DENSO ROBOT

Vertical articulated

V*-G-T SERIES

Horizontal articulated

H*-G-T SERIES

SETTING-UP MANUAL (T03)

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Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

This manual covers the following products.

■ Robot system configured with the RC7M controller

- Vertical articulated robot V∗-G-T series
- Horizontal articulated robot H∗-G-T series

(Note) The robot controller version is indicated in the main software ver. column of the controller setting table affixed on the controller. It can also be checked on the Version screen called up by pressing [ExtScrn]—[Set]—[Maint.]—[Version] from the top screen of the teach pendant.

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

How this book is organized

This book is just one part of the documentation set. This book consists of SAFETY PRECAUTIONS and chapters one through five.

Chapter 1 Operating Devices

This chapter describes how to connect the teach pendant to the robot controller. It also provides explanations of the names and functions of their keys, buttons, and switches which allow you to operate the robot.

Chapter 2 Preparations for Teaching

This chapter describes preparations necessary to make before starting teaching or running the robot from the teach pendant.

The preparations include powering the robot controller and motor on/off, calibrating the robot, modifying the speed, inching selection, setting payload and its center of gravity, and setting the robot installation condition. Be sure to read this chapter before powering on the robot controller.

Chapter 3 General Introduction to Operation Modes and Optional Functions

This chapter describes the three operation modes of the robot: Teach, Individual, and Auto modes. It also describes additional functions including machine lock used for simulation.

Chapter 4 General Introduction to Coordinates and Figures

This chapter explains the coordinates used for the robot and figures of the shoulder, elbow, and wrist.

Chapter 5 Commands Assigned to Function Keys on the Extended Screen

This chapter describes a variety of commands assigned to the function keys on the extended screen of the teach pendant. The first section illustrates the command menu tree. The following sections provide a detailed explanation of those commands, together with the access routes.

Contents

Chapter 4 General Introduction to Coordinates and Figures

Chapter 5 Commands Assigned to Function Keys on the Extended Screen

Chapter 1

Operating Devices

This chapter describes how to connect the teach pendant to the robot controller. It also provides explanations of the names and functions of its keys, buttons, and switches which allow you to operate the robot.

NOTE 1: Avoid letting the teach pendant undergo strong shocks, impacts, or vibrations.

NOTE 2: Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

1.1 Connecting the Teach Pendant

You may teach or operate the robot from the teach pendant (TP). When the robot leaves the factory, no teach pendant is connected to the robot controller.

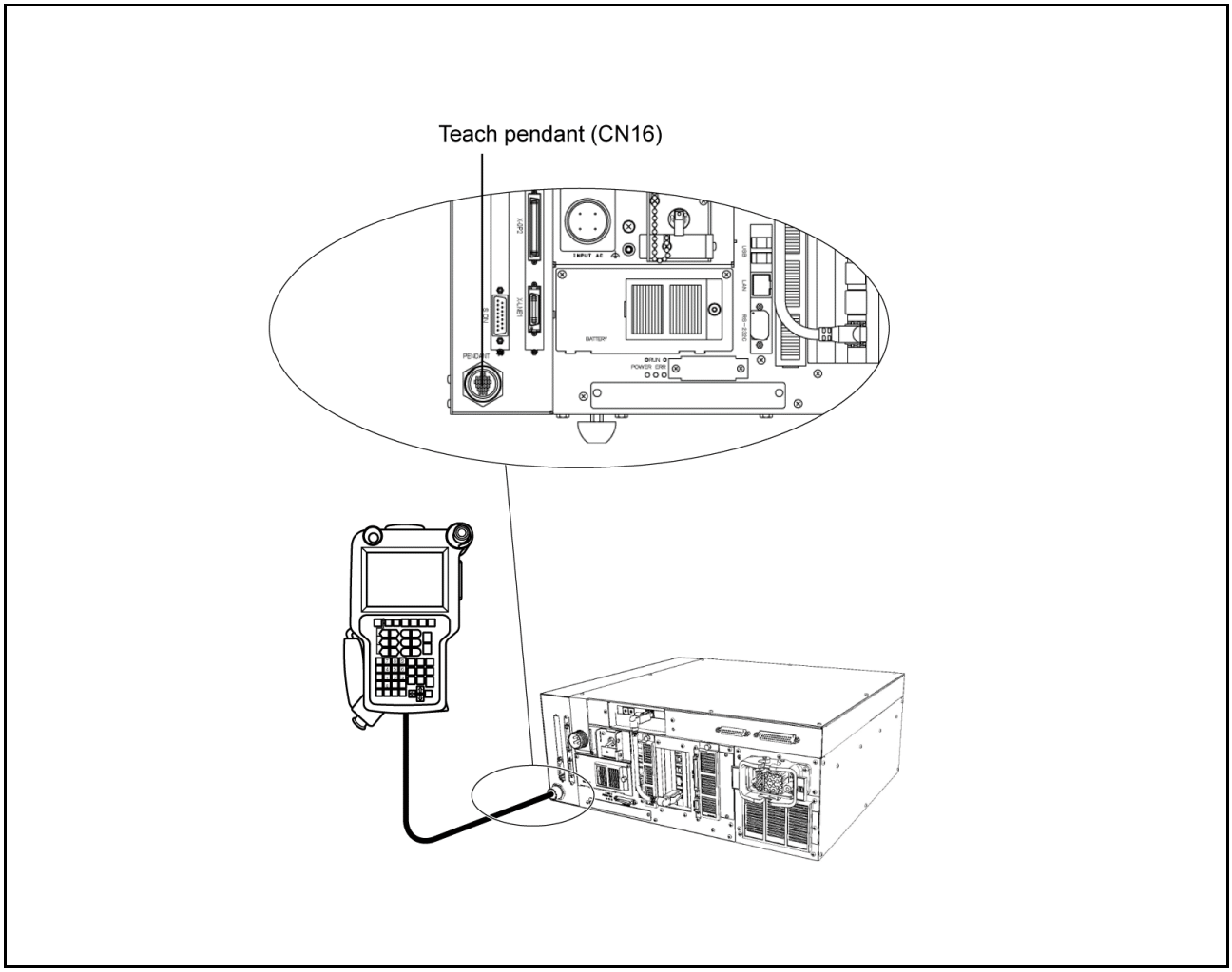
After unpacking the robot package, connect the teach pendant to the robot controller as shown below.

Cautions for connecting or disconnecting the teach pendant cable to/from the controller:

(1) When and after connecting the cable to the controller, take care not to apply upward/downward or rightward/leftward external pressure to the connector. Such pressure may break the connector, resulting in a communications error.

(2) When disconnecting the cable from the controller, first turn the controller power OFF, unlock the connecter and pull it out straight.

Connect the teach pendant to connector CN16 of the robot controller as shown below.

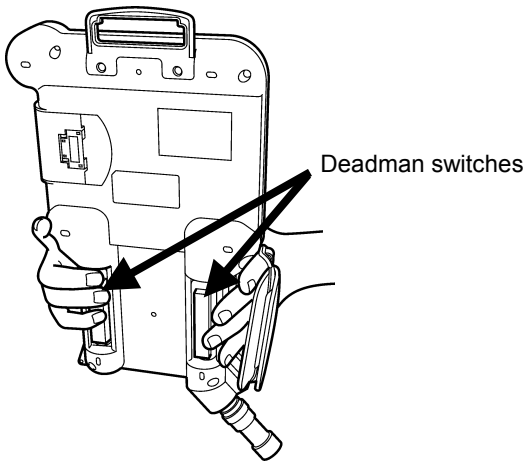


Connecting the Teach Pendant

1.2 Handling the Teach Pendant

1.2.1 Holding the Teach Pendant and the Deadman Switches

Grasp the teach pendant when operating it, as shown below. The teach pendant has two deadman switches for ensuring safety.



★Tip★ The deadman switches are provided to stop the robot automatically and safely when the operator can no longer operate the robot correctly due to unforeseen circumstances such as the operator suffering a blackout or dying while running the robot manually with the teach pendant. If a situation such as this arises, the strength with which the operator is pressing either one of the deadman switches will become either decrease or increase markedly. The deadman switch is a 3-position switch which is able to recognize and react to the following 3 operating statuses.

1) When the switch is not being pressed or is being pressed lightly
   → Switch: OFF
2) When the switch is being pressed with correct pressure
   → Switch: ON
3) When the switch is being pressed too strongly
   → Switch: OFF

Only when either one of the two deadman switches is ON, you can run the robot. If the switch is OFF or goes OFF, the robot cannot run or the running robot will stop, respectively.

In order to ensure safety, the robot is so designed that in manual mode either one of the two deadman switches should be held down for example when the operator presses any of the arm traverse keys.

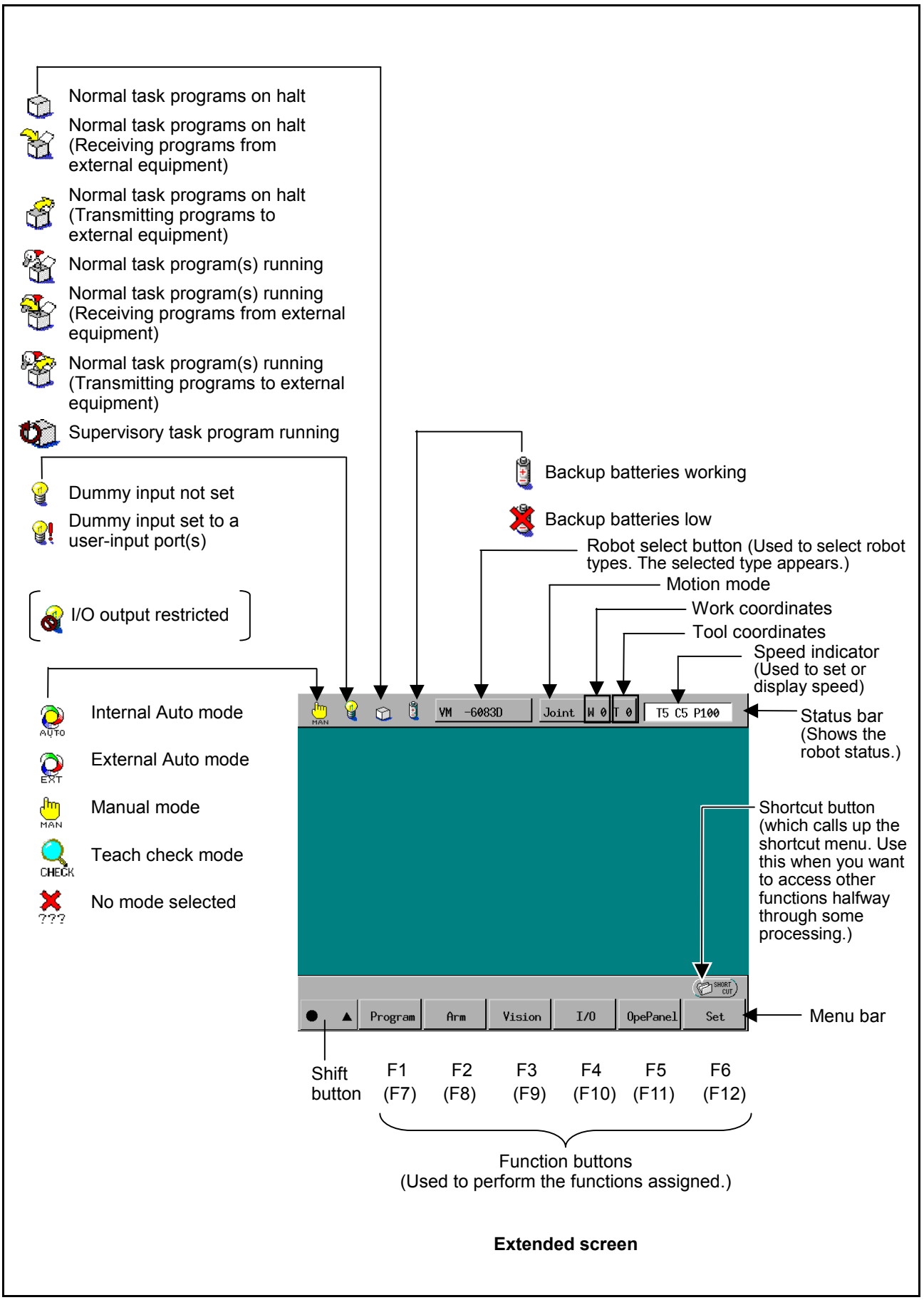
1.2.2 Basic Operation on Extended Screen

For the names and functions of keys, buttons, and switches on the top screen of the teach pendant, refer to the OPERATION MANUAL (T03).

This section describes the extended screen (Denso original screen).

■ Extended screen

The extended screen is as shown on the next page. At the top of the screen is a status bar, which displays the current operation mode, task program status, backup battery states, robot status and other conditions. At the bottom of the screen is a menu bar that shows the functions assigned to the function buttons. The middle of the screen displays a variety of windows.



Extended screen

Names of Keys, Buttons, and Switches on the Extended Screen

■ Function buttons

The extended screen of the teach pendant has six function buttons in the menu bar at the bottom of the screen. Each of the function buttons usually displays the function assigned to it (F1 to F6).

Pressing the Shift button switches the menu bar between "F1 to F6" and "F7 to F12." When those function buttons are shifted, their functions (assigned to F7 to F12) are displayed on the six buttons.

Shown below is an example of menu bar shifting.

- When the function buttons are not shifted:

- When the function buttons are shifted:

Function buttons

■ Shift button and shift mark

If the shift mark is ▲ (facing up and filled with black), it means that the current menu bar can be shifted. Pressing the Shift button will shift the menu bar from "F1 to F6" to "F7 to F12" and turn the shift mark to ▼ (facing down).

If the shift mark is △ (facing up and filled with gray), it means that the current menu bar cannot be shifted. Pressing the Shift button will result in no change in the menu display.

■ Cursor keys

The teach pendant has four cursor keys which are used on the extended screen to select target data or for other purposes. Pressing up-, down-, left-, or right-arrow cursor key moves the cursor on the screen up, down, leftwards, or rightwards, respectively.

When the cursor movement direction is restricted to either up/down or leftwards/rightwards, the restricted direction keys are used to increase or decrease values.

■ Touch panel

The LCD screen of the teach pendant acts as a touch panel. You may directly touch the screen to operate the touch buttons or select data entry areas.

CAUTION: Touch the screen with your fingers only. Pressing the screen with the tip of a pen or any pointed object will result in failures.

■ ENTER key and RESET R key

The **ENTER** key or **RESET R** key is usually used to allow input of a new entry or to discard it, respectively.

Those keys are also used to close the current window and return to the previous one. Pressing the **ENTER** key will save the new entry and exit from the current window; pressing the **RESET R** key will exit from the current window without saving new entry.

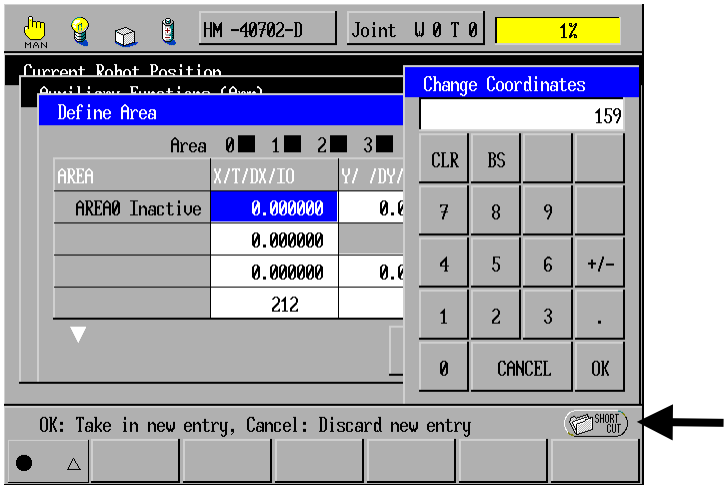
■ SHORTCUT button

The use of a shortcut allows you halfway through the current processing to carry out other processing. From any of the processing screens, you can call up the Shortcut Menu by pressing the **SHORTCUT** button.

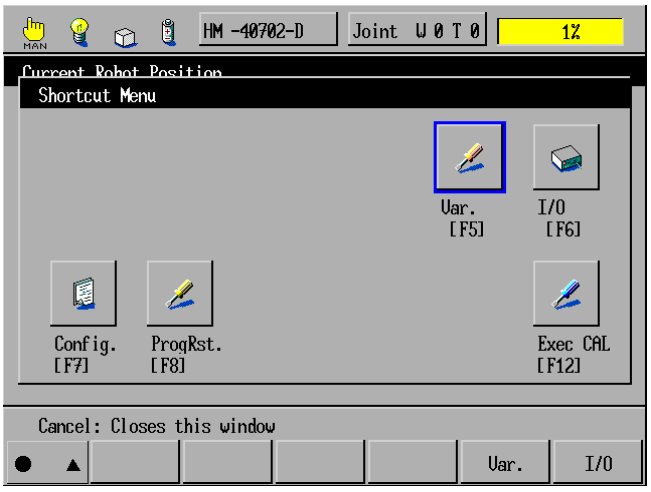
On the Shortcut Menu, you can choose the desired processing.

Step 1 Switch the teach pendant to the extended screen.

Step 2 On the extended screen, press the **SHORTCUT** button.



Step 3 Press the desired function button on the Shortcut Menu. (Or press the corresponding function button on the menu bar.)



The screen will switch to the processing screen of the selected function.

Chapter 2

Preparations for Teaching

This chapter describes preparations necessary to make before starting teaching or running the robot from the teach pendant.

The preparations include turning the robot controller and motor on/off, calibrating the robot, modifying the speed, inching selection, setting payload and its center of gravity, and setting the robot installation condition.

Be sure to read this chapter before powering on the robot controller

NOTE 1: This chapter uses the abbreviations (TP) and (WC) which inform you that operations marked with those abbreviations can be performed from the teach pendant and in WINCAPSIII, respectively.

NOTE 2: Avoid letting the teach pendant undergo any strong shocks, impacts, or vibrations.

NOTE 3: Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

2.1 Turning the Robot Controller ON (TP)

Turning the robot controller on enables you to operate the robot from the teach pendant or run the robot automatically.

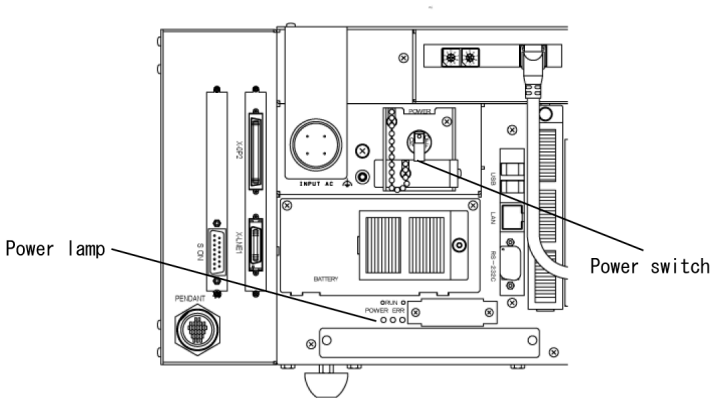
The robot controller supplies the robot unit with power and controls it.

Operating procedure

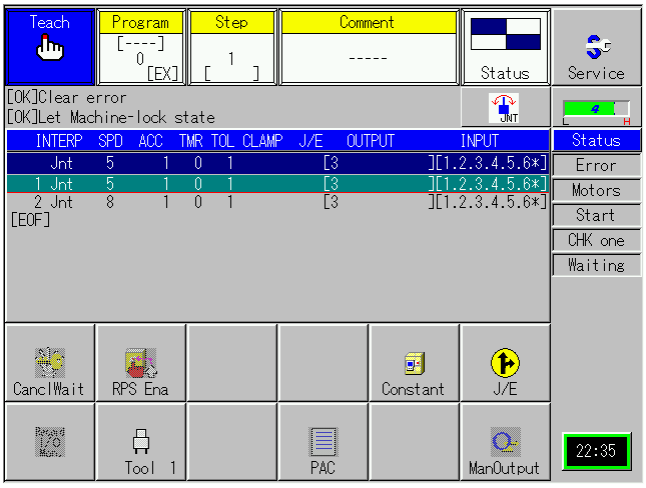
Step 1

Flip the power toggle switch provided on the robot controller upward.

The power lamp (the left one of the three pilot lamps) comes on. The other two pilot lamps (Auto mode lamp and error lamp) will flash for an instant.



After turning the controller power ON, the teach pendant screen shown below appears.



CAUTION: If you want to turn the controller power ON immediately after turning it OFF, wait at least 10 seconds and check that all of the pilot lamps on the robot controller are no longer lit and the teach pendant screen is turned OFF.

2.2 Turning the Robot Controller OFF (TP)

Turn the robot controller off when

(1) The necessary robot operations have been completed.

(2) Performing maintenance on the robot unit.

(3) Performing maintenance on the robot controller.

(4) Connecting any device except USB devices and Ethernet cables.

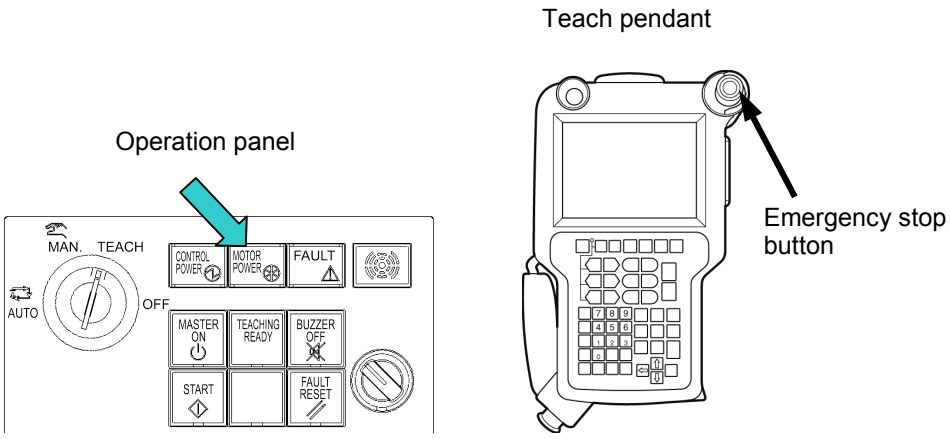
(5) Connecting or disconnecting the robot control cable between the robot unit and its controller.

⚠ **CAUTION**: Be sure to turn the robot controller off before connecting or disconnecting the robot control cable between the robot unit and its controller. Connection/disconnection of the robot control cable while the robot controller power is on may damage the encoder interface circuitry in the robot controller.

Operating procedure

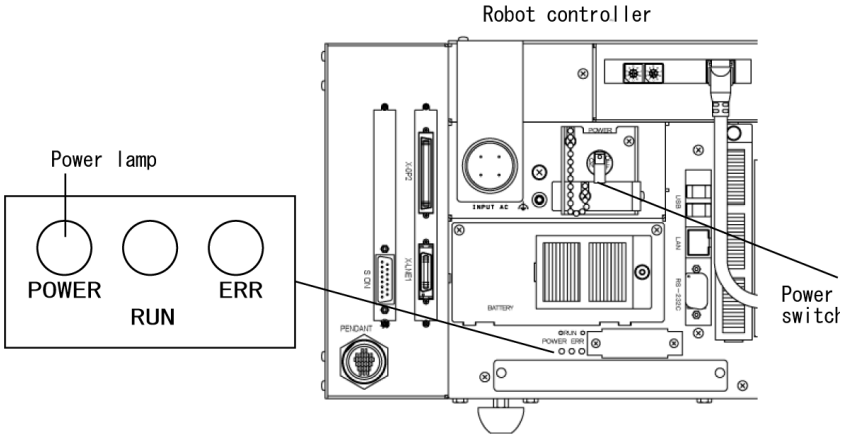
Step 1 If the MOTOR POWER lamp on the operation panel is on, press the emergency stop button of the teach pendant to turn the motor power off.

The MOTOR POWER lamp goes off.



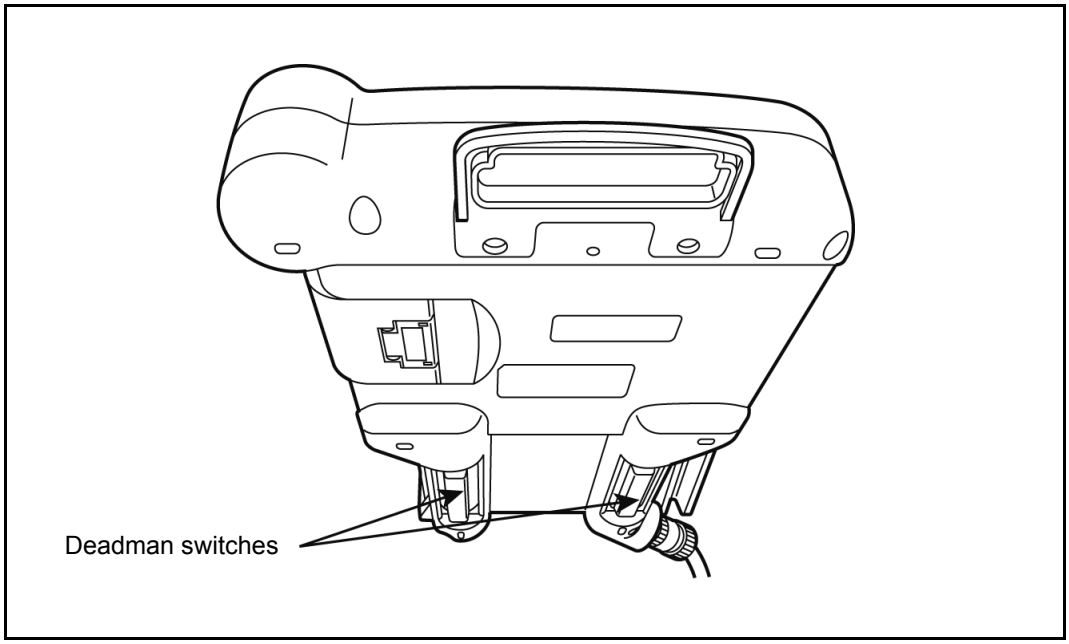
Step 2 Flip the power toggle switch on the robot controller downwards.

The power lamp (the left one of the three pilot lamps) goes off.



2.3 Deadman Switches (TP)

The teach pendant has two deadman switches. Holding down either one of the deadman switches properly activates some functions in Teach or Individual mode.



Teach Pendant

Hold down either one of the deadman switches when

(1) Pressing any of the arm traverse keys in Teach mode.

(2) Pressing the CHECK GO or CHECK BACK key in Teach mode.

(3) Pressing the Manual Output button on the touch panel in Teach mode to turn output signals ON or OFF.

(4) Canceling the Waiting state in Teach or Individual mode.

(5) Issuing user output signals in Teach mode.

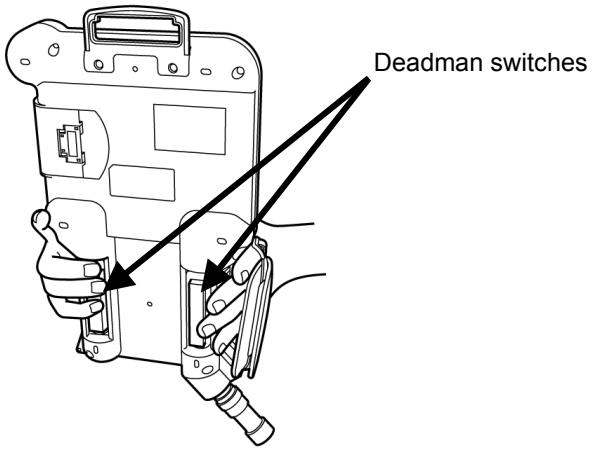
⚠**CAUTION**: Never keep the deadman switch(es) held down with adhesive tape or the like. Doing so may fail to stop the robot when running it in Teach mode. It is extremely DANGEROUS.

NOTE: The deadman switches on the teach pendant are of a 3-position type. Releasing the switch or pressing it excessively turns it off, stopping robot motion.

Released (OFF) ⇒ Pressed lightly (ON) ⇒ Pressed strongly (OFF)

Operating procedure

Step 1 While holding down either one of the deadman switches, press any of the keys (e.g., arm traverse key).



Step 2 Release the deadman switch. (Or press it stronger.)

The robot will stop.

2.4 Turning the Motor ON (TP)

Turning the motor on enables you to run the robot.

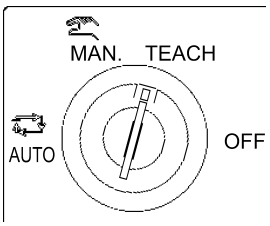
⚠**CAUTION**: Before turning the motor on, be sure to confirm no person(s) is in the restricted space of the robot.

Turn the motor on when

Running the robot in Teach mode, Individual mode, or Auto mode.

Operating procedure

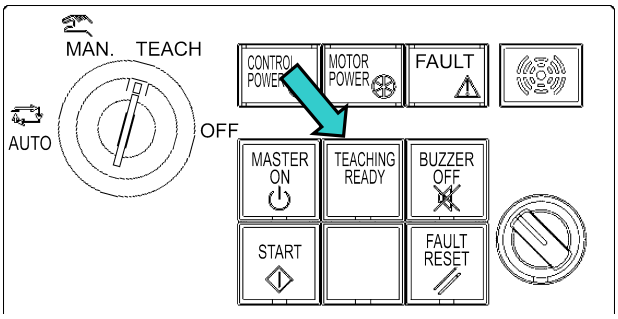
Step 1 Turn the mode selector switch on the operation panel to the TEACH position.



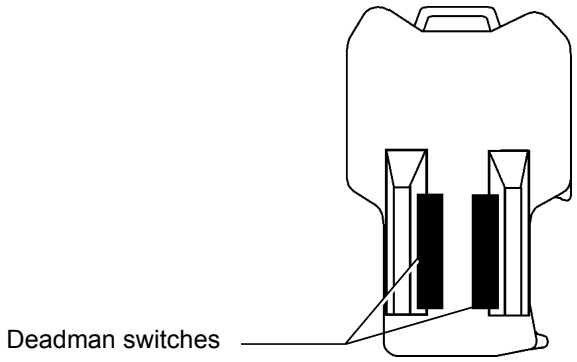
NOTE 1: If turning the mode selector switch to the TEACH position triggers the "Error 2008: Robot Stop is activated," it means that the "Line emergency stop" pin on controller connector CN19 is open-circuited. The controller interprets its state as "Emergency stop." Close the "Line emergency stop" pin. (Refer to the CONTROLLER MANUAL (T03).)

NOTE 2: The motor cannot be turned on if the machine is locked. (Refer to Section 3.1.)

Step 2 Press the TEACHING READY key on the operation panel.

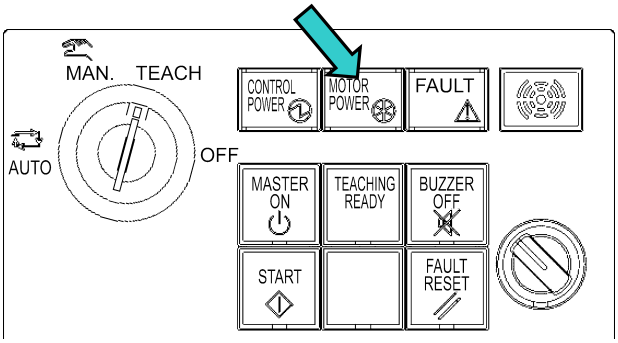


Step 3 Hold down either one of the deadman switches on the teach pendant.



Step 4 The robot motor turns ON.

The MOTOR POWER lamp on the operation panel lights.



2.5 Turning the Motor OFF (TP)

Turn the motor off when

(1) Anyone enters the restricted space of the robot.
(2) Turning the robot controller off.
(3) Running the robot manually.
(4) Performing file operations (e.g. making a backup file)
(5) Modifying parameters.
(6) Loading task programs.
(7) Carrying out CALSET (selecting/deselecting joints to be calibrated).
(8) Releasing brakes.

Operating procedure

Step 1 Release the deadman switch on the teach pendant, and the MOTOR POWER lamp on the operation panel goes off.

2.6 Setting the Playback Speed on the Extended Screen (TP)

For speed setting on the top screen of the teach pendant, refer to the OPERATION MANUAL (T03).

The robot speed is determined by the programmed internal speed and the playback speed. The internal speed is specified by commands in programs. The playback speed is specified using the teach pendant for teaching or trial run. It is expressed in the percentage of the internal speed.

Notes for setting the playback speed

(1) When the power is turned ON, the initial playback speed is 1%.

(2) Once the playback speed is set, it will remain in effect until update the setting.

(3) In Playback mode, the robot will run at the (internal speed x playback speed (%)). If the playback speed is set at 80%, the robot will run at 80% of the internal speed.

In Teach mode, the robot controller is designed to run the robot at 10% of the internal speed. If the playback speed is set at 80%, therefore, the robot will run at 10% x 80% of the internal speed, that is, at 8%, as shown in Figure 2-3.

(4) The minimum allowable playback speed is 1%.

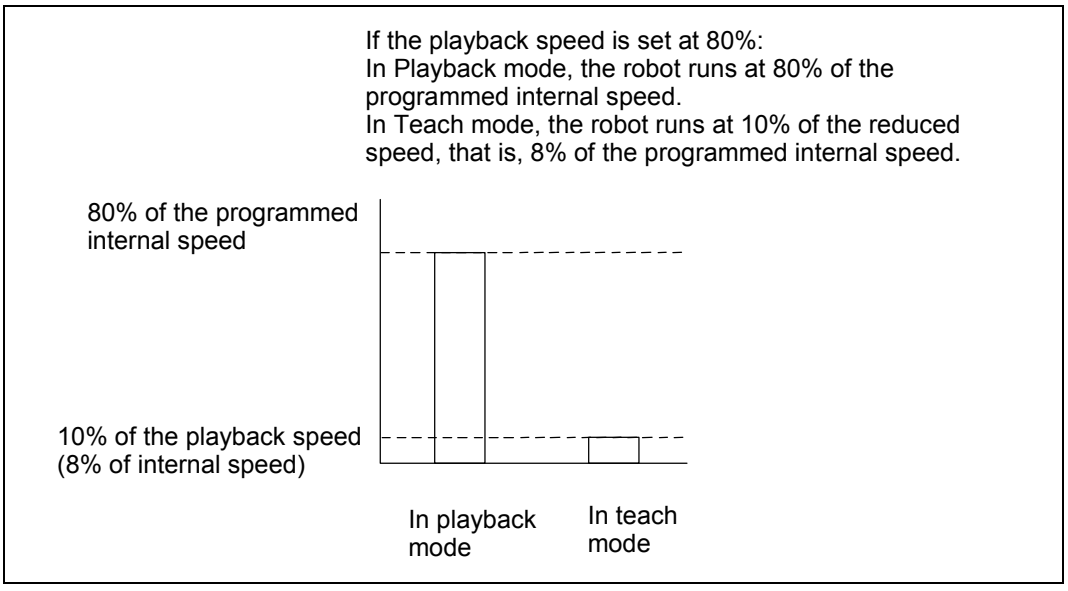


Figure 2-3. Actual Speed Differences in Playback Mode and Teach Mode

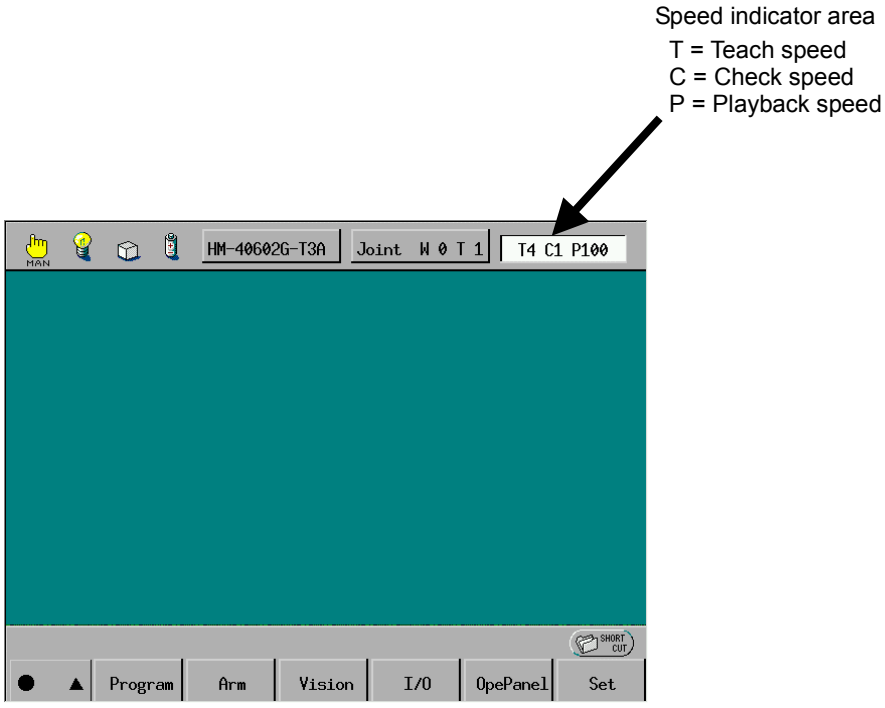
Operating procedure

⚠**WARNING**: At the start, set the playback speed to 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

⚠**WARNING**: It is possible to set the playback speed even while the program is running. Doing so may suddenly change the robot speed. It is DANGEROUS.

Step 1 Switch the teach pendant to the extended screen.

Step 2 Touch the speed indicator button in the top right corner of the extended screen.

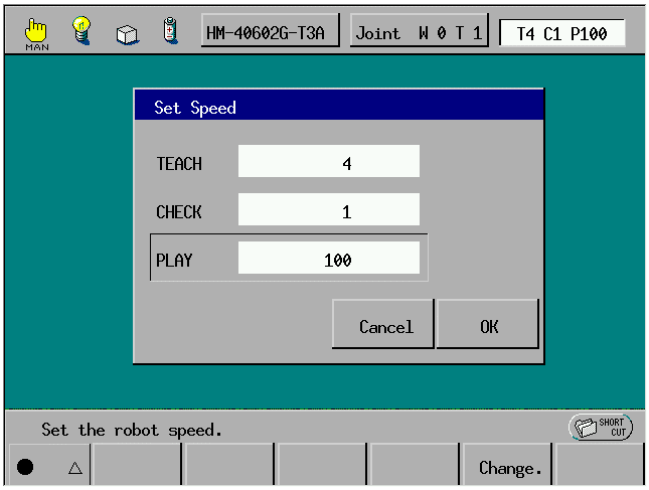


The Set Speed window appears as shown in the next step.

TIP: You can call up this window also by pressing [Arm]—[Speed] from the extended screen.

Step 3

In the Set Speed window, check that the desired row (TEACH, CHECK, or PLAY) is selected and then press [Change.].



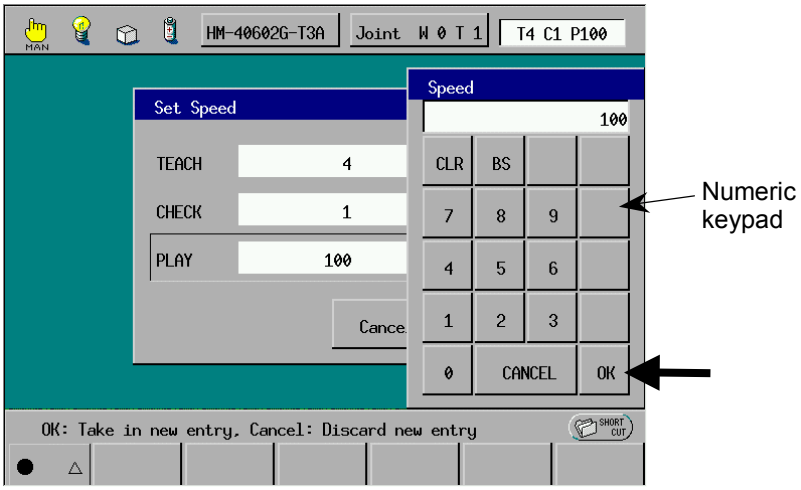
The numeric keypad appears as shown below.

Step 4

Use the numerical buttons on the numeric keypad to enter the desired value.

To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it.



The numeric keypad disappears.

To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad instead of the OK button.

2.7 Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization (TP/WC)

You may set the master control parameters of the mass of payload (end-effector and object to be mounted at the end of the robot arm), the payload center of gravity and control set of motion optimization. For details, refer to the PROGRAMMER'S MANUAL (I) (T03), Chapter 4, Section 4.7.

Set the master control parameters of the payload, center of gravity, and control set of motion optimization when

You have determined the mass of the payload (end-effector and object to be mounted at the end of the robot arm) and the payload center of gravity.

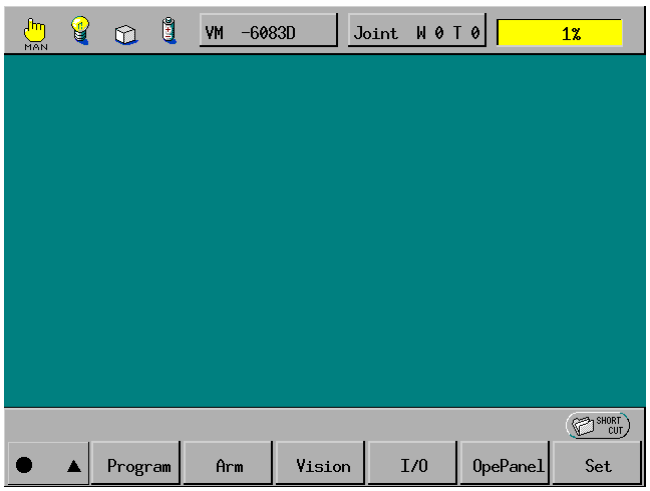
Operating procedure

Use the teach pendant or WINCAPSIII for this setting.

■ ***From the teach pendant***

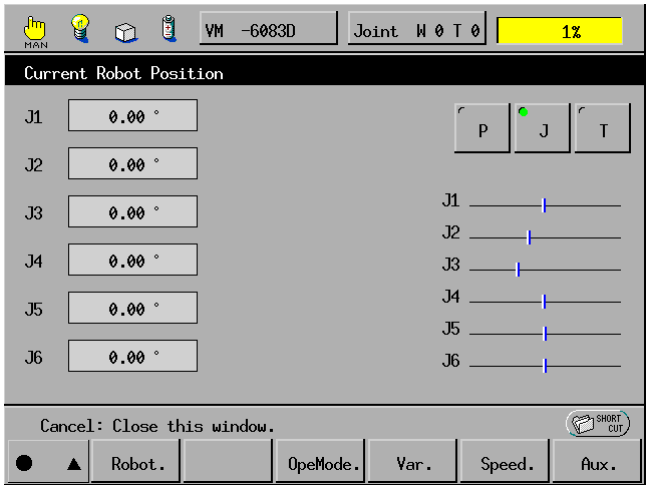
Step 1 Switch the teach pendant to the extended screen.

Step 2 On the extended screen, press [Arm].



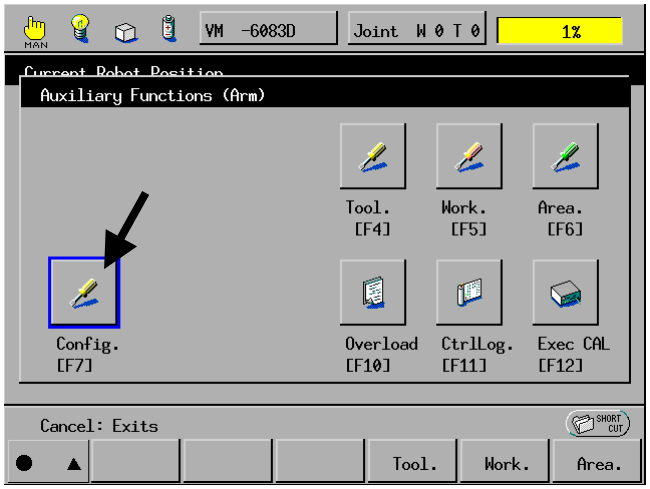
The Current Robot Position window appears as shown below.

Step 3 On the Current Robot Position window, press [Aux.].



The Auxiliary Functions (Arm) window appears as shown below.

Step 4 Press [Config.].



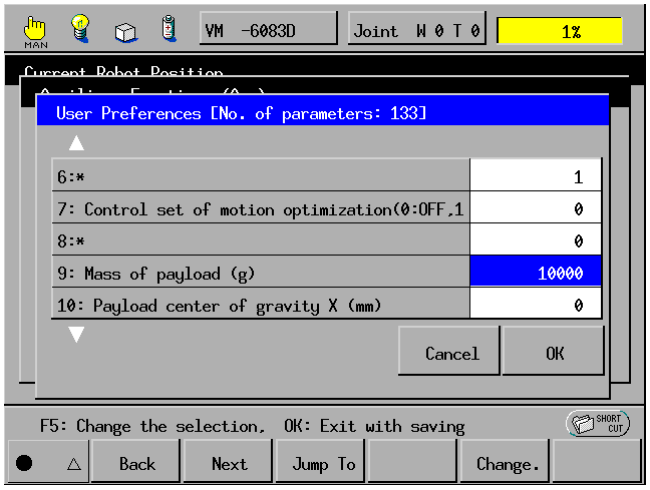
The User Preferences window appears as shown in the next step.

Step 5

Select the "9: Mass of payload (g)" area, using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



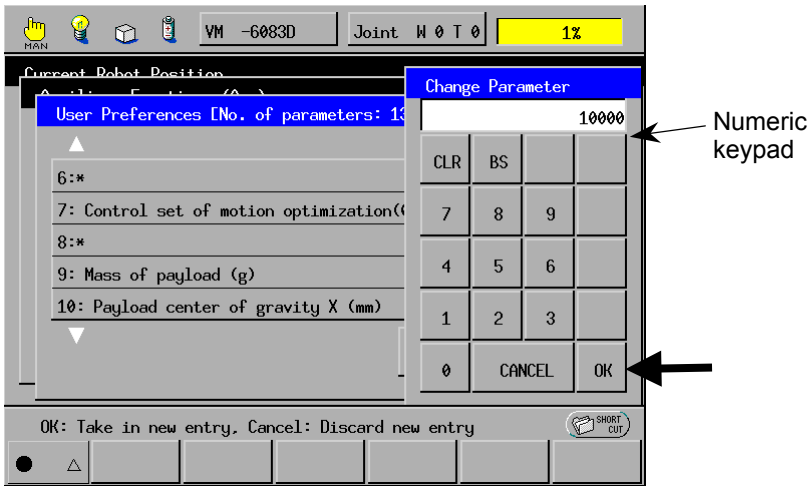
The numeric keypad appears as shown below.

Step 6

Use numerical buttons on the numeric keypad to enter the desired value.

To cancel the newly entered value, press the CLR or BS button.

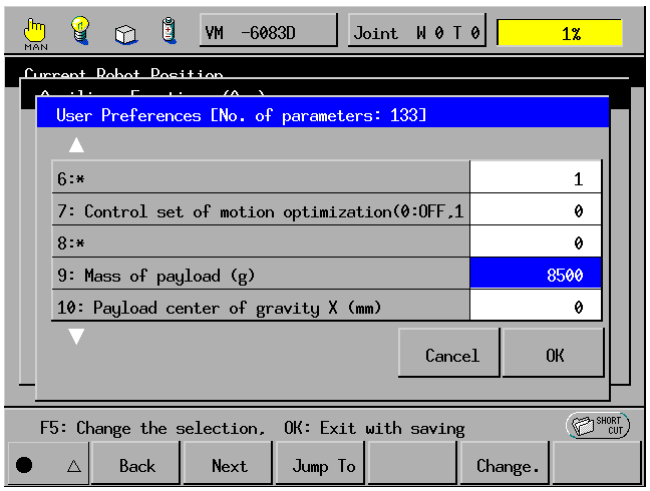
Check the entered value and press the OK button to establish it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears.

The newly entered value is displayed in the "9: Mass of payload (g)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button

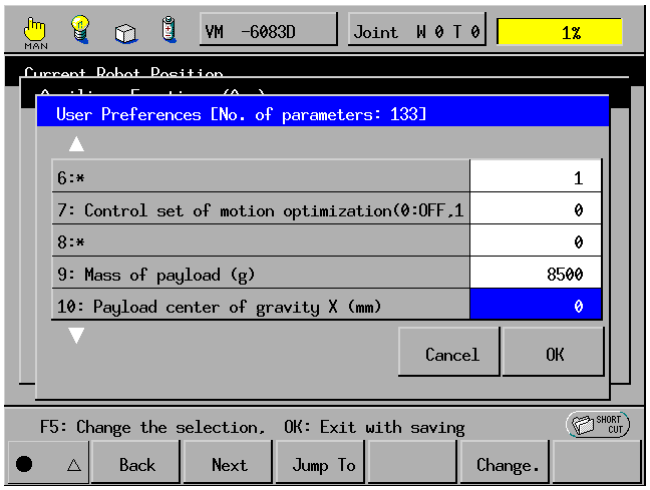


Step 7

Select the "10: Payload center of gravity X (mm)" area, using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



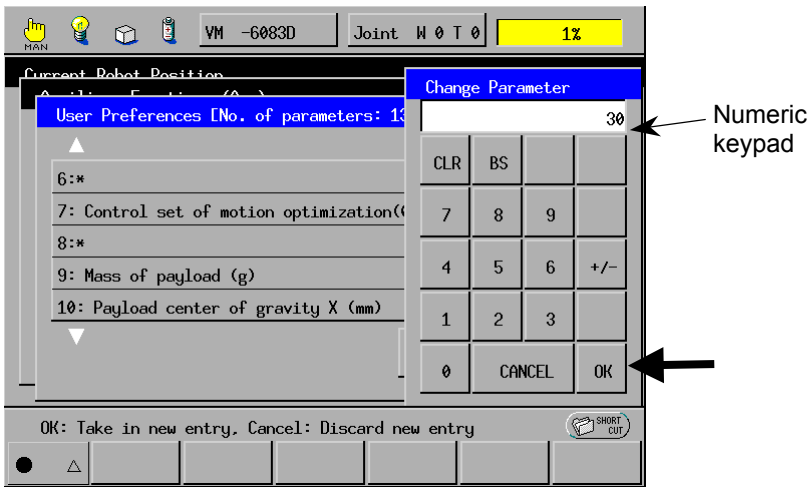
The numeric keypad appears as shown in the next step.

Step 8

Use the numerical buttons on the numeric keypad to enter the desired value.

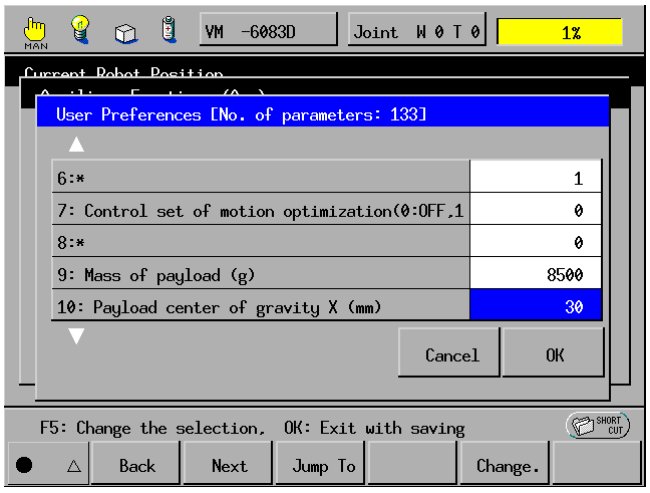
To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears and the newly entered value is displayed in the "10: Payload center of gravity X (mm)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

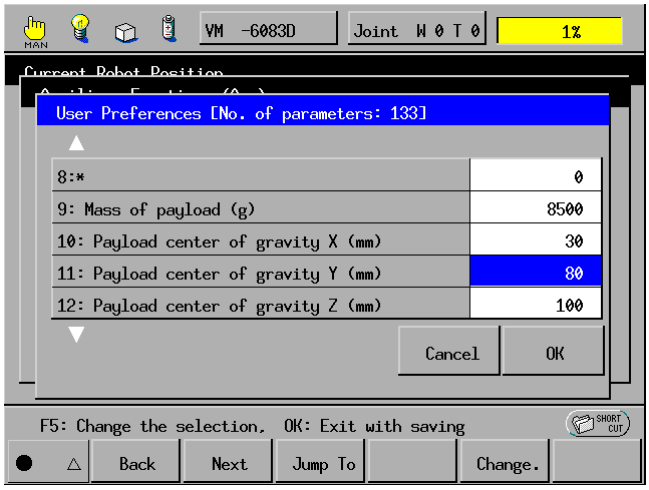


Step 9

Select the "11: Payload center of gravity Y (mm)" area by using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



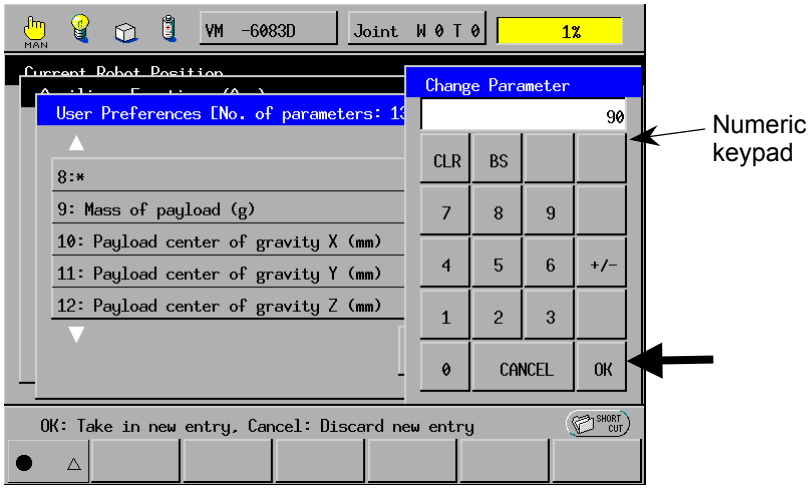
The numeric keypad appears as shown below.

Step 10

Use the numerical buttons on the numeric keypad to enter the desired value.

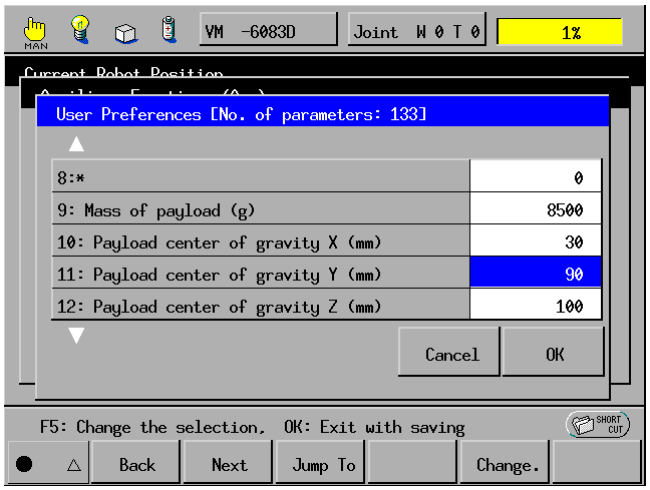
To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears and the newly entered value is displayed in the "11: Payload center of gravity Y (mm)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

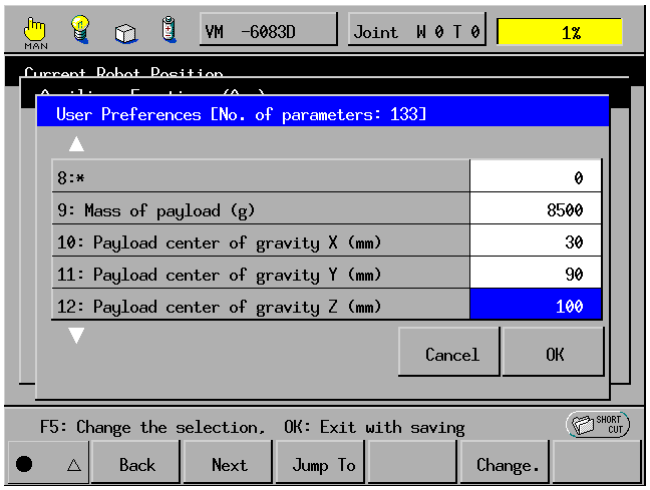


Step 11

Select the "12: Payload center of gravity Z (mm)" (for 6-axis robots) or "12: Load inertia (kgcm^2)" (for 4-axis robots), using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



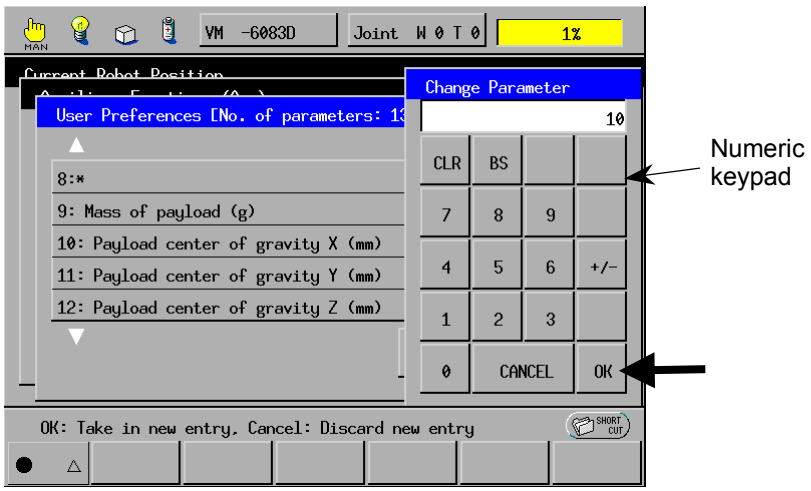
The numeric keypad appears as shown in the next step.

Step 12

Use the numerical buttons on the numeric keypad to enter the desired value.

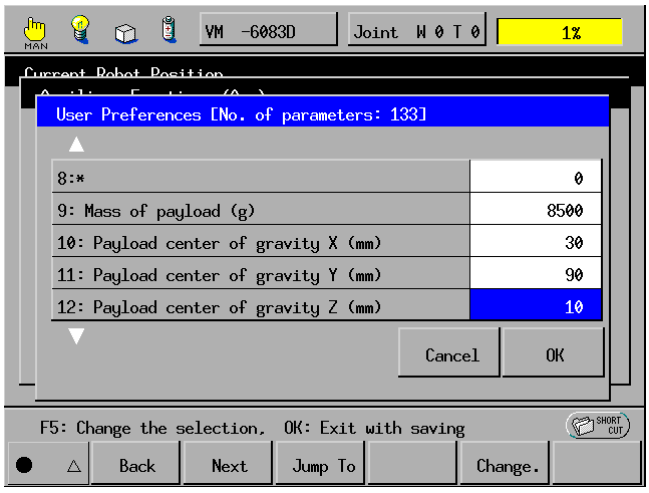
To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears and the newly entered value is displayed in the "12: Payload center of gravity Z (mm)" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.

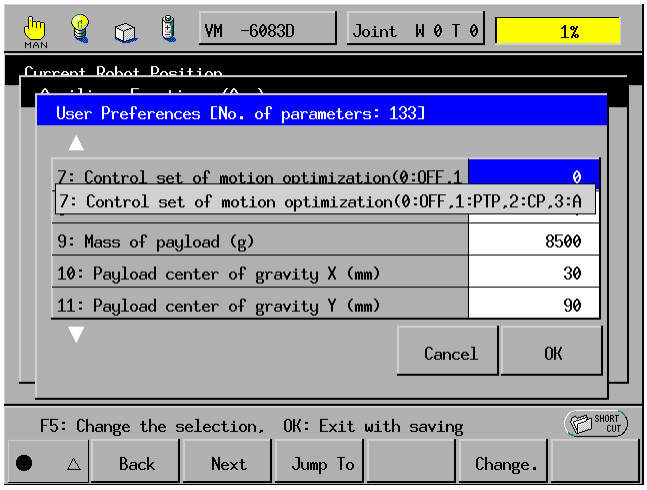


Step 13

Select the "7: Control set of motion optimization" area by using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



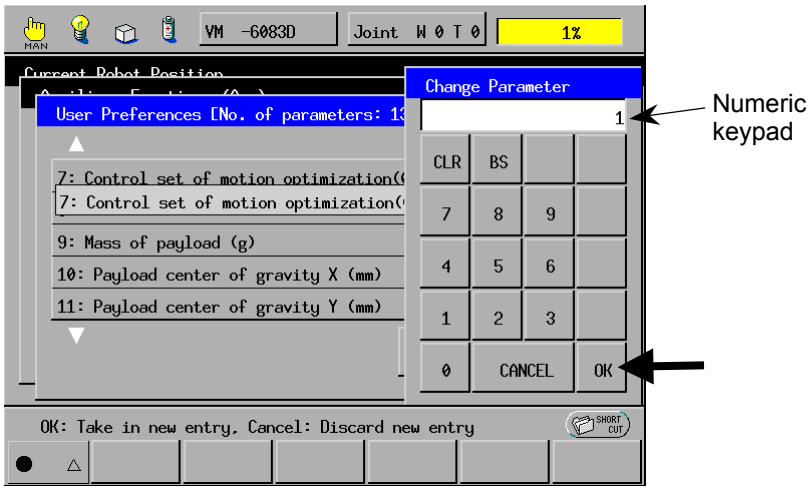
The numeric keypad appears as shown below.

Step 14

Use the numerical buttons on the numeric keypad to enter the desired value.

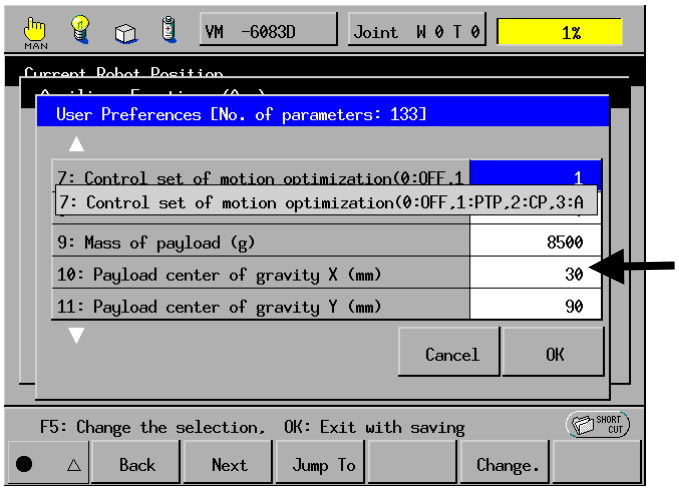
To cancel the newly entered value, press the CLR or BS button.

Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears and the newly entered value is displayed in the "7: Control set of motion optimization" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.



Step 15

Press the OK button on the User Preferences window as shown above.

The Auxiliary Functions (Arm) window appears.

Step 16

Press the Cancel key two times.

The display returns to the top screen.

The master control parameters set through the above procedure automatically apply to the local control parameters.

■ ***In WINCAPSIII***

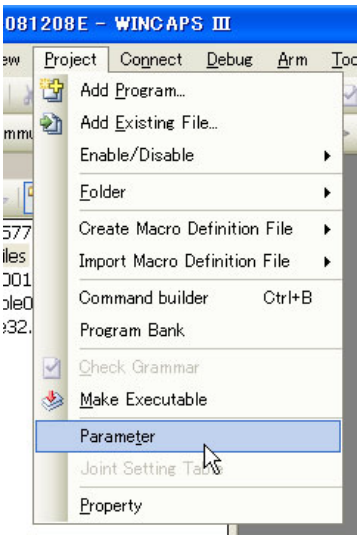
Step 1

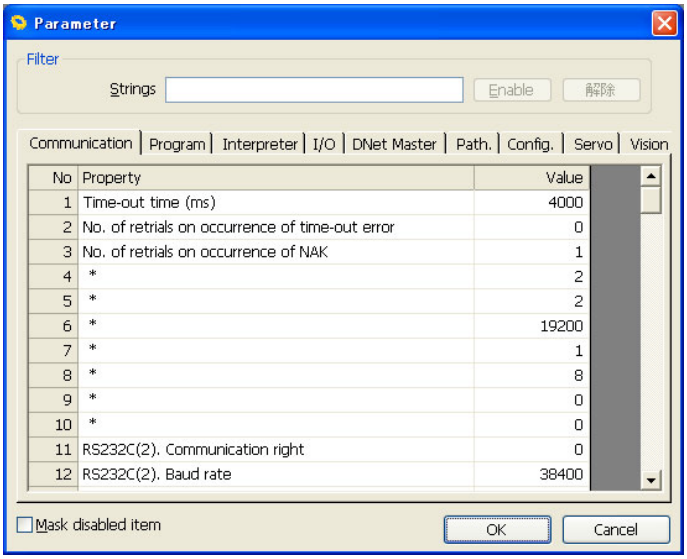
Run WINCAPSIII.

NOTE: Log on as a Programmer. Logging on as an Operator does not allow editing of configuration parameters in Step 4.

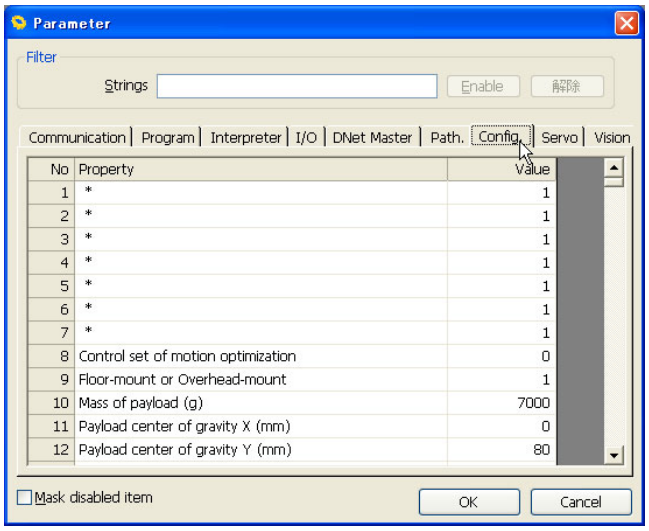
Step 2

Choose Project | Parameters to display the Parameters window.





Step 3 Choose the Config. tab.



Step 4 Enter the desired values to the following parameters in the Value column of the window above.

- Control set of motion optimization
- Mass of payload (g)
- Payload center of gravity X (mm)
- Payload center of gravity Y (mm)
- Payload center of gravity Z (mm) Inertia of payload ($kgcm^2$) for 4-axis robots

For details about parameter values, refer to Section 2.10 "Configuration List."
After completion of entry, press OK to save them into the current project.

Step 5

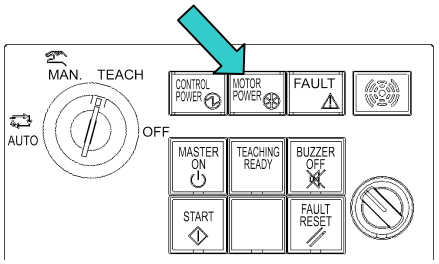
Check the MOTOR POWER lamp on the operation panel.

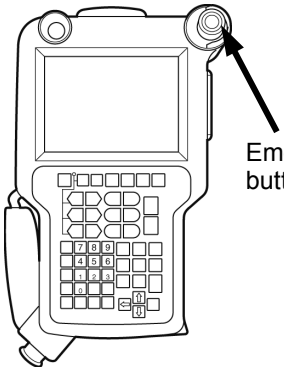
If it is on, press the emergency stop button on the teach pendant to turn the motor power off. The MOTOR POWER lamp goes off.

CAUTION: NEVER skip this step. Turning the motor off is essential to assure safety in the following operation.

Teach pendant

Operation panel

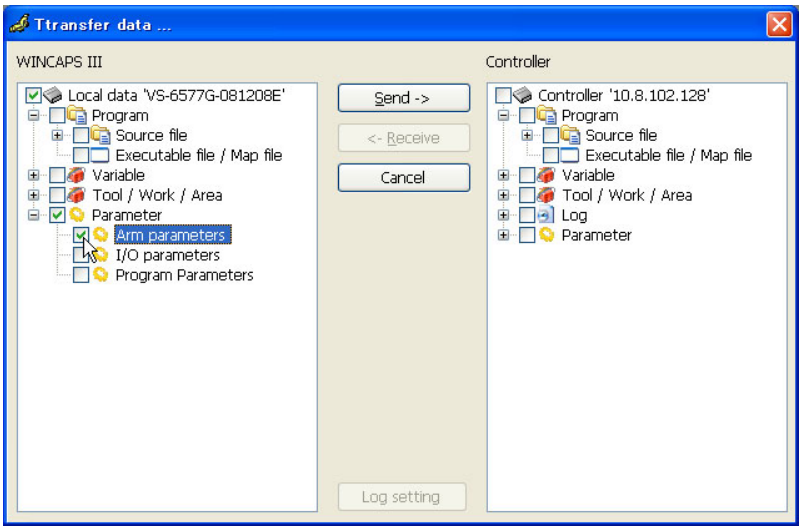




Step 6

Choose Connect | Transfer data to display the bidirectional transfer dialog box.

Select arm parameters in WINCAPSIII and press Send.



Step 7

Restart the robot controller.

DEFINITION: Payload Center of Gravity

6-axis robot

Define the payload center of gravity in the TOOL0 coordinates in units of mm (refer to Figure 2-4).

- The origin of the TOOL0 coordinates is located in the center of the flange surface on the 6th axis.
- The Y component is defined on the orientation vector directed from the center of the flange to the center of the orientation pin hole (dia. 6H7).
- The Z component is defined on the approach vector directed from the center of the flange to the normal line of the flange center.
- As shown in Figure 2-5, the X component is defined on the normal vector directed along the X axis (+) in the right-hand coordinates whose Y axis is an orientation vector and whose Z axis is an approach vector.

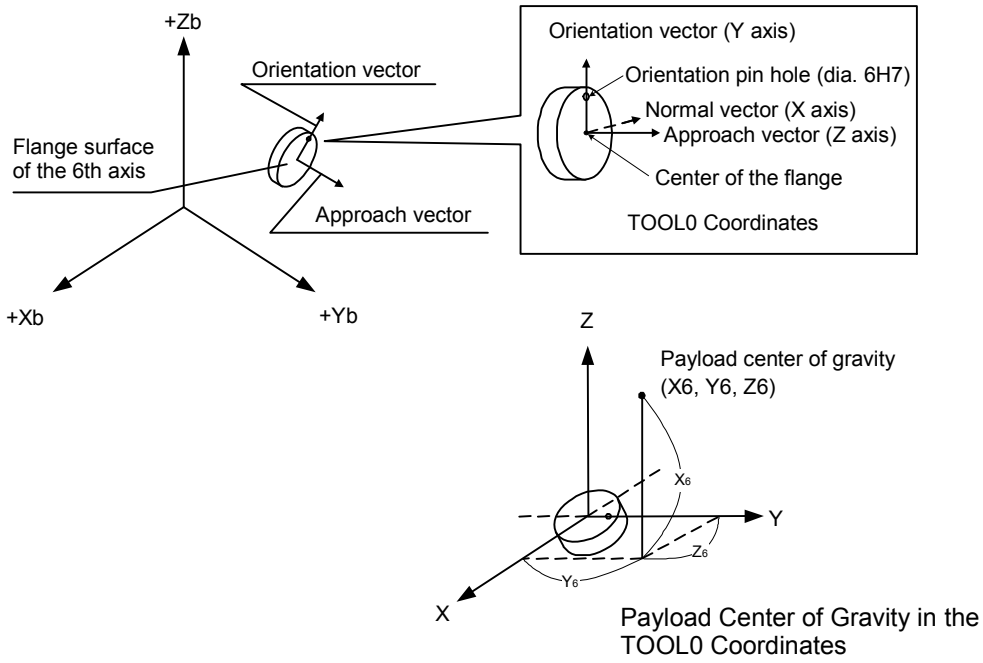


Figure 2-4. Payload Center of Gravity

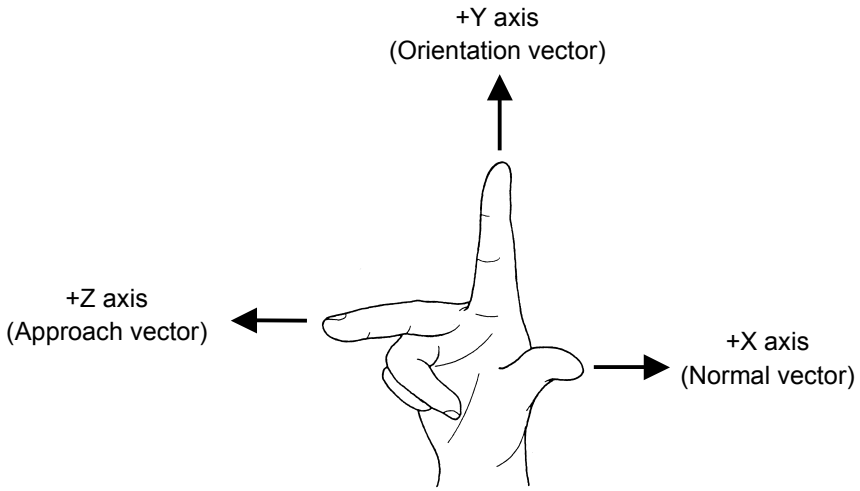


Figure 2-5. Right-hand Coordinates

4-axis robot

The TOOL0 coordinates of the 4-axis robot are defined as illustrated below. Based on the coordinates, the payload center of gravity will be defined.

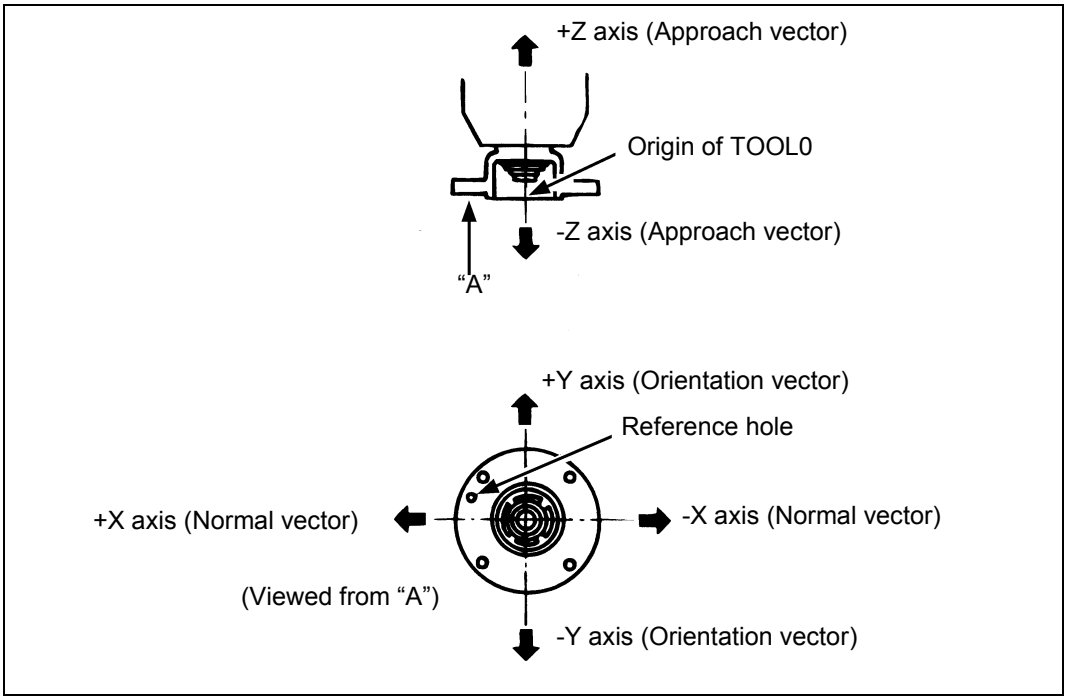


Figure 2-6. TOOL0 Coordinates in the HM/HS Series

2.8 Setting the Robot Installation Condition (TP/WC)

This section describes how to set the robot installation condition (floor-mount, overhead-mount) for the VM-G-T/VS-G-T series.

Set the robot installation condition when

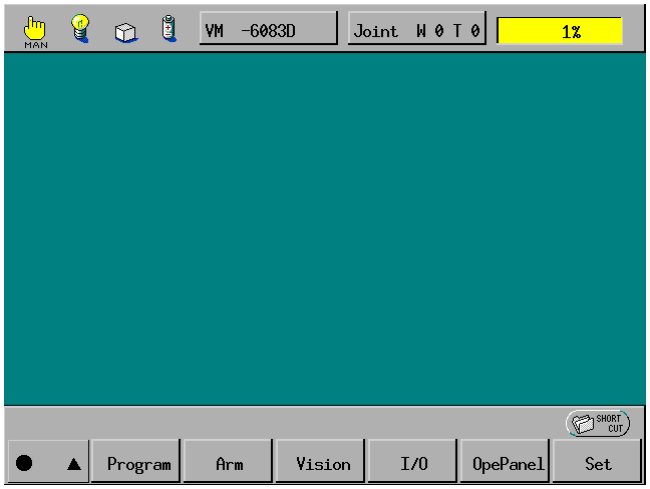
You change the robot installation from floor-mount (0) to overhead-mount (1) and vise versa. The factory default is floor-mount (0).

Operating procedure

■ ***From the teach pendant***

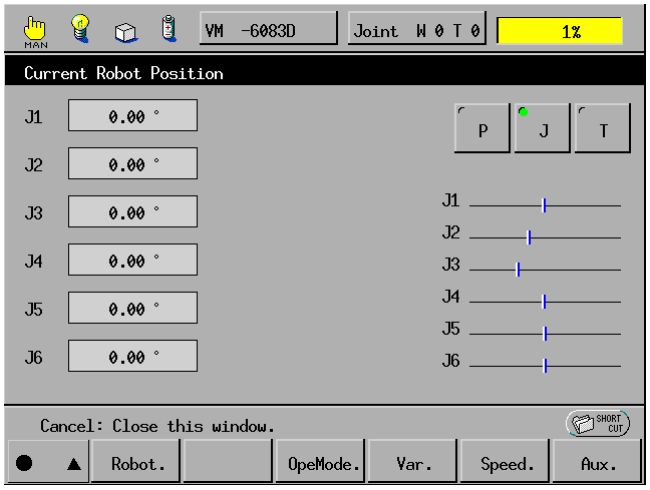
Step 1 Switch the teach pendant to the extended screen.

Step 2 On the extended screen, press [Arm].



The Current Robot Position window appears as shown below. For 4-axis robots, J5 and J6 rows do not appear.

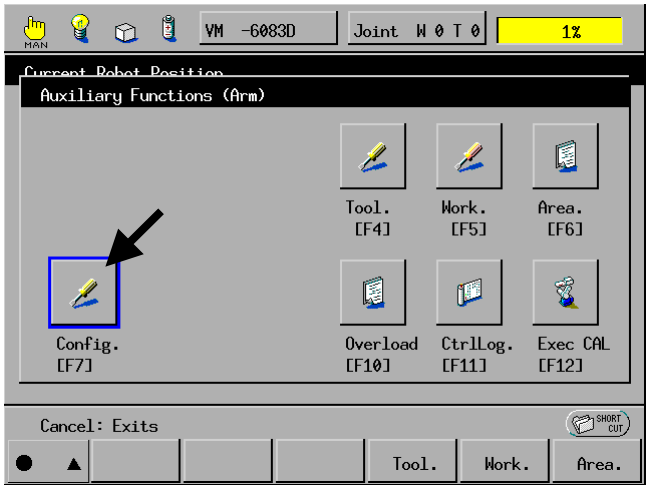
Step 3 Press [Aux.].



The Auxiliary Functions (Arm) window appears as shown in the next step.

Step 4

Press [Config.] on the Auxiliary Functions (Arm) window.



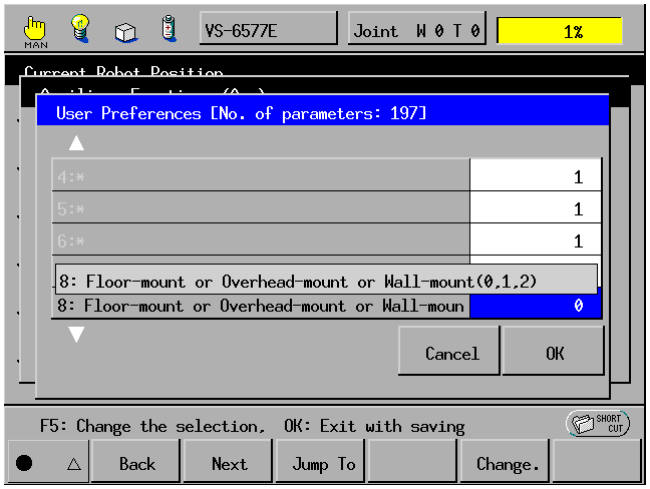
The User Preferences window appears as shown below.

Step 5

Select the "8: Floor-mount or Overhead-mount or Wall-mount" area by using [Back] to [Jump To].

The selected area will become highlighted.

Then press [Change.].



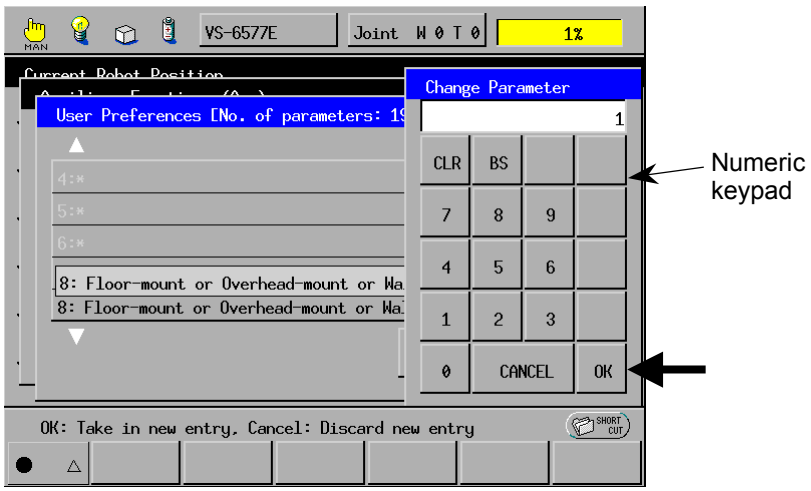
The numeric keypad appears as shown in the next step.

Step 6

Use numerical buttons on the numeric keypad to enter 0 for floor-mount or 1 for overhead-mount.

To cancel the newly entered value, press the CLR or BS button.

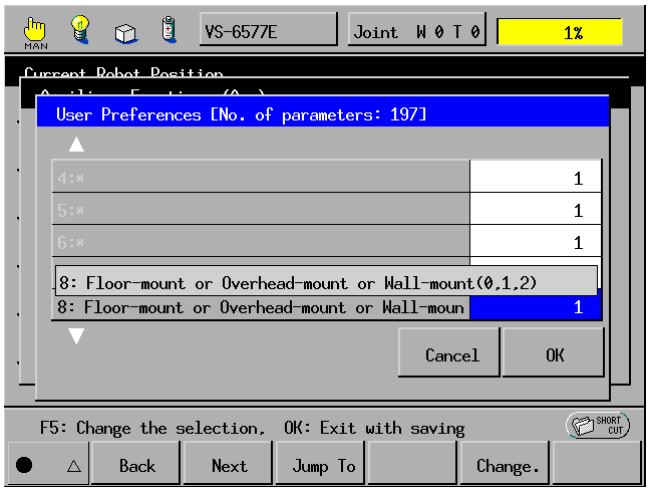
Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button.



The numeric keypad disappears.

The newly entered value (0 for floor-mount or 1 for overhead-mount) is displayed in the "Floor-mount or Overhead-mount" area, as shown below.

Press the OK button to establish the new settings. To cancel the new settings and return to the previous window, press the Cancel button.



Step 7

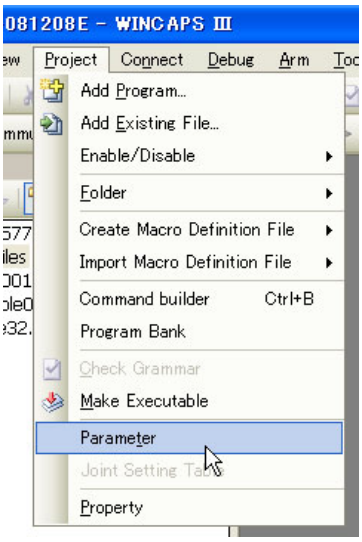
If the project of this robot has been created in WINCAPSIII, also modify the installation condition of that project stored in WINCAPSIII. Choose Connect | Transfer data and receive arm parameters from the robot controller.

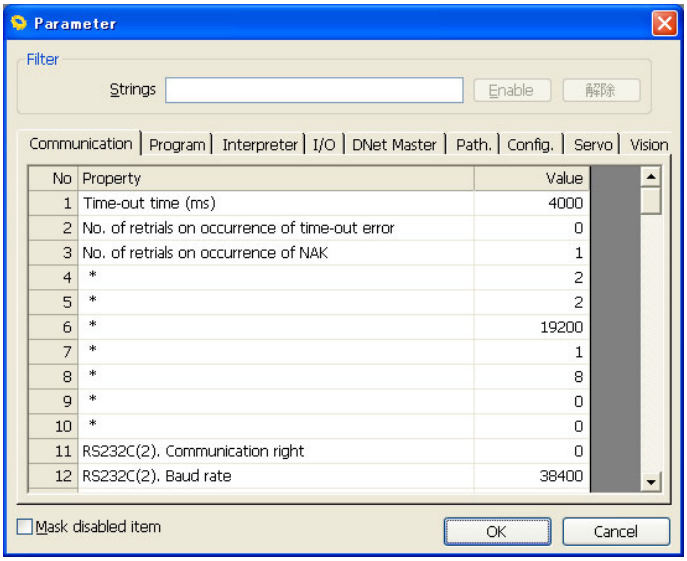
■ ***In WINCAPSIII***

Step 1 Run WINCAPSIII.

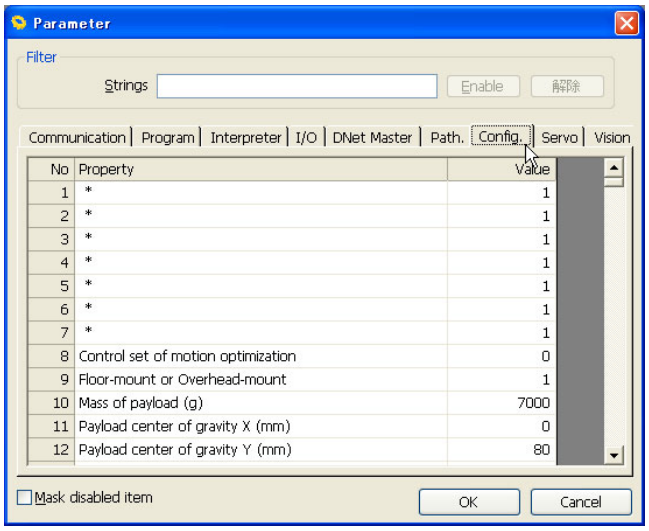
NOTE: Log on as a Programmer. Logging on as an Operator does not allow editing of configuration parameters in Step 4.

Step 2 Choose Project | Parameters to display the Parameters window.





Step 3 Choose the Config. tab.



Step 4 Enter the desired values to the "Floor-mount or Overhead-mount" parameter.

0: Floor-mount

1: Overhead-mount

After completion of entry, press OK to save them into the current project.

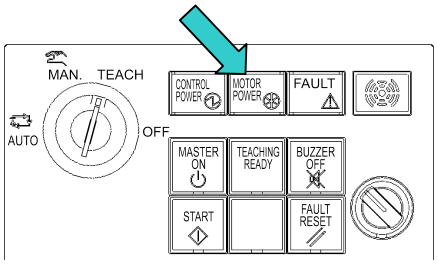
Step 5

Check the MOTOR POWER lamp on the operation panel.

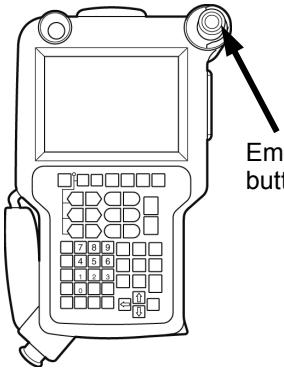
If it is on, press the emergency stop button on the teach pendant to turn the motor power off. The MOTOR POWER lamp goes off.

CAUTION: NEVER skip this step. Turning the motor off is essential to assure safety in the following operation.

Operation panel



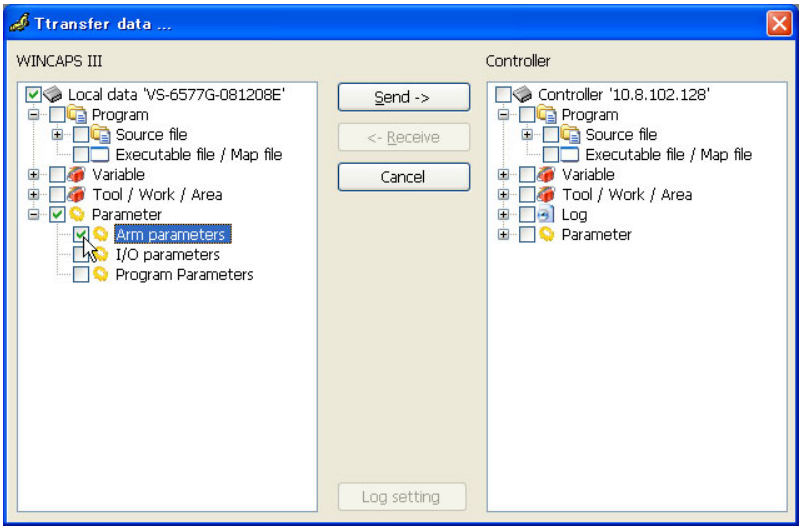
Teach pendant



Step 6

Choose Connect | Transfer data to display the bidirectional transfer dialog box.

Select arm parameters in WINCAPSIII and press Send.



Step 7

Restart the robot controller.

2.9 Configuration List

The table below lists the items displayed in the User Preferences window of the teach pendant (Access: [Ext.Scrn]—[Arm]—[Aux.]—[Config.]) or in the Config. table of the Parameters window in WINCAPSIII (Access: Project | Parameters | Config. tab).

Table 2-1. Configuration List (Example)

No.	Items	Factory default	Powering-on default	Description	Comments
7	Control set of motion optimization	0	0	0: OFF 1: PTP movement only 2: CP movement only 3: Both PTP and CP movement (Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 4.6, "Control Sets of Motion Optimization.")	Can be set with aspChange ().
8	Floor-mount, or Overhead-mount	0	Last value at powering-off	0: Floor-mount 1: Overhead-mount	Required for 6-axis robots.
9	Mass of payload (g)	Differs depending upon models.	Last value at powering-off	Mass of end-effector and object to be mounted at the end of the robot arm.	Can be set with aspACLD.
10	Payload center of gravity X (mm)	0	Last value at powering-off	X component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 4.6, "Control Sets of Motion Optimization.")	Can be set with aspACLD.
11	Payload center of gravity Y (mm)	80	Last value at powering-off	Y component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 4.6, "Control Sets of Motion Optimization.")	
12	Payload center of gravity Z (mm) For 4-axes robot in Ver. 1.9 or later: Inertia of payload ($kgcm^2$)	100	Last value at powering-off	Z component of payload center of gravity (consisting of end-effector and object) (Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 4.6, "Control Sets of Motion Optimization.")	
13 to 20	Encoder pulse count for positioning allowance (J1 to J8)	20	20	Convergence accuracy for specified axis (one of J1 to J8) at execution of a motion command with @E option	Can be set with mvSetPulseWidth ().
21	Positioning completion timeout (ms)	5600	5600	At execution of a motion command with @E option, if positioning is not completed within this specified time, a timeout will occur.	Can be set with mvSetTimeOut ().

No.	Items	Factory default	Powering-on default	Description	Comments
22	Control log mode	1	Last value at powering-off	No. of control logs to be stored. Entry range: 1 to 3 (1250 x Set value) = No. of control logs	If many programs and/or variables are used, setting many control logs may cause an error at powering-on time. If such occurs, decrease the number of control logs.
23	Control log sampling intervals	8	Last value at powering-off	Sampling intervals of control log. Entry range: 8, 16, 24, or 32 ms	If a value other than a multiple of 8 is set, the controller automatically modifies it to a multiple of 8.
24	Efficiency of gravity effect (For 6-axis robot)	0	Last value at powering-off	0: Gravity compensation feature disabled 1: Gravity compensation feature enabled	Can be set with SetGravity or ResetGravity.
25	Curlmt function cancellation switch	0	Last value at powering-off	a) If lowest bit is 0: Resets the current limit setting when the motor is turned on. b) If 2nd lowest bit is 0: Resets the servo lock releasing when the motor is turned on. (Only for 4-axis robots) c) If 3rd lowest bit is 0: Resets the cancellation of the PWM switching when the motor is turned on. (Only for 4-axis robots)	Do not change the initial setting.
26	Servo-lock configuration (For 4-axis robot)	0	Last value at powering-off	1: Servo lock released	Can be set with OffSrvLock or OnSrvLock.
29	Changing accel mode	0 or 1	Last value at powering-off	0: Gain change function enabled 1: Gain change function disabled	The initial setting is 0 or 1 for 4-axis or 6-axis robots, respectively. Do not change the initial setting.
35	Cycloid motion setting	0	Last value at powering-off	0: Cycloid motion disabled 1: Cycloid motion enabled	Can be set with Setcycloid or Resetcycloid.

No.	Items	Factory default	Powering-on default	Description	Comments
53 to 60	Gain reduce rate (J1 to J8)	Value proper to each robot	Last value at powering-off	Gain reduction rate for one of J1 to J8	Takes effect when the "Changing accel mode," "Control method" and "High-inertia configuration" are set to 0. Do not change the initial value.
61 to 68	High-inertia load operation gain reduce rate (J1 to J8) (For HM/HS-D series)	0	Last value at powering-off	Gain reduction rate for one of J1 to J8 when the high-inertia load operation is selected	Takes effect when the "Changing accel mode" and "Control method" are set to 0 and "High-inertia configuration" is set to 1. Do not change the initial value.
69	New type robot or old type robot (For 4-axis robot)	0	Last value at powering-off	0: New type (D series) 1: Old type (C series)	If you purchase the controller alone to connect it to the HM/HS/HC-C series, set this item to 1.
70	Pass motion setting	0	Last value at powering-off	When restarted after any stop operation during pass motion, the robot will make motion towards: 0: Target position specified after the pass motion (Default) 1: Target position specified before the pass motion	
71	Positioning allowance of pass end	5	Last value at powering-off	Condition for preventing the robot from taking motion towards the target position specified before pass motion, when the robot is restarted The condition should be set as a distance from the target position.	The condition refers to a distance from the target position at the command level, not the actual distance from the current robot end position. Do not change the initial value.
78	Damper setting rate (X) (For 6-axis robot)	10000	10000	Damping ratio along the X-axis under compliance control	Can be set with SetDampRate or ResetDampRate. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
79	Damper setting rate (Y) (For 6-axis robot)	10000	10000	Damping ratio along the Y-axis under compliance control	
80	Damper setting rate (Z) (For 6-axis robot)	10000	10000	Damping ratio along the Z-axis under compliance control	

No.	Items	Factory default	Powering-on default	Description	Comments
81	Damper setting rate (RX) (For 6-axis robot)	10000	10000	Damping ratio around the X-axis under compliance control	Can be set with SetDampRate or ResetDampRate. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
82	Damper setting rate (RY) (For 6-axis robot)	10000	10000	Damping ratio around the Y-axis under compliance control	
83	Damper setting rate (RZ) (For 6-axis robot)	10000	10000	Damping ratio around the Z-axis under compliance control	
84	Compliance control mode (For 6-axis robot)	1	1	If lowest bit is 0: Compliance speed control mode If 2nd lowest bit is 1: Disables the gravity compensation feature under compliance control	Can be set with SetCompVMode, ResetCompV Mode, SetCompControl, or SetCompF Control. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
86	Antivibration setting (For 6-axis robot)	0	Last value at powering-off	1: Residual vibration reduction control mode	Can be set with SetVibControl or ResetVibControl.
87	Compliance control ON/OFF (For 6-axis robot)	0	0	1: Under compliance control	Can be set with SetCompControl, SetCompF Control, or ResetComp Control. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
88	Coordinates for compliance control (For 6-axis robot)	0	0	0: Base coordinates 1: Tool coordinates 2: Work coordinates	Can be set with SetFrcCoord. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
89	Force limit rate (+X) (For 6-axis robot)	10000	10000	Force control rate along the +X axis under compliance control	Can be set with SetFrcCoord. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
90	Force limit rate (+Y) (For 6-axis robot)	10000	10000	Force control rate along the +Y axis under compliance control	
91	Force limit rate (+Z) (For 6-axis robot)	10000	10000	Force control rate along the +Z axis under compliance control	

No.	Items	Factory default	Powering-on default	Description	Comments
92	Force limit rate (+RX) (For 6-axis robot)	10000	10000	Force control rate around the +X axis under compliance control	Can be set with SetFrcCoord. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
93	Force limit rate (+RY) (For 6-axis robot)	10000	10000	Force control rate around the +Y axis under compliance control	
94	Force limit rate (+RZ) (For 6-axis robot)	10000	10000	Force control rate around the +Z axis under compliance control	
95	Force limit rate (-X) (For 6-axis robot)	10000	10000	Force control rate along the -X axis under compliance control	Can be set with SetFrcCoord. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
96	Force limit rate (-Y) (For 6-axis robot)	10000	10000	Force control rate along the -Y axis under compliance control	
97	Force limit rate (-Z) (For 6-axis robot)	10000	10000	Force control rate along the -Z axis under compliance control	
98	Force limit rate (-RX) (For 6-axis robot)	10000	10000	Force control rate around the -X axis under compliance control	Can be set with SetFrcCoord. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
99	Force limit rate (-RY) (For 6-axis robot)	10000	10000	Force control rate around the -Y axis under compliance control	
100	Force limit rate (-RZ) (For 6-axis robot)	10000	10000	Force control rate around the -Z axis under compliance control	
101	Compliance setting rate (X) (For 6-axis robot)	10000	10000	Compliance rate along the X-axis under compliance control	Can be set with SetCompRate. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
102	Compliance setting rate (Y) (For 6-axis robot)	10000	10000	Compliance rate along the Y-axis under compliance control	
103	Compliance setting rate (Z) (For 6-axis robot)	10000	10000	Compliance rate along the Z-axis under compliance control	
104	Compliance setting rate (RX) (For 6-axis robot)	10000	10000	Compliance rate around the X-axis under compliance control	Can be set with SetCompRate. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
105	Compliance setting rate (RY) (For 6-axis robot)	10000	10000	Compliance rate around the Y-axis under compliance control	
106	Compliance setting rate (RZ) (For 6-axis robot)	10000	10000	Compliance rate around the Z-axis under compliance control	
107	Compliance/positional error allowance (X) (For 6-axis robot)	100	100	Allowable deviation along the X-axis under compliance control	Can be set with SetCompEralw. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
108	Compliance/positional error allowance (Y) (For 6-axis robot)	100	100	Allowable deviation along the Y-axis under compliance control	
109	Compliance/positional error allowance (Z) (For 6-axis robot)	100	100	Allowable deviation along the Z-axis under compliance control	

No.	Items	Factory default	Powering-on default	Description	Comments
110	Compliance/positional error allowance (RX) (For 6-axis robot)	300	300	Allowable deviation around the X-axis under compliance control	Can be set with SetCompEralw. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
111	Compliance/positional error allowance (RY) (For 6-axis robot)	300	300	Allowable deviation around the Y-axis under compliance control	
112	Compliance/positional error allowance (RZ) (For 6-axis robot)	300	300	Allowable deviation around the Z-axis under compliance control	
113	Force offset (X) (For 6-axis robot)	0	0	Force offset along the X-axis under compliance control	Can be set with SetFrcAssist. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
114	Force offset (Y) (For 6-axis robot)	0	0	Force offset along the Y-axis under compliance control	
115	Force offset (Z) (For 6-axis robot)	0	0	Force offset along the Z-axis under compliance control	
116	Force offset (RX) (For 6-axis robot)	0	0	Offset moment around the X-axis under compliance control	Can be set with SetFrcAssist. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
117	Force offset (RY) (For 6-axis robot)	0	0	Offset moment around the Y-axis under compliance control	
118	Force offset (RZ) (For 6-axis robot)	0	0	Offset moment around the Z-axis under compliance control	
120	Optimization initialize	0	Last value at powering-off	0: Will reset the control set of motion optimization to 0 when the power is turned OFF and ON (Default) 1: Will not reset the control set of motion optimization when the power is turned OFF and ON. Maintains the last value at powering-off.	(Ver. 1.4 or later)
121 to 128	Torque limit for compliance control (J1 to J8) (For 6-axis robot)	0	0	Current limit value for one of J1 to J8 under compliance control	Can be set with SetCompJLimit or ResetCompJ Limit. Cannot be modified with the teach pendant. (Ver. 1.4 or later)
196	J4 brake lock setting (For VM-6083D/ VM-60B1D and VS-E series)	0	0	If the J4 overrides its software motion limit when the brake is released: 0: Will lock the J4 brake 1: Will not lock the J4 brake	(Ver. 1.7 or later)

No.	Items	Factory default	Powering-on default	Description	Comments
197	Setting of TCP speed pattern **(Note 1)**	0	Last value at powering-off	0: Conventional speed control 1: Constant TCP speed (Tool end speed in CP motion)	(Ver. 1.8 or later)
	Note 1: If you specify a CP motion involving the rotation of the robot hand, then the system will automatically decrease the TCP speed (Tool end speed in CP motion) according to the rotation angle by default. This causes some problems that the robot does not run in the specified speed or at constant speed. In Version 1.8 or later, it is possible to keep the TCP speed constant by setting Parameter No. 197 to 1. If you specify such a motion that will exceed the rotation speed limit, then the system will issue a warning message and run the robot while increasing/decreasing the TCP speed.				
198	Restoration of TOOL/WORK data **(Note 2)**	0	Last value at powering-off	0: No resume 1: Resume	(Ver. 1.8 or later)
	Note 2: In earlier versions, the system will not retain TOOL/WORK coordinates declared or defined in programs if the power is turned off. Accordingly, to make a same job, you need to set up the same operation environments every time when restarting the robot. Setting Parameter No. 198 to 1 will make the system retain those operation environments. When the power is on, they will be resumed.				
199	Arc interpolation approved value of easy teaching	100	100	Positional error allowance for arc motion in easy teaching	Do not change this setting if not necessary. (Ver. 1.8 or later)
200	Arch Move Execution Flag	0	Last value at powering-off	Setting the arch form at the execution of the ArchMove	Can be set with SetArchParam. (Ver. 1.9 or later)
201	Arch Move start position at the side of a rise	0	Last value at powering-off	The start position of a horizontal movement in upward movement at the execution of the ArchMove	Can be set with SetArchParam. (Ver. 1.9 or later)
202	Arch Move start position at the side of a descent	0	Last value at powering-off	The start position of a horizontal movement in downward movement at the execution of the ArchMove	Can be set with SetArchParam. (Ver. 1.9 or later)
233	Setting of real time belt cutting detection	0	Last value at powering-off	Parameter for the individual robot	(Ver. 1.9 or later)
234	ZT interfere check on CURLMT	0	Last value at powering-off	Sets if the ZT-axes have the gear interference.	Do not change this setting if not necessary. (Ver. 1.9 or later)
235	Reserved	0	Last value at powering-off	Reserved parameter for the extended function	(Ver. 1.9 or later)
237	Reference error clear permission	0	Last value at powering-off	Permission setting of clearing the reference error with the teach pendant	Do not change this setting if not necessary. (Ver. 1.95 or later)
238	Setting of Movement Speed Limit	0	Last value at powering-off	Parameter for the individual robot	Do not change this setting if not necessary. (Ver. 1.95 or later)

No.	Items	Factory default	Powering-on default	Description	Comments
239	Tracking Mode	0	Last value at powering-off	Do not change the setting in this screen. Setting screens are not yet prepared.	Do not change the setting in this screen. (Ver. 1.95 or later)
240	Enc.1 Std Pos. in recognition	0			
241	Enc.1 Std Pos. in movement	0			
242	Enc.2 Std Pos. in recognition	0			
243	Enc.2 Std Pos. in movement	0			
244	Enc.1 Current Pos.	0			
245	Enc.2 Current Pos.	0			
246	Enc.1 CALDAT	0			
247	Enc.2 CALDAT	0			
248	Accuracy of Work position detection 1	5			
249	Upper Limit 1 of Tracking Range	20000			
250	Lower Limit 1 of Tracking Range	-20000			
251	Upper Limit 2 of Tracking Range	20000			
252	Lower Limit 2 of Tracking Range	-20000			
253	Trigger range of Tracking 1 (side +)	20000			
254	Trigger range of Tracking 1 (side -)	-20000			
255	Trigger range of Tracking 2 (side +)	20000			
256	Trigger range of Tracking 2 (side -)	-20000			
257	User Interrupt Setting	0			
258	Enc. 1 Number of Interrupt	0			
259	Enc. 2 Number of Interrupt	0			
260	Enc. 1 Interrupt Setting	0			
261	Enc. 2 Interrupt Setting	0			

No.	Items	Factory default	Powering-on default	Description	Comments
262	Enc. 1 Updating of Interrupt data	0	Last value at powering-off	Do not change the setting in this screen. Setting screens are not yet prepared.	Do not change the setting in this screen. (Ver. 1.95 or later)
263	Enc. 2 Updating of Interrupt data	0			
264	Enc. 1 CALDAT (Z)	0			
265	Enc. 2 CALDAT (Z)	0			
266	Accuracy of Work position detection 2	5			
267	Check Enc. Lower velocity	0			
268	Enc. 1 Interrupt data Setting	0			
269	Enc. 2 Interrupt data Setting	0			
270	Reference error detect setting	0			
271	High precision CP line control	0			
272	Enc. vel or acc abnormality detection	1			
273	Tracking Target	0			
274	Center position (X) of index 1	100000			
275	Center position (Y) of index 1	100000			
276	Center position (Z) of index 1	100000			
277	Radius of index 1	100000			
278	Center position (X) of index 2	100000			
279	Center position (Y) of index 2	100000			
280	Center position (Z) of index 2	100000			
281	Radius of index 2	100000			
282	Upper Limit 1 of Index Tracking Range	1000			
283	Lower Limit 1 of Index Tracking Range	0			
284	Upper Limit 2 of Index Tracking Range	1000			

No.	Items	Factory default	Powering-on default	Description	Comments
285	Lower Limit 2 of Index Tracking Range	0	Last value at powering-off	Do not change the setting in this screen. Setting screens are not yet prepared.	Do not change the setting in this screen. (Ver. 1.95 or later)
286	Standard position (X) of index 1	0			
287	Standard position (Y) of index 1	0			
288	Standard position (Z) of index 1	0			
289	Standard position (X) of index 2	0			
290	Standard position (Y) of index 2	0			
291	Standard position (Z) of index 2	0			
292	Figure tracking of index 1	0			
293	Figure tracking of index 2	0			
294	Check multi detect area 1	200			
295	Check multi detect area 2	200			
296	Motor command Setting	0	Last value at powering-off	Motor command setting for error detect 0: Will occur an error if the MOTOR OFF command is executed when the robot is running. 1: Will not occur an error if the MOTOR OFF command is executed when the robot is running.	
297	Servo data number	0	Last value at powering-off	Parameter for the individual robot	Do not change this setting if not necessary. (Ver. 1.98 or later)
307	Setting of singularity avoidance mode	0	Last value at powering-off	0: Singular point avoiding function disabled 1: Singular point avoiding function enabled (Refer to the PROGRAMMER'S MANUAL I, Section 3.3.6 "Singular Point Avoiding Function.")	Can be modified with SetSingularAvoid (). (Ver. 2.61 or later)

Chapter 3

General Introduction to Operation Modes and Additional Functions

This chapter describes the three operation modes of the robot: Teach, Individual, and Auto modes. It also describes additional functions including machine lock used for simulation.

NOTE 1: Avoid letting the teach pendant undergo any strong shocks, impacts, or vibrations.

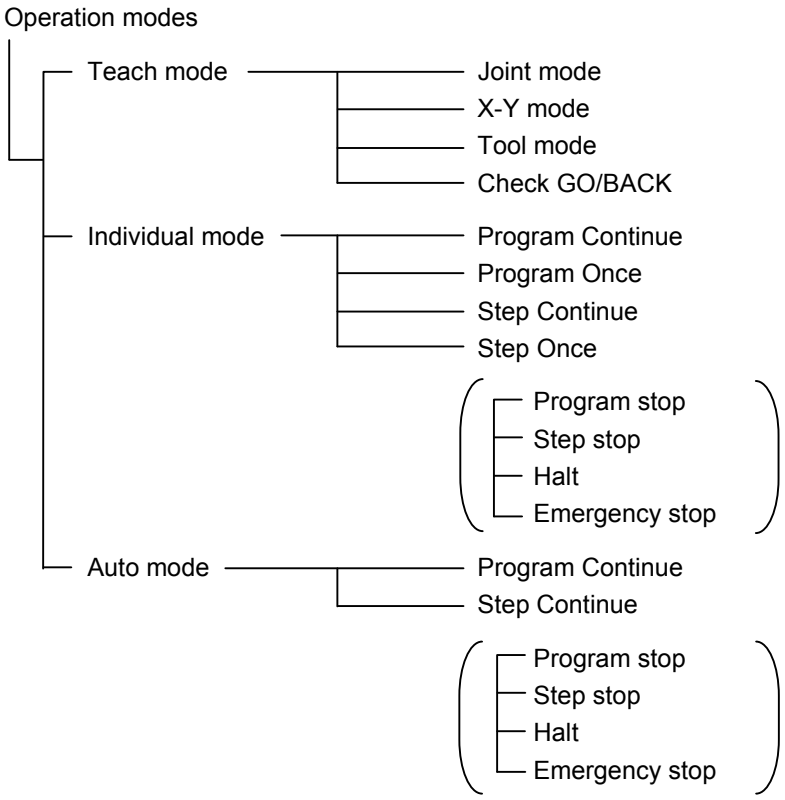
NOTE 2: Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

3.1 Operation Modes and Machine Lock

The robot offers three operation modes--Teach, Individual, and Auto modes.

Teach mode allows you to run the robot manually from the teach pendant. Individual mode allows you to run the selected task program from the teach pendant. Auto mode allows the robot to run automatically.

Teach, Individual, and Auto modes are described in Sections 3.2, 3.3, and 3.4, respectively.



In each of the above three operation modes, you can lock the robot (so called "machine lock") so that it is possible to perform simulations with the robot controller without running the robot practically.

When the robot is in machine lock, you can restrict the I/O output. For details, refer to Section 5.5, "Displaying I/O Signals and Simulating Robot Motion."

3.1.1 Switching Between Operation Modes

Operating procedure

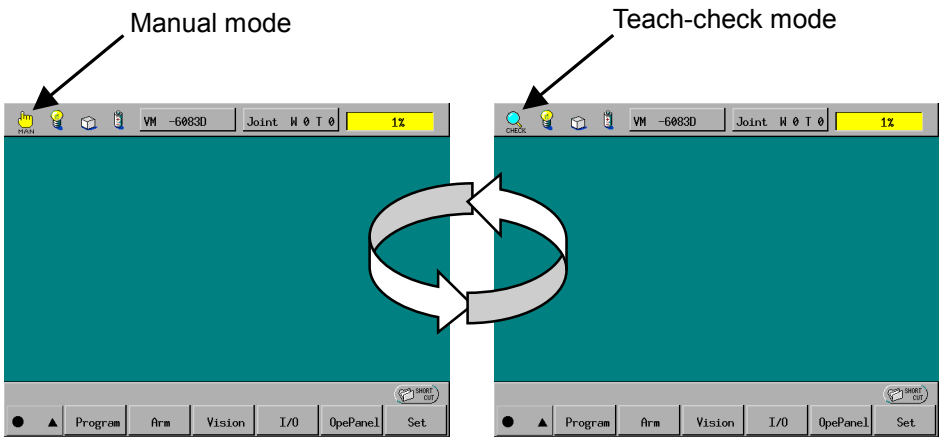
On the teach pendant, turn the manual/auto selector switch to the desired position. On the operation panel, turn the mode selector switch to the desired position.

On the extended screen called in Teach mode, you can switch between manual mode and teach-check mode.

The manual mode enables you to run the robot manually and edit PAC programs. The teach-check mode allows you to check the program running.

Touching the mode icon (the leftmost icon on the status bar) on the extended screen toggles between the manual (MAN) and teach-check (CHECK) modes.

NOTE: If the teach pendant screen is switched to the extended screen during check GO/BACK operation, the system enters the teach check mode. To change to the manual mode, perform the operation above.



3.1.2 Machine Lock

Locking the machine allows you to perform simulations with the robot controller without running the robot practically.

Lock the machine when

(1) Testing programs without running the robot practically.

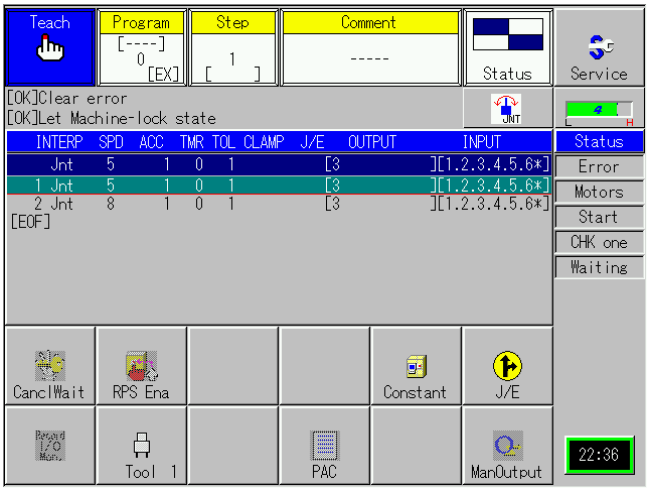
(2) Checking the cycle time.

NOTE: The cycle time calculated may be shorter than the actual one since End motion (@0 option) will apply when the machine is locked. For details, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 3.2.5.

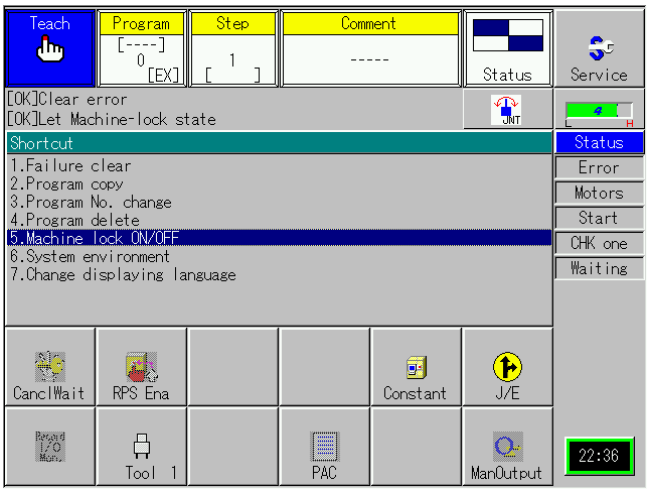
Operating procedure

NOTE: If the motor power is on, press the emergency stop button to turn the motor off (refer to Section 2.5). When the motor power is on, the machine cannot be locked.

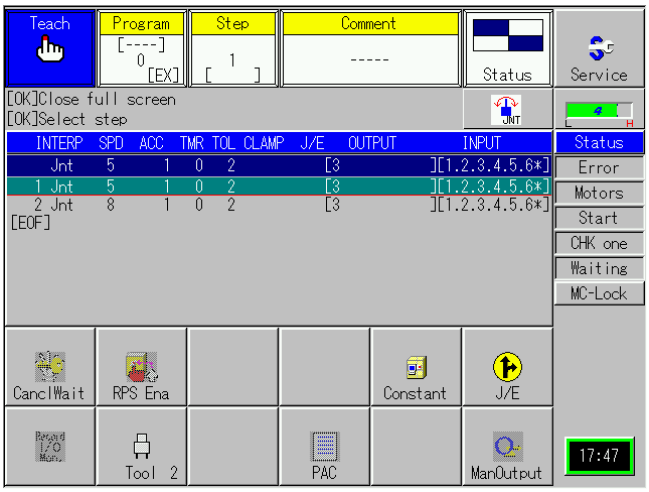
Step 1 Press the RESET R key on the teach pendant keypad.



The shortcut menu appears on the top screen. Execute "5. Machine lock ON/OFF."



The machine becomes locked and the "MC-Lock" appears at the right of the top screen.



NOTE: On the extended screen, the dummy input icon on the status bar will change according to the output restriction conditions of I/O signals.

 : No I/O output restricted,  : I/O output restricted

Step 2

Execute "5. Machine Lock (ON/OFF)" again.

The lock is released and the Machine Lock icon disappears.

3.2 Teach Mode

In Teach mode, you may run the robot manually or manage robot controller output signals manually from the teach pendant.

NOTE: To run the robot manually, release the machine lock beforehand; otherwise, the robot controller will perform simulations without running the robot practically. Working with a PC teaching system, the robot may be locked even in Teach mode.

3.2.1 Teaching the Robot

In Teach mode, you can run the robot manually from the teach pendant in any of the three modes--Joint mode, X-Y mode, and Tool mode.

NOTE: To run the robot manually, the teach plug (prepared by the customer) should be inserted. (Refer to the RC7M CONTROLLER MANUAL (T03).)

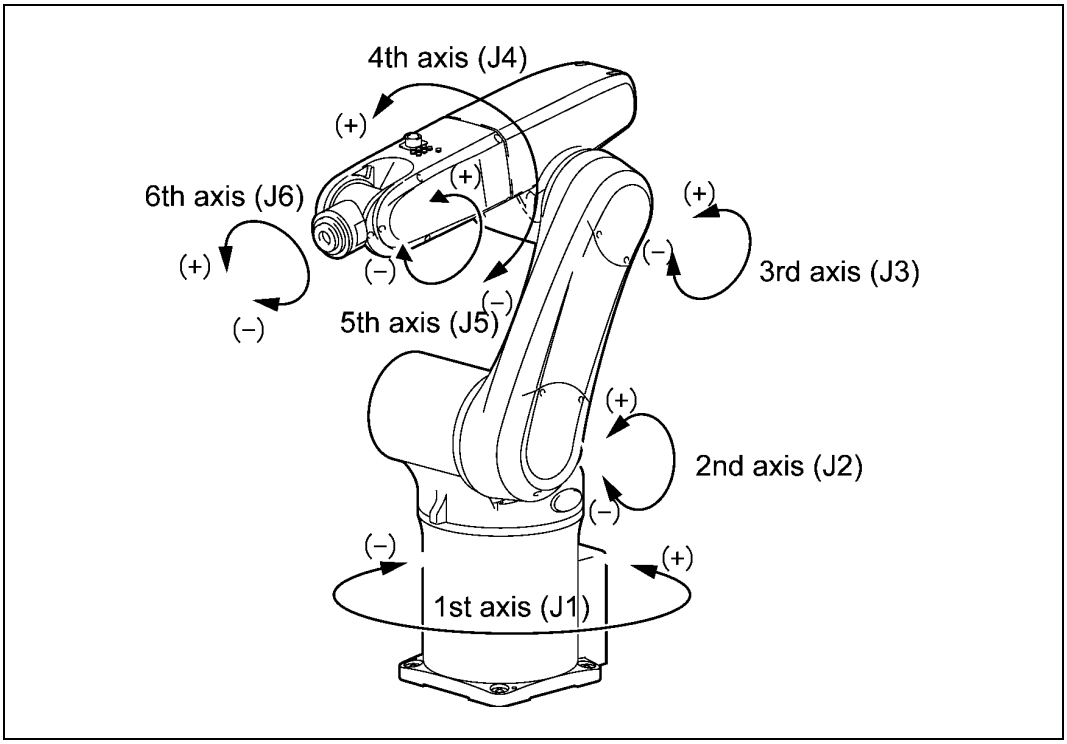
Run the robot manually when

(1) Moving the robot flange to a position where Teach-Checking should start.

6-axis robot

[1] Joint mode

As shown below, the Joint mode allows you to drive each of the six joints independently. Before performing CAL operation, the robot can run only in this mode.



Movements in Joint Mode

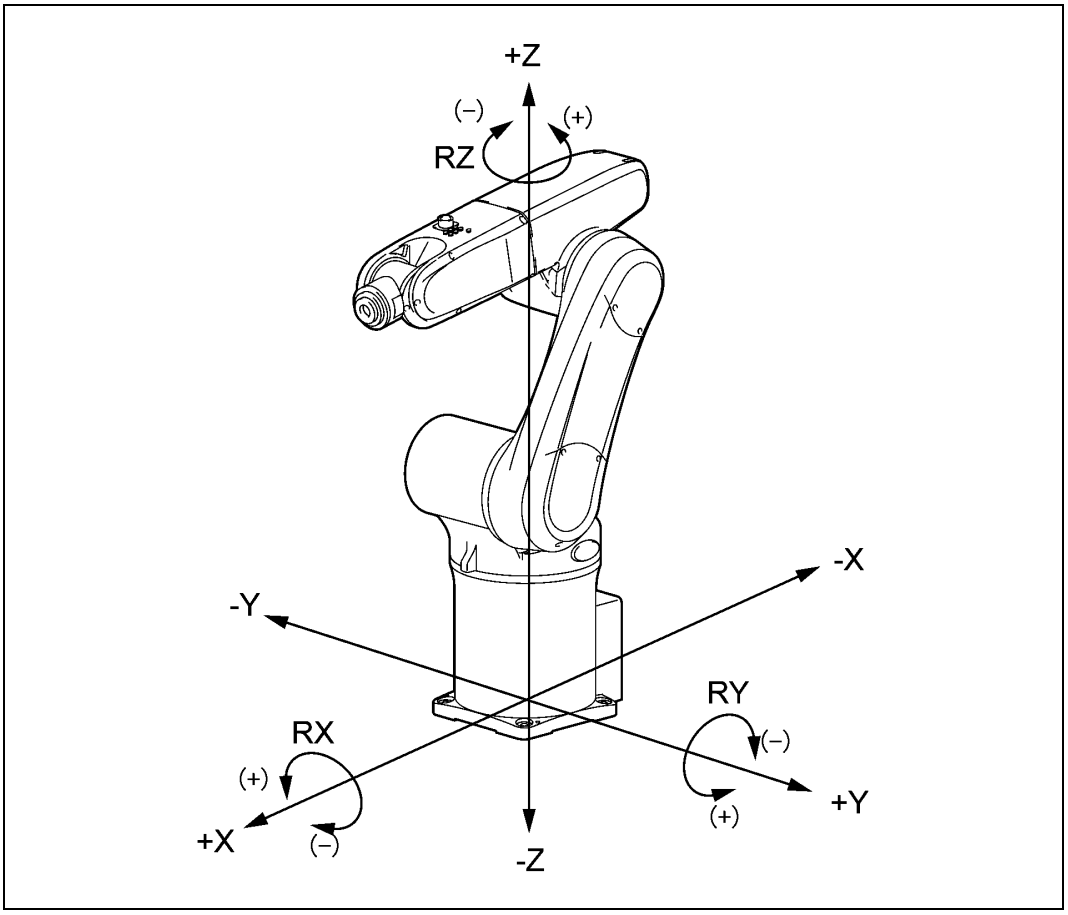
[2] X-Y mode

X-Y mode allows you to drive the robot arm in base coordinates (whose origin is defined at the center of the robot basement). Pressing the X, Y, or Z key in X-Y mode moves the robot flange linearly along the X, Y, or Z axis, respectively, as shown below.

If work coordinates (whose origin is defined at a corner of the cubic envelope of an object piece) is defined, then the robot flange moves linearly in the work coordinates.

For details about base coordinates and work coordinates, refer to Chapter 4.

If you use the RX, RY, or RZ key in X-Y mode, the robot arm rotates on each axis of the virtual work coordinates defined on the center of the flange surface without changing the center position of the flange surface, as shown below.



Movements in X-Y Mode

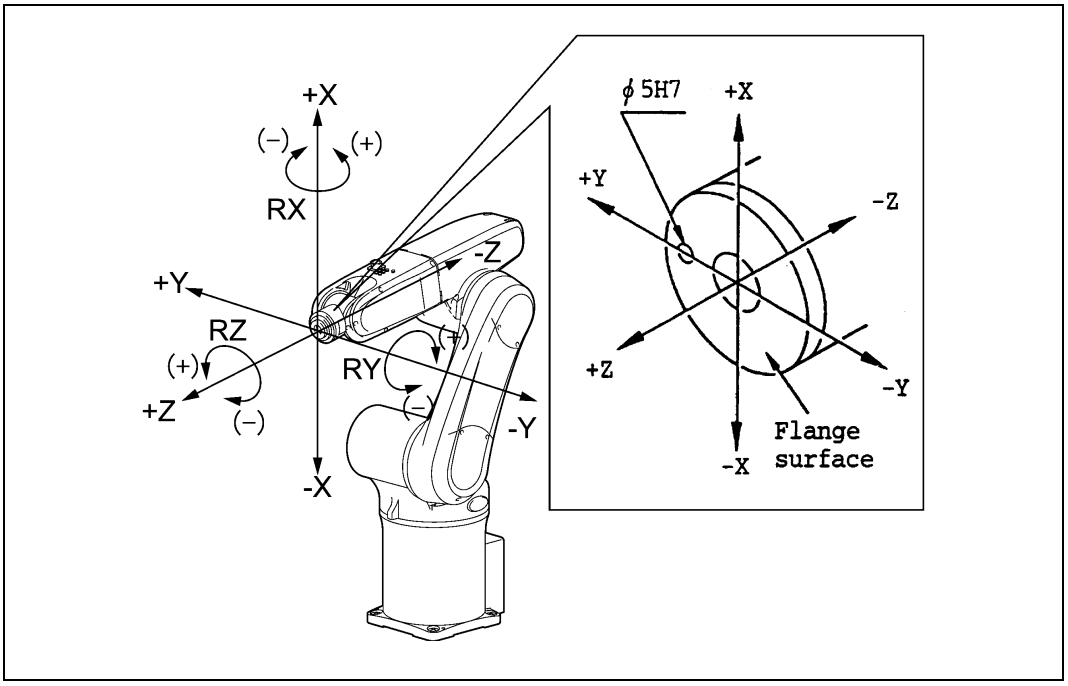
[3] Tool mode

Tool mode allows you to drive the robot arm in mechanical interface coordinates (whose origin is defined at the center of the flange surface) or in tool coordinates. For details about those coordinates, refer to Chapter 4.

Pressing the X, Y, or Z key in Tool mode moves the robot flange linearly along the Z, Y, or Z axis, respectively, as shown below.

If you use the RX, RY, or RZ key in Tool mode, the robot arm rotates on each axis of the tool coordinates.

NOTE: The figure below shows the tool coordinates when TOOL0 is set. These are also called mechanical interface coordinates.

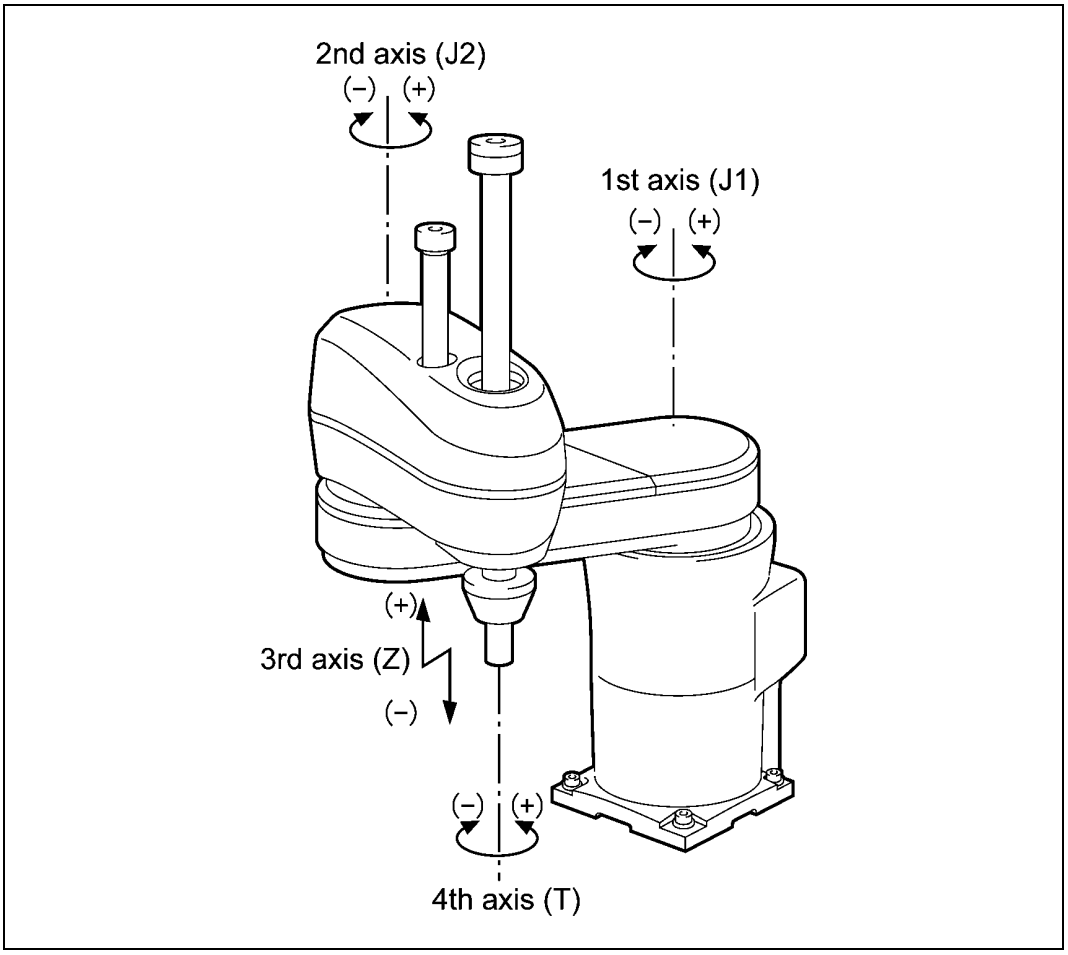


Movements in Tool Mode

4-axis robot

[1] Joint mode

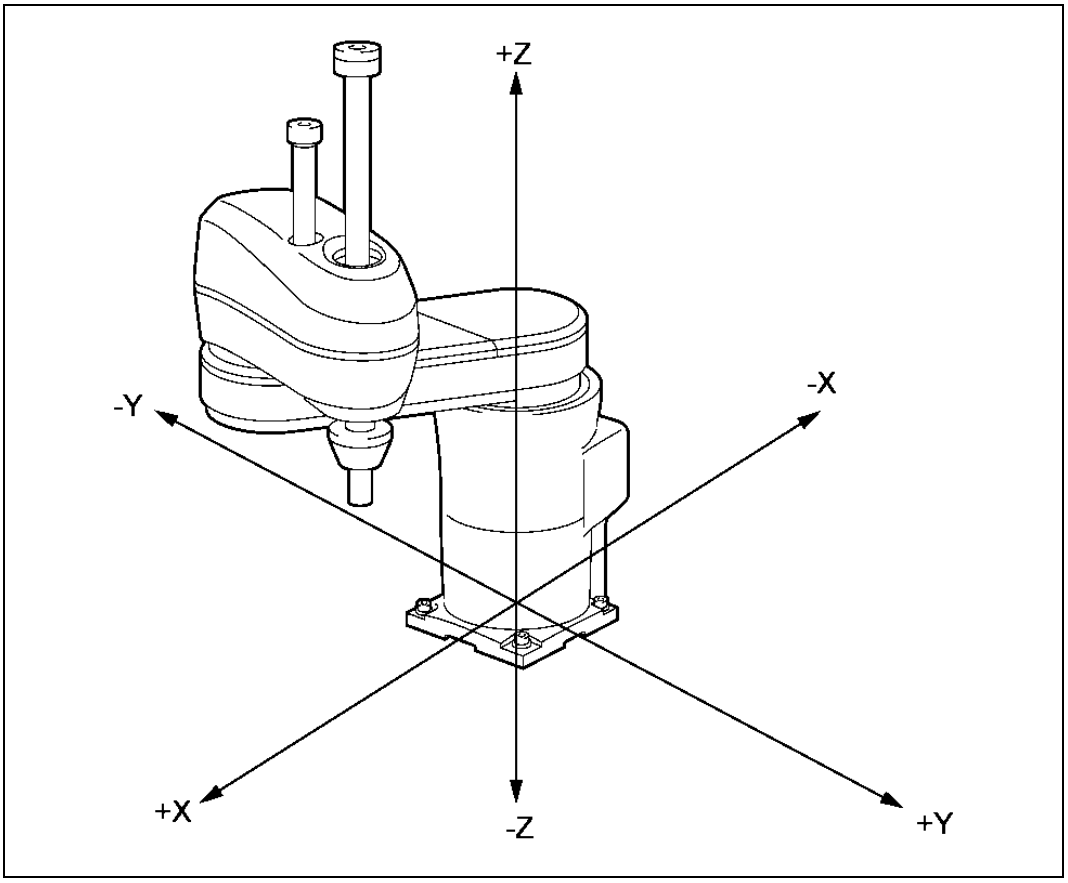
The figure below shows movement of the robot in joint mode, in which arms can be operated individually. This mode also enables each operation was carried out.



Movements in Joint Mode

[2] X-Y mode

The figure below shows movement of the robot in X-Y mode, in which each axis is operated in straight movement along the rectangular coordinate (X-Y-Z). The 4th axis is held stationary in the current posture.



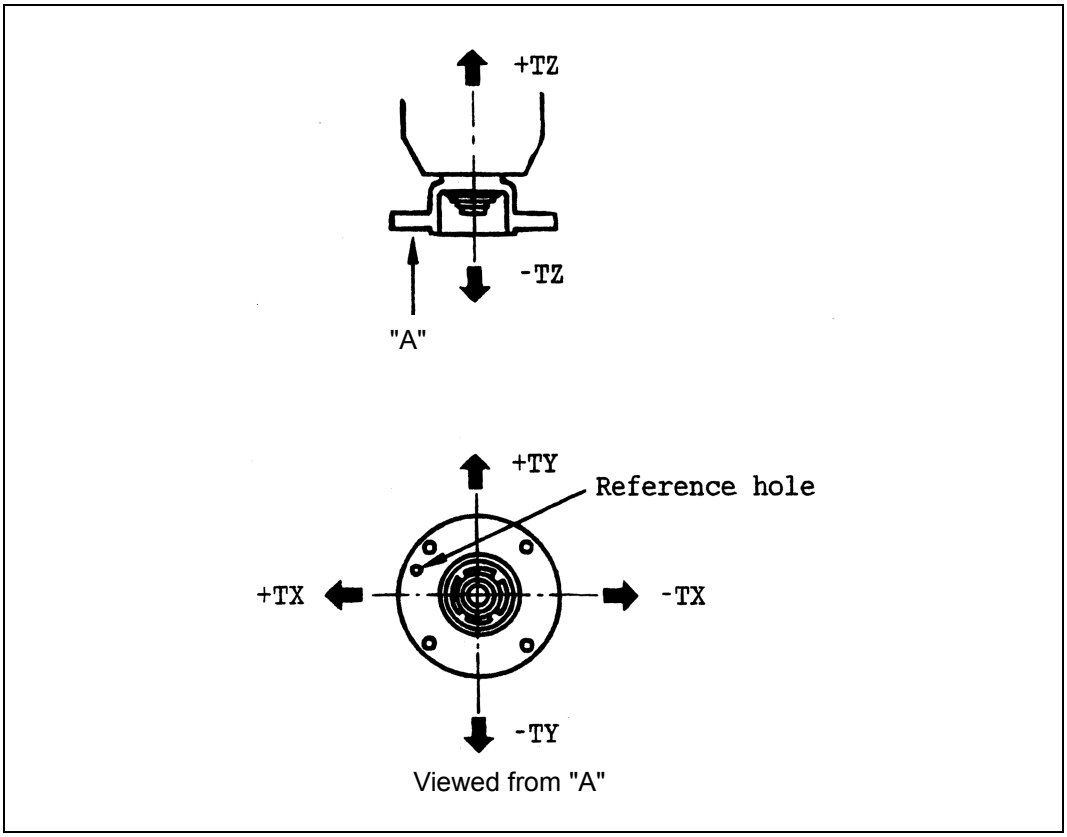
Movements in X-Y Mode

[3] Tool mode

The figure below shows movement of the robot in tool mode, in which the 4th axis is operated in straight movement along the coordinates based on the 4th axis.

These coordinates are called the tool coordinates. The 4th axis is held stationary in the current posture.

These coordinates are expressed in TX, TY and TZ to distinguish them from X-Y mode.



Movements in Tool Mode

Operating procedure

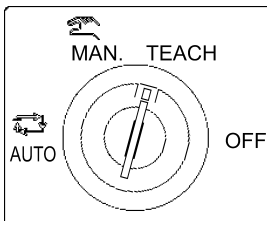
⚠**CAUTION**: At the start, set the reduced ratio of the programmed speed to 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

NOTE: In X-Y or Tool mode, if a pass runs through the vicinity of a singular point during manual operation, the robot will issue error code 6080s (Overspeed) and come to a halt. Avoid running a pass through the vicinity of a singular point.

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.



Step 2

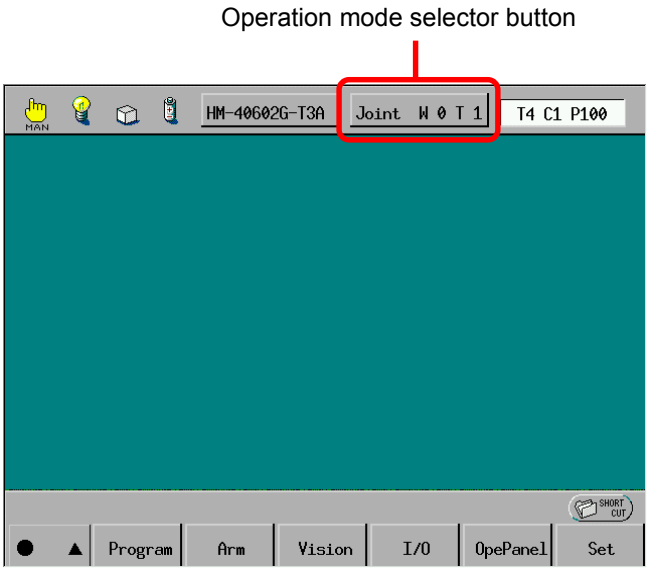
Turn the motor power on. (Refer to Section 2.4 "Turning the Motor ON.")

Step 3

Switch the teach pendant to the extended screen.

Step 4

Press the operation mode selector button.

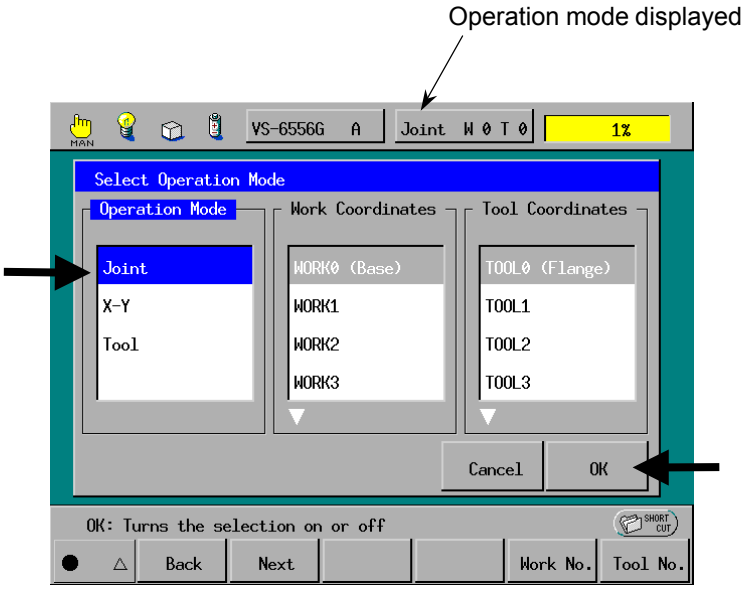


The Select Operation Mode window appears as shown in the next step.

Step 5

Select the desired operation mode by using the cursor keys or touching the screen directly, then press the OK key.

On the operation mode selector button area appears the selected operation mode.



Tip: It is also possible to select the operation mode by pressing 

on the top screen, instead of performing Steps 3 to 5.

Step 6

While holding down either one of the deadman switches, press one of the arm traverse keys to drive the robot arm. For details regarding the relationship between the arm traverse keys and driven axes, refer to Table 3-1.

Table 3-1. Arm Traverse Keys and Driven Axes in Teach Mode

No.	Operation mode	Axis	Arm traverse keys		Comments
			For motion in the positive direction	For motion in the negative direction	
1	Joint mode	Joint 1	+ J1 X	- J1 X	
		Joint 2	+ J2 Y	- J2 Y	
		Joint 3	+ J3 Z	- J3 Z	
		Joint 4	+ J4 RX	- J4 RX	
		Joint 5	+ J5 RY	- J5 RY	
		Joint 6	+ J6 RZ	- J6 RZ	
2	X-Y mode	X axis	+ J1 X	- J1 X	The robot arm moves in the currently selected work coordinates. (For work coordinates, refer to Chapter 4.)
		Y axis	+ J2 Y	- J2 Y	
		Z axis	+ J3 Z	- J3 Z	
		X axis as rotation center	+ J4 RX	- J4 RX	
		Y axis as rotation center	+ J5 RY	- J5 RY	
		Z axis as rotation center	+ J6 RZ	- J6 RZ	
3	Tool mode	X axis	+ J1 X	- J1 X	The robot arm moves in the currently selected tool coordinates. (For tool coordinates, refer to Chapter 4.)
		Y axis	+ J2 Y	- J2 Y	
		Z axis	+ J3 Z	- J3 Z	
		X axis as rotation center	+ J4 RX	- J4 RX	
		Y axis as rotation center	+ J5 RY	- J5 RY	
		Z axis as rotation center	+ J6 RZ	- J6 RZ	

3.2.2 Managing Robot Controller Output Signals

The robot controller has user- and system-I/O ports. You can manually manage output signals from the robot controller with the teach pendant.

Only Hand I/O and Mini I/O signals can be manually managed with the procedure given in this section. (Refer to the CONTROLLER MANUAL (T03), Sections 2.1.2 and 2.1.3.)

Manage robot controller output signals when

You need to turn output signals on or off without running programs.

Operating procedure

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

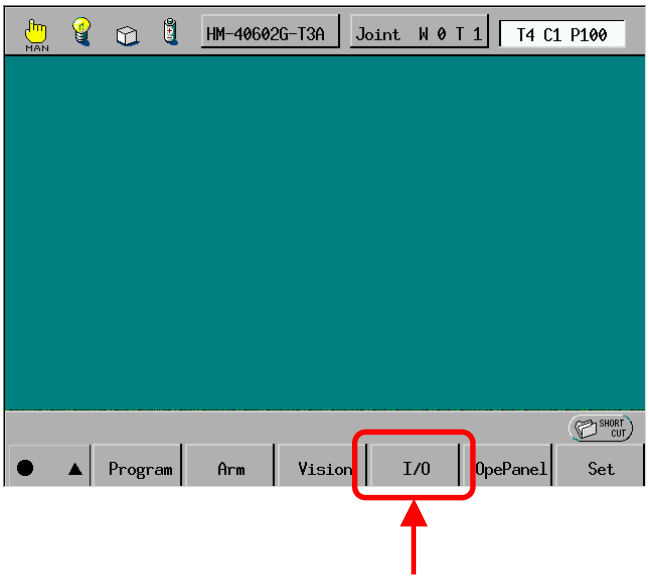
On the operation panel, turn the mode selector switch to the TEACH position.

Step 2

Switch the teach pendant to the extended screen.

Step 3

Press [I/O].

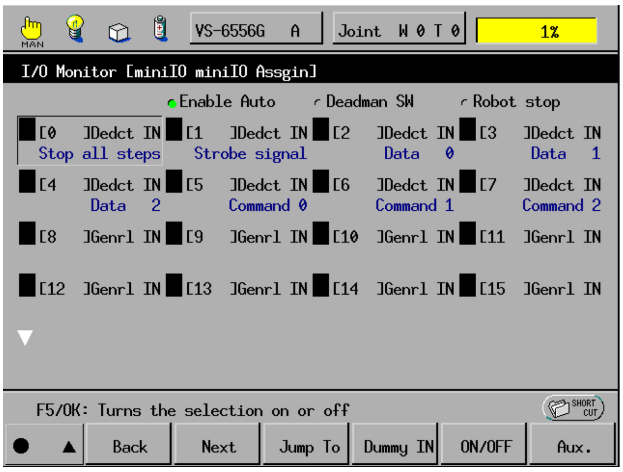


The I/O Monitor window appears as shown in the next step.

Step 4

Display a target I/O signal, by scrolling the screen with the cursor keys, [Back], or [Next].

TIP: You can press [Jump To] to call up the numeric keypad where you can enter the output port address. Doing so will directly call up the target I/O signal.



The I/O Monitor window appears as shown below.

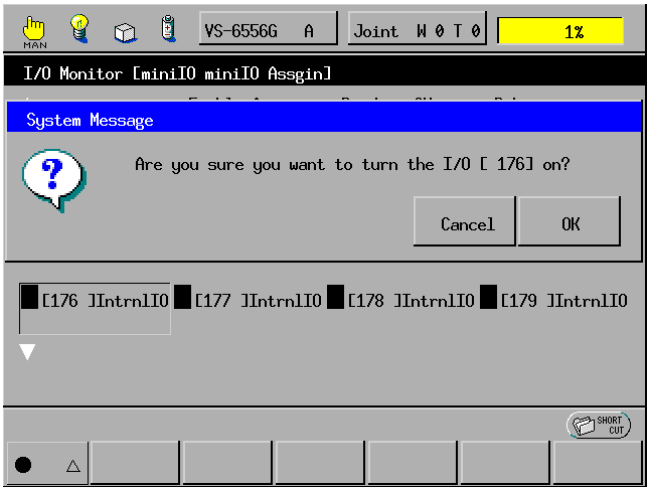
Step 5

Select the target I/O signal by using the cursor keys or touching the screen directly.

Step 6

Press [ON/OFF] on the above screen (or ENTER key on the keypad) to toggle the selected I/O signal on or off.

The system message dialog box appears as shown below.



Step 7

Check the ON/OFF state of the target I/O signal, then press the OK button while holding down either one of the deadman switches.

To manage other I/O signals, go back to Step 4.

To finish this procedure, press the CLOSE key with the ENABLE key being held down.

3.2.3 Using the Command Builder

The command builder facilitates program editing and entry using the teach pendant.

The use of the command builder allows you to enter program codes with ease as described below.

- You may enter commands even if you do not remember complicated command names.
- When entering commands, you may easily enter the associated parameters.
- With the "Favorites" function, you may quickly enter frequent-to-use commands.

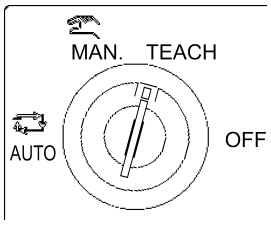
Operating procedure

Given below is an operating procedure for entering commands with the command builder.

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.



Step 2

Switch the teach pendant to the extended screen.

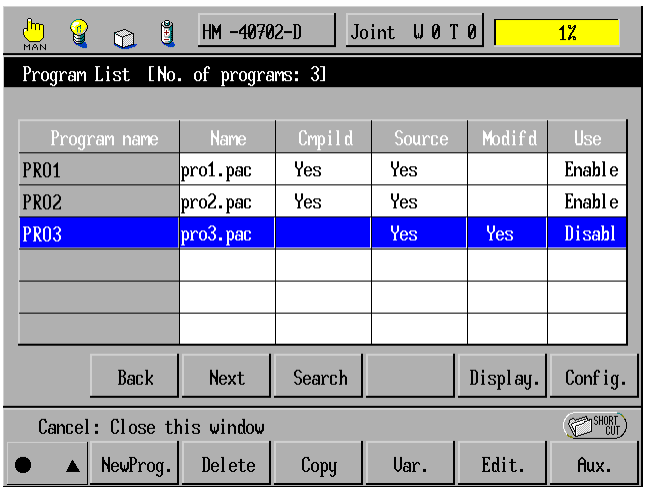
Step 3

Press [Program].

The Program List window appears as shown in the next step.

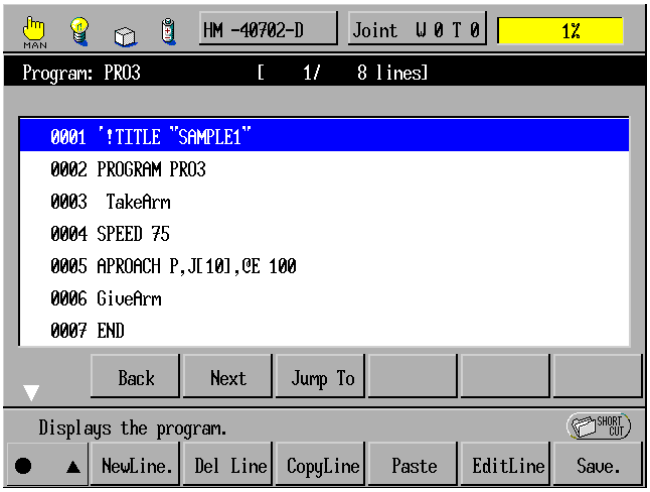
Step 4

Select the task program you want to edit, by using the cursor keys or by touching the screen directly. Then press [Edit.].



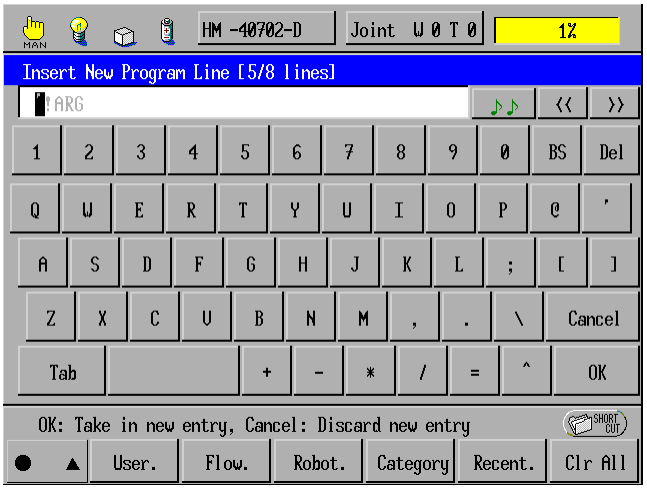
The coding list of the selected program appears as shown in the next step.

Step 5 Move the cursor to the line after which you want to insert a new line, then press [NewLine.]. Or move the cursor to the line you want to edit, then press [EditLine].



The Insert New Program Line window appears as shown below.

Step 6 Press [Category].



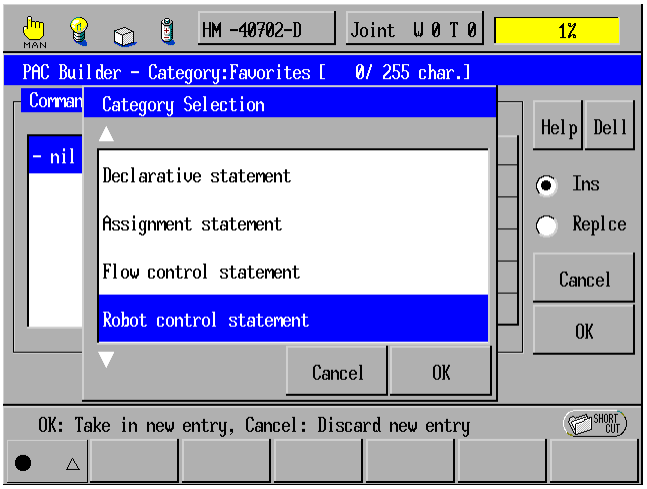
The Category Selection window appears as shown in the next step.

Step 7

In the Category Selection window, choose the category, which contains a command(s) you want to enter, and then press the OK button to display the Commands selection screen shown in the next step.

If you choose "All commands" in the Category Selection window, all commands will appear in the Commands window.

If you choose "Favorites," a set of commands registered beforehand will be listed.



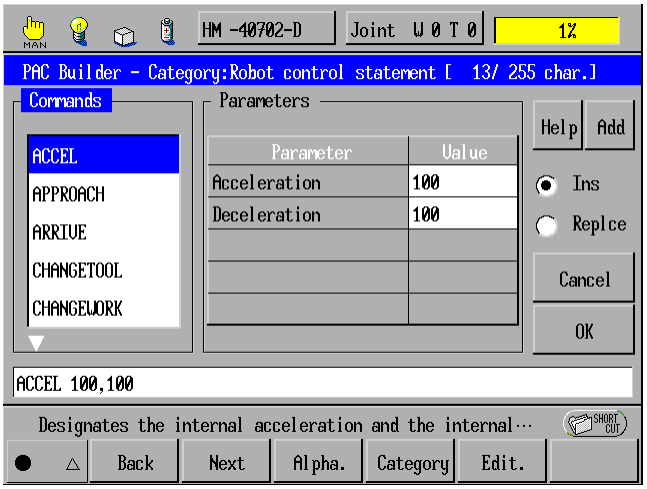
Tip

In step 6, on the Insert New Program Line window or on the Edit Program window:

- [User.] is a shortcut key to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
- [Flow.] is a shortcut key to the flow control statement window (that can be called up by choosing the "Flow control statement" on the Category Selection window).
- [Robot.] is a shortcut key to the robot control statement window (that can be called up by choosing the "Robot control statement" on the Category Selection window).
- [Recent.] is a shortcut key to a list of commands in the most recently selected category.

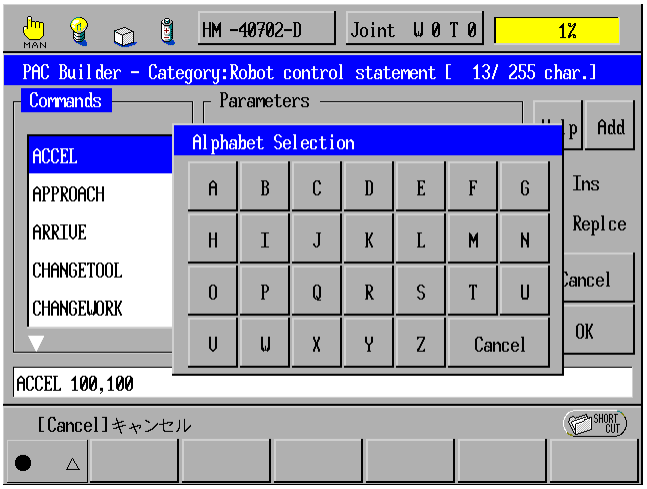
Step 8

Scroll the Commands window that shows commands contained in the selected category and choose the desired command.

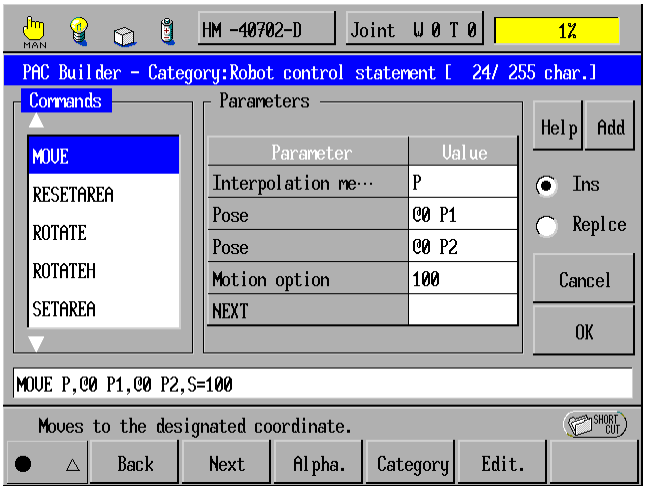


If you do not remember the name of the necessary command, press [Alpha.].

The Alphabet Selection window will appear as shown below.

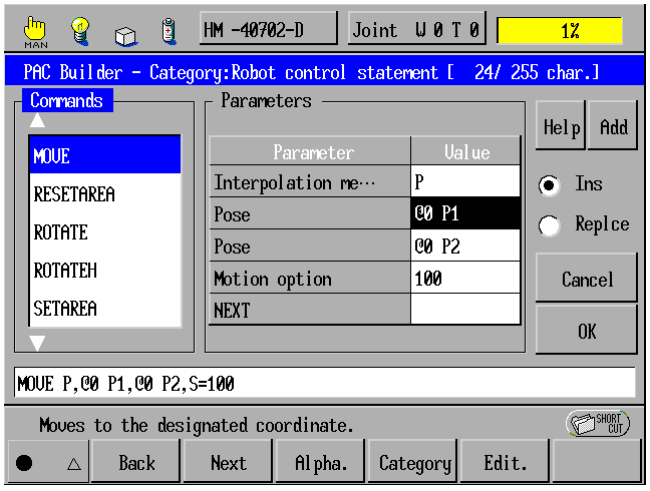


Choose a leading character of the desired command on the above window, and a command(s) starting with it will be automatically displayed.

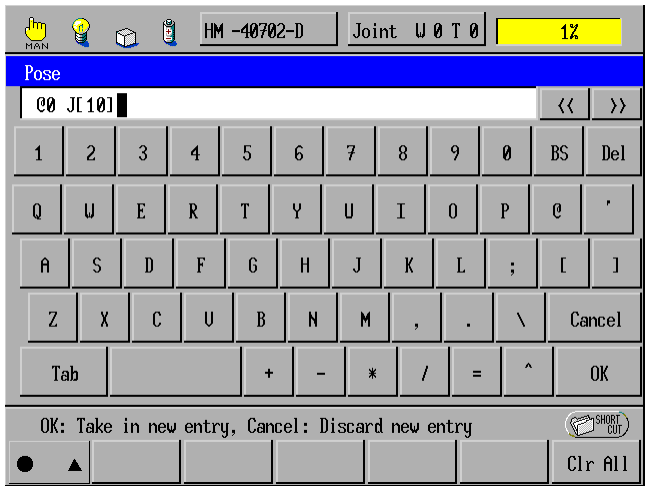


Step 9

If the selected command has a parameter(s), move the cursor to the associated parameter listed in the Parameters window by using the cursor key or by pressing the touch panel. Then press [Edit.].



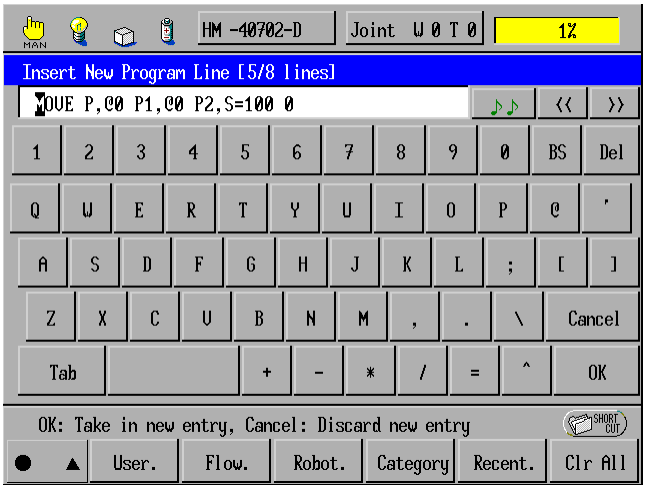
The parameter entry screen will appear as shown below, where you edit parameter values. (After editing, press the OK button, and the screen will return to the Commands window.)



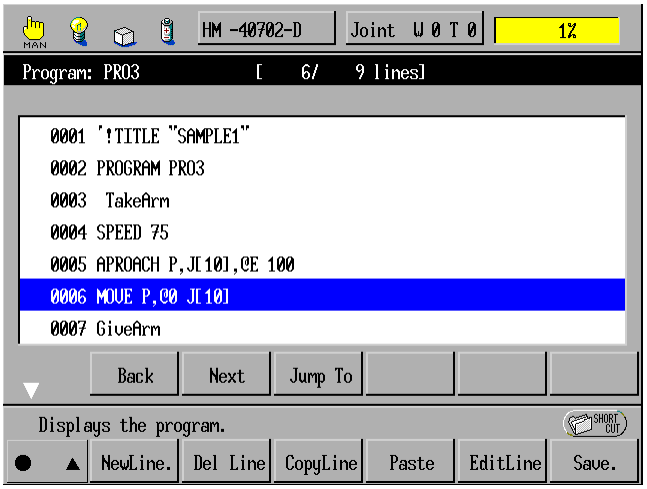
Some parameter values may not be cleared. Therefore, even if no specification of the initial value is required such as DEFINT ix=0, you need to enter for the initial value substitution area once.

If you do so, press the OK button and then delete unnecessary character strings in Step 10.

Step 10 If it is necessary to modify other parameter values, choose the target parameter and repeat Step 9. Upon completion of parameter editing, press the OK button. The screen will return to the program code entry screen.

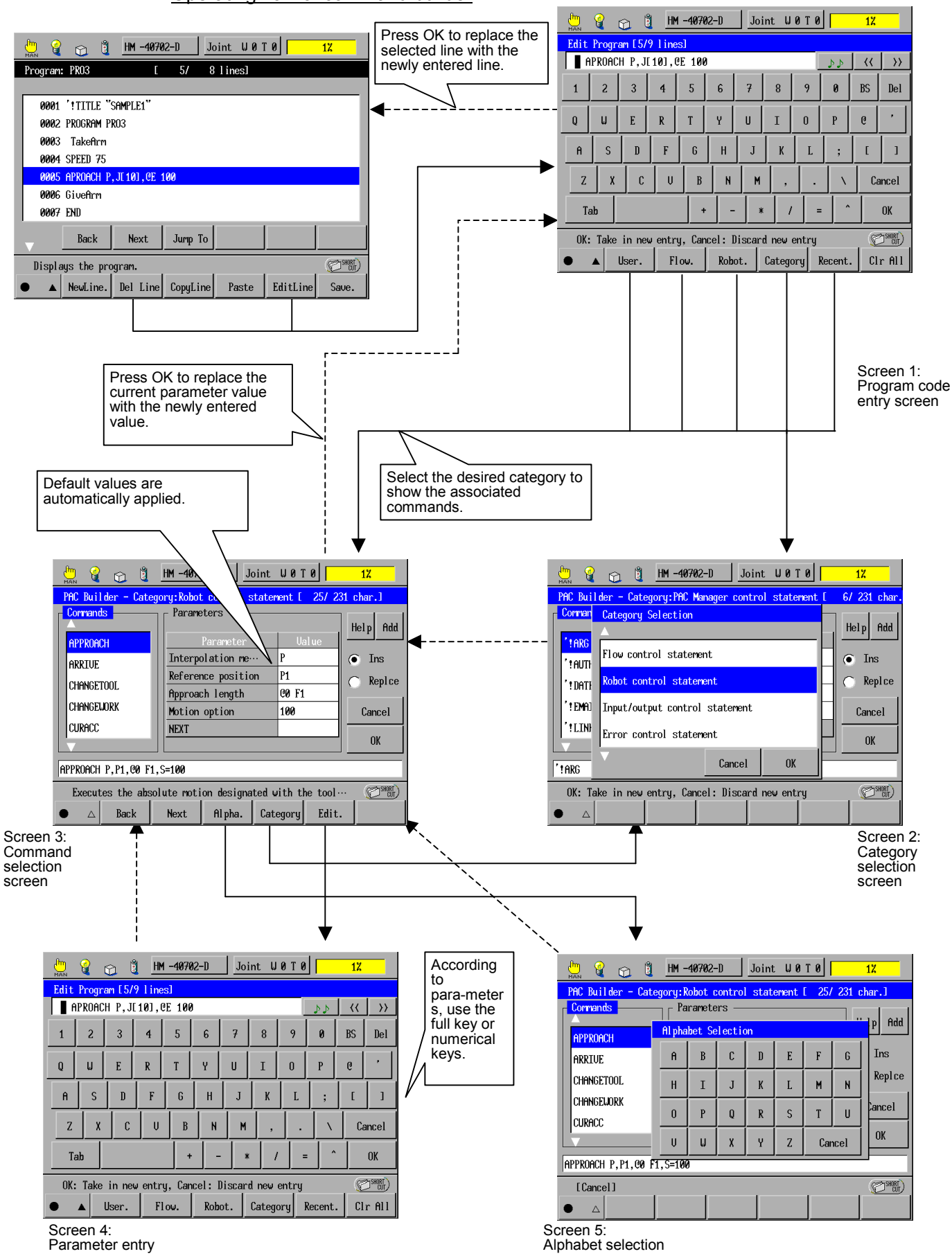


Step 11 Edit the program, e.g., by deleting unnecessary parameters, according to your needs. Then press the OK button, and the screen will return to the program coding list.



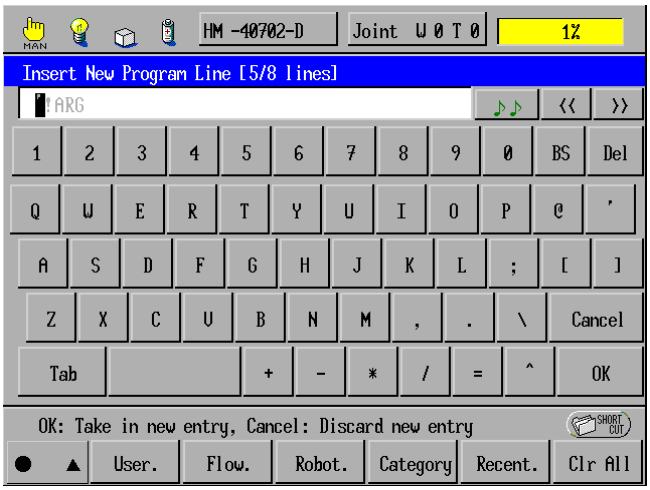
Command Builder

Operating flow of command builder



Program code entry screen

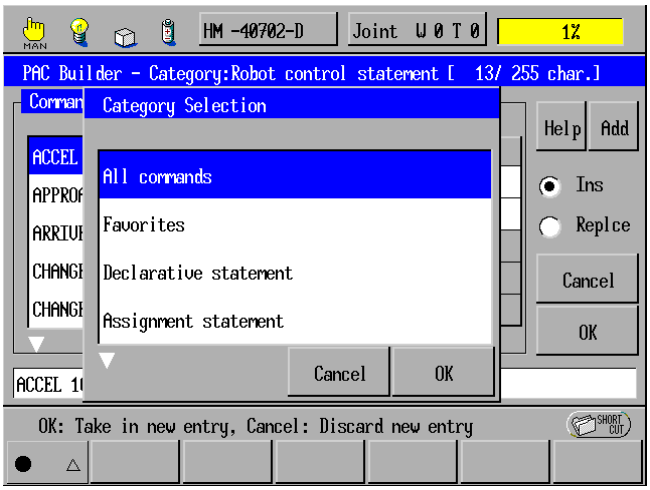
On the program code entry screen, you may edit character strings to be inserted as a new program line or to be replaced with the current program line.



[User.]	Shortcut key to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
[Flow.]	Shortcut key to the flow control statement screen (that can be called up by choosing the "Flow control statement" on the Category Selection window).
[Robot.]	Shortcut key to the robot control statement screen (that can be called up by choosing the "Robot control statement" on the Category Selection window).
[Category]	Displays the Category Selection window.
[Recent.]	Shortcut key to a list of commands in the most recently selected category.
[Clr All]	Clears all characters being entered.

Category selection screen

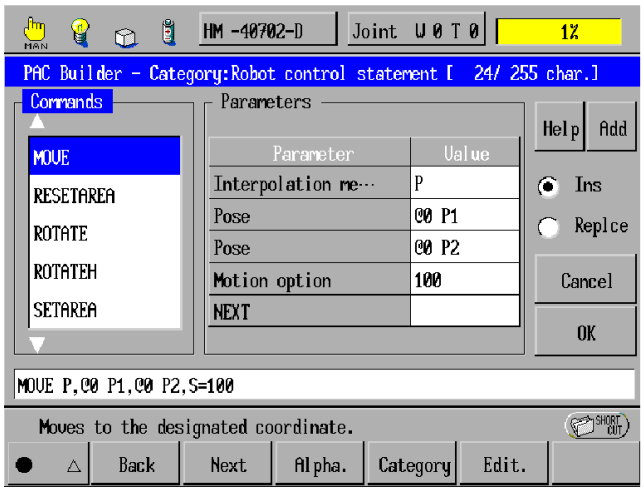
On the category selection screen, you may choose the type of commands you want to enter for the command builder.



- To choose the desired category, use the cursor keys.
- After choosing the desired category, press the OK button. Commands in the selected category will be listed in the Commands window. If you press the Cancel button, the screen will switch to a list of commands in the most recently selected category.
- If you choose "All commands," all commands will be listed in the Commands window.
- If you choose "Favorites," a list of commands you have registered by using the Add button on the command selection screen will be listed in the Commands window.

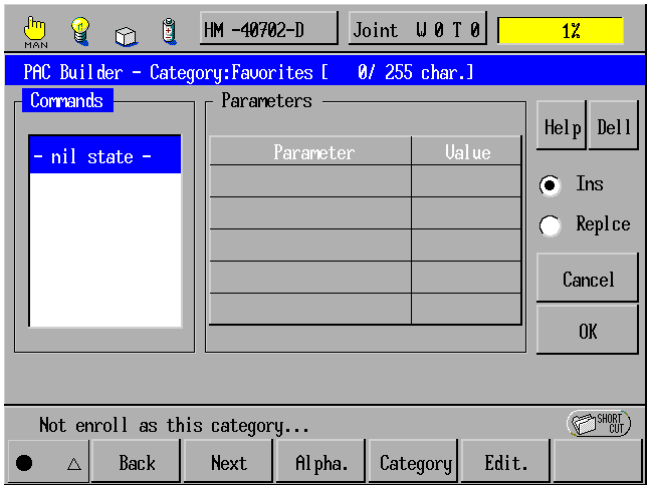
Command selection screen

On the command selection screen, you may choose necessary commands from those listed in the Commands window and enter the associated parameter(s).



[Back]	Displays the previous page of the command/parameter selection screen.
[Next]	Displays the next page of the command/parameter selection screen.
[Alpha.]	Calls up the Alphabet Selection window.
[Category]	Calls up the Category Selection window.
[Edit.]	Calls up the Parameters window if a parameter value is selected with the cursor.

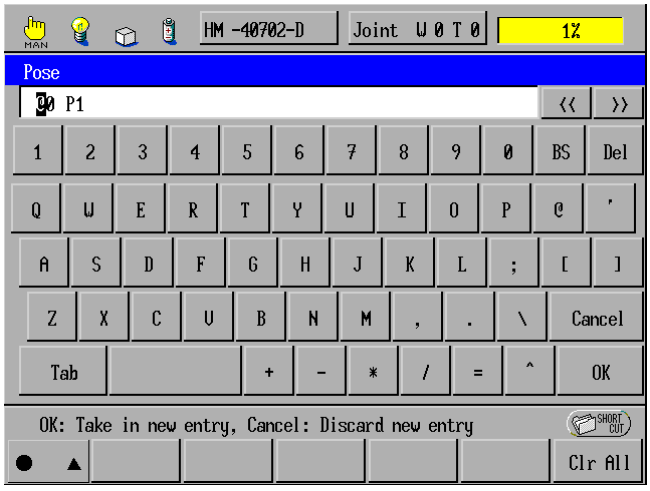
[Add]	Adds the currently selected command to the Favorites category. When the Favorites category window is displayed, the Del button will appear instead of Add. Up to 256 commands may be registered. If no commands are registered, "--Not registered--" will appear in the Commands window of the Favorites category.
[Dell]	Deletes the currently selected command from the Favorites category. When the categories other than the Favorites are selected, the Add button will be displayed instead of Del.



[Ins]	Inserts a newly entered character string to the current cursor position.
[Replce]	Replaces the contents of the program line currently selected for editing with a newly entered character string.

Parameter entry screen

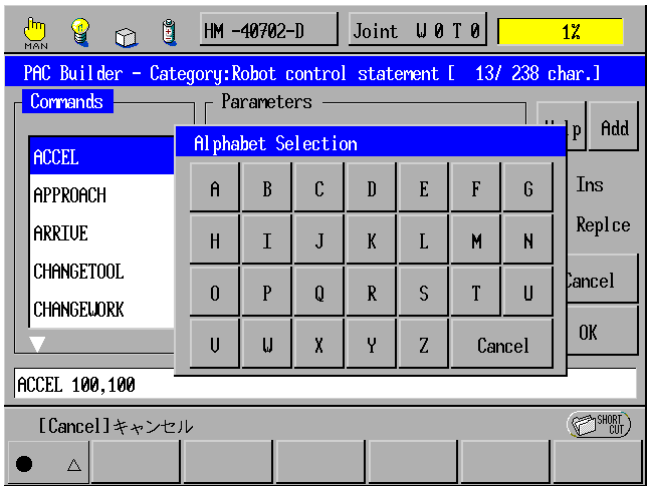
On the parameter entry screen, you may enter or edit parameters of the selected command.



- According to the type of parameters selected, the full keypad or numerical keypad will appear.
- An initial value previously specified for each parameter will be displayed.
- If you press the OK button after editing character strings or numerical values, the screen will return to the command/parameter selection screen.

Alphabet selection window

In the alphabet selection window, you may quickly search necessary commands by entering an alphabet letter of a leading character.



- If you enter an alphabet letter, a command(s) starting with it will be automatically displayed.
- If there is more than one command starting with the selected alphabet letter, you need to choose the target command in the Commands window.
- If there is no command starting with the selected alphabet letter, a command next to the alphabet letter in the alphabet order will be selected.

3.2.4 Easy Teaching

Easy teaching is a new facility that enables data entry, program edition, and teaching of point coordinates from the teach pendant with ease of operation. (Available only with PAC programs.)

The easy teaching allows you to:

(1) Insert a motion command and its parameters (including destination positions) to the desired program by one-touch operation.

(2) Edit motion commands and their parameters by one-touch operation.

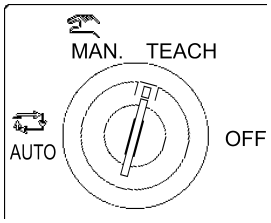
(3) Execute and check programs you have edited before compiling them.

3.2.4.1 Inserting a Motion Command

What follows is an operation flow for inserting a motion command by using the easy teaching facility.

Step 1 On the teach pendant, turn the manual/auto selector switch to the manual position.

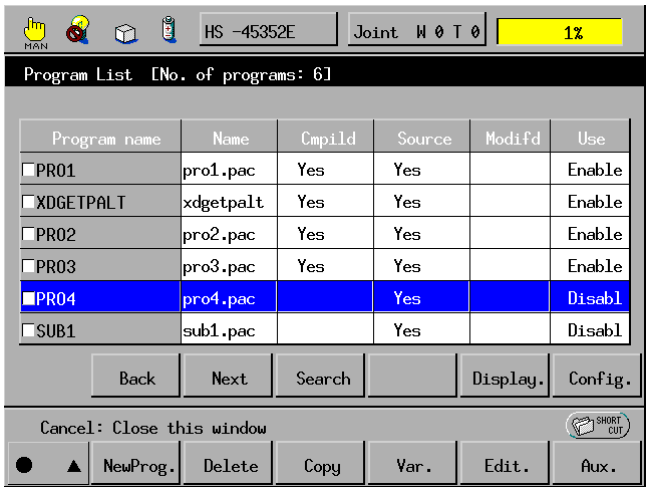
On the operation panel, turn the mode selector switch to the TEACH position.



Step 2 Switch the teach pendant to the extended screen.

Step 3 On the extended screen, press [Program].

The Program List window appears as shown below.

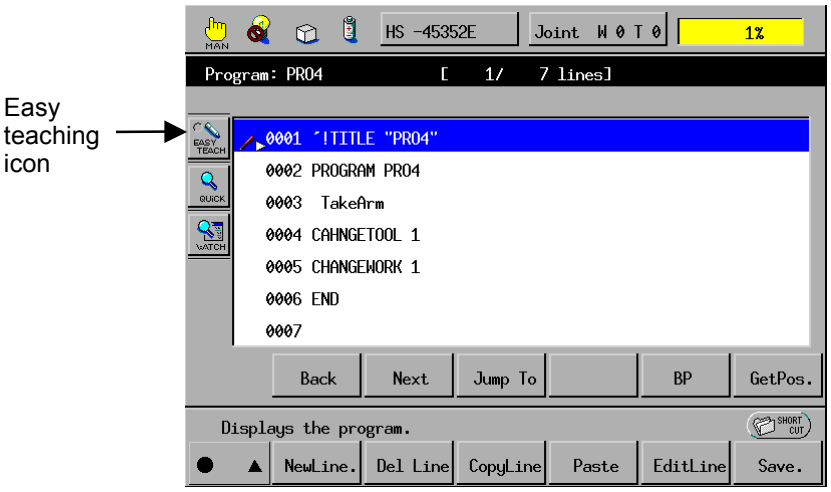


Select a program you want to edit and then press [Edit.] or [Display.] (or [NewProg.]).

NOTE: To edit existing programs, use [Edit.]; to check them, use [Display.]. To create a new program, use [NewProg.].

Step 4

The coding list of the selected program appears as shown below.

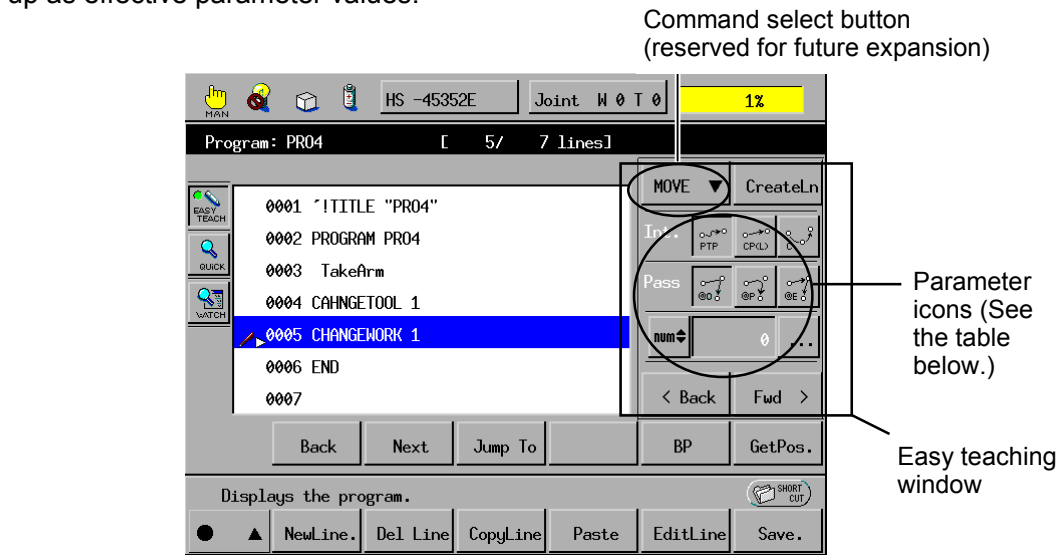


Press the easy teaching icon to call up the easy teaching window.

Step 5

Press parameter icons to set up the motion command parameters.

TIP: The specifications of parameter icons that seem to be depressed will be set up as effective parameter values.



NOTE: The Command select button is reserved for future expansion. It is currently disabled.

Interpolation (Note 1)		Pass Start Position (Note 1)		Destination Position	
PTP	PTP control (Syntax: "P")	@0	End motion (@0 option)	num	Immediate value (Note 2)
CP(L)	CP control (Syntax: "L")	@P	Pass motion (@P option)	P	Global, position variable (Note 2)
C	Arc Motion (Syntax: "C")	@E	Encoder value check motion (@E option)	J	Global, joint variable (Note 2)
				T	Global, homogeneous transform matrix variable (Note 2)
				0 ...	Global variable number. Press this button to call up a numeric keypad where you can modify the current variable value.

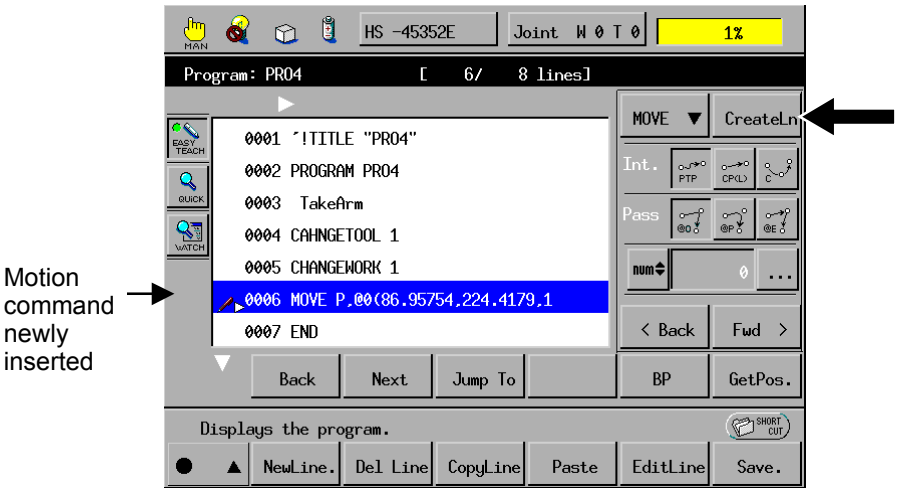
(Note 1) The feature implemented for the depressed icon takes effect.

(Note 2) Each time you press this button, the icon will cycle through [Immediate] -> [Position variable] -> [Joint variable] -> [Trans variable] in this order. The feature implemented for the displayed icon takes effect.

Step 6

Move the cursor to a line immediately preceding the line where you want to insert a motion command, then press [CreateLn].

By calculating the parameter icon information and the current robot position, the controller automatically creates an appropriate motion command. Then it inserts the command to the line next to the selected line.



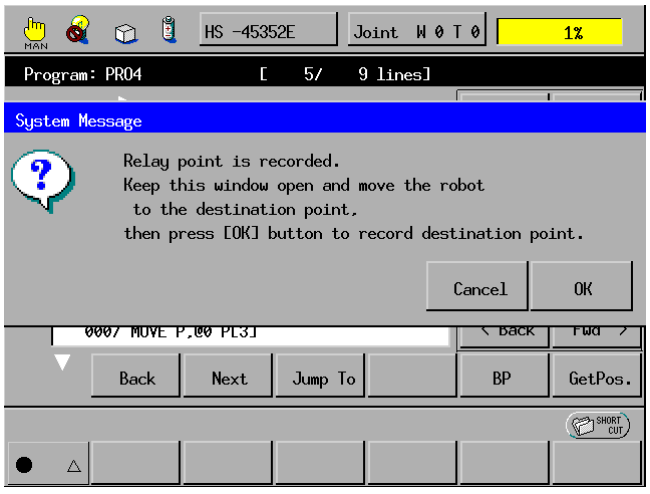
If you select <u>an immediate value</u> to specify the destination position, then the current position value will be written in the current motion command. For the procedure, go to Step 7.

If you select <u>a global variable</u> to specify the destination position, then the current position will be saved into the global variable. For the procedure, go to Step 8.

Step 7

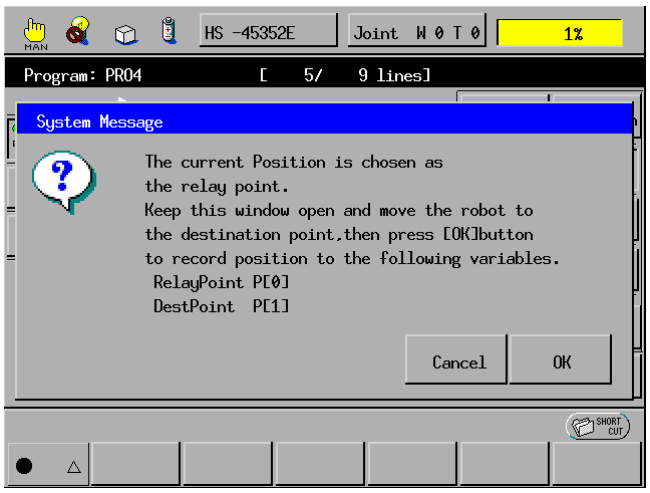
If you insert such a motion command that defines interpolation along an arc (e.g., MOVE C) and destination position <u>with an immediate value</u>, then pressing [CreateLn] will display the following message.

With this dialog being opened, move the robot arm to the destination position and then press [OK]. The command will be inserted.



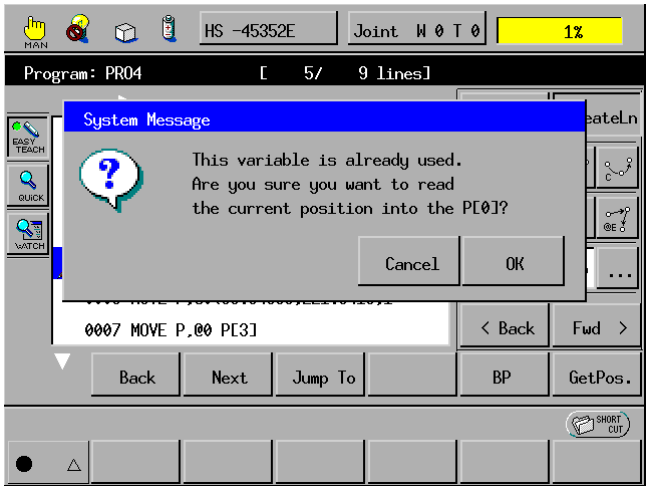
Step 8

If you insert such a motion command that defines interpolation along an arc (e.g., MOVE C) and destination position with a global variable, then pressing [CreateLn] will display the following message. (See Note below.)



With this dialog being opened, move the robot arm to the destination position and then press [OK]. The destination position will be read into the specified variable. The variable number is "viapoint + 1."

(Note)
If the specified variable has been used (any value already assigned) when [CreateLn] is pressed, the following confirmation massage appears informing that the global variable has already contained any value.



If overwriting is OK, press [OK]. The variable will be updated.

3.2.4.2 Editing a Motion Command

What follows is an operation flow for editing an existing motion command by using the easy teaching facility.

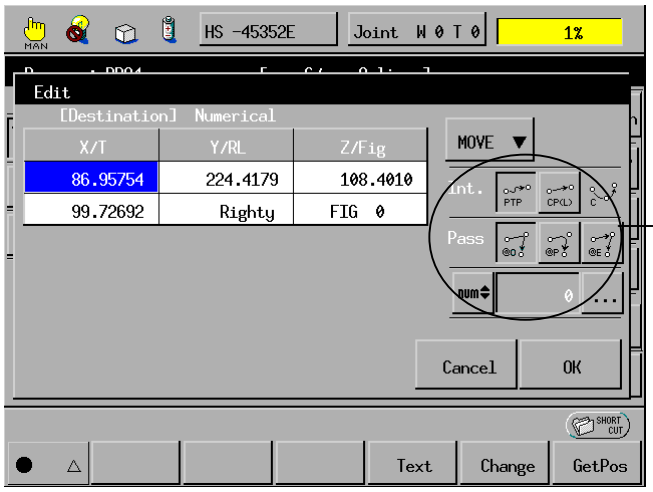
Step 1

Carry out Steps 1 through 4 in Section 3.2.4.1 to call up the easy teaching window.

Step 2

Move the blue cursor to a program line you want to edit, then press [EditLine].

If the command on the selected line can be edited in the easy teaching window (refer to Section 3.2.4.4), then the parameter information will display according to the parameter icons.



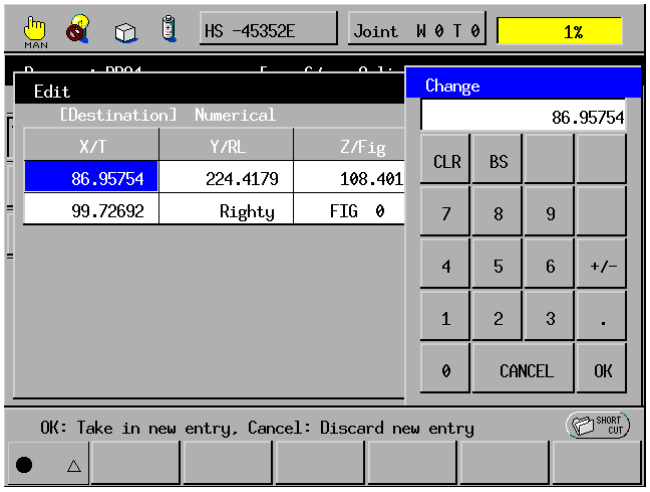
When the window is called up, the parameter icons reflect the command information on the selected line.

You may change the parameters by using the parameter icons or change the destination point (or viapoints) by pressing [Change] (see Step 3) or [GetPos] (See Step 4). After that, pressing [OK] will make the new settings go into effect.

Step 3

To enter the desired numeric value by using [Change]:

Move the cursor to a field you want to change with the cursor keys, then press [Change]. The numeric keypad will appear as shown below. Enter the desired numeric value.



NOTE: If a motion command you selected defines interpolation along an arc (e.g. MOVE C), you can define the viapoints and destination points by using the cursor keys.

Step 4

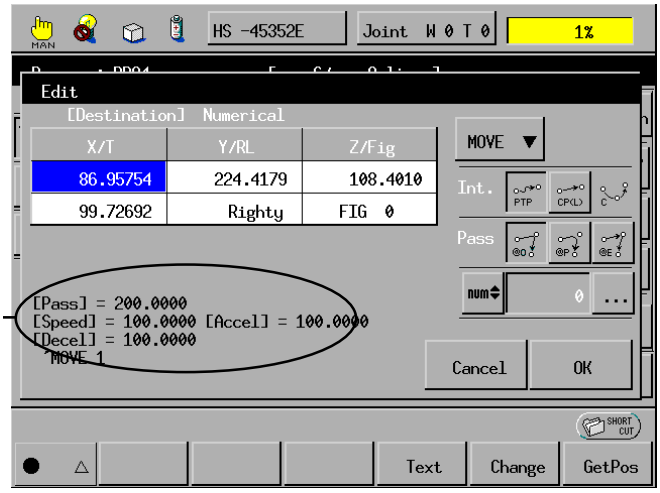
To get the current robot position by using [GetPos]:

Press [GetPos], and the controller will get the current robot position into the memory area and overwrite the line you are editing with the gotten data.

NOTE: If you are editing a motion command that defines interpolation along an arc (e.g. MOVE C), a window will appear prompting you to choose either a viapoint or destination point. Choose either one.

Step 5

Circled below are parameters that cannot be edited in this screen.

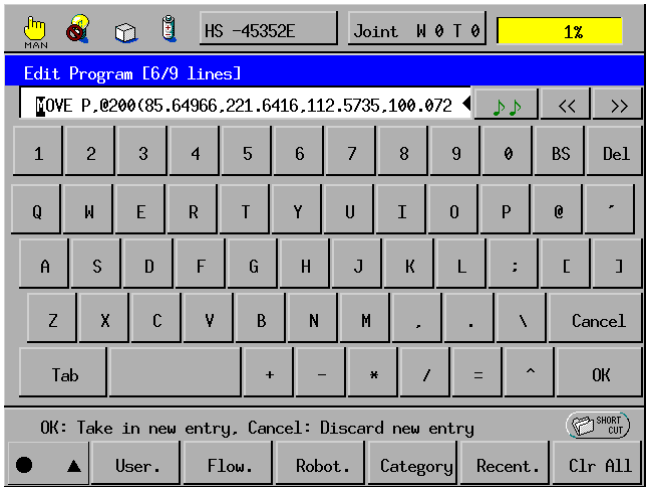


Parameters that cannot be edited here.

To edit them, press [Text]. The alphanumeric key screen will appear as shown in Step 6.

Step 6

Use the alphanumeric key screen shown below to edit parameters in the text mode.



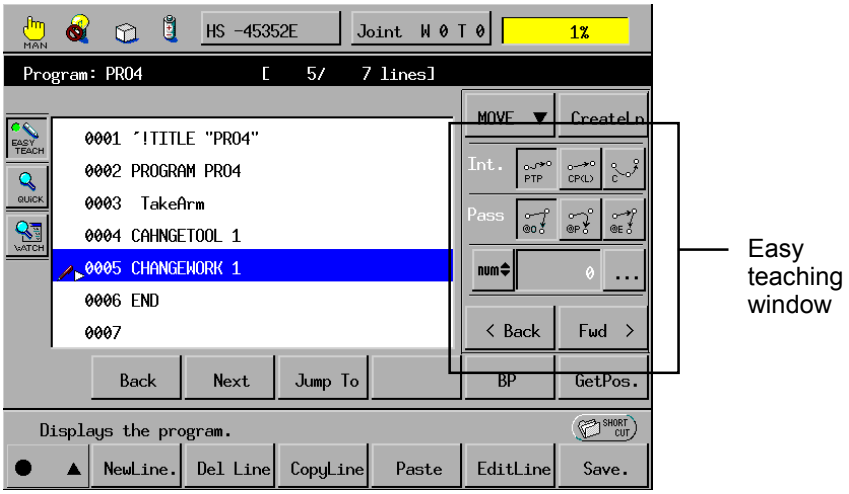
NOTE: Pressing [Cancel] in the above screen will cancel all settings made in the easy teaching window.

3.2.4.3 Executing Motion Commands

What follows is an operation flow for executing motion commands by using the easy teaching facility.

Step 1

Carry out Steps 1 through 4 in Section 3.2.4.1 to call up the easy teaching window.



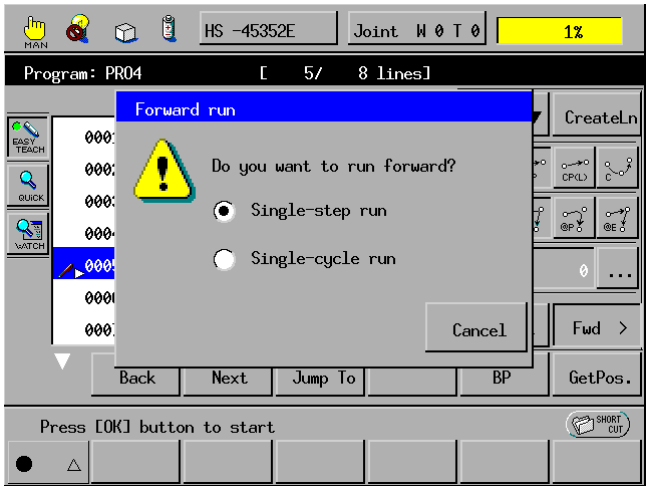
Move the blue cursor to a program line to be executed, then press [<Back] or [Fwd>].

[Fwd>]: If a command on the selected line can be edited in the easy teaching window (refer to Section 3.2.4.4), then the program line will execute [Fwd>]: Pressing this button will execute the command selected with the blue cursor.

[<Back]: Pressing this button will execute the command selected with the blue cursor if the command does not include a destination point. If the command includes a destination point, it will apply a destination point defined in a motion command preceding the selected command.

Step 2

Pressing [<Back] or [Fwd.>] button will call up the execution confirmation window shown below.



Choose "Single-step run" or "Single-cycle run." Then while holding down either one of the deadman switches, press the OK button. The program will execute. Releasing either one of the deadman switch and OK button will stop the running program.

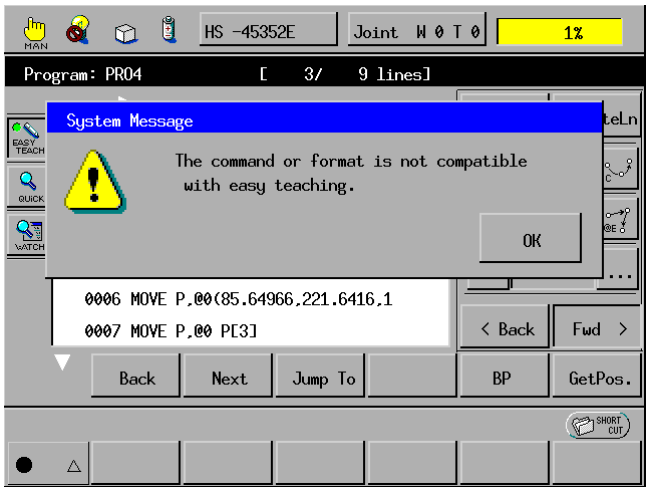
"Single-step run": Runs a single step of the selected program and stops the execution.

"Single-cycle run": Runs the selected program once from the beginning to the end or to any command not executable by easy teaching.

In either "Single-step run" or "Single-cycle run," you can stop the program run halfway just by performing any of stop operations (e.g., pressing the STOP key) during execution.

Tip

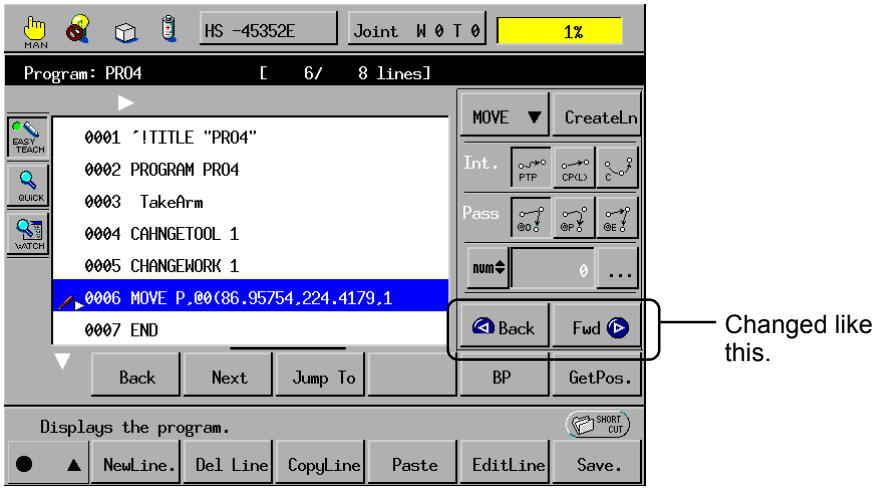
If you attempt to run any command that is not executable by easy teaching or contains a syntax error, then the following warning message will appear.



Tip

When the easy teaching window is displayed, pressing either one of the deadman switches will change the functions assigned to the left- and right-arrow cursor keys from the horizontal scrolling on a program line to the same function as the [<Back] and [Fwd>], respectively.

The [<Back] and [Fwd>] icons will be also changed as shown below.



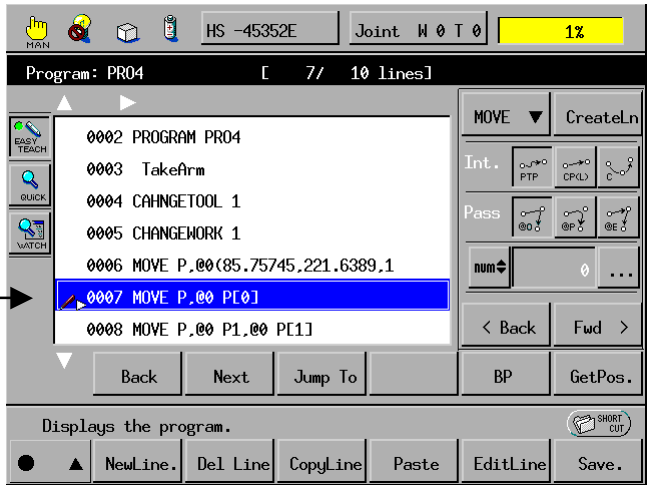
■ Additional Explanation about Easy Teaching

[1] Box frame on a program line

If you run a motion command by using the easy teaching window, a box frame may appear on a program line in addition to a blue cursor. The box frame indicates that the boxed line includes a destination point obtained by a command executed most recently.

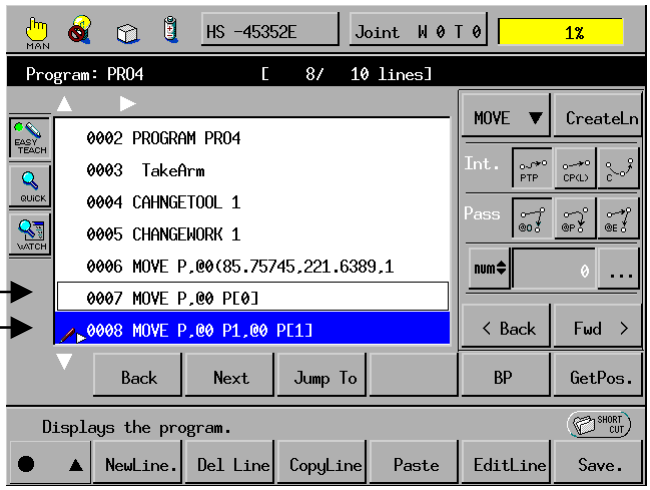
In the case of [Fwd>]: If you temporarily stop the following program at line 0007 being executed by [Fwd>], for example, then a box frame comes on line 0007 since the destination point obtained by the most recently executed motion command is written in line 0007.

Box frame and blue cursor are overlapped with each other.

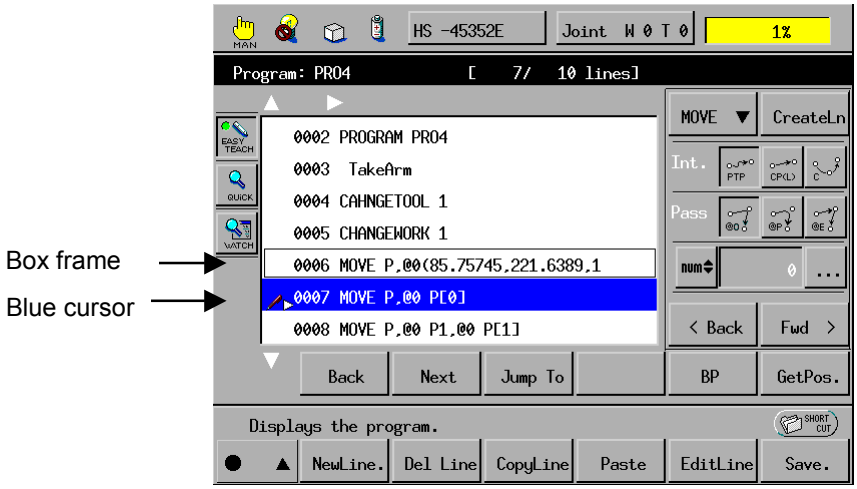


If line 0007 is executed again with [Fwd>] by a single step, the blue cursor moves to line 0008 but the box frame stays on 0007. This is because the destination point obtained by the most recently executed motion command is written in line 0007.

Box frame
Blue cursor



In the case of [<Back]: If line 0007 is executed with [<Back] by a single step (or the execution is stopped temporarily), then the blue cursor stays on line 0007 but the box frame comes on line 0006. This is because the destination point is still in the motion command immediately preceding the line marked with the blue cursor.



[2] About the GetPos function

You may use the GetPos function when a coding list of the selected program or the easy teaching window is displayed.

The GetPos function may get the current robot position even expressed in immediate operand format provided that the easy teaching window is displayed.

Note: Immediate operand format refers to writing command operands in numeric values as shown below, not in variables.

```
MOVE P,@0(1025.721,-354.7859,1026.708,-179.9987,65.01270,160.9215,5)
```

Immediate operands

3.2.4.4 Applicability of Parameters in Easy Teaching

The following tables show whether parameters of commands are applicable to editing, displaying of the easy teaching window, and execution in easy teaching.

NOTES

(1) If a command contains any parameter not listed in these tables, then no easy teaching window will be displayed. Neither is such a command executable.

(2) When an easy teaching window is displayed:

- Pressing the OK key will eliminate unnecessary space codes in parameters.
- A very small value entered to a destination position or initial passing start position may be automatically expressed in floating point or double-precision floating point format.

Symbols

O: Operable & editable
OP: Operable
D: Displayable
NO: Not operable or editable
CPL: Operable after compile
FW: Forward motion only

G-var: Global variable
L-var: Local variable
Pos: Position

Command	Arguments													
MOVE	Interpolation		Passing Start Offset		Pose (Destination position)***		Motion Options			Other Options				
	P	O	@0	O	Immediate	O	SPEED	Immediate	OP, D	NEXT	NO, D			
	L	O	@P	O	G-var: Pos	O		G-var: Value	OP, D					
	C	O*	@E	O	L-var: Pos	NO		L-var: Value	NO					
			@Numeral	OP, D			ACCEL	Immediate	OP, D					
								G-var: Value	OP, D					
								L-var: Value	NO					
							DECEL	Immediate	OP, D					
								G-var: Value	OP, D					
								L-var: Value	NO					

	Interpolation		Reference Position		Passing Start Offset		Approach Distance		Motion Options			Other Option	
APPROACH	P	OP	Immediate	OP	@0	OP	Immediate	OP	SPEED	Immediate	OP	NEXT	NO
	L	OP	G-var: Pos	OP	@P	OP	G-var Value	OP		G-var Value	OP		
			L-var: Pos	NO	@E	OP	L-var: Value	NO		L-var: Value	NO		
					@Numeral	OP			ACCEL	Immediate	OP		
										G-var Value	OP		
										L-var: Value	NO		
									DECEL	Immediate	OP		
										G-var Value	OP		
										L-var: Value	NO		

	Interpolation		Passing Start Offset		Depart Distance		Operation Option			Other Options	
DEPART**	P	OP	@0	OP	Immediate	OP	SPEED	Immediate	OP	NEXT	NO
	L	OP	@P	OP	G-var Value	OP		G-var Value	OP		
			@E	OP	L-var: Value	NO		L-var: Value	NO		
			@Numeral	OP			ACCEL	Immediate	OP		
								G-var Value	OP		
								L-var: Value	NO		
							DECEL	Immediate	OP		
								G-var Value	OP		
								L-var: Value	NO		

Symbols

O: Operable & editable
OP: Operable
D: Displayable
NO: Not operable or editable
CPL: Operable after compile
FW: Forward motion only

G-var: Global variable
L-var: Local variable
Pos: Position

Command	Argument			
CHANGETOOL	Tool Coordinates			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		
CHANGEWORK	User Coordinates			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		
SPEED	Robot Speed			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		
JSPEED	Joint Speed			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		
ACCEL	Acceleration		Deceleration	
	Immediate	OP, FW	Immediate	OP, FW
	G-var: Value	OP, FW	G-var: Value	OP, FW
	L-var: Value	NO	L-var: Value	NO
JACCEL	Joint Acceleration		Joint Deceleration	
	Immediate	OP, FW	Immediate	OP, FW
	G-var: Value	OP, FW	G-var: Value	OP, FW
	L-var: Value	NO	L-var: Value	NO
DECEL	Deceleration			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		
JDECEL	Joint Speed			
	Immediate	OP, FW		
	G-var: Value	OP, FW		
	L-var: Value	NO		

Symbols

O: Operable & editable
OP: Operable
D: Displayable
NO: Not operable or editable
CPL: Operable after compile
FW: Forward motion only

G-var: Global variable
L-var: Local variable
Pos: Position

Command	Argument

Indirect reference range of "G-var: Value"

		Array		Array		
Numeric , global variable		Immediate	O			Example: P1,P[1] means that the variable number of position global variable P1 is 1.
		Numeric, global variable		Immediate	OP	Example: P[I1],P[I[1]] means the contents of global integer variable number 1 of global position variable P1.
				G-var	NO	
				L-var	NO	
		Numeric, local variable	NO			
		Array, local variable		Immediate	NO	
				G-var	NO	
				L-var	NO	
Numeric, local variable	NO					
Array, global variable		Immediate	NO			
		Numeric, global variable		Immediate	NO	
				G-var	NO	
				L-var	NO	
		Numeric, local variable	NO			
		Array, local variable		Immediate	NO	
				G-var	NO	
				L-var	NO	

Variable type

G-var: Pos	P, T, J
L-var: Pos	DEFPOS, DEFTRN, DEFJNT, DIM POSITION, DIM JOINT, DIM TRANS

Variable Type Global Variable	I, F, D
Value Variable Type Local Variable	DEFINT, DEFSNG, DEFDBL, %, !, #, DIM INTEGER, DIM SINGLE, DIM DOUBLE
Array Type Value Local Variable	

* If you stop the robot temporarily during an arc motion, you may restart it from the stopped position only in the same direction ([Fwd>] or [<Back] run) as before the temporary stop. Restart in the opposite direction is not allowed.

Once you attempt to restart the robot in the opposite direction, Error 27BE ("Arc motion not allowed from the current position") will occur. After that, restart is no longer possible even in the same direction.

No arc motion can start unless the current robot position is the same as a destination position defined in the immediately preceding motion command. If you attempt to do so, Error 27BE ("Arm motion not allowed from the current position") will occur.

** No DEPART motion can start unless the current robot position is the same as a destination position defined in the immediately preceding motion command. If you attempt to do so, Error 27BE ("Arm motion not allowed from the current position") will occur.

*** In easy teaching, you may edit or operate only a single pose in a same command line. The easy teaching facility cannot process a pose array (more than one pose in a line).

Invalid example: `MOVE P,P3,P4,P5` This command line includes three poses (P3, P4, and P5).

3.2.4.5 Notes for Easy Teaching

(1) At the start of a pass motion, the robot motion in easy teaching may be slightly different from that in Teach or Playback mode.

(2) If a figure flag is set to -1, the final robot figure may be different between [Fwd>] and [<Back] run.

(3) If any motion command is executed in easy teaching, then arm semaphore needed for that motion will be automatically obtained.

The arm semaphore will be released when:

- The robot arm has reached the final destination point after a single-step run or single-cycle run.
- The coding list of the selected program is closed.
- In the Shortcut Menu, the [ProgRst.] has been performed.
- In Teach or Playback mode, the [ProgRst.] has been performed, regardless of whether "This program only" or "All programs" is selected.
- A Level 3 error has occurred except errors caused when the teach pendant is used.
- A Level 4 error or higher one has occurred.
- *Program reset* signal is received via I/O line in Standard mode (only when negative values are set in the data area).
- *Program reset* & *Operation preparation start* signals are received via I/O line in Compatible mode.

IMPORTANT

Once you temporarily stop the robot halfway through a single-step run or a single-cycle run, then manual operation or operation mode switching (between Joint mode, X-Y mode, and Tool mode) is no longer possible. This is because the currently running program has held an arm semaphore.

To make manual operation or operation mode switching possible, release the arm semaphore by carrying out [ProgRst.] in the Shortcut Menu.

3.2.4.6 User Preferences for Using Easy Teaching (Add to the Configuration List)

The next table lists user preferences to be added for using easy teaching.

No.	Items	Factory default	Power-on default	Description	Comments
199	Positioning allowance of arc motion in easy teaching	100	100	Allowable positioning error for arc motion in easy teaching	Do not change this setting usually.

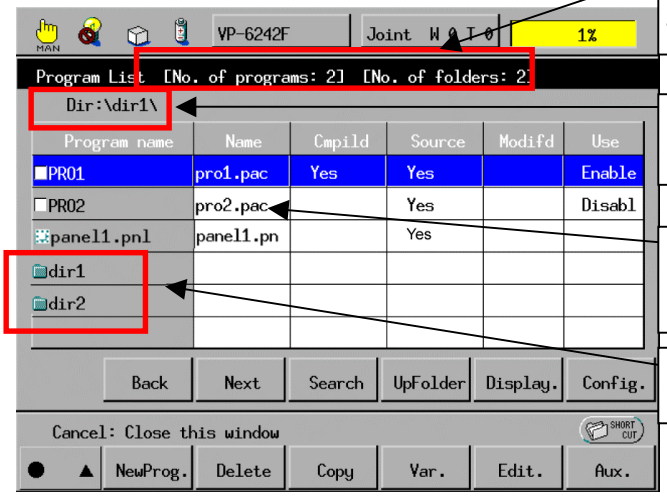
3.2.5 Folder Feature

The folder feature applies only to PAC programs.

3.2.5.1 Folders Displayed on Teach Pendant

The folder feature added allows the teach pendant to display folder-related items in the Program List on the teach pendant as shown below.

■ **Enhanced display in Manual mode**



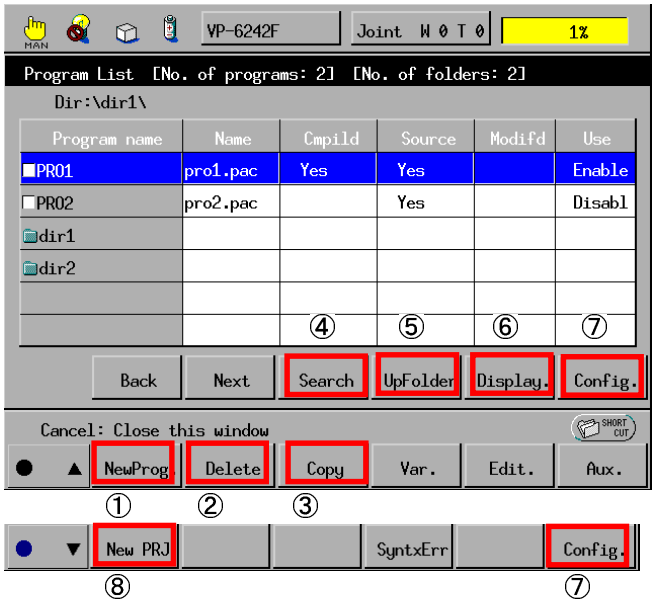
Shows the number of programs in the current folder and the number of folders. The number of programs includes header files and excludes operation panel files.

Shows the directory level of the current folder.

Indicates the operation panel files. Refer to the "Panel Designer" User's Manual.

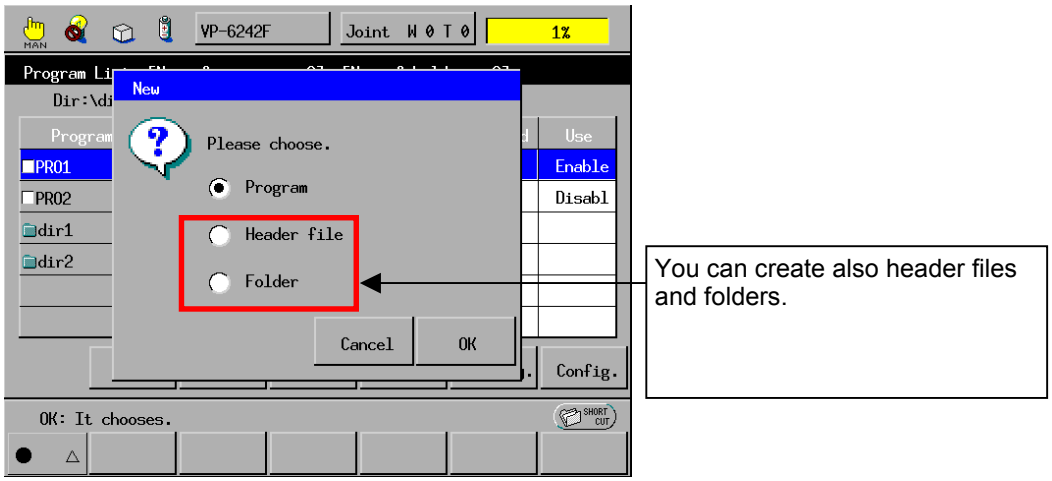
Indicates folders (directories).

■ Enhanced function keys in Manual mode



① [NewProg.]

In Version 2.2 or later, this command allows you to create also header files and folders.



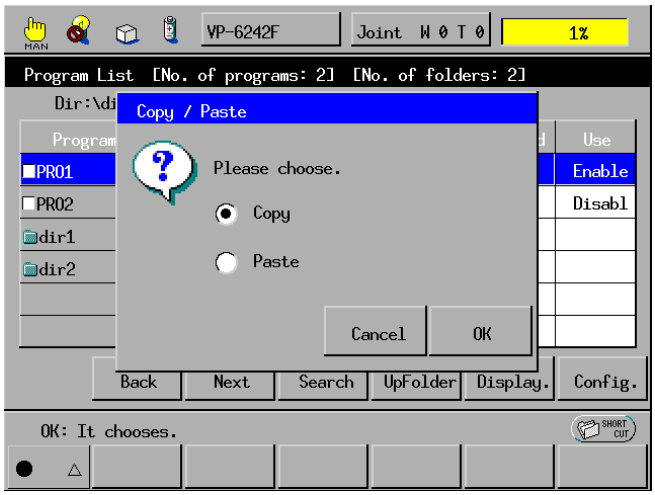
- Program: One controller can hold up to 256 programs created.
- Header file: The file name can be up to 32 characters long. One controller can hold up to 256 "header files plus operation panel files."
- Folder: The folder name can be up to 16 characters long. One controller can hold up to 256 folders created. Folders can be organized in a maximum of four levels excluding the root folder.

② [Delete]

This command can delete PAC programs, header files, folders, and operation panel files.

Deleting a folder erases all the objects inside the deleted folder.

③ [Copy]



- Copy: Selecting this option copies the selected PAC program, header file, or folder. The name of the object copied last appears in parenthesis following the Paste option button, meaning that the object is the one that will be pasted next.

  Copying a folder copies also all objects contained in that folder.

  No operation panel file can be copied except when it is contained in a folder. Copying such a folder can copy also operation panel files contained.

- Paste: Selecting this option pastes the object copied last into the current folder designated by "Dir:."

  If the current folder already contains an object having the same name as the object to copy, a "Paste under a new name or Overwrite" dialog appears, prompting the user's choice.

  Pasting PAC program(s) under a new name automatically makes its compile flag inactive ("Disable" in the Use column); overwriting it with a new one retains the compile flag status of the old one.

  Overwriting the destination folder with a source one

  In overwriting a folder, if the destination folder contains objects not contained in the source folder, those objects will remain intact.

④ [Search]

This command searches for a PAC program having the specified name in the current folder designated by "Dir:." It cannot search for header files, operation panel files, or folders.

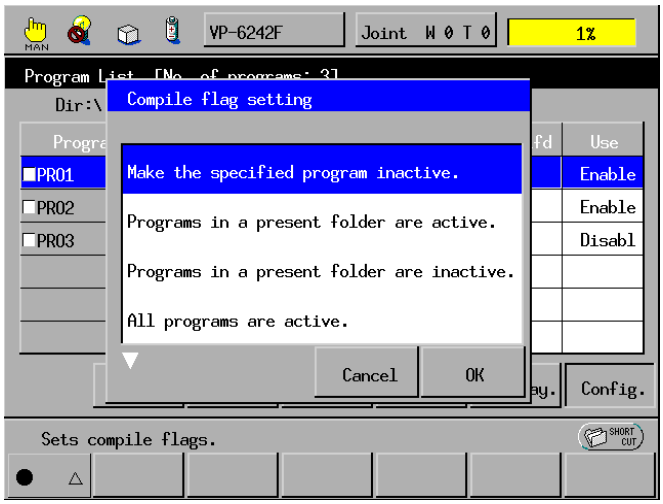
⑤ [UpFolder]

This command shifts to the upper folder from the current folder. If the current folder is already the root folder, nothing happens.

⑥ [Display.]

Pressing this command button with a PAC program or header file being selected displays its contents; pressing it with a folder being selected shifts the screen to the inside of that folder.

⑦ **[Config.]**



Pressing this command button toggles the compile flag on (active) and off (inactive). This applies to PAC programs only. Programs whose compile flags are active are subject to compilation.

The compile flag provides the following five choices:

1) "Make the specified program active." or "Make the specified program inactive."
   This appears only when the cursor points to a particular PAC program. Taking this choice reverses the current status of the selected PAC program.
2) "Make all programs in the current folder active."
   Selecting this makes all the PAC programs displayed in the current folder (folder designated by "Dir:") active.
3) "Make all programs in the current folder inactive."
   Selecting this makes all PAC programs displayed in the current folder designated by "Dir:" inactive.
4) "Make all programs active."
   Selecting this makes all PAC programs in the controller active.
5) "Make all programs inactive."
   Selecting this makes all PAC programs in the controller inactive.

⑧ **[New PRJ]**

This command erases all PAC programs, header files, folders, and operation panel files stemming from the root folder.

NOTE: Measuring the run time of a program in a folder

Selecting [ExtScrn]–[Program]–[Aux.]–[Set PRJ.] displays the configuration list. The list contains the parameter "13: Delete cycle time calculation code" that provides the following three choices.

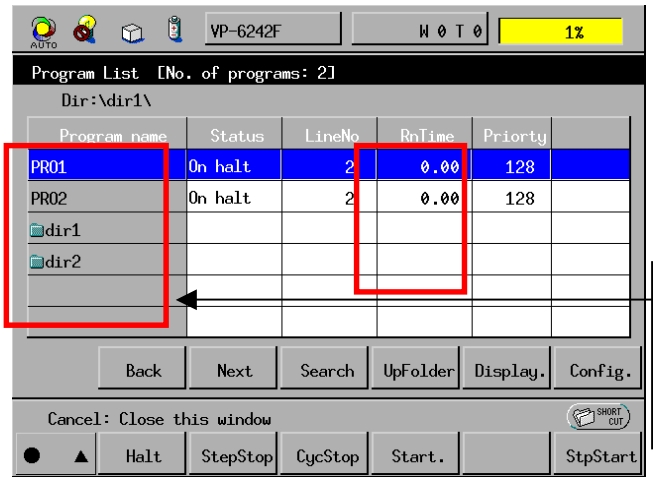
0: Measure the run time of all programs.
1: Measure the run time of programs that can be called through IO (that is, their roots are named "PRO⋆").
2: Do not measure the run time of any programs.

To display the run time of programs in the folder, set this parameter to "0."

■ Enhanced display in modes other than Manual mode

In modes other than Manual mode, only executable PAC programs and the folders containing such programs are displayed.

You can move objects from one folder to another in the same way as in Manual mode.



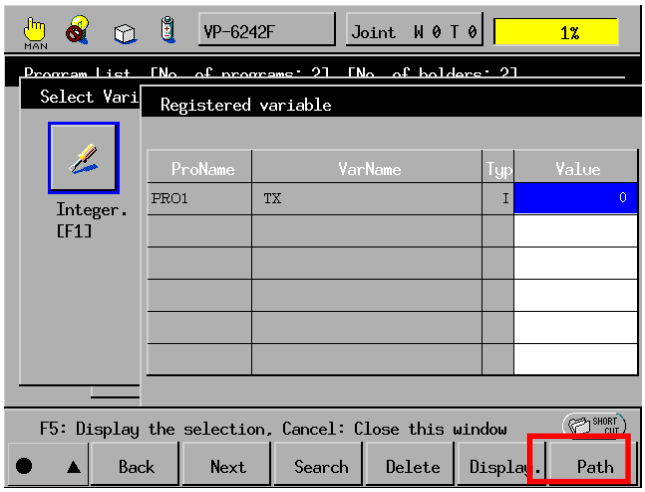
In modes other than Manual mode, only executable PAC programs and the folders containing such programs are displayed.

■ Handling local variables

The folder feature added enables programs or variables having the same name to coexist in a robot controller, as long as those programs or variables are located individually in different folders.

If located in different folders, variables having the same variable name and used in programs with the same name will be treated as different variables. To locate a particular program, click the Path button.

Register variable window



3.2.5.2 Staring Programs from I/O

Starting programs from I/O is possible only in base programs.

3.2.5.3 Supervisory Tasks

The folder feature newly added enables supervisory tasks having the same name to coexist in a robot controller, as long as those tasks are located in individual folders.

The function and operation of supervisory tasks are the same as those in the previous system version, except that the number of supervisory tasks allowed is changed from 10 to 32 (TSR0 to TSR31).

Up to 32 supervisory tasks can run simultaneously independent of normal task programs. If more than 32 supervisory tasks are made active simultaneously, the error "7799: The maximum number of TSR was exceeded." occurs, terminating all programs including supervisory tasks.

3.3 Individual and Auto Modes

Robot automatic operation is possible in Individual and Auto modes.

In Individual mode, selecting the desired program in the robot controller with the teach pendant enables automatic operation.

In Auto mode, selecting the desired program with control signals issued from external equipment enables automatic operation.

Note: Individual and Auto modes are collectively called Playback mode. Before starting automatic operation in Individual or Auto mode, it is necessary to specify the playback speed.

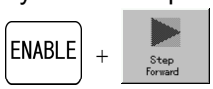
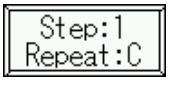
Note: To place the robot in Individual or Auto mode, it is required that the manual/auto selector switch on the teach pendant is set to AUTO and the teach plug (prepared by the customer) is removed.

Confirm that no one is within the restricted space of the robot, remove the teach plug, clear errors, and then proceed to automatic operation. For details about the teach plug (to be prepared by the customer), refer to the INTERFACE CIRCUIT DIAGRAMS (T03).

3.3.1 Running the Robot in Individual Mode

In Individual mode, you may run the selected task program from the teach pendant in any of the four types of runs described in the table below.

Table 3-2. Four Types of Runs in Individual Operation

		Step Forward	
		Once	Continue
Repeat	Once	 If the program is activated, only a single step executes and the robot comes to a halt. Pressing the **Step Forward** key with the **ENABLE** key held down proceeds to the next step.  When the program is executed up to the final step (the highest step number or the END step), it stops.	 If the program is activated, all steps execute continuously. When the program is executed up to the final step (the highest step number or the END step), it stops.
	Continue	 In the same way as above, steps execute step by step. When the program is executed up to the final step (the highest step number or the END step), control returns to the first step to allow continuous playback. If the RPS is enabled, at the END step, the program selection signal switches control to any other program	 If the program is activated, all steps execute continuously. When the program is executed up to the final step (the highest step number or the END step), control returns to the first step to allow continuous playback. If the RPS is enabled, at the END step, the program selection signal switches control to any other program. This setting applies to the usual practical operation.

⚠**CAUTION**: Automatic operation in Individual mode automatically starts running the robot. Before operation in Individual mode, be sure to read SAFETY PRECAUTIONS, Section 4.7 "Precautions for automatic operation" given at the beginning of this manual.

Run the robot in Individual mode when

You check the robot motion or run the robot independently without using a sequencer or other external equipment.

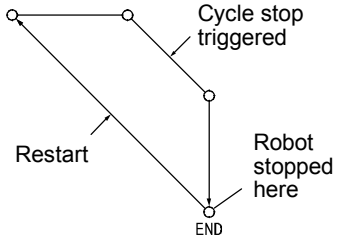
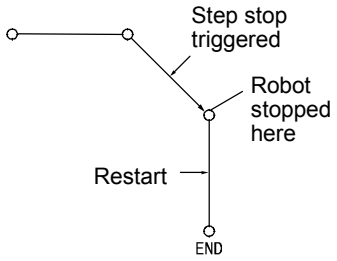
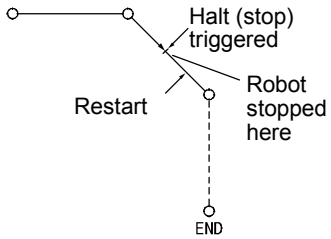
For details on the operating procedures in Individual and Auto modes, refer to the OPERATION MANUAL (T03), Chapter 5, "Operational Check (Individual/Auto)." Programs are executable only from the base program.

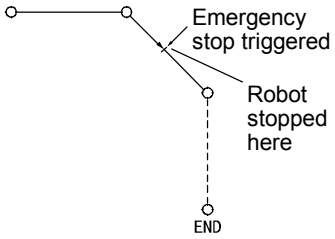
Sections 3.3.2 to 3.3.5 describes the program stop functions that stop PAC programs being executed.

3.3.2 Stopping the Robot in Individual Mode

Any of Cycle stop, Step stop, Halt (Stop), and Emergency stop entered from the teach pendant can stop the robot in Individual mode. The table below details Cycle stop, Step stop, Halt (Stop), and Emergency stop.

Table 3-3. Four Types of Stops in Individual Mode

	Types of Stops	Explanation	When stopped			Restart
			Motor	Auto mode	Step No.	
1	Cycle stop TP: [CycStop] 	Stops the robot after executing the last step of the task program. ATTENTION: This stop function is effective only to the program executed by RUNPAC.	ON	ON	Last step	Select the program again, and you may start a single-step run or single-cycle run from the head of the program.
2	Step stop TP: [StepStop] 	Interrupts the running task program midway after executing the step in which the step stop key is pressed. ATTENTION: This stop function is effective only to the program executed by RUNPAC.	ON	ON	Step executed	You may start a single-step run or single-cycle run from the step immediately following the current step.
3	Halt (Stop) TP: [Halt] or [ENABLE]+[STOP] 	When [F1 Halt] key is pressed, a selected running task program is interrupted immediately. When [ENABLE]+[STOP] keys are pressed, all running task programs are interrupted immediately. ATTENTION: Halt (Stop) is effective only to the program executed by RUNPAC.	ON	ON	Step in progress	You may start a single-step run or single-cycle run from the current step again.

	Types of Stops	Explanation	When stopped			Restart
			Motor	Auto mode	Step No.	
4	Emergency stop TP: Emergency stop button 	Immediately stops all running task programs midway and turns the motor off the moment the emergency stop button is pressed.	OFF	OFF	Step in progress	Turn the motor on, and you may start a single-step run or single-cycle run from the head of the program again.

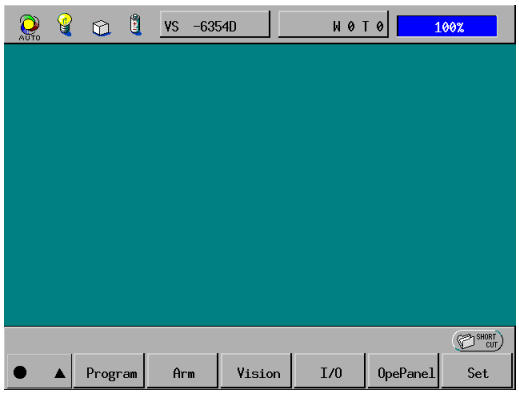
[1] Cycle Stop

Cycle stop can be triggered from the teach pendant.

Operating procedure

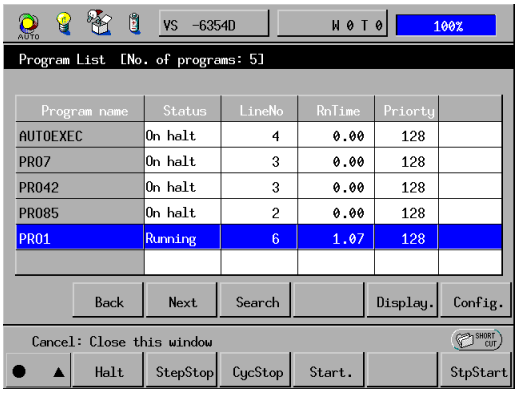
Step 1 Switch the teach pendant to the extended screen.

Step 2 Press [Program].



The Program List window appears as shown in the next step.

Step 3 Press [CycStop].



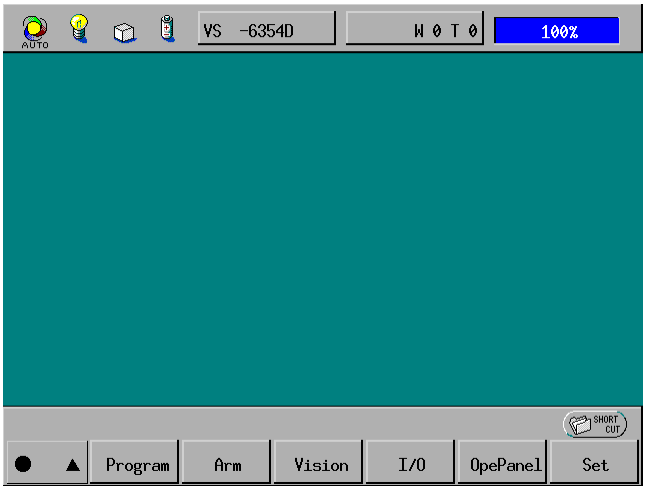
The current program will execute up to the last step and then the robot will stop.

[2] Step Stop

Operating procedure

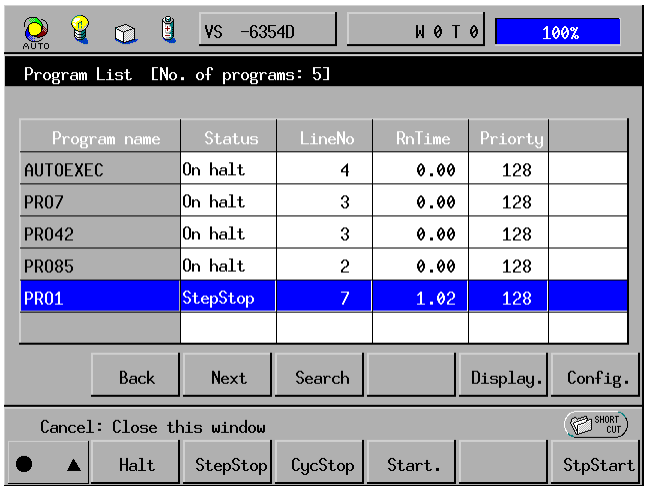
Step 1 Switch the teach pendant to the extended screen.

Step 2 Press [Program].



The Program List window appears as shown in the next step.

Step 3 Press [StepStop].



The current program step in progress will execute and then the program will be interrupted.

⚠**CAUTION:** Before restarting the robot after a Step Stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a Step Stop as it was will execute the step immediately following the current step displayed on the teach pendant.

[3] Halt (Stop)

Operating procedure

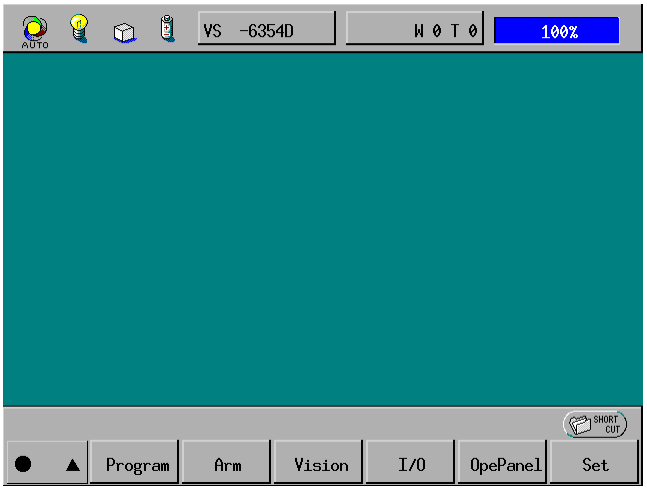
Pressing the [ENABLE]+[STOP] key immediately interrupts all running task programs midway. In this case, switching the teach pendant to the extended screen is not required.

The following steps are to execute Halt(Stop) by selecting a running task program.

⚠**CAUTION**: Before restarting the robot after a Halt, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a Halt as it was will execute the interrupted step.

Step 1 Switch the teach pendant to the extended screen.

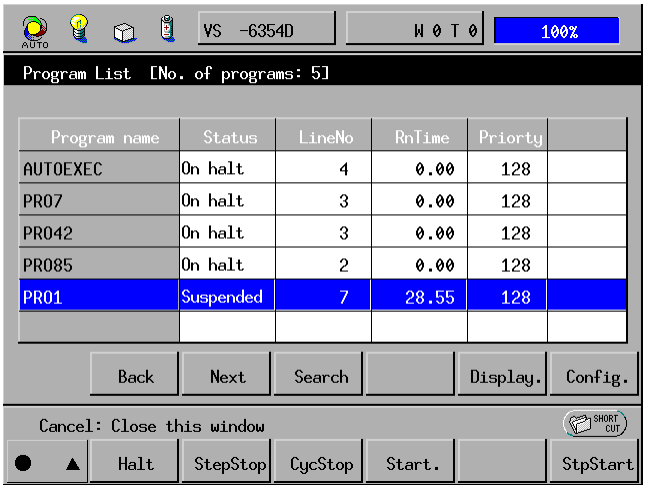
Step 2 Press [Program].



The Program List window appears as shown in the next step.

Step 3 Press [Halt] or STOP key.

NOTE: Pressing [Halt] immediately stops the task program selected on the Program List window; pressing the STOP key immediately stops all task programs.



The current program step in progress will be immediately interrupted so that the robot comes to a halt.

[4] Emergency Stop

Operating procedure

Step 1

Press the Emergency stop button.

All running task programs will be immediately stopped so that the robot will stop.

⚠**CAUTION:** The emergency stop procedure turns the motor off; however, the robot may move unexpectedly due to inertia.

⚠**CAUTION:** Before restarting the robot after an emergency stop, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after an Emergency Stop as it was will execute the selected program from its beginning.

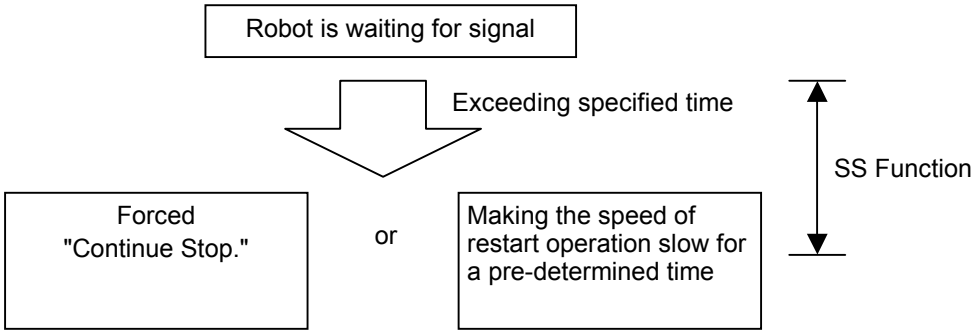
3.3.3 Stopping the Robot in Auto Mode

The robot can be stopped by the teach pendant with the same procedure as in Individual mode as described in Section 3.3.2.

The robot can also be stopped from external equipment. For details, refer to the INTERFACE CIRCUIT DIAGRAMS (T03).

3.3.4 SS (Safe Start) Function

In automatic operation, if the inaction status of robot exceeds a specific time because of awaiting signal from external device, then for the sake of safety, this function either carries out Continue Stop or it makes the speed of restart operation slow for a pre-determined time.



[1] This function is useful when

Ensuring further safety, as a part of safety function of the equipment.

Examples of processes unsafe for an operator when work is damaged by robot are given below.

(1) Work (product) is damaged.
(2) No output of signal from the sensor indicating presence of work.
(3) Robot is in a state of inaction and awaiting signal.
(4) The operator mistakes robot's inaction as robot being in "Stop Operation"
(5) The worker rearranges the product that was damaged without first temporarily stopping the operation of the robot.
(6) Output of signal from the sensor indicating presence of work.
(7) The robot begins the next operation immediately at normal high speed.

↓

These conditions can pose potential danger to the operator.

In this way, with the help of this function you can stop the process automatically or make the speed of next operation slow for a pre-determined time when the inaction period of the robot exceeds a specific time because of awaiting signal from external device and render conditions safe.

[2] Notes for SS Function

- When you are using SS function, perform a preliminary test (including those of peripherals).

  Particularly, make sure that the there is no danger of the speed of the robot in SS function and the speed of the peripherals not matching and therefore causing mutual interference.
- This function is very much a part of safety function. Please read "For safe use" before actual designing or operation for safe use of the robot.

[3] Operation Modes of SS Function

The SS function works in the following two operation modes.

(1) Stop Mode

When inaction period exceeds a specific period, ‘Continue Stop’ is executed in this mode.

(2) Slow mode

When inaction period exceeds a specific period, the speed of next operation is slow for a pre-determined time in this mode.

■ Stop mode

< Function >

- When inaction period exceeds a specific period, ‘Continue Stop’ is executed in this mode.

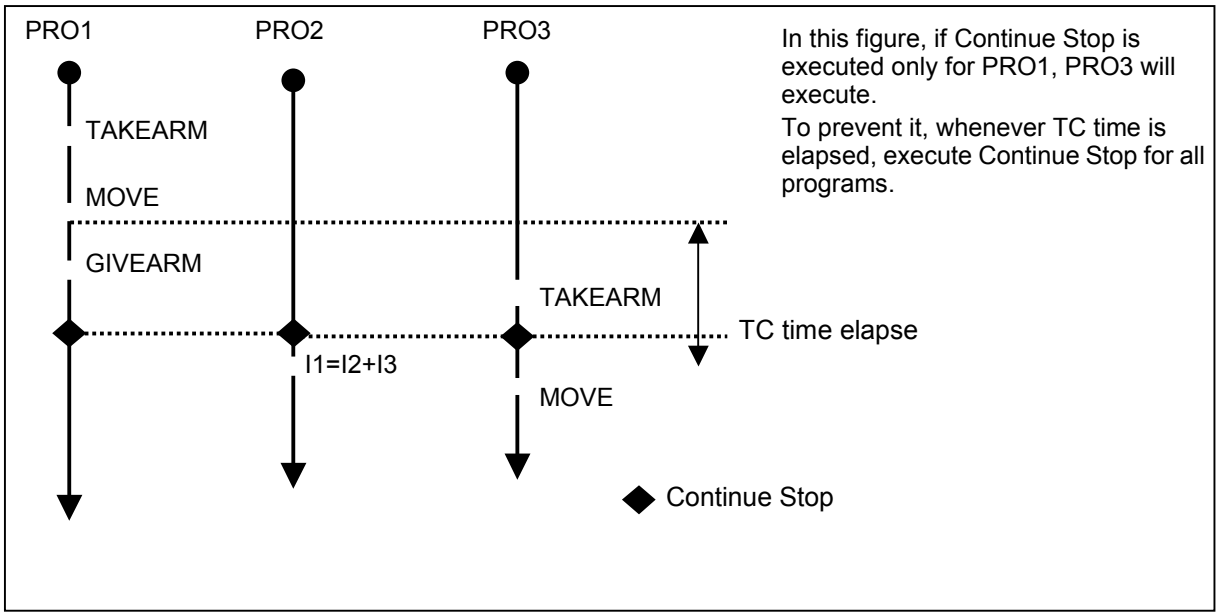
  This specific time is called as "TC period." Also, period of robot inaction is called "Inaction Period." The time is counted from 0 from the moment when the external device temporarily stops the operation of arm or tool. When TC period is exceeded, Continue Stop is carried out.

  From the time TC period is exceeded till the time ‘Continue Stop’ is executed, the mode is said to be ‘SS Mode’
- If the MOVE operation is started within the TC period, the time count of inaction period is stopped.
- After "Continue Stop", when operation is restarted and if again it goes into inaction status, inaction period count will be restarted from 0

< Operation example >

The figure below depicts the Stop Mode operation.

In this example, inaction period count is started after the end of MOVE operation of PRO1 and when TC time is exceeded, "Continue Stop" is executed.

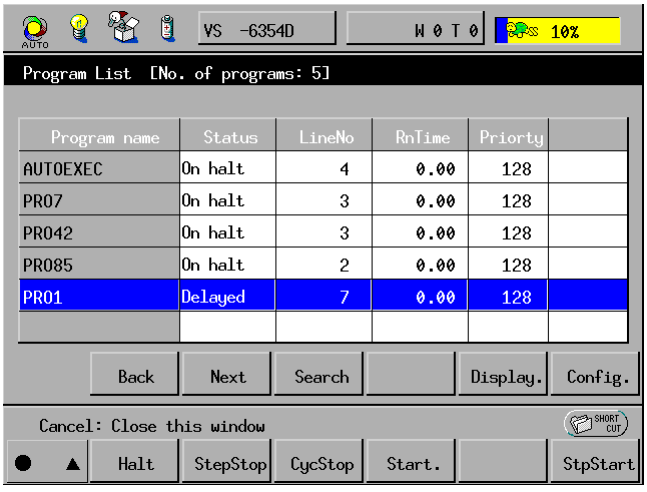


■ Slow mode

< Function >

- When inaction period exceeds a specific period, the speed of next operation is slow for a pre-determined time in this mode.

  This fixed time is called "TS period." From the time TC period is exceeded till the end of TS period, the mode is said to be ‘SS Mode’
- Speed of slow operation is called "Slow speed."
- All operation commands which are run in SS modes run slow.
- If all the programs are stopped or all programs are closed in SS operation, then the SS mode ends.
- Once the slow operation is started, an icon that indicates the SS mode is displayed in the graph in the Speed Setting window as shown below.



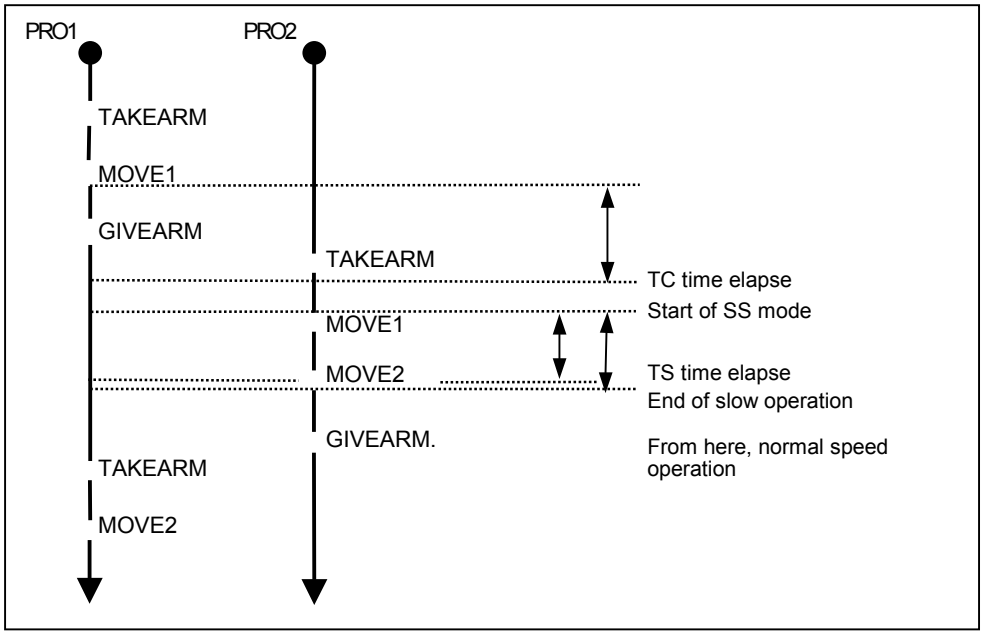
< Operation example >

The following figure shows an example of Slow Mode operation.

In this example, after the end of MOVE1 operation of PRO1, the counting of inaction period is started and after TC period is exceeded, the mode switches to SS mode.

Then, the slow operation of MOVE1 of PRO2 is started. MOVE2 of PRO2 is carried out slowly because it is started in the TS period.

From MOVE2 of PRO1 onwards, the actions take place at original speed.

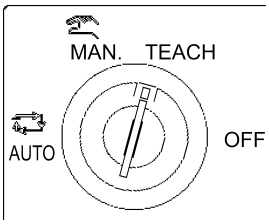


■ **Setting procedure of SS function operation mode**

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.

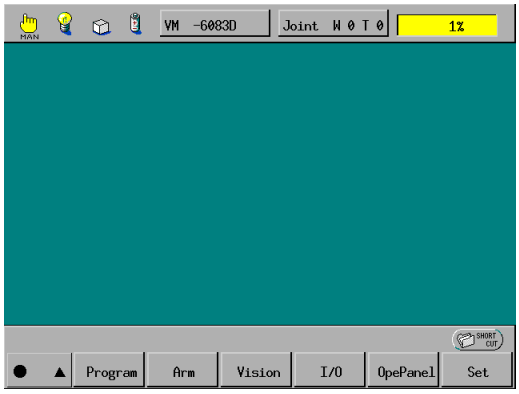


Step 2

Switch the teach pendant to the extended screen.

Step 3

Press the mode icon (the leftmost icon on the status bar) to switch to manual mode.

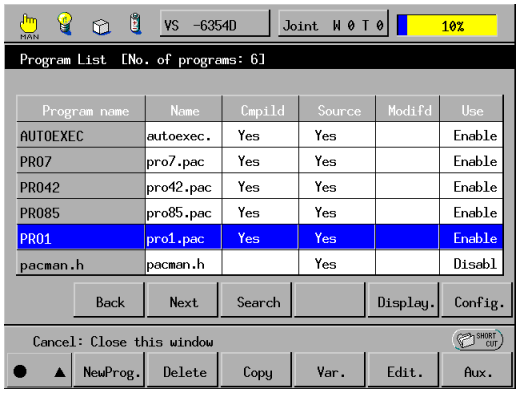


Check that the MAN is displayed below the mode icon.

Step 4

Press [Program].

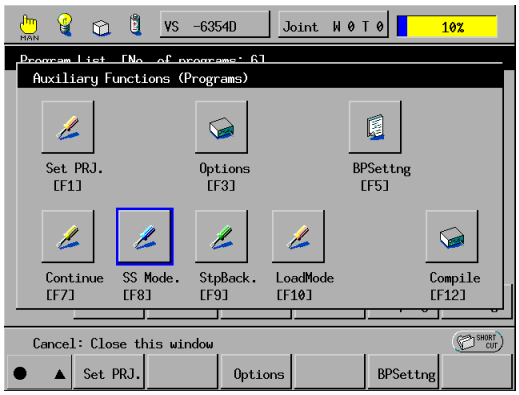
The Program List window appears as shown below.



Step 5

In the Program List window, press [Aux.].

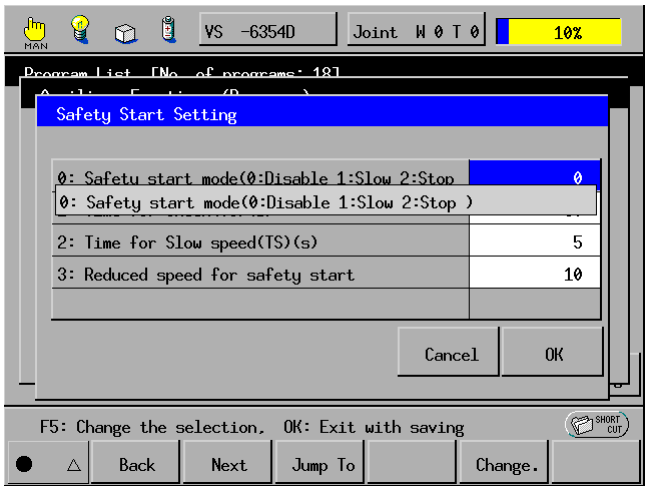
The Auxiliary Functions (Programs) window appears as shown below.



Step 6

In the Auxiliary Functions (Program) window, press [SS Mode.].

The Safety Start Setting window appears as shown below.



Step 7

Select the "Safety start mode" by using the cursor keys or by touching the screen directly.

The "Safety start mode" will become highlighted.

Step 8

Set the desired value and press the OK button.

To disable the SS function	: 0
Slow mode	: 1
Stop mode	: 2

[4] Setting Time and Speed

You may set the TC period, TS period and Slow speed in either of the following two ways.

(1) By direct entry of values

Set the TC time, TS time and slow speed from the teach pendant.

This method should be used when you want to enable the SS function for all operations during automatic operation.

(2) By entering commands in the program

Insert ndTC and ndTS commands in programs.

This method should be used when you want to enable the SS function in a particular operation during automatic operation.

NOTE:

- Do not use both the above ways concurrently. Doing so will make you confused as to which settings made in those ways are effective. It is DANGEROUS.
- The specified value is effective even if you turn the robot controller off.
- The most recently executed value will becomes the default thereafter.

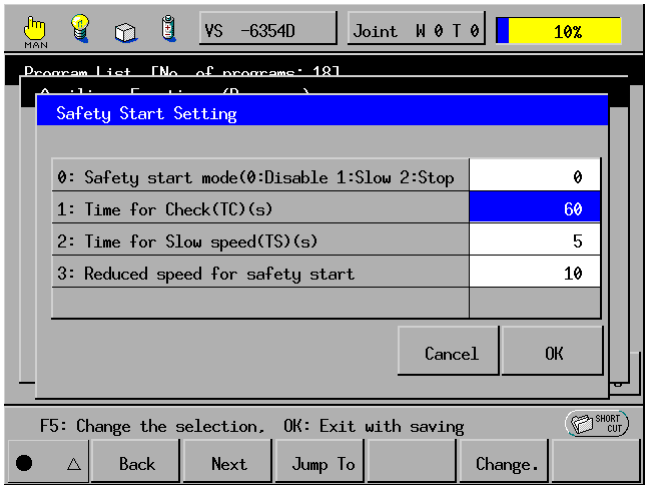
By direct entry of values

Setting the TC period

Step 1 | 6 Follow steps 1 through 6 in "Setting procedure of SS function operation mode."

Step 7 Select the "TC time" by using the cursor keys or by touching the screen directly.

The "TC time" will become highlighted.



Step 8 Enter an arbitrary TC period and press OK.

You may enter any value from 0 to 600 seconds. The factory default is 60 seconds.

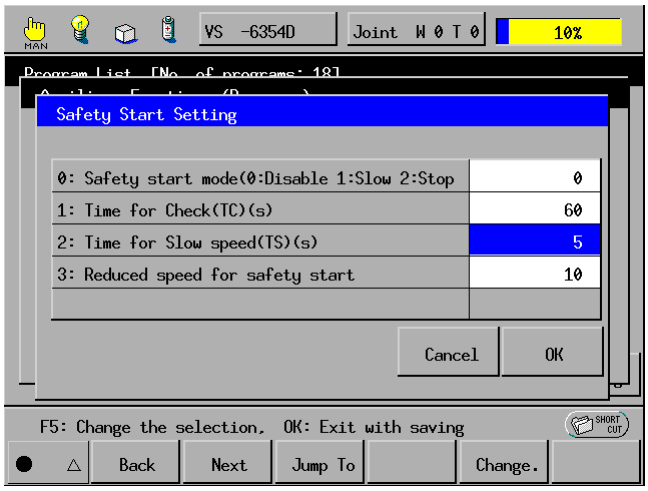
NOTE: Setting "0" will disable the SS function. The SS function is kept disabled until you enter a value other than 0 to the TC time.

Setting the TS period

Step 1-6 Follow steps 1 through 6 in "Setting procedure of SS function operation mode."

Step 7 Select the "TS time" by using the cursor keys or by touching the screen directly.

The "TS time" will become highlighted.



Step 8 Enter any TS time and press OK.

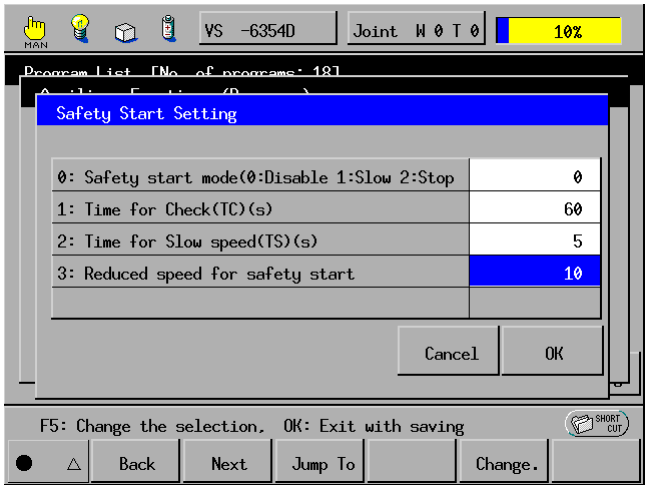
You may enter any value from 3 to 30 seconds. The factory default is 5 seconds.

Setting the Slow speed

Step 1-6 Follow steps 1 through 6 in "Setting procedure of SS function operation mode."

Step 7 Select the "Reduced speed for safety start" by using the cursor keys or by touching the screen directly.

The "Reduced speed for safety start" will become highlighted.



Step 8 Enter the desired slow speed and press OK.

You can enter any value from 1% to 10%. The factory default is 10%.

By typing the commands in programs

TC time setting command

[Function] Set the TC time

[Prototype] ndTc (<TCtime>)

[Explanation] Same as the TC function of any programming language.

Sets the TC time.

Valid values for TC time are 0 to 600 seconds. Factory setting is 60 seconds.

When 0 is set, it is equivalent to executing TC OFF of a programming language.

[Macro definition] <pacman.h> file is required.

[Related Function] ndTS

TS time and slow speed setting command

[Function] Sets the TS time and Slow speed.

[Prototype] ndTS (< TS time >, < Slow speed>)

[Explanation] Same as the TS function of any programming language.

Sets the TS time and Slow speed.

Valid values for TS time are 3 to 30 seconds. Factory setting is 5 seconds.

Valid values for Slow speed are 1% to 10%. Factory setting is 10%.

[Macro definition] <pacman.h> file is required.

[Related Function] ndTC

[5] Dedicated output in SS function

Function

Outputs in SS mode.

This function is enabled only if set in "Slow mode."

Port number

Compatibility mode : Connector No. 29 of CN10.

Standard mode : Connector No. 11 of CN10.

How it works

This function gives the indication to the operator that the operations are taking place in "SS mode" by ringing a buzzer or by making the LED ON when this signal is ON.

ON

When operation is in SS mode.

OFF

When TS time is exceeded and operation is not in SS mode.

NOTE: This signal is OFF even in slow operation if TS time is exceeded. The operations subsequent to signal OFF are carried out at original speed.

3.3.5 Break Point Function

You can set a break point at any program step in PAC programs. If a PAC program is running and encounters a break point, it will immediately stop. The step where a break point is set cannot be executed. This function applies only to PAC programs.

You can set a break point only from the teach pendant.

Max. number of break points that can be set	32 points in all PAC programs	
Operation modes in break points take effect	Automatic operation	Cycle start
	Check GO, Check BACK	Cycle start
Requirements for setting break points	Individual/Auto mode	Highlighted step
	Teach mode	Any step

Break point stop mode

When a program encounters a break point step, you can choose either of the following two stop modes:

(1) Immediate halt of that PAC program in which the break point is set

(2) Immediate halt of all running base programs and PAC programs

Program status when stopped at the break point

When the program is stopped at the break point, the teach pendant screen will display the following 2 status.

(1) Halt at BP (Break point): Only the program in which the break point is set is stopped (factory default)

Saving the break point settings

All break points you have set will be saved even if the controller power is switched OFF, except for the following:

Break points will be released when:

- You clear the break point
- You clear all the break points
- The PAC program is edited
- The PAC program is deleted
- The PAC program is recompiled with the teach pendant
- The controller receives program data from WINCAPSIII.

Restarting after BP stop

Restart the program at the BP stopping step to proceed the robot operation.
According to the BP stop status, the program will restart in the following way:
Halt at BP: Only the program in which the break point is set will restart.

When this operation needed

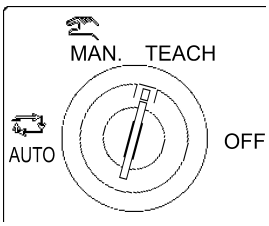
This operation is needed when you want to stop the program at any step in a program.

Setting a break point

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.

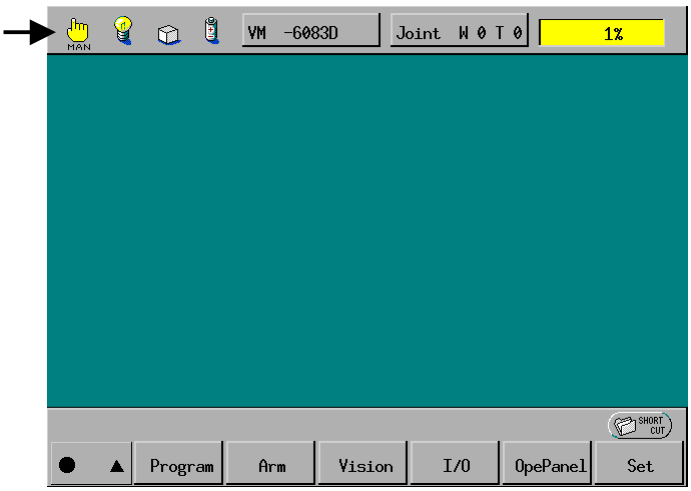


Step 2

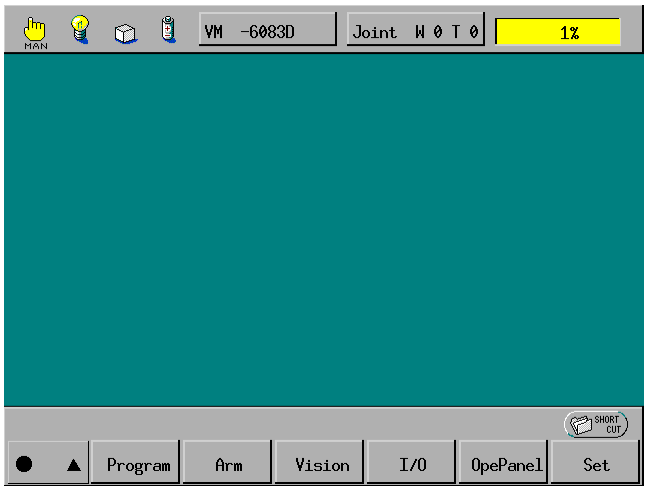
Switch the teach pendant to the extended screen.

Step 3

Press the mode icon (the leftmost icon on the status bar) to switch to manual mode.



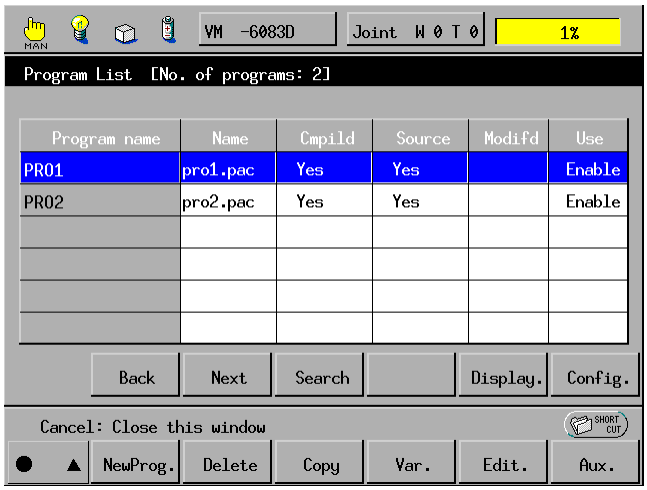
Step 4 On the extended screen, press [Program].



The Program List window appears, as shown in the next step.

Step 5 Select a program in which you want to set break points.

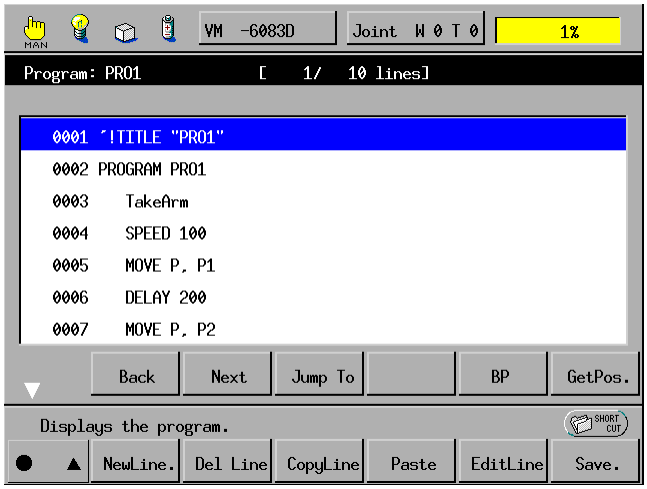
The selected program will become highlighted.



Step 6

Press [Edit.] or [Display].

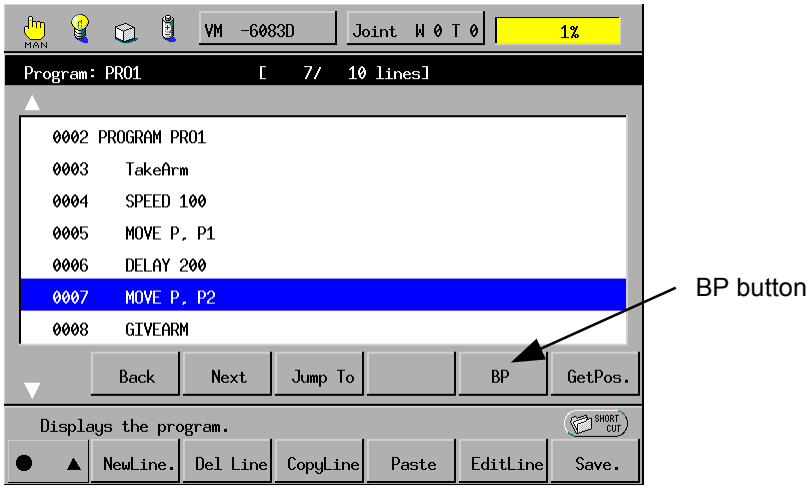
The program steps appear as shown below.



Step 7

Select a step where you want to set a break point.

The selected step will become highlighted.

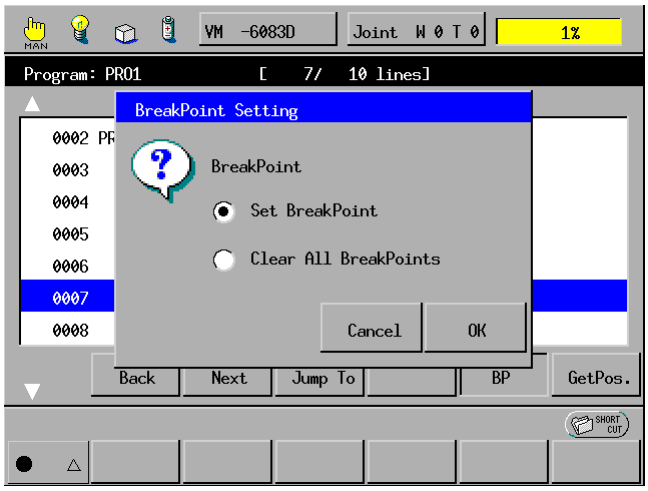


Step 8

Press [BP].

The BreakPoint Setting window appears as shown in the next step.

Step 9 Select "Set BreakPoint" and press the OK button.



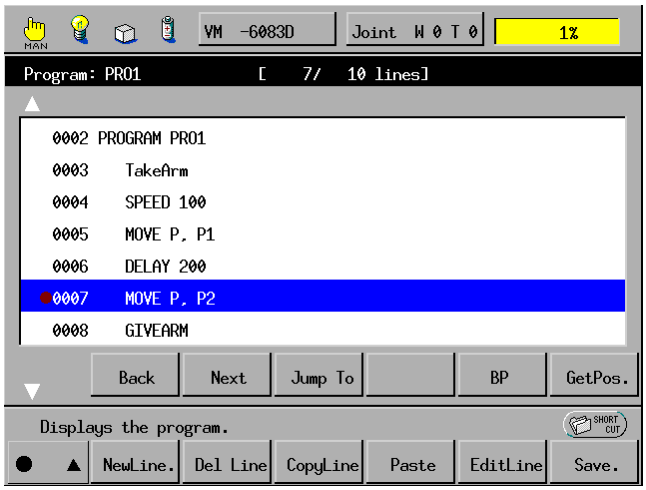
A red circle will appear at the left side of line number where the break point is set.

Clearing the break point

Step 1

On the teach pendant, turn the manual/auto selector switch to the manual position.

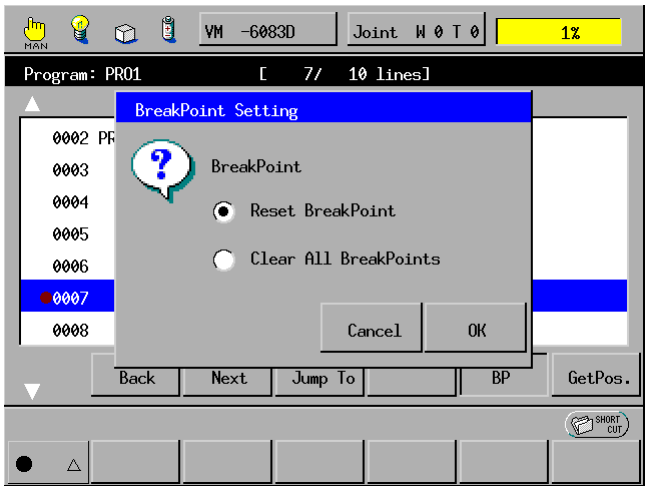
Choose the program step from which you want to clear the break point, following Steps 1 to 7 given in the "Setting a break point" above.



The step, where the break point is set, is highlighted.

Step 2

Press [BP].



Step 3

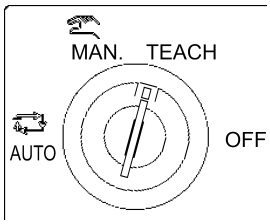
Select "Reset BreakPoint" and press the OK button.

The red circle marked at the left side of the line number disappears and the break point will be cleared.

Setting the Break Point Stop mode

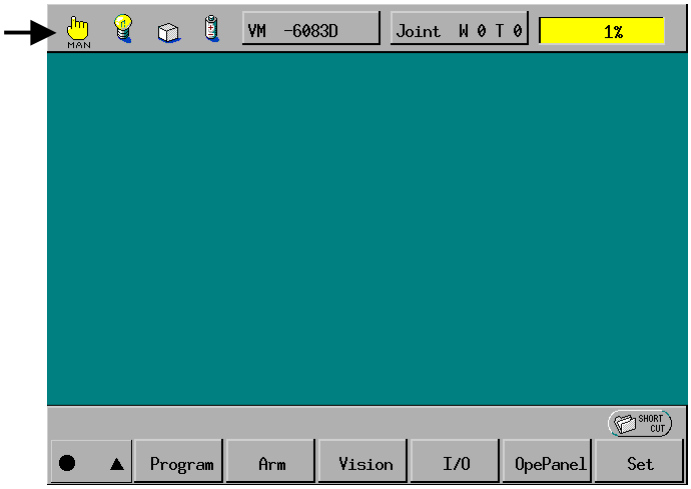
Step 1 On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.

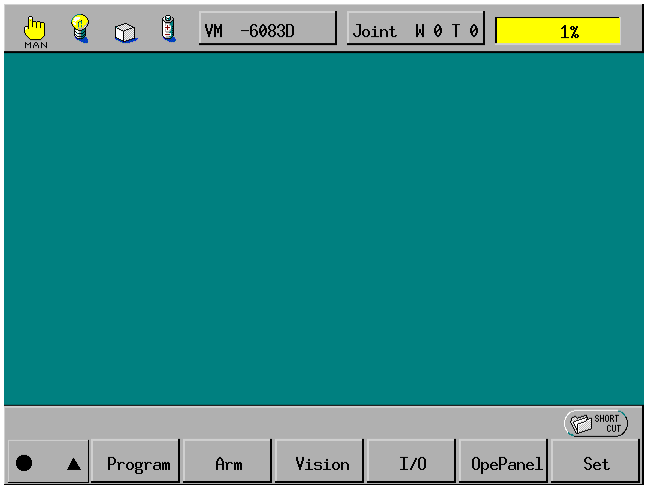


Step 2 Switch the teach pendant to the extended screen.

Step 3 Press the mode icon (the leftmost icon on the status bar) to switch to manual mode.



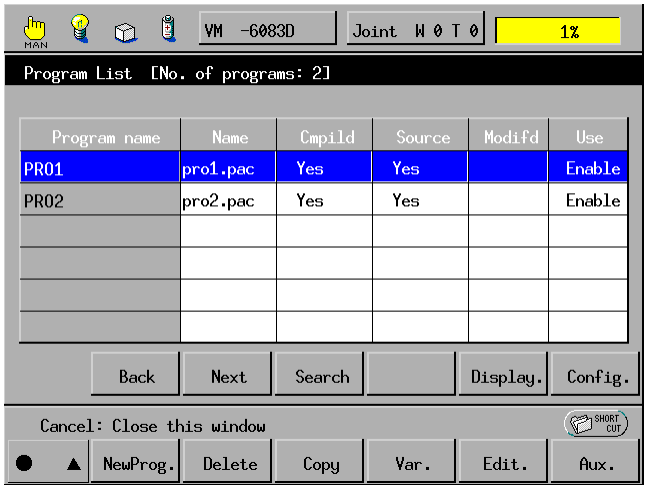
Step 4 Press [Program] on the extended screen.



The Program List window appears as shown in the next step.

Step 5

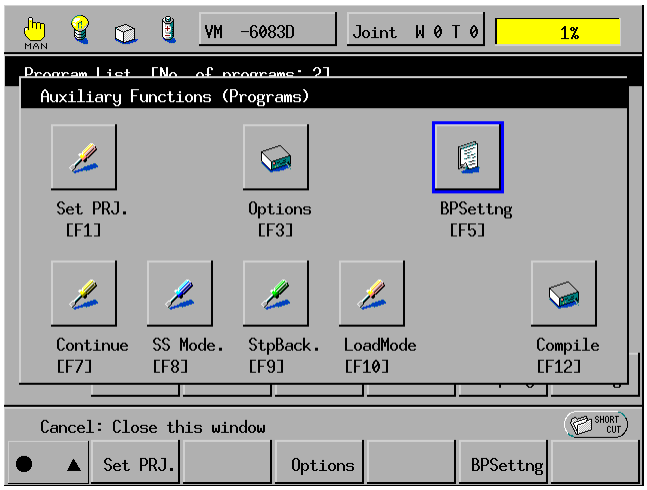
On the Program List window, press [Aux.].



The Auxiliary Functions (Program) window appears as shown in the next step.

Step 6

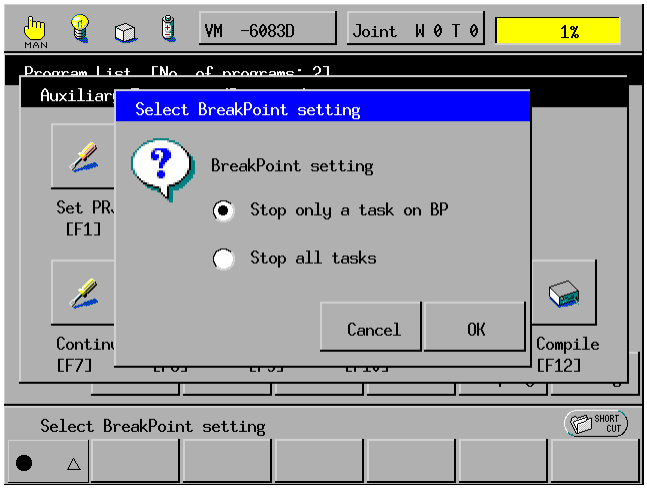
Press [BP Settng].



The Select BreakPoint setting window appears as shown below.

Step 7

Select whether to Stop only a task on BP or to Stop all tasks, then press OK.



Executing BP (break point) stop operations

■ ***Auto mode***

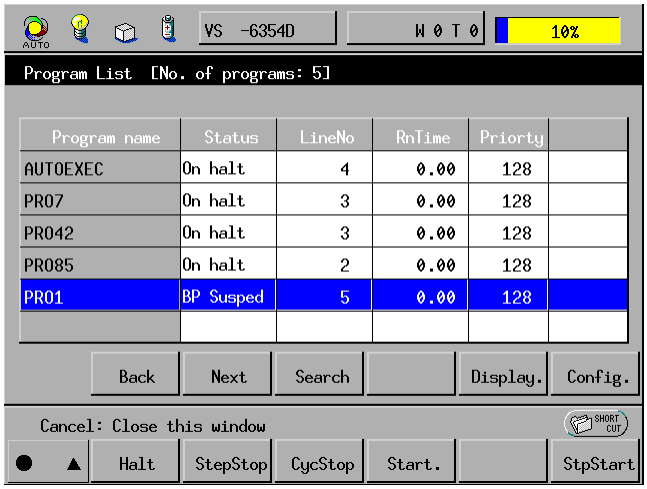
Step 1 Set a BP (break point) in the desired step.

For the setting procedure, see "Setting a break point" given earlier in this section.

Step 2 Start the program in which the BP (break point) is set.

For the program start procedure, see Section 3.3.1 "Running the Robot in Individual Mode."

Step 3 The program will halt at the step where the BP (break point) is set.



Note 1 About Step Start

When the step to be executed after Step Start is the BP Stet Start, the program first Step Stops at that step. After that, if restarted, the program will temporarily stop at the BP step.

■ *Teach check mode*

In teach check mode, there are two types of BP setting display.

Red circle	Step in which you can stop at BP by the BP setting
Gray circle	Step in which there is BP setting step, however it does not stop at the break point • The command of Step Back is effective for only controlling the robot motion and this step cannot be executed when running any program referring to the historical record of robot motions. • BP step at the time of step back

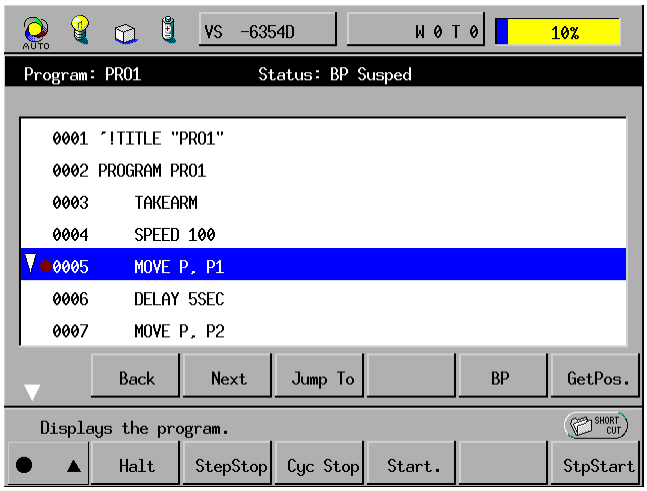
Step 1 Set a BP (break point) in any step.

For the setting procedure, see "Setting a break point" given earlier in this section.

Step 2 Cycle Start the program in which the BP (break point) is set.

For the program start procedure, see Section 3.3.1 "Running the Robot in Individual Mode."

Step 3 The program will halt at the step in which the BP (break point) is set showing the screen shown below.



Note 1 About StepStart

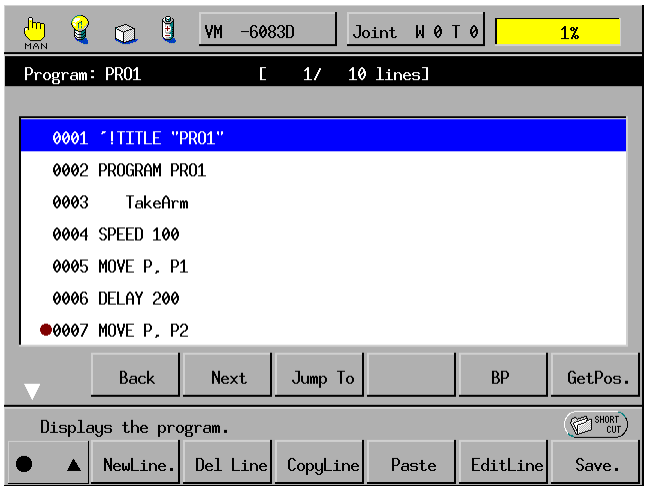
When the step to be executed after StepStarted is the BP-set step, first step stops at the BP-set step. After that, if you restart it, the program temporarily stops at the BP.

Note 2 Any program steps with a gray-circled BP-set will not stop at the BP step after CycleStarted or StepStarted..

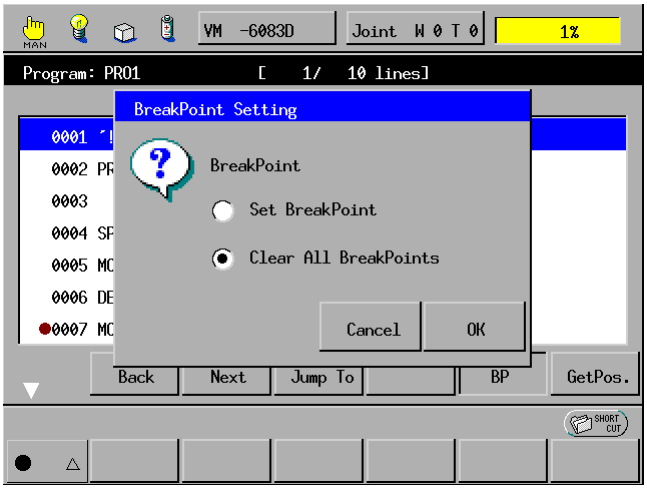
Clearing all break points

Step 1 Choose a program from which you want to clear all break points, following Steps 1 to 5 in "Setting a break point" given earlier in this section.

(You can choose any program.)



Step 2 Press [BP]. The BreakPoint Setting window appears as shown below.



Step 3 Select "Clear All BreakPoints" and press the OK button.

Red circles marked on all break points will disappear and the break points will be cleared.

3.3.6 Local Variable-Related Enhancement

3.3.6.1 Referring To or Writing Into Local Variables

This new local variable-related enhancement allows you to refer to or write into local variables (integer, floating-point, double-precision, vector, position, joint, homogeneous transform matrix, string, and DEFIO variables) in a program.

This function applies only to PAC programs.

This enhancement includes the following variable facilities:

(1) Quick reference

You may immediately refer to local variables defined in a program just by specifying a desired program line.

(2) Referring to registered variables

You may refer to local variables as well as global variables. Use this facility when you cannot designate a program line since the program is running or when you want to refer to variables in more than one program.

(3) Running a program with local variable arguments

You may run a program with local variable arguments independently.

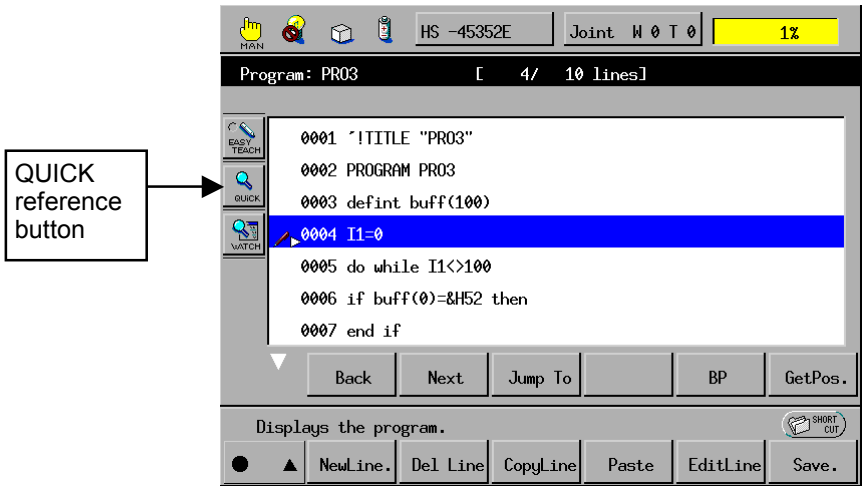
NOTE: This facility will not be supported for a program with array variable arguments, e.g., `PROGRAM SUB1 (li%(10))`.

(4) Referring to or writing into local variables in WINCAPSIII

In WINCAPSIII you may refer to or write into local variables.

3.3.6.2 Quick Reference

You can immediately refer to local variables defined in a program. Specify a desired program line and press the **QUICK** reference button that is newly provided in the coding list window as shown below.

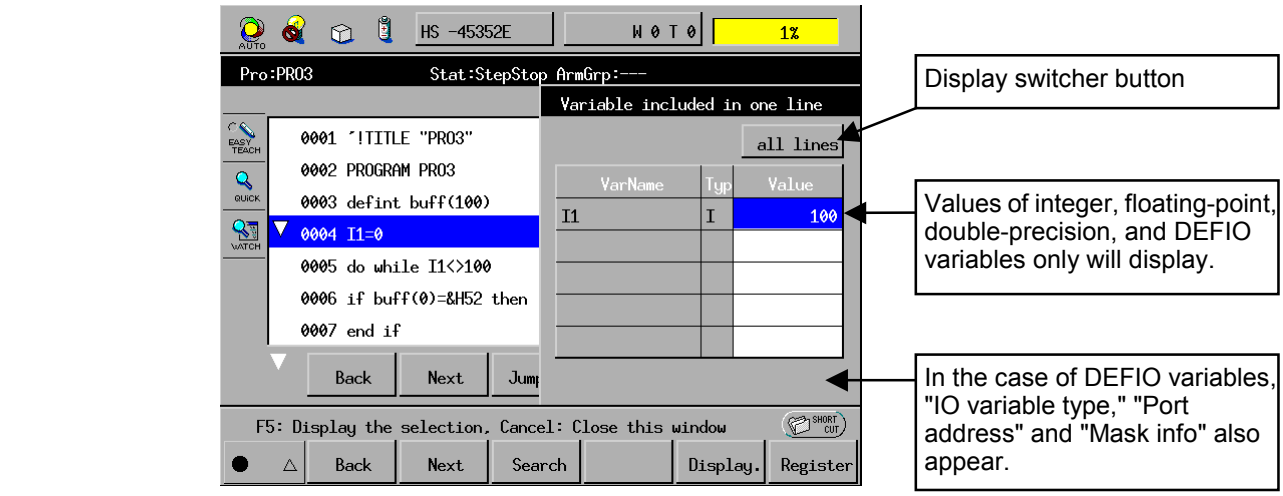


NOTE: Only in manual mode, you can highlight a desired program line or move the cursor to a desired line.

The "Variables included in one line" window (see below) appears where local variables involved in the currently highlighted line and global variables are displayed. The sample window below displays variable "I1" in the STEP STOP program line.

Integer, floating-point, double-precision, or DEFIO variables, if any, will display with their values.

If DEFIO variables are referred to, "IO variable type," "Port address" and "Mask info" also appear.



NOTE 1: If the index of the referred-to variable is out of range (Example 1 below) or not a numerical value (Example 2 below), then the index field of the variable name will show "?."

(Example 1) Although the number of integer variables defined is 200, you attempt to refer to integer variable I201 written in a program line.

(Example 2) You attempt to display a variable with macro name index like `I[slotnum]`.

If the index field shows "?," then no value will display even for integer, floating-point, double-precision, and DEFIO variables. Press the [Display.] and choose the index you want to refer to.

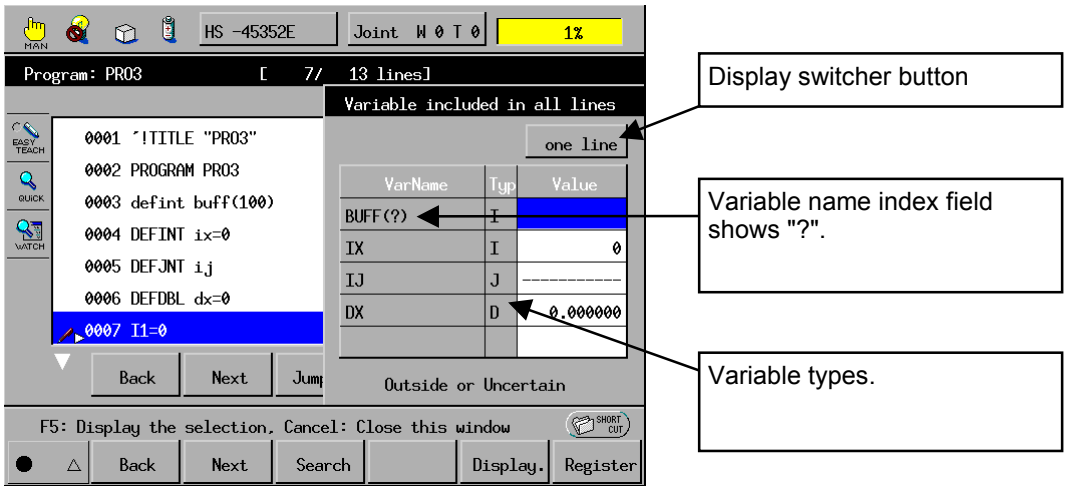
NOTE 2: If the port address of a referred-to DEFIO variable is out of the specified I/O range, then the DEFIO variable will display in gray.

NOTE 3: An array variable assigned to an argument cannot be displayed.

(Example) `PROGRAM SUB1 (li%, li2%(10))`

The `li2` cannot be displayed since the argument is an array variable.

With the display switcher button, you may switch from the "Variables included in one line" to "Variables included in all lines." The sample window below shows variables included in all program lines in the currently selected program.

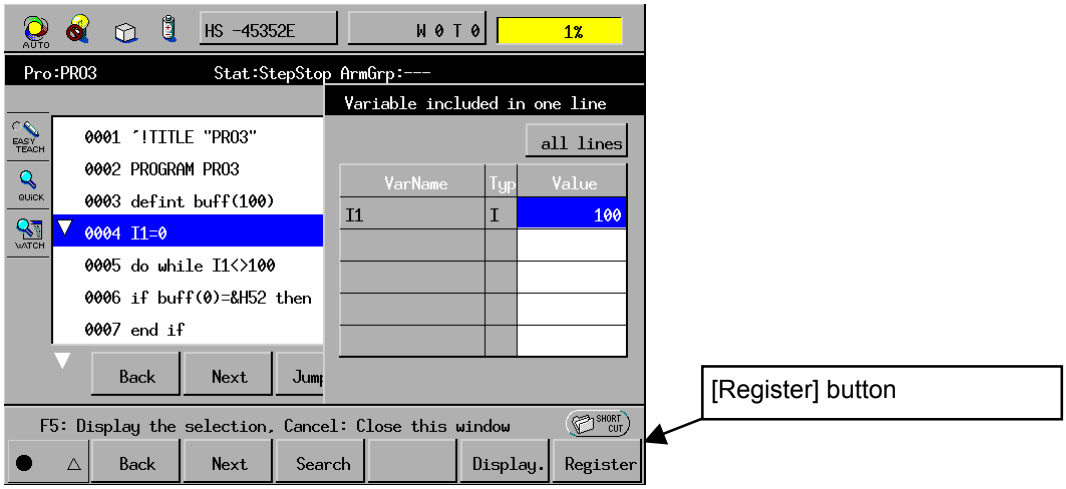


NOTE 1: While the "Variables included in one line" window displays not only local variables but global variables, the "Variables included in all lines" window cannot display global variables.

NOTE 2: In the "Variables included in all lines" window, all array variables will display with "?" in their indexes. Press the [Display] and choose the index you want to refer to.

On this screen, you may register variables by pressing [Register]. It is possible to register a maximum of 50 variables.

TIP: You may refer to those registered variables with the display facility described in Section 2.3.

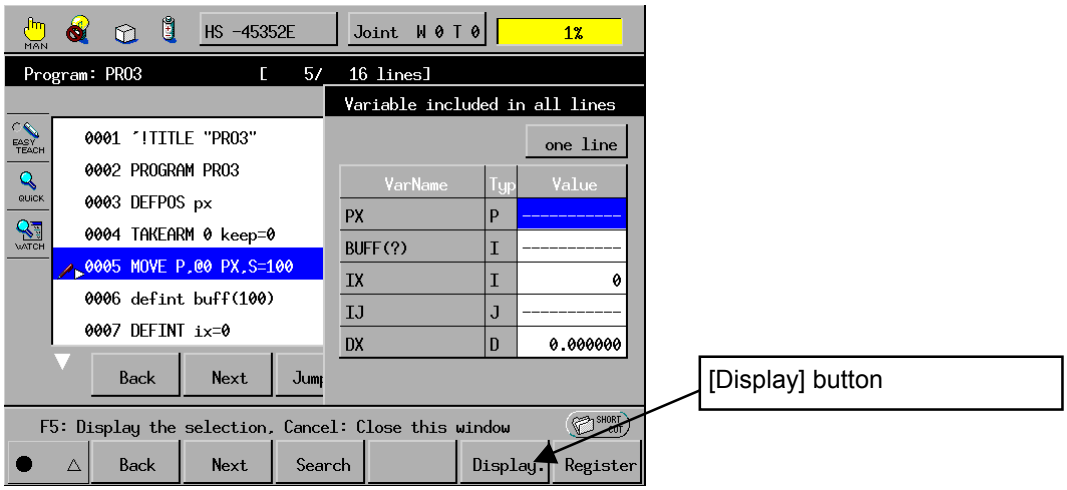


NOTE 1: If the index field of a variable name shows "?" on the above screen, the variable cannot be registered here.

NOTE 2: Any DEFIO variable whose port address is out of the specified range cannot be registered here.

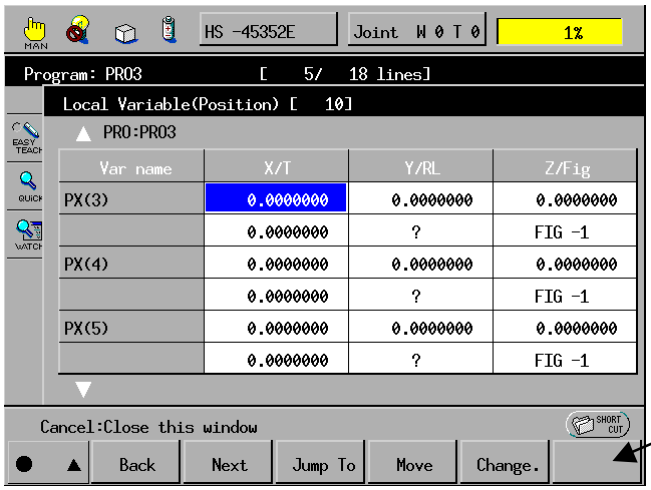
Press [Display] shown below to display the values of the selected variable (see the next page)

NOTE: If you select a DEFIO variable whose port address is out of the specified range, its details cannot be displayed.



The next sample screen shows the values of locally defined position variable PX (3).

On this screen, you may modify the local variable values or replace local variables as well as for global variables. To register the modified variables, press [Register].



Press the Shift button to shift the menu bar and show [Register] button here.

NOTE 1: When a variable's index field is "?," pressing [Display] will display a variable whose index is 0. Move the cursor to that index.

NOTE 2: To modify the current value of a DEFIO variable, you need to hold down either one of the deadman switches, same way as modifying I/Os.

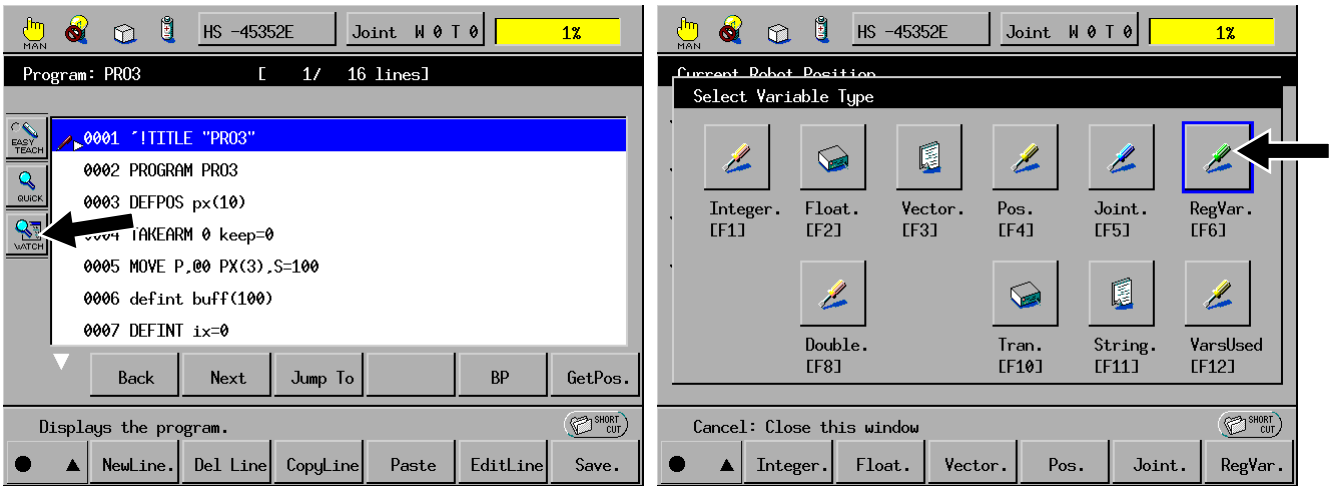
NOTE 3: This quick reference facility cannot take position data into local variables.

3.3.6.3 Referring to Registered Variables

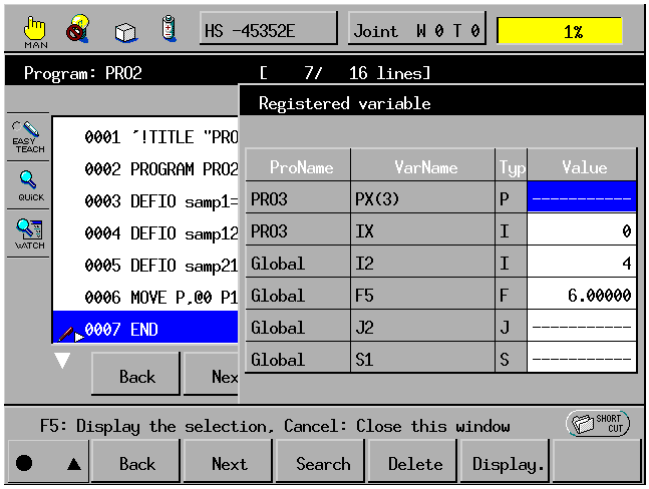
Up to 50 variables can be registered with [Register] in the variable quick reference facility (Section 3.3.6.2) or [Register] on the variable value screen.

You can refer to previously registered variables. Use the variable reference function when you cannot designate a program line since the program is running or when you refer to variables in more than one program.

To call up the registered variables window, press [WATCH] in the coding list window or [RegVar.] in the Select Variable Type window.



The Registered variable list window will appear as shown below.



NOTE 1: Global variables registered will appear as "Global" in the program name column (ProName).

NOTE 2: If the program name, variable name, or the number of dimensions of a registered variable is modified and compiled, then the variable will appear in gray.

NOTE 3: If the program name, variable name, I/O variable type, port address, or mask information of a registered DEFIO variable is modified and compiled, then the DEFIO variable will appear in gray.

Press [Display.], and the values of the selected variable will appear where you may modify those values or replace local variables as well as for global variables.

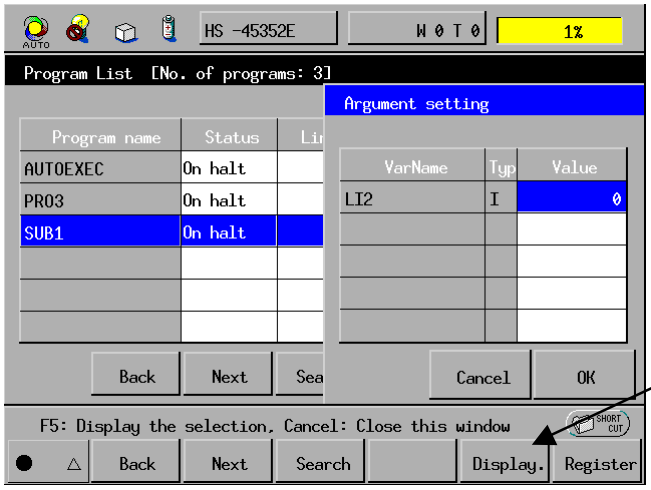
3.3.6.4 Running a Program with Local Variable Arguments

You may run a program containing local variable arguments in stand-alone mode or edit those arguments.

If you attempt to start an on-halt program containing arguments in the Program List screen, the Argument setting window will appear. The sample screen given below will appear if you attempt to start the PROGRAM SUB1 (li%).

NOTE: If a program has an argument containing an array variable, no Argument setting window will appear. Instead, a run-time error will occur with the error message 736F "Cannot start any programs with array argument(s)."

To modify argument values, press [Display.]. After modification, check the new argument values in the Argument setting window and then press [OK].



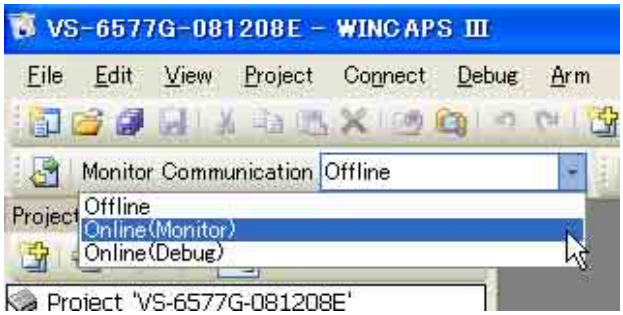
To modify arguments, press [Display]. You can modify it in the same way as for global variables.

As shown below, the same prompting dialog as for ordinary start will appear. After that, the same starting operation as usual will take place.

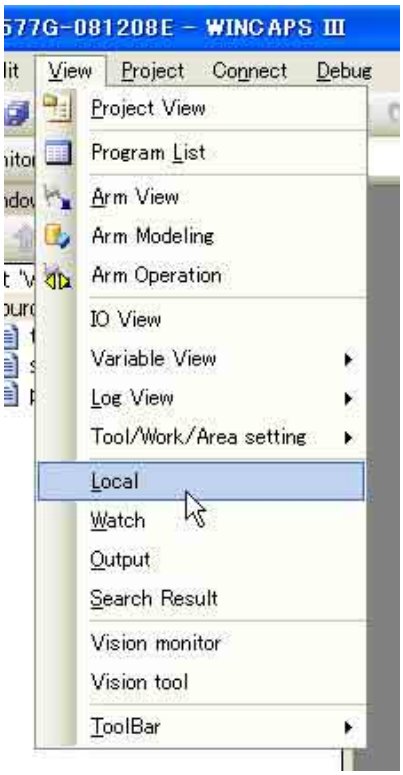
3.3.6.5 Referring To or Writing Into Local Variables in WINCAPSIII

WINCAPSIII refers to or writes into local variables.

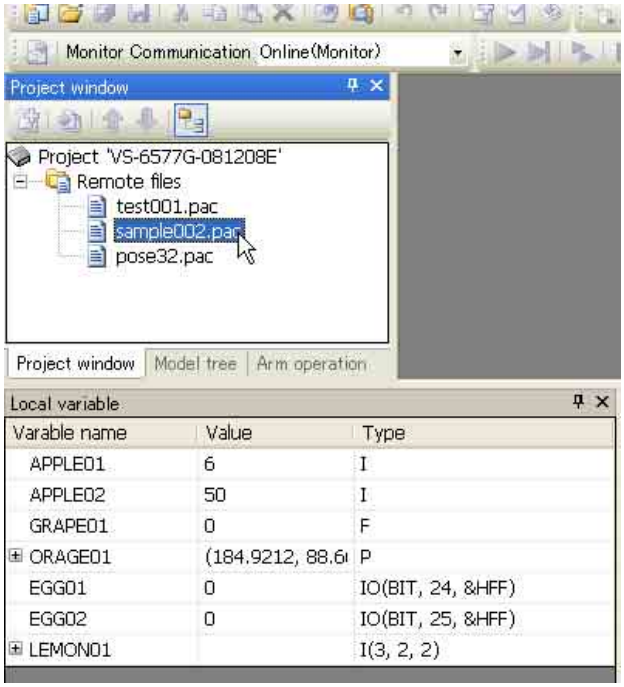
Start WINCAPSIII. Choose Connect | Monitor Communication | Monitoring (online).



Choose View | Locals to display the Local variables window.

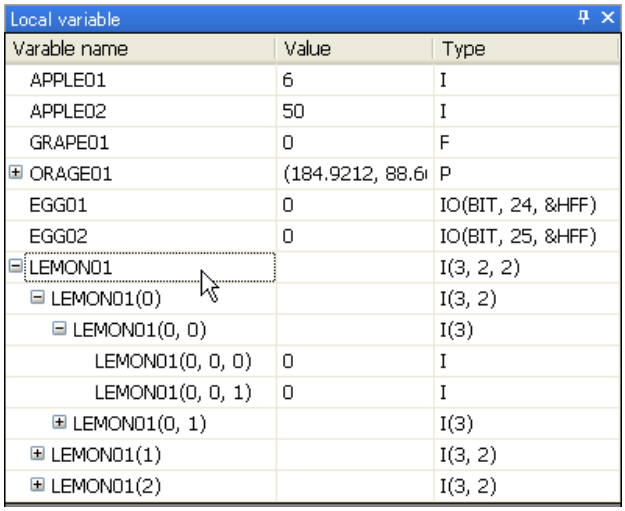


Select a program to display the local variables used in the program, in the Local variables window.



Local variables of type array appear as shown below.

The sample below shows local variables of type array declared with DIM LEMON01%(3,2,2).

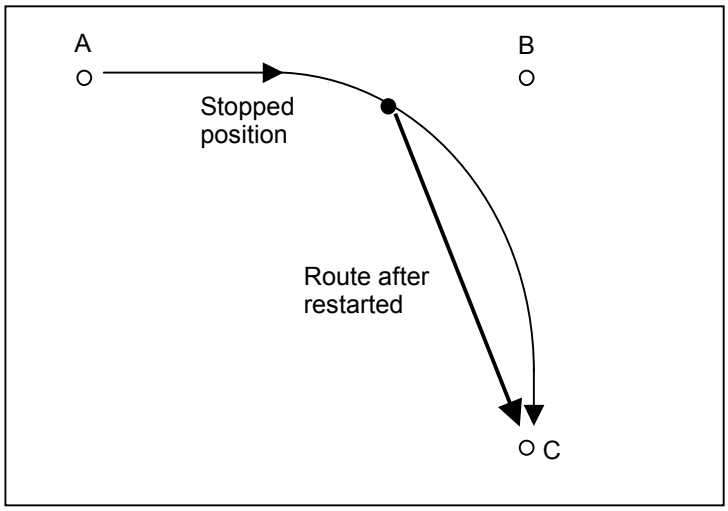


Modify variable values by direct entry to the Value column.

3.3.7 Changing Route in Restarting the Pass Motion

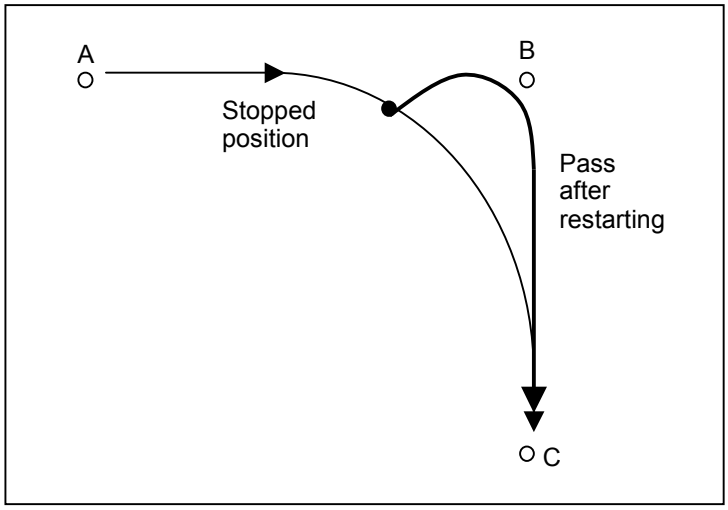
When stopped in the pass motion, for the route for the robot motion after restarting it, you can select one of the following two options.

(1) Move the robot end to the target position after restarting the pass motion without any change.



Pass motion without any change (Traditional)

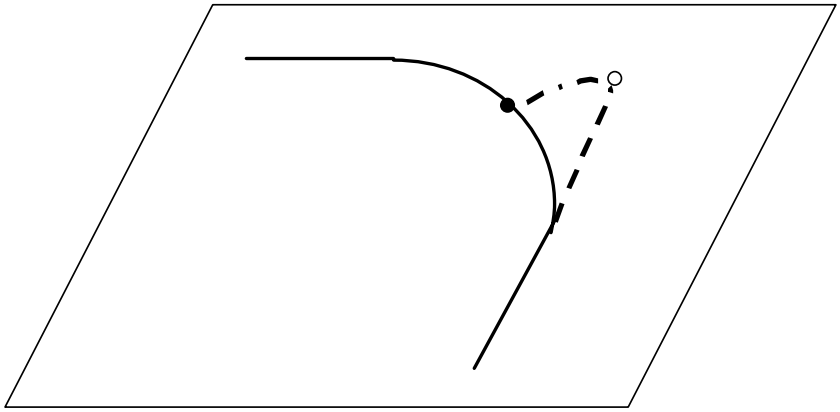
(2) The new feature can execute the pass motion to the target position on the path previously defined (PTP control) or to the target position on the path newly defined after restarting.



New pass motion, added in Version 1.4

Precautions for using the New Feature

(1) In spite of the interpolation method of pass motion command, the movement of robot to the target position before the pass motion, when restarting the robot runs in the PTP control mode. When the movement on the 2 straight lines is considered to be the pass motion, the end of robot moves on the plane, determined by the 2 straight lines, resulting in the route shown by the solid line (as shown in the following figure). When the robot is stopped or restarted during the pass motion, the route becomes the one that is shown by the broken line, however, the end is not moved on the plane, determined by the 2 straight lines, as in the original operation. The end moves on the plane or under the plane, depending on the stopping position. Besides, as the posture of the robot arm is also changed, be sure to run the robot after confirming that there is no interference with any surroundings.



Difference of the robot end route depending on the stop process enabled or disabled

(2) This function will become effective if the specified stop process is performed in the interval within the pass motion started and ended. When restarting, as the robot moves to the target position before pass motion started, the operation returning the robot end to the target position before pass motion started is sometimes performed even when the robot stops near the target position after the pass motion started.

(3) As the movement after restarting becomes the pass motion of the movement to the target position before pass started and movement to the target position after pass started, depending on the stop position, error may occur when restarting and the operation is incomplete.

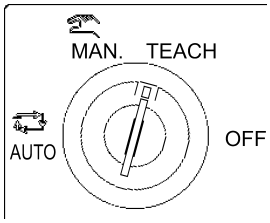
(4) When the pass motion command is Step-run, movement to the target position is not possible even after restarting and the robot will proceed to execute next step of the program.

Changing the robot end route

Perform the operations according to the following procedure. This setting can be made only from the teach pendant.

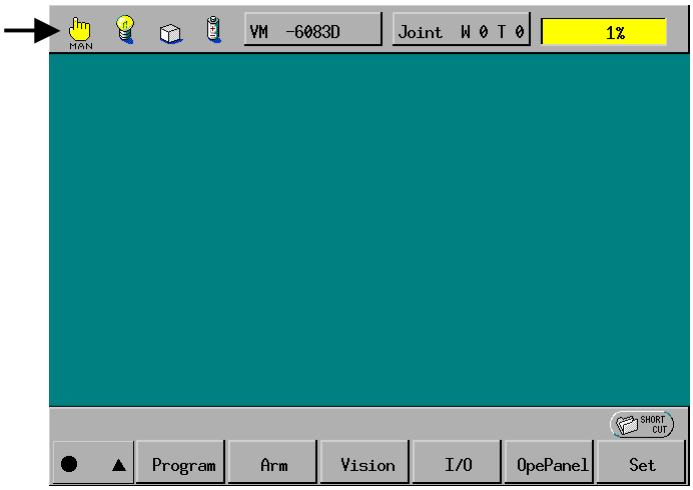
Step 1 On the teach pendant, turn the manual/auto selector switch to the manual position.

On the operation panel, turn the mode selector switch to the TEACH position.

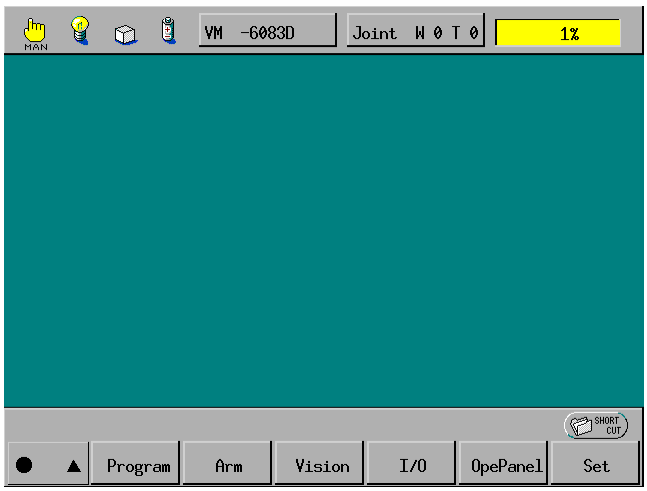


Step 2 Switch the teach pendant to the extended screen.

Step 3 Press the mode icon (the leftmost icon on the status bar) to switch to manual mode.



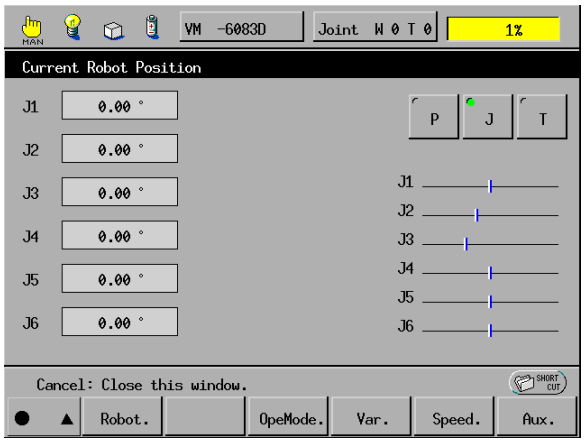
Step 4 Press [Arm] on the extended screen.



The Current Robot Position window appears as shown below.

Step 5

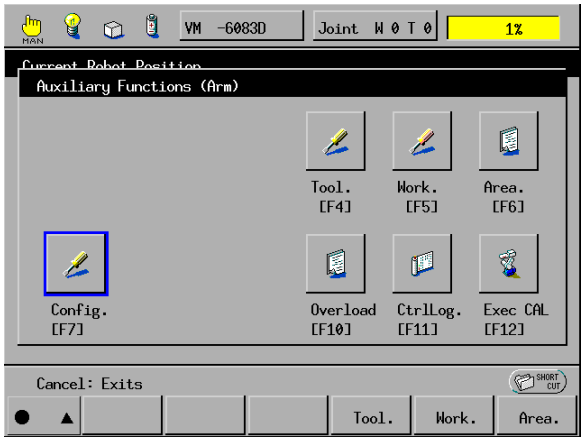
Press [Aux.].



The Auxiliary Functions (Arm) screen appears.

Step 6

Press [Config].



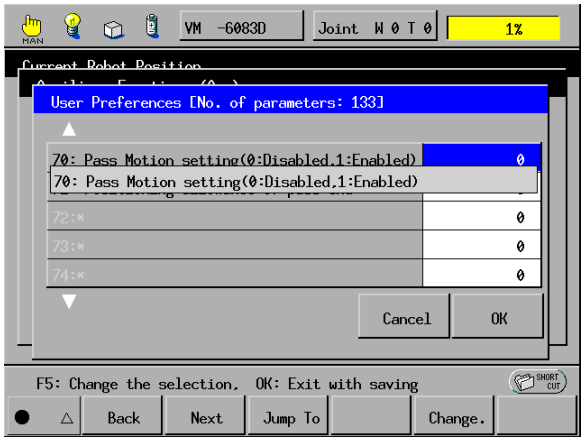
The User Preferences window appears.

Step 7

Select [70: Pass Motion setting (0: Disabled, 1: Enabled)] using [Back] to [Jump To].

The selected line will become highlighted.

Press [Change].



The numerical keypad will appear.

Step 8

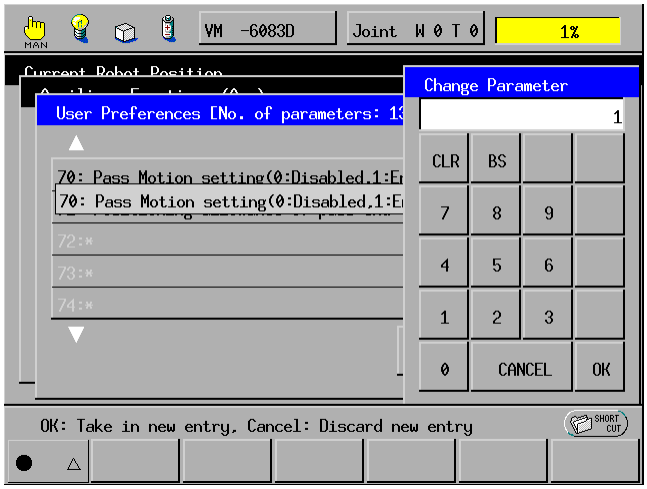
Enter 0 or 1 from the numeric keypad.

If you enter 0, "(1) Move to the target position after starting the pass motion" will be performed; if you enter 1, "(2) Pass motion of movement to the target position before pass start (PTP control) and movement to the target position after pass start" will be performed, as mentioned in the beginning of this section.

To cancel the entered value, press the CLR or BS button.

Confirm the entered value. If it is right, press the OK button to fix it.

If you want to cancel this operation as it is, press the CANCEL button.



The numeric keypad disappears and [70: Pass Motion setting (0: Disabled, 1: Enabled)] is updated by the newly entered value.

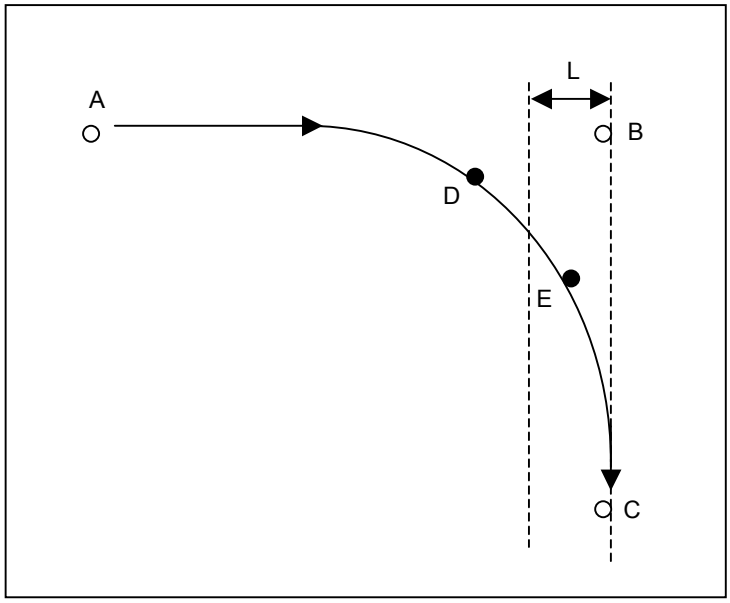
Press the OK button. To cancel the value, press the Cancel button.

The setting procedure is now completed. In further operations, the set movement/motion will be executed.

■ References

At the time of restart, you may switch between the enable and disable of movement to the target position before pass motion start, by setting the [71: Pass Motion End Range]. The [71: Pass Motion End Range] may be set by the distance to the target position.

The setting procedure is the same as the [70: Pass Motion setting (0: Disabled, 1: Enabled)]. Refer to the (1) to (5) process of setup changing method. It becomes enabled when the value to be set is more than 1.



Relation between the movements based on the set distance and stopping position

With [71: Pass Motion End Range] being set to L, if the straight line movement from A to B and from B to C as shown above is considered as a pass motion, then restarting will run the robot to B if the stop position is D. However, if the stop position is E, then the robot will be directly moved to C instead of moving to B.

Notes

The set values are given as an approximate range. They will not the absolute position.

Even changing those values will sometimes bring no actual operation, depending upon the current running speed or the interpolation method.

3.3.8 Supervisory Task (Software PLC)

3.3.8.1 Outline of Supervisory Task

System software version 1.7 newly supports a supervisory task (programmable logic control software (software PLC)). This enables the robot controller to centralize control of an entire facility.

If defined as a supervisory task, a task program written in PAC can keep running independently of normal task programs and operation modes. You may define ten supervisory tasks (TSR0.PAC to TSR31.PAC) and operate them with the system software version 1.7 or later. It is useful to define programs described below as supervisory tasks.

For safety, names of supervisory tasks are restricted to TSR0.PAC to TSR31.PAC and any motion-control programs are prohibited in supervisory tasks.

Note: [Ver. 2.2 or later] Enhancement by the folder feature added

(1) The folder feature newly added enables supervisory tasks having the same name to coexist in a robot controller, as long as those tasks are located in individual folders.

The function and operation of supervisory tasks are the same as those in the previous system version, except that the number of supervisory tasks allowed is changed from 10 to 32 (TSR0 to TSR31).

(2) Up to 32 supervisory tasks can run simultaneously independent of normal task programs. If more than 32 supervisory tasks are made active simultaneously, the error "7799: The maximum number of TSR was exceeded." occurs, terminating all programs including supervisory tasks.

Use the following as supervisory tasks:

(1) Customizing operation screens on the teach pendant, which can contain up to 500 buttons and 50 screens (Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 13.5 "Customizing TP Operation Screens.")

(2) Writing programs for automatic recovery process to be followed if an error occurs in facilities or robots

(3) Controlling facilities (As an alternative of sequencer for facility scale of 200 I/O points and approx. 100 steps in a rudder command)

Supervisory tasks feature:

(1) Written in PAC language. (Up to 32 programs may be defined and their names. are fixed to TSR0.PAC to TSR31.PAC.)

(2) Arithmetic/logical operation commands, I/O get commands, program control commands only executable.

(3) Highest priority (101) over all other normal task programs (whose priority will be automatically changed to 102 or more)

(4) Limited occupation time frame (Uses 2 ms every 8 ms).

Supervisory task start condition parameters

(1) Supervisory task enable/disable parameter

"Not Use Supervisor TASK" or "Use Supervisor TASK" in the Supervisor TASK Setting window

(2) INIT run mode parameter, whether or not to involve motor on and CAL

"INIT:(not [MOTOR ON + CAL])" or "INIT:(MOTOR ON + CAL)" in the INIT Setting window

(3) Speed parameter (10 or 100) for INIT run mode

"INIT Set SPEED 10" or "INIT Set SPEED 100" in the INIT Setting (SPEED) window

Starting supervisory tasks

Supervisory tasks may be started by any of the following operations or events provided that:

- the supervisory task mode has been enabled (by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window) and
- any supervisory task program (TSR0 to TSR31) exists.

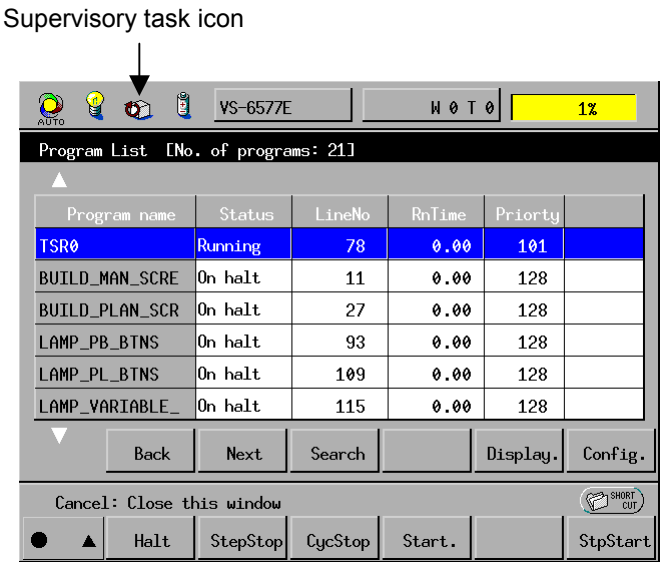
(1) Turning the robot controller on

(2) Switching the operation mode from Manual to Auto

(3) Pressing the [START] in the Supervisor TASK Setting window

(4) Selecting and starting a supervisory task in the Program List window in Individual/Auto mode

If a supervisory task is initiated, the supervisory task icon will appear in the task bar as shown below.



Terminating supervisory tasks

Supervisory tasks will terminate if any of the following events occurs:

(1) Turning the robot controller off
(2) Pressing the [STOP] in the Supervisor TASK Setting window
(3) Loading or compiling a project
(4) Error in a supervisory task itself
(5) Level 4 error or higher one
(6) Reading or writing from/onto a USB flash memory drive
(7) Receiving a file from WINCAPSIII
(8) Making the supervisory task mode inactive to delete it from optional features

Supervisory task commands

(1) `INIT` (Initialize the robot controller)

This command may turn the motor power on and execute CAL depending upon the INIT run mode setting. For details about INIT command, refer to the PROGRAMMER'S MANUAL (I) (T03).

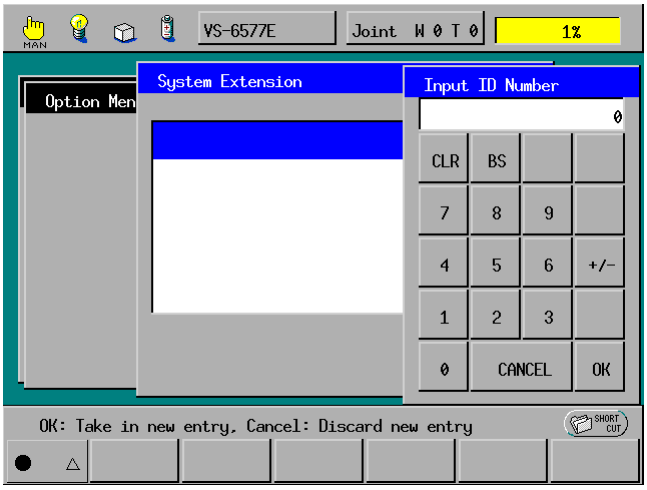
3.3.8.2 Using Supervisory Tasks

[1] Making the supervisory task mode active

The supervisory task mode is an optional feature, so you need to make it active on the extended screen according to the procedure given below.

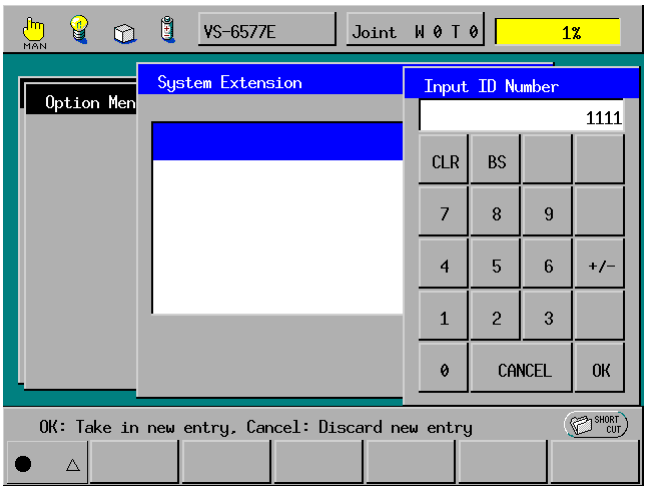
(1) Calling up the System Extension window

Access: [ExtScrn]—[Set]—[Options.]—[Extnsion]—[Input ID] from the top screen of the teach pendant

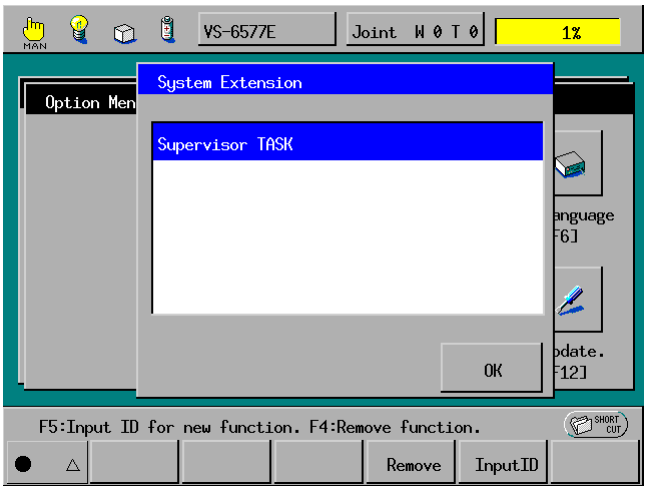


(2) Adding a supervisory task mode

Enter "1111" from the numeric keypad.



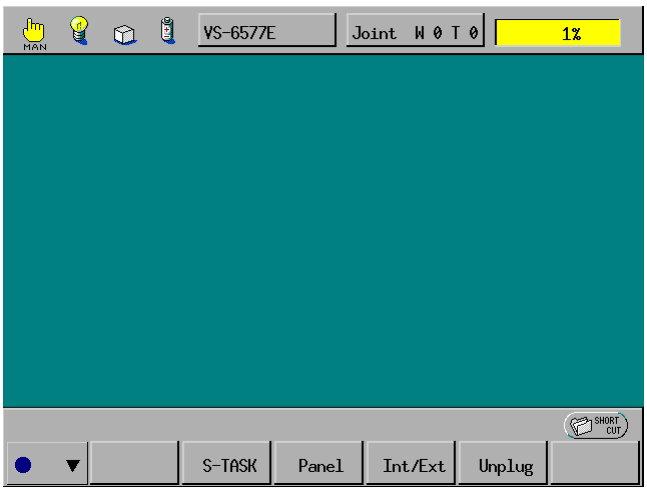
Press the OK button. The supervisory task mode will be added.



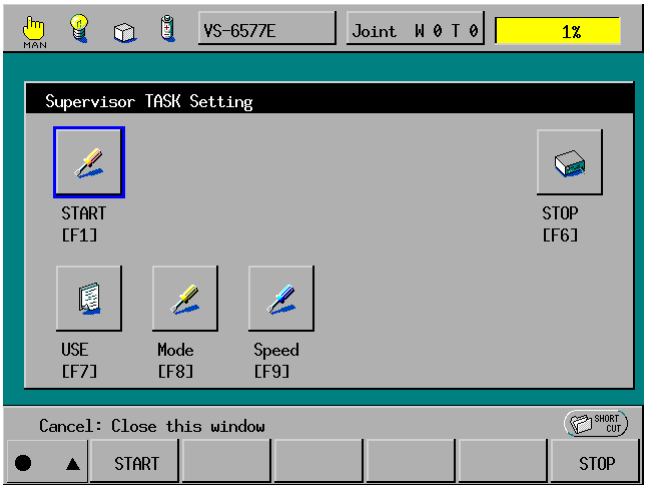
(3) Restarting the robot controller

Turn the controller off and then on. The supervisory task mode becomes active and you may make supervisory task settings.

On the extended screen, press the SHIFT key and check that the S-TASK is displayed in the menu bar.



Press [S-TASK]. The Supervisor TASK Setting window appears as shown below.



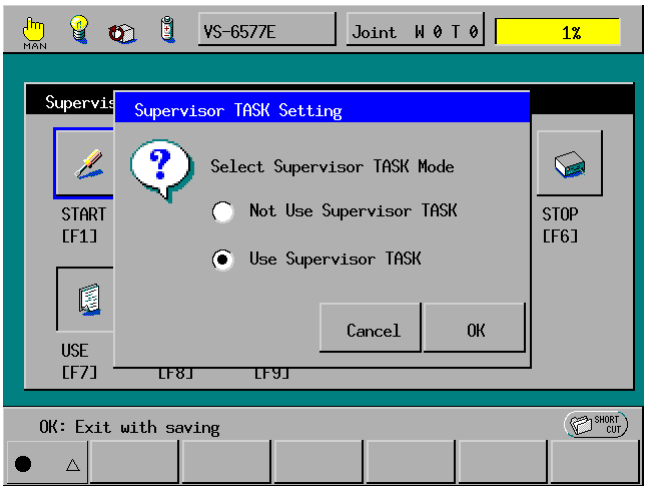
[2] Setting supervisory task parameters

(1) Supervisory task enable/disable parameter

This parameter enables or disables the supervisory task mode.

Access: [S-TASK]—[USE] from the extended screen of the teach pendant

In the Supervisor TASK Setting window shown below, choose the desired setting and press the OK. To make no change, press the Cancel.

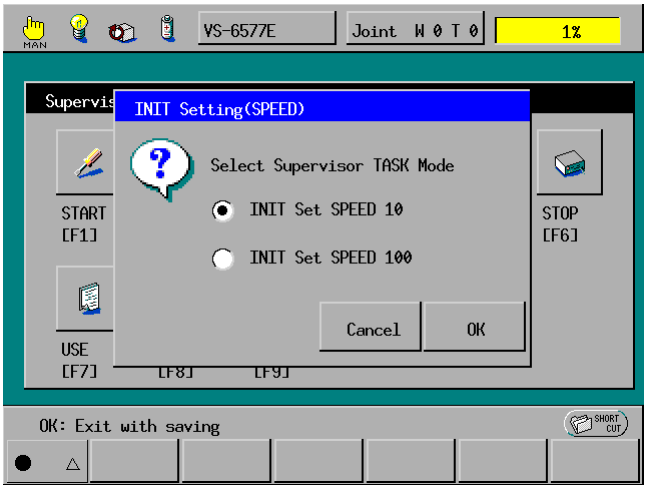


(2) INIT playback speed parameter

This parameter determines whether the speed will be 10 or 100 at execution of INIT command.

Access: [S-TASK]—[Speed] from the extended screen of the teach pendant

In the INIT Setting (SPEED) window shown below, choose the desired setting and press the OK. To make no change, press the Cancel.



[3] Starting supervisory tasks

Turn the robot controller on.

Supervisory tasks will start automatically provided that:

- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR31) exists.

NOTE: Under the above conditions, supervisory tasks will be started even in Teach mode.

To start no supervisory task, turn the controller on while holding down either one of the deadman switches.

Switch the operation mode from Teach to Individual/Auto mode with the teach pendant.

Supervisory tasks will start automatically provided that:

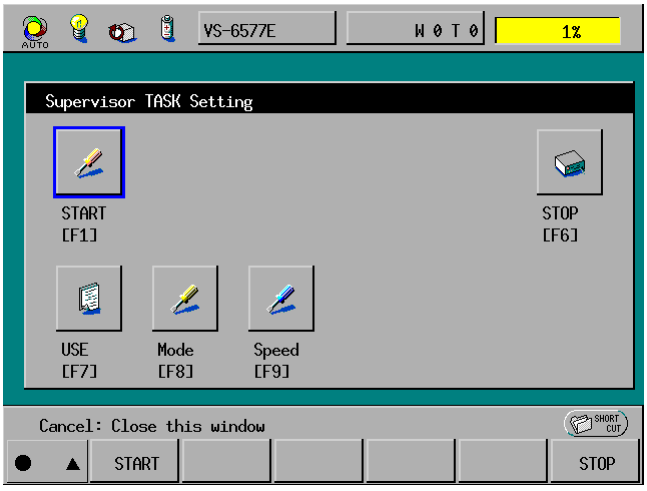
- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR31) exists.

NOTE: Switching to Individual/Auto mode with Robot Error Clear signal will also start supervisory tasks.

Press the START button in the Supervisor TASK Setting window.

From the top screen of the teach pendant, choose [ExtScrn]—[S-TASK]—[START] under the following conditions:

- the supervisory task mode has been enabled by selecting the "Use Supervisor TASK" in the Supervisory TASK Setting window and
- any supervisory task program (TSR0 to TSR31) exists.



Select and start a supervisory task in the Program List window in Auto mode.

From the Program List window, choose a desired supervisory task program(s) (TSR0 to TSR31) and start it, provided that any supervisory task program(s) exists.

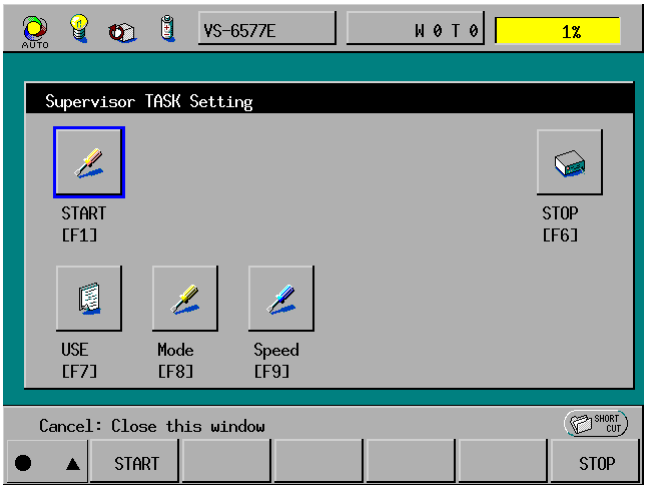
[4] Terminating supervisory tasks

If any of the following operations takes place or any of the following errors occurs when a supervisory task program is running, then the supervisory task will terminate.

Turn the robot controller off

Press the STOP button in the Supervisor TASK Setting window

Access: [S-TASK]—[STOP] from the extended screen of the teach pendant



Load or compile a project

Access: [Set]—[Load!] from the extended screen of the teach pendant

or

Access: [Program]—[Aux.]—[Compile] from the extended screen of the teach pendant in Teach mode

Error in a supervisory task itself

If any error occurs in a supervisory task itself, the supervisory task currently running will terminate.

Level 4 error or higher one

If an error at level 4 or above occurs in supervisory tasks, normal tasks, or robot controller system, then the supervisory task currently running will terminate.

Read or write from/onto a USB flash memory drive

Reading data stored in a USB flash memory drive to the robot controller or writing data stored in the robot controller to a USB flash memory drive will terminate the currently running supervisory task.

Access: [Set]—[USB.]—[Read.] from the extended screen of the teach pendant

Access: [Set]—[USB.]—[Write.] from the extended screen of the teach pendant

Receive a file from WINCAPSIII

Receiving an execution file or parameters from WINCAPSIII will terminate the supervisory task currently running.

Make the supervisory task mode inactive to delete it from optional features

Access: [Set]—[Options.]—[Extnsion]—[Remove] from the extended screen of the teach pendant

Note that the supervisory task setting remains enabled.

3.3.8.3 Restrictions on the Use of Supervisory Tasks

The purpose of a supervisory task is to centralize control of an entire facility. It involves placing some restrictions on the use of it.

[1] Restrictions on the normal program operation

(1) No motion commands or vision commands are executable in a supervisory task. To execute those commands, make a user program containing them and run it as a supervisory task.

(2) A supervisory task may support robot stop and start commands, but not support Temporary stop, Instantaneous stop, Step stop, or Break point stop. It also ignores the SUSPEND command.

(3) If you want to start a supervisory task only when the robot controller is turned on, then use internal I/Os to bypass the overlapped initiation of the supervisory task.

(4) If a supervisory task is started by any other supervisory task, then no priority options or cycle options are supported. This means that these supervisory tasks may conflict with each other.

(5) A supervisory task is so designed that it cannot be self-started repeatedly. To repeat it, use loop commands.

(6) A supervisory task does not support Check GO/BACK.

(7) A HOLD command for a supervisory task will be ignored.

(8) A normal task cannot manage any supervisory task by using KILL or SUSPEND command or other means.

(9) During execution of a supervisory task, you may make vision board settings. However, it may block the operation of the supervisory task.

(10) If an error occurs or an emergency stop signal is inputted, a supervisory task cannot run any normal task.

[2] Rules for using a supervisory task

(1) Avoid using the following commands in a loop to repeat them in a supervisory task. Otherwise, the supervisory task itself may not terminate. This is because a supervisory task has higher priority over normal task programs.

INIT, RUN, KILL, SUSPEND commands

(2) Avoid simultaneous execution of RUN and SUSPEND commands or that of RUN and KILL commands to a same program in a supervisory task. Doing so may freeze the robot system, skip a Stop command, or cause any other failures. To recover from such states, you need to restart the robot controller.

(3) If a semaphore (priority order) is specified in a supervisory task, there is a possibility that a lower priority task may get a semaphore. This is because using a semaphore may cause a supervisory task to lose highest priority 101.

(4) If a supervisory task that repeats normal tasks runs, then mode switching from the external equipment may become no longer possible.

To recover from such states, stop the supervisory task from the teach pendant.

To prevent such states,

- design programs so that they will conditionally start according to Individual/Auto mode, or
- design a supervisory task itself so that it will be terminated from external input.

Starting a user program during switching to Individual/Auto mode may issue an alarm. Correct the program so that it will conditionally start according to the mode, just as above.

[3] Rules for a supervisory task mode not in use

When a supervisory task mode is not in use, programs named TSR0 to TSR31 execute as normal task programs. To debug supervisory task programs, therefore, disable a supervisory task mode and use the Break Point function.

3.3.9 Supervisory Task Extension

Conventional supervisory tasks are designed to terminate if Level 4 error or higher one occurs.

The supervisory task extension prevents supervisory tasks from terminating if Level 4 error occurs except memory errors (errors 7000s).

3.3.9.1 What is a supervisory task extension?

On some occasions, e.g., when the robot controller is controlled by external equipment in RS232C communication, the robot controller is required to operate independently to some extent.

The solution is to use a supervisory task. However, current supervisory tasks will terminate if Level 4 error or higher one occurs so that the communication will stop and the external equipment will no longer monitor the controller status.

To prevent it, the supervisory task extension limits termination to essential occasions only. If the extension is enabled, supervisory tasks will no longer terminate even if Level 4 error such as a servo error, operation error, or I/O error occurs. They will terminate only if a memory error (error 7000s) occurs.

If Level 5 error occurs, supervisory tasks will terminate as they have been.

The table below lists whether supervisory tasks will terminate or not if the following level errors occur.

Error code		7***	6***	5***	4***	3***	2***	1***
Error level	Level 5	T	T	T			T	T
	Level 4	T	T/R	T/R			T/R	T/R
	Level 3 or lower	R	R	R	R	R	R	R

T: Terminate.

T/R: Keep running if the supervisory task extension is enabled.

R: Keep running.

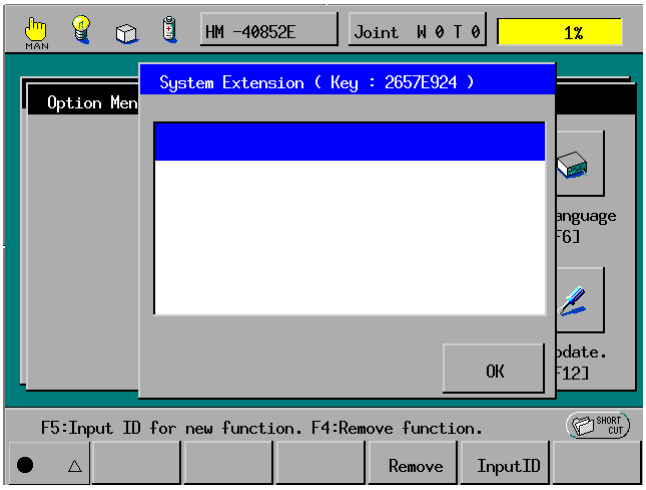
/: Not applicable.

3.3.9.2 Enabling the supervisory task extension

The supervisory task extension is optionally provided. You need to enable the extension from the extended screen of the teach pendant according to the steps given below.

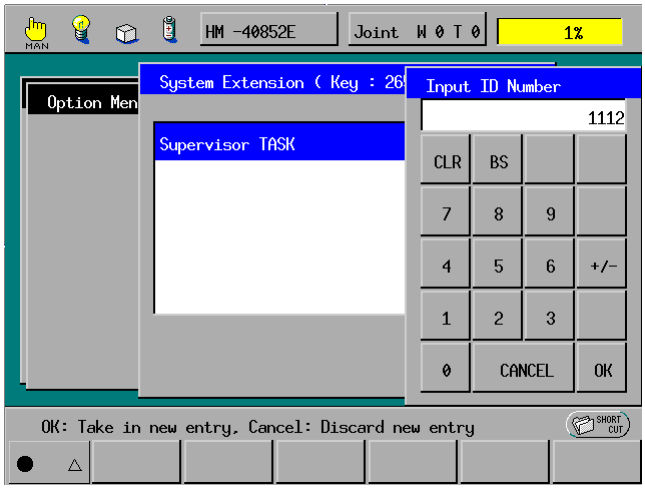
(1) Call up the System Extension window.

Access: [Set]—[Options.]—[Extnsion]

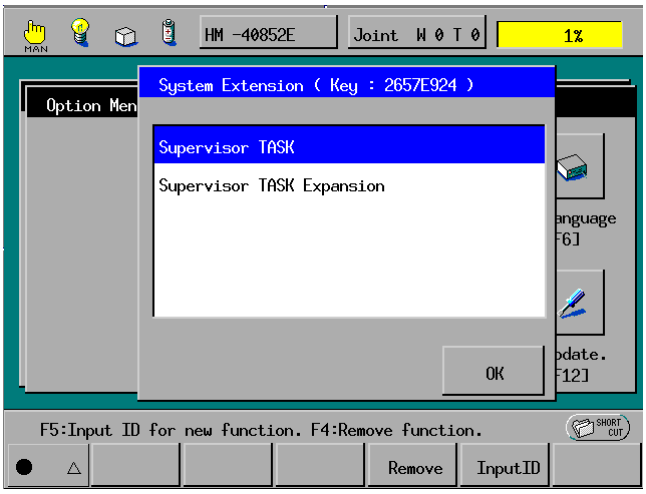


(2) Press [Input ID].

The numeric keypad will appear where you enter the necessary ID code--1111 for conventional supervisory task or 1112 for supervisory task extension.



(3) Press the OK button. Your selection will be saved.



(4) Reboot your robot controller to make the new setting go into effect.

3.3.10 Modification of Processing Time Exclusively Occupied by Supervisory Tasks

This new feature allows you to modify the processing time exclusively occupied by supervisory tasks in a processing cycle (8 ms) to be applied when the supervisory tasks and user tasks (PAC programs) run concurrently (multitasking).

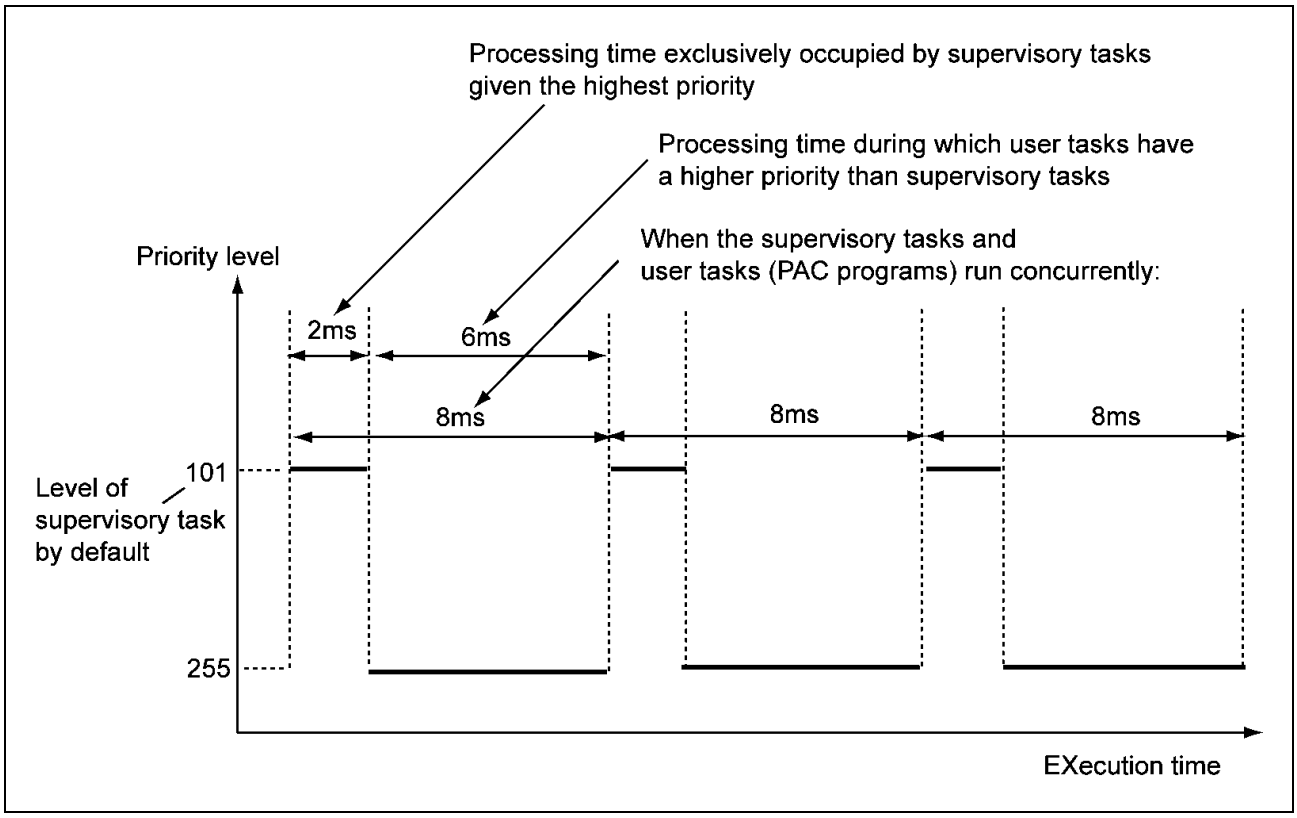
With this feature, you can switch the priority levels between supervisory tasks and user tasks at the desired timing. This makes it possible to assign higher priority to processing of supervisory tasks during particular operation or vice versa.

3.3.10.1 What is the processing time exclusively occupied by supervisory tasks?

As shown below, the task processing cycle of the robot controller is 8 ms that is shared by supervisory tasks and user tasks.

When supervisory tasks and user tasks are running concurrently, the processing time exclusively occupied by supervisory tasks is 2 ms by default (because the supervisory tasks are given the highest priority "101" by default).

During the remaining 6 ms, user tasks have higher priority than supervisory tasks (because user tasks are given higher priority than supervisory tasks by default).



Processing Time Exclusively Occupied by Supervisory Tasks in the Processing Cycle (by default)

3.3.10.2 Choice of processing time periods to be exclusively occupied by supervisory tasks

You can make a choice from the following five processing time periods:

0 ms, 2 ms, 4 ms, 6 ms and 8 ms in an 8 ms task processing cycle

Example: If you select "4 ms," the execution time required for supervisory tasks will be shorter and that for user tasks, longer than ones required by default (2 ms).

Note: If you select "0 ms," supervisory tasks will be processed only when no user tasks are being processed. If there is no free time, no supervisory tasks will be able to be processed.

Note: If you select "8 ms," no user tasks can be processed when any supervisory task is being processed. To process user tasks, you need to insert a process of DELAY or WAIT for getting an arm semaphore in the supervisory tasks.

3.3.10.3 Modifying the processing time exclusively occupied by supervisory tasks

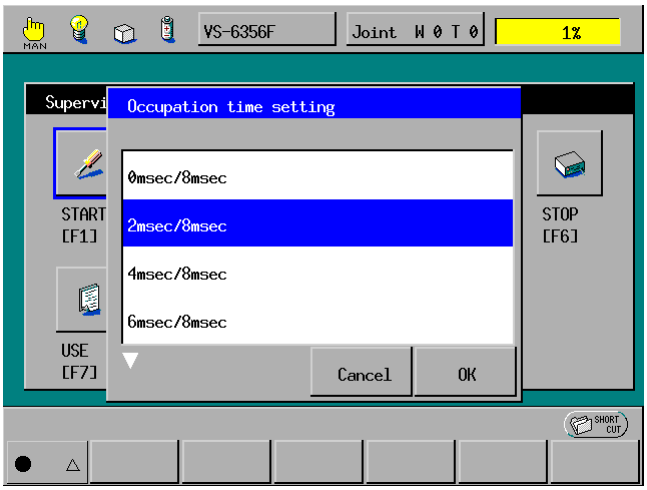
You can modify the processing time to be exclusively occupied by supervisory tasks in PAC programs or with the teach pendant.

This modification can be made even if any supervisory task is executing and it will immediately take effect.

■ *From the teach pendant*

(1) Call up the processing time window (Occupation time setting).
Access: [ExtScrn]—[S-TASK]—[Occupy]

(2) Select the desired processing time and press [OK].



■ *In PAC programs*

Use the `SETOCCUPATIONTIME` command. Refer to the PROGRAMMER'S MANUAL (I) (T03).

Syntax `SETOCCUPATIONTIME <Processing time>`

Coding example
```
SETOCCUPATIONTIME 4      'Set 4 ms/8 ms
```

3.3.11 Supervisory Task Start Mode

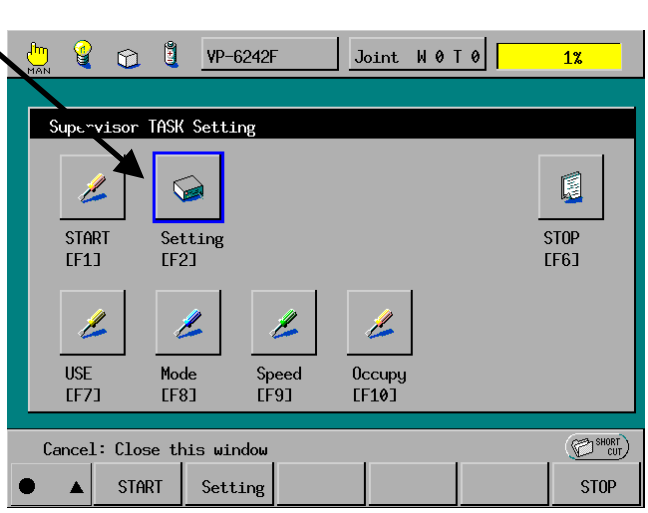
Any of the following events activates supervisory tasks only in the current route.

(1) Turning the controller power on
(2) Switching from Teach mode to Individual/Auto mode
(3) Pressing [S-TASK]–[START]

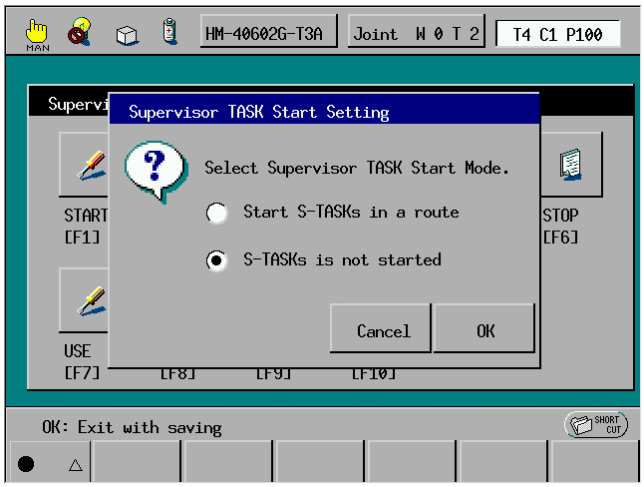
Tip: The folder feature enables supervisory tasks to be stored in a folder.

Tip: In the supervisory task start setting, you can disable the auto activation of supervisory tasks when any of the above three events occurs.

Access: [ExtScrn]—[S-TASK]—[Setting]



The Supervisory Task Start Mode window appears.



- Start S-TASKs in a route: Selecting this starts only supervisory tasks in the current route when any of the above three events occurs.
- S-TASKs is not started: Selecting this starts no supervisory tasks when any of the above three events occurs.

Note: Independent of the current setting of the supervisory task start mode, supervisory tasks can start by selecting them on the Program List or by using a RUN command.

Chapter 4

General Introduction to Coordinates and Figures

This chapter explains the coordinates used for the robot and figures of the shoulder, elbow, and wrist.

NOTE 1: Avoid letting the teach pendant undergo any strong shocks, impacts, or vibrations.

NOTE 2: Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

4.1 Coordinates, Interference Check Area, and Figures in 6-axis Robots

4.1.1 Coordinates

This section describes the coordinates required for correct handling of the robot.

[1] Base coordinates

[1.1] Base (world) coordinates and work coordinates

The base coordinates are so-called world coordinates which refer to 3-dimensional Cartesian coordinates whose origin is at the center of the robot basement. It has components Xb, Yb, and Zb which are identical with X, Y, and Z in X-Y mode explained in Section 3.2.1 "Teaching the Robot," [2] X-Y mode.

Work coordinates are 3-dimensional Cartesian coordinates defined for each operation space of workpiece. The origin can be anywhere and it lies at a corner of the rectangular parallelepiped envelope of an object workpiece as shown below. Work coordinates are expressed by the coordinate origin (X, Y, Z) corresponding to the base coordinates and the angles of rotation (Rx, Ry, Rz) around X, Y and Z axes of base coordinates.

If work coordinates are not defined, base coordinates go into effect.

Work coordinates can be configured only on the extended screen. Once configured, they affect robot motions in X-Y mode even after the controller exits from the extended screen.

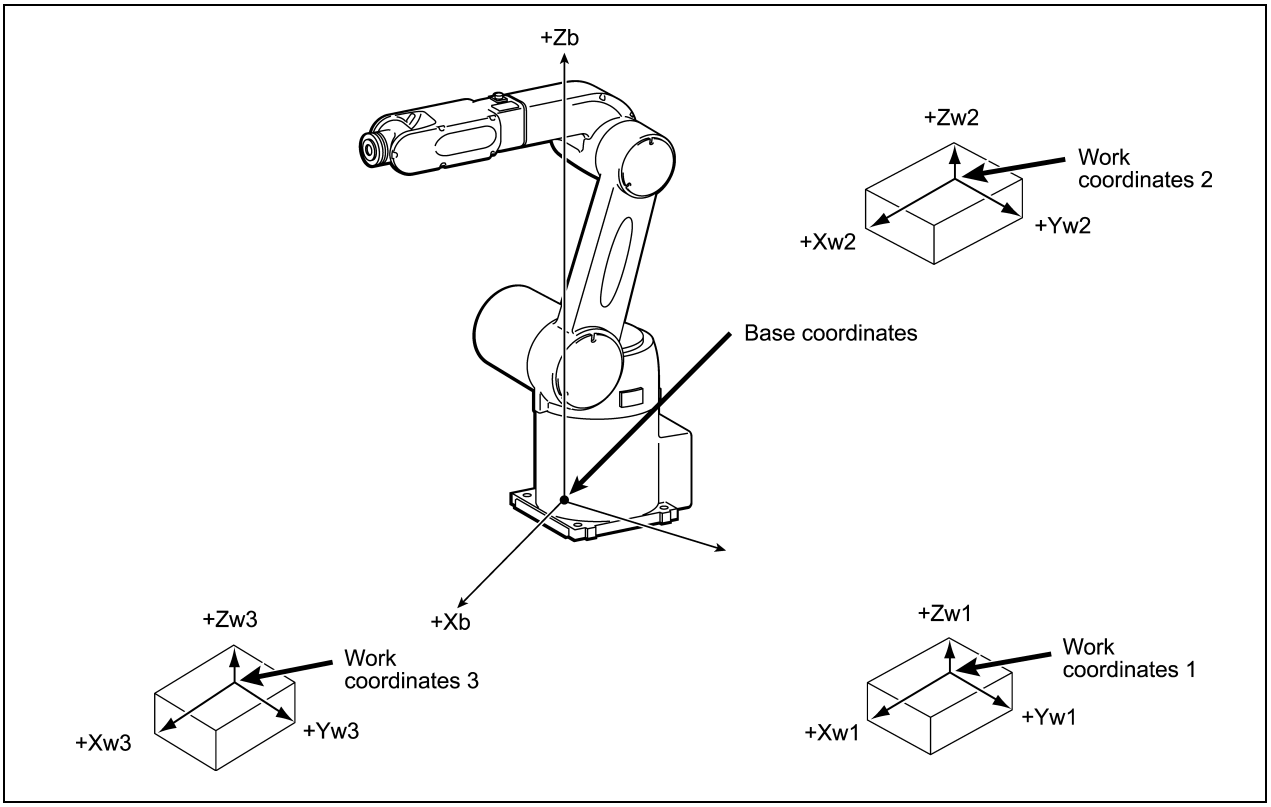


Figure 4-1. Base Coordinates and Work Coordinates

[1.2] Position data

Position data refers to a set of data which includes seven components of base coordinates. Of these seven components, three are robot flange center coordinates (the end-effector tip coordinates if an end-effector is defined) and four are current robot attitude components, as shown below.

Position data allows you to represent the current position of the robot flange center and object points.

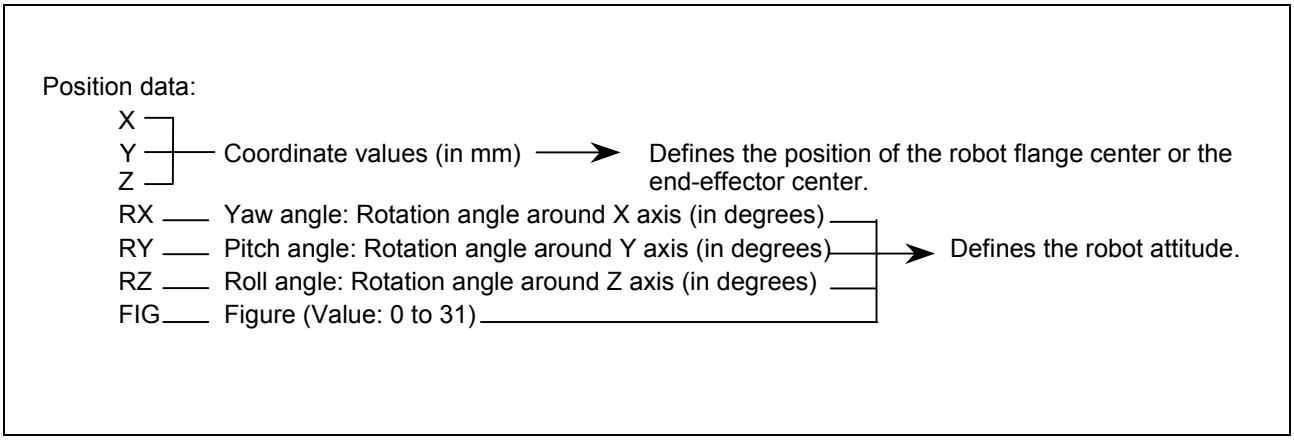


Figure 4-2. Components of Position Data

A set of X, Y, and Z coordinate values represents the position of the robot flange center (or tip of the end-effector if defined) expressed in base coordinates (Xb, Yb, and Zb) in units of mm.

As shown in Figure 4-3, the yaw, pitch, and roll angles, which are expressed by RX, RY, and RZ, refer to rotation angles around the respective axis of Xm, Ym, and Zm defined in mechanical interface coordinates (refer to Section 4.1.1, [2.1]) whose origin is at the center of the flange surface. These angles are expressed in units of degree.

With respect to the positive (+) direction on axes of the base coordinates, clockwise rotation is treated as positive (+).

You should always preserve the rotation order of RZ, RY, and RX. Changing it will cause the robot to take a different attitude in spite of the same rotation angle defined.

Figure represented by FIG value refers to a figure of robot arm joints. It is explained in Section 4.1.3, "Figures of the Shoulder, Elbow, and Wrist."

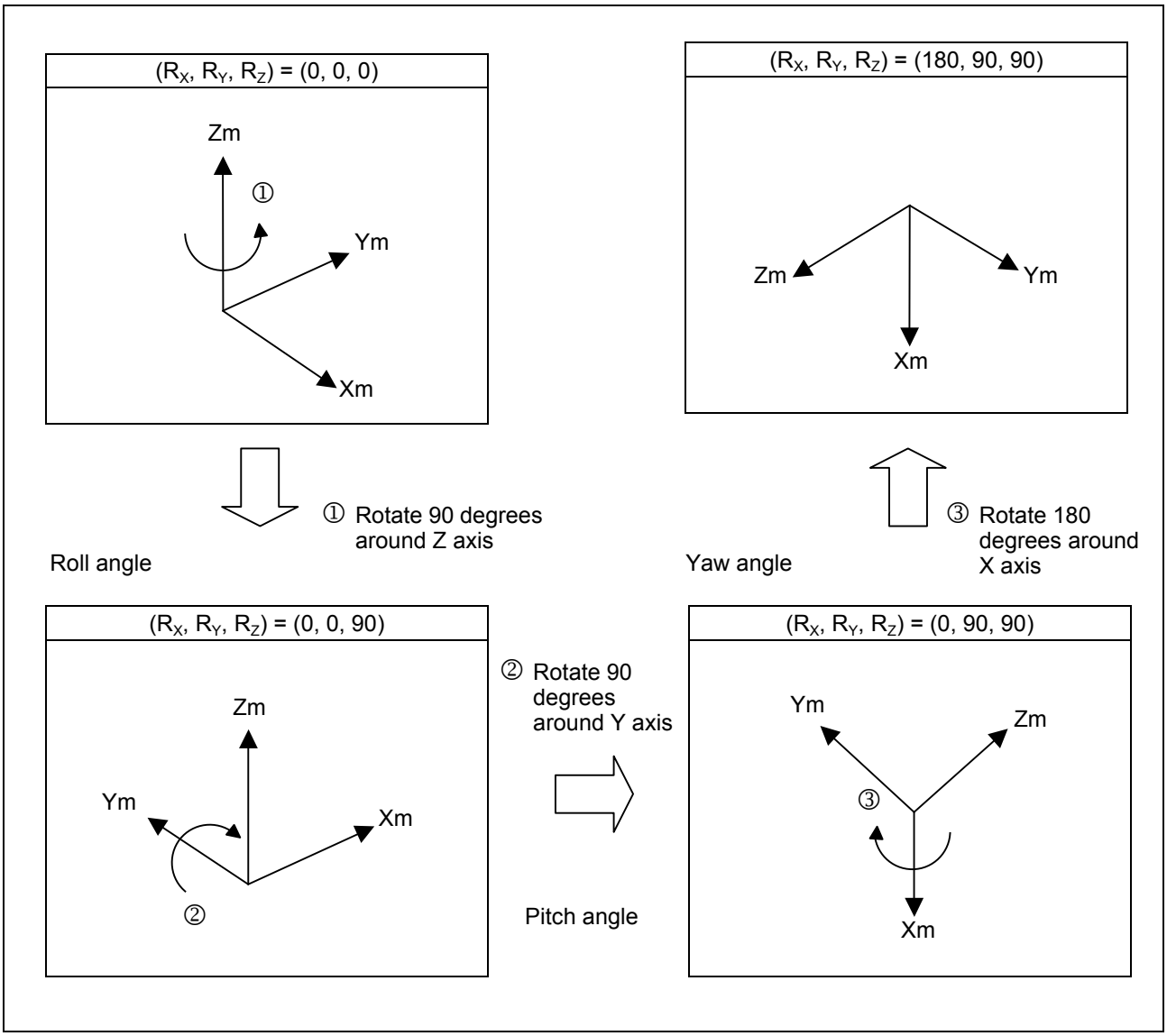


Figure 4-4. Examples of roll, pitch and yaw angle rotation

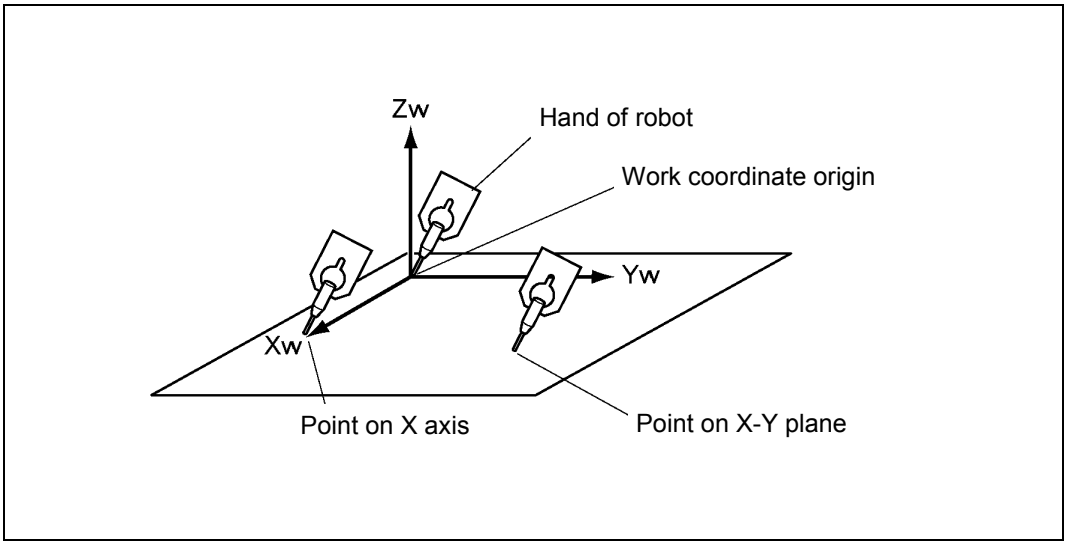
Attitude: (Rx, Ry, Rz) = (0, 0, 0) → (Rx, Ry, Rz) = (180, 90, 90)

[1.3] Defining work coordinates

Two procedures, 3-point teaching and direct value entry, are available for defining work coordinates.

Defining work coordinates by 3-point teaching
[ExtScrn]—[Arm]—[Aux.]—[Work]—[AutoCalc]

In this method coordinates are created by teaching three points, namely, the origin of work coordinates, a point on X-axis and a point on X-Y plane.



Defining work coordinates by direct value entry
[ExtScrn]—[Arm]—[Aux.]—[Work]—[Change.]

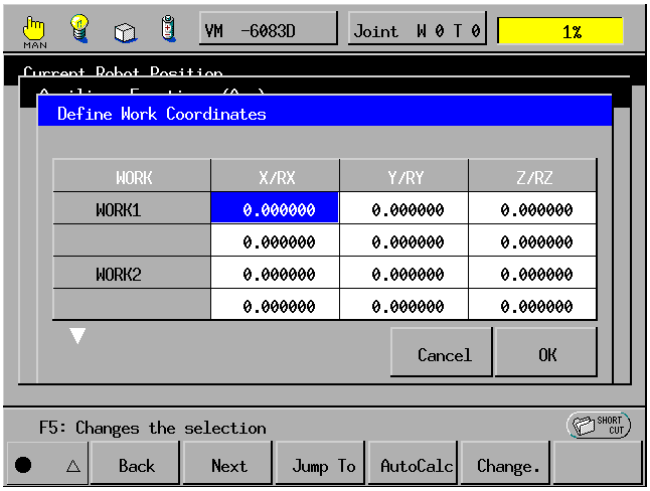
Enter the coordinate origin (X, Y, Z) corresponding to the base coordinates and rotation angles (Rx, Ry, Rz) around the X-axis, Y-axis and Z-axis of base coordinates.

■ Defining work coordinates by 3-point teaching

Step 1 On the extended screen of the teach pendent, press [Arm].

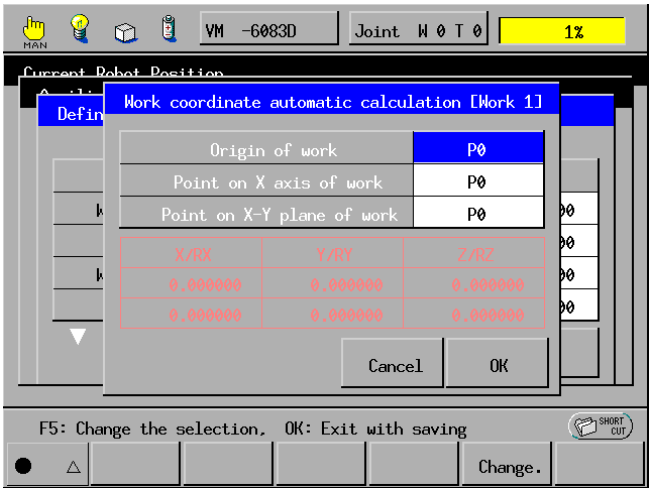
Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 Press [Work] in the Auxiliary Functions (Arm) window.
The Define Work Coordinates window appears as shown below.



Select the coordinates by using the cursor keys, and then press [AutoCalc].

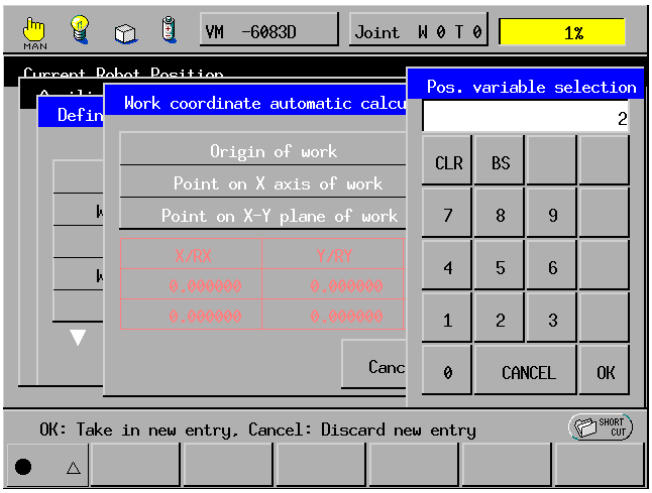
Step 4 The Work coordinate automatic calculation window appears.



To set a desired position variable name to each of the "Origin of work," "Point on X axis of work," and "Point on X-Y plane of work," first choose the "Origin of work" row and press [Change.].

Step 5

The numeric keypad will appear as shown below. Enter a desired position variable name for the "Origin of work" and press the OK button. In the same way, set desired position variable names to the "Point on X axis of work" and "Point on X-Y plane of work."



Step 6

Call up the Position Variables assignment window ([Arm]—[Var.]—[Position.]) shown below.

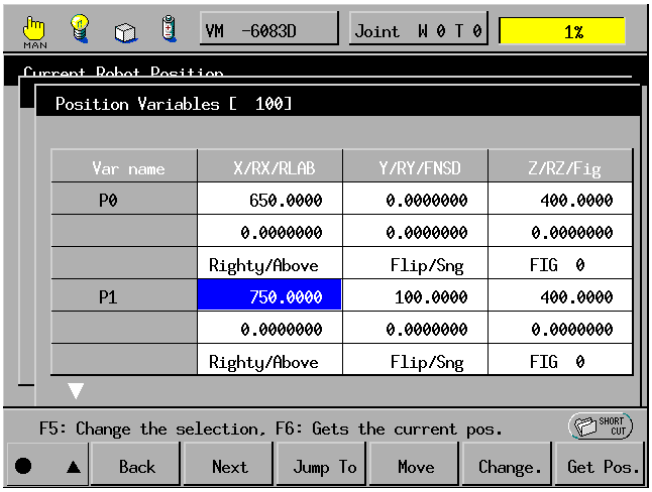
In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the three position variables you have set in Step 5.

(1) Place the cursor on the position variable to which you want to assign the robot arm position value.

(2) In manual mode, move the tool end of the robot arm to the teaching point.

(3) Press [Get Pos.] in order to read in the current position of the tool end to the selected position variable.

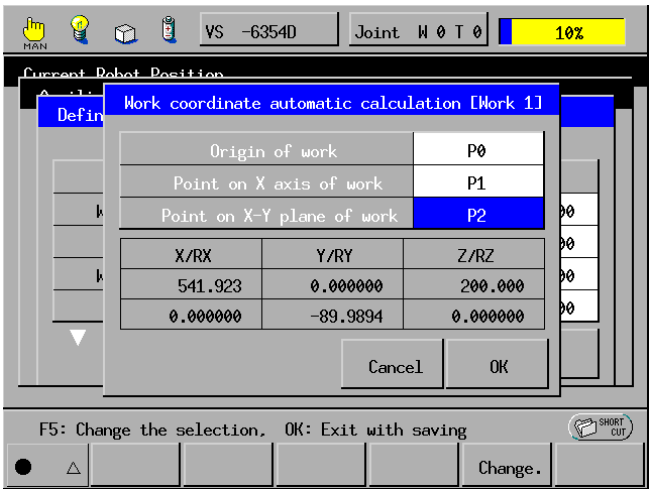
(4) Carry out steps (1) through (3) above for each of the "Origin of work," "Point on X axis of work," and "Point on X-Y plane of work."



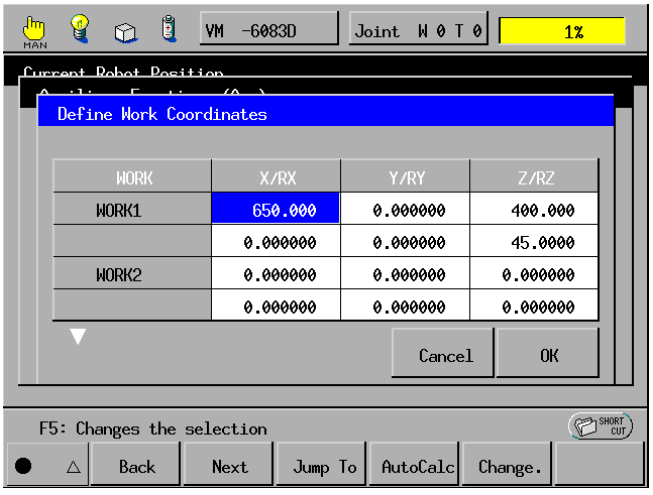
NOTE • Teach the "Origin of work" and "Point on X axis of work" precisely.
• Define work coordinates after establishing the tool definition.

Step 7 Press the Cancel button twice to return to the Work coordinate automatic calculation window.

Step 8 At the bottom of the Work coordinate automatic calculation window, the defined work coordinates are displayed. If they are satisfactory, press the OK button; if not, press the Cancel button.



Step 9 If you press the OK button in Step 8, the defined work coordinates will be entered into the target work number.



■ Defining work coordinates by direct value entry

Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in Current Robot Position window.

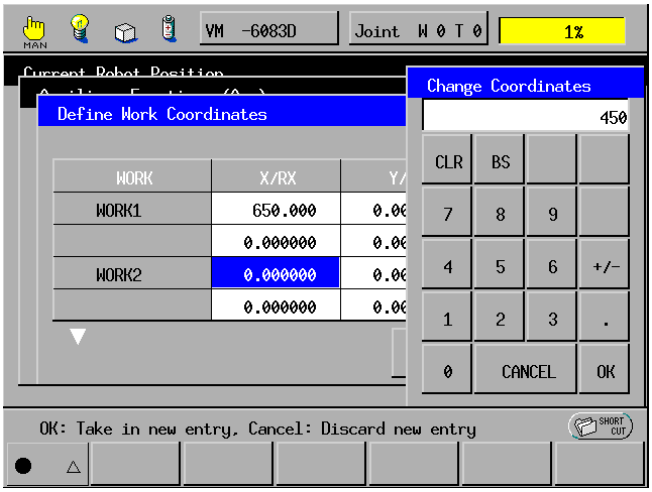
Step 3 Press [Work.] in Auxiliary Functions (Arm) window.

The Define Work Coordinates window appears.

Select the work coordinates to be defined using the cursor keys.

Step 4 Press [Change.] in the Define Work Coordinates window.

The numeric keypad will appear as shown below.



Step 5 Using the numeric keypad, enter the desired numerical values. After checking the entered values, press the OK button.

[2] Tool Coordinates

A 6-axis robot has tool coordinates that make it easy to express the position and moving path of an end-effector mounted on the robot flange.

The tool coordinates are defined based on the mechanical interface coordinates. This section begins with an explanation of the mechanical interface coordinates.

[2.1] Mechanical interface coordinates

The mechanical interface coordinates refers to 3-dimensional Cartesian coordinates whose origin is at the center of the flange surface as shown in Figure 4-5. X, Y, and Z axes in mechanical coordinates are expressed as Xm, Ym, and Zm as shown in Figure 4-5.

The Xm, Ym, and Zm are identical with X, Y, and Z in Tool mode explained in Section 3.2.1, "Running the Robot Manually," [3] Tool Mode."

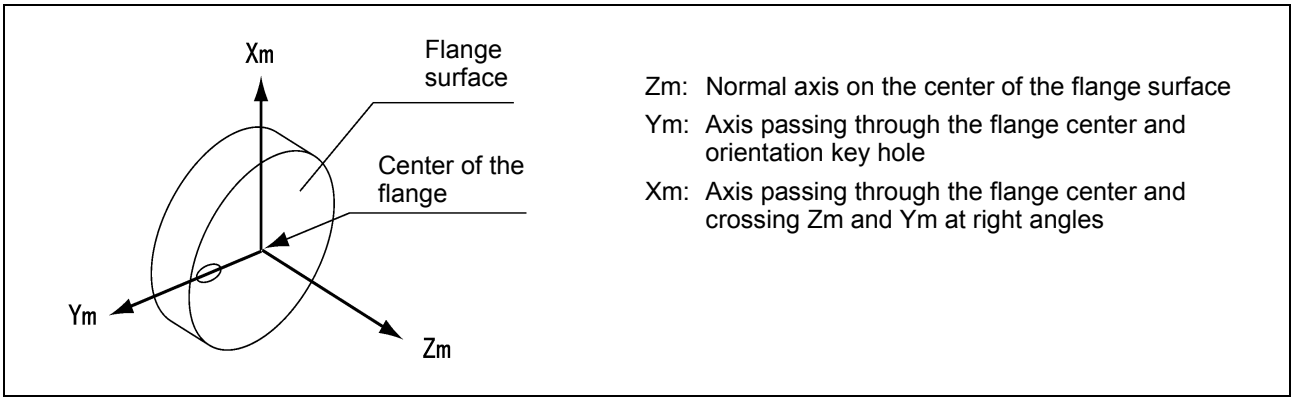


Figure 4-5. Definition of Mechanical Interface Coordinates

Unlike the work coordinates or base coordinates, the mechanical interface coordinates rotate as the robot flange rotates.

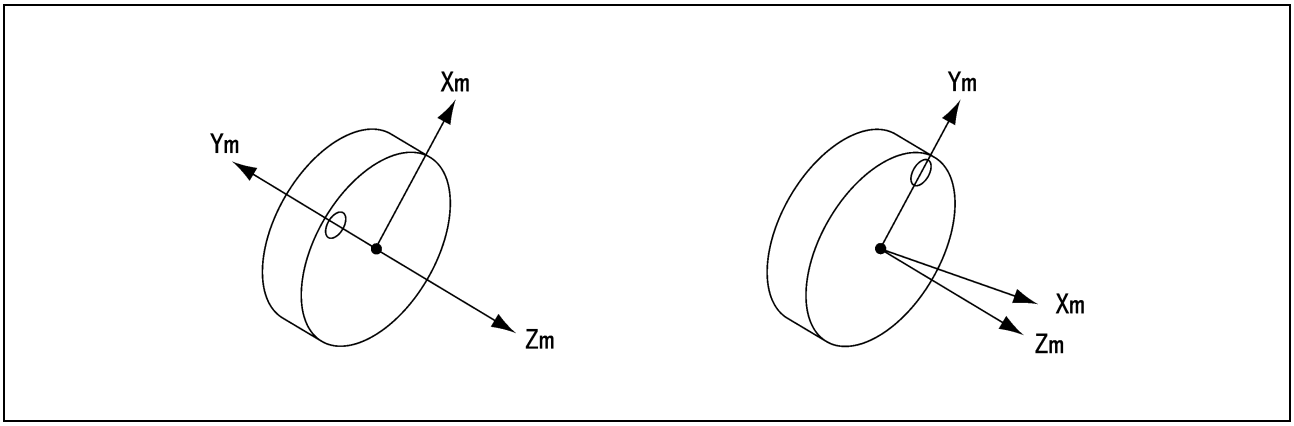


Figure 4-6. Rotation of Mechanical Interface Coordinates Following the Flange Rotation

[2.2] Difference in robot motion when driven in mechanical interface coordinates and base coordinates

In manual mode, if you choose Tool mode and TOOL0 (Flange) on the teach pendant, the robot will run in mechanical interface coordinates. If you choose X-Y mode, WORK0 (Base) will be automatically selected so that the robot will run in base coordinates.

For details about TOOL0, refer to [2.5] in this section.

Figures 4-7 and 4-8 show the differences in robot motion when the robot is driven in mechanical interface coordinates and base coordinates, by using the X, Y, and Z keys and by using the RX, RY, and RZ keys, respectively.

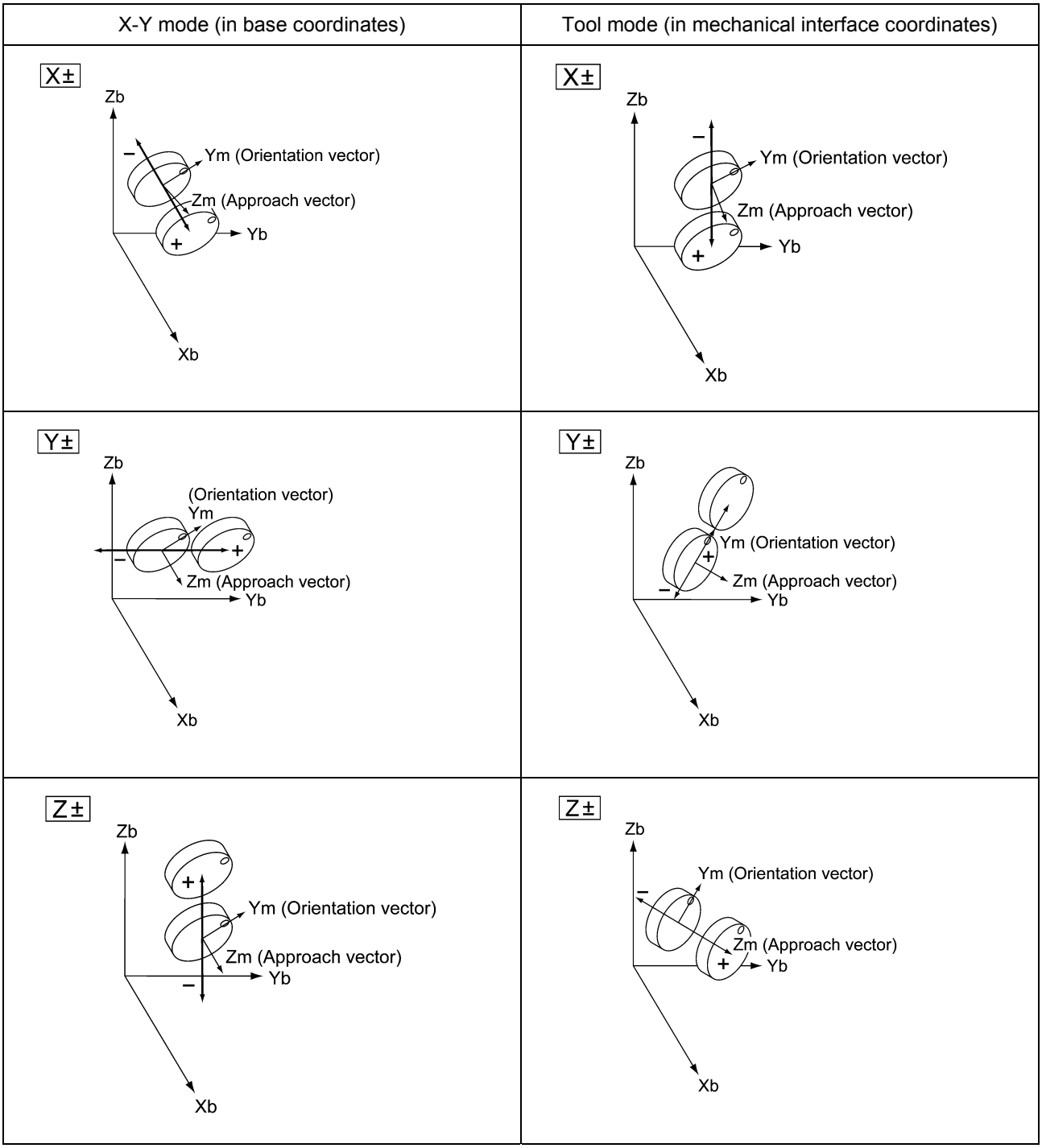


Figure 4-7. Robot Motion Manually Driven by X, Y, and Z Keys

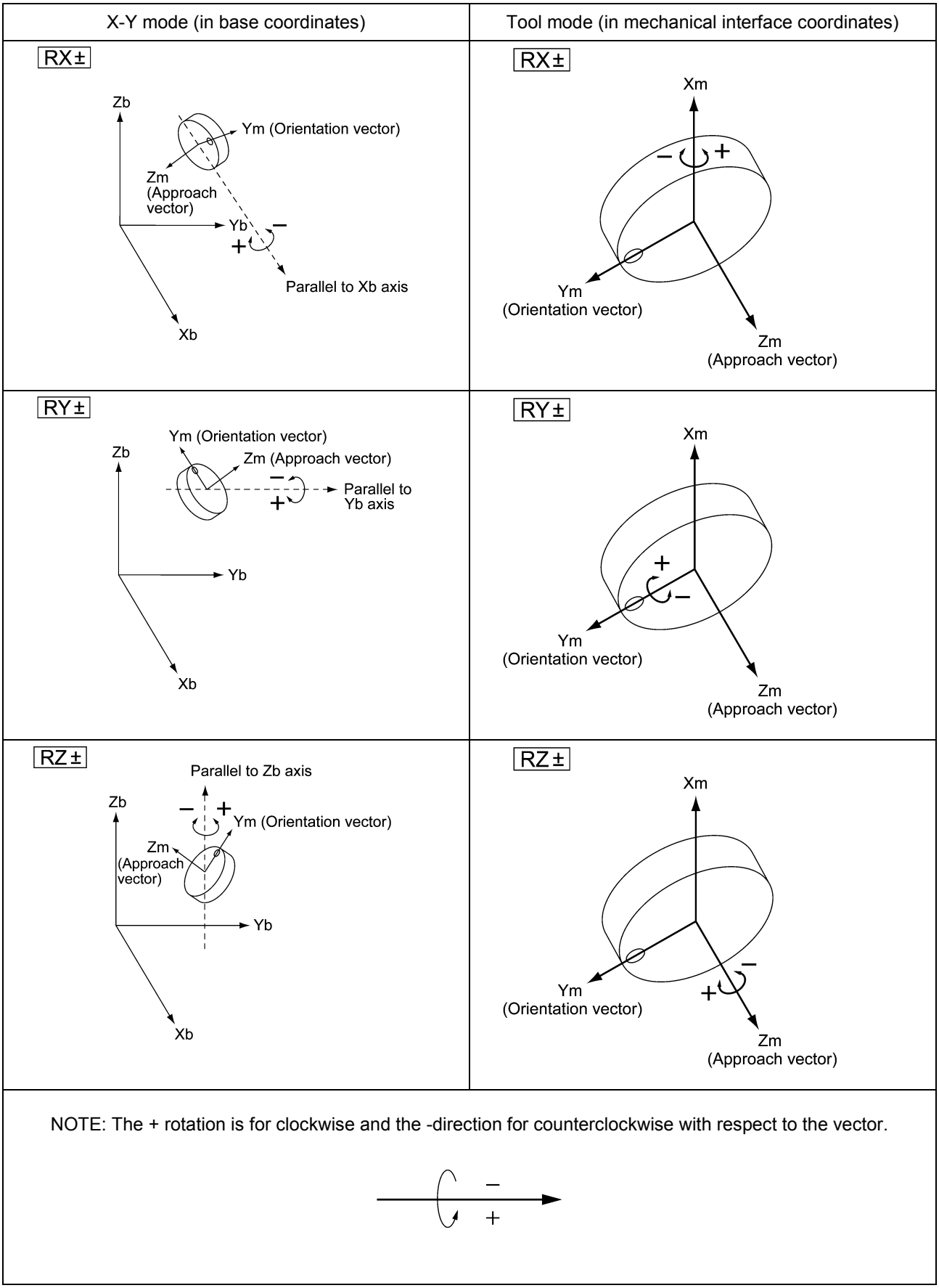


Figure 4-8. Robot Motion Manually Driven by RX, RY, and RZ Keys

[2.3] Tool coordinates

Based on mechanical interface coordinates, you may define tool coordinates by specifying the origin offset distance from the mechanical interface coordinates and the yaw/pitch/roll angles.

Up to 63 tool coordinates (TOOL1 to TOOL63) can be defined on the extended screen. (On the top screen, only TOOL1 to TOOL9 are available.)

TOOL0 is defined by system for mechanical interface coordinates.

The X, Y, and Z axes in tool coordinates are expressed by Xt, Yt, and Zt, respectively, as shown below.

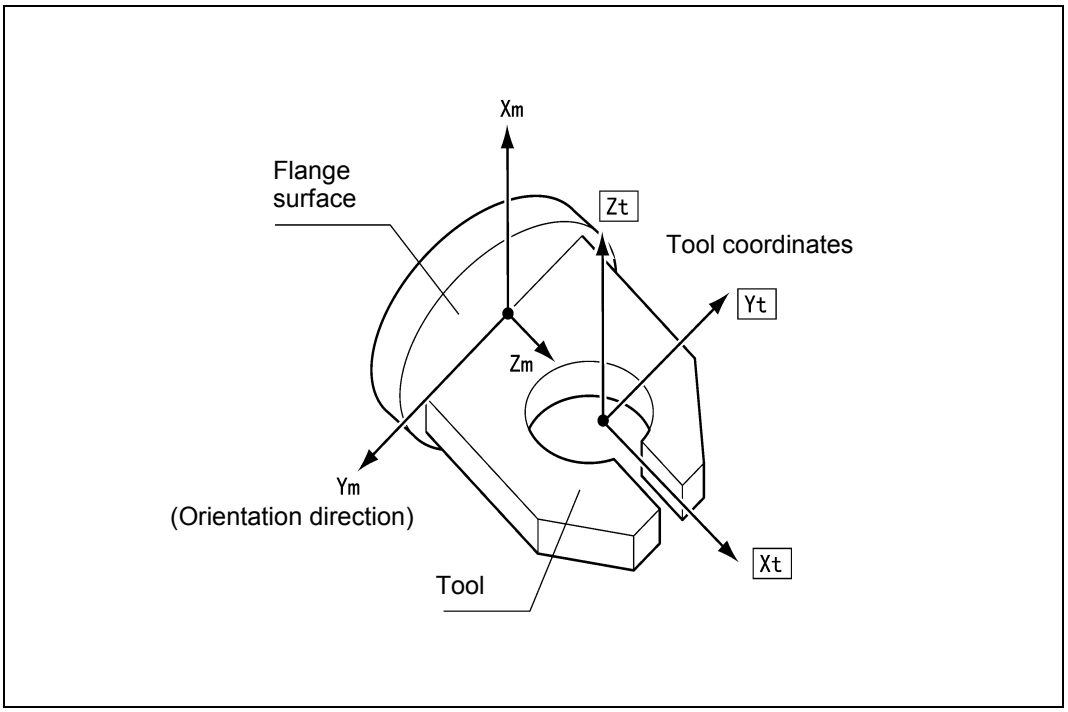


Figure 4-9. Mechanical Interface Coordinates and Tool Coordinates

[2.4] Creating tool coordinates

You may create tool coordinates by entering necessary data from the teach pendant or by writing TOOL command in your program.

The figure below shows the necessary data to be set for creating tool coordinates.

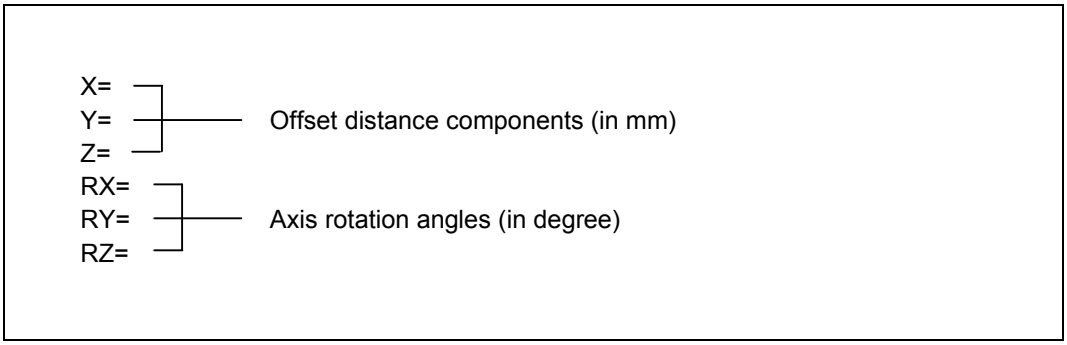


Figure 4-10. Definition Data for Tool Coordinates

The offset distance and the rotation angles should be specified, based on the mechanical interface coordinates. The rotation order should be RZ, RY, and RX.

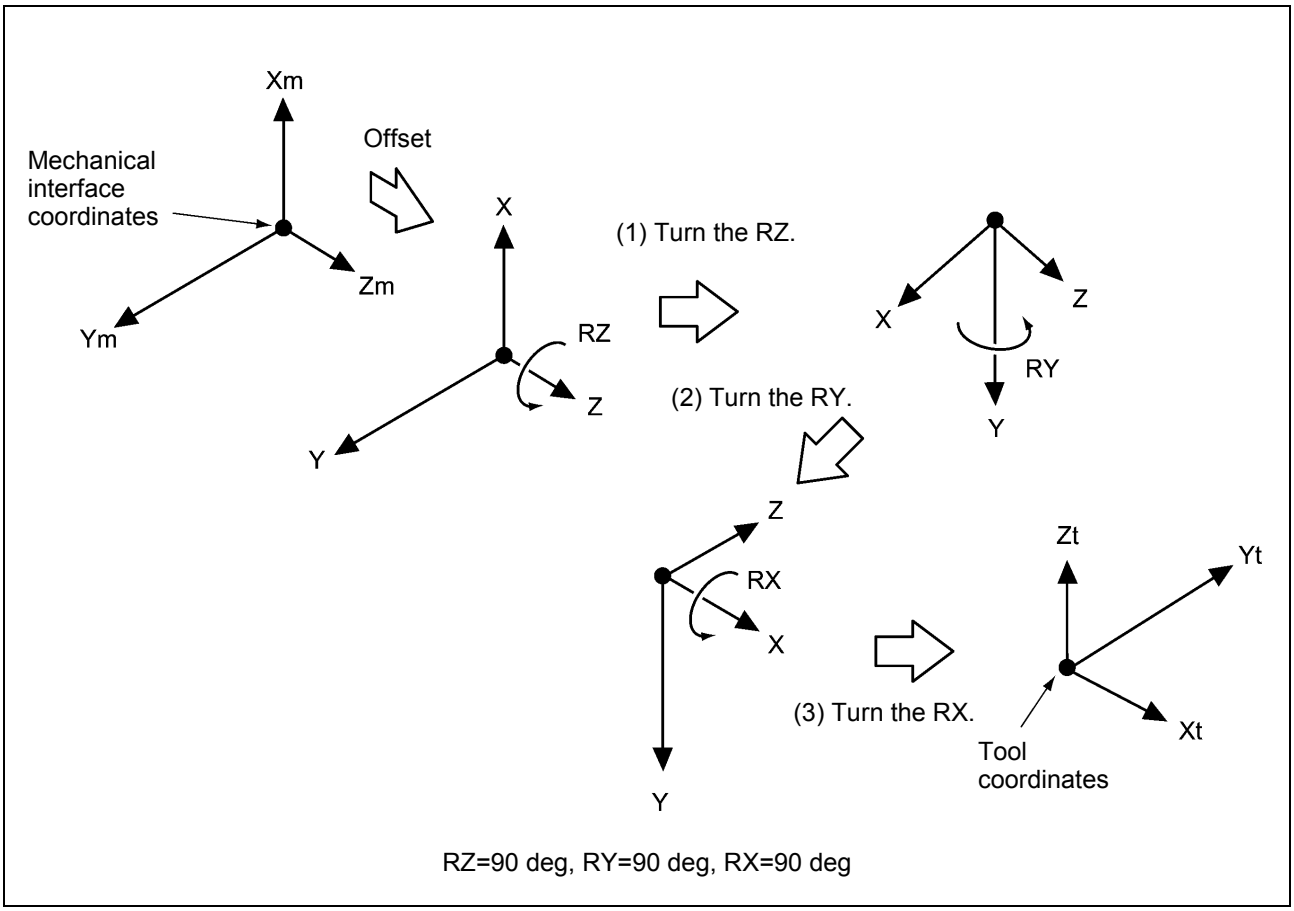


Figure 4-11. Example: Creating Tool Coordinates

[2.5] TOOL0 (Mechanical interface coordinates)

TOOL0 is reserved for mechanical interface coordinates defined by the system. You cannot define these coordinates.

If expressed in the same way as shown in Figure 4-10, TOOL0 may be defined as shown in Figure 4-12.

Default settings for TOOL1 to TOOL63 are the same as TOOL0.

NOTE: If an undefined tool coordinates is specified, the robot runs in TOOL0 equivalent.

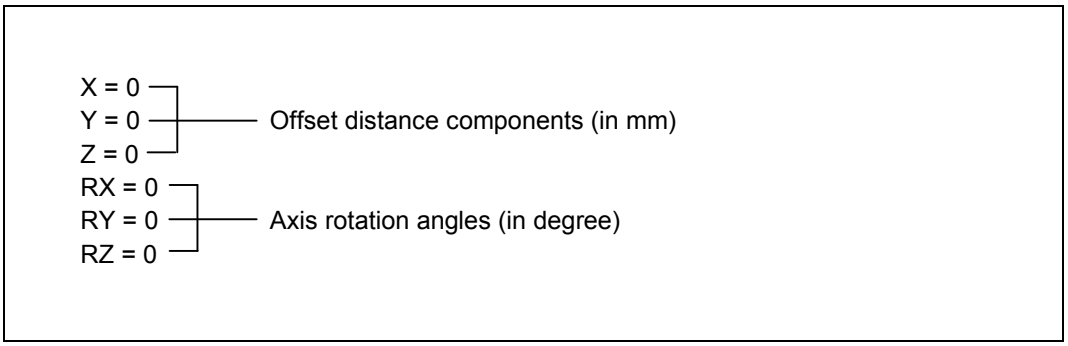


Figure 4-12. Definition Data for TOOL0

[2.6] Advantages of tool coordinates

This section describes what advantages you may have by using tool coordinates.

In manual operation or in teaching

When running the robot in tool coordinates, you can directly handle the end-effector mounted on the flange, making teaching easier.

The figure below shows the comparison of robot moving paths between in mechanical interface coordinates and in tool coordinates.

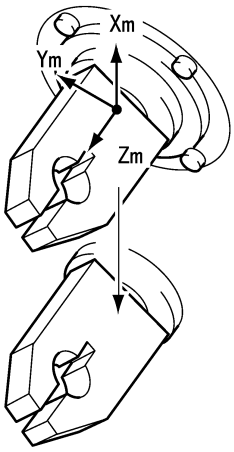
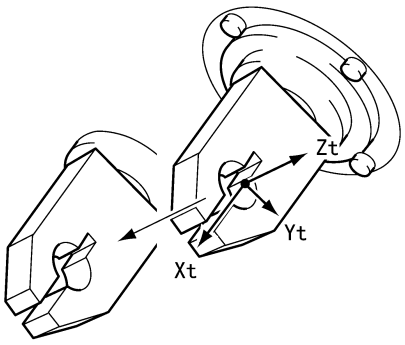
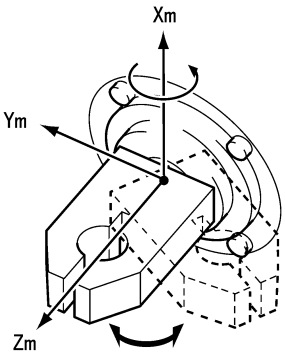
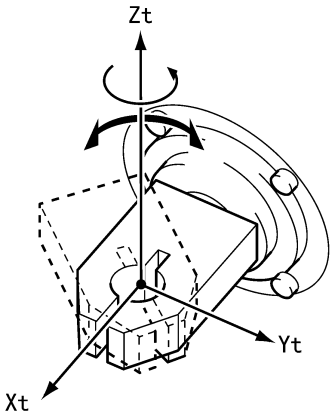
In mechanical interface coordinates (TOOL0)	In tool coordinates (TOOLn where n is any of 1 to 63)
If X- key is pressed: 	If Z- key is pressed:  Enables you to move the end-effector to your object point in teaching.
If RX+ key is pressed: 	If RZ+ is pressed:  Enables you to rotate the end-effector around the Zt axis.

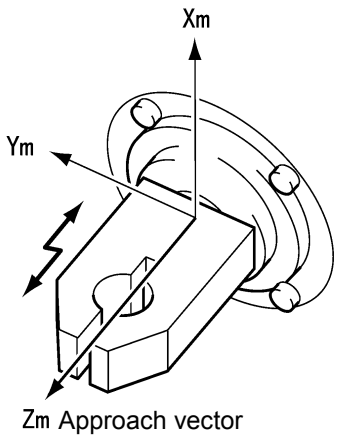
Figure 4-13. Example of Manual Robot Running in Tool Coordinates

In programmed running

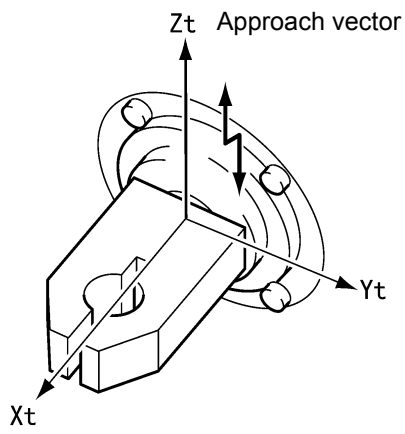
(1) Using APPROACH or DEPART command

APPROACH or DEPART command controls the robot movement on the Z axis of the tool coordinates. You can arbitrarily define the Z-axis orientation in the tool coordinates, allowing you to easily control the end-effector. The figure below shows an example of the tool coordinates definition.

For details about APPROACH and DEPART commands, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 12.1, "Motion Control."



TOOL0 (mechanical interface coordinates)



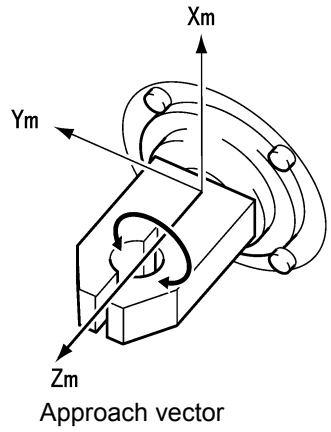
Changing the Z-axis orientation by tool coordinates definition

Figure 4-14. Example of APPROACH (DEPART) Execution in Tool Coordinates

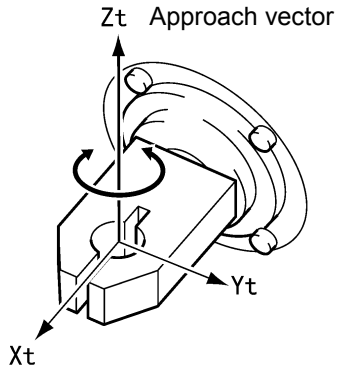
(2) Using ROTATEH command

ROTATEH command controls rotation around the Z axis of the tool coordinates. You can arbitrarily define the Z-axis orientation in the tool coordinates, allowing you to easily control the end-effector. Figure 4-15 shows an example of the tool coordinates definition.

For details about ROTATEH command, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 12.1, "Motion Control."



TOOL0 (mechanical interface coordinates)



Changing the vector orientation and offsetting the coordinate origin by tool definition

Figure 4-15. Example of ROTATEH Execution in Tool Coordinates

[2.7] Tool definition

Tool definition refers to defining arbitrary tool coordinates by specifying the components listed in the table given below.

The offset distances (X, Y, and Z) are values in mm from the origin of the mechanical interface coordinates. The rotation angles (RX, RY, and RZ) are values in degree around the X, Y, and Z axes of the tool coordinates.

Table 4-1. Components Required for Tool Coordinates Definition

Components	Description	Unit
X	Offset distance on the X axis of the mechanical interface coordinates	mm
Y	Offset distance on the Y axis of the mechanical interface coordinates	mm
Z	Offset distance on the Z axis of the mechanical interface coordinates	mm
RX	Rotation angle around the X axis of the tool coordinates	degree
RY	Rotation angle around the Y axis of the tool coordinates	degree
RZ	Rotation angle around the Z axis of the tool coordinates	degree

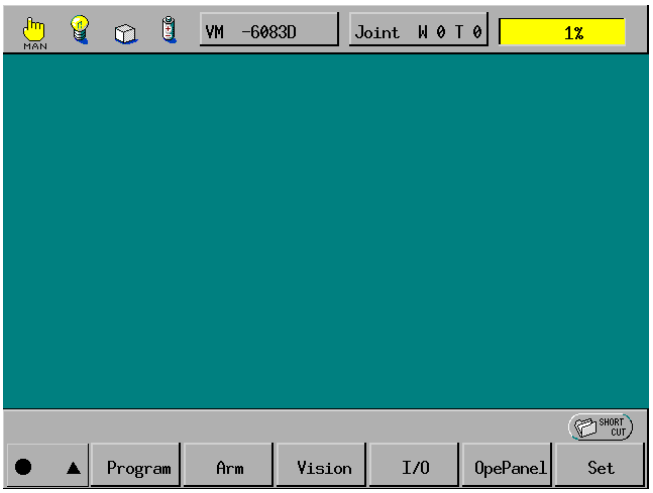
Operating procedure for tool definition

According to the procedure below, you may define arbitrary tool coordinates from the teach pendant. In this example, TOOL1 is defined. The same procedure would apply to TOOL2 through TOOL63.

With this procedure, you may also display or modify the current tool coordinates.

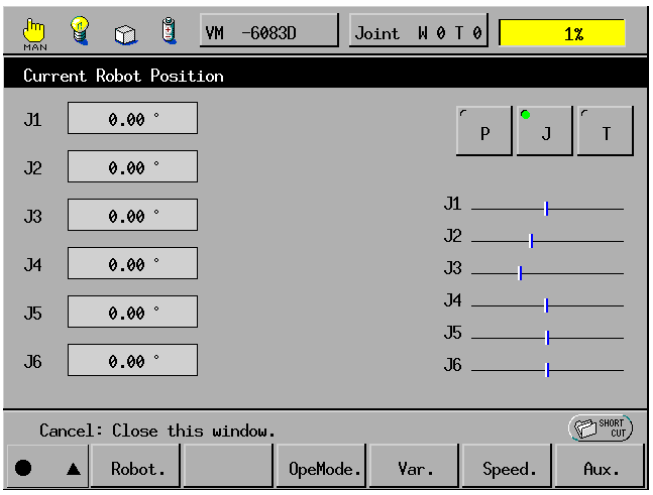
■ ***From the teach pendant***

Step 1 On the extended screen of the teach pendant, press [Arm].



The Current Robot Position window will appear as shown below.

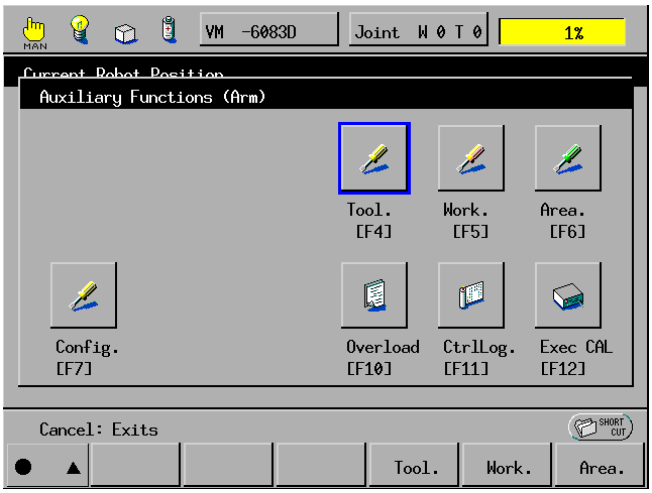
Step 2 On the Current Robot Position window, press [Aux.].



The Auxiliary Functions (Arm) window will appear as shown in Step 3.

Step 3

On the Auxiliary Functions (Arm) window, press [Tool.].



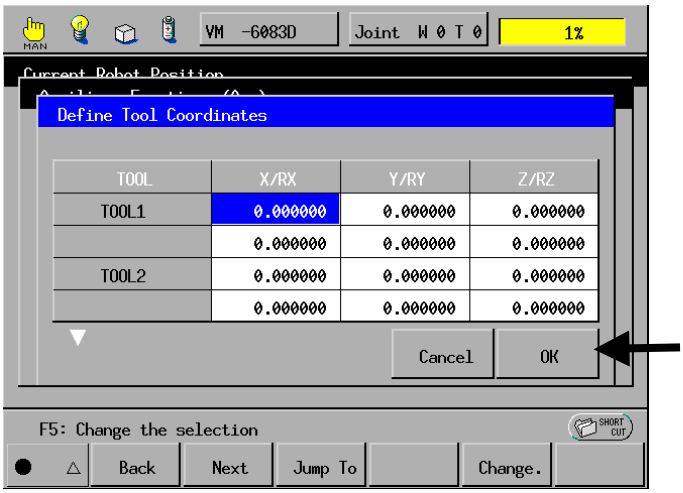
The Define Tool Coordinates window will appear as shown below.

Step 4

Select the X area of TOOL1 by using the cursor keys.

The X area of TOOL1 will become highlighted.

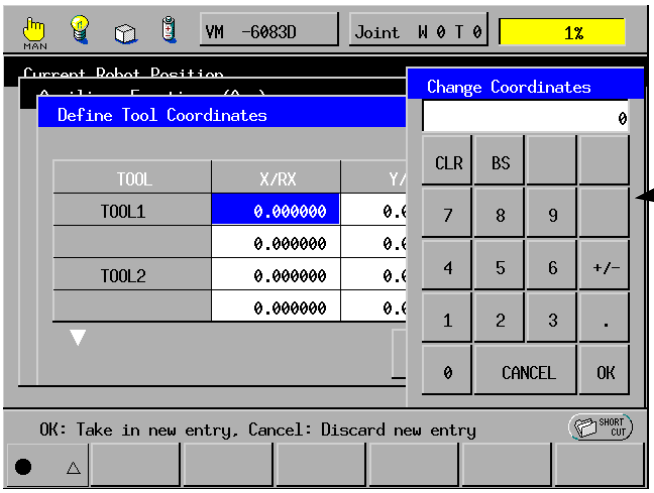
Then press [Change.].

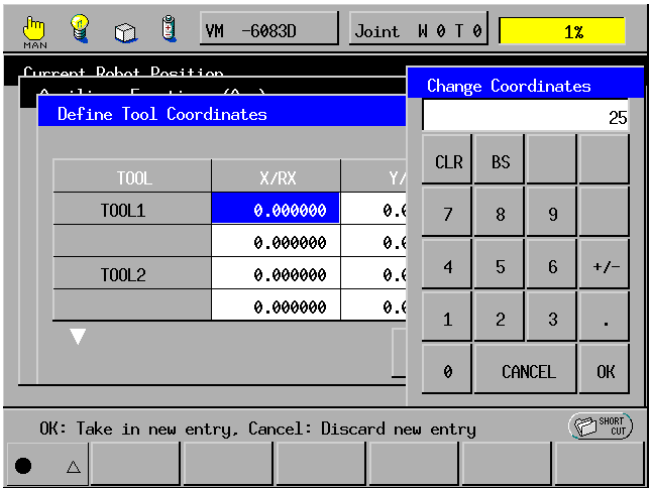


The Define Tool Coordinates window can also be called up by pressing [Constant]—[Teach/Playback Conditions]—[Tool] from the top screen of the teach pendant.

The numeric keypad will appear as shown in Step 5.

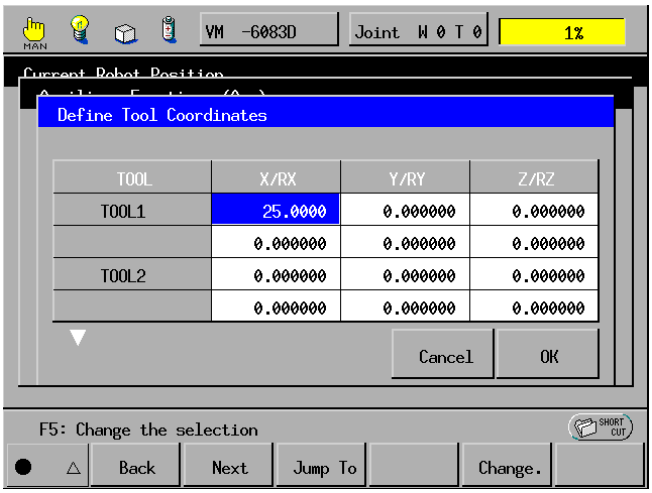
Step 5 In the numeric keypad shown below, enter the desired offset distance on the X axis with the numerical buttons





Step 6 Check the new entry (offset distance on the X axis), and then press the OK button.

The new entry will be entered into the X area of TOOL1 as shown below.



Step 7 Repeat Steps 4 through 6 to enter offset values to the Y, Z, RX, RY, and RZ areas of TOOL1.

Step 8 Press the OK button to finish the procedure of the tool coordinates definition.

Precautions when defining tool coordinates

(1) The CHANGETOOL statement will take effect only in a program that has gotten robot control by successful execution of the TAKEARM statement.

Execution of the TAKEARM statement will initialize the tool coordinates definition to TOOL0 (default that is the same as settings for the mechanical interface coordinates).

(2) From the step where CHANGETOOL statement is written in the programs, the defined tool coordinates will take effect. The definition will remain valid up to the step immediately preceding the step where new CHANGETOOL statement is written.

(3) If no CHANGETOOL statement is written in a program, TOOL0 (mechanical interface coordinates) will apply.

(4) Once you select tool coordinates on the Select Operation Mode window called up by the M-MOD key on the teach pendant, it will take effect in Tool mode until it will be changed.

(5) If TOOL number used for running the robot to the object point and attitude differs from TOOL number previously used in writing the current point and attitude, the resulting position and attitude of the robot flange will become different from the previous ones.

For example, when programming, if you have written the object point and attitude using the APPROACH command in TOOL0 and you insert TOOLn (n is any of 1 through 63) in any step preceding the APPROACH command, then executing the program brings the center of the robot flange to a different point and attitude than those defined in TOOL0, depending upon the contents of those different tool definitions.

(6) The tool coordinates definitions made in program execution and in Teach mode are saved in the same memory location.

If you switch the operation mode from Auto to Teach mode, the tool coordinates definition made in programming will remain in effect.

(7) You may at anytime check the current TOOL number in the status bar on the teach pendant. Refer to p. 4-26.

(8) On the top screen of the teach pendant, only TOOL1 to TOOL9 are available.

For details about commands and tool definitions, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 12.1, "Motion Control, APPROACH" and Section 9.5, "Tool Coordinates, TOOL." Also refer to Section 4.1.1, [2.7] Tool definition in this chapter.

Sample program for switching defined tool coordinates

Execution of CHANGETOOL 0 will cancel the current tool coordinates definition and restore the default TOOL0 (mechanical interface coordinates).

TAKEARM statement automatically involves CHANGETOOL 0.

The figure below shows a sample program that switches the defined tool coordinates from TOOL1 to TOOL2. End-effector 1 and End-effector 2 used in this program are illustrated in Figures 4-17 and 4-18, respectively. The positional relationship between the robot unit, End-effector 1, and End-effector 2 is assumed as shown in Figure 4-19. End-effector 1 is placed at P1 and End-effector 2 is at P2.

```
PROGRAM  TOOL Sample

Tool 1, (0, -49.7, 79.2, 45, 0, 0)  'Defines TOOL1.
Tool 2, (0, -65, 37.5, 90, 0, 0)    'Defines TOOL2.

TakeArm     'Executes CHANGETOOL0 automatically.

'Setting End-effector 1
   Approach P, P1, 200
   Move L, P1                                  } See Figure 4-19.
   Set IO[104]          'Sets End-effector 1.
   Depart P, 200
   ChangeTool 1         'Switches to TOOL1.
        :
        :
'Releasing End-effector 1
   ChangeTool 0         'Restores the default TOOL0.
   Approach P, P1, 200                         } See Figure 4-20.
   Move L, P1
   Reset IO[104]        'Releases End-effector 1.
   Depart P, 200

'Setting End-effector 2
   Approach P, P2, 200
   Move L, P2                                  } See Figure 4-21.
   Set IO[105]          'Sets End-effector 2.
   Depart P, 200
   ChangeTool 2         'Switches to TOOL2.
        :
        :
```

Figure 4-16. Switching the Defined Tool Coordinates

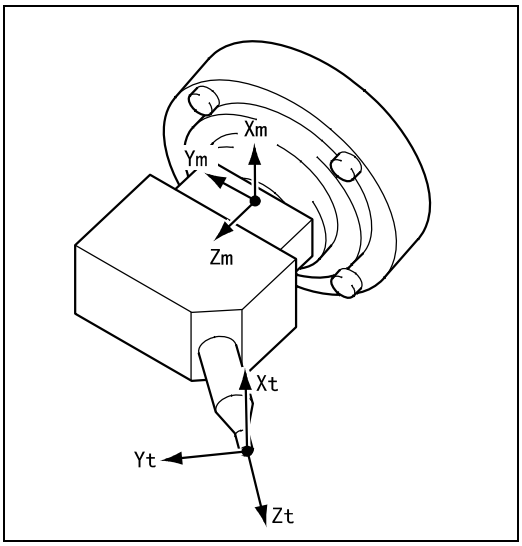


Figure 4-17. End-effector 1

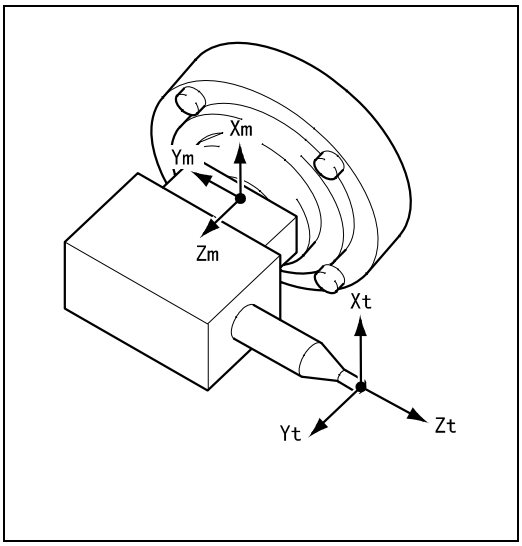


Figure 4-18. End-effector 2

In the sample program shown in Figure 4-16, End-effector 1 and End-effector 2 are defined as TOOL1 and TOOL2, respectively.

Execution of TAKEARM automatically specifies TOOL0, so the robot will move to P1 (where End-effector 1 is placed) on the flange surface basis. As illustrated in Figure 4-19, End-effector 1 will be mounted by "Set IO [104]." "Depart P,200" will make the robot apart from P1 and CHANGETOOL 1 switches the tool coordinates from TOOL0 to TOOL1.

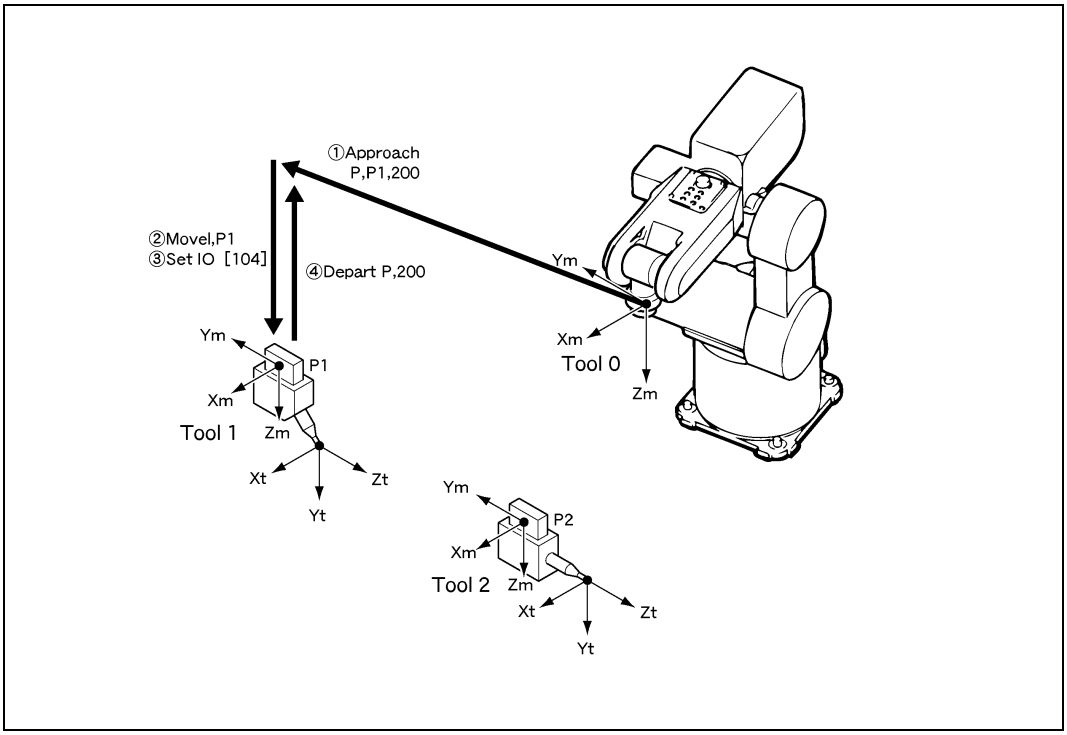


Figure 4-19. Moving Path for Setting End-effector 1

To replace End-effector 1 with End-effector 2, first release End-effector 1 as follows.

"CHANGETOOL 0" will switch the current tool coordinates from TOOL1 to TOOL0. As shown in Figure 4-20, the robot will move to P1 on the flange surface basis and release End-effector 1 at P1.

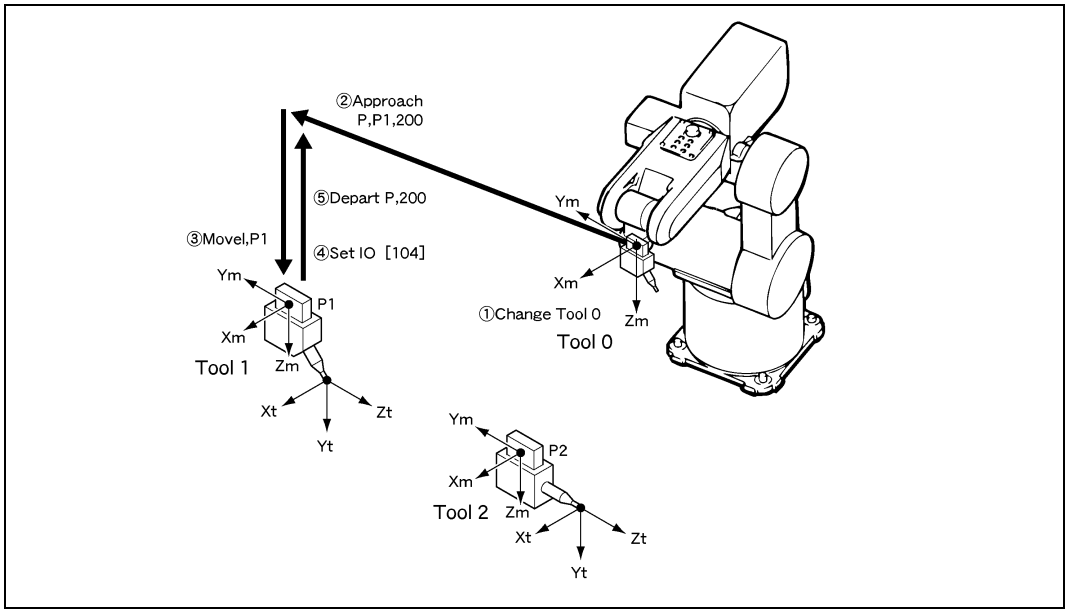


Figure 4-20. Moving Path for Releasing End-effector 1

As shown in Figure 4-21, in mechanical interface coordinates, the robot will move to P2 where End-effector 2 will be mounted. "Depart P,200" will make the robot apart from P2. Then TOOL0 will be switched to TOOL2.

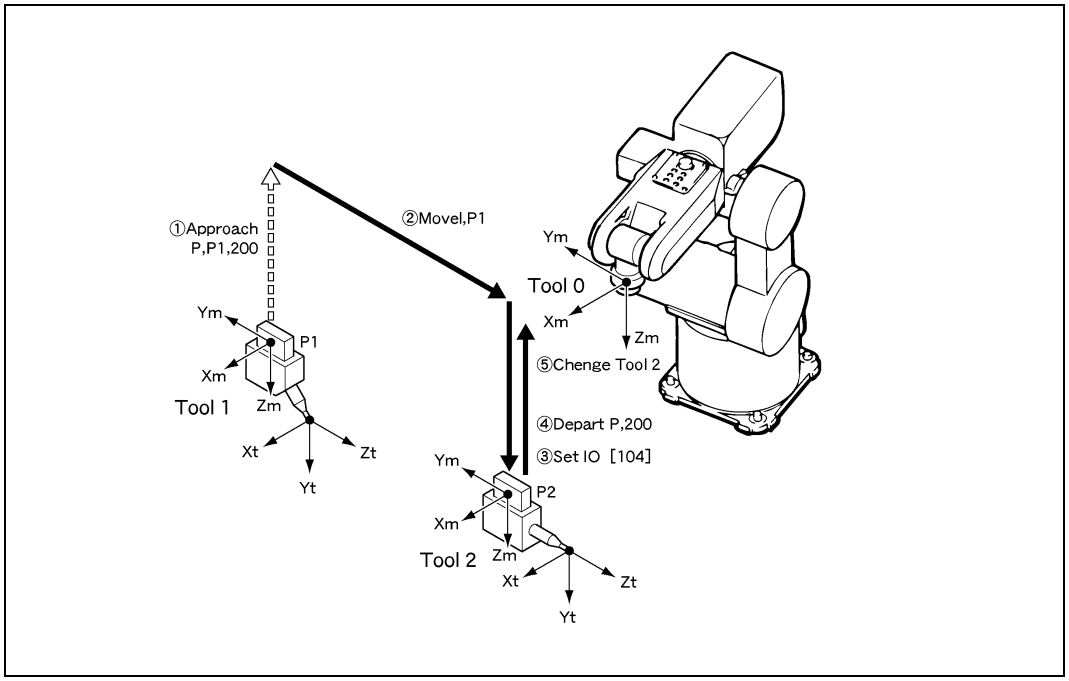
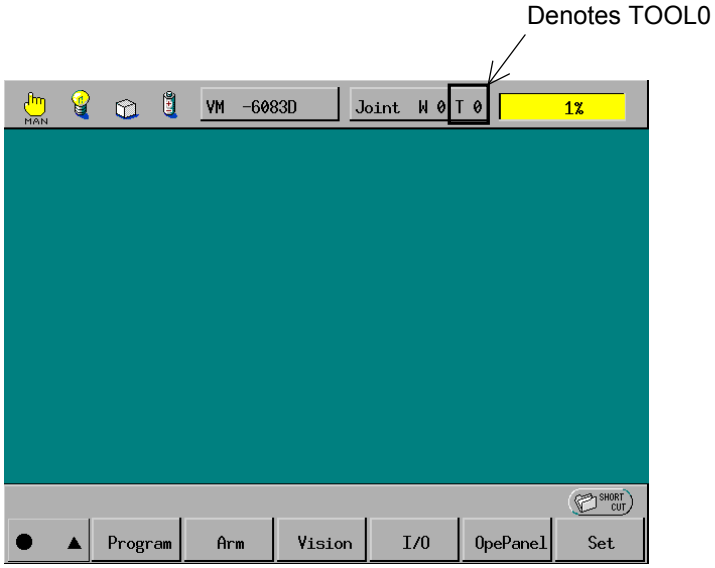


Figure 4-21. Moving Path for Setting End-effector 2

Displaying the current tool coordinates

The current tool coordinates are always shown in the status line of the extended screen of the teach pendant in any of the operation modes (Auto, Individual, and Teach modes).



[2.8] End-effector samples and their tool coordinates definitions

The figure below shows end-effector samples (chuck and other tools). Figure 4-23 shows their tool coordinate definitions.

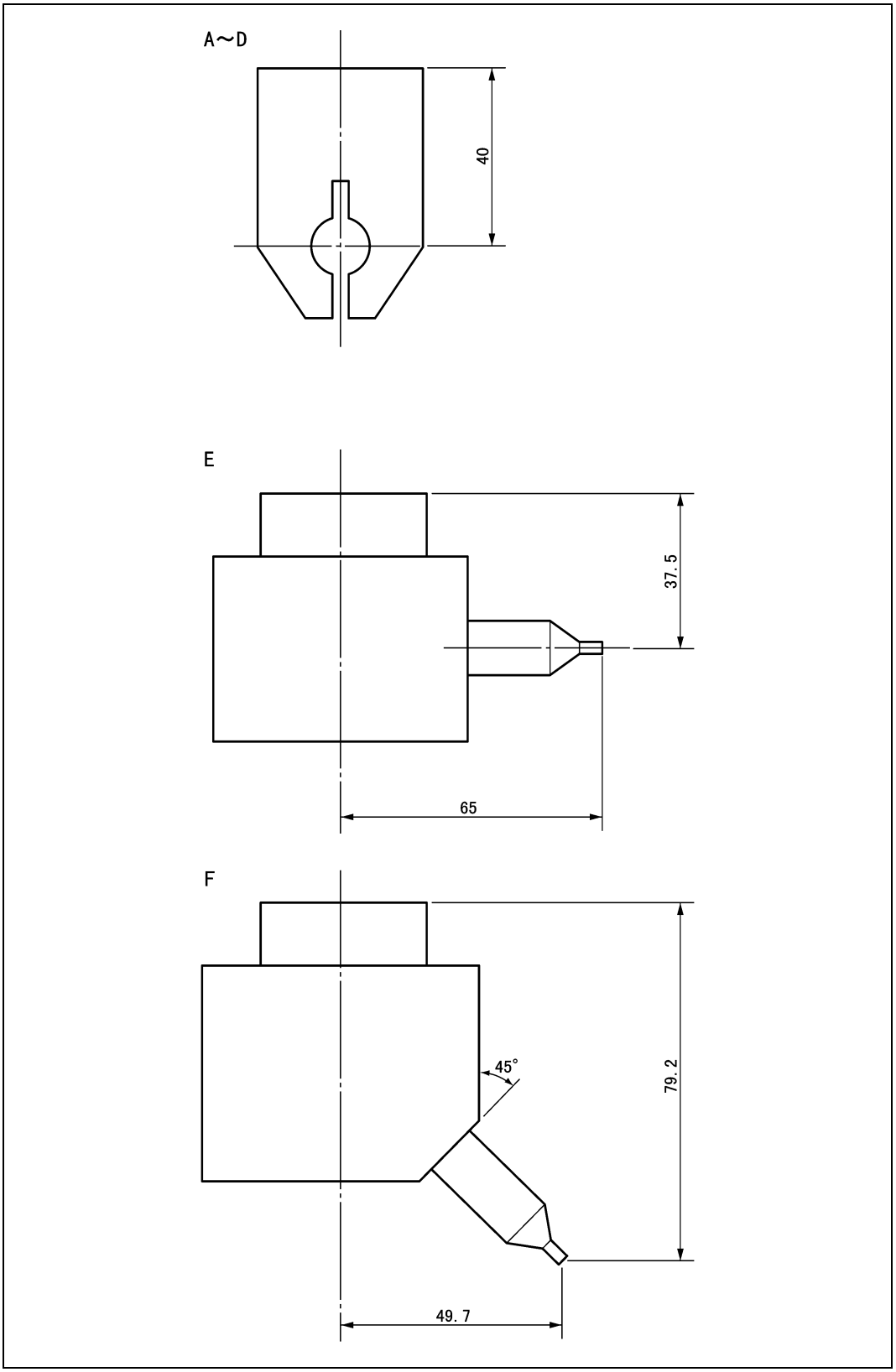
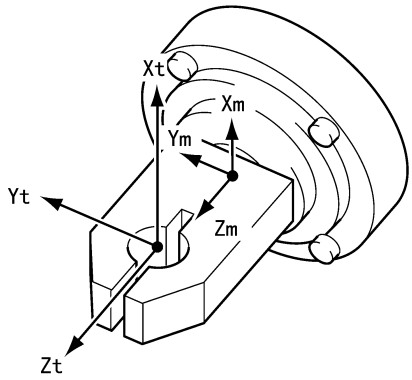


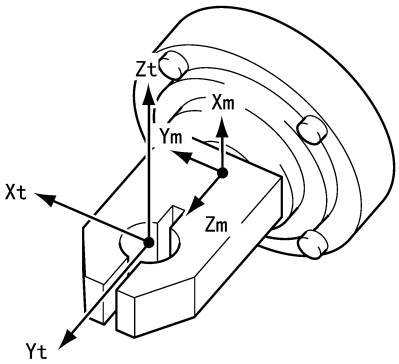
Figure 4-22. End-effector Types and Their Coordinate Origins

The chuck is mounted in parallel with the orientation vector of the flange. A



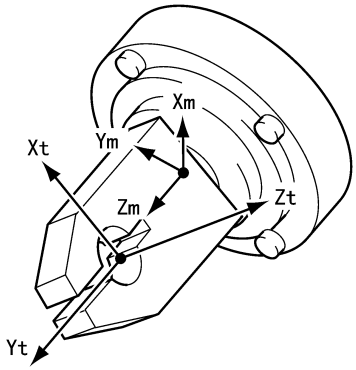
TX = 0
TY = 0
TZ = 40
RX = 0°
RY = 0°
RZ = 0°

The chuck is mounted in parallel with the orientation vector of the flange. B



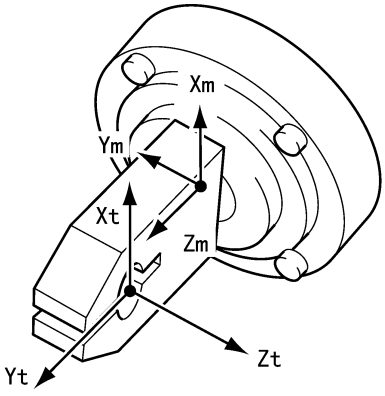
TX = 0
TY = 0
TZ = 40
RX = 90°
RY = 0°
RZ = 90°

The chuck is mounted at an angle of 45° to the orientation vector of the flange. C



TX = 0
TY = 0
TZ = 40
RX = 90°
RY = 0°
RZ = 45°

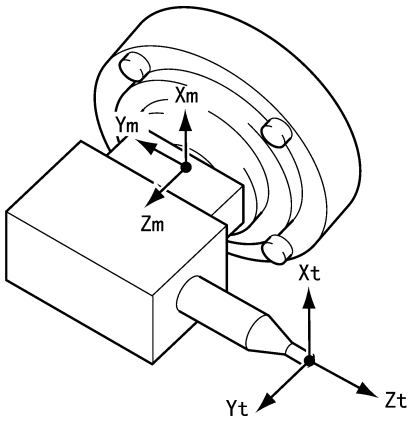
The chuck is mounted at right angles to the orientation vector of the flange. D



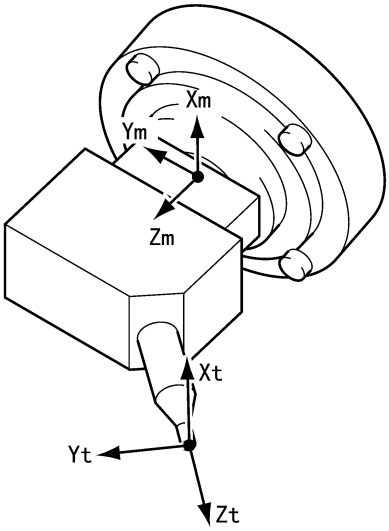
TX = 0
TY = 0
TZ = 40
RX = 90°
RY = 0°
RZ = 0°

E

TX = 0
TY = -65
TZ = 37.5
RX = 90°
RY = 0°
RZ = 0°



F



TX = 0
TY = -49.7
TZ = 79.2
RX = 45°
RY = 0°
RZ = 0°

Figure 4-23. Tool Coordinates Definition Examples

4.1.2 Interference Check Area

You can define an interference check area(s) to prevent the robot arm from interfering with other devices or facilities.

The interference check area can be defined based on the base coordinates and work coordinates shown below.

There are eight interference check areas (AREA0 to AREA7). The robot system uses AREA0 to AREA3 for setting up the origin point, so they are not available in PAC programs. AREA4 to AREA7 are available.

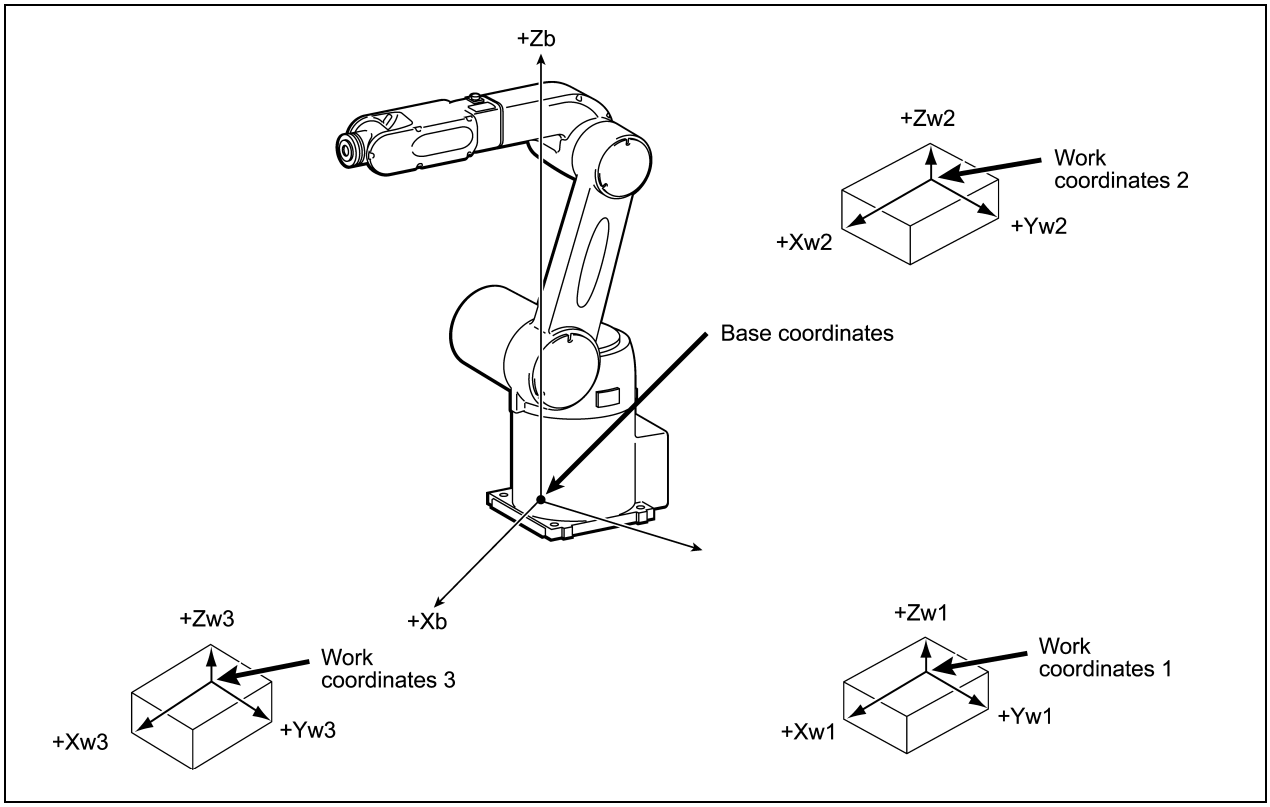


Figure 4-24. Work Coordinates and Base Coordinates

[1] Notes on interference check area

(1) The center of the interference check area is always based on the base coordinates (WORK0).

(2) Even if work coordinates are changed, the interference check area does not change

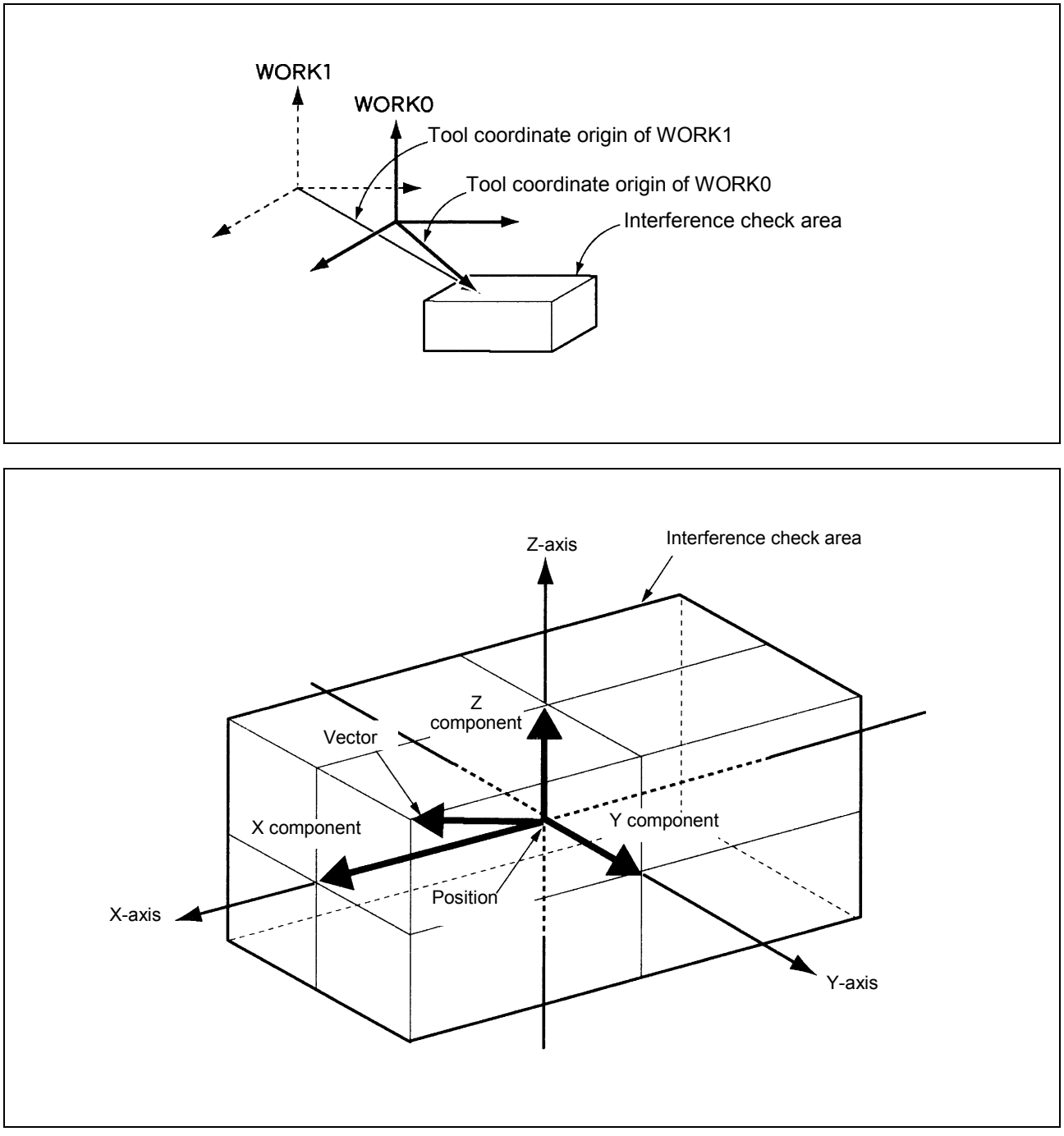


Figure 4-25. Interference Check Area

[2] Setting the center, angle and range of area

Two procedures, 2-point teaching and direct value entry, are available for defining an interference check area(s).

Defining an interference check area by 2-point teaching [AutoCalc]

You may define an interference check area(s) by teaching a work coordinates number (where you want to set an interference check area) and two points—vertexes farthest and nearest to the origin of the base coordinates.

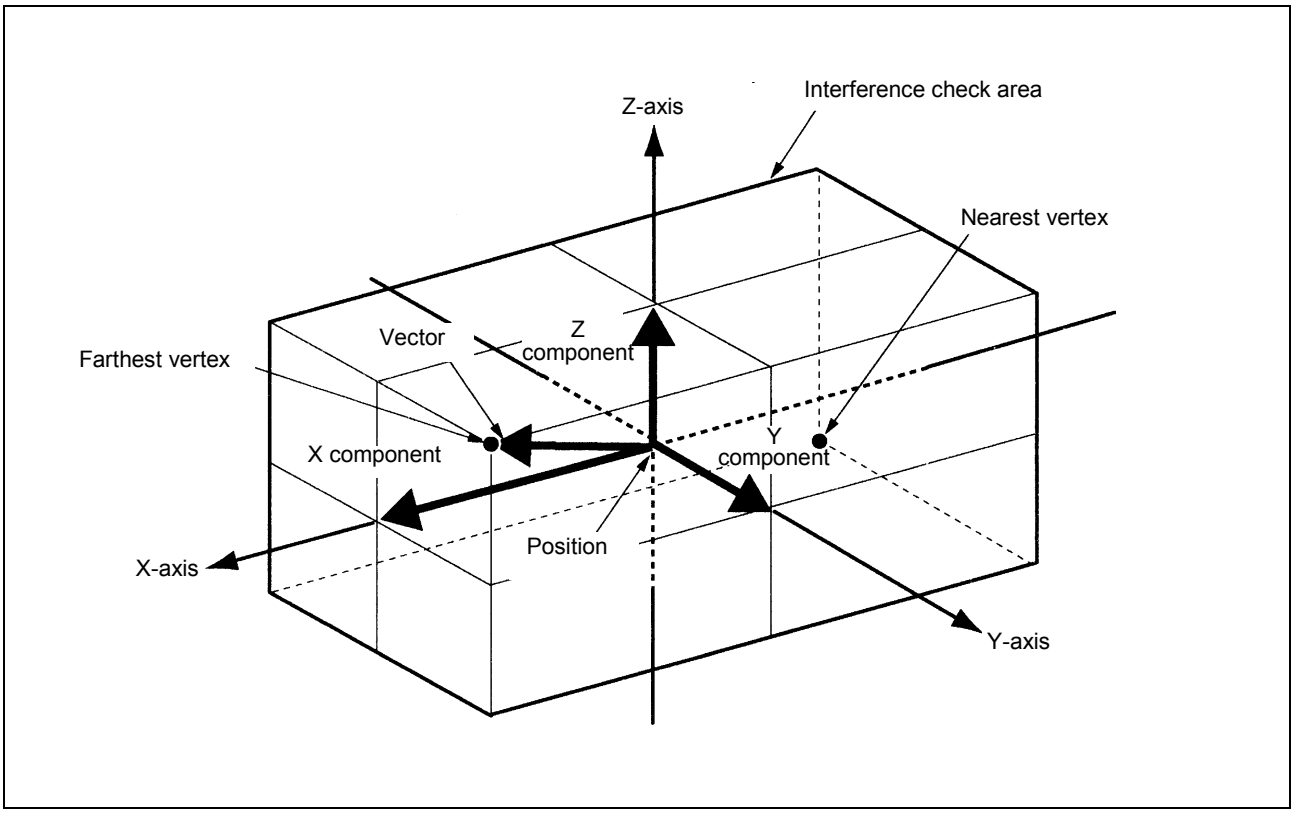


Figure 4-26. Defining an Interference Check Area by 2-point Teaching

Defining an interference check area by direct value entry [Change.]

You may define an interference check area by entering an area origin point (X, Y, and Z) relative to the base coordinates, the rotation angles (Rx, Ry, and Rz) around the X-axis, Y-axis, and Z-axis of the base coordinates, and the vector.

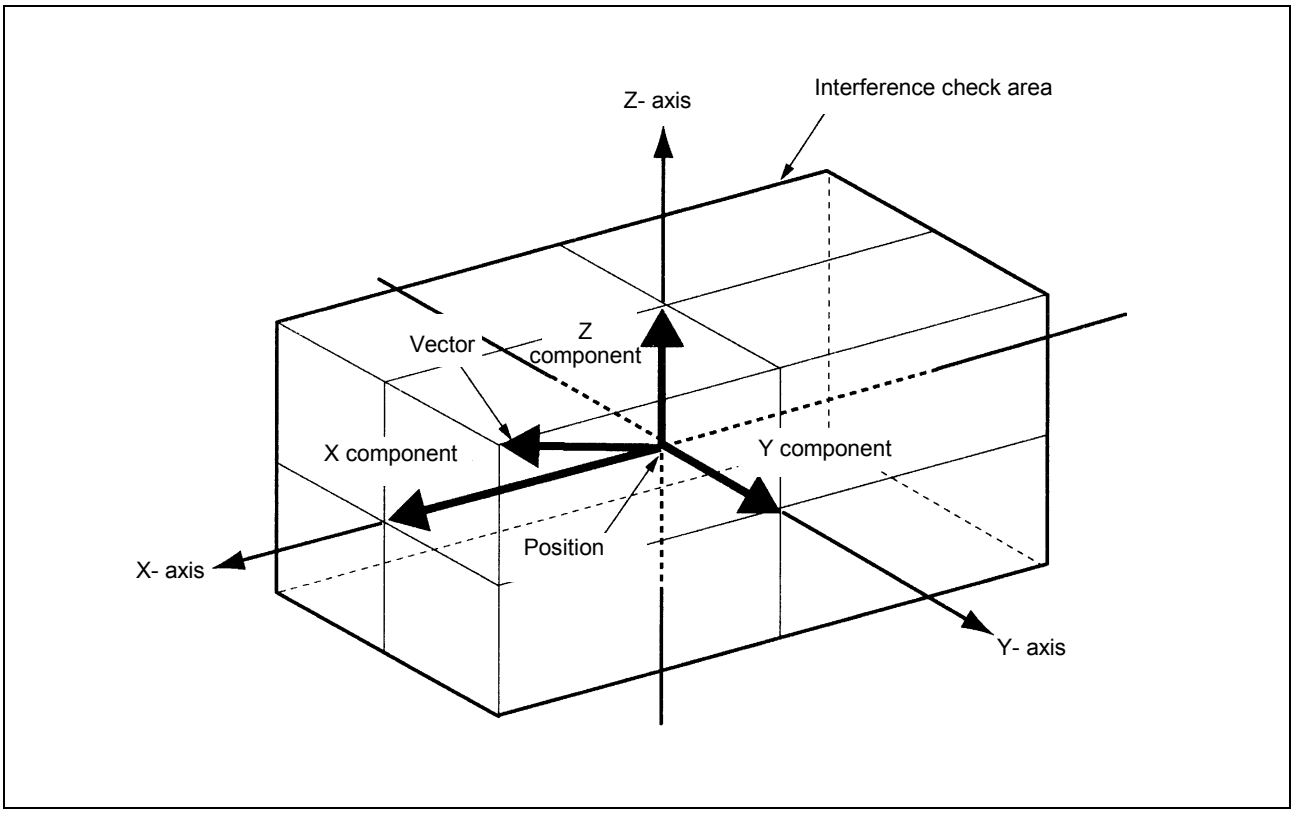


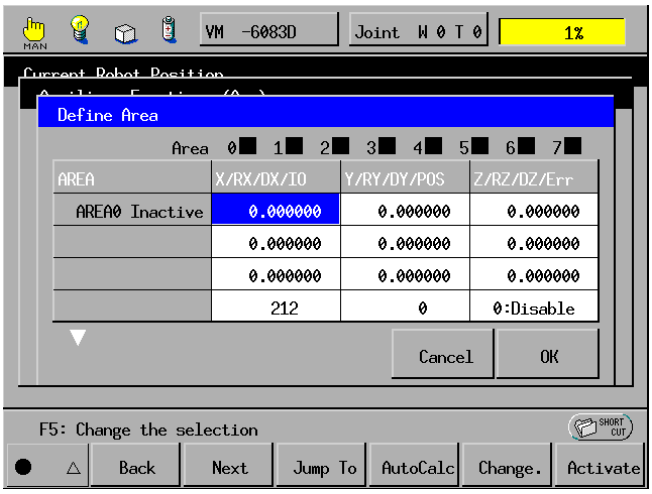
Figure 4-27. Defining an Interference Check Area by Direct Value Entry

[3] Defining an interference check area by 2-point teaching

Step 1 On the extended screen of the teach pendant, press [Arm].

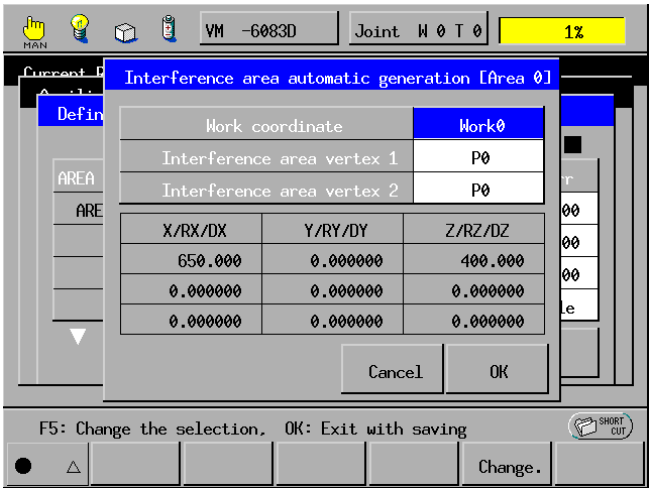
Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 In the Auxiliary Functions (Arm) window, press [Area], and the Define Area window appears as shown below.



Select the desired work coordinates using the cursor keys, and then press [AutoCalc].

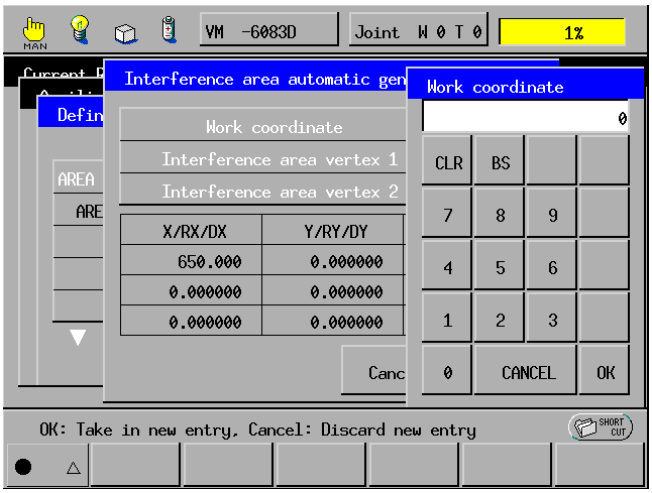
Step 4 The Interference area automatic generation window appears as shown below.



To set the reference work coordinates number (to be used for defining an interference check area) and unassigned position variable names to be used for farthest and nearest vertexes, select "Work coordinate," "Interference area vertex 1," or "Interference area vertex 2," respectively, by using the cursor keys and then press [Change.].

Step 5

The numeric keypad will appear as shown below. Enter the desired number and two position variable names to the "Work coordinate," "Interference area vertex 1," and "Interference area vertex 2," respectively.



NOTE: For base coordinates, enter 0 to the "Work coordinate."

Step 6

Call up the Position Variables assignment window ([Arm]—[Var.]—[Position]) shown below.

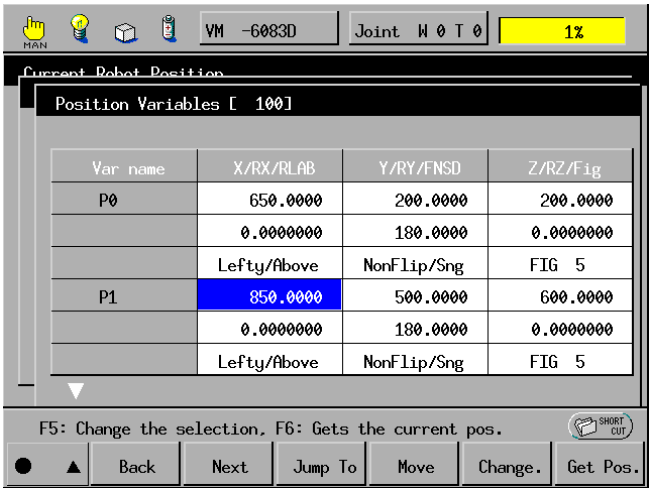
In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the two position variables you have entered for vertexes farthest and nearest to the origin of the base coordinates in Step 5.

(1) Place the cursor on the position variables set for 2-point teaching.

(2) In Manual mode, move the tool end of the robot arm to the teaching point.

(3) Press [Get Pos.] in order to read in the current position of the tool end to the selected position variable.

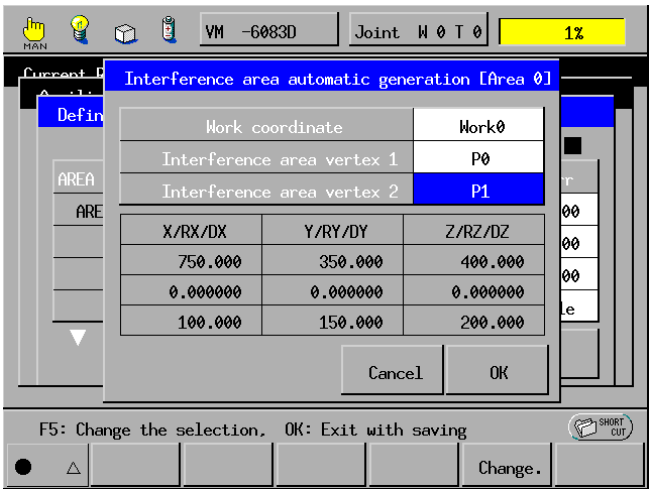
(4) Carry out (1) through (3) above for each of the farthest and nearest vertexes.



NOTE
- Define an interface check area after defining tool coordinates and work coordinates.
- Before teaching the nearest and farthest vertexes, set the Manual mode in the work coordinates of the reference work coordinated number.

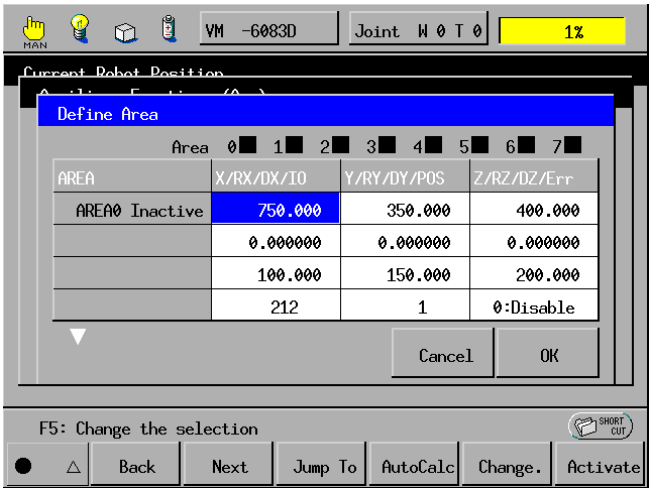
Step 7 Press the Cancel button twice to return to the Interference area automatic generation window.

Step 8 At the bottom of the Interference area automatic generation window, the defined interference check area is displayed. If its values are satisfactory, press the OK button; if not, press the Cancel button.



NOTE: The center of the interference check area is always based on the base coordinates (Work0). Therefore, the calculated center of position is not the center of the specified work coordinates.

Step 9 If you press the OK button in Step 8, the defined interference check area values will be entered into the target interference check area.



[4] Defining an interference check area by direct value entry

Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in the Current Robot Position window

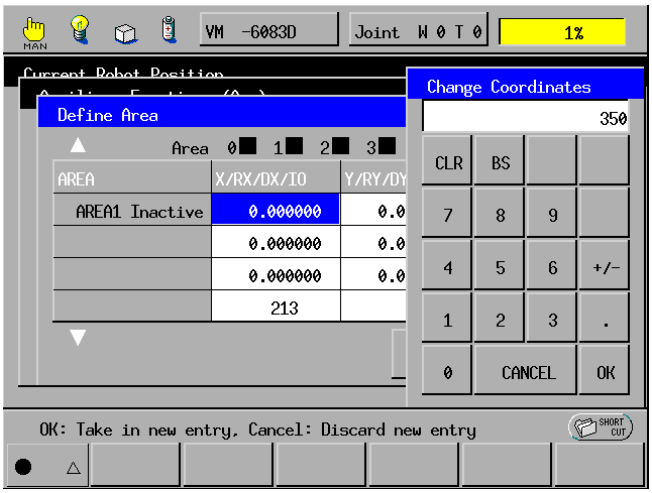
Step 3 Press [Area] in the Auxiliary Functions (Arm) window.

The Define Area window appears.

Select an interference check area to be defined using the cursor keys.

Step 4 Press [Change.] in the Define Area window.

The numeric keypad will appear as shown below.



Step 5 Using the numeric keypad, enter the desired numerical values. After checking the entered values, press the OK button.

[5] Making the defined interference check areas active or inactive

There are eight interference check areas AREA0 to AREA7. Select areas to be used from AREA4 to AREA7 according to the procedure given below. (AREA0 to AREA3 are reserved for the system.)

If you make many defined interference check areas active, the sampling interval will become long, resulting in delayed detection. Only the necessary areas should be made active.

TIP: The sampling interval of the interference check areas can be shortened by setting the "400 High-resolution area" in the User Preferences window to "Enable: 1." The interval can be shortened down to approximately 1/8.

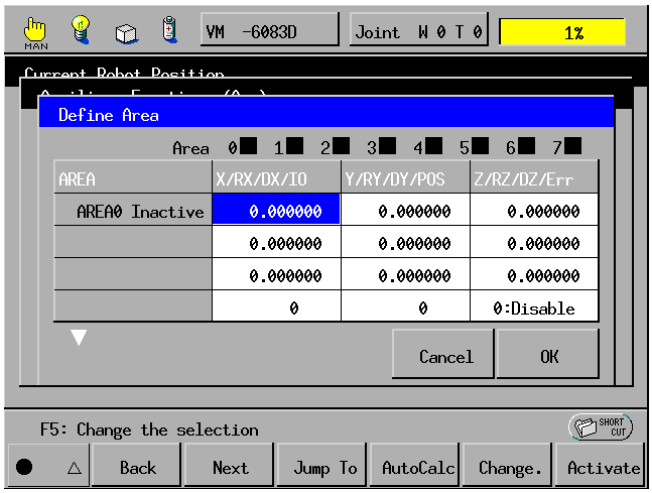
Operating procedure

■ ***From the teach pendant***

Step 1 On the extended screen of the teach pendant, press [Arm].

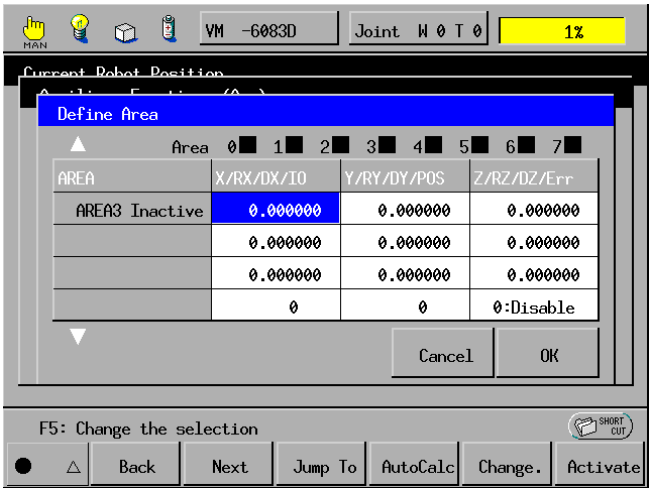
Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 Press [Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.



Step 4

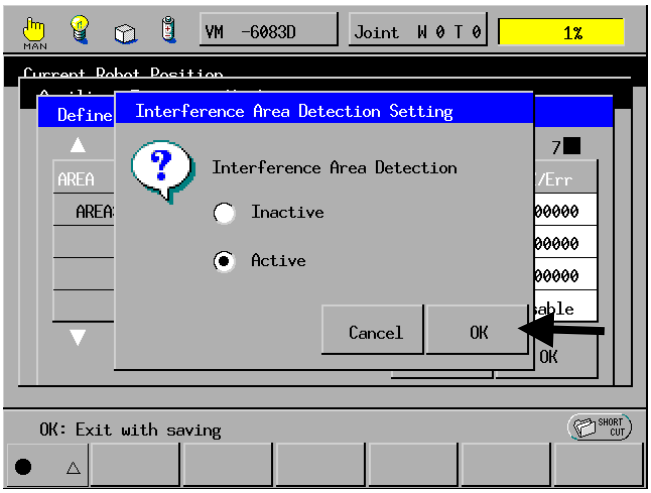
Call up the defined interference check area to be modified with the cursor keys as shown below.



Then press [Activate], and the Interference Area Detection Setting window will appear as shown below.

Step 5

Select Inactive or Active (in this example, select Active), then press the OK button.

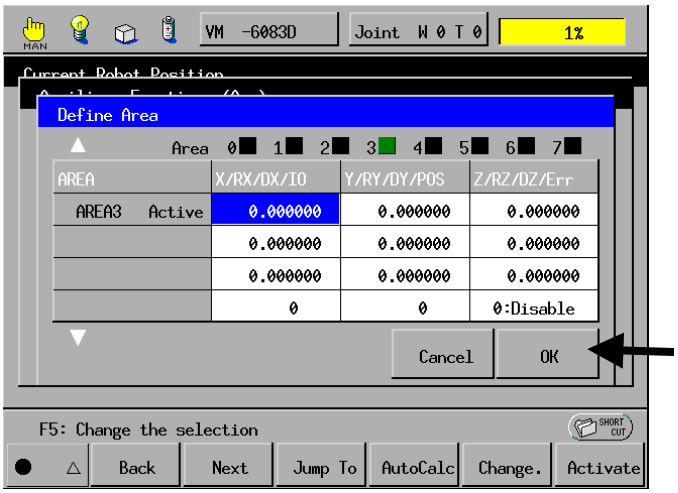


The screen will return to the Define Area window as shown on the next page.

Step 6

The new setting (in this example, AREA 3 Active) will appear and the color of the square indicator for that setting will change (in this example, the indicator for Area 3 turns green).

Meaning of the square indicator color Green: Active
Black: Inactive



Press the OK button.

[6] Turning the specified I/O signal(s) on or off at the detection of area interference

If you make the following signal setting, the controller will turn the specified signal(s) on when the origin of the tool coordinates enters interference check area(s) defined and made active.

NOTE: Be careful when specifying I/O signal numbers. If you set a wrong I/O signal(s), the wrong signal will come ON when the origin of the tool coordinates enters interference check areas.

Operating procedure

■ ***From the teach pendant***

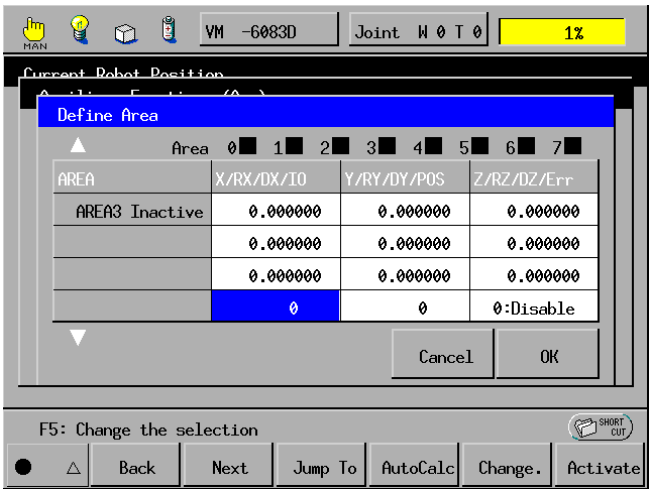
Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 Press [Area.] in the Auxiliary Functions (Arm) window.

Step 4 Call up the defined interference check area to be modified with the cursor keys.

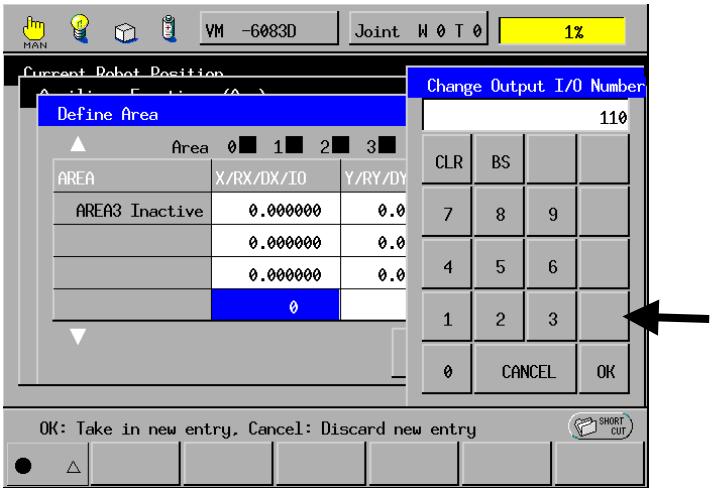
Step 5 In the Define Area window, select an entry field in the 1st column of the bottom line.



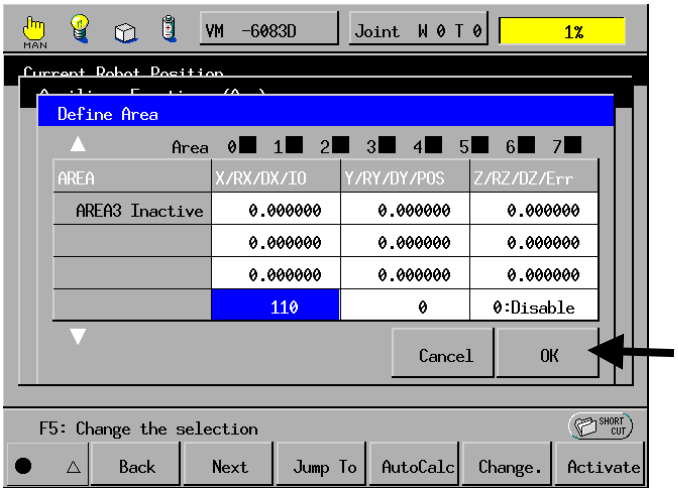
Then press [Change.]. The numeric keypad will appear as shown on the next page.

Step 6 From the numeric keypad, enter the desired value, and then press the OK button.

If no I/O output is required, enter "-1."



Step 7 The new setting will appear in the selected entry field. Press the OK button.



[7] Specifying a position variable name to which the current position value will be assigned at the detection of area interference

You may specify the name of a position variable to which the current position value will be assigned the moment the origin of the tool coordinates enters the interference check area.

NOTE: Be careful when specifying a position variable name(s). If you specify a wrong variable name(s), the value of the specified position variable will be changed when the origin of the tool coordinates enters the interference check area.

Operating procedure

■ ***From the teach pendant***

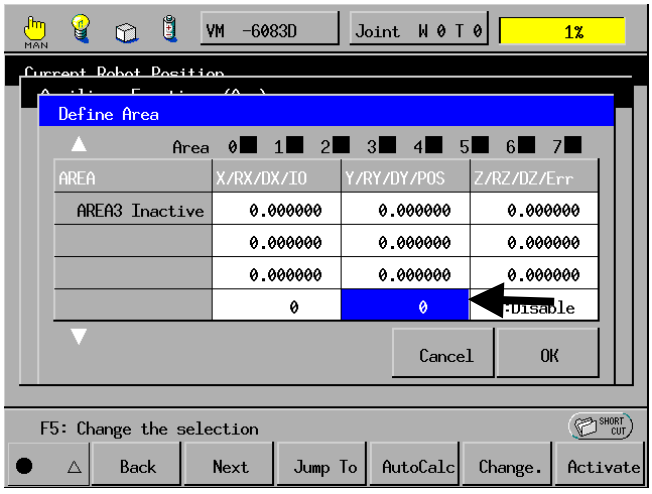
Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 Press [Area.] in the Auxiliary Functions (Arm) window.

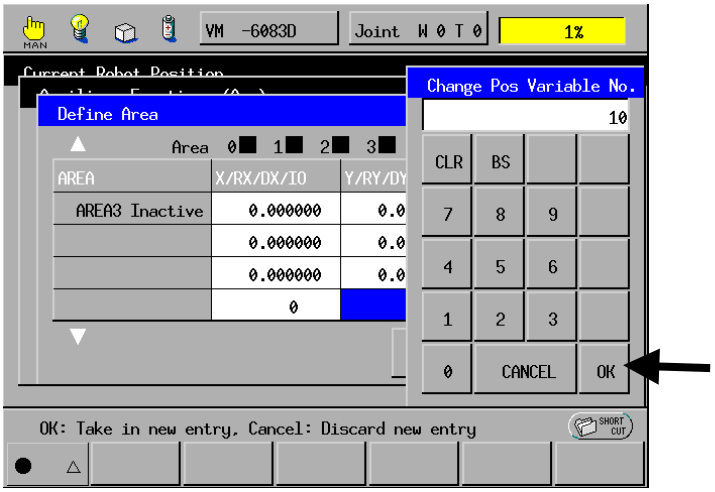
Step 4 Call up the defined interference check area to be modified with the cursor keys.

Step 5 In the Define Area window, select an entry field in the 3rd column of the bottom line.

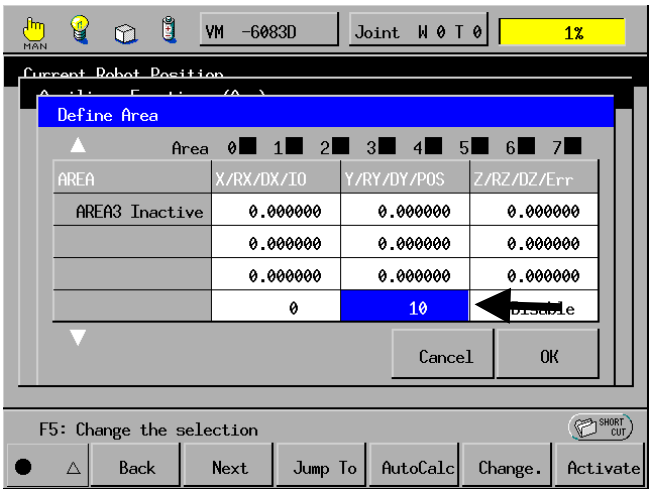


Then press [Change.]. The numeric keypad will appear as shown on the next page.

Step 6 From the numeric keypad, enter the desired position variable name, and then press the OK button.



Step 7 The new setting will appear in the selected entry field. Press the OK button.



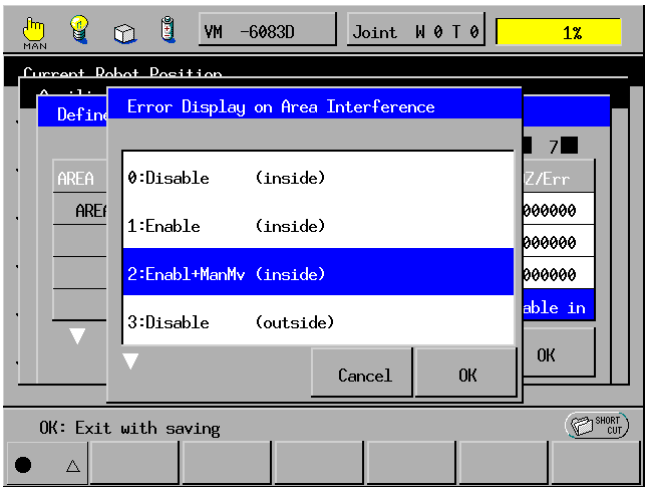
[8] Interpreting a detected area interference as an error

The moment the origin of the tool coordinates interferes with the active interference area, the system can detect it as an error and cut the motor power off to prevent the arm from proceeding into the area further.

You can choose any of the following items on the Error Display on Area Interference window.

Items	The system will detect it as an error when:	Error signal output
0: Disable (inside)	The robot arm invades the defined area.	No
1: Enable (inside)		Yes
2: Enable+ManMv (inside)		Yes (You may switch to Manual mode and operate the robot manually for recovery.)
3: Disable (outside)	The robot arm exits from the defined area.	No
4: Enable (outside)		Yes
5: Enable+ManMv (outside)		Yes (You may switch to Manual mode and operate the robot manually for recovery.)

Access: [ExtScrn]—[Arm]—[Aux.]—[Area.]



NOTES

(1) Once an area interference error occurs, the system cuts off the motor power so that the origin of the tool coordinates remains in the area. If you attempt to turn the motor power on under this state, an error will occur again and the motor power will be cut off. You need to disable the error detection, turn the motor power on, move the origin of the tool coordinates out of the area by manual operation, and then enable the error detection again.

(2) In Version 1.8 or later, if you set up any of items 3 through 5 (Detection when the robot arm exits from the defined area) for two check areas or more concurrently, then the system will interpret the overlapped area only as a motion space. If no overlapped area exists, the robot cannot run, so you need to modify the settings.

(3) When enabling interference check areas overlapped, refer to the precautions on the next page.

■ *Precautions in enabling interference check areas overlapped*

Enabling interference check areas overlapped and assigning an area output signal having the same number to those areas makes only the first invaded interference check area effective.

NOTES

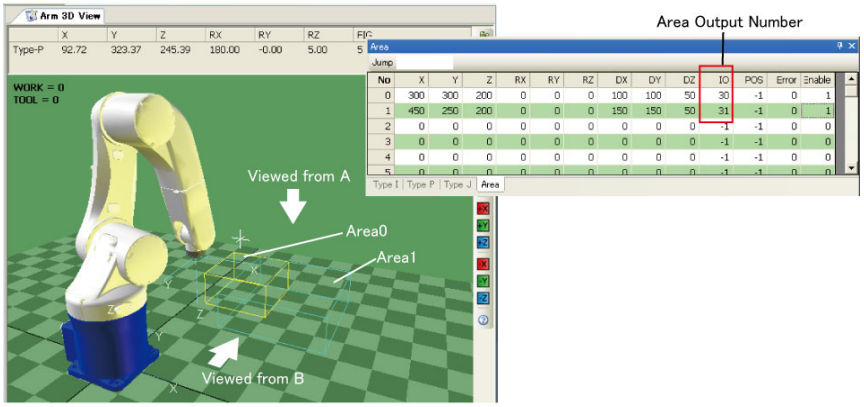
(1) Leaving an area and entering the adjoining area that overlaps the first one does not output an area interference error signal.

(2) There are no problems as long as an area output signal having the same number is not double assigned to interference check areas.

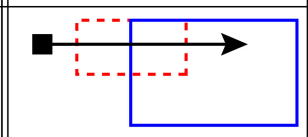
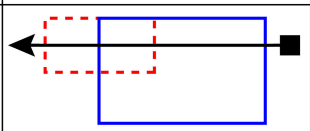
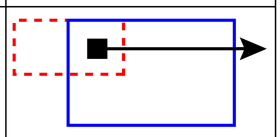
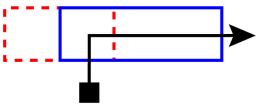
(3) There are no problems as long as interference check areas are not overlapped.

Description

The following describes the area signal output state resulting from these conditions--interference check areas overlapped and the same output port specified for their signal outputs.



Arm motion examples

Pattern	Pattern 1	Pattern 2	Pattern 3
Viewed from A			
Viewed from B			
Symbol	Area 0 Area 1 Arm path (Start point) (End point)		

Area signal output state by patterns

Pattern 1	Entering Area 0 turns the output signal ON. Leaving Area 0 turns it OFF. In the figure above, the origin of the tool coordinates has left Area 0 and is now staying in Area 1. Turning the motor power off and on in this state keeps the output signal OFF relating to Area 0. However, staying in Area 1 is detected so that the output signal relating to Area 1 is turned ON.
Pattern 2	Entering Area 1 turns the output signal ON. Leaving Area 1 turns it OFF.
Pattern 3	Entering Area 0 turns the output signal ON. Leaving Area 0 turns it OFF. If the origin of the tool coordinates enters an overlapped plane of two interference check areas, the output signal assigned to the area from which the origin first exits will be enabled.

The following procedure specifies whether or not to detect the invasion to the interference check area(s) as an error.

■ ***Operating procedure for area interference error detection***

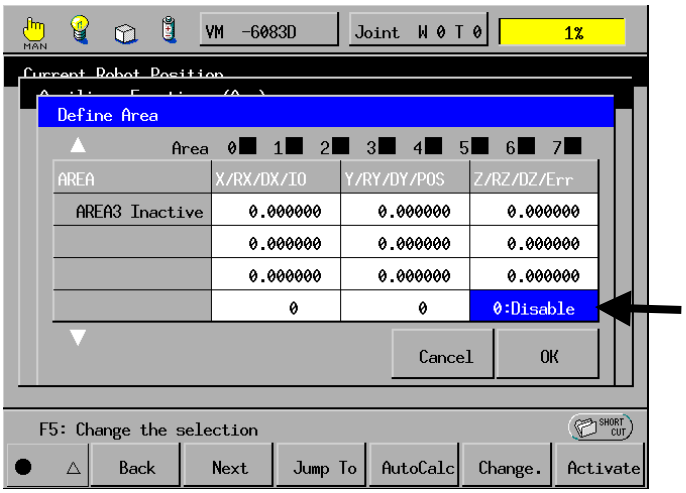
Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in the Current Robot Position window.

Step 3 Press [Area.] in the Auxiliary Functions (Arm) window.

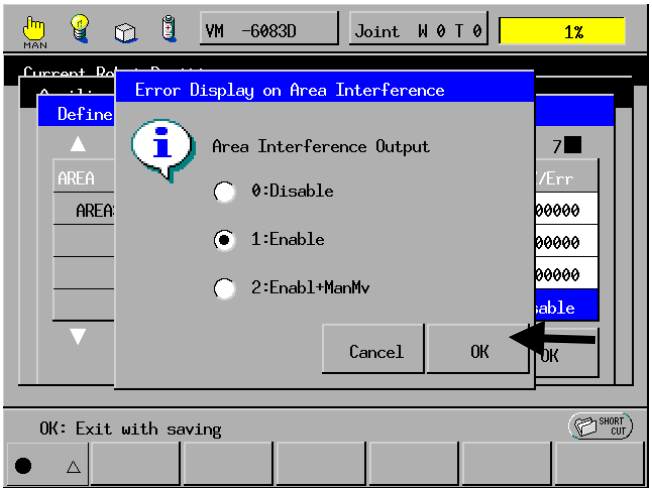
Step 4 Call up the defined interference check area to be modified with the cursor keys.

Step 5 In the Define Area window, select an entry field in the rightmost column of the bottom line.

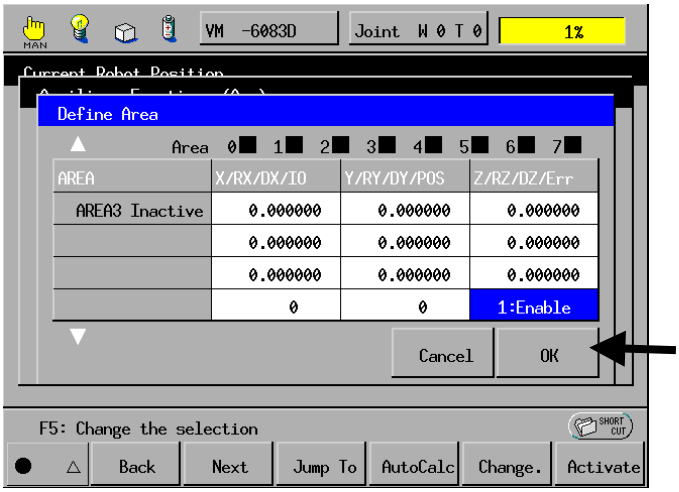


Then press [Change.]. The error detection disable/enable screen will appear as shown on the next page.

Step 6 Select Enable (or Disable), and then press the OK button.



Step 7 The new setting will appear in the selected entry field. Press the OK button.



[9] Defining an interference check area in WINCAPSIII

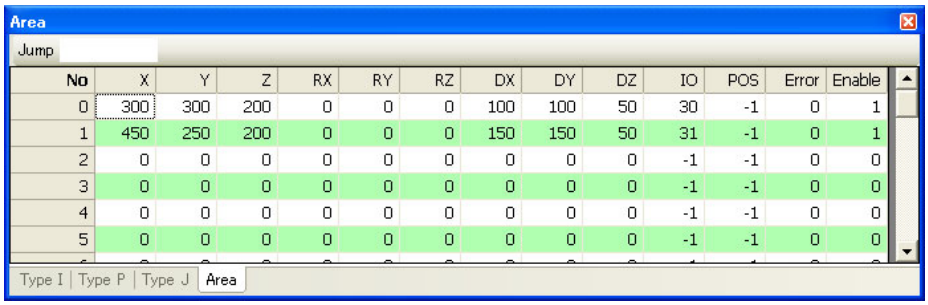
AREA0 to AREA3 are reserved for the system and not available to users.

Step 1

Start WINCAPSIII and log on as a Programmer.

Open the project of the target robot.

Choose View | Tool/Work/Area Settings to display the Area window shown below.



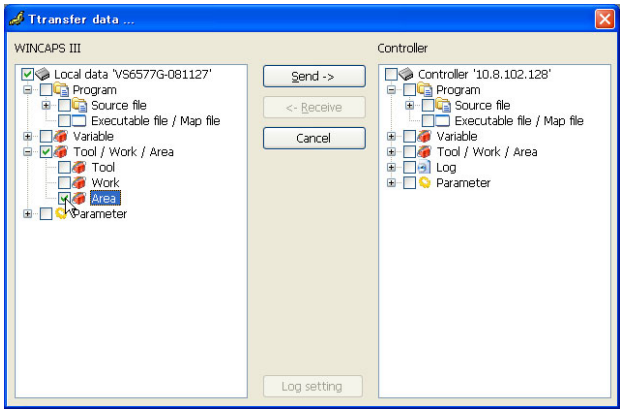
Step 2

Specify the interference check area related parameters for each area.

- X, Y, Z: Origin of the interference check area
- RX RY, RZ: Rotation angles of the interference check area
- DX, DY, DZ: Vectors of the interference check area
- IO: Number of an I/O signal that is turned ON when the origin of the tool coordinates invades the interference check area.
- POS: Number of a position variable (global variable) to which the position value of the end-of-arm tooling should be assigned the moment the origin of the tool coordinates invades the area.
- ERR: Specify whether or not to interpret a detected area interference as an error. (0: Do not interpret as an error, 1: Interpret as an error)
- ENABLE: Specify whether or not to detect an area interference. (0: Do not detect, 1: Detect)

Step 3

After completion of data entry, choose Connect | Transfer data to transfer the area data to the robot controller.



The area data received by the robot controller takes effect immediately.

[10] Escaping from the interference check area

If the robot enters the interference check area, errors of entering prohibited area will occur. If you set [2: Enable +ManMv] in the interference check area setting, then you may move the robot out of the interference check area from the teach pendant or the mini-pendant in the cases marked with "Available" in the table below.

Mode	Operation				
	Motor ON	Manual key	Variable shift	Motor lock	Direct
Manual	Available	Available	N/A	Available	N/A
Teach check	N/A	-	N/A	N/A	-
Internal auto	N/A	-	-	N/A	-
External auto	N/A	-	-	N/A	-

Setting [2:Enable + ManMv]

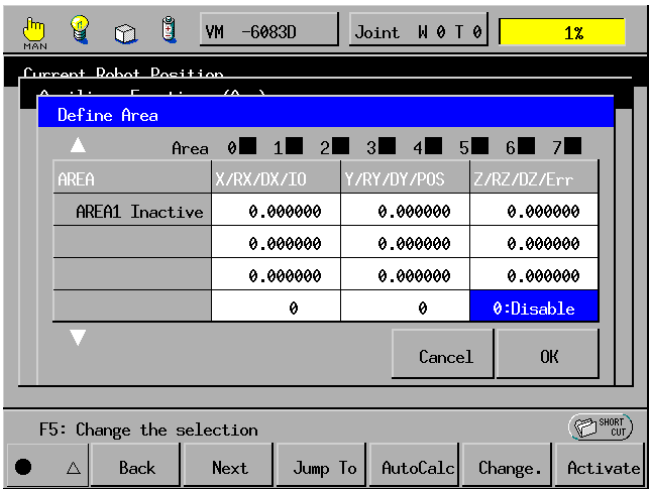
Step 1 On the extended screen of the teach pendant, press [Arm].

Step 2 Press [Aux.] in the Current Robot Position window.

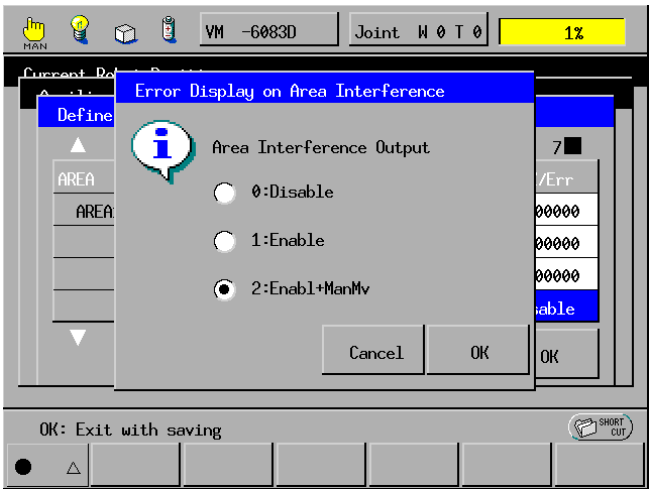
Step 3 In the Auxiliary Functions (Arm) window, press [Area].

Step 4 Using the cursor keys, select the area to be changed.

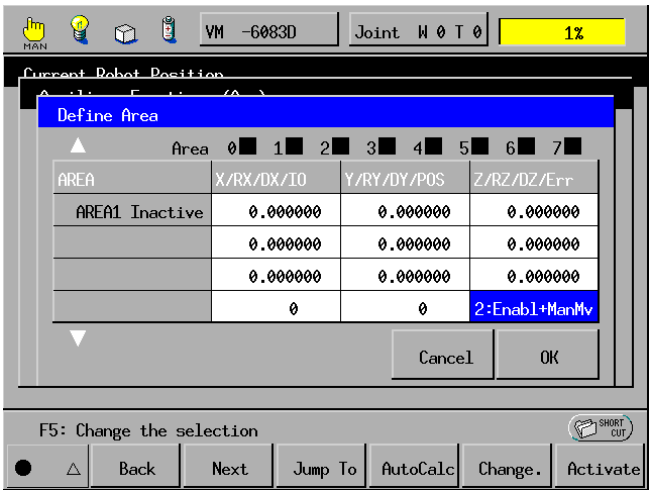
Step 5 Select the rightmost column of the table. Press [Change.].



Step 6 Select [2: Enable+ManMv] and press OK.

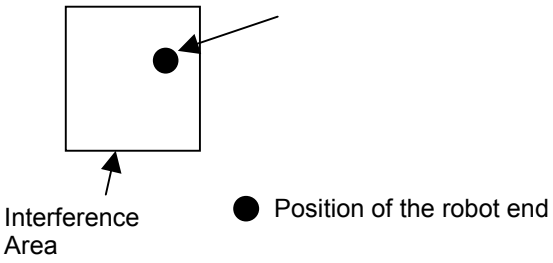


Step 7 You can change all the settings in the window for values you want. If you change any of them, confirm them and press OK.

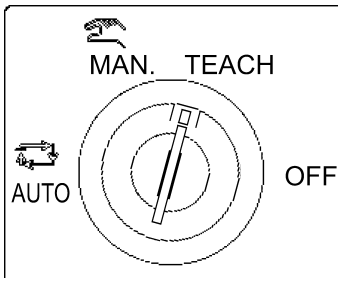


Escaping procedure

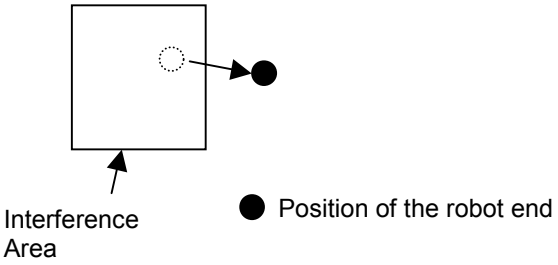
Step 1 Error will occur when the robot enters the interference area.



Step 2 On the operation panel, turn the mode selector switch to the TEACH position.



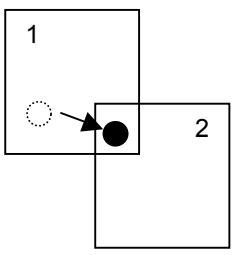
Step 3 Move the robot outside the interference area.



Note 1. Move the robot in the direction away from the interference point, although robots can move to the position anywhere commanded.

Note 2. If the robot enters an area of interference again, Error 2490-2497 (Prohibited area 0 - 7) will reoccur.

Note 3. If the areas of interference overlap, as shown in the figure below, error occurs first upon the robot end starting within the area 1 enters in the area 2. However, you can avoid this by aid of the method given above.



4.1.3 Figures of the Shoulder, Elbow, and Wrist

[1] Available 32 Figures

A 6-axis robot can take different figures for its shoulder, elbow, wrist, 6th axis, and 4th axis for a single point and attitude (X, Y, Z, RX, RY, and RZ) at the end of the end-effector.

Figures 4-28 through 4-32 show how the robot can take different figures for its shoulder, elbow, wrist, 6th axis, and 4th axis, respectively.

Combining these different figures allows the robot to take 32 different figures for its single position and attitude, as listed in Table 4-2.

Figure 4-33 shows examples of eight possible combinations of the shoulder, elbow, and wrist figures in 6-axis robots.

Table 4-2. Available Figures

Value	4th-Axis Figure	6th-Axis Figure	Wrist Figure	Elbow Figure	Shoulder Figure
0	SINGLE 4	SINGLE	FLIP	ABOVE	RIGHTY
1	SINGLE 4	SINGLE	FLIP	ABOVE	LEFTY
2	SINGLE 4	SINGLE	FLIP	BELOW	RIGHTY
3	SINGLE 4	SINGLE	FLIP	BELOW	LEFTY
4	SINGLE 4	SINGLE	NONFLIP	ABOVE	RIGHTY
5	SINGLE 4	SINGLE	NONFLIP	ABOVE	LEFTY
6	SINGLE 4	SINGLE	NONFLIP	BELOW	RIGHTY
7	SINGLE 4	SINGLE	NONFLIP	BELOW	LEFTY
8	SINGLE 4	DOUBLE	FLIP	ABOVE	RIGHTY
9	SINGLE 4	DOUBLE	FLIP	ABOVE	LEFTY
10	SINGLE 4	DOUBLE	FLIP	BELOW	RIGHTY
11	SINGLE 4	DOUBLE	FLIP	BELOW	LEFTY
12	SINGLE 4	DOUBLE	NONFLIP	ABOVE	RIGHTY
13	SINGLE 4	DOUBLE	NONFLIP	ABOVE	LEFTY
14	SINGLE 4	DOUBLE	NONFLIP	BELOW	RIGHTY
15	SINGLE 4	DOUBLE	NONFLIP	BELOW	LEFTY
16	DOUBLE 4	SINGLE	FLIP	ABOVE	RIGHTY
17	DOUBLE 4	SINGLE	FLIP	ABOVE	LEFTY
18	DOUBLE 4	SINGLE	FLIP	BELOW	RIGHTY
19	DOUBLE 4	SINGLE	FLIP	BELOW	LEFTY
20	DOUBLE 4	SINGLE	NONFLIP	ABOVE	RIGHTY
21	DOUBLE 4	SINGLE	NONFLIP	ABOVE	LEFTY
22	DOUBLE 4	SINGLE	NONFLIP	BELOW	RIGHTY
23	DOUBLE 4	SINGLE	NONFLIP	BELOW	LEFTY
24	DOUBLE 4	DOUBLE	FLIP	ABOVE	RIGHTY
25	DOUBLE 4	DOUBLE	FLIP	ABOVE	LEFTY
26	DOUBLE 4	DOUBLE	FLIP	BELOW	RIGHTY
27	DOUBLE 4	DOUBLE	FLIP	BELOW	LEFTY
28	DOUBLE 4	DOUBLE	NONFLIP	ABOVE	RIGHTY
29	DOUBLE 4	DOUBLE	NONFLIP	ABOVE	LEFTY
30	DOUBLE 4	DOUBLE	NONFLIP	BELOW	RIGHTY
31	DOUBLE 4	DOUBLE	NONFLIP	BELOW	LEFTY

(1) Shoulder figure

A shoulder figure is defined by a set of the values of the 1st-, 2nd-, and 3rd-axis components.

The robot can take two different shoulder figures--Left-handed (LEFTY) and Right-handed (RIGHTY).

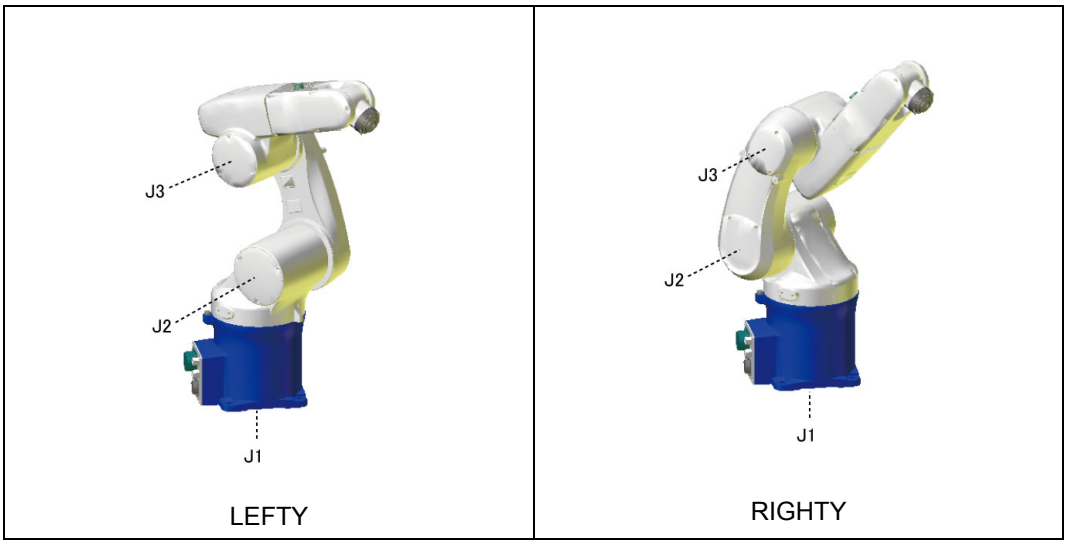


Figure 4-28. Shoulder Figure

(2) Elbow figure

An elbow figure is defined by a set of the values of the 2nd- and 3rd-axis components.

The robot can take two different elbow figures--Over-handed (ABOVE) and Under-handed (BELOW).

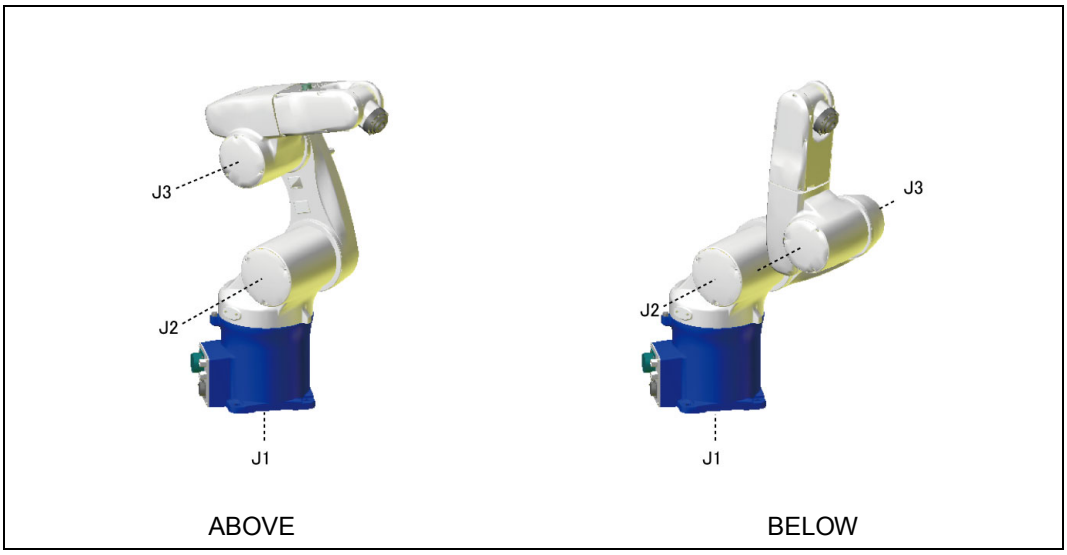


Figure 4-29. Elbow Figure

(3) Wrist figure

A wrist figure is defined by a set of the values of the 4th- and 5th-axis components.

The robot can take two different shoulder figures--Normal (NONFLIP) and Reversed (FLIP). The NONFLIP figure refers to a figure of the robot whose 4th axis is turned by 180 degrees without changing the wrist figure.

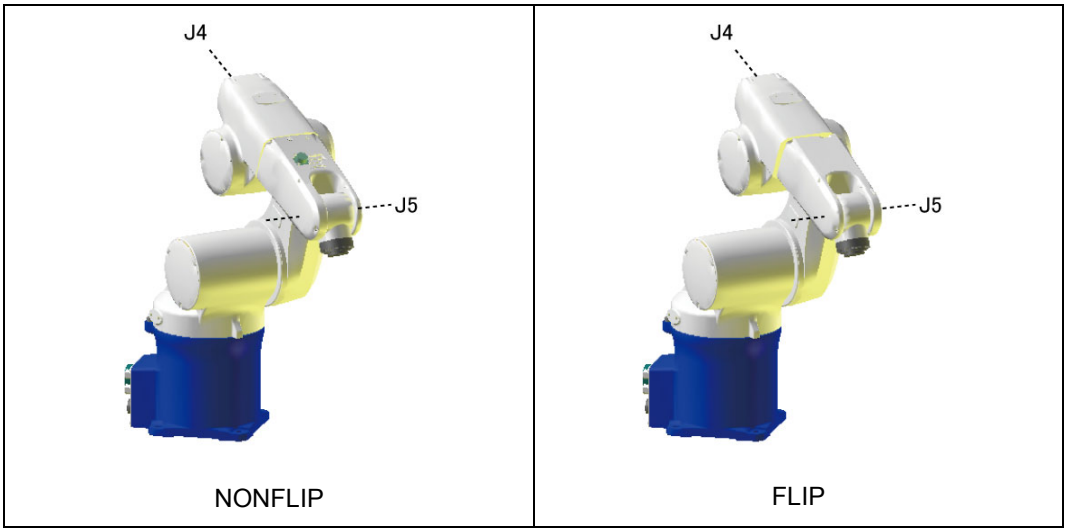


Figure 4-30. Wrist Figure

(4) 6th-axis figure

A 6th-axis figure is defined by the value of the 6th-axis component.

The robot can take two different 6th-axis figures--SINGLE and DOUBLE. If the 6th axis rotates by -180°<θ6≤180° in mechanical interface coordinates, the figure is SINGLE; if it rotates by 180°<θ6≤360° or -360°<θ6≤-180°, the figure is DOUBLE.

The robot takes quite different figures when θ6 is 180° or 181°. Take special care when changing any position data fort the 6th-axis figure. For example, supposing that you want to change the 6th-axis figure at θ6=181°, the robot will take the 6th-axis figure at θ6=-179° if you make no figure modification.

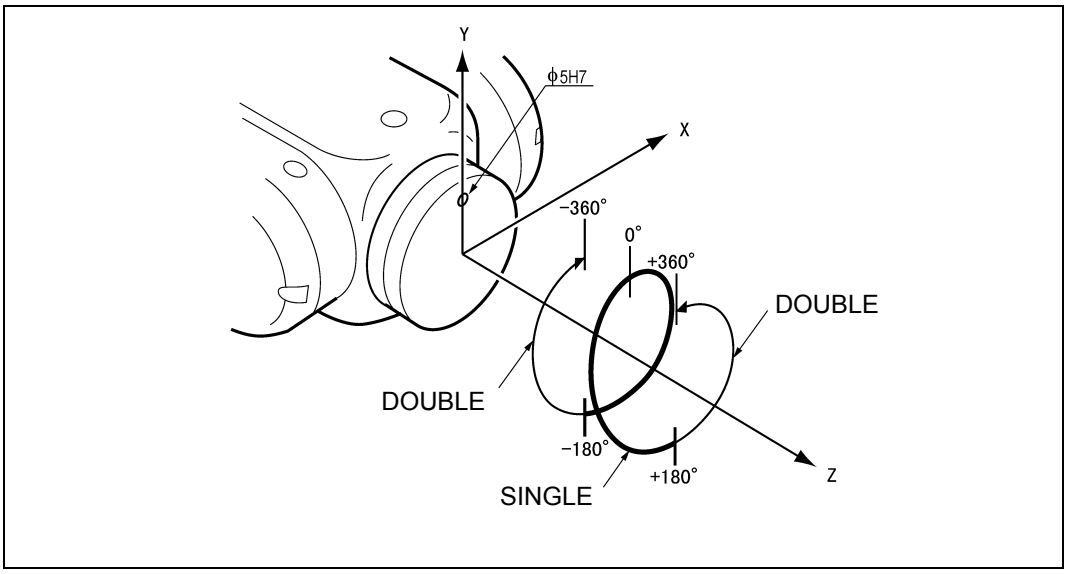


Figure 4-31. 6th-Axis Figure

(5) 4th-axis figure

The 4th-axis figure is defined by the value of the 4th-axis component.

The robot can take two different 4th-axis figures--SINGLE 4 and DOUBLE 4. If the 4th axis rotates by $-180° < \theta_4 \leq 180°$ in mechanical interface coordinates, the figure is SINGLE 4; if it rotates by $180° < \theta_4 \leq 185°$ or $-185° < \theta_4 \leq -180°$, the figure is DOUBLE 4.

The robot takes quite different figures when θ_4 is 180° or 181°. Take special care when changing any position data fort the 6th-axis figure. For example, supposing that you want to change the 4th-axis figure at θ_4=181°, the robot will take the 4th-axis figure at θ_4=-179° if you make no figure modification.

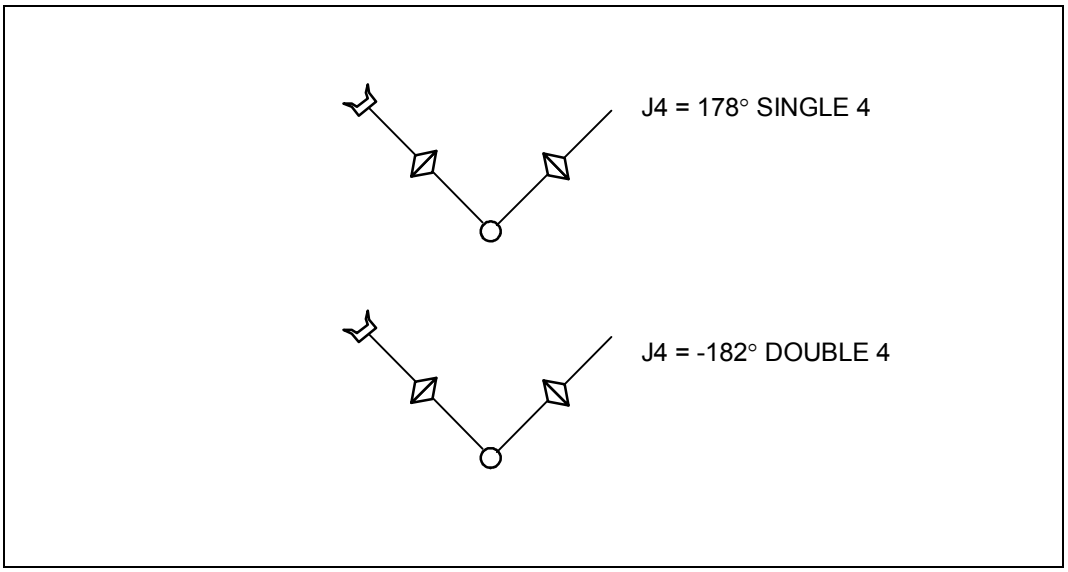


Figure 4-32. 4th-Axis Figure

Figure-1
LEFTY, ABOVE, and NONFLIP

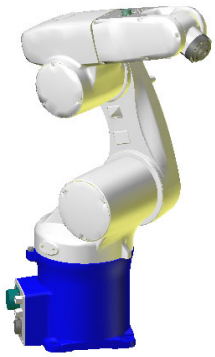


Figure-2
LEFTY, ABOVE, and FLIP

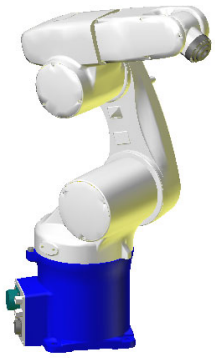


Figure-3
LEFTY, BELOW, and NONFLIP

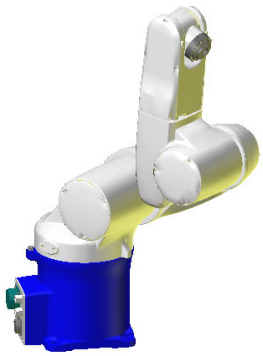


Figure-4
LEFTY, BELOW, and FLIP

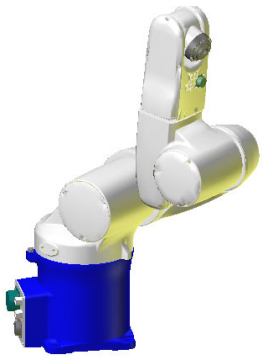


Figure-5
RIGHTY, ABOVE, and NONFLIP

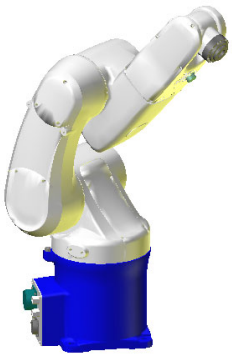


Figure-6
RIGHTY, ABOVE, and FLIP

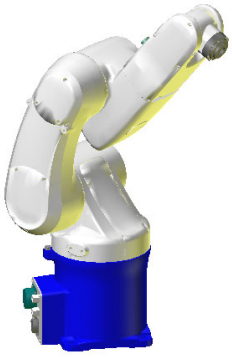


Figure-7
RIGHTY, BELOW, and NONFLIP

Figure-8
RIGHTY, BELOW, and FLIP

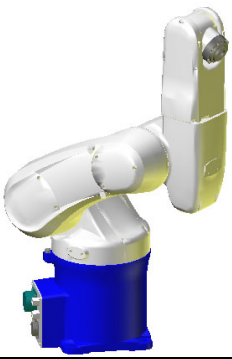
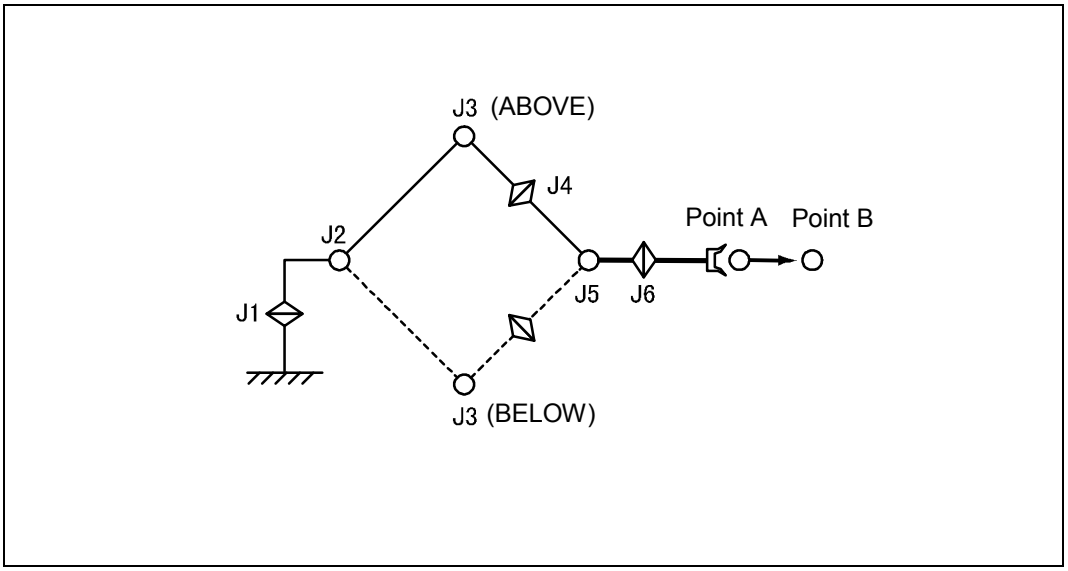


Figure 4-33. Possible Combinations of Robot Shoulder, Elbow, and Wrist Figures

⚠**CAUTION**: When carrying out a command with CP control, if the robot figures at the start point differ from those saved in programming or teaching, be sure to check beforehand that no part of the robot will interfere with the surrounding equipment or facilities. This is because each joint of the robot will take currently suitable motions depending upon the current figures to make the tip of the end-effector reach an object point even if the robot position and attitude at the start point are the same as those in programming or teaching. However, the path of the end-effector is virtually the same although the figures may be different.



CAUTION: All of the 32 different figures may not be applicable to every position and attitude of the robot due to the robot structure. In some cases, only the LEFTY/ABOVE/NONFLIP figure may be applicable depending upon point and attitude. (In almost of all practical cases, the robot may not take all of the logically possible figures, but only two figures are possible--LEFTY/ABOVE/NONFLIP and LEFTY/ABOVE/FLIP. For the 4th-axis figure, the robot will take SINGLE 4.)

[2] Boundaries of Robot Figures

This section describes the boundary of each of the robot shoulder, elbow, wrist, and 6th-axis figures.

When judging the boundaries of the robot shoulder, elbow, and wrist, the system uses intersection point Pw of the two rotary axes of the 5th and 6th axes, as illustrated in Figure 4-34.

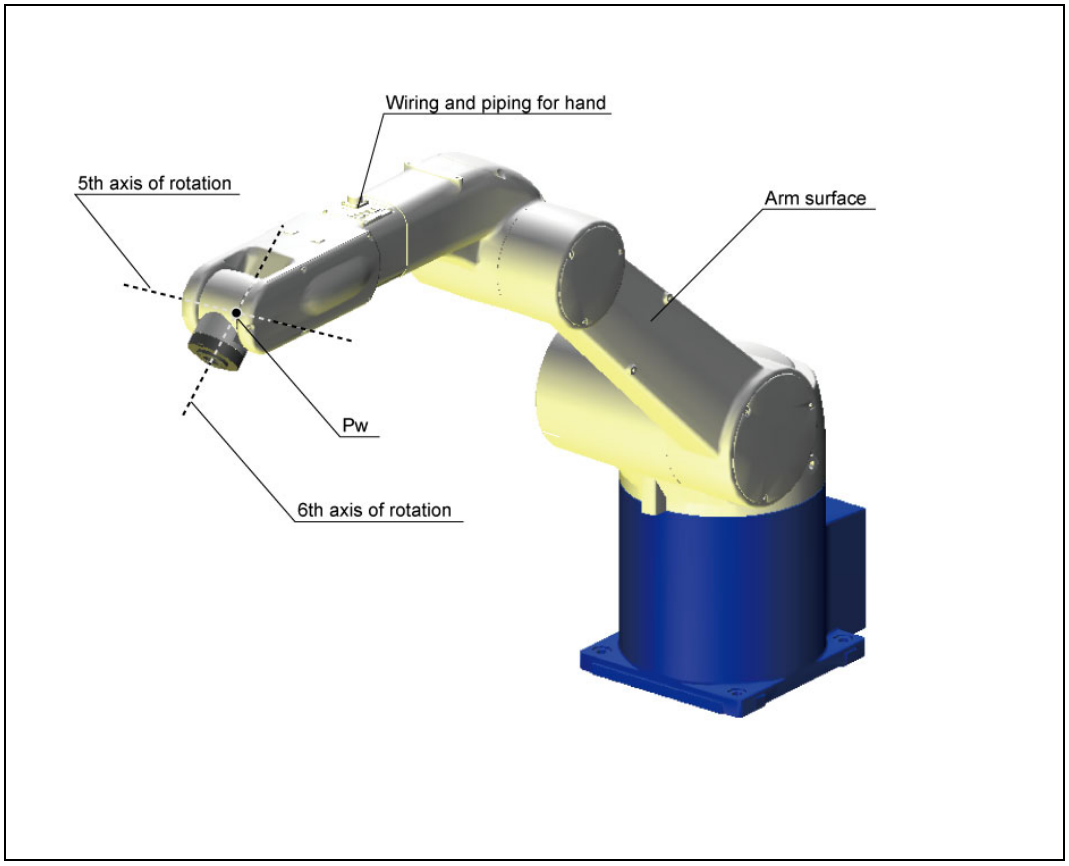


Figure 4-34. Location of Pw

A boundary point in figures is called a singular point.

Any path defined by commands with CP control (e.g., MOVE, APPROACH, and DEPART) should not run through the vicinity of the singular point. Refer to the PROGRAMMER'S MANUAL (I) (T03), Section 3.3, "Interpolation Control." If the path runs through the vicinity of the singular point, the robot will issue ERROR6080s (Overspeed) or ERROR6070s (Over software motion limit) and then stop.

(1) LEFTY/RIGHTY (Shoulder figure)

The rotary axis of the 1st axis is defined as the boundary between LEFTY and RIGHTY.

When viewed from the normal line on the side of the arm link, if point Pw exists in the left-hand side of the rotary axis of the 1st axis, the figure is LEFTY; if point Pw exists in the right-hand side, it is RIGHTY. In Figure 4-35, the boundary is drawn with alternate long and short dash lines.

NOTE: If point Pw exists on the rotary axis of the 1st axis, that is, on the boundary between LEFTY and RIGHTY, then it is called a singular point.

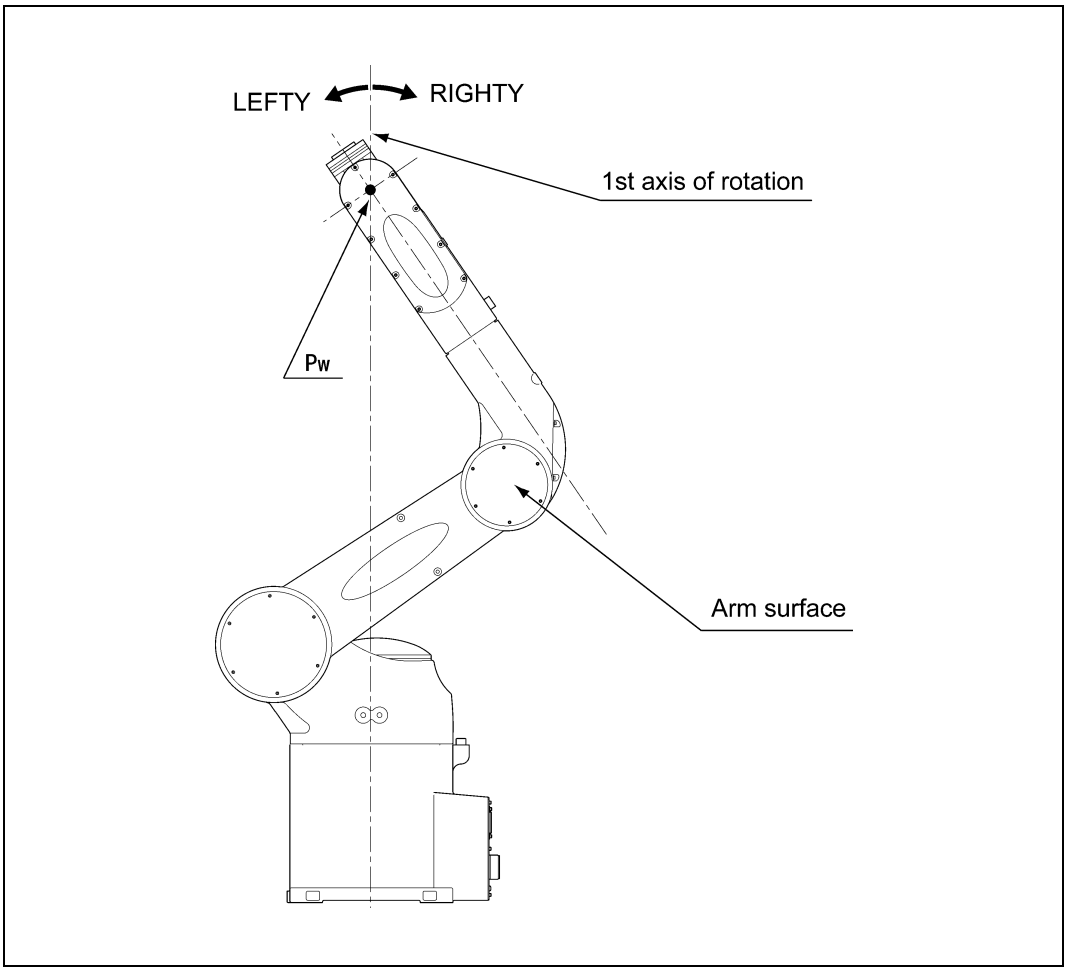


Figure 4-35. Boundary between LEFTY and RIGHTY

(2) ABOVE/BELOW (Elbow figure)

The centerline of the arm link (connecting the shoulder with elbow) is defined as the boundary between ABOVE and BELOW.

If point Pw exists in the + side of the centerline, the figure is ABOVE; if point Pw exists in the -side, it is BELOW. In Figures 4-36 and 4-37, the boundary is drawn with alternate long and short dash lines.

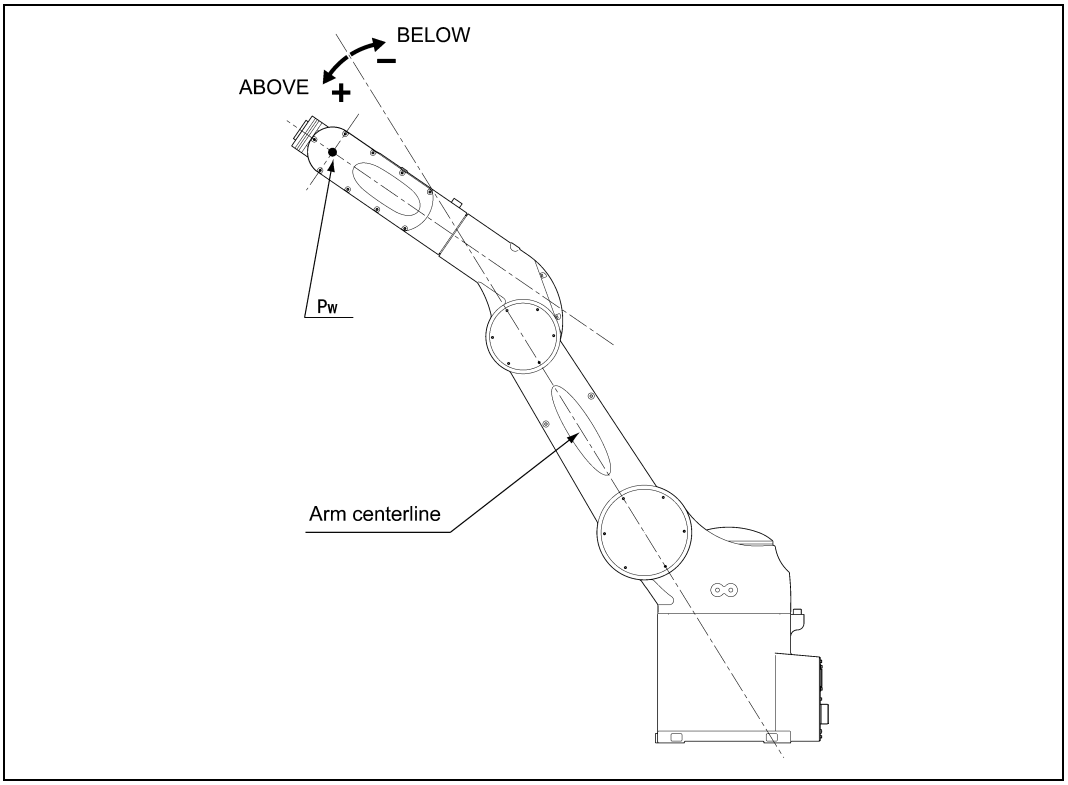


Figure 4-36. Boundary between ABOVE and BELOW for LEFTY

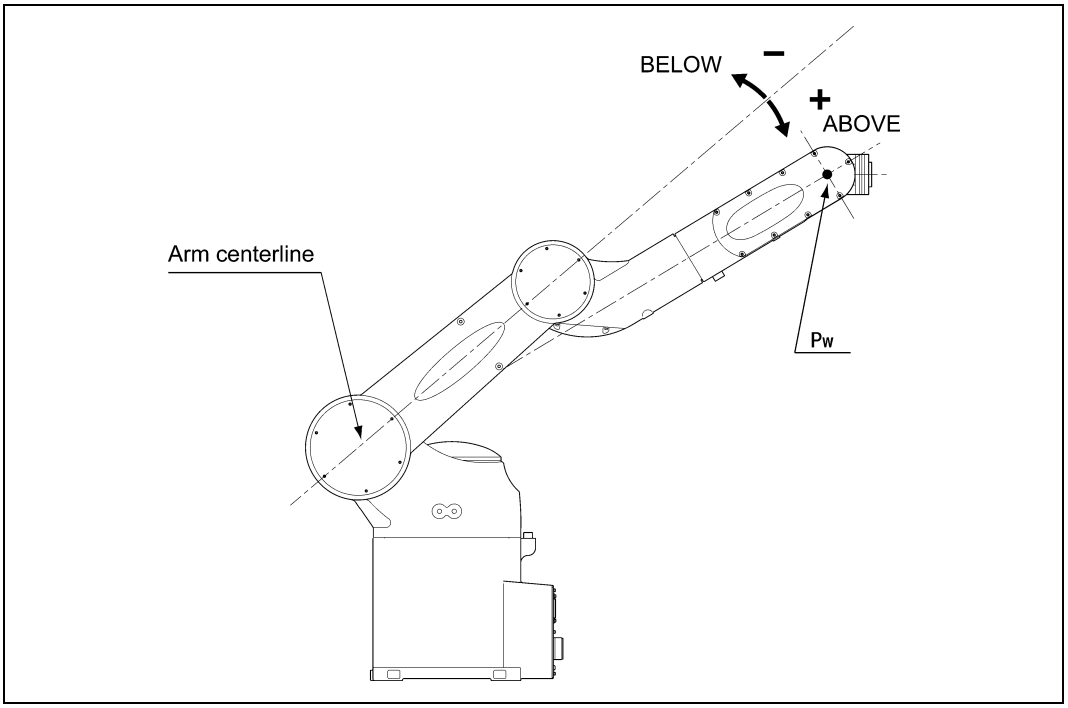


Figure 4-37. Boundary between ABOVE and BELOW for RIGHTY

(3) FLIP/NONFLIP (Wrist figure)

The rotary axis of the 4th axis is defined as the boundary between FLIP and NONFLIP.

If the normal line on the flange surface tilts up the rotary axis of the 4th axis, the figure is FLIP; if it tilts down the rotary axis, it is NONFLIP. In Figures 4-38 and 4-39, the boundary is drawn with alternate long and short dash lines.

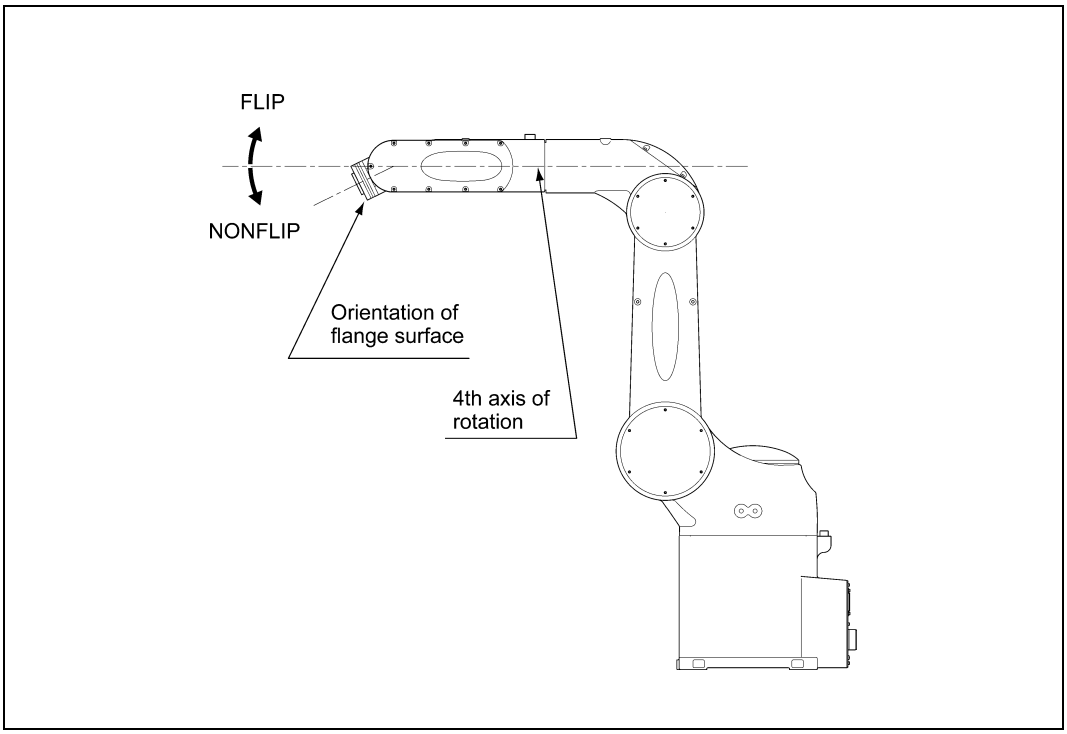


Figure 4-38. Boundary between FLIP and NONFLIP for LEFTY

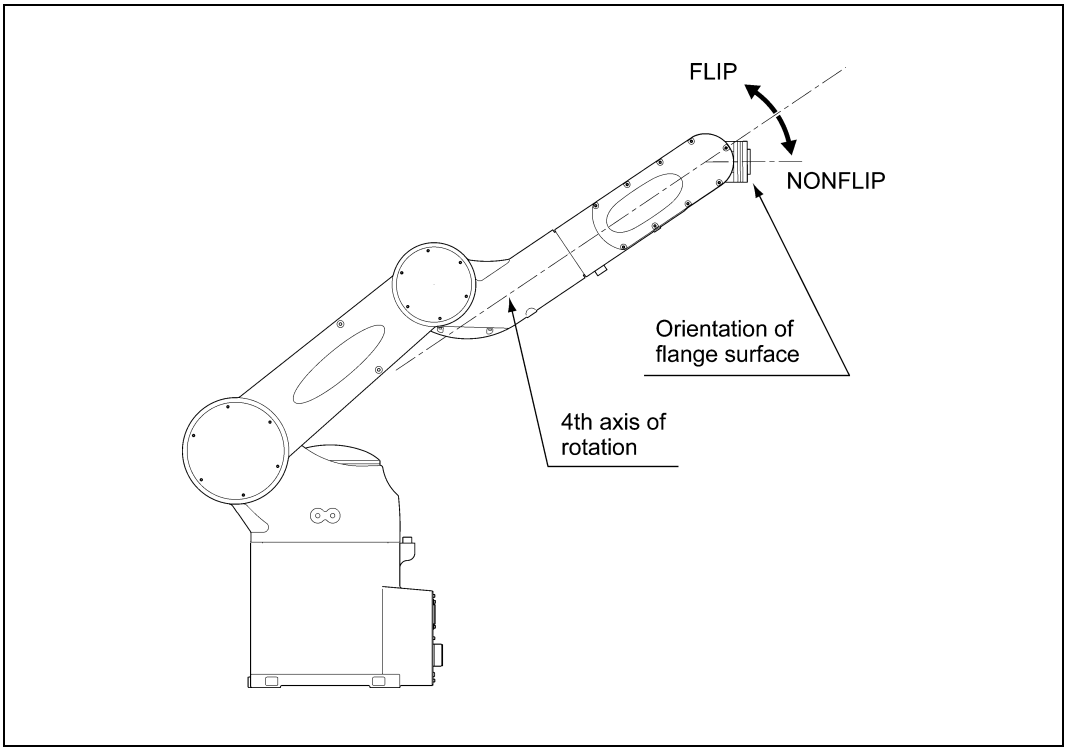


Figure 4-39. Boundary between FLIP and NONFLIP for RIGHTY

(4) SINGLE/DOUBLE (6th-axis figure)

If the rotation angle ($\theta 6$) of the 6th axis is within the range of $-180° < \theta 6 \leq 180°$ around the Z axis in mechanical interface coordinates, the figure is SINGLE; if it is within the range of $180° < \theta 6 \leq 360°$ or $-360° < \theta 6 \leq -180°$, the figure is DOUBLE. Boundaries exist at -180° and +180°.

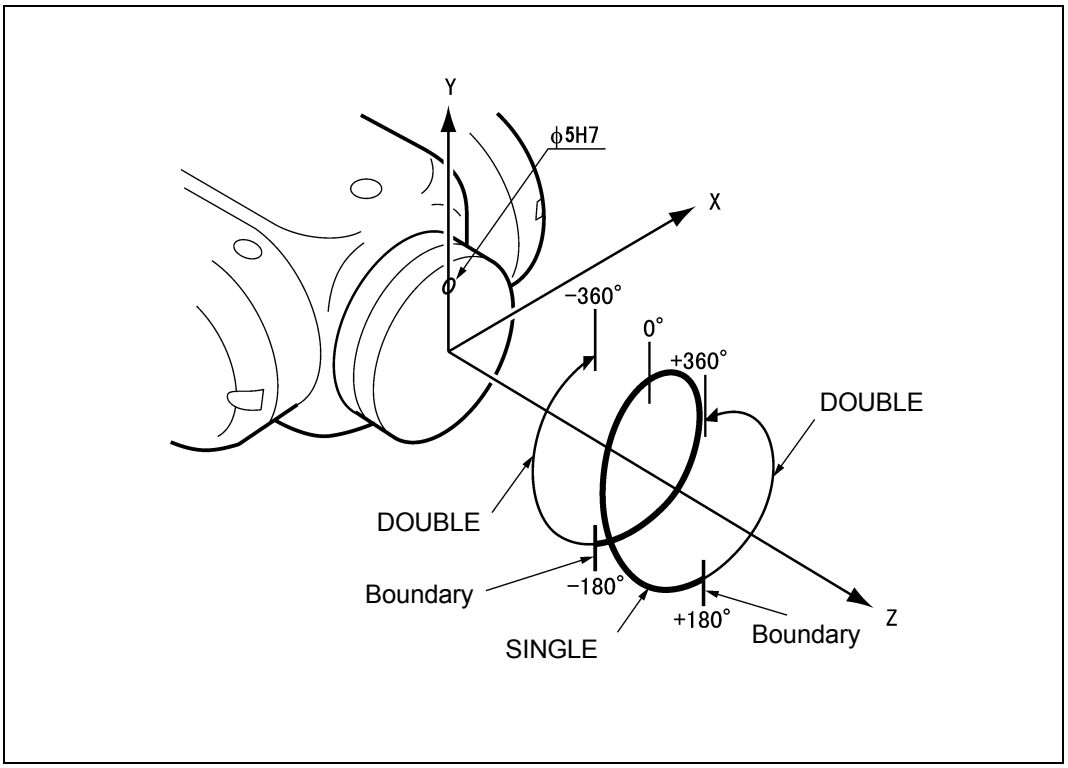


Figure 4-40. Boundary between SINGLE and DOUBLE

4.2 Coordinates, Interference Check Area, and Figures in 4-axis Robots

4.2.1 Coordinates

This section describes the coordinates required for correct handling of the robot.

[1] Base coordinates

[1.1] Base (world) coordinates and work coordinates

The base coordinates are so-called world coordinates which refer to 3-dimensional Cartesian coordinates whose origin is at the center of the robot basement. It has components Xb, Yb, and Zb which are identical with X, Y, and Z in X-Y mode explained in Section 3.2.1 "Teaching the Robot," [2] X-Y mode.

Work coordinates are 3-dimensional Cartesian coordinates defined for each operation space of workpiece. The origin can be anywhere and it lies at a corner of the rectangular parallelepiped envelope of an object workpiece as shown below. Work coordinates are expressed by the coordinate origin (X, Y, Z) corresponding to the base coordinates and the angles of rotation (Rx, Ry, Rz) around X, Y and Z axes of base coordinates.

If work coordinates are not defined, base coordinates go into effect.

Work coordinates can be configured only on the extended screen. Once configured, they affect robot motions in X-Y mode even after the controller exits from the extended screen.

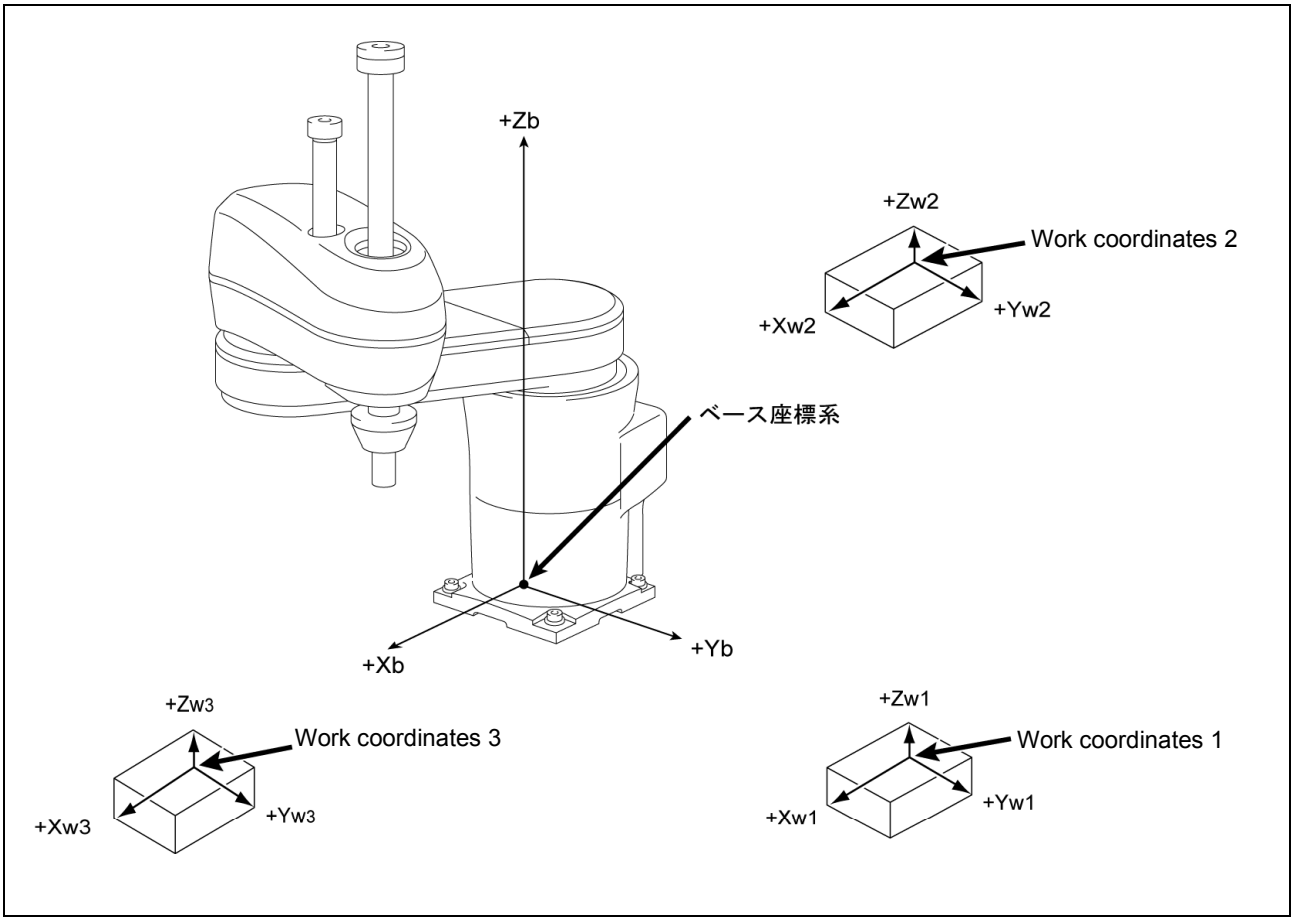


Figure 4-41. Base Coordinates and Work Coordinates

[1.2] Position data

Position data refers to a set of data which includes five components of base coordinates. Of these five components, three are robot flange center coordinates (the end-effector tip coordinates if an end-effector is defined) and two are current robot attitude components, as shown below.

Position data allows you to represent the current position of the robot flange center and object points.

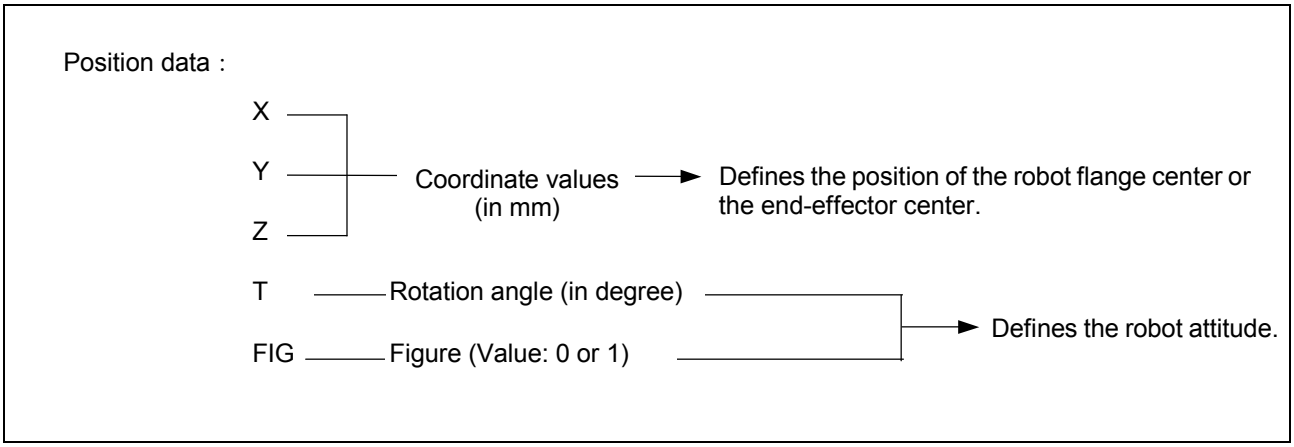


Figure 4-42. Components of Position Data

A set of X, Y, and Z coordinate values represents the position of the robot flange center (or tip of the end-effector if defined) expressed in base coordinates (Xb, Yb, and Zb) in units of mm.

The rotation angle expressed by T refers to an angle formed by the X axis of the TOOL0 coordinates and the Xb axis of the base coordinates. The angle is expressed in units of degree.

Figure represented by FIG value refers to a figure of robot arm joints. It is explained in Section 4.2.3, "Shoulder Figure."

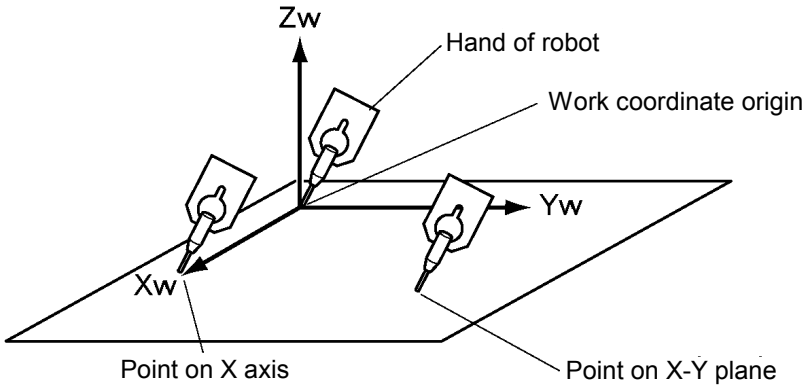
[1.3] Defining work coordinates

Two procedures, 3-point teaching and direct value entry, are available for defining work coordinates.

Defining work coordinates by 3-point teaching
[Arm]—[Aux.]—[Work]—[AutoCalc] from the extended screen

In this method coordinates are created by teaching three points, namely, the origin of work coordinates, a point on X-axis and a point on X-Y plane.

For the operating procedure, refer to "■ Defining work coordinates by 3-point teaching" on page 4-5.



Defining work coordinates by direct value entry
[Arm]—[Aux.]—[Work]—[Change.] from the extended screen

Enter the coordinate origin (X, Y, Z) corresponding to the base coordinates and rotation angles (Rx, Ry, Rz) around the X-axis, Y-axis and Z-axis of base coordinates.

Note 1. For the operating procedure, refer to "■ Defining work coordinates by direct value entry" on page 4-8.

Note 2. Work coordinates defined on the extended screen are valid also on the top screen.

[2] Tool Coordinates

[2.1] Tool definition

Tool definition refers to entering offset values for the dimensions of end-effectors to be mounted. This enables the robot to move the end of the mounted end-effector to desired positions.

Without tool definition, the point defined in X-Y mode (that is, the coordinates shown in X-Y mode on the LCD) is referred to as the tool end. When the power is turned on, the rotation center of the 4th axis (the center of the robot flange) is referred to as the tool end.

If you establish tool definition according to the actual end-effector to be mounted and select the X-Y mode, the robot controller will automatically offset the coordinates in X-Y mode by the values specified in tool definition so as to show the actual end position of the end-effector as a tool end.

Therefore, even if the same position has been taught, the tool end will differ depending upon whether or not tool definition is established.

In X-Y mode, you may rotate the 4th axis or the tool end manually. The center of the rotation will differ depending upon whether or not tool definition is established, as shown below.

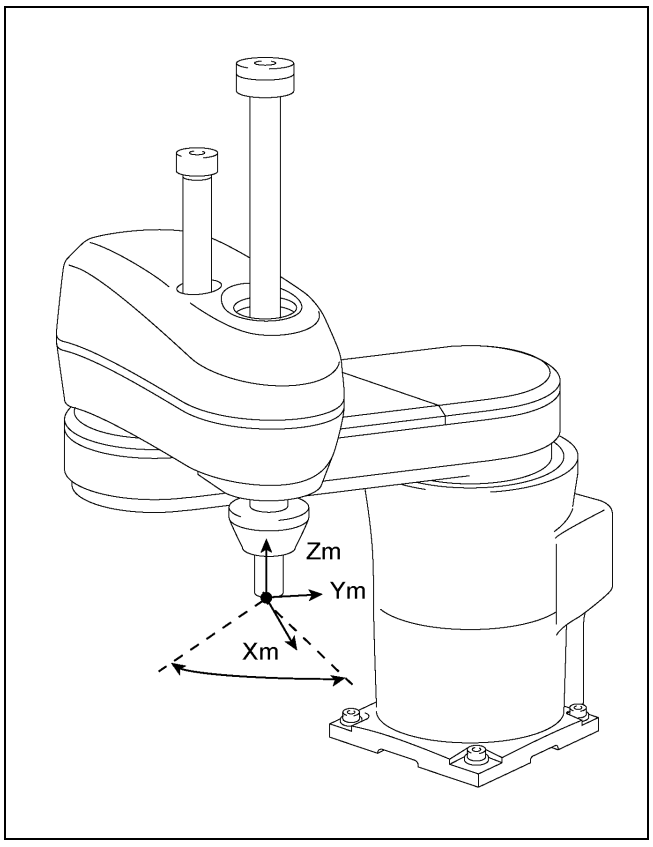


Figure 4-43. Manual Rotation of 4th Axis in X-Y mode, w/o Tool Definition

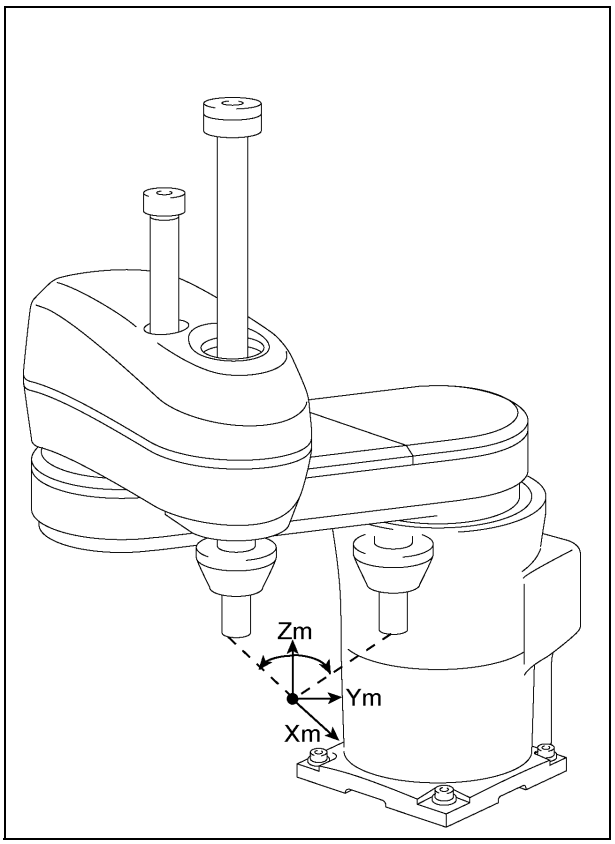


Figure 4-44. Manual Rotation of 4th Axis in X-Y mode, w/ Tool Definition

[2.2] Tool definition procedure

You may enter data relating to end-effectors to be used with the teach pendant.

Enter numerical values in the X-Y coordinates whose origin is the center of rotation of the 4th axis. The coordinates are called "Tool coordinates" which are shown below.

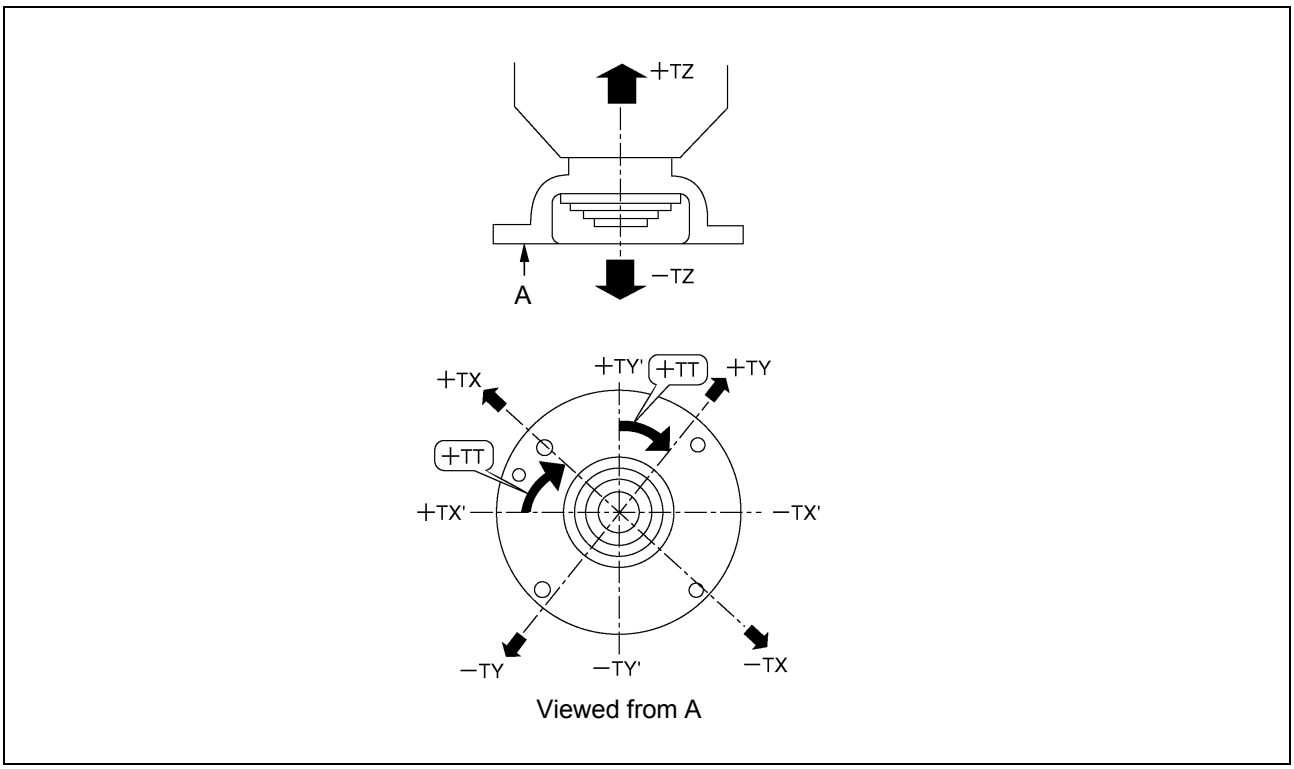


Figure 4-45. Tool Coordinates

Table 4-3 lists parameters in tool definition. Each parameter specifies tool offset on each tool coordinate.

Table 4-3. Tool Components and Parameters

Tool components	Used for	Unit
X	Offset in TX direction	mm
Y	Offset in TY direction	mm
Z	Offset in TZ direction	mm
T	Offset in TT direction	degree

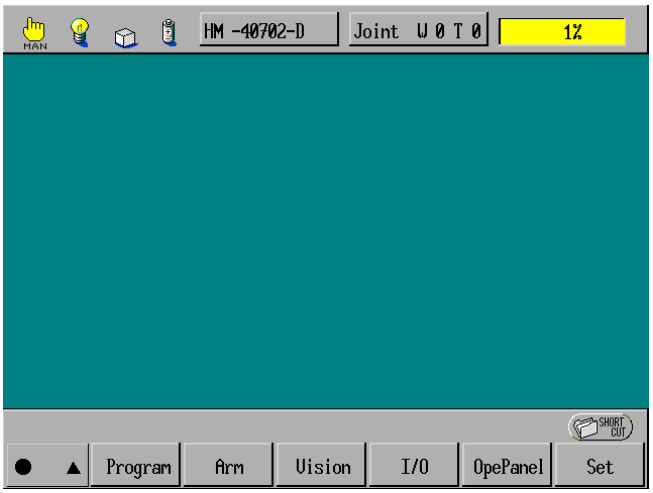
Operating procedure for tool definition

According to the procedure below, you may define arbitrary tool coordinates from the teach pendant. In this example, TOOL1 is defined. The same procedure would apply to TOOL2 through TOOL63.

With this procedure, you may also display or modify the current tool coordinates.

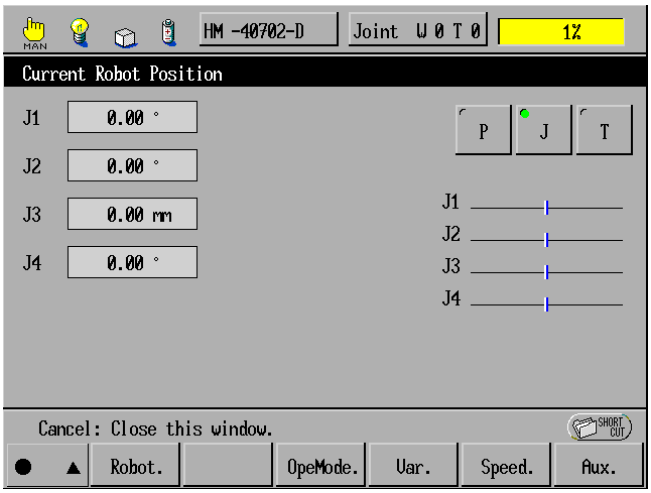
■ ***From the teach pendant***

Step 1 On the extended screen of the teach pendant, press [Arm].



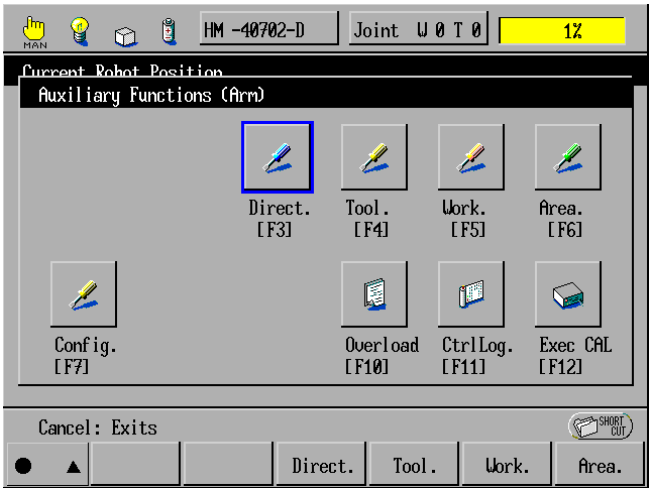
The Current Robot Position window appears as shown below.

Step 2 On the Current Robot Position window, press [Aux.].



The Auxiliary Functions (Arm) window appears as shown below.

Step 3 On the Auxiliary Functions (Arm) window, press [Tool.].

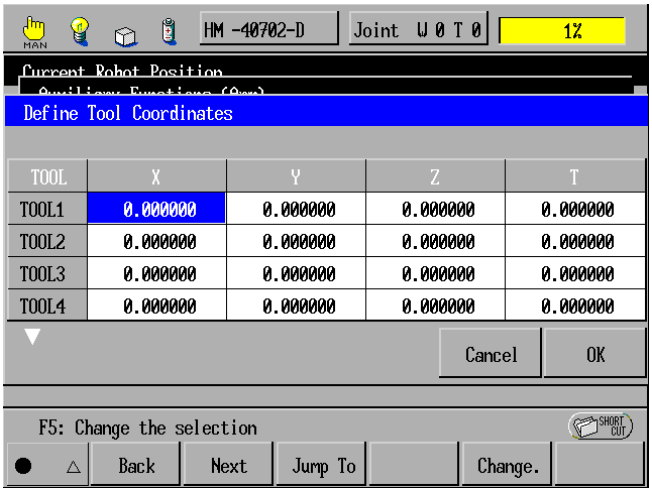


The Define Tool Coordinates window appears as shown below.

Step 4 Select the X column of TOOL1 row by using the cursor keys.

The selected area will become highlighted.

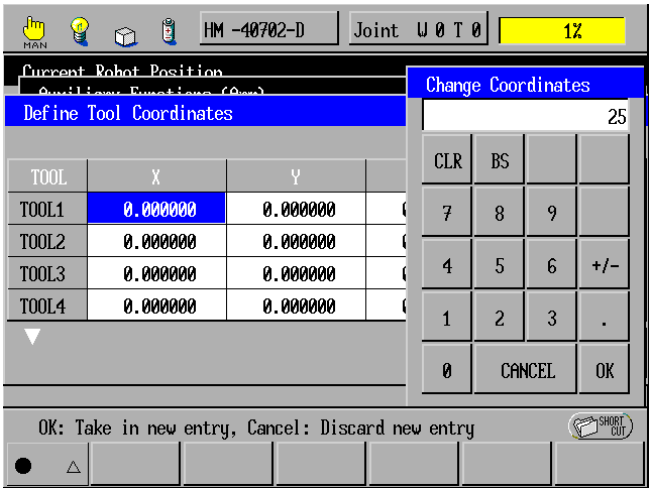
Then press [Change.].



The numeric keypad appears as shown in the next step.

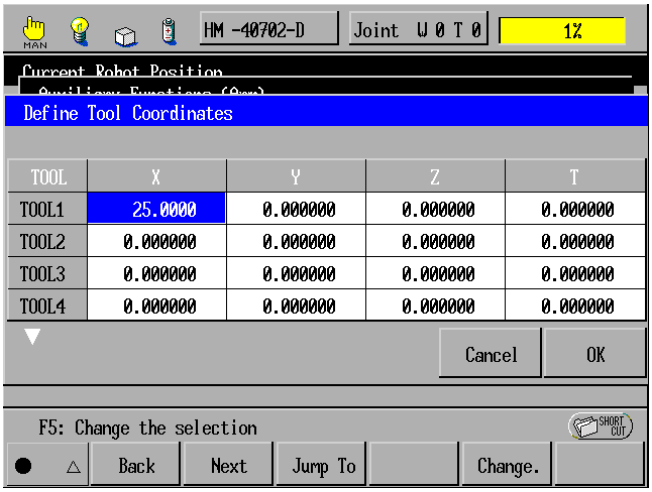
The Define Tool Coordinates window can also be called up by pressing [Constant]—[Teach/Playback Conditions]—[Tool] from the top screen of the teach pendant.

Step 5 Use the numerical buttons on the numeric keypad to enter the desired offset distance on the X axis. Then press the OK button.



The numeric keypad disappears and the offset distance on the X axis will be entered in the X column of the TOOL1 row as shown below.

If the newly entered value is satisfactory, press the OK button; if not, press the Cancel button.



Step 6 Repeat Steps 4 and 5 to enter offset distances to the Y, Z, and T columns of the TOOL1 row.

Step 7 After entering offset values to all of the X, Y, Z, and T of the TOOL1, press the OK button. This completes the procedure of tool definition for TOOL1.

Precautions when defining tool coordinates

(1) The CHANGETOOL statement will take effect only in a program that has gotten robot control by successful execution of the TAKEARM statement.

Execution of the TAKEARM statement will initialize the tool coordinates definition to TOOL0 (default that is the same as settings for the mechanical interface coordinates).

(2) From the step where CHANGETOOL statement is written in the programs, the defined tool coordinates will take effect. The definition will remain valid up to the step immediately preceding the step where new CHANGETOOL statement is written.

(3) If no CHANGETOOL statement is written in a program, TOOL0 (mechanical interface coordinates) will apply.

(4) Once you select tool coordinates on the Select Operation Mode window called up by the M-MOD key on the teach pendant, it will take effect in Tool mode until it will be changed.

(5) If TOOL number used for running the robot to the object point and attitude differs from TOOL number previously used in writing the current point and attitude, the resulting position and attitude of the robot flange will become different from the previous ones.

For example, when programming, if you have written the object point and attitude using the APPROACH command in TOOL0 and you insert TOOLn (n is any of 1 through 63) in any step preceding the APPROACH command, then executing the program brings the center of the robot flange to a different point and attitude than those defined in TOOL0, depending upon the contents of those different tool definitions.

(6) The tool coordinates definitions made in program execution and in manual running are saved in the same memory location.

If you switch the operation mode from Auto mode to Manual mode, the tool coordinates definition made in programming will remain in effect.

(7) You may at anytime check the current TOOL number in the status bar on the teach pendant. Refer to "Displaying the current tool coordinates" on page 4-26.

For details about commands and tool definitions, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 12.1, "Motion Control, APPROACH" and Section 9.5, "Tool Coordinates, TOOL." Also refer to Section 4.1, "[2.7] Tool definition" in this chapter.

4.2.2 Interference Check Area

You can define an interference check area(s) to prevent the robot arm from interfering with other devices or facilities.

The interference check area can be defined based on the base coordinates and work coordinates shown below.

There are eight interference check areas (AREA0 to AREA7). The robot system uses AREA0 to AREA3 for setting up the origin point, so they are not available in PAC programs. AREA4 to AREA7 are available.

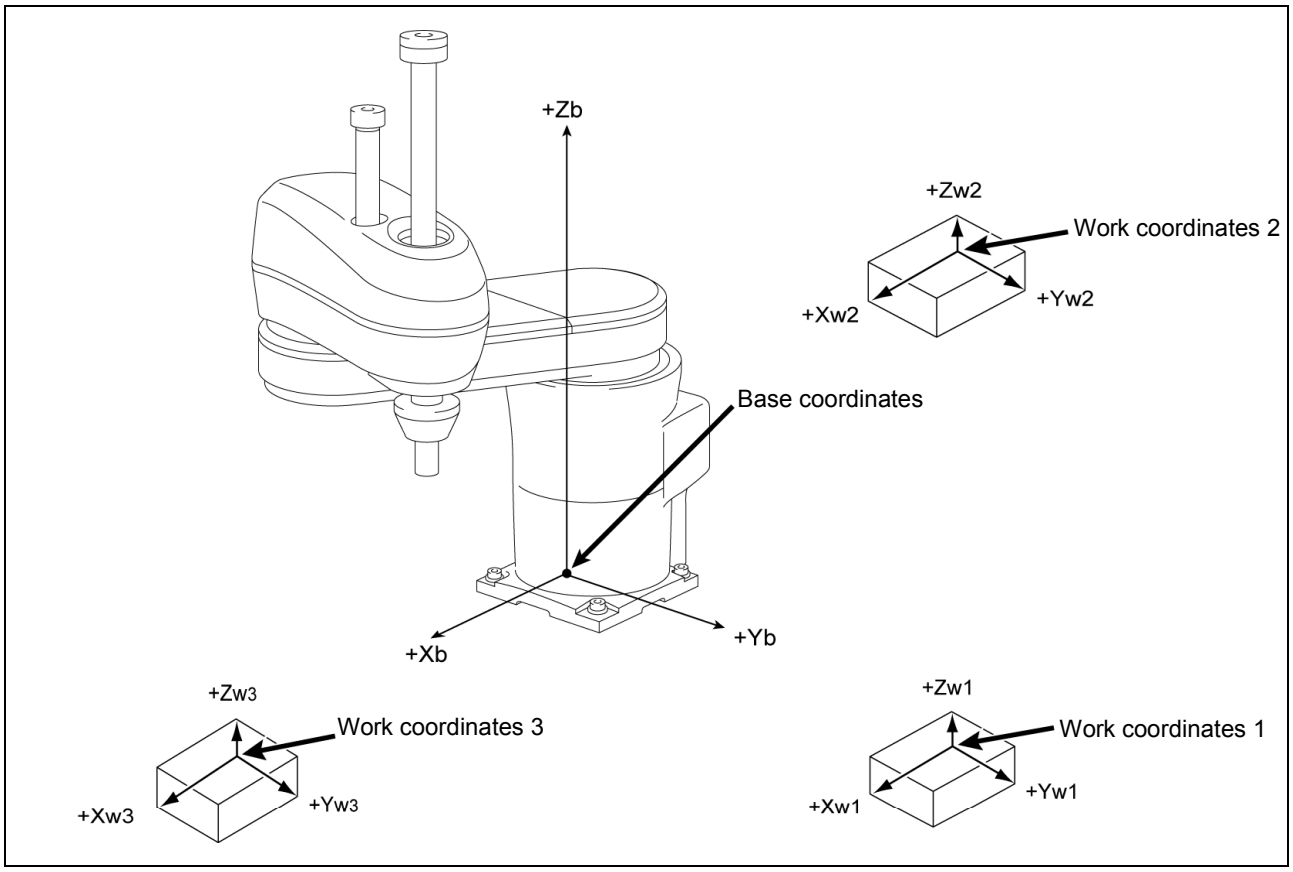


Figure 4-46. Work Coordinates and Base Coordinates

[1] Notes on interference check area

(1) The center of the interference check area is always based on the base coordinates (WORK0).

(2) Even if work coordinates are changed, the interference check area does not change.

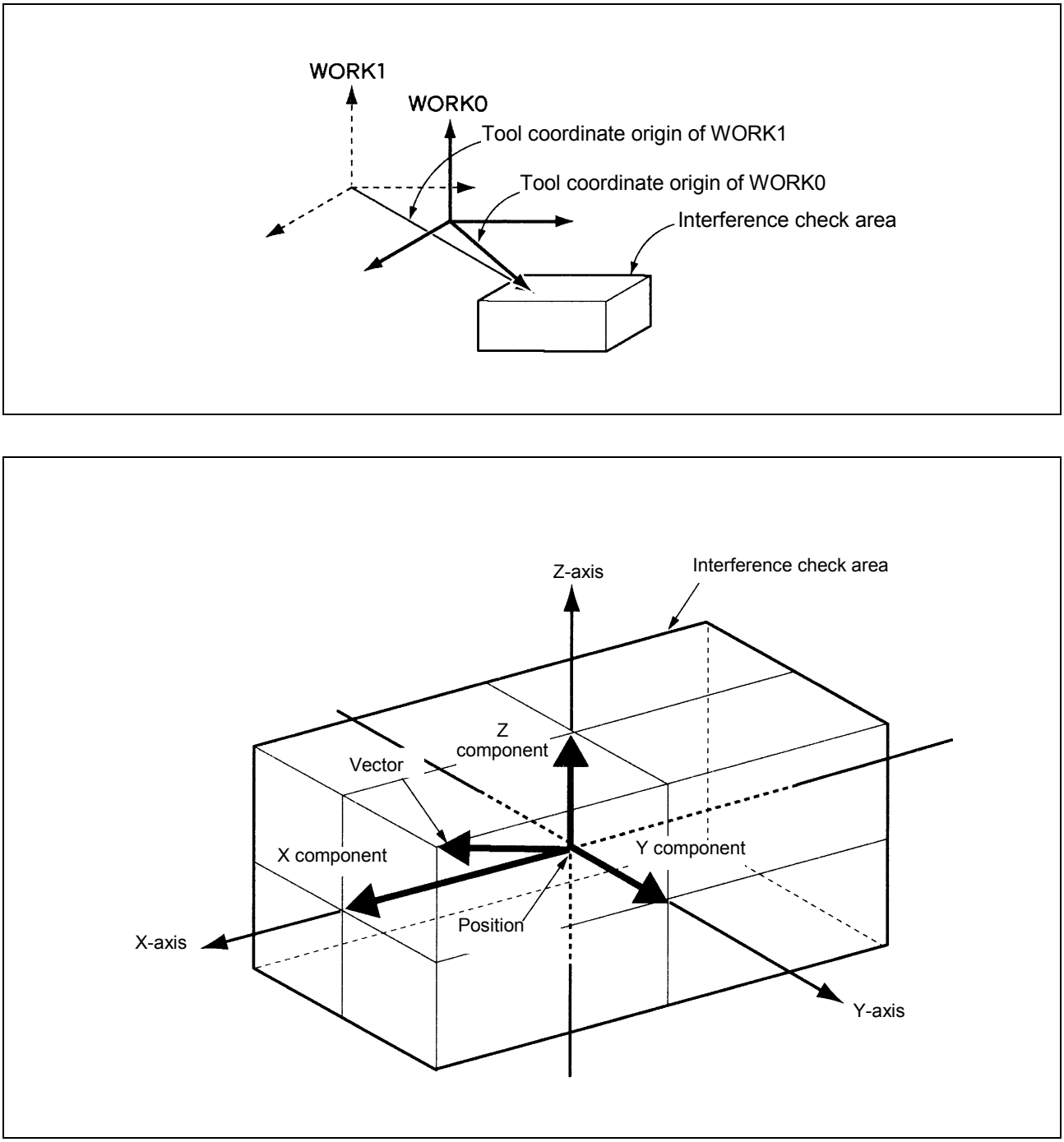


Figure 4-47. Interference Check Area

[2] Setting the center, angle and range of area

Two procedures, 2-point teaching and direct value entry, are available for defining an interference check area(s).

Defining an interference check area by 2-point teaching [AutoCalc]

You may define an interference check area(s) by teaching a work coordinates number (where you want to set an interference check area) and two points—vertexes farthest and nearest to the origin of the base coordinates.

For the operating procedure, refer to "[3] Defining an interference check area by 2-point teaching" on page 4-33.

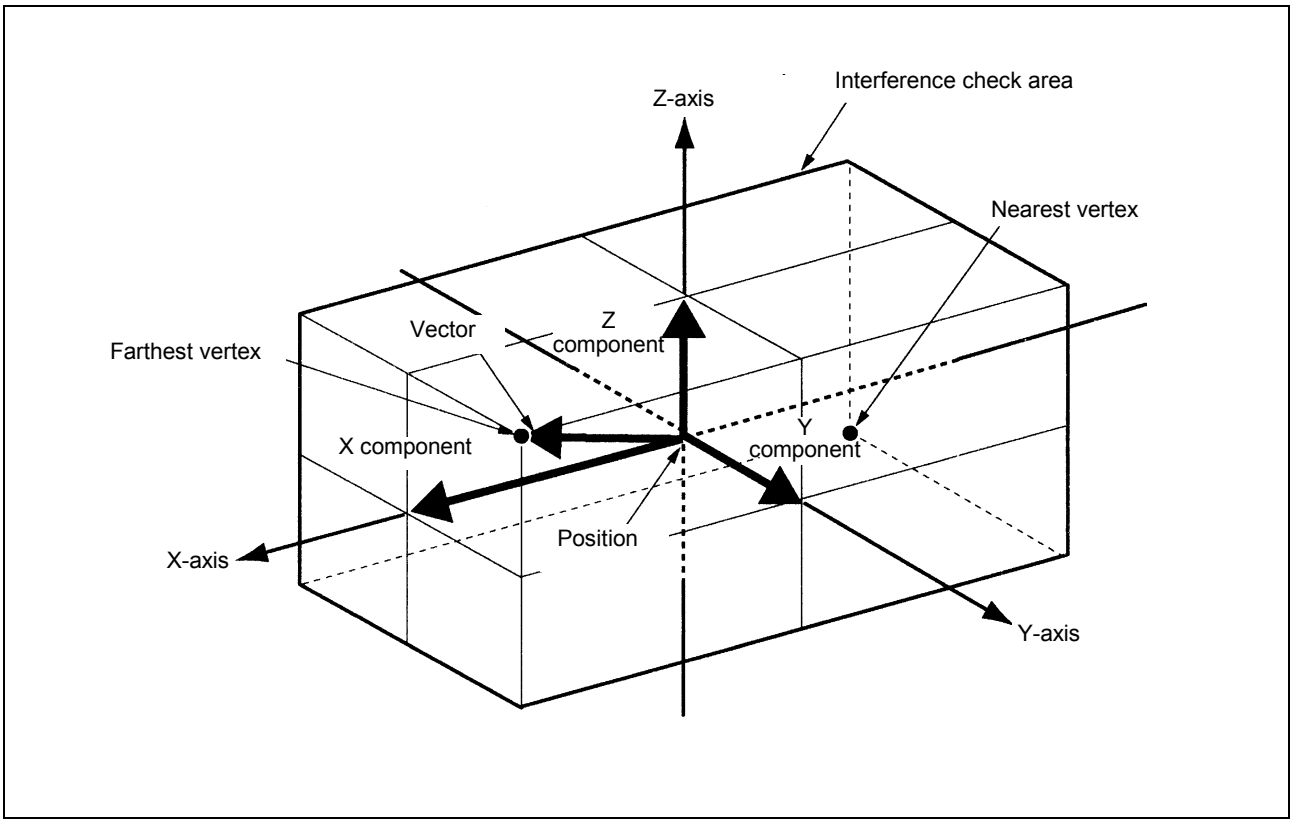


Figure 4-48. Defining an Interference Check Area by 2-point Teaching

Defining an interference check area by direct value entry [Change.]

You may define an interference check area by entering an area origin point (X, Y, and Z) relative to the base coordinates, the rotation angles (Rx, Ry, and Rz) around the X-axis, Y-axis, and Z-axis of the base coordinates, and the vector.

For the operating procedure, refer to "[4] Defining an interference check area by direct value entry" on page 4-36.

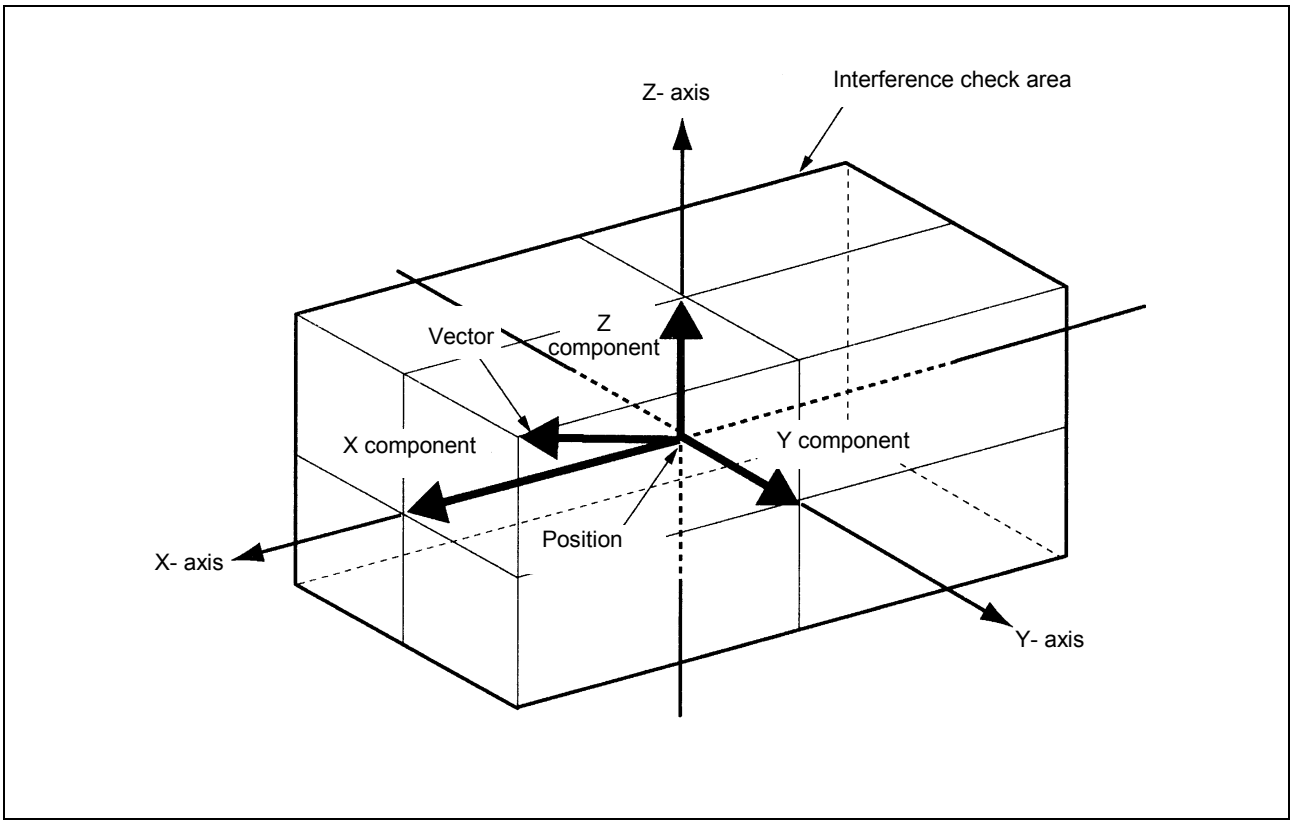


Figure 4-49. Defining an Interference Check Area by Direct Value Entry

[3] Making the defined interference check areas active or inactive

For settings, refer to Section 4.1.2 [5].

[4] Turning the specified I/O signal(s) on or off at the detection of area interference

For settings, refer to Section 4.1.2 [6].

[5] Specifying a position variable name to which the current position value will be assigned at the detection of area interference

For settings, refer to Section 4.1.2 [7].

[6] Interpreting a detected area interference as an error

For settings, refer to Section 4.1.2 [8].

[7] Defining an interference check area in WINCAPSIII

For settings, refer to Section 4.1.2 [9].

[8] Escaping from the interference check area

For settings, refer to Section 4.1.2 [10].

4.2.3 Shoulder Figure

The 4-axis robot can take two figures when positioning as shown in Figures 4-50 and 4-51.

Table 4-4. Available Figures

Value	Figures
0	SINGLE-RIGHTY
1	SINGLE-LEFTY
2	
3	
4	
5	
6	
7	
8	DOUBLE-RIGHTY
9	DOUBLE-LEFTY
10	

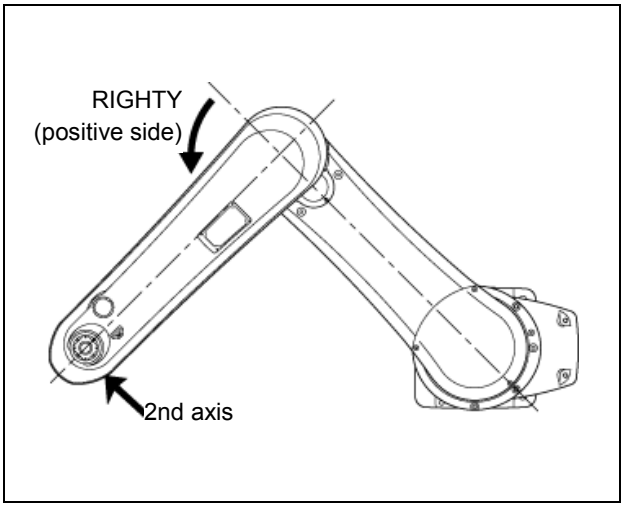


Figure 4-50. RIGHTY

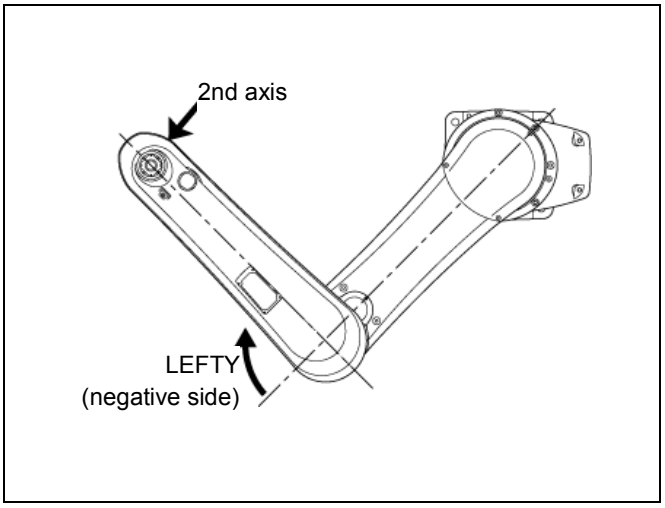


Figure 4-51. LEFTY

When the floor-mounted robot is viewed from the top:

If the 2nd axis is positioned at the positive side on the X axis of the base coordinates as shown in Figure 4-50, the figure is called "RIGHTY"; if at the negative side as shown in Figure 4-51, it is called "LEFTY."

Chapter 5

Commands Assigned to Function Keys on the Extended Screen

This chapter describes the variety of commands assigned to the function keys on the extended screen of the teach pendant. The first section illustrates the command menu tree. The following sections provide a detailed explanation of those commands, together with the access routes.

NOTE 1: Avoid letting the teach pendant undergo any strong shocks, impacts, or vibrations.

NOTE 2: Touch the teach pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

5.1 Commands Menu

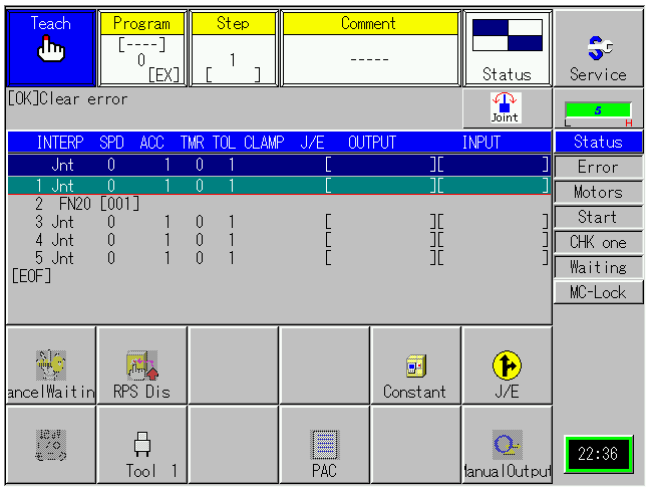
Using the keys, buttons, and switches on the extended screen of the teach pendant allows you to call up a variety of screens on the LCD, each of which has its exclusive commands menu. From the menu, you may choose commands by pressing the function keys.

5.1.1 Switching to Extended Screen

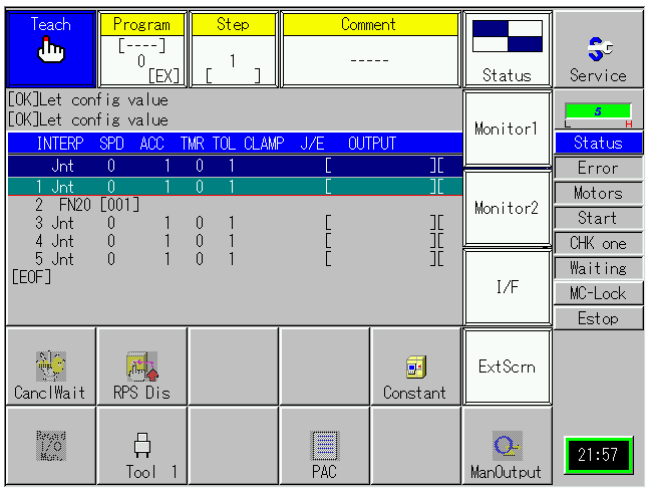
In addition to the top screen, the teach pendant has the extended screen. This section describes the switching procedure from the top screen to the extended one.

Step 1 Press the Status button at the top right on the top screen.

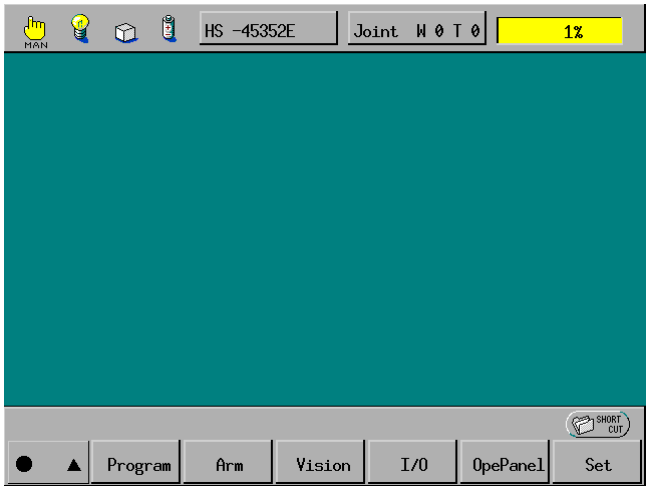
The drop-down menu appears as shown in Step 2.



Step 2 Press the ExtScrn on the drop-down menu.



Step 3 The extended screen appears as shown below.

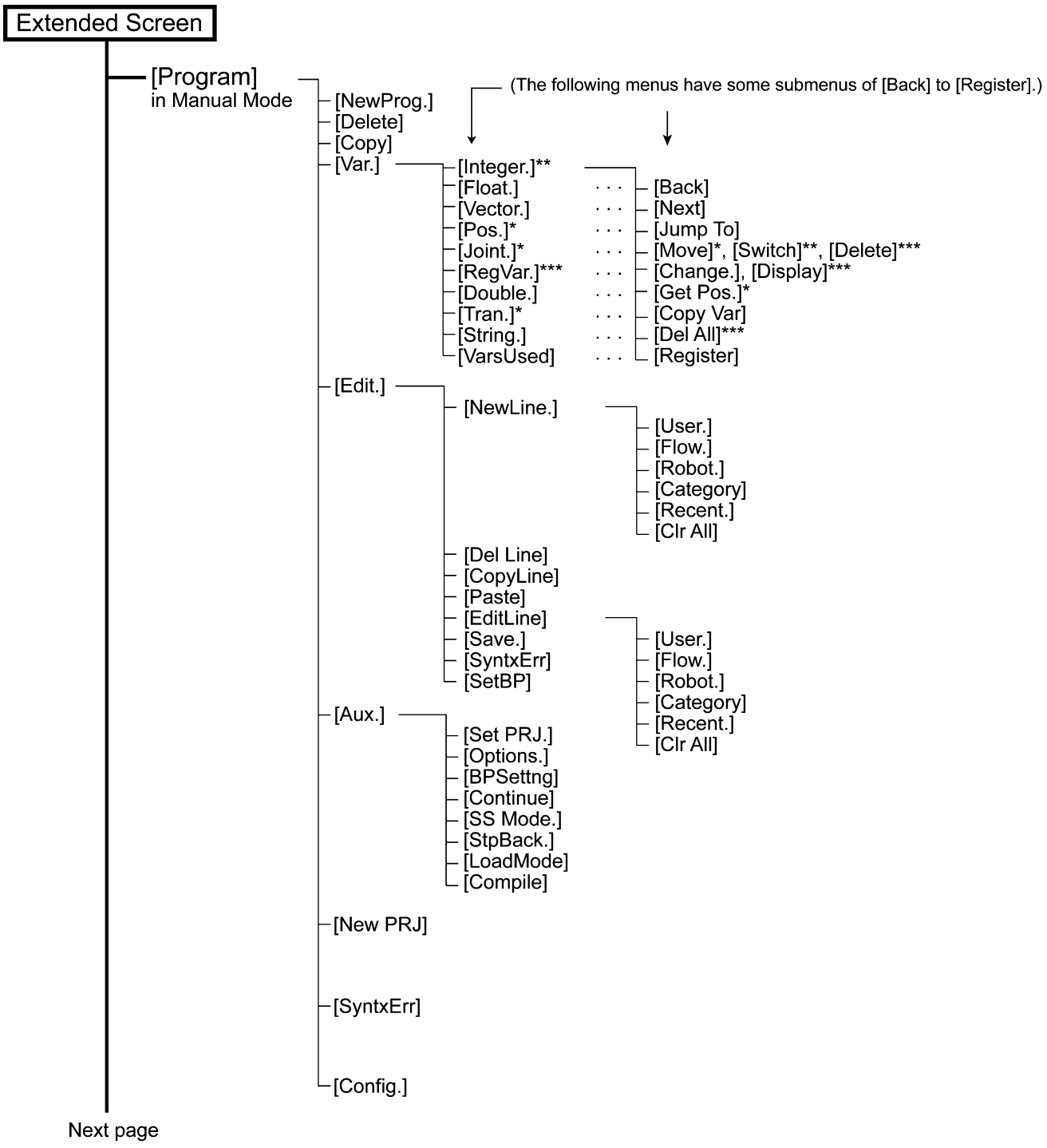


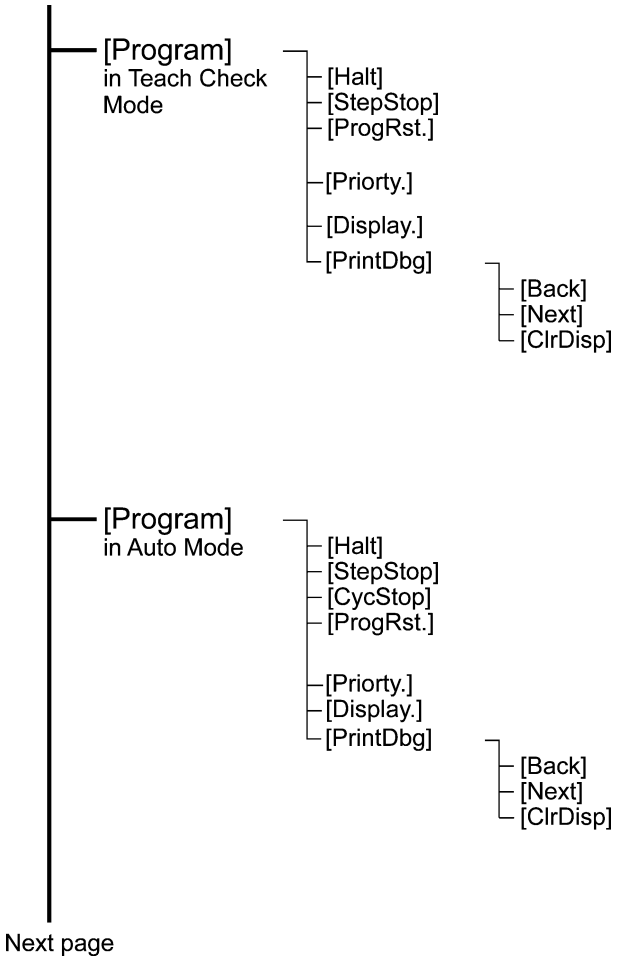
Step 4 While holding down the ENABLE key, press the CLOSE key to return to the top screen.

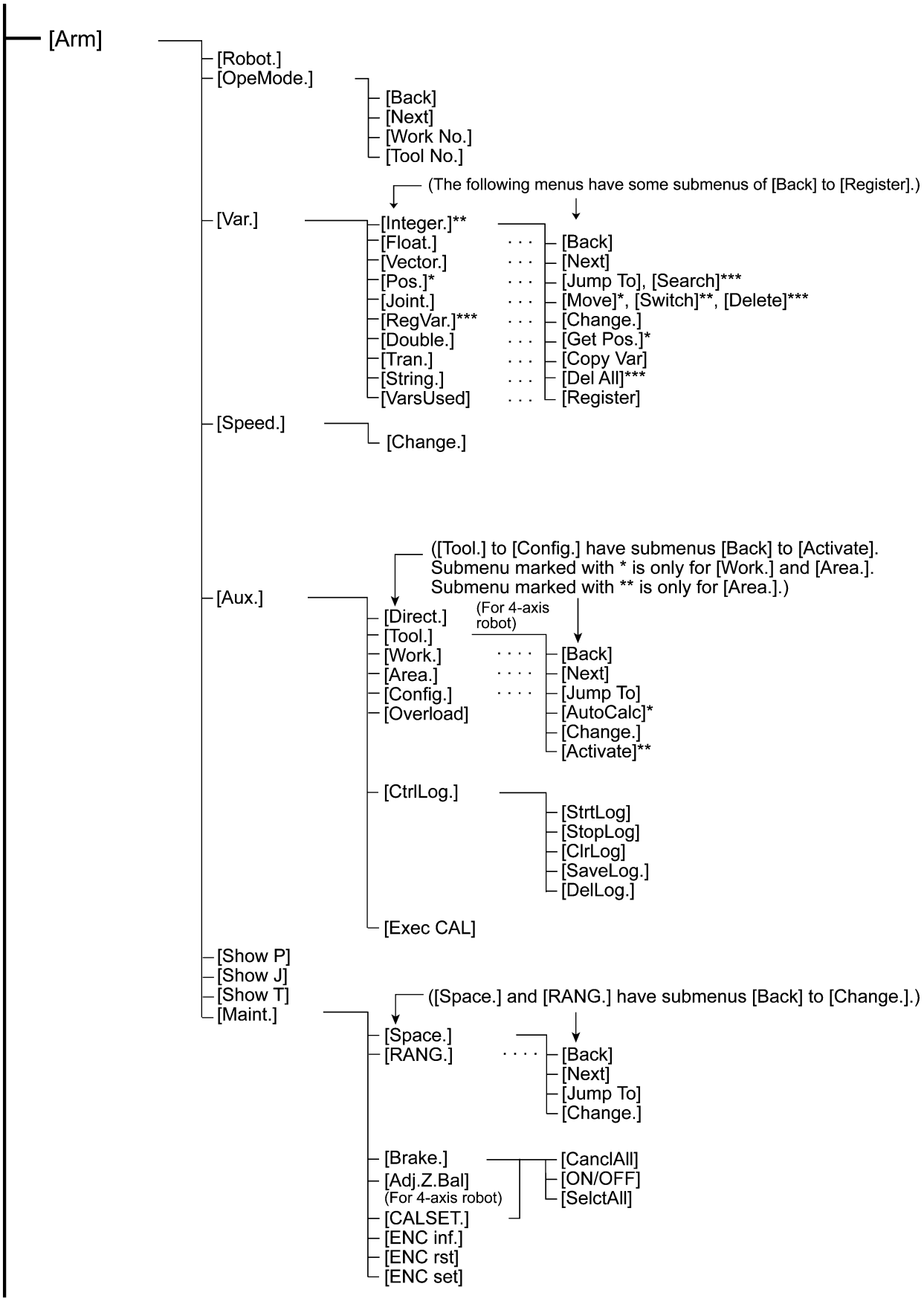
Note that this operation may not close the extended screen in any of the following states.

- During program editing
- During parameter editing
- In error occurrence state
- During file operation
- During program loading

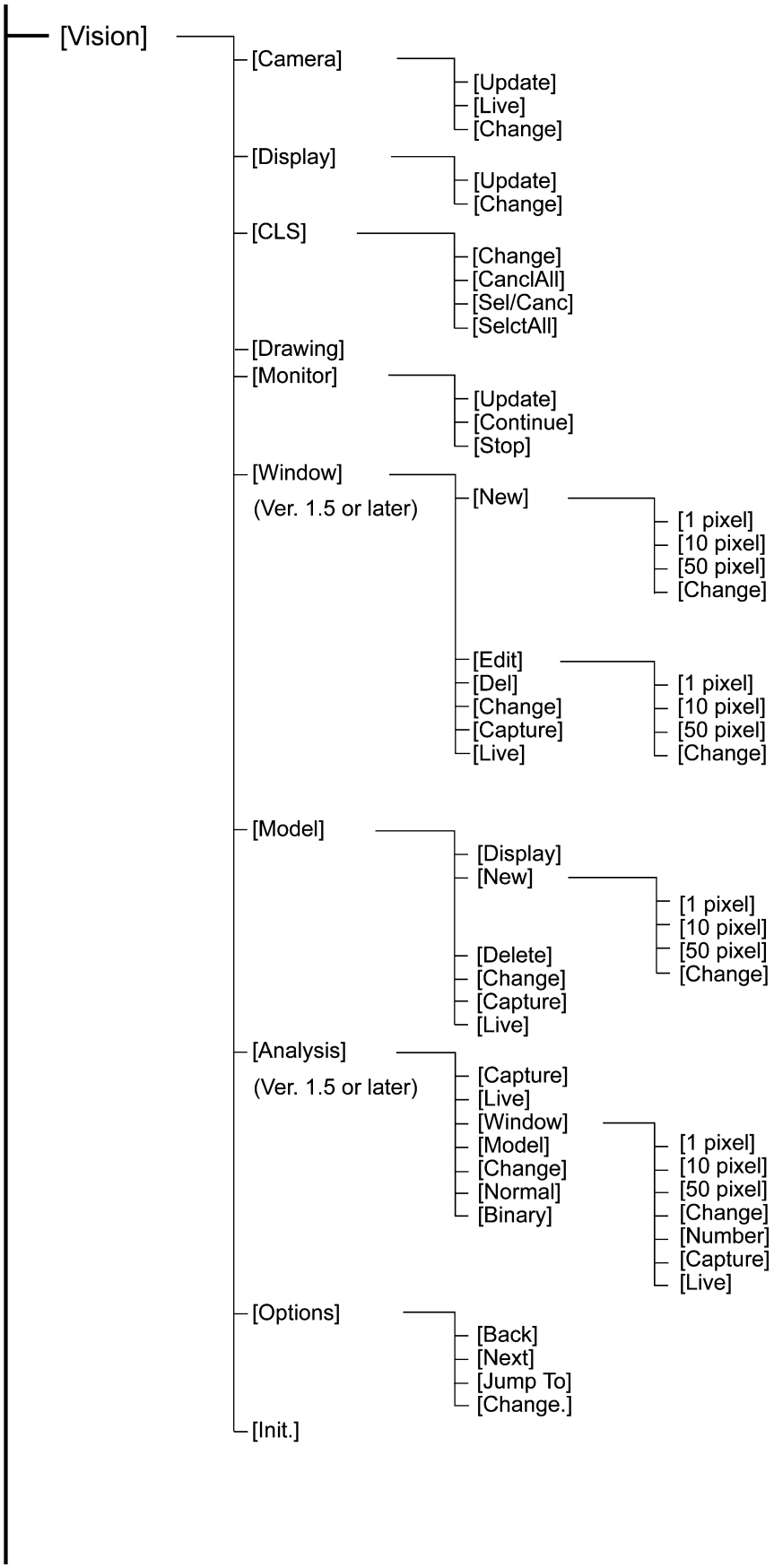
5.1.2 Menu Tree



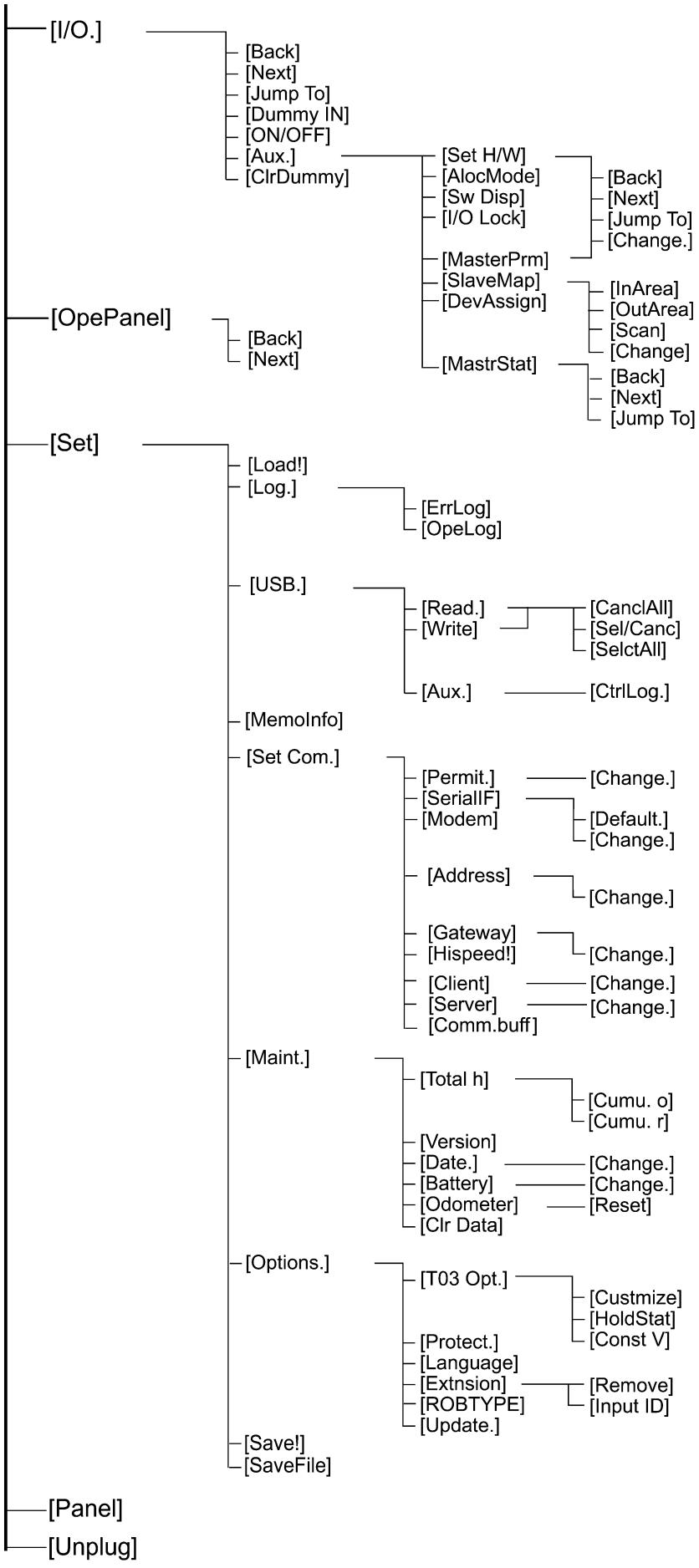

[Program]
in Teach Check
Mode
[Halt]
[StepStop]
[ProgRst.]
[Priorty.]
[Display.]
[PrintDbg]
[Back]
[Next]
[ClrDisp]
[Program]
in Auto Mode
[Halt]
[StepStop]
[CycStop]
[ProgRst.]
[Priorty.]
[Display.]
[PrintDbg]
[Back]
[Next]
[ClrDisp]
Next page


[Arm]
[Robot.]
[OpeMode.]
[Back]
[Next]
[Work No.]
[Tool No.]
(The following menus have some submenus of [Back] to [Register].)
[Var.]
[Integer.]**
[Float.]
[Vector.]
[Pos.]*
[Joint.]
[RegVar.]***
[Double.]
[Tran.]
[String.]
[VarsUsed]
[Back]
[Next]
[Jump To], [Search]***
[Move]*, [Switch]**, [Delete]***
[Change.]
[Get Pos.]*
[Copy Var]
[Del All]***
[Register]
[Speed.]
[Change.]
([Tool.] to [Config.] have submenus [Back] to [Activate].
Submenu marked with * is only for [Work.] and [Area.].
Submenu marked with ** is only for [Area.].)
[Aux.]
[Direct.]
[Tool.]
[Work.]
[Area.]
[Config.]
[Overload]
(For 4-axis robot)
[Back]
[Next]
[Jump To]
[AutoCalc]*
[Change.]
[Activate]**
[CtrlLog.]
[StrtLog]
[StopLog]
[ClrLog]
[SaveLog.]
[DelLog.]
[Exec CAL]
[Show P]
[Show J]
[Show T]
[Maint.]
([Space.] and [RANG.] have submenus [Back] to [Change.].)
[Space.]
[RANG.]
[Back]
[Next]
[Jump To]
[Change.]
[Brake.]
[Adj.Z.Bal]
(For 4-axis robot)
[CALSET.]
[ENC inf.]
[ENC rst]
[ENC set]
[CanclAll]
[ON/OFF]
[SelctAll]

Next page


[Vision]
[Camera]
[Update]
[Live]
[Change]
[Display]
[Update]
[Change]
[CLS]
[Change]
[CanclAll]
[Sel/Canc]
[SelctAll]
[Drawing]
[Monitor]
[Update]
[Continue]
[Stop]
[Window]
(Ver. 1.5 or later)
[New]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Edit]
[Del]
[Change]
[Capture]
[Live]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Model]
[Display]
[New]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Delete]
[Change]
[Capture]
[Live]
[Analysis]
(Ver. 1.5 or later)
[Capture]
[Live]
[Window]
[Model]
[Change]
[Normal]
[Binary]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Number]
[Capture]
[Live]
[Options]
[Back]
[Next]
[Jump To]
[Change.]
[Init.]

Next page


[I/O.]
[Back]
[Next]
[Jump To]
[Dummy IN]
[ON/OFF]
[Aux.]
[ClrDummy]
[Set H/W]
[AlocMode]
[Sw Disp]
[I/O Lock]
[Back]
[Next]
[Jump To]
[Change.]
[MasterPrm]
[SlaveMap]
[DevAssign]
[InArea]
[OutArea]
[Scan]
[Change]
[MastrStat]
[Back]
[Next]
[Jump To]
[OpePanel]
[Back]
[Next]
[Set]
[Load!]
[Log.]
[ErrLog]
[OpeLog]
[USB.]
[Read.]
[Write]
[CanclAll]
[Sel/Canc]
[SelctAll]
[Aux.]
[CtrlLog.]
[MemoInfo]
[Set Com.]
[Permit.]
[Change.]
[SerialIF]
[Modem]
[Default.]
[Change.]
[Address]
[Change.]
[Gateway]
[Hispeed!]
[Change.]
[Client]
[Change.]
[Server]
[Change.]
[Comm.buff]
[Maint.]
[Total h]
[Cumu. o]
[Cumu. r]
[Version]
[Date.]
[Change.]
[Battery]
[Change.]
[Odometer]
[Reset]
[Clr Data]
[Options.]
[T03 Opt.]
[Custmize]
[HoldStat]
[Const V]
[Protect.]
[Language]
[Extnsion]
[Remove]
[Input ID]
[ROBTYPE]
[Update.]
[Save!]
[SaveFile]
[Panel]
[Unplug]

5.2 Displaying the Program List Window

Access: [ExtScrn]—[Program]

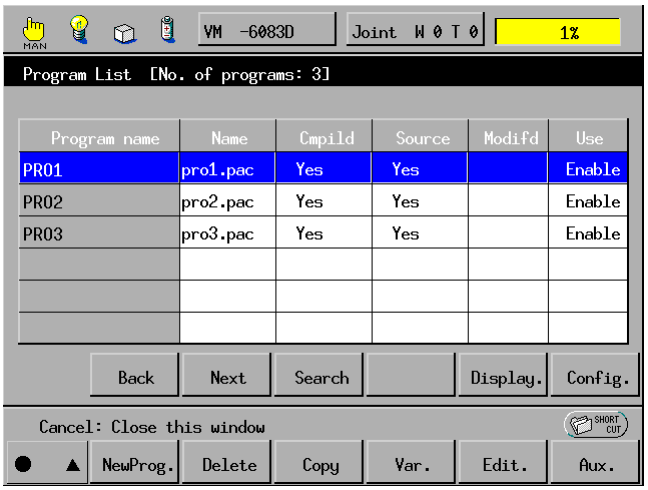
The [Program] command on the extended screen has different three menu hierarchies for Manual, Teach Check, and Auto modes as shown in Section 5.1.2.

Sections 5.2.1, 5.2.2, and 5.2.3 describe the function of the [Program] command in Manual, Teach Check, and Auto modes, respectively.

5.2.1 Showing the Program List Window in Manual Mode

In Teach mode, you can alternately switch between manual mode and teach check mode by touching the mode icon (the leftmost icon on the status bar) on the extended screen.

After switching to the manual mode on the extended screen, pressing [Program] will display the Program List window as shown below.



When shifted

The Program List window has the following items:

[Program Name] Lists program names declared by the PROGRAM statement.
In Ver. 2.2 or later, this column also displays folder names, header file names, and operation panel file names.

[Name] Shows the source file name of the listed program. The [Name] and [Program Name] are not always coincident with each other.

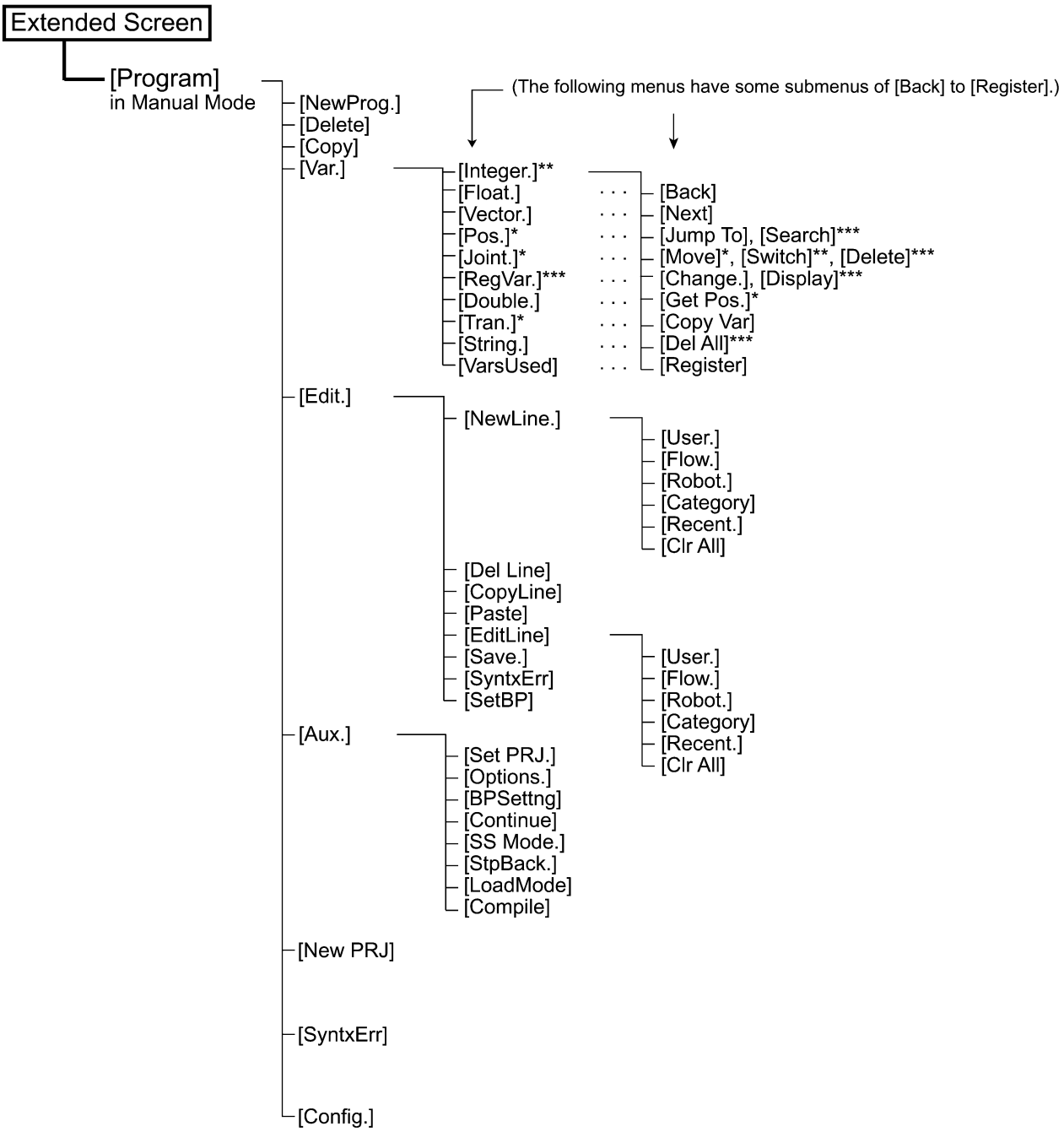
[Cmpild] Shows whether the listed file has been compiled into run-time format. PAC files are usually compiled.

[Source] Shows whether the source file of the listed program has been loaded to the robot controller. If loaded, it is displayed with "Yes."

[Modifd] Shows whether the listed program is modified after compiled into run-time format. If the program only is uploaded from WINCAPSIII to the robot controller, for example, "Yes" is displayed in this column.

[Use] Shows whether the listed program is to be compiled. If you press [Config.] and make the compile flag active, this column will display "Enable" and the program will be compiled in compilation.

The hierarchy of the [Program] menu in Manual mode is given on the next page.

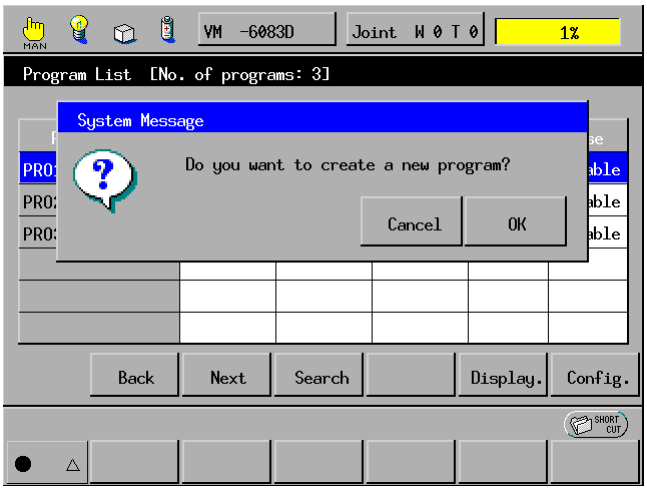

Extended Screen
[Program]
in Manual Mode
(The following menus have some submenus of [Back] to [Register].)
[NewProg.]
[Delete]
[Copy]
[Var.]
[Integer.]**
[Float.]
[Vector.]
[Pos.]*
[Joint.]*
[RegVar.]***
[Double.]
[Tran.]*
[String.]
[VarsUsed]
[Back]
[Next]
[Jump To], [Search]***
[Move]*, [Switch]**, [Delete]***
[Change.], [Display]***
[Get Pos.]*
[Copy Var]
[Del All]***
[Register]
[Edit.]
[NewLine.]
[User.]
[Flow.]
[Robot.]
[Category]
[Recent.]
[Clr All]
[Del Line]
[CopyLine]
[Paste]
[EditLine]
[Save.]
[SyntxErr]
[SetBP]
[User.]
[Flow.]
[Robot.]
[Category]
[Recent.]
[Clr All]
[Aux.]
[Set PRJ.]
[Options.]
[BPSettng]
[Continue]
[SS Mode.]
[StpBack.]
[LoadMode]
[Compile]
[New PRJ]
[SyntxErr]
[Config.]

Creating a new program in Manual mode

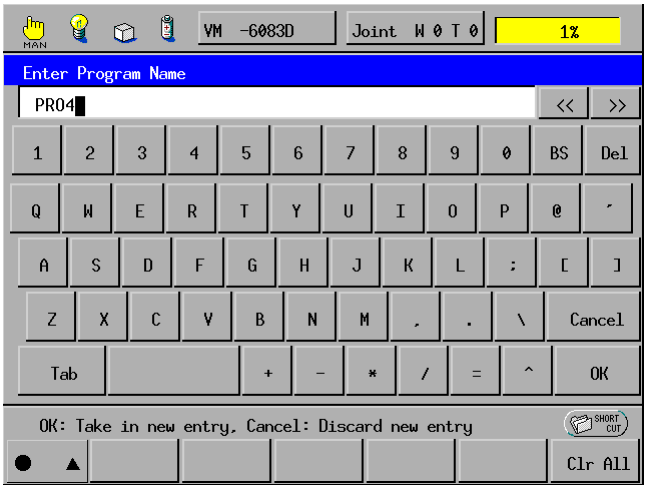
Access: [ExtScrn]—[Program]—[NewProg.]

Creates a new program.

(1) Press [NewProg.] in the Program List window, and the system message dialog box will appear as shown below.

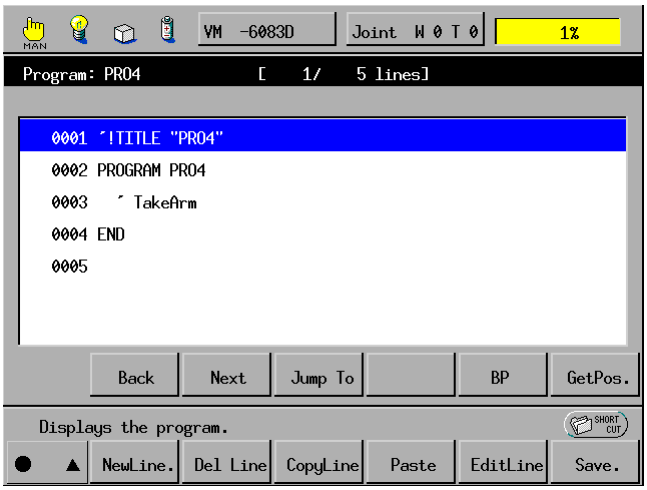


(2) Press the OK button in the system message dialog box to proceed, and the Enter Program Name window will appear as shown below.



(3) Enter the desired program name and then press the OK button.

A new program edit window will appear as shown below where you may create a new program.

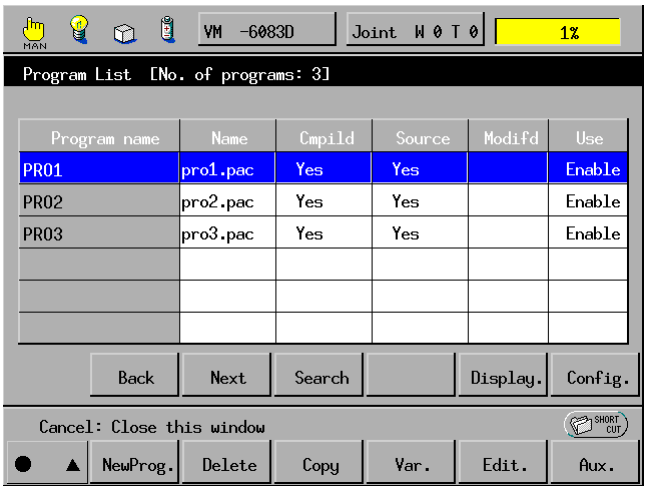


Deleting a program in Manual mode

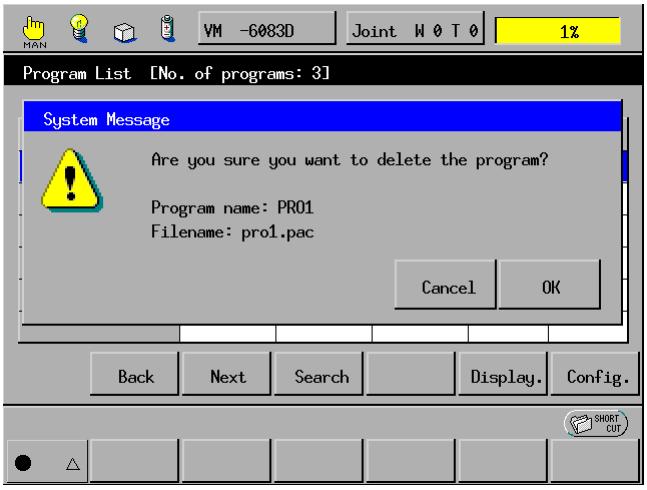
Access: [ExtScrn]—[Program]—[Delete]

Deletes an existing program selected in the Program List window.

(1) In the Program List window, select the program to be deleted.



(2) Press [Delete], and the system message dialog box will appear as shown below.



(3) Press the OK button in the above system message dialog box to proceed.

The system will delete the selected program and display the system message "Do you want to compile?"

(4) Press the OK button.

If you press the Cancel button, the program deletion will be cancelled and the screen will return to the Program List window.

Copying a program in Manual mode

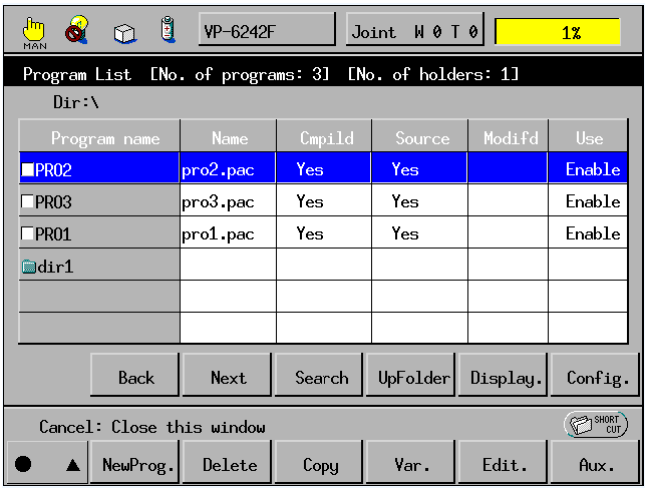
Access: [ExtScrn]—[Program]—[Copy]

Copies an existing program, header file, or folder when selected in the Program List window.

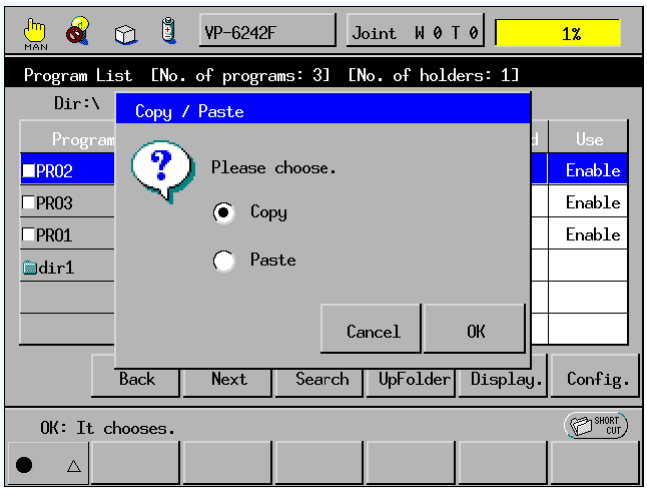
NOTE 1: In Version 2.2 or later (supporting the folder feature), header files and folders can be copied, but operation panel files cannot.

NOTE 2: Copying a folder copies also all elements contained in that folder. If that folder contains an operation panel file, therefore, the file is also copied.

(1) In the Program List window, select the program to be copied.

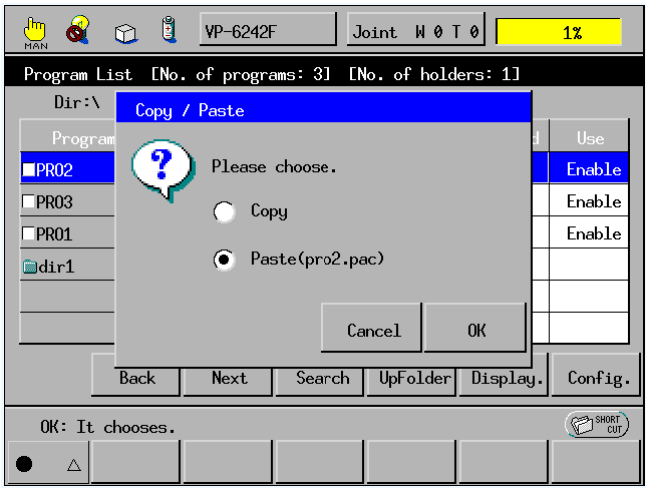


(2) Press [Copy], and the system message dialog box will appear as shown below.



(3) Select Copy and press the OK button, and the selected program file will be copied.

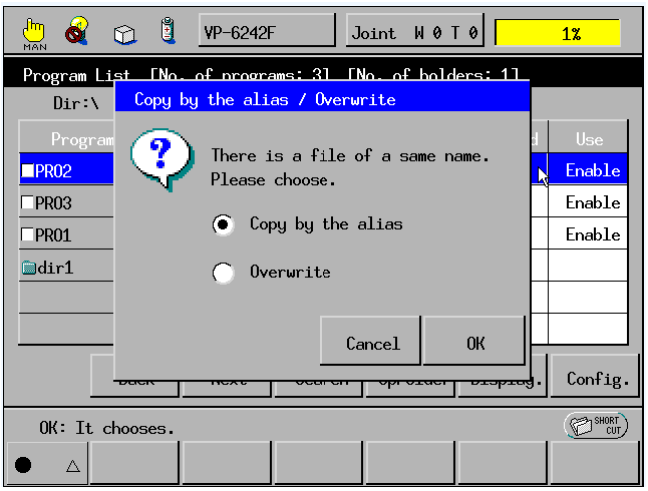
(4) Press [Copy] again to regard the file copied last as an object to be pasted. The object name appears in parentheses as shown below.



(5) Select Paste and press the OK button, and the object will be pasted into the current folder designated by "Dir:."

If the current folder already contains a file having the same name as the object to be pasted, the following dialog box appears, prompting you to select "Copy by the alias" or "Overwrite."

NOTE: In overwriting a folder, if the destination folder contains elements not contained in the source folder, those elements will remain intact.

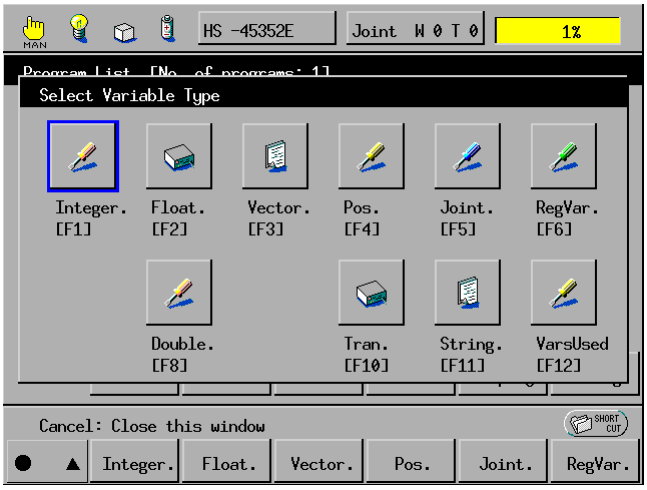


Displaying and modifying variable values in Manual mode

Access: [ExtScrn]—[Program]—[Var.]

Displays values assigned to various types of variables, the number of variables used, and/or modifies them.

(1) Press [Var.] in the Program List window, and the Select Variable Type window will appear as shown below.



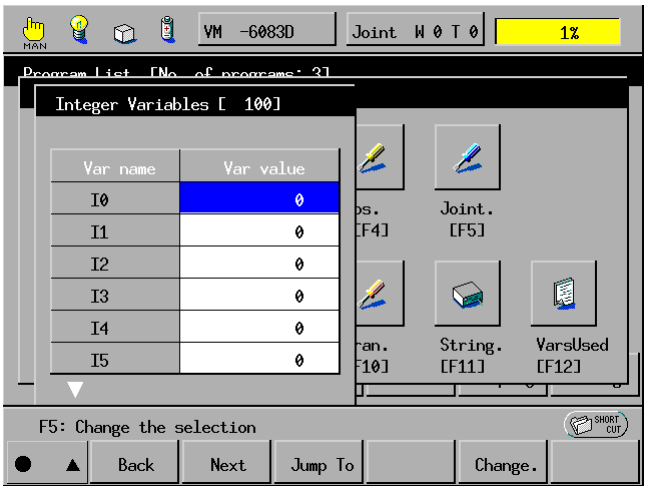
(2) Select the desired variable type or the number of variables used. The corresponding window will display as described on the following pages.

Displaying and modifying integer variable values

Access: [ExtScrn]—[Program]—[Var.]—[Integer.]

Displays values assigned to integer variables and/or modifies them.

Pressing [Integer.] will display the Integer Variables window as shown below.



Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

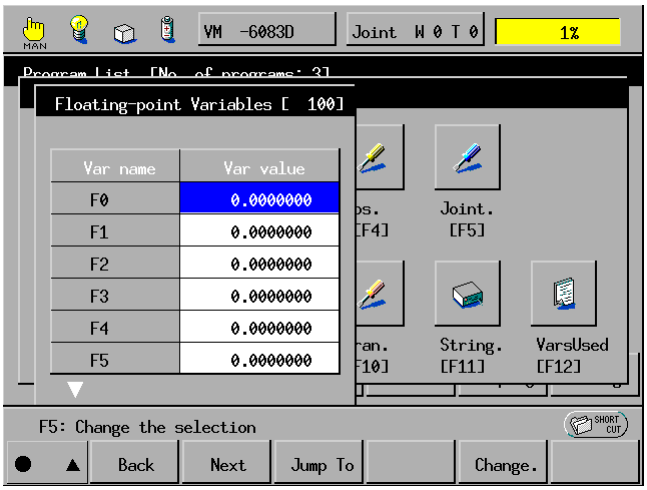
Take care when using integer variables in PAC programs since they are used also in the base program.

Displaying and modifying floating-point variable values

Access: [ExtScrn]—[Program]—[Var.]—[Float.]

Displays values assigned to floating-point variables and/or modifies them.

Pressing [Float.] will display the Floating-point Variables window as shown below.



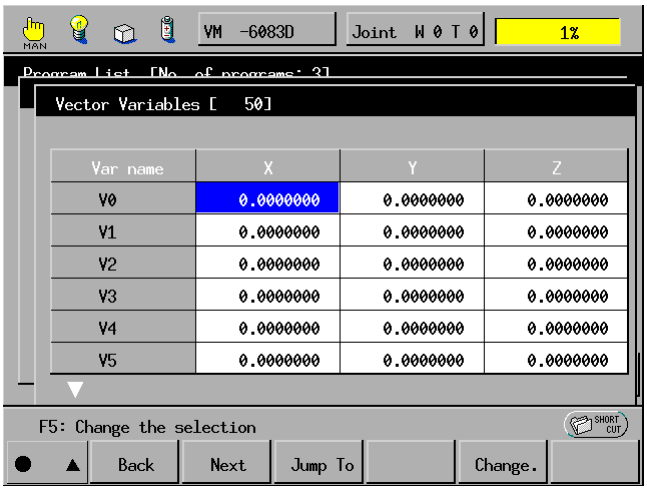
Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Displaying and modifying vector variable values

Access: [ExtScrn]—[Program]—[Var.]—[Vector.]

Displays values assigned to vector variables and/or modifies them.

Pressing [Vector.] will display the Vector Variables window as shown below.



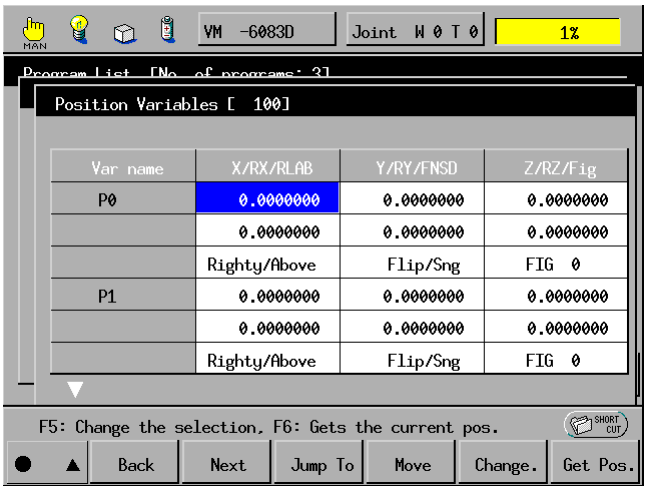
Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Displaying and modifying position variable values

Access: [ExtScrn]—[Program]—[Var.]—[Pos.]

Displays values assigned to position variables and/or modifies them.

Pressing [Pos.] will display the Position Variables window as shown below.



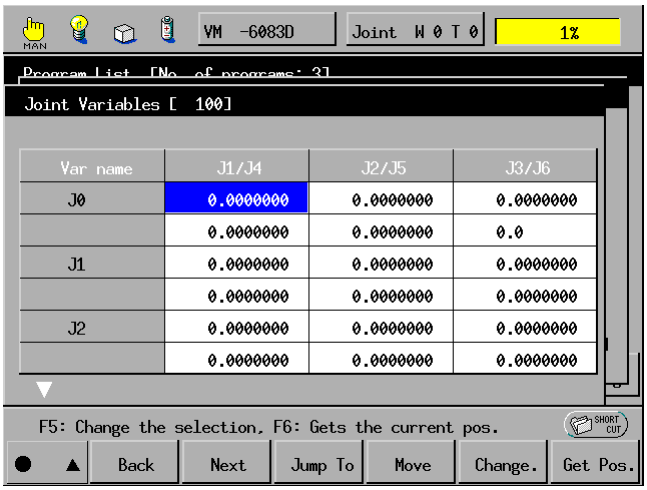
Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Move]	Displays the system message "Will move to the position specified by the variable xx." While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Get Pos.]	Displays the system message "Are you sure you want to read the current position into the variable xx?" Pressing OK will enter the current position values into the selected variable name.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Displaying and modifying joint variable values

Access: [ExtScrn]—[Program]—[Var.]—[Joint.]

Displays values assigned to joint variables and/or modifies them.

Pressing [Joint.] will display the Joint Variables window as shown below.



Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Move]	Displays the system message "Will move to the position specified by the variable xx." While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Get Pos.]	Displays the system message "Are you sure you want to read the current position into the variable xx?" Pressing OK will enter the current position values into the selected variable name.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

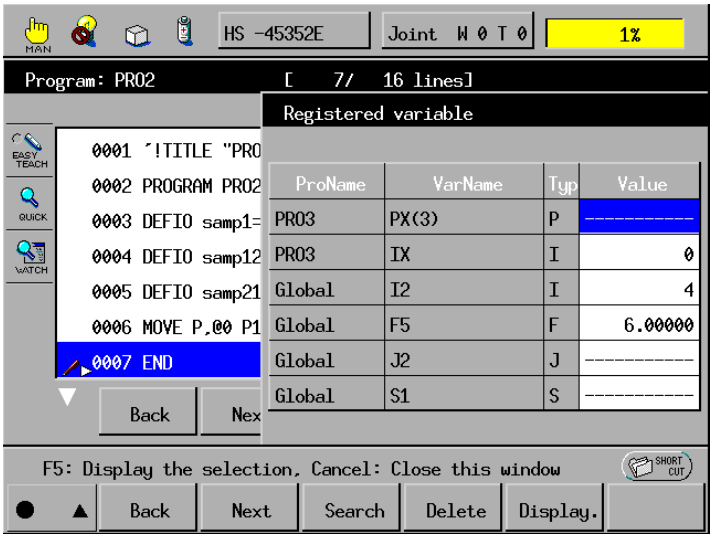
Displaying registered variable list

Access: [ExtScrn]—[Program]—[Var.]—[RegVar.]

Displays the registered variable list.

This registered variable reference facility allows you to refer to previously registered variables. Use this facility when you cannot designate a program line since the program is running or when you want to refer to variables in more than one program.

To call up the registered variables window, press [WATCH] in the coding list window or [RegVar.] in the Select Variable Type window. The Registered variable list window will appear as shown below.



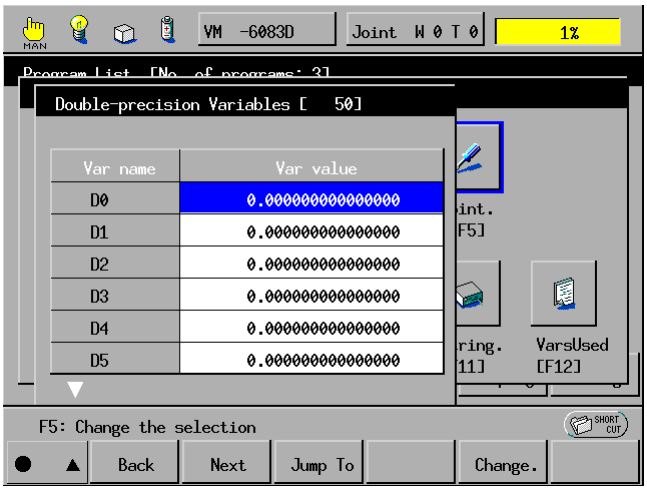
For details, refer to Section 3.3.6 "Local Variable-Related Enhancement."

Displaying and modifying double-precision variable values

Access: [ExtScrn]—[Program]—[Var.]—[Double.]

Displays values assigned to double-precision variables and/or modifies them.

Pressing [Double.] will display the Double-precision Variables window as shown below.



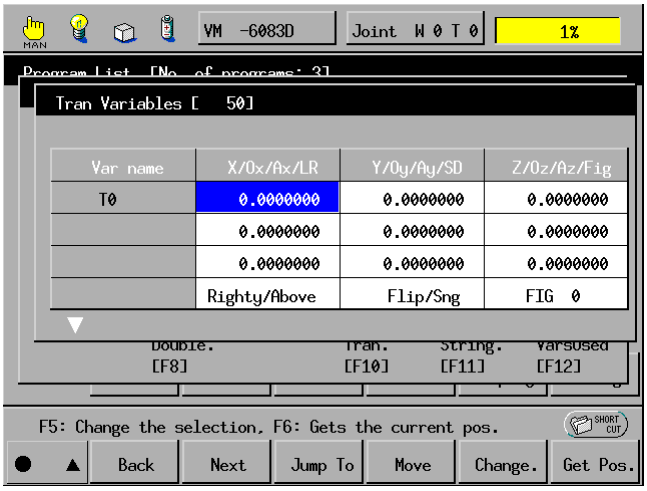
Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Displaying and modifying variable values in homogeneous transform matrix

Access: [ExtScrn]—[Program]—[Var.]—[Tran.]

Displays values assigned to variables in homogeneous transform matrix and/or modifies them.

Pressing [Tran.] will display the Tran Variables window as shown below.



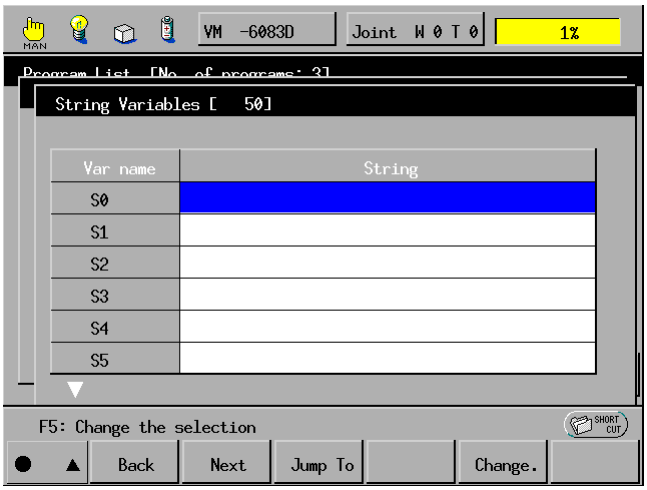
Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Move]	Displays the system message "Will move to the position specified by the variable xx." While holding down OK, the robot arm will move to the specified position. You may specify PTP or CP movement.
[Change.]	Displays the numeric keypad where you may enter a variable value you want to assign with the numerical keys and then press OK. Doing so will assign the newly entered value to the variable.
[Get Pos.]	Displays the system message "Are you sure you want to read the current position into the T variable XX?" Pressing OK will enter the current position values into the selected variable name.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Displaying and modifying string variable values

Access: [ExtScrn]—[Program]—[Var.]—[String.]

Displays values assigned to string variables and/or modifies them.

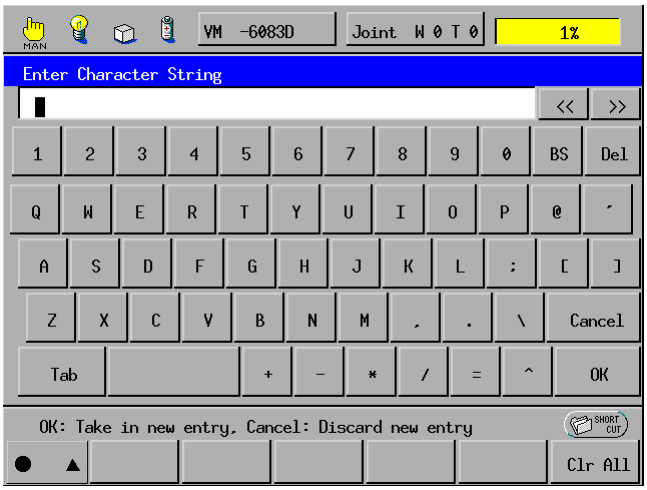
Pressing [String.] will display the String Variables window as shown below.



Function keys available	
[Back]	Displays the previous page of the variables list.
[Next]	Displays the next page of the variables list.
[Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[Change.]	Displays the Enter Character String window (see the next page) where you may enter a character string you want to assign with the letter buttons and then press OK. Doing so will assign the newly entered string to the variable.
[Copy Var]	Displays the Variable Number of Copy Destination window where you may enter a variable name to which you want to copy a variable value and then press OK. Doing so will display the system message "Are you sure you want to copy the variable X into the Y." Selecting Yes will copy the currently selected variable value to the specified variable name.

Pressing [Change.] on the String Variables window will call up the Enter Character String window as shown below.

Use the letter buttons to enter a character string you want to assign to the currently selected string variable. Then press the OK button to fix the new string.

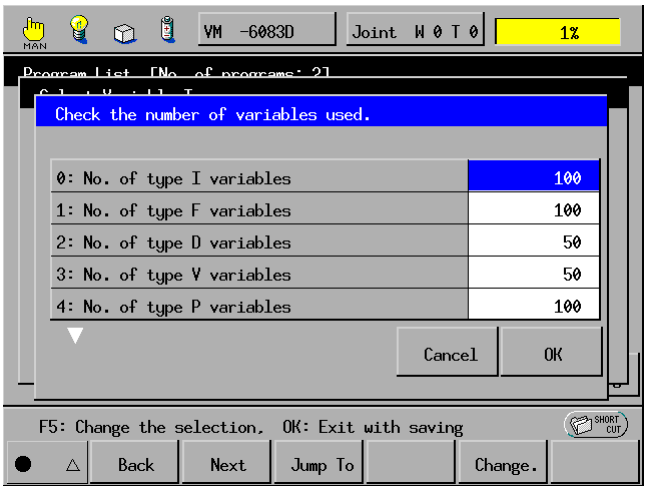


Displaying and modifying the number of variables used

Access: [ExtScrn]—[Program]—[Var.]—[VarsUsed.]

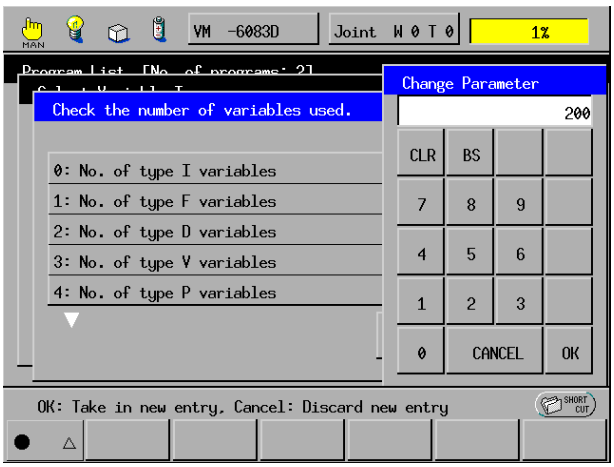
Displays the number of variables used for each type of variables and/or modifies them.

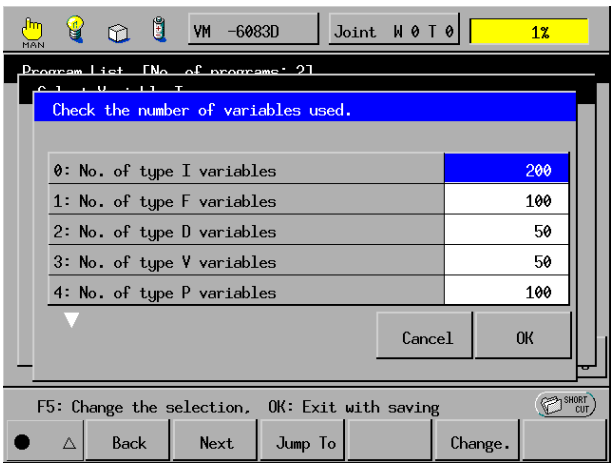
(1) Press [VarsUsed.] to display the following window.



(2) Select the item whose number of variables you want to change, then press [Change.]. The numeric keypad will appear.

(3) Enter the desired value and press the OK button. The newly entered value will appear in the selected item box.

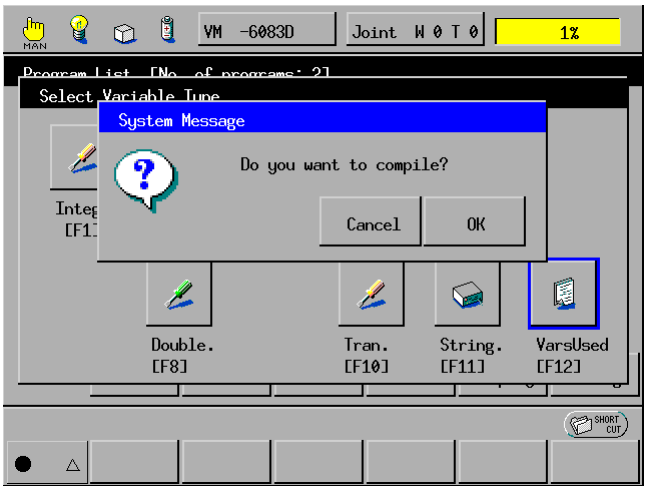




(4) Check the entered value and press the OK button.

The following system message will appear. Press the OK button, and compiling will start.

Upon successful completion of compiling and loading, the number of variables you have entered becomes effective.



If you press the Cancel button in the above window, the entered value does not become effective until compiling and loading takes place next time.

NOTE: Regarding the number of global variables

In this controller, the number of variables used can be modified only when the execution program is loaded.

When the number of variables used is modified, depending on the compiler, first a file indicating the modification of the number of variables used is created and then the program is loaded. The new setting becomes effective from when loading is completed.

When it is necessary to increase the number of global variables, the remaining memory area may not be sufficient. In this case, the error codes "739E Failure to load execution file" and "73D4 Lack of memory" are displayed.

In some cases, the following procedures may be effective for securing the necessary memory area.

a) Make a back-up of the variables by WINCAPSIII.

b) Change the number of all global variables to 1, compile and load them.

c) Change the number of the global variables to the desired number, compile and load them.

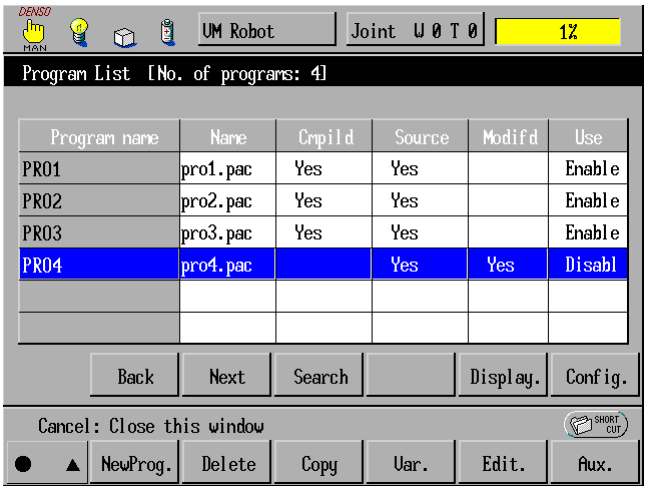
d) Return the back-up variables to the controller.

Editing a program in Manual Mode

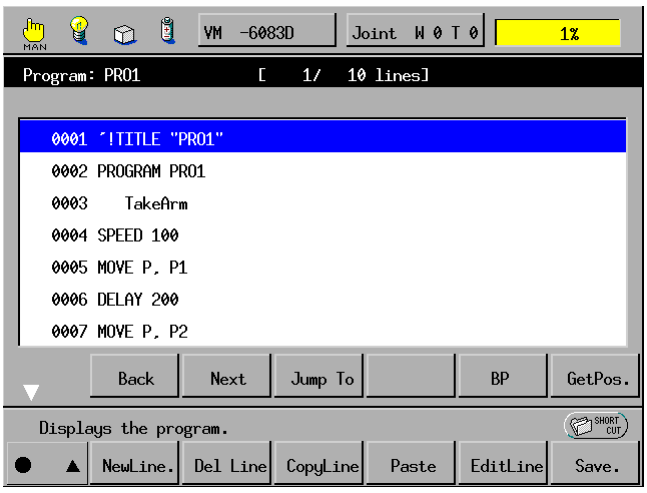
Access: [ExtScrn]—[Program]—[Edit.]

Edits a program you select in the Program List window.

(1) Select the program to be edited.



(2) Press [Edit.], and the selected program will appear in the program edit window as shown below.



(3) Select the desired edit type (NewLine, Del Line, CopyLine, Paste, EditLine, Save., or SyntxErr) by pressing the corresponding function key. The corresponding window will display as described on the following pages.

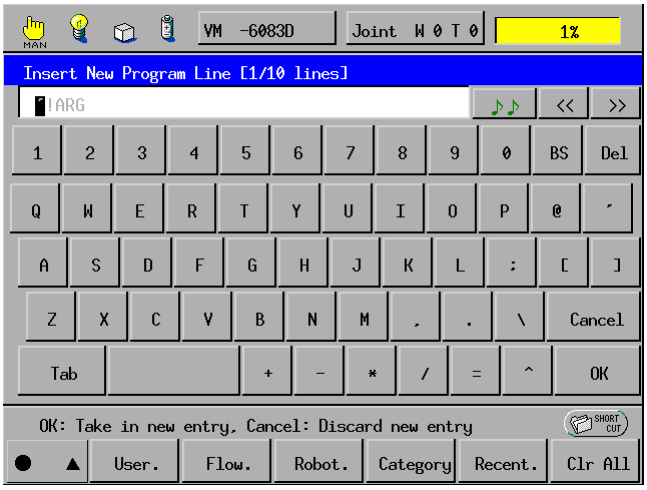
Inserting a new program line in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[NewLine.]

Insert a new program line immediately after the line selected in the Program List window.

(1) Select the program line after which you want to insert a new program line.

(2) Press [NewLine.] in the program edit window, and the coding window will appear as shown below.



(3) Enter a line of code by using the letter buttons.

(4) Press the OK button to enter the new line into the program.

(5) Press [Save.].

The system message "Do you want to save/compile this program?" appears.

(6) Press the OK button to compile the edited program.

If you press the Cancel button, the system message will disappear and the coding window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, Save: Save the modification"

Function keys available	
[User.]	Shortcut to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
[Flow.]	Shortcut to the flow control statement screen (that can be called up by choosing the "Flow control statement" on the Category Selection window).
[Robot.]	Shortcut to the robot control statement screen (that can be called up by choosing the "Robot control statement" on the Category Selection window).
[Category]	Displays the Category Selection window.
[Recent.]	Shortcut to a list of commands in the most recently selected category.
[ClrAll]	Clears all characters being entered.

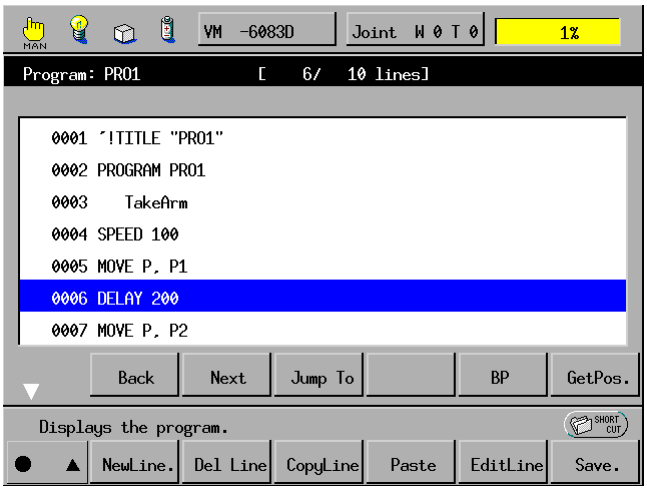
Deleting a program line in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[Del Line]

Deletes the program line you select in the program edit window.

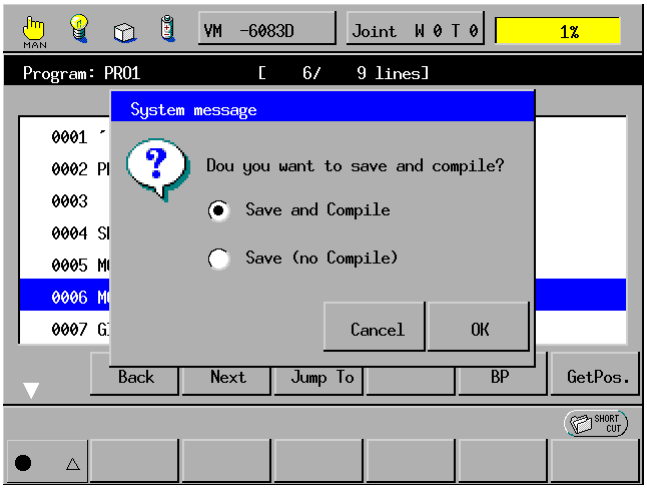
(1) Select the program line that you want to delete.

(2) Press [Del Line] in the program edit window, and the selected line will be erased.



(3) Press [Save.].

The system message "Do you want to save and compile?" appears.



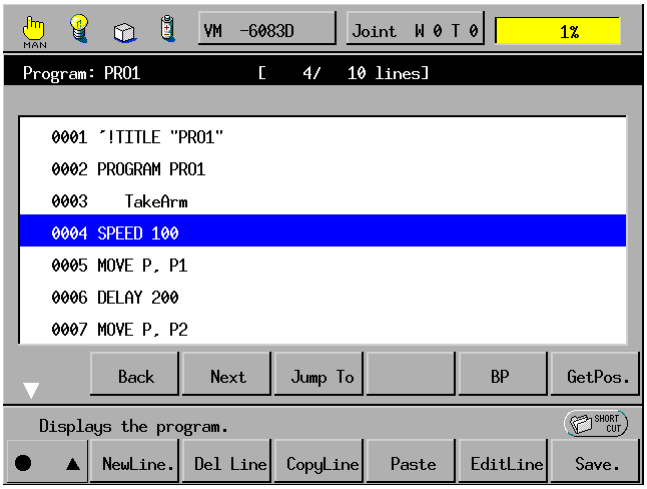
(4) Select whether to compile or not, then press the OK button.

If you press the Cancel button, the system message will disappear and the program edit window after the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, Save: Save the modification"

Copying a program line in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[CopyLine]

Copies the program line selected in the program edit window (shown below), into the memory. The copied data will be used when [Paste] command will execute.



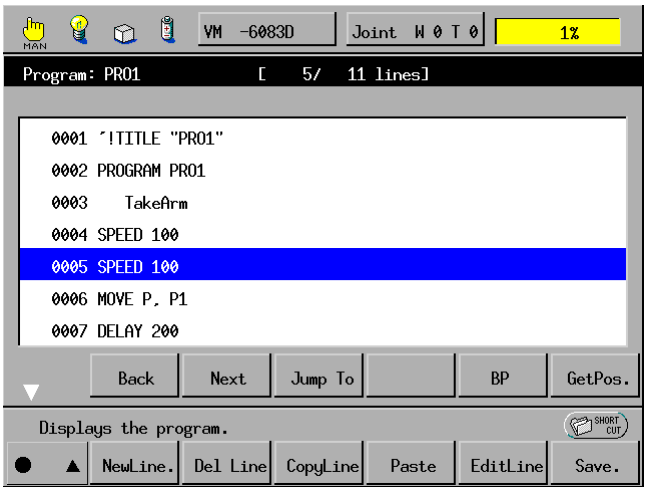
Pasting a program line in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[Paste]

Pastes the program line (that you copied with [CopyLine] into the memory) immediately following a line you select in the program edit window.

(1) In the program edit window as shown below, select the program line after which you want to paste a copied line.

(2) Press [Paste].



(3) Press [Save.].

The system message "Do you want to save/compile this program?" appears.

(4) Press the OK button to compile the edited program.

If you press the Cancel button, the system message will disappear and the program edit window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, Save: Save the modification"

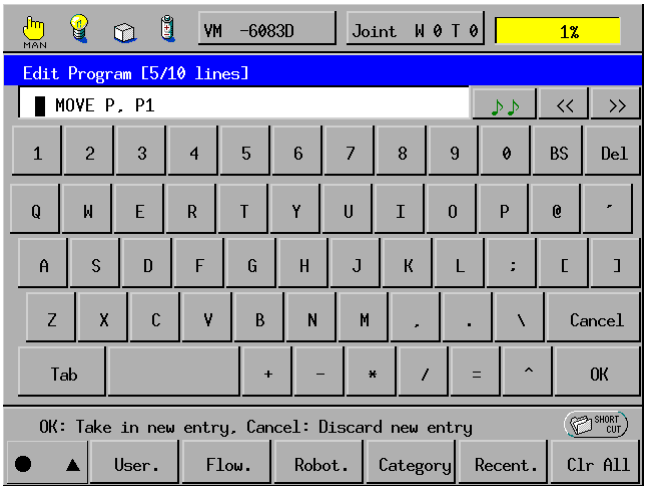
Editing a line of program code in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[EditLine]

Edits the line of program code selected in the program edit window.

(1) Select the program line that you want to edit.

(2) Press [EditLine] in the program edit window, and the coding window will appear as shown below.



(3) Edit a line of code by using the letter buttons.

(4) Press the OK button to enter the edited line into the program.

(5) Press [Save.].

The system message "Do you want to save/compile this program?" appears.

(6) Press the OK button to compile the edited program.

If you press the Cancel button, the system message will disappear and the program edit window with the new entry will remain displayed. In this state, if you press the OK key, the system will discard the new entry and return to the Program List window. If you press the Cancel key, the following system message appears: "This program has been modified. Are you sure you want to discard this modified program? OK: Discard this program, Cancel: Continue editing, Save: Save the modification"

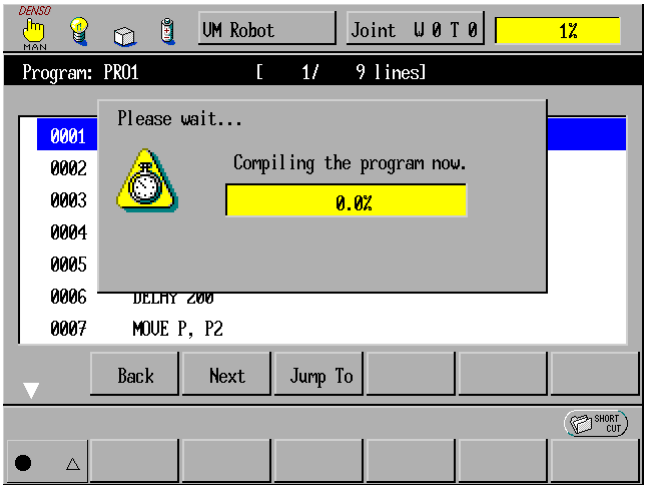
Function keys available	
[User.]	Shortcut to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
[Flow.]	Shortcut to the flow control statement screen (that can be called up by choosing the "Flow control statement" on the Category Selection window).
[Robot.]	Shortcut to the robot control statement screen (that can be called up by choosing the "Robot control statement" on the Category Selection window).
[Category]	Displays the Category Selection window.
[Recent.]	Shortcut to a list of commands in the most recently selected category.
[ClrAll]	Clears all characters being entered.

Saving and compiling an edited program in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[Save.]

Saves and compiles an edited program. If the program is set to "Disable" in the Program List window, this command performs saving only; if it is set to "Enable," this command performs both saving and compiling.

During compiling, the following window is displayed.



After compiling, the "Compile Log" will appear if the task program contains any errors. Fix the program until no syntax error will be detected, since the task program cannot execute if containing any error.

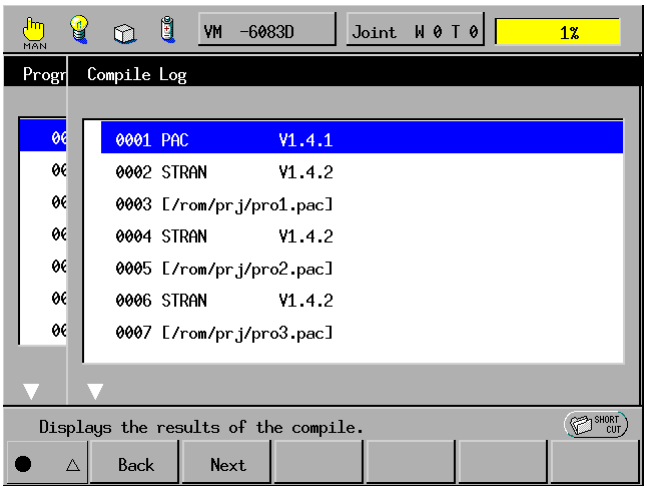
You may check anytime a compile log, by pressing [Program]—[SyntxErr] in Manual mode.

Displaying a compile log in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[SyntxErr]

Displays the compile log as shown below.

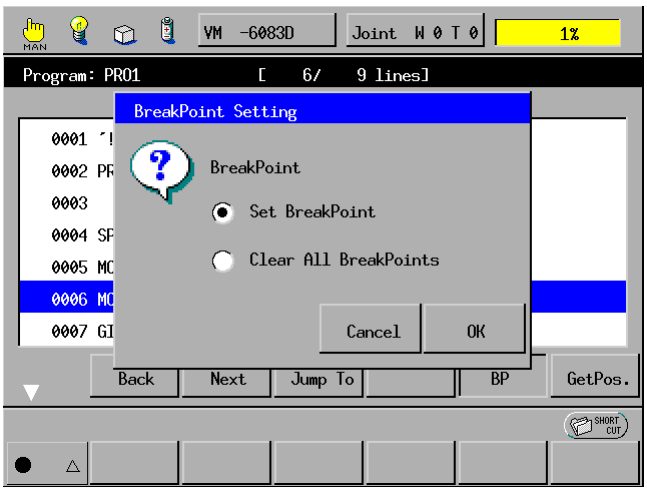
The compile log is useful when you correct syntax errors in programming. You must correct the program until no syntax errors are detected.



Setting a break point(s) in Manual mode

Access: [ExtScrn]—[Program]—[Edit.]—[SetBP]

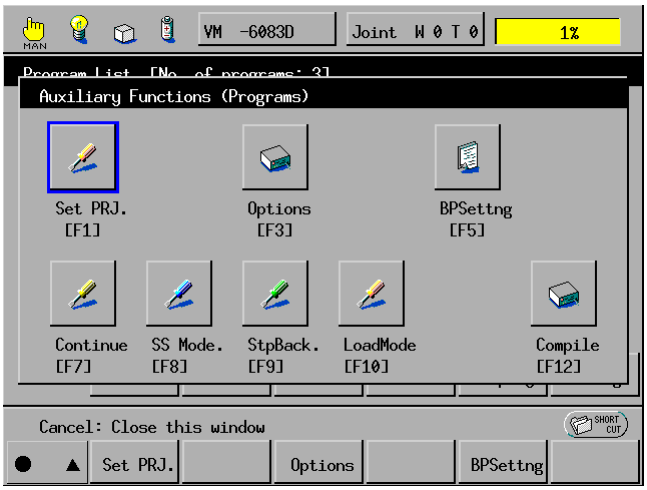
Sets a break point(s) at a desired program step(s). If the set break point is encountered during execution of program, the program will immediately stop.



Providing auxiliary functions in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]

Provides the following auxiliary functions for project editing.



When shifted

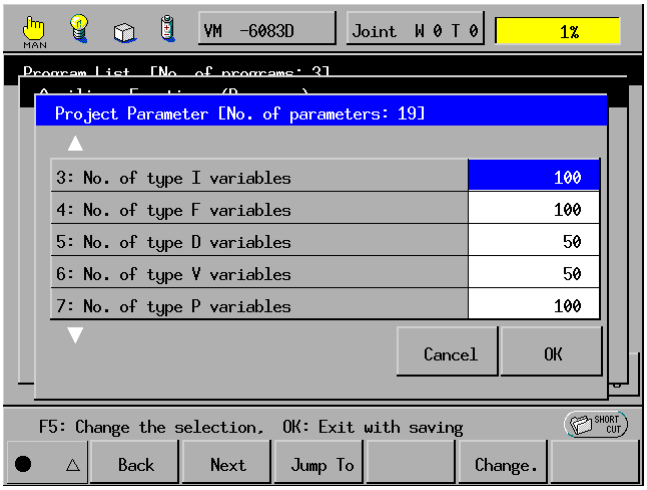
Setting project parameters in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[Set PRJ.]

Sets the parameters of variables to be used by the project and makes project-related settings.

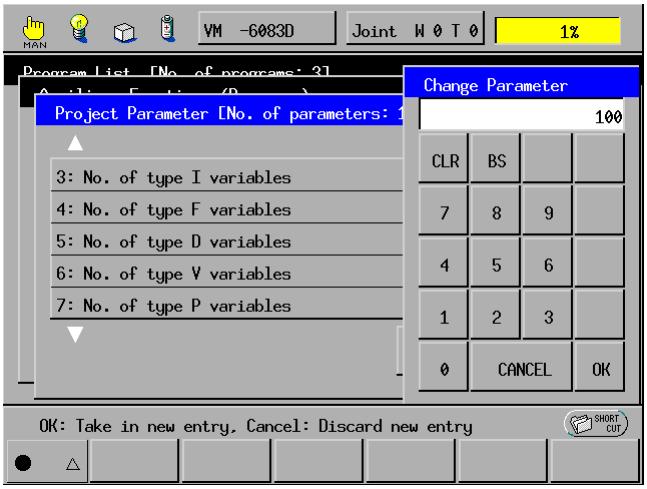
For details about parameters, refer to the PROGRAMMER'S MANUAL (I) (T03), Chapter 22 (Appendix), "22.4 Configuration List."

(1) Press [Set PRJ.] in the Auxiliary Functions (Programs) window. The Project Parameter window will appear as shown below.



(2) Select the item to be modified and then press [Change.]

The numeric keypad will appear as shown below.



(3) Enter the desired value(s) with the numerical buttons in the above window, and then press the OK button.

The new settings will appear in the Project Parameter window.

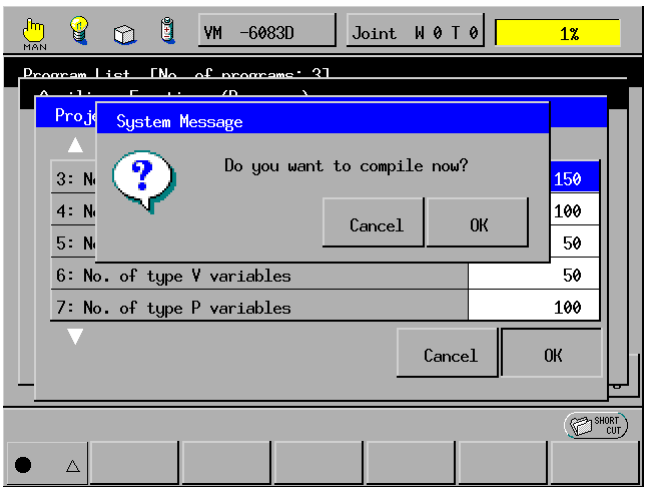
(4) Check the new settings. If they are satisfactory, press the OK button, and the system message dialog box will appear as shown below.

To clear the new settings, press the Cancel button in the Project Parameter window.

(5) The system message dialog box asks whether the new settings are to be applied to the current project.

To apply the new settings to the current project immediately, press the OK button, making compilation start soon.

To apply those settings from subsequent project compilation, press the Cancel button.

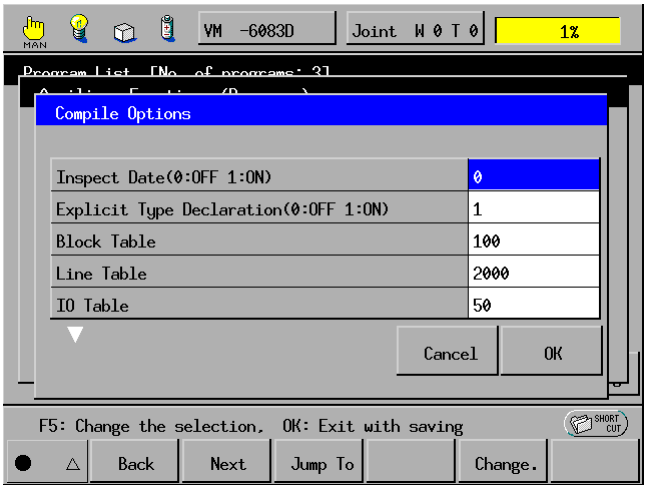


Setting compiling options in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[Options.]

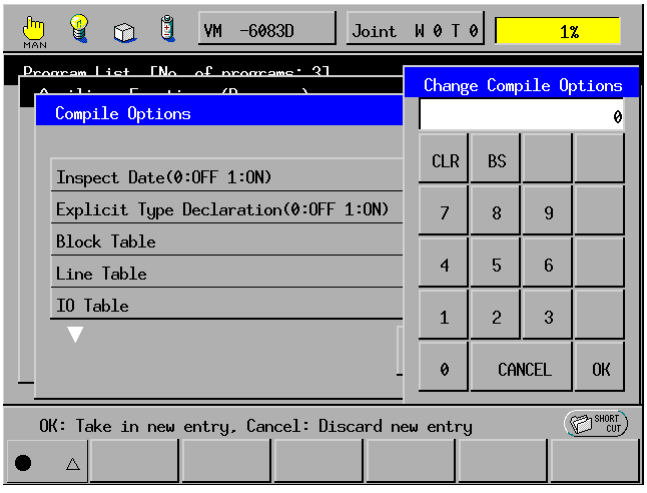
Sets the compiling options.

(1) Press [Options] in the Auxiliary Functions (Programs) window. The Compile Options window will appear as shown below.



(2) Select the item to be modified and then press [Change.]

The numeric keypad will appear as shown below.



(3) Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button.

The new settings will appear in the Compile Options window.

(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.

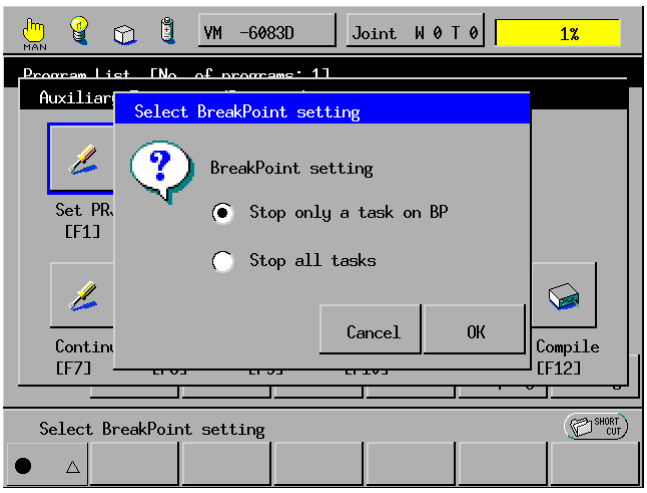
Setting the break point stop mode in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[BP Settng]

Selects either of the following two BP stop modes to be applied when break points are encountered:

- Stop only the program on which the encountered break point is set
- Stop all running programs

(1) Press [BP Settng] in the Auxiliary Functions (Programs) window. The Select BreakPoint Setting window will appear as shown below.



(2) Select the desired option.

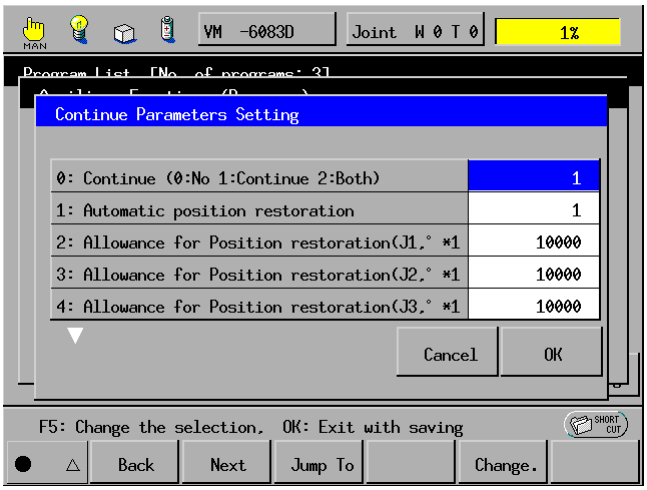
(3) Press the OK button to make the new setting effective. To cancel it, press the Cancel button.

Setting the resume-related parameters in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[Continue]

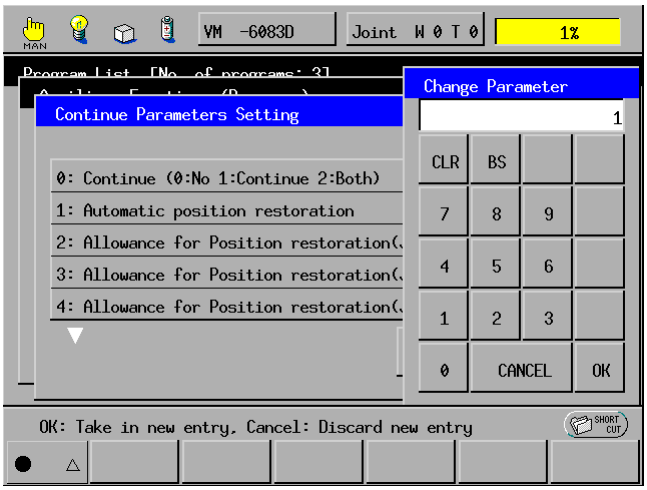
Sets the resume-related parameters for Continue Start.

(1) Press [Continue] in the Auxiliary Functions (Programs) window. The Continue Parameters Setting window will appear as shown below.



(2) Select the item to be modified and then press [Change.]

The numeric keypad will appear as shown below.



(3) Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button.

The new settings will appear in the Continue Parameter Setting window.

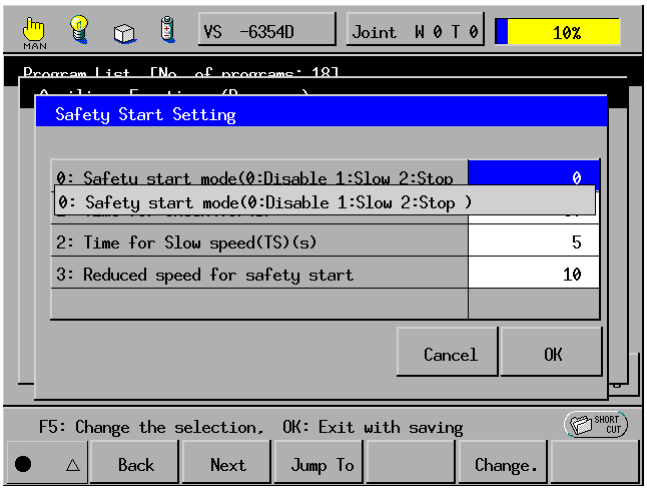
(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.

Setting the safe start related parameters in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[SS Mode.]

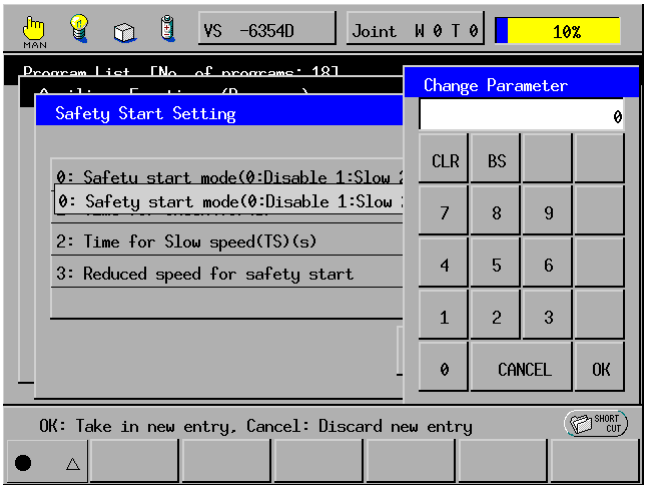
Sets the safe start related parameters.

(1) Press [SS Mode.] in the Auxiliary Functions (Programs) window. The Safety Start Setting window will appear as shown below.



(2) Select the item to be modified and then press [Change.]

The numeric keypad will appear as shown below.



(3) Enter the desired value(s) with the numerical buttons in the above table, and then press the OK button.

The new settings will appear in the Safety Start Setting window.

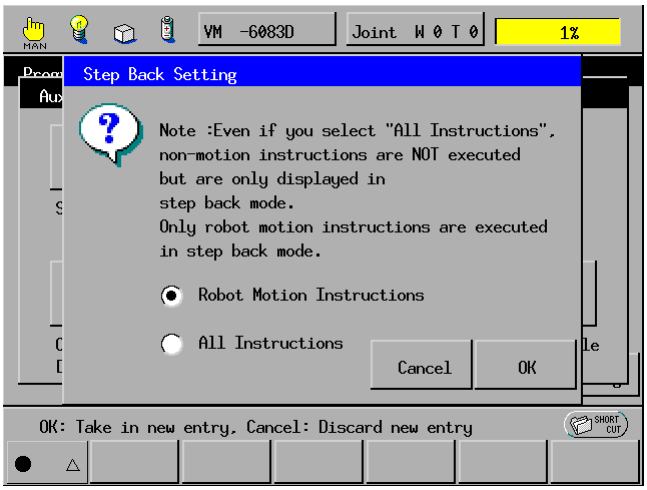
(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.

Setting the step return options in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[StpBack.]

Sets the step return options.

(1) Press [StpBack.] in the Auxiliary Functions (Programs) window. The Step Back Setting window will appear as shown below.



(2) Select the desired option.

(3) Press the OK button to make the new setting effective. To cancel it, press the Cancel button.

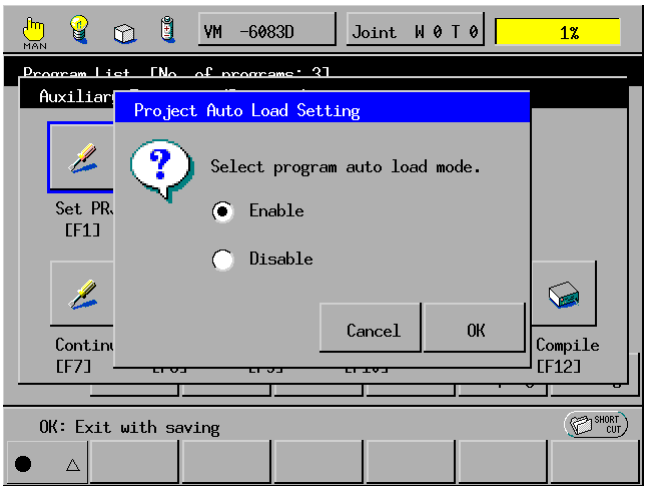
Restarting the controller will make this setting go into effect.

Enabling/disabling the automatic loading of a project in Manual mode

Access: [ExtScrn]—[Program]—[Aux.]—[LoadMode]

Enables or disables the automatic loading of a project.

(1) Press [LoadMode] in the Auxiliary Functions (Programs) window. The Project Auto Load Setting window will appear as shown below.



(2) Select the desired option.

(3) Press the OK button to make the new setting effective. To cancel it, press the Cancel button.

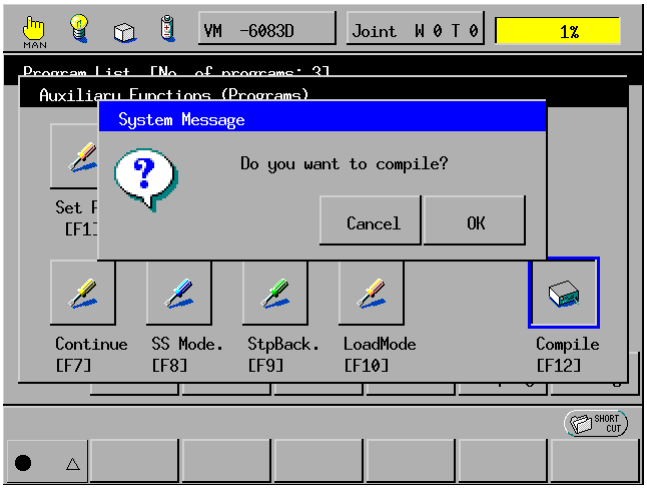
Restarting the controller will make this setting go into effect.

Compiling a project

Access: [ExtScrn]—[Program]—[Aux.]—[Compile]

Compiles a project or all programs which are set to "Enable" in the Program List window.

(1) Press [Compile.] in the Auxiliary Functions (Programs) window. The system message will appear as shown below.

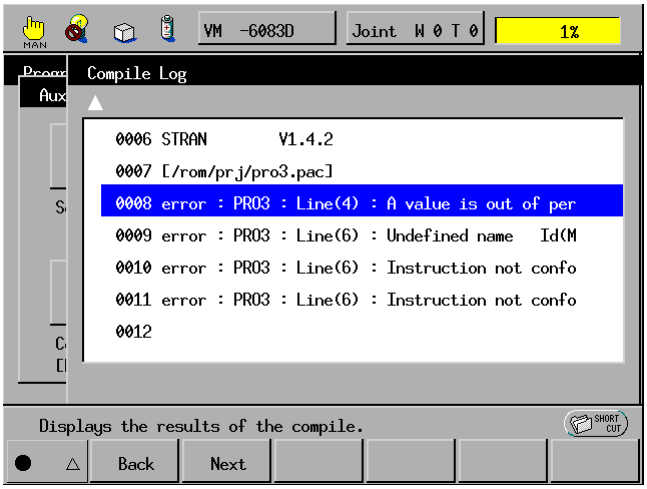


(2) To cancel compiling and return to the Auxiliary Functions (Programs) window, press the Cancel button.

To start compiling, press the OK button.

(3) Upon successful completion of project compilation, the system will automatically load the project and then return to the Auxiliary Functions (Programs) window.

If project compilation is not successful, the compile log window will appear as shown below. It displays syntax errors in the program. According to these error messages, modify your program.



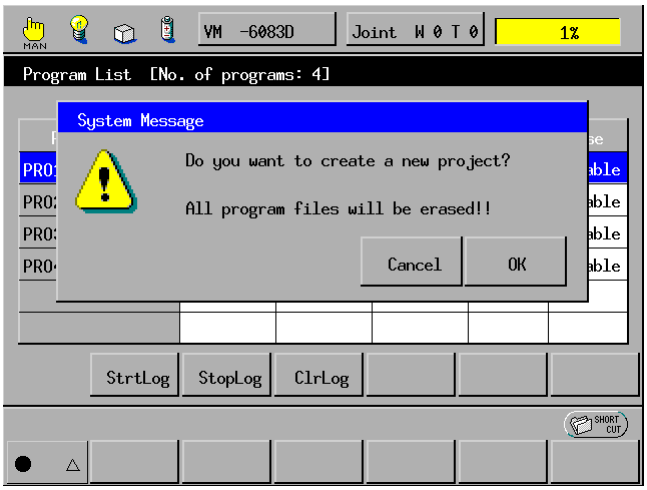
Creating a new project in Manual mode

Access: [ExtScrn]—[Program]—[New PRJ]

Erases all task programs stored in the robot controller and will then create a new project.

(1) Press [New PRJ] in the Program List window. The system message dialog box will appear as shown below.

(2) Press the OK button.



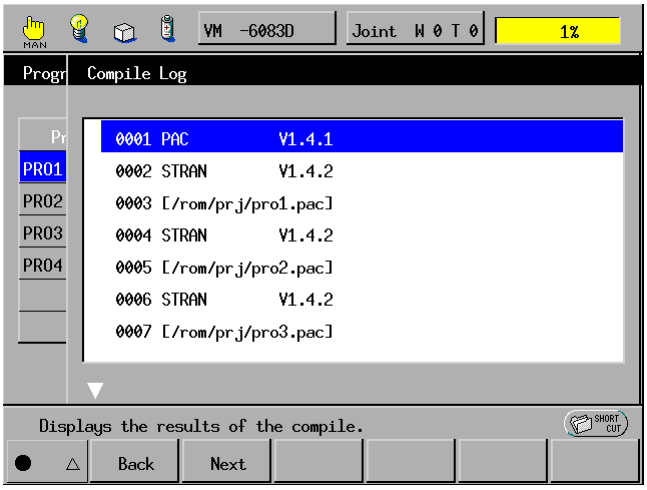
Displaying syntax errors in Manual mode

Access: [ExtScrn]—[Program]—[SyntxErr]

Displays syntax errors found in compilation.

The display of syntax errors is useful for fixing syntax errors contained in a program. You should fix the program until no syntax errors will display.

(1) Press [SyntxErr] in the Program List window. The Compile Log window will appear as shown below.



Enabling/disabling a selected program for compilation in Manual mode

Access: [ExtScrn]—[Program]—[Config.]

Enables a selected program to get compiled or disables it from getting compiled.

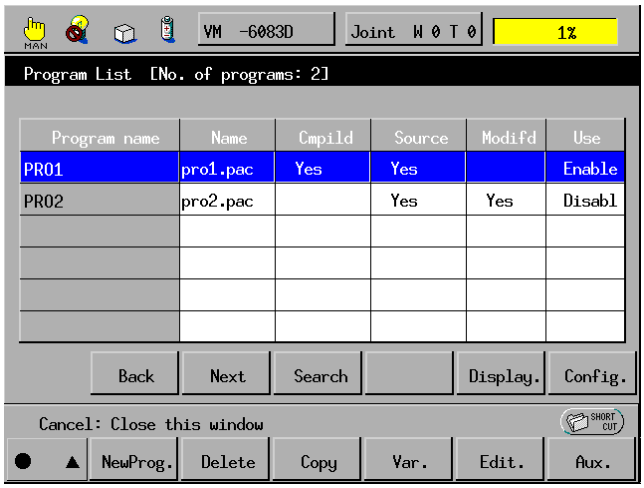
In compilation, the system will first check the enable/disable flags of programs and then compile only those programs whose flags are set to "Enable."

If a project contains more than one program with a same name but only one of them is set to "Enable," then no compile error will occur.

If you edit and save programs whose flags are set to "Enable," the system will automatically compile them.

(1) In the Program List window, select a program that you want or do not want to compile.

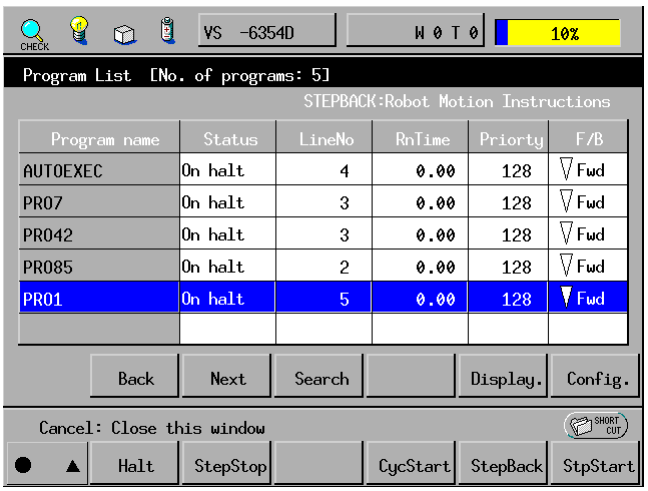
(2) Press [Config.] (or the Config. button located at the bottom of the Program List window). This switches the selected program between "Enable" and "Disable."



5.2.2 Showing the Program List Window in Teach Check Mode

In Teach mode, touching the mode icon (the leftmost icon on the status bar) on the extended screen toggles between the manual mode and teach check mode.

After switching to the teach check mode, pressing [Program] displays the Program List window as shown below.



When shifted

The Program List window has the following items:

[Program Name] Lists program names declared by the PROGRAM statement.

[Status] Shows the execution status of the listed program.

[LineNo.] Shows the line being executed or on halt.

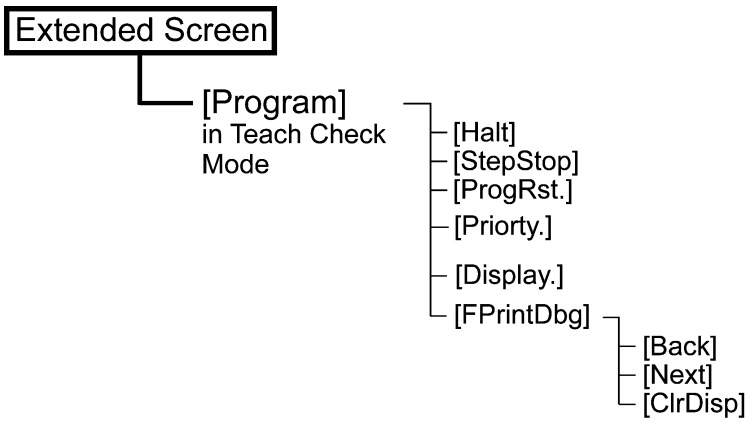
[RnTime] Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.

If the listed program runs continuously, the run time required for every cycle will appear.

[Priorty] Shows the priority order for executing programs. The less the numeric value, the higher the priority.

[F/B] Shows whether the listed program is currently executing forwards or backwards.

The hierarchy of the [Program] menu in Teach checks mode is given on the next page.


Extended Screen
[Program]
in Teach Check
Mode
[Halt]
[StepStop]
[ProgRst.]
[Priorty.]
[Display.]
[FPrintDbg]
[Back]
[Next]
[ClrDisp]

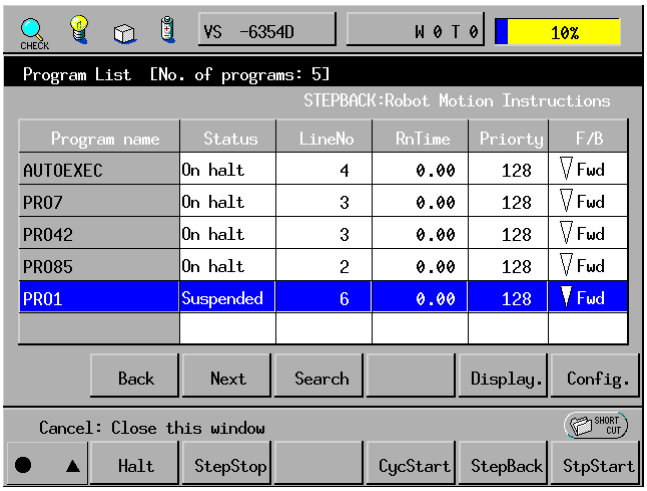
Halting the selected program in Teach check mode

Access: [ExtScrn]—[Program]—[Halt]

Halts the task program selected in the Program List window.

Pressing [Halt] in the Program List window (shown below) will immediately interrupt the selected program.

Refer to the Table 3-3.



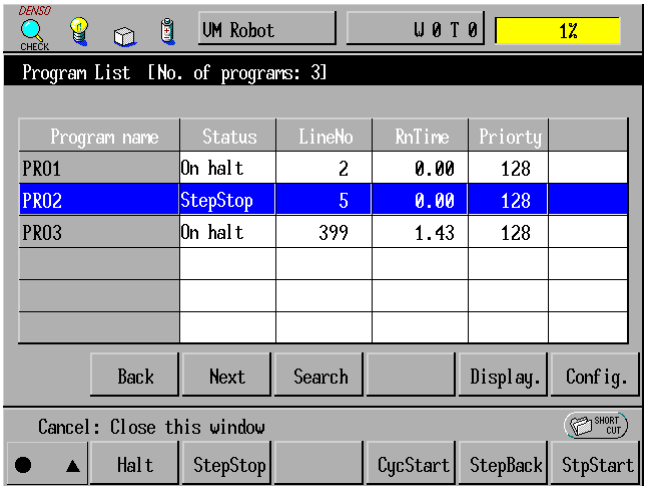
TIP: Pressing [Halt] halts the selected program only. Pressing the STOP key on the teach pendant stops all task programs.

Causing a step stop in Teach check mode

Access: [ExtScrn]—[Program]—[StepStop]

Interrupts the task program selected in the Program List window as shown below, after executing the current program step.

Refer to the Table 3-3.



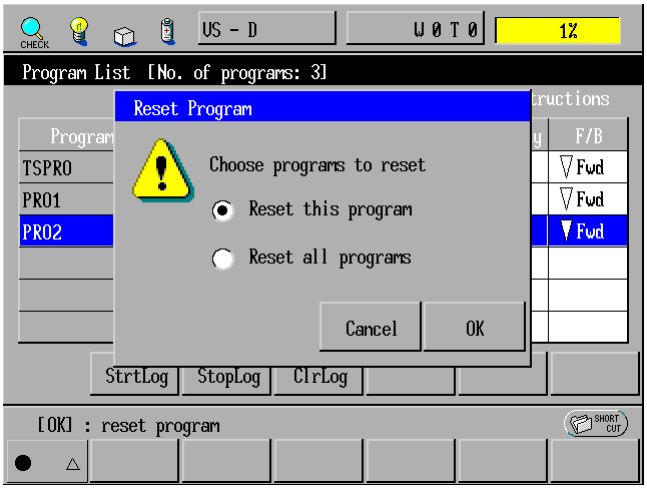
Stopping the program(s) in Teach check mode

Access: [ExtScrn]—[Program]—[ProgRst.]

Stops the program(s).

(1) Press [ProgRst.] in the Program List window.
The Reset Program window will appear as shown below.

(2) Select the program to be stopped and press the OK button.
The task will be stopped.
NOTE: The currently running program also stops.



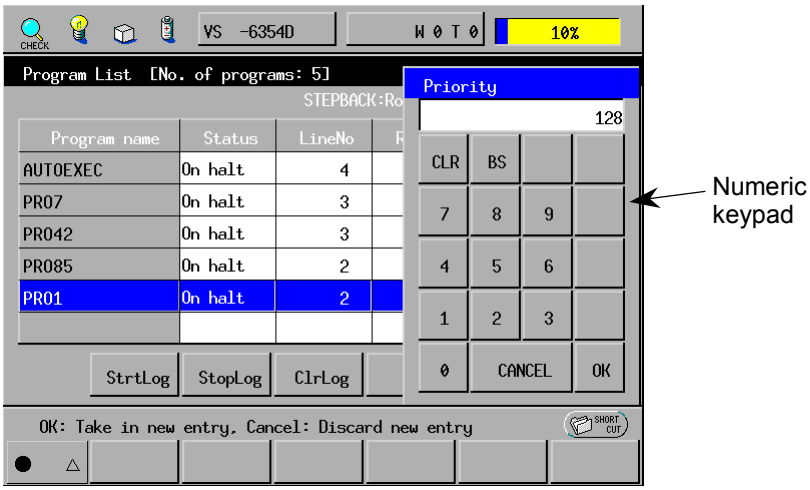
Setting the priority order of programs in Teach check mode

Access: [ExtScrn]—[Program]—[Priorty.]

Sets the priority order of a program you select in the Program List window.

(1) Select the target program.

(2) Press [Priorty.], and the numeric keypad will appear as shown below.



(3) Enter the priority order with the numerical buttons. (Entry range: 102 to 255)
Note: The priority order of the supervisory task cannot be changed.

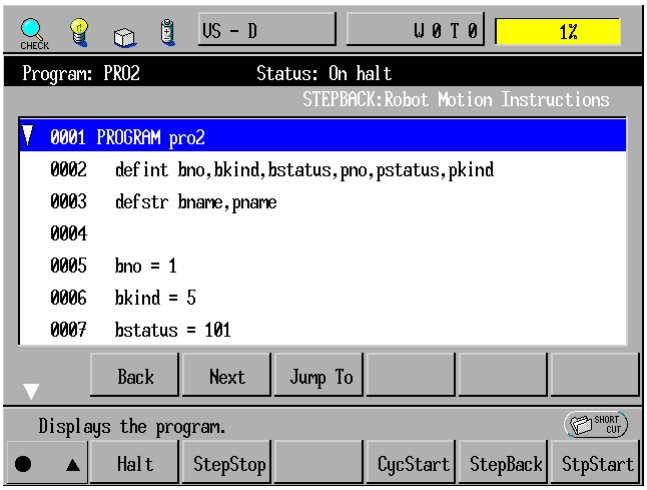
(4) Press the OK button.

Displaying codes of the selected program in Teach check mode

Access: [ExtScrn]—[Program]—[Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.
(2) Press [Display.], and the program code window will appear as shown below.



When the program code window is displayed, the following commands are still effective: [Halt], [StepStop], [CycStart], [StpStart], [Var.], [I/O.], [Priorty.], and [PrintDbg].

Displaying a debug window in Teach check mode

Access: [ExtScrn]—[Program]—[PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

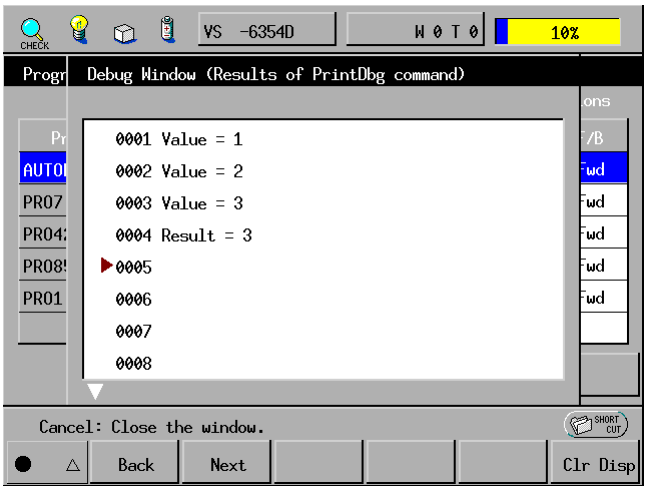
This command allows you to check the execution result of a program or the intermediate result of the computation.

The debug window displays the last 40 lines of the execution result. Scroll the screen to show older data.

A red triangle marker indicates a current line being used by this command.

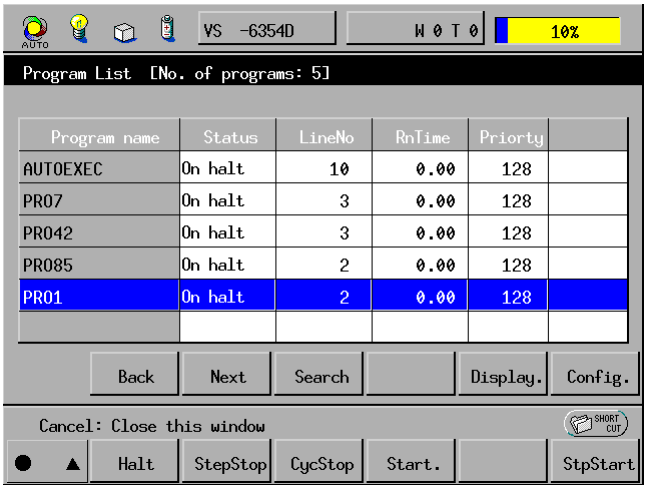
If a sample program shown below is executed, the debug window will display the results as shown below.

```
'!TITLE "PrintDbg test program"
PROGRAM TEST
  DIM COUNTER AS INTEGER

  FOR COUNTER = 1 TO 5
    PRINTDBG "Value =";COUNTER
    IF COUNTER = 3 THEN EXIT FOR
  NEXT

  PRINTDBG "Result = ";COUNTER
END
```



5.2.3 Showing the Program List Window in Auto Mode

Pressing [Program] on the top screen in Auto mode will display the Program List window as shown below.



When shifted

The Program List window has the following items:

[Program Name] Lists program names declared by the PROGRAM statement.

[Status] Shows the execution status of the listed program.

[LineNo.] Shows the line being executed or on halt.

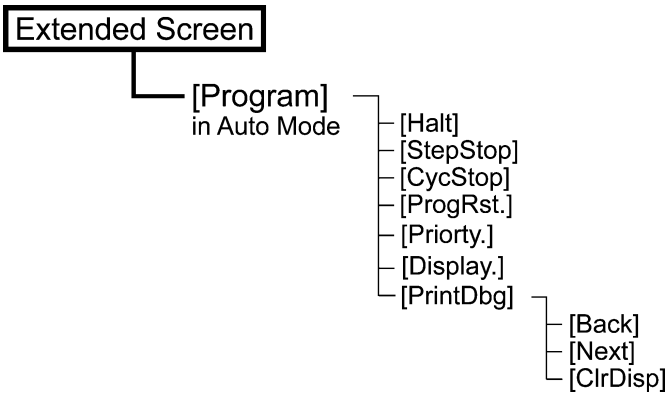
[RnTime] Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.

If the listed program runs continuously, the run time required for every cycle will appear.

Note: In Version 1.4 or later, the run time is displayed for each step when step run is carried out.

[Priorty] Shows the priority order for executing programs. The less the numeric value, the higher the priority.

The hierarchy of the [Program] menu in Auto mode is given on the next page.


Extended Screen
[Program]
in Auto Mode
[Halt]
[StepStop]
[CycStop]
[ProgRst.]
[Priorty.]
[Display.]
[PrintDbg]
[Back]
[Next]
[ClrDisp]

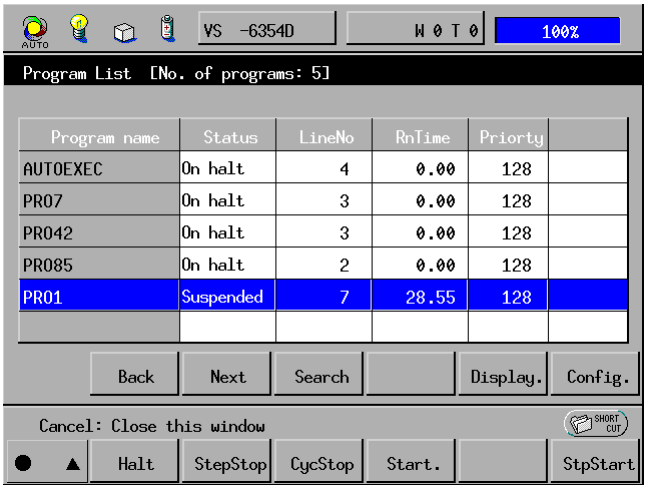
Halting the selected program in Auto mode

Access: [ExtScrn]—[Program]—[Halt]

Halts the task program selected in the Program List window.

Pressing [Halt] in the Program List window (shown below) will immediately interrupt the selected program.

Refer to the Table 3-3.

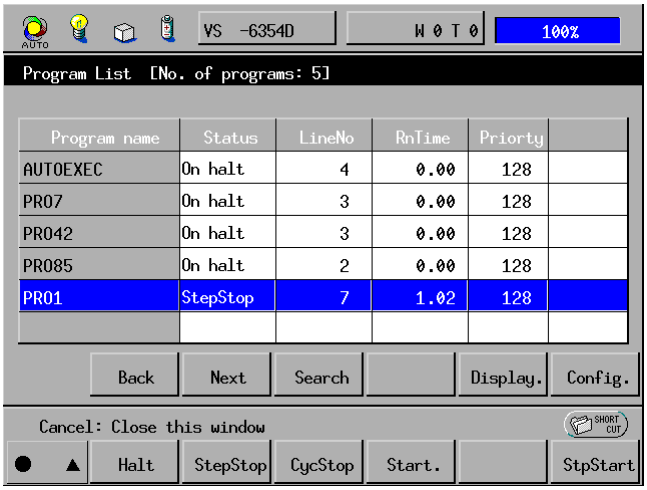


Causing a step stop in Auto mode

Access: [ExtScrn]—[Program]—[StepStop]

Interrupts the program selected in the Program List window as shown below, after executing the current program step.

Refer to the Table 3-3.

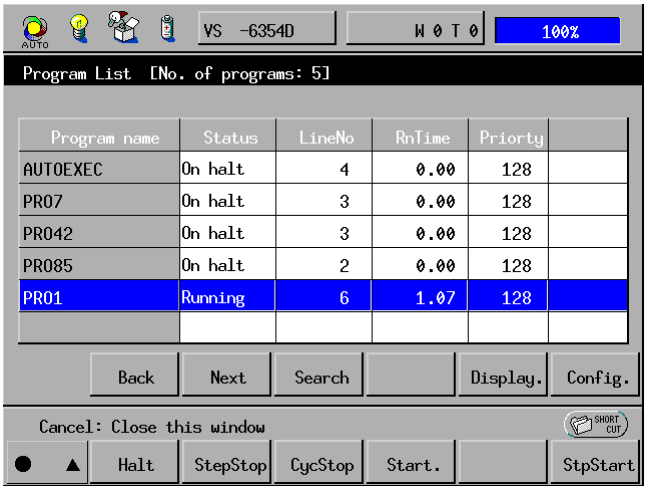


Causing a cycle stop in Auto mode

Access: [ExtScrn]—[Program]—[CycStop]

Stops the task program selected in the Program List window as shown below, after executing the current program up to the last step.

Refer to the Table 3-3.



NOTE: The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.

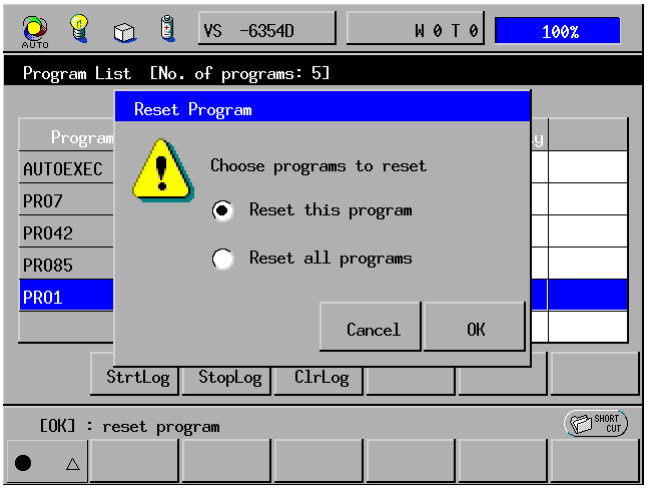
Displaying the Reset Program window in Auto mode

Access: [ExtScrn]—[Program]—[ProgRst.]

Displays the Reset Program windows.

(1) Press [ProgRst.] in the Program List window.
The Reset Program window will appear as shown below.

(2) Select the program to be stopped and press the OK button.
The task will be stopped.
NOTE: The currently running program also stops.



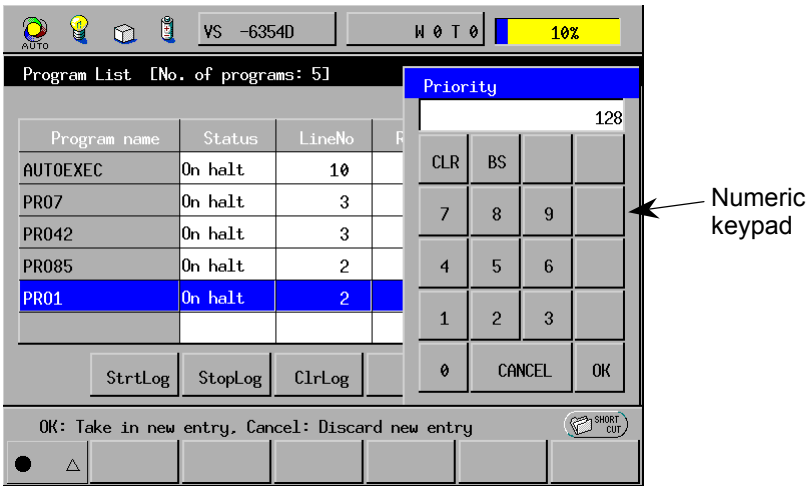
Setting the priority order of programs in Auto mode

Access: [ExtScrn]—[Program]—[Priorty.]

Sets the priority order of the task programs selected in the Program List window.

(1) Select the target program.

(2) Press [Priorty.], and the numeric keypad will appear as shown below.



(3) Enter the priority order with the numerical buttons. (Entry range: 102 to 255)
Note: The priority order of the supervisory task cannot be changed.

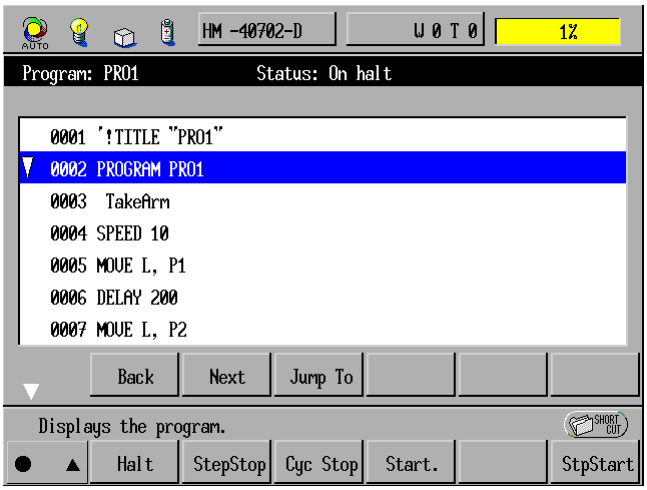
(4) Press the OK button.

Displaying codes of the selected program in Auto mode

Access: [ExtScrn]—[Program]—[Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.
(2) Press [Display.], and the program code window will appear as shown below.



When the program code window is displayed, the following commands are still effective: [Halt], [StepStop], [CycStop], [Var.], [I/O.], [Priorty.], and [PrintDbg].

Displaying a debug window in Auto mode

Access: [ExtScrn]—[Program]—[PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

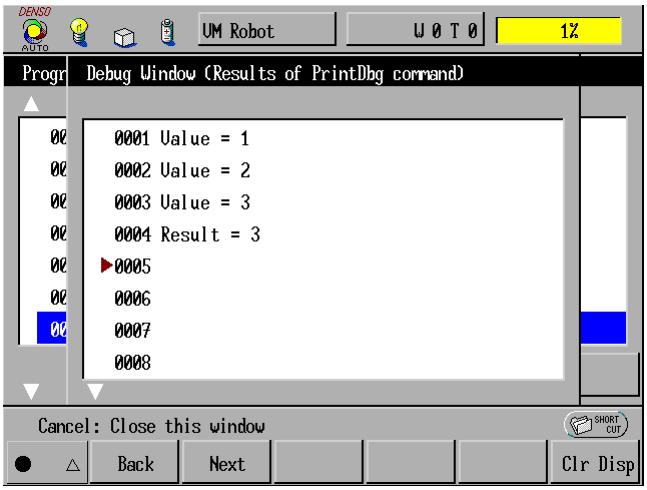
This command allows you to check the execution result of a program or the intermediate result of the computation.

The debug window displays the last 40 lines of the execution result. Scroll the screen to show older data.

A red triangle marker indicates a current line being used by this command.

If a sample program shown below is executed, the debug window will display the results as shown below.

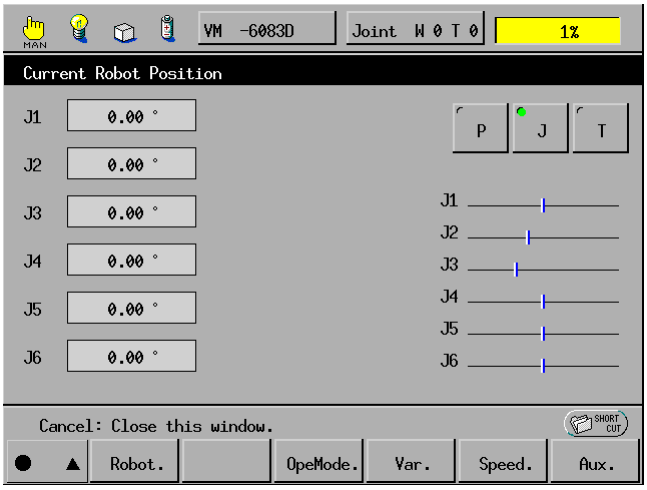
```
'!TITLE "PrintDbg test program"
PROGRAM TEST
  DIM COUNTER AS INTEGER

  FOR COUNTER = 1 TO 5
    PRINTDBG "Value =";COUNTER
    IF COUNTER = 3 THEN EXIT FOR
  NEXT

  PRINTDBG "Result = ";COUNTER
END
```



5.3 Displaying the Current Robot Position

Access: [ExtScrn]—[Arm]

Pressing [Arm] on the extended screen will display the Current Robot Position window as shown below.

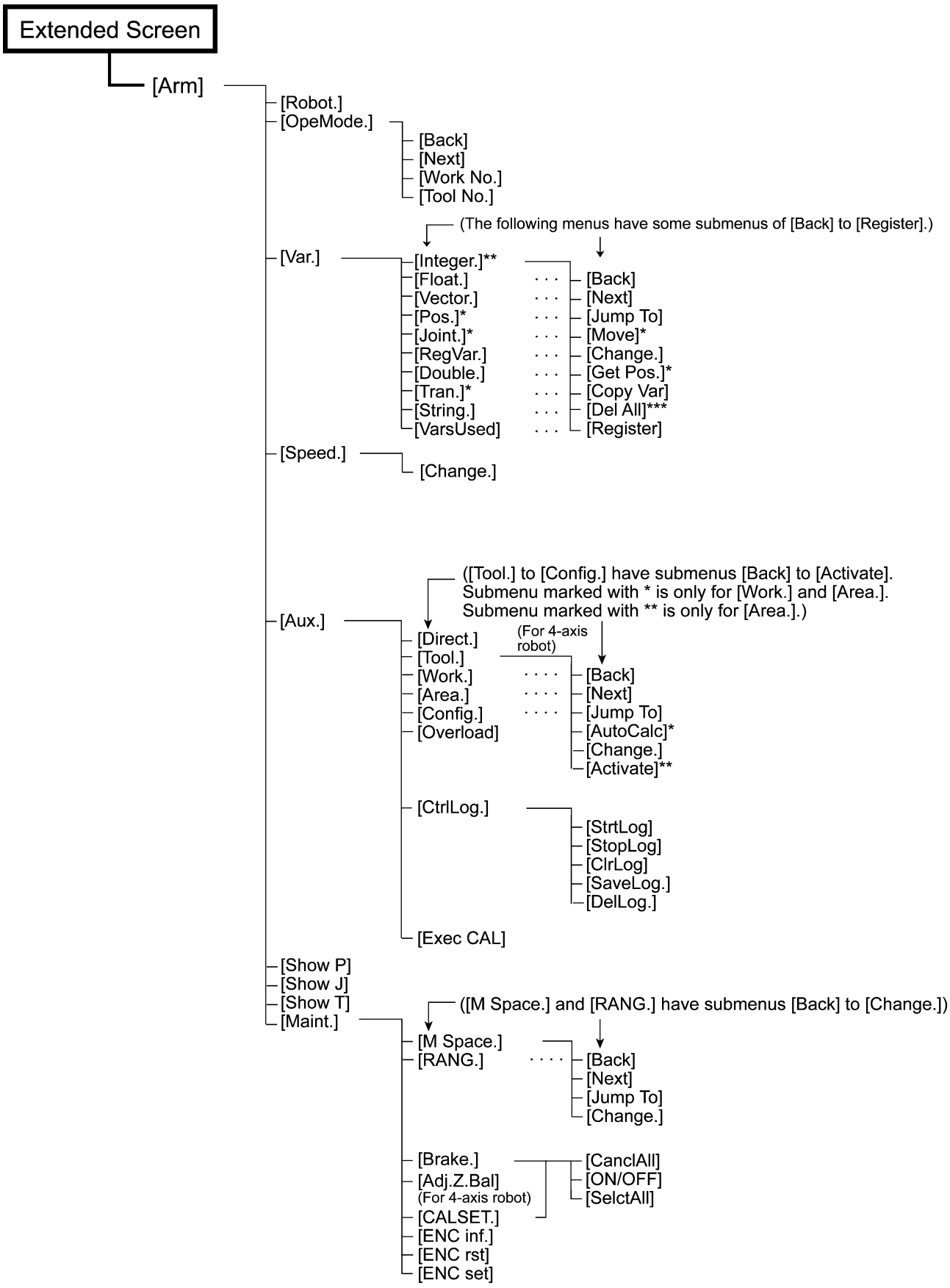


When shifted

Pressing [Show P] (or P button), [Show J] (or J button), or [Show T] (or T button) switches the expression of the current robot position to the position variable type, joint variable type, or homogeneous transform matrix variable type, respectively.

The J1 through J6 (J4 for the 4-axis robot) show where each axis is positioned within the motion space.

The hierarchy of the [Arm] menu is given on the next page.


Extended Screen
[Arm]
[Robot.]
[OpeMode.]
[Back]
[Next]
[Work No.]
[Tool No.]
(The following menus have some submenus of [Back] to [Register].)
[Var.]
[Integer.]**
[Float.]
[Vector.]
[Pos.]*
[Joint.]*
[RegVar.]
[Double.]
[Tran.]*
[String.]
[VarsUsed]
[Back]
[Next]
[Jump To]
[Move]*
[Change.]
[Get Pos.]*
[Copy Var]
[Del All]***
[Register]
[Speed.]
[Change.]
([Tool.] to [Config.] have submenus [Back] to [Activate].
Submenu marked with * is only for [Work.] and [Area.].
Submenu marked with ** is only for [Area.].)
[Aux.]
[Direct.]
[Tool.]
[Work.]
[Area.]
[Config.]
[Overload]
(For 4-axis robot)
[Back]
[Next]
[Jump To]
[AutoCalc]*
[Change.]
[Activate]**
[CtrlLog.]
[StrtLog]
[StopLog]
[ClrLog]
[SaveLog.]
[DelLog.]
[Exec CAL]
[Show P]
[Show J]
[Show T]
[Maint.]
([M Space.] and [RANG.] have submenus [Back] to [Change.])
[M Space.]
[RANG.]
[Back]
[Next]
[Jump To]
[Change.]
[Brake.]
[Adj.Z.Bal]
(For 4-axis robot)
[CALSET.]
[ENC inf.]
[ENC rst]
[ENC set]
[CanclAll]
[ON/OFF]
[SelctAll]

Selecting the robot type (reserved)

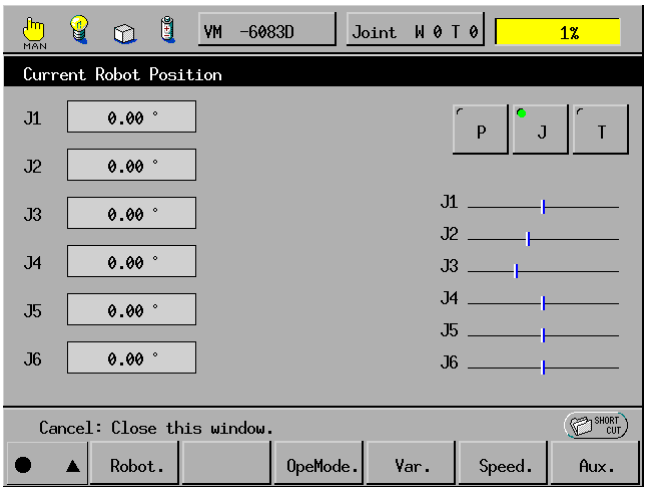
Access: [ExtScrn]—[Arm]—[Robot.]

Selects the type of robot you have. This command is reserved for future use of eight-axis robots or two 4-axis robots. It allows the control of the teach pendant to switch between six axes and two extended axes or between two 4-axis robots.

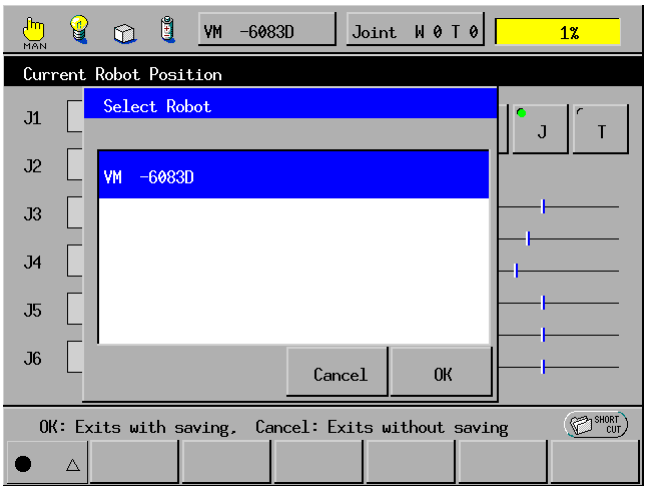
While the teach pendant has only six arm traverse keys, the robot controller can control up to 8 axes (e.g., controlling a single 6-axis robot plus two extended axes or two 4-axis robots). To control more than six axes with those six keys of the teach pendant, you need to use this command and switch the control to the extended axes.

This command is functionally equivalent to the R-SEL key.

(1) In the Current Robot Position window shown below, press [Robot.].



(2) The Select Robot window will appear as shown below. Select the type of your robot and then press the OK button.



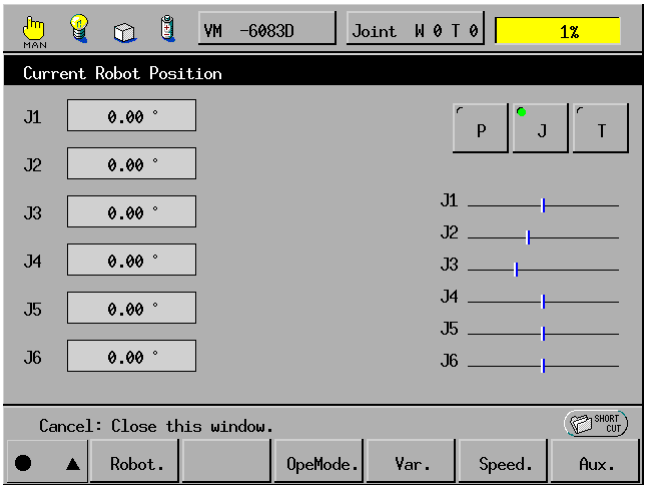
Switching the operation modes, work coordinates and tool coordinates

Access: [ExtScrn]—[Arm]—[OpeMode.]

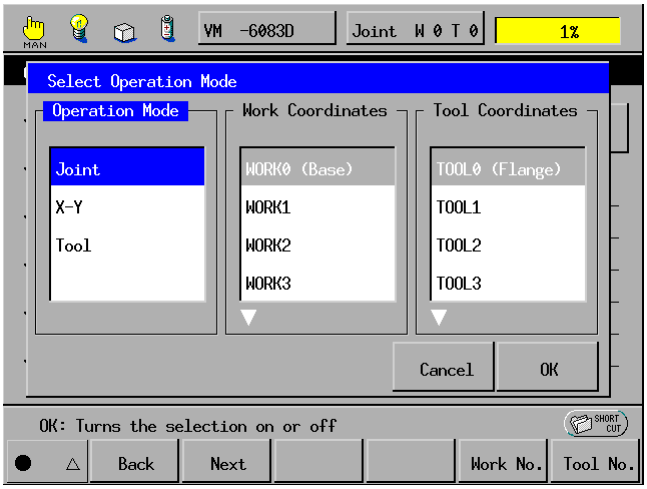
Switches the operation modes, work coordinates and tool coordinates.

This command is functionally equivalent to the M-MOD key.

(1) In the Current Robot Position window shown below, press [OpeMode.].



(2) The Select Operation Mode window will appear as shown below. Select the desired operation mode, work coordinates and tool coordinates, and then press the OK button.



NOTE: The work coordinates selected on the extended screen remains in effect after the screen switches back to the top one. Be careful with the fact that in X-Y mode, the robot runs with the work coordinates selected.

Displaying and modifying variable values

Access: [ExtScrn]—[Arm]—[Var.]

Displays values assigned to various types of variables and the number of variables used and/or modifies them.

This command is functionally equivalent to [ExtScrn]—[Program]—[Var.] in Manual mode.

Displaying and modifying integer variable values
[ExtScrn]—[Arm]—[Var.]—[Integer.]

Refer to page 5-17.

Displaying and modifying floating-point variable values
[ExtScrn]—[Arm]—[Var.]—[Float.]

Refer to page 5-18.

Displaying and modifying vector variable values
[ExtScrn]—[Arm]—[Var.]—[Vector.]

Refer to page 5-19.

Displaying and modifying position variable values
[ExtScrn]—[Arm]—[Var.]—[Pos.]

Refer to page 5-20.

Displaying and modifying joint variable values
[ExtScrn]—[Arm]—[Var.]—[Joint.]

Refer to page 5-21.

Displaying registered variable list
[ExtScrn]—[Arm]—[Var.]—[RegVar.]

Refer to page 5-22.

Displaying and modifying double-precision variable values
[ExtScrn]—[Arm]—[Var.]—[Double.]

Refer to page 5-23.

Displaying and modifying variable values in homogeneous transform matrix
[ExtScrn]—[Arm]—[Var.]—[Tran.]

Refer to page 5-24.

Displaying and modifying string variable values
[ExtScrn]—[Arm]—[Var.]—[String.]

Refer to page 5-25.

Displaying and modifying the number of variables used
[ExtScrn]—[Arm]—[Var.]—[VarsUsed.]

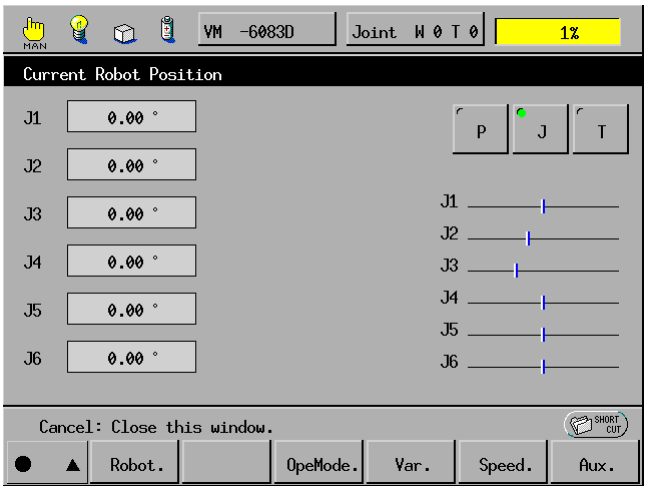
Refer to page 5-27.

Setting the speed

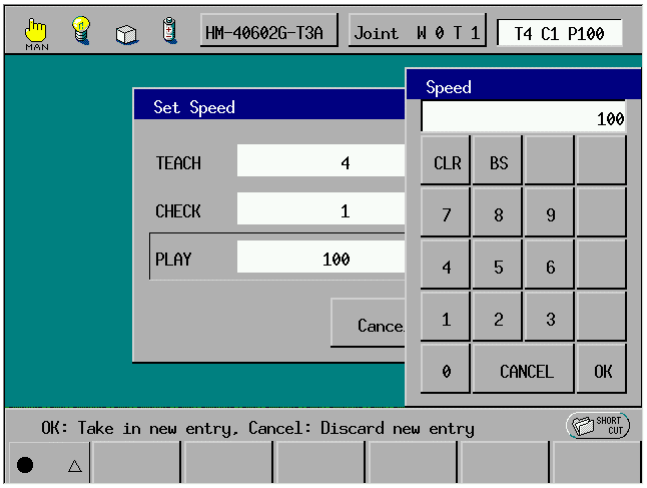
Access: [ExtScrn]—[Arm]—[Speed.]

Sets speeds for Teach, Individual, and Auto modes.

(1) In the Current Robot Position window shown below, press [Speed.].



(2) The Set Speed window will appear as shown below. Set the desired speeds for Teach, Individual and Auto modes, respectively. Then press the OK button.



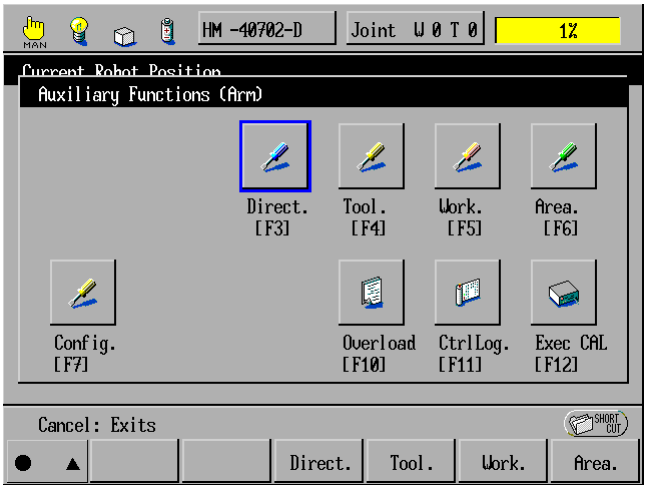
TIP: For the detailed operating procedure about speed, refer to Chapter 2, Section 2.6.

Providing auxiliary functions

Access: [ExtScrn]—[Arm]—[Aux.]

Provides the auxiliary functions concerning coordinates definition, interference area definition, user preferences, overload anticipation, and CAL operation.

(1) Press [Aux.], and the Auxiliary Functions (Arm) window will appear as shown below.



(2) Select the desired auxiliary function by pressing the corresponding function key. The corresponding window will display as described on the following pages.

Entering the direct teaching mode (For 4-axis robots)

Access: [ExtScrn]—[Arm]—[Aux.]—[Direct.]

The direct teaching mode allows you to move the robot arm by hand (without using the teach pendant) with the motor being OFF and teach the current position to a joint variable, position variable, or homogeneous transform matrix variable. (Usual teaching requires the motor to be turned ON.)

Note 1: The HS-G-T series robots have no air balance cylinder on the Z-axis, so the operation procedure for the direct teaching mode differs from that of the conventional 4-axis robots.

Note 2: Holding down either one of the deadman switches is required for direct teaching mode operation and brake releasing.

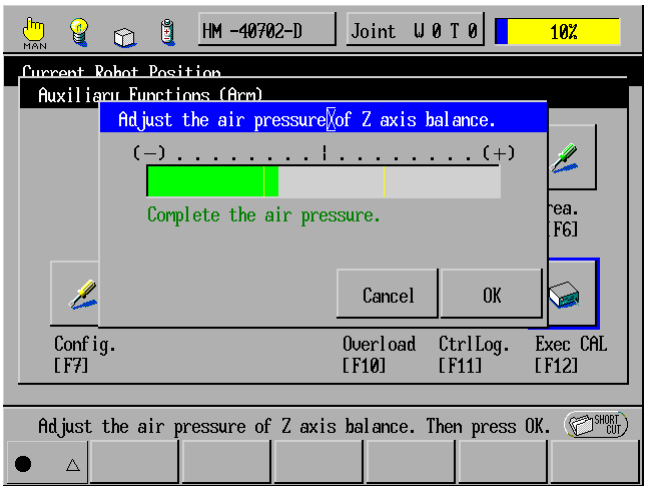
Note 3: Do not quickly start and stop the direct teaching mode in succession. It may trigger the error 5790 "Speed over in direct mode."

■ For conventional 4-axis robots except the HS-G-T series

(1) In the Auxiliary Functions (Arm) window, press [Direct.]. The air balance adjustment window will appear.

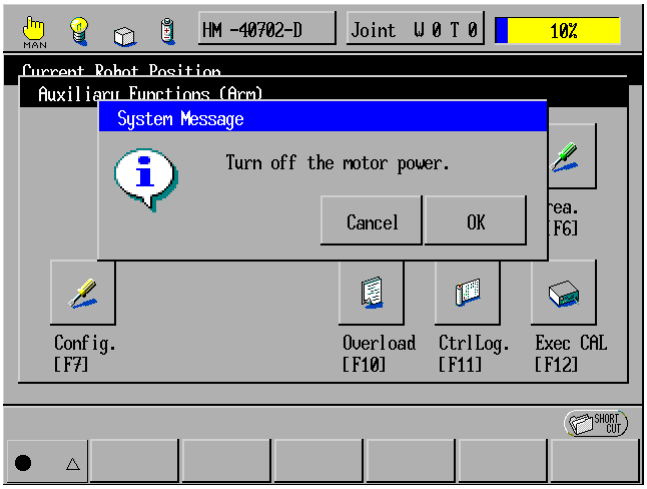
NOTE: The air pressure adjustment for Z-axis balance is required only when you make the robot enter the direct teaching mode at the first time after turning the robot controller ON.

(2) According to the instructions given on the screen, adjust the air pressure. If the "Complete the air pressure" is displayed as shown below, press the OK button.

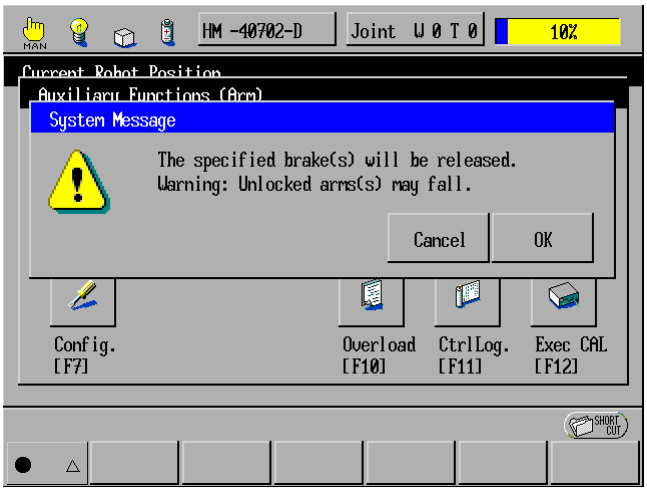


(3) Wait for the following window to appear and press the OK button.

(4) Wait for the following window to appear.
Turn the motor OFF and then press the OK button.



(5) Wait for the following window to appear.
Check the message and press the OK button.



The robot is placed in the direct teaching mode.

■ For the HS-G-T series

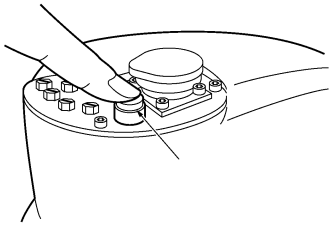
The HS-G-T series robots have no air balance cylinder on the Z-axis, so the operation procedure for the direct teaching mode differs from that of the conventional 4-axis robots.

(1) In the Auxiliary Functions (Arm) window, press [Direct.].
The following message will appear.

(2) Press the OK button in the above window.
After that, holding down the brake release switch provided on the top of the 3rd arm releases the brake.
Note: The brake release switch is effective only in the direct teaching mode.

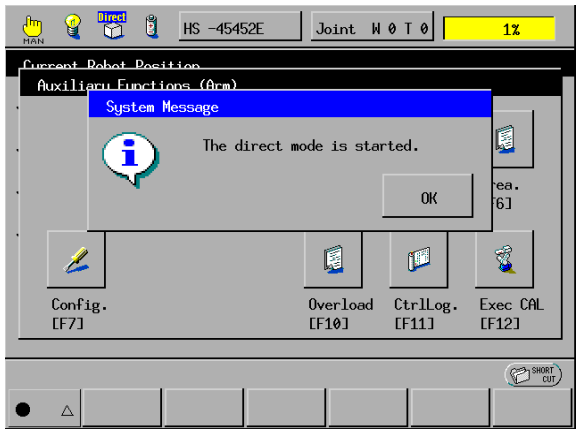
⚠Caution: Releasing the brake will drop the Z-axis downward. Make sure beforehand that it will not cause damage to person or equipment.

Brake release button for the 3rd-axis



<HS-G-T series>

(3) In the following start window, press the OK button.

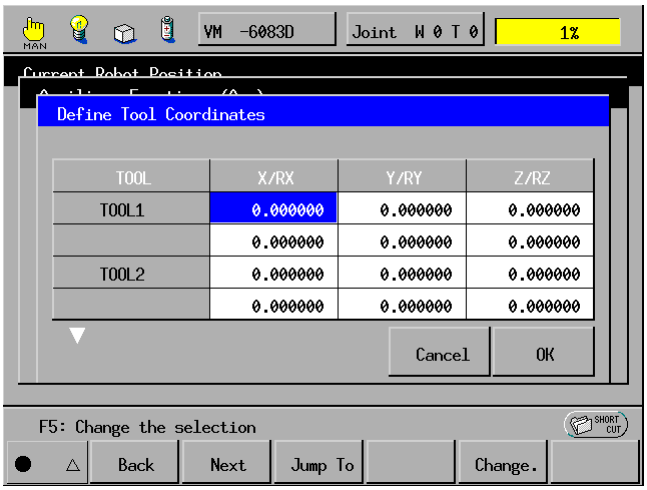


Defining tool coordinates

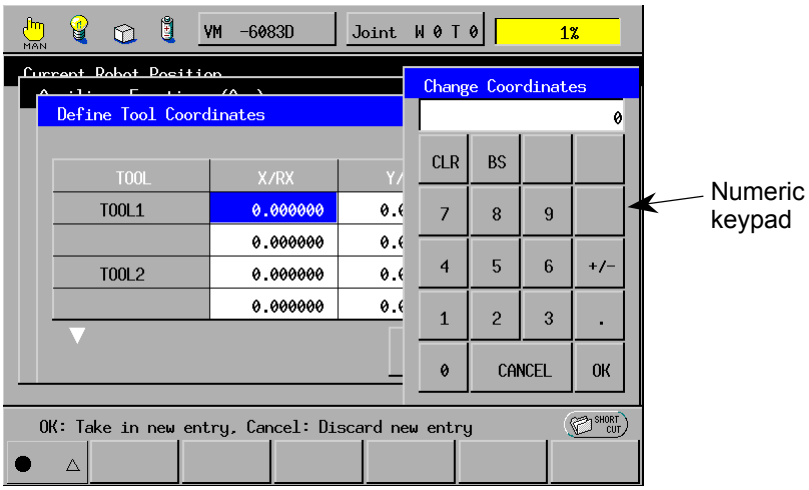
Access: [ExtScrn]—[Arm]—[Aux.]—[Tool.]

Defines tool coordinates.

(1) Press [Tool.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [Change.]
The numeric keypad will appear as shown below.



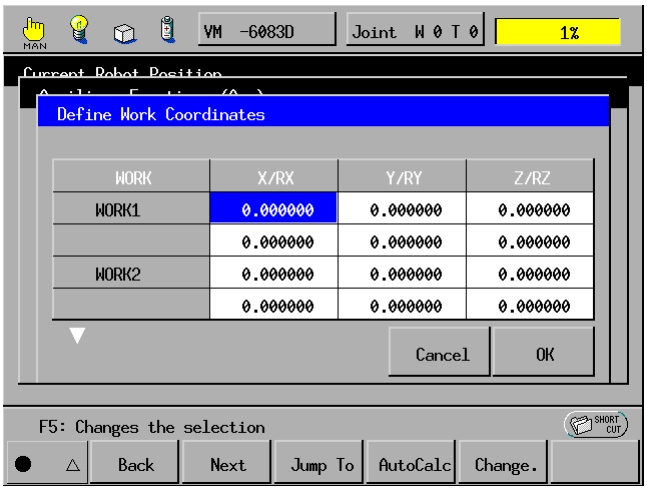
(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Defining work coordinates

Access: [ExtScrn]—[Arm]—[Aux.]—[Work.]

Defines work coordinates.

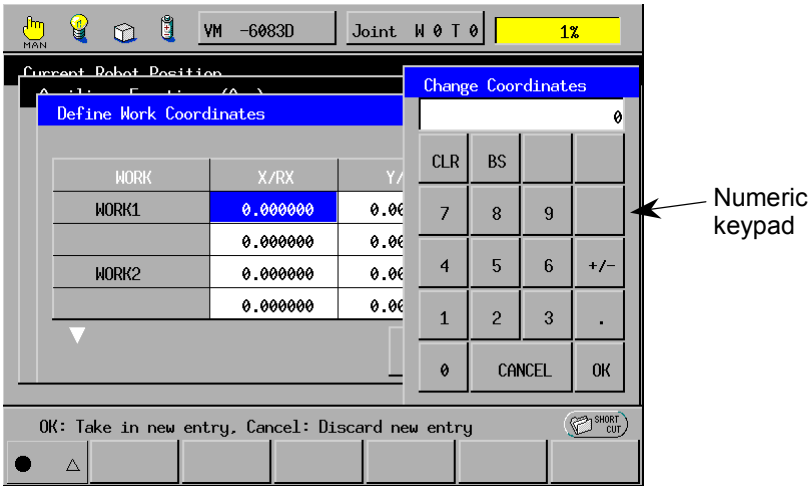
(1) Press [Work.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [Change.].

NOTE: For automatic calculation of work coordinates, press [AutoCalc]. For details, refer to the next page.

The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

NOTE: The work coordinates selected on the extended screen remains in effect after the screen switches back to the top one. Be careful with the fact that the work coordinates selected here affects robot motions in manual mode.

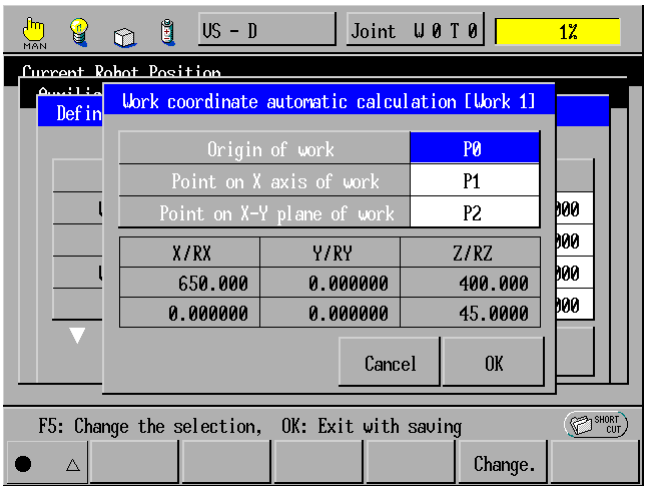
Calculating work coordinates automatically in Manual mode

Access: [ExtScrn]—[Arm]—[Aux.]—[Work.]—[AutoCalc]

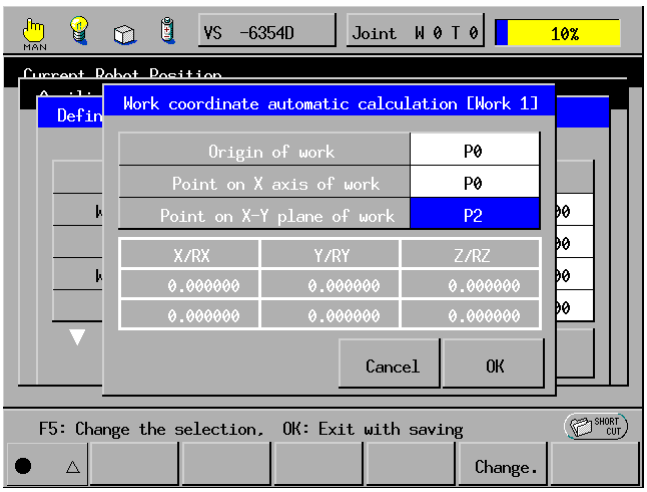
Calculates work coordinates automatically if you merely specify three points--Origin of work coordinates, point on the X axis of work coordinates and point on the X-Y plane of work coordinates.

For details regarding work coordinates definition, refer to Section 4.1.1, [1.3] and Section 4.2.1, [1.3] for 6-axis and 4-axis robots, respectively.

(1) Press [AutoCalc] in the Define Work Coordinates window, and the following window appears.



If three points are on a straight line, the automatic calculation will fail to set work coordinates and the following window appears.

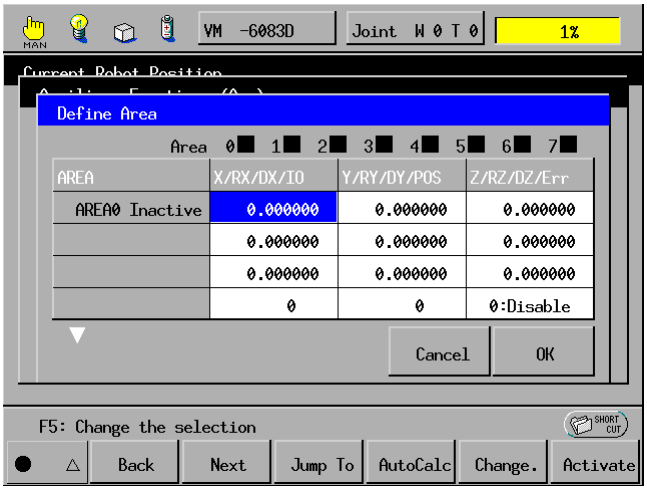


Defining an interference check area

Access: [ExtScrn]—[Arm]—[Aux.]—[Area.]

Defines an interference check area(s) or cube(s). If the end-effector comes in or goes out of the defined interference check area, the system interprets it as interference so that it can activate specified tasks preprogrammed if an I/O port address is set. Note that AREA0 to 3 are reserved for the system.

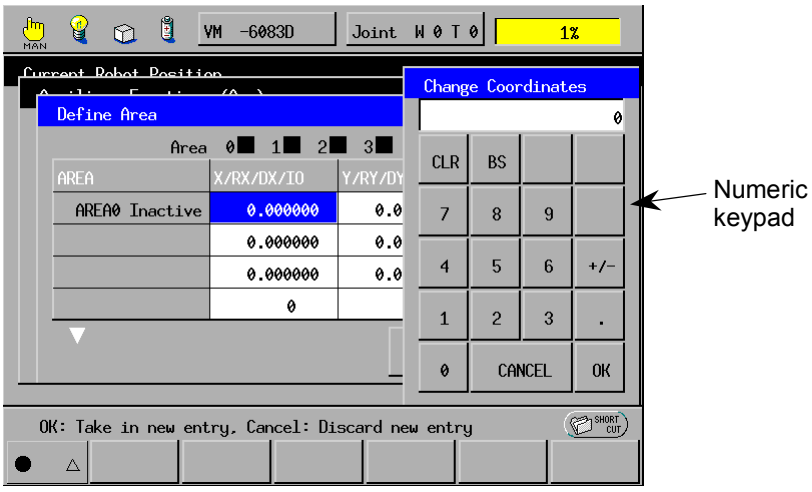
(1) Press [Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [Change.].

NOTE: For automatic calculation of the interference check area, press [AutoCalc]. For details, refer to the next page.

The numeric keypad will appear as shown below.

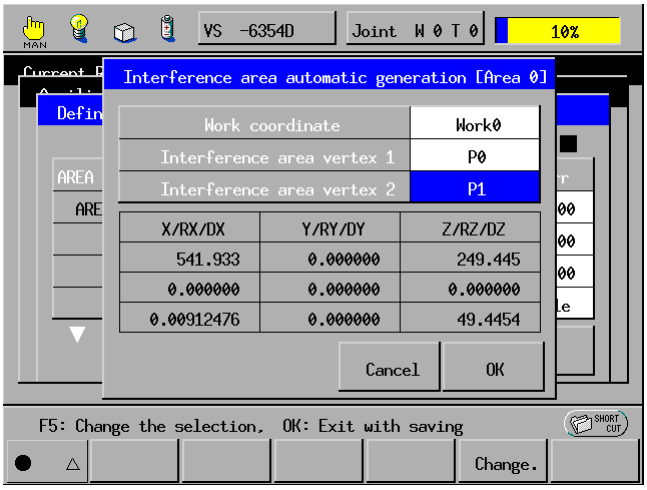


(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Calculating the coordinates of an interference check area automatically in Manual mode

Access: [ExtScrn]—[Arm]—[Aux.]—[Area.]—[AutoCalc]

Calculates the coordinates of an interference check area(s) automatically if you merely specify three points--Work coordinates and two vertexes (farthest and nearest to the origin of the base coordinates) of the interference check area.

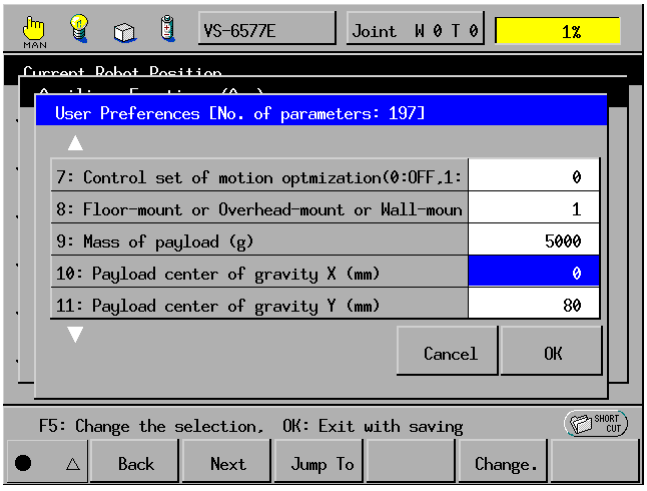


Setting the user preferences

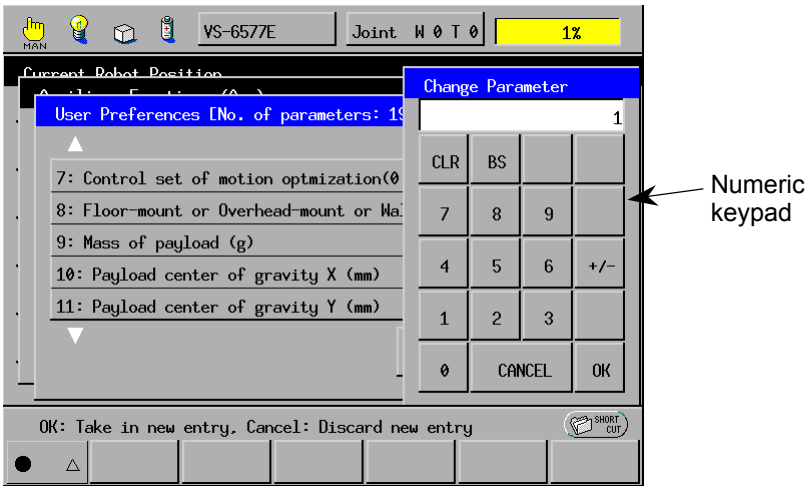
Access: [ExtScrn]—[Arm]—[Aux.]—[Config.]

Sets or modifies the user preferences such as the control set of motion optimization, robot mounting style, mass of payload, and payload center of gravity (as master control parameters).

(1) Press [Config.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [Change.].
The numeric keypad will appear as shown below.



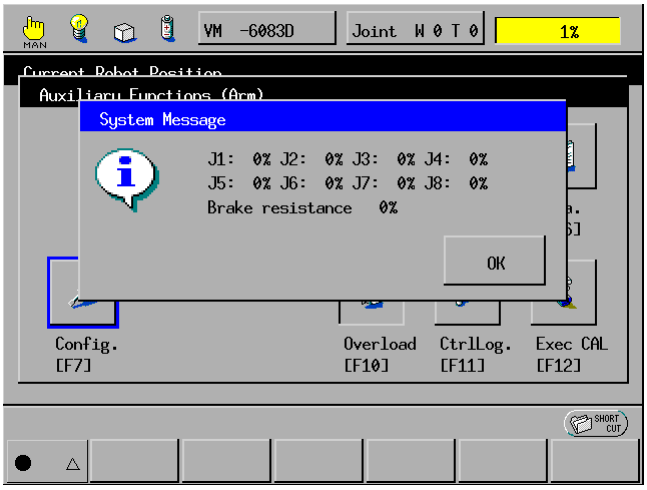
(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Displaying anticipated overloads to the capacity of motors and brake resistance of the robot controller

Access: [ExtScrn]—[Arm]—[Aux.]—[Overload]

Displays anticipated overloads (percentages) to the capacity of joint-drive motors and to the brake resistance of the robot controller.

(1) Press [Overload] in the Auxiliary Functions (Arm) window, and the following system message dialog box will appear.



(2) Press the OK button to close the dialog box.

When the system logs control data, it calculates anticipated overloads. To update the anticipated overloads; therefore, write program in which STARTLOG will execute at the start of the motion whose overloads should be anticipated, as shown in the sample program given on the next page.

The system will calculate anticipated overloads for a maximum of 10 seconds from the start of logging. If the time from the start (STARTLOG) of logging to the end (STOPLOG) is less than 10 seconds, the system will calculate overloads for that time.

If the time exceeds 10 seconds, the system will calculate them for the first 10 seconds. If a motion cycle whose overloads should be anticipated takes more than 10 seconds, therefore, you need to log control data for each of 10-second or less motion cycles to monitor anticipated overloads.

Anticipated overloads will not be updated until STARTLOG executes again.

(Sample program for logging)

```
PROGRAM PRO1 'Main program'

TAKEARM
CLEARLOG :Clears log data before STARTLOG
STARTLOG :Start of logging

CALL SUB1
CALL SUB2
STOPLOG  :End of logging
GIVEARM
END
```

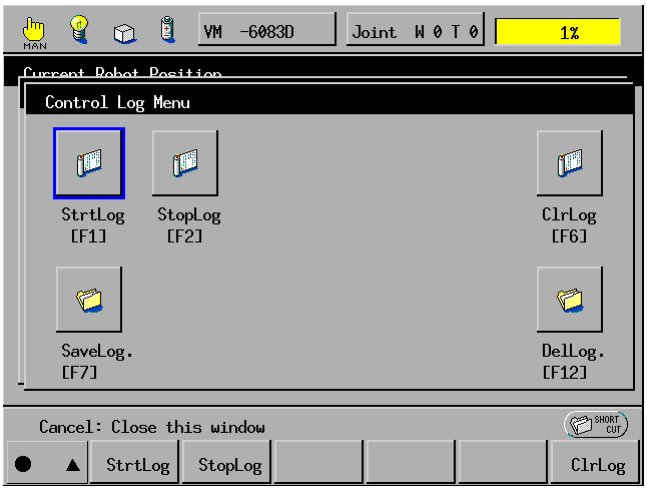
(If STOPLOG executes within 10 seconds from STARTLOG, the anticipated overloads for that time will appear.)

Saving or deleting control log to/from the flash memory

Access: [ExtScrn]—[Arm]—[Aux.]—[CtrlLog.]

Saves or deletes control log preserved in the flash memory.

(1) Press [CtrlLog.] in the Auxiliary Functions (Arm) window, and the following window appears.



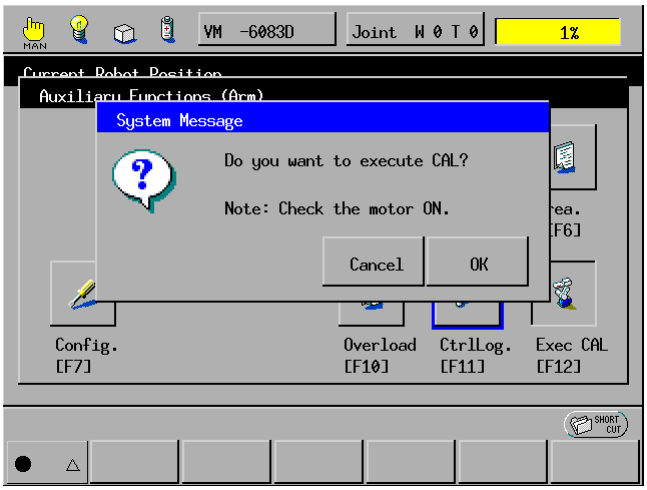
Function keys available	
[StrtLog]	Starts keeping a control log.
[StopLog]	Stops keeping a control log.
[ClrLog]	Clears the current log so as to allow a new log.
[SaveLog.]	Saves the current log stored in the work memory into the flash memory. If the controller is turned OFF, data stored in the work memory will be lost, but data in the flash memory will not. You may read out log data stored in the flash memory by specifying the log in WINCAPSIII.
[DelLog.]	Deletes the current log stored in the flash memory.

Executing CAL operation

Access: [ExtScrn]—[Arm]—[Aux.]—[Exec CAL]

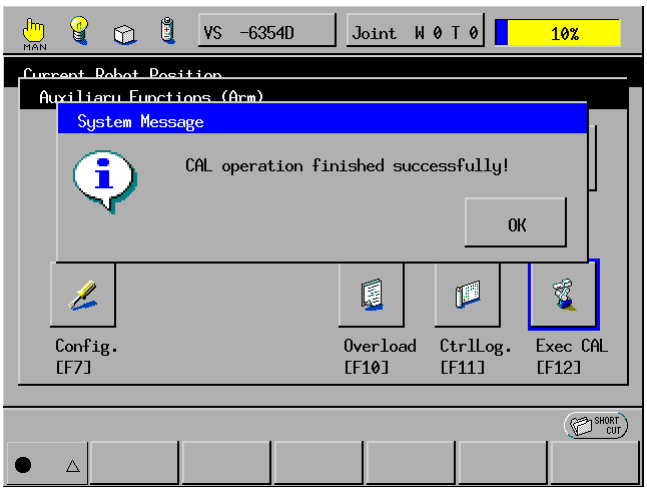
Executes CAL operation.

(1) Press [Exec CAL] in the Auxiliary Functions (Arm) window, and the following system message dialog box will appear.



(2) Check that the motor power is ON, and then press the OK button in the above dialog box to proceed.

The system message dialog box will appear as shown below.



(3) Press the OK button in the above dialog box.

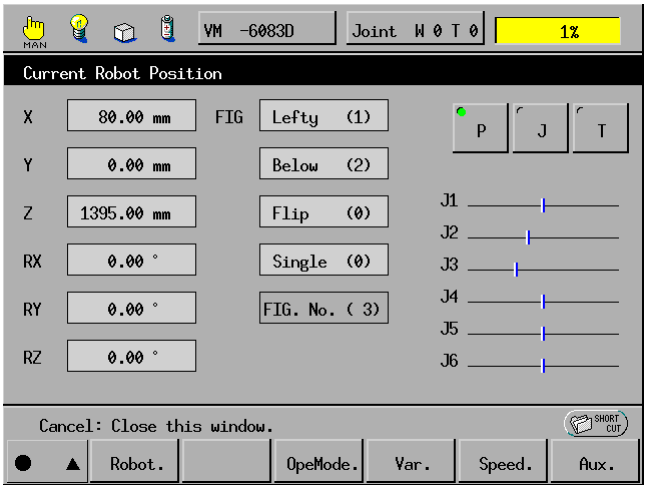
Switching the expression of the current robot position to the position variable type

Access: [ExtScrn]—[Arm]—[Show P]

Switches the expression of the current robot position to the position variable type.

Press [Show P] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in position variables.

This command is functionally equivalent to the P button provided in the upper right corner of the Current Robot Position window.



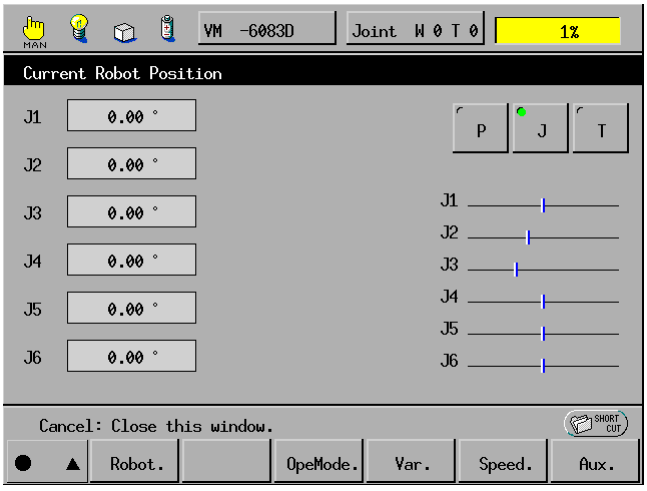
Switching the expression of the current robot position to the joint variable type

Access: [ExtScrn]—[Arm]—[Show J]

Switches the expression of the current robot position to the joint variable type.

Press [Show J] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in joint variables.

This command is functionally equivalent to the J button provided in the upper right corner of the Current Robot Position window.



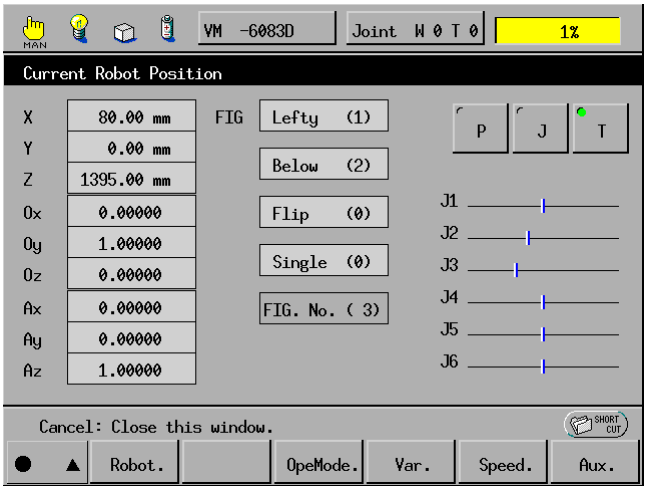
Switching the expression of the current robot position to the tran. variable type

Access: [ExtScrn]—[Arm]—[Show T]

Switches the expression of the current robot position to the homogeneous transform matrix variable type.

Press [Show T] in the Current Robot Position window, and the screen will switch as shown below where the current robot position is expressed in tran. variables.

This command is functionally equivalent to the T button provided in the upper right corner of the Current Robot Position window.



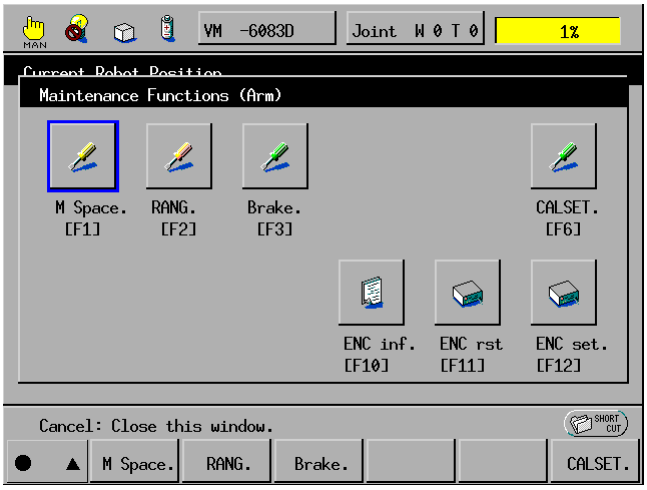
Displaying the Maintenance Functions (Arm) window

Access: [ExtScrn]—[Arm]—[Maint.]

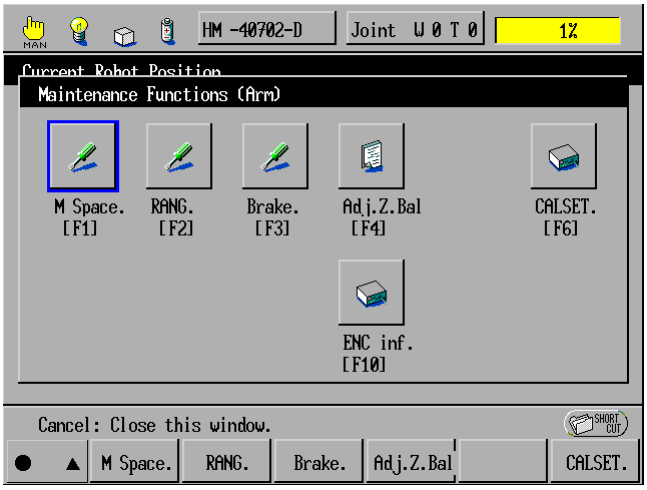
Displays the Maintenance Functions (Arm) window.

(1) Press [Maint.] in the Current Robot Position window, and the Maintenance Functions (Arm) window will appear as shown below.

■ 6-axis robots



■ 4-axis robots



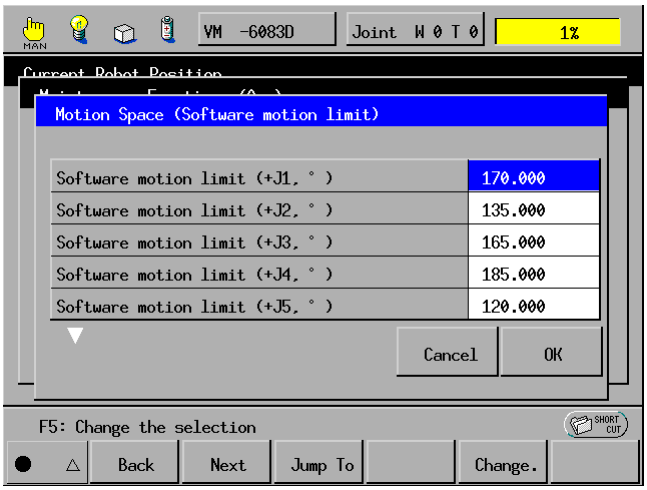
(2) Select the desired maintenance function. The corresponding window will display as described on the following pages.

Setting the motion space (software motion limit)

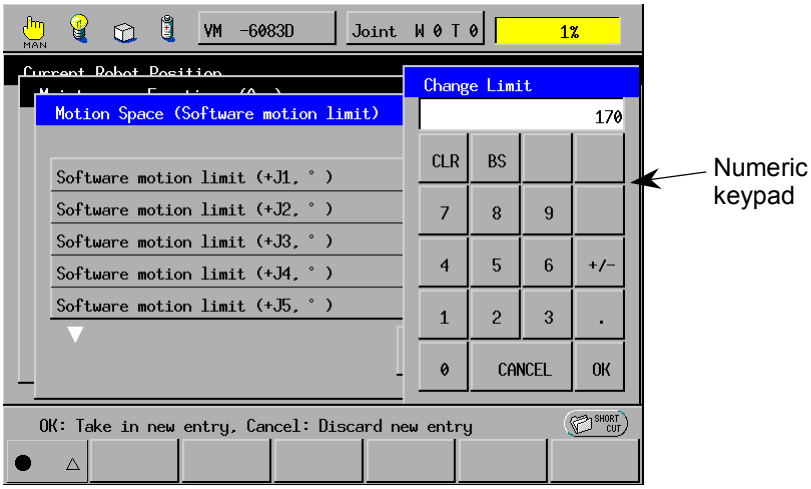
Access: [ExtScrn]—[Arm]—[Maint.]—[M Space.]

Sets the motion space or software motion limit.

(1) Press [M Space.] in the Maintenance Functions (Arm) window.
The Motion Space (Software motion limit) window will appear as shown below.



(2) Select the item to be modified and then press [Change.].
The numeric keypad will appear.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.
The new entry will be entered into the Motion Space (Software motion limit) window.

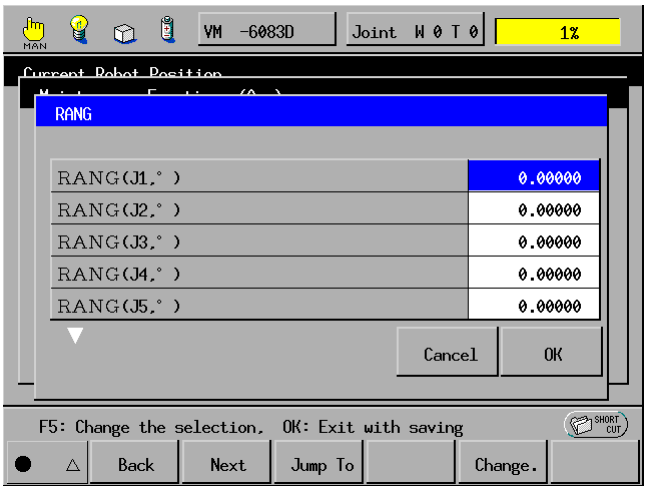
(4) Press the OK key.
To cancel the new entry, press the Cancel key.

Setting the ready angle

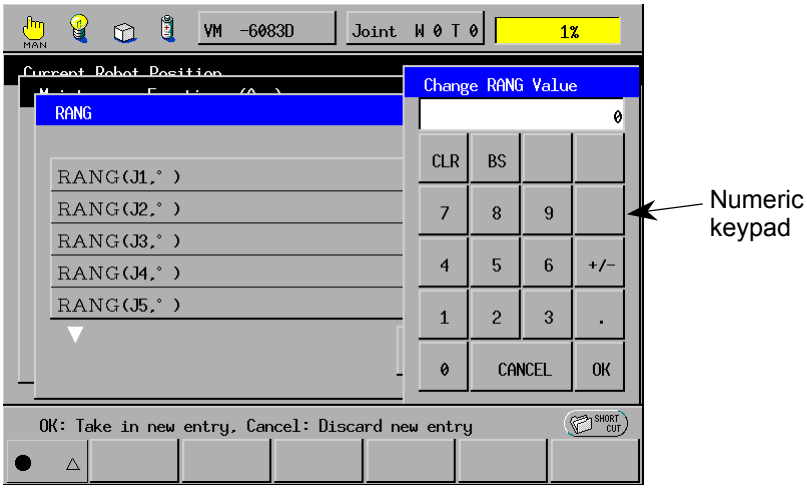
Access: [ExtScrn]—[Arm]—[Maint.]—[RANG.]

Sets the ready angle (RANG).

(1) Press [RANG.] in the Maintenance Functions (Arm) window.
The RANG window will appear as shown below.



(2) Select the item to be modified and then press [Change.].
The numeric keypad will appear.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.
The new entry will be entered into the RANG window.

(4) Press the OK key.
To cancel the new entry, press the Cancel key. To return to the Maintenance Functions (Arm) window, press the OK or Cancel key.

Releasing or locking brakes

Access: [ExtScrn]—[Arm]—[Maint.]—[Brake.]

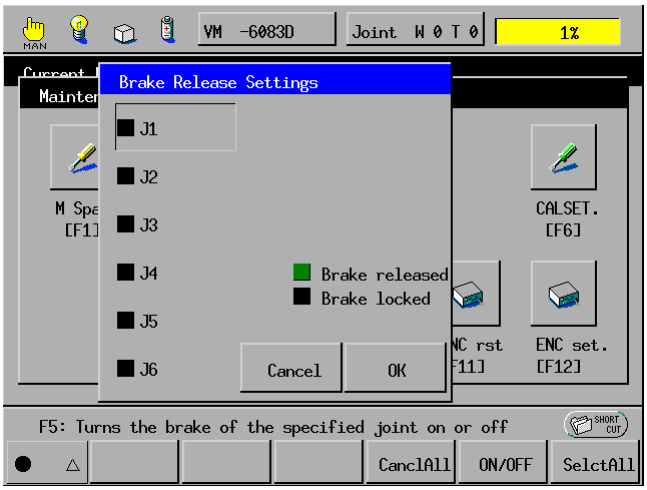
NOTE: In the global type of robot systems of the early version of the -G series, holding down either one of the deadman switches is required for direct teaching mode operation and brake releasing.

■ For 6-axis robots: VM-G-T, VS-G-T and VP-G-T series

Releases and locks J1 to J6 brakes.

(1) Press [Brake.] in the Maintenance Functions (Arm) window.

The Brake Release Settings window will appear as shown below.



(2) Select the target brake.

(3) Press [ON/OFF], and the indicator color of the selected brake will change from black to green if locked or from green to black if released.

Black: Brake locked, Green: Brake released

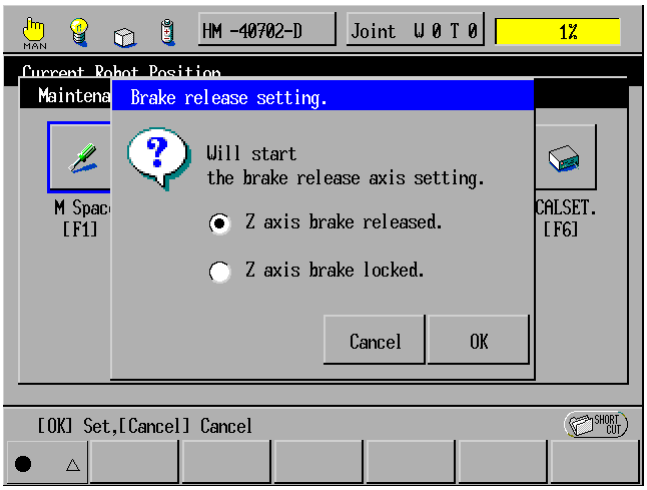
To lock all axes' brakes, press [CanclAll]; to release them, press [SelctAll].

(4) Check the brake status, and then press the OK button to make the new entry take effect.

■ For 4-axis robots

Releases or locks the Z-axis brake in the H∗-G-T series.

(1) Press [Brake.] in the Maintenance Functions (Arm) window.
The Brake Release Settings window will appear as shown below.



(2) Select the "Z axis brake released." or "Z axis brake locked."

(3) Check the brake status, and then press the OK button to make the new entry take effect.

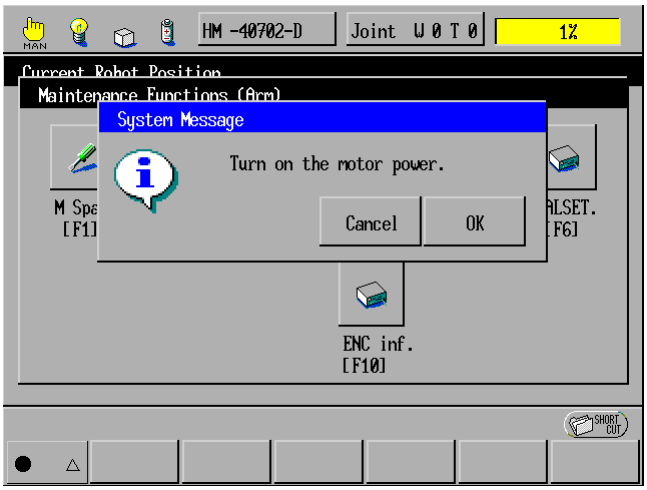
Adjusting the air pressure balance of the Z axis (for 4-axis robots)

Access: [ExtScrn]—[Arm]—[Maint.]—[Adj.Z.Bal]

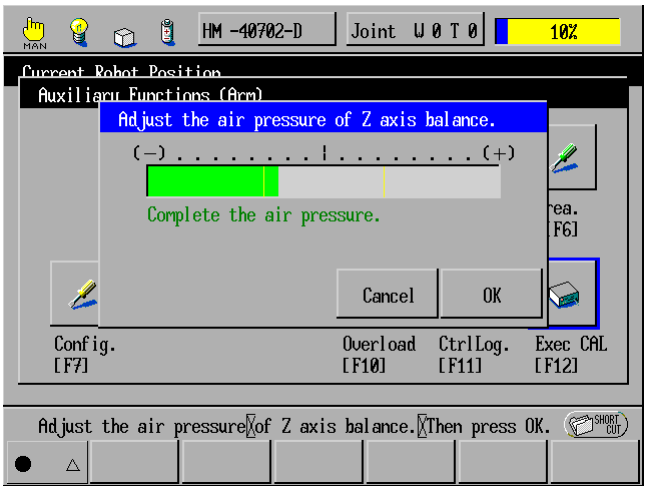
Adjusts the air pressure balance of the Z axis in 4-axis robots. (This command does not apply to 6-axis robots.)

(1) Press [Adj.Z.Bal] in the Maintenance Functions (Arm) window, and the following window will appear.

Make sure that the motor is turned ON and press the OK button.



(2) According to the instructions given on the screen, adjust the air pressure. If the "Complete the air pressure" is displayed as shown below, press the OK button.



(3) If the air pressure balance of the Z axis is not proper, the warning message appears. Follow the instruction to readjust the air pressure balance.

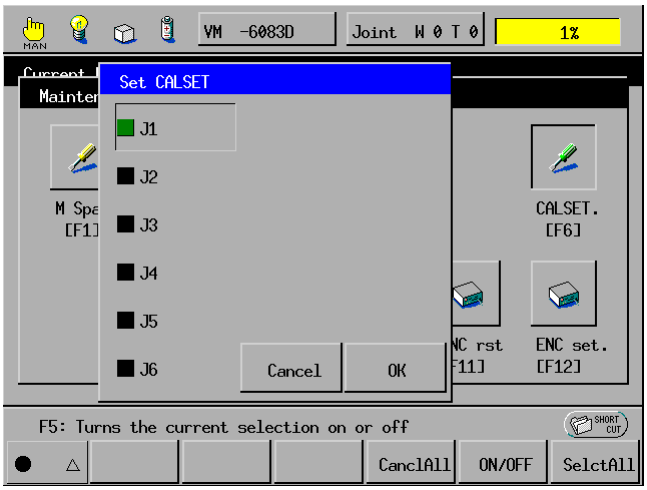
(4) Wait for the following window to appear, then press the OK button.

Selecting and deselecting joints to be calibrated

Access: [ExtScrn]—[Arm]—[Maint.]—[CALSET.]

Selects and/or deselects joints to be calibrated.

(1) Press [CALSET.] in the Maintenance Functions (Arm) window.
The Set CALSET window will appear as shown below.



(2) Select the target joint.

(3) Press [ON/OFF], and the indicator color of the selected joint will change from green to black if selected or from black to green if deselected.

Green: Joint selected for calibration, Black: Joint deselected

To deselect all joints, press [CanclAll]; to select them for calibration, press [SelctAll].

(4) Check the joint status, and then press the OK button to make the new entry take effect.

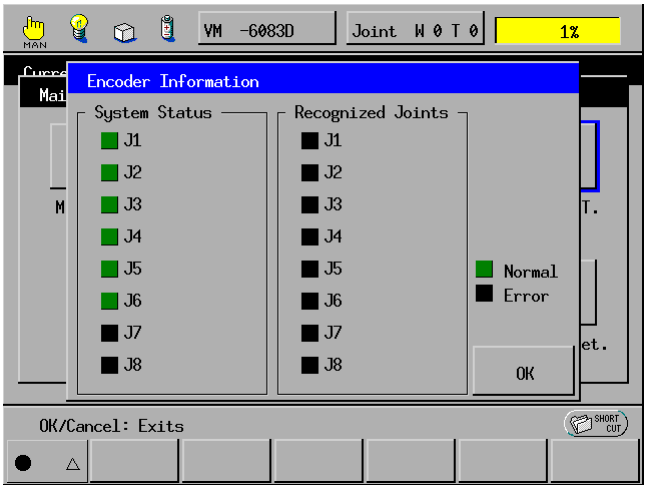
TIP: For details about the CALSET procedure, refer to the INSTALLATION & MAINTENANCE GUIDE (T03), "CALSET."

Displaying encoder information

Access: [ExtScrn]—[Arm]—[Maint.]—[ENC inf.]

Displays encoder information.

Pressing [ENC inf.] in the Maintenance Functions (Arm) window will display the Encoder Information window as shown below.



The above window displays the system status of the robot controller and the joint status. If the status is normal, the indicator lights in green; if abnormal, it goes off.

Pressing the OK or Cancel button will return the screen to the Maintenance Functions (Arm) window.

Resetting the motor encoder data

Access: [ExtScrn]—[Arm]—[Maint.]—[ENC rst]

Resets the motor encoder data.

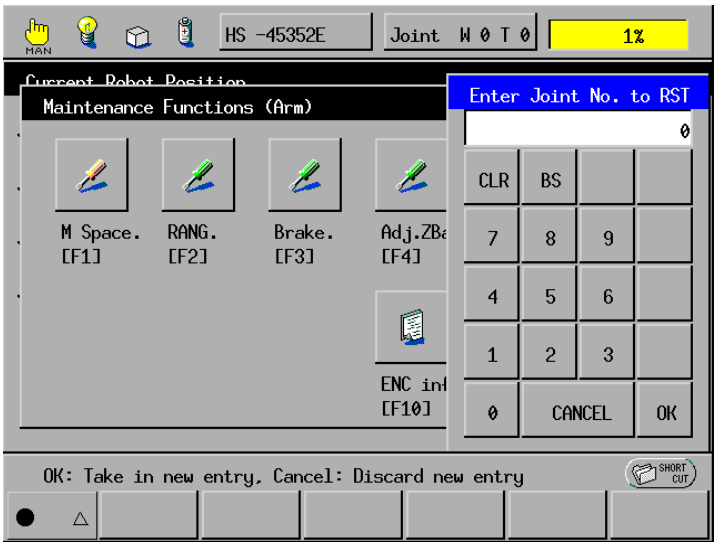
You need to reset encoders and perform CALSET if:

-Error 641∗ occurs due to run-down encoder backup batteries, or
-Error 677∗ occurs due to a great impact applied to the robot when the power is off.

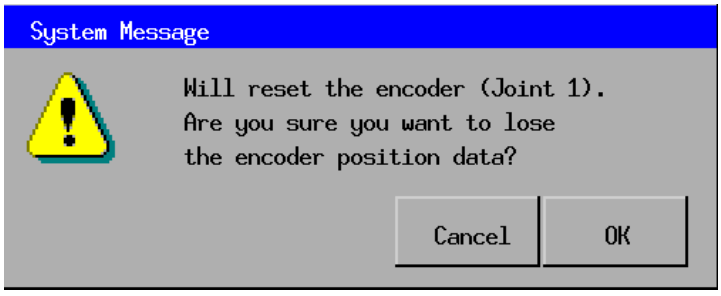
(∗ is any of 1 to 6 denoting the object axis.)

Given below is an encoder resetting procedure.

(1) Pressing [ENC rst] in the Maintenance Functions (Arm) window will display the Encoder reset window as shown below.



(2) Enter the axis number whose encoder is to be reset, then press [OK]. The System Message appears.



(3) Press [OK], ad the encoder of the selected axis will be reset.

Setting ID data of motor encoders

Access: [ExtScrn]—[Arm]—[Maint.]—[ENC set]

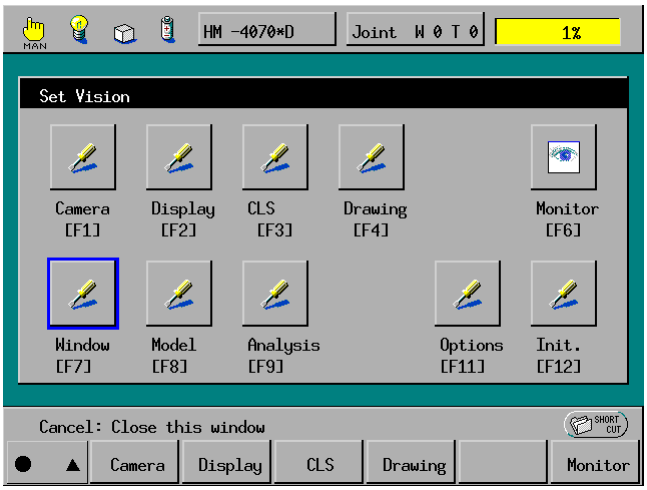
Sets the ID data of motor encoders.

This command is intended for DENSO WAVE service personnel only. Do not use this command.

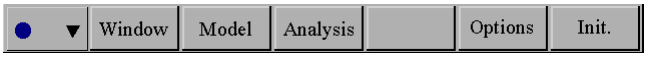
5.4 Displaying the Vision Menu

Access: [ExtScrn]—[Vision]

Pressing [Vision] on the extended screen displays the Set Vision menu as shown below.



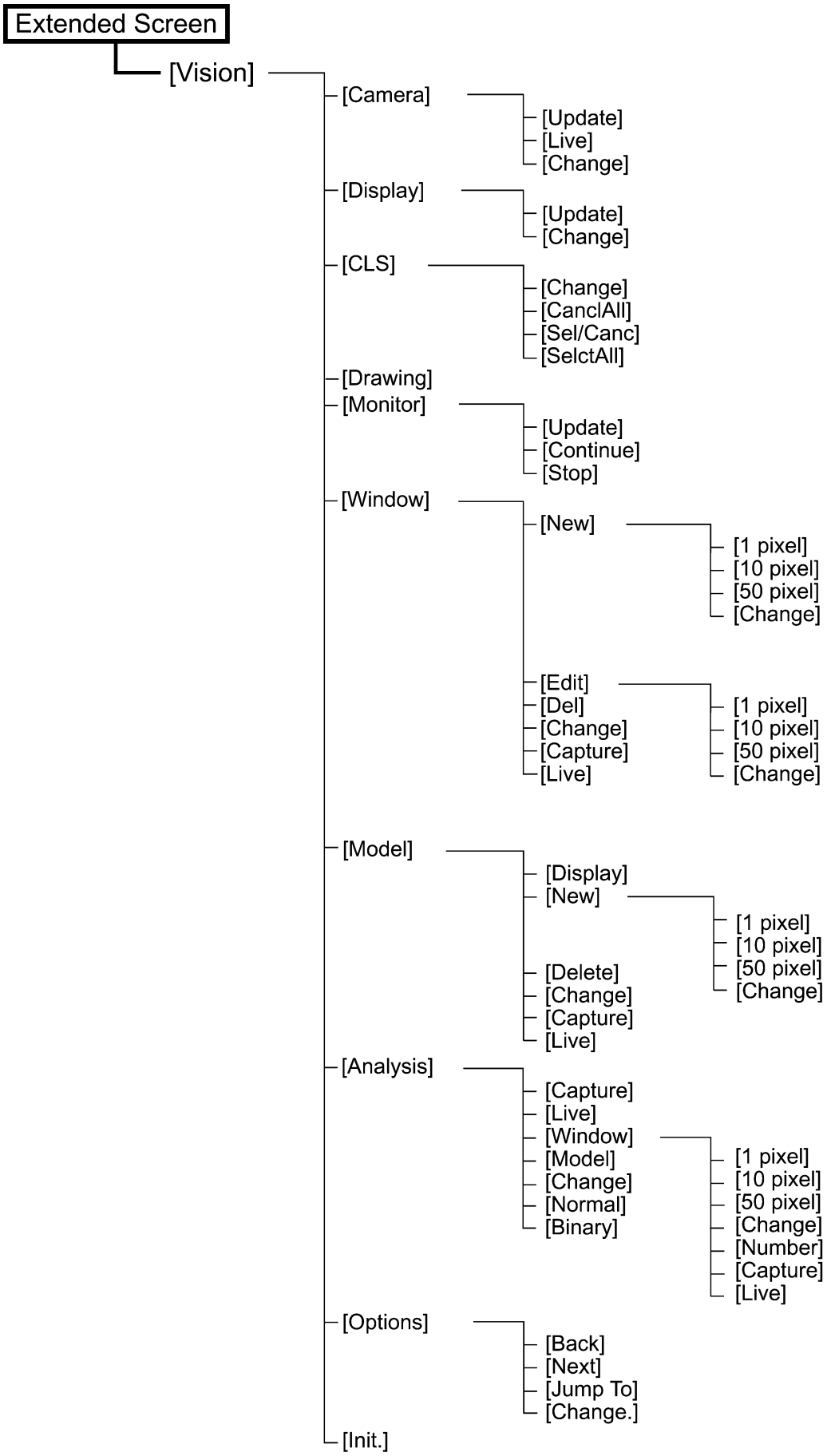
When shifted



NOTE: Before using the [Vision] menu, make sure that:

- An optional µVision board is integrated in the robot controller,
- The robot is placed in Manual mode, and
- The vision semaphore is released (no TAKEVIS obtained).

The hierarchy of the [Vision] menu is given on the next page.

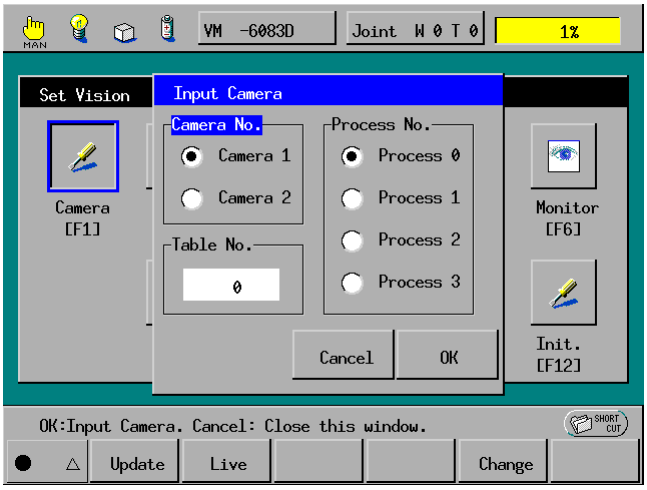

Extended Screen
[Vision]
[Camera]
[Update]
[Live]
[Change]
[Display]
[Update]
[Change]
[CLS]
[Change]
[CanclAll]
[Sel/Canc]
[SelctAll]
[Drawing]
[Monitor]
[Update]
[Continue]
[Stop]
[Window]
[New]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Edit]
[Del]
[Change]
[Capture]
[Live]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Model]
[Display]
[New]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Delete]
[Change]
[Capture]
[Live]
[Analysis]
[Capture]
[Live]
[Window]
[Model]
[Change]
[Normal]
[Binary]
[1 pixel]
[10 pixel]
[50 pixel]
[Change]
[Number]
[Capture]
[Live]
[Options]
[Back]
[Next]
[Jump To]
[Change.]
[Init.]

Getting image signals from the specified camera into the vision board

Access: [ExtScrn]—[Vision]—[Camera]

Sets the camera input parameters and gets image signals sent from the specified camera into the µVision board.

(1) Press [Camera] in the Set Vision window, and the Input Camera window will appear as shown below.



(2) Set the camera input parameters as follows:

Camera No.: Specify the connected camera number.

Table No.: Specify the number of the table that is looked up during input.

Table No. 0: Normal (Brightness 0 to 255)
Table No. 1: 70% brightness compression (Brightness 0 to 175)
Table No. 2: γ correction
Table No. 3: Reversal
Table No. 4: 70% brightness compression reversal
Table Nos. 5 to 15: User defined tables

Process No.: Specify the process screen number from which camera image signals will be read.

(3) Press [Update] to get image signals from the specified camera.

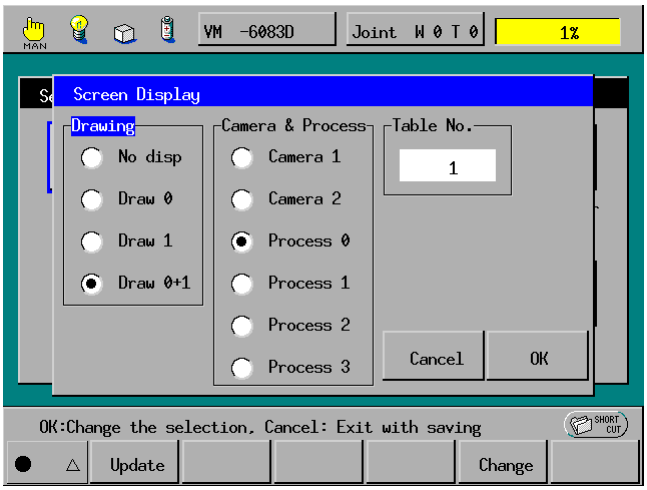
Function keys available	
[Update]	Updates camera input parameters and reads image signals from the camera. The Camera Input window remains open.
[Live]	Displays the image of the camera selected on the monitor by lookup table 0 (fixed).
[Change]	Displays the numeric keypad where you may modify the table number.

Displaying the specified image on the monitor

Access: [ExtScrn]—[Vision]—[Display]

Sets the monitor display parameters and displays the specified image on the monitor.

(1) Press [Display] in the Set Vision window, and the Screen Display window will appear as shown below.



(2) Set the monitor display parameters as follows:

Drawing: Specify the screen to be drawn.

Camera & Process: Specify the image to be displayed.

Table No.: Specify the number of the table that is looked up during input.

- Table No. 0: Normal (Brightness 0 to 255)
- Table No. 1: 70% brightness compression (Brightness 0 to 175)
- Table No. 2: γ correction
- Table No. 3: Reversal
- Table No. 4: 70% brightness compression reversal
- Table Nos. 5 to 15: User defined tables

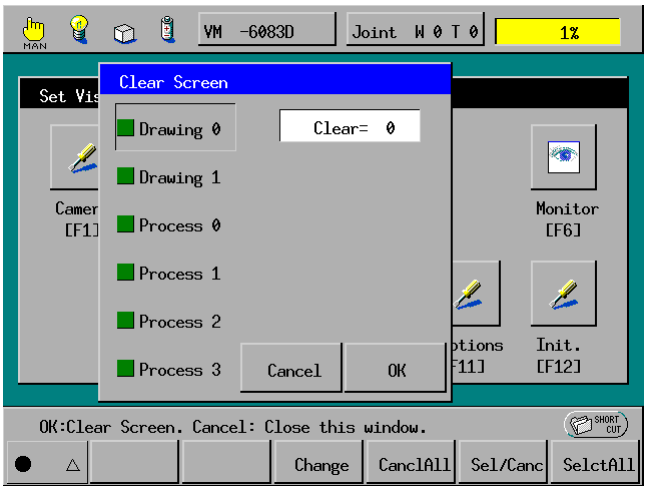
Function keys available	
[Update]	Updates monitor display parameters and calls up the specified image on the monitor. The Screen Display window remains open.
[Change]	Displays the numeric keypad where you may modify the table number.

Clearing the drawing screen or process screen

Access: [ExtScrn]—[Vision]—[CLS]

Clears data on the specified drawing screen or process screen.

(1) Press [CLS] in the Set Vision window, and the Clear Screen window will appear as shown below.



(2) Specify the Clear value.

Clear: Set the value with which the clearing process should take place.

The Process screen will be filled with brightness of specified value. The Drawing screen will be cleared by 0.
Normally specify 0.

Function keys available	
[Change]	Displays the numeric keypad where you may modify the clear value.
[CanclAll]	Cancels all the selections of the screen.
[Sel/Canc]	Selects/cancels selection of the screen to be cleared.
[SelctAll]	Selects all the screens.

Setting the drawing destination screen

Access: [ExtScrn]—[Vision]—[Drawing]

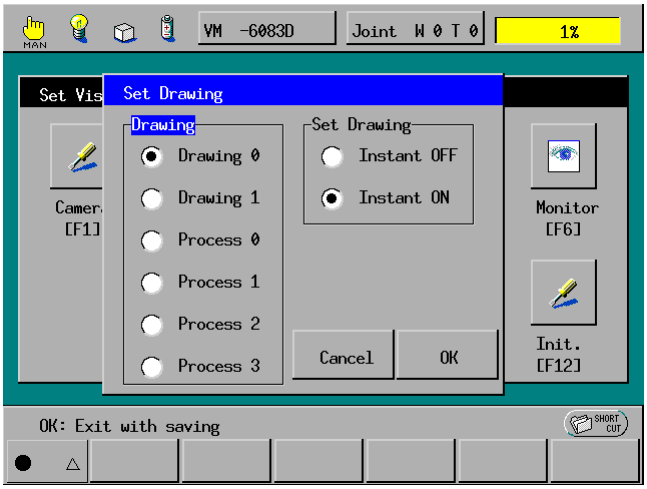
Sets the drawing destination screen.

When this menu is called up, its settings show the current ones of the µVision board.

Unless otherwise specified with VISSCREEN again when the programs are running, the drawing destination screen configured in this menu applies.

The configuration shown below produces the same as when "VISSCREEN 1, 0, 1" is executed.

(1) Press [Drawing] in the Set Vision window, and the Set Drawing window will appear as shown below.



Displaying the camera input screen and process screen

Access: [ExtScrn]—[Vision]—[Monitor]

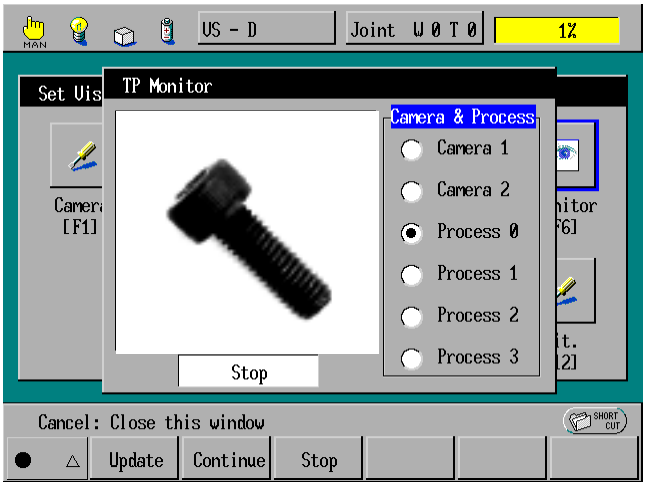
Displays a camera image and process screen image on the LCD of the teach pendant (TP).

The resolution is 256 x 240 pixels and the grayscale is 16 levels. The display rate is 2 frames per second for camera images.

When a camera image is displayed, process screen 3 is used as a video capture memory (where camera images are temporarily stored), so temporary data of process screen 3 will be lost.

Camera images or process screen images on the LCD are temporarily in grayscale, which is normal. Once this menu screen is closed, the teach pendant screen reverts to the original color display.

(1) Press [Monitor] in the Set Vision window, and the TP Monitor window will appear as shown below.



Function keys available	
[Update]	Updates the teach pendant screen according to the settings.
[Continue]	Gets camera images continuously. If Camera 1 or 2 is selected, the images will be get at a rate of two frames per second (and updated once every 0.5 second).
[Stop]	Stops continuous reading.

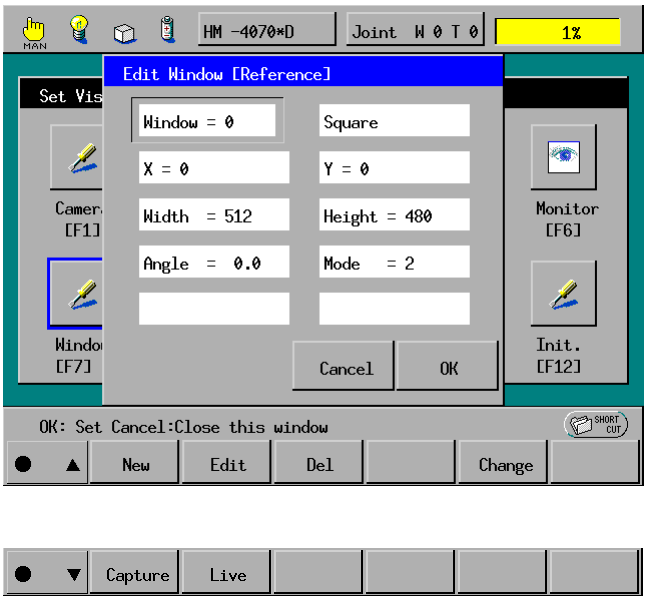
Note: When using this command, be sure to turn off the screen saver on the teach pendant.

Browsing windows to be used in image analysis [Ver. 1.5 or later]

Access: [ExtScrn]—[Vision]—[Window]

Browses the parameter values of windows to be used in image analysis and allows you to monitor the frame of the specified window.

(1) Press [Window] in the Set Vision window, and the Edit Window will display as shown below.



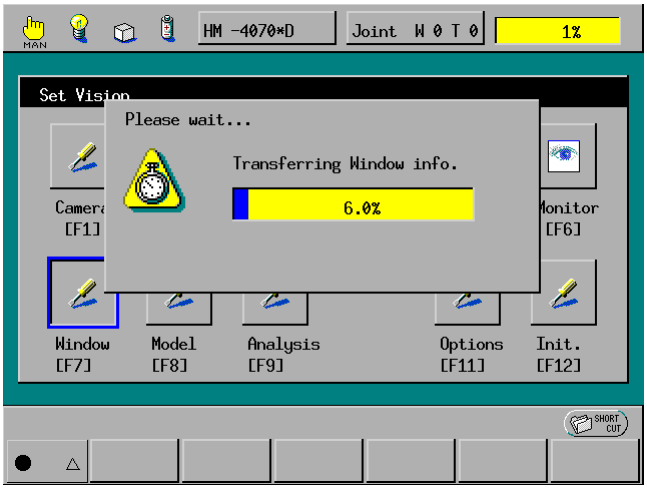
Parameters		Description
Window No.	:	Number assigned to a window (0 to 255)
Window type	:	Shape of a window (Square, line, circle, ellipse, or sector)
X origin	:	X-coordinate origin of a stored window (0 to 511)
Y origin	:	Y-coordinate origin of a stored window (0 to 480)

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL (I) (T03).

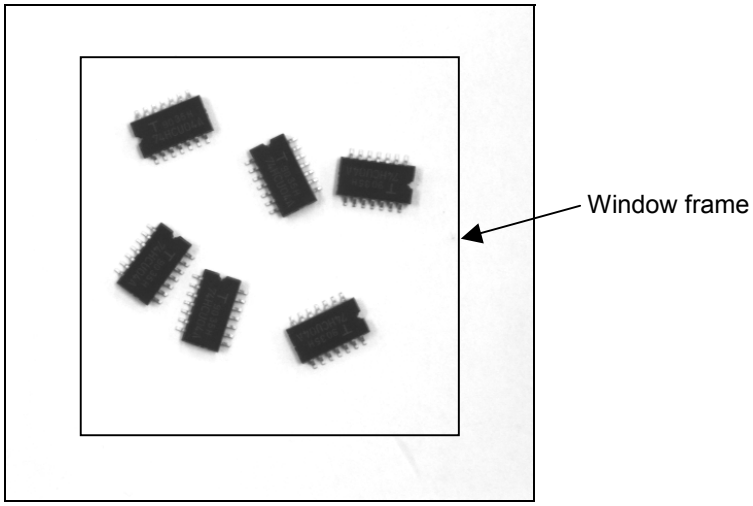
Function keys available	
[New]	Creates, edits, and saves a new window (Edit mode)
[Edit]	Edits a window already stored (Edit mode)
[Del]	Deletes data of the selected window number. The deleted data will be completely lost.
[Change]	Changes the window number.
[Capture]	Captures a camera image and displays it on the process screen.
[Live]	Switches to a camera image.

(2) Press OK to display the frame of the selected window.

During execution of "New," "Edit" or "Del," a progress bar will appear as shown below since it takes several seconds to retrieve necessary data from the µVision board.



Shown below is a frame example of a window number selected. (The colors are not the same as the original image colors).



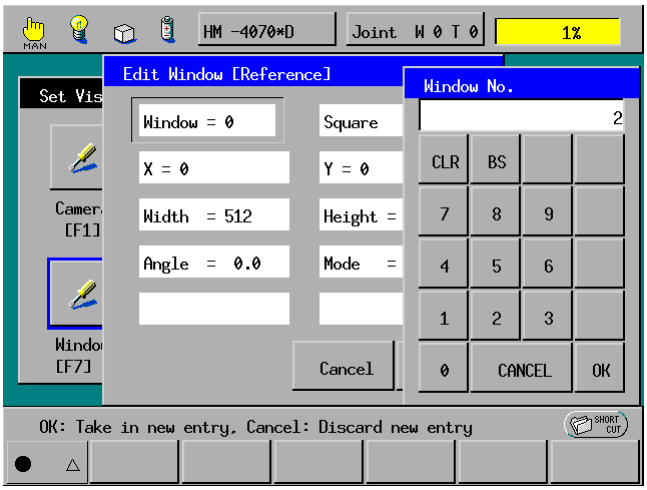
Creating, editing and saving a new window (Edit mode) [Ver. 1.5 or later]

Access: [ExtScrn]—[Vision]—[Window]—[New]

Creates, edits and saves a new window.

(1) Press [New] in the Edit Window, and the numeric keypad will appear as shown below.

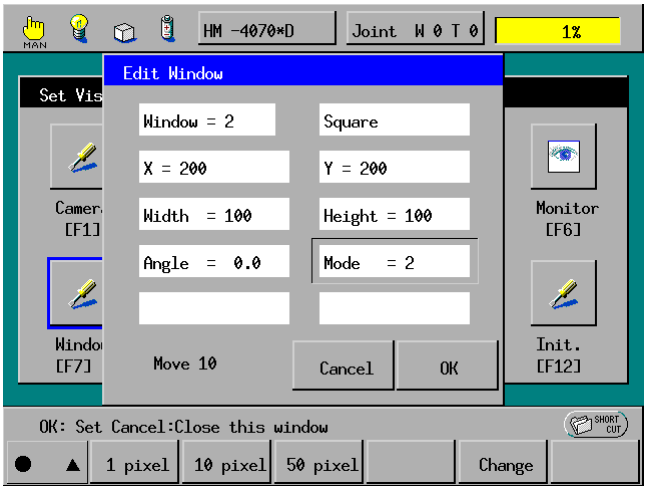
(2) Enter the number of a new window to be created.



Parameters		Description
Window No.	:	Number assigned to a window (0 to 255)
Window type	:	Shape of a window (Square, line, circle, ellipse, or sector)
X origin	:	X-coordinate origin of a stored window (0 to 511)
Y origin	:	Y-coordinate origin of a stored window (0 to 480)

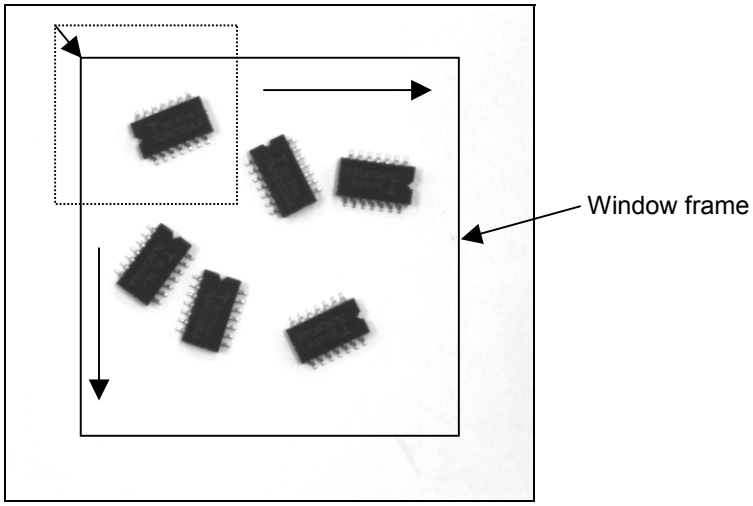
Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL (I) (T03).

(3) Press OK. The system message will appear and then the following Edit Window will display.



Function keys available	
[1 pixel]	Specifies the movement quantum in units of 1 pixel.
[10 pixel]	Specifies the movement quantum in units of 10 pixels.
[50 pixel]	Specifies the movement quantum in units of 50 pixels.
[Change]	Changes each model data.
[Capture]	Captures a camera image and displays it on the process screen.
[Live]	Switches to a camera image.

(4) You may change the size of the window by modifying the parameters in the window and check the changed size on the monitor.

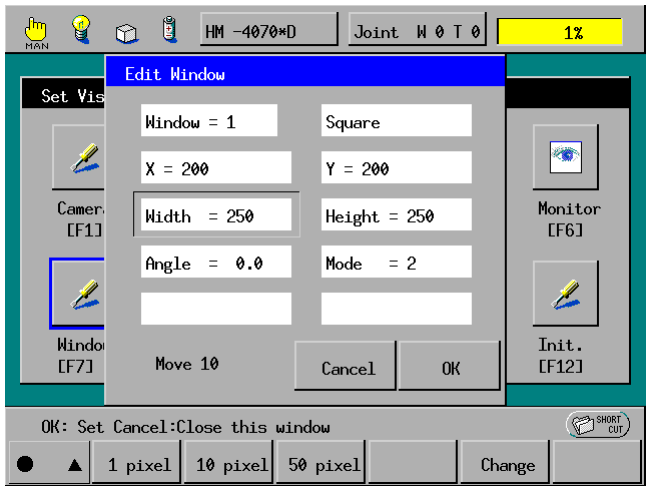


Editing and saving an existing window (Edit mode)

Access: [ExtScrn]—[Vision]—[Window]—[Edit]

Edits and saves a new window.

(1) Press [Edit] in the Edit Window, and the following window will appear.



Parameters		Description
Window type	:	Shape of a window (Square, line, circle, ellipse, or sector)
X origin	:	X-coordinate origin of a stored window (0 to 511)
Y origin	:	Y-coordinate origin of a stored window (0 to 480)

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL (I) (T03).

(2) Other operating procedure is the same as in [New].

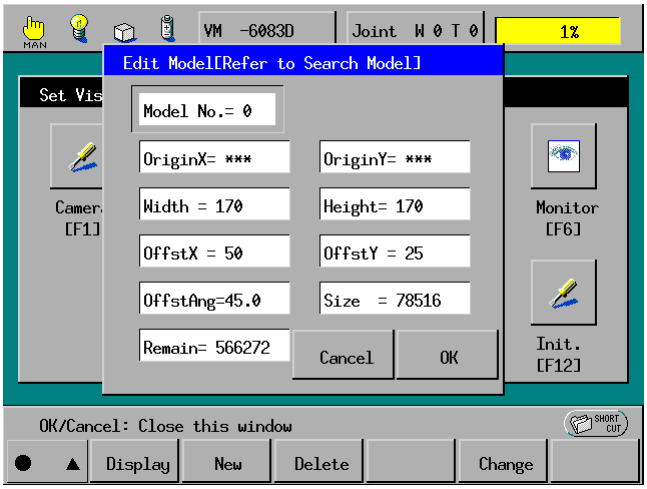
Function keys available	
[1 pixel]	Specifies the movement quantum in units of 1 pixel.
[10 pixel]	Specifies the movement quantum in units of 10 pixels.
[50 pixel]	Specifies the movement quantum in units of 50 pixels.
[Change]	Changes each model data.
[Capture]	Captures a camera image and displays it on the process screen.
[Live]	Switches to a camera image.

Browsing the stored model data

Access: [ExtScrn]—[Vision]—[Model]

Browses the stored model data that is required in search function.

(1) Press [Model] in the Set Vision window, and the Edit Model window will appear as shown below.



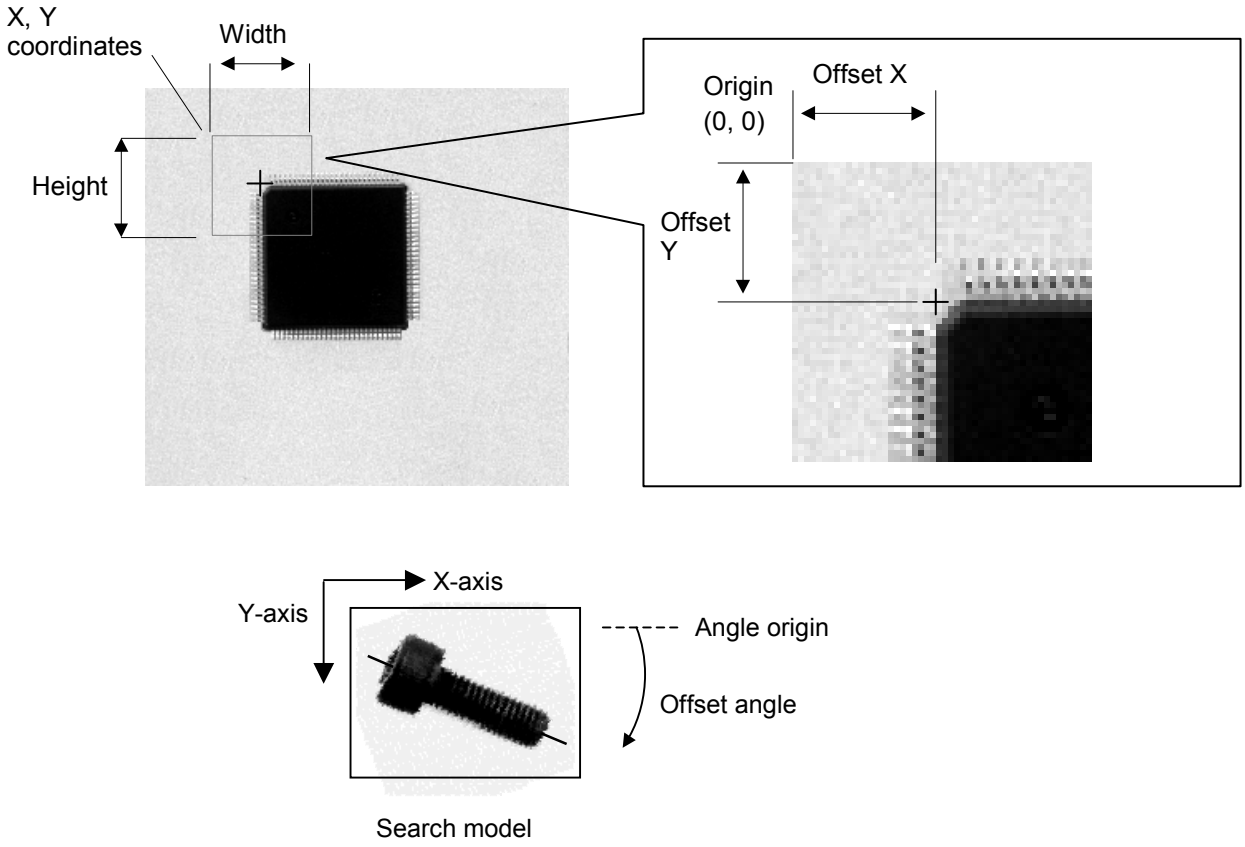
When shifted

Model No.:	Stored model number (0 to 99)
Origin X:	Origin of X coordinates of the stored model (16 to 485)
Origin Y:	Origin of Y coordinates of the stored model (16 to 454)
Width:	Width of the stored model (10 to 256)
Height:	Height of the stored model (10 to 256)
Offset X:	Offset X from origin (-511 to +511)
Offset Y:	Offset Y from origin (-511 to +511)
Offset angle:	Offset angle from the origin of angle (-360 to 360)
Size:	File size of the stored model
Remain:	Memory available for storing models

Origin X and origin Y are not stored into registered data, so they are indicated by "***."

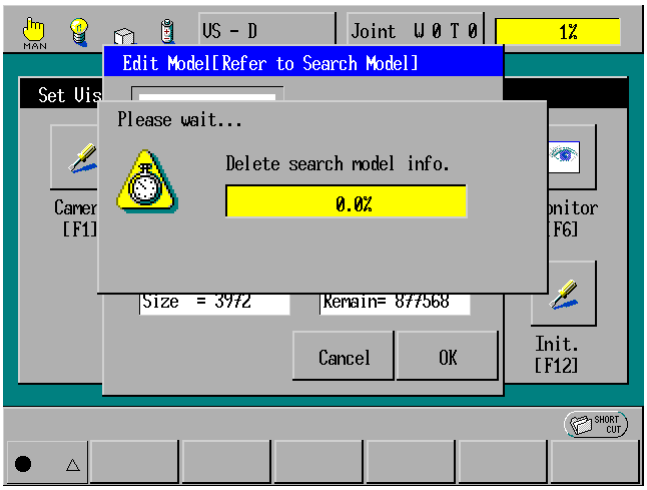
When a new model is created, process screen 3 is used as a work area and hence the contents of the screen will change.

Function keys available	
[Display]	Displays the image of the selected model number on the monitor.
[New]	Creates and stores a new model (in Edit mode).
[Delete]	Deletes the data of the selected model number. The deleted data is lost completely.
[Change]	Allows you to modify model numbers.
[Capture]	Captures a camera image and displays it on the process screen.
[Live]	Switches to a camera image.



The offset from the angle origin is specified in 'Offset Angle'. As shown in the drawing, when [Offset Angle] is specified when there is an offset with respect to the angle origin, the offset value is affects the resultant [Angle] of [SHMODEL].

During model editing, deleting, or creating, a progress bar will appear as shown below since it takes several seconds to retrieve necessary data from the μVision board. The time required will vary depending upon the number of models stored.

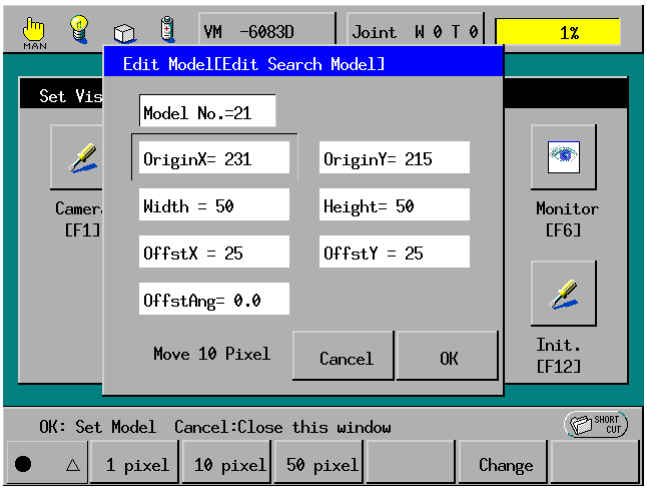


Creating a new model

Access: [ExtScrn]—[Vision]—[Model]—[New]

Creates a new model and stores it.

(1) Press [New] in the Edit Model window, and the following edit window will appear as shown below.



Model No.: Specify the number of a model to be created. (0 to 99)
Origin X: Specify the origin of X coordinates of a model to be created. (16 to 485)
Origin Y: Specify the origin of Y coordinates of a model to be created. (16 to 454)
Width: Specify the width of a model to be created. (10 to 256)
Height: Specify the height of a model to be created. (10 to 256)
Offset X: Specify offset X from origin (-511 to +511)
Offset Y: Specify offset Y from origin (-511 to +511)
Offset angle: Offset angle from the angle origin (-360-360).

(2) The allowable range of parameter values appears on the monitor screen. Taking those as reference, set the desired values.

Function keys available	
[1 pixel]	Specifies the movement quantum at the rate of 1 pixel.
[10 pixel]	Specifies the movement quantum at the rate of 10 pixels.
[50 pixel]	Specifies the movement quantum at the rate of 50 pixels.
[Change]	Allows you to modify model data.

Analyzing images

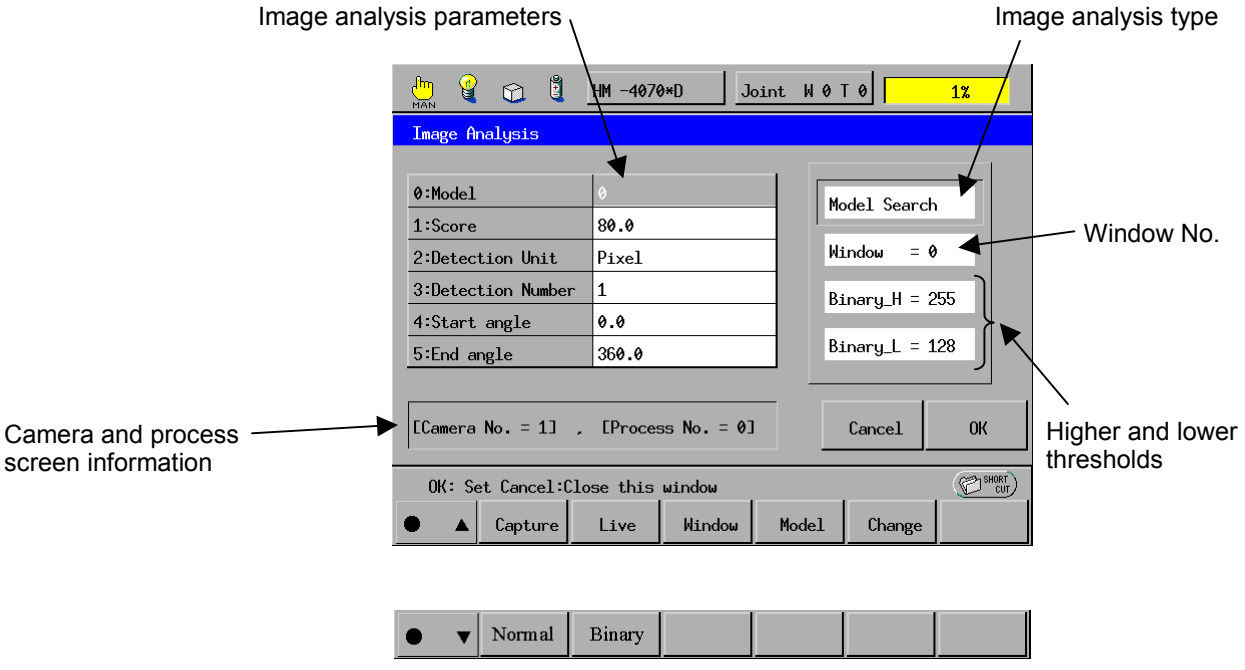
Access: [ExtScrn]—[Vision]—[Analysis]

Allows you to analyze images temporarily from the teach pendant without setting up corresponding programs.

Types of image analysis

Image analysis functions	Image processing instructions	Remarks
Model search	SHMODEL	
Labeling	BLOB	If labeling does not finish within the specified time, a timeout error occurs.
Edge finding	VISEDGE	If the specified processing range exceeds 360 degrees in the sector window, edge finding applies to the range exceeding 360 degrees.
Area/Center of gravity/ Major axis angle	VISMEASURE	Extracts features such as area, center of gravity, and major axis angle.
QR code	VISREADQR	Reads QR code symbols.
Filter processing	VISFILTER	Filters input screens.
Circle search	SHCIRCLE	
Corner search	SHCORNER	If a timeout occurs during searching, the number of corners found before the occurrence of the timeout will be displayed. The timeout length can be modified with the search timeout parameter accessed by [Vision]—[Options].

(1) Press [Analysis] in the Set Vision window, and the Image Analysis window will display as shown below.



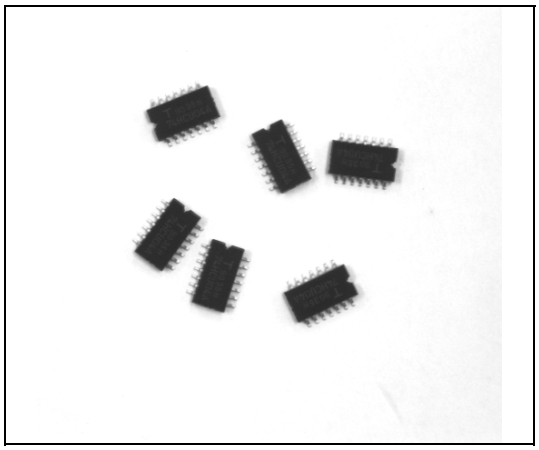
Window No. : Number of the target window to be processed.
Binary vision parameters : Specifies the upper and lower limits for binary vision.

Function keys available	
[Capture]	Captures a camera image and displays it on the process screen.
[Live]	Switches to a camera image.
[Window]	Sets the shape and size of a temporary window.
[Model]	Temporarily displays the image of the model to be searched in model search.
[Change]	Changes parameter values.
[Normal]	Switches to the normal vision where a grayscale image displays in 256-tone.
[Binary]	Switches to the binary vision where a binary image displays in 2-tone.

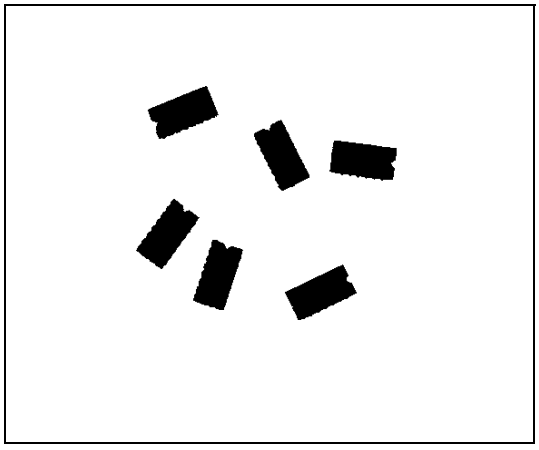
(2) Select the desired image analysis.

Pressing [Binary] will show a binary image based on the higher and lower threshold values you have entered. A camera live image may also display as a binary image in real-time.

Normal vision



Binary vision

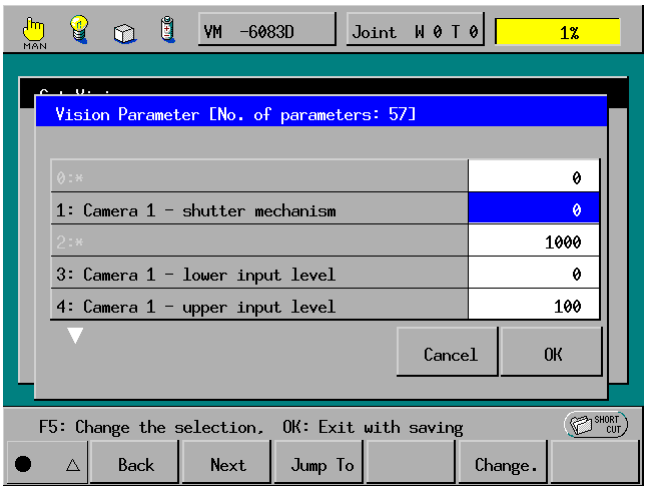


Setting or modifying vision board parameters

Access: [ExtScrn]—[Vision]—[Options]

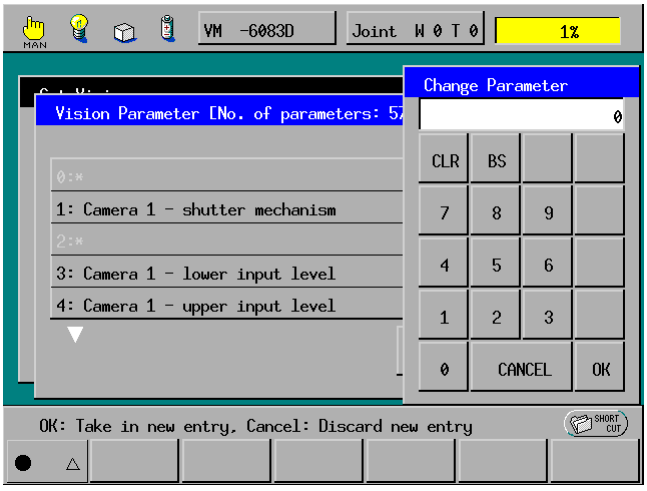
Sets or modifies vision board parameters.

(1) Press [Options] in the Set Vision window, and the Vision Parameters window will appear as shown below.



Function keys available	
[Back]	Displays the previous page of the parameter list.
[Next]	Displays the next page of the parameter list.
[Jump To]	Displays the setup data of the specified number.
[Change.]	Displays the numeric keypad where you may enter a new parameter.

(2) To modify the parameters, press [Change.]. The numeric keypad will appear as shown below.



Initializing the vision board

Access: [ExtScrn]—[Vision]—[Init.]

Initializes the vision board to the default settings.

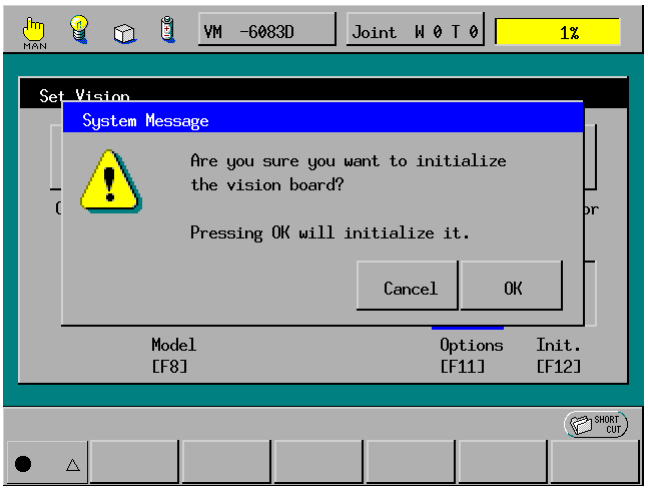
This is equivalent to the powering-on reset. This command resets settings made in programs, such as temporary window data, drawing-related settings made in programs, image data in the process screen memory.

Use this command if a vision board error occurs.

NOTE: You may initialize the vision board only in Manual mode.

NOTE: Never execute this command during setting in WINCAPSIII or with the teach pendant. Doing so will initialize the vision board so that no correct setting may be made.

(1) Press [Init.] in the Set Vision window, and the system message will appear as shown below.

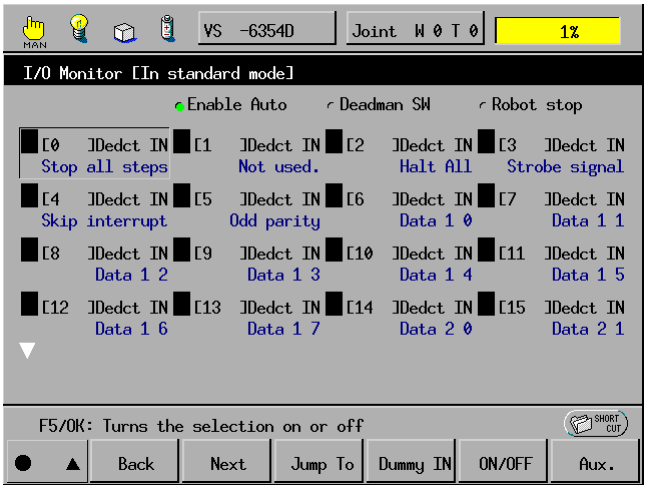


5.5 Displaying I/O Signals and Simulating Robot Motion

Access: [ExtScrn]—[I/O]

Displays the I/O Monitor window where you may monitor I/O signals and/or simulate the robot motion with the I/O signals.

Pressing [I/O] on the top screen will display the I/O Monitor window as shown below.



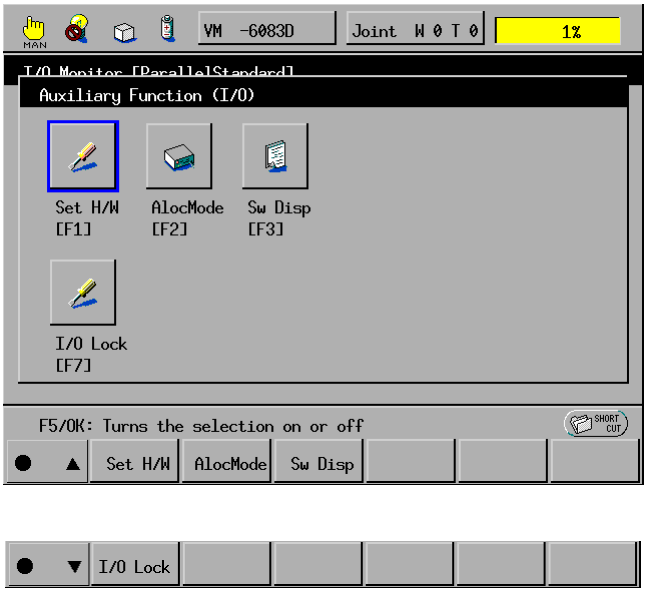
Function keys available	
[Back]	Displays the previous page of the I/O signal list.
[Next]	Displays the next page of the I/O signal list.
[Jump To]	Displays the Jump to I/O No. window where you may type an I/O port address you want to see with the numerical keys and press OK. Doing so will display the target input or output signal.
[Dummy IN]	Allows the selected system-input port to accept a dummy input. That input port will be marked with "!" and the dummy I/O icon will appear in the status bar of the top of the screen. This command is useful for testing programs.
[ON/OFF]	Displays the system message "Are you sure you want to turn the I/O xxxx on (or off)?" Pressing the OK button will turn the selected input port on (or off).
[Aux.]	Details are given on the next page.
[ClrDummy]	Clears the dummy input setting.

Providing auxiliary functions

Access: [ExtScrn]—[I/O]—[Aux.]

Provides the auxiliary functions concerning I/Os.

Pressing [Aux.] in the I/O Monitor window will display the Auxiliary Function (I/O) window as shown below.

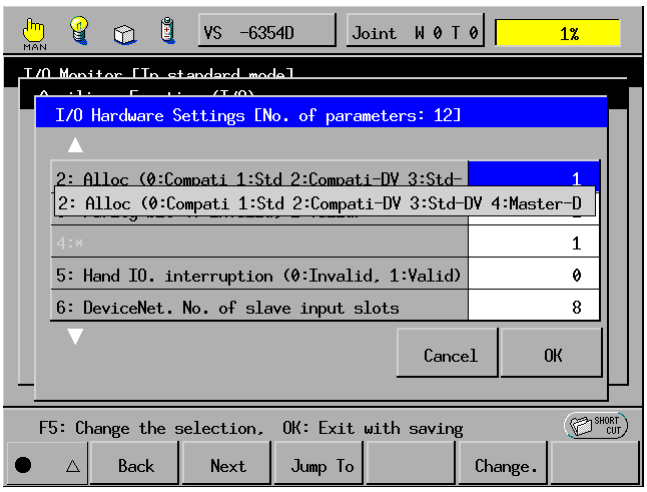


Configuring hardware

Access: [ExtScrn]—[I/O]—[Aux.]—[Set H/W]

Configures hardware such as I/O assignment mode and DeviceNet expansion.

(1) Press [Set H/W] in the Auxiliary Function (I/O) window, and the I/O Hardware Settings window will appear as shown below.



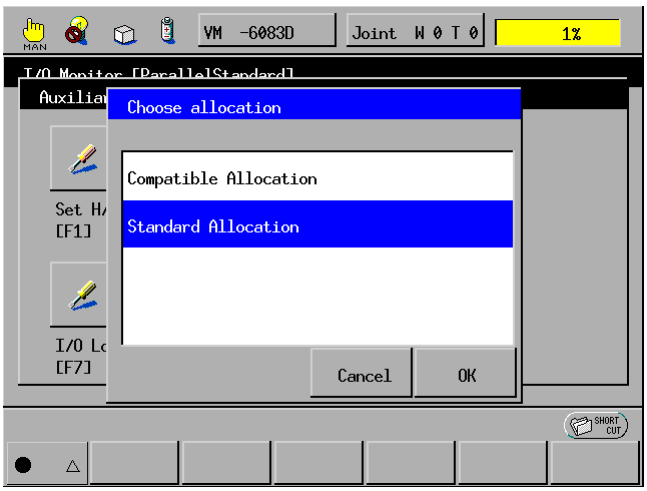
(2) Select the desired item and press [Change.]. You can modify the setting.

Switching between standard and compatible allocation modes [Ver. 1.6 or later]

Access: [ExtScrn]—[I/O]—[Aux.]—[AlocMode]

Switches between the standard and compatible allocation modes from the teach pendant.

(1) Press [AlocMode] in the Auxiliary Functions (I/O) window. The Choose allocation window appears as shown below.



(2) Using the cursor keys, select the desired allocation mode.

(3) Press OK.

The following system message appears, requesting you to restart your controller.

(4) Press OK.

The screen returns to the Auxiliary Functions (I/O) window.

(5) Turn the controller power off and then on.

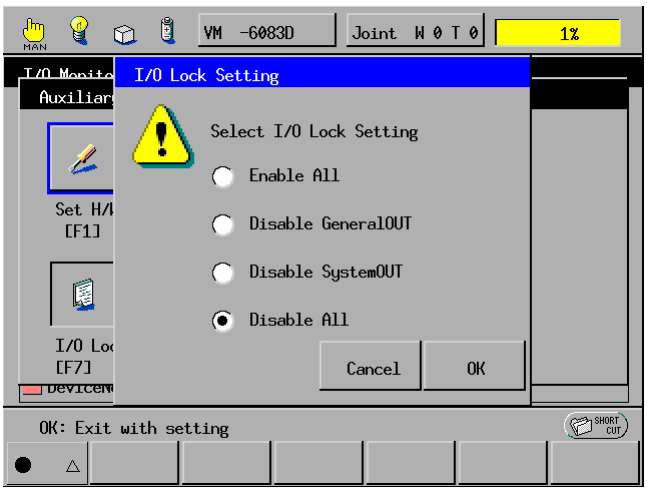
The I/O allocation mode is changed.

Setting I/O output restrictions when machine is locked

Access: [ExtScrn]—[I/O]—[Aux.]—[I/O Lock]

Sets the I/O output restriction range when machine is locked.

(1) Press [I/O Lock] in the Auxiliary Functions (I/O) window. The I/O Lock Setting window appears as shown below.



(2) Select the desired I/O output restriction type and press the OK button.

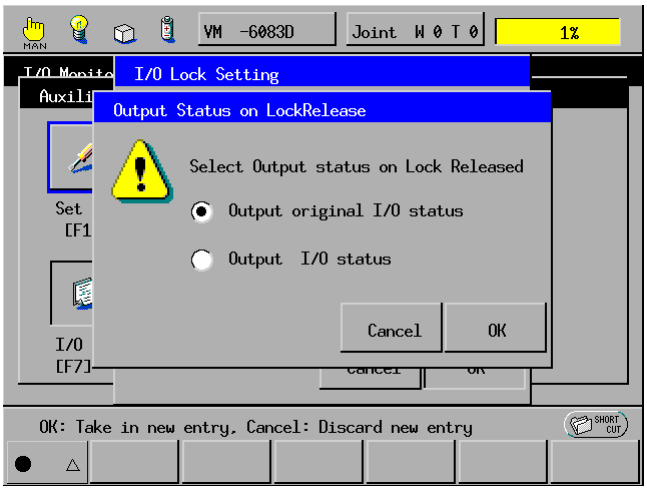
Then, the Output Conditions Setting When Machine Lock is released window will appear.

Choice

Enable All:	All outputs are allowed with no I/O output restrictions even when the machine is locked.
Disable GeneralOUT:	Forbids all outputs of ports used for general output.
Disable SystemOUT:	Forbids all outputs of ports used for specialized output. However, ports 72, 73, 74 are not prohibited.
Disable All:	Forbids all outputs of ports apart from ports 72, 73, 74 when the machine is locked.

Note 1: In all case other than "Enable All," the actual I/O output is restricted when the machine is locked. However, the I/O display of teach pendant is refreshed. according to the program.
Note 2: I/O output is refreshed on clicking [OK] after modifying I/O lock settings.
Note 3: I/O lock settings are reset to "Disable All" every time the computer is switched on.

(3) The output conditions set when freeing machine lock become valid when [OK] is pressed after selecting the output conditions set when freeing machine lock.



Note: The settings of I/O output restrictions when machine is locked are reset to the original I/O conditions.

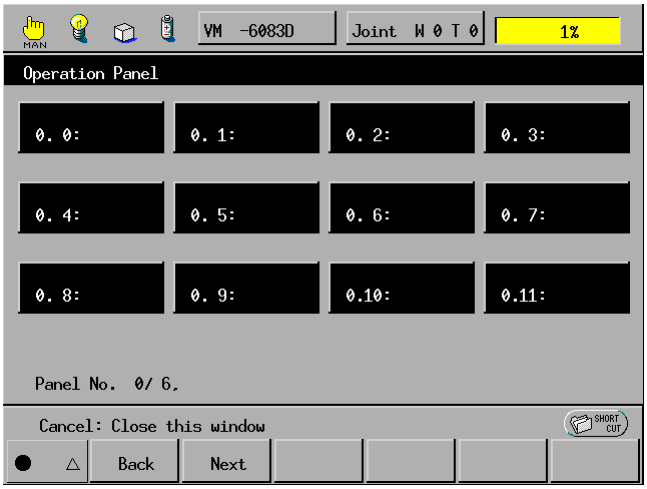
5.6 Displaying the Operation Panel

Access: [ExtScrn]—[OpePanel]

Displays the operation panel on the teach pendant screen.

Pressing [OpePanel] on the extended screen will display the Operation Panel window as shown below.

Touching a button on the panel will change its color between black (OFF) and green (ON). Switching on/off on the panel concurrently modifies the internal I/O values, 128 to 211.



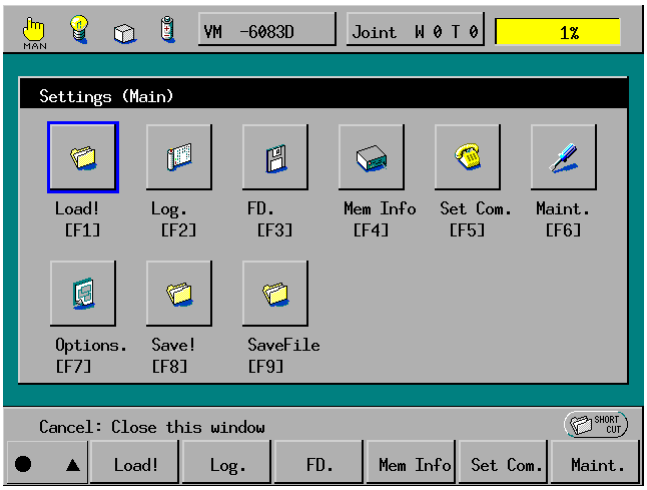
Function keys available	
[Back]	Displays the previous page of the operation panel.
[Next]	Displays the next page of the operation panel.

5.7 Displaying the Settings (Main) Window

Access: [ExtScrn]—[Set]

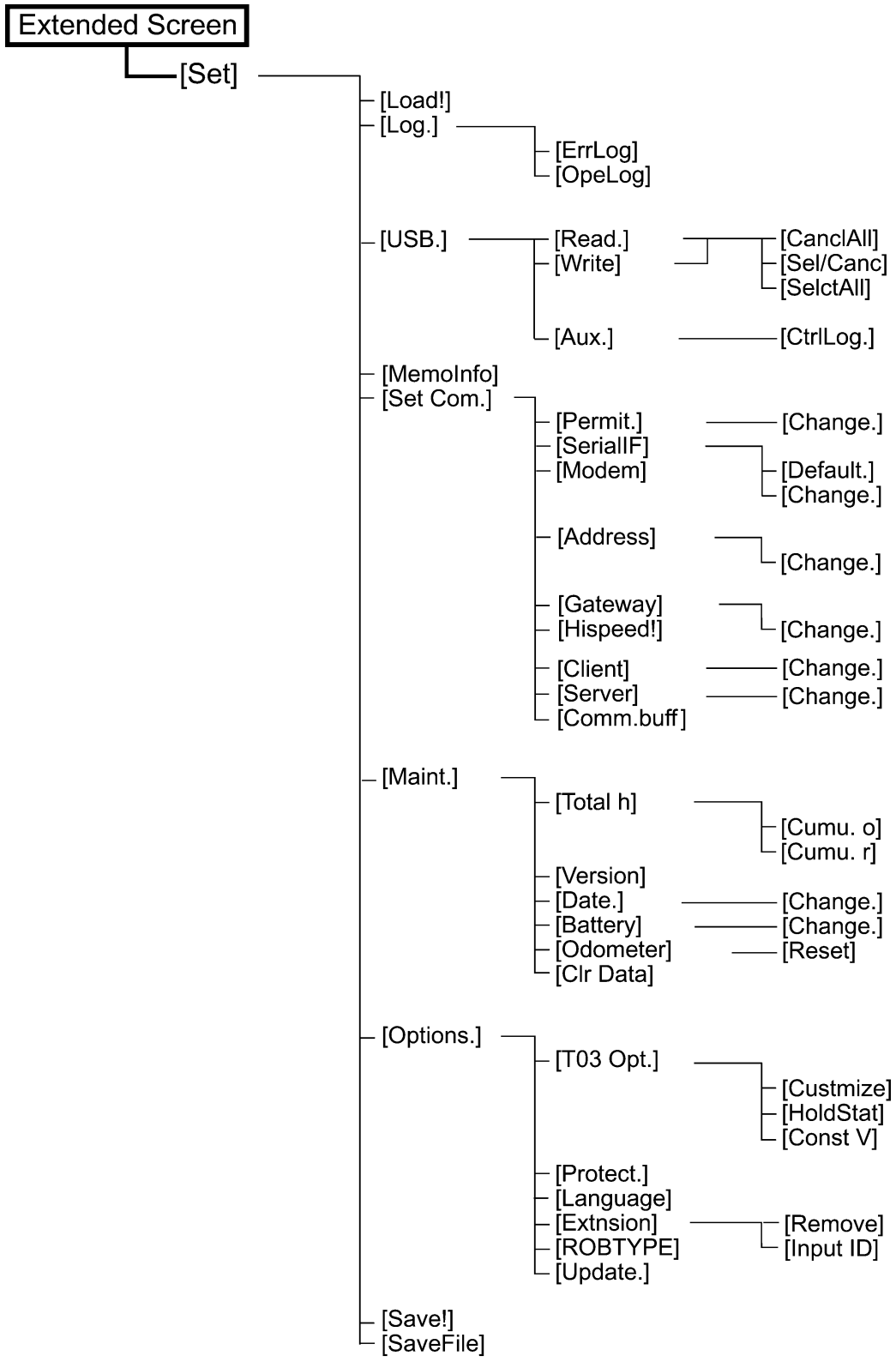
Displays the Settings (Main) window.

(1) Press [Set] on the extended screen, and the following window will appear.



When shifted

(2) Select the desired setting function. The corresponding window will display as described on the following pages.

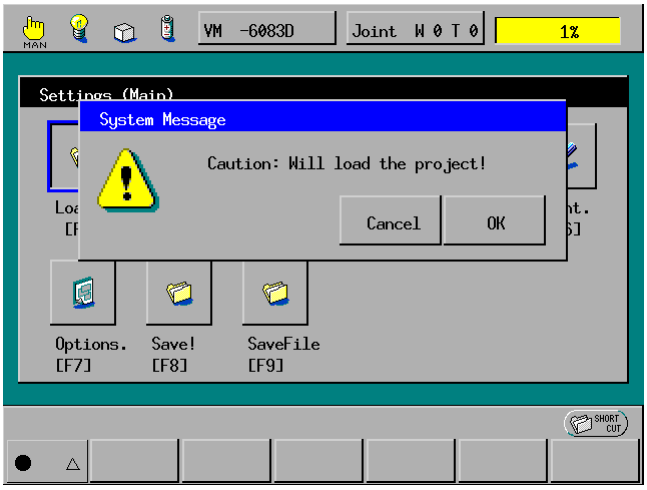

Extended Screen
[Set]
[Load!]
[Log.]
[ErrLog]
[OpeLog]
[USB.]
[Read.]
[Write]
[CanclAll]
[Sel/Canc]
[SelctAll]
[Aux.]
[CtrlLog.]
[MemoInfo]
[Set Com.]
[Permit.]
[Change.]
[SerialIF]
[Modem]
[Default.]
[Change.]
[Address]
[Change.]
[Gateway]
[Hispeed!]
[Change.]
[Client]
[Change.]
[Server]
[Change.]
[Comm.buff]
[Maint.]
[Total h]
[Cumu. o]
[Cumu. r]
[Version]
[Date.]
[Change.]
[Battery]
[Change.]
[Odometer]
[Reset]
[Clr Data]
[Options.]
[T03 Opt.]
[Custmize]
[HoldStat]
[Const V]
[Protect.]
[Language]
[Extnsion]
[Remove]
[Input ID]
[ROBTYPE]
[Update.]
[Save!]
[SaveFile]

Loading a project

Access: [ExtScrn]—[Set]—[Load!]

Loads a project sent from the PC teaching system, enabling the robot controller to execute it.

(1) Press [Load!] in the Settings (Main) window, and the following system message dialog box will appear.



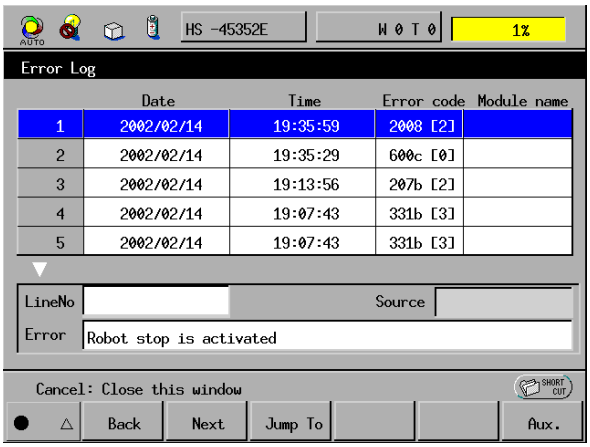
(2) Press the OK button to start loading.

Displaying the error log

Access: [ExtScrn]—[Set]—[Log.]—[ErrLog]

Displays the error log.

(1) Press [Set]—[Log.]—[ErrLog] on the extended screen, and the Error Log window will appear as shown below.



In the bottom line of the log list appears the error details of the selected error number.

The LineNo and Source areas show nothing.

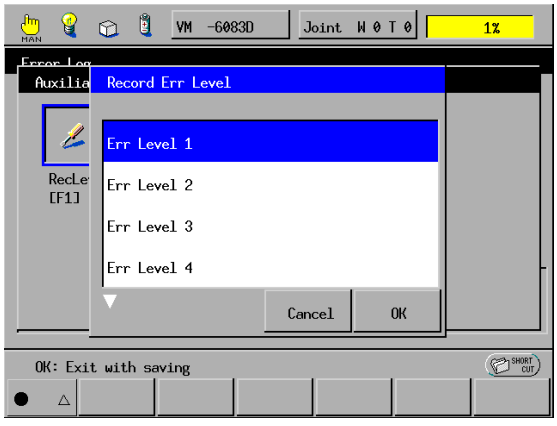
(2) To check older log, scroll the log list with the cursor keys, [Back], or [Next]. Or, press [Jump To] to call up the numeric keypad where you enter the line number of the desired error log. Doing so will directly call up the target log.

(3) You can choose which level errors should be logged. In the Error Log window shown on the previous page, press [Aux.] and [ErrLvl] to call up the Record Err Level window shown below.

Choose the desired error level. The system will log errors at the level you have chosen or higher errors.

NOTE: Errors at levels lower than the specified here will not be logged but it does not mean that such errors will no longer occur.

NOTE: The "Emergency stop ON 600C (Error level 0)" will be always logged regardless of the error level setting.

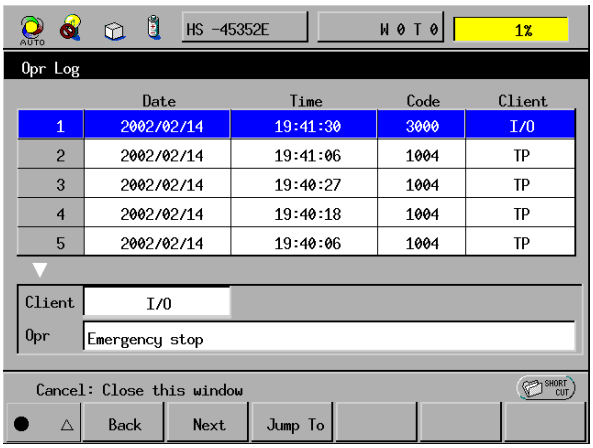


Displaying the operation log

Access: [ExtScrn]—[Set]—[Log.]—[OpeLog]

Displays the error log.

(1) Press [Set]—[Log.]—[OpeLog] on the extended screen, and the Operation Log window will appear as shown below.



(2) Contents of the Operation Log Display

In the bottom line of the log list appears the operation details of the selected item number.

The Client column shows the operation sources that trigger the logged operations. The client may be any of the following:

TP: Teach pendant
PC: In WINCAPSIII
I/O: I/O
SYS: Main system software

NOTE 1: Emergency stop is triggered by operating the teach pendant, but the client is treated as I/O.

NOTE 2: In some processing operations, the log information may be shown in such a format as [cnfPAC 9 val 1]. This means that the operation has changed the environment settings. In the case of [cnfPAC9 val 1], it means that the 9th item of the PAC parameter table has been changed to value "1." For environment setting values, refer to the PROGRAMMER'S MANUAL (I) (T03), Chapter 22 (Appendix), Section 22.3.

NOTE 3: The operation logging maintains a record of processing operations required for maintenance and does not maintain all operation records.

Reading and Writing Data with USB Flash Memory

The USB memory access menu is available in the robot controller RC7, Version 2.2 or later.

Access: [ExtScrn]—[Set]—[USB.]

The robot controller RC7 Version 2.2 or later supports a USB flash memory drive.

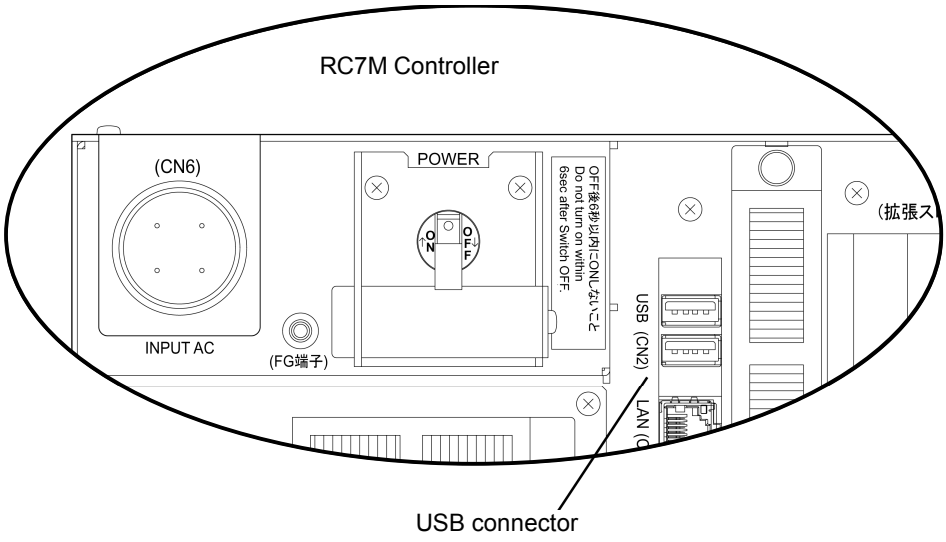
The controller Version 2.3 or later can read/write multiple projects using the USB flash memory drive while Ver. 2.2 can handle a single project per media.

The following USB flash memory drives are available to the controller.

Manufacturer	Model
I-O DATA	EDP-###M, EDC-###M
Logitec	LMC-###UDA

denotes the capacity.

- When formatting the USB flash memory drive, select the "FAT" in the file system menu.
- Never touch or remove a USB flash memory drive or turn the controller power off when the USB flash memory drive is being accessed.



Data that can be handled by USB flash memory drive

The table below lists data that can be handled by USB flash memory drives. Select the appropriate data to read or write as necessary.

Data Type	File or Data	Remarks
Source program data	Source program files (PAC, H, PNL) Executable files (NIC, MAP) Settings files (DAT) Data files for base program	Only files with their compile flags active ("Enable" in the Use column) can be written into USB flash memory.
Variables data	All global data Number of variables used	Reading variables data into the robot controller automatically changes the "number of variables used" in the controller.
I/O data	I/O settings Settings for expansion board	
Arm data	Arm parameters Tool/work/area coordinates definition Parameter files for top screen and base program	• Never read in arm data prepared for other robots. • Tool and work data modified by TOOL or WORK command will not be updated when written into the memory. To write updated data, first save the system parameters (see p. 5-174) and then write data into the USB flash memory.
Visual-related data	Visual equipment settings	Write (to USB flash memory) only.
Log data	Communications settings Version information Various log data	
Backup data	Various types of data	Ver. 2.3 or later

Data exchange between robot controller and WINCAPSIII

Data can be exchanged between the robot controller and WINCAPSIII by means of a USB flash memory drive.

USB memory data modification not allowed

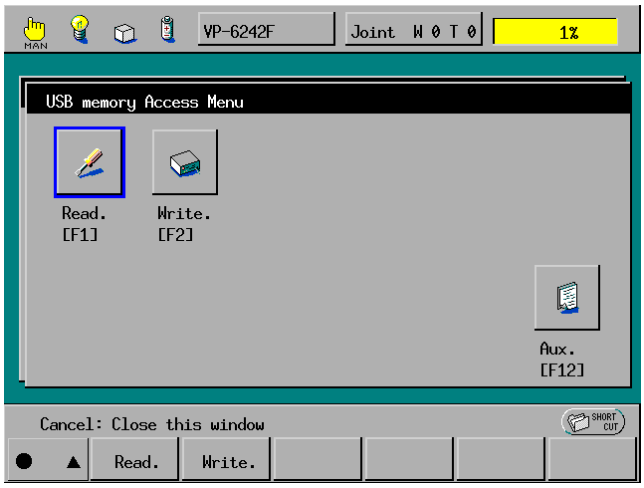
Never modify data stored in the USB flash memory drive from the robot controller. Any modification makes it impossible to access the memory because USB memory data contains check codes used for checking data corruption and guaranteeing accurate data read/write.

Reading USB memory data into the robot controller

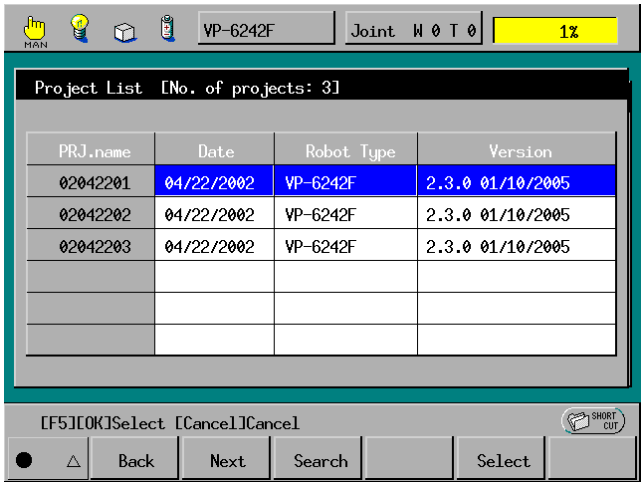
Access: [ExtScrn]—[Set]—[USB.]—[Read.]

Reads data stored in a USB flash memory into the robot controller.

(1) Press [USB.] in the Setting (Main window), and the USB Memory Access Menu appears as shown below.



(2) Press [Read.] in the USB Memory Access Menu, and projects stored in the USB flash memory appear as shown below.

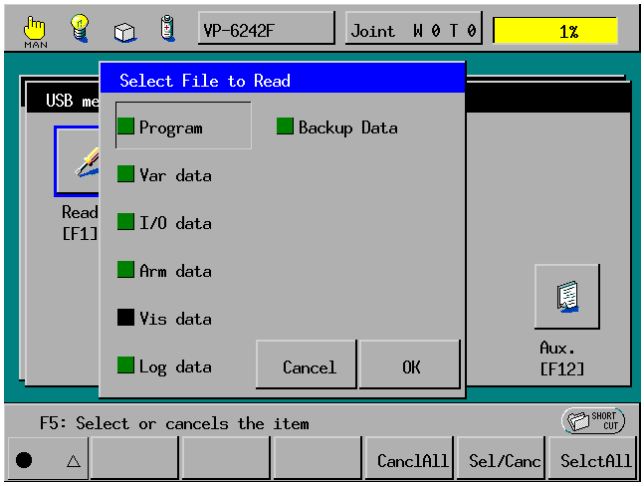


Select a project to read from the USB flash memory, then press [Select] and OK button.

CAUTION: Never read in arm data prepared for other robots. Doing so will cause the robot to malfunction. It is very DANGEROUS.

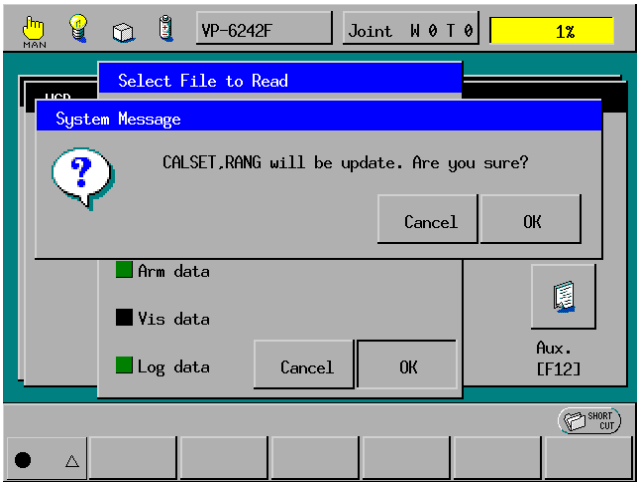
(3) The Select File to Read window appears as shown below.

Select data to read and then press the OK button.

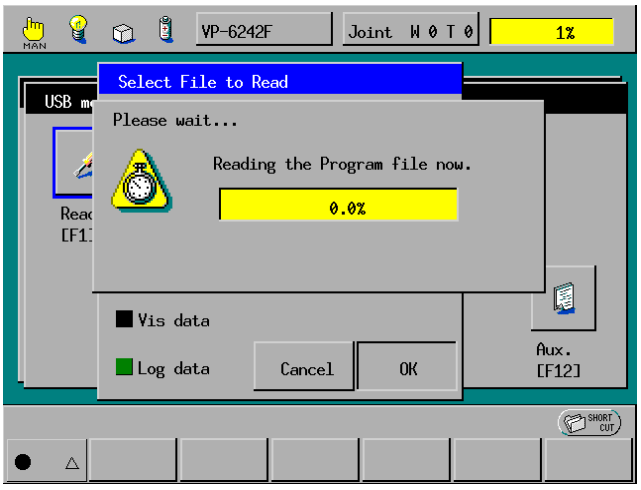


(4) The update confirmation screen for the CALSET and RANG appears as shown below.

Press the OK button, and the controller starts reading data from the USB flash memory.



(5) During reading, the following system message appears.



(6) Upon completion of reading, the following message appears.

Restart the robot controller.

CAUTION: Without restarting the robot controller, the robot may not operate normally.

Notes on reading new *variables* data from USB flash memory

Reading new *variables* from the USB flash memory overwrites the current variables stored in the robot controller with the new ones.

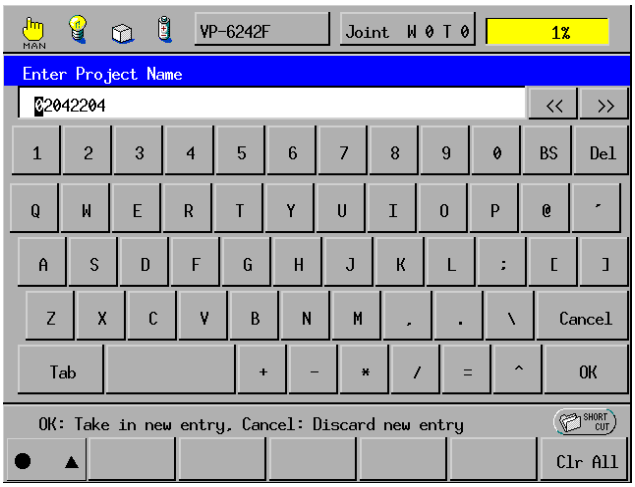
Note that, if the robot controller has 50 integer variables and the USB flash memory contains 30 integer variables, the 31st to 50th variables in the controller will be lost at the end of the read operation.

Writing data stored in the robot controller to USB flash memory

Access: [ExtScrn]—[Set]—[USB.]—[Write.]

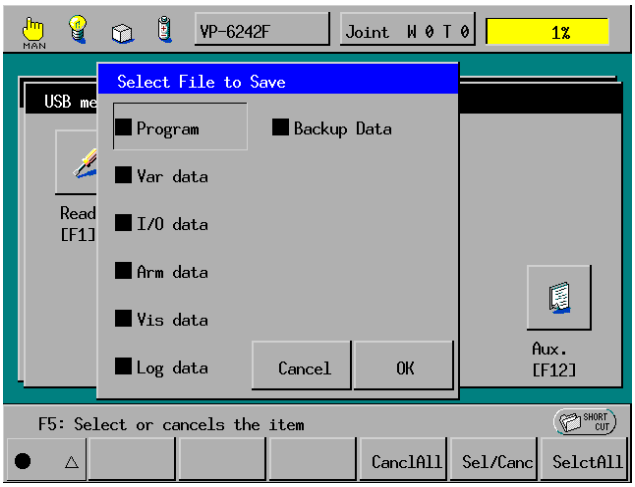
Writes (Saves) data stored in the robot controller into a USB flash memory.

(1) Press [Write.] in the USB Memory Access Menu, and the Enter Project Name window appears as shown below.



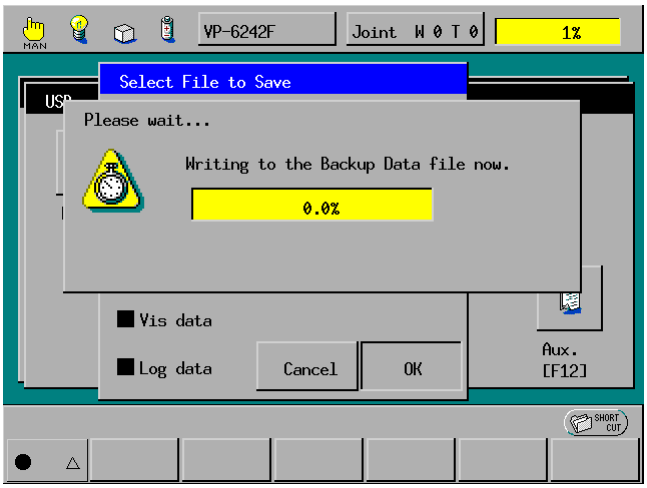
Enter the project name and press the OK button.

(2) The Select File to Save window appears.



Press the OK button, and the controller starts writing data into the USB flash memory.

(3) During writing, the following system message appears.



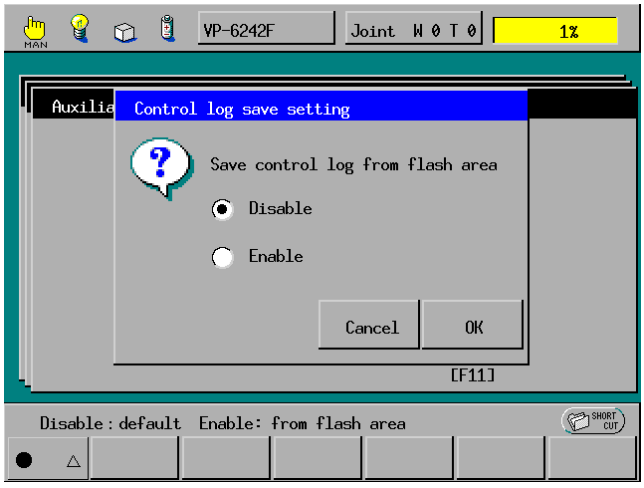
Saving Control Log into USB Flash Memory

Access: [ExtScrn]—[Set]—[USB.]—[Aux.]—[CtrlLog.]

Determines whether or not to save the control log into a USB flash memory together with data stored in the robot controller.

The control log takes up a large storage space, while it is not required as backup of the facility data. Therefore, enable this feature only when you need to save the control log.

(1) In the USB Memory Access Menu, press [Aux.]—[CtrlLog.], and the Control Log Save Setting window appears as shown below.



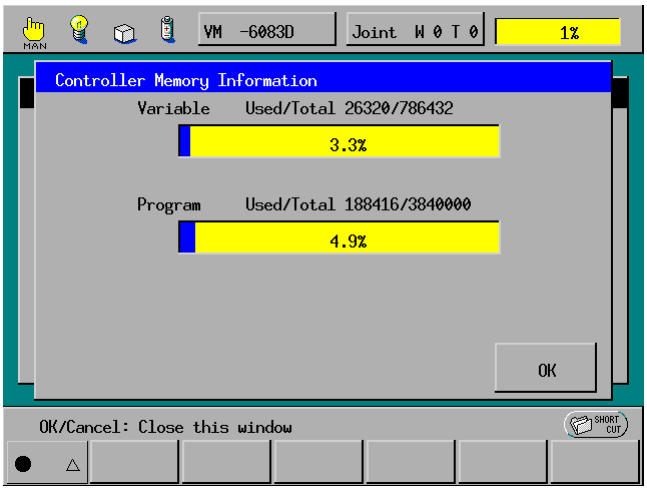
(2) Select "Enable" or "Disable" and then press the OK button.

Displaying the memory information of the robot controller

Access: [ExtScrn]—[Set]—[Mem Info]

Displays the memory information of the robot controller.

(1) Press [Mem Info] in the Settings (Main) window, and the Controller Memory Information window will appear as shown below.



The window shows the used and total sizes of the Variables memory and Programs memory.

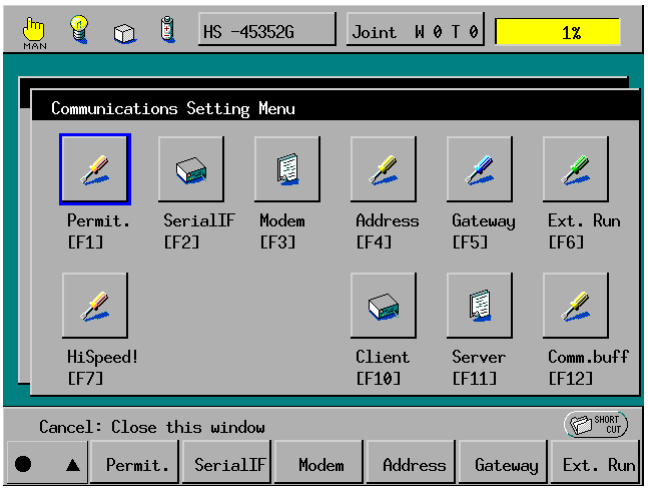
(2) To close the Controller Memory Information window, press the OK button.

Displaying the Communications Setting Menu

Access: [ExtScrn]—[Set]—[Set Com.]

Displays the communications setting menu.

(1) Press [Set Com.] in the Settings (Main) window, and the Communications Setting Menu will appear as shown below.



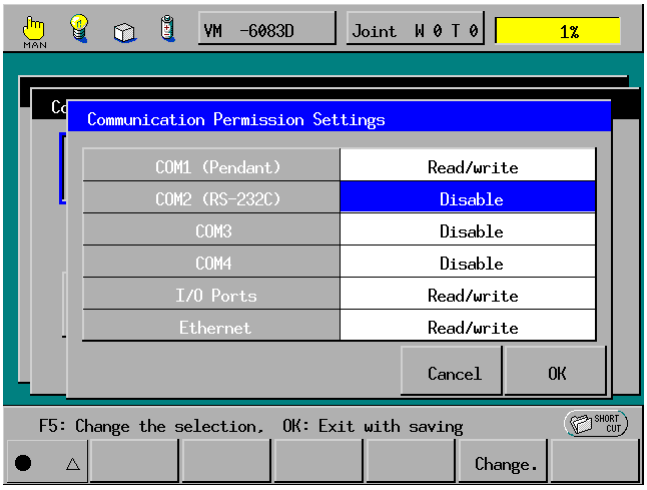
(2) Select the desired setting function. The corresponding window will display as described on the following pages.

Setting the communication permission

Access: [ExtScrn]—[Set]—[Set Com.]—[Permit.]

Sets the communication permission or the read/write permission for each communications port.

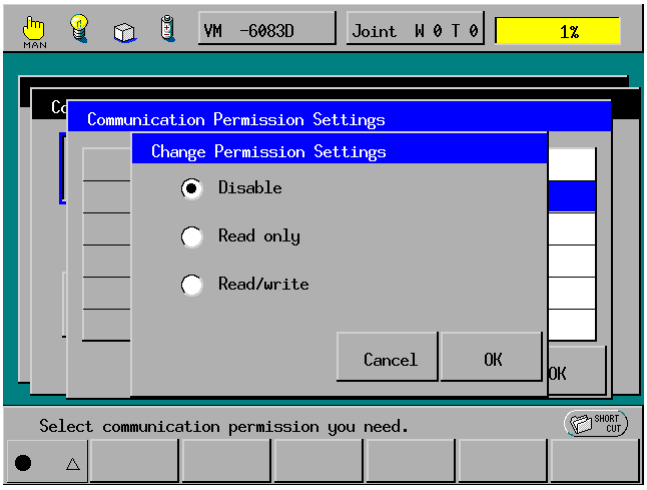
(1) Press [Permit.] in the Communications Setting Menu, and the Communication Permission Settings window will appear as shown below.



NOTE: COM1 is reserved by the system, so its settings cannot be changed. COM2 is used for communication with the PC teaching system. COM3 and COM4 are reserved for future extension. Ethernet is used as Ethernet port.

(2) Select the target port and then press [Change.]. The Change Permission Settings window will appear as shown below.

NOTE: "Read only" or "Read/write" can be set to only any one of COM2, COM3, COM4, and Ethernet port.



TIP: In the Change Permission Settings window are three choices, defined as:

"Disable": Disables the selected communications port.

"Read only": Allows external equipment (such as PC teaching system) to read data from the robot controller.

"Read/write": Allows external equipment (such as PC teaching system) to exchange data with the robot controller.

(3) Select the desired item and press the OK button. The Communication Permission Settings window will reappear.

(4) Check the new entry, then press the OK button to make the new entry take effect.

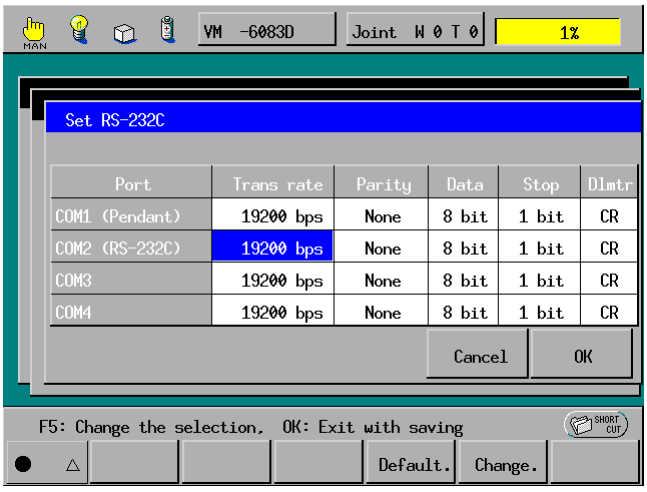
If you press the Cancel button instead of the OK button, the new entry will be cancelled.

Setting the transmission rates for RS-232C serial interface ports

Access: [ExtScrn]—[Set]—[Set Com.]—[Serial IF]

Sets the transmission rate for each of the RS-232C serial interface ports.

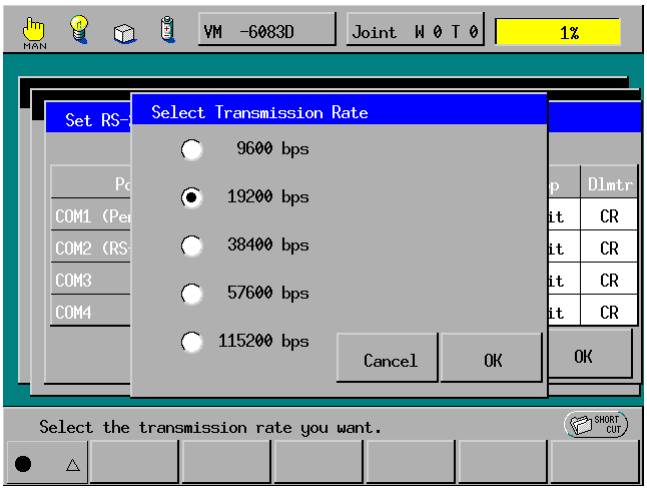
(1) Press [Serial IF] in the Communications Setting Menu, and the Set RS-232C window will appear as shown below.



NOTE: COM1 is reserved by the system, so its settings cannot be changed. COM2 is used for communication with the PC teaching system and its default transmission rate is 19,200 bps. COM3 and COM4 are reserved for future extension.

NOTE: The higher transmission rate may yield the higher transmission error rate.

(2) Select the target port and then press [Change.]. The Select Transmission Rate window will appear as shown below.



(3) Select the desired transmission rate, then press the OK button to close the Select Transmission Rate window.

(4) Check the new entry, then press the OK button to make the new entry take effect.

If you press the Cancel button instead of the OK button, the new entry will be cancelled.

If you press [Default.] in the Set RS-232C window, the following defaults will be restored:

The default of the COM1 (reserved by system) cannot be changed.

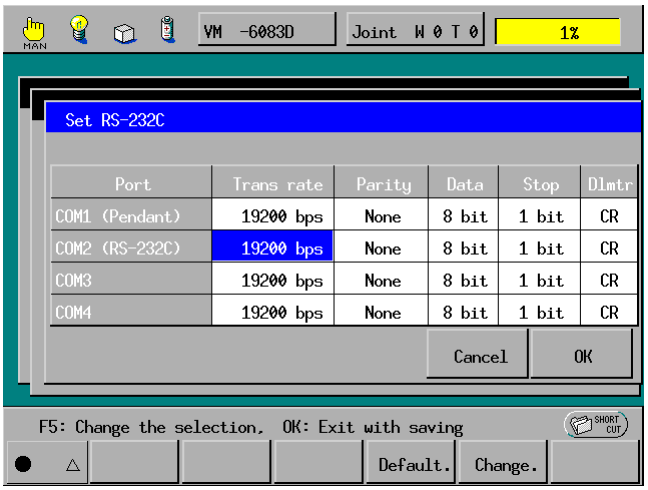
Port	Transmission rate (bps)	Parity	Data (character length)	Stop bit	CR/LF code
COM1 (reserved by system)	19200	None	8 bits	1 bit	CR
COM2 (RS-232C)	19200	None	8 bits	1 bit	CR
COM3	19200	None	8 bits	1 bit	CR
COM4	19200	None	8 bits	1 bit	CR

Initializing modem

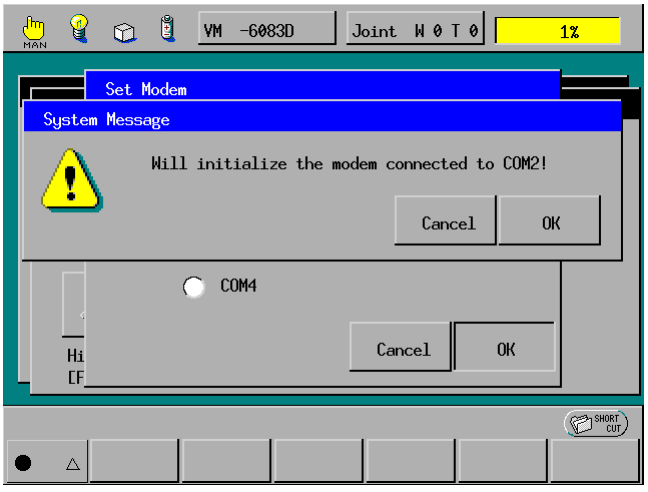
Access: [ExtScrn]—[Set]—[Set Com.]—[Modem]

Initializes the modem connected to the selected modem port.

(1) Press [Modem] in the Communications Setting Menu, and the Set Modem window will appear as shown below.



(2) Select the modem port with which the target modem is connected and then press the OK button to proceed. The following system message will appear.



(3) Check the message and then press the OK button to start initializing the modem. The system message "Completed initializing the modem successfully." will appear.

(4) Press the OK button to close the system message dialog box.

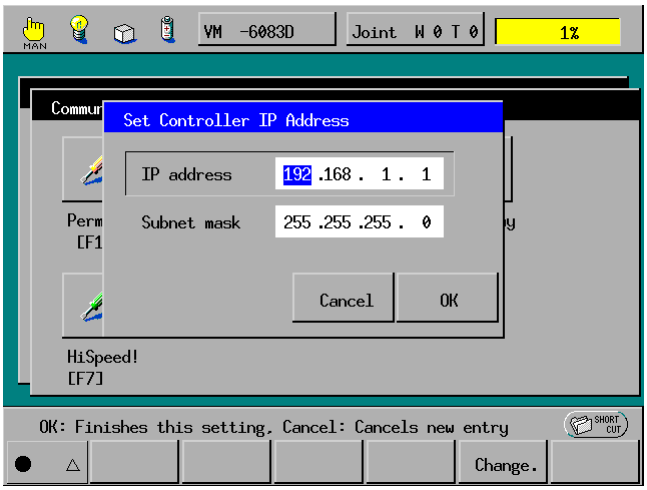
Setting the IP address of the robot controller

Access: [ExtScrn]—[Set]—[Set Com.]—[Address]

Sets the IP address of the robot controller.

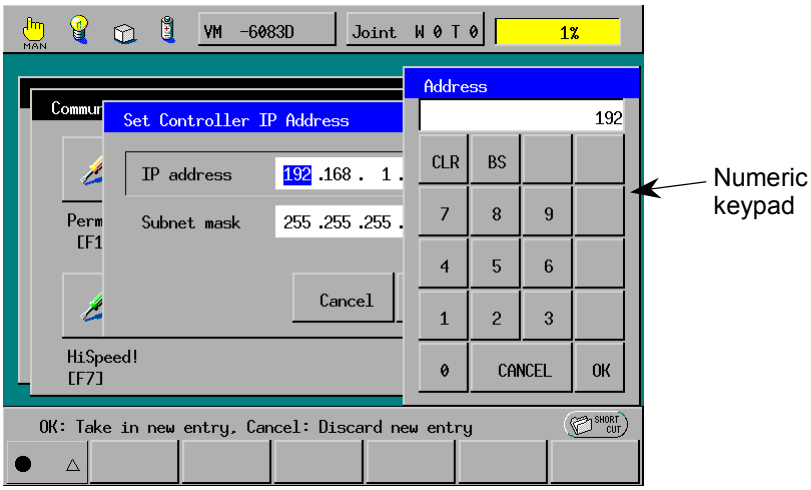
NOTE: The IP addresses 10.255.255.252 to 10.255.255.255 cannot be used.

(1) Press [Address] in the Communications Setting Menu, and the Set Controller IP Address window will appear as shown below.



(2) Select the item to be set, and then press [Change.].

The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button to enter the new entry into the Set Controller IP Address window.

(4) Check the new entry, then press the OK button to make the new entry take effect.

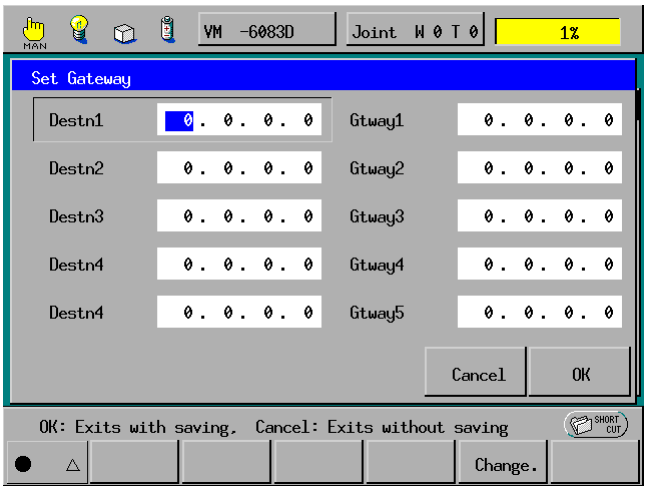
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Controller IP Address window, press the OK or Cancel button.

Setting gateways

Access: [ExtScrn]—[Set]—[Set Com.]—[Gateway]

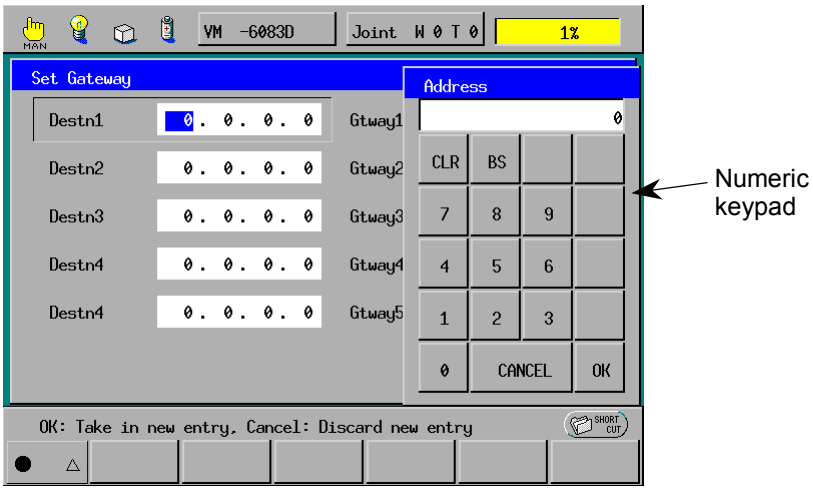
Sets the gateways and destinations.

(1) Press [Gateway] in the Communications Setting Menu, and the Set Gateway window will appear as shown below.



(2) Select the item to be set, and then press [Change.].

The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

The new entry will be entered into the Set Gateway window.

(4) Check the new entry, then press the OK button to make the new entry take effect.

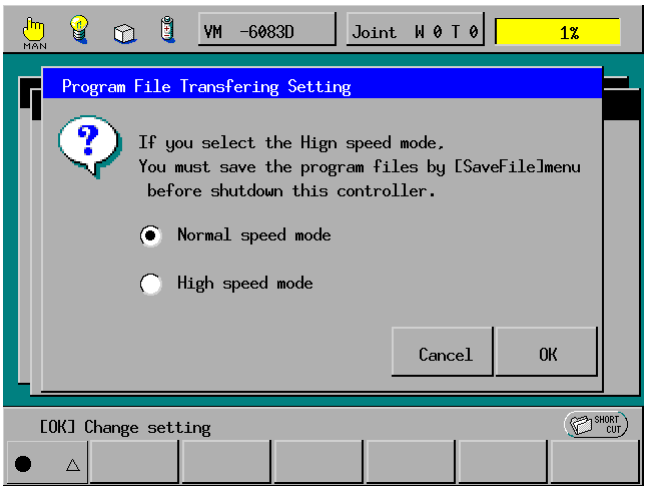
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Gateway window, press the OK or Cancel button.

Setting the high speed mode in receiving projects

Access: [ExtScrn]—[Set]—[Set Com.]—[HiSpeed!]

Sets the high speed mode to receive projects from the teaching system in the PC.

(1) Press [HiSpeed!] in the Communications Setting Menu. This opens [Program File Transferring Settings] window.



(2) Select either "Normal speed mode" or "High speed mode," then press [OK].

Note in using "High speed mode"

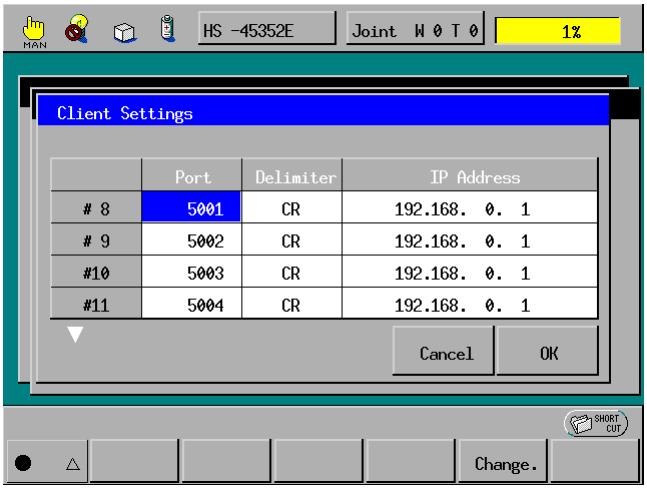
In the high speed mode, the received data will not be automatically saved even upon completion of project reception. Therefore, turning the robot controller off loses the data. To avoid data loss, be sure to press [SaveFile] in the [Set (Main)] window.

Configuring the client of the robot controller

Access: [ExtScrn]—[Set]—[Set Com.]—[Client]

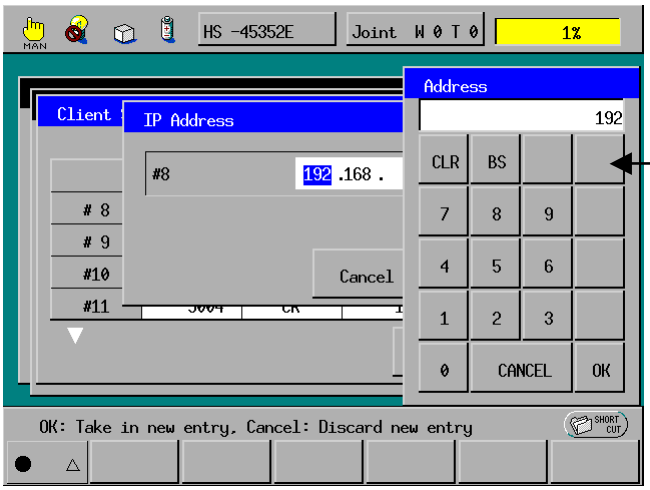
Configures the client port of the robot controller.

(1) Press [Client] in the Communications Setting Menu, and the Client Settings window will appear as shown below.



(2) To set the IP address of the target connection port, select the IP Address field to be set and press [Change.] and then [Edit].

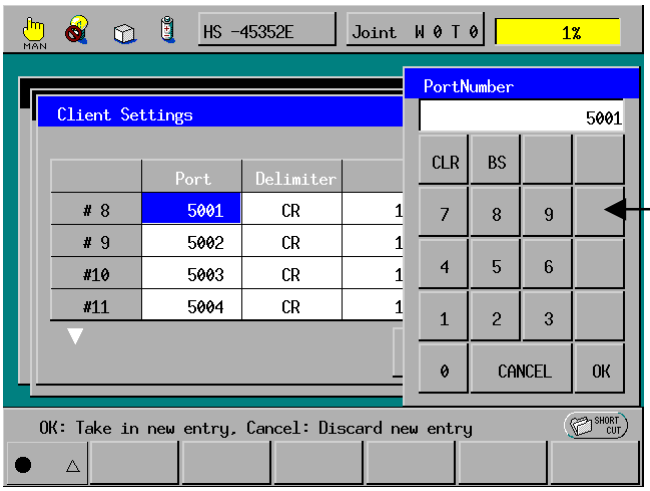
The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button. The newly entered value will appear on the Client Settings window.

(4) To set the target connection port number, select the Port field to be set and press [Change.].

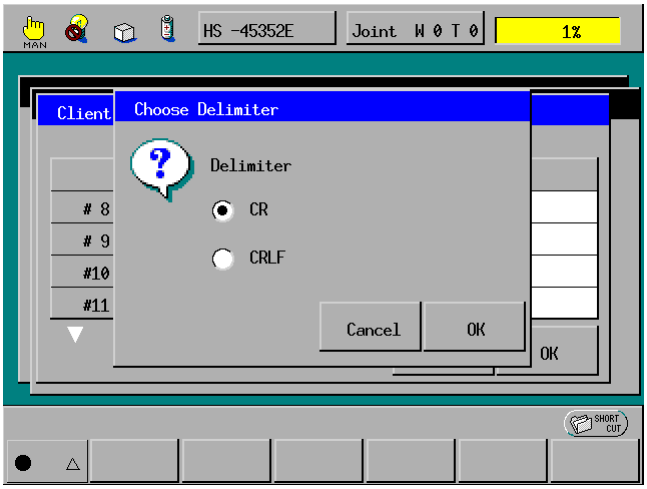
The numeric keypad will appear as shown below.



(5) Enter the desired value to the target connection port with the numerical buttons in the above window, and then press the OK button. The newly entered value will appear on the Client Settings window.

(6) To set the delimiter, select the Delimiter field to be set and press [Change.].

The Choose Delimiter window will appear as shown below.



(7) Select the desired delimiter code in the above window, and then press the OK button. The new delimiter code will appear on the Client Settings window.

(8) Check the new entry, then press the OK button to make the new entry go into effect.

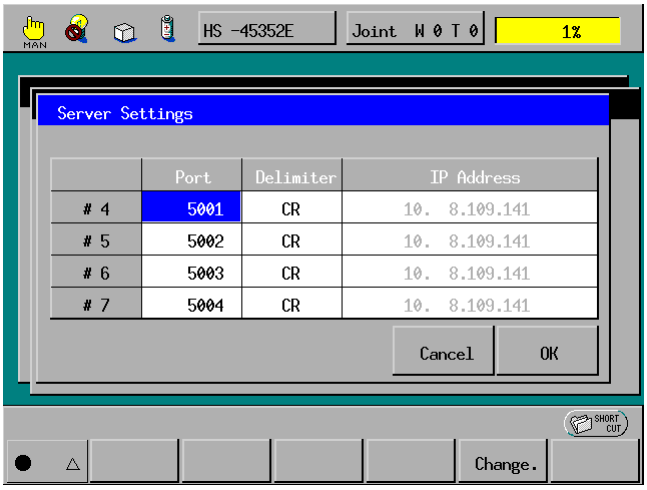
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Client Settings window, press the OK or Cancel button.

Configuring the server of the robot controller

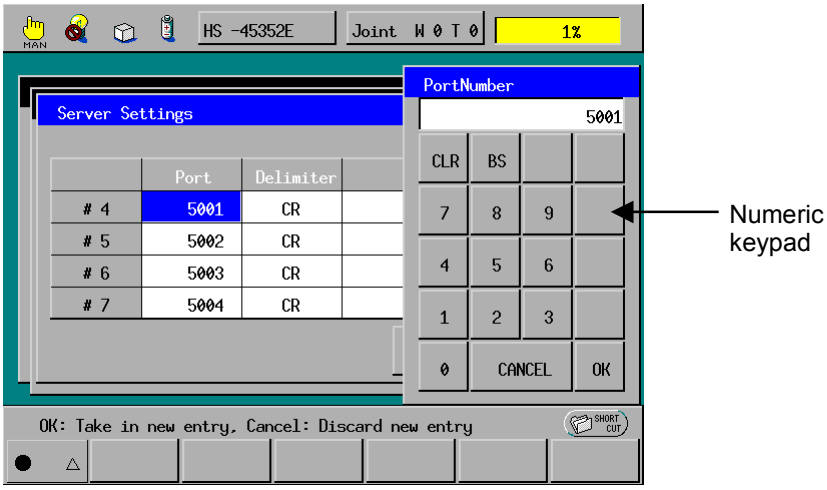
Access: [ExtScrn]—[Set]—[Set Com.]—[Server]

Configures the server port of the robot controller.

(1) Press [Client] in the Communications Setting Menu, and the Server Settings window will appear as shown below.



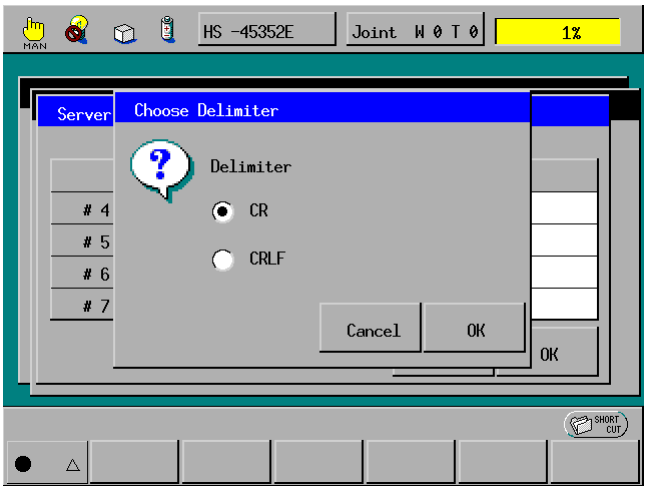
(2) To set the port number, select the Port field to be set and press [Change.].
The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button. The newly entered value will appear on the Server Settings window.

(4) To set the delimiter, select the Delimiter field to be set and press [Change.].

The Choose Delimiter window will appear as shown below.



(5) Select the desired delimiter code in the above window, and then press the OK button. The new delimiter code will appear on the Server Settings window.

(6) Check the new entry, then press the OK button to make the new entry go into effect.

If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Server Settings window, press the OK or Cancel button.

Resizing the communications buffer

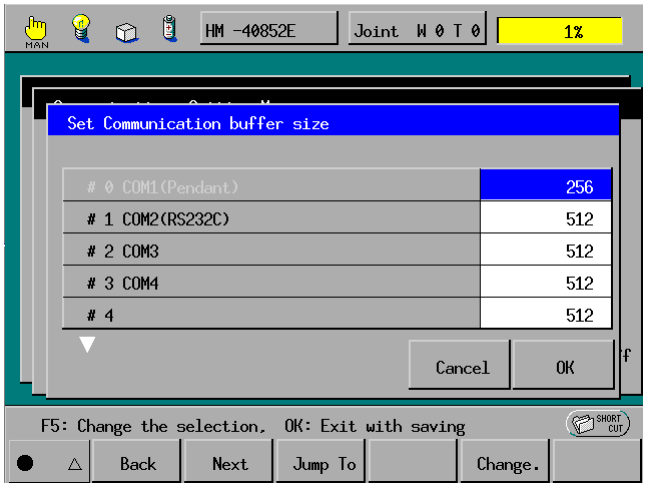
Access: [ExtScrn]—[Set]—[Set Com.]—[Comm.buff]

The communications buffer resizing function allows you to resize the communications buffer of each port on the RS-232C serial interface.

Usually it is not necessary to modify the factory default of the communications buffer sizes. If you need to resize the communications buffers for your applications, use this command.

NOTE: Resizing a communications buffer will discard the data that has not been read out from the buffer or saved into the memory. According to your needs, first use I/O control commands for the RS-232C or serial-binary communications (refer to the PROGRAMMER'S MANUAL (I) (T03)) to save the data stored in the buffer, and then resize the communications buffer.

(1) In the Communications Setting Menu, press [Comm. buff].
The Set Communication Buffer Size window will appear as shown below.



NOTE: In the Set Communication Buffer Size window, #0 through #15 COM ports are assigned as shown below.

#0 COM1: Reserved by the system. No access is allowed.

#1 COM2: Used for communication with WINCAPSIII.

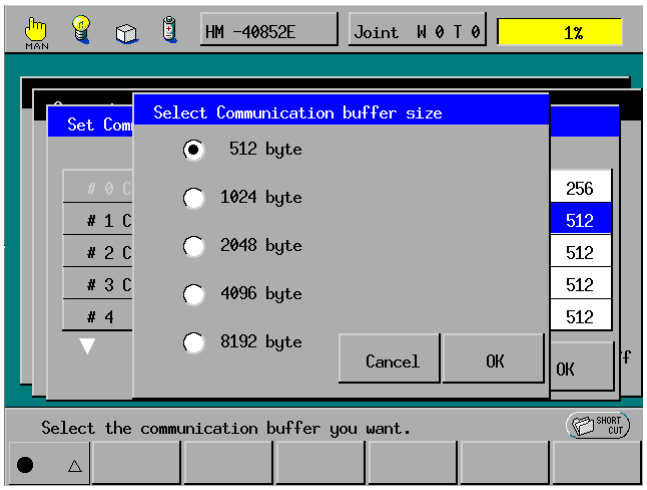
#2 COM3 and #3 COM4: Reserved for function extension.

#4 through #7: For servers.

#8 through #15: For clients.

(2) Select the target port and press [Change.].

The Select Communications Buffer Size window will appear as shown below.



(3) Select the desired buffer size and press the OK button. The Select Communications Buffer Size window will be closed.

(4) Confirm the new setting value and then press the OK button. The new setting will go into effect.

If you press the Cancel button instead of the OK button, the new setting value will be canceled.

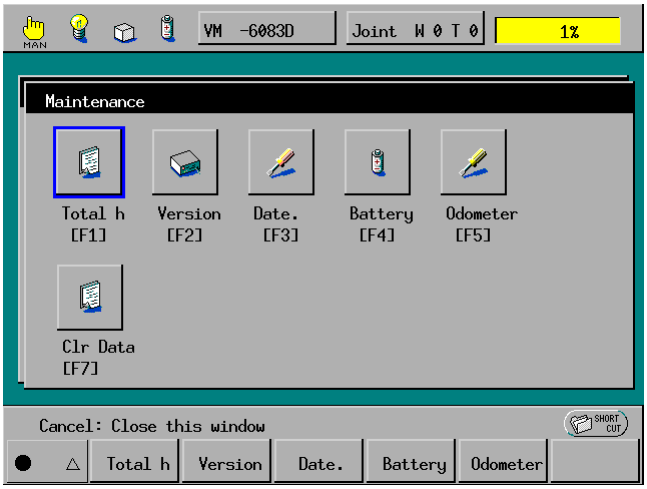
NOTE: Pressing the OK button to make the new setting go into effect will discard the buffer data.

Displaying the Maintenance menu

Access: [ExtScrn]—[Set]—[Maint.]

Displays the Maintenance menu.

(1) Press [Maint.] in the Settings (Main) window, and the Maintenance menu will appear as shown below.



When shifted

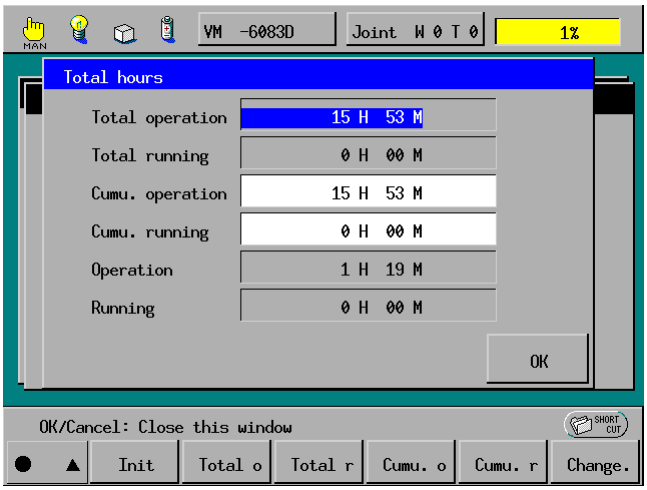
(2) Select the desired setting function. The corresponding window will display as described on the following pages.

Displaying the robot controller ON-time and the robot running time

Access: [ExtScrn]—[Set]—[Maint.]—[Total h]

Displays the robot controller ON-time and the robot running time.

(1) Press [Total h] in the Maintenance menu, and the Total hours window will appear as shown below.



The Total hours window has the following items:

[Total operation] Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.

[Total running] Shows the grand total of the robot running time counted after the robot leaves the factory.

[Cumu. operation] Shows the ON-time of the robot controller counted after it is turned ON this time.

[Cumu. running] Shows the running time of the robot counted after the robot controller is turned ON this time.

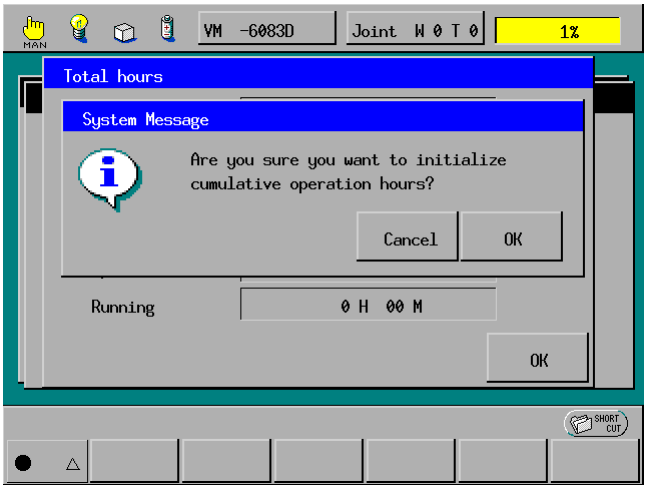
[Operation] Shows the total of the robot controller ON-time counted after you reset the user counter to zero.

[Running] Shows the total of the robot running time counted after you reset the user counter to zero.

Function keys available	
[Cumu. o]	Calls up the system message dialog box where you may reset the user counter of the robot controller ON-time.
[Cumu. r]	Calls up the system message dialog box where you may reset the user counter of the robot running time.

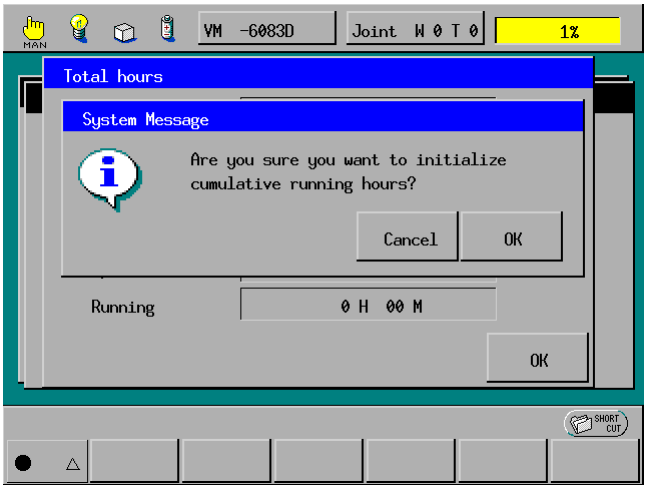
(2) To reset the user counter of the robot controller ON-time to zero, press [Cumu. o] in the Total hours window.

The following window will appear. If you want to reset the counter to zero, press the OK button.



(3) To reset the user counter of the robot running time to zero, press [Cumu. r] in the Total hours window.

The following window will appear. If you want to reset the counter to zero, press the OK button.



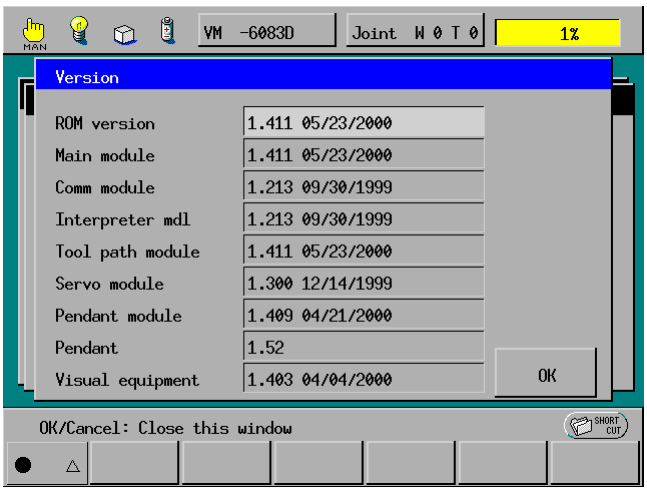
Displaying the version information of each module

Access: [ExtScrn]—[Set]—[Maint.]—[Version]

Displays the version information of each module in the robot controller.

Note: This procedure cannot display the version information of the teach pendant. To display the teach pendant version, use the shortcut menu from the top screen.

(1) Press [Version] in the Maintenance menu, and the Version window will appear as shown below.



(2) Press the OK button or Cancel key to close the Version window.

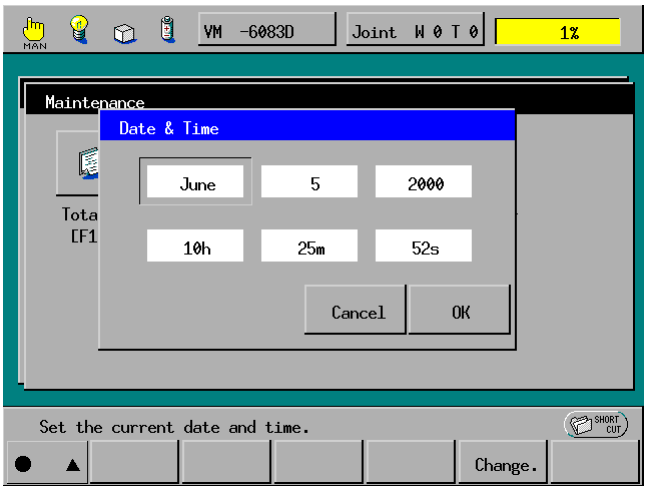
Setting the calendar clock built in the robot controller

Access: [ExtScrn]—[Set]—[Maint.]—[Date.]

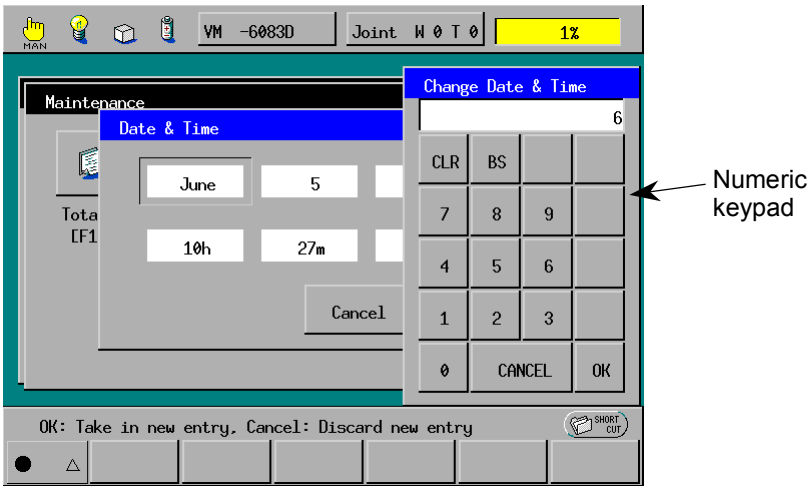
Sets the calendar clock built in the robot controller.

Note: The calendar clock displayed on the teach pendant screen is based on the time when the robot controller has started up. If the calendar clock is changed with the procedure below, restarting the robot controller will display the new calendar clock.

(1) Press [Date.] in the Maintenance menu, and the Date & Time window will appear as shown below.



(2) Select the item to be set, and then press [Change.].
The numeric keypad will appear as shown below.



(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button to take the new entry into the Date & Time window.

(4) Check the new entry, then press the OK button to make the new entry take effect.
If you press the Cancel button instead of the OK button, the system message "The parameters have been changed. Are you sure you want to revert to previous settings?" will appear. Press the OK button to cancel the new entry; press the Cancel button to return to the Date & Time screen.

Setting the next battery replacement date

Access: [ExtScrn]—[Set]—[Maint.]—[Battery]

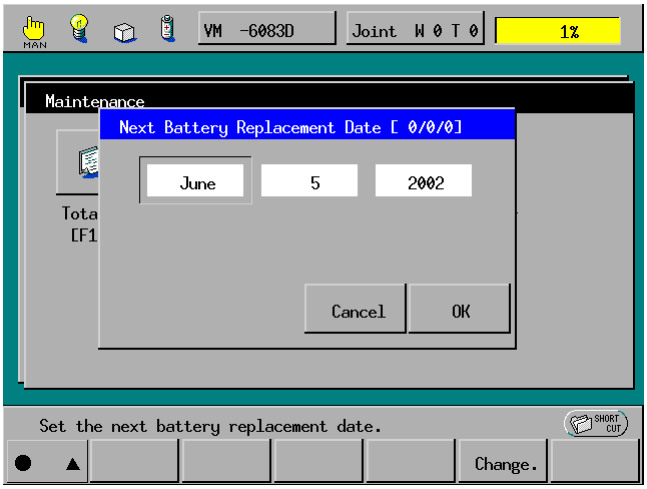
Sets the next replacement date of the memory backup battery of the robot controller.

When the replacement day comes, the message "It's time to replace the backup battery of the robot controller." will appear in the menu bar of the teach pendant.

(1) Press [Battery] in the Maintenance menu, and the Next Battery Replacement Date window will appear as shown below.

The current setting (June/5/2002 in this example) is displayed in the top of the window.

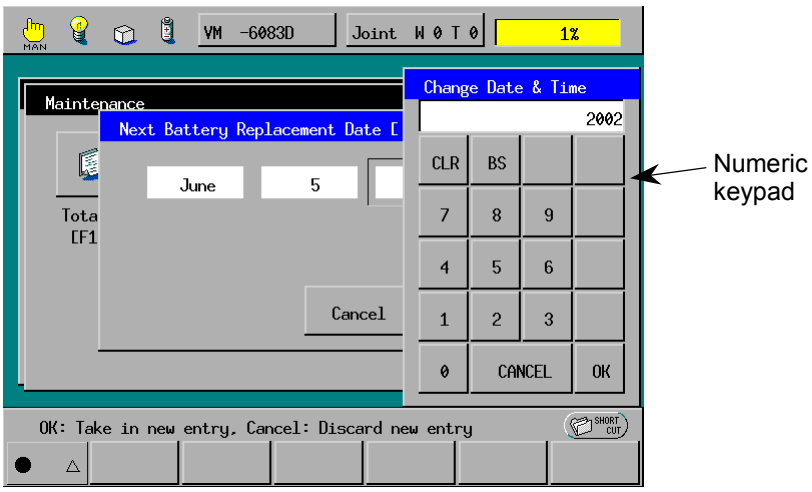
The date entry areas display the default replacement date (June 5, 2002) that is two years later the current date (June/5/2000) at which you open this window, assuming that the battery service life is two years.



(2) If you open this window just to check the current setting, be sure to press the Cancel button.

If the displayed default replacement date is the date you want to set, press the OK button.

To set new replacement date, select the item to be modified, and then press [Change.]. The numeric keypad will appear as shown below.



(3) Enter the desired date with the numerical buttons in the above window, and then press the OK button.

NOTE: To set months, use the numerical buttons. For January, February, ...December, enter 1, 2, ...12, respectively.

The new entry will be entered into the Next Battery Replacement Date window.

CAUTION: Make sure that the new replacement date you set is within two years from when you have actually replaced the battery with a new one.

(4) Check the new entry, then press the OK button to make the new entry take effect.

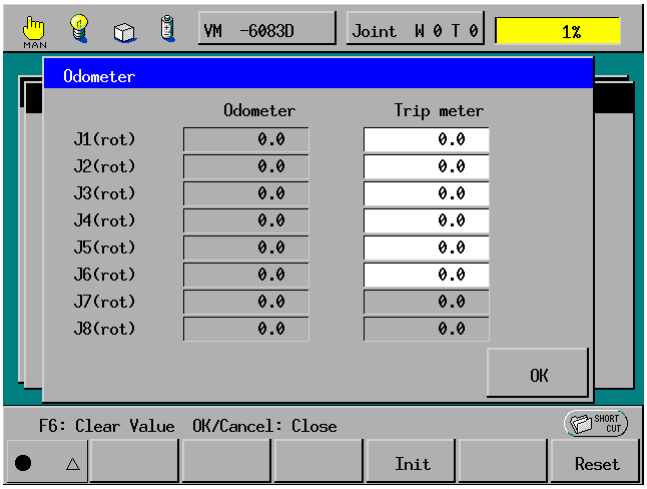
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Next Battery Replacement Date window, press the OK or Cancel button.

Displaying the odometer and trip meter for each axis

Access: [ExtScrn]—[Set]—[Maint.]—[Odometer]

Displays the odometer and trip meter which count traversed distance of each axis.

(1) Press [Odometer] in the Maintenance menu, and the following window will appear.

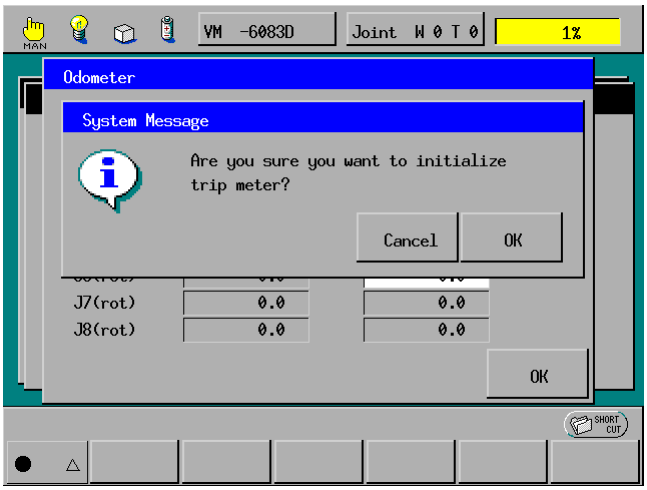


The Odometer window has the following items:

[Odometer] Shows the total distance of each axis traversed after the robot leaves the factory.

[Trip meter] Shows the distance of each axis traversed after you reset the trip meter to zero.

(2) To reset the trip meter to zero, press [Reset]. The following window will appear. If you want to reset the trip meter to zero, press the OK button.

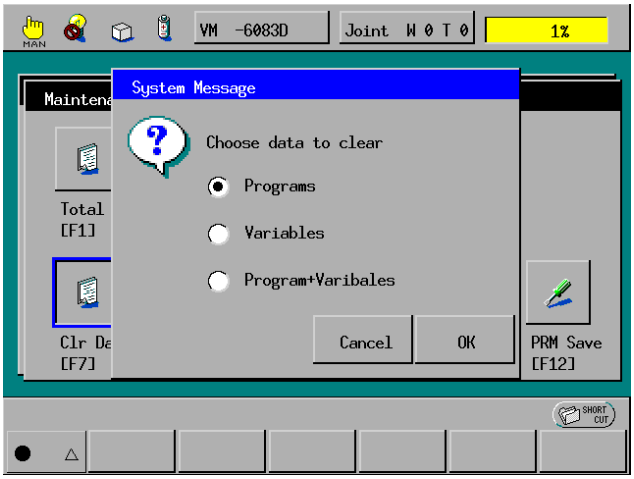


Clearing user programs and variables

Access: [ExtScrn]—[Set]—[Maint.]—[Clr Data]

Deletes all user programs stored and clears all global variables to zero.

(1) In the Maintenance window, press [Clr Data].
The choice screen appears where you may choose data type to be cleared.

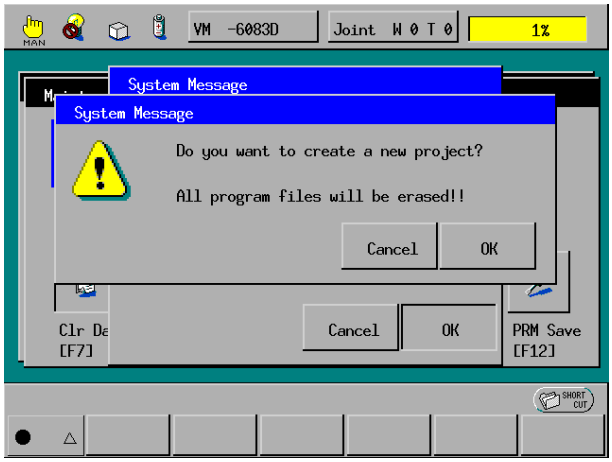


(2) Choose either one of the following three choices and press OK.

- Programs: Delete all PAC programs and all base programs, as well as initializing the interface panel configuration file (IFPANELnn.IFP) and controller error definition file (PLCERROR.EPL).
- Variables: Clear all global variables to zero.
- Programs + Variables: Delete all PAC programs and all base programs, and clear all global variables to zero.

(3) The following system message appears.
Press OK. Then deleting programs or clearing variables will start.

(Program Deletion Confirmation Message)



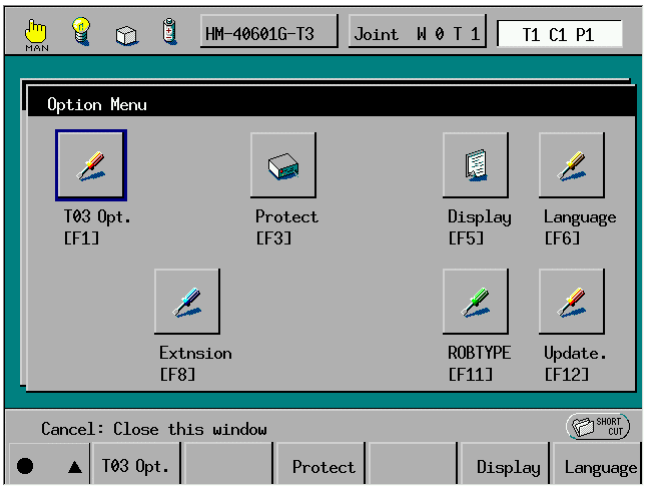
(Variable Clearing Confirmation Message)

Displaying the Option Menu

Access: [ExtScrn]—[Set]—[Options.]

Displays the option menu.

(1) Press [Options.] in the Settings (Main) window, and the Option Menu window will appear as shown below.

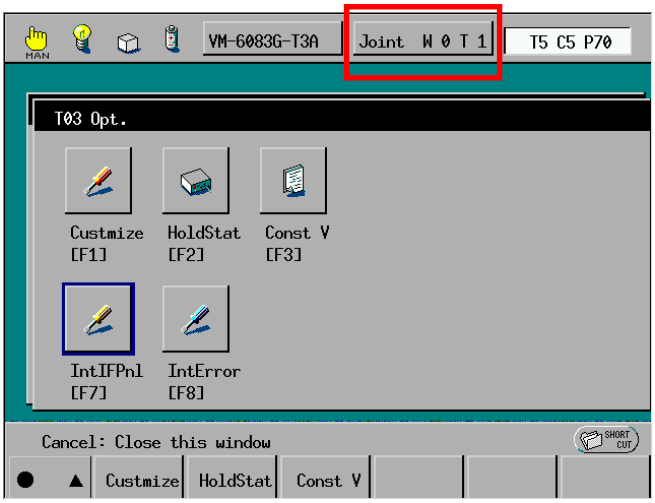


(2) Select the target option setting function. The corresponding window will display as described on the following pages.

Selecting T03 options

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.]

(1) Press [T03 Opt.] in the Option Menu window, and the T03 Options window will appear as shown below.

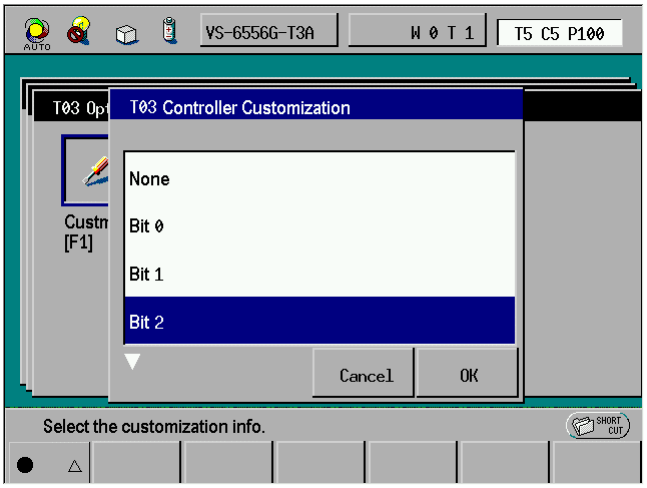


(2) Select the desired T03 option function. The corresponding window will display as described on the following pages.

Setting T03 controller customization

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.] —[Custmize]

Selects the controller customization info to be issued.

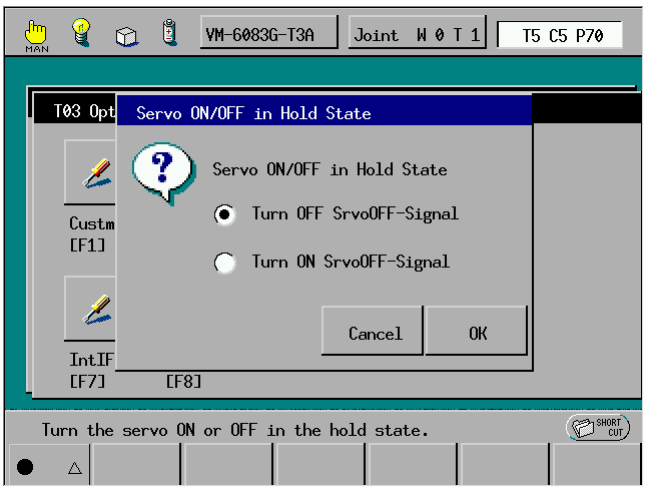


After executing this command, restart the controller.

Selecting servo ON/OFF state in hold state

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.] —[HoldStat]

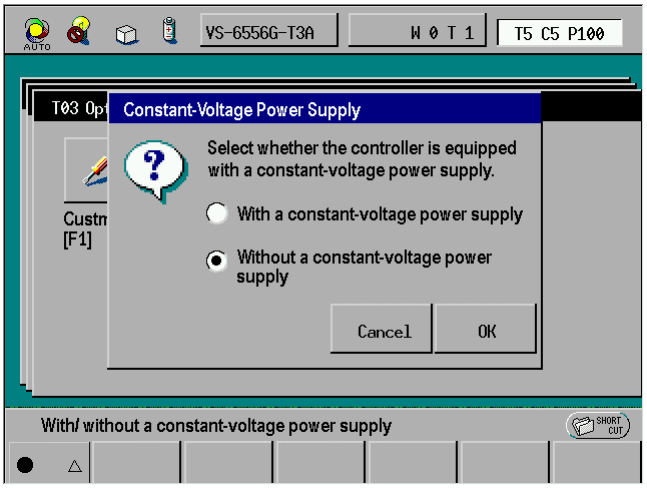
Selects whether to turn the servo OFF or keep it ON when the Hold signal is turned ON.



Setting the constant-voltage power supply

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.] —[Const V]

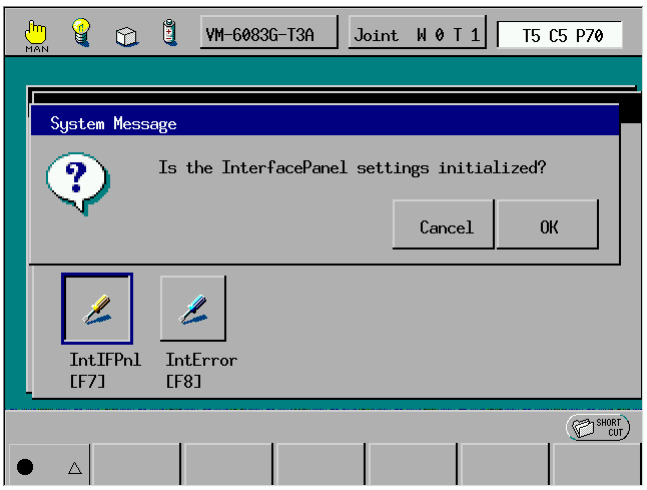
Selects whether the controller is equipped with a constant-voltage power supply.



Initializing the interface panel settings

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.] —[IntIFPnl]

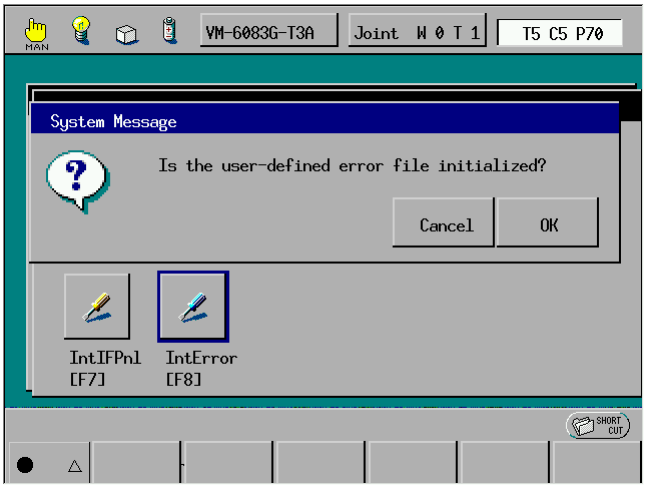
Initializes the interface panel settings.



Initializing the user-defined error file

Access: [ExtScrn]—[Set]—[Options.]—[T03 Opt.] —[IntError]

Initializes the user-defined error file.



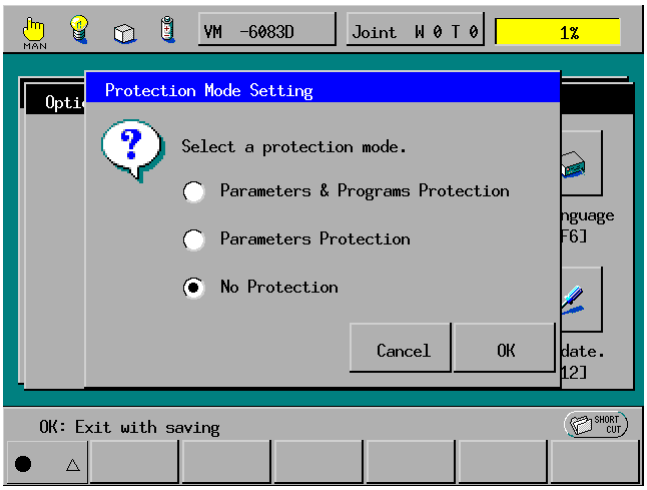
Protecting parameters/programs

Access: [ExtScrn]—[Set]—[Options.]—[Protect.]

Sets the protection mode which protects programs and/or parameters from getting modified unintentionally from the teach pendant.

Note: This command is effective only for PAC programs and parameters configured on the extended screen of the teach pendant. It is not for base programs and parameters configured on the top screen.

(1) Press [Protect.] in the Option Menu, and the Protection Mode Setting window will appear as shown below.



(2) The Protection Mode Setting window provides the following three choices. Select the desired one and press the OK button. The selected one goes into effect.

Choices	Function
Parameters & Programs Protection	Protect parameters, variables and programs from getting edited with the teach pendant.
Parameters Protection	Protect parameters from getting edited with the teach pendant.
No Protection	Cancel the protection mode.

Enabling extension functions

Access: [ExtScrn]—[Set]—[Options.]—[Extnsion]—[Input ID]

Enables extension functions.

Once enabled, the setting will be retained even if the controller power is turned off and on.

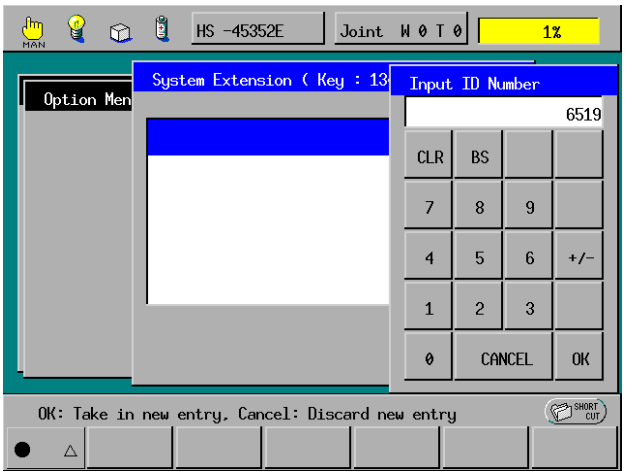
(1) Press [Extnsion] in the Option Menu, and the System Extension window appears.

(2) Press [Input ID], and the Input ID Number window appears.

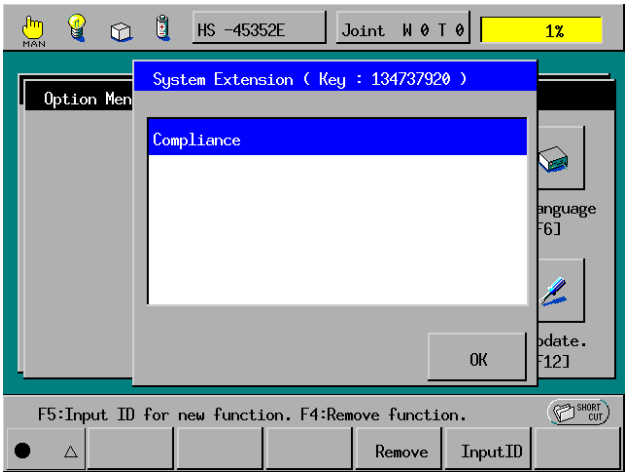
(3) Enter the ID number and press [OK].

ID Number List

Extension function	ID No.	Reference
Tip compliance control	6519	PROGRAMMER'S MANUAL (I) (T03), Section 3.5.3
Supervisory task	1111	Chapter 3, Section 3.3.8
Supervisory task extension	1112	Chapter 3, Section 3.3.9
Error code saving feature	3237	PROGRAMMER'S MANUAL(I) (T03), Section 8.13.2



(4) System message appears and press [OK]. The extended function appears.



NOTE: When removing the extended function, press [Remove] and then input the ID number.

Setting the robot type for the controller

Access: [ExtScrn]—[Set]—[Options.]—[ROBTYPE]

Sets the robot type for the controller.

This command is intended for DENSO WAVE service personnel only. Do not use this command.

Updating the controller system

Access: [ExtScrn]—[Set]—[Options.]—[Update.]

Updates the controller system version.

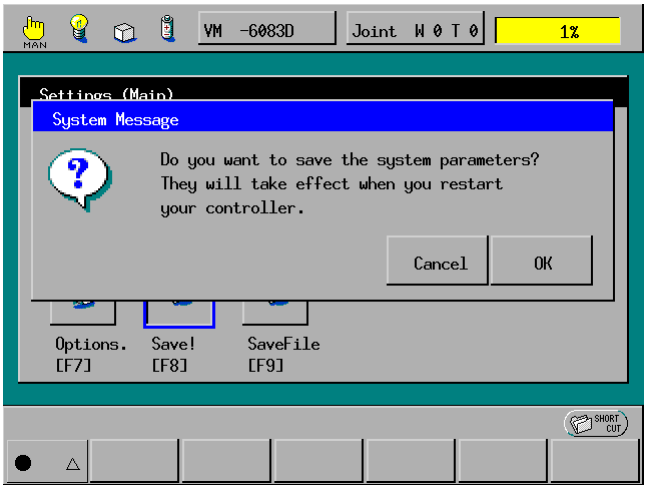
This command is intended for DENSO WAVE service personnel only. Do not use this command.

Saving System Parameters

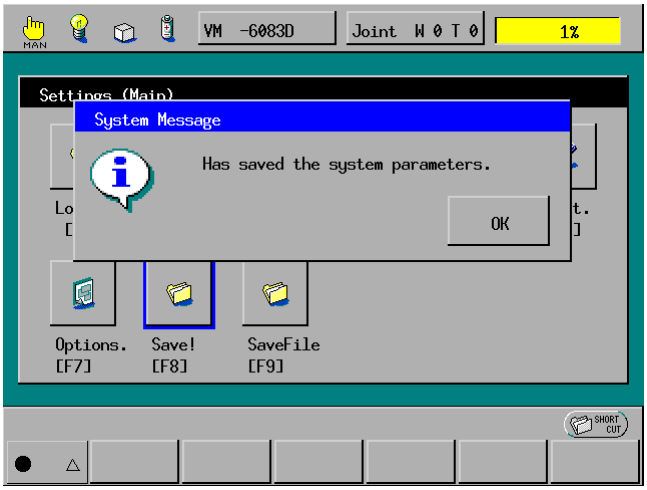
Access: [ExtScrn]—[Set]—[Save!]

Saves the system parameters stored in the robot controller so that turning the robot controller off will not lose those parameter values.

(1) Press [Save!] in the Settings (Main) window, and the following system message dialog box will appear.



(2) Press the OK button to save the system parameters and display the following system message dialog box.



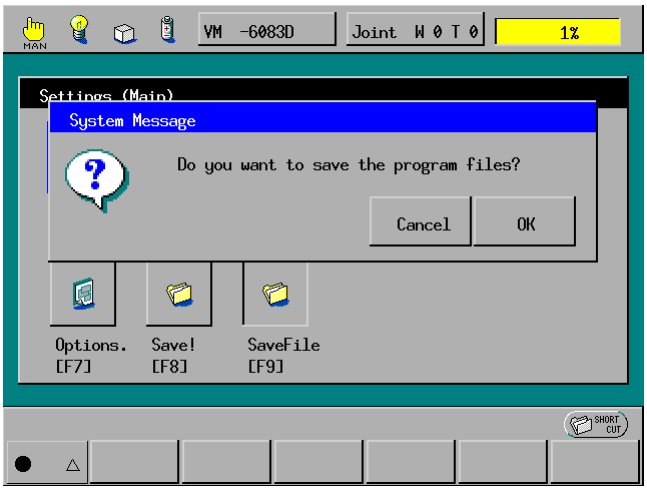
(3) Press the OK button to close the system message dialog box.

Saving Programs

Access: [ExtScrn]—[Set]—[SaveFile]

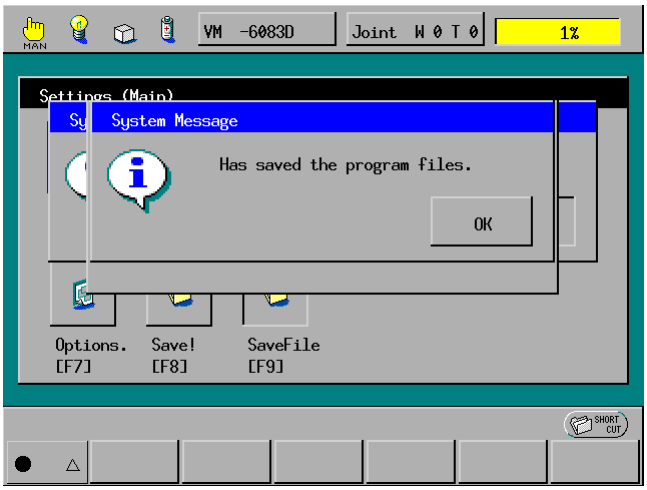
Saves the programs stored in the robot controller. The programs can be maintained even when the power to the robot controller is switched off.

(1) Press [SaveFile] in the Settings (Main) window. The following system message dialog box will appear.



(2) Press [OK] to save the program.

(3) Once the program is saved the following system message will appear



(4) Press [OK].

5.8 Customizing TP Operation Screens

Access: [ExtScrn]—[Panel]

Customizes the TP operation screens.

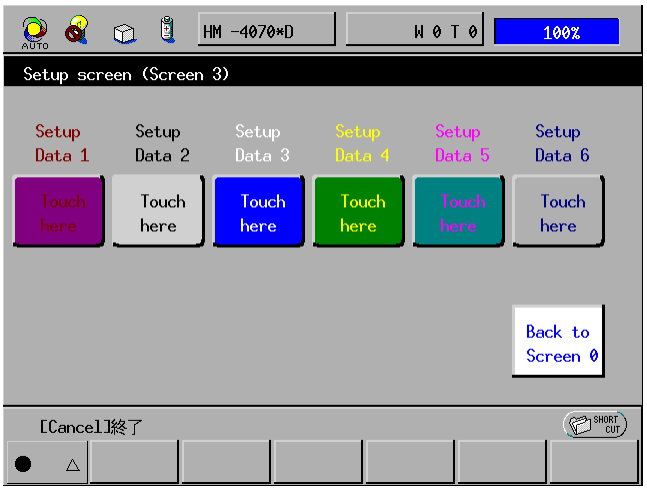
This command allows you to easily customize your own operation screens on the teach pendant for facilitating control of the robot by the robot controller.

In PAC language, you may program your own control buttons in size, position, and color and paste them onto the Teach Pendant screen.

Once the PAC program in which you have defined your own screens runs, those screens go into effect and remain in effect as long as you do not clear them, even if you restart the robot system or controller.

For details, refer to the PROGRAMMER'S MANUAL (I) (T03), Section 13.5 "Customizing TP Operations Screens" and PROGRAMMER'S MANUAL (II) (T03), PAC library".

(1) Displays TP Operation Screen by pressing [Panel] on the extended screen.



Sample Screen

Vertical Articulated V*-G-T Series
Horizontal Articulated H*-G-T Series

SETTING-UP MANUAL (T03)

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DENSO WAVE INCORPORATED

The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.