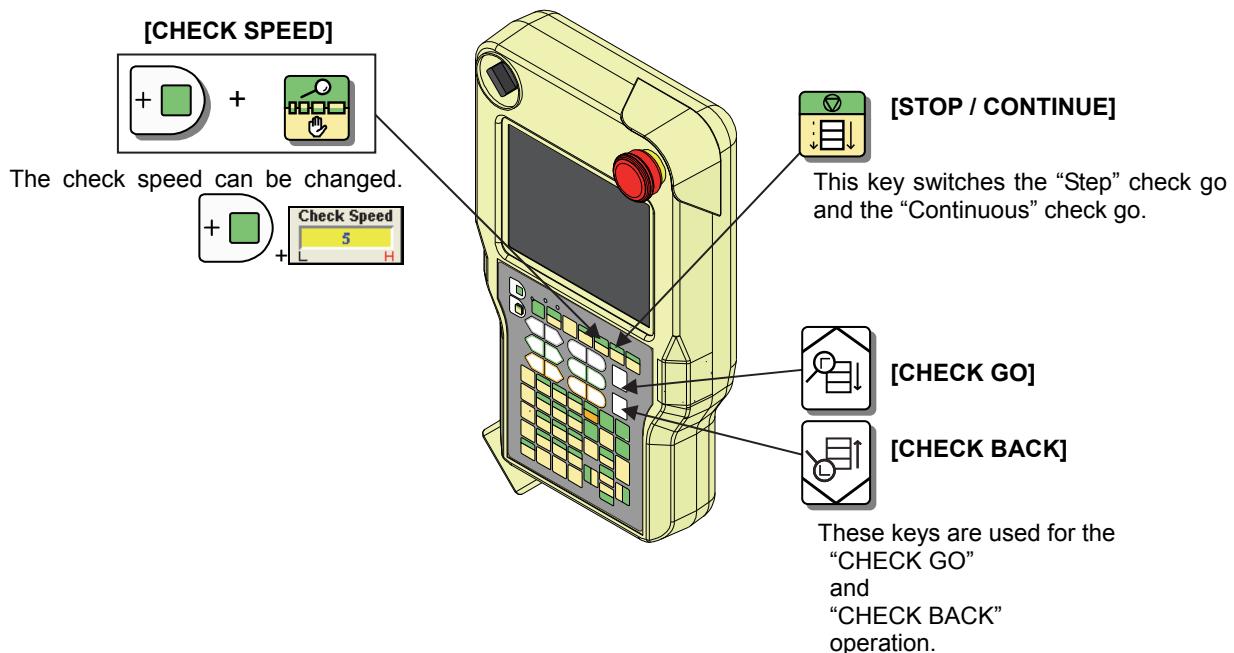
After the program has been created, be absolutely sure to check what has been taught.

This checking work is called the “**Check operation**”. When the check operation is performed, the robot can be made to stop at each step so that its position and posture at each step, and the path of its movement between steps can be checked. If necessary, modifications can be made.

Use **[CHECK GO]** and **[CHECK BACK]** on the teach pendant for the check operation. “Check go” refers to moving the robot step by step starting with the smaller step number; “check back” refers to operating the robot starting with the larger step number.

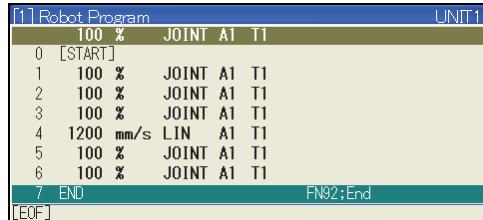
The robot can also be moved through all the steps continuously.

Operation keys for the CHECK GO/BACK operation



4.5.2 [CHECK GO] operation

The operation of the program created in the previous section will be checked here.
The screen that appears when teaching is completed should be the one shown below.



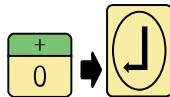
If the created program has not been selected, select it using the method described in “4.2 Preparations prior to teaching” (Page 4-2).

Operation procedure



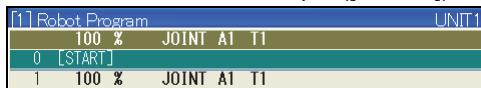
- 1 Press [PROG/STEP] in order to call the step which is to be checked first.**

>> The [Step Selection] screen now appears.

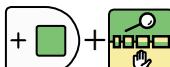


- 2 Input [0] in “Designated step”, and press [Enter].**

>> The cursor moves to step 0 ([START]).



To check from the start of the program, specify “0” as the Designated step.

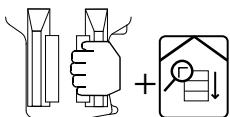


- 3 To specify the speed to be used during the check operation, press [CHECK SPD/TEACH SPEED] while holding down [ENABLE]. Here, select “3” to ensure safety.**

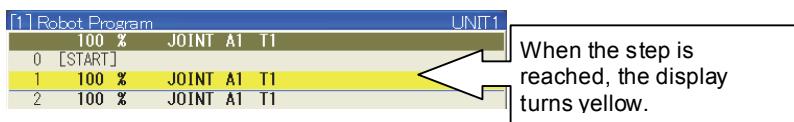
>> Each time the [CHECK SPD/TEACH SPEED] key is pressed, the speed changes in sequence to the next of the 5 settings.

“1” is the slowest speed, and “5” is the fastest.



**4****Press [CHECK GO] while grasping the [ENABLE SWITCH].**

>> While [CHECK GO] is pressed, the robot starts moving toward step 1, and when it reaches step 1, it stops.



When [CHECK GO] is released while the robot is moving, the robot stops.

The robot also stops when the enable switch is released during operation. However, in this case, the servo power is turned off immediately without the acceleration or deceleration applying a heavy load to the mechanisms. Before releasing the enable switch, try to remember to release [CHECK GO] and wait for the robot to come to a standstill.

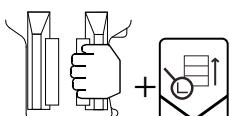
5**To move to step 2, first release [CHECK GO] and then press it again.**

Check up to the final step by repeating these operations.

When the final step is reached, the robot operates again from step 1.

4.5.3 [CHECK BACK] operation

The robot can also be operated in the reverse order of the steps.

**Operation procedure****1****Press [CHECK BACK] while grasping the [ENABLE SWITCH].**

>> The robot now moves in the reverse order of the steps.

When step 1 is reached by [CHECK BACK], the robot operates no further. (Check back cannot be performed to the final step.)

2

The operation method after the speed has been switched or robot has stopped at a step, etc. are the same as for Check Go.

The robot also stops when the enable switch is released during operation. However, in this case, the servo power is turned off immediately without the acceleration or deceleration applying a heavy load to the mechanisms. Before releasing the enable switch, try to remember to release [CHECK BACK] and wait for the robot to come to a standstill.

4.5.4 Checking the steps continuously

The robot can be operated continuously step by step by holding down [CHECK GO] or [CHECK BACK].

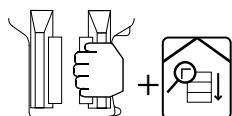
When the continuous mode is specified, the robot passes along an arc on the inside of the recorded points, reflecting the accuracy levels taught at each step.

Operation procedure



- 1 Press [STOP/CONT].**

>> "CONT" is displayed in the [Step number display area].



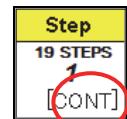
- 2 Perform the Check Go/Check Back operation. Hold down the [CHECK GO] or [CHECK BACK] key.**

>> The robot operates continuously step by step.



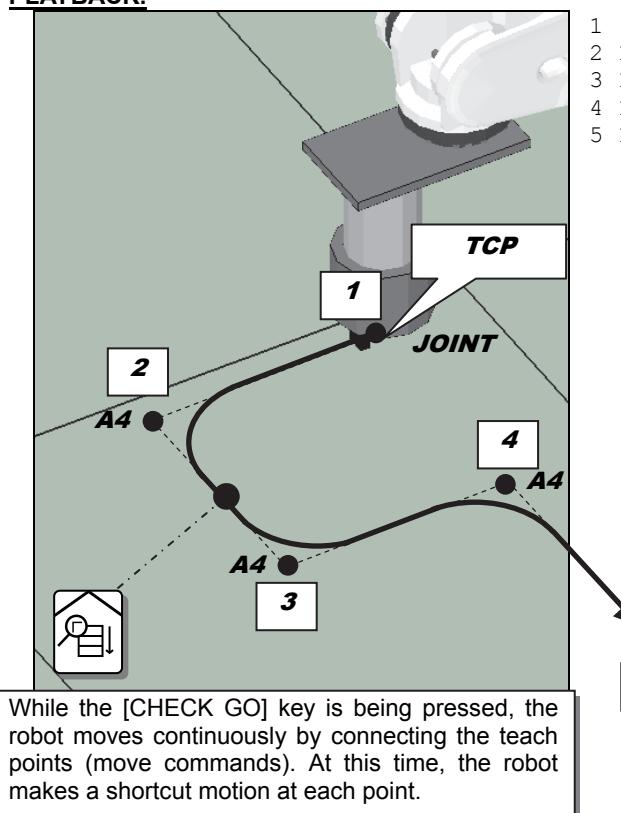
- 3 To release the continuous mode, press [STOP/CONT] again.**

An example of the continuous CHECK GO operation

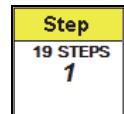


While the [CHECK GO] key is being pressed, the robot moves continuously by connecting the teach points (move commands).

At each teach point, the robot does not stop and make a shortcut motion based on the accuracy level (A1 to A8) of each point. This motion path is almost the same with that of PLAYBACK.



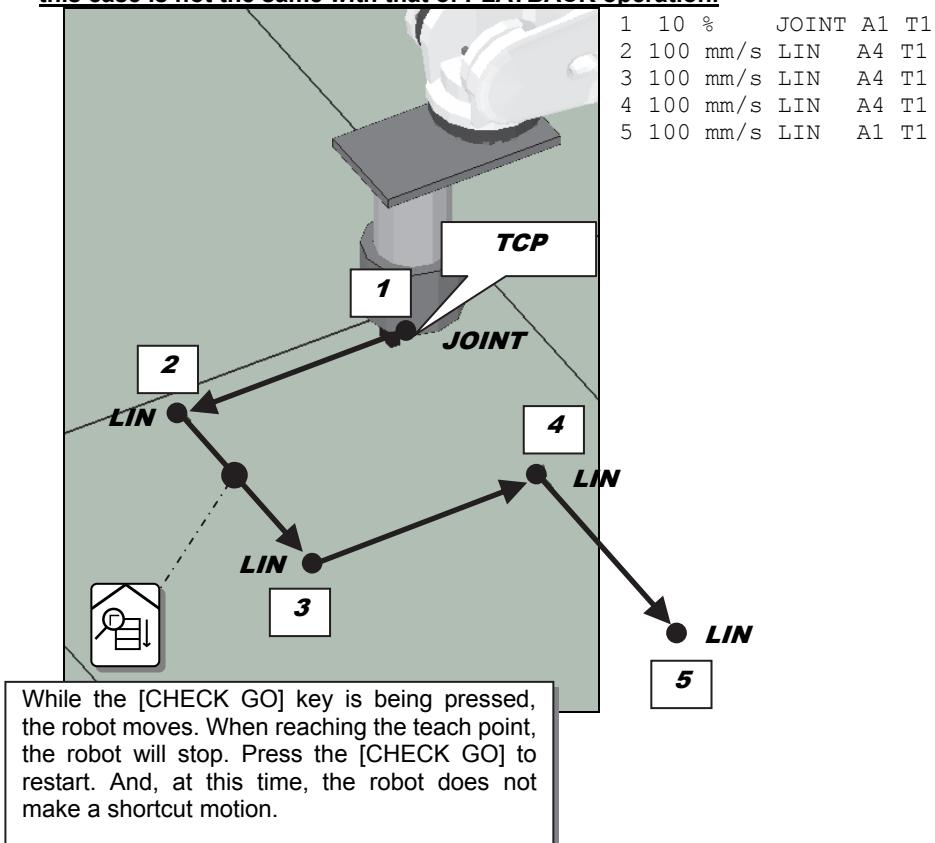
1	10 %	JOINT	A1	T1
2	100 mm/s	LIN	A4	T1
3	100 mm/s	LIN	A4	T1
4	100 mm/s	LIN	A4	T1
5	100 mm/s	LIN	A1	T1

An example of the single CHECK GO operation

The robot stops at every teach point. (The cursor color turns to yellow.)

When the robot stops, release the [CHECK GO] key and then press the key again to restart.

At this time, the shortcut motion at teach point is not made. Therefore, the motion path in this case is not the same with that of PLAYBACK operation.



4.5.5 Switching the continuous/single mode during Check Go operation

The “Continuous CHECK GO” mode can be switched to the “Single CHECK GO” mode and vice versa by pressing down [Shift] while pressing [CHECK GO].

While pressing the [Shift], the display is shown to switch from the continuous mode to the step mode and conversely, therefore Check Go is operated following the mode which is switched.

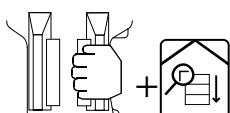
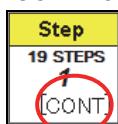
Operation procedure

In case of the “Continuous CHECK GO” mode



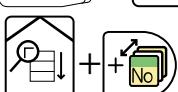
- 1 Press the [STOP/CONT].**

>> “CONT” is displayed in the [Step number display area].



- 2 Perform the Check Go operation. Press down the [CHECK GO].**

>> The robot operates continuously step by step.



- 3 Pressing down the [Shift] while Check Go operation, switching from the continuous mode into the step mode.**

>> During this time, the display changes from “[CONT]” to “[step].”

While this “step” is displayed, Check Go is considered as the completion when the current step has been completed as the same Check Go of “BREAK” mode.

When Check Go is completed, the display returns from “[step]” to “[CONT].”



- 4 To release the step mode, release the [Shift].
Or release the [CHECK GO].**

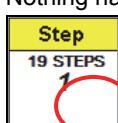
>> When the mode release is completed, the display returns from “[step]” to “[CONT].”

In case of the “Single CHECK GO” mode



- 1 Press [Stop/Cont].**

>> Nothing has been displayed in the [Step number display area].



- 2 Perform the Check Go operation. Pressing down the [CHECK GO].**

>> The robot operates step toward the next step.



- 3 Pressing down the [Shift] while playback, switching from the single mode into the continuous mode.**

>> During this time, the display changes from “ ” (no display) to “[CONT].”

While this “CONT” is displayed, Check Go is considered as the completion when the final step has been completed, and the robot operates continuously step by step as the same Check Go of the continuously mode.

When Check Go is completed, the display returns from “[CONT]” to “ ” (no display).



- 4 To release the continuous mode, release the [Shift].
Or release the [CHECK GO].**

>> When the mode release is completed, the display returns from “[CONT]” to “ ” (no display).

4.5.6 How to select a step

When you want to move to a specified step, press [PROG/STEP] and specify the number of the step to which you want to move.

However, when you move the robot using [CHECK GO] operation after specifying the step, always be sure to specify a move command step. You can specify a function command step and only move the cursor, but an error will occur when you do [CHECK GO].

Operation procedure



- 1 Press [PROG/STEP].**

>> [Step Selection] screen appears.



Number



- 2 When designating the number of the step, input the number of the step in "Designated step", and press [Enter].**

>> The cursor moves to the step which has been designated.

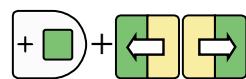


- 3 When you move relatively from the current step, without specifying a step number, specify the jump destination in the "Edit" column.**

>> The cursor moves to the step which has been designated.

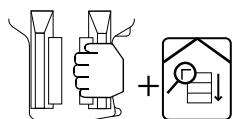
You can select from among the following items.

Movement destination	Movements of the cursor
Next Move Step	Move from the current step to the next move step (skip function command steps).
Prev. Move Step	Move from the current step to the previous move step (skip function command steps).
Last Move Step	Move to the last move step in the program.
Bottom	Move to the last step in the program.
Copy	Call the step copy function. This is the same as selecting <Service Utilities> — [9 Program Conversion] — [2 Step copy].



- 4 "Select Interpolation" specifies the operation method when moving to a step. Before inputting a step number, you can switch using [LEFT/RIGHT] while holding down [ENABLE].**

Movement format	Movements of the robot
depend on step	At the time of a check operation to the specified step, operation is done according to the interpolation classification of the target step. For example, when the target step is "LIN", movement is done using linear interpolation.
Joint	At the time of check operation to the specified step, movement is done using joint interpolation.



- 5 While grasping the [ENABLE SWITCH], press [CHECK GO].**
>> The robot moves as far as the designated step.

4.5.7 Execute the CHECK GO operation from a function command step

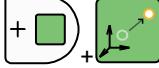
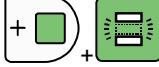
See the following section.

"7.12 Selecting a Function Command Step and operating"

4.6 Modifying the program

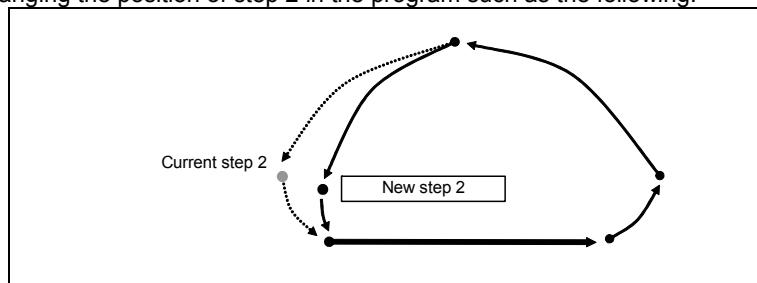
This section describes how to modify the commands which have been recorded in the program. The commands can be modified in a number of ways as follows.

Table 4.6.1 How to change the steps

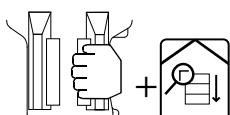
Description of modification	Operation method	Reference page
Movement command modification	Modifying the position only  [ENABLE] + [MOD Position]	 Page 4-45
	Modifying the speed only  [SPD]	 Page 4-46
	Modifying the accuracy only  [ACC]	 Page 4-46
	Modifying everything together (Movement command overwriting)  [ENABLE] + [O.WRITE/REC] ※ Use this method to modify the interpolation type, tool number, etc. since they cannot be modified separately.	 Page 4-47
Adding movement commands	 [ENABLE] + [INS]	 Page 4-48
Adding function commands	This is added automatically with the same method as in new teaching. It is added at the same position as the move command.	
Deleting movement commands and function commands	 [ENABLE] + [DEL]	 Page 4-49
Using the screen editing function to modify commands	 [EDIT] ※ The parameters of the function commands cannot be modified in the teach screen. Use the screen editing function to modify commands.	 Page 4-50

4.6.1 Modifying the robot position

Try changing the position of step 2 in the program such as the following.



Modifying the robot position

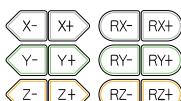


- Move the robot to step 2 using [CHECK GO] (or [CHECK BACK]).

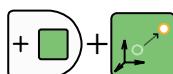


Alternatively, the step may be called.

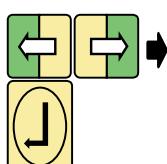
An alternative to the operation in 1 is to call step 2 by selecting [PROG/STEP] → [2] → [Enter]. In this case, however, what happens is that only the display moves and the robot fails to move to step 2. To move the robot, designate the step and then press [CHECK GO].



- Use the [Axis operation keys] to operate the robot manually to set it to the position and posture to which they are to be changed.



- Hold [ENABLE] and press [Modify position].
-> A confirmation screen is displayed.



- Select "OK" and press [Enter].
-> The position is now modified.

This completes the modification of the step 2 position.



If this operation is applied to the movement commands created using "FN645 MOVEX" function, the position data of the step will be converted to "Encoder" (=Encoder value format). Be careful. To keep the original position data format, follow the procedures shown as below.

<In case of "Angle" or "Cartesian">

Open the screen editor and enter the position data edit screen.

The current position of the robot can be set using "Record Current Position" key.

<In case of "Variable type" (=Pose variable)>

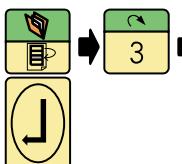
Open the pose file and modify the pose variable included in the file.

For details, refer to the instruction manual "**ROBOT LANGUAGE**" (TFDEN-012).

4.6.2 Modifying movement command data

The speed and accuracy recorded in a movement command can be modified separately without changing the position data of the robot. This method can only be used when <>Operating mode S>> is set. This method cannot be used for modification when <>Operating mode A>> is set. Overwrite the linear command, or use screen editing.
Modifying the speed and accuracy in step 3 is given here as an example.

Modifying movement command data



- 1 Press [PROG/STEP] → [3] → [Enter].**
 >> The cursor moves to step 3.



- 2 To change the speed, press [SPD].**
 >> The [Modify speed] screen now appears.



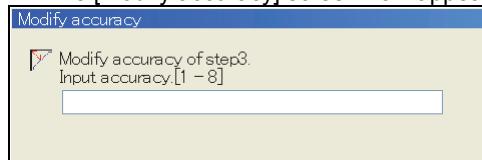
- 3 Use the [Number input keys] to input the value.**



- 4 Press [Enter].**
 >> The new specified speed is recorded.



- 5 To change the accuracy, press [ACC].**
 >> The [Modify accuracy] screen now appears.



- 6 Press [Enter].**
 >> The new specified accuracy is recorded.
 This completes the modification of the step 3 speed and accuracy.

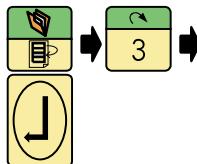
4.6.3 Overwriting movement commands

Steps can also be overwritten.

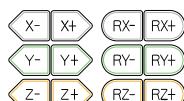
When a step has been overwritten, all the data including the position of the robot, its speed and interpolation type is modified.

Changing joint interpolation in step 3 to linear interpolation is given here as an example.

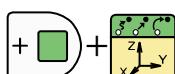
Overwriting movement commands



- 1 Press [PROG/STEP] → [3] → [Enter].
-> The cursor moves to step 3.



- 2 To change the position, use the [Axis operation keys] to operate the robot manually.



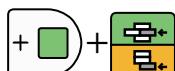
- 3 While holding down [ENABLE], press [INTERP/COORD], and set the interpolation specification of the recording status to linear interpolation. ("LIN" is displayed for the recording status.)

500 mm/s LIN A1 T1



- 4 Press [CHECK SPD/TEACH SPEED], and set a suitable value for the speed.

300 mm/s LIN A1 T1



- 5 While holding down [ENABLE], press [O.WRITE/REC].
-> A confirmation screen now appears.



- 6 Select "OK" and press [Enter].
-> The step is overwritten.

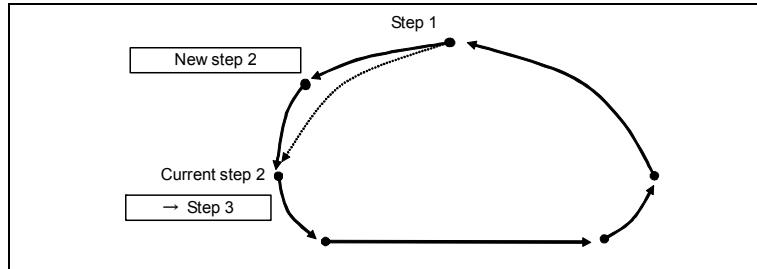


IMPORTANT

If this operation is applied to the movement commands created using "FN645 MOVEX" function, the position data of the step will be converted to "Encoder value format". Be careful.

4.6.4 Adding (inserting) movement commands

Using the following work program as an example, a new step will now be added between steps 1 and 2



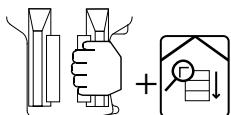
The new step will be inserted before the current step.



The position at which the command is added is set by [Constant Setting] — [5 Operation Constants] — [1 Operation Condition] — [7 Step insertion position], so you can change it.

However, you must be **EXPERT** level or above to make changes.

Adding movement commands

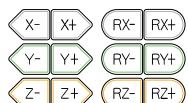


1 Move the robot to step 2 using [CHECK GO] (or [CHECK BACK]).

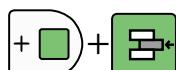
To add a step, move to the step after the location where you want to add the step.

Moving the cursor as shown below adds the step before the 2nd step.

[1] Robot Program		UNIT1
100 %	JOINT A1 T1	
0 [START]		
1 100 %	JOINT A1 T1	
2 100 %	JOINT A1 T1	
3 100 %	JOINT A1 T1	
4 1200 mm/s	LIN A1 T1	
5 100 %	JOINT A1 T1	
6 100 %	JOINT A1 T1	
7 END		FN82;End
[EOF]		



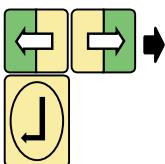
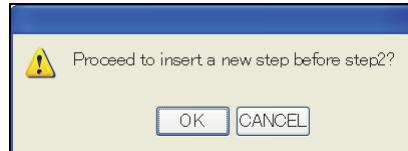
2 Use the [Axis operation keys] to operate the robot manually, and set the robot to the position and posture to be added.



3 Set the speed and interpolation classification using the same method as when doing new teaching.

4 While holding down [ENABLE], press [INS].

>> A confirmation screen now appears.



5 Select "OK" and press [Enter].

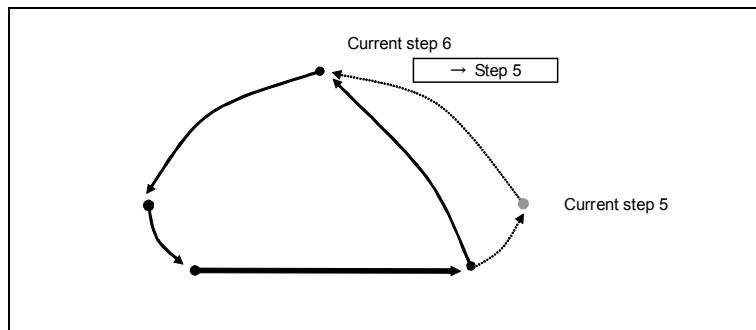
>> This completes the addition of the new step.

All the previous steps 2, 3 and up are incremented by one to become steps 3, 4 and up.

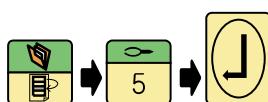
The numbers of the steps recorded as the parameters of jump/call and other function commands are automatically modified at this time.

4.6.5 Deleting movement and function commands

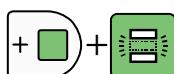
Using the following work program as an example, step 5 will be deleted here.



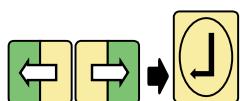
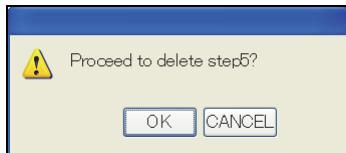
Deleting movement and function commands



- 1 Press [PROG/STEP] → [5] → [Enter].**
 >> The cursor moves to step 5.



- 2 While holding down [ENABLE], press [DEL].**
 >> A confirmation message now appears.



- 3 Select “YES” and press [Enter].**
 >> This completes the deletion of step 5.
 The previous step 6 is decremented by one to become step 5.
 The numbers of the steps recorded as the parameters of jump/call and other function commands are automatically modified at this time.

4.7 Using the screen editor function to modify commands

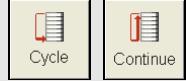
All the data recorded in the program can easily be modified using the screen editor function. The screen editing function can be used in the teaching mode, and during playback in the playback mode. The operations which can be performed using the screen editor function are listed below.

Table 4.7.1 Operations which can be performed using the screen editor function

Operation	Details
Data modification	All the data (such as the speed, interpolation type and position data) recorded for movement commands can be modified. (To correct position data, you must be EXPERT level or above.) Further, the data recorded for function commands can also be modified.
File Copy	One line or several lines can be copied and inserted into another position.
Cut	One line or several lines can be deleted.
Paste	The copied or deleted line or lines are inserted at another position.
Function command insertion, replacement	An function command can be inserted at any position. In addition, an function command can be changed into another function command.
Function command search	Function commands can be searched.
Screen Separation	The screen can be divided into the top half and bottom half.
Batch changing of the speed	The speed of MOVE command set in two or more lines can be batch changed.

- If <Service Utilities> [9 Program Conversion] [13 Hot Edit] menu is used, it is possible to use the Screen editor while the robot is executing a program. And, it is also possible to edit a program that is not running.

- In the following 2 modes, the modifications in the screen editor will get effective from the step 0 of the next playback cycle.



- In the following mode, the modifications in the screen editor will get effective immediately.



If a program is edited while it is being played back, interference to the peripheral devices may happen. It is strongly recommended to modify programs only in the TEACH mode and check the modification carefully by the CHECK GO / BACK operation.

4.7.1 Modifying with the screen editor function

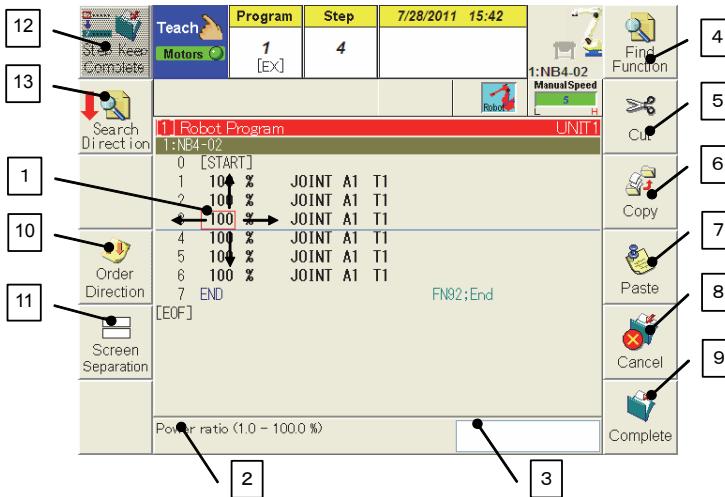
This section describes how to select and modify the screen editor function.

Screen editor



- 1 In the teach mode or when step playback has been selected in the playback mode, press [EDIT].**

>> The screen display for the currently selected program is now switched.



1 Cursor

The cursor can be moved to the data.

2 Description of data

A description of the data at the cursor position and the range of the values in which the data can be input are displayed here.

3 Input field

To change the data at the cursor position, input the new value here, and press [Enter].

4 Find Function

This is used to search the function commands.

5 Cut

This is used to cut (delete) the selected line or lines. The cut line or lines can be inserted at any position using "Paste".

6 Copy

This is used to copy the selected line or lines. The copied line or lines can be inserted at any position using "Paste".

7 Paste

This is used to insert the cut or copied line or lines at any position.

8 Cancel

This is used to terminate program editing without reflecting the modifications made.

It is also used to cancel a cut or copy operation at any point.
[RESET/R] also has the same functions.

9 Complete

This is used to save the modification results and terminate the program editing.

10 Other Direction

This is used to select the direction during pasting.

When “reverse direction” is selected, the order of the data in the cut or copied lines is reversed, and the data is pasted in this reverse order.

11 Screen Separation

This is used to divide the screen into the top half and bottom half.

Use [CLOSE/SELECT SCREEN] to select the half of the screen where operations are to be performed.

12 Step Keep

Normally, when screen editing ends, it automatically returns to the step it was at prior to starting screen editing. If you press this key while holding down [ENABLE], it will stay at the step it was at in screen editing when it returns to the program screen (write is also done). This is useful in cases such as when you found a step in screen editing that can be an indicator for Check GO and Check BACK operations.

However, in such cases, the displayed step will differ from the actual robot step. Therefore, you need to be careful when doing Check GO and Check BACK operations after that.

13 Search Direction

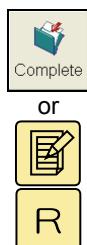
Switch the search direction between up and down.

2 Move the cursor to the desired position, input the new numerical value in the “Input” field in response to the guide message displayed in the “Description of data” field, and press [Enter].

>> The contents of the program directory now change to the new number that was input.
At this time, the program contents are not rewritten.

3 To reflect the changes, press f12 <Complete> or press the [EDIT] key again.

>> The program contents are updated, the screen editor function is exited, and the original screen is restored.



To quit the function without reflecting the changes, press the [RESET/R] key.

“Hot edit” function

By opening the menu shown as below, it is possible to use the “Screen editor” while in the playback operation. (An operator class **EXPERT** or higher is required.)

<Service Utilities> [9 Program Conversion] [13 Hot Edit]

And, by using this hot edit function, it is also possible to display (or edit) a program that is not being played back while the robot is running.

**CAUTION**

- When the modified program is saved in the screen editor, the result is reloaded at the step 0 of the next cycle.

- To avoid an unexpected motion of the robot, please do not add/delete step data as much as possible. Especially, please avoid the modification of the accuracy, the add/delete operations for movement commands, and the position modification of movement commands. If movement commands are modified carelessly in the PLAYBACK mode, the motion path of the robot may change and it results in the interference to peripheral devices, the tool breakage, etc.

- Basically, it is recommended to modify the program data in TEACH mode and check the program using CHECK GO and CHECK BACK operation.

Editable parameters (1)

2	10.0	%	LIN	A1	T1	D1S1	F	
(A)	(B)	(C)	(D)(E)(F)	(G)(H)	(I)		(J)	

(A)	Speed	Input the speed using the numeric keys.						
(B)	Speed unit	0 mm/s 1 sec 2 % 3 deg/s (Tool angle change speed per second)						
		For details, refer to "4.3.6 Speed and its unit".						
(C)	Interpolation type	0 Interpolation OFF (Joint) JOINT 1 Linear interpolation LIN 2 Circular interpolation (middle point) CIR1 3 Circular interpolation (end point) CIR2						
		For details, refer to "4.3.7 Interpolation type".						
(D)	Accuracy (A)	This is the Accuracy level (1-8). For details, refer to "4.3.8 Accuracy (A)".						
(E)	Continue/ pause (P)	This is a switch for Continue / Pause. 0 : Pause OFF ("P" is not displayed) (=Continue) 1 : Pause ON ("P" is displayed)						
		For details, refer to "Continue / pause (P)".						
(F)	Tool number (T)	This is the tool number that is used for controlling the robot posture, the motion path, etc. (1-32) For details, refer to "4.3.10 Tool number (T)".						
(G)	Acceleration (D)	This is the acceleration setting. (0-3) In case of "0" (=standard setting), this parameter is not displayed. For details, refer to "4.3.11 Acceleration (D)".						
(H)	Smoothness (S)	This is the smoothness setting. (0-3) In case of "0" (=standard setting), this parameter is not displayed. For details, refer to "4.3.12 Smoothness (S)".						
(I)	Fine motion (F)	This is the ON/OFF switch for the "Fine motion function". 0 : OFF ("F" is not displayed) 1 : ON ("F" is displayed) For details, refer to "4.3.13 Fine motion (F)".						
(J)	Step comment	It is possible to put a simple comment to the step data. For details, refer to "4.3.14 Step comment".						

Editable parameters (2)

If the movement command was recorded using the [RECORD] key (Encoder value format)



[RECORD] key

2	V	ANG	0.00	90.00	0.00	0.00	-90.00	0.00
---	---	-----	------	-------	------	------	--------	------

If the right cursor key is pressed several times, the data like this will be displayed.

In case of operator class **EXPERT** or higher, these position data can be edited.

Set the cursor to the desired axis number and then input the value in [DEG] and press [Enter].



- Only the data of "Encoder value format" can be modified directly.
- If the system has plural mechanisms, it is possible to switch the mechanism to be edited by moving the cursor to right direction.

If the movement command was recorded using the MOVEX command of the robot language
and

If the movement command was recorded using the "FN645 MOVEX" function
("Angle", "Cartesian", and "Variable type")

When the right cursor key is pressed several times on the movement command line in the screen editor, a screen like this will appear. In this screen, the parameters can be edited. In addition, in case of operator class **EXPERT** or higher, the position data can be edited also.

MOVEX Robot movement 2/2

1 : MZ07-01 (6Axis)

Tool No.

Interpolation JOINT LIN CIR1 CIR2
 S-LIN S-CIR1 S-CIR2

Pose

Pose type Encoder Angle Cartesian Variable type

X	563.0 [463.0] mm	r	0.0 [0.0] deg
Y	0.0 [0.0] mm	p	-90.0 [-90.0] deg
Z	720.0 [720.0] mm	y	-180.0 [-180.0] deg

Coordinate Robot(JIS) Robot(AW) User coord

Axial angle refer Previous Step Configuration

Please input tool number. [1 - 32]

Manual Speed

Record Current Position

Up/Down arrows

Speed Setting

Complete

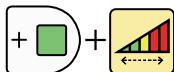


For details, refer to "4.8 A movement command recorded using FN645 MOVEX (for expert)".

4.7.2 Batch changing the speed of MOVE command

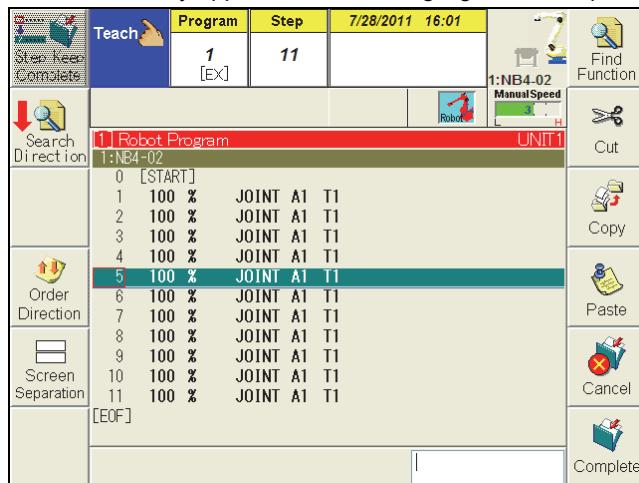
The speed of MOVE command set in two or more lines can be batch changed while performing the screen edit.

Batch changing the speed of MOVE command



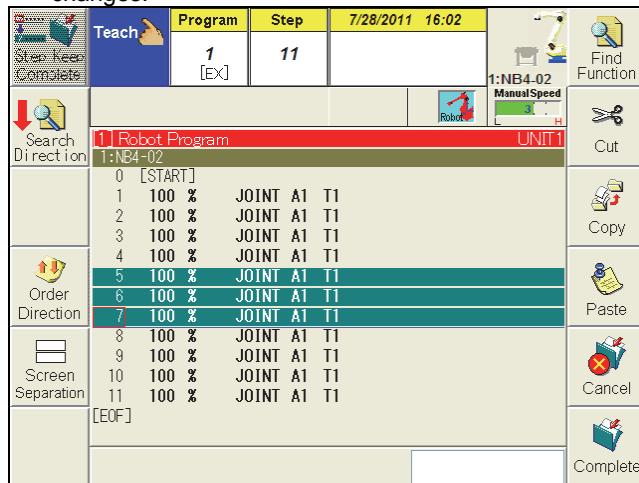
1 Press [SPD] with holding [ENABLE].

>> The currently appeared cursor is highlighted as a speed batch change start step.



2 Press [Up/Down].

>> The highlighted line(s) can be adjusted as a range of the target steps to make changes.



3 To cancel selecting a target step, press [Cancel] or [RESET/R] key.

>> The highlighted lines are restored.

**4 Press [SPD].**

>> The display changes to the "Speed change" screen. The range of speed change is indicated by the "Start Step" and "End Step".

Speed change		UNIT1
Start Step	0005	
End Step	0007	
Confirm	ON	
Conv. method	Ratio	
Speed	50%	

Please select whether to do the execution confirmation in each step by pushing 'Enter'.

Cancel
 Execute

**Without the range selecting operation**

If pressing [SPD] without specifying the range for change-target steps ([ENABLE] + [SPD]), all steps are to be targeted.

5 Refer to Table 4.7.2, and set the conditions for batch changing.**6 To set "Confirm", align the cursor on it and press [Enter].**

>> Every time you press this key, the status (ON/OFF) is switched.

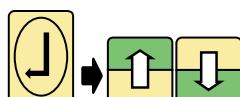
Speed change	
Start Step	0005
End Step	0007
Confirm	OFF
Conv. method	Ratio
Speed	50%

**7 To set "Conv. method", align the cursor on it and press [Enter].**

>> Every time you press this key, the status (Ratio/Direct) is switched.

Speed change	
Start Step	0005
End Step	0007
Confirm	OFF
Conv. method	Direct
Speed	1.0

Joint
Line/Circular



When switched to "Direct", the pull-down list for the interpolation type appears on the right side.

If pressing [Enter] as moving to the pull-down list, alternatives (Joint/Line/Circular) are displayed. Then, select an appropriate interpolation type with [Up/Down] key.

Entering
the speed
value

**8 To set "Speed", align the cursor on it, enter the speed value, and press [Enter]**

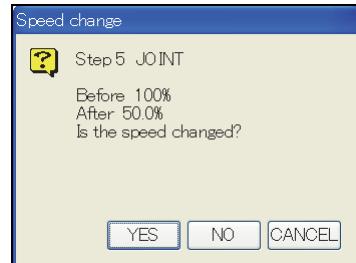


9 Press f12 <Execute>.

>> Now, the speed batch change starts.

If "Confirm" has been set to OFF, the screen-editor window is restored after executing the speed batch change.

If "Confirm" has been set to ON, on the other hand, the screen as below appears.



Button	Action
[YES]	The speed of the indicated step is changed, proceeding to "Confirm" in the next step. After changing the speed in the last step, the screen-editor window is restored.
[NO]	The speed of the indicated step is not changed, proceeding to "Confirm" in the next step. After changing the speed in the last step, the screen-editor window is restored.
[CANCEL]	The speed change is aborted for the indicated step and after, and then the speed batch change screen is restored.



10 To reflect the change just made, restore the screen-editor window and press f12 <Complete> or [EDIT].

>> The program details are updated, the screen editing function exits and the screen returns to the previous screen.



11 If not to reflect the change, restore the screen-editor window, and press [RESET].

Table 4.7.2 Condition settings for the speed batch changing

Condition parameter	Setting range	Meanings	Default
Confirm	ON	Pressing f12 <Execute>, the "Confirm" message appears by every step, which enables to select ON/OFF/Cancel.	ON
	OFF	All steps from the start step to the end step are batch changed without any confirming action.	
Conv. method	Ratio	Designates the ratio (%) to the current record speed for changing. (Example: To make the speed half, designate 50%.) All steps are the targets for change.	Ratio
	Direct : Joint	Designate the speed only for the step of which interpolation type is "Joint". The step of "Line/Circular" is not changed.	
	Direct : Line/Circular	Designate the speed only for the step of which interpolation type is "Line/Circular". The step of "Joint" is not changed.	
Speed	Ratio	0~200% Note that the value after change does not exceed the upper/lower limit of the record speed.	50%
	Direct : Joint	Use the unit in entering the value specified in "Joint Interpolation" on the record speed screen. The screen appears by proceeding to f5<Constant Setting> - [5 Operation Constants] – [4 Record Speed].	Minimum value within the available range

Condition parameter	Setting range	Meanings	Default
	Direct : Line/Circular	Use the unit in entering the value specified in “Line/Circular” on the record speed screen. The screen appears by proceeding to f5<Constant Setting> - [5 Operation Constants] – [4 Record Speed].	



In the step with the multi-mechanism configuration, the target step will be the one of which interpolation type agrees with that of the speed-based mechanism. And only the speed of that mechanism within the step is to be changed.

4.8 A movement command recorded using FN645 MOVEX (for expert)

4.8.1 FN645 MOVEX



[RECORD] key

Normally, a movement command can be recorded using [RECORD] key.

However, it is also possible to record a movement command using a function command "**FN645 MOVEX**". When using this function command, the movement command can be recorded with the following position data styles. Concerning how to input a function command in a program, see the "4.3.16 Recording the function commands (FN)".

<Example of screen editor display>

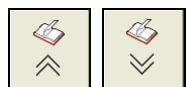
Encoder values	(E1, E2, E3, E4, E5, E6)	Step 1
Angle values	(J1, J2, J3, J4, J5, J6)	Step 2
Cartesian coordinates	(X, Y, Z, roll, pitch, yaw)	Step 3, 4
Pose variable	"P1" etc.	Step 5, 6, 7, 8, 9

[1] Robot Program							UNIT1
	1:MZ07-01	J1/X	J2/Y	J3/Z	J4/A	J5/B	J6/C
0	[START]						
1	V ANG	0.00	90.00	0.00	0.00	0.00	0.00
2	V ANG	0.00	90.00	0.00	0.00	0.00	0.00
3	V MEC	463.0	0.0	720.0	0.00	-90.00	-180.00
4	V MEC	463.0	0.0	720.0	0.00	-90.00	-180.00
5	V ANG P1						
6	V ANG P[V1%]						
7	V ANG P[V1!]						
8	V ANG P[L1%]						
9	V ANG P[L1!]						

(In this picture, Step 2-9 were created using "FN645 MOVEX")

<An example of the "FN645 MOVEX" inputting screen>

MOVEX Robot movement		2/2
1 : MZ07-01 (6Axis)		1
Tool No.		ManualSpeed
Interpolation		Record
<input type="radio"/> JOINT <input checked="" type="radio"/> LIN <input type="radio"/> CIR1 <input type="radio"/> CIR2 <input type="radio"/> S-LIN <input type="radio"/> S-CIR1 <input type="radio"/> S-CIR2		Current
Pose		Position
<input type="radio"/> Encoder <input type="radio"/> Angle <input checked="" type="radio"/> Cartesian <input type="radio"/> Variable type		<input type="radio"/> L <input type="radio"/> R <input type="radio"/> U <input type="radio"/> D <input type="radio"/> F <input type="radio"/> B
Pose type X: 463.0 [463.0] mm r: 0.0 [0.0] deg Y: 0.0 [0.0] mm p: -90.0 [-90.0] deg Z: 720.0 [720.0] mm y: -180.0 [-180.0] deg		<input type="radio"/> Robot(JIS) <input checked="" type="radio"/> Robot(AW) <input type="radio"/> User coord
Coordinate		<input type="radio"/> Previous Step <input checked="" type="radio"/> Configuration J1: Left <input type="radio"/> Right J3: On elbow <input type="radio"/> Underelbow J5: Flip <input type="radio"/> Non Flip
Axial angle refer		<input type="radio"/> Speed Setting <input type="radio"/> Complete
Please input tool number: [1 - 32]		



These keys can switch the screen.

(The total number of the screen depends on the system configuration.)



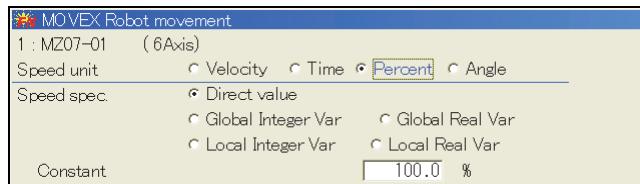
After setting the respective parameters, press **Complete** to save.

Each screen is explained in the following pages.

Speed setting screen

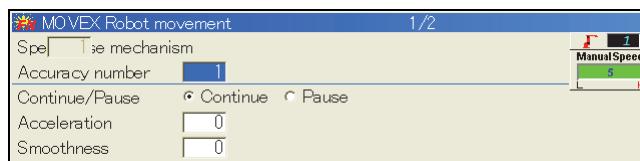


If this key is pressed, the following screen will be displayed.



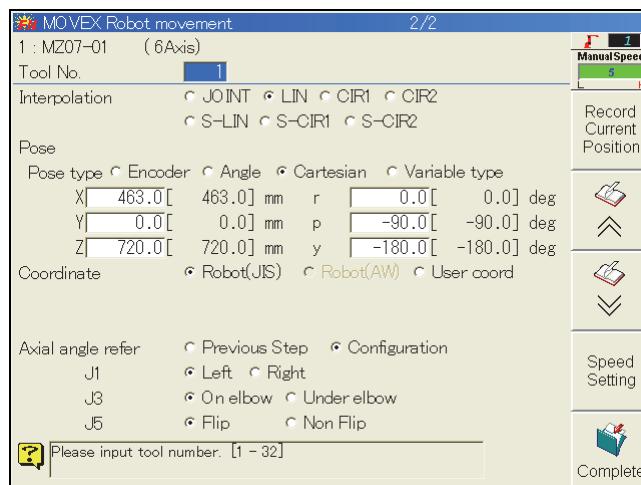
Name	Description	
Speed unit	Set the speed unit of the movement command.	
	Velocity	The motion speed of the tool tip (TCP) (mm/s)
	Time	The time that takes to the next teach point (sec)
	Percent	The percentage to the robot's maximum capacity. (%)
Speed specification	Angle	The speed of the tool posture change (deg/s)
	Direct value	Input the speed value directly in this screen.
	Global Integer Variable	Global integer variable is used. Vn%
	Global Real Variable	Global real variable is used. Vn !
	Local Integer Variable	Local integer variable is used. Ln%
Variable No.	Local Real Variable	Local real variable is used. Ln !
	This is the number of the variable to be used. This item is not displayed in case of "Direct value".	
Constant	This is the constant value for the motion speed. This item is displayed only in case of "Direct value".	

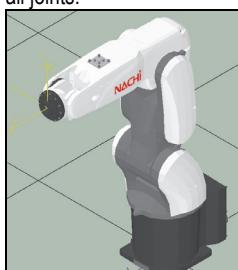
Accuracy number, Acceleration, etc.

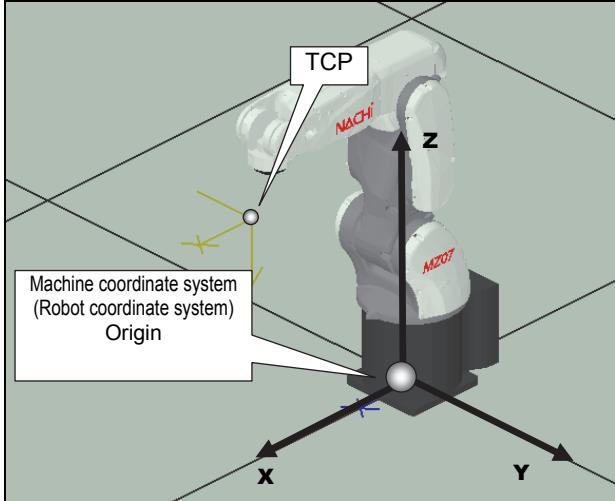


Name	Description
Speed base mechanism	This is the number of the speed base mechanism. Normally, this number cannot be changed. (It depends on the system configuration or the factory settings, etc.).
Accuracy number	Refer to "4.3.8 Accuracy (A)".
Continue / pause	Refer to "4.3.9 Continue / pause (P)".
Acceleration	Refer to "4.3.11 Acceleration (D)".
Smoothness	Refer to "4.3.12 Smoothness (S)".

Interpolation type, position data, etc.



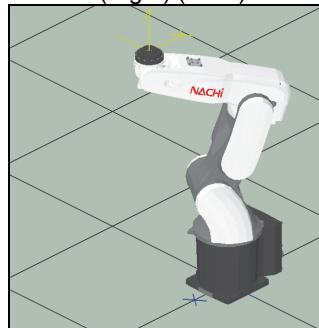
Name	Description																	
Tool No.	The number of the “ Tool constant ” that is used for posture, locus, acceleration, and deceleration control. (1 to 32)																	
Interpolation	<p>This is the “Interpolation type” to determine the shape of the locus of the robot’s TCP. (See “4.3.7 Interpolation type”)</p> <p>JOINT Joint interpolation (=interpolation OFF) LIN Linear interpolation CIR1 Circular interpolation (middle point) CIR2 Circular interpolation (end point) S-LIN Stationary tool linear interpolation S-CIR1 Stationary tool circular interpolation (middle point) S-CIR2 Stationary tool circular interpolation (end point)</p>																	
<p>Pose type = “<i>Encoder</i>” (Editable by EXPERT or higher)</p>	<p>The robot position data is recorded using the encoder value of each joint. (See “4.8.2 Encoder values format”) But, in this screen, the data is displayed as angle value in [deg]. It is not possible to input/display the encoder value in the format of [bit] (pulse).</p> <p>Pose</p> <table border="1"> <tr> <td>Pose type</td> <td><input checked="" type="radio"/> Encoder</td> <td><input type="radio"/> Angle</td> <td><input type="radio"/> Cartesian</td> <td><input type="radio"/> Variable type</td> </tr> <tr> <td>J1</td> <td>0.0 [0.0] deg</td> <td>J4</td> <td>0.0 [0.0] deg</td> </tr> <tr> <td>J2</td> <td>90.0 [90.0] deg</td> <td>J5</td> <td>0.0 [0.0] deg</td> </tr> <tr> <td>J3</td> <td>0.0 [0.0] deg</td> <td>J6</td> <td>0.0 [0.0] deg</td> </tr> </table> <p>Record Current Position</p> <p>This key can capture the present encoder values of the current robot’s joints.</p> <p>(NOTE) “(J1, J2, J3, J4, J5, J6) = (0, 90, 0, 0, 0, 0)” stands the mechanical reference posture of the MZ series robot. This is a posture in which the zeroing pins/blocks can be attached for the all joints.</p>  <p>(J1,J2,J3,J4,J5,J6) = (0, 90, 0, 0, 0, 0) (MZ07)</p> <p>(NOTE) If “<i>Encoder</i>” is selected for the “Pose type” and <Complete> key is pressed, the position data is saved in the movement command as the same format with the normal movement command (See “4.3.3 Recording a move command”). In this case, this input interface screen will not appear again even if the screen editor is opened.</p>	Pose type	<input checked="" type="radio"/> Encoder	<input type="radio"/> Angle	<input type="radio"/> Cartesian	<input type="radio"/> Variable type	J1	0.0 [0.0] deg	J4	0.0 [0.0] deg	J2	90.0 [90.0] deg	J5	0.0 [0.0] deg	J3	0.0 [0.0] deg	J6	0.0 [0.0] deg
Pose type	<input checked="" type="radio"/> Encoder	<input type="radio"/> Angle	<input type="radio"/> Cartesian	<input type="radio"/> Variable type														
J1	0.0 [0.0] deg	J4	0.0 [0.0] deg															
J2	90.0 [90.0] deg	J5	0.0 [0.0] deg															
J3	0.0 [0.0] deg	J6	0.0 [0.0] deg															

<p>Pose type = "Angle" (Editable by EXPERT or higher)</p>	<p>The robot position data is recorded using the angle value of each joint. (See "4.8.3 Angle values format")</p> <table border="1"> <tr><td>Pose</td></tr> <tr><td>Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input type="radio"/> Cartesian <input type="radio"/> Variable type</td></tr> <tr><td>J1 0.0 [0.0] deg J4 0.0 [0.0] deg</td></tr> <tr><td>J2 90.0 [90.0] deg J5 0.0 [0.0] deg</td></tr> <tr><td>J3 0.0 [0.0] deg J6 0.0 [0.0] deg</td></tr> </table> <p>Record Current Position This key can capture the present angle values of the robot.</p>	Pose	Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input type="radio"/> Cartesian <input type="radio"/> Variable type	J1 0.0 [0.0] deg J4 0.0 [0.0] deg	J2 90.0 [90.0] deg J5 0.0 [0.0] deg	J3 0.0 [0.0] deg J6 0.0 [0.0] deg
Pose						
Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input type="radio"/> Cartesian <input type="radio"/> Variable type						
J1 0.0 [0.0] deg J4 0.0 [0.0] deg						
J2 90.0 [90.0] deg J5 0.0 [0.0] deg						
J3 0.0 [0.0] deg J6 0.0 [0.0] deg						
<p>Pose type = "Cartesian" (Editable by EXPERT or higher)</p>	<p>The robot's TCP position data is recorded using the (X, Y, Z, roll, pitch, yaw). (See "4.8.4 Cartesian values format")</p> <table border="1"> <tr><td>Pose</td></tr> <tr><td>Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input checked="" type="radio"/> Cartesian <input type="radio"/> Variable type</td></tr> <tr><td>X 463.0 [463.0] mm r 0.0 [0.0] deg</td></tr> <tr><td>Y 0.0 [0.0] mm p -90.0 [-90.0] deg</td></tr> <tr><td>Z 720.0 [720.0] mm y -180.0 [-180.0] deg</td></tr> </table> <p>X X coordinate in [mm] Y Y coordinate in [mm] Z Z coordinate in [mm] roll Rotational angle around the Z axis [deg] pitch Rotational angle around the Y axis [deg] yaw Rotational angle around the X axis [deg]</p> <p>Record Current Position This key can capture the present coordinates (X, Y, Z, r, p, y) of the robot.</p>	Pose	Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input checked="" type="radio"/> Cartesian <input type="radio"/> Variable type	X 463.0 [463.0] mm r 0.0 [0.0] deg	Y 0.0 [0.0] mm p -90.0 [-90.0] deg	Z 720.0 [720.0] mm y -180.0 [-180.0] deg
Pose						
Pose type <input checked="" type="radio"/> Encoder <input type="radio"/> Angle <input checked="" type="radio"/> Cartesian <input type="radio"/> Variable type						
X 463.0 [463.0] mm r 0.0 [0.0] deg						
Y 0.0 [0.0] mm p -90.0 [-90.0] deg						
Z 720.0 [720.0] mm y -180.0 [-180.0] deg						
<p>Coordinate This item can be changed only in case of "Cartesian" (Editable by EXPERT or higher)</p>	<p>Select the reference coordinate system. The factory setting is "Robot (JIS)".</p> <table border="1"> <tr><td>Coordinate</td><td><input checked="" type="radio"/> Robot(JIS) <input type="radio"/> Robot(AW) <input type="radio"/> User coord</td></tr> </table> <p>"Robot (JIS)" The "Machine coordinate system (Robot coordinate system)" is used as the reference coordinate system.</p>  <p>"Robot (AW)" This setting can not be used.</p> <p>"User coordinate" In case of this, the user coordinate system that has been selected in advance is used as the reference coordinate system. To select the user coordinate system, please use the function command "FN113 CHGCOORD".</p> <p>(NOTE) If the "FN113 CHGCOORD" has not been executed in advance of executing the FN645 MOVEX that is using "User coordinate" as the coordinate system, an error will be detected and the robot will stop.</p>	Coordinate	<input checked="" type="radio"/> Robot(JIS) <input type="radio"/> Robot(AW) <input type="radio"/> User coord			
Coordinate	<input checked="" type="radio"/> Robot(JIS) <input type="radio"/> Robot(AW) <input type="radio"/> User coord					

	<p>Generally, normal articulated 6-axes robots may have plural postures to achieve the same TCP coordinate (X, Y, Z, roll, pitch, yaw). By setting these parameters, it is possible to choose 1 posture among those plural postures. (The factory setting is "Previous Step".)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Axial angle refer</td><td style="padding: 2px;"><input type="radio"/> Previous Step</td><td style="padding: 2px;"><input checked="" type="radio"/> Configuration</td></tr> </table> <p>(CAUTION) This setting is effective only in the following cases. - The robot is executing the shift motion. Or - The robot is executing a movement command that has Cartesian coordinates as its position data.</p> <p>"Previous Step" The robot takes the posture that is the similar to the previous step automatically.</p> <p>(NOTE) Please refer to the online help (displayed on the screen) for the following command. FN160 POSAUTO</p> <p>"Configuration" It is possible to force the robot to select the posture using the configuration setting.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Axial angle refer</td><td style="padding: 2px;"><input type="radio"/> Previous Step</td><td style="padding: 2px;"><input checked="" type="radio"/> Configuration</td></tr> <tr> <td style="padding: 2px;">J1</td><td style="padding: 2px;"><input checked="" type="radio"/> Left</td><td style="padding: 2px;"><input type="radio"/> Right</td></tr> <tr> <td style="padding: 2px;">J3</td><td style="padding: 2px;"><input checked="" type="radio"/> On elbow</td><td style="padding: 2px;"><input type="radio"/> Under elbow</td></tr> <tr> <td style="padding: 2px;">J5</td><td style="padding: 2px;"><input checked="" type="radio"/> Flip</td><td style="padding: 2px;"><input type="radio"/> Non Flip</td></tr> </table> <p>Left The posture is selected so that "J1>0[deg]" is satisfied. Right The posture is selected so that "J1<0[deg]" is satisfied. On elbow The posture is selected so that the elbow gets upper side. Under elbow The posture is selected so that the elbow gets lower side. Flip The posture is selected so that "J5<0[deg]" is satisfied. Non Flip The posture is selected so that "J5>0[deg]" is satisfied. (For details, refer to p4-64)</p> <p>  This key can get the current configuration setting of the robot.</p> <p>(NOTE) Please refer to the online helps (displayed on the screen) for the following commands. FN160 POSAUTO FN161 LEFTY FN162 RIGHTY FN163 ABOVE FN164 BELOW FN165 FLIP FN166 NONFLIP FN202 FRANGE</p>	Axial angle refer	<input type="radio"/> Previous Step	<input checked="" type="radio"/> Configuration	Axial angle refer	<input type="radio"/> Previous Step	<input checked="" type="radio"/> Configuration	J1	<input checked="" type="radio"/> Left	<input type="radio"/> Right	J3	<input checked="" type="radio"/> On elbow	<input type="radio"/> Under elbow	J5	<input checked="" type="radio"/> Flip	<input type="radio"/> Non Flip
Axial angle refer	<input type="radio"/> Previous Step	<input checked="" type="radio"/> Configuration														
Axial angle refer	<input type="radio"/> Previous Step	<input checked="" type="radio"/> Configuration														
J1	<input checked="" type="radio"/> Left	<input type="radio"/> Right														
J3	<input checked="" type="radio"/> On elbow	<input type="radio"/> Under elbow														
J5	<input checked="" type="radio"/> Flip	<input type="radio"/> Non Flip														
<p>Variable type (Editable by EXPERT or higher)</p>	<p>The robot's position data is represented using the pose variable. (See "4.8.5 Pose variable format") Before using this format, it is necessary to load a "Pose file" using a function command "FN98 USE".</p> <p>Pose variable</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Direct value</td> <td style="width: 50%;">+ direct Pose No. (1-9999)</td> </tr> <tr> <td>Global integer variable</td> <td>+ indirect variable No. (1-200, 301-500)</td> </tr> <tr> <td>Global real variable</td> <td>+ indirect variable No. (1-200, 301-500)</td> </tr> <tr> <td>Local integer variable</td> <td>+ indirect variable No. (1-200, 301-500)</td> </tr> <tr> <td>Local integer variable</td> <td>+ indirect variable No. (1-200, 301-500)</td> </tr> </table> <p>In case of "Direct value", set the Pose variable No. directly. (Example: P9999). For others, the Pose variable No. is indirectly selected by the number determined by the indirect variable. (Example: "P[V1%]" stands for "P1" if the value of V1% is 1)</p>	Direct value	+ direct Pose No. (1-9999)	Global integer variable	+ indirect variable No. (1-200, 301-500)	Global real variable	+ indirect variable No. (1-200, 301-500)	Local integer variable	+ indirect variable No. (1-200, 301-500)	Local integer variable	+ indirect variable No. (1-200, 301-500)					
Direct value	+ direct Pose No. (1-9999)															
Global integer variable	+ indirect variable No. (1-200, 301-500)															
Global real variable	+ indirect variable No. (1-200, 301-500)															
Local integer variable	+ indirect variable No. (1-200, 301-500)															
Local integer variable	+ indirect variable No. (1-200, 301-500)															

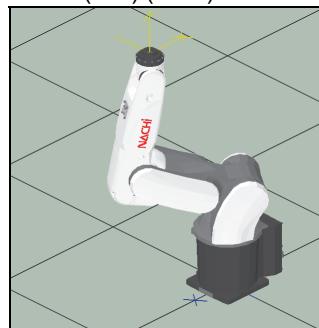
(Reference) Examples of configurations

RIGHTY(Right) (J1<0)



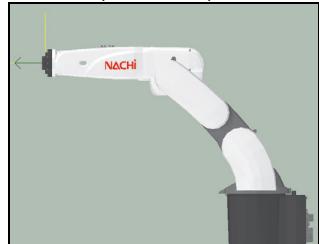
J1	-35.0	X=	200.0
J2	112.2	Y=	-140.0
J3	-8.1	Z=	850.0
J4	0.0	r=	180.0
J5	75.9	p=	-0.0
J6	35.0	y=	-0.0

LEFTY(Left) (J1>0)



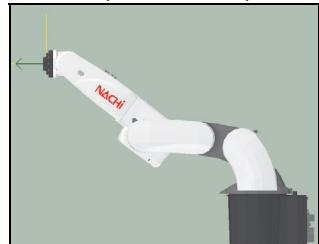
J1	145.0	X=	200.0
J2	164.2	Y=	-140.0
J3	4.3	Z=	850.0
J4	0.0	r=	180.0
J5	11.5	p=	0.0
J6	-145.0	y=	0.0

ABOVE (On elbow)



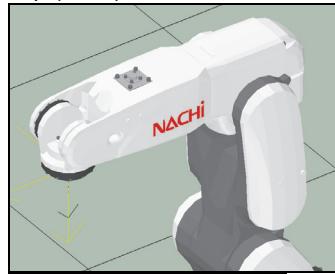
J1	-0.0	X=	696.3
J2	45.0	Y=	0.0
J3	45.0	Z=	623.3
J4	-0.6	r=	0.0
J5	0.0	p=	-90.0
J6	0.6	y=	-180.0

BELOW (Under elbow)



J1	-0.0	X=	696.3
J2	6.8	Y=	0.0
J3	120.0	Z=	623.3
J4	0.0	r=	0.0
J5	-36.7	p=	-90.0
J6	-0.0	y=	-180.0

Flip (J5<0)



J1	0.0	X=	390.0
J2	90.0	Y=	0.0
J3	0.0	Z=	647.0
J4	0.0	r=	-0.0
J5	-90.0	p=	-0.0
J6	0.0	y=	-180.0

Non flip (J5>0)



J1	0.0	X=	390.0
J2	90.0	Y=	0.0
J3	0.0	Z=	647.0
J4	-180.0	r=	-0.0
J5	90.0	p=	-0.0
J6	-180.0	y=	-180.0

4.8.2 Encoder values format

A movement command with “Encoder values format”



If a movement command is recorded using the [RECORD] key, the encoder values of joints of the robot will be recorded as the position data for the movement command. This is the “Encoder values format” movement command.

(1) Display in the screen editor

	J1	J2	J3	J4	J5	J6
V ANG	0.00	90.00	0.00	0.00	0.00	0.00

In the screen editor, the position data (encoder values) of the step are converted to **angle values** and displayed. In case of operator class **EXPERT** or higher, it is possible to set the cursor here and edit the value (angle value) using the numeric keys.

(NOTE)

J1 080000	080000	0.0	X= 463.0
J2 080000	080000	90.0	Y= 0.0
J3 080000	080000	0.0	Z= 720.0
J4 080000	080000	0.0	r= 0.0
J5 080000	080000	0.0	p= -90.0
J6 080000	080000	0.0	s= -180.0

These encoder values (current values) are used for the position data for the movement command.

POINT

(2) Edit screen

Pose					
Pose type	<input checked="" type="radio"/> Encoder	<input type="radio"/> Angle	<input type="radio"/> Cartesian	<input type="radio"/> Variable type	
J1	0.0	[0.0] deg	J4	0.0	[0.0] deg
J2	90.0	[90.0] deg	J5	0.0	[0.0] deg
J3	0.0	[0.0] deg	J6	0.0	[0.0] deg

(This screen will be displayed only at first time)

(3) Remarks

- Even if the length of the tool is changed, the robot posture (the values of each joint) at the step does not change. But, as a result, the (X,Y,Z,r,p,y) at the step will change.
- When executing the movement command of “Encoder values format”, the robot always reaches the same (unique) posture (combination of joint angles). (The starting posture does not matter)
- This data format equals to the “MOVEX-E” style of the robot language.
When this movement command is converted to robot language, the step will be converted following the pre-designated command style. (e.g. MOVEX-X, MOVEX-J, MOVEX-E, etc.)

4.8.3 Angle values format

A movement command with “Angle values format”

If “***FN645 MOVEX***” is used, it is possible to record a movement command that has “**Angle values**” for its position data.

(1) Display in the screen editor

	J1	J2	J3	J4	J5	J6
V ANG	0.00	90.00	0.00	0.00	0.00	0.00

In the screen editor, the position data (J1, J2, J3, J4, J5, J6) of the step are displayed. In case of operator class **EXPERT** or higher, it is possible to open an edit screen and change the values using the numeric keys.
(See p4-61)

(2) Edit screen



Pose							
Pose type	<input type="radio"/> Encoder	<input checked="" type="radio"/> Angle	<input type="radio"/> Cartesian	<input type="radio"/> Variable type			
J1	0.0[0.0]	deg	J4	0.0[0.0]	deg
J2	90.0[90.0]	deg	J5	0.0[0.0]	deg
J3	0.0[0.0]	deg	J6	0.0[0.0]	deg

(3) Remarks

- Even if the length of the tool is changed, the robot posture (the values of each joint) at the step does not change. But, as a result, the (X,Y,Z,r,p,y) at the step will change.
- When executing the movement command of “Angle values format”, the robot always reaches the same (unique) posture (combination of joint angles). (The starting posture does not matter)
- This data format equals to the “**MOVEX-J**” style of the robot language.
When this movement command is converted to robot language, the step will be converted to **MOVEX-J** forcibly.

4.8.4 Cartesian values format (X, Y, Z, r, p, y)

A movement command with “Cartesian values format” (X, Y, Z, r, p, y)

If “**FN645 MOVEX**” is used, it is possible to record a movement command that has “**Cartesian coordinates**” for its position data. The Cartesian coordinates include the 3-dimensional position (X,Y,Z) of the TCP and the tool angle (roll, pitch, yaw).

(1) Display in the screen editor

	X	Y	Z	roll	pitch	yaw
V MEC	463.0	-0.0	720.0	0.00	-90.00	-180.00

In the screen editor, the position data (X, Y, Z, roll, pitch, yaw) of the step are displayed. In case of operator class **EXPERT** or higher, it is possible to open an edit screen by the cursor key (right) and change the values using the numeric keys. (See p4-61)

(2) Edit screen

Pose				
Pose type	<input checked="" type="radio"/> Encoder	<input type="radio"/> Angle	<input checked="" type="radio"/> Cartesian	<input type="radio"/> Variable type
X	463.0 [463.0] mm	r	0.0 [0.0] deg	
Y	0.0 [0.0] mm	p	-90.0 [-90.0] deg	
Z	720.0 [720.0] mm	y	-180.0 [-180.0] deg	

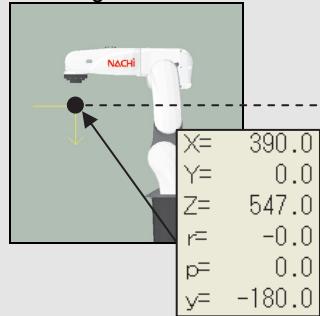
(3) Remarks

- When the length or the angle of the Tool Constant is changed, the robot angle at the step will change.

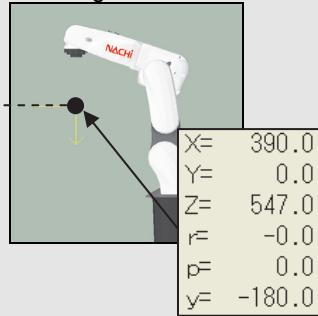
POINT

(Example)

Tool length is Z=100



Tool length is Z=200



The TCP coordinates (X,Y,Z) are the same but the robot posture is different.

- In some cases, plural robot postures are acquired to achieve the (X, Y, Z, roll, pitch, yaw). Therefore, depending on the starting posture, **the robot may take unexpected posture** at the point.
- In case of this “Cartesian values format”, there is a possibility in which the robot makes unexpected posture because of singularity etc. Therefore, for the 1st movement command of a program, “Encoder values format” is recommended.
- This data format equals to the “MOVEX-X” style of the robot language. When this movement command is converted to robot language, the step will be converted to MOVEX-X forcibly.

4.8.5 Pose variable format

A movement command with “Pose variable format”

If “***FN645 MOVEX***” is used, it is possible to record a movement command that has “**Pose variable**” for its position data. A “Pose variable” is a sort of variable that contain the position data for the robot only. To use pose variables in a program, it is necessary to create a “**Pose file**” and record a pose variable in the file in advance of executing the program.

(1) Display in the screen editor

If the position data format of the movement command is “Pose variable format”, the screen editor display the data like this picture.

```
V ANG P1
V ANG P[V1%]
V ANG P[V1!]
V ANG P[L1%]
V ANG P[L1!]
```

P1	Direct value
P[V1%]	Indirect call via the Global integer variable V1%
P[V1!]	Indirect call via the Global real variable V1!
P[L1%]	Indirect call via the Local integer variable L1%
P[L1!]	Indirect call via the Local real variable L1!

(See p4-61)

POINT

(2) Remarks

- Because the internal data of the Pose variable is “Encoder values”, the robot posture (the values of each joint) at the step does not change even if the length or the angle of the tool constant is changed. But, as a result, the (X, Y, Z, r, p, y) at the step will change.
- When executing the movement command of “Pose variable format”, the robot always reaches the same (unique) posture (combination of joint angles). (The starting posture does not matter)
- Pose variables can be shared in plural programs by loading the same pose file..
- It is necessary to load the pose file using “***FN98 USE***” in advance of using the pose variable that is included in the pose file. The pose file can be switched (reloaded) in the program any time by the FN98.

```
0 [START]
1 USE[1]
2 V ANG P1
```

- To open the edit screen for the pose file, please use the short cut command R11.

Pose File No	=	1	Record No	=	5
1	463.0	0.0	720.0	0.00	-90.00-180.00
2	463.0	0.0	720.0	0.00	-90.00-180.00
3	463.0	0.0	720.0	0.00	-90.00-180.00
4	463.0	0.0	720.0	0.00	-90.00-180.00
[EOF]					

(Supplement)

For details of the pose file, pose variable (P1), global integer variable (V1%), etc., please refer to the instruction manual “ROBOT LANGUAGE”(TFDEN-012).

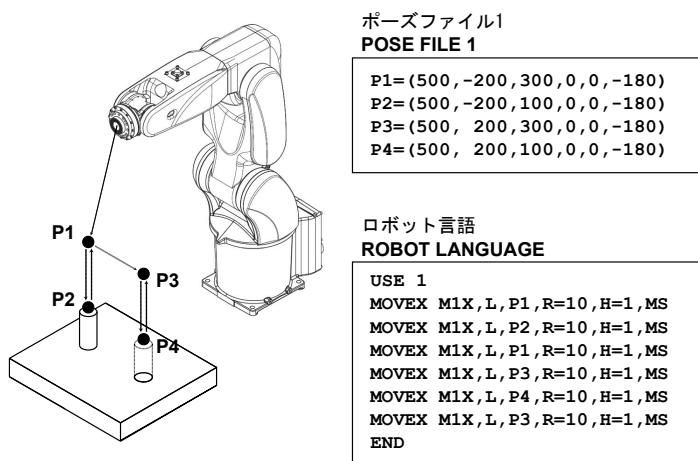
4.9 Pose file and pose variable (for expert)

"Pose file" is a sort of data file that contain plural position data ("Pose variables") of a robot.

The pose files and the pose variables can be used by MOVEX command of robot language or the function command "FN645 MOVEX" in a robot program. It is possible to use 1 pose variable repeatedly in a program or to share 1 pose variable from different programs. For details, refer to the instruction manual "ROBOT LANGUAGE"(TFDEN-012).

Teaching example using pose variables

P1, P2, P3, P4 are "Pose variable"



These pose variables are displayed in the teach pendant screen like the following picture.

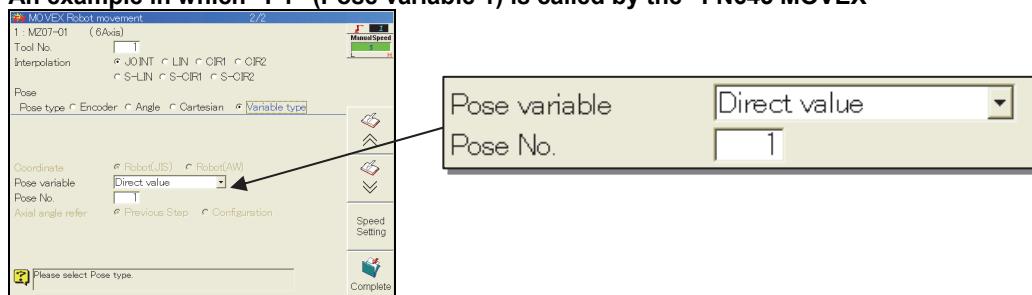
The content of the pose file 1 (In this example, 4 pose variables are included)

[1] Robot Program						UNIT1
Pose File No	=	1	Record No	=	1	
1	500.0	-200.0	300.0	0.00	0.00-180.00	
2	500.0	-200.0	100.0	0.00	0.00-180.00	
3	500.0	0.0	300.0	0.00	0.00-180.00	
4	500.0	0.0	100.0	0.00	0.00-180.00	

Work program

100 %	JOINT	A1	T1	
0 [START]				
1 USE[1]				Load the pose file 1 by USE command.
2 10.0 %	LIN	A1	T1	
3 10.0 %	LIN	A1	T1	
4 10.0 %	LIN	A1	T1	
5 10.0 %	LIN	A1	T1	
6 10.0 %	LIN	A1	T1	
7 10.0 %	LIN	A1	T1	
8 END				

An example in which "P1" (Pose variable 1) is called by the "FN645 MOVEX"



NOTE

Chapter 5 Auto operation (playback)

This chapter described how to automatically run (playback) the programs that have been created.

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5.1 Before starting auto operation

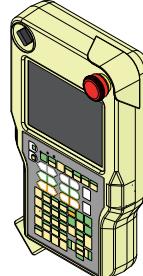
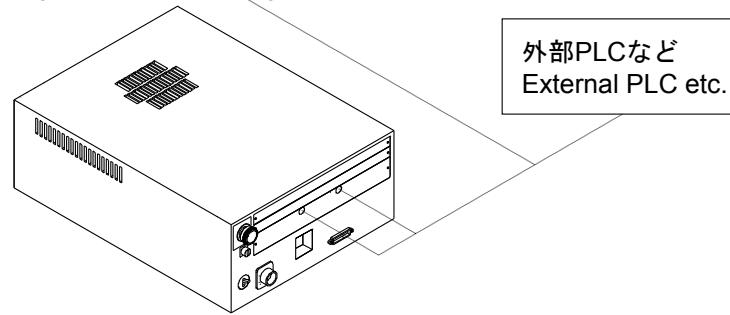
This section describes the basic knowledge required to perform automatic operation (PLAYBACK).

5.1.1 “Internal start” and “External start”

There are 2 methods for starting operation. The 1st one is “Internal start” and the other one is “External start”.

By selecting one of these starting methods in the PLAYBACK mode, it becomes possible to run the program automatically (=Playback) using the teach pendant or the external input signals.

Table 5.1.1 Start method “Internal” and “External”

Start method	Details
<p>Internal start method</p>  <p>“Motors ON/START selection source” is “Controller” and “Playback mode program selection” is “Controller”</p>	<p>This method is used when using this robot controller as stand alone. The operations of “Program selection”, “Motors ON”, and “Program start” can be done using the teach pendant.</p>  <p>(NOTE) In this mode, it is impossible to execute “Program selection”, “Motors ON”, and “Program start” using the external signals.</p>
<p>External start method</p>  <p>“Motors ON/START selection source” is “External” and “Playback mode program selection” is “External”</p>	<p>This method is used when controlling this robot controller by the external PLC etc. The operations of “Program selection”, “Motors ON”, and “Program start” can be done using the external input signals.</p>  <p>In this mode, please input the external input signals (e.g. “Program selection bits”, “Motors ON external”, and “Ext. play start”) from external PLC etc. In this case, those signals must be assigned to specific signal No. in advance. (Of course, signal connection must be done in advance)</p> <p>(NOTE) In this mode, it is impossible to execute “Program selection”, “Motors ON”, and “Program start” using the teach pendant.</p>

POINT

There are many styles of inputting signals to this controller. (e.g. DC24V I/O, DeviceNet, CC-LINK, etc.) For details, refer to the instruction manual “CFD CONTROLLER TECHNICAL DOCUMENT 2” (TCFEN-156).

Switching startup methods and program selection methods

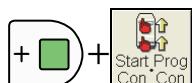
The startup method can be switched using a simple operation. (Internal can be changed to external and vice versa.) For instance, even when “external start” has been selected, it is possible to switch to “internal start” temporarily in order to check what has been taught.

Internal or external can be selected as the method to select the task program to be played back.

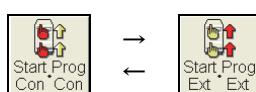
- 1 The current settings can be checked on the display of the teach pendant.



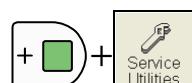
In the case of the screen shown above, internal is selected both as the start method and program select.



- 2 The method can be switched between <Start Con/Prog Con> and <Start Ext/Prog Ext> by pressing f2 while holding down [ENABLE].

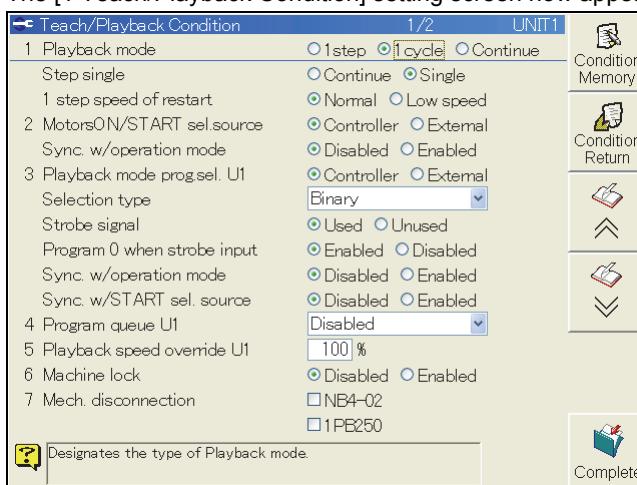


- 3 The settings can also be changed from the service menu. On the service menu, start select and program select can be changed independently.

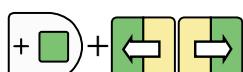


Press f6 <Service Utilities> while holding down [ENABLE], and select [1 Teach/Playback Condition].

>> The [1 Teach/Playback Condition] setting screen now appears.



- 4 Align the cursor with “2 MotorsON/START sel.source” and “3 Playback mode prog.sel.”, and set these two items.



To make changes, use [ENABLE] + [left or right].



- 5 Upon completion of the changes, press f12 <Complete>.

>> The settings are now stored in the memory, and operation returns to the original screen.

Table 5.1.1 "Motors ON / START selection source" setting

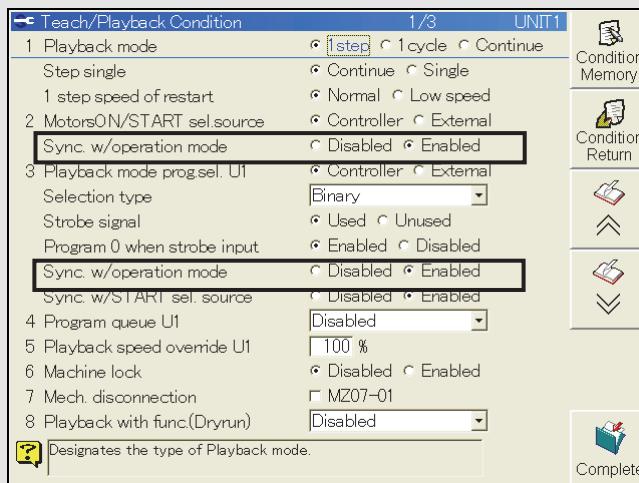
"Motors ON/START selection source"	Description
Controller (=Internal)	The playback operation can be started using the teach pendant. ("Motors ON" and "Playback start")
External	The playback operation can be started using the external input signals. ("Motors ON" and "Playback start")

Table 5.1.2 "Playback mode program selection" setting

"Playback mode program selection"	Description
Controller (=Internal)	The program number can be selected using the teach pendant operation.
External	The program number can be selected using the external input signals. 8 bits input signals are assigned to the " Program selection bits " when shipping the robot.

How to make a synchronization setting with TEACH and PLAYBACK mode

By making a setting shown as below, it is possible to make "**Motors ON/START selection source**" and "**Playback mode program selection**" synchronize with the selection status of the TEACH mode and the PLAYBACK mode. When this setting is made, those setting will be changed automatically according to the operation mode (TEACH or PLAYBACK).



If the setting is made like this picture, the settings are automatically changed.

<In case of PLAYBACK mode>

The setting will be changed to;
"Motors ON/START selection source" = "External"
"Playback mode program selection" = "External"



<In case of TEACH mode>

The setting will be changed to;
"Motors ON/START selection source" = "Controller"
"Playback mode program selection" = "Controller"



5.1.2 Playback methods (5 operation modes)

There are five operation modes for the playback methods. One of these modes is selected prior to playback, but the mode can also be selected during playback.
Either “Cycle” or “Continuous” is selected during actual operations. All the other modes are selected when checking what has been taught or when trying out an auto operation.

Table 5.1.2 Playback methods

Playback methods	Details
Step 	<ul style="list-style-type: none"> When the START operation is done, one step of the program is executed and then the robot stops. To advance to the next step, execute the START operation again.
Cycle 	<ul style="list-style-type: none"> When the START operation is done once, the program is executed once from start to end. When the last step is reached, the robot stops.
Cycle step by step 	<ul style="list-style-type: none"> When the START operation is done once, one step of the program is executed, and the robot stops. To advance to the next step, press [ENABLE] + f8 <Step by Step>. When the last step is reached, the robot stops.
Continue 	<ul style="list-style-type: none"> When the START operation is done once, the program is executed repeatedly.
Continuous step by step 	<ul style="list-style-type: none"> When the START operation is done once, one step of the program is executed, and the robot stops. To advance to the next step, press [ENABLE] + f8 <Step by Step>. When the last step is reached, operation returns to the first step, and the program is executed again.

5.1.3 Specifying the step which playback starts

Where playback is to start can be specified at any step from the teach pendant. (When the program has just been selected, the program start, namely step 0, is specified.) However, instances in which the step can be specified are the following.

Table 5.1.3 Specifying the step from which playback starts

Start method	First startup after program selection	Startup after a stop
Internal start (Controller)	Step specification enabled	Step specification enabled
Ext. play start.	Step specification disabled	Step specification enabled



In case of the factory default setting, it is not possible to playback a program from a function command step. To make it possible, it is necessary to make a setting. For details, refer to "7.12 Selecting a Function Command Step and operating". And, there are some function commands that cannot be designated as a start step even if this setting is made.

5.1.4 Operating speed when the start step is specified

When a step other than step 0 has been selected from the teach pendant and playback has been started, the robot moves from the current position to the specified start step at the safety speed (less than 250 mm/sec.). This operation prevents unforeseen interference and other trouble resulting from the operator selecting the incorrect step. The safety speed restriction is canceled starting from the next step.

If the selected step (any step except 0) is a function command, the safety speed restriction comes into effect for the first operation to the movement command step. In the default settings, playback cannot be performed with a function command step selected. For details, see "7.12 Selecting a Function Command Step and Operating."

If a start step is selected for the program start (namely, step 0), the program runs at normal speed instead of safety speed.

If, for instance, step 2 is selected from the teach pendant to start the operation, the robot will move at the safety speed until step 2. From step 3 onward, it will move at the specified speed.

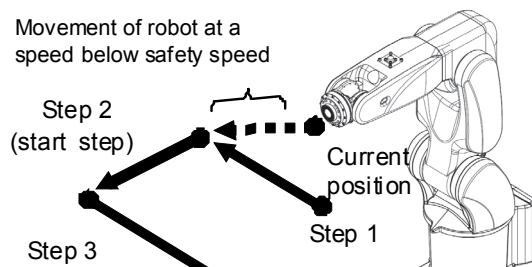


Fig. 5.1.1 Robot movements at safety speed



If <Service Utilities> - [1 Teach/Playback Conditions] – [20 Recover to stopped position] is set to [Enabled], and [After Step Set] in the detailed conditions is set to [Current position], the robot operates at the specified speed, not the safety speed.
Restart operation after checking operation in advance using the check operation.

5.1.5 Playback speed override

“Playback speed override” is a function to increase / decrease the playback speed of the program. 100% means the same speed that is recorded in the program data.

(Example) The recorded speed of a program

1	1000	mm/s	LIN
2	50.0	%	LIN

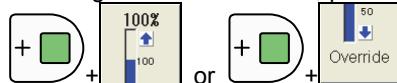
(1) If the Override value is 100%;

Step 1 : 1000 mm/s
 Step 2 : 50.0 %

(2) If the override value is 50%;

Step 1 : 500 mm/s
 Step 2 : 250.0 %

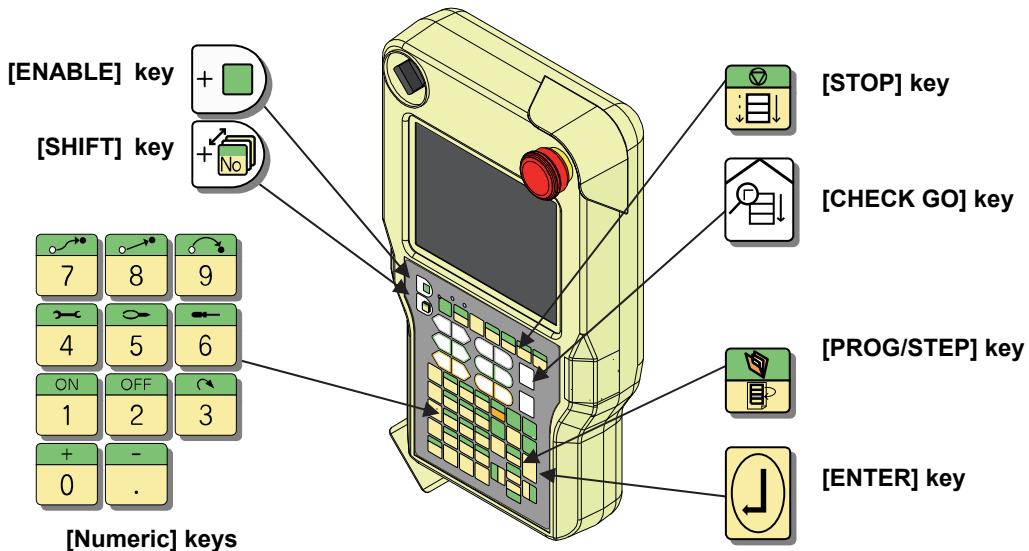
To change the override value, please use the following keys;



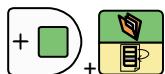
When trying to playback a program at first time, it is recommended to use low speed override value e.g. 10% etc. After checking the robot motion in low speed, increase the value gradually and carefully. And then after finishing the program check completely, set the value of 100%. If a program is not checked enough and high speed playback is tried carelessly, unexpected interference or crash, etc. may happen.

5.2 Internal start operation (using teach pendant)

5.2.1 Keys to be used for the internal start operation

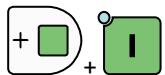


5.2.2 Program selection



After pressing these keys, input the program No. and then press [ENTER].

5.2.3 Motors ON



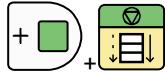
This operation will turn ON the motor power source circuit.

5.2.4 Program start (playback start)



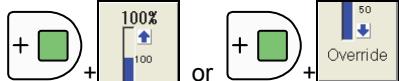
This operation will start the playback operation of the work-program.
When the confirmation message is displayed, select YES and press [ENTER] key.

5.2.5 Program stop (playback stop)



can stop the playback operation of the robot.
It is also possible to restart the program by the "Start" operation.

5.2.6 How to change the Playback speed override



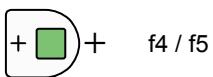
can change the Playback speed override setting.
For the first try of a program, approximately 10% setting is recommended for safety.

5.2.7 Playback operation

How to start(playback) the work-program (internal start)



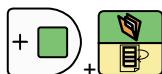
1 Select the playback mode.



2 Select the playback method required.

The playback method (operation mode) can be selected by pressing the [ENABLE] and the f4 key together or by pressing [ENABLE] and the f5 key together (in other words, one of these two combinations of keys is pressed together).

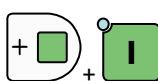
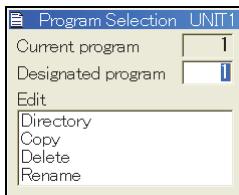
f4	f5	Operation
 	 	<ul style="list-style-type: none"> When f4 is set to step continuous, the mode is switched from "Cycle" → "Continue" → "Step" every time f5 is pressed. When f4 is set to single step, the mode is switched from "Cycle Step by Step" → "Continuous Step by Step" → "Step" every time f5 is pressed. When f4 is pressed while f5 is at any setting, single is switched to continuous or continuous is switched to single.



Or
Touch the icon.



3 Press [ENABLE] and [PROG/STEP] to select the program which is to be played back. Input the desired program number and press [ENTER].

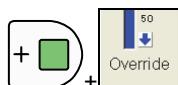
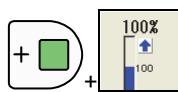


4 Turn the Motors ON.

>> The motor power source circuit is now turned ON.

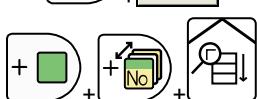


(At this time, do not grasp the ENABLE SWITCH on the backside of the teach pendant)



5 Set the Playback speed override.

Until enough motion check has been finished, 10% or less is recommended.



5 Execute the Start operation. Press [ENABLE] + [SHIFT] + [CHECK GO].



6 A confirmation window is displayed. Select [YES] and press [ENTER].

>> Automatic operation now starts.



7 To stop the program, press [ENABLE] + [STOP].

>> The program will stop. If the Start operation is executed again, the program will restart.

(Increase the Playback speed override gradually and set 100% finally after completing the program check work)

5.3 External start operation (using external input signals)

For the external start operation, external input signals are used. Please complete the connections and the assignment settings in advance. For details, refer to the following instruction manuals.

“CFD CONTROLLER TECHNICAL DOCUMENT 2” (TCFEN-156)

“FD CONTROLLER INSTRUCTION MANUAL : EXTERNAL INPUT / OUTPUT (TFDEN-007)

5.3.1 External input signals to be used for the external start operation

Signal name	Description
“Ext. play start” (External playback start) (Factory setting : I30)	- When this signal turns ON, the program will start. - The width of this signal should be 200ms or more. - This signal can be used only when the “Motors ON/START sel. source” is “External”.
“Ext. unit play stop” (External unit playback stop) (Factory setting : I31)	- While this signal is ON, the start operation is allowed. - When this signal turns OFF, the robot will stop. - This signal can be used in spite of the setting of “Motors ON/START sel. source”.
“Motors ON external” (Factory setting : none)	- When this signal turns ON, the motor power source circuit will turn ON. - This signal can be used only when the “Motors ON/START sel. source” is “External”.
“Motors OFF external” (Factory setting : I32)	- When this signal turns ON, the Motors power circuit will turn OFF. - This signal can be used in spite of the setting of “Motors ON/START sel. source”.
“Program sel. bits” (Program selection bits) (Factory setting : I17 – I24) (8 bits)	- Please assign these signals depending on the number of the programs to be used. (When shipping, these signals can be used as 8 bits binary signals that can cover 0 to 255) - These signals can be used only when the “Playback mode prog. sel. U1” is “External”.



The “**Motors ON external**” is not assigned to any signal number. To use this signal, please be sure to assign an input signal number in advance.

<Constant Setting> - [6 Signals] [2 Input Signal Assignment] [1 Standard Inputs]

Standard Inputs		1/6	
Ext. play start.	U1	30	
Int.unit play stop	U1	0	
Ext. All unit play stop		0	
Ext unit play stop	U1	31	
MotorsON external		0	
MotorsOFF external		32	
Program sel. bits	U1	1[17] 2[18] 3[19] 4[20] 5[21] 6[22] 7[23] 8[24] 9[0] 10[0] 11[0] 12[0] 13[0] 14[0] 15[0] 16[0]	

(Factory setting)

5.3.2 Program selection

Please input the program number by the combination of the “**Program sel. bits**” input signals.

5.3.3 Motors ON

When the “**Motors ON external**” signal turns ON, the motor power source circuit will turn ON.

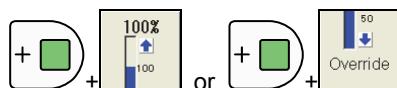
5.3.4 Program start (playback start)

When the “**Ext. play start**” signal turns ON, the program will start. But, please be sure that before turning ON this signal, it is necessary to turn ON the “**Ext. unit play stop**” signal in advance.

5.3.5 Program stop (Playback stop)

When the “**Ext. unit play stop**” signal turns OFF, the program will stop.

5.3.6 How to change the Playback speed override



can change the Playback speed override setting.

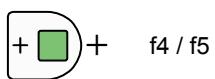
For the first try of a program, approximately 10% setting is recommended for safety.

5.3.7 Playback operation

How to start (playback) the work-program (external start)



- 1 Select the playback mode.**



f4 / f5

- 2 Select the playback method required.**

The playback method (operation mode) can be selected by pressing the [ENABLE] and the f4 key together or by pressing [ENABLE] and the f5 key together (in other words, one of these two combinations of keys is pressed together).

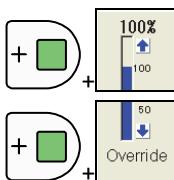
f4	f5	Operation
 	 	<ul style="list-style-type: none"> When f4 is set to step continuous, the mode is switched from "Cycle" → "Continue" → "Step" every time f5 is pressed. When f4 is set to single step, the mode is switched from "Cycle Step by Step" → "Continuous Step by Step" → "Step" every time f5 is pressed. When f4 is pressed while f5 is at any setting, single is switched to continuous or continuous is switched to single.

- 3 Input the number of the program to be started (program selection bit) from the external device using "Program sel. bits" input signals.**

>>The "Program sel. bits" input signals should be kept ON until the "Program selected" output signal turns ON.

- 4 Turn ON the "Motors ON external" signal from the external device.**

>> The motor power source circuit is now turned ON.



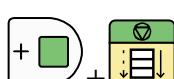
- 5 Set the Playback speed override.**

Until enough motion check has been finished, 10% or less is recommended.



- 6 Turn ON the "Ext. play start" signal from the external device.**

>>Automatic operation now starts.



- 7 To stop the program, turn OFF the "Ext. unit play stop" signal or press [ENABLE] + [STOP].**

>>The program will stop. If the "Ext. play start" signal is turned ON after turning ON the "Ext. unit play stop" signal, the program will start again.

(Increase the Playback speed override gradually and set 100% finally after completing the program check work)

5.3.8 How to change the reading method of the “Program sel. bits” signal

In case of factory setting, the “**Program selection bits**” signals are treated as binary signals. To treat those signals as discrete signals or BCD signals, please change the setting by the following procedures.

How to change the setting

For this procedure, the operator must select the operator class **EXPERT** or above. (Use R314 command)



- 1 Open <Service Utilities> [1 Teach/Playback condition] menu.**

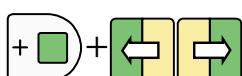
>>The following screen will be displayed.



- 2 Align the cursor with "Selection type".**



There are three ways to read the program select bits (16 signal lines): "binary," "discrete" and "BCD (Binary Coded Decimal)."



- 3 Press [ENTER] to select one of the methods as followed.**

External program selection method	
Binary	With this method, the signals are read out as binary numbers. If, for instance, bits 3 and 5 are ON, program no.20 ($2^2+2^4 = 4+16$) will be selected.
Discrete	With this method, the number of the bit turned ON by the signal is used as the program number. This means that only programs with numbers from 1 to 16 can be selected. If two or programs are input at the same time, the one with the lower number is selected.
BCD	With this method, the signal is read out as a BCD code. If, for instance, bits 3 and 5 are ON, program no.24 will be selected since the 1's digit is $2^2=4$ and the 10's digit is $2^1=2$.

Program select bit U1																
Signal	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Binary	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Discrete	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
BCD	1000's digit				100's digit				10's digit				1's digit			

Signals 1 to 16 are the numbers of the 16 "Program sel. bits" input signals.

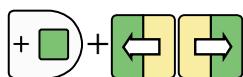
When "binary" or "BCD" is selected for the "selection system," a multiple number of signal lines are read so that the program strobe signal for determining their read timing is used. There is a special method that does not use the program strobe signal, as set forth below.

- 4** On the same setting screen as the one mentioned above, align the cursor with "Strobe signal."



There are two methods: one uses the program strobe signal and the other does not use it.

Strobe signal	Description/Explanation
Used	When the robot is to be started from an external source, maintain a pulse width of at least 0.2 sec. for the start signal. Input the strobe signal when at least 0.01 sec. has elapsed after the program select signal has stabilized. If the start status has already been established by this time, program selection is executed at this time. If the start status is not established, program selection is executed as soon as the start signal has been input. (Program selection range: 0 to 9999) (Note that even No.0 can be selected.)
Unused	When the robot is to be started from an external source, maintain a pulse width of at least 0.2 sec. for the start signal. At the point when no change has occurred for 0.10 sec. after the program select signal was input, the input signal is considered to be a definite signal, and it can be captured. If the start status has already been established by this time, program selection is executed. If the start status is not established, program selection is executed as soon as the start signal has been input. (Program selection range: 0 to 9999) (Note that No.0 cannot be selected.)



- 5** Press [ENABLE] and left or right cursor keys to select the settings of the radio buttons (the horizontal rows of selector buttons) and select one of these two methods.

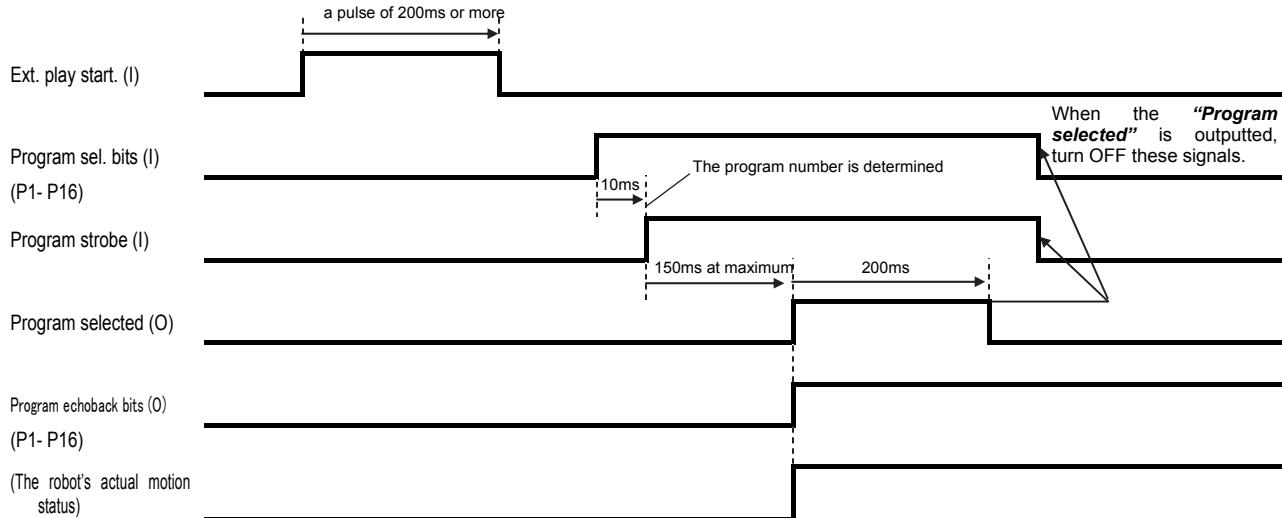


- 6** Upon completion of the settings, press the <Complete> f key.

5.3.9 Timing chart example for the external input signal

When using a strobe signal

- In a case in which “**Program strobe**” is inputted after “**Ext.play start**”
(Motors should be turned ON in advance by using the “**MotorsON external**” input signal.)



(I) : Input signal (From external device to robot controller / (O):Output (From robot controller to external device)



- “**Ext. play start**” signal should be a pulse signal of 200ms or more.
- “**Program strobe**” signal should be inputted after the “**Program sel.bits**” signals are inputted and all of those signals get stable and 10ms or more passed. If the “**Program strobe**” signal is inputted during the “**Program sel.bits**” are still unstable, an unexpected program number may be chosen.
- The pulse’s width of the “**Program selected**” signal is 200ms at the factory(default) setting. But the width can be changed in the following setting menu.
→<Constant Setting>[6 Signals][1 Signal condition][6 Program acknowledge time] (unit : sec)
- “**Program selected**” and “**Program echoback bits**” are outputted when the actually selected program starts.
- When the “**Program selected**” is outputted, turn OFF the “**Program sel.bits**” and the “**Program selected**” signals altogether.

The following signals must be assigned in advance.

<Constant Setting> - [6 Signals] [2 Input Signal Assignment] [1 Standard Inputs]

Ext. play start	(per UNIT)
Ext. All unit play stop	
Ext. unit play stop	(per UNIT)
Motors ON external	
Program sel. bits	(per UNIT)
Program strobe	(per UNIT)

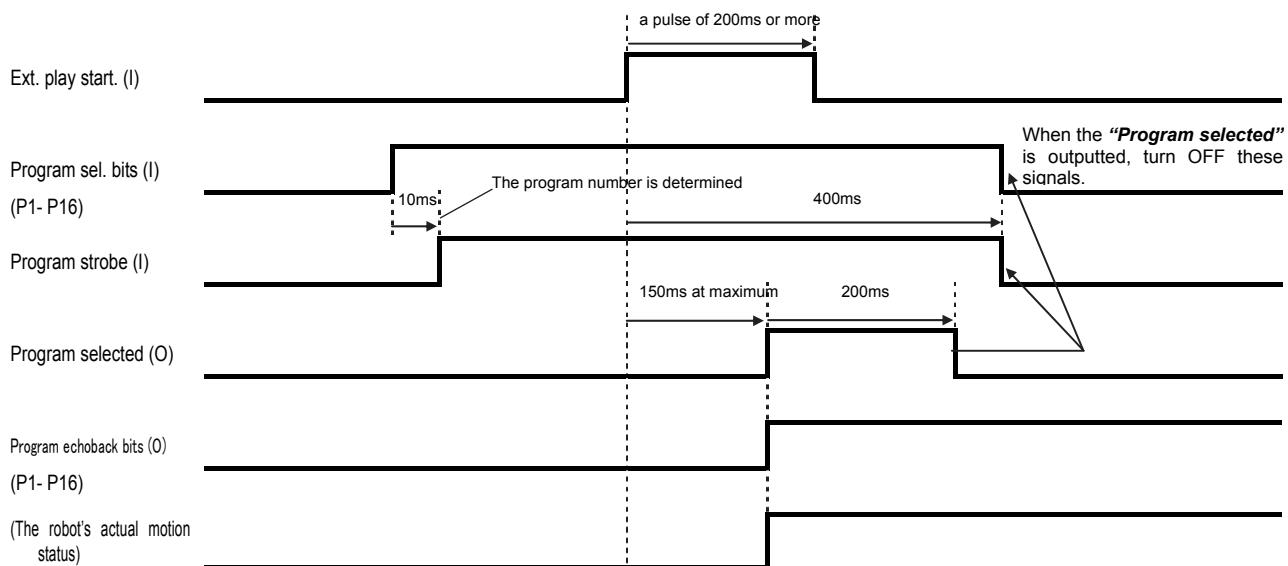


<Constant Setting> - [6 Signals] [3 Output Signal Assignment] [1 Standard Outputs]

Program selected	(per UNIT)
Program echo-back bits	(per UNIT)

Concerning other signals and details, refer to the instruction manual
“FD CONTROLLER INSTRUCTION MANUAL : EXTERNAL INPUT / OUTPUT”
(TFDEN-007)

- In a case in which “**Program strobe**” is inputted before “**Ext.play start**”
(Motors should be turned ON in advance by using the “**MotorsON external**” input signal.)



(I) : Input signal (From external device to robot controller) / (O):Output (From robot controller to external device)

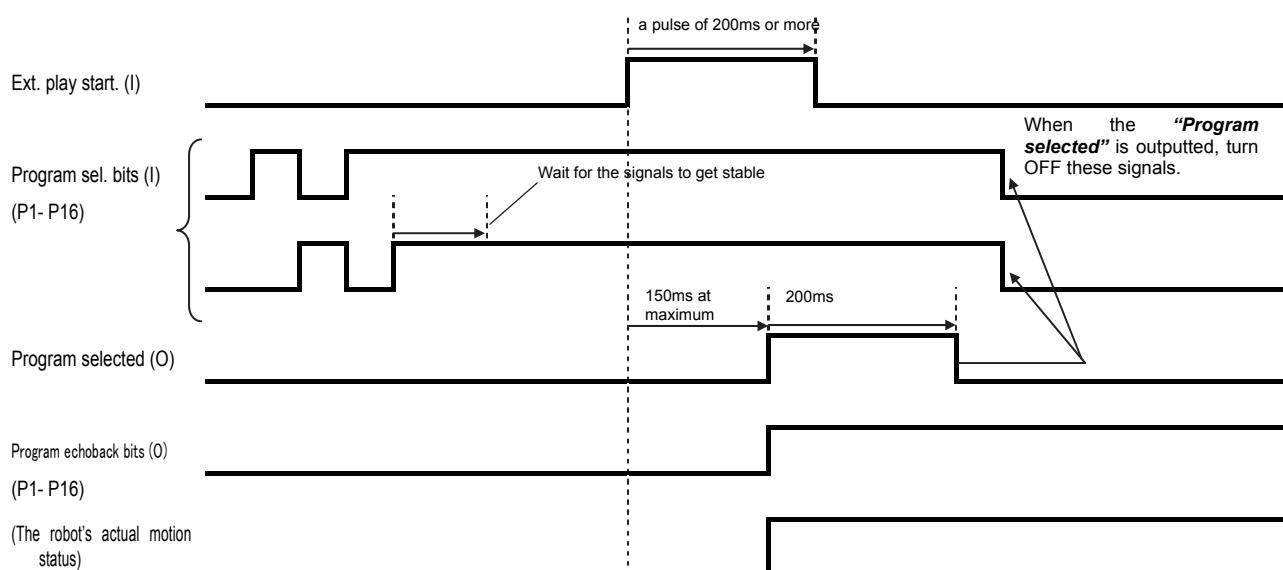


CAUTION

- “**Ext. play start**” signal should be a pulse signal of 200ms or more.
- “**Program strobe**” signal should be inputted after the “**Program sel.bits**” signals are inputted and all of those signals get stable and 10ms or more passed. If the “**Program strobe**” signal is inputted during the “**Program sel.bits**” are still unstable, an unexpected program number may be chosen.
- The pulse’s width of the “**Program selected**” signal is 200ms at the factory(default) setting. But the width can be changed in the following setting menu.
→<Constant Setting>[6 Signals][1 Signal condition][6 Program acknowledge time] (unit : sec)
- “**Program selected**” and “**Program echoback bits**” are outputted when the actually selected program starts.
- When the “**Program selected**” is outputted, turn OFF the “**Program sel.bits**” and the “**Program selected**” signals altogether.

When not using a strobe signal

Input the “**Ext. play start**” signal after the combination of “**Program sel.bits**” gets sufficiently stable (100 msec or more). In this case, the “**Ext. play start**” signal plays a role of “**Program strobe**” signal at the same time.
 (Motors should be turned ON in advance by using the “*MotorsON external*” input signal.)



(I) : Input signal (From external device to robot controller / (O):Output (From robot controller to external device)



CAUTION

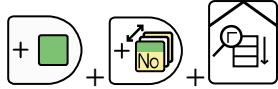
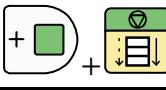
- (NOTE 1) “**Ext. play start**” signal should be a pulse signal of 200ms or more.
- (NOTE 2) The pulse’s width of the “**Program selected**” signal is 200ms at the factory(default) setting.
 But the width can be changed in the following setting menu.
 →<Constant Setting>[6 Signals][1 Signal condition][6 Program acknowledge time] (unit : sec)
- (NOTE 3) “**Program selected**” and “**Program echoback bits**” are outputted when the actually selected program starts.
- (NOTE 4) When the “**Program selected**” is outputted, turn OFF the “**Program sel.bits**”.

5.4 Operations in different operation modes

Operations in five operation modes are described here.

The explanation given below describes the start and stop methods using the “***Internal start method***”. For the “***External start method***”, read the following as the alternatives of the “Internal method”.

Fig. 5.4.1 Alternatives for the START and STOP operation

Internal start method	External start method
 Start Prog Con*Con	 Start Prog Ext*Ext
START operation  + + +	START operation = Turn ON the “Ext. play start” input signal
STOP operation  + +	STOP operation = Turn OFF the “Ext. unit play stop” input signal



Basically, the CFD controller is single unit setting. But if this controller's configuration is multi-unit system, it is necessary to prepare plural signals for the “***Ext. play start***” signals and the “***External unit play stop***” signals respectively. (In case of “Internal start method”, please select the UNIT No. in advance of playback start key operation.)



DANGER

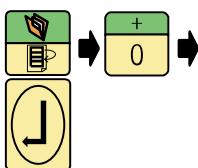
Before starting playback, check that no one is near the robot.
If the robot should come into contact or sandwich a person, death or serious injury may result.

5.4.1 Step playback

First, to ensure safety, check the operations of the robot during step playback.



- 1 Select step playback.**



- 2 Specify the step at which playback is to start.**

To play back from the start of the program, press [PROG/STEP], [0] and then [Enter].

>> The cursor now moves to step 0.

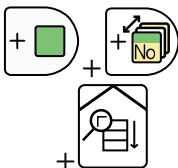
To play back from step 2, press [PROG/STEP], [2] and then [Enter].



Concerning the designation of the step

You can specify a step prior to beginning playback when “Internal start method” is employed.

When “External start method” is used, you cannot specify a step prior to beginning playback. (Playback will always start with Step 0 for the first startup.) However, if you stop after beginning playback, you can specify a step using the method described above.



- 3 Execute the START operation.**

>> While the button is held down, the robot moves from the current position to the specified step.

- 4 In the step playback mode, the robot stops at the next step.**

To continue playback, execute the START operation again.

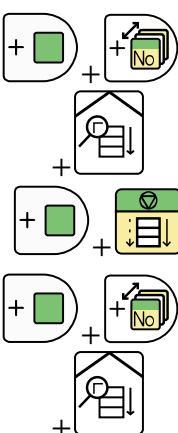
>> The robot moves again to the next step.

5.4.2 Cycle playback

Next, check the operation of the robot during cycle playback.



- 1 Select cycle playback.**



- 2 As with step playback, specify the step at which playback is to start.**

- 3 Execute the START operation.**

>> The robot moves from the current position to the specified step, and operates as far as the last step. When the START operation is executed again after the last step has been reached, the robot operates again from the first step.

- 4 To stop the robot at any time, execute the STOP operation.**

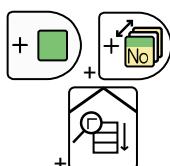
- 5 To restart the robot, execute the START operation again.**

5.4.3 Continuous playback

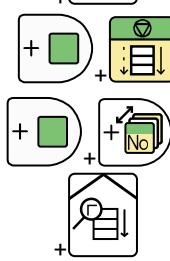
Proceed as follows to initiate continuous playback.



- 1 Select continuous playback.**



- 2 As with step playback, specify the step at which playback is to start.**



- 3 Execute the START operation.**

>> The robot moves from the current position to the specified step, and operates as far as the last step. When the last step is reached, operation proceeds again from the first step, and cycle playback is repeated.

- 4 To stop the robot at any time, execute the STOP operation.**

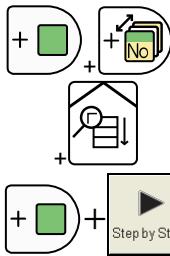
- 5 To restart the robot, execute the START operation again.**

5.4.4 Cycle playback (step by step)

Proceed as follows to perform cycle playback in the step by step mode.



- 1 Select cycle playback (step by step).**



- 2 As with step playback, specify the step at which playback is to start.**

- 3 Execute the START operation.**

>> The robot operates from the current position to the specified step.

- 4 To advance to the next step, press f8 <Step by Step> while holding down [ENABLE].**

>> The robot operates as far as the next step.

Repeat this procedure to check the operation as far as the last step.

When the [START BUTTON] is pressed again after the last step has been reached, the robot operates again from the first step.

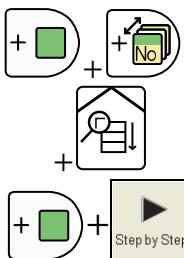
5.4.5 Continuous playback (step by step)

Proceed as follows to perform cycle playback in the step by step mode.



- 1 Select continuous playback (step by step) by following the procedure.**

- 2 As with step playback, specify the step at which playback is to start.**



- 3 Execute the START operation.**

>> The robot operates from the current position to the specified step.

- 4 To advance to the next step, press f8 <Step by Step> while holding down [ENABLE].**

>> The robot operates as far as the next step.

Repeat this procedure and check.

When the last step is reached, the robot operates again from the first step.

NOTE

Chapter 6 File operations

This chapter describes how to copy, delete and back up files.

6.1	Copying, deleting and renaming programs.....	6-1
6.1.1	Copying programs	6-1
6.1.2	Deleting programs	6-2
6.1.3	Renaming (renumbering) programs.....	6-3
6.2	Concerning the file operation menu.....	6-4
6.2.1	File operation menu selection and common operations.....	6-4
6.2.2	Types of usable storage media	6-6
6.2.3	Operable files.....	6-7
6.2.4	Folder structure of internal memory	6-8
6.3	Inserting the USB Memory	6-10
6.3.1	Types of USB memory that can be used	6-10
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6.4	Copying files.....	6-13
6.5	Displaying a list of the files	6-16
6.6	Deleting files.....	6-17
6.7	Setting protection for files	6-20
6.8	Verifying files	6-23
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6.11	Restoring all files from backup	6-30
6.12	Performing automatic backup.....	6-34



CAUTION

Do not switch the power off when using any of the file operation menus explained in this chapter, or while the automatic backup function is operating. Switching off the power while the controller is accessing various files may cause unexpected damage to files in the controller. This may prevent the controller from starting.



CAUTION

Precautions when using USB Memory:

For commercially available USB memory operation is not covered by warranty. Only the USB memory in "Controller Maintenance" section of the instruction manual is guaranteed to operate.

When using USB memory that has been accessed by a different device with this controller, always check using commercially available anti-virus software that there are no viruses or other malicious software on the USB memory before connecting it to the controller.

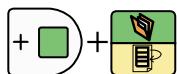
6.1 Copying, deleting and renaming programs

This section describes the operations to copy, delete and rename programs inside the internal memory.

6.1.1 Copying programs

How to copy programs is described here. The operations described here enable a single program to be selected and copied. To specify a multiple number of programs and copy them, refer to page 6-13 "6.4 Copying files".

Copying programs



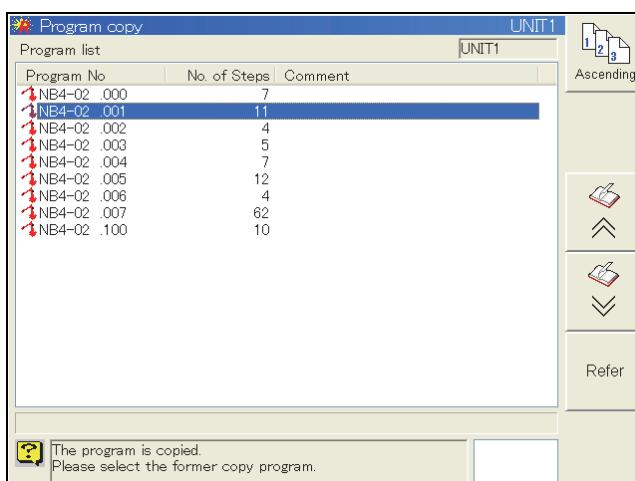
- 1 While holding down [ENABLE], press [PROG/STEP].**
 >> The [Program Selection] window now opens.



- 2 Select "Copy."**



- 3 Press [Enter].**
 >> The [Program copy] screen now appears.



- 4 Select the programs to be copied.**
 If the programs do not fit into 1 screen, they are displayed over multiple pages.
 In this case, search the program targeted for the operation using f9 <△> or f10 <▽>.



- 5 Press [Enter].**
 >> It is now possible to input the number of the copy destination program.



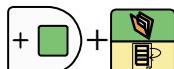
Number input →

- 6 Input the number of the copy destination program, and press [Enter].**
 >> The program is copied, and the operation returns to the previous screen.

6.1.2 Deleting programs

How to delete programs is described here. The operations described here enable a single program to be selected and deleted. To specify a multiple number of programs and delete them, refer to page 6-17 "6.6 Deleting files".

Deleting programs



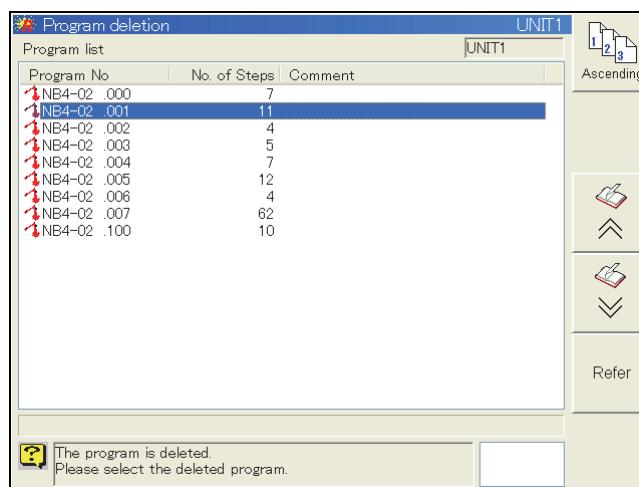
- 1 While holding down [ENABLE], press [PROG/STEP].**
 >> The [Program Selection] window now opens.



- 2 Select "Delete."**



- 3 Press [Enter].**
 >> The [Program deletion] screen now appears.



- 4 Select the program to be deleted.**
 If the programs do not fit into 1 screen, they are displayed over multiple pages.
 In this case, search the program targeted for the operation using f9 <↖↗> or f10 <↙↘>.



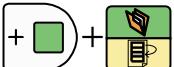
- 5 Press [Enter].**
 >> A confirmation screen now appears.



- 6 Select "OK" and press [Enter].**
 >> The program is deleted, and the operation returns to the previous screen.

6.1.3 Renaming (renumbering) programs

How to rename (renumber) programs is described here.

- Rename the program.**
-
-  **1 While holding down [ENABLE], press [PROG/STEP].**
 >> The [Program Selection] window now opens.
-
-  **2 Select “Rename.”**
-
-  **3 Press [Enter].**
 >> The [Program number conversion] screen now appears.
- | Program No | No. of Steps | Comment |
|-------------|--------------|---------|
| NB4-02 .000 | 7 | |
| NB4-02 .001 | 11 | |
| NB4-02 .002 | 4 | |
| NB4-02 .003 | 5 | |
| NB4-02 .004 | 7 | |
| NB4-02 .005 | 12 | |
| NB4-02 .006 | 4 | |
| NB4-02 .007 | 62 | |
| NB4-02 .100 | 10 | |
-
-  **4 Select the program to be changed.**
 If the programs do not fit into 1 screen, they are displayed over multiple pages.
 In this case, search the program targeted for the operation using f9 <↖↖> or f10 <↙↙>.
-
-  **5 Press [Enter].**
 >> The new program number can now be input.
-
-
-  **6 Input the number of the program after changing, and press [Enter].**
 >> A confirmation screen now appears.
-
-  **7 Select “OK” and press [Enter].**
 >> The number of the program is changed, and the operation returns to the previous screen.

6.2 Concerning the file operation menu

Selecting the file operation menu enables operations for not only programs but also constant files, etc. to be performed.

This menu has the following functions which can be selected in either the teach mode or playback mode.

Table 6.2.1 Functions of file operation menu

Operation menu	Details
File Copy	This is for copying files. Files can be copied not only between internal memories, but also from an internal memory to an external storage device using a USB memory (stored), or from an external storage device to an internal memory (read).
Directory	This is for displaying a list of the files stored in the internal memory or external storage device.
File Delete	This is for deleting the files stored in the internal memory or external storage device.
File Protect	This is for setting protection for the files stored in the internal memory or external storage device.
Verify	This is for verifying whether the contents match between two files or between all the files on different storage media match.
Format IC card/Floppy disk	This is for initializing the USB memory. Initialization can only be executed by "RC External Storage."
File Backup	This stores all the files in an external storage device.
Backup restore	This is for restoring all the backed up files in the controller. An operator must have the qualifications class of EXPERT or above to use the backup restore function.
Automatic backup	This is for automatically backing up the files under the specified conditions. An operator must have the qualifications class of EXPERT or above to use this function.

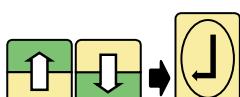
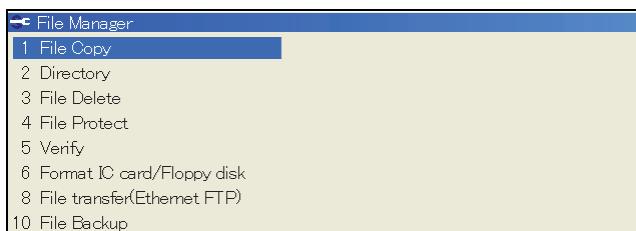
6.2.1 File operation menu selection and common operations

This section describes how to select the file operation menu and how to perform operations after its functions have been selected.

Selecting the file operation menu



- 1 Press f4 <File>.
If this soft key is not provided, the menu can be opened from the service menu. In this case, select "7 File Manager" from the service menu, and press [Enter].
>> The file operation menu such as the one shown below is now opened.

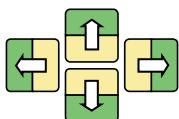
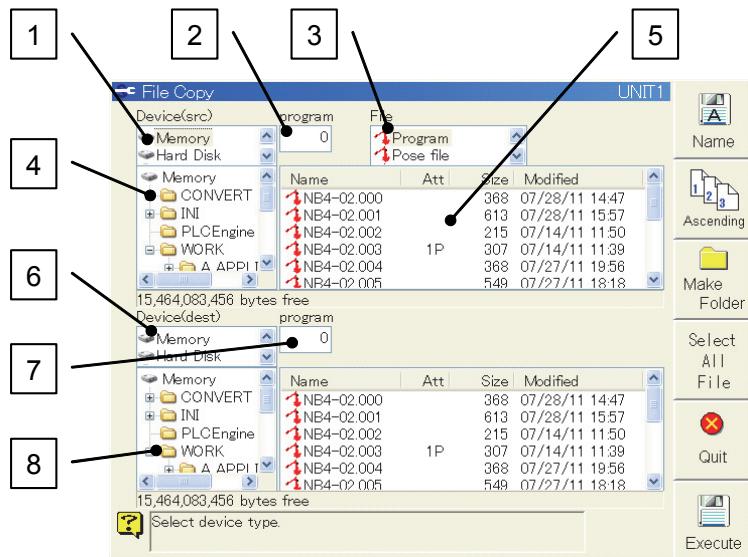


- 2 When a function is selected and [Enter] is pressed, the function concerned is selected.

Common operation using file operation menu

This section describes the common operations performed after the functions have been selected on the file operation menu.

- 1 When copy is selected, for instance, the screen shown below appears.**



- 2 Move through fields 1 to 8, and set the items required.**

To move through each field (1 to 8), use the left and right keys.

To select the items displayed in the fields, use the up and down keys.

- 1** Device selection field (for details, refer to page 6-6 “6.2.2 Types of usable storage media”)

Select the device containing the file targeted for operation.

To copy a file, select the copy source device in field **1** and the copy destination device in field **6**.

- 2** Program input field

To specify a program to be copied or deleted, input its number in this field (program files in ¥WORK¥PROGRAM can be specified). To display a list of files and select one or more of these files, specify “PROGRAM” in field **4**.

- 3** File type selection field (for details, refer to page 6-7 “6.2.3 Operable files”)

Select the file type. Select the type here when performing file operation by type of file such as program file or constant file.

- 4** older selection field (for details, refer to page 6-6-8 “6.2.4 Folder structure of internal memory”)

To search the file targeted for operation, specify the folder that contains the file.

- 5** File directory

If a folder is specified in **4**, a list of files is displayed in **5**. To select an individual file or files and perform file operations, select the files here.

- 6** Device selection field (when copying only)

Select the copy destination device.

- 7** Program input field (when copying only)

Input the number of the program to be copied.

- 8** Folder selection field (when copying only)

Specify the copy destination folder.



- 3** If a folder is specified in **4**, a list of files is displayed in **5**. In this case, the sequence in which the files are arranged can be switched using f7 <Name> or f8 <Ascending>.



- 4** Upon completion of the necessary settings, press f12 <Execute>.
 >> The file operation is now executed.

To stop the processing during a file operation, press f11 <Quit>.
 >> A confirmation message now appears.



Processing is aborted by pressing any key.



- 5** To exit the operation, press [RESET/R].
 >> Operation returns to the file operation menu.

6.2.2 Types of usable storage media

This controller is equipped with a USB port for external storage devices, and USB memory can be used as storage media. Data can be stored in an external storage device, or conversely, data can be read from an external storage device.

USB ports for external storage devices are equipped to both the controller and the teach pendant. To access the external storage device, it is necessary to select the target beforehand. See table 6.2.2.

Table 6.2.2 Usable storage media

External storage device (media)	Details
RC External memory 1	This accesses the USB memory connected to the USB port on the controller.
TP External memory	This accesses the USB memory connected to the USB port on the teach pendant.

Before files are stored in an external storage device, the storage media must have been initialized.

See page 6-26 "6.9 Initializing the USB memory".



6.2.3 Operable files

The files that can be operated using the file operation menu are listed below.

Table 6.2.3 Operable files

File	Description of file
Program file	This kind of file contains the created programs. [Example] MZ07-01.**** (**** denotes numbers)
Pose file	This kind of file is for the position data used in the robot language. [Example] MZ07-01-P.**** (**** denotes numbers)
Language file	This is a program file which is described in the robot language. It is a text file. [Example] MZ07-01-A.**** (**** denotes numbers)
Constant file	This kind of file contains the values inherent to the robots and various settings. It is an INI format text file. [Examples] MECHANISM.CON (mechanism definition file) TOOTOL01.C01 (tool constants file)
Log file	This kind of file contains error histories, welding histories etc. It is an INI format text file. [Example] LG-ERR001.LOG (Error history file 001)
PLC program (Ladder program)	This is a PLC program (ladder program) used by the software PLC. [Example] *****.stf (***** denotes any name)

6.2.4 Folder structure of internal memory

The internal memory of the controller is structured in the following way.

The operator must be familiar with the folder structure when performing operations for files stored in the internal memory

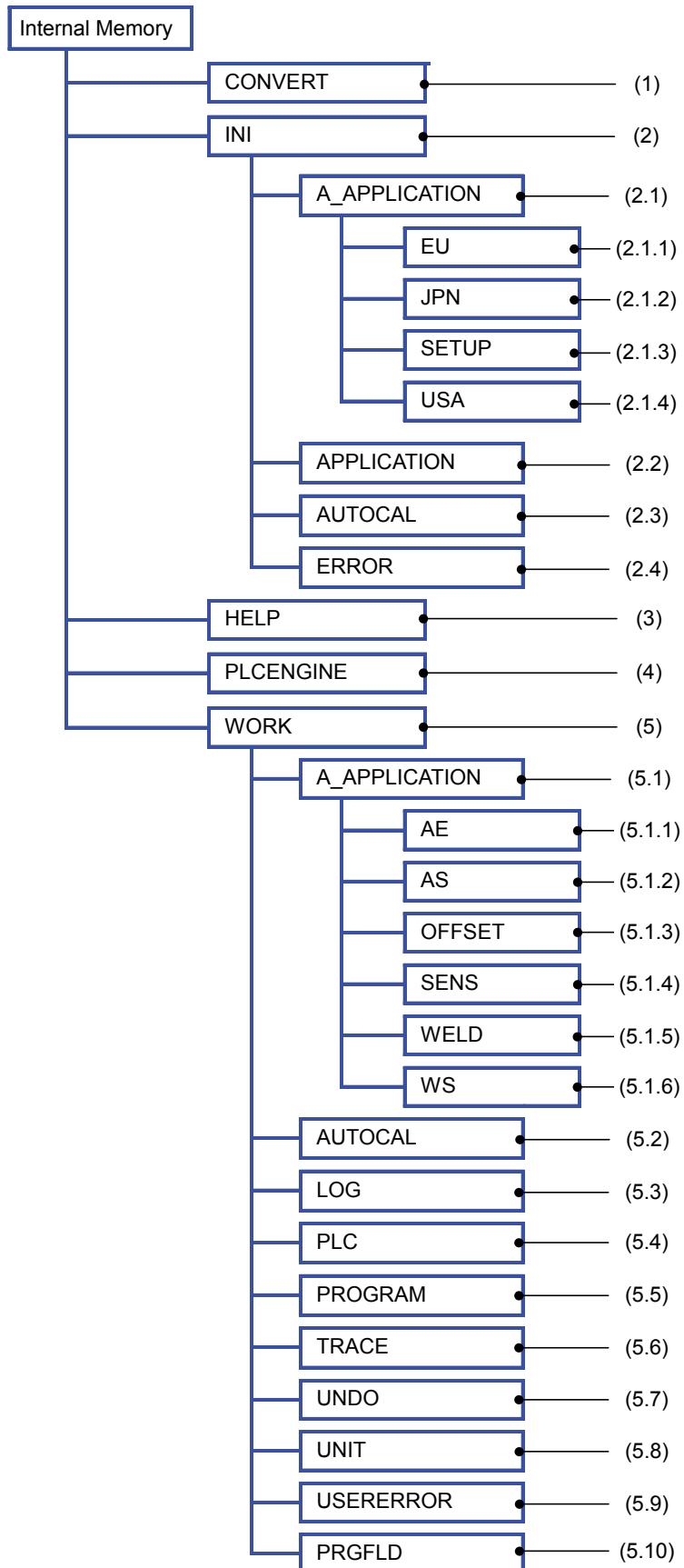


Fig. 6.2.1 Folder structure of internal memory

Table 6.2.4 Files stored in folders

No.	Folder	Files stored in folders	Filename (example) ("****" denotes numbers)
(1)	CONVERT	Folder used by conventional model format conversion function	¥AW, ¥EX
(2)	INI	Initial value files (serving as source for generating constant files when constants are to be prepared)	AC00SOFTKEY.INI, Ac01arcw.ini, etc.
(2.1)	INI¥A_APPLICATION	Not used	
(2.1.1)	INI¥A_APPLICATION¥EU	Not used	
(2.1.2)	INI¥A_APPLICATION¥JPN	Not used	
(2.1.3)	INI¥A_APPLICATION¥SETUP	Not used	
(2.1.4)	INI¥A_APPLICATION¥USA	Not used	
(2.2)	INI¥APPLICATION	Initial value files used for specific applications (such as spot welding, arc welding and handling)	A_C00CTRL.INI, A_S00SIGL.INI, etc.
(2.3)	INI¥AUTOCAL	Initial value files used by automatic calibration function (option)	nv6.kin nv6.prm, etc.
(2.4)	INI¥ERROR	Error files	Err****.ini
(3)	HELP	Help files	AX-HELP*.chm, AX-HELP*.hhc, AX-HELP*.hhk
(4)	PLCENGINE	Files related to software PLC	IsaGRAF.exe, IsaIXL.dll, etc.
(5)	WORK	Constant files	C00ctrl.con, S00sigl.con, etc.
(5.1)	A_APPLICATION		
(5.1.1)	A_APPLICATION¥AE		
(5.1.2)	A_APPLICATION¥AS		
(5.1.3)	A_APPLICATION¥OFFSET		
(5.1.4)	A_APPLICATION¥SENS		
(5.1.5)	A_APPLICATION¥WELD		
(5.1.6)	A_APPLICATION¥WS		
(5.2)	WORK¥AUTOCAL		
(5.3)	WORK¥LOG	Error log files	LG-Err***.log
		MTBF/MTTR files	lg-MTBF_MTTR_A.bin, etc.
		Overhaul prediction files	Lg-pmd.log
		Program diagnosis files	LG-PMDOP****.LOG
		Stop log files	LG-STOP.log
(5.4)	WORK¥PLC	Ladder program	*.STF
(5.5)	WORK¥PROGRAM	Program files	MZ07-01.****, etc.
		Pause files	MZ07-01-P.****, etc.
		Language files	MZ07-01-A.****, etc.
(5.6)	WORK¥TRACE	Measurement data prepared by oscilloscope function	TRACE**.CSV
(5.7)	WORK¥UNDO	Undo operation history files	NV6_Undo_0.001, etc.
(5.8)	WORK¥UNIT	Unit-dependent constant files	U00UNIT001.CON, etc.
(5.9)	WORK¥USERERROR	User error definition file	Err7****.ini
(5.10)	WORK¥PRGFLD	Program management file	****NV6.**** etc.



Some of the files listed in the above table may not be displayed depending on whether the optional functions concerned are provided and on the qualifications level of the operator.

6.3 Inserting the USB Memory

This controller is equipped with USB ports as a standard feature.
To prepare to back up the data, plug a USB memory into the USB port.



Backing up the data on a frequent base is advised.
If, by any chance, the data is accidentally lost by an incorrect operation, the data can be restored from the backup.



Do not connect any other type of USB device other than USB memory to the USB port.

6.3.1 Types of USB memory that can be used

For details on the types of USB memory that can be used and for precautions for use, see the "Controller Maintenance" section of the instruction manual.

6.3.2 Inserting the USB Memory

To save files onto the USB memory, plug the USB memory into the USB port of the controller or teach pendant in advance.

If there are two storage devices available which USB memories are inserted into, it is advisable to use them as shown in table 6.3.1 below.

Table 6.3.1 USB memory uses

External Storage Device (Media)	Use
RC External memory 1	Suitable for transferring large files, such as for backup etc. Use this when the USB memory is always connected for automatic backup.
TP External memory	Suitable for transferring small files, such as for copying files etc.

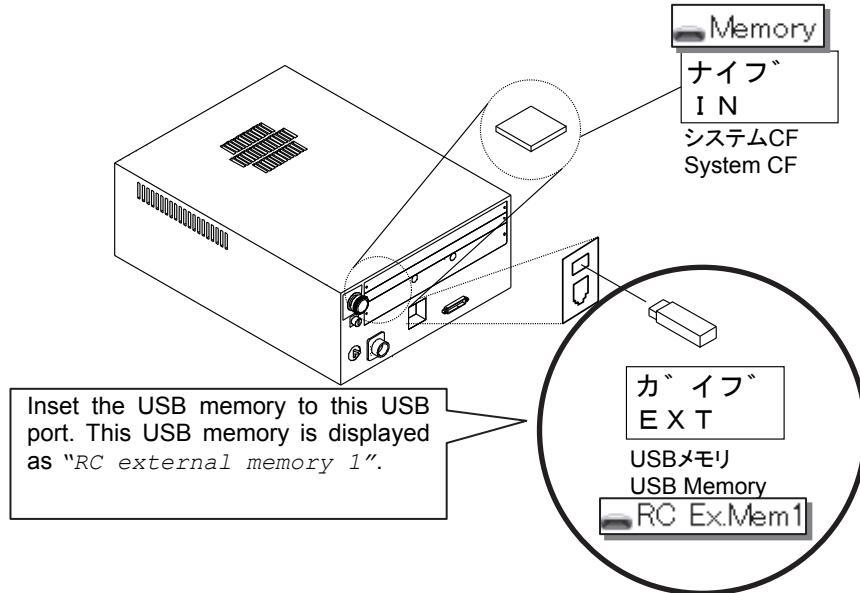
Inserting USB memory into the robot controller (RC External Memory)



Only insert and remove the USB memory when the robot controller power is switched off.
Inserting or removing the USB memory when the power is on may corrupt the data saved on the USB memory.

1 Turn OFF the power of the robot controller, and insert the USB memory.

The USB memory cannot be inserted in the wrong orientation.



3 Perform backup and other tasks.

4 The USB memory can be used continually when connected.

Before removing the USB memory, always be sure to turn off the controller power.

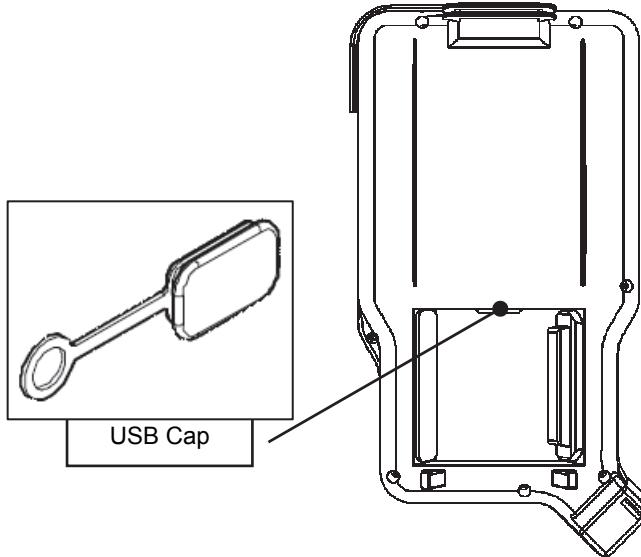
Inserting USB memory into the teach pendant (TP External Memory)



IMPORTANT

During LED of the USB memory has been flashing, please don't remove the USB memory from the USB port. Data may break.

- 1 Remove the USB cap from the back of the teach pendant.**



- 2 Insert the USB memory.**

>> Insert the USB memory in the correct orientation. It cannot be inserted in the wrong orientation.

- 3 Perform file copying and other tasks.**

- 4 When the tasks are complete, remove the USB memory.**

When the USB memory is removed, firmly close the USB cap on the back of the teach pendant.



CAUTION

Only connect USB memory to the USB port when operating files. When the TP external storage memory is not being used, always close the USB cap on the back of the teach pendant.

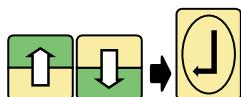
Leaving the USB cap open for long periods may hinder the dust protection and waterproofing properties, which may lead to failure.

6.4 Copying files

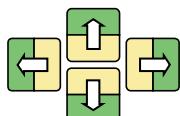
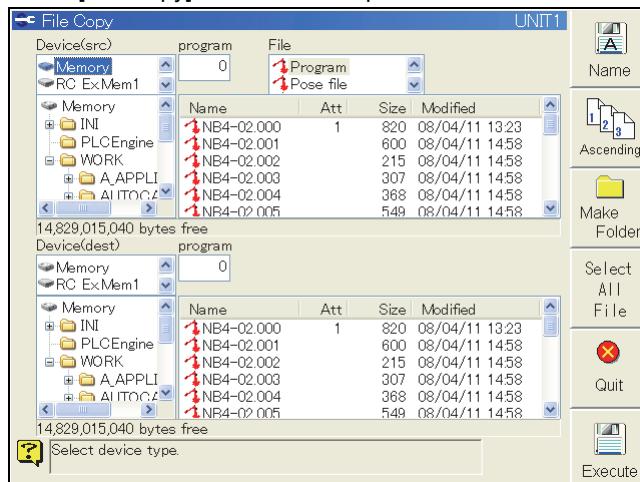
When files are copied, files with the same contents can be created in the internal memory or stored in an external storage device. The files that can be copied are listed below.

- Program file
- Pose file
- Language file
- Constant file
- Log file
- All files (all of the above files)

Opening the copy screen



- 1 Select “1 File Copy” on the file operation menu, and press [Enter].
 >> The [File Copy] screen is now opened.



- 2 It is on the above screen that the files are copied.
 To move through each field, use the [left or right] keys.
 To select the items displayed in the fields, use the [up or down] keys.

Specify a file and copy it.

As an example, the steps taken to copy program “1” stored in the internal memory as program “10” in the internal memory will be described.

- 1 Select “Memory” in the copy source device selection field.



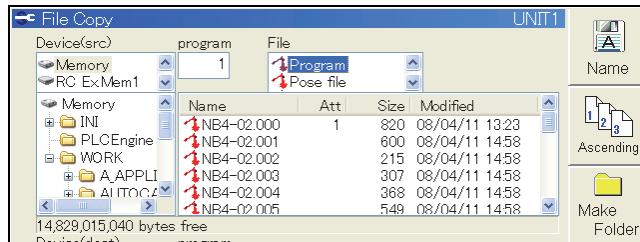
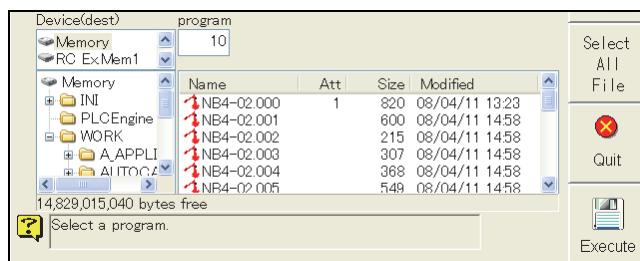
- 2 After moving to the program input field, input “1” and press [Enter].
 >> The program “1” in “¥WORK¥PROGRAM” is selected for copying.



When you copy a program by specifying the program number, the program copied will always be in a folder with the same name as the original folder, no matter what folder is specified or displayed. In this case, the folder is “¥WORK¥PROGRAM”.

If there is no folder that has the same name, a new folder is made.

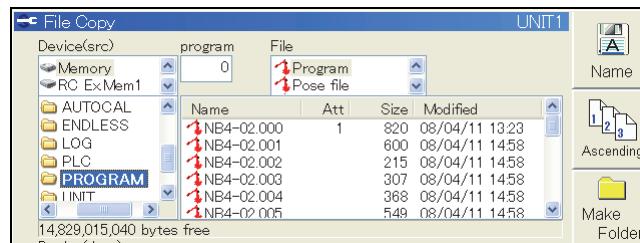
Concerning the details of the file types and the folder names and their structure, refer to “6.2.4 Folder structure of internal memory”.

3 Move to the file type selection field, and select “Program”.**4 Move to the copy destination device selection field, and select “Memory”.****5 Move to the program input field, and input “10”.**

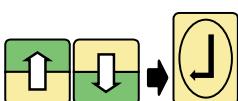
If the initial value for the copy location program number is not changed, the program is copied as number 0. Be careful.

**6 Press f12 <Execute>.**
>> Copying now starts.**Specifying and copying a multiple number of files**

As an example, the steps taken to select a multiple number of programs stored in the internal memory and copy them onto a USB memory stick will be described.

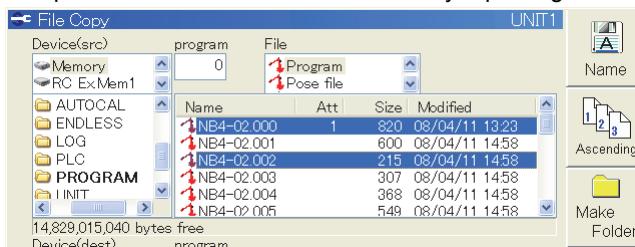
1 Select “Memory” in the copy source device selection field.**2 Move to the file type selection field, and select “Program”.****3 Move to the folder selection field, and select “PROGRAM”.**
>> A list of the programs now appears.

Any settings may be used for the program input field and file type selection field. (The selection made from the file list takes precedence over the program input field and file type selection field settings.)



- 4 Select a file using the up or down key, and press [Enter]. The selected file is highlighted in blue.**

A multiple number of files can be selected by repeating these steps.



To release the selected status, select the file to be released, and press [BS].

- 5 Move to the copy destination device selection field, and select "RC ExMem1."**

- 6 Move to the folder selection field, and select the destination folder.**



- 7 Press f12 <Execute>.**
 >> Copying now starts.

Copying all the files

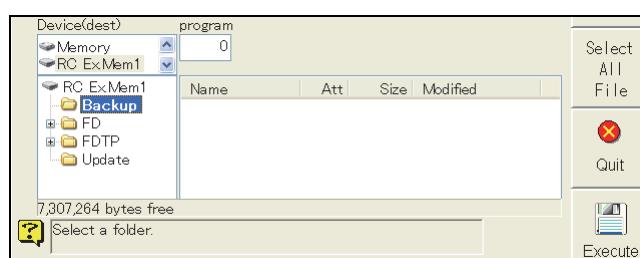
As an example, the steps taken to copy all the programs stored in the Memory onto a USB memory stick will be described.

- 1 Select "Memory" in the copy source device selection field.**

- 2 Move to the file type selection field, and select "All programs".**

- 3 Move to the copy destination device selection field, and select "RC ExMem1."**

- 4 Move to the folder selection field, and select the copy destination folder.**

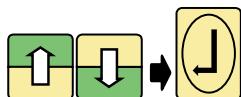


- 5 Press f12 <Execute>.**
 >> This now completes the copying.

6.5 Displaying a list of the files

When the display list function is used, what files are stored in the internal memory or external storage device can be checked.

Displaying a list of the files

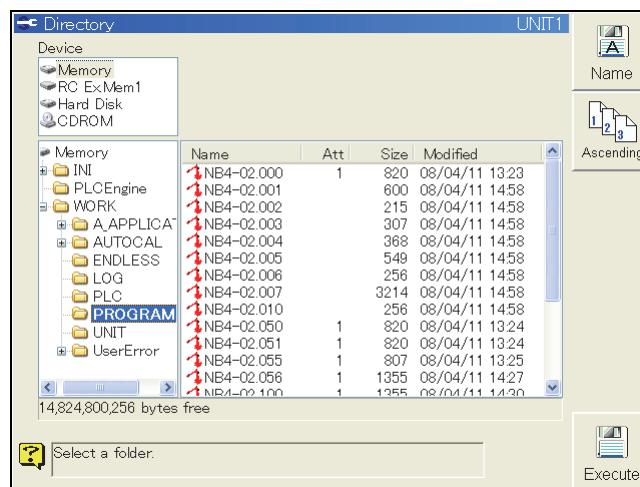


- 1 Select “2 Directory” on the file operation menu, and press [Enter].**
 >> The [Directory] screen now appears.

- 2 In the device selection field, select the device whose files are to be listed and displayed.**

- 3 In the folder selection field, select the folder whose files are to be listed and displayed.**

As an example of a program, select the “PROGRAM” folder.
 >> A list of the programs is displayed.



- 4 To exit the display list, press [RESET/R].**
 >> Operation returns to the file operation menu.

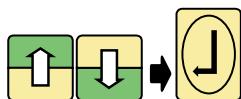


6.6 Deleting files

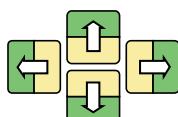
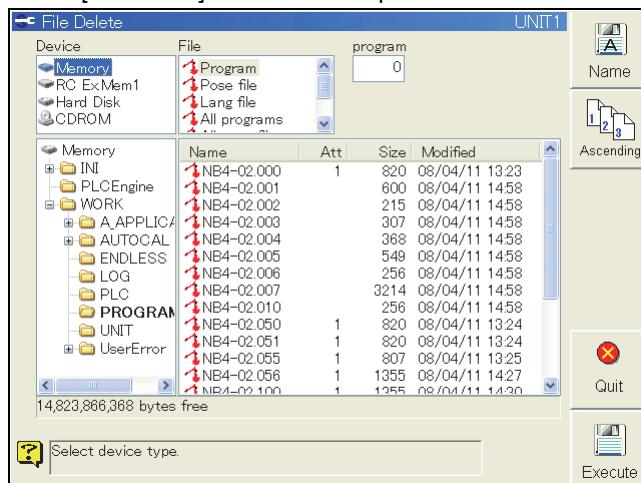
The files stored in the internal memory or external storage device can be deleted.
The files that can be deleted are as follows.

- Program files (deleted individually or altogether)
- Pose files (deleted individually or altogether)
- Language files (deleted individually or altogether)
- Log file (deleted altogether)

Opening the deletion screen



- 1 Select “3 File delete” on the file operation menu, and press [Enter].**
>> The [File delete] screen is now opened.



- 2 Files are deleted on this screen.**
To move through each field, use the left and right keys.
To select the items displayed in the fields, use the up and down keys.

Specifying one file and deleting it

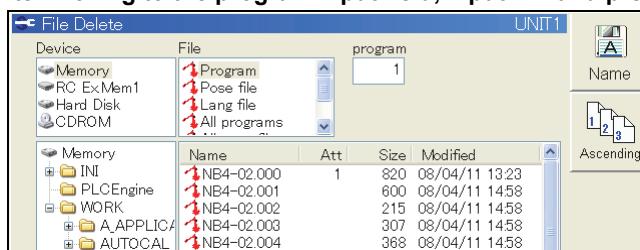
As an example, the steps taken to delete program “1” stored in the Memory will be described.

- 1 In the device selection field, select “Memory”.**

- 2 Move to the file type selection field, and select “Program”.**



- 3 After moving to the program input field, input “1” and press [Enter].**



- 4 Press f12 <Execute>.**
>> This completes the file deletion.

Specifying a multiple number of files and deleting them

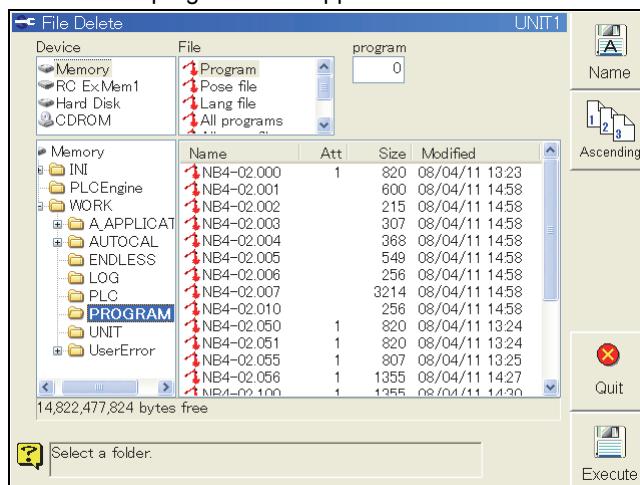
As an example, the steps taken to select a multiple number of programs stored in the internal memory and delete them will be described.

1 In the device selection field, select “Memory”.

2 Move to the file type selection field, and select “Program”.

3 Move to the folder selection field, and select “PROGRAM”.

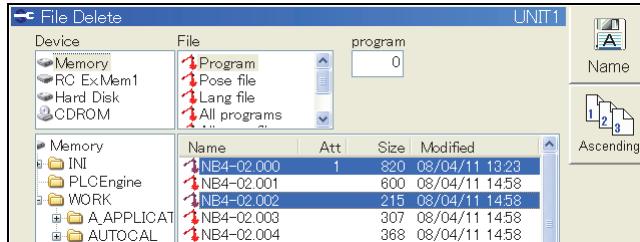
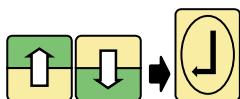
>> A list of the programs now appears.



Any settings may be used for the program input field and file type selection field.
(The selection made from the file list takes precedence over the program input field and file type selection field settings.)

4 Select a file using the up or down key, and press [Enter]. The selected file is highlighted in blue.

A multiple number of files can be selected by repeating these steps.



To release the selected status, select the file to be released, and press [BS].



5 Press f12 <Execute>.

>> This completes the file deletion.



Deleting all the files

As an example, the method for deleting all programs saved on the USB memory will be described.

1 In the device selection field, select “RC ExMem1.”

2 Move to the file type selection field, and select “All programs”.



3 Press f12 <Execute>.
>> This completes the file deletion.

6.7 Setting protection for files

Protection settings are used for files in order to prohibit them from being changed or deleted. There are three types of protection: complete protection, partial protection and playback protection. When these settings are used, files can no longer be deleted or changed, as shown below.

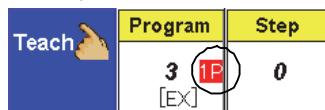
Table 6.7.1 Protection types and functions

	All protect	Partial protect	Playback protect (Either complete or partial protection only can be selected.)
	1	2	
Display mark (highlighting in red)	1	2	P
Modification of position data	x	◎	◎
Modification of all other data		x	◎
File Delete		x	◎
Playback or step go from step 0, CHECK GO		◎	x
Playback, check go after step 1		◎	◎

◎ : Possible

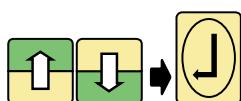
x : Cannot be performed (= protected)

- When opening a program for which protection has been set, the protection status is displayed.

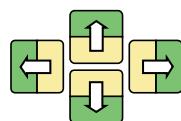
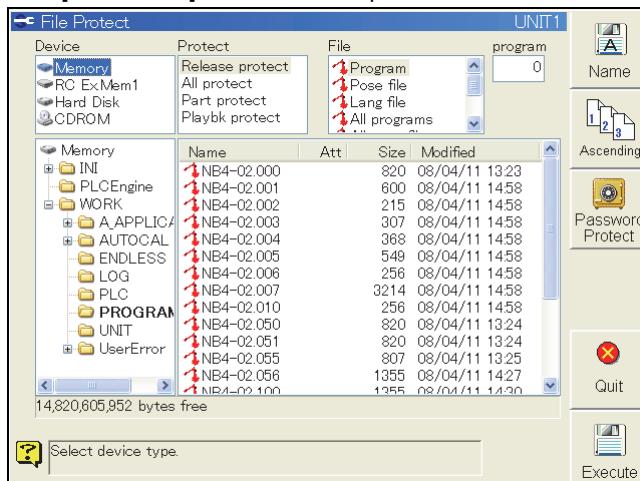


- Complete protection (or partial protection) and playback protection can be used simultaneously.(With a combination of "O" and "x", "x" takes precedence.) In this case, The display mark that indicates the protection status of the file is a combination of the two display marks.
- For constant files, partial protection has the same significance as complete protection. Playback protection cannot be set for these files.
- When files are copied, the protection information is also copied.

Opening the protection setting screen



- 1 Select “4 File Protect” on the file operation menu, and press [Enter].**
 >> The [File Protect] screen is now opened.



- 2 The protection is set on this screen.
 To move through each field, use the left and right keys.
 To select the items displayed in the fields, use the up and down keys.**

Select a file, and set the type of protection for it.

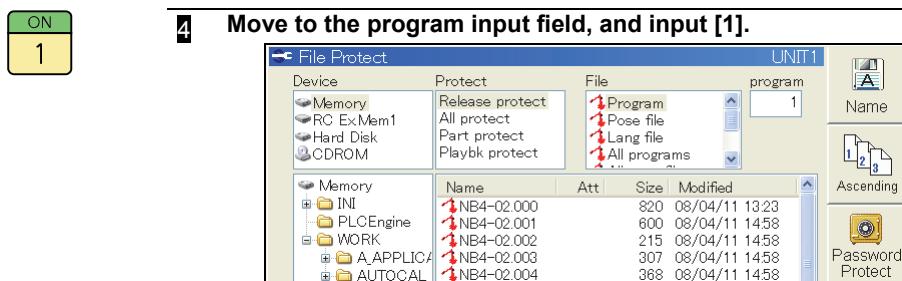
As an example, the steps taken to set “All protect” for program “1” stored in the internal memory will be described.

- 1 In the device selection field, select “Memory”.**

- 2 Move to the protection type field, and select “All protect”.**

- 3 Move to the file type selection field, and select “Program”.**

- 4 Move to the program input field, and input [1].**



- 5 Press f12 <Execute>.**
 >> The protection setting is now completed.

Setting protection for all files

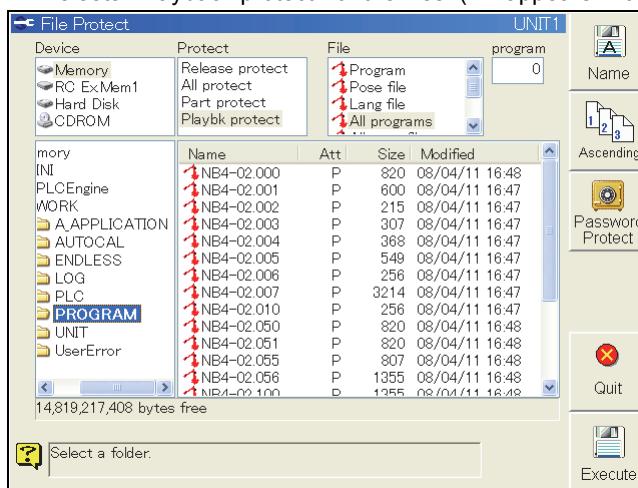
As an example, the steps taken to set “All protect” and “Playback protect” for all the programs stored in the internal memory will be described.

- 1 In the device selection field, select “Memory”.**
- 2 Move to the protection type field, and select “Playback protect”.**
- 3 Move to the file type selection field, and select “All programs”.**
- 4 Move to the folder selection field, and select “PROGRAM”.**
 >>A list of the programs now appears.



5 Press f12 <Execute>.

>> This sets “Playback protect” for the files. (“P” appears in the attribute field.)



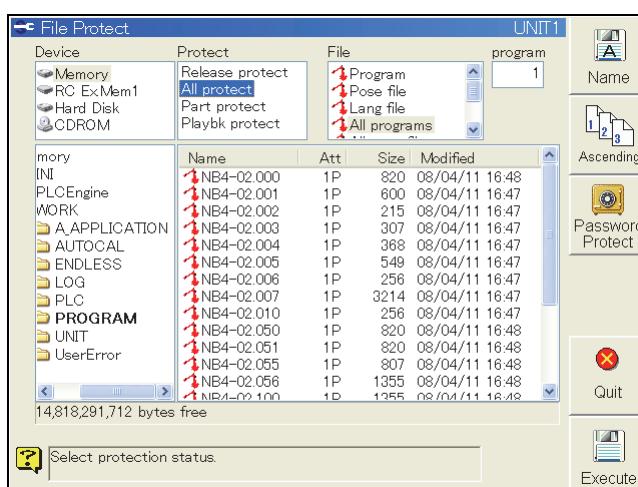
“P” appears in the attribute field.

6 Move to the protection type field, and select “All protect”.



7 Press f12 <Execute>.

>> This sets “All protect” for the files. (“1P” appears in the attribute field.)



“1P” appears in the attribute field.

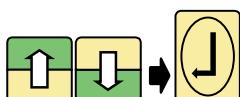
6.8 Verifying files

This is for verifying whether the contents match between two files or between all the files on different storage media match.

The files which can be verified are as shown below.

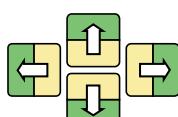
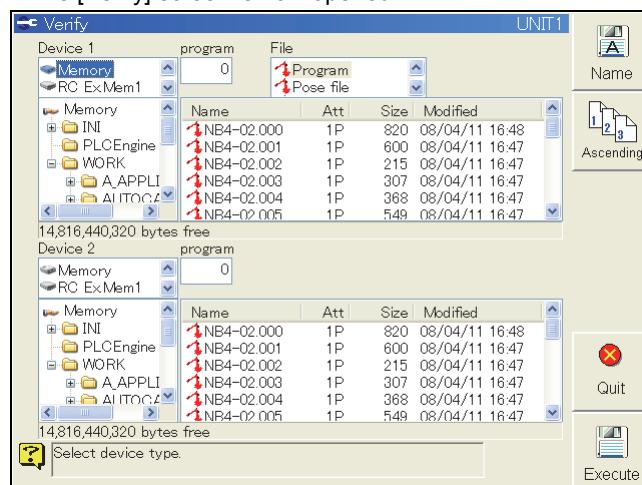
- Program file
- Pose file
- Language file
- Constant file
- Log file
- All files (all of the above files)

Opening the verify screen



- 1 Select “5 Verify” on the file operation menu, and press [Enter].**

>> The [Verify] screen is now opened.



- 2 Files are verified on this screen.**

To move through each field, use the left and right keys.

To select the items displayed in the fields, use the up and down keys.

Specifying a file and verifying it

As an example, the steps taken to verify programs “1” and “2” stored in the Memory will be described.

- 1 In the device 1 selection field, select “Memory”.**



- 2 Move to the program input field, and input [1].**

- 3 Move to the file type selection field, and select “Program”.**

- 4 Move to the device 2 selection field, and set “Memory”.**



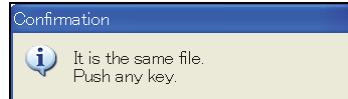
- 5 Move to the program input field, and input [2].**



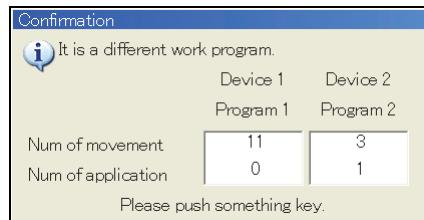
6 Press f12 <Execute>.

>> Verifying now starts.

If the contents of the two files are identical, the screen such as the one shown below appears.

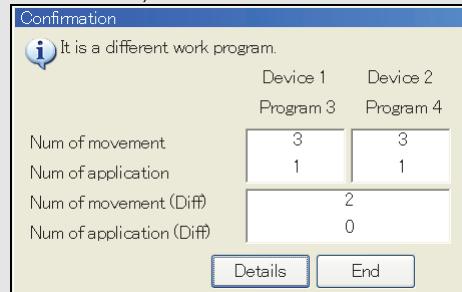


If the contents of the two files are different, the screen such as the one shown below appears.

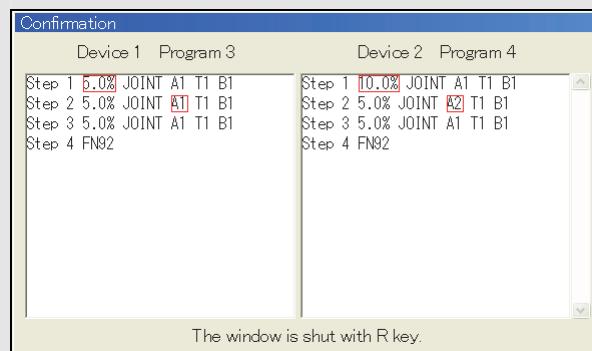


If the num of movement is same, the details can be see.

In that case , the screen such as the one shown below appears.



“Details” is selected, the different places are shown as below appears.
To close screen, select “End”.



To close the screen, press [RESET/R].

Verifying all files

As an example, the method for verifying whether all of the files saved in the internal memory correspond with those in the USB memory is explained.

1 In the device 1 selection field, select “Memory”.

2 Move to the file type selection field, and select “All files”.

3 Move to the device 2 selection field, and select “RC ExMem1.”

**4 Press f12 <Execute>.
>> Verifying now starts.**



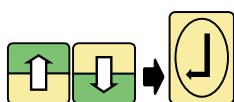
6.9 Initializing the USB memory

To save data onto an external storage device, the USB memory needs to be initialized in advance. Initialization is only required the first time the USB memory is connected to the controller. (If initialization is done once, these steps are no longer required). Also, initialization is performed to erase all of the contents of the media.



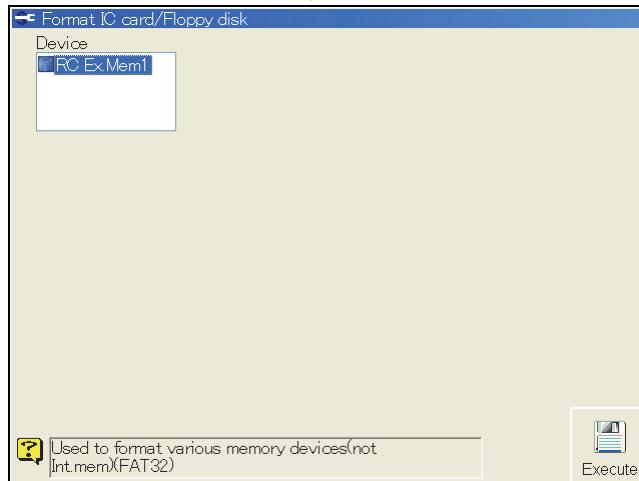
- When the USB memory is initialized, all of the data stored on it is deleted. Be careful when initializing the memory.
- Connect the USB memory to be used to the CPU board in this controller to initialize it. When initializing USB memories using an external device such as a personal computer, initialize it to "FAT32" format.
- Do not remove the USB memory, and switch off the power while the USB memory is initialized.

Initializing the USB Memory



- 1** Select "6. Format IC card/Floppy disk" on the file operation menu, and press [Enter].

>> The [Format IC card/Floppy disk] screen now appears.



- 2** In the device selection field, select the USB memory to be initialized.



- 3** Press f12 <Execute>.

>> Initializing now starts.

6.10 Backing up files

All the files stored in the internal memory can be backed up and saved.
Differences with file copying are as follows.

- There is no need to select which files to copy.
- Important parameters such as option protection information that is not copied when “Specify and copy all files” is used are also copied.

Either the internal memory or external storage device may be used as the storage media.
Backup does not include copying the system (operating system and the software itself).

The name of the backup folder is given automatically using the following format.



NRA2011-2011-11-06-0932

Date

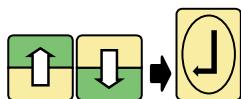
Time



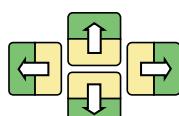
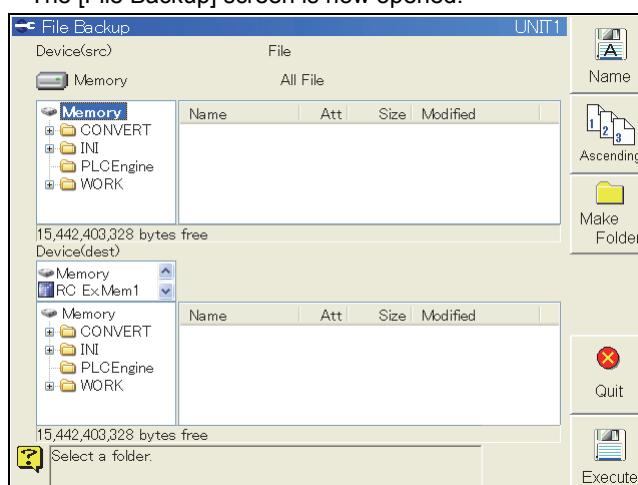
The external storage device is recommended for the backup destination device.

If the backup destination to the internal memory, please make sure you have enough free space in internal memory
(Only as a guide. requires at free space of 10MB after the backup).

Opening the backup screen



- 1 Select “10 File Backup” on the file operation menu, and press [Enter].**
>> The [File Backup] screen is now opened.



- 2 Files are backed up on this screen.**
To move through each field, use the left and right keys.
To select the items displayed in the fields, use the up and down keys.

Creating folders in the storage media

To back up and store the files of a multiple number of robots in a single storage media, create folders under the kind of names that will enable the robots to be identified.



- 1 Press f9 <Make Folder>, and input the folder name.

The soft keyboard starts up. Input the folder name.

For details on how to input text, see “2.5 To input characters”.



- 2 Press f12 <Complete>.

>> A folder is now created in the storage media.

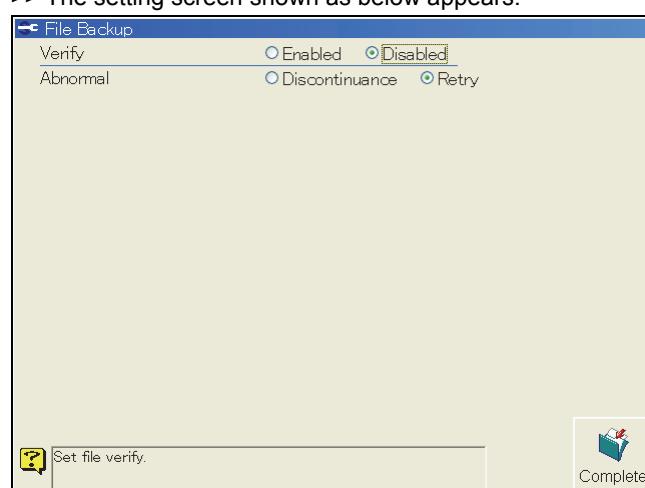
Setting the file verification

For this setting, it is necessary to switch operator class to **EXPERT** or above.



- 1 Press f-key <File Verify Setting>.

>> The setting screen shown as below appears.



- 2 Set the each setting.



- 3 After completion of the all settings, press f12 <Complete>

>> File verification will be done using the settings on this screen when executing backup process.

Table 6.10.1 File Verify Settings for Backup

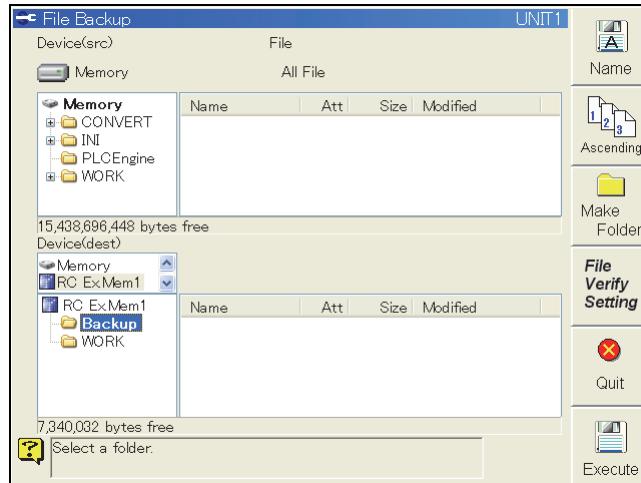
Parameter	Default setting	Input range	Description
Verify	Disabled	Enabled / Disabled	Set the file verification Enabled/Disabled when executing the backup.
Abnormal	Retry	Discontinuance / Retry	Select the process to be executed when an error occurs while the file verification.

Backing up the folders

1 In the device selection field, select “RC ExMem1” for instance.



2 Move to the folder selection field, select the backup destination folder, and press [Enter].



3 Press f12 <Execute>.
>> Backup now starts.

6.11 Restoring all files from backup

The steps taken to restore all the files using the stored backup data in order to restore normal operation after trouble has occurred or on other such occasions will be described.

When restoration has been performed, all the files including the constant files, program files and history files (all the files in 6.2.4 Folder structure of internal memory) inside the internal memory are destroyed and replaced with the backup data files.

Restoration should be done by an operator with the qualifications class of **EXPERT** or above.

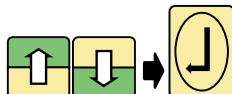
For details on switching operator qualifications, see the instruction manual "SETUP MANUAL".



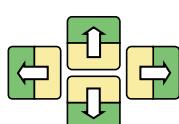
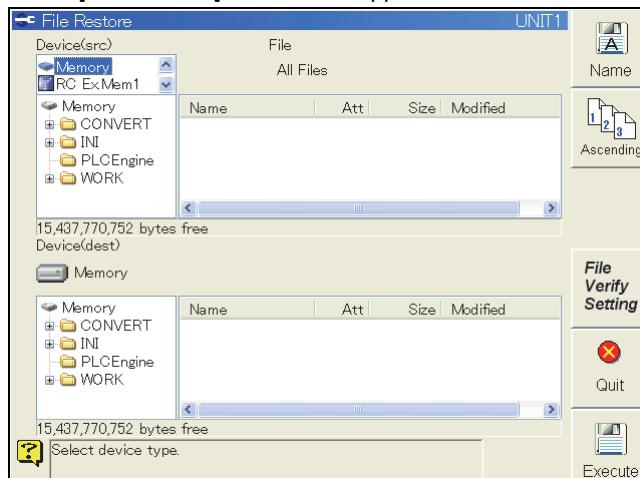
CAUTION

- 1) Do not execute backup restoration so lightly except when upgrading accompanied with replacement of the system CF or restoring after a trouble occurred.
- 2) At the shutdown after backup restoration and at the power restoration, the status restoration processing of the auto resume function (restoration of the manual status, playback and others) cannot be executed. This is one of the safety measures against the mismatch in the system configuration before and after the restoration operation.
- 3) Follow the directions described in the instruction manual for the endless rotation function to execute the backup restoration operation when the endless rotation function is used.
- 4) When restoring the backup, it is necessary to change the settings of the system memory maintenance function. For details, see the "Controller Maintenance" section of the instruction manual.

Opening the File Restore screen



- 1 Select "11 File Restore" on the file operation menu, and press [Enter].**
 >> The [File Restore] screen now appears.



- 2 To move through each field, use the [Left/Right] keys.
 To select the items displayed in the fields, use the [Up/Down] keys.**

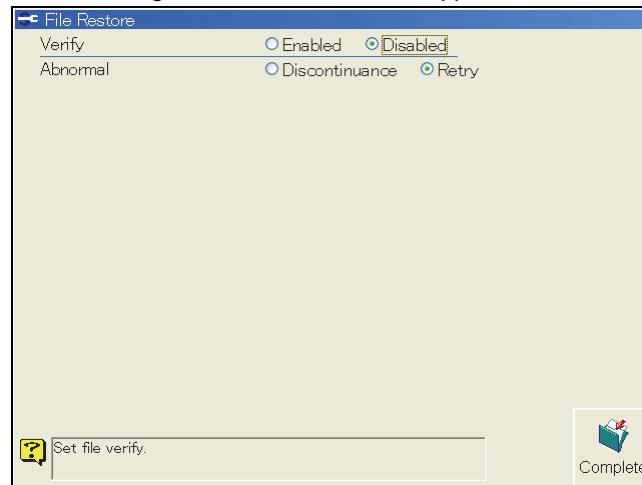
Setting the file verification

For this setting, it is necessary to switch to operator class **EXPERT** or above.



1 Press f-key <File Verify Setting>.

>> The setting screen shown as below appears.



2 Set the each setting.



3 After completion of the all settings, press f12 <Complete>.

>> File verification will be done using the settings on this screen when executing restoring process.

Table 6.11.1 File Verify Settings for File Restore

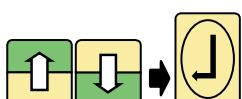
Parameter	Default setting	Input range	Description
Verify	Disabled	Enabled / Disabled	Set the file verification Enabled/Disabled when executing the file restore.
Abnormal	Retry	Discontinuance / Retry	Select the process to be executed when an error occurs while the file verification.

Restoring all files from the backup

1 Stop the robot, and set the motor power to OFF.

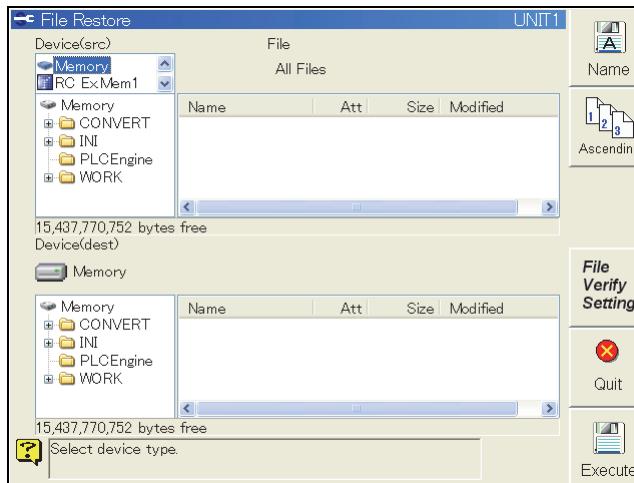
Backup data cannot be restored while the robot is operating.

Before proceeding, the robot must be stopped and the motor power set to OFF.



2 Select “11 File Restore” on the file operation menu, and press [Enter].

>> The [File Restore] screen now appears.



3 In the device (source) selection field, select the device on which the backup data to be restored is saved.

For example, if backup data is saved to the USB memory and the USB memory is inserted in the controller, select “RC ExMem1.”



4 Move to the folder selection field, select the folder containing the backup data to be restored, and press [Enter].



IMPORTANT

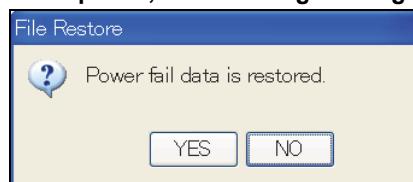
The folder in which the backup data is stored must have “read-only” attributes. (Backup folders are automatically given “read-only” attributes when data is backed up manually or automatically.) If the USB memory is accessed by a PC or other devices and the attributes of the backup folder are changed to an attribute other than “read-only,” the folder cannot be selected because it is not recognized as a backup source folder.



5 Press f12 <Execute>.

>> Backup restoration now starts.

6 If a preserve data for the Power Failure detection function is included in the backup data, the following message will be displayed (FDV3.22 or after).



If “YES” is selected, the preserve data (e.g. Program No., Step No, signal conditions, or Variables etc.) will be restored.



If the Preserved data for the Power Failure detection function (Manual operation status, playback statue, etc.) is restored, an error of "E2518" will be displayed when trying to operate the robot after shutdown and power ON operation.

This is a sort of safety measurement to avoid unexpected movement of the robot when the conditions of the robot before and after the restore process are different.

If the robot posture or the configuration is not the same, it is very dangerous to move the robot. Therefore, please do not forget to move the robot to the safe position in advance by e.g. the step selection and the check go operation.



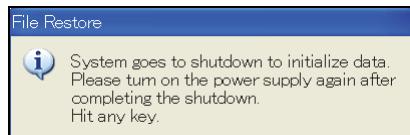
In the following cases, it is not possible to restore the preserved data for the Power Failure detection function because the backup data does not include the preserved data.

1. The backup was executed with the power failure detection function has been disabled
2. The backup was executed with the FDV3.21 or before.

The following message will be displayed. Press [OK] to continue the restore operation.



- 7 The following message is displayed. Press a key to shutdown.
Do not switch off the power during shutdown.**



6.12 Performing automatic backup

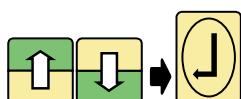
This function is used to back up all the files contained in the NRA2011\WORK folder at the predetermined time, day of the week and date in order to store a history of the robot's operation statuses at regular intervals. These files can also be automatically backed up when the power is turned on or when the mode is switched.

By utilizing this function, the robot's operation statuses can be accurately grasped so that restoration can be initiated promptly when trouble has occurred, for example.

An operator must have the qualifications class of **EXPERT** or above to use this function.

For details on switching operator qualifications, see the instruction manual "SETUP MANUAL".

Automatic backup procedure



- 1 Select "12 Automatic Backup" on the file operation menu, and press [Enter].**

>> The "Automatic Backup" screen is opened.

- 2 Set the conditions listed on Table 6.12.1, and press f12 <Execute>.**

>> Automatic backup starts when the set conditions are met.



Table 6.12.1 Automatic backup settings

Parameter	Initial setting	Input range	Description of function
Dev.	Internal memory	Internal memory/ RC External memory 1/ Host 1/ Host 2	This is for selecting the media that is stored backup files. "TP external memory" cannot be used in automatic backup.
Max. backup number	0	0 to 10	This is for setting the maximum number of backup folders. Up to 10 folders can be created. Folders are given names as follows on the basis of their dates and times. (Folder name) NRA2011-2011-09-26-1834 If automatic backup is performed when the maximum number of backup folders already exists, the backup folders will be deleted one by one starting with the oldest one.
Verify	Enable	Enable/Disable	This is for setting file verification when backup files are created.
Abnormal	Discontinuance	Discontinuance/ Retry	This is for selecting the processing to be performed when trouble has occurred during file verification.
Power on	Disable	Enable/Disable	This is for setting whether automatic backup is to be performed when the control power is turned on.

Parameter	Initial setting	Input range	Description of function
Mode change	Disable	Enable/Disable	This is for setting whether automatic backup is to be performed when the mode has been switched (from teaching to playback or vice versa).
Frequency	Disable	Disable/ Every day/ Every week/ Every month	This is for setting the automatic backup frequency.
Day	Sunday	Monday - Sunday	This is for setting the day of the week on which the data is to be backed up when "Every week" has been selected as the backup frequency.
Date	1	1 to 31	This is for setting the day of the month on which the data is to be backed up when "Every month" has been selected as the backup frequency. If 29, 30 or 31 has been set as the day of the month but the day concerned does not exist, backup will be performed at the end of the month.
Time	00:00	00:00 to 24:00	This is for setting the time at which the data is to be backed up when "Every month," "Every week" or "Every day" has been selected as the backup frequency. Automatic backup is not performed when 00:00 has been set as the time. To start backup at 00:00 AM, set "24:00."

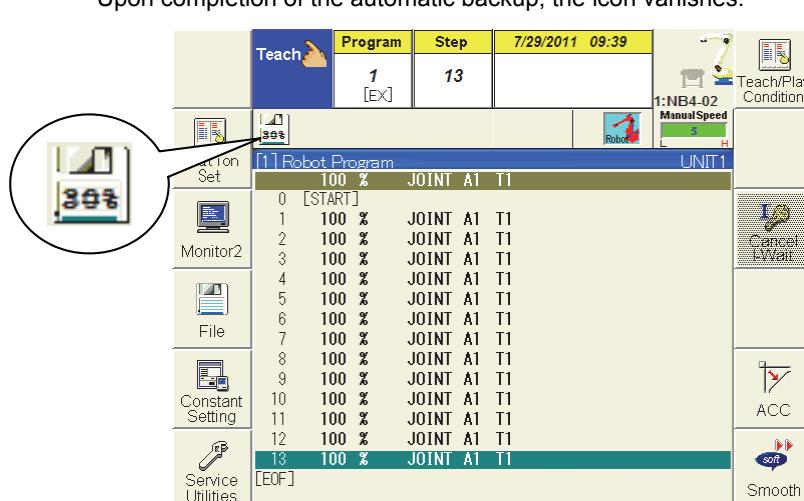


If the "Dev." is set to "Host 1" or "Host 2", the backup folder is generated on the FTP server that is set in the FTP client function. In this case, the backup folder is generated on the initial folder that is set in the FTP client function. For the details of the FTP client function, refer to the Chapter 8 of the SETUP MANUAL.

Displays during automatic backup

Automatic backup is commenced when the backup execution conditions which were set on the "Automatic backup" menu are met.

When automatic backup is started, an icon is displayed in the variable status display area. The progress made during automatic backup is indicated as a percentage. Upon completion of the automatic backup, the icon vanishes.



If the destination device is set to "Host 1" or "Host 2", the attribute of the backup folder that will be created on the FTP server is "Read Only". And, the attribute of the initial folder on the FTP server is "Read Only"; the backup folder cannot be created. Therefore, remove the "Read Only" attribute from the initial folder on the FTP server in advance.

NOTE

Chapter 7 Useful functions

Some useful functions which are frequently used are described in this section.

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7.1 Using short-cuts

The controller comes with a short-cut function for selecting functions quickly.

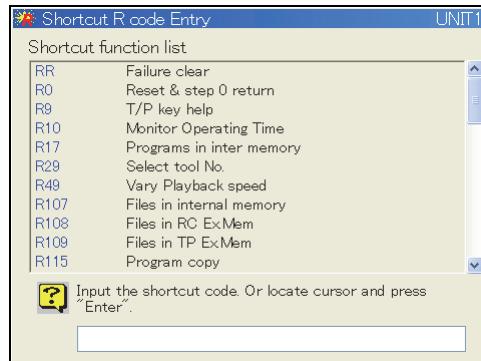
Normally, even with operations where one menu is opened from another, a target operation can be quickly accessed simply by inputting a short-cut code (a number with up to 3 digits). It is a good idea to learn frequently used short-cut codes to memory.

For details on the short-cut codes that can be used, refer to the Help function contained in the robot controller.

Using short-cuts



- 1 On the teach or playback mode top screen, press the [RESET/R] key.**
- >> The [Shortcut R code Entry] screen now appears.



- 2 If the number of the target function is not known, press the [up or down] key.**
- >> The list of codes in the center of the screen is scrolled, and the usable short-cut codes (R codes) are displayed.

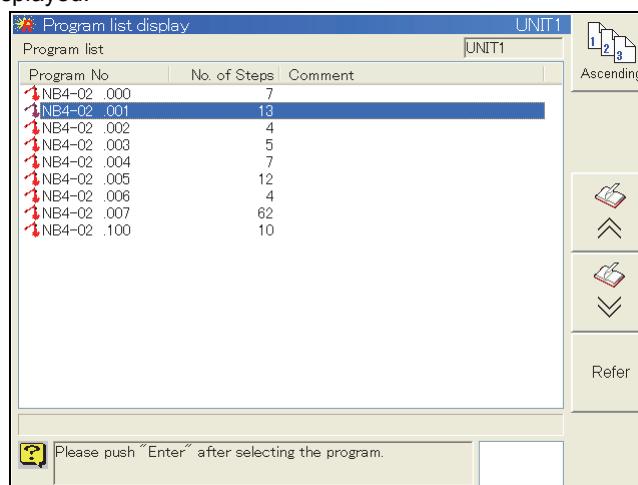


- 3 Align the cursor with the desired short-cut code, and press the [Enter] key.**
If the number is already known, input the code number directly into the edit box at the bottom of the screen, and press the [Enter] key.

- 4 This completes the selection procedure.**

The short-cut which has been input is now executed.

If, for instance, R17 (display program file list) has been input, a list of the programs of the current unit picked out from among the files stored in the internal memory is displayed.

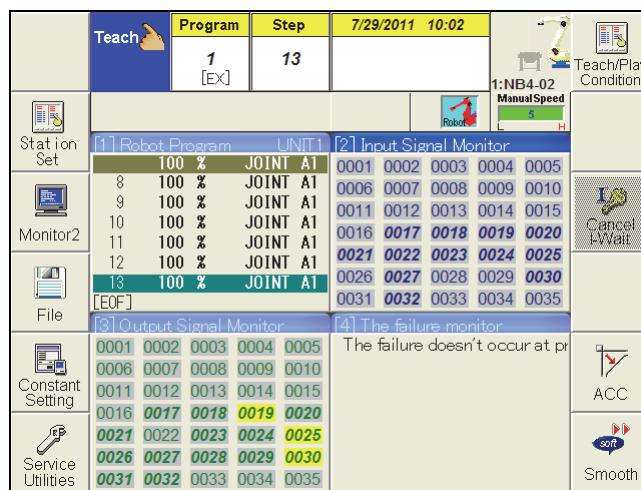


7.2 Monitoring various information of the robot

With this controller, various information from the robot can be monitored and displayed on the teach pendant. Monitors 1 to 4 (maximum of 4) can be started and their information can be displayed simultaneously on the teach pendant. The program display screen is one of these monitors, and this is set at the factory as monitor 1.

The monitor updating cycle is approximately 100 [msec].

The next screen shows an example where all four monitors were started simultaneously. Programs are monitored on monitor 1, general-purpose input signals are monitored on monitor 2, general-purpose output signals are monitored on monitor 3, and errors are monitored on monitor 4.



7.2.1 Starting a multiple number of monitors

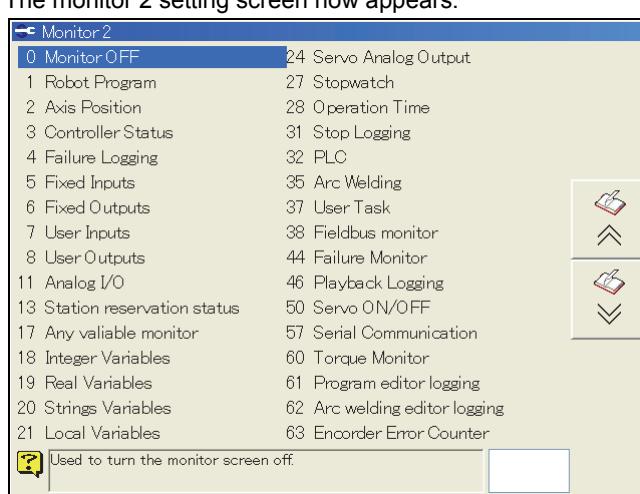
As an example, the steps taken to allocate the display of the general-purpose input signals to monitor 2 and the display of the general-purpose output signals to monitor 3 will be described.

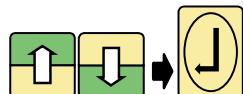
Starting a multiple number of monitors



- 1** The signals can easily be displayed on monitor 2 by operating an f key.
Press <Monitor 2>.

>> The monitor 2 setting screen now appears.





- 2 Align the cursor with “7 User Inputs”, and press [Enter].**
-> Monitor 2 now starts.

>> Monitor 2 now starts.

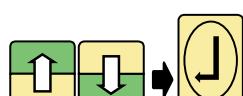
	Teach	Program	Step	7/29/2011	10:04	1:NB4-02 ManualSpeed	Teach/Play Condition				
Station Set		1 [Ex]	13			5	L H				
Monitor2		[1] Robot Program				UNIT1					
		100 %	JOINT	A1	T1						
		8 100 %	JOINT	A1	T1						
		9 100 %	JOINT	A1	T1						
		10 100 %	JOINT	A1	T1						
		11 100 %	JOINT	A1	T1						
		12 100 %	JOINT	A1	T1						
		13 100 %	JOINT	A1	T1						
	[EOF]										
File		[2] Input Signal Monitor									
Constant Setting		0001	0002	0003	0004	0005	0006	0007	0008	0009	0010
	0011	0012	0013	0014	0015	0016	0017	0018	0019	0020	
	0021	0022	0023	0024	0025	0026	0027	0028	0029	0030	
	0031	0032	0033	0034	0035	0036	0037	0038	0039	0040	
	0041	0042	0043	0044	0045	0046	0047	0048	0049	0050	
	0051	0052	0053	0054	0055	0056	0057	0058	0059	0060	
	0061	0062	0063	0064	0065	0066	0067	0068	0069	0070	
Service Utilities		[3] Acceleration				ACC					
						soft					
		[4] Smooth				Smooth					



- 3** Monitor 3 is set from the service menu. Press <Service Utilities>. (All four monitors 1 to 4 can be set from the service menu.)

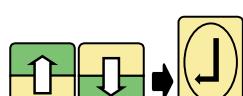
>> The service screen now appears.

Service	UNIT1
1 Teach/Playback Condition	25 Robot Diagnosis
2 Select Monitor Window Layout	26 Torque sampling for Interfer...
3 Monitor 1	29 Sensor Application
4 Monitor 2	30 Auto.moment of inertia Setting
5 Monitor 3	
6 Monitor 4	
7 File Manager	
8 Text Out	
9 Program Conversion	
10 User Coord. Definition	
12 User Task	
13 System Version	
14 PLC Program Edit	
15 ASCII File Edit	
19 Automatic COG Setting	
21 Arcwelding Application	



- 4 Select “5 Monitor 3”, and press [Enter].**

>> The monitor 3 setting screen now appears.



- 5 Align the cursor with “8 User Outputs”, and press [Enter].

>> Monitor 3 now starts

Monitor & How Starts:		Teach	Program	Step	7/29/2011 10:06			
			1 [Ex]	13				
						1:NB4-02 Manual Speed 5 H		
Station Set	[1] Robot Program		UNIT 1					
Monitor 2	8	100 %	JOINT	A1 T1				
	9	100 %	JOINT	A1 T1				
	10	100 %	JOINT	A1 T1				
	11	100 %	JOINT	A1 T1				
	12	100 %	JOINT	A1 T1				
File	13	100 %	JOINT	A1 T1				
	[EOF]							
Constant Setting	[2] Input Signal Monitor		[3] Output Signal Monitor					
	0001	0002	0003	0004 0005	0001	0002	0003	0004 0005
	0006	0007	0008	0009 0010	0006	0007	0008	0009 0010
	0011	0012	0013	0014 0015	0011	0012	0013	0014 0015
	0016	0017	0018	0019 0020	0016	0017	0018	0019 0020
	0021	0022	0023	0024 0025	0021	0022	0023	0024 0025
Service Utilities	0026	0027	0028	0029 0030	0026	0027	0028	0029 0030
	0031	0032	0033	0034 0035	0031	0032	0033	0034 0035
	[4] Analog Input Monitor		[5] Analog Output Monitor		[6] Digital Input Monitor			
	ACC							
	SORT							
	Smooth							

7.2.2 Switching and closing the monitors

Any one of a multiple number of monitors started can be selected to be operated or closed.

Switching and closing the monitors



- 1 To select a monitor to be operated from among a multiple number of monitors, press [CLOSE/SELECT SCREEN].**

>> Each time [CLOSE/SELECT SCREEN] is pressed; the monitor which can be operated is switched.

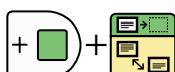
The monitor which can be operated has a deep blue title bar.
Monitors that cannot be operated have light blue title bars.

In the case of the screen shown below, monitor 1 can be operated.

Station Set	Teach	Program	Step	7/29/2011	0:08	1:NB4-02 Manual Speed	Teach/Play Condition
		1 [EX]	13				
Monitor2							
File							
Constant Setting							
Service Utilities							

When deep blue:
The monitor can be operated.

When light blue:
The monitor cannot be operated.
(The information is updated.)



- 2 To close a monitor, select the monitor to be closed, and while holding down [ENABLE], press [CLOSE/SELECT SCREEN].**

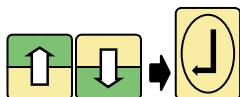
>> The monitor now selected is closed.

7.2.3 Operating the Use Inputs and Outputs monitors

When a general-purpose input or output monitor is started, the ON/OFF statuses of the general-purpose signal attributes can be viewed.

Using the general-purpose output monitor as an example, how to read the information and perform the operations on the monitor screen will be described below.

Operating the User Inputs and Outputs monitors



- 1 By performing the steps on page 7-2, select “8 User Outputs”.**

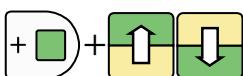
>> The statuses of general-purpose output signals 0001 to 2048 are now displayed.

0001	0002	0003	0004	0005	0006	0007	0008	0009	0010
0011	0012	0013	0014	0015	0016	<i>0017</i>	<i>0018</i>	0019	0020
0021	0022	0023	0024	0025	0026	0027	0028	0029	0030
0031	0032	0033	0034	0035	0036	0037	Ext.start enabled	0039	0040
0041	0042	0043	0044	0045	0046	0047	0048	0049	0050
0051	0052	0053	0054	0055	0056	0057	0058	0059	0060
0061	0062	0063	0064	0065	0066	0067	0068	0069	0070

A yellow background signifies “ON” whereas a gray background signifies “OFF”.

When the cursor is aligned here, a description of the signal is displayed.

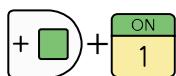
The bold and italic numbers signify the robot status signals. The other numbers signify the general-purpose signals.



- 2 There is a limit on the number of signals which can be displayed on one screen. To view the statuses of other signals, move the cursor using the up and down keys.**

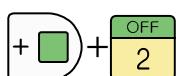
When the up or down key is pressed while holding down [ENABLE], one page of information can be scrolled on the screen.

- 3 Output signals can be turned on and off manually with the general-purpose output monitor. (You cannot turn input signals on and off with the general-purpose input monitor.)**



To set the signal to ON, press [1] while holding down [ENABLE] (or press [Enter]).

>> The specified signal is now set to ON.



To set the signal to OFF, press [2] while holding down [ENABLE].

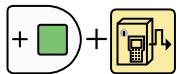
>> The specified signal is now set to OFF.

7.3 Setting the output signals ON or OFF manually

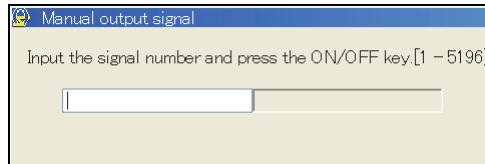
The output signals can be set to ON or OFF manually. (Each signal to be set to ON or OFF is specified using an output signal number.)

This function can be used in the teach mode or playback mode (step by step).

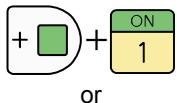
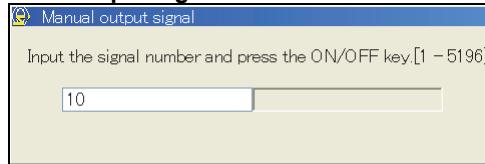
Setting the output signals to ON or OFF manually



- 1** While holding down [ENABLE], press [OUT].
 >> The [Manual output signal] screen now appears.

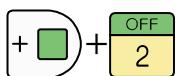


- 2** Input the output signal number.



- 3** To set the signal to ON, press [1] while holding down [ENABLE] (or press [Enter]).

>> The specified signal is now set to ON.



- To set the signal to OFF, press [2] while holding down [ENABLE].

>> The specified signal is now set to OFF.

7.4 Using help for information on functions

This controller comes with a help function (built-in tutorial function).

For information on functions to be known or to be checked out, press [HELP]. The help function can be called not only during teaching but also during playback.

7.4.1 Calling the help top page

The best way to browse carefully through the help information from the beginning is to call the top page.

In order to call the top page, make sure that none of the functions has been selected, and press the [HELP] key.

Calling the help top page



- 1 While making sure that none of the functions has been selected, press the [HELP] key.**

>> The help top page now appears.

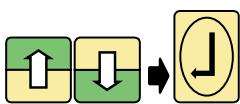
This is the table of contents for help

- Select the desired item using [Up/Down], and press [Enter].
- The information for the selected item appears in the window on the right.
- If the contents window is partially covered, press [Left/Right].

The current mode, program number and step number are displayed here.

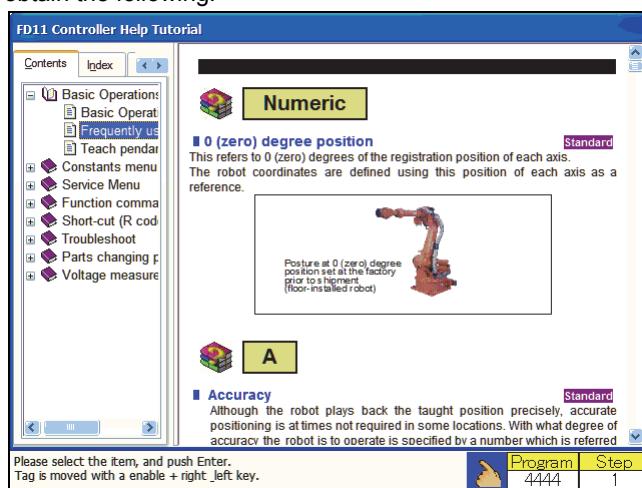
This is the help text.

- Once the item in the table of contents has been selected, press [CLOSE>Select screen] to set the window to active.
- The window can be scrolled using [Up/Down].
- Pages can be scrolled using [ENABLE] and [Up/Down].

**2 Select the item to be viewed using the [Up/Down] key, and press [Enter].**

>> The selected item now appears on the right.

For instance, select "Frequently used terms" under Basic Operations Manual to obtain the following.

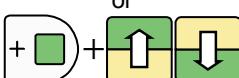
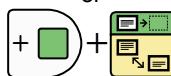
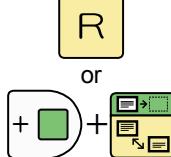
**3 To manipulate the window showing the text information, press [CLOSE/Select screen].**

>> The text window is set to active.

To return to the table of contents window, press [CLOSE>Select screen] again

**4 To scroll up or down, press [Up/Down].**

The text can be scrolled quickly by press [Up/Down] together with [ENABLE].

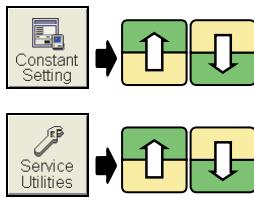
**5 To close help, either press [RESET/R] or press [ENABLE] and [CLOSE>Select screen].**

7.4.2 Directly calling a function to be checked out

For information on the constants menu, service menu, function commands or shortcuts, select the menu, and then press the [HELP] key. The help text concerned is displayed straight away.

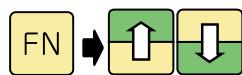
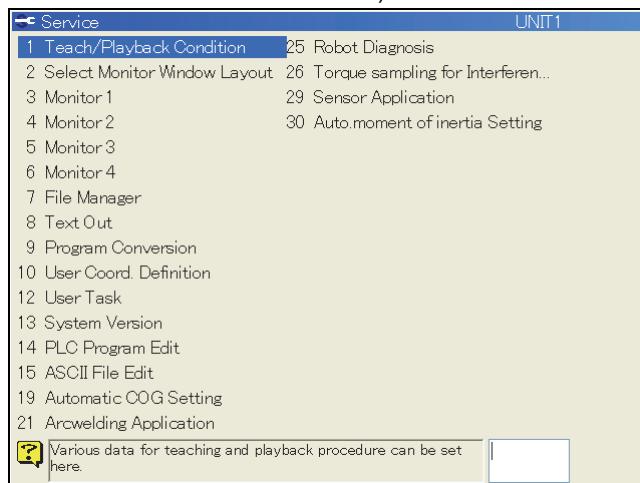
Directly calling a function to be checked out

1 Align the cursor bar with the menu.



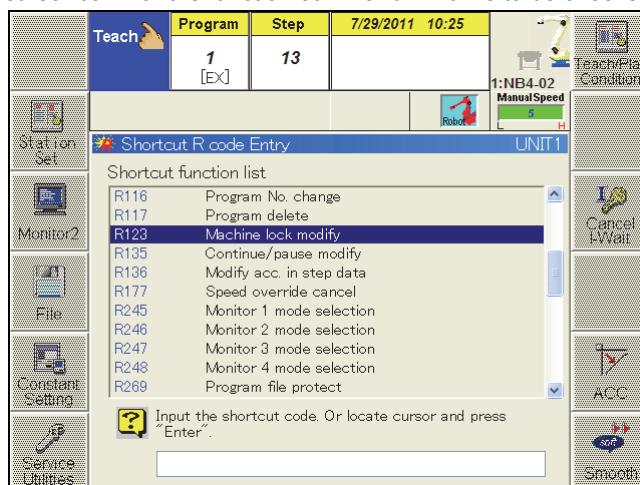
When the constants menu or service menu has been selected

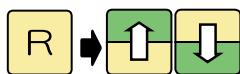
Align the cursor bar with the menu to be checked out. (The screen shown appears when the service menu is selected.)



When a function command has been selected

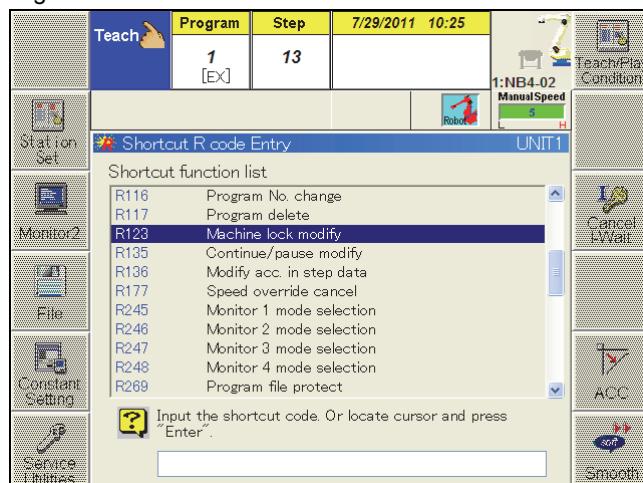
First press [FN] on the top screen of the teach/playback mode, and then align the cursor bar with the function command which is to be checked out.





When a shortcut has been selected

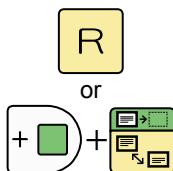
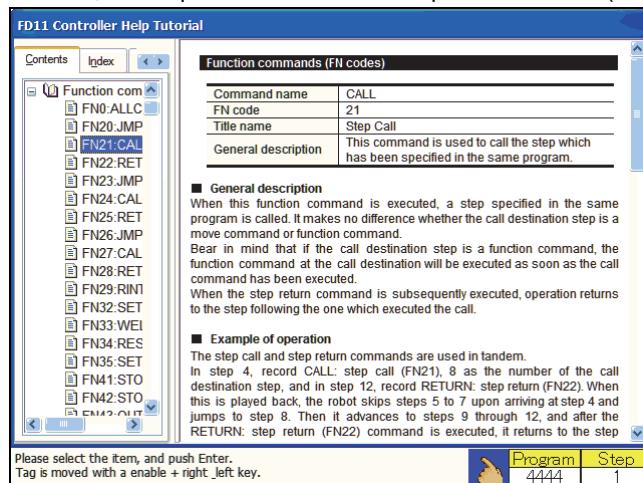
First press [RESET/R] on the top screen of the teach/playback mode, and then align the cursor bar with the function command which is to be checked out.



2 Press [HELP].

>> The help information on the selected menu item appears on the right.

For instance, when [HELP] is pressed with the "FN21: Step call" function command selected, the help information on the step call command (FN21) is displayed.



3 To close help, either press [RESET/R] or press [ENABLE] and [CLOSE>Select screen].

7.5 Displaying T/P Key Help

The name, position, and design of each operating key on the monitor screen can be checked. By displaying "68 T/P Key Help" on the monitor screen, the content can be checked when using either the teach mode or playback mode.

7.5.1 Displaying the T/P Key Help

Display the T/P key help on the monitor screen.

>Selecting from the monitor menu

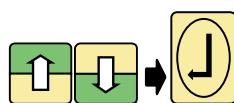


1 Press <Monitor 2>

>> A list of monitor functions that can be displayed is shown.

Function Number	Description
0	Monitor OFF
1	Robot Program
2	Axis Position
3	Controller Status
4	Failure Logging
5	Fixed Inputs
6	Fixed Outputs
7	User Inputs
8	User Outputs
11	Analog I/O
13	Station reservation status
17	Any variable monitor
18	Integer Variables
19	Real Variables
20	Strings Variables
21	Local Variables
24	Servo Analog Output
27	Stopwatch
28	Operation Time
31	Stop Logging
32	PLC
35	Arc Welding
37	User Task
38	Fieldbus monitor
44	Failure Monitor
46	Playback Logging
50	Servo ON/OFF
57	Serial Communication
60	Torque Monitor
61	Program editor logging
62	Arc welding editor logging
63	Encoder Error Counter

Used to turn the monitor screen off.



2 Select "68 T/P Key help," and press [Enter]. Alternatively, enter the numbers [6] [8] directly into the edit box at the bottom, and press [Enter].

>> The T/P key help is displayed on the monitor screen.

>Selecting from the shortcut function

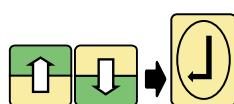


1 Press the [RESET/R] key in the top screen of Teach/Playback mode.

>> The "Shortcut R Code Entry" screen is displayed.

Function Number	Description
RR	Failure clear
R0	Reset & step 0 return
R9	T/P key help
R10	Monitor Operating Time
R17	Programs in inter memory
R29	Select tool No.
R49	Vary Playback speed
R107	Files in internal memory
R108	Files in RC ExMem
R109	Files in TP ExMem
R115	Program copy

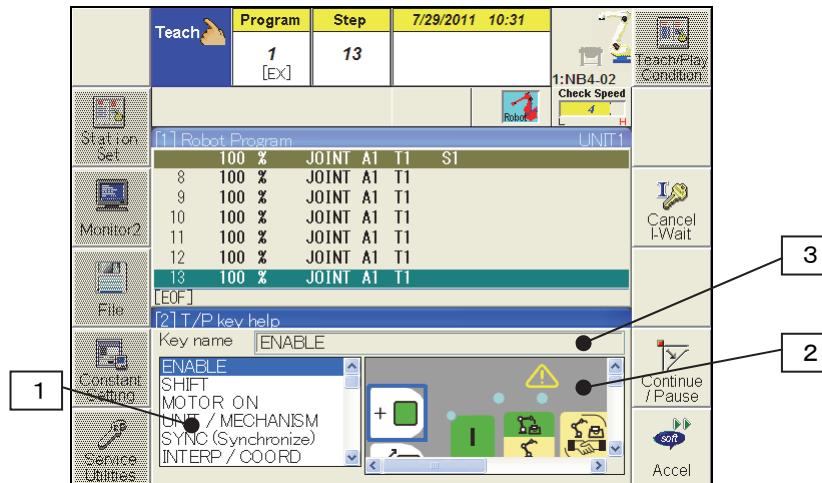
Input the shortcut code. Or locate cursor and press "Enter".



2 Select "T/P Key help" with the [Up/Down] keys, and press the [Enter] key. Alternatively, enter the number [9] directly into the edit box at the bottom, and press the [Enter] key.

7.5.2 Operating T/P Key Help

This section explains the operations of the T/P key help. The structure of the T/P key help screen is as shown below. Here, T/P key help is displayed in monitor 2.



1 Operation key list

Displays a list of operation keys. Selected operation keys are reverse highlighted in blue.

2 Operation key arrangement

Displays the arrangement of the operation keys. Selected operation keys are encircled by a blue line.

3 Key names

Displays the key name of the operation key selected in the operation key list or operation key arrangement.

■ Searching for the operation key position and design from the name

Perform the following operations to search for the position and design of an operation key from the name of the operation key.

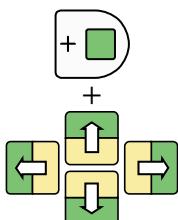


- 1 Press the [Up/Down] key, and select the name of the operation key that you want to search for from the “Operation Key List” on the left side of the monitor. Alternatively, touch the key name in the “Operation Key List.”
 >> The selected operation key is displayed in the “Operation Key Arrangement” on the right of the monitor with a blue border.



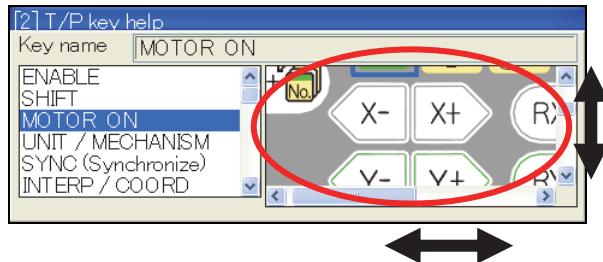
Searching for the operation key name from the position or design

Select the key name from the operation key arrangement.



- 1 Use [ENABLE] + cursor keys to scroll up, down, left, and right the "Operation Key Arrangement" on the right side of the monitor screen, and display the operation key that you want to research.

>> The "Operation Key Arrangement" is scrolled up, down, left and right.



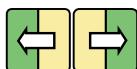
Use [ENABLE] + [Up/Down] to scroll vertically, and [ENABLE] + [Left/Right] to scroll horizontally.

- 2 Touch the operation key that you want to research from the "Operation Key Arrangement" on the right side of the monitor screen.

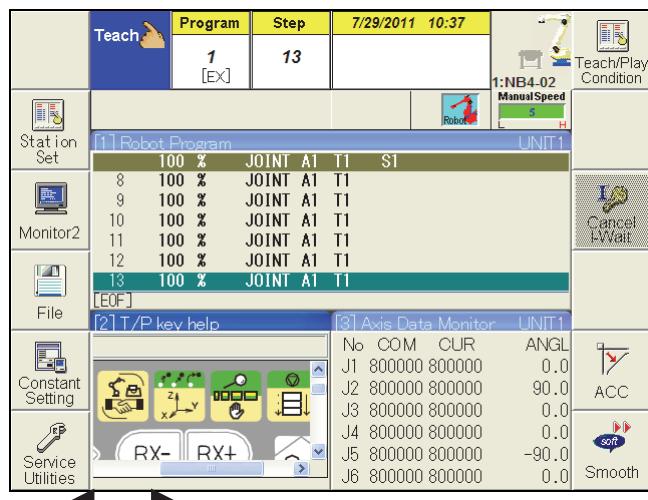
>> The name of the touched operation key is displayed in "Key Name" at the top of the monitor screen.
Also, the same name also becomes selected in the "Operation Key List" on the left of the monitor screen.

Moving the display area

When multiple monitors are running, part of the T/P key help screen may be hidden. In this situation, the following operations can be used to display the hidden parts of the display area.



- 1 Press the [Left/Right] keys to scroll the T/P key help screen itself horizontally.



For example, if the "Operation Key Arrangement" is hidden press [Right], or if the "Operation Key List" is hidden press [Left] to scroll the monitor screen itself.



If this operation is performed when no parts are hidden, the screen does not scroll.

7.6 Managing programs in folders

This controller comes with a function that manages programs in folders.

When there are many programs, you can create folders according to use and store organized related programs in folder, which is useful to find out the programs easily.

The programs which are stored in folders can perform playback operation and teach modification.



IMPORTANT

When managing the programs in folders, there are constraints as following.

- The folders which can manage programs, which is a hierarchical folder of less than (5.5) that is in PROGRAM folder of a memory (fig 6.2.2).
- Programs that have the same program number cannot be stored in multiple folders.
- The programs stored in except these folders cannot be performed playback operation and teach modification.

7.6.1 Setting displaying the Folder list

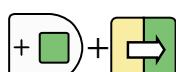
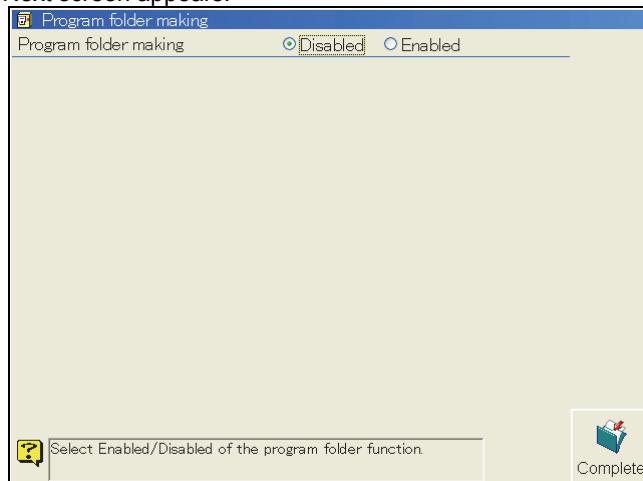
To manage the programs in folders are necessary setting as follows. This setting should be done by an operator with the qualifications class of **EXPERT** or above.

Setting displaying the Folder list



- 1 Press f5<Constant setting>. Select [5 Operation Constants] - [10 Program folder making] in the constant menu.

>> Next screen appears.

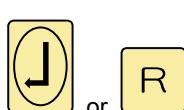
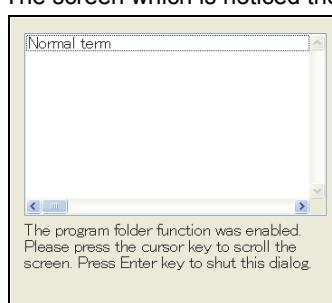


- 2 Align the cursor with “Program folder making” and holding down [ENABLE] and press [\rightarrow] to switch into “Enabled”.



- 3 After switching “Enabled”, press f12<Complete>.

>> The screen which is noticed the setting completion appears.



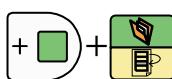
Press [Enter] or [RESET/R] to be completed the screen



Program numbers cannot be overlapped.

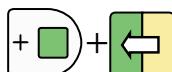
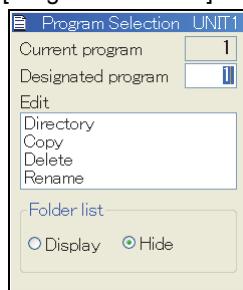
If program numbers are overlapped, the following screen is displayed, and "Make program folder" cannot be enabled.

In this case, the overlapped programs are displayed. Therefore delete these any of programs or change the program number.



5 Holding down [ENABLE] and press [PROG/STEP].

>> [Program Selection] screen appears.



6 Holding down [ENABLE] and press [\leftarrow].

>> "Folder list" switches into "Display".



7 When displaying a list of the folders align the cursor with "Directory" and press [Enter].

>> The programs which have done to create are displayed.

You can confirm the stored programs in every folder.

Program list display			UNIT1
Program list			JUNIT1
PROGRAM			Ascend
	Program No.	No. of Steps	Comment
1 NB4-02 .000	7		
1 NB4-02 .001	13		
1 NB4-02 .002	4		
1 NB4-02 .003	5		
1 NB4-02 .004	7		
1 NB4-02 .005	12		
1 NB4-02 .006	4		
1 NB4-02 .007	62		
1 NB4-02 .100	10		

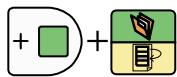
Please push "Enter" after selecting the program.

7.6.2 Creating, deleting and renaming folders

You can create the folders to be stored the programs, delete and rename the folders.

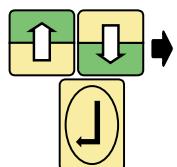
Creating folders

As an example, the procedures of creating a new folder below the PROGRAM folder are as follows.



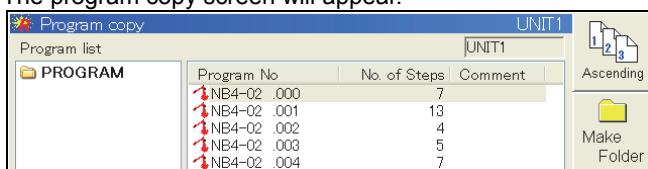
1 Holding down [ENABLE], press [PROG/STEP].

>> The program selection screen will open.



2 Align the cursor to “Copy” and press [Enter].

>> The program copy screen will appear.



3 After the PROGRAM folder has been selected, press f8 <Make Folder>.

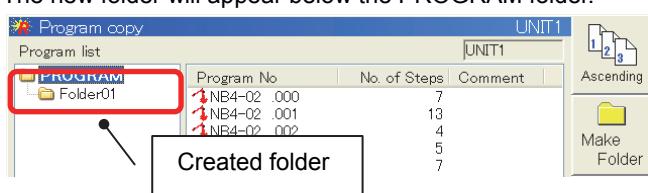
>> The soft keyboard appears and entering characters will become possible.



4 By using the soft keyboard, name the folder and press f12<Complete>.

In this section, the created folder has been named "Folder01".

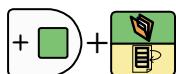
>> The new folder will appear below the PROGRAM folder.



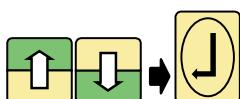
Refer to Chapter 2 “2.5 To input characters” for the procedures of entering characters.

Renaming folders

As an example, the procedures of renaming a new folder below the PROGRAM folder are as follows.



- 1 Holding down [ENABLE], press [PROG/STEP].**
 >> [Program Selection] screen appears.



- 2 Align cursor to “Rename” and press [Enter].**
 >> “Program number conversion” screen will appear.

Program number conversion			UNIT1
Program list			
PROGRAM	Program No	No. of Steps	Comment
Folder01	NB4-02_000	7	
	NB4-02_001	13	
	NB4-02_002	4	
	NB4-02_003	5	
	NB4-02_004	7	



- 3 After selecting the folder that is to be changed, press f8<Folder change>.**
 In this section, the selected folder is “Folder01”.
 >> The soft keyboard appears and entering characters will become possible.



- 4 Using the soft keyboard, enter the name of the folder that is to be changed and press f12<Complete>.**
 In this section, the name entered for the folder is “Folder01”.
 >> The name of the selected folder changes.

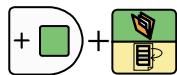
Program number conversion			UNIT1
Program list			
PROGRAM			
Prg01	Program No	No. of Steps	Comment
	NB4-02_000	7	
	NB4-02_001	13	
		4	
		5	
		7	

Renamed folder

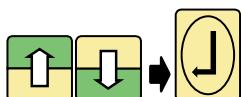
Refer to Chapter 2 “2.5 To input characters” for the procedures of entering characters.

Deleting folders

As an example, the procedures of deleting the folder listed below the PROGRAM folder will be described.



- 1 Holding down [ENABLE], press [PROG/STEP].**
 >> "Program selection" screen appears.



- 2 Align cursor to "Delete" and press [Enter].**
 >> "Program deletion" screen appears.

Program deletion		
UNIT1		
Program list	Program No.	No. of Steps
PROGRAM	NB4-02 .000	7
Prg01	NB4-02 .001	13
	NB4-02 .002	4
	NB4-02 .003	5
	NB4-02 .004	7

1 2 3
 Ascending
Folder deletion



- 3 After selecting the folder that is to be deleted, press f8<Folder deletion>.**
 In this section, the selected folder is "Folder01".
 >> Confirmation screen appears.



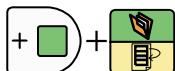
- 4 Select "OK" and press [Enter].**
 >> The selected folder and the programs stored inside it will be deleted.

7.6.3 Assign the stored folder inside programs

When a newly teaching, the stored folder inside programs that will be created is assigned

Assign the stored folder inside programs

- 1 Select the Teach mode.**



- 2 Holding down [ENABLE], press [PROG/STEP].**

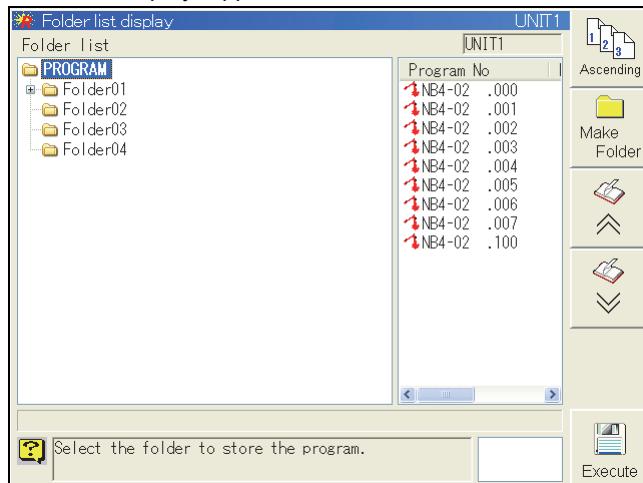
>> "Program selection screen" appears.

Input a
newly
number



- 3 Input the newly program number into "Designated program", and press [Enter].**

>> "Folder list display" appears.



Input
an
existing
number



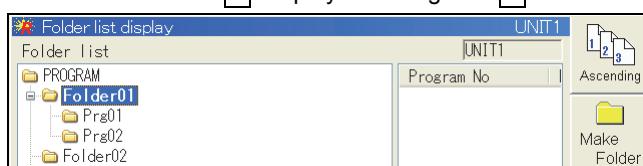
When inputting an existing number and press [Enter], the assigned program is opened directly. "Folder list display" does not appear.



- 4 When displaying an underneath folder, select **[+]** folder and press [Enter].**

>> The underneath folder which is selected in folder is developed.

The selected folder **[+]** display is turning into **[−]**.



- 5 When an underneath folder makes no display, select **[−]** folder and press [Enter].**

>> The underneath folder which is selected is stored.

The selected folder **[−]** display is turning into **[+]**.



- 6 After select the stored folder, press f12<Execute>.**

>> The program is created on the selected folder.



When you do not know an empty number.

When you do not know an empty number, once try to switch the Folder list display "Hide" on the program selection screen.

After switching, check the programs already created by listing them on the display.

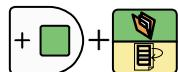
 Refer to Chapter 4 "4.2.2 Listing the programs on the display."

7.6.4 Copying and transferring programs within folders

The programs can be copied and transferred into other folders. These functions are useful when organizing the programs in the stored folders.

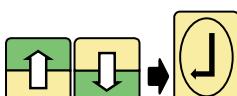
Copying and transferring programs within folders

The copied programs can be copied the selected programs into the assigned folders. Also the transferred programs can be transferred into the assigned folders with the same procedure as copying. How to transfer the programs are described here.



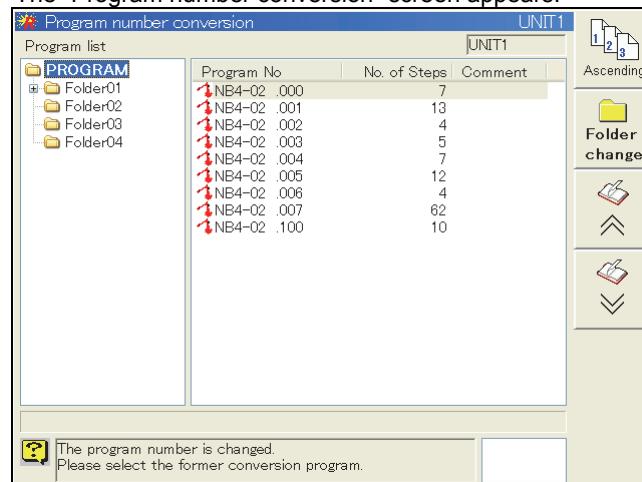
- 1 Holding down [ENABLE] and press [PROG/STEP].**

>> The “program number conversion” screen appears.



- 2 Align the cursor with “Rename” and press [Enter].**

>> The “Program number conversion” screen appears.



- 3 When displaying an underneath folder, select **[+]** folder and press [Enter].**

>> The underneath folder which is selected in folder is developed.

The selected folder **[+]** display is turning into **[]**.



- 4 When an underneath folder makes no display, select **[]** folder and press [Enter].**

>> The underneath folder which is selected is stored.

The selected folder **[]** display is turning into **[+]**.

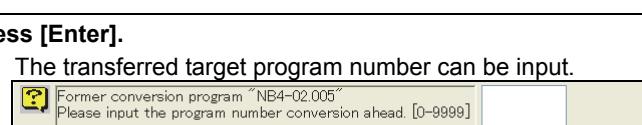
- 5 Select the transferred source folder is selected.**

>> The selected folder is highlighted in blue.



- 6 The transferred target program is selected.**

>> The selected folder is highlighted in blue.



- 7 Press [Enter].**

>> The transferred target program number can be input.

Input
number



- 8 The transferred target folder can be selected.**

>> The selected folder is highlighted in blue.



- 9 Input the transferred target program number and press [Enter].**

>> The programs are transferred and then put back the original screen.

7.7 Customizing the Hard Keys

In order to simplify the teaching operation of programs, the function commands of each application or movement command can be taught by holding down the [ENABLE] key and pressing a number key (4~9). When this operating method is enabled, the initial values of the operations allocated to [ENABLE] + number keys (4~9) are shown in Table 7.7.1.

Table 7.7.1 Operation allocation to number keys (4~9)

Operation Key	Called Functions	Changing Allocation
	Not allocated	Can be changed
	Joint interpolation (JOINT) movement command	
	Linear interpolation (LIN) movement command	Cannot be changed
	Circular interpolation (CIR) movement command	
	END Command	Cannot be changed

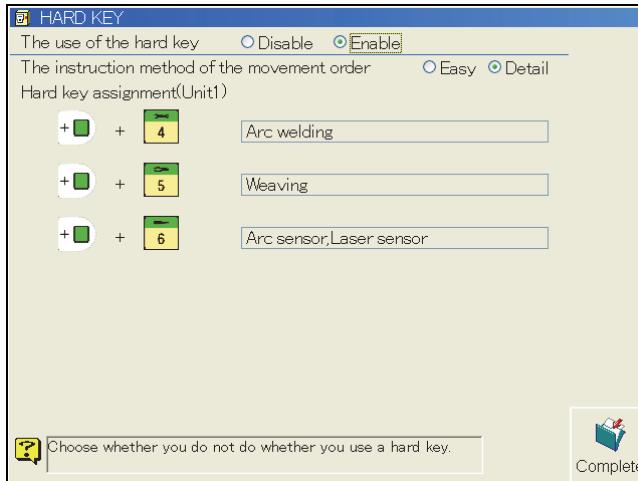
An operator qualification of **EXPERT** or higher is required to change hard key usage settings.

Operator qualifications below **EXPERT** cannot be used to change the settings, but can be used to search setting contents.

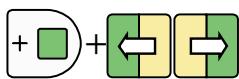
Customizing the Hard Keys

1 Press [Constant Setting] - [7f-Keys] - [8 HARD KEY].

>> The hard key usage selection screen is displayed.



The items below "The instruction method of the movement order" are only displayed when "Enable" is selected for "The use of the hard key."



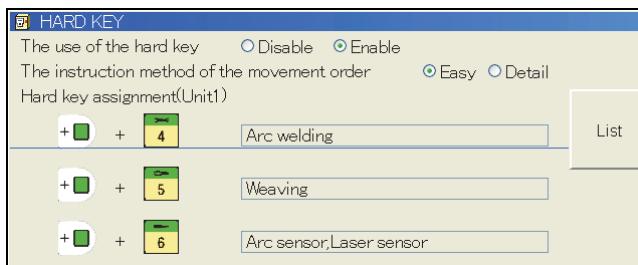
- 2 Align the cursor to “The use of the hard key” or “The instruction method of the movement order,” then hold [ENABLE] and press [Left/Right].**

When “Enable” is selected for hard key use, select one of the teach methods for the movement command.

To only set the number keys for 7~9, press f12 <Complete> here.

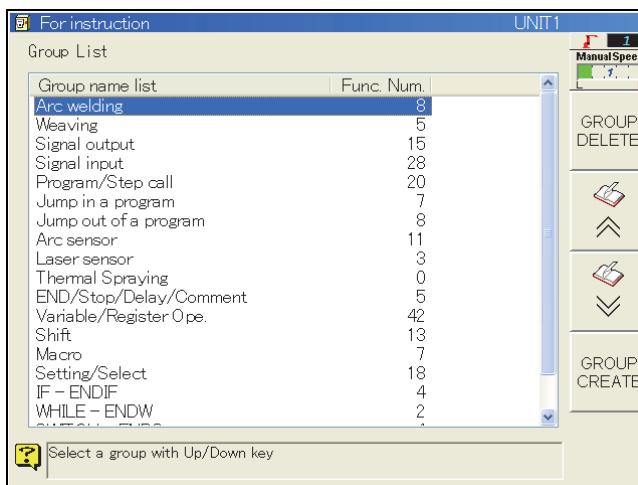
- 3 Align the cursor with each key (4~6) of “Hard key assignment.”**

>> The screen is as shown below.



- 4 When f7 <List> is pressed, the function group list is displayed.**

>> The screen is as shown below.



- 5 Select the function group to be allocated using [Up/Down], and press [Enter].**

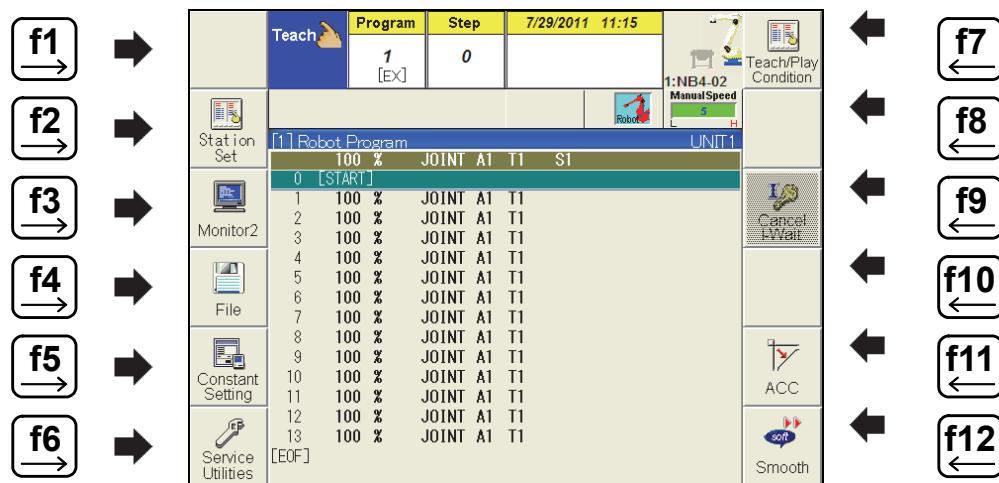


- 6 After configuring all of the conditions, press f12 <Complete>.**

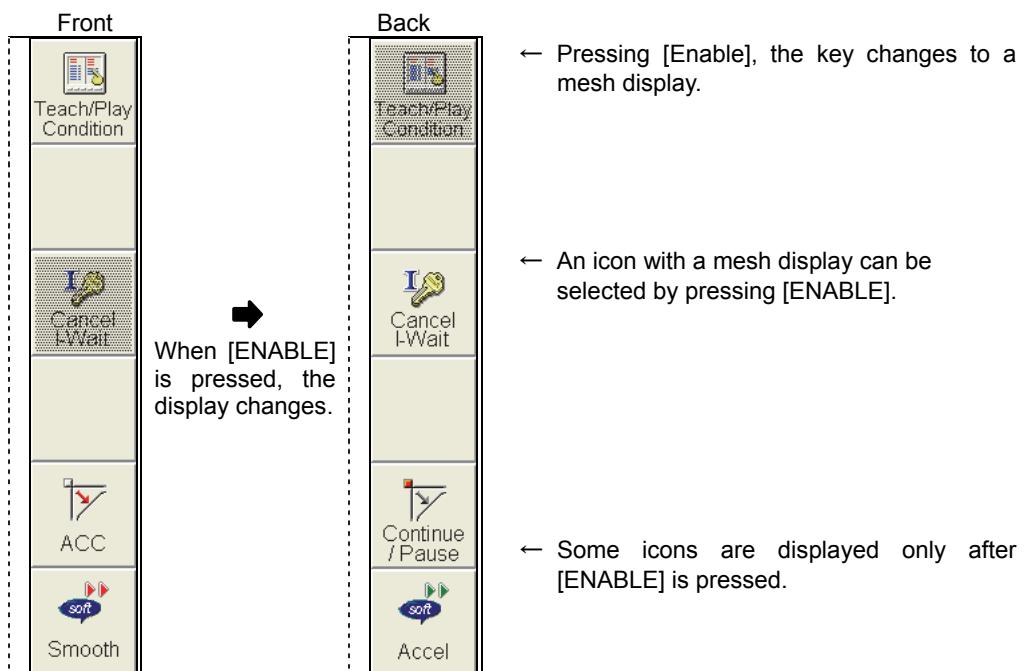
>> The hard key usage settings are recorded.

7.8 Customizing the Softkey

There are 12 f key (f1~f12) display areas on both sides of the teach pendant display screen. As various functions can be allocated for these f-keys, we call each of them a softkey. It is available to set up the softkey respectively for Teach mode and Playback mode. Usually, the most suitable function for each application is allocated by default.



There are two ways for the softkey allocation both on the front and the back, which the front allows to operate only by the softkey while the back, using both [Enable] key and f-key by pressing at the same time. However, you will sometimes find it only allowed on the back depending on the function of that key.



Also, it is available to set [Disable] on the softkey operation to make it disable the "Back" allocation. [7.8.3 Setting the Softkey Condition Enable/Disable](#)

Types of softkey

Two types are available; Function and Operation switch.



Function	Functions such as various settings, R-code, Function commands are allocated.
Operation switch	This key allows to display and operate the lamp, switches, and status of signals.

7.8.1 Changing the Softkey Allocation

For the softkey setting, select the icon from the list for each corresponding function, and allocate it for each softkey.

Changing the Function key

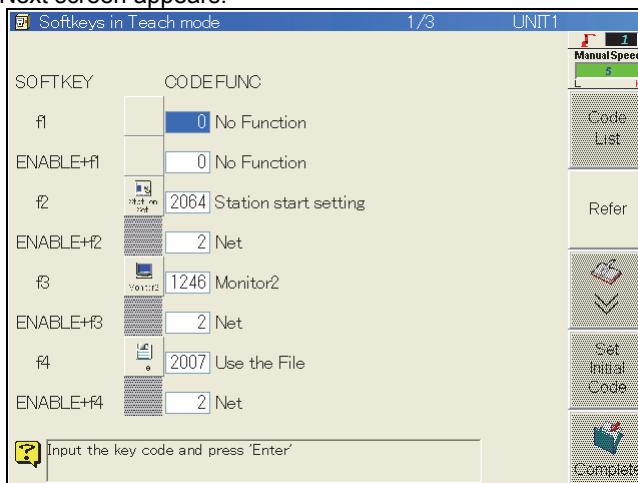


- 1 Press f5<Constant setting> and select [7. f-Keys].**

Choose either [2. Softkeys in Teach mode] or [3. Softkeys in Playback mode] depending on the mode to set up the softkey.

* Currently, [4. Softkeys in High Speed Teach mode] is not available.

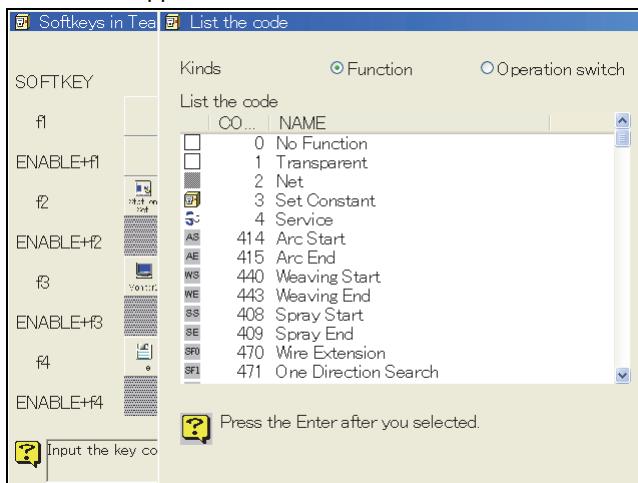
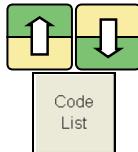
>> Next screen appears.



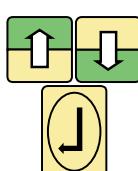
If you already know the code number of function, enter the number directly in the code field.

- 2 If you are not sure about the code number, select the softkey to be set using [UP/DOWN] key, and press f8<Code List>.**

>> Next screen appears.



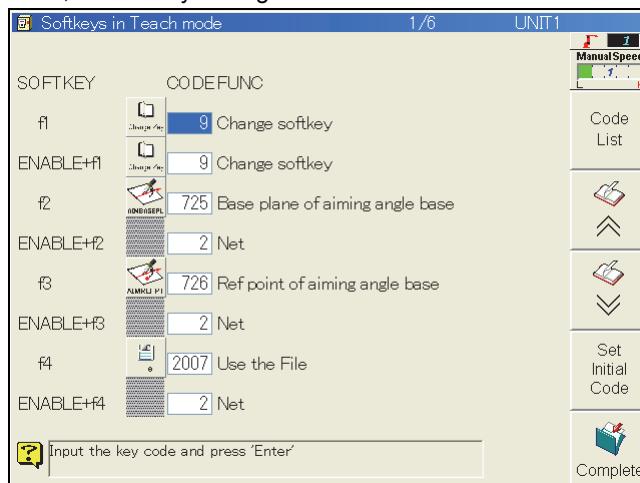
Select the function by [UP/DOWN] key, and confirm by pressing [Enter] key.



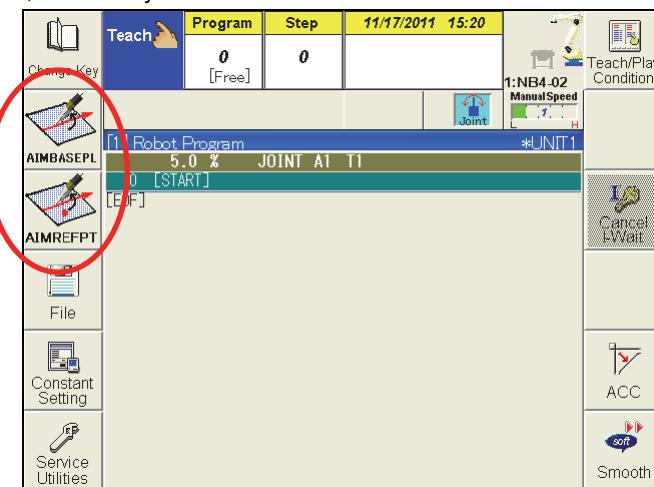


3 On completion of the code setting, press f12<Complete>.

>> Then, the softkey setting is saved.



4 Now, the softkey is set as shown below.



Setting the operation switch is also available in the same way.
 Setting the Operation switch

Table 7.8.1 List of softkey functions

Code	Function Name	Icon	Teach	Play back	Code	Function Name	Icon	Teach	Play back
0	No Function		○	○	490	Start Laser Sensor Tracking		○	○
1	Transparent		○	○	491	End Point Detecting		○	○
2	Net		○	○	492	End Laser Sensor Tracking		○	○
3	Set Constant		◎	○	495	Groove point Detecting		○	○
4	Service		◎	◎	725	Base plane of aiming angle base		○	○
408	Spray Start		○	○	726	Ref point of aiming angle base		○	○
409	Spray End		○	○	1005	Select Starting		○	○
414	Arc Start		○	○	1006	Select Program		○	○
415	Arc End		○	○	1029	Select tool No.		○	○
440	Weave Start		○	○	1245	Monitor1		○	○
443	Weave End		○	○	1246	Monitor2		○	○
470	Wire Extension		○	○	1247	Monitor3		○	○
471	One Direction Search		○	○	1248	Monitor4		○	○
473	Deviation call		○	○	1288	Wrist posture limit		○	○
474	Dev Composition		○	○	1295	Connect Mec		△	×
479	Gap file generation		○	○	1296	Change Mec		△	×
480	One Direction search (Laser)		○	○	1315	Select Spot		○	○
483	Groove Detection Search		○	○	1320	Step Go/Back		○	○
487	Laser Sensor ON		○	○	1334	Record the spot		○	○
488	Laser Sensor OFF		○	○	1400	Oscillo Scope		○	○
489	Start point Detecting		○	○	1503	Log In		○	○

Code	Function Name	Icon	Teach	Play back	Code	Function Name	Icon	Teach	Play back
2000	Drive Mode		<input type="radio"/>	<input type="radio"/>	2069	Step by Step		<input type="radio"/>	<input type="radio"/>
2001	Cancel I-Wait		<input type="radio"/>	<input type="radio"/>	2070	Arc Weld ON		<input type="radio"/>	<input type="radio"/>
2002	Cancel WI		<input type="radio"/>	<input type="radio"/>	2071	Weaving ON		<input type="radio"/>	<input type="radio"/>
2003	High Override		<input type="radio"/>	<input type="radio"/>	2072	External Signal ON		<input type="radio"/>	<input type="radio"/>
2004	Select Step By Step		<input type="radio"/>	<input type="radio"/>	2073	Sensor ON		<input type="radio"/>	<input type="radio"/>
2007	Use the file		<input type="radio"/>	<input type="radio"/>	2080	Change Stroke		<input type="radio"/>	<input type="radio"/>
2011	Accuracy		<input type="radio"/>	<input type="radio"/>	2081	Spot Condition		<input type="radio"/>	<input type="radio"/>
2012	Continue/pause select		<input type="radio"/>	<input type="radio"/>	2082	Spot Constant		<input type="radio"/>	<input checked="" type="checkbox"/>
2013	Accel		<input type="radio"/>	<input type="radio"/>	2084	Manual Pressur		<input type="radio"/>	<input type="radio"/>
2014	Smooth		<input type="radio"/>	<input type="radio"/>	2085	Status Monitor		<input type="radio"/>	<input type="radio"/>
2015	Speed Mechanism Change		<input type="radio"/>	<input type="radio"/>	2086	Spot Weld. Cond.		<input type="radio"/>	<input type="radio"/>
2016	Conveyor status ON/OFF		<input type="radio"/>	<input type="radio"/>	2087	Station Monitor		<input type="radio"/>	<input type="radio"/>
2017	Conveyor mode change		<input type="radio"/>	<input type="radio"/>	2088	Manual welding		<input type="radio"/>	<input type="radio"/>
2018	Fine motion select		<input type="radio"/>	<input type="radio"/>	2089	Panel rigid type select		<input type="radio"/>	<input type="radio"/>
2053	Weld ON/OFF		<input type="radio"/>	<input type="radio"/>	2090	Change Stroke 1		<input type="radio"/>	<input type="radio"/>
2054	Spot Monitor		<input type="radio"/>	<input type="radio"/>	2091	Change Stroke 2		<input type="radio"/>	<input type="radio"/>
2058	Gun Status		<input type="radio"/>	<input type="radio"/>	2092	Change Stroke 3		<input type="radio"/>	<input type="radio"/>
2064	Station start setting		<input type="radio"/>	<input type="radio"/>	2093	Change Stroke 4		<input type="radio"/>	<input type="radio"/>
2065	Ret Condition		<input type="radio"/>	<input type="radio"/>	2094	Change Stroke 5		<input type="radio"/>	<input type="radio"/>
2066	Play condition		<input type="radio"/>	<input type="radio"/>	2095	Change Stroke 6		<input type="radio"/>	<input type="radio"/>
2067	Select Stroke		<input type="radio"/>	<input type="radio"/>	2096	Manual Pressure 1		<input type="radio"/>	<input type="radio"/>
2068	Select starting and program		<input type="radio"/>	<input type="radio"/>	2097	Manual Pressure 2		<input type="radio"/>	<input type="radio"/>

Code	Function Name	Icon	Teach	Play back	Code	Function Name	Icon	Teach	Play back
2098	Manual Pressure 3		<input type="radio"/>	<input type="radio"/>	2160	Seam manu. rotation		<input type="radio"/>	<input type="radio"/>
2099	Manual Pressure 4		<input type="radio"/>	<input type="radio"/>	2161	Seam manu. rot. sel.		<input type="radio"/>	<input type="radio"/>
2100	Manual Pressure 5		<input type="radio"/>	<input type="radio"/>	2162	Seam manu. rot. Dir.		<input type="radio"/>	<input type="radio"/>
2101	Manual Pressure 6		<input type="radio"/>	<input type="radio"/>	2163	Seam manu. weld		<input type="radio"/>	<input type="radio"/>
2102	Manual welding 1		<input type="radio"/>	<input type="radio"/>	2200	Select arc welder		<input type="radio"/>	<input type="radio"/>
2103	Manual welding 2		<input type="radio"/>	<input type="radio"/>	2201	Select Manipulator		<input type="radio"/>	<input type="radio"/>
2104	Manual welding 3		<input type="radio"/>	<input type="radio"/>	2202	Inching (Low speed)		<input type="radio"/>	<input type="radio"/>
2105	Manual welding 4		<input type="radio"/>	<input type="radio"/>	2203	Retract (Low speed)		<input type="radio"/>	<input type="radio"/>
2106	Manual welding 5		<input type="radio"/>	<input type="radio"/>	2204	Inching (High speed)		<input type="radio"/>	<input type="radio"/>
2107	Manual welding 6		<input type="radio"/>	<input type="radio"/>	2205	Retract (High speed)		<input type="radio"/>	<input type="radio"/>
2108	Manual Cond Out 1		<input type="radio"/>	<input type="radio"/>	2206	Check gas		<input type="radio"/>	<input type="radio"/>
2109	Manual Cond Out 2		<input type="radio"/>	<input type="radio"/>	2207	Arc Constant		<input type="radio"/>	<input type="radio"/>
2110	Manual Cond Out 3		<input type="radio"/>	<input type="radio"/>	2208	Arc Condition		<input type="radio"/>	<input type="radio"/>
2111	Manual Cond Out 4		<input type="radio"/>	<input type="radio"/>	2209	Arc Monitor		<input type="radio"/>	<input type="radio"/>
2112	Manual Cond Out 5		<input type="radio"/>	<input type="radio"/>	2210	AS Monitor		<input type="radio"/>	<input type="radio"/>
2113	Manual Cond Out 6		<input type="radio"/>	<input type="radio"/>	2211	Restart method in Play mode		<input type="radio"/>	<input type="radio"/>
2114	Stop Playback		<input type="radio"/>	<input type="radio"/>	2212	Recover to stopped position		<input type="radio"/>	<input type="radio"/>
2115	Weld schedule		<input type="radio"/>	<input type="radio"/>	2213	Recover pos. after step set		<input type="radio"/>	<input type="radio"/>
2116	Adjust position		<input type="radio"/>	<input type="radio"/>	2214	Select sensor		<input type="radio"/>	<input type="radio"/>
2120	Manual Speed INC.		<input type="radio"/>	<input type="radio"/>	2215	Trial Operation		<input type="radio"/>	<input type="radio"/>
2121	Manual Speed DEC.		<input type="radio"/>	<input type="radio"/>	2216	Manual Laser		<input type="radio"/>	<input type="radio"/>
2150	Vision mode switch		<input type="radio"/>	<input type="radio"/>	2217	Check Welding		<input type="radio"/>	<input checked="" type="radio"/>

Code	Function Name	Icon	Teach	Play back	Code	Function Name	Icon	Teach	Play back
2218	SF2/ZF2 Check-Go		○	×	2401	Sealing flow		△	△
2219	Robot RS ON/OFF		○	○	2402	Sealing reload		△	△
2220	APCS Adjust		○	○	2500	Int. play start		×	△
2221	MOVEX Record (Robot language)		○	○	2510	XYZ shift		○	○
2222	Pilot arc ON/OFF		○	○	2511	Wrist Rotate Change		○	○
2223	Purge ON/OFF		○	○	2520	User Help		○	○
2224	ZF1/ZF2 Distance Data		○	○	2525	Test tracking ON		○	○
2225	ZG1 Groove Data		○	○	2529	FLEX hand Clamp		△	△
2253	Manual Grip		△	×	2530	FLEX hand Clamp1		△	△
2300	Select thermal spraying		○	○	2531	FLEX hand Clamp2		△	△
2301	Thermal spraying Constant		○	○	2532	FLEX hand Clamp state		○	○
2302	Thermal spraying Constant		○	○	2533	FLEX hand Clamp state 1		○	○
2303	Thermal spraying Monitor		○	○	2534	FLEX hand Clamp state 2		○	○
2304	Thermal spraying ON/OFF		○	○	2535	FLEX hand Clamp Side		○	○
2305	Stopping release		○	○	2536	FLEX hand Hand select		○	○
2400	Sealing condition		○	○					

○ : Setting available

◎ : Setting required

× : Setting unavailable

△ : [Enable] needs to be pressed at the same time (when "Enable" is set ON).

About the function marked “◎”

Be sure to set up the function marked “◎”. Otherwise, the softkey setting cannot be completed.

Functions that require the [ENABLE] key to be pressed at the same time (△)

- When enable switching is “enabled,” this function (△) cannot be allocated to the “Front screen” to prevent incorrect operation.
- When enable switching is “disabled,” an operator qualification of **EXPERT** or higher is required to allocate this function (△).

For details of the softkey condition setting Enable/Disable, see the “7.8.3 Setting the Softkey Condition Enable/Disable”.



Setting the Operation switch

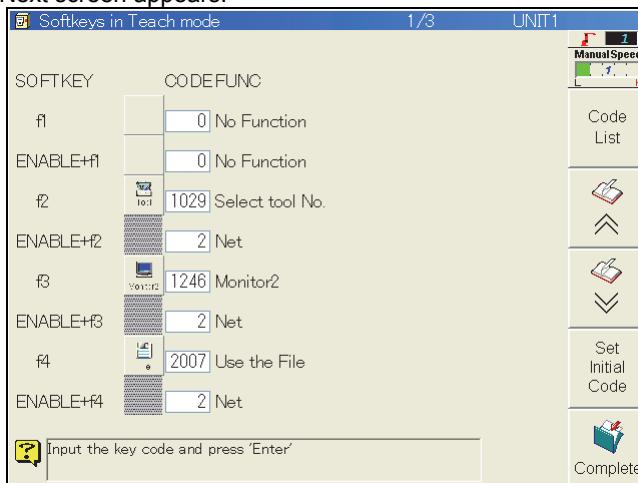
There are various types of operation switch, which allows to set the color, signal, indicated messages, etc.



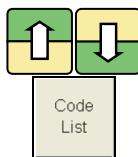
- 1 Press f5<Constant setting> and select [7. f-Keys].**

Choose either [2. Softkeys in Teach mode] or [3. Softkeys in Playback mode] depending on the mode to set up the softkey..

>> Next screen appears.

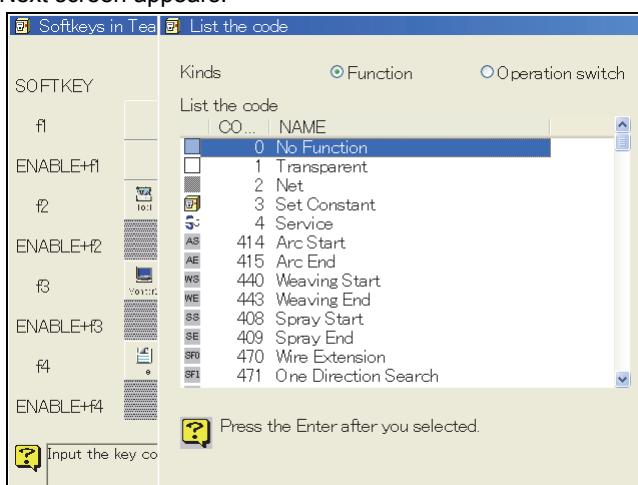


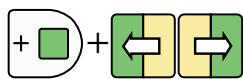
If you already know the code number, enter the number directly in the code field.



- 2 If you are not sure about the code number, select the softkey to set using [UP/DOWN] key, and press f8<Code List>.**

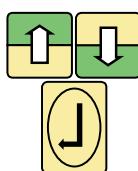
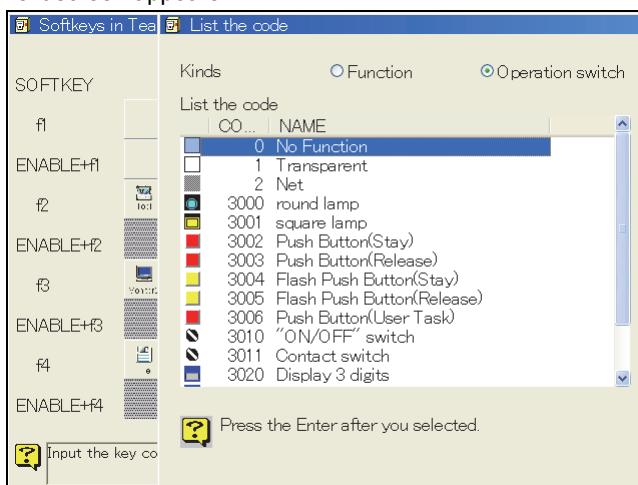
>> Next screen appears.



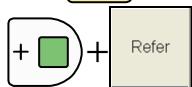


3 Select the desired Operation switch by pressing [Enable] + arrow key.

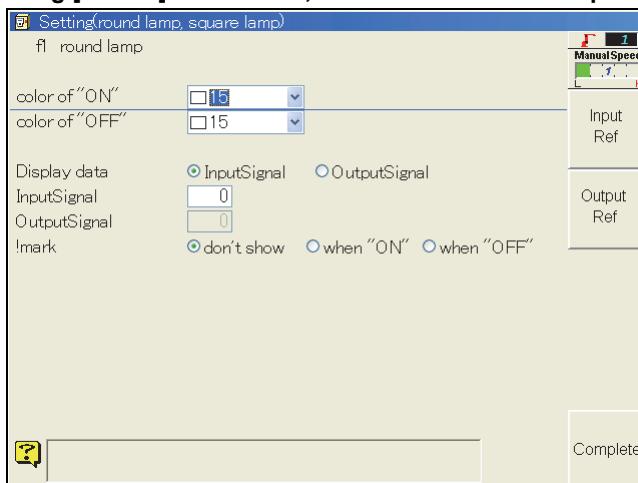
>> Next screen appears.



Then, confirm it by pressing [Enter].



4 Pressing [Enable] + f9<Refer>, set the details of each operation switch.



Now, each detail can be set.



5 On completion of the detail setting, press f12<Complete>.



6 On completion of the softkey setting, press f12<Complete>.

>> Now, the softkey settings can be saved.

Table 7.8.2 List of softkey operation switches

Code	Operation switch Name	Icon	Teach	Play back	Code	Operation switch Name	Icon	Teach	Play back
3000	Round lamp		<input type="radio"/>	<input type="radio"/>	3011	Contact switch		<input type="radio"/>	<input type="radio"/>
3001	Square lamp		<input type="radio"/>	<input type="radio"/>	3020	Display 3 digits		<input type="radio"/>	<input type="radio"/>
3002	Push button (Stay)		<input type="radio"/>	<input type="radio"/>	3021	Display 6 digits		<input type="radio"/>	<input type="radio"/>
3003	Push button (Release)		<input type="radio"/>	<input type="radio"/>	3030	Input 3 digits		<input type="radio"/>	<input type="radio"/>
3004	Flash Push Button (Stay)		<input type="radio"/>	<input type="radio"/>	3031	Input 6 Digits		<input type="radio"/>	<input type="radio"/>
3005	Flash Push Button (Release)		<input type="radio"/>	<input type="radio"/>					
3006	Push Button (User task)		<input type="radio"/>	<input type="radio"/>					
3010	ON/OFF switch		<input type="radio"/>	<input type="radio"/>					

○ : Setting available

◎ : Setting required

× : Setting unavailable

△ : Necessary to press [Enable]. (When the [Enable] is set ON.)

Round/ Square Lamp

Indicates the status of input or output signal

Item	Contents
Color of ON	Lamp color when the signal is ON.
Color of OFF	Lamp color when the signal is OFF.
Display data	Selection of input /output signal
Input Signal	Input signal No. to indicate
Output Signal	Output signal No. to indicate
! mark	Timing to indicate the mark “!”

Push Button

Outputs the preset signal

Item	Contents
Color of ON	Lamp color when the signal is ON.
Color of OFF	Lamp color when the signal is OFF.
Output Sig.	Signal No. to be output when the button pressed
! mark	Timing to indicate the mark “!”

Flash Push Button

Outputs not only the status of input or output signal but also the preset signal

Item	Contents
Color of ON	Lamp color when the signal is ON.
Color of OFF	Lamp color when the signal is OFF.
Display data	Selection of input/output signal
Input Signal	Input signal No. to indicate
Output Signal	Output signal No. to indicate
Output Sig.	Signal No. to be output when the button pressed
Operation method	Choice of operation whether the [Enable] key needs to be pressed together
! mark	Timing to indicate the mark "!"
Disabled operate	Setting whether to disable the operation according to the status of common switch
Touch Panel key	Setting whether to disable the button operation on the touch panel

Push Button (User task)

Executes the user tasks

Item	Contents
Color of ON	Lamp color when the signal is ON.
Color of OFF	Lamp color when the signal is OFF.
User Task Prog. No.	Signal No. to be output when the button pressed
! mark	Timing to indicate the mark "!"

ON/OFF switch

Switches the output signal ON/OFF

Item	Contents
Base color	Color of switch base
Lever Color	Color of switch lever
The place of ON	Setting the position to place "ON" whether on the right or the left side of the switch
Output Sig.	Output signal number
Operation method	Choice of operation whether the [Enable] key needs to be pressed together when changing the status
Disabled operate	Setting whether to disable the operation according to the status of common switch

Contact switch

Switches ON/OFF of two output signals

Item	Contents
Base color	Color of switch base
Lever Color	Color of switch lever
Output Signal1	Output signal No. of the output signal 1
Output Signal2	Output signal No. of the output signal 2
Operation method	Choice of operation whether the [Enable] key needs to be pressed together when changing the status
Disabled operate	Setting whether to disable the operation according to the status of common switch

Display 3 digit

Indicates the input/output signal and the variable integer by 3 digits

Item	Contents
Base color	Color of display base
Display data	Choosing the data to display out of the following. - Input Signal - Output Signal - Variable Integer
Method of read	Choosing the data format to read out of the following. - Binary - BCD
Input Signal	Setting the input signal to indicate by 12bit. The data format is as preset by “Method of read”.
Output Signal	Setting the output signal to indicate by 12bit. The data format is as preset by “Method of read”.
Variable integer	Setting the variable integer No. to indicate.

Input 3 digit

Inputs the output signal and the variable integer by 3 digits

Item	Contents
Base Color	Color of display base
Method of Output	Choosing the data format to read out of the following. - Binary - BCD
Output Sig	Setting the output signal to indicate by 12bit. The data format is as preset by “Method of read”.
Disabled operate	Setting the variable integer No. to indicate.

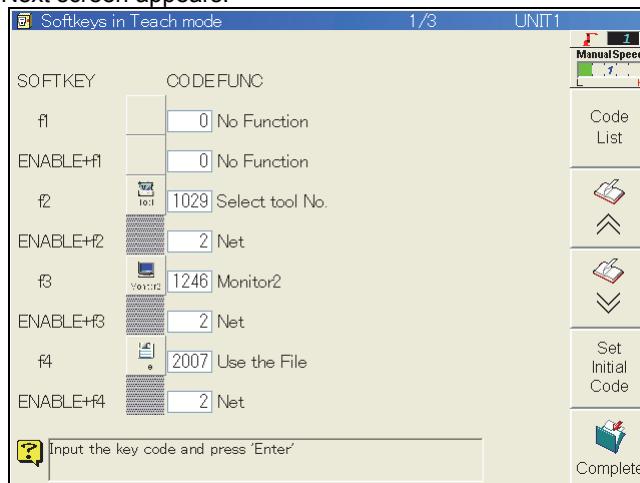
Restoring the softkey to the default



- 1 Press f5<Constant setting> and select [7. f-Keys].**

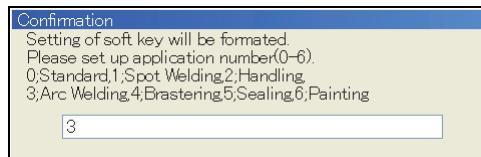
Choose either [2. Softkeys in Teach mode] or [3. Softkeys in Playback mode] depending on the mode of softkey to set up.

>> Next screen appears.



- 2 Press f11<Set initial Code>.**

>> Next screen appears.



Enter the number corresponding to the application currently in use, and press [Enter].

- 0: Standard (The case of the application is not 1 to 6)
- 1: Spot welding
- 2: Handling
- 3: Arc welding
- 4: Thermal spraying
- 5: Sealing
- 6: Painting

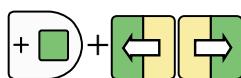


- 3 The default of softkey corresponding to the application chosen is now set. Then, press f12<Complete>.**

7.8.2 Changing the Maximum Number of Pages for Softkey

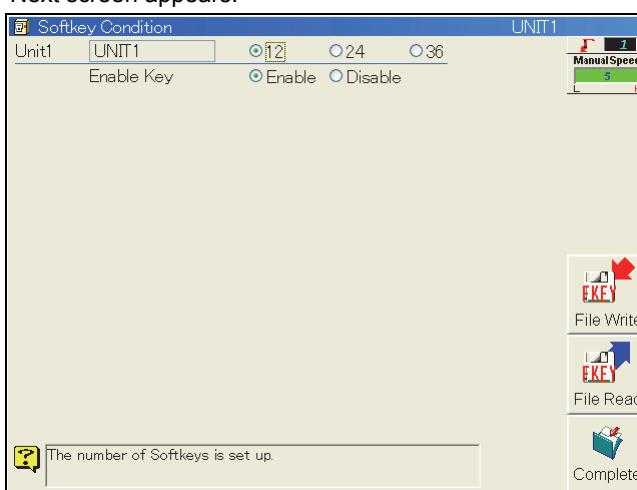
The softkey setting allows the maximum of 3 pages. Applying 3 pages (36), it is available to set up the maximum of 72 (sum of the front and back) softkeys.

Changing the maximum number of pages for softkey



- 1 Press f5<Constant setting> and select [7 f-Keys] – [1 Softkey Condition]**

>> Next screen appears.



12: 1 Page (f1 to f12, [Enable]+f1 to [Enable]+f12)

24: 2 Pages (f1 to f24, [Enable]+f1 to [Enable]+f24)

36: 3 Pages (f1 to f36, [Enable]+f1 to [Enable]+f36)

When there are 2 or more units, please set up by each unit.



- 2 On completion of setting, press f12<Complete> to save the settings.**



When setting 2 or more pages, the function key f1, f13, and f25 are automatically set out for the page shift. In this case, therefore, the number of softkeys you are able to freely use is $11 + 11 = 22$.



To reduce the number of pages, make sure that the functions in Table 7.8.1 “◎ (setting required)” are still set when the pages are reduced.
If not, you cannot reduce the number of pages.

7.8.3 Setting the Softkey Condition Enable/Disable

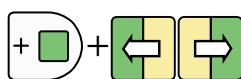
Setting the softkey condition [Disable], it allows the maximum number of softkeys in 1 page from f1 ~ f12 only.



Use this function when you are going to set only a few softkeys or you are to reduce the [Enable] key operation.

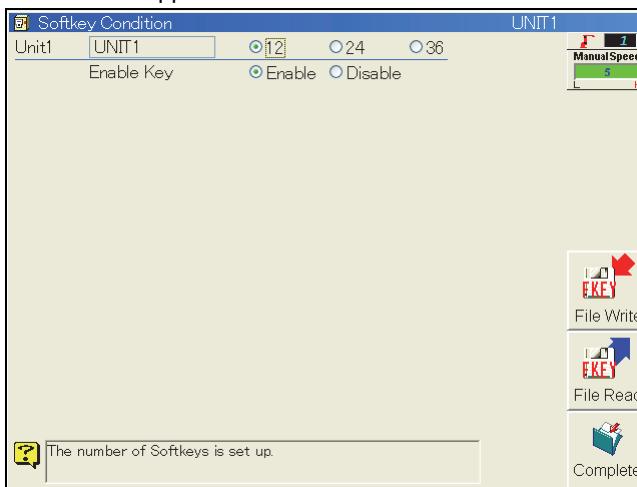
For this operation, the operator qualification of **EXPERT** or higher is required.

Setting the softkey condition Enable/Disable



- 1 Press f5<Constant setting> and select [7 f-Keys] – [1 Softkey Condition]

>> Next screen appears.



Default is set at [Enable].

When there are 2 or more units, please set up by each unit.



- 2 On completion of setting, press f12<Complete> to save the settings.



- For functions marked "◎ (functions that require settings)" in Table 7.8.1, always set the "Front screen" before performing the enable switch "Disable" settings. If the settings are not performed, enable switching cannot be "Disable."
- When "Enable Key" is changed from "Disable" to "Enable," it is not checked whether functions that require the [ENABLE] key to be pressed at the same time are allocated to the "Front screen." Always be sure to allocate functions as failure to do so may increase the possibility of incorrect operation.

7.8.4 Saving the Softkey Settings

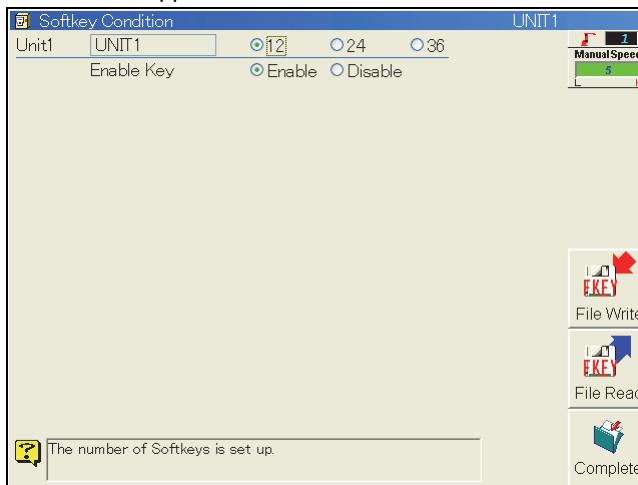
The softkey settings can be saved in the external memory.

Saving the softkey settings



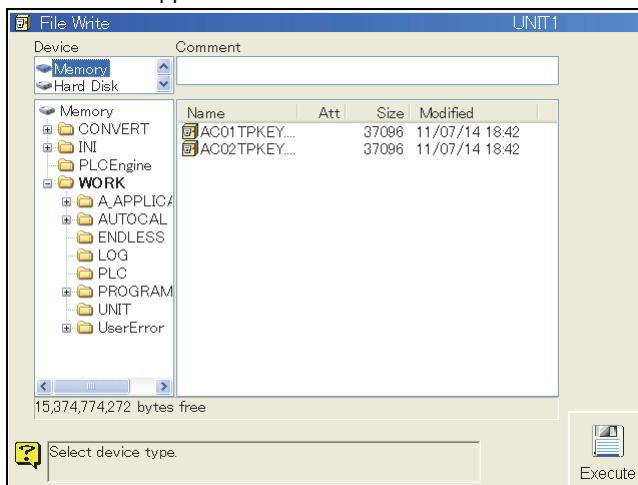
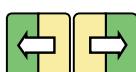
1 Press f5<Constant setting> and select [7 f-Keys] – [1 Softkey Condition]

>> Next screen appears.



2 Press f10<File Write>.

>> Next screen appears.

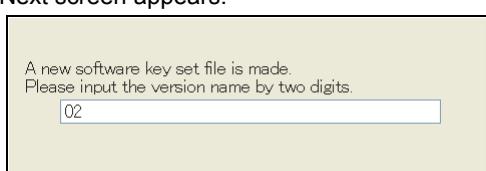


Select Device, and folder.



3 Press F12<Execute>.

>> Next screen appears.



Enter a 2-digit number.

**4 Press [Enter].**

>> Next screen appears.

File Write

UNIT1

File Name
AC02TPKEY.CON

Comment

Set the comment. If a "Enable" + "Edit" key is pushed, it will become a soft keyboard screen.

Execute

Press "Enable" + "Edit" key to enter the comment.

**5 Press f12<Execute> to save the settings.**

This setting is now saved in a file :

ACXXTPKEY.CON (XX: Version No. fixed in saving)

7.8.5 Loading Softkey Settings from the File

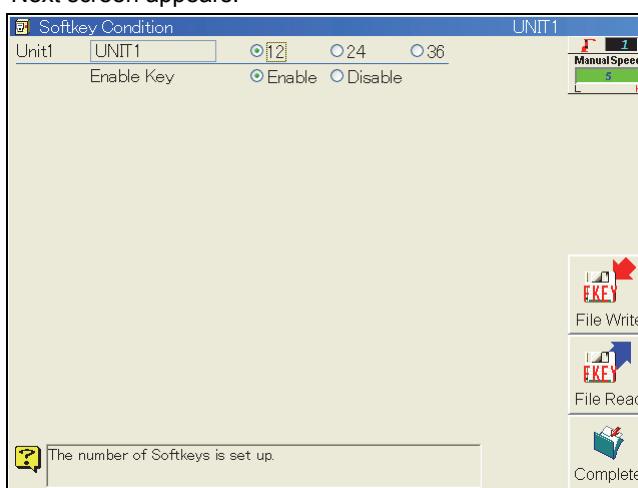
You are able to load the softkey settings from the file.

Loading the softkey settings



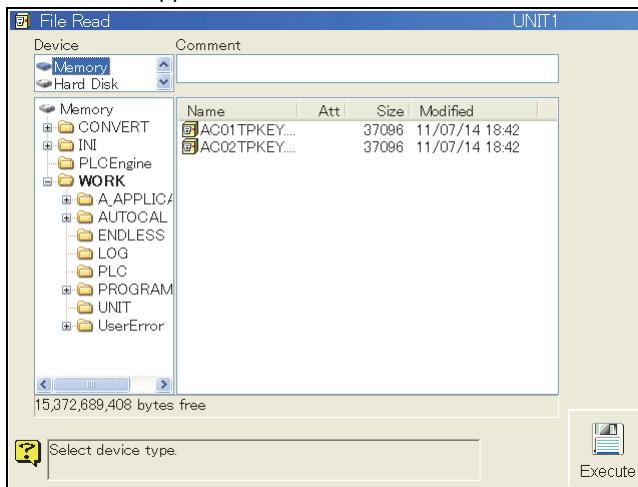
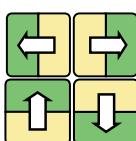
- 1 Press f5<Constant setting> and select [7 f-Keys] – [1 Softkey Condition]**

>> Next screen appears.



- 2 Press f11<File Read>.**

>> Next screen appears.



Choose a desired file, and press f12<Execute>.



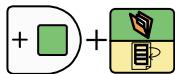
- If the settings of the “Enable Key Enable/Disable” differ between the controller and soft key setting file, the soft key setting file cannot be read.
- To read the file in such a condition, the operator qualification of **EXPERT** or higher is required.

7.9 Selecting the Program Number from the Program List

In the function record, the program number can be selected from the program list. In addition to the function record, the program number can also be selected in the same way, in the robot program screen edit or constant settings, or the service screen. Furthermore, when selecting the program, the list can be displayed for each unit, and the contents of the program checked.

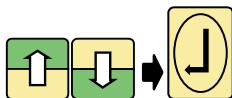
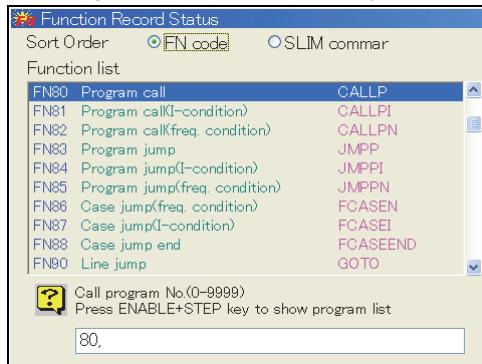
7.9.1 Selecting the Program Number from the Program List

Function Record



- 1 When inputting the program number in the function record status screen, hold [ENABLE] and press [PROG/STEP].**

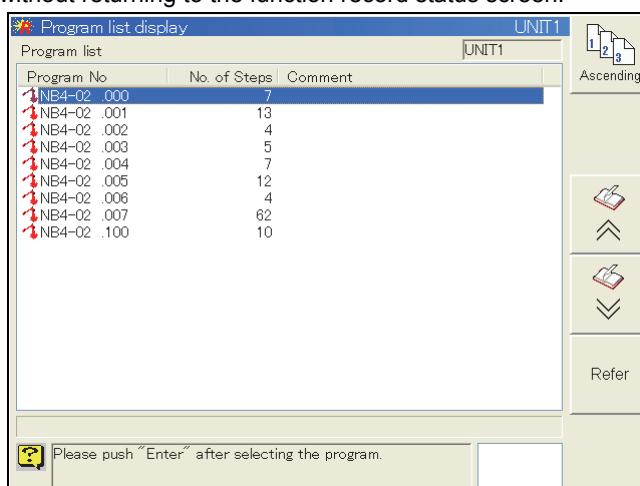
>> The [Program List] screen is displayed.



- 2 Select the program from the program list, and press [Enter].**

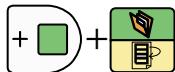
>> The selected program number is displayed in the function record status.

When the function parameter is only the program number, steps are recorded without returning to the function record status screen.



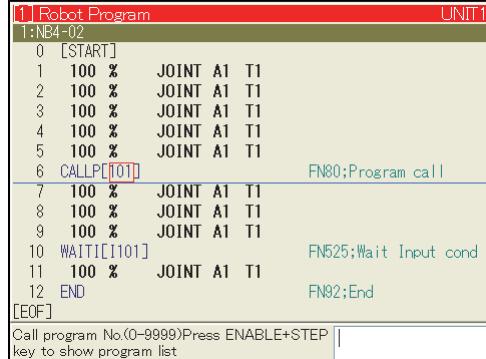
When the program list is displayed from CALL/JUMP type functions, only the programs for the currently selected unit are displayed.

When the program list is displayed from FORK/CALLFAR type functions (call outside the unit), programs for units other than the currently selected units are displayed.

Screen Edit

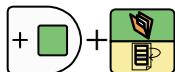
- 1 In the robot program screen edit, select the program number, hold [ENABLE] and press [PROG/STEP].**

>> The [Program List] screen is displayed.

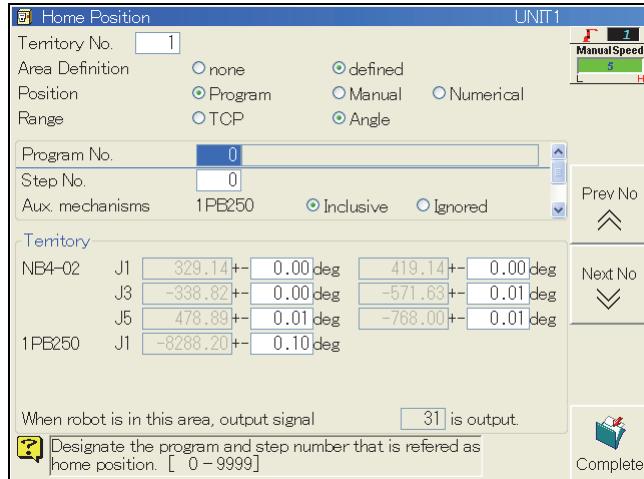


When the program list is displayed from CALL/JUMP type functions, only the programs for the currently selected unit are displayed.

When the program list is displayed from FORK/CALLFAR type functions (call outside the unit), programs for units other than the currently selected units are displayed.

Constant Settings/Service

- 1 In the constant settings screen or service screen, select the edit box for entering the program number, hold [ENABLE] and press [PROG/STEP].**

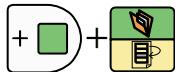


>> The [Program List] screen is displayed.

Monitor

- 1 Open the monitor in which the program number can be set, and press [Edit].**

>> The monitor switches to edit mode.

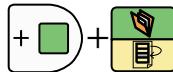


- Select the edit box for entering the program number, hold [ENABLE] and press [PROG/STEP].**

>> The [Program List] screen is displayed.

7.9.2 Displaying Programs for Each Unit

When multi-unit specifications are used, it is possible to limit the programs displayed in a list for each unit.



- 1 Hold [ENABLE] and press [PROG/STEP].**

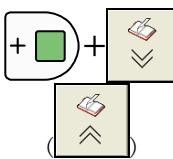
>> The program list is displayed.

At the top right of the screen, the name of the unit whose program list is displayed is shown.

"ALL UNIT" ... The programs of all units are displayed.

Program list display		
UNIT		
ALL UNIT		
Program No	No. of Steps	Comment
NB4-02 .000	7	
NB4-02 .001	12	
NB4-02 .002	4	
NB4-02 .003	5	
NB4-02 .004	7	
NB4-02 .005	12	
NB4-02 .006	4	
NB4-02 .007	62	
NB4-02 .100	10	
UNIT2 .101	3	
UNIT2 .102	3	
UNIT2 .200	11	
UNIT2 .201	9	
UNIT2 .202	19	

Please push "Enter" after selecting the program.



- 2 Hold [ENABLE] and press f10 <▽>.**

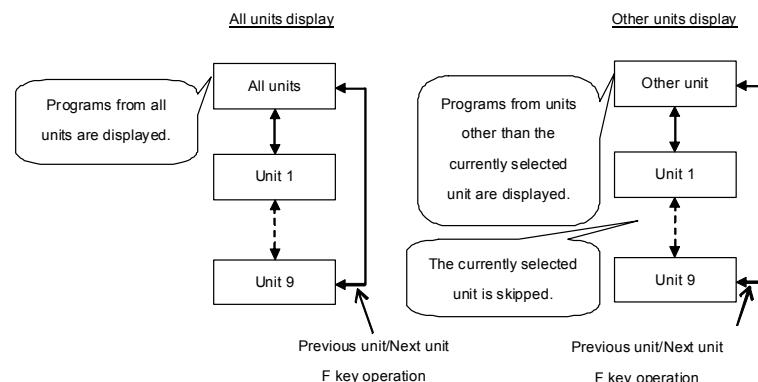
>> Only the programs for UNIT 1 are displayed.

The unit name is displayed at the top right of the list.

Program list display		
UNIT		
UNIT1		
Program No	No. of Steps	Comment
NB4-02 .000	7	
NB4-02 .001	12	
NB4-02 .002	4	
NB4-02 .003	5	
NB4-02 .004	7	
NB4-02 .005	12	
NB4-02 .006	4	
NB4-02 .007	62	
NB4-02 .100	10	

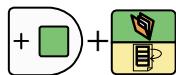
Please push "Enter" after selecting the program.

When the previous unit/next unit f keys are pressed, the units transit as shown below.
Other unit displays are applied when the unit external program is selected.
Also, units that do not exist are skipped.



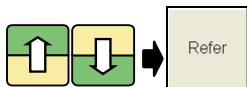
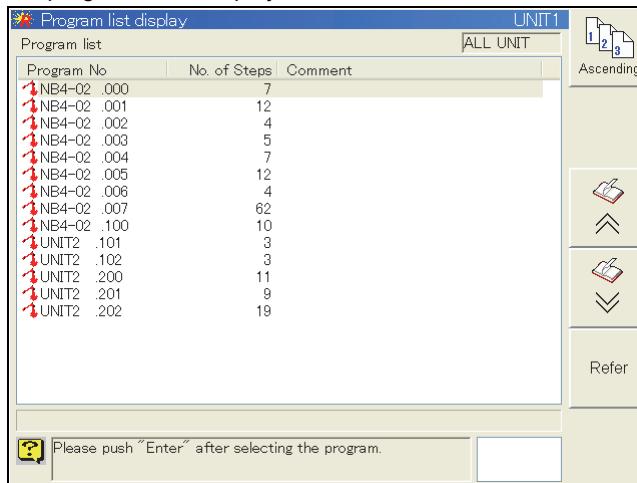
7.9.3 Checking Program Contents

You can check an overview of programs when they are shown in the program list display. If the pose record is enabled, the contents of pose files can also be checked.



1 Hold [ENABLE] and press [PROG/STEP].

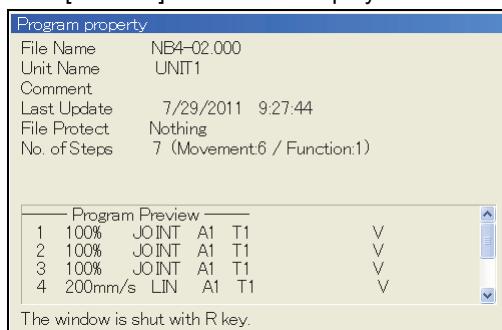
>> The program list is displayed.



2 Select the program, and press f11 <Refer>.

>> The program properties are displayed.

Press [Reset/R] to close the display.



The displayed contents are as shown below.

Item	Details
File name	File name of the program
Unit name	Unit name
Comment	The comment registered for the step 1 is displayed.
Last Update	Latest date on which the program was changed
File Protect	Protect status (All/Part/Playback)
No. of Steps	Total No. of steps
Movement command (*1)	No. of steps for the movement command
Function command (*1)	No. of steps for the function command
Application data (*1)	Date for each application is displayed. For spot welding, the number of spot welds is displayed. Depending on the application, this may not be displayed.
Program preview	The content of programs can be checked. (Maximum of 16 steps) It can be scrolled using the Up/Down key.

(*1) This is not displayed when pose record is enabled.

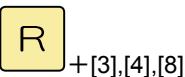
7.10 Displaying Language Switching Function

With this controller, the display of the operation screen can be switched to Japanese or to English. In addition, if optional languages are added, switching to and displaying those languages are also possible. Switching the display language can be done easily with the shortcut command R348. The power-on display language is turned on can also be set.

POINT

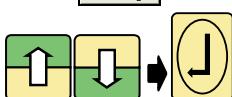
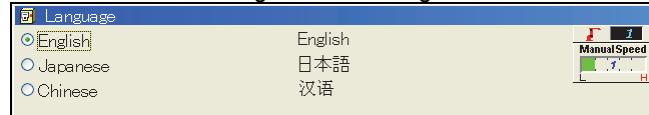
In order to set the candidate languages, switch the operator qualification to **EXPERT**.

Setting the languages for display switching



- 1 **Shortcut command R348,**
Select [Constant Setting] - [2 Screen Constants] - [2 Language Selection].

>>The following setting screen is displayed.



POINT

If a language option has not been added (Japanese and English only), when running R348, the above language selection menu will not appear, and the language will be switched to the other language. In addition, the following steps will not be necessary.



- 2 **Select language.**



- 3 **When the selections are completed, press f12 <Complete>.**

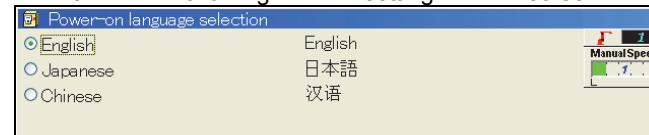
>> The display language will be switched to the selected language.

Setting the languages selection at power-on



- 1 **Select [Constant Setting] - [2 Screen Constants] - [1 Language Selection at power-on].**

>>The following setting screen is displayed.



- 2 **Select language.**



- 3 **When the settings are completed, press f12 <Complete>.**

>> The power-on display language selection and the display language is switched to the selected language.

7.11 Selecting a Function Command Step and Operating

With this controller, you can select a function command step from the teach pendant, and perform playback operation or check operation. As this function is set to "Prohibited" by default, settings are required in order to use it.

7.11.1 Selecting the playback operation from the function command

The following three types of operation are available for selecting the function command step from the teach pendant, and performing playback operation or check operation. They are set to "Prohibited" by default.

Table 7.11.1 Playback operation settings from the function command

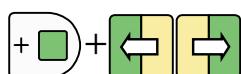
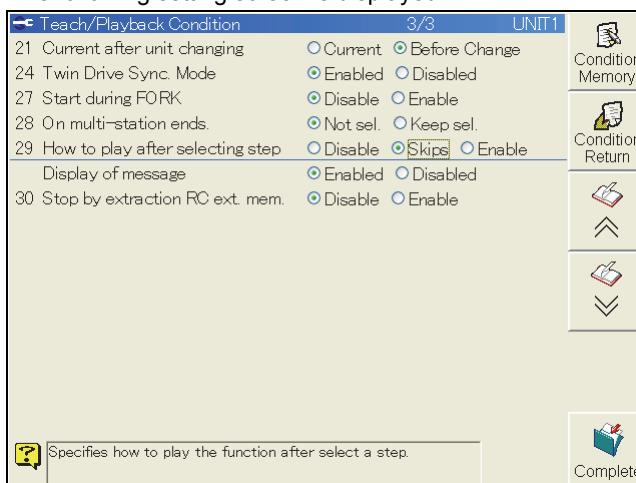
Setting	Controls for Check Operation	Controls for Playback
Disable	Check operation cannot be performed.	Playback operation cannot be performed.
Skips	After selecting the function command in the step selection, press [Check go] or [Check back] and the current step moves to movement command nearest to the operation direction. None of the function commands that exist between the function command in which the step was selected or the movement commands are executed.	Playback operation cannot be performed.
Enable	When a function command is selected in the step selection and "*" is displayed in the appropriate step of the program monitor, check go operation and playback operation are available. Depending on the selected function command, "*" may not be displayed, and there may be some function commands that cannot be executed. Check back operation and reverse playback operation cannot be performed.	

Setting the playback operation for the function command after step selection



- 1 In the teach mode, select [29 How to play after selecting step] in <Service Utilities> - [1 Teach/Playback Condition].**

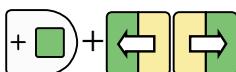
>> The following setting screen is displayed.



- 2 Select using [ENABLE] + [Left/Right].**

>> Select from the settings shown in Table 7.11.1.

When "Skips" or "Enable" is selected, the "Display of message" becomes selectable.



- 3 Align the cursor with “Display of message” and select using [ENABLE] + [Left/Right].**

Table 7.11.2 Message Settings

Setting	Details of Operation
Enabled	After selecting the function command in the step selection, a confirmation message is displayed when check operation or playback operation controls are performed.
Disabled	After selecting the function command in the step selection, a confirmation message is not displayed even if check operation or playback operation controls are performed.



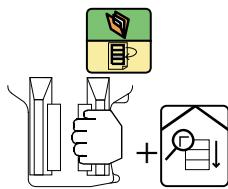
- 4 When the settings are completed, press f12 <Complete>.**

>> The settings are saved to the internal memory.

7.11.2 Skipping the Step Selected Function Command and Operating

When <Service Utilities - [1 Teach/Playback Conditions] – [29 How to play after selecting step] is set to “Skip,” step selection can be performed for function command, and check operation controls can be performed. In this case, if [Check go] or [Check back] is pressed, the function command for which steps were selected is skipped, and the current step can be transferred to the closest movement command.

Skipping the Step Selected Function Command and Operating



- 1 Press [PROG/STEP], and select the function command step.**

- 2 While grasping the [Enable Switch], press [Check go] (or [Check back]).**
 >> The current step is transferred to the movement command closest to the check operation direction.
 (If a movement command does not exist, the current step is not transferred.)

When “Confirmation message” is set to “Enabled” (see Table 7.11.2), a confirmation message is displayed after the current step is transferred.



In this operation, just the current step is moved (re-selected), and the function command is not executed.

7.11.3 Performing Check Go Operation from the Step Selected Function Command

When <Service Utilities - [1 Teach/Playback Conditions] – [29 How to play after selecting step] is set to “Enable”, check go operation can be executed for the function command in which steps were selected.

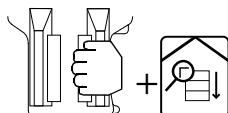
Skipping the Step Selected Function Command and Operating Check Go



1 Press [PROG/STEP], and select the function command step.

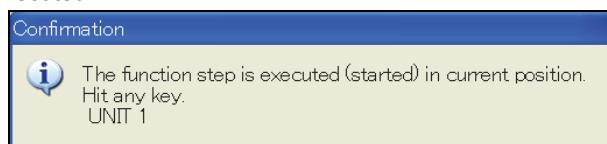
>> When an executable function command is selected, “*” is displayed for the applicable steps in the program monitor.

	Teach Motors	Program	Step	7/29/2011 16:04	U1	Teach/Play Condition
	1 [EX]	6			1:NB4-02 Manual Speed 3 H	
Station Set		I11 Robot Program			*UNIT1	
Monitor2			100 %	JOINT A1 T1		
File			0 [START]		pos	
Constant Setting			1 100 %	JOINT A1 T1		
Service Utilities			2 100 %	JOINT A1 T1		
			3 100 %	JOINT A1 T1		
			4 100 %	JOINT A1 T1		
			5 100 %	JOINT A1 T1		
			6 * CALLP[101]		FN80:Prog	
			7 100 %	JOINT A1 T1		ACC
			8 SETM[01, 1]		FN105:Outpu	
			9 100 %	JOINT A1 T1		
			10 100 %	JOINT A1 T1		



2 While grasping the [Enable Switch], press [Check go].

When “Confirmation message” is set to “Enabled” (see Table 7.11.2), the following confirmation message is displayed. At this point, the function command is not executed.



Press any key to close the confirmation message.

Once again, grasp the [Enable Switch], press [Check go].

3 The robot remains in the current position, and the function command for the current step is executed.



The function command is executed in the current robot position. For this reason, the position is different to the position taught by the program (position when the program is played from the start), and that function command may be executed. Before performing check go controls, always check the current position of the robot.



- Depending on the function command, check go operation may not be available for this control.
- Check back operation cannot be performed.



In order to execute the function command, <Service Utilities> – [1 Teach/Playback conditions] – [9 Check with function] needs to be set to “Enabled” (or “I-enabled”).

7.11.4 Performing Playback Operation from the Step Selected Function Command

When <Service Utilities> - [1 Teach/Playback Conditions] – [29 How to play after selecting step] is set to “Enable,” playback operation can be executed for the function command in which steps were selected.

Skipping the Function Command in which Steps were Selected and Performing Playback Operation



1 Press [PROG/STEP], and select the function command step.

>> When an executable function command is selected, “*” is displayed for the applicable steps in the program monitor.

	Play-back	Program	Step	7/29/2011 16:51	U1	Teach/Play Condition
	1 [EX]	6			1:NB4-02 Manual Speed 5 H	Step by Step
Start/Prog Con. Con.					Robot	
Monitor2						
Step Single						
Cycle Step by Step						
Service Utilities						
		[1] Robot Program			*UNIT1	
		100 %	JOINT A1 T1			
		0 [START]				
		1 100 %	JOINT A1 T1	pos		
		2 100 %	JOINT A1 T1			
		3 100 %	JOINT A1 T1			
		4 100 %	JOINT A1 T1			
		5 100 %	JOINT A1 T1			
		6 *CALLP[101]		FN80:Program		
		7 100 %	JOINT A1 T1			
		8 SETM[01, 1]		FN105:Output		
		9 100 %	JOINT A1 T1			
		10 100 %	JOINT A1 T1			

2 Press the [Start Button].

When “Confirmation message” is set to “Enabled” (see Table 7.11.2), the following confirmation message is displayed. At this point, playback operation is not started.



Press any key to close the confirmation message.
Press the [Start Button] again.

3 Playback operation starts.



The function commands taught from the function commands in which steps were selected until the next move command are all executed in the current robot position. For this reason, the position is different to the position taught by the program (position when the program is played from the start), and the function command may be executed.

Before performing playback operation, always check the current position of the robot.

- Depending on the function command, playback operation may not be available for this control.
- Multiple function commands may be taught from the function command in which steps were selected to the next movement command. If there are function commands that cannot be executed because of this function in the function commands, an error occurs when those function commands are played.

7.12 Input robot language for the function parameter

It is possible to use a robot language style description for the function parameter. For example, it is possible to use descriptions like “Vn%”(integer number variable) or “Vn!” (real number variable) (1<n<500) for the “FN50 DELAY”. By setting the function parameter like this method, it is possible to improve the maintainability of the program. And, it is also possible to modify a executable program that was created by the robot language.

Table 7.12-1 Available functions (Available in the system software FDV03.21 or after)

Function Number	Command	Name
50	DELAY	Timer delay
58	SHIFTA	XYZ shift
68	LETR	Set shift value
330	VRESET	Vision reset
331	VSTART	Vision start
333	VSHIFT	Vision shift

7.12.1 How to input the robot language style parameter

The robot language style parameter can be added / edited in the screen editor.



- 1 Select the “Robot program monitor” window and press [Edit] key.**

>>The screen editor will be displayed.

```
[1] Robot Program UNIT1
1:SRA166-01
0 [START]
1 LETVF[V1!,2] FN76;Set real variable
2 100 % JOINT A1 T1
3 100 % JOINT A1 T1
4 100 % JOINT A1 T1
5 100 % JOINT A1 T1
6 DELAY[2] FN50;Timer delay
7 100 % JOINT A1 T1
8 100 % JOINT A1 T1
9 END FN92;End
[EOF]
```

The function can be inserted with the “FN” key.

For details, refer to the chapter 4.

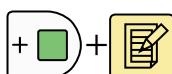


- 2 Set the cursor to the parameter to be edited.**

>>In this example, set the cursor to the parameter for the “FN50 DELAY”.

```
[1] Robot Program UNIT1
1:SRA166-01
0 [START]
1 LETVF[V1!,2] FN76;Set real variable
2 100 % JOINT A1 T1
3 100 % JOINT A1 T1
4 100 % JOINT A1 T1
5 100 % JOINT A1 T1
6 DELAY[2] FN50;Timer delay
7 100 % JOINT A1 T1
8 100 % JOINT A1 T1
9 END FN92;End
[EOF]
```

Delay time(sec)(0-60)
[Enable+Edit] display soft keyboard.



- 3 Press [Enable] + [Edit] key.**

>>The software keyboard will be displayed.



- 4 Input “V1!” for the parameter using the software keyboard and then press f12 <Complete>.**

>>The inputted description is displayed at the cursor position.

```
[1] Robot Program UNIT1
1:SRA166-01
0 [START]
1 LETVF[V1!,2] FN76;Set real variable
2 100 % JOINT A1 T1
3 100 % JOINT A1 T1
4 100 % JOINT A1 T1
5 100 % JOINT A1 T1
6 DELAY[V1!] FN50;Timer delay
7 100 % JOINT A1 T1
8 100 % JOINT A1 T1
9 END FN92;End
[EOF]
```

Delay time(sec)(0-60)
[Enable+Edit] display soft keyboard.



- 5 Save the edited parameter to the program file by pressing f12 <Complete>.**



When using a number for the function parameter, the number can be inputted directly by using the numeric keys of the teach pendant. (The software keyboard is not used)



For the register variable parameter and the step number parameter, only constant number can be set.



Only the following variables, constants, and arithmetic operators are available for inputting the parameter. For details, refer to the instruction manual “Robot Language”.

Variables;

Vn%	Global variable(integer value)
Vn!	Global variable(real number)
Ln%	Local variable (integer number)
Ln!	Local variable (real number)

Example;

```
DELAY [ (V1!+V2!)/V3! ]
SHIFTA [ 0,L![1],L![2],L![11] MOD L![12] ]
```

NOTE

Chapter 8 Compact teach pendant

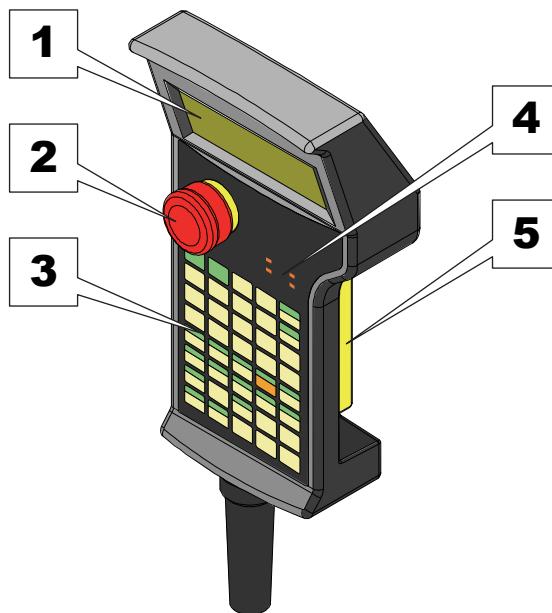
This chapter describes the Compact Teach Pendant.

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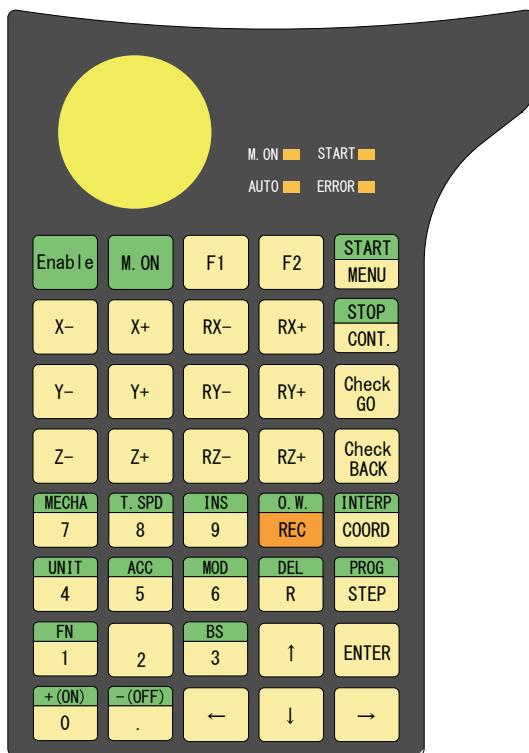
8.1 Compact Teach Pendant

8.1.1 Functions of each part

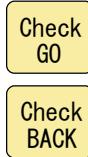
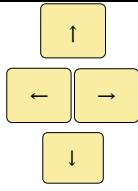


No.	Name	Description
1	Character display [Character display]	Character LCD. Program etc. are displayed.
2	[EMERGENCY STOP BUTTON]	This is a button to stop the robot forcibly. To release the lock status of this button, turn this button to right. While this button is being locked, it is impossible to turn the motors power source circuit ON. The CFD controller operation panel also has the same button.
3	Operation keys [Operation keys]	These are the operation keys to operate the robot manually or execute the various settings.
4	LED [LED] M.ON START AUTO ERROR	Condition LED. M.ON : This turns ON while the motors power source circuit is ON. START : This turns ON while the robot is running the program. AUTO : This turns ON in case of the PLAYBACK mode. ERROR : This turns ON when an error happens.
5	(Back side) [ENABLE SWITCH]	This switch is used to execute the "Servo ON" in the TEACH mode. This switch is not used in the PLAYBACK mode. While this switch is being grasped, it is possible to operate the robot manually. In addition, this is a 3-position switch. Released : OFF Grasped : ON Grasped strongly : OFF When the robot moves in unexpected way, please release this switch or grasp this switch strongly. Then the robot will make emergency stop.

8.1.2 Operation keys



External view	Name in this document	Functions
	[Enable]	The functions are executed by pressing this key together with other keys.
	[M.ON]	The motor power is set to ON by pressing this key together with the [Enable] key.
	[F1]	The general output signals that are assigned in advance can be turned ON / OFF by this key.
	[F2]	This key is used to perform an "Input signal cancel operation".
	[START/MENU]	MENU DISPLAY When this key is pressed, setting menu is displayed. START THE PLAYBACK When this key is pressed, the playback operation of the work program will start.
	[INTERP/COORD]	COORDINATE SYSTEM SELECTION During manual operation, the operating coordinate system can be selected by this key. Each time this key is pressed, the joint coordinates, robot coordinates (or user coordinates) or tool coordinates are selected and displayed on the LCD screen. INTERPOLATION TYPE SELECTION This key changes the interpolation type of the recording status.
	[STOP/CONT.]	CONTINUOUS / NON-CONTINUOUS Continuous or non-continuous during a check go or check back operation is selected. When continuous operation is selected, the operation of the robot does not stop at each step. PLAYBACK STOP The program being played back is stopped.

External view	Name in this document	Functions
	[AXIS OPERATION]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE SWITCH] AXIS OPERATION The robot is moved manually. If an auxiliary axis to be moved, the operation target is selected ahead of time.</p>
	[Check GO] [Check BACK]	<p>PRESSED ON ITS OWN No function</p> <p>WITH [ENABLE SWITCH] CHECK GO / CHECK BACK When these are pressed together with the [ENABLE SWITCH], the check go or check back operation is performed. Normally, the robot is stopped at each recorded position (step). It is also possible to move the robot continuously. Use [STOP / CONT.] to select step or continuous.</p>
	[O.W./REC] O.W. = OVER WRITE	<p>PRESSED ON ITS OWN RECORDING A MOVEMENT COMMAND During teaching, the movement command is recorded. This can be used only when the last step in the work program has been selected.</p> <p>WITH [Enable] key OVERWRITING THE MOVEMENT COMMAND The already recorded movement command is overwritten by the current recording statuses (position, speed, interpolation type, and accuracy). However, the command can be overwritten only when changes are made to what is recorded for the movement commands. A movement command cannot be overwritten by a function command; neither can a function command be overwritten by another function command.</p>
	[DEL/R]	<p>PRESSED ON ITS OWN INPUT CLEAR or R-CODE INPUT This clears the input or returns the setting screen to its original status. It also enables R codes (short-cut codes) to be input. The function that is to be used can be called immediately by inputting an R code.</p> <p>WITH [Enable] key STEP DELETION The step now selected (movement command or function command) is deleted.</p>
	[PROG/STEP]	<p>PRESSED ON ITS OWN STEP SELECTION This is used to select a step specified in the program.</p> <p>WITH [Enable] key WORK PROGRAM SELECTION This is used to open a specified work-program.</p>
	[ENTER]	This enters the menu or numerical input contents.
	[CURSOR]	When these keys are pressed, the cursor moves.

External view	Name in this document	Functions
	<p>[Numeric keys]</p> <p>[INS/9] [T.SPD/8] [MECHA/7] [MOD/6] [ACC/5] [UNIT/4] [BS/3] [2] [FN/1] [+/0] [- ·]</p>	<p>PRESSED ON ITS OWN Numerical input ("0"- "9", ",") Numbers (0 to 9, decimal point) are input.</p> <p>WITH [Enable] key [9] INSERTION OF A MOVEMENT COMMAND The movement command is inserted “Before” the current step.</p> <p>WITH [Enable] key [8] MANUAL SPEED CHANGE The operating speed of the robot during manual operation is selected. Each time this key is pressed, one of the 1 to 5 operating speeds is selected (the higher the number, the faster the speed). And the check go/back speed is changed also.</p> <p>WITH [Enable] key [7] MECHANISM SELECTION When a multiple number of mechanisms are connected to the system, the mechanism to be operated manually is selected.</p> <p>WITH [Enable] key [6] STEP POSITION MODIFICATION The position stored in the movement command now selected is changed to the current robot position.(in encoder values format)</p> <p>WITH [Enable] key [5] ACCURACY SELECTION This is used to change the accuracy setting in the recording status.</p> <p>WITH [Enable] key [4] UNIT SELECTION When a multiple number of units are defined in the system, the unit to be operated is selected.</p> <p>WITH [Enable] key [3] BACK SPACE The number or character before the cursor position is deleted.</p> <p>WITH [Enable] key [1] FUNCTION This is used when inputting the function commands.</p> <p>WITH [Enable] key [0] "+" input “+” is input. / or “ON” operation is done.</p> <p>WITH [Enable] key [.] "-" input “-” is input. / or “OFF” operation is done.</p>

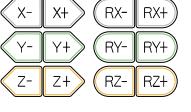
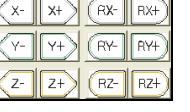
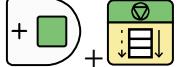
8.1.3 Alternative operation list

Although the basic operations can be done using the Compact Teach Pendant, there are operations that the Compact Teach Pendant cannot be used. For those operations, please use the software of "FD on DESK".

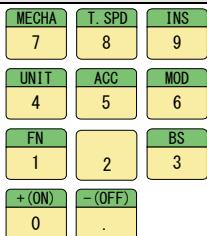
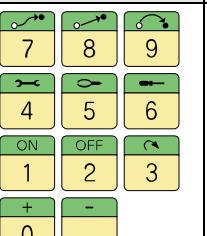
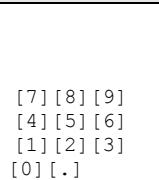
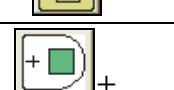
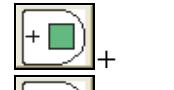
For details of the "FD on DESK", refer to the following instruction manuals.

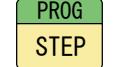
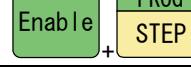
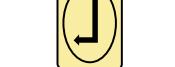
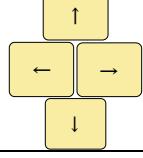
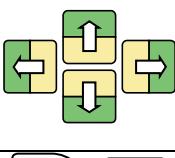
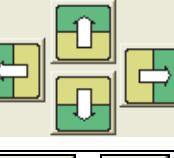
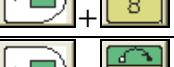
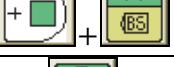
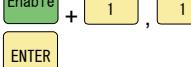
**"Simulation tool for CFD controller FD on Desk Light OPERATING MANUAL"
(TFDEN-906)**

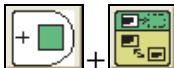
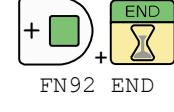
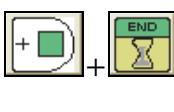
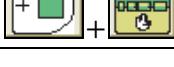
**"Simulation tool for FD/CFD controller FD on DESK Light/Regular/Pro OPERATING MANUAL"
(TFDEN-904)**

Compact Teach Pendant	Smart Teach Pendant	FD on Desk Virtual TP Virtual I/O	FD on Desk PC keyboard	Remarks
				
Enable			[Shift]	[ENABLE]
Enable + M. ON	 + 			[MOTORS ON]
Enable + F1	 + 	 + 	[Shift]+[g]	Turning ON/OFF the output signal (Setting is necessary)
Enable + F2	 + 	 + 		I-signal waiting condition release
START MENU				Menu screen for the Compact Teach Pendant
Enable + START MENU	 + 			Start operation for a program (Internal start method)
X- X+ RX- RX+ Y- Y+ RY- RY+ Z- Z+ RZ- RZ+				[Axis operations keys]
STOP CONT.			[h]	[CONTINUE]
Enable + STOP CONT.	 + 	 or 		[STOP]
Enable + Check GO				[CHECK GO] In case of the Compact TP, the [Enable] is also necessary.
Enable + Check BACK				[CHECK BACK] In case of the Compact TP, the [Enable] is also necessary.

8.1 Compact Teach Pendant

				
Compact Teach Pendant	Smart Teach Pendant	FD on Desk Virtual TP Virtual I/O	FD on Desk PC keyboard	Remarks
				[7] [8] [9] [4] [5] [6] [1] [2] [3] [0] [.] [Numeric keys]
Enable + MECHA 7				[j] [MECHANISM]
Enable + T. SPD 8				[p] [TEACH SPEED]
Enable + INS 9				[Shift]+[a] [INSERT]
Enable + UNIT 4				[Shift]+[j] [UNIT]
Enable + ACC 5				[a] [ACCURACY]
Enable + MOD 6				[Shift]+[m] [MOD] (Modify)
Enable + FN 1				[f] [FN]
Enable + BS 3				[Back space] [BS] (Back Space)
Enable + (ON) 0				[Shift]+[+] [Shift]+[/] ([/] is ten key) [+] [ON]
Enable + -(OFF) .				[-] [Shift]+[/] ([-] is ten key) [-] [OFF]
O. W. REC				[c] [REC] (Record)
Enable + O. W. REC				[Shift]+[c] [O.W] (Over Write)
INTERP COORD				[b] [COORD] (Coordination)
Enable + INTERP COORD				[Shift]+[b] [INTERP] (Interpolation)
DEL R				[r] [Reset]

				
Compact Teach Pendant	Smart Teach Pendant	FD on Desk Virtual TP Virtual I/O	FD on Desk PC keyboard	Remarks
			[Shift]+[d]	[DELETE]
			[s]	[PROG / STEP]
			[Shift]+[s]	
			[Enter]	[Enter]
			[↑] [↓] [←] [→]	[CURSOR]
None				Change the interpolation type to the "JOINT"
None				Change the interpolation type to the "LIN"
None				Change the interpolation type to the "CIR"
None				<Constant setting> [7 f-Keys] [8 HARD KEY]
None				<Constant setting> [7 f-Keys] [8 HARD KEY]
None				<Constant setting> [7 f-Keys] [8 HARD KEY]
None				[REDO]
None				[UNDO]
None			[g]	[CLAMP / ARC]
None			[Delete]	[HELP] To use the help function, FD on DESK is necessary.
None			[o]	[OUTPUT] FN105 SETM can be inputted by the operation of;      
None			[Shift]+[o]	Manual signal output operation

				
Compact Teach Pendant	Smart Teach Pendant	FD on Desk Virtual TP Virtual I/O	FD on Desk PC keyboard	Remarks
None	 FN525 WAITI		[i]	[INPUT] FN525 WAITI can be inputted by the operation of; Enable + FN 1, ACC 5, 2, ACC 5, ENTER
None			[TAB]	[SELECT SCREEN] For the monitor windows or the operation for them, please use FD on DESK.
None			[Shift]+[TAB]	[CLOSE] For the monitor windows or the operation for them, please use FD on DESK.
None				[SYNC] To operate the synchro-motion, please use FD on DESK.
None			[Ctrl]	[SHIFT]
None			[v]	[SPEED] To change the recorded speed of the step, please use FD on DESK.
None	 FN50 DELAY		[t]	[TIMER] FN50 DELAY can be inputted by the operation of; Enable + FN 1, ACC 5, + (ON) 0, ENTER
None	 FN92 END			[END] FN92 END can be inputted by the operation of; Enable + FN 1, INS 9, 2, ENTER
None			[e]	[EDIT] To use the screen editor, please use FD on DESK.
None				[I/F] To use the interface panel, please use FD on DESK.
None			[Shift]+[p]	[CHECK SPEED]

8.1.4 Menu for Compact Teach Pendant

The Compact Teach Pendant has its original menu structure shown as below.
To use this menu, please press [START/ MENU] key.



Menu list

Menu	Sub menu	Functions
ROBOT	ENCRESET (Encoder reset)	In case of robot replacement etc., a reference position adjustment is necessary. In this menu, encoder reset and encoder correction can be done. ->“CFD CONTROLLER INSTRUCTION MANUAL : SETUP MANUAL” Chapter 6
	ENCCORRE (Encoder correction)	
SETTINGS	F-KEY	Function of F1-key and the F2-key can be set. ->“8.6.2 Manual ON/OFF of general output signal (F1 key)” ->“8.6.3 Canceling of input signal waiting (F2 key)”
	REC STS (Recording status)	The recording status of a movement command can be set. This menu is used often for teaching operation. ->“8.3.3 Try teaching”
	TCP/IP	Ethernet settings (e.g. IP address etc.) ->“CFD CONTROLLER INSTRUCTION MANUAL : SETUP MANUAL” Chapter 6
	FILE	Data backup and data restore using USB memory ->“8.5 File backup and restore”
	LANGUAGE	Language selection (JP / EN / CN (Pin-yin)) ->“CFD CONTROLLER INSTRUCTION MANUAL : SETUP MANUAL” Chapter 6
MONITOR	TP (Teach pendant)	The contrast of the LCD can be changed. Normally, it is not necessary to change this setting. ->“CFD CONTROLLER INSTRUCTION MANUAL : SETUP MANUAL” Chapter 6
	AXISMON	Monitoring function for robot position, I/O signals, etc. ->“8.6.4 Monitoring various conditions of robot”
	OUTPUT	
	INPUT	
	ALM REC	

8.1.5 The layout of the screen (TEACH mode)



Screen layout in the TEACH mode

P 9 9 9 9	U 1 M 1 J	S 1 C 1
S 0 0 0 1	1 0 0 0 L N	A 1 P T 3 2
^ ^ ^ ^	m m / s	
>		

1st line: Manual operation related information

Display	Description	Smart TP / FD on DESK
P9999	Program No. = 9999	
U1	UNIT No. = 1	
M1	MECHANISM No. = 1	
J	Manual operation coordinate system J : Joint coordinate system LR: Robot coordinate system LT: Tool coordinate system Lw: World coordinate system U*: User coordinate system	<ul style="list-style-type: none"> J LR LT Lw U*
S1	Manual operation speed = 1 (Check go/back speed = 1)	
C1	Interpolation method of the "Record status" JT : JOINT LN : LIN C1 : CIR1 C2 : CIR2	<p>[1] Robot Program 1200 mm/s CIR A1 T1</p> <p>CIR1 and CIR2 is displayed as "CIR"</p>

2nd line: Current step data (1st)

Display	Description	Smart TP / FD on DESK												
S0001	Step No. = 0001													
1000	SPEED = 1000 mm/s													
LN	Interpolation type of the step JT:JOINT LN:LIN C1:CIR1 C2:CIR2	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> <tr><td>1000 mm/s</td><td>LIN</td><td>A1P</td><td>T32</td></tr> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> </table> <p>Current step = green</p>	100 %	JOINT	A1	T1	1000 mm/s	LIN	A1P	T32	100 %	JOINT	A1	T1
100 %	JOINT	A1	T1											
1000 mm/s	LIN	A1P	T32											
100 %	JOINT	A1	T1											
A1	Accuracy = 1													
P	Pause = ON													
T32	Tool No. = 32													

3rd line: Current step data (2nd)

Display	Description	Smart TP / FD on DESK												
~~~~~	Step position reached (The all axes have reached their recorded positions in the step)	<table border="1"> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> <tr><td>1000 mm/s</td><td>LIN</td><td>A1P</td><td>T32</td></tr> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> </table> <p>The current step cursor turns to yellow</p>	100 %	JOINT	A1	T1	1000 mm/s	LIN	A1P	T32	100 %	JOINT	A1	T1
100 %	JOINT	A1	T1											
1000 mm/s	LIN	A1P	T32											
100 %	JOINT	A1	T1											
mm/s	Speed = 1000 mm/s	<table border="1"> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> <tr><td>1000 mm/s</td><td>LIN</td><td>A1P</td><td>T32</td></tr> <tr><td>100 %</td><td>JOINT</td><td>A1</td><td>T1</td></tr> </table>	100 %	JOINT	A1	T1	1000 mm/s	LIN	A1P	T32	100 %	JOINT	A1	T1
100 %	JOINT	A1	T1											
1000 mm/s	LIN	A1P	T32											
100 %	JOINT	A1	T1											

4th line: Prompt / Error No.

### 8.1.6 The layout of the screen (PLAYBACK mode)



#### Screen layout in the PLAYBACK mode

P 9 9 9 9	U 1	1 s 1 0 0 %
S 0 0 0 1	1 0 0 0 L N	A 1 T 1
	m m / s	
>		

1st line: Automatic operation related information

Display	Description	Smart TP / FD on DESK
P9999	Program No. = 9999	
U1	UNIT No. = 1	
1s	Operation mode 1s : 1 step Cy : 1 cycle ↵ Co : Continuous	
100%	Playback speed override	

2nd line: Step data 1

Display	Description	Smart TP / FD on DESK
S0001	Step No. = 0001	
1000	SPEED = 1000 mm/s	
LN	Interpolation method of the step JT : JOINT LN : LIN C1 : CIR1 C2 : CIR2	 Current step = green
A1	Accuracy = 1	
P	Pause = ON	
T32	Tool No. = 32	

3rd line: Step data 2

Display	Description	Smart TP / FD on DESK
~~~~~	(The all axes have reached their recorded positions in the step)	 The current step cursor turns to yellow
mm/s	SPEED = 1000 mm/s	

4th line: Prompt / Error No.

8.2 Basic operations

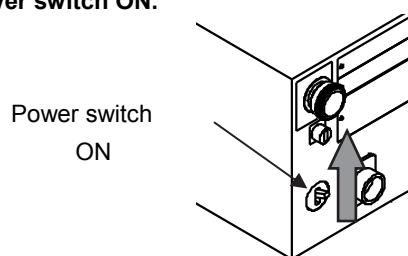
8.2.1 Turning ON the controller power



Before turning ON the controller power, do not forget to close the cover of the controller. When touching the power supply parts and an electric shock occurs, death or serious injury may occur.



1 Turn the power switch ON.



>> The software version will be displayed on the Compact TP.

S T A R T I N G

V 3 . 0 7

>> After completing the initial diagnosis, the following screen will be displayed.
(This is an example of TEACH mode.)

P 0 0 0 1	U 1 M 1 J	S 1 L N
S 0 0 0 0	[S T A R T]	
>		

8.2.2 Selecting the TEACH mode or the PLAYBACK mode

How to select the TEACH mode



- 1** Turn the [MODE SELECT SWITCH] to the TEACH mode side.

- 2** The screen like the following will be displayed.

P 9 9 9 9	U 1 M 1 J	S 1 C 1
S 0 0 0 1	1 0 0 0 L N	A 1 P T 3 2
^ ^ ^ ^	m m / s	
>		

>>The “AUTO” LED turns OFF.



>>If a PC of FD on Desk is connected, the ICON turns to TEACH mode.



How to select the PLAYBACK mode



- 1** Turn the [MODE SELECT SWITCH] to the PLAYBACK mode side.

- 2** The screen like the following will be displayed.

P 9 9 9 9	U 1	s 1 0 0 %
S 0 0 0 1	1 0 0 0 L N	A 1 T 1
	m m / s	
>		

>>The “AUTO” LED turns ON.



>>If a PC of FD on Desk is connected, the ICON turns to PLAYBACK mode.



8.2.3 Turning ON the MOTORS

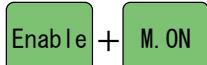
To move the robot, it is necessary to turn the MOTORS ON. If the robot does not need to move, it is not necessary to turn the MOTORS ON.



DANGER

Before turning ON the MOTORS, please be sure to confirm that there are no persons around the robot. If the robot moves suddenly and those persons are hit or sandwiched, it may cause death or serious injury.

How to turn the MOTORS ON (TEACH mode)



1 Select the TEACH mode.

2 Press [Enable] + [M.ON].

>> The LED of the [M.ON] key will lit to show that the MOTORS are ON. (But the servo power is still OFF)



3 Grasp the [ENABLE SWITCH] on the backside of the teach pendant.

>> The [M.ON] lamp on the TEACH pendant will lit to show that the servo power is ON. While grasping the [ENABLE SWITCH], the servo power is supplied to the motors and it is possible to move the robot using the axis operation keys.



Now it is ready to move the robot.

About the [ENABLE SWITCH] operation

- In the TEACH mode, the [ENABLE SWITCH] must be grasped to move the robot. (In the PLAYBACK mode, the [ENABLE SWITCH] is not used)
- If the [ENABLE SWITCH] is released, the servo power is turned OFF and the robot will stop immediately. When grasping the [ENABLE SWITCH], the servo power will be turned ON again.
- Also when grasping the [ENABLE SWITCH] strongly, the servo power will be turned OFF and the robot will stop immediately.
- If the [EMERGENCY STOP BUTTON] is pressed or the "External emergency stop signal" is inputted while the robot is being operated, the servo ON/OFF operation using the [ENABLE SWITCH] will become impossible. In this case, perform the operations of 2 to 3 again after releasing the [EMERGENCY STOP BUTTON] and the "External emergency stop signal".



When the robot cannot be operated (I2103 is displayed)



- The [EMERGENCY STOP BUTTON] is locked.
-> Turn the [EMERGENCY STOP BUTTON] right to release.
- The [Emergency Stop] of the fixed input signal (Normal Close) is OFF.
-> The external devices that are connected to the TBEX1 EX_EMG terminals on the sequence board are not ready yet. Turn the signal ON by completing the preparation of them. And, if this signal is not used, please jumper the signals.
(See "2.8 Safety-related signal connections" in the CFD SETUP MANUAL)

How to turn the MOTORS ON (PLAYBACK mode)

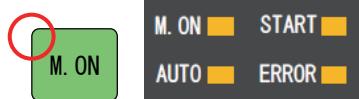


Enable + M. ON

1 Select the PLAYBACK mode.

2 Press [Enable] + [M.ON].

>> The LED of the [M.ON] key and the [M.ON] lamp on the TEACH pendant will lit to show that the MOTORS (and the servo power) are ON. Now it is ready to start (playback) the selected work-program anytime.



[ENABLE SWITCH] operation is not necessary

In the PLAYBACK mode, when executing the MOTRS ON operation, the servo power is automatically turned ON. The [ENABLE SWITCH] (the switch on the backside of the teach pendant) is not used.



When the robot cannot be operated (I2111 is displayed)

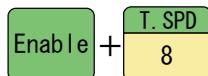
- The "**Motors ON/START selection source**" is "**External**".
-> To turn the Motors ON or to start the work-program using the teach pendant, this setting must be "**Internal**". Set this setting parameter to "Internal" by entering the shortcut command of [R] [5] [Enter] [0] [Enter].

8.2.4 Moving the robot with manual operation

In this section, let's move the robot actually.

Before the operation, please select the "**Manual operation speed**" and the "**Manual operation coordinate system**".

(1) How to select the manual operation speed



By this key, it is possible to select the manual operation speed. 1 is the slowest, and 5 is the fastest.



- POINT**
- Speed 1 is very slow. Please be sure that it is difficult to see the robot is moving.
 - Even in case of the fastest speed (5), the TCP speed is limited to 250 mm/s at maximum.
 - By this operation, the manual operation speed and the check go/back speed are changed at the same time. If the robot speed is slow while performing the check go / back operation, please try to select "5" for the manual operation speed.

(2) How to select the manual operation coordinate system



By this key, it is possible to select the manual operation coordinate system (direction of the robot movement).



Coordinate system	Compact TP	Smart TP	How the robot moves
Joint coordinate system	J		Each axis (joint) of the robot will move independently.
Machine coordinate system (Robot coordinate system)	LR		This is a rectangular coordinate system based on the robot's base unit. X is forward / backward, Y is left / right, and the Z is up / down.
Tool coordinate system	LT		This is a rectangular coordinate system based on the robot's current tool number (TCP: Tool Center Point).
World coordinate system	Lw		This is a rectangular coordinate system based on the ground (floor) where the robot is installed. Normally, this is the same with the machine coordinate system
User coordinate system	U*		This is a rectangular coordinate system defined by customer. (* is the user coordinate system No.)

- POINT**
- When using the "LT", the robot will move based on the current tool number (1- 32). To change the current tool number, please use the shortcut command R29.
 - To use the User coordinate system, it is necessary to define the coordinate system by making 3 points (movement commands) in a work-program in advance. To define a user coordinate system, the Smart TP or the FD on DESK Light is necessary. (The menu is <Service Utilities> - [10 User Coord. Definition]) The Compact TP cannot be used for the User Coordinate system definition.

For details of the motion of the respective coordinate systems, see the chapter 3 also.

(3) Manual operation



Enable + **M. ON**

- 1 Select the TEACH mode.**

Enable + **T. SPD**
8

- 2 Press the [Enable] + [M.ON].**
>> The MOTORS get ready to move the robot.

- 3 Press [Enable] + [T.SPD / 8] to change the manual operation speed.**

P 0 0 0 1	U 1 M 1 J	S 5 L N
S 0 0 0 0	[S T A R T]	

>

INTERP
COORD



- 4 Press [INTERP / COORD] to change the manual operation coordinate system.**
>> While grasping the [ENABLE SWITCH], the servo power is supplied to the motors and it is possible to move the robot using the axis operation keys.

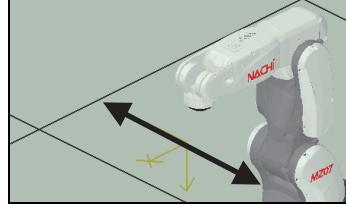
X-	X+	RX-	RX+
Y-	Y+	RY-	RY+
Z-	Z+	RZ-	RZ+

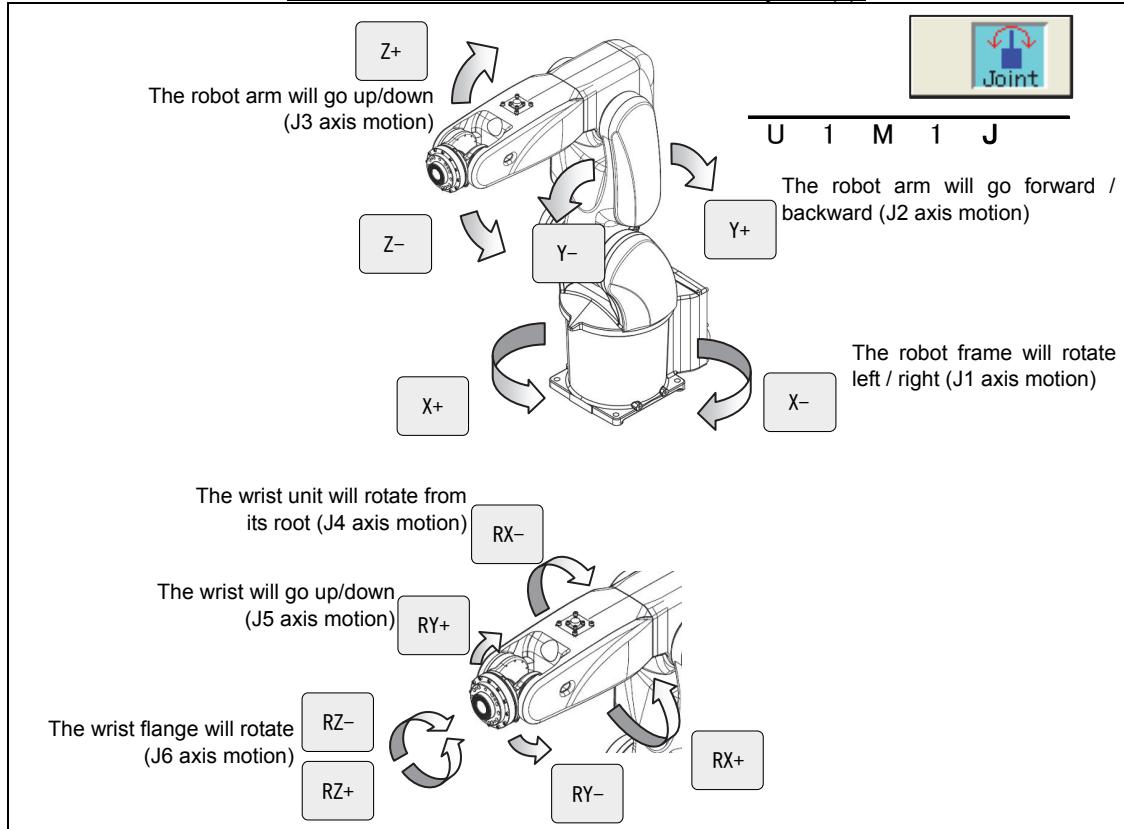
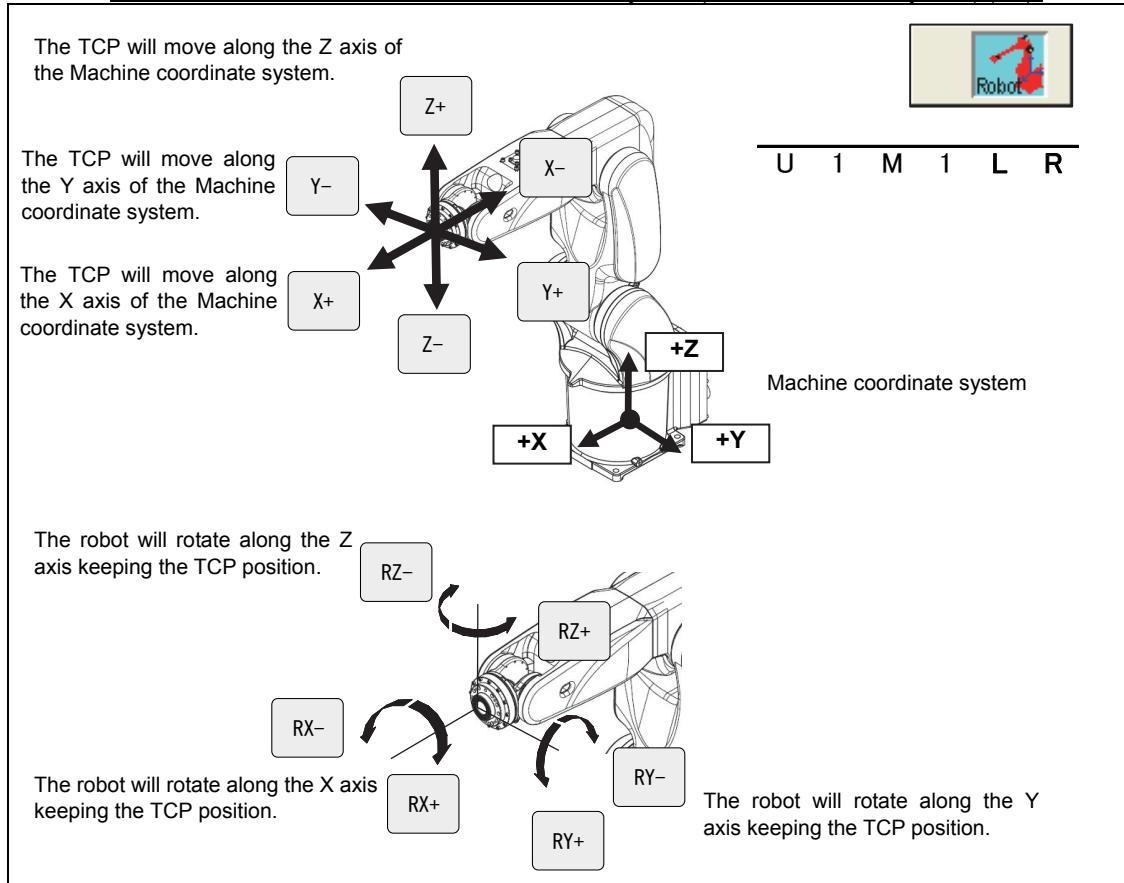
- 5 Grasp the [ENABLE SWITCH].**

>> While grasping the [ENABLE SWITCH], the servo power is supplied to the motors and it is possible to move the robot using the axis operation keys.

- 6 Press the [AXIS OPERATION KEYS].**

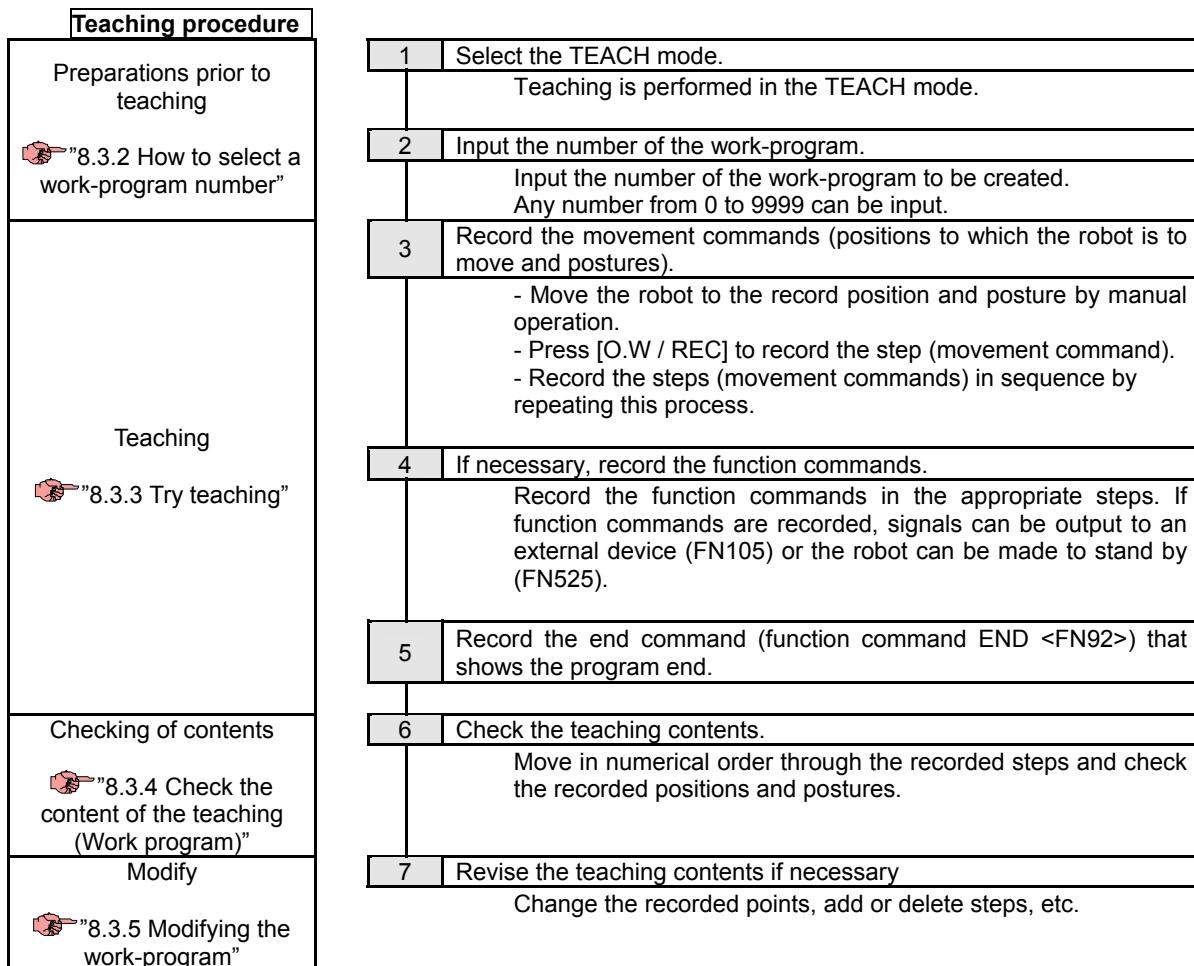
>> The robot will move based on the selected coordinate system.



Movement direction in the "Joint coordinate system(J)"Movement direction in the "Machine coordinate system (Robot coordinate system) (LR)"

8.3 Teaching (Programming)

8.3.1 Basics of the teaching operation



"Work-program" and "Step"

"Work-program" is a unit of one work. And in this controller, it is possible to record plural work-programs in the internal memory. The work-programs are managed using the program number and those numbers can be set freely. By switching the work-program number, the robot can do various work.

"Step" is one command. And plural steps will be recorded in a work-program. The steps are managed using the step number and the step number increases automatically every time a new step is recorded in the program.

There 2 types of the "Step". The 1st one is "Movement command" and the 2nd one is "Function command".

The "Movement command" is a command to move the robot. Not only position information, but also speed, interpolation type, accuracy, etc. that are necessary to move the robot are recorded in a step.

P 9 9 9 9 U 1 M 1 J S 5 L N
S 0 0 0 1 1 2 0 0 L N A 1 T 1
m m / s
>

Step 1 is a movement command with 1200mm/s speed.

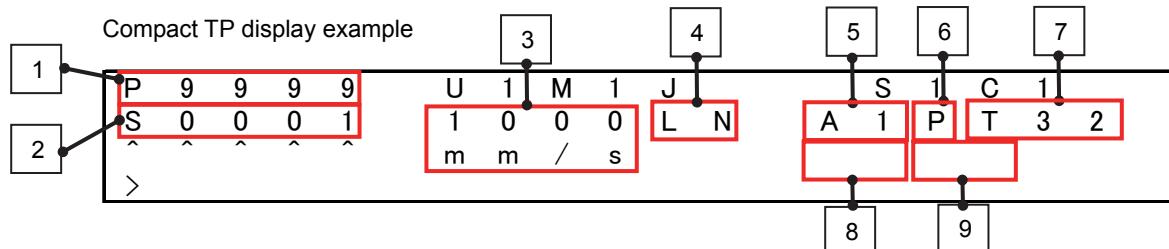
The "Function command" is a command to make the robot execute various functions. For example, output signal can be turned ON/OFF to drive the gripper hand etc. Function commands do not include position data like the movement command.

P 9 9 9 9 U 1 M 1 L R S 4 L N
S 0 0 1 1 S E T [0 1 0 0]
>

Step 11 is a function command "SET".

When running (playing back) a work-program, the robot will execute the steps one by one from the current step. It is also possible to change the order of steps to be executed freely by using the function commands.

Screen display and the content of a MOVEMENT command



- 1: This is the current work-program number.
- 2: This is the current step number.
- 3: This is the speed of this step. 4 types of units can be selected. (The example is "500mm/sec")

Unit	Description
mm/s	This is the TCP movement speed. If the interpolation type is "LN", "C1", or "C2", this unit should be used.
%	This is the percentage compared to the robot's maximum performance (100%). If the interpolation type is "JT", this unit should be used.

The speed of the current step (selected step) can be changed using the shortcut command R12.
(Input range)

In case of [mm/s] 1 to 5000 [mm/s]

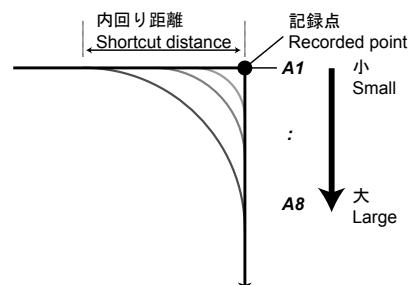
In case of [%] 1 to 100 [%]

- 4: The interpolation type (shape of the TCP motion path) towards this step. There are 3 types.

Interpolation type	Display	Path of tool tip movement
Joint interpolation	JT	Since each axis moves independently, the path of the tool tip is not a straight line.
Linear interpolation	LN	If the next step (target step) involves linear interpolation, the tool tip moves in a straight line that connects the steps.
Circular interpolation	C1 C2	If the target step and the step that follows involve circular interpolation, the tool tip moves along an arc. (The C1 is the middle point and the C2 is the end point)

- 5: This is the positioning accuracy at this step. (A1~A8)

This refers to the degree to which the path along which the tool moves as it passes through the recorded point of each step describes an arc on the inside of the recorded point. A1 to A8 can be specified as this degree. When A1 is specified, the tool tip will pass through the recorded point. When A2 or above is specified, the time required for playback is reduced depending on how far the tool passes along an arc on the inside of the recorded points. Select a stringent (lower) accuracy level at the points that requires high accuracy and a lax (higher) level in the air cutting areas.



The accuracy of the current step (selected step) can be changed using the shortcut command R136.
(Input range) 1 to 8

6 : This is the pause ON/OFF switch. " "(Non-display) stands for "Continue(Pause OFF)" and "P" stands for "Pause(Pause ON)".

With the "Continue" method, the robot tool passes smoothly along the inside of the tool path with no reduction in its speed.

With the "Pause" method, which is also referred to as "in-position check," each time the command position inside the robot reaches a step, the actual robot arrival is awaited before advancing to the next step. This method is used at steps which require a high level of positioning accuracy.

The Pause ON/OFF setting of the current step (selected step) can be changed using the shortcut command R135.

(Input range) 0 (= Continue) / 1 (= Pause)

7 : This is the tool number of this step. (from T1 to T32)

If the interpolation type is LN, C1, or C2, the TCP (Tool Center Point) defined in this tool number draws linear line or circular line. In case of JT (Joint interpolation), this parameter is not used.

8 : This is the acceleration of this step. (From D0 to D3; D0 is not displayed)

9 : This is the smoothness of this step. (From S0 to S3; S0 is not displayed)

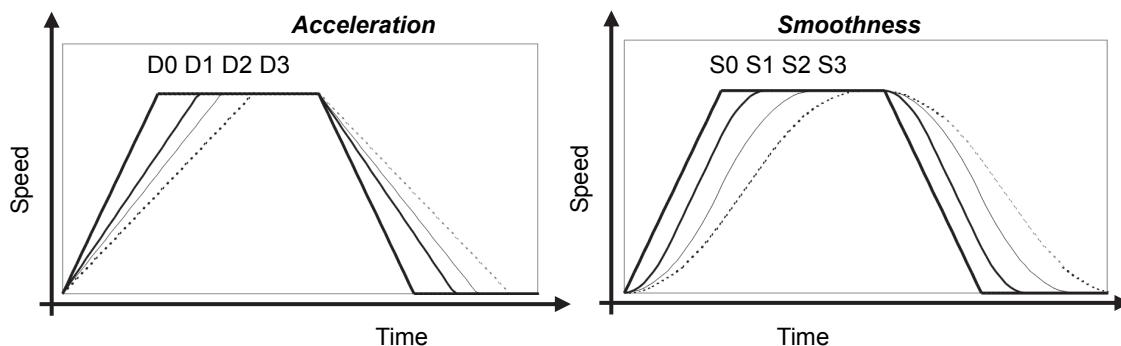
The "**Acceleration**" is a function which adjusts the acceleration of the robot operation.

The "**Smoothness**" is a function which adjusts the smoothness of the edge of the acceleration curve of the robot operation.

When vibration arises due to a factor such as the rigidity of the tool or work, the robot can be moved gently by using these functions in the movement command concerned. As a result, the amount of vibration is reduced.

The "Acceleration" and the "Smoothness" can be specified for each movement command independently, and one of four different settings (0, 1, 2 or 3) can be selected. At a setting of 0 (D0), the robot accelerates or decelerates at its maximum capacity, and the higher the setting used, the more smoothly (that is to say, the lower the acceleration) the robot moves.

When these parameters are set higher, it always takes longer for the robot to move. Since this will adversely affect the cycle (tact) time, do not record these functions in movement commands unnecessarily.



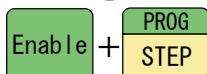
In the Compact TP, the comment in a movement command cannot be displayed / edited. And, if a step which was created in the Smart TP with comment is selected in the Compact TP and the movement command step was over written, the comment is still held in the step data.

8.3.2 How to select a work-program number

When starting a new teaching, it is necessary to put a number to the work-program. The range of a work-program number is from 0 to 9999.



- 1** Select the TEACH mode.



- 2** Press [Enable] + [PROG / STEP].
>> "P" is displayed at the prompt.

P	0	0	0	1	U	1	M	1	L	R	S	5	L	N
S	0	0	0	0	[S	T	A	R	T]			
> P														

- 3** Enter the work-program number using the numeric keys.

For example, if "9999" is used for the work-program number, press [9] 4 times.

P	0	0	0	1	U	1	M	1	L	R	S	5	L	N
S	0	0	0	0	[S	T	A	R	T]			
> P 9 9 9 9														



- 4** Press [ENTER].
>> A new work-program "9999" will be opened.

P	9	9	9	9	U	1	M	1	L	R	S	5	L	N
S	0	0	0	0	[N	o	d	a	t	a]		
>														

Now it is ready to start the teaching operation.



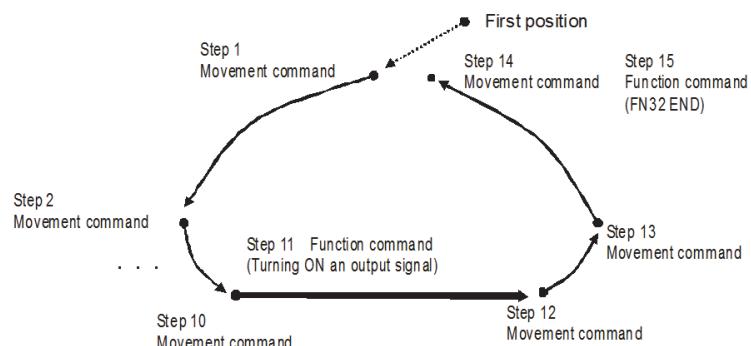
When opening an empty work-program that does not contain any steps, "[No data]" is displayed at the step 0. And when recording a step 1, this display will disappear.

8.3.3 Try teaching

Let's try to teach (make) a work-program. In this section, the program shown below will be created.

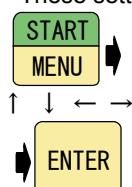
As shown in the figure, from step 1 to step 15 will be created in the work-program. There are 13 movement commands and 2 function commands.

At the step 11, output signal is turned ON to move a gripper etc. for example.



(1) How to set a recording status

First, setup the speed, interpolation type, etc. for the movement command that is to be recorded from now. These setting data for the movement command recording is called as "**Recording status**".

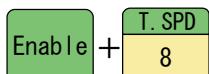


- 1 Open the [START / MENU] - <SETTING> <REC STS> menu.**

>>" REC STS" menu is displayed.

At first, the cursor is on the position of the "Interpolation type".

P 9 9 9 9	U 1 M 1 L R	S 5 L N
R E C	1 2 0 0 L N	A 1 T 1
S T S	m m / s	



- 2 To set the speed, press [Enable] + [T.SPD / 6] several times.**

>> The record speed (and the manual operation speed) is changed.

P 9 9 9 9	U 1 M 1 L R	S 1 L N
R E C	1 0 . 0 L N	A 1 T 1
S T S	m m / s	

P 9 9 9 9	U 1 M 1 L R	S 2 L N
R E C	1 0 0 L N	A 1 T 1
S T S	m m / s	

(NOTE) The speed unit for the LN, C1, and C2 is [mm/s]. And the speed unit for the JT is [%].



- 3 Set the recording status to the desired condition.**

Refer to the descriptions on the next page.

(For the parameters for which numerical input operation are available, set the cursor and then enter the desired number using the numeric keys.)

- 4 After setting the recording status, press [START / MENU] to exit.**

Now, the recording status is set.

How to change the recording status

P 9 9 9 9	U 1 M 1 J	S 5 L N
R E C	1 2 0 0 L N	A 1 P T 3 2
S T S	m m / s	
>		

P 9 9 9 9	U 1 M 1 J	S 1 L N
R E C	(1) (2)	(4) (5) (6)
S T S	(3)	(7) (8)
>		

No.	Name	How to set	Description
1	Speed	 +  8	The recording speed is changed by changing the manual operation speed. (5 levels) In case of "JT" 5, 10, 20, 50, 100 [%] In case of LN, C1, and C2 10, 100, 300, 500, 1200 [mm/s]
2	Interpolation type	 +  or Numerical input (0-3)	The interpolation type can be changed. 0: JT (Joint interpolation) 1: LN (Linear interpolation) 2: C1 (Circular interpolation : middle point) 3: C2 (Circular interpolation : end point)
3	Speed unit	-	This setting is automatically changed when the interpolation type is changed. JT : [%] LIN, C1, C2 : [mm/s]
4	Accuracy	 +  or Numerical input (1-8)	The accuracy level of the step can be changed.
5	Pause ON/OFF	Numerical input (0 or 1)	0: Continue (Pause OFF) 1: Pause
6	Tool number	Numerical input (1-32)	Tool number for the step can be set.
7	Acceleration	Numerical input (0-3)	Acceleration can be changed. (D0 – D3) In case of 0, the setting is not displayed.
8	Smoothness	Numerical input (0-3)	Smoothness can be changed.(S0 – S3) In case of 0, the setting is not displayed.



For details, refer to the Chapter 4.

(2) How to record a movement command

When [O.W./REC] key is pressed, a new "Movement command" will be recorded by binding the recording status and the present robot position.

1 Move the robot to the desired position using the [AXIS OPERATION KEYS].



2 Press [O.W. / REC].

>>The 1st step was recorded referring to the recording status.

P	9	9	9	9	U	1	M	1	J	S	5	L	N	
S	0	0	0	1	1	2	0	0	L	N	A	1	T	1
	m	m	/	s										

>

(NOTE)

This operation is possible only when selecting the last step of the work program. Please refer to "*How to insert a new movement command*"(p4-22) to insert a new move command to the work program.

3 Then, repeat the operations in the following order to record 2nd step, 3rd step, ... in the work-program.

- Move the robot with [AXIS OPERATION KEYS]
- Set the recording status
- Record a movement command step

Note for the speed unit

If, the following 2 conditions are satisfied, the speed unit for the step should be "%". When "mm/s" is used, the robot may move very fast and cause unexpected accident even if the speed value (in mm/sec) is small.

1. The TCP position does not change between 2 steps.
2. But the tool angle changes much between the 2 steps.



WARNING

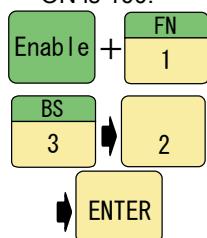
And, to use "%" with the linear interpolation, the Smart TP or the FD on DESK Light is necessary. Please open a screen editor and set the cursor to the speed unit and then input [2][Enter].

0	[START]
1	5.0 mm/s LIN A1 T1
2	5.0 % LIN A1 T1
3	5.0 mm/s LIN A1 T1

(3) How to record a function command (FN)

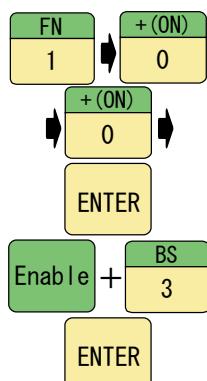
Function commands can be recorded in number. Several parameters (conditions) may be required depending on the function command number.

In this section, let's record a signal output function (FN32) at the step 11. The output signal that is to be turned ON is 100.



- 1 After recording the 10th step, press [Enable] + [FN / 1].**
>> "F" is displayed at the prompt.

- 2 Input the function number "32" and then press [ENTER].**
>> "F32," is displayed at the prompt.



- 3 Input the output signal number "100" and then press [ENTER].**
>> "F32,100" is displayed at the prompt.

P	9	9	9	9	U	1	M	1	L	R	S	4	L	N
S	0	0	1	0		5	0	0	L	N	A	1	T	1
					m	m	/	s						
>	F	3	2	,	1	0	0							

- 4 To revise the input miss, press [Enable] + [BS / 3].**

(If the function command requires 2 or more parameters)

After inputting the 1st parameter, the 2nd parameter is required after pressing [ENTER]. Input the 2nd parameter in the same way and press [ENTER].



- 5 After finishing the parameter input, press [ENTER].**

>> Now the function command (output signal ON command) has been recorded.

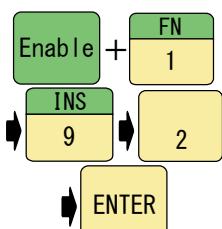
P	9	9	9	9	U	1	M	1	L	R	S	4	L	N
S	0	0	1	1	S	E	T	[0	1	0	0]	
>														

- There are some function commands that use special exclusive input interface (screen). The Compact TP does not support such an interface. For those function commands, please use the Smart TP or the FD on DESK.

- The function commands can be inputted at any position in a work-program with the same operation. Although it is possible to input a function command at the last step, it is also possible to insert a new function command at the middle step of the work-program.

(4) How to record FN92 (END function) at the end of the program

- 1 Then, continue to record the movement command steps (12th, 13th, ...).**



- 2 At the last step, END function (FN92) is necessary.**

This function command FN92 must be recorded at the last step always.

If the work-program is played back in 1 cycle mode, the robot executes this function and stops. If this function does not exist, an error will be displayed.

To input this function command, press [Enable]+[FN/1], [INS/9], [2], and [ENTER]. This function command does not have a parameter.

8.3.4 Check the content of the teaching (Work program)

After recording a work-program, let's check the teaching content.

This checking work is called as "Checking operation". When executing the checking operation, the robot will stop at every step so it is possible to check the position, posture at the point and the motion path (locus) between the steps. And it is also possible to modify them if necessary.

To perform the check operation, [Check GO] and [Check BACK] keys on the teach pendant are used. To execute the steps in the order of step number is called as "Check GO" and the reversed order is called as "Check BACK". And, it is also possible to execute the steps continuously.

(1) CHECK GO

- 1 Press [PROG / STEP] to call the step from which the check operation will start.
>> "S" is displayed at the prompt.**

- 2 Input [+/-] using numeric key.
>> "S0" is displayed at the prompt.**

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	1	0		5	0	0	L	N	A	1	T	1
m m / s														
> S 0														

- 3 Press [ENTER].
>> The cursor moves to the step 0 (= "START").**

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	0	0	[S	T	A	R	T]			
>														

To check the work-program from the beginning, select the step "0".
This is a special step that does not have any information like position etc.

Select movement command step always. For safety, it is not possible to select a function command step as the direct check go / back destination.

The manual operation speed 1 and the check operation speed 1 are very slow.

8

- 4 To set the speed for the check operation, press [Enable] + [T.SPD / 8]. At this time, set "3" for safety.**

(And, every time the [T.SPD / 8] is pressed, the manual operation speed of the robot will also change in 5 levels. 1 is the slowest and 5 is the fastest.)

- 5 Press [Check GO] with grasping the [ENABLE SWITCH] on the backside of the teach pendant.**

>> While the [Check GO] is held, the robot will move towards the Step 1. And after reaching the Step 1 position, the robot will stop.

P	9	9	9	9	U	1	M	1	L	R	S	1	I	N
S	0	0	0	1		1	2							
^	^	^	^	^										
When reaching the position, this mark will appear.														
>														

If the [Check GO] is released while moving, the robot will stop smoothly.

It is also possible to stop the robot forcibly by releasing the [ENABLE SWITCH]. However, in this case, the robot will stop without deceleration control and the servo power will be shut off immediately, so the large load torque is added to the mechanism of the robot. Therefore, please be sure to release the [ENABLE SWITCH] after releasing the [Check GO] key and confirming that the robot stops completely.

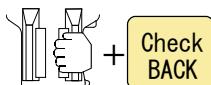
- 6 To move to the Step 2, release the [Check GO] and press it again.**

By repeating these operations, check the motion to the last step.

If [Check GO] is pressed after reaching the last step, the check operation will start from the Step 1 again.

(2) CHECK BACK

It is possible to move the robot step by step in a reversed sequence.



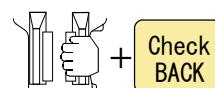
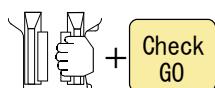
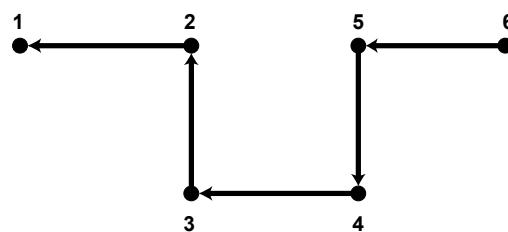
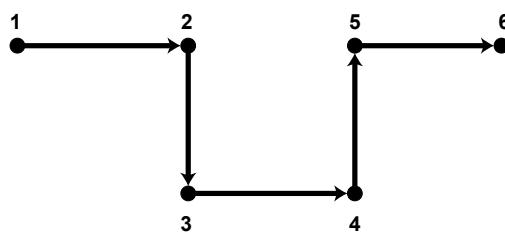
- 1 Press [Check BACK] with grasping the [ENABLE SWITCH] on the backside of the teach pendant.**

>> The robot will move along reversed way through the steps. When reaching the 1st step, the robot will stop. Check back operation to the last step is impossible.

- 2** The operation to change the check speed or the operation when the robot stops at the step are the same with [Check GO].

It is also possible to stop the robot forcibly by releasing the [ENABLE SWITCH]. However, in this case, the robot will stop without deceleration control and the servo power will be shut off immediately, so the large load torque is added to the mechanism of the robot. Therefore, please be sure to release the [ENABLE SWITCH] after releasing the [Check BACK] key and confirming that the robot stops completely.

(NOTE) Check GO and Check BACK



In case of initiali setting, the function commands are not executed when the Check go / back operation is begining executed. To execute those functions, please use shortcut command R8 in advance.

DEL	T. SPD	ENTER	+ (ON)	ENTER
R	8		0	
DEL	T. SPD	ENTER	FN	ENTER
R	8		1	
DEL	T. SPD	ENTER	2	ENTER
R	8			

"Disabled" (not executed)

"Enabled" (All function commands are executed)

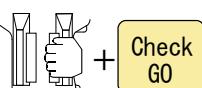
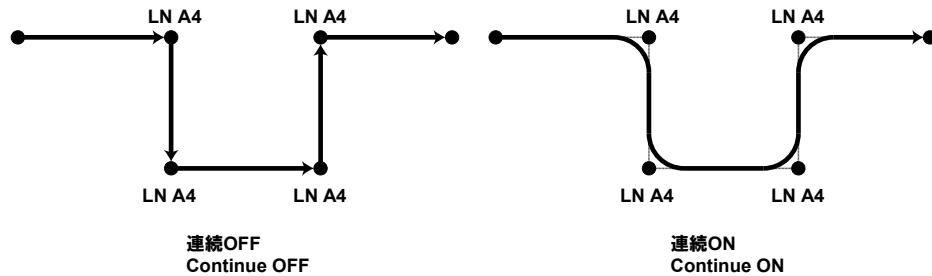
"I-enabled" (I-signal waiting functions only)



And, while executing the Check BACK operation, only I-signal waiting functions are executed.

(3) Checking the steps continuously

It is possible to move the robot through the steps continuously while pressing the [Check GO] and the [Check BACK] keys. If the "Continuous check go" is enabled, the robot will move smoothly thorough the movement steps by referring to the accuracy setting (A1 – A8) and making shortcut locus.



- Press [STOP / CONT.].**
- >> The mark of "!" will be displayed on the upper right side of the screen.

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N	!
S	0	0	0	1	1	2	0	0	L	N	A	1	T	1	
^	^	^	^	^	m	m	/	s							
>															

Now the "Continuous check go" is enabled.

- Perform the [Check GO] operation.**
- >> Every step will be executed continuously.



- To disable the continuous check go operation, press [STOP / CONT.] again.**
- >> The mark of "!" disappears.

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N	!
S	0	0	0	1	1	2	0	0	L	N	A	1	T	1	
^	^	^	^	^	m	m	/	s							
>															

8.3.5 Modifying the work-program

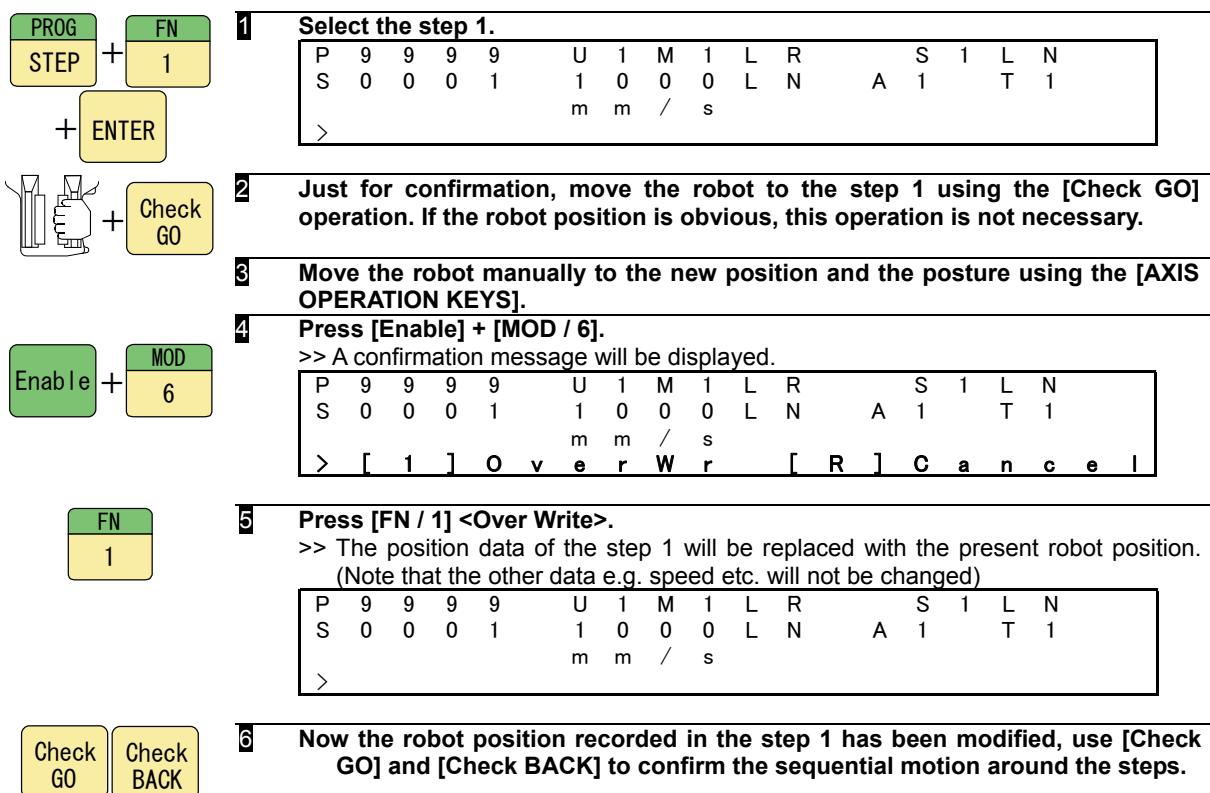
In this section, how to modify a command recorded in the work-program is explained.
There are several methods to modify a step data.

Methods to modify a step data

	Content of the modification	Operation
Movement command modification	Modify the position only	[Enable] + [MOD 6]
	Modify the speed only	Shortcut R12
	Modify the accuracy only	Shortcut R136
	Over-write the every data of the movement command step altogether (e.g. interpolation type, tool number, etc.)	[Enable] + [O.W REC]
	Insert a new movement command	[Enable] + [INS 9]
	Insert a new function command (FN)	Same with how to record a new step
	Delete a movement command or function command	[Enable] + [DEL R]

How to modify only the position of the movement command

Let's modify the position of the 1st step that has been already recorded.
Here, the other data like the "Speed" or the "Interpolation type" etc. is not modified.

- 
- Select the step 1.**

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	0	1	1	0	0	0	L	N	A	1	T	1
					m	m	/	s						
>														
 - Just for confirmation, move the robot to the step 1 using the [Check GO] operation. If the robot position is obvious, this operation is not necessary.**
 - Move the robot manually to the new position and the posture using the [AXIS OPERATION KEYS].**
 - Press [Enable] + [MOD / 6].**
 >> A confirmation message will be displayed.

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	0	1	1	0	0	0	L	N	A	1	T	1
					m	m	/	s						
> [1] O v e r W r [R] C a n c e l														
 - Press [FN / 1] <Over Write>.**
 >> The position data of the step 1 will be replaced with the present robot position.
 (Note that the other data e.g. speed etc. will not be changed)

P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	0	1	1	0	0	0	L	N	A	1	T	1
					m	m	/	s						
>														
 - Now the robot position recorded in the step 1 has been modified, use [Check GO] and [Check BACK] to confirm the sequential motion around the steps.**

How to modify the speed of the step

To modify the speed of the recorded step, use the shortcut R12.
For details, refer to "8.6.1 Using short-cuts (R code)".

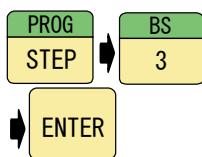
How to modify the accuracy of the movement command

To modify the accuracy of the recorded step, use the shortcut R136.
For details, refer to "8.6.1 Using short-cuts (R code)".

How to overwrite the movement command

It is possible to over-write the movement command with a new movement command.

When over-writing a movement command, the all data (e.g. robot position, speed, interpolation type, etc.) in the movement command will be over-written.



- 1 Press [PROG / STEP], [BS / 3], and [ENTER].**

>> The Step 3 is displayed.

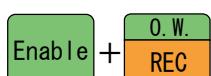
P	9	9	9	9	U	1	M	1	L	R	S	1	L	N
S	0	0	0	3	1	0	0	0	J	T	A	1	T	1

m m / s

- 2 To change the position, manually move the robot using the [AXIS OPERATION KEYS].**

- 3 Setup the recording status in the same way with the "How to record a movement command".**

At this time, change the interpolation type from "JT(Joint)" to "LN(Linear)". And the speed is changed to 1200 mm/s (Manual speed 5).



- 4 Press [Enable] + [O.W. / REC].**

>> A confirmation screen is displayed.

P	9	9	9	9	U	1	M	1	L	R	S	5	L	N
S	0	0	0	3	1	0	0	0	J	T	A	1	T	1

m m / s

- > [1] O v e r W r [R] C a n c e l

- 5 Press [FN / 1] <Over Write>.**

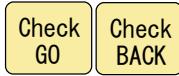
>> The step is over-written.

P	9	9	9	9	U	1	M	1	L	R	S	5	L	N
S	0	0	0	3	1	2	0	0	L	N	A	1	T	1

m m / s

To cancel, press [DEL / R].

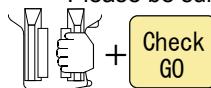
- 6 Now the robot position and conditions recorded in the step has been modified, use [Check GO] and [Check BACK] to confirm the sequential motion around the steps.**



How to insert a new movement command

Let's insert a new movement command (step) between the Step 1 and 2.

Please be sure that the new step will be inserted between the current step and the previous step.



- 1 Move the robot to the Step 2 using the [Check GO] or [Check BACK].**

P	9	9	9	9	U	1	M	1	J	S	1	J	T
S	0	0	0	2	1	0	0	0	J	T	A	1	T
^	^	^	^	^	m	m	/	s					

>

- 2 To change the position, manually move the robot using the [AXIS OPERATION KEYS]. (This position is used for the new step.)**

- 3 Setup the recording status (e.g. the speed or the interpolation type etc.) in the same way with a new movement command.**

- 4 Press [Enable] + [INS / 9].**

>> A Confirmation screen is displayed.

P	9	9	9	9	U	1	M	1	J	S	1	J	T
S	0	0	0	2	1	0	0	0	J	T	A	1	T
^	^	^	^	^	m	m	/	s					

> [1] I n s e r t [R] C a n c e l

- 5 Press [FN / 1] <Insert>.**

>> Now a new step has been inserted to the work-program.

The Step number 2, 3, ... will be changed to 3, 4,

And at this time, the step number recorded as the parameter for the destination of Jump/Call functions will be modified automatically.

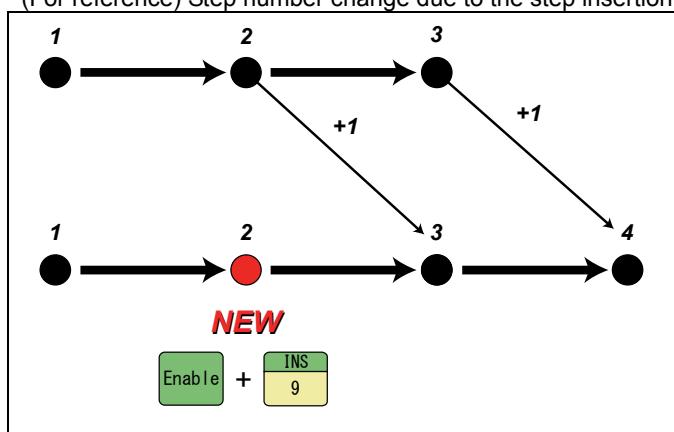
To cancel, press [DEL / R].

(NOTE)

To record a new movement command at the end of the work-program, refer to "(2) How to record a movement command"(p8-26).

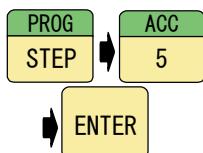
- 6 Now a new step has been inserted, use [Check GO] and [Check BACK] to confirm the sequential motion around the steps.**

(For reference) Step number change due to the step insertion



How to delete a step (movement command / function command)

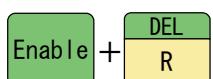
Let's try to delete the Step 5.



- 1 Press [PROG / STEP], [ACC / 5], [ENTER].**

>> The cursor moves to the Step 5.

In case of movement command, it is recommended to move the robot to the physical position using [Check GO] or [Check BACK] to confirm that it is truly the step to be deleted.



- 2 Press [Enable] + [DEL / R].**

>> A confirmation screen is displayed.

P	9	9	9	9	U	1	M	1	J	S	1	J	T
S	0	0	0	5	1	0	0	0	J	T	A	1	T
^	^	^	^		m	m	/	s					

> [1] D e l e t e [R] C a n c e l



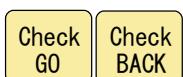
- 3 Press [FN /1] <Delete>.**

>> Now the Step 5 has been deleted.

The Step number 6, 7, ... will be changed to 5, 6,

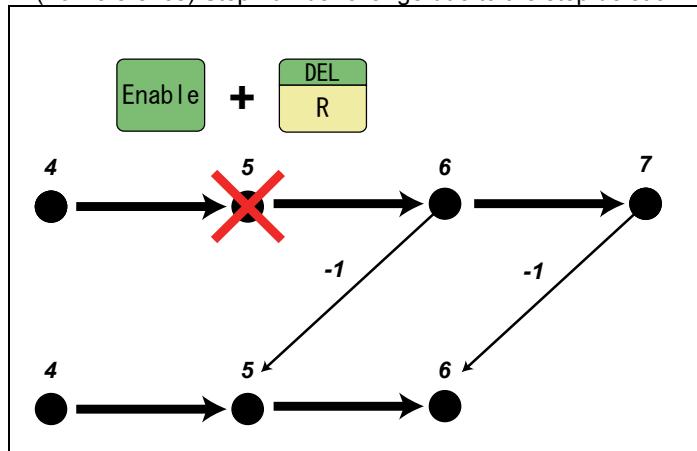
And at this time, the step number recorded as the parameter for the destination of Jump/Call functions will be modified automatically.

To cancel, press [DEL / R].



- 4 Now a step has been deleted, use [Check GO] and [Check BACK] to confirm the sequential motion around the steps.**

(For reference) Step number change due to the step deletion



8.4 Playback (Automatic operation)

8.4.1 Basics of the Playback operation

Playback procedure

1	Select the PLAYBACK mode Select "Step" or "1 Cycle" or "Continuous" playback mode.	8.4.2 How to select the operation mode
2	Slow down the playback speed using the "Playback speed override" setting. High speed playback from the beginning is dangerous. So, start the playback from the slow speed. To slow down the speed, please use the "Playback speed override".	8.4.3 How to slow down the playback speed (Playback speed override)
3	Select the start step It is possible to start the work-program from the beginning. And it is also possible to select a middle step and start the work-program from the step. (But it is not possible to start the playback from a function command step.)	
4	Start the work-program	8.4.4 How to playback a work-program (Internal start method)
	After checking the present robot position and the condition of the peripheral devices, start the playback operation. Start the playback with placing your hand on the [EMERGENCY STOP BUTTON] and if the robot tries to move in an unexpected way (direction, speed, etc.), stop the robot immediately without hesitation .	
5	Increase the playback speed slightly. If the playback speed override is increased suddenly, unexpected troubles (e.g. the cables swing too much, etc.) may happen. So, the setting value should be increased carefully. If something wrong is found, return to the TEACH mode and modify the work-program. Repeat this several times and check the playback motion at the speed of 100%.	
6	Make the setting for the actual playback (production) Program file protection, MOTORS ON/START selection source (internal / external) setting, etc., are to be set for the automatic operation.	

3 playback modes

In the PLAYBACK mode, there are 3 modes. Before starting the playback operation, please select one of them. And it is also possible to select them while the robot is playing a program.

In an actual production, "1 Cycle" or "Continue" is selected. "Step" is only for a program check.

Playback mode			
Mode	Display	Content	
Step		1s The program will be executed (only 1 step) while + is being pressed. The robot will stop when the key is released. To go to the next step, press those keys again.	
1 Cycle		Cy The program will start when + is pressed. And then the robot will stop when executing the END function command (FN92). To start the program 1 more cycle again, press those keys again.	
Continue		Co The program will start when + is pressed. And then the robot will repeat the program until the + is pressed.	



The playback operation mode can be switched using the shortcut R7.

Playback speed override

For the first time, please use slow speed. And then increase the speed slightly after checking the safety.
To change the playback speed, please use "Playback speed override".

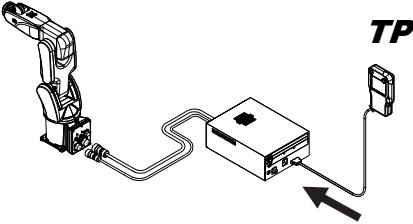
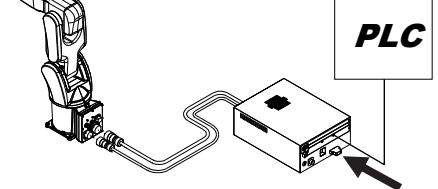


"Playback speed override" can be set by shortcut command R49.

(An example of override)

Recorded speed	The speed after the setting of playback speed override	
	100 %	50 %
1000 mm/s	1000 mm/s	500 mm/s
50 %	50%	25%

The internal playback and the external playback

Playback method	Content
Internal start method 	<p>This is the factory default setting. Please use this mode when to use this robot controller in stand alone.</p> <ul style="list-style-type: none"> - The operations of "MOTORS ON", "Program start", and "Program selection" are executed using the teach pendant key operation. - The starting step for a playback operation can be selected by the teach pendant.  <div style="border: 1px solid black; padding: 5px;"> <p>"MOTORS ON" "Program start" "Program selection"</p> <p>These operations are executed using the teach pendant.</p> </div>
External start method 	<p>This robot controller is remote-controlled from PLC etc.</p> <ul style="list-style-type: none"> - The operations of "MOTORS ON", "Program start", and "Program selection" are executed using the external input signals. - The starting step is always set to Step 0. <p>To use this mode, it is necessary to make a connection of external signals in advance and assign some functions to the external I/O signals respectively. External input signals refer to the signals that are inputted to this robot controller from an external PLC etc. For details of 24V DC I/O connection procedures etc., please refer to "CFD CONTROLLER TECHNICAL DOCUMENT 2"</p>  <div style="border: 1px solid black; padding: 5px;"> <p>"MOTORS ON" "Program start" "Program selection"</p> <p>These operations are executed using the external input signals.</p> </div>

Selecting the starting step for the playback (Internal start method)

When playing back a work-program, it is possible to designate the starting step for the playback operation.

(Precautions)

- When selecting a work-program, the Step 0 is automatically selected.
- When restarting the work-program after stopping it in half-way, the work-program will restart from the step where the stop operation was executed.
- It is also possible to select the next starting step after stopping the program in half-way.
- If a step other than Step 0 is selected, ***the robot's TCP will move towards the designated starting step with the slower speed than 250mm/sec*** and then start to move normally from the next step using the recorded speed.
- In case of the initial setting, the function command steps cannot be selected as a starting step.

**CAUTION**

If a wrong step is designated, the robot may move with unexpected motion and crash to the peripheral devices etc. Please pay special attention before starting the operation.



In case of "External mode", the starting step selection is prohibited. (Step 0 is always selected as the playback starting step)

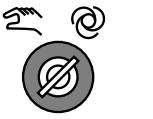
8.4.2 How to select the operation mode

Let's run (playback) a work-program in the "Internal" mode. The "internal mode" is a mode to run a work-program that is selected in the teach pendant via teach pendant key operations.



DANGER

Before playing back the work-program, please be sure to confirm that there are no persons around the robot. If persons are hit or sandwiched by the robot, it may cause death or serious injury.



1 Select the PLAYBACK mode.

2 Select the mode for the automatic operation.
In the PLAYBACK mode, press [DEL / R], [MECHA / 7], and [ENTER] sequentially. Then input the following number and press [ENTER].

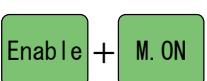
0; 1s (Step)
1; Cy (1 Cycle)
2; Co(Continue)

P 9 9 9 9	U 1	1 s	1 0 0 0 %
S 0 0 0 1	1 0 0 0	L N	A 1 T 1
m m / s			

P 9 9 9 9	U 1	C v	1 0 0 0 %
S 0 0 0 1	1 0 0 0	L N	A 1 T 1
m m / s			

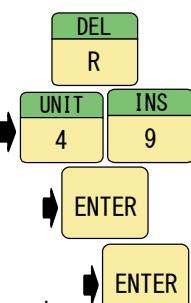
P 9 9 9 9	U 1	C o	1 0 0 0 %
S 0 0 0 1	1 0 0 0	L N	A 1 T 1
m m / s			

For safety, "1s (Step)" is recommended to check the robot motion.



- 3 Press [Enable] + [M.ON].**
 >> The MOTORS are turned ON. The [M.ON] lamp will be turned ON.
 Now it is ready to start the automatic playback operation.

8.4.3 How to slow down the playback speed (Playback speed override)



1 Slow down the playback speed using the playback speed override setting.
 Press [DEL / R] [UNIT / 4] [INS / 9] [ENTER] at the top screen of the PLAYBACK mode.

2 Then the override rate in [%] and press [ENTER].
 If the number is 100, the robot will move based on the recorded speed.
 For safety, please use 20 – 30% at first.

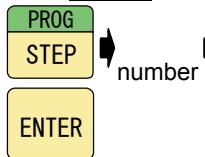
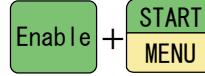
>> The override setting will be displayed on the screen.

P 9 9 9 9	U 1	1 s	1 0 0 0 %
S 0 0 0 1	1 0 0 0	L N	A 1 T 1
m m / s			

8.4.4 How to playback a work-program (Internal start method)

Playback with "Step"

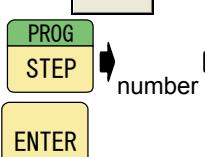
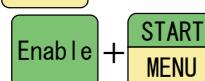
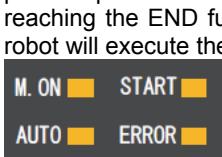
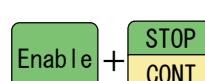
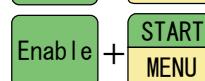
-  Step
- Select "1s" mode (step mode) using shortcut command R7.

 - 
Select the starting step for the playback.
To start the work-program from the beginning, press [PROG / STEP] [+ / 0] [ENTER].
>> The cursor moves to the Step 0.
 - 
Press [ENABLE] + [START / MENU].
>> While pressing the key, the robot will move to the designated step from the present position.

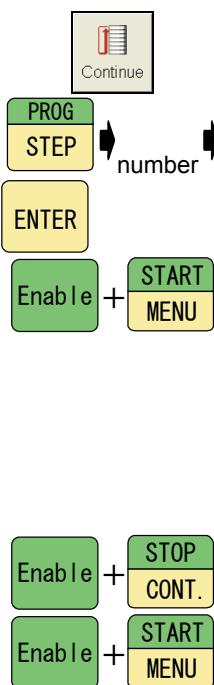
[START] lamp will light.
 - When reaching the next step, the robot will stop. To restart the playback, press [Enable] + [START / MENU] again.

Playback with "1 Cycle" mode

-  Cycle
- Select "Cy" mode (1 cycle mode) using shortcut command R7.

 - 
Select the starting step for the playback.
 - 
Press [ENABLE] + [START / MENU].
>> Once these keys are pressed, the robot will move to the designated step from the present position and execute the work-program until the END function. After reaching the END function, if the [Enable] + [START / MENU] are pressed, the robot will execute the program from the Step 0 again.

[START] lamp will light.
 - 
To stop the robot, press [Enable] + [STOP / CONT.]
 - 
To restart the program, press [Enable] + [STOP / CONT.] again.

Playback with "Continue" mode



1 Select "Co" mode (Continue mode) using shortcut command R7.

2 Select the starting step for the playback.

3 Press [ENABLE] + [START / MENU].

>> Once these keys are pressed, the robot will move to the designated step from the present position and execute the work-program until the END function. After reaching the END function, the robot will return to the Step 0 and playback the program repeatedly.



[START] lamp will light.

4 To stop the robot, press [Enable] + [STOP / CONT.]

5 To restart the program, press [Enable] + [STOP / CONT.] again.

If the playback operation is completed and it is confirmed that the program can be played back normally and safely, increase the override rate 10 or 20 % and playback the program again to check.

Repeat these procedures until override rate 100%.

8.4.5 How to playback (External start method)

For details, refer to the following explanations;

- "Chapter 5 Auto operation (playback)" "5.3 External start operation (using external input signals)"
- "Chapter 9 Example to use" in the "CFD CONTROLLER TECHNICAL DOCUMENT 2"

To control this robot controller using an external PLC unit etc., please make the following settings in advance.

(1) Set the "MOTORS ON" and the "Program start" to "External (1)" using the shortcut command R5.



(1) Set the "Program selection" to "External (1)" using the shortcut command R6.



Both of these 2 modes are set to "Internal (0)" when shipping the controller. It is possible to change these settings independently. But, normally, please set both of these 2 modes to the same setting. And, to make the signal number assignment setting, the Smart TP or the FD on DESK Light is necessary.



8.5 File backup and restore



Do not switch the power off when using any of the file operation menus explained in this chapter, or while the automatic backup function is operating. Switching off the power while the controller is accessing various files may cause unexpected damage to files in the controller. This may prevent the controller from starting.



Precautions when using USB Memory:

For commercially available USB memory operation is not covered by warranty. Only the USB memory in "Controller Maintenance" section of the instruction manual is guaranteed to operate.

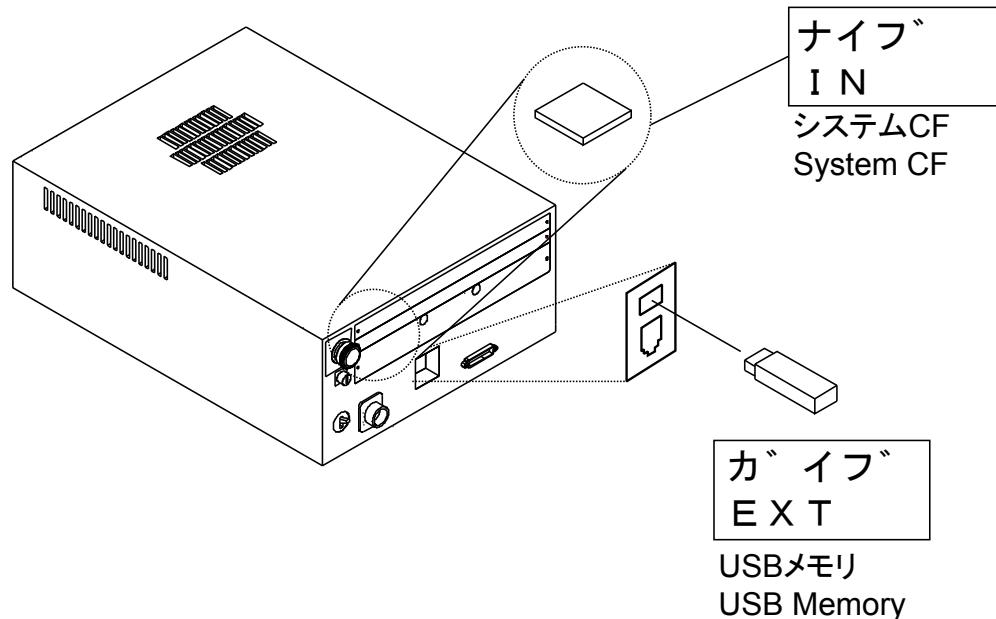
When using USB memory that has been accessed by a different device with this controller, always check using commercially available anti-virus software that there are no viruses or other malicious software on the USB memory before connecting it to the controller.



Insert and remove USB memory when controller power is OFF.
Inserting or removing USB memory when controller power is ON may corrupt the data saved on USB memory.

8.5.1 Inserting USB memory

Insert USB memory by referring to the figure below.



In case of using Compact TP, 2 drives are selectable.

"IN" (internal) : means internal memory that is system CF card on CPU board.
"EXT" (external) : means USB memory device.

8.5.2 Back up files

All the files stored in the internal memory can be backed up and saved.

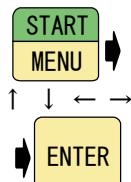
The name of the backup folder is given automatically using the following format

¥NRA2011- YYYY-MM-DD hh-mm

Example) NRA2011-2012-07-21-0844



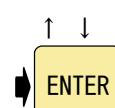
- EXT (=USB memory) is recommended for the backup destination device.
- In case of using Compact TP, only above folder name is permitted. In order to create the free folder name, please prepare Smart TP or "FD on DESK".



- 1 Press [START/MENU] and select <FILE>.**

» FILE menu is displayed.

* M E N U * F I L E	V 3 . 0 7
< B A C K U P >	
R E S T O R E	
>	



- 2 Move cursor to <BACKUP> and press [ENTER].**

» BACKUP menu is displayed.

* M E N U * B A C K U P	V 3 . 0 7
< D R I V E > E X T	
> [1] E X E C U T E [R] R E T U R N	

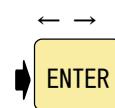


- 3 Press [ENTER].**

» DRIVE menu is displayed.

<EXT> is USB memory, and <IN> is internal memory.

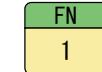
* M E N U * D R I V E	V 3 . 0 7
< E X T > I N	



- 4 Here, selecting <EXT> (USB memory) and pressing [ENTER].**

» Following screen is displayed again.

* M E N U * B A C K U P	V 3 . 0 7
< D R I V E > E X T	
> [1] E X E C U T E [R] R E T U R N	

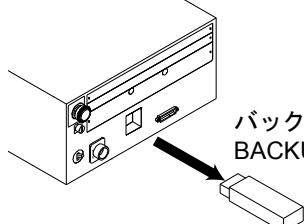


- 5 Press [FN / 1] <EXECUTE>.**

» Now backup procedure is started. Its progress is displayed by "*" mark. When this mark reaches to the right end, procedure is completed.

* M E N U * B A C K U P	V 3 . 0 7
D R I V E E X T	
> * * * *	

* M E N U * B A C K U P	V 3 . 0 7
D R I V E E X T	
> C O M P L E T E	



NRA2011-2013-07-24-0932



- 6 Press [START / MENU] again to go back to the top screen.**

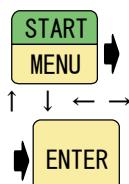
8.5.3 Restoring all files from backup

This section explains how to restore all files from backup data. Backup data folder is permitted to exist on the root folder in backup device and its file name must be ¥NRA2011-** (* is alphabet or '-')

- 1 Stop the robot and turn the motor power off.**

When robot is while playback, restoring procedure is not permitted.

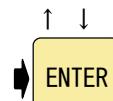
Beware that robot must be stopped and motor power must be turned off.



- 2 Press [START/MENU] and select <FILE>.**

» FILE menu is displayed.

* M E N U * F I L E	V 3 . 0 7
< B A C K U P >	
R E S T O R E	
>	

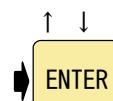


- 3 Move cursor to <RESTORE> and press [ENTER].**

» RESTORE menu is displayed.

Folder candidates are displayed "NRA2011-".

* M E N U * R E S T O R E	V 3 . 0 7
< D R I V E > E X T	
F O L D E R 2 0 1 3 - 0 7 - 0 2	
> [1] E X E C U T E [R] R E T U R N	

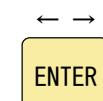


- 4 Move cursor to <DRIVE> and press [ENTER].**

» DRIVE menu is displayed.

<EXT> is USB memory, and <IN> is internal memory.

* M E N U * D R I V E	V 3 . 0 7
< E X T > I N	
>	



- 5 Here, selecting <EXT> (USB memory) and pressing [ENTER].**

Following screen is displayed again.

* M E N U * R E S T O R E	V 3 . 0 7
< D R I V E > E X T	
F O L D E R 2 0 1 3 - 0 7 - 0 2	
> [1] E X E C U T E [R] R E T U R N	



- 6 Move cursor to <FOLDER> and press [ENTER].**

Press up/down cursor key.

» Folder name is changed.



* M E N U * R E S T O R E	V 3 . 0 7
D R I V E E X T	
< F O L D E R > 2 0 1 3 - 0 7 - 0 2	
> ¥	

If two or more backup folders exist, press up/down cursor key to select one.

- 7 Pres right cursor key.**

» Folder same is scrolled.



* M E N U * R E S T O R E	V 3 . 0 7
D R I V E E X T	
< F O L D E R > - 0 7 - 2 4 - 1 3	
>	



- 8 Press [ENTER].**

» Selected folder name is displayed.

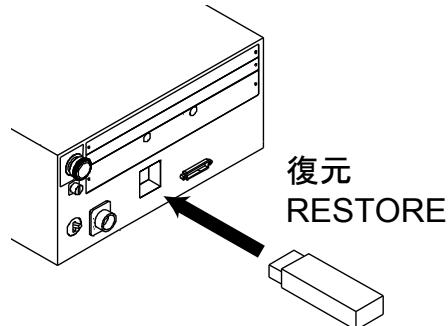
* M E N U * R E S T O R E	V 3 . 0 7
D R I V E E X T	
< F O L D E R > 2 0 1 3 - 0 7 - 0 2	
> [1] E X E C U T E [R] R E T U R N	

FN
1

9 Press [FN / 1] <EXECUTE>.

» Now restoring procedure is started. Its progress is displayed by “*” mark. When this mark reaches to the right end, procedure is completed.

*	M	E	N	U	*	R	E	S	T	O	R	E	V	3	.	0	7		
D	R	I	V	E						E	X	T							
<	F	O	L	D	E	R			>	2	0	1	3	-	0	7	-	0	2
>	*	*	*	*	*														



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10 Following message is displayed. Please turn off the controller power.

*	M	E	N	U	*	R	E	S	T	O	R	E	V	3	.	0	7		
D	R	I	V	E						E	X	T							
<	F	O	L	D	E	R			>	2	0	1	3	-	0	7	-	0	2
>	P	I	e	a	s	e	p	o	w	e	r		O	f	f				

8.6 Useful functions

8.6.1 Using short-cuts (R code)

Normally, even with operations where one menu is opened from another, a target operation can be quickly accessed simply by inputting a short-cut code (a number with up to 3 digits). It is a good idea to learn frequently used short-cut codes to memory.

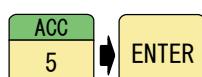
Here, operation is explained with the example of R5 short-cut (Motors-on/Start selection).



- 1 On teach or playback mode top screen, press [DEL/R].**

» "R" is displayed in prompt line.

P	9	9	9	9	U	1	M	1	L	R	S	5	L	N
S	0	0	0	1	1	0	0	0	L	N	A	1	T	1
								m	m	/	s			
> R														



- 2 Input the shortcut number "5" and press [Enter].**

» "R5" is displayed in prompt line.

P	9	9	9	9	U	1	M	1	L	R	S	5	L	N
S	0	0	0	1	1	0	0	0	L	N	A	1	T	1
								m	m	/	s			
> R 5 ,														



- 3 When setting to "controller", Press [-/0]. When setting to "external", press [FN/1]. Then press [Enter].**

(Example) R5; Motors-on/Start selection

Setting to "controller":

Setting to "external" :

Available short-cut with using Compact TP

R code	Title	Usage
5	Motors-on/Start selection (Ref) FD on DESK screen Controller External	This is to select "Motors-on" and "Start" operation whether by teach pendant (=controller) or by input signal from customer's PLC or so (=external). [0; Controller, 1; External] (Refer to 5.1.1 "Internal start" and "External start")
6	Program selection (Ref) FD on DESK screen Controller External	This is to select "Program selection" operation whether by teach pendant (=controller) or by input signal from customer's PLC or so (=external). [0; Controller, 1; External] (Refer to 5.1.1 "Internal start" and "External start")
7	Playback mode selection (Ref) FD on DESK screen Step Cycle Continue	This is to select one playback mode among 3 mode. [0; 1 step, 1; 1r cycle, 2; Continue] (Refer to "5.4 Operations in different operation modes")
8	Check with function	This is to select whether executing function command or not executing function command while check go/back operation. [0; Disabled, 1; Enabled, 2; I-Enabled] "Disabled" ; No function command is executed while check go/back operation. "Enabled" ; All function command is executed while check go operation. Only I-wait function command is executed while check back operation. "I-Enabled" ; Only I-wait function command is executed while check go/back operation.
11	Record of POSE	This is to select whether POSE record is enabled or

R code	Title	Usage
		disabled. [0; Disabled, 1; Enabled] ("8.7 Editing POSE file")
12	Modifying speed	This is to modify the speed of the current step (already recorded step). Speed value: [1.0 to 5000.0] (mm/s), [1.0 to 100.0] (%) ("4.6 Modifying the program")
29	Selecting tool number	This is to modify the tool number of record status. [1 to 32] ("4.6 Modifying the program")
49	Speed Override (Ref) FD on DESK screen 	In playback operation, this value can determine the robot speed by override ratio [%]. At the first time playback, 20 to 30% is recommended for safety. [1 to 150] ("5.2.6 How to change the Playback speed override") ("5.3.6 How to change the Playback speed override")
123	Machine lock (Ref) FD on DESK screen 	Playback operation can be done while robot is kept stationary. This utility is convenient to check the program flow. [0; Disabled, 1; Enabled]
135	Continue/In-position (Ref) FD on DESK screen 	This is to modify the continue/In-position status of current step (already recorded step). [0; Continue, 1; In-position] ("4.6 Modifying the program")
136	Modifying accuracy in step data	This is to modify the accuracy of current step (already recorded step). [1 to 8] ("4.6 Modifying the program")
314	Changing protection level	This is to change the protection level of operator. Password is necessary. (Refer to The SETUP MANUAL "4.7 Concerning the qualifications of the operators")
348	Changing language	This is to change the display language. Every time pressing this code, language is switched Japanese -> English -> Chinese -> Japanese.

It is possible to change "**R5 Motors-on/Start selection**" and "**R6 Program selection**" independently. But, normally, please set both of these 2 modes to the same setting like the followings.

POINT
Program selection and start are executed from the TP

R5 Motors-on/Start selection : Internal

R6 Program selection : Internal

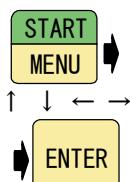
Program selection and start are executed from the external PLC

R5 Motors-on/Start selection : External

R6 Program selection : External

8.6.2 Manual ON/OFF of general output signal (F1 key)

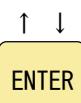
General output signal can be set to ON/OFF by manual operation. (Up to 2 output signals can be designated.) If 2 output signals are designated, those signals are switched oppositely.
This operation can be utilized in teach mode and 1 step playback mode.



- 1 Press [START/MENU] and select <SETTING> - <F-KEY>.**

» F-KEY menu is displayed.

* M E N U * F - K E Y	V 3 . 0 7
< F 1 K E Y > 0 0 0 1	0 0 0 2
F 2 K E Y I C a n c e l	
>	



- 2 Move cursor to <F-KEY> and press [ENTER].**

» "O" is display in prompt line.

* M E N U * F - K E Y	V 3 . 0 7
< F 1 K E Y > 0 0 0 1	0 0 0 2
F 2 K E Y I C a n c e l	
> O	

- 3 With numeric keys, input the general output signal number to be assigned to F1 key. (0 to 2048)**

Here, "3" is inputted as sample.

» "O3" is display in prompt line.

* M E N U * F - K E Y	V 3 . 0 7
< F 1 K E Y > 0 0 0 1	0 0 0 2
F 2 K E Y I C a n c e l	
> O 3	



- 4 Press [ENTER].**

» First output signal is changed to "0003".

* M E N U * F - K E Y	V 3 . 0 7
< F 1 K E Y > 0 0 0 3	0 0 0 2
F 2 K E Y I C a n c e l	
>	



- 5 Next, second output signal number and press [ENTER].**

If only one signal is enough, please input "0" to second signal.

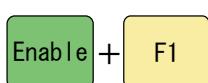
» Here, assigning "O5".

* M E N U * F - K E Y	V 3 . 0 7
< F 1 K E Y > 0 0 0 3	0 0 0 5
F 2 K E Y I C a n c e l	
>	

» Setting is completed. F1 key light on or off due to the current condition.



- 6 Press [START / MENU] again to going back to top screen.**



- 7 Press [Enable] + [F1].**

» Designated output signal on/off is changed alternatively.
F1 key light indicates the current condition.

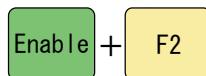
Same signal can be operated manually by [F1] key, unless otherwise setting is changed in <SETTING> menu.

8.6.3 Canceling of input signal waiting (F2 key)

- 1** Please suppose that following program is now in playback.

```
1 MOVE
2 WAITI          (Function command to wait for input signal)
3 MOVE
```

Robot makes a brief stop at step 2 to wait for input signal. Then F2 key lamp illuminates.



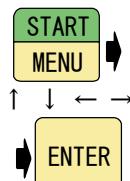
- 2** Press [Enable] + [F2].

Waiting condition is forcibly canceled. F2 key lamp goes out and robot starts moving to step 3.

8.6.4 Monitoring various conditions of robot

Various conditions can be monitored and displayed on teach pendant screen. Following items are available on Compact TP.

Monitor of robot position



- 1** Press [START/MENU] and select <MONITOR> - <AXISMON>.

» AXIS monitor is displayed.

*	M	E	N	U	*	A	X	I	S	M	O	N	V	3	.	0	7
J	1		0	8	0	0	0	0		J	4		0	8	0	0	0
J	2		0	8	0	0	0	0		J	5		0	8	0	0	0
J	3		0	8	0	0	0	0		J	6		0	8	0	0	0

(Reference) in case of Smart TP

J1	080000 080000	0.0	X=	1730.0
J2	080000 080000	90.0	Y=	0.0
J3	080000 080000	0.0	Z=	2030.0
J4	080000 080000	0.0	r=	0.0 a= 0.0
J5	080000 080000	0.0	p=	-90.0 b= 90.0
J6	080000 080000	0.0	y=	-180.0 c= -180.0



- 2** Press up/down cursor key.

» Display changes from each joint position to robot coordinate XYZ values.

*	M	E	N	U	*	A	X	I	S	M	O	N	V	3	.	0	7
X		>	1	7	3	0	.	0		r				0	.	0	
Y							0	.	0		p			-	9	0	.
Z			2	0	3	0	.	0		y			-	1	8	0	.

(Reference) in case of Smart TP

J1	080000 080000	0.0	X=	1730.0
J2	080000 080000	90.0	Y=	0.0
J3	080000 080000	0.0	Z=	2030.0
J4	080000 080000	0.0	r=	0.0 a= 0.0
J5	080000 080000	0.0	p=	-90.0 b= 90.0
J6	080000 080000	0.0	y=	-180.0 c= -180.0



- 3** Press [DEL/R].

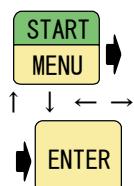
» Display changes to monitor menu.

*	M	E	N	U	*	M	O	N	I	T	O	R	V	3	.	0	7
<	A	X	I	S	M	O	N	>	O	U	T	P	U	T			
I	N	P	U	T					A	L	M	R	E	C			



- 4** Press [START / MENU] again to going back to top screen.

Monitor of general input signal



- 1 Press [START/MENU] and select <MONITOR> - <INPUT>.**

» INPUT signal monitor is displayed.
OFF signal is displayed “-”, ON signal is displayed “O”.

*	M	E	N	U	*	I	N	P	U	T	V	3	.	0	7
I	0	0	0	1	>	-	-	-	-	-	O	-	-	-	-
I	0	0	1	1	-	-	-	-	-	-	O	-	-	-	-
I	0	0	2	1	-	-	-	-	-	-	O	-	-	-	-

↑ ↓

- 2 Press up/down cursor key.**

» Signal number is scrolled.

*	M	E	N	U	*	I	N	P	U	T	V	3	.	0	7
I	0	0	2	1	-	-	-	-	-	-	O	-	-	-	-
I	0	0	3	1	-	-	-	-	-	-	O	-	-	-	-
I	0	0	4	1	>	-	-	-	-	-	O	-	-	-	-



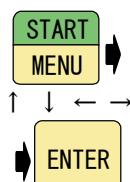
- 3 Press [START / MENU] again to going back to top screen.**

(Reference) General input signal monitor in case of Smart TP

0001	0002	0003	0004	0005	0006	0007	0008	0009	0010						
0011	0012	0013	0014	0015	0016	0017	0018	0019	0020						
0021	0022	0023	0024	0025	0026	0027	0028	0029	0030						
0031	0032	0033	0034	0035	0036	0037	0038	0039	0040						
0041	0042	0043	0044	0045	0046	0047	0048	0049	0050						
0051	0052	0053	0054	0055	0056	0057	0058	0059	0060						
0061	0062	0063	0064	0065	0066	0067	0068	0069	0070						



Monitor of general output signal and set to ON/OFF manually



1 Press [START/MENU] and select <MONITOR> - <OUTPUT>.

» OUTPUT signal monitor is displayed.
OFF signal is displayed “-”, ON signal is displayed “O”.

*	M	E	N	U	*	O	U	T	P	U	T	V	3	.	0	7
O	0	0	0	1	>	-	-	-	-	o	-	-	-	-	-	-
O	0	0	1	1	-	-	-	-	-	o	-	-	-	-	-	-
O	0	0	2	1	-	-	-	-	-	o	-	-	-	-	-	-

↑ ↓

2 Press up/down cursor key.

» Signal number is scrolled.

*	M	E	N	U	*	O	U	T	P	U	T	V	3	.	0	7
O	0	0	2	1	-	-	-	-	-	-	o	-	-	-	-	-
O	0	0	3	1	-	-	-	-	-	o	o	-	-	-	-	-
O	0	0	4	1	>	-	-	-	o	-	-	o	-	-	-	-

ENTER

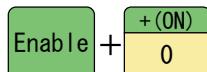
3 Press [ENTER].

» Cursor is located on left top signal.

*	M	E	N	U	*	O	U	T	P	U	T	V	3	.	0	7
O	0	0	2	1	-	-	-	-	-	-	o	-	-	-	-	-
O	0	0	3	1	-	-	-	-	-	o	o	-	-	-	-	-
O	0	0	4	1	-	-	-	o	-	-	o	-	-	-	-	-

↑ ↓ ← →

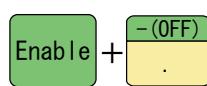
4 Move cursor to the signal which is needed to be changed.



5 In case of setting to ON, press [Enable] + [+/-].

» Signal of cursor position is set to ON and display changes to "O".

*	M	E	N	U	*	O	U	T	P	U	T	V	3	.	0	7
O	0	0	3	1	-	-	-	-	-	o	o	-	-	-	-	-
O	0	0	4	1	-	-	-	o	-	-	o	-	-	-	-	-
O	0	0	5	1	-	o	-	-	-	-	o	-	-	-	-	-



In case of setting to OFF, press [Enable] + [-/-].

» Signal of cursor position is set to OFF and display changes to “-”.

*	M	E	N	U	*	O	U	T	P	U	T	V	3	.	0	7
O	0	0	3	1	-	-	-	-	-	o	o	-	-	-	-	-
O	0	0	4	1	-	-	-	o	-	-	o	-	-	-	-	-
O	0	0	5	1	-	-	-	-	-	o	-	-	-	-	-	-



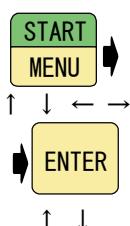
6 Press [START / MENU] again to going back to top screen.

(Reference) General output signal monitor in case of Smart TP

0001	0002	0003	0004	0005	0006	0007	0008	0009	0010							
0011	0012	0013	0014	0015	0016	0017	0018	0019	0020							
0021	0022	0023	0024	0025	0026	0027	0028	0029	0030							
0031	0032	0033	0034	0035	0036	0037	0038	0039	0040							
0041	0042	0043	0044	0045	0046	0047	0048	0049	0050							
0051	0052	0053	0054	0055	0056	0057	0058	0059	0060							
0061	0062	0063	0064	0065	0066	0067	0068	0069	0070							



Monitor of alarm record



- 1 Press [START/MENU] and select <MONITOR> - <ALM REC>.**

>> ALM REC (alarm record) monitor is displayed.

*	M	E	N	U	*	A	L	M	R	E	C	V	3	.	0	7
0	0	1	>	1	3	/	0	7	/	1	7	E	0	1	2	1
0	0	2		1	3	/	0	7	/	1	7	E	0	1	1	1
0	0	3		1	3	/	0	7	/	1	6	E	0	1	0	7

- 2 Press up/down cursor key.**

>> Alarm record number is scrolled.

*	M	E	N	U	*	A	L	M	R	E	C	V	3	.	0	7
0	0	3		1	3	/	0	7	/	1	6	E	0	1	0	7
0	0	4		1	3	/	0	7	/	1	6	E	0	1	1	1
0	0	5	>	1	3	/	0	7	/	1	5	E	0	1	2	1

- 3 Press [START / MENU] again to going back to top screen.**

8.6.5 Selecting the operating target (UNIT and MECHANISM)

This section is necessary only for the case of "Multi unit" or "Multi mechanism" specification.

Manual operation target UNIT and MECHANISM is needed to be selected. Normally, there is only 1 UNIT and MECHANISM in controller. So it is not necessary to select them explicitly.



An "UNIT" is a unit to make a work-program. If there are plural UNITS in the controller, it is necessary to select one of them before the manual operation and the teaching operation. A "MECHANISM" refers to a unit such as a "manipulator" or "positioner" that configures a control group and cannot be broken down any further. And one UNIT consist one or more mechanisms. If there are plural mechanisms in the UNIT, it is necessary to select which mechanism will be manually operated.

- 1 Current UNIT and current MECHANISM is displayed on teach pendant.**

P	9	9	9	9	U	1	M	1	J	S	1	C	1		
S	0	0	0	1	1	0	0	0	L	N	A	1	P	T	3
					m	m	/	s							

- 2 To select UNIT, press [Enable] + [UNIT / 4].**
>> Every time these keys are pressed, the current UNIT number will be changed like 1, 2 ... within the number of the registered UNITS.

- 3 After selecting UNIT, UNIT can be operated manually.**
>> Operate the UNIT with [AXIS OPERATION KEYS] with grasping [ENABLE SWITCH].



- 4 To select MECHANISM, press [Enable] + [MECHA / 7].**
>> Every time these keys are pressed, current MECHANISM number will be changed like 1, 2 ... within the number of the registered MECHANISM.



- 5 After selecting the MECHANISM, the MECHANISM can be operated manually.**
Operate the MECHANISM with [AXIS OPERATION KEYS] with grasping [ENABLE SWITCH].

8.7 Editing POSE file

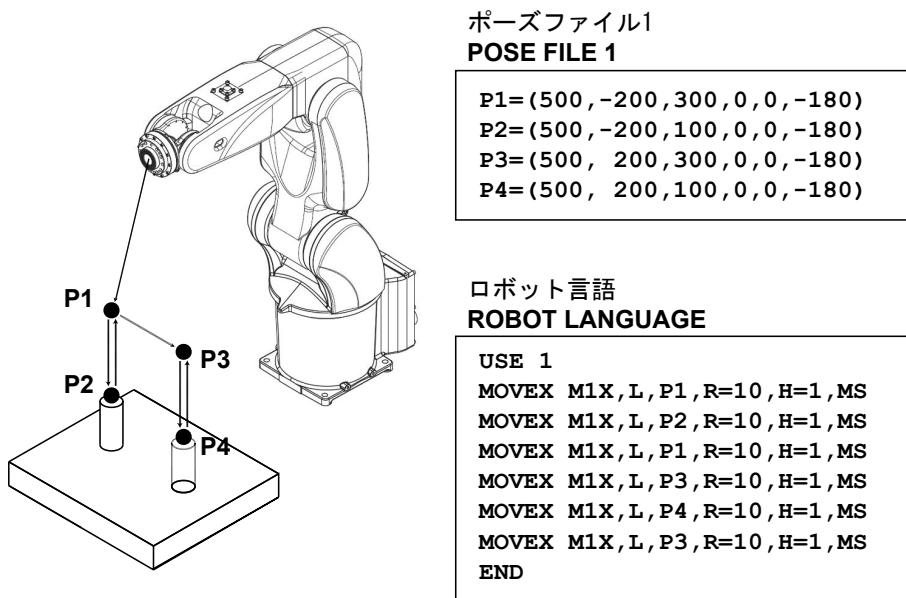
How to edit POSE file by using Compact TP is explained in this section. In case of using Smart TP, please refer to FD controller instruction manual “Robot Language”.

8.7.1 What is POSE file?

“POSE file” is a data file which consist plural robot position data (POSE variable). POSE file and POSE variable can be referred from robot program by using MOVEX command or “FN645 MOVEX” function command.

Example : Referring POSE variable from robot language

P1, P2, P3 and P4 are POSE variables.



8.7.2 Creating POSE file

Declaring to begin POSE record



1 Select the TEACH mode.

2 Utilize shortcut “R11”. Input “1” to select POSE record “Enabled”.

» POSE record screen is displayed.

DEL	FN	FN	ENTER	FN	ENTER
R	1	1		1	

» For now on, only POSE file operation is permitted. Normal program operation is not permitted. (This condition is maintained even when controller power is turned off. In order to finish POSE record, please change this setting to “Disabled”.)

F	I	L	E	0	0	0	1	P	O	S	E	0	0	0	1
X		>						r							
Y								p							
Z			>					y							

↓ (Scroll)

F	I	L	E	0	0	0	1	P	O	S	E	0	0	0	1
Y								p							
Z			>					y							
>															

Following display means the example of “FILE 0001 POSE 0001”, when using Smart TP or “FDonDESK” software.



[1] Robot Program

Pose File No = 1 Record No= 1

Pose File No = Current POSE FILE number to be edited

Record No = Current POSE variable number to be edited

Recording POSE variables in POSE file

Enable + **PROG
STEP**

- 1 Press [Enable] + [PROG/STEP].**

» "P" is displayed in prompt line.

F	I	L	E	0	0	0	1	P	O	S	E	0	0	0	1
X	>							r							
Y								p							
>	P														

- 2 Input the POSE file number by numeric keys.**

Here, POSE file number 777 is inputted.

» POSE file number "P777" is displayed in prompt line.

F	I	L	E	0	0	0	1	P	O	S	E	0	0	0	1
X	>							r							
Y								p							
>	P	7	7	7											

ENTER

- 3 Press [ENTER].**

» Selected POSE file number is displayed.

Following example shows the example of POSE file number 777.

F	I	L	E	0	7	7	7	P	O	S	E	0	0	0	1
X	>							r							
Y								p							
>															

Enable + **M.ON**



- 4 Turn motor power on and operate robot with axis operation keys. Then press [O.W./REC].**

» One POSE variable is recorded.

F	I	L	E	0	7	7	7	P	O	S	E	0	0	0	2	
X	>	1	7	3	0	.	0	r					0	.	0	
Y				0	.	0		p				-	9	0	.	0
>																

**O.W.
REC**

- 5 Press [O.W./REC] again to continue recording POSE variables.**

F	I	L	E	0	7	7	7	P	O	S	E	0	0	0	5	
X	>	1	7	0	0	.	0	r					0	.	0	
Y				1	0	.	0	p				-	9	1	.	0
>																

**PROG
STEP**

No. **ENTER**

- 6 Position of POSE variables can be confirmed by check go/back operation. (Select step number = POSE variable number and press check go or back)**

**Check
GO** **Check
BACK**

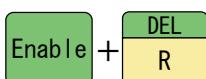
- 7 All POSE variables are recorded, please proceed with the next step "Finishing POSE record".**

- 1 Utilize shortcut "R11". Input "0" to select POSE record "Disabled".**

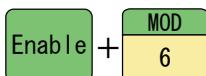
» Now going back to normal operation mode.

DEL	FN	FN	ENTER	+ (ON)	ENTER
R	1	1		0	

8.7.3 Modifying POSE file



- 1** Pressing [Enable] + [DEL/R] can delete the recorded POSE variable in the middle of file.
But other POSE variable numbers are not renumbered. Deleted POSE variable number becomes missing number.



- 2** Pressing [Enable] + [MOD/6] can modify the position of recorded POSE variable.

(Notes) In POSE record mode, same result is obtained by following operation.
 • Pressing [O.W./REC]
 • Pressing [Enable] + [O.W./REC]

8.7.4 (Reference) Modifying POSE file by numeric input (Smart TP / FD on DESK)

In order to edit values of (X, Y, Z, roll, pitch, yaw) in POSE file, Smart TP or “FDonDESK” software is necessary.

Please refer to FD controller instruction manual “Robot Language” “Chapter 3” for detail.

8.7.5 (Reference) Utilizing POSE variable in robot language

(1) Select POSE file by function command “USE”

At the top of source program, please designate POSE file number by function command “USE”. Following example shows the case of POSE file 1.

```
USE [1]
```

(2) Call a pose variable by MOVEX

Refer to the descriptions in the “4.8.1 FN645 MOVEX”

POINT

To input the “FN645 MOVEX” function command, the Smart TP or FD on DESK is necessary.

NOTE



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