DENSO ROBOT

Vertical articulated

V*-D/-E SERIES

Horizontal articulated

H*-D/-E SERIES

Cartesian coordinate

XYC-4D SERIES

SETTING-UP MANUAL
(Ver. 1.98)

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.

Products covered by this manual

■ **Robot**

- Vertical articulated robot V⁎-D/-E series
- Horizontal articulated robot H⁎-D/-E series
- Cartesian coordinate robot XYC-4D series

■ **Robot controller**

Model RC5, Version 1.98⁎ or earlier (See NOTE.)

NOTE: The version of your robot controller is written in the MAIN SOFTWARE Ver. column of the SETPRM LIST attached to the top of your robot controller.

It may also be shown on the Version window of the teach pendant, which may be accessed by [F6 Set]—[F6 Maint.]—[F2 Version] from the top screen.

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS," on pages 1 through 9.

How the documentation set is organized

The documentation set consists of the following books. If you are unfamiliar with this robot and option(s), please read all books and understand them fully before operating your robot and option(s).

GENERAL INFORMATION ABOUT ROBOT

Provides the packing list of the robot and outlines of the robot system, robot unit, and robot controller.

INSTALLATION & MAINTENANCE GUIDE

Provides instructions for installing the robot components and customizing your robot, and maintenance & inspection procedures.

BEGINNER'S GUIDE

Introduces you to the DENSO robot. Taking an equipment setup example, this book guides you through running your robot with the teach pendant, making a program in WINCAPSII, and running your robot automatically.

SETTING-UP MANUAL - this book -

Describes how to set-up or teach your robot with the teach pendant, operating panel, or mini-pendant.

WINCAPSII GUIDE

Provides instructions on how to use the teaching system WINCAPSII which runs on the PC connected to the robot controller for developing and managing programs.

PROGRAMMER'S MANUAL (I), (II)

Describes the PAC programming language, program development, and command specifications in PAC.

RC5 CONTROLLER INTERFACE MANUAL

Describes the RC5 controller, interfacing with external devices, system- and user-input/output signals, and I/O circuits.

ERROR CODE TABLES

List error codes that will appear on the teach pendant, operating panel, or PC screen if an error occurs in the robot series or WINCAPSII. These tables provide detailed description and recovery ways.

OPTIONS MANUAL

Describes the specifications, installation, and use of optional devices.

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.

SAFETY PRECAUTIONS

Defines safety terms, safety related symbols and provides precautions that should be observed. Be sure to read this section before operating your robot.

Chapter 1 Teach Pendant and Operating Panel

This chapter describes how to connect the teach pendant and/or operating panel. It also provides descriptions of the names of keys, buttons, and switches on them.

Chapter 2 Preparations for Teaching

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

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 Machine Lock

This chapter describes the three operation modes of the robot: Manual mode, Teach check mode, and Auto mode. It also describes 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 of the Teach Pendant

This chapter describes a variety of commands assigned to the function keys 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.

Chapter 6 Commands Assigned to Function Keys of the Mini-Pendant

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

SAFETY PRECAUTIONS

Be sure to observe all of the following safety precautions.

Strict observance of these warning and caution indications are a MUST for preventing accidents, which could result in bodily injury and substantial property damage. Make sure you fully understand all definitions of these terms and related symbols given below, before you proceed to the text itself.

⚠ **WARNING**	Alerts you to those conditions, which could result in serious bodily injury or death if the instructions are not followed correctly.
⚠ **CAUTION**	Alerts you to those conditions, which could result in minor bodily injury or substantial property damage if the instructions are not followed correctly.

Terminology and Definitions

Maximum space: Refers to the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, workpiece and attachments. (Quoted from the RIA* Committee Draft.)

Restricted space: Refers to the portion of the maximum space to which a robot is restricted by limiting devices (i.e., mechanical stops). The maximum distance that the robot, end-effector, and workpiece can travel after the limiting device is actuated defines the boundaries of the restricted space of the robot. (Quoted from the RIA Committee Draft.)

Motion space: Refers to the portion of the restricted space to which a robot is restricted by software motion limits. The maximum distance that the robot, end-effector, and workpiece can travel after the software motion limits are set defines the boundaries of the motion space of the robot. (The "motion space" is DENSO WAVE-proprietary terminology.)

Operating space: Refers to the portion of the restricted space (or motion space in Denso robot) that is actually used by the robot while performing its task program. (Quoted from the RIA Committee Draft.)

Task program: Refers to a set of instructions for motion and auxiliary functions that define the specific intended task of the robot system. (Quoted from the RIA Committee Draft.)

(*RIA: Robotic Industries Association)

1. Introduction

This section provides safety precautions to be observed during installation, teaching, inspection, adjustment, and maintenance of the robot.

2. Installation Precautions

2.1 Insuring the proper installation environment

2.1.1 For standard type

The standard type has not been designed to withstand explosions, dust-proof, nor is it splash-proof. Therefore, it should not be installed in any environment where:

(1) there are flammable gases or liquids,

(2) there are any shavings from metal processing or other conductive material flying about,

(3) there are any acidic, alkaline or other corrosive gases,

(4) there is cutting or grinding oil mist,

(5) it may likely be submerged in fluid,

(6) there is sulfuric cutting or grinding oil mist, or

(7) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise.

2.1.2 For dust-proof, splash-proof type

The dust-proof, splash-proof type is an IP54-equivalent structure, but it has not been designed to withstand explosions. (The HM/HS-E-W and the wrist of the VM-D-W/VS-E-W are an IP65-equivalent dust-proof and splash-proof structure.)

Note that the robot controller is not a dust- or splash-proof structure. Therefore, when using the robot controller in an environment exposed to mist, put it in an optional protective box.

The dust-proof, splash-proof type should not be installed in any environment where:

(1) there are any flammable gases or liquids,

(2) there are any acidic, alkaline or other corrosive gases,

(3) there are any large-sized inverters, high output/high frequency transmitters, large contactors, welders, or other sources of electrical noise,

(4) it may likely be submerged in fluid,

(5) there are any grinding or machining chips or shavings,

(6) any machining oil not specified in this manual is in use, or

Note: Yushiron Oil No. 4C (non-soluble) is specified.

(7) there is sulfuric cutting or grinding oil mist.

2.2 Service space

The robot and peripheral equipment should be installed so that sufficient service space is maintained for safe teaching, maintenance, and inspection.

2.3 Control devices outside the robot's restricted space

The robot controller, teach pendant, and operating panel should be installed outside the robot's restricted space and in a place where you can observe all of the robot’s movements when operating the robot controller, teach pendant, or operating panel.

2.4 Positioning of gauges

Pressure gauges, oil pressure gauges and other gauges should be installed in an easy-to-check location.

2.5 Protection of electrical wiring and hydraulic/pneumatic piping

If there is any possibility of the electrical wiring or hydraulic/pneumatic piping being damaged, protect them with a cover or similar item.

2.6 Positioning of emergency stop switches

Emergency stop switches should be provided in a position where they can be reached easily should it be necessary to stop the robot immediately.

(1) The emergency stop switches should be red.

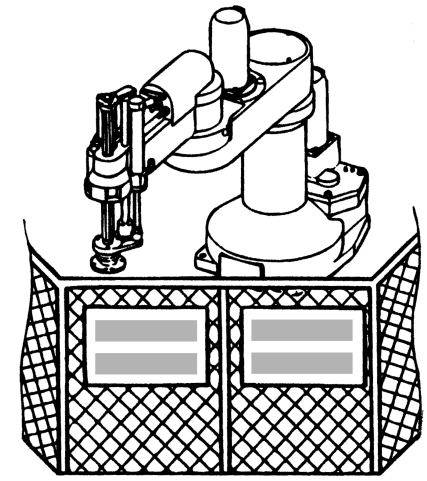
(2) Emergency stop switches should be designed so that they will not be released after pressed, automatically or mistakenly by any other person.

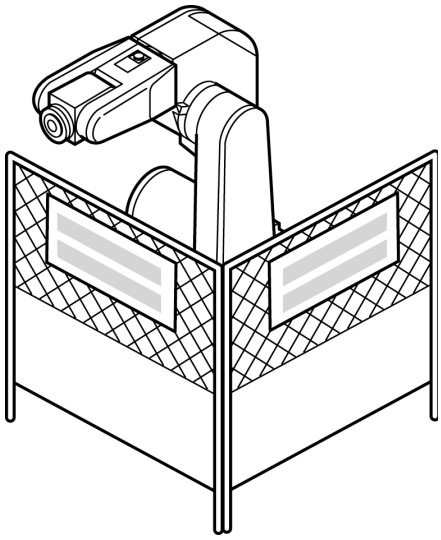
(3) Emergency stop switches should be separate from the power switch.

2.7 Positioning of operating status indicators

Operating status indicators should be positioned in such a way where workers can easily see whether the robot is on temporary halt or on an emergency or abnormal stop.

2.8 Setting-up the safety fence or enclosure





A safety fence or enclosure should be set up so that no one can easily enter the robot's restricted space. If it is impossible, utilize other protectors as described in Section 2.9.

(1) The fence or enclosure should be constructed so that it cannot be easily moved or removed.

(2) The fence or enclosure should be constructed so that it cannot be easily damaged or deformed through external force.

(3) Establish the exit/entrance to the fence or enclosure. Construct the fence or enclosure so that no one can easily get past it by climbing over the fence or enclosure.

(4) The fence or enclosure should be constructed to ensure that it is not possible for hands or any other parts of the body to get through it.

(5) Take any one of the following protections for the entrance/ exit of the fence or enclosure:

1) Place a door, rope or chain across the entrance/exit of the fence or enclosure, and fit it with an interlock that ensures the emergency stop device operates automatically if it is opened or removed.

2) Post a warning notice at the entrance/exit of the fence or enclosure stating "In operation--Entry forbidden" or "Work in progress--Do not operate" and ensure that workers follow these instructions at all times.

When making a test run, before setting up the fence or enclosure, place an overseer in a position outside the robot’s restricted space and one in which he/she can see all of the robot’s movements. The overseer should prevent workers from entering the robot's restricted space and be devoted solely to that task.

2.9 Positioning of rope or chain

If it is not possible to set up the safety fence or enclosure described in Section 2.8, hang a rope or chain around the perimeter of the robot’s restricted space to ensure that no one can enter the restricted space.

(1) Ensure the support posts cannot be moved easily.

(2) Ensure that the rope or chain’s color or material can easily be discerned from the surrounds.

(3) Post a warning notice in a position where it is easy to see stating "In operation--Entry forbidden" or "Work in progress --Do not operate" and ensure that workers follow these instructions at all times.

(4) Set the exit/entrance, and follow the instructions given in Section 2.8, (3) through (5).

2.10 Setting the robot's motion space

The area required for the robot to work is called the robot's operating space.

If the robot's motion space is greater than the operating space, it is recommended that you set a smaller motion space to prevent the robot from interfering or disrupting other equipment.

Refer to the "INSTALLATION & MAINTENANCE GUIDE."

2.11 No robot modification allowed

Never modify the robot unit, robot controller, teach pendant or other devices.

2.12 Cleaning of tools

If your robot uses welding guns, paint spray nozzles, or other end-effectors requiring cleaning, it is recommended that the cleaning process be carried out automatically.

2.13 Lighting

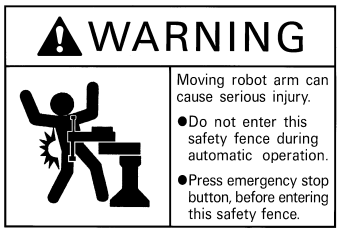
Sufficient illumination should be assured for safe robot operation.

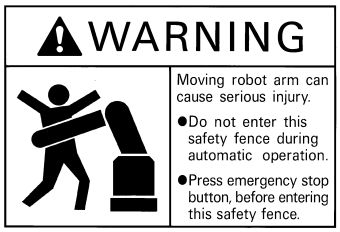
2.14 Protection from objects thrown by the end-effector

If there is any risk of workers being injured in the event that the object being held by the end-effector is dropped or thrown by the end-effector, consider the size, weight, temperature and chemical nature of the object and take appropriate safeguards to ensure safety.

2.15 Affixing the warning label

Place the warning label packaged with the robot on the exit/entrance of the safety fence or in a position where it is easy to see.

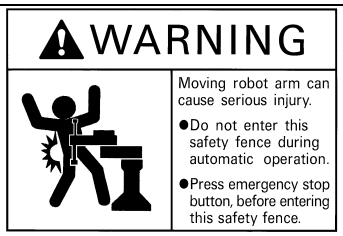


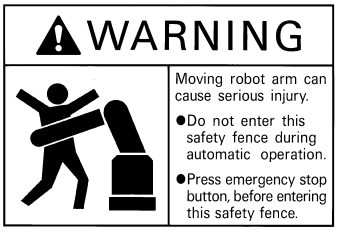


3. Precautions while robot is running

⚠ Warning

Touching the robot while it is in operation can lead to serious injury. Please ensure the following conditions are maintained and that the cautions listed from Section 3.1 onwards are followed when any work is being performed.





1) Do not enter the robot's restricted space when the robot is in operation or when the motor power is on.
2) As a precaution against malfunction, ensure that an emergency stop device is activated to cut the power to the robot motor upon entry into the robot's restricted space.
3) When it is necessary to enter the robot's restricted space to perform teaching or maintenance work while the robot is running, ensure that the steps described in Section 3.3 "Ensuring safety of workers performing jobs within the robot's restricted space" are taken.

3.1 Creation of working regulations and assuring worker adherence

When entering the robot’s restricted space to perform teaching or maintenance inspections, set "working regulations" for the following items and ensure workers adhere to them.

(1) Operating procedures required to run the robot.

(2) Robot speed when performing teaching.

(3) Signaling methods to be used when more than one worker is to perform work.

(4) Steps that must be taken by the worker in the event of a malfunction, according to the contents of the malfunction.

(5) The necessary steps for checking release and safety of the malfunction status, in order to restart the robot after robot movement has been stopped due to activation of the emergency stop device

(6) Apart from the above, any steps below necessary to prevent danger from unexpected robot movement or malfunction of the robot.

1) Display of the control panel (See Section 3.2 on the following page)
2) Assuring the safety of workers performing jobs within the robot's restricted space (See Section 3.3 on the following page)

3) Maintaining worker position and stance

   Position and stance that enables the worker to confirm normal robot operation and to take immediate refuge if a malfunction occurs.

4) Implementation of measures for noise prevention

5) Signaling methods for workers of related equipment

6) Types of malfunctions and how to distinguish them

Please ensure "working regulations" are appropriate to the robot type, the place of installation and to the content of the work.

Be sure to consult the opinions of related workers, engineers at the equipment manufacturer and that of a labor safety consultant when creating these "working regulations".

3.2 Display of operation panel

To prevent anyone other than the worker from accessing the start switch or the changeover switch by accident during operation, display something to indicate it is in operation on the operating panel or teach pendant. Take any other steps as appropriate, such as locking the cover.

3.3 Ensuring safety of workers performing jobs within the robot's restricted space

When performing jobs within the robot’s restricted space, take any of the following steps to ensure that robot operation can be stopped immediately upon a malfunction.

(1) Ensure an overseer is placed in a position outside the robot’s restricted space and one in which he/she can see all robot movements, and that he/she is devoted solely to that task.

   ① An emergency stop device should be activated immediately upon a malfunction.

   ② Do not permit anyone other than the worker engaged for that job to enter the robot’s restricted space.

(2) Ensure a worker within the robot's restricted space carries the portable emergency stop switch so he/she can press it (the robot stop button on the teach pendant) immediately if it should be necessary to do so.

3.4 Inspections before commencing work such as teaching

Before starting work such as teaching, inspect the following items, carry out any repairs immediately upon detection of a malfunction and perform any other necessary measures.

(1) Check for any damage to the sheath or cover of the external wiring or to the external devices.

(2) Check that the robot is functioning normally or not (any unusual noise or vibration during operation).

(3) Check the functioning of the emergency stop device.

(4) Check there is no leakage of air or oil from any pipes.

(5) Check there are no obstructive objects in or near the robot’s restricted space.

3.5 Release of residual air pressure

Before disassembling or replacing pneumatic parts, first release any residual air pressure in the drive cylinder.

3.6 Precautions for test runs

Whenever possible, have the worker stay outside of the robot's restricted space when performing test runs.

3.7 Precautions for automatic operation

(1) At start-up

Before the robot is to be started up, first check the following items as well as setting the signals to be used and perform signaling practice with all related workers.

1) Check that there is no one inside the robot’s restricted space.

2) Check that the teach pendant and tools are in their designated places.

3) Check that no lamps indicating a malfunction on the robot or related equipment are lit.

(2) Check that the display lamp indicating automatic operation is lit during automatic operation.

(3) Steps to be taken when a malfunction occurs

Should a malfunction occur with the robot or related equipment and it is necessary to enter the robot's restricted space to perform emergency maintenance, stop the robot’s operation by activating the emergency stop device. Take any necessary steps such as placing a display on the starter switch to indicate work is in progress to prevent anyone from accessing the robot.

3.8 Precautions in repairs

(1) Do not perform repairs outside of the designated range.

(2) Under no circumstances should the interlock mechanism be removed.

(3) When opening the robot controller's cover for battery replacement or any other reasons, always turn the robot controller power off and disconnect the power cable.

(4) Use only spare tools specified in this manual.

4. Daily and periodical inspections

(1) Be sure to perform daily and periodical inspections. Before starting jobs, always check that there is no problem with the robot and related equipment. If any problems are found, take any necessary measures to correct them.

(2) When carrying out periodical inspections or any repairs, maintain records and keep them for at least 3 years.

5. Management of floppy disks

(1) Carefully handle and store the "Initial settings" floppy disks packaged with the robot, which store special data exclusively prepared for your robot.

(2) After finishing teaching or making any changes, always save the programs and data onto floppy disks.

Making back-ups will help you recover if data stored in the robot controller is lost due to the expired life of the back-up battery.

(3) Write the names of each of the floppy disks used for storing task programs to prevent incorrect disks from loading into the robot controller.

(4) Store the floppy disks where they will not be exposed to dust, humidity and magnetic field, which could corrupt the disks or data stored on them.

contents

Chapter 1

Operating Devices (TP/OP/MP)

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

NOTE 1: The operating panel should be secured to a safe place.

NOTE 2: Avoid letting the teach pendant, operating panel, or mini-pendant undergo strong shocks, impacts, or vibrations.

NOTE 3: Touch the teach pendant, operating panel, or mini-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, Operating Panel, and Mini-Pendant

You may teach or operate the robot from the teach pendant (TP), operating panel (OP), or mini-pendant (MP). When the robot leaves the factory, none of them is connected to the robot controller (pendantless state) as shown in Subsection 1.1.4.

After unpacking the robot package, connect the teach pendant, operating panel, or mini-pendant to the robot controller where necessary. The teach pendant and operating panel can be connected to the robot controller together. The mini-pendant cannot be together with the teach pendant or operating panel; it can be single connected.

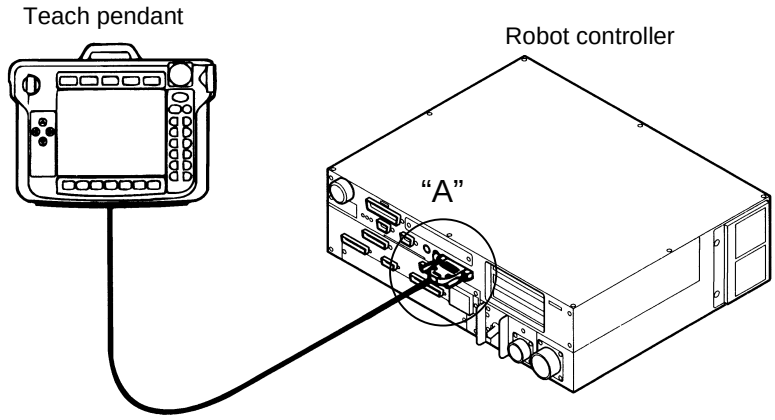
Cautions at connecting the TP/OP/MP cable to the controller:

(1) When and after connecting the cable to the controller, pay attention not to stress on to the connector ("A" in the figure below). The stress on to the connector may occur communication error.
(2) When removing the cable from the controller, unlock the connecter and disconnect it.

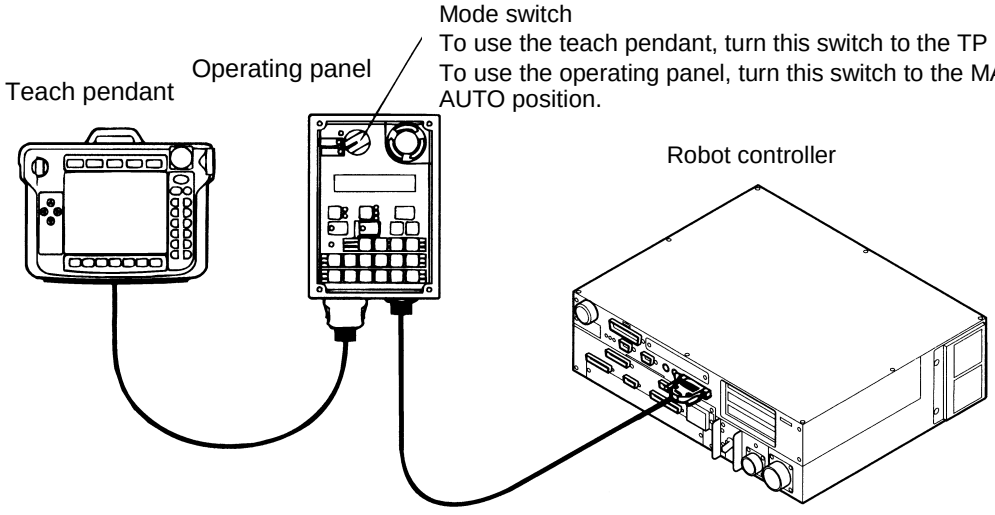
1.1.1 Connecting the Teach Pendant

Connect the teach pendant to connector CN5 of the robot controller as shown below.

Connection type 1: Teach pendant only



Connection type 2: Operating panel connected with the teach pendant

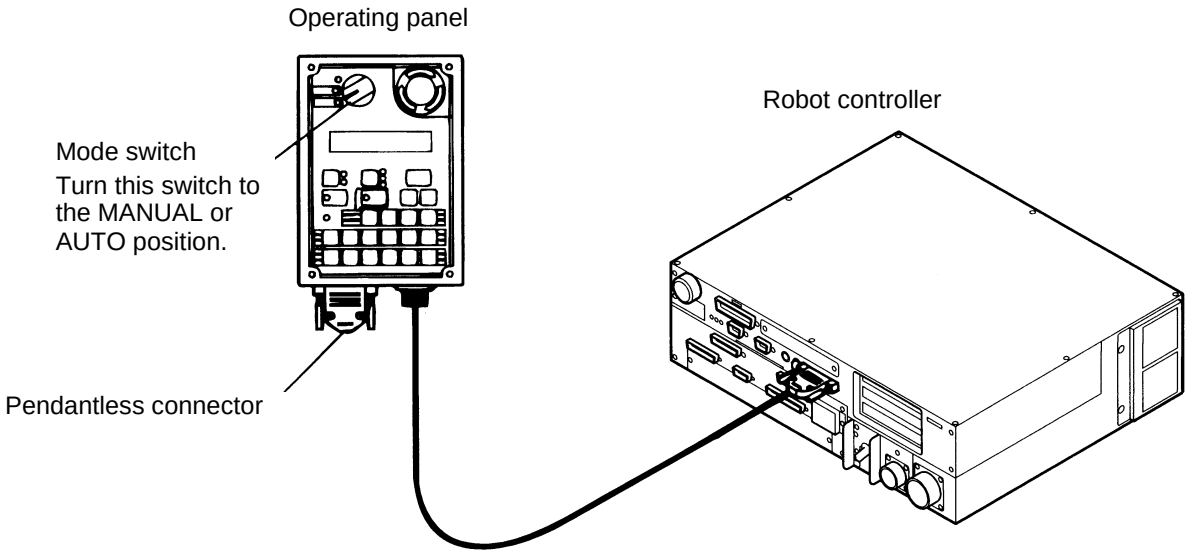


Connecting the Teach Pendant

1.1.2 Connecting the Operating Panel

Connect the operating panel to connector CN5 of the robot controller as shown below.

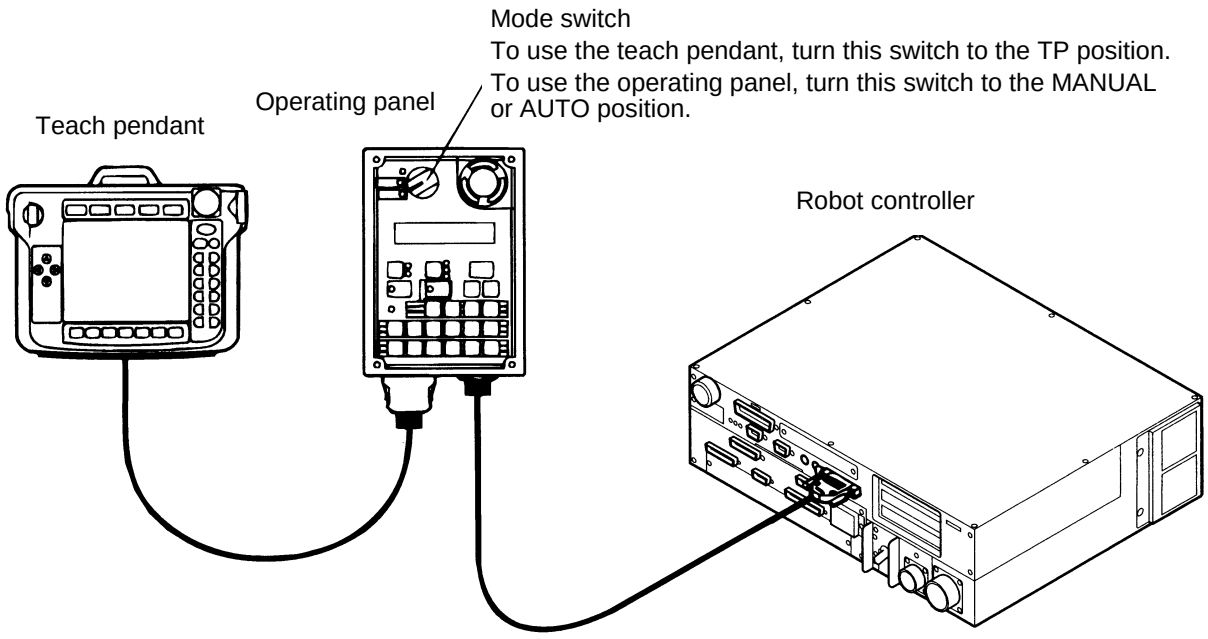
Connection type 1: Operating panel only



NOTE: Be sure to secure the operating panel to a safe place such as equipment.

NOTE: When using the operating panel without the teach pendant connected, always insert the pendantless connector into the TP socket on the operating panel.

Connection type 2: Operating panel connected with the teach pendant



Note : The total cable length must not be more than 12 m when the operating panel and the teach pendant are to be connected in series.

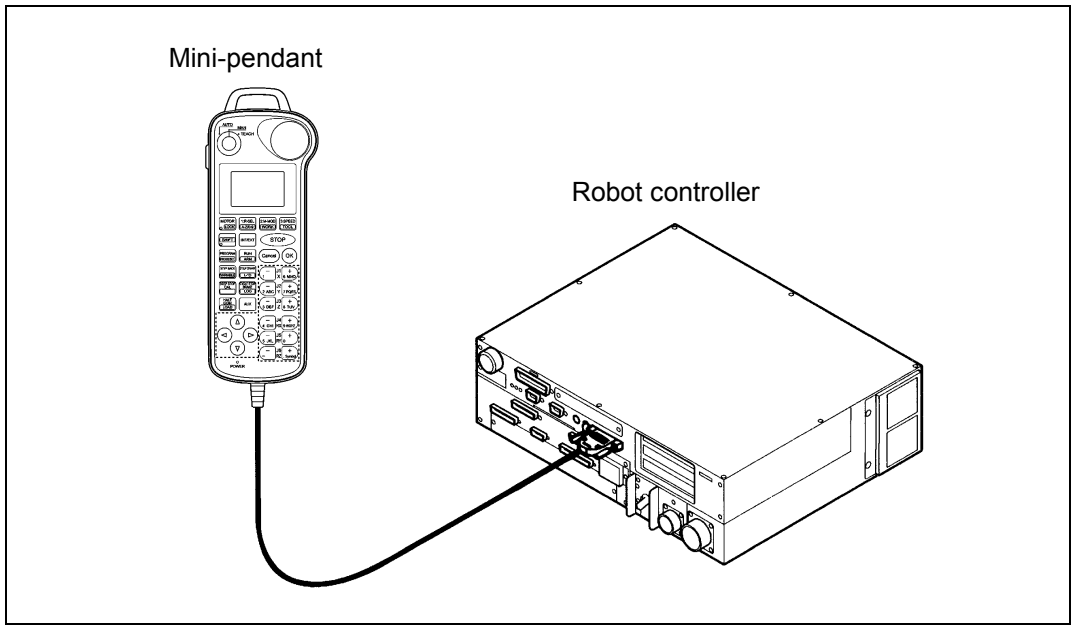
Connecting the Operating Panel

1.1.3 Connecting the Mini-Pendant

Connect the mini-pendant to connector CN5 of the robot controller as shown below.

NOTE: The mini-pendant cannot be connected together with the teach pendant or operating panel.

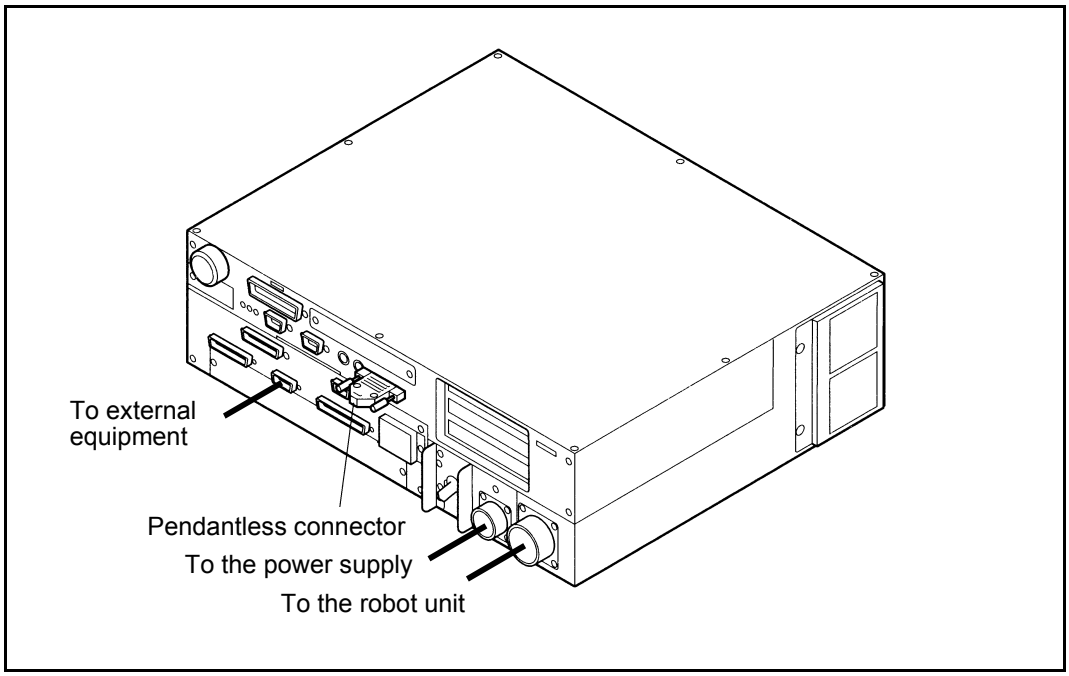
NOTE: Turn the controller power off before connecting or disconnecting the mini-pendant.



Connecting the Mini-Pendant

1.1.4 Pendantless State

If you disconnect the teach pendant or operating panel from the robot controller after teaching, connect the pendantless connector instead. In this pendantless state, you may run the robot automatically by controlling I/O signals from external equipment.



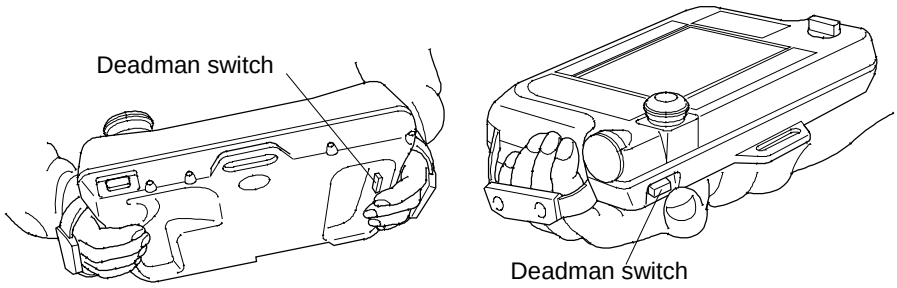
Pendantless State

1.2 Handling the Teach Pendant

1.2.1 Holding the Teach Pendant and the Deadman Switch

When operating the teach pendant, grasp it as shown below.

The teach pendant has two deadman switches, so it is possible to hold the teach pendant in the 2 ways.



Holding the Teach Pendant

★**Tip**★ The deadman switch is 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 the deadman switch 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

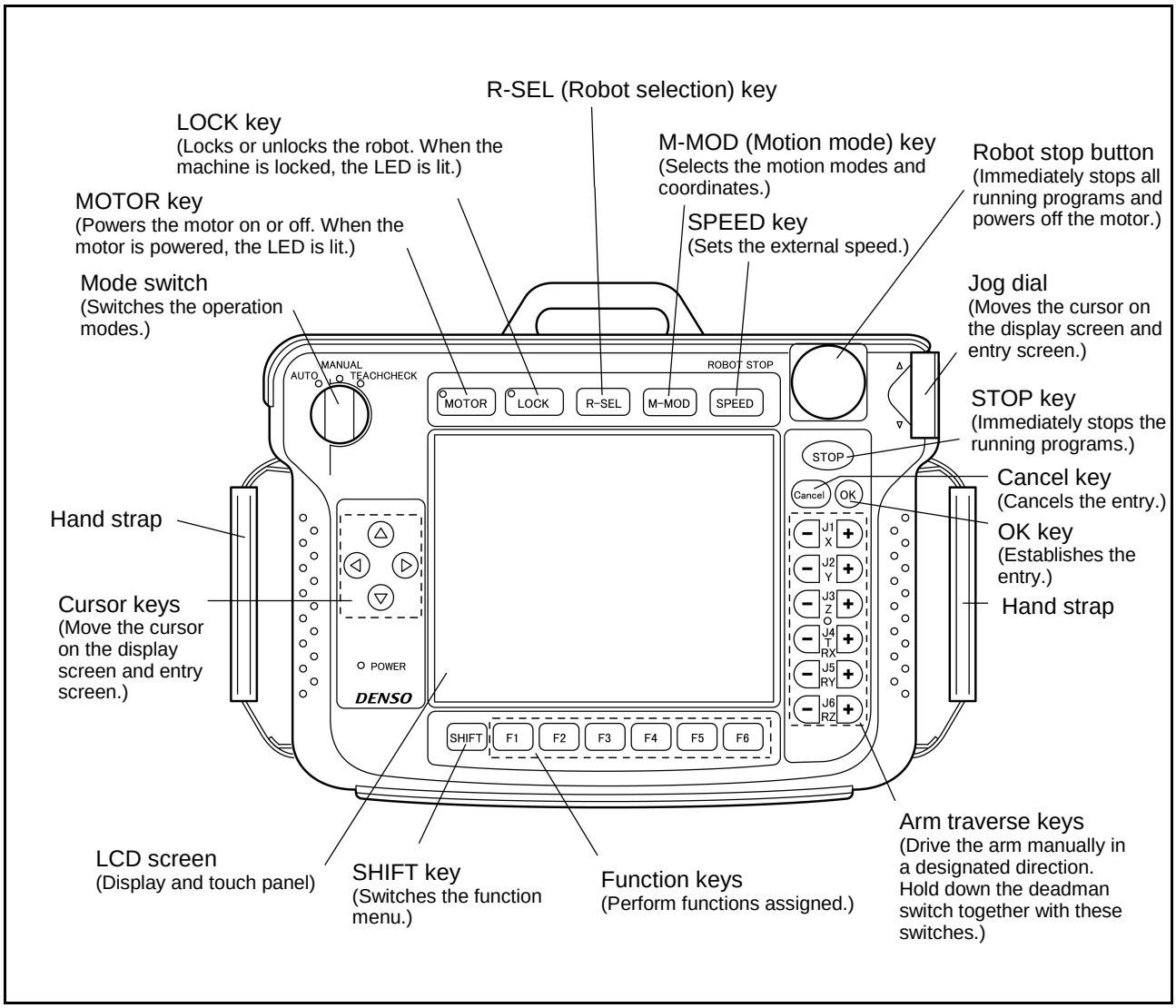
If the switch is OFF or goes OFF, the robot cannot run or the running robot will stop, respectively.

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

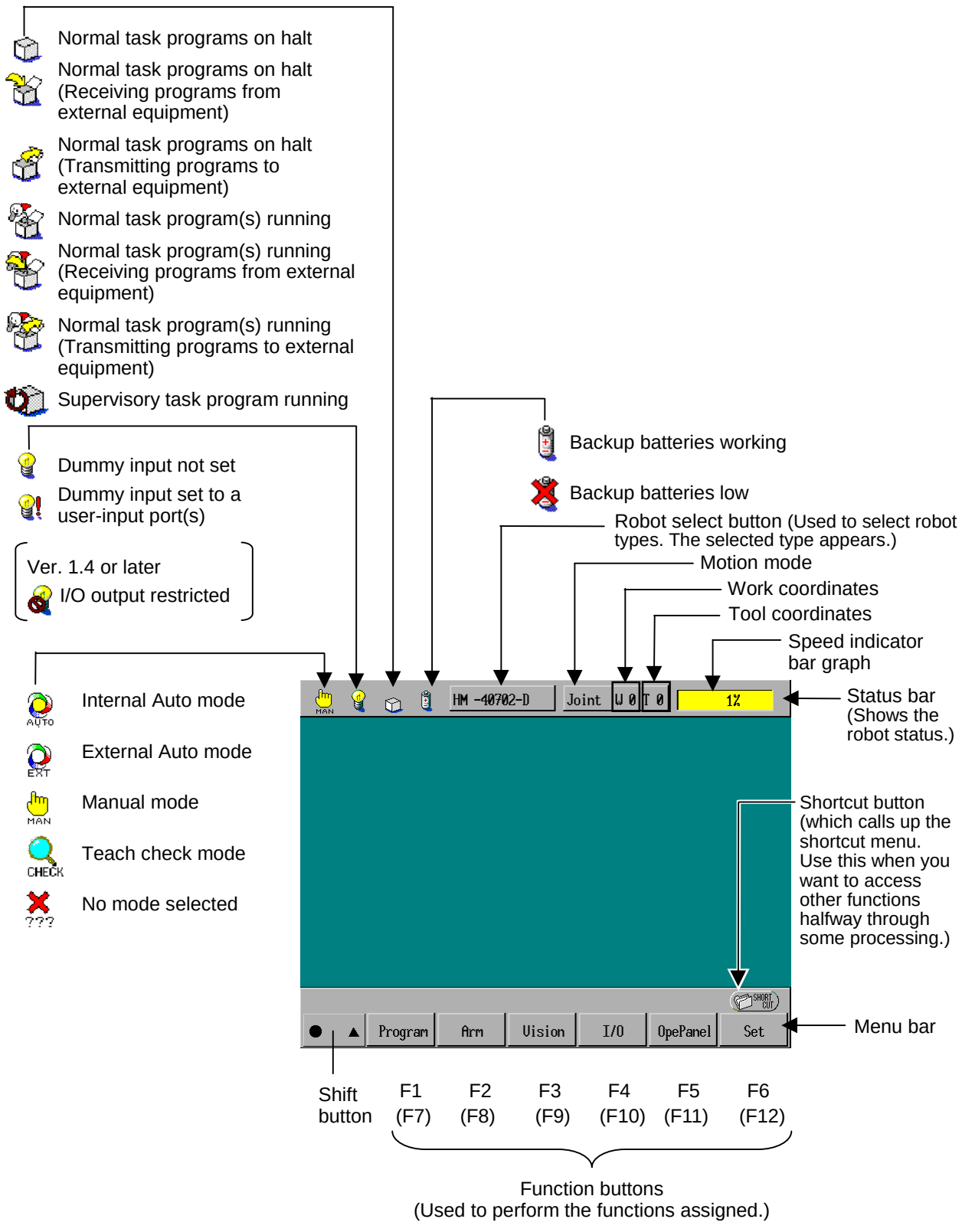
1.2.2 Names of Keys, Buttons, and Switches on the Teach Pendant

The figure below shows the names of keys, buttons, switches, and other sections of the teach pendant. On the LCD screen are function buttons, shortcut button, and icons which are shown on the next page.

Before running the robot, learn the location of those keys, buttons, and switches, which will help you run the robot smoothly and safely. Some functions are newly added, so read this manual carefully even if you are familiar with the conventional DENSO robot.



Names of Keys, Buttons, and Switches on the Teach Pendant



Names of Keys, Buttons, and Switches on the Teach Pendant Screen

1.2.3 Basic Operation of the Teach Pendant

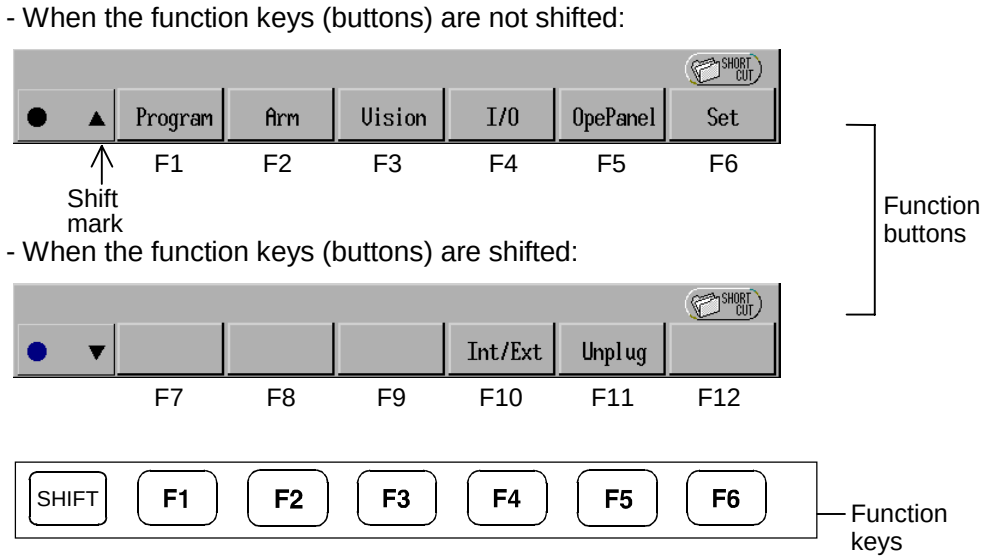
Top screen

Turning on the power to the teach pendant will display the top screen as shown on the previous page. In 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. In the bottom of the screen is a menu bar that shows the functions assigned to the function keys. The middle of the screen displays a variety of windows.

Function keys and function buttons

The teach pendant has six function keys whose functions (F1 to F6 assigned) are usually displayed on the six buttons in the menu bar of the screen. Pressing the SHIFT key (or Shift button) switches the menu bar between "F1 to F6" and "F7 to F12." When those function keys are shifted, their functions (F7 to F12 assigned) are displayed on the six buttons.

Pressing the function keys is functionally equivalent to pressing their corresponding buttons in the menu bar.



Function Keys and SHIFT Key

SHIFT key 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 key 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 key will result in no change in the menu display.

Cursor keys and jog dial

There are four cursor keys that are used to select the target data or increase/decrease values. Pressing up-, down-, left-, or right-arrow cursor key moves the cursor 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.

The jog dial has the same functions as the cursor keys.

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.

OK key and Cancel key

The OK key or Cancel key is usually used to allow input of a new entry or to discard it, respectively.

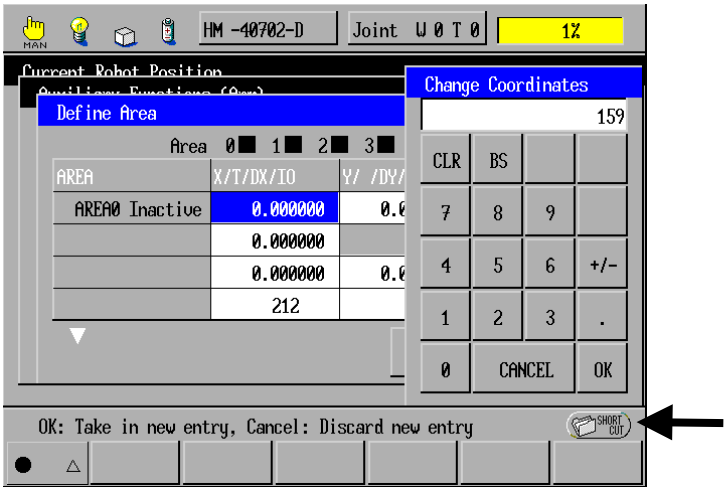
Those keys are also used to close the current window and return to the previous one. Pressing the OK key will save the new entry and exit from the current window; pressing the Cancel key will exit from the current window without saving new entry.

SHORTCUT button

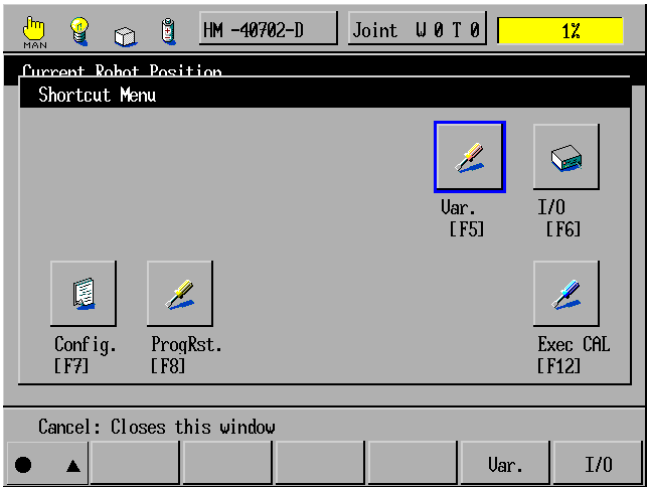
The use of a shortcut allows you halfway through the current processing to carry out other processing. From any of the processing screens, you may call up the Shortcut Menu by pressing the SHORTCUT button.

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

Step 1 Press the SHORTCUT button.



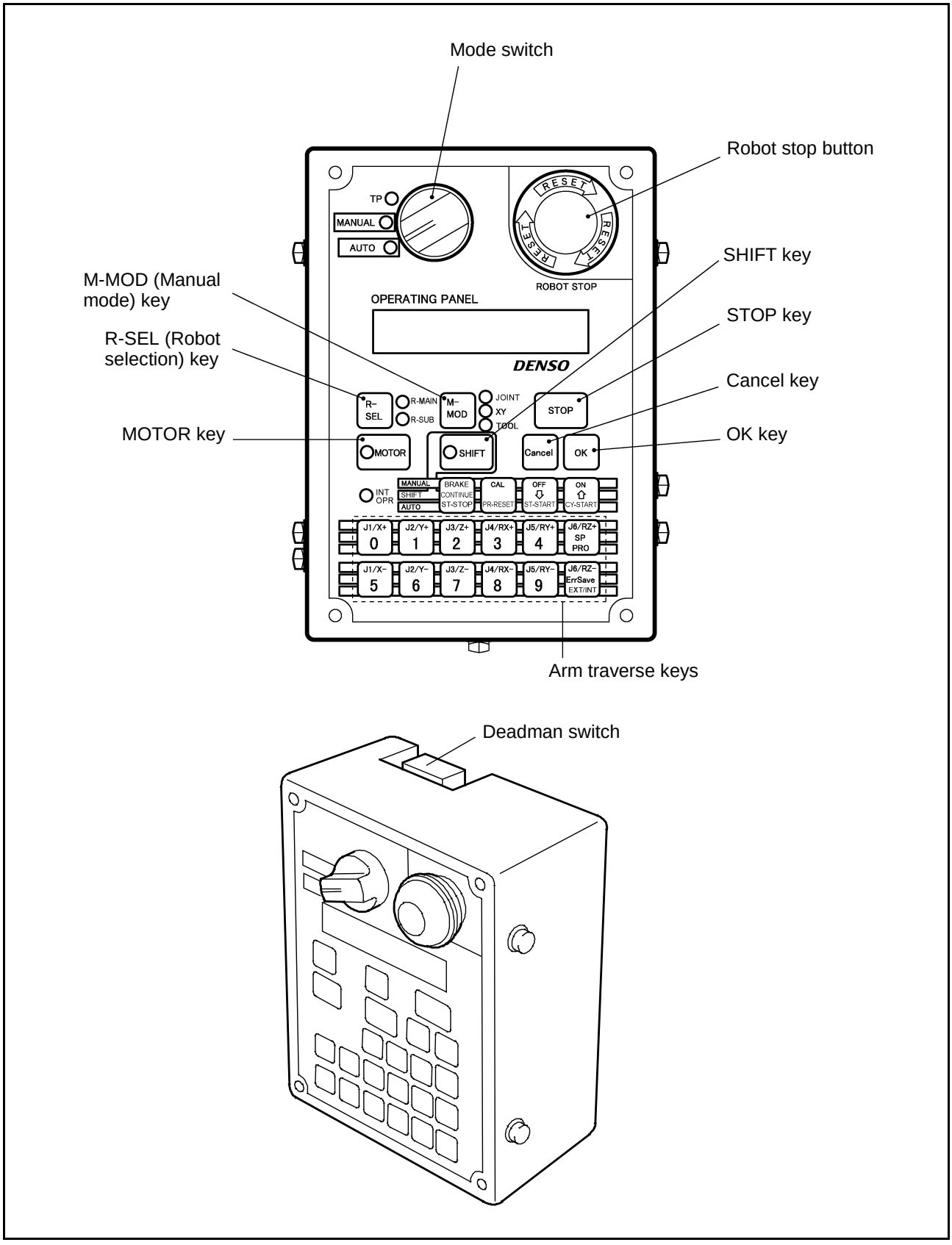
Step 2 Press the desired function button on the Shortcut Menu. (Or press the corresponding function button on the menu bar or press the function key on the teach pendant.)



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

1.3 Handling the Operating Panel

The figure below shows the names of keys and switches of the operating panel.



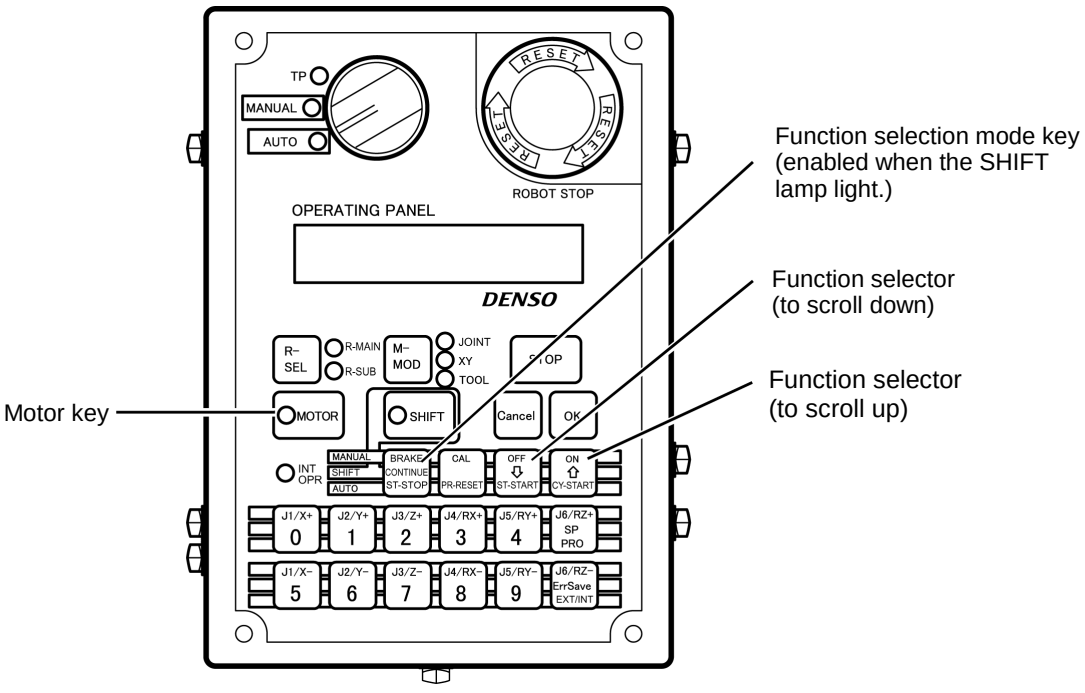
Names of Keys and Switches on the Operating Panel

[1] Functions

With the operating panel, you may run the robot manually, start programs, edit variables, get robot arm positions into variables in teaching, and move the robot arm by specifying a desired variable. Choosing work coordinates or tool coordinates is also possible.

Operating Panel Functions

Version	Function:	Description
Ver.1.2 or later	Editing variables	You may edit variables by entering numerical values.
Ver.1.4 or later	- Teaching the current position - Choosing work coordinates or tool coordinates	- You may get the current position into P variables, J variable, and T variables. It is used for position teaching. - You may choose work coordinates or tool coordinates.
Ver.1.6 or later	Operating the robot arm by specifying a desired variable	You may move the robot arm according to the specified variable. It is used to confirm variables you have preset in teaching.



[2] Operating procedure

According to the procedure below, you may choose the desired function in Manual mode.

Step 1 Turn the mode selector switch to the MANUAL position.

Step 2 Press the SHIFT key.

The SHIFT lamp should come on.

Step 3 Press the function selection mode key to enter the selection mode.

BRAKE
CONTINUE
ST-STOP

The following display appears.

F1:Chg VarVal I

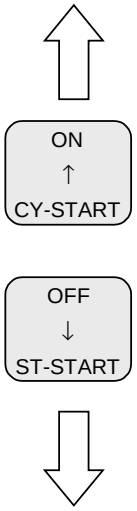
Step 4 Press the following function selectors to scroll the display up or down.

OFF ↓ ST-START

ON ↑ CY-START

F2: Chg VarVal F

Step 5



You may select any of the following functions:

[Chg VarVal I]	Edit integer variables by entering numerical values
[Chg VarVal F]	Edit floating-point variables by entering numerical values
[Chg VarVal D]	Edit double-precision variables by entering numerical values
[Chg VarVal V]	Edit vector variables by entering numerical values
[Chg VarVal P]	Edit position variables by entering numerical values
[Chg VarVal J]	Edit joint variables by entering numerical values
[Chg VarVal T]	Edit variables in homogeneous transform matrix by entering numerical values
[Set VarVal P]	Get the current position into a position variable
[Set VarVal J]	Get the current position into a joint variable
[Set VarVal T]	Get the current position into a variable in homogeneous transform matrix
[Move to Pvar]	Operate the robot by selecting a position variable
[Move to Jvar]	Operate the robot by selecting a joint variable
[Move to Tvar]	Operate the robot by selecting a variable in homogeneous transform matrix

When the desired function is displayed, press the OK key.

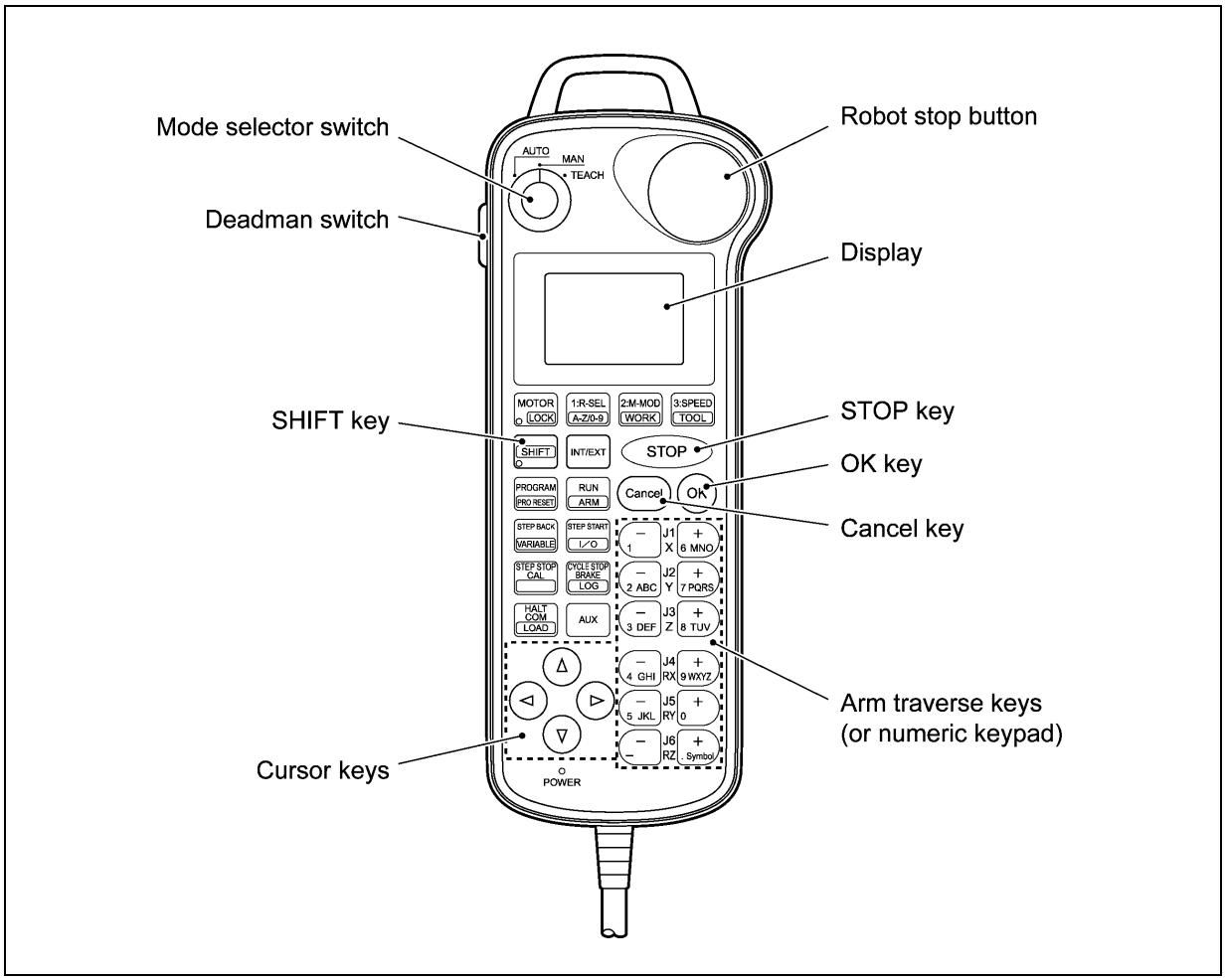
To exit from the function selection mode, press the Cancel key.

If any error occurs during the function selection procedure, the operating panel will automatically exit from the function selection mode.

1.4 Handling the Mini-Pendant

The figure below shows the names of keys and switches of the mini-pendant. When the power is applied, the mini-pendant displays the top screen on the LCD (see the next page). In the uppermost row of the top screen is a status bar which always displays the current operation mode, program status, connected robot model, motion mode, speed, and other information.

For the operating procedure, refer to Chapter 6.

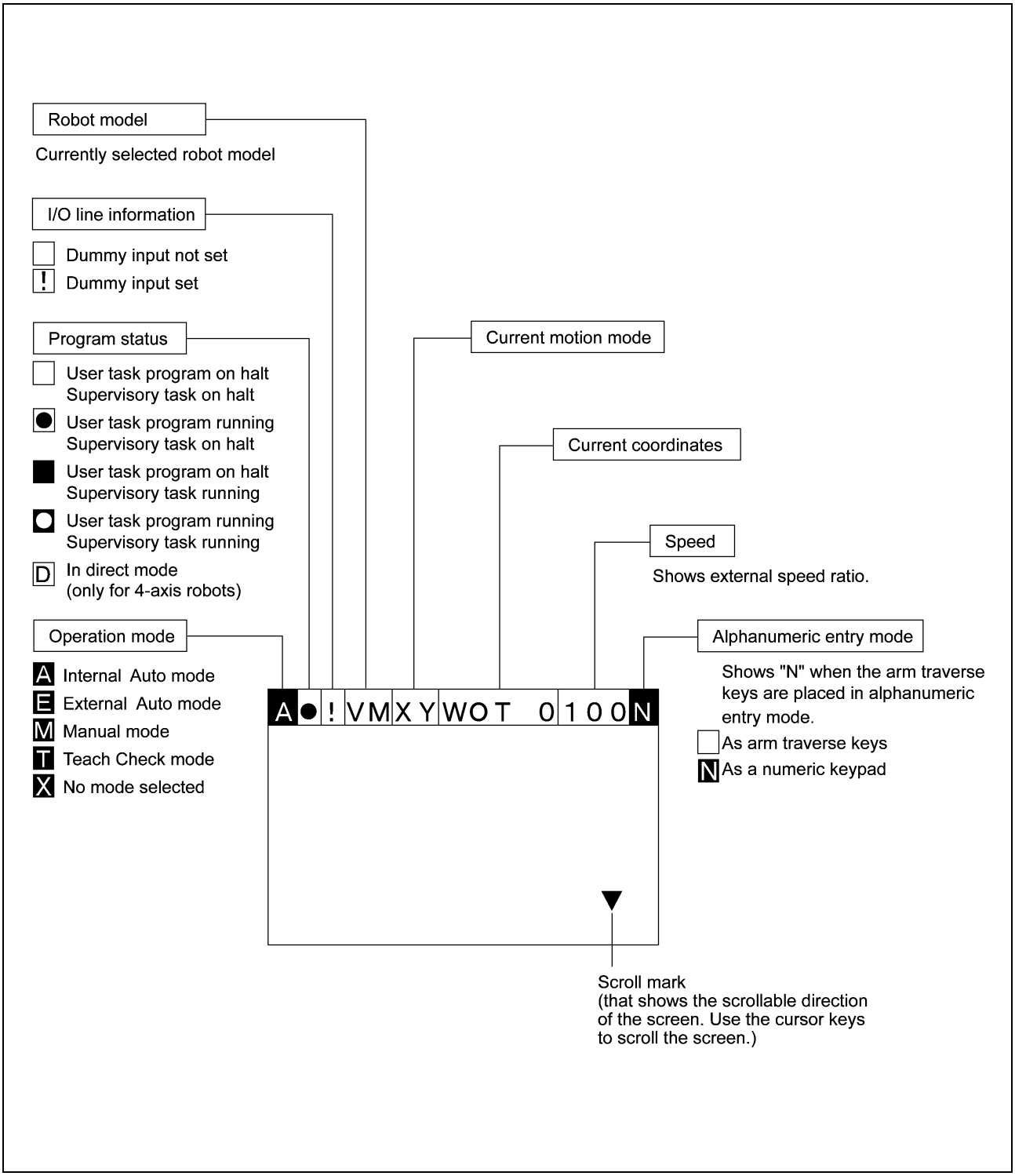


Names of Keys and Switches on the Mini-Pendant

NOTE: On almost all key tops are two (or three) function names printed. The upper and center functions are enabled when the keypad is not shifted; that is, the SHIFT lamp is off. The lower ones boxed are enabled when it is shifted; that is, the lamp is on.

The center functions on key tops take effect in Manual mode.

NOTE: The mini-pendant cannot be connected to the controller together with the teach pendant or operating panel. It can be single connected.



Top Screen of the Mini-Pendant

Chapter 2

Preparations for Teaching

This chapter describes preparations necessary to make before starting teaching or running the robot from the teach pendant, operating panel, or mini-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), (OP), (MP), and (WC) which inform you that operations marked with those abbreviations can be performed from the teach pendant, operating panel, mini-pendant, and in WINCAPSII, respectively.

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

NOTE 3: Touch the teach pendant, operating panel, or mini-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/OP/MP)

Turning the robot controller on enables you to operate the robot from the teach pendant, operating panel, or mini-pendant or run the robot automatically.

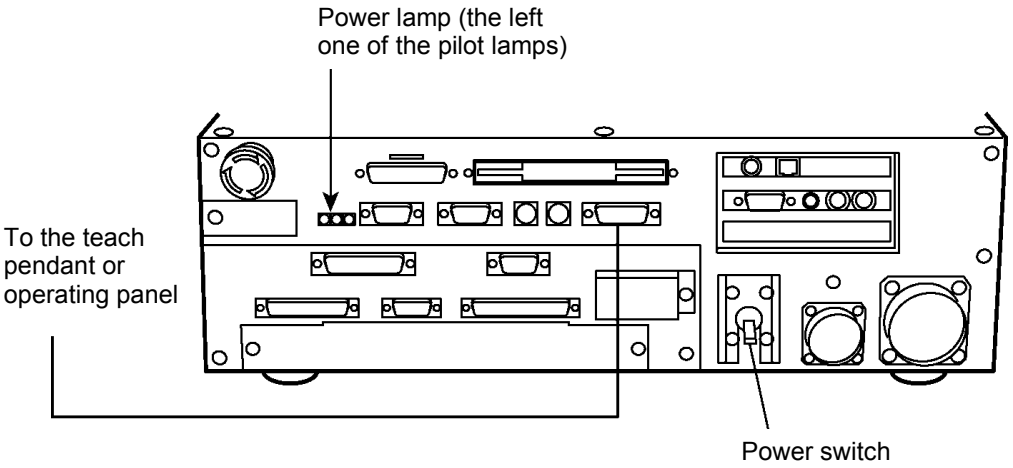
The robot controller supplies the robot unit with power and controls it.

Operating procedure

Step 1

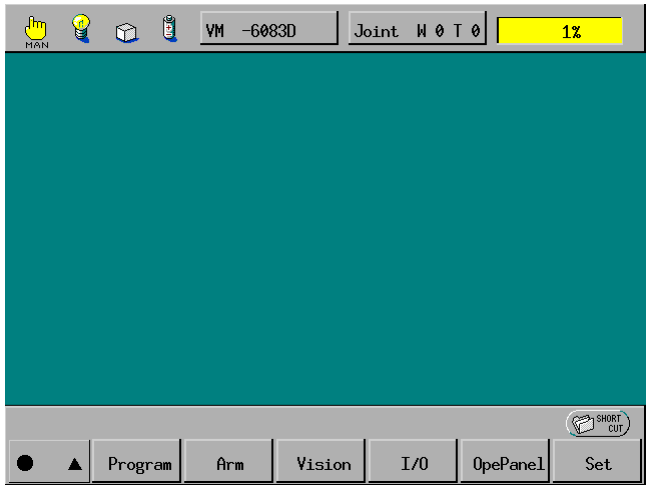
Flip the power toggle switch provided on the robot controller upward.

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.



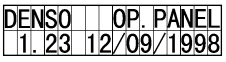
(TP screen)

If the teach pendant (TP) is connected to the robot controller, the top screen shown below appears on the pendant's display.



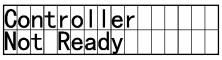
(OP display)

If the operating panel (OP) is connected to the robot controller, the LCD first shows the following:



(Version of operating panel module and updated date)

Next, during initialization of the robot controller hardware, the following appears:

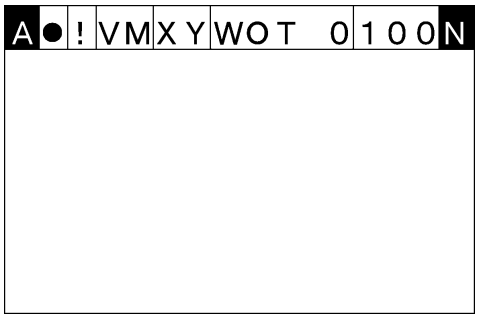


Then during initialization of data transaction between the robot controller and operating panel, the following appears:

Upon completion of the above sequence, the LCD shows nothing and the AUTO lamp flashes two times.

(MP screen)

When the mini-pendant (MP) is connected to the robot controller, the LCD first shows the following:



CAUTION: If you want to turn the controller power on immediately after turning it off, wait 10 seconds or more and check that all of the pilot lamps on the robot controller are no longer lit and the TP screen, OP display, and MP screen are turned off.

2.2 Turning the Robot Controller OFF (TP/OP/MP)

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 or disconnecting visual equipment, Ethernet board, floppy disk drive, and others to or from the robot controller.

(5) Replacing the operating panel.

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

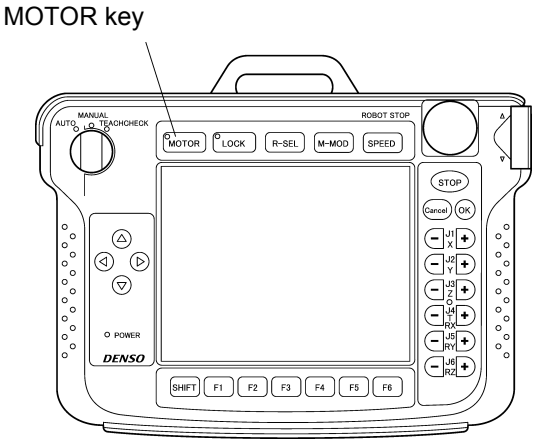
⚠**CAUTION**: Be sure to turn the robot controller off before connecting or disconnecting the robot control cable between the robot unit and its controller. Connection/disconnection of the robot control cable while the robot controller power is on will damage the encoder interface circuitry in the robot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

Operating procedure

■ ***From the teach pendant***

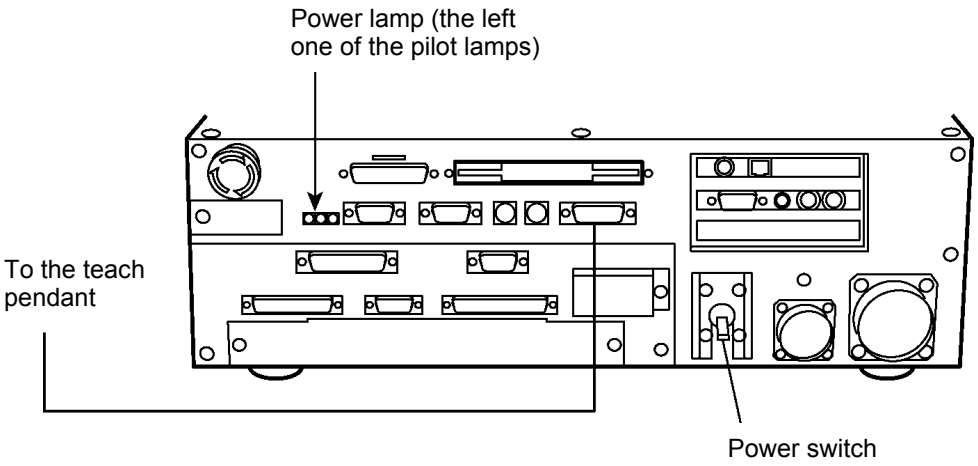
Step 1 If the MOTOR lamp is on, press the MOTOR key to turn the motor power off.

The MOTOR lamp goes off.



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

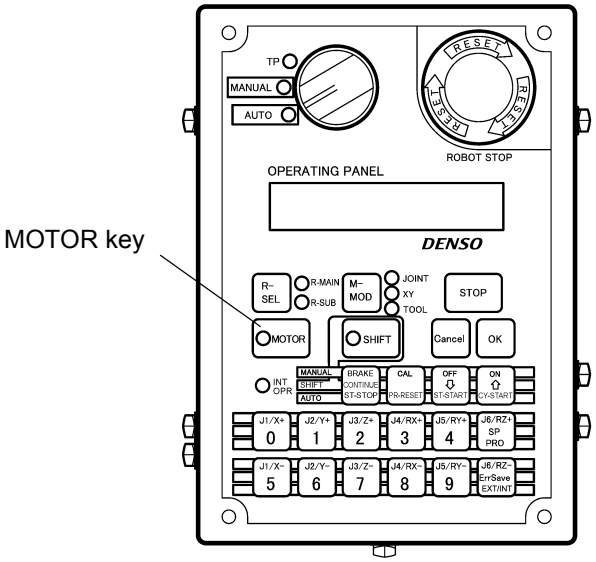
The power lamp (the left one of the three pilot lamps) goes off.



■ ***From the operating panel***

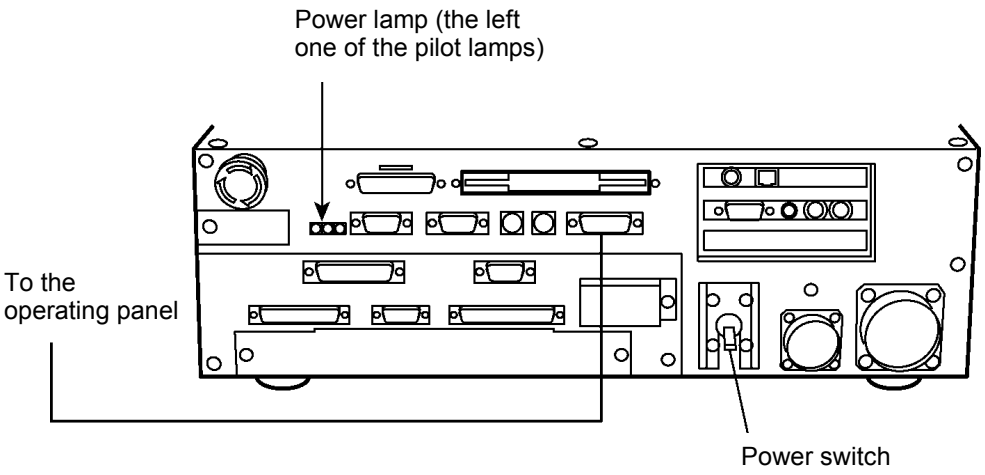
Step 1 If the MOTOR lamp is on, press the MOTOR key to turn the motor power off.

The MOTOR 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.

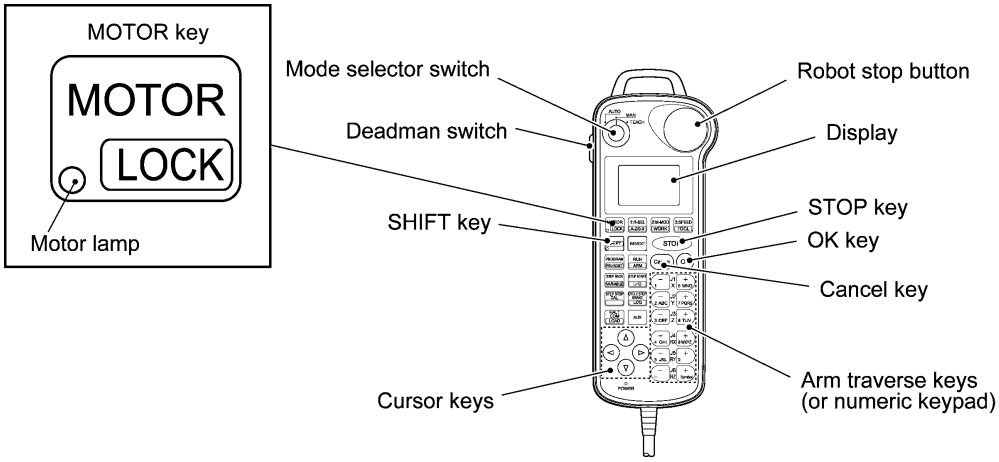


■ ***From the mini-pendant***

Step 1

If the MOTOR lamp is lit, press the MOTOR key to turn the motor off.

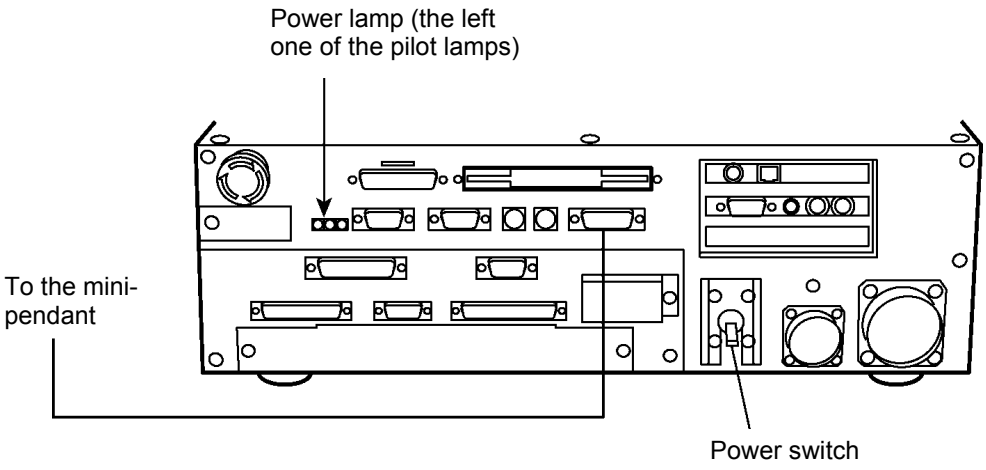
The MOTOR lamp goes off.



Step 2

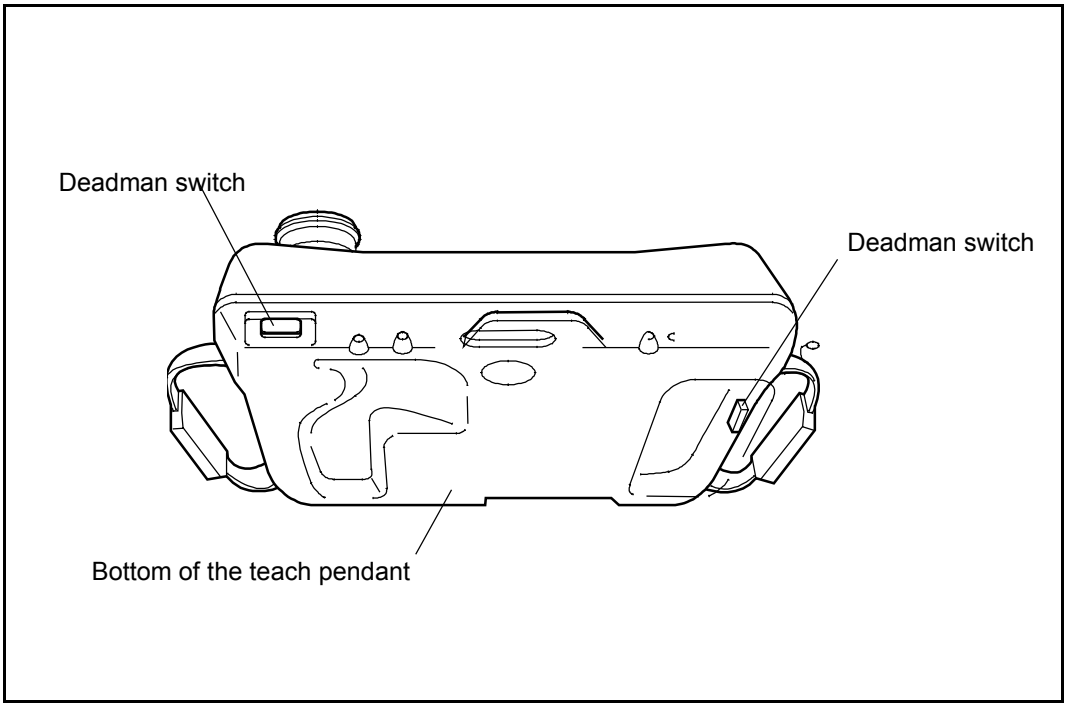
Flip the power toggle switch on the robot controller downwards.

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

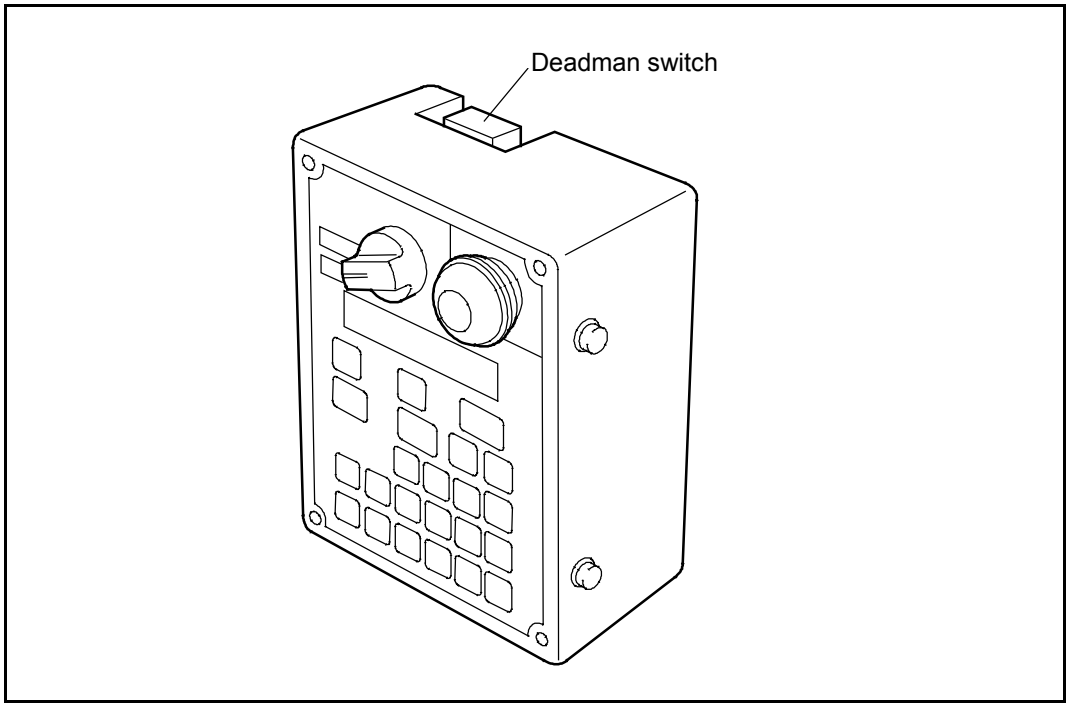


2.3 Deadman Switch(es) (TP/OP/MP)

The deadman switch activates a number of functions in Manual mode or Teach check mode when it is held down. The teach pendant has two deadman switches, and the operating panel or mini-pendant has a single deadman switch, as shown below.



Deadman Switches on the Teach Pendant



Deadman Switch on the Operating Panel

Hold down the deadman switch when

(1) You press any of the arm traverse keys in the Manual mode.

(2) You press the OK key after pressing the CycStart or StpStart button in the Teach check mode.

(3) You press [F5 ON/OFF] to turn output signals on or off without running task programs.

(4) You turn the selected user-input port on or off after setting dummy input to the port.

⚠**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 Manual mode. It is extremely DANGEROUS.

NOTE 1: A deadman switch of the teach pendant or operating panel is of a 3-position type. Releasing the switch or pressing it excessively will turn it off, stopping robot motion.

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

NOTE 2: A deadman switch of the mini-pendant is of a 2-position type.

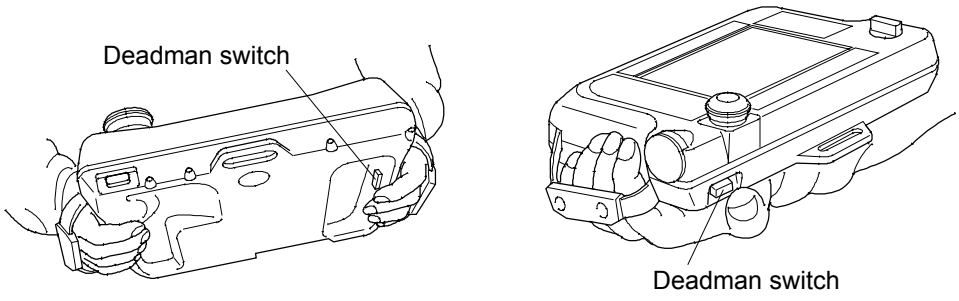
Released (OFF) ⇒ Pressed (ON)

Operating procedure

■ ***From the teach pendant***

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

You may hold the teach pendant in two ways as shown below. Press and hold down either deadman switch that you can access easily.

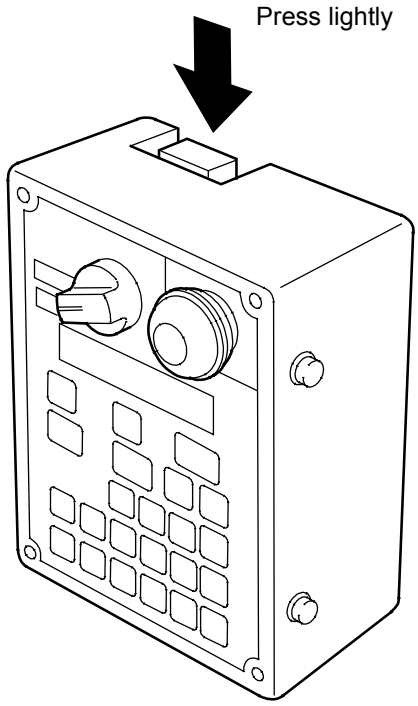


Step 2 Release the deadman switch. (Or press it stronger.)

The robot will stop.

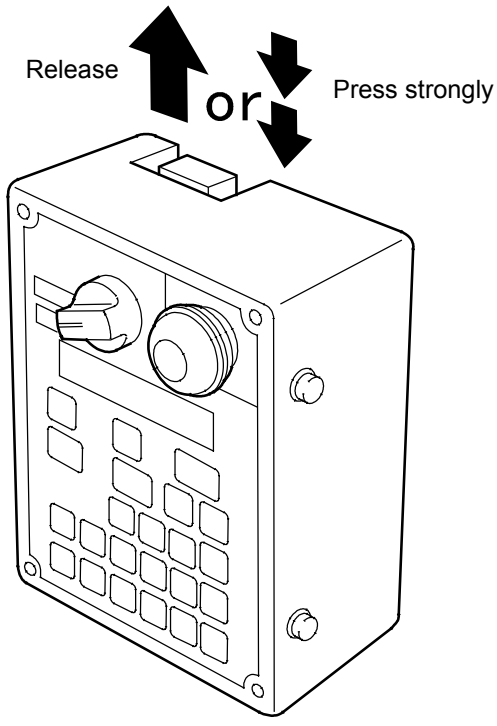
■ ***From the operating panel***

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



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

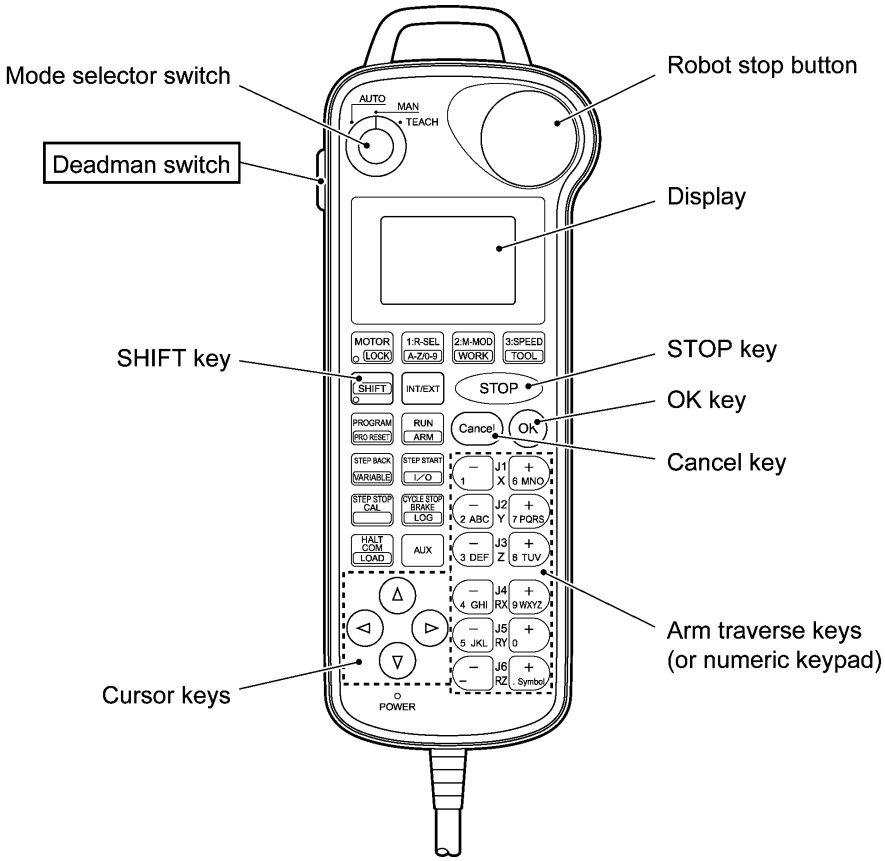
The robot will stop.



■ ***From the mini-pendant***

Step 1

While holding down the deadman switch, press any of the keys (e.g., arm traverse key).



Step 2

Release the deadman switch.

The robot will stop.

2.4 Turning the Motor ON (TP/OP/MP)

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

(1) Running the robot in Manual mode, Teach check mode, or Auto mode.

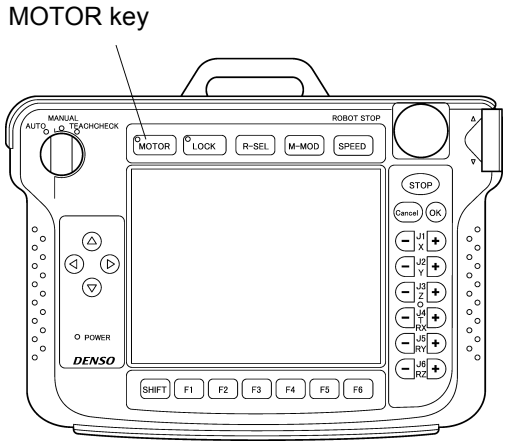
(2) Performing CAL operation.

Operating procedure

■ ***From the teach pendant***

Step 1 Press the MOTOR key to turn the motor power on.

The MOTOR lamp comes on.



NOTE 1: If the "ERROR 2008 Robot Stop signal is on" appears when you turn the motor on, it means that the "Robot Stop" pin of input connector CN8 on the robot controller has not been short-circuited (not ON). Short-circuit the "Robot Stop" pin (refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.2 and 5.5.4.6).

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

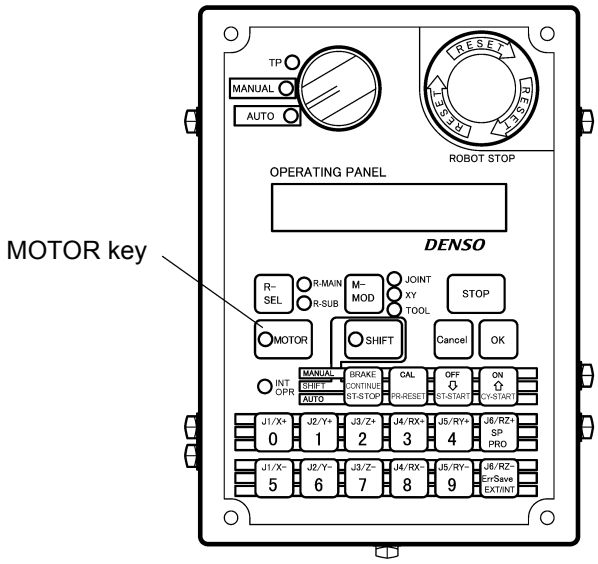
NOTE 3: You may turn the motor on even when a program is running in Auto mode. However, take extra care since the robot may suddenly move.

■ ***From the operating panel***

Step 1

Press the MOTOR key to turn the motor power on.

The MOTOR lamp comes on.



NOTE 1: If the "ERROR 2008 Robot Stop signal is on" appears when you turn the motor on, it means that the "Robot Stop" pin of input connector CN8 on the robot controller has not been short-circuited (not ON). Short-circuit the "Robot Stop" pin (refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.2 and 5.5.4.6).

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.1.

2.5 Turning the Motor OFF (TP/OP/MP)

⚠**CAUTION**: The 1st axis (J1) has no brake. Turning the motor off will lose the holding torque so that the freed J1 will move by the force of gravity or external force. It is extremely DANGEROUS.

Turn the motor off when

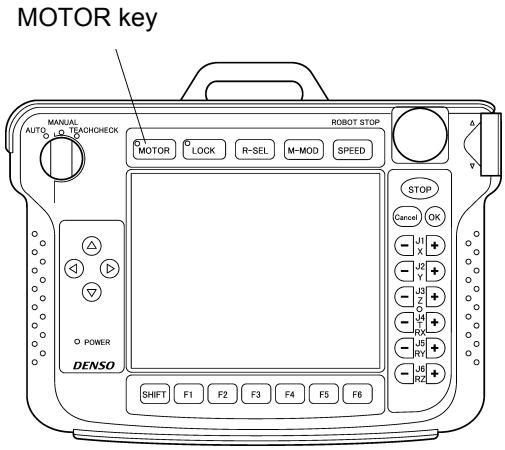
(1) Anyone enters the restricted space of the robot.
(2) Turning the robot controller off.
(3) Running the robot manually.
(4) Operating the floppy disk drive.
(5) Modifying parameters.
(6) Loading task programs.
(7) Carrying out CALSET (selecting/deselecting joints to be calibrated).
(8) Releasing brakes.

Operating procedure

■ ***From the teach pendant***

Step 1 Press the MOTOR key to turn the motor off.

The MOTOR lamp goes off.

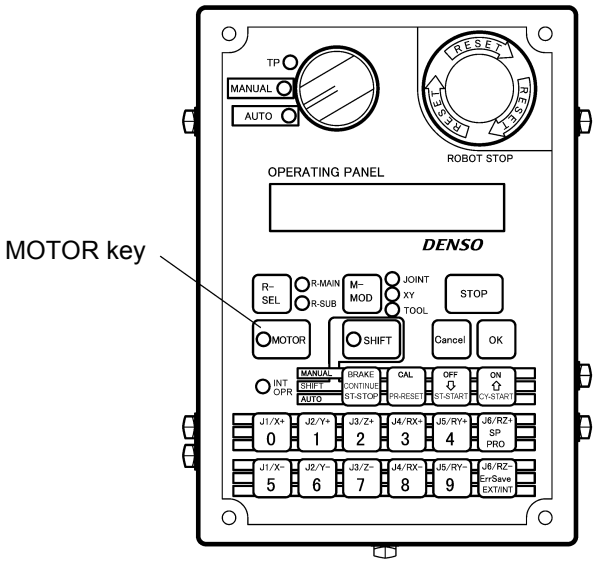


■ ***From the operating panel***

Step 1

Press the MOTOR key to turn the motor power off.

The MOTOR lamp goes off.



■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.1.

2.6 Calibrating (CAL) the Robot (TP/OP/MP)

CAL stands for calibration that calibrate all robot axes to confirm the current arm position. Performing CAL will turn on all robot motors to actuate all axes.

Perform CAL operation when

You run the robot first after turning the robot controller on.

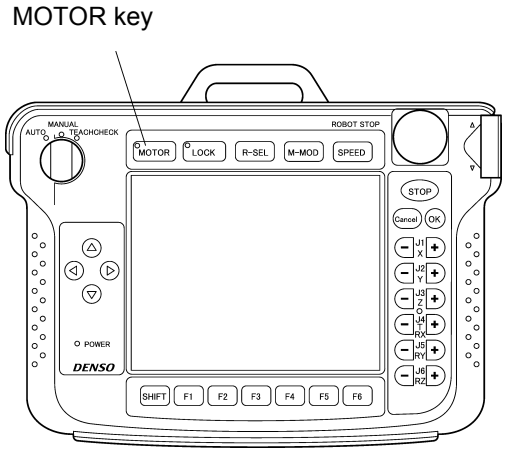
No CAL operation is required to lock the robot without running it after turning the controller on. (For Machine Lock, refer to Section 3.1.)

Once the CAL operation is performed, no CAL operation is required as long as the robot controller remains on.

Operating procedure

■ ***From the teach pendant***

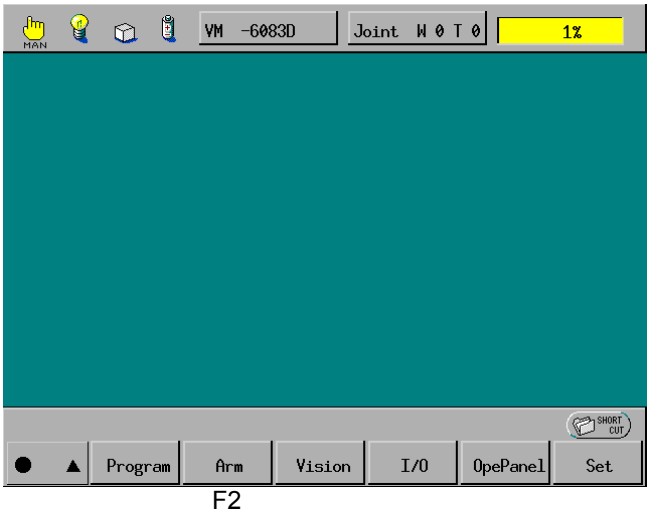
Step 1 If the MOTOR lamp is off, press the MOTOR key to turn the motor power on.



The motor is turned on and the MOTOR lamp comes on.

Step 2

Press [F2 Arm] on the top screen.

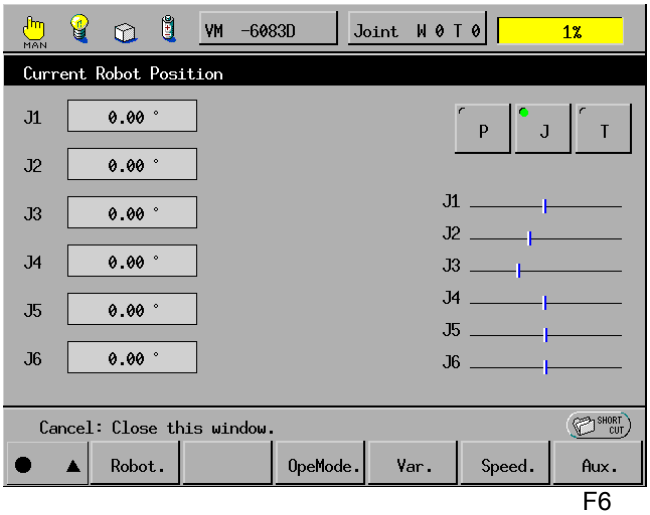


F2

The Current Robot Position window appears as shown below.

Step 3

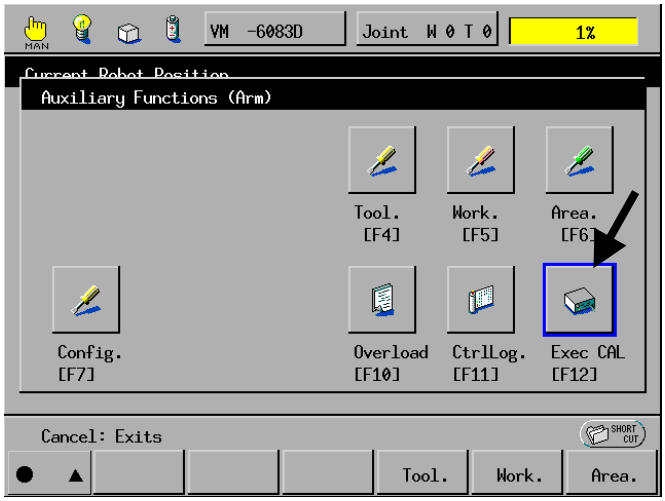
Press [F6 Aux.].



F6

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

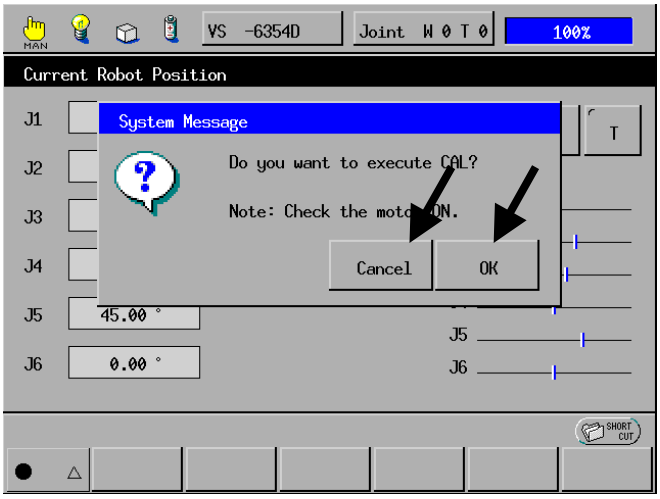
Step 4 Press [F12 Exec CAL].



The system message dialog box appears as shown below.

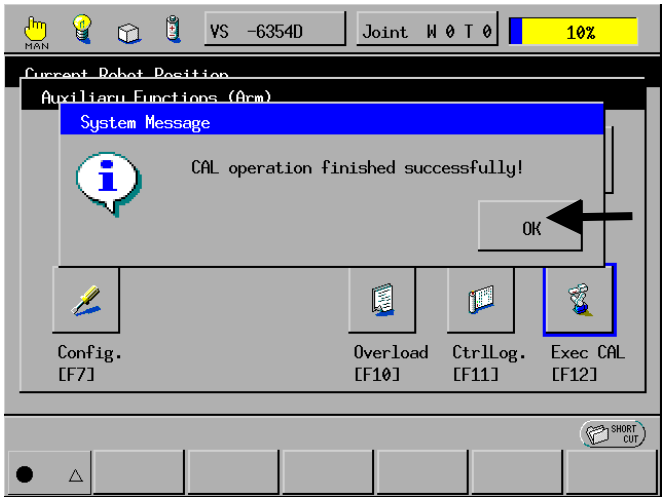
Step 5 Perform a safety check of the robot's restricted space, and then press the OK button.

To cancel CAL operation, press the Cancel button.



Step 6

On the window below, press the OK button.



The Auxiliary Functions (Arm) window remains displayed. Each time you press the Cancel button, the screen returns to the previous one.

■ ***From the operating panel***

Step 1

Turn the mode switch to the MANUAL position.

The robot enters the Manual mode and the MANUAL lamp comes on.

Step 2

Press the MOTOR key.

The motor power is turned on and the MOTOR lamp comes on.

Step 3

Press the CAL key.

The LCD shows the following:

To cancel CAL, press the Cancel key.

Step 4

Press the OK key.

The LCD shows the following:

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.15.

2.7 Setting the Reduced Ratios of the Programmed Speed, Acceleration, and Deceleration (TP/OP/MP)

You may set the reduced ratios (%) of the programmed speed, acceleration, and deceleration, from the teach pendant, operating panel, or mini-pendant.

(1) The default reduced ratios at powering on are 1%.

(2) Once the reduced ratios are set, they will remain in effect until you turn the robot controller off or make new settings.

(3) In Auto mode, the robot will run at the (programmed speed x reduced ratio (%)). If you set 80%, the robot will run at 80% of the programmed speed.

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

(4) If you set the reduced ratio of the programmed speed, the robot controller automatically calculates the reduced ratios of the programmed acceleration and deceleration according to the formulas below.

$$\text{Reduced ratio for acceleration} = (\text{Reduced ratio for speed})^2 /100$$
$$\text{Reduced ratio for deceleration} = (\text{Reduced ratio for speed})^2 /100$$

where, the calculated value will be rounded up to 1% if it is less than 1%.

(Example) If the reduced ratio for speed is 20%

$$\text{Reduced ratio for acceleration} = 20^2/100 = 4\%$$

If you modify the automatically calculated ratios (%) manually from the teach pendant, operating panel, or mini-pendant, then the most recently modified ratios will take effect.

(5) The minimal reduced ratio for speed is 0.1% and that for acceleration/ deceleration is 0.0001%. If any value less than 1% is set, the teach pendant or mini-pendant will display the value as 1% in the speed indicator bar graph of the status bar.

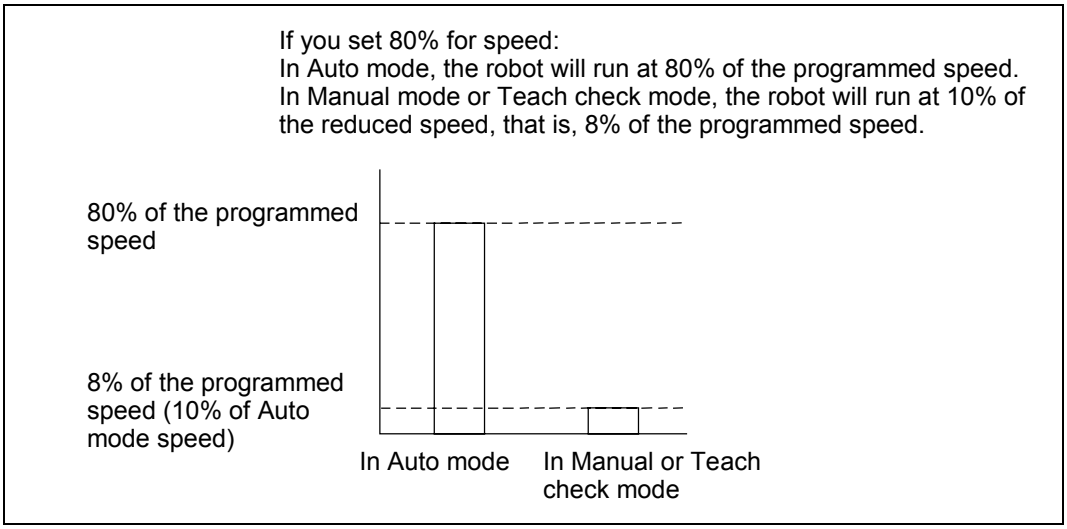


Figure 2-3. Differences in Auto Mode and in Manual/Teach Check Mode

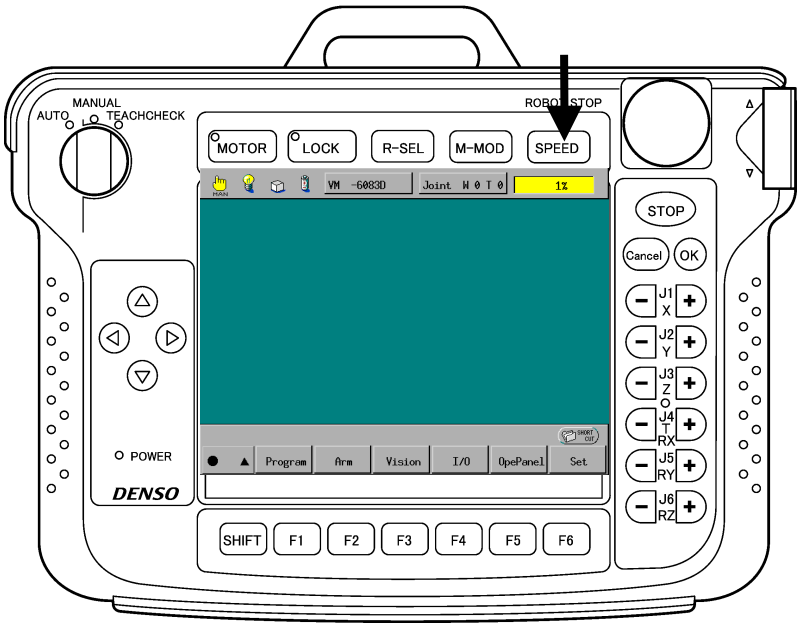
Operating procedure

⚠**CAUTION**: At the start, set the 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.

⚠**CAUTION**: It is possible to set the reduced ratios of the programmed speed, acceleration, and deceleration even while the program is running. Doing so may suddenly change the robot speed. It is DANGEROUS.

■ ***From the teach pendant***

Step 1 Press the SPEED key.

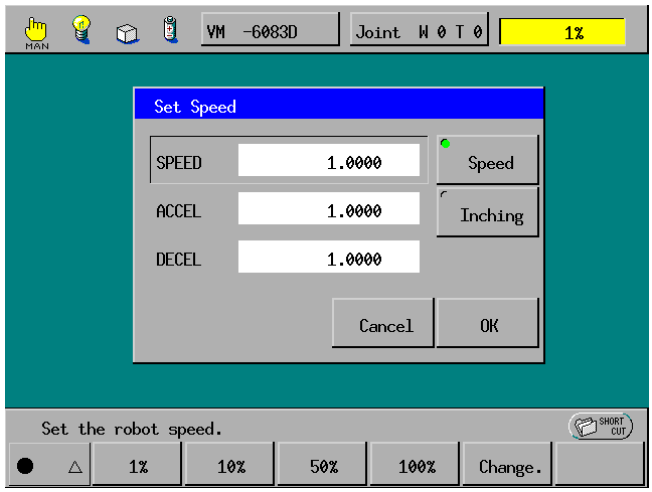


The Set Speed window appears as shown in the next step.

TIP: You may call up the window by pressing [F2 Arm]—[F5 Speed] from the top screen.

Step 2

In the Set Speed window, check that the SPEED row is selected and then press [F5 Change.]



F5

The numeric keypad appears as shown below.

TIP: If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

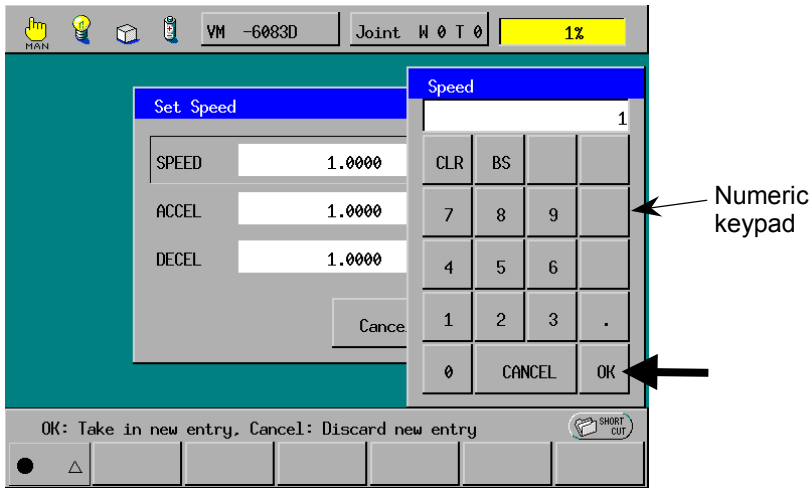
TIP: You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may do it in units of 2% by using the jog dial.

Step 3

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.

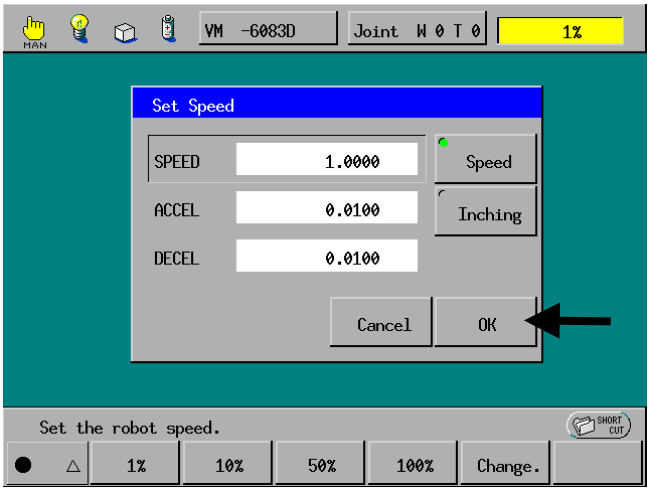
To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad instead of the OK button.

Step 4

In the Set Speed window, check the automatically calculated ratios of the acceleration and deceleration.

(1) If the ratios of acceleration and deceleration are OK, press the OK button and skip to Step 8.

(2) To set an arbitrary reduced ratio of acceleration, press the down-arrow cursor key to select the ACCEL row and then press [F5 Change.].



The numeric keypad appears as shown below.

TIP: If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

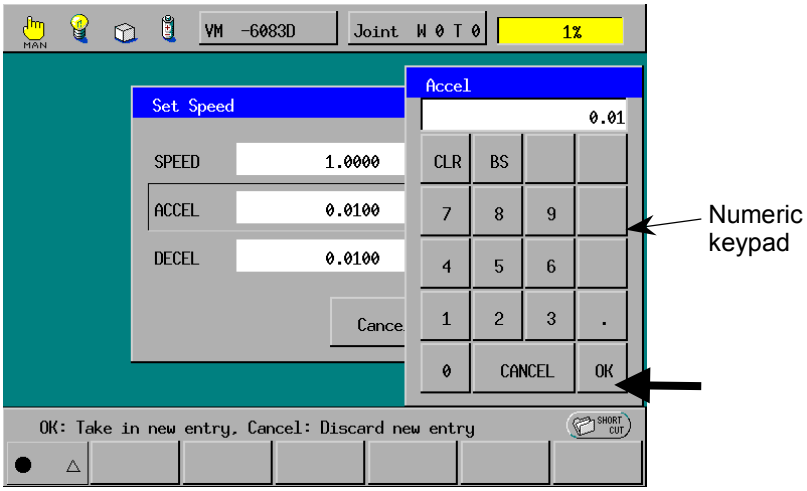
TIP: You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may also increase or decrease the value in units of 1% by using the jog dial.

Step 5

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.

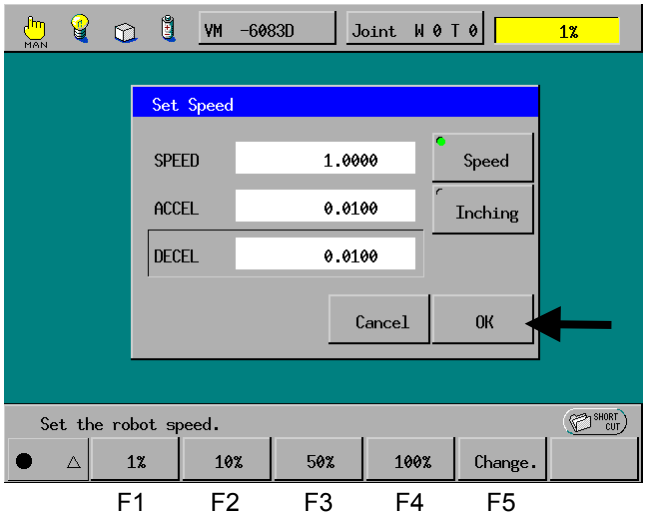
To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad instead of the OK button.

Step 6

In the Set Speed window, check the automatically calculated deceleration ratio.

(1) If the ratio of the deceleration is OK, press the OK button and skip to Step 8.

(2) To set an arbitrary reduced ratio of the deceleration, press the down-arrow cursor key to select the DECEL row and then press [F5 Change.].



The numeric keypad appears as shown below.

TIP: If you use one of the F1 to F4 keys instead of [F5 Change.], you may directly enter any of the values displayed on the function buttons.

TIP: You may increase or decrease the value in units of 5% by using the right- or left-arrow cursor key, respectively. You may also increase or decrease the value in units of 1% by using the jog dial.

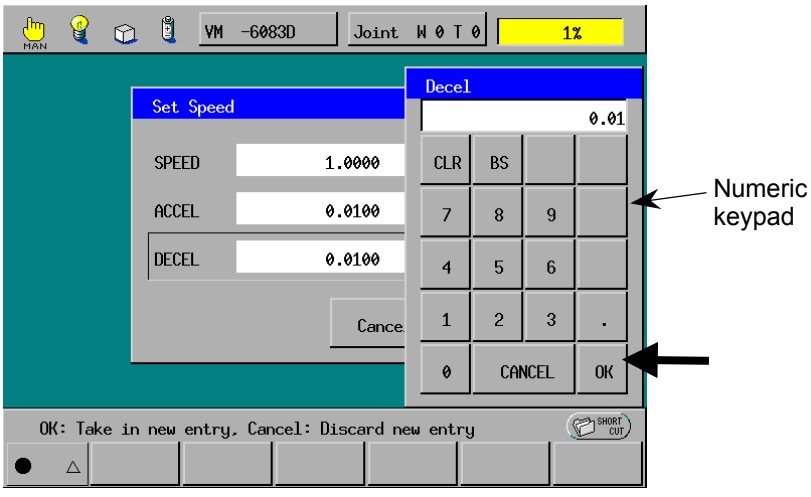
Step 7

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.

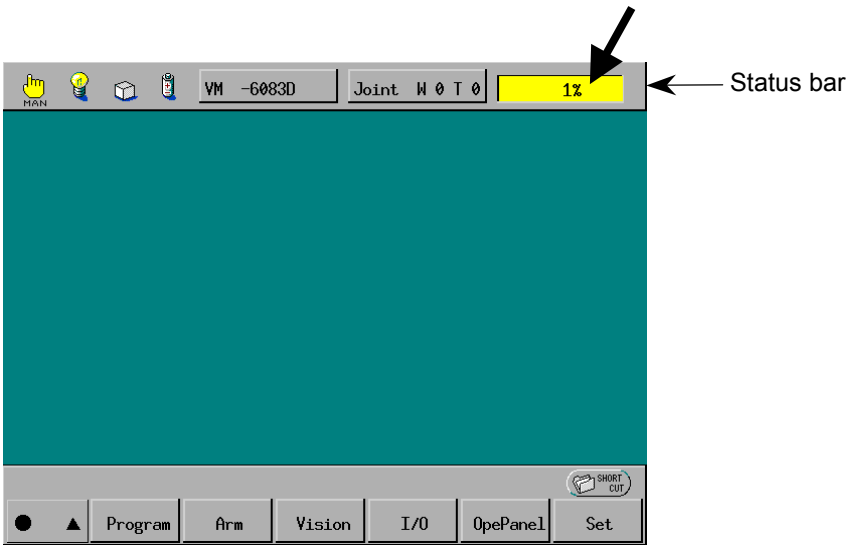
(To discard the new entry and return to the Set Speed window, press the CANCEL button on the numeric keypad.)



The numeric keypad disappears.

Step 8

The top screen shown below appears. Check that the newly entered ratio is displayed in the rightmost area of the status bar.



■ ***From the operating panel***

Step 1

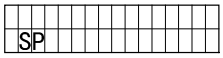
Press the SHIFT key.

The SHIFT lamp comes on.

Step 2

Press the SP key.

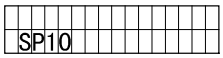
The LCD shows the following:



Step 3

Use the numerical keys to enter the desired value.

The LCD shows the following:



To cancel the new entry, press the Cancel key. The panel status returns to Step 1.

Step 4

Check the newly entered value and press the OK key.

NOTE: In the Manual mode or Auto mode also, you may set the robot speed. The permissible entry range is 1 to 100.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.6.

2.8 Inching Selection (TP/MP)

You may inch the robot by a specified distance or angle each time you press any of the arm traverse keys in Manual mode. Once inching is selected, it takes effect until the robot controller is turned off or you switch the robot from inching to normal speed running.

When the robot controller is turned on, the default is normal speed running.

In Auto mode or Teach check mode, inching will not take effect. Even if inching is selected, switching from Manual mode to any other mode will automatically cause the robot to switch from inching to normal speed running. Switching back to Manual mode will cause the robot to switch back to inching.

Select inching when

Inching the robot in Manual mode.

Operating procedure

NOTE: Even if inching is selected, the robot will run at a normal speed if the robot is switched to an operation mode other than Manual mode.

■ ***From the teach pendant***

Step 1

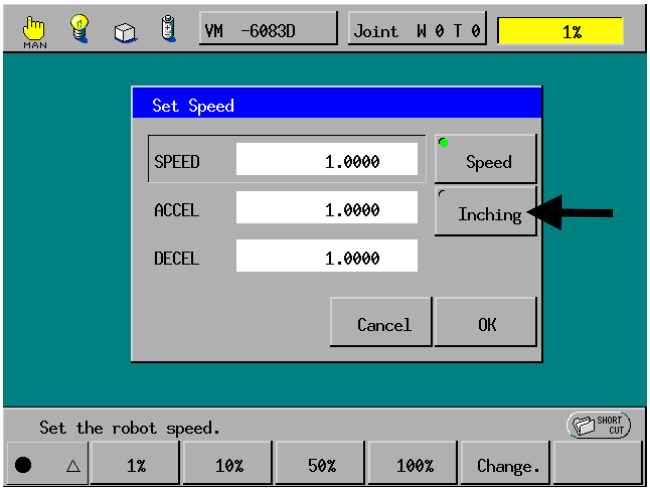
Press the SPEED key.

The Set Speed window appears as shown below.

TIP: You may call up the Set Speed window by pressing [F2 Arm]—[F5 Speed] from the top screen.

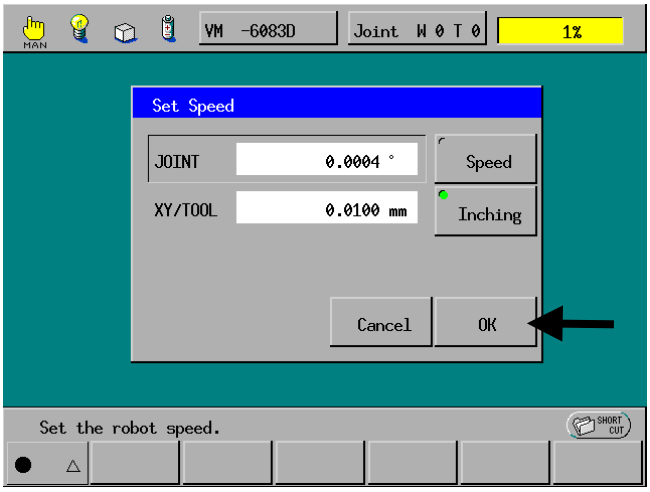
Step 2

In the Set Speed window, press the Inching button.

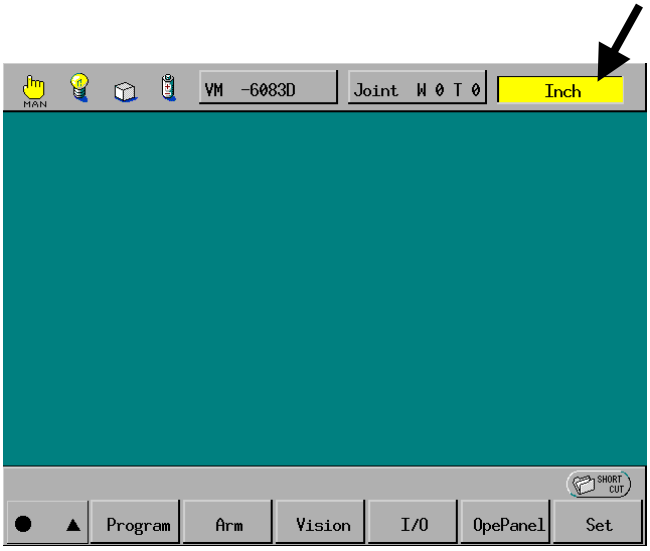


The window shows the inching display.

Step 3 Check the inching values and press the OK button.



The display returns to the top screen where "Inch" is shown in the rightmost area of the status bar, as shown below.



■ ***From the mini-pendant***

Step 1 Refer to Chapter 6, Subsection 6.2.7.

2.9 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, Chapter 4, Section 4.7.

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

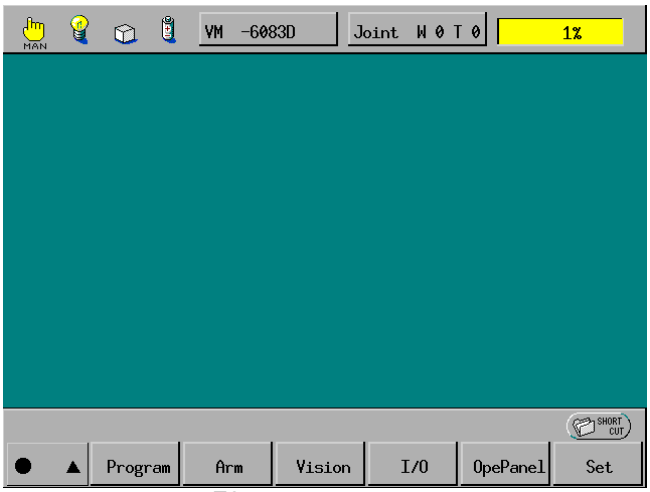
You have determined the mass of the payload (end-effector and object to be mounted at the end of the robot arm) and the payload center of gravity.

Operating procedure

This setting cannot be performed from the operating panel or mini-pendant. Use the teach pendant or WINCAPSII. For details about the WINCAPSII, refer to the WINCAPSII GUIDE.

■ ***From the teach pendant***

Step 1 On the top screen, press [F2 Arm].

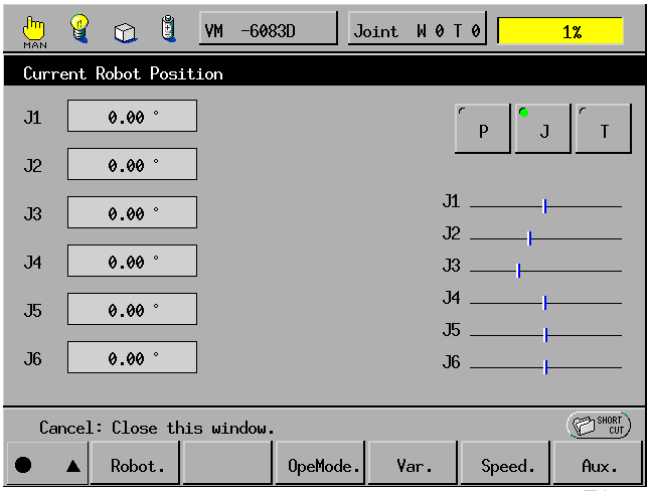


F2

The Current Robot Position window appears as shown below.

Step 2

Press [F6 Aux.].

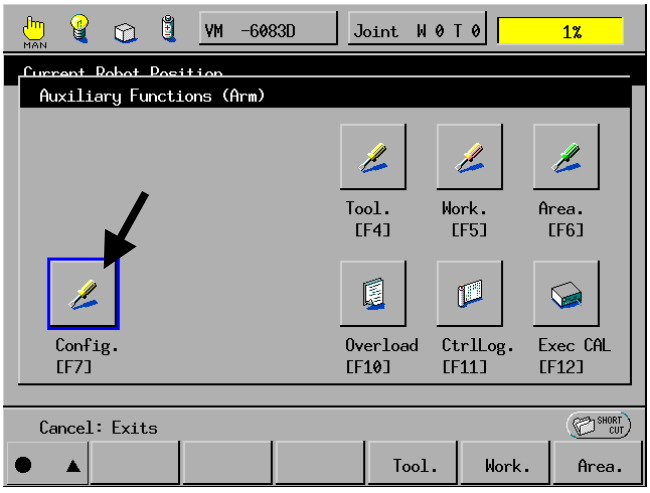


F6

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

Step 3

Press [F7 Config.].



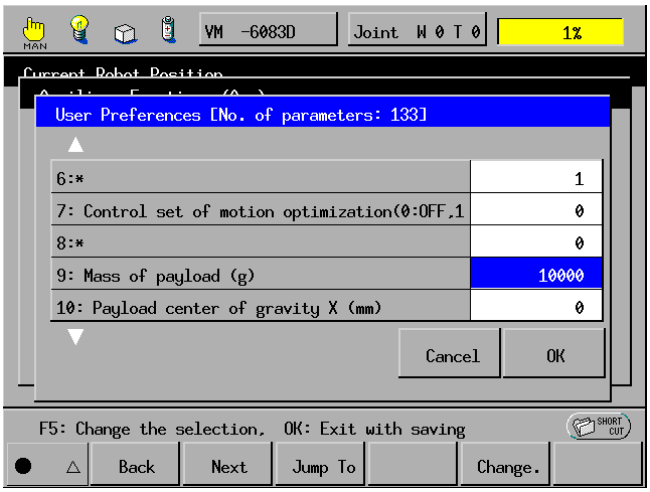
The User Preferences window appears as shown in the next step.

Step 4

Select the "Mass of payload (g)" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



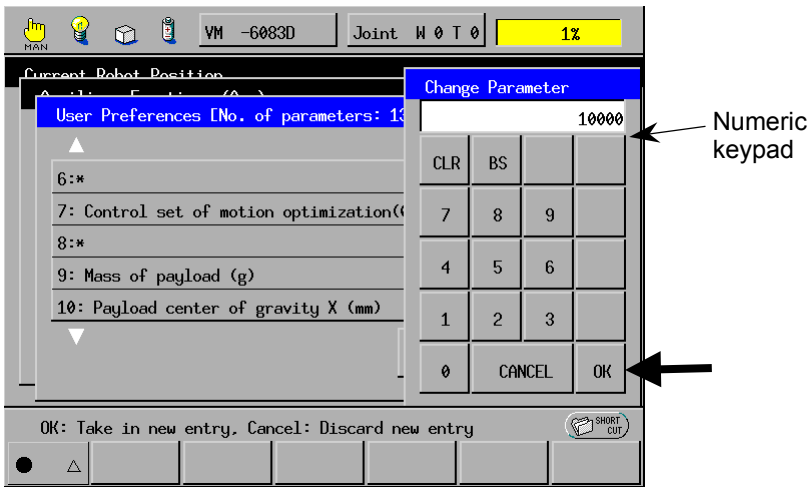
The numeric keypad appears as shown below.

Step 5

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

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

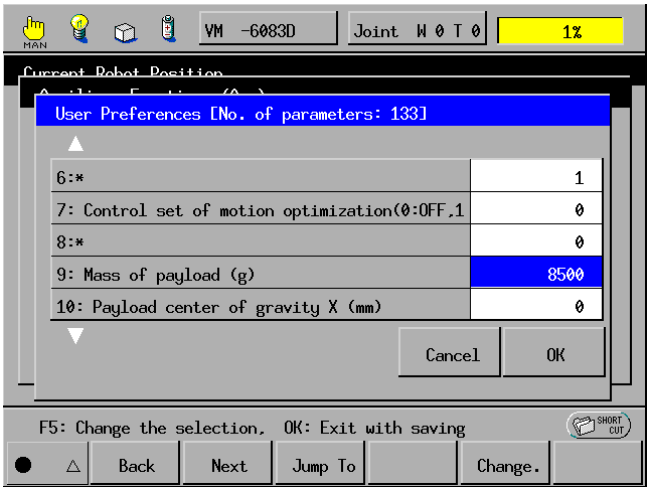
Check the entered value and press the OK button to establish it. To cancel entry made in this step and restore the previous setting, press the CANCEL button on the numeric keypad instead of the OK button.



The numeric keypad disappears.

The newly entered value is displayed in the "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

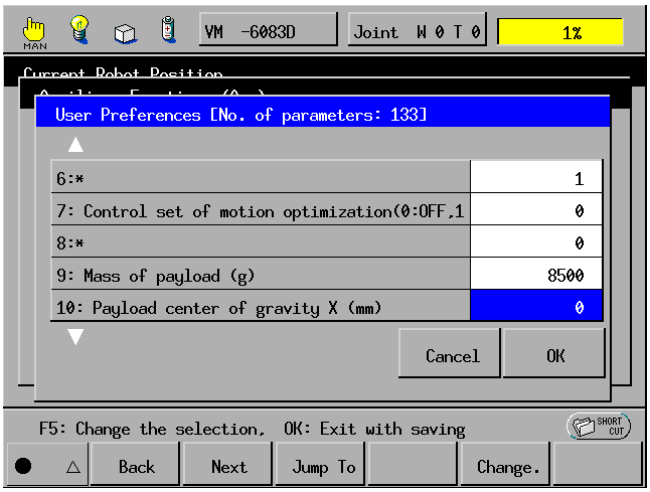


Step 6

Select the "Payload center of gravity X (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



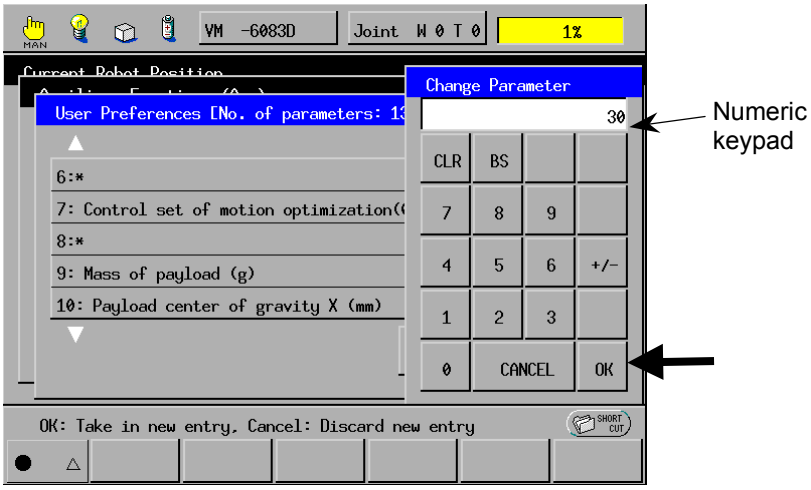
The numeric keypad appears as shown in the next step.

Step 7

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

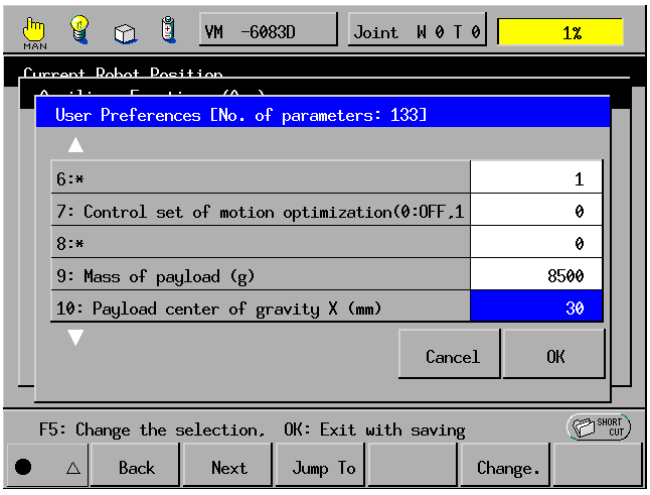
To cancel the newly entered value, press the CLR or BS button.

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 "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.

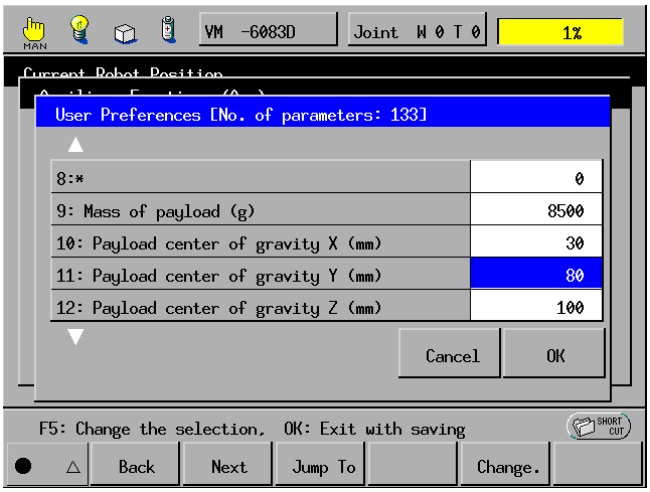


Step 8

Select the "Payload center of gravity Y (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



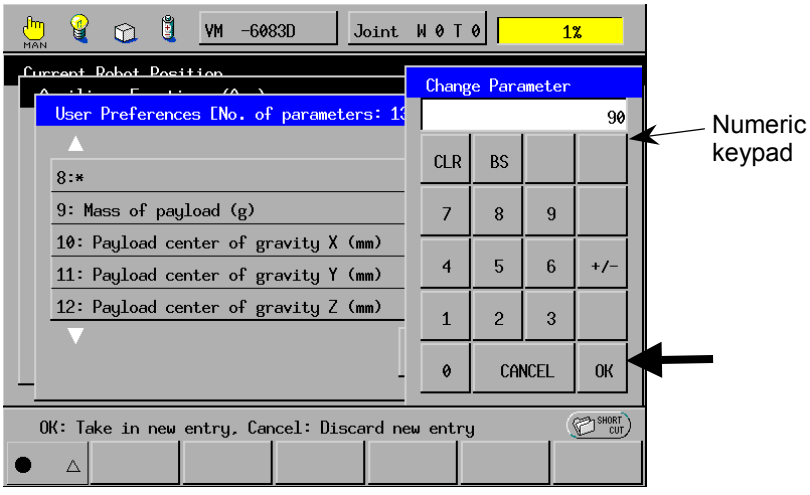
The numeric keypad appears as shown below.

Step 9

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

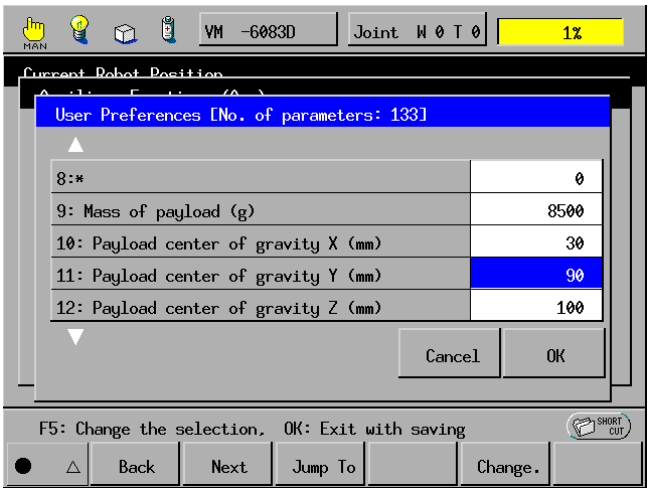
To cancel the newly entered value, press the CLR or BS button.

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 "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.

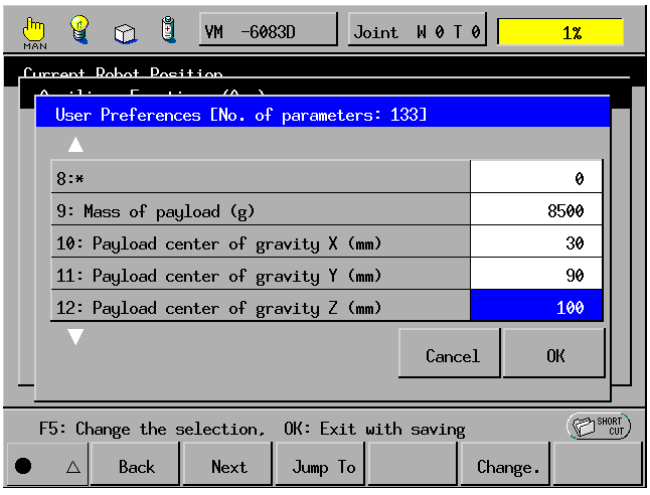


Step 10

Select the "Payload center of gravity Z (mm)" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



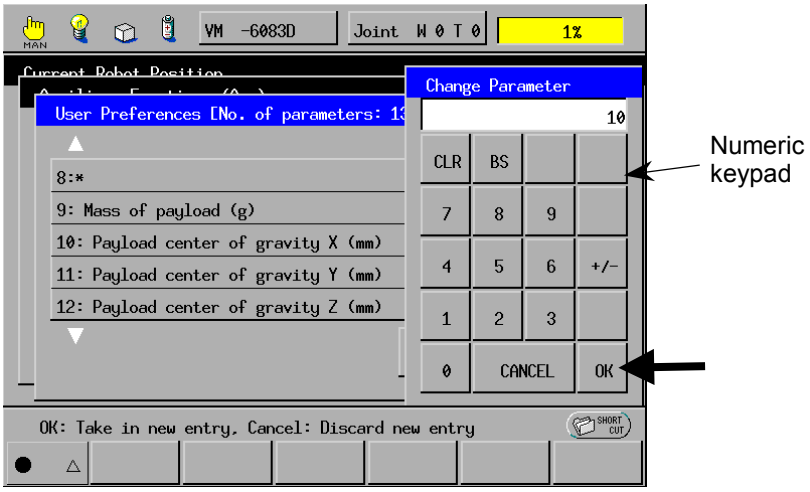
The numeric keypad appears as shown in the next step.

Step 11

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

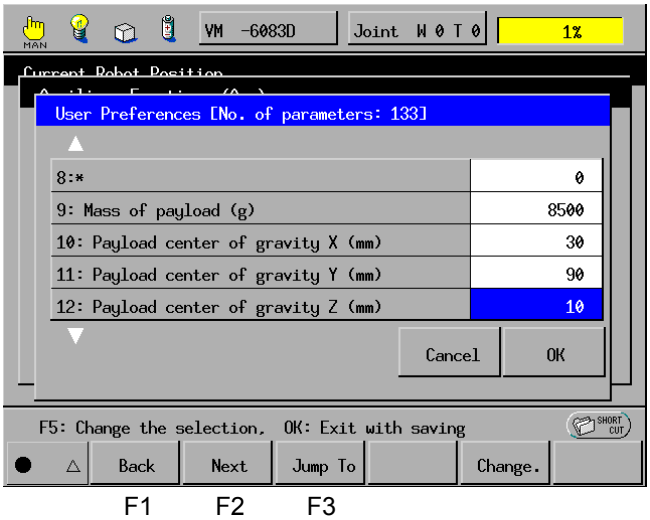
To cancel the newly entered value, press the CLR or BS button.

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 "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.

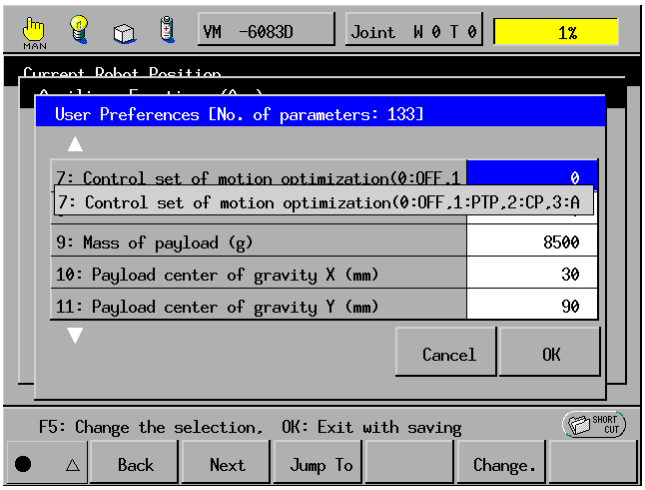


Step 12

Select the "Control set of motion optimization" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



F5

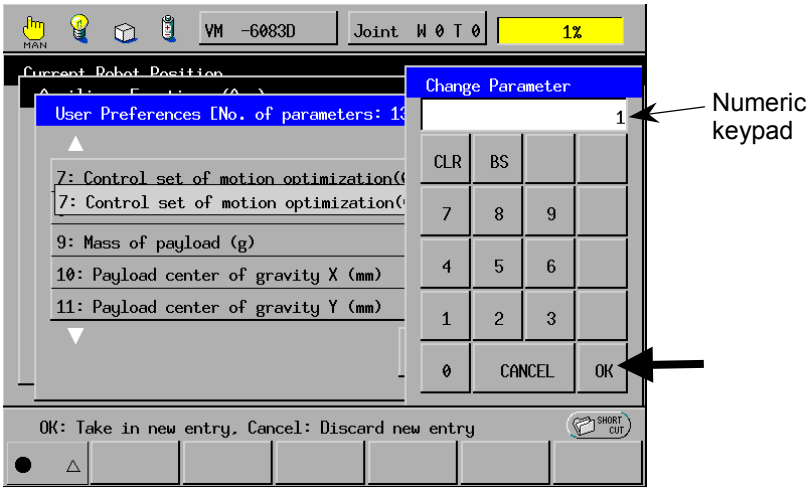
The numeric keypad appears as shown below.

Step 13

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

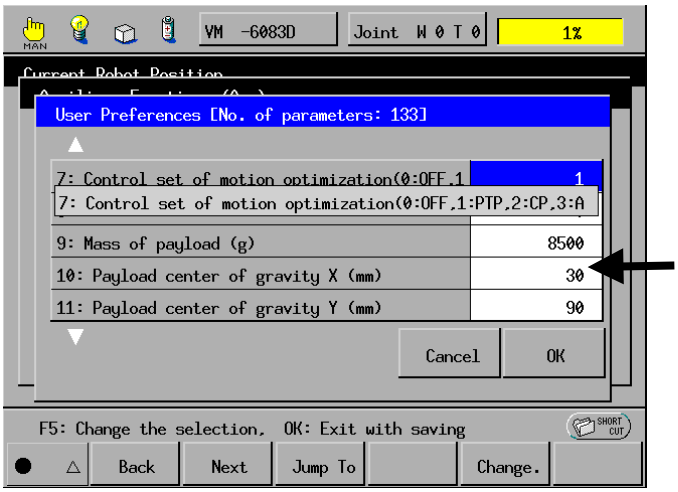
To cancel the newly entered value, press the CLR or BS button.

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 "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 14

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

The Auxiliary Functions (Arm) window appears.

Step 15

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 WINCAPSII*

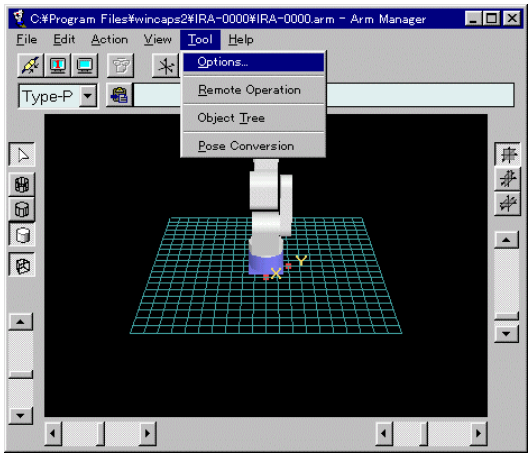
Before proceeding to the following procedure, run the WINCAPSII System Manager. For details, refer to the WINCAPSII GUIDE, Chapters 1 to 3.

This section is intended for persons who have basic operating knowledge of Microsoft Windows95/98/NT4.0.

Step 1 Click the arm manager button in System Manager.

The Arm Manager window appears as shown below.

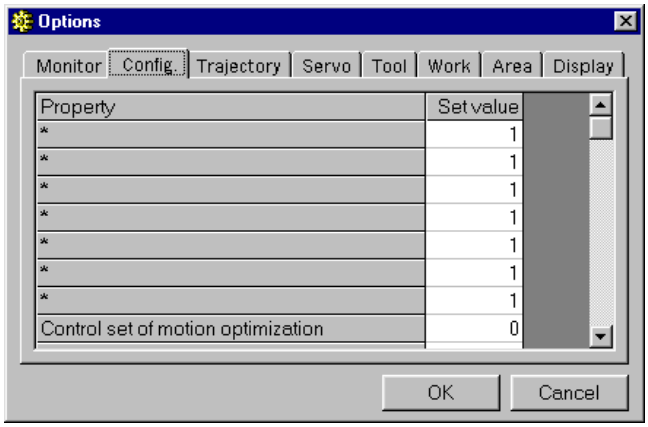
Step 2 On the Tools menu of Arm Manager, click Options.



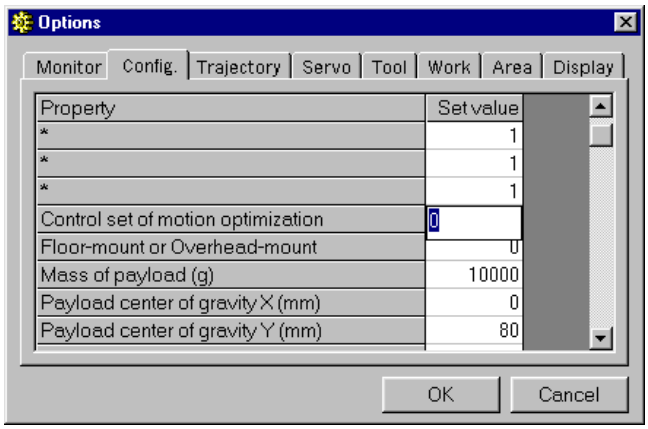
The Options window appears as shown in the next step.

NOTE: If no password has been entered, the Password dialog box appears. Select user level and type password. For details on password entry, refer to the WINCAPSII GUIDE, Section 1.3.

Step 3 In the Options window, click the Config. tab to display the current conditions.



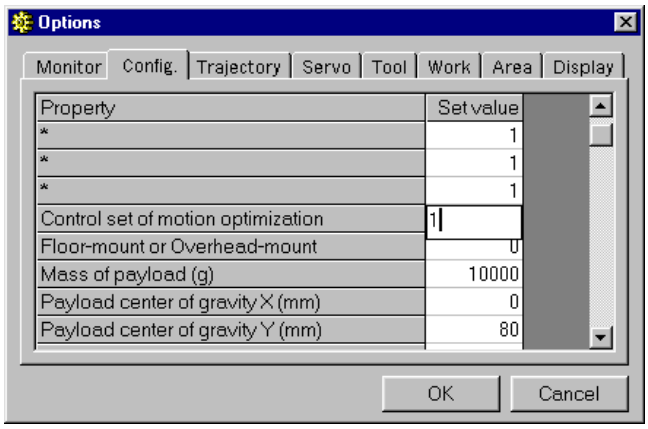
Step 4 Double-click the setting area of the "Control set of motion optimization" to prepare it to accept a new entry.



Step 5

Enter the desired value to the “Control set of motion optimization.”

The newly entered value appears in the setting area. To establish it, double-click any other line within this tab or press the OK button. If established, the value will be right justified. (This explanation applies also to the following procedures.)



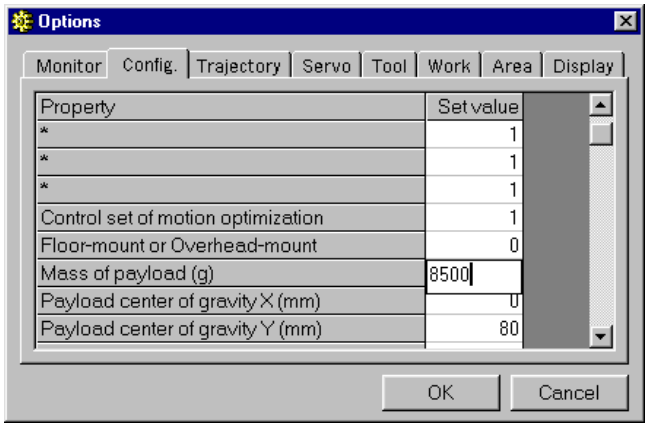
Step 6

Double-click the setting area of the "Mass of payload (g)" to prepare it to accept a new entry.

Step 7

Enter the desired value.

The newly entered value is displayed in the setting area.

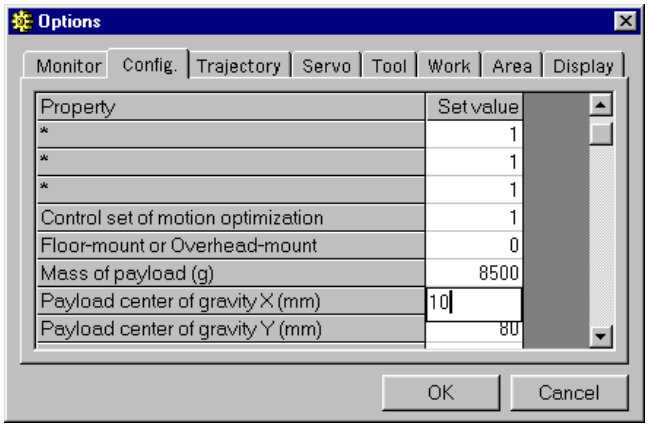


Step 8 Double-click the setting area of the "Payload center of gravity X (mm)" to prepare it to accept a new entry.

Step 9 Enter the desired value.

NOTE: For the setting values about the center of gravity of payload, refer to the definition given at the end of this section.

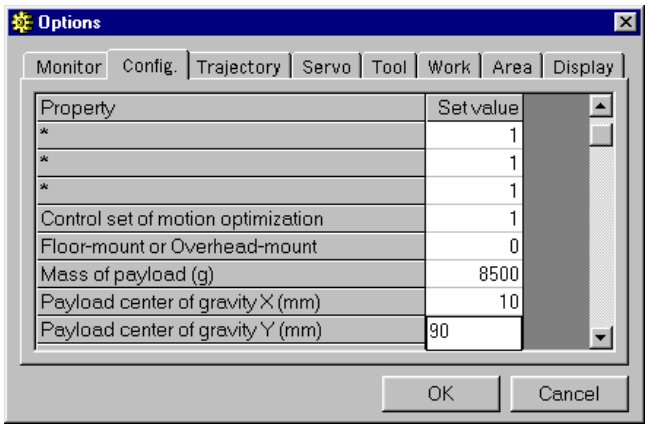
The newly entered value is displayed in the setting area.



Step 10 Double-click the setting area of the " Payload center of gravity Y (mm)" to prepare it to accept a new entry.

Step 11 Enter the desired value.

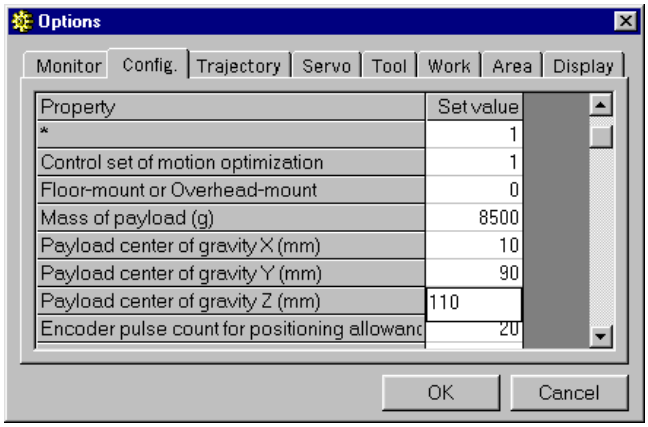
The newly entered value is displayed in the setting area.



Step 12 Double-click the setting area of the " Payload center of gravity Z (mm)" to prepare it to accept a new entry.

Step 13 Enter the desired value.

The newly entered value is displayed in the setting area.



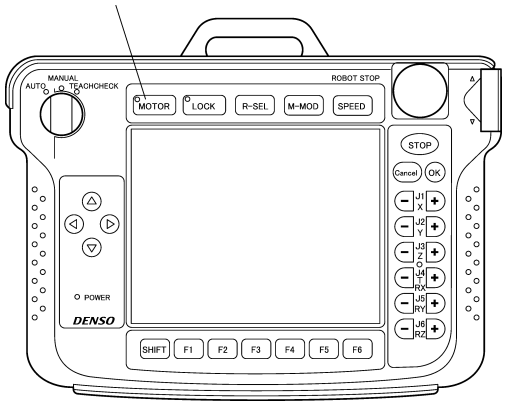
Step 14 Click OK in the Config. window to close it.

Step 15 On the teach pendant, press the MOTOR key to turn the motor off.

The MOTOR lamp goes off.

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

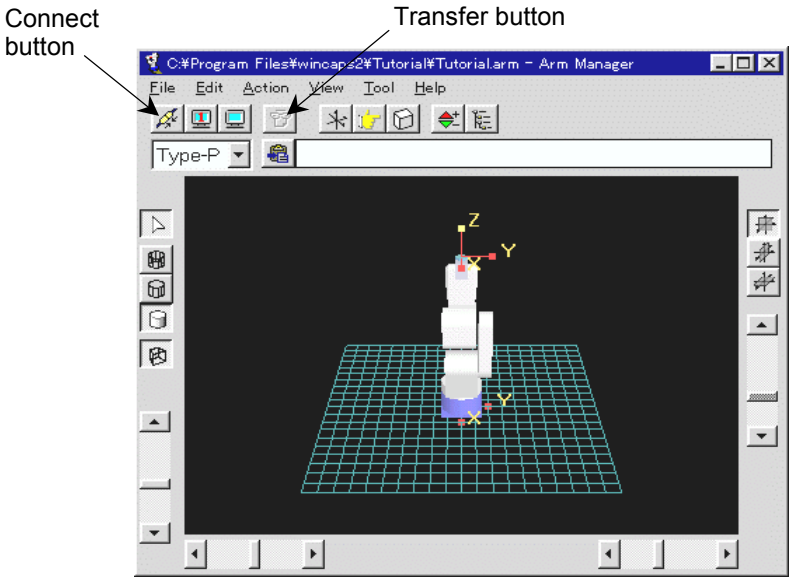
MOTOR key



Step 16

In Arm Manager, click the connect button.

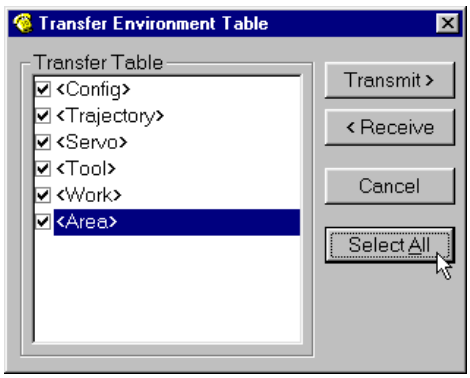
The connect button appears depressed.



Step 17

Click the transfer button in Arm Manager.

The Transfer Environments Table window appears as shown below.



Step 18

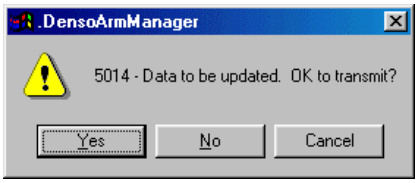
Click the Select All button in the Transfer Environments Table window to select all items.

The selected items (all items in this example) will be marked with √.

Step 19

Click the Transmit button in the Transfer Environments Table window.

The following dialog box appears.



NOTE: If you click the <Receive button in the Transfer Environments Table window, then WINCAPSII will receive the master control parameter values currently stored in the Arm Manager area of the robot controller. The local control parameters that are stored in the temporary area of the robot controller and may be modified in application programs cannot be transferred to WINCAPSII.

Step 20

Click the Yes (Y) button in the above dialog box to send the data to 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.

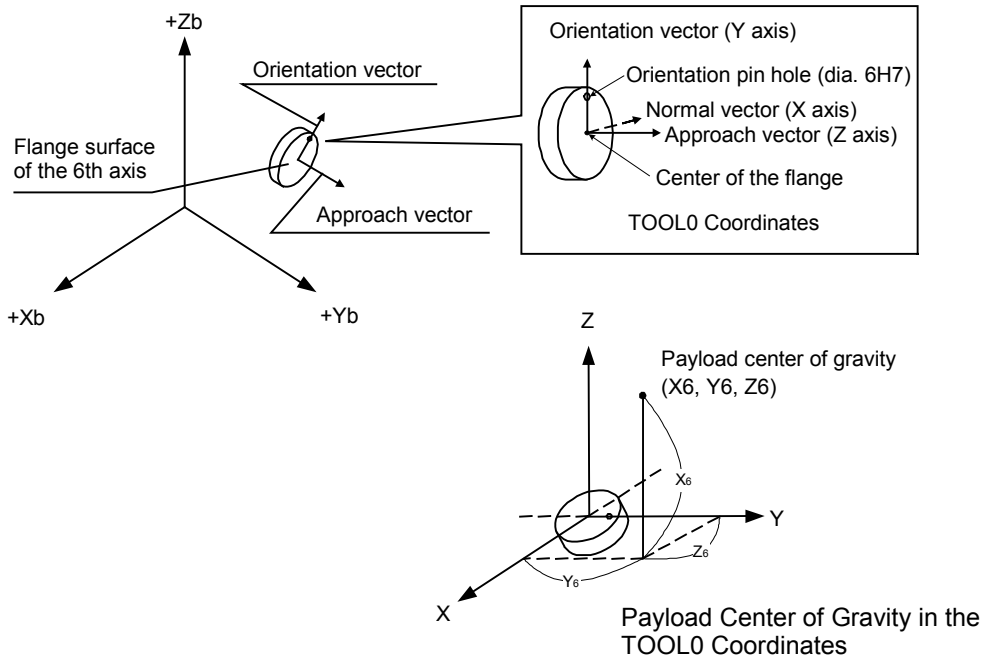


Figure 2-4. Payload Center of Gravity

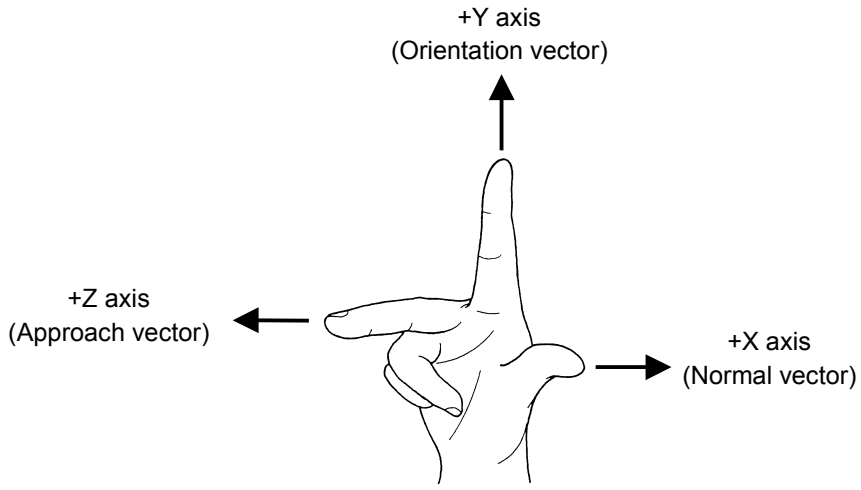


Figure 2-5. Right-hand Coordinates

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.

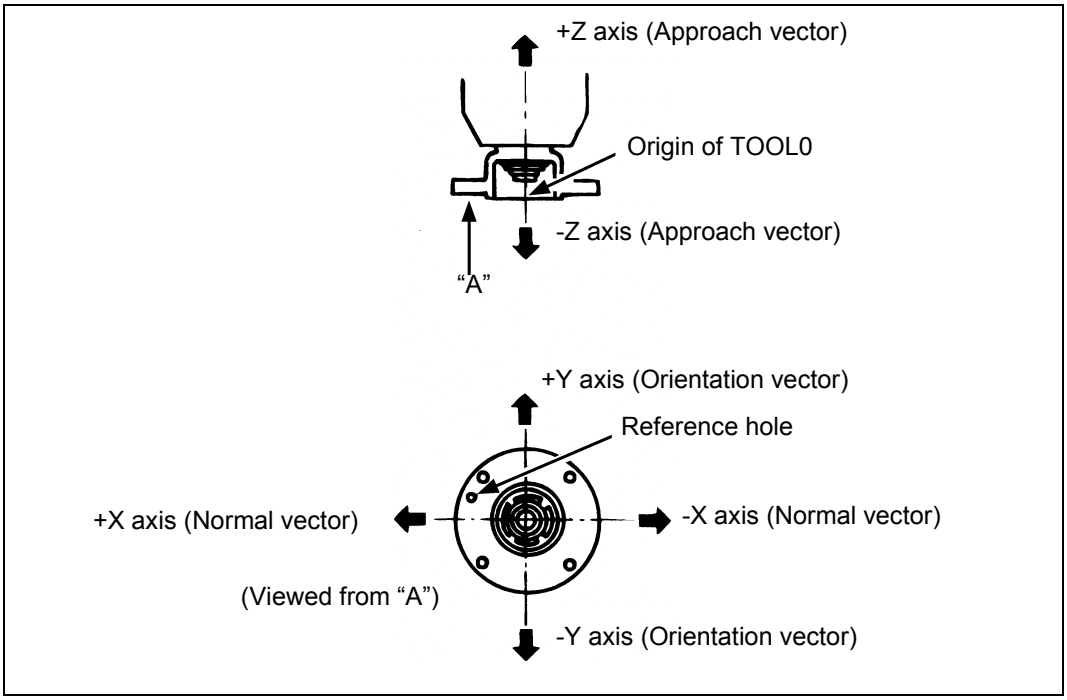


Figure 2-6. TOOL0 Coordinates in the HM/HS Series

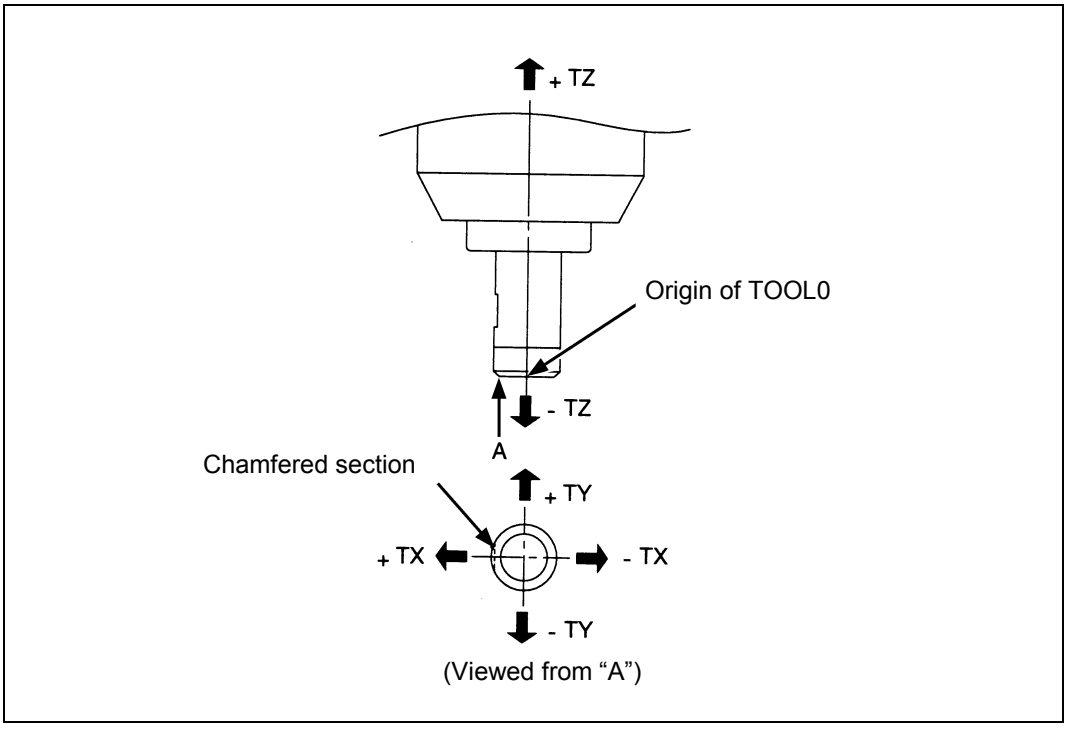


Figure 2-7. TOOL0 Coordinates in the HC Series

2.10 Setting the Robot Installation Condition (TP/WC)

This section describes how to set the robot installation condition (floor-mount, overhead-mount, or wall-mount) for the VM-D/VS-E series.

As for the VS-D/HM-D/HS-D series, the installation condition is fixed to either floor-mount or overhead-mount depending upon its robot type.

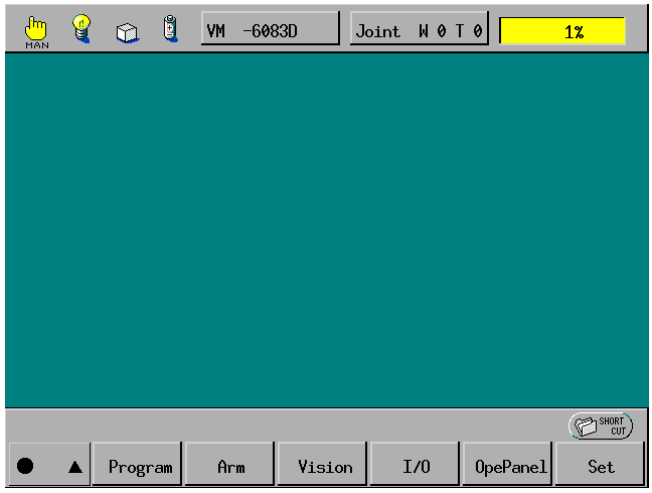
Set the robot installation condition when

You change the robot installation from floor-mount (0) to overhead-mount (1) and vise versa. The factory default is floor-mount (0). When connecting a wall-mount type of robot to the robot controller, you need to set wall-mount (2).

Operating procedure

■ ***From the teach pendant***

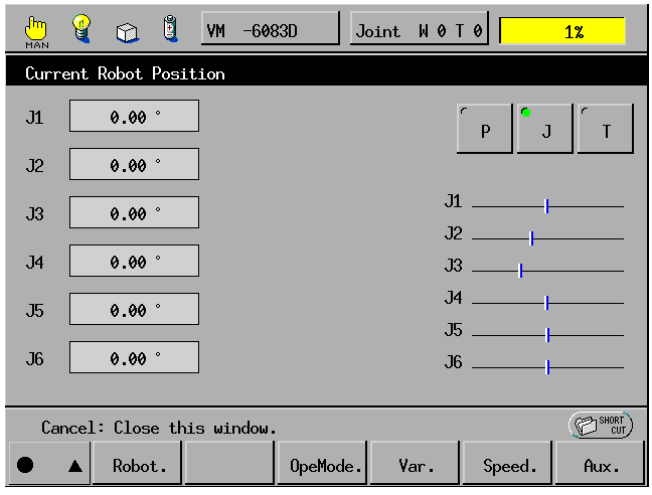
Step 1 On the top screen, press [F2 Arm].



F2

The Current Robot Position window appears as shown below.

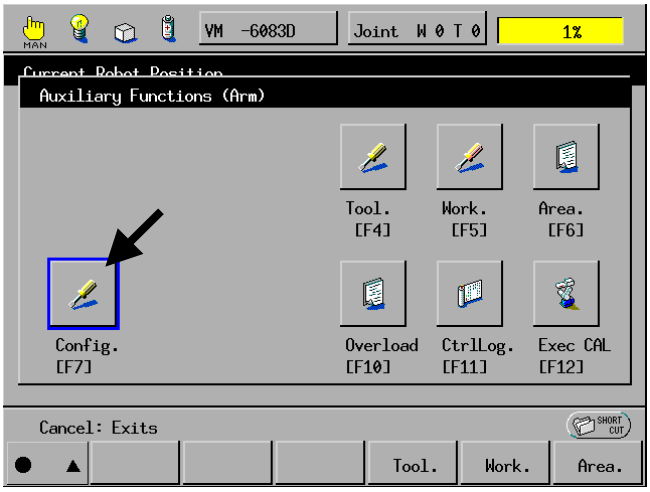
Step 2 Press [F6 Aux.].



F6

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

Step 3 Press [F7 Config.] on the Auxiliary Functions (Arm) window.

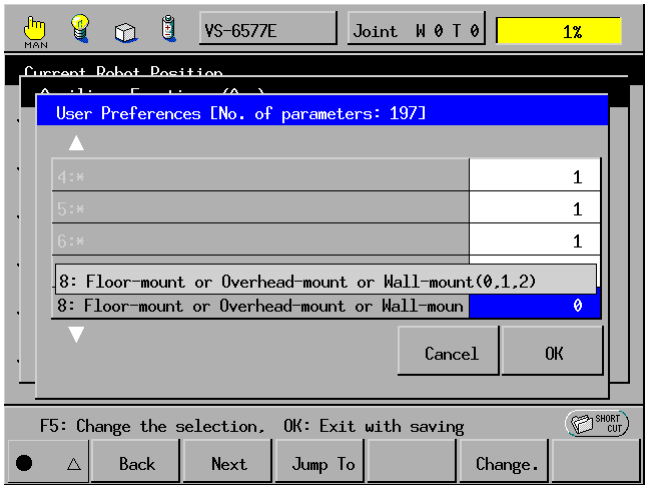


The User Preferences window appears as shown below.

Step 4 Select the "Floor-mount, Overhead-mount, or Wall-mount" area by using the jog dial or [F1 BACK] to [F3 Jump To].

The selected area will become highlighted.

Then press [F5 Change.].



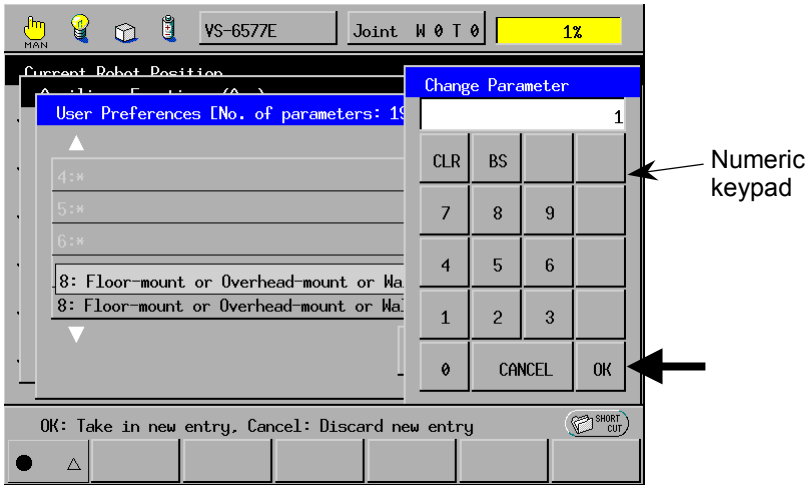
The numeric keypad appears as shown in the next step.

Step 5

Use numerical buttons on the numeric keypad to enter 0 for floor-mount, 1 for overhead-mount, or 2 for wall-mount.

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

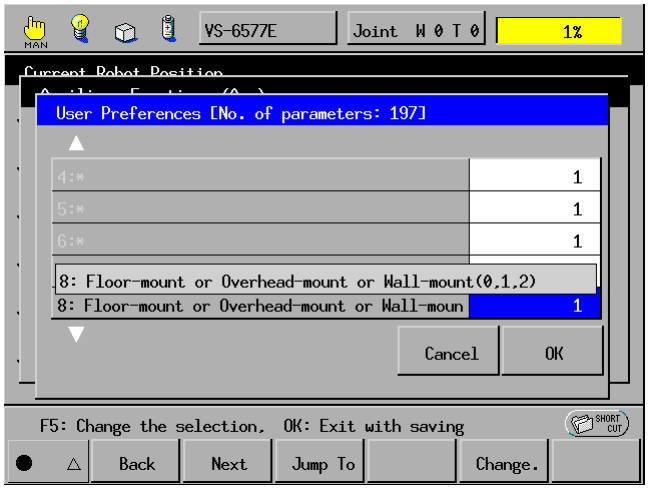
Check the entered value and press the OK button to enter it. To cancel entry made in this step and restore the previous setting, press the CANCEL button.



The numeric keypad disappears.

The newly entered value (0 for floor-mount, 1 for overhead-mount, or 2 for wall-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 6

In WINCAPSII, click the <Receive button in the Transfer Environments Table window. WINCAPSII will receive the master control parameters of the robot installation condition that have set with the teach pendant.

■ *In WINCAPSII*

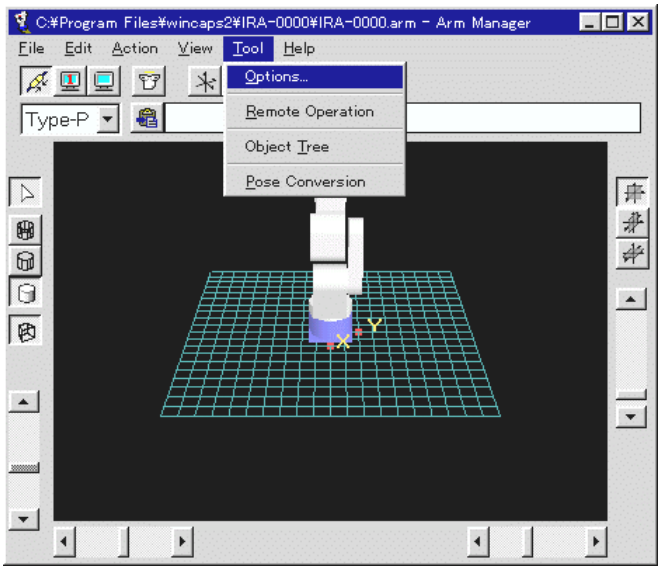
Before proceeding to the following procedure, run WINCAPSII System Manager. For details, refer to the WINCAPSII GUIDE, Chapters 1 to 3.

This section is intended for persons who have basic operating knowledge of Microsoft Windows95/98/NT4.0.

Step 1 Click the arm manager button in System Manager.

The Arm Manager window appears as shown below.

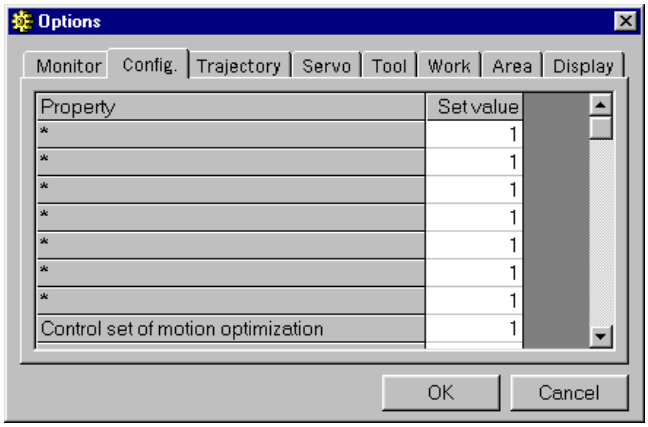
Step 2 On the Tools menu of Arm Manager, click Options.



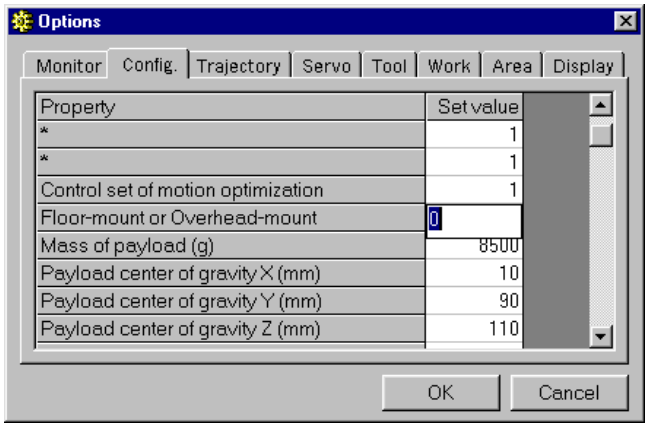
The Options window appears as shown in the next step.

NOTE: If no password has been entered, the Password dialog box appears. Select user level and type password. For details on password entry, refer to the WINCAPSII GUIDE, Section 1.3.

Step 3 On the Options window, click the Config. tab to display the conditions.



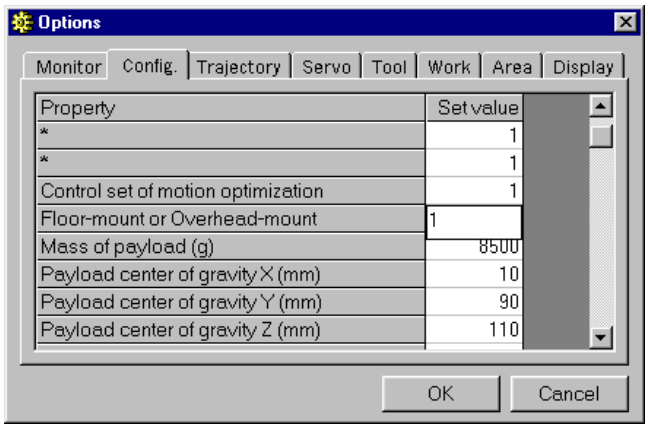
Step 4 Double-click the setting area of the "Floor-mount, Overhead-mount, or Wall-mount" to prepare it to accept a new entry.



Step 5

Enter the desired value (0 for floor-mount, 1 for overhead-mount, or 2 for wall-mount).

The newly entered value is displayed in the setting area.



Step 6

Click OK in the Options window to close it.

Step 7

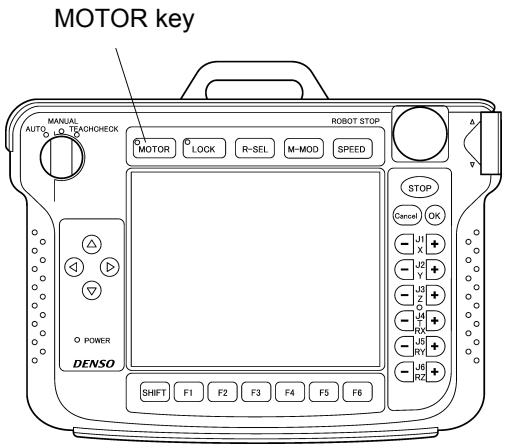
On the teach pendant, press the MOTOR key to turn the motor off.

The MOTOR lamp goes off.

CAUTION

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

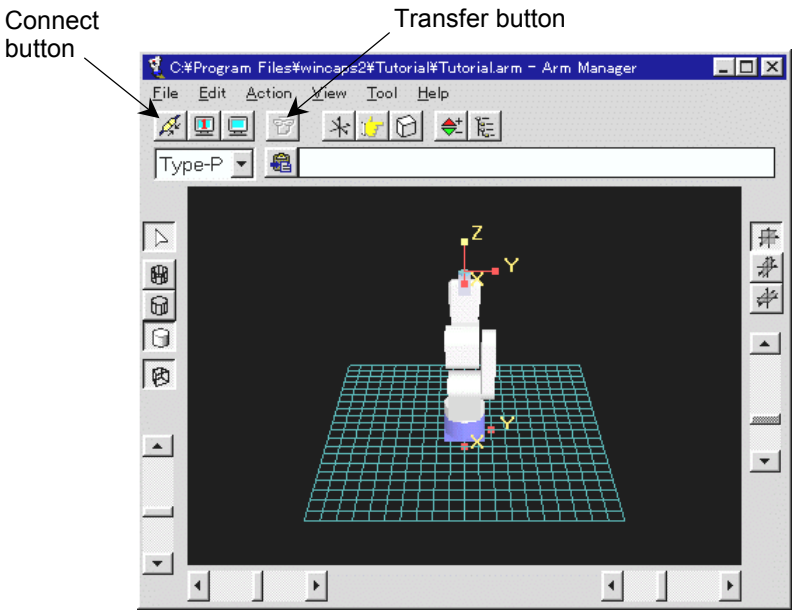
MOTOR key



Step 8

In Arm Manager, click the connect button.

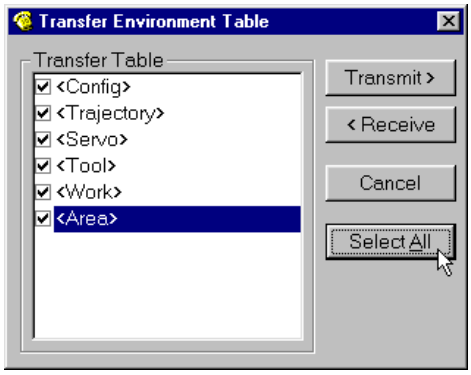
The connect button appears depressed.



Step 9

Click the transfer button in Arm Manager.

The Transfer Environments Table window appears as shown below.



Step 10

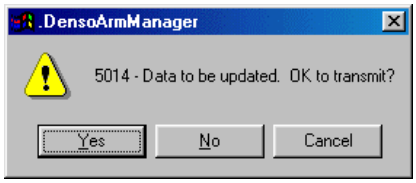
Click the Select All button in the Transfer Environments Table window to select all items.

All items will be marked with √.

Step 11

Click the Transmit> button in the Transfer Environments Table window.

The following dialog box appears.



NOTE: If you click the <Receive button in the Transfer Environments Table window, WINCAPSII will receive the master control parameter values currently stored in the Arm Manager area of the robot controller. The local control parameters that are stored in the temporary area of the robot controller and may be modified in application programs cannot be transferred to WINCAPSII.

Step 12

Click the Yes (Y) button in the above dialog box to send the data to the robot controller.

2.11 Configuration List

The table below lists the items displayed in the User Preferences window of the teach pendant (Access: [F2 Arm]—[F6 Aux.]—[F7 Config.]) or in the Config. tab of the Options window in WINCAPSII (Access: [Arm Manager]—[Tools Menu]—[Options]—[Configuration]).

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, Section 4.6, "Control Sets of Motion Optimization.")	Can be set with aspChange ().
8	Floor-mount, Overhead-mount, or Wall-mount	0	Last value at powering-off	0: Floor-mount 1: Overhead-mount 2: Wall-mount (Ver. 1.6 or later)	Required for 6-axis robots.
9	Mass of payload (g)	Differs depend-ing 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, 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, 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, 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 (Refer to the WINCAP□ GUIDE, Section 10.7.3, “Setting the Ring Buffer for Preserving Data.”)	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 (Refer to the WINCAP□ GUIDE, Section 10.7.3, “Setting the Ring Buffer for Preserving Data.”)	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.
27	Control method (For HM/HS series)	0	Last value at powering-off	1: P-control (Refer to the INSTALLATION & MAINTENANCE GUIDE, “Switching to the Vibration Suppression Control”.) H*-D series: Refer to the section 4.7. H*-E series: Refer to the section 2.7.	Make sure that the "Changing accel mode" is set to 0.
28	High-inertia configuration (For HM/HS series)	0	Last value at powering-off	1: Loop gain set to high-inertia (Refer to the INSTALLATION & MAINTENANCE GUIDE, “Setting the High-Inertia Configuration”.) H*-D series: Refer to the section 4.8. H*-E series: Refer to the section 2.8.	Make sure that the "Changing accel mode" is set to 0 and the "Mass of payload (g)" is 10000.
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.
34	Motor power holding function	1	Last value at powering-off	Sets the motor power state when the Auto Enable switch is switched. 0: Turns the motor power OFF if it was ON 1: Keeps the current state of the motor power	

No.	Items	Factory default	Powering-on default	Description	Comments
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.
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. (Ver1.9 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. (Ver1.9 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. (Ver1.9 or later)
233	Setting of real time belt cutting detection	0	Last value at powering-off	Parameter for the individual robot	(Ver1.9 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. (Ver1.9 or later)
235	Reserved	0	Last value at powering-off	Reserved parameter for the extended function	(Ver1.9 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. (Ver1.95 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. (Ver1.95 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.	(Ver.1.98 or later)
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)

Chapter 3

General Introduction to Operation Modes and Machine Lock

This chapter describes the three operation modes of the robot: Manual mode, Teach check mode, and Auto mode. It also describes machine lock used for simulation.

NOTE 1: This chapter uses the abbreviations (TP), (OP), (MP), and (WC) which inform you that operations marked with those abbreviations can be performed from the teach pendant, operating panel, mini-pendant, and in WINCAPSII, respectively.

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

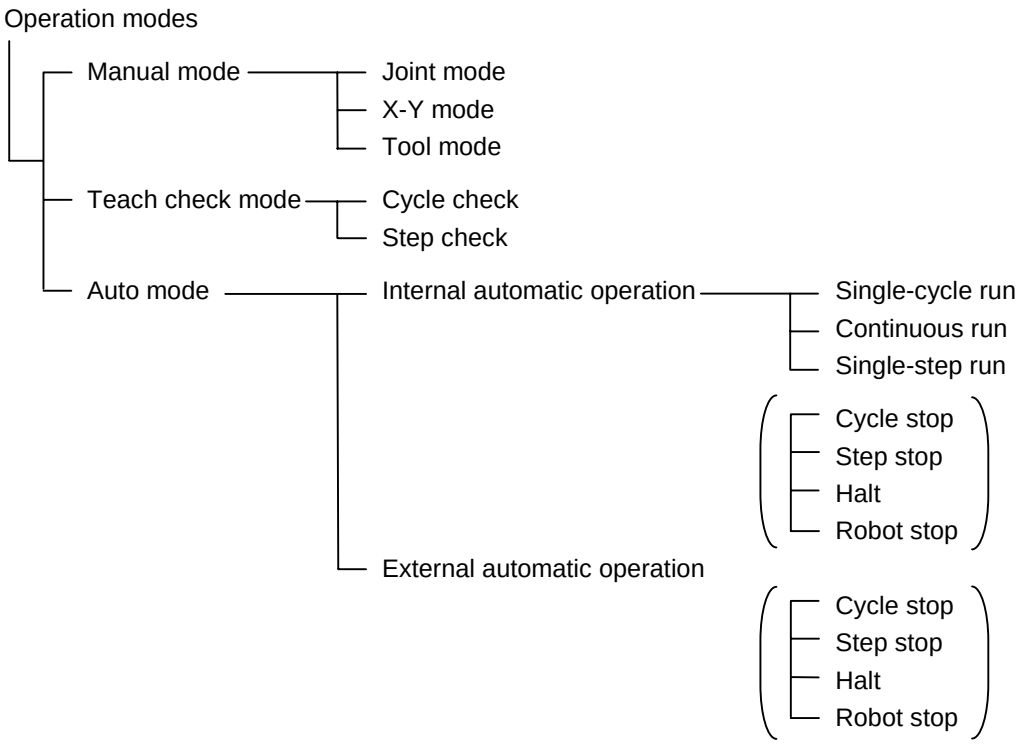
NOTE 3: Touch the teach pendant, operating panel, or mini-pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

3.1 Operation Modes and Machine Lock

The robot offers three operation modes--Manual mode, Teach check mode, and Auto mode. Manual mode allows you to run the robot manually from the teach pendant or operating panel. Teach check mode provides restricted automatic operation in which you may make a final check of programs with the teach pendant after teaching. Auto mode allows the robot to run automatically.

Manual mode, Teach check mode, and Auto mode are described in Sections 3.2, 3.3, and 3.4, respectively.

The teach pendant or mini-pendant supports all of the above three modes. The operating panel supports Manual mode and Auto mode. The mode switch on the operating panel has three positions (MANUAL, AUTO, and TP). When you use the teach pendant connected to the operating panel, set the mode switch of the operating panel to the TP position.



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

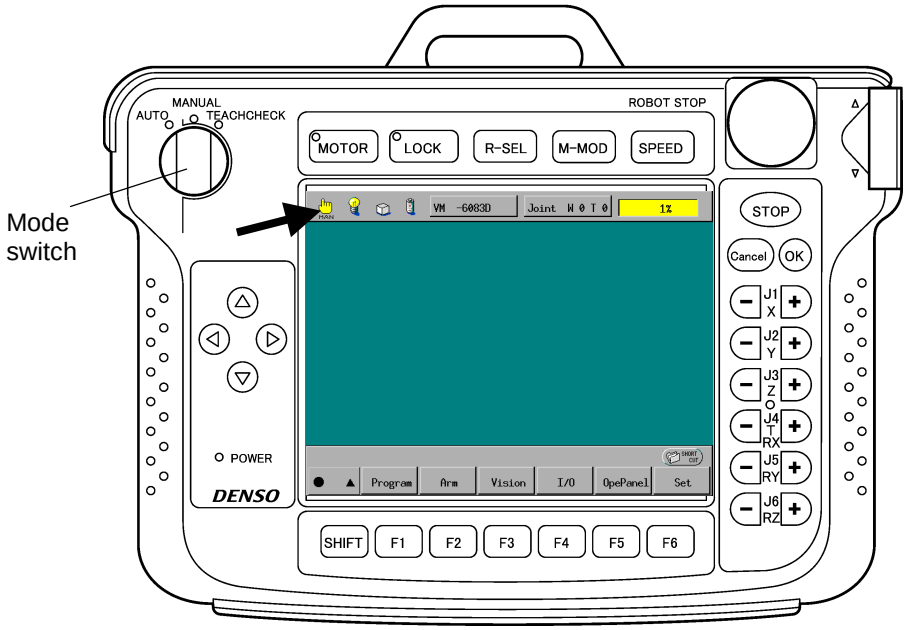
When the robot is in machine lock, you may restrict the I/O output. For details, refer to Section 5.5, "Displaying I/O Signals and Simulating Robot Motion."

3.1.1 Switching Between Operation Modes (TP/OP/MP)

Operating procedure

■ ***From the teach pendant***

Step 1 Turn the mode switch to the desired mode position.



The selected mode icon appears in the leftmost area of the status bar.

: Internal Auto mode,

: External Auto Mode

: Manual mode,

Teach check mode

■ ***From the operating panel***

Step 1 Turn the mode switch to the desired mode position.

The selected mode lamp comes on.

NOTE: If the mode switch is set to the TP position, the operating panel shows the following on the LCD and no longer accepts entry except from the STOP and ROBOT STOP keys.

TP MODE ACTIVE

■ ***From the mini-pendant***

Step 1 Turn the mode switch to the desired mode position.

3.1.2 Machine Lock (TP/MP)

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.

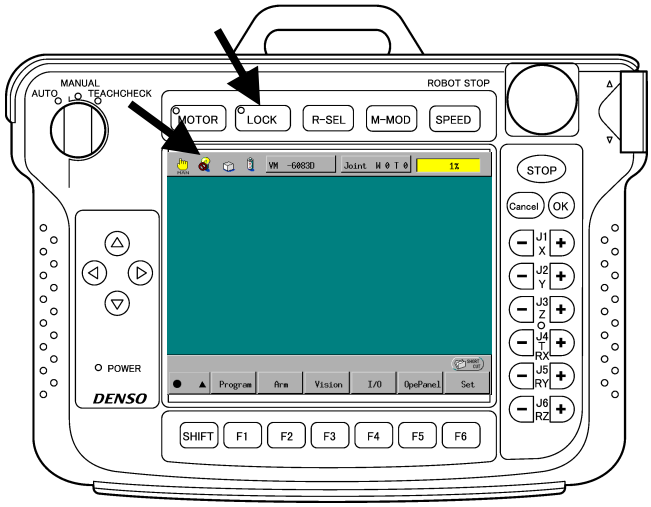
NOTE: The cycle time calculated may be shorter than the actual one since End motion (@0 option) will apply when the machine is locked. For details, refer to the PROGRAMMER'S MANUAL, Subsection 3.2.5.

Operating procedure

■ ***From the teach pendant***

NOTE: If the motor power is on, press the MOTOR key 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 LOCK key.



The machine becomes locked and the LOCK lamp comes on.

According to the output restriction conditions of I/O signals, the dummy input icon on the status bar will change.

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

Step 2 Press the LOCK key again.

The lock is released and the LOCK lamp goes off.

■ ***From the mini-pendant***

Step 1 Refer to Subsection 6.2.2.

3.2 Manual Mode (TP/OP/MP)

In Manual mode, you may run the robot manually or manage robot controller output signals manually from the teach pendant, operating panel, or mini-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 Manual mode.

3.2.1 Running the Robot Manually

You may run the robot manually from the teach pendant, operating panel, or mini-pendant in any of the three modes--Joint mode, X-Y mode, and Tool mode.

NOTE: To run the robot manually, the system-input port "Enable Auto" on pin 4 of connector CN8 is required to be OFF (opened). (Refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.1 and 5.5.4.1.)

Run the robot manually when

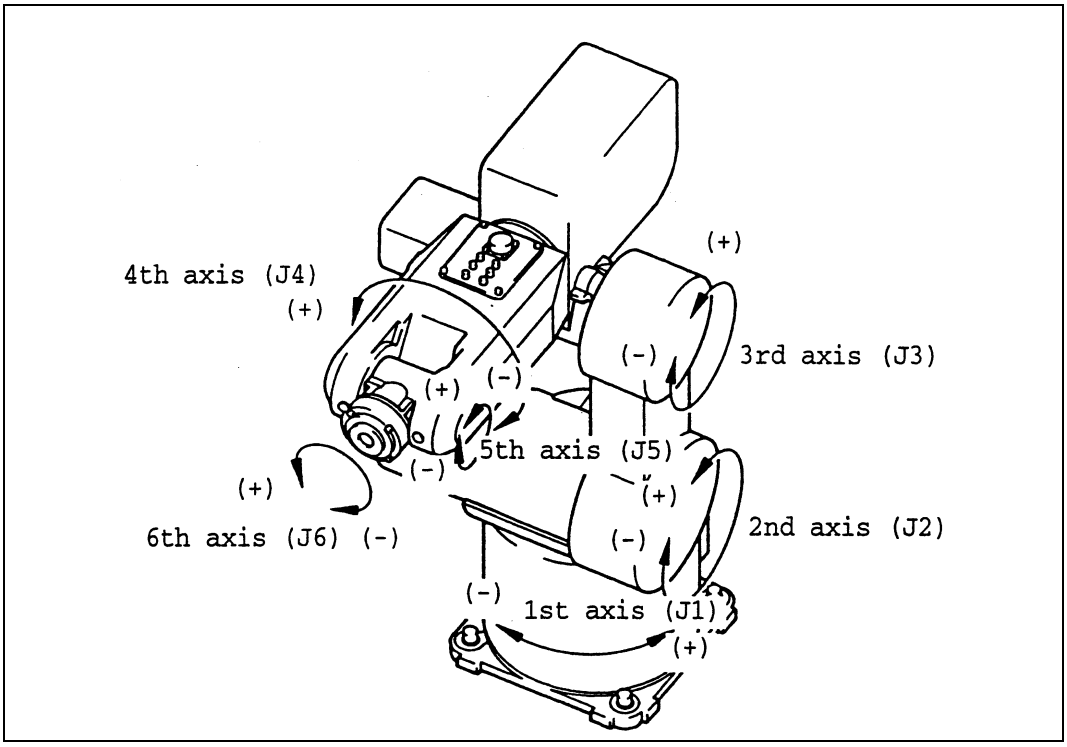
(1) Moving the robot flange (the end of the robot arm) to access an object point after CAL operation.

(2) Moving the robot flange to a position where Teach Check 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

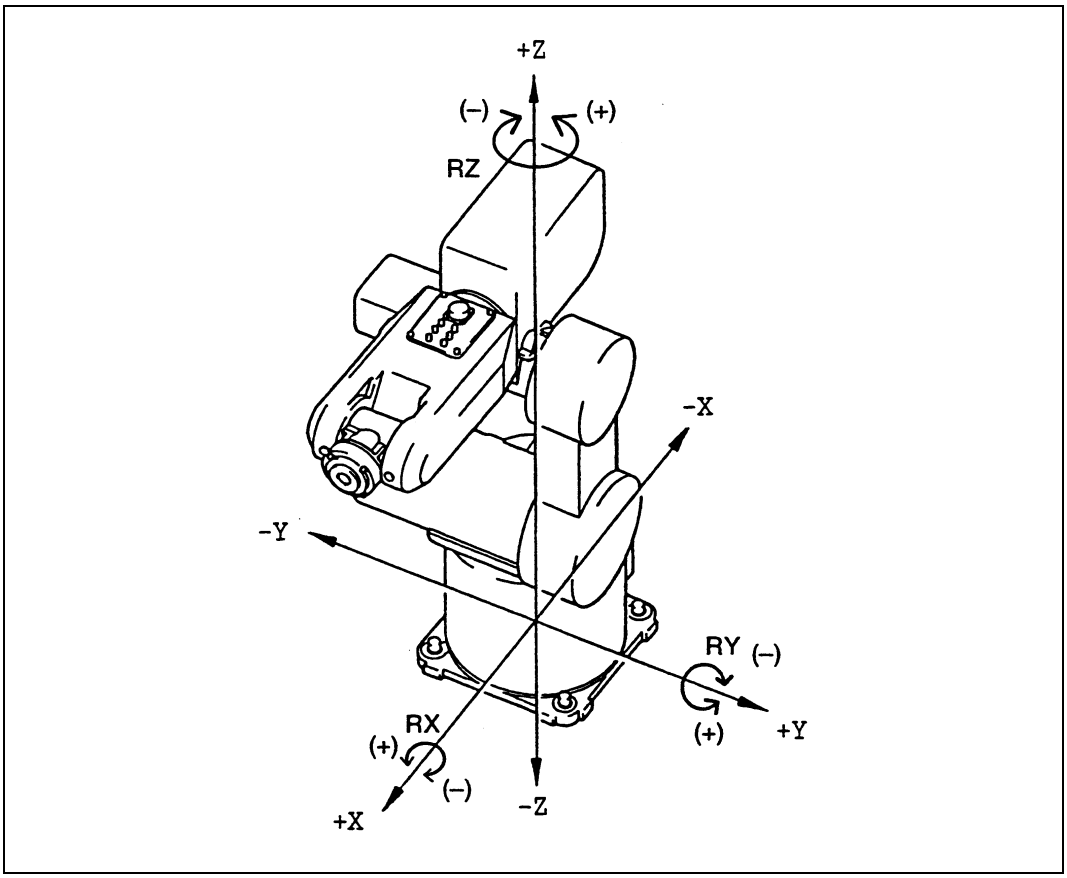
[2] X-Y mode

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

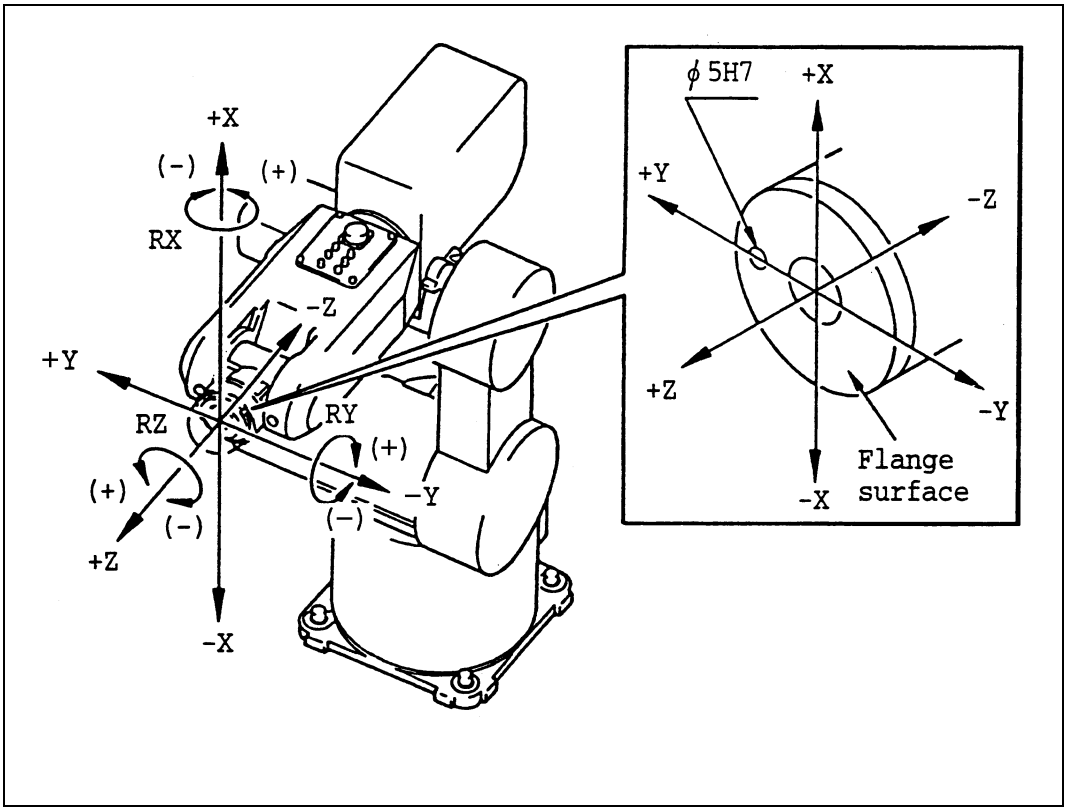
[3] Tool mode

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.

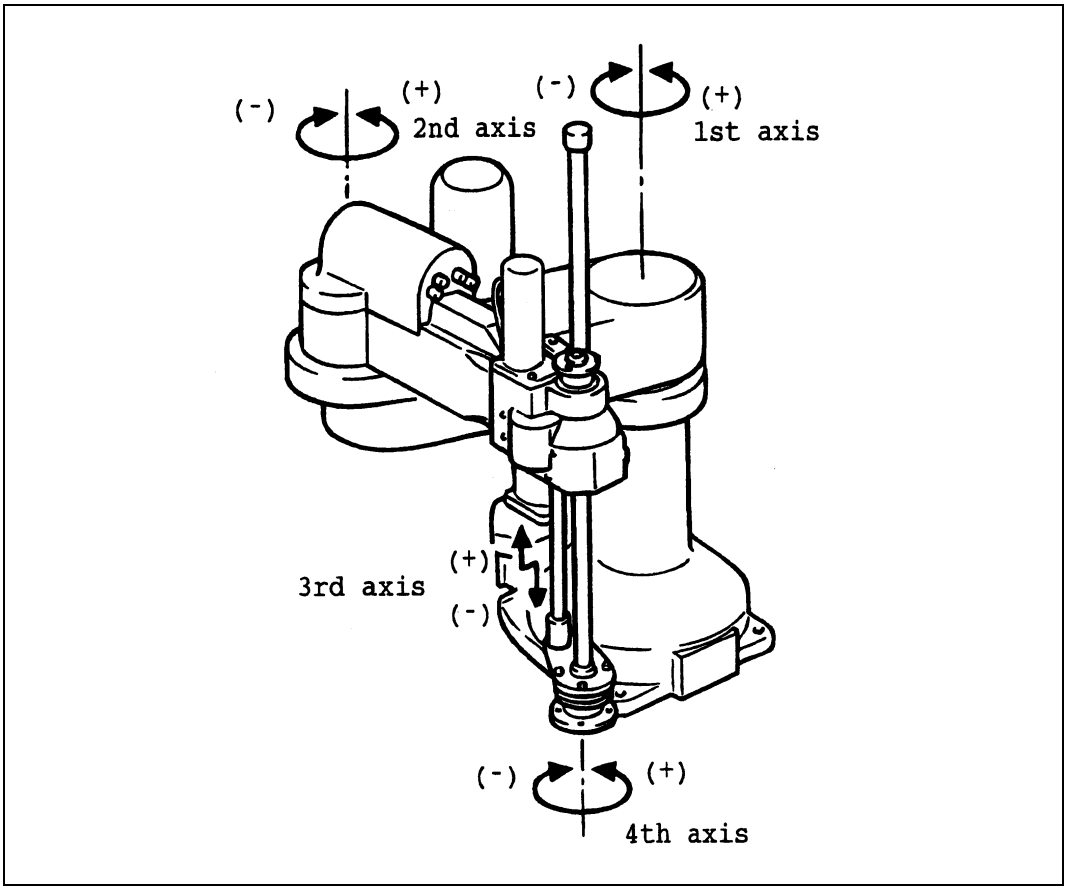


Movements in Tool Mode

4-axis robot

[1] Joint mode

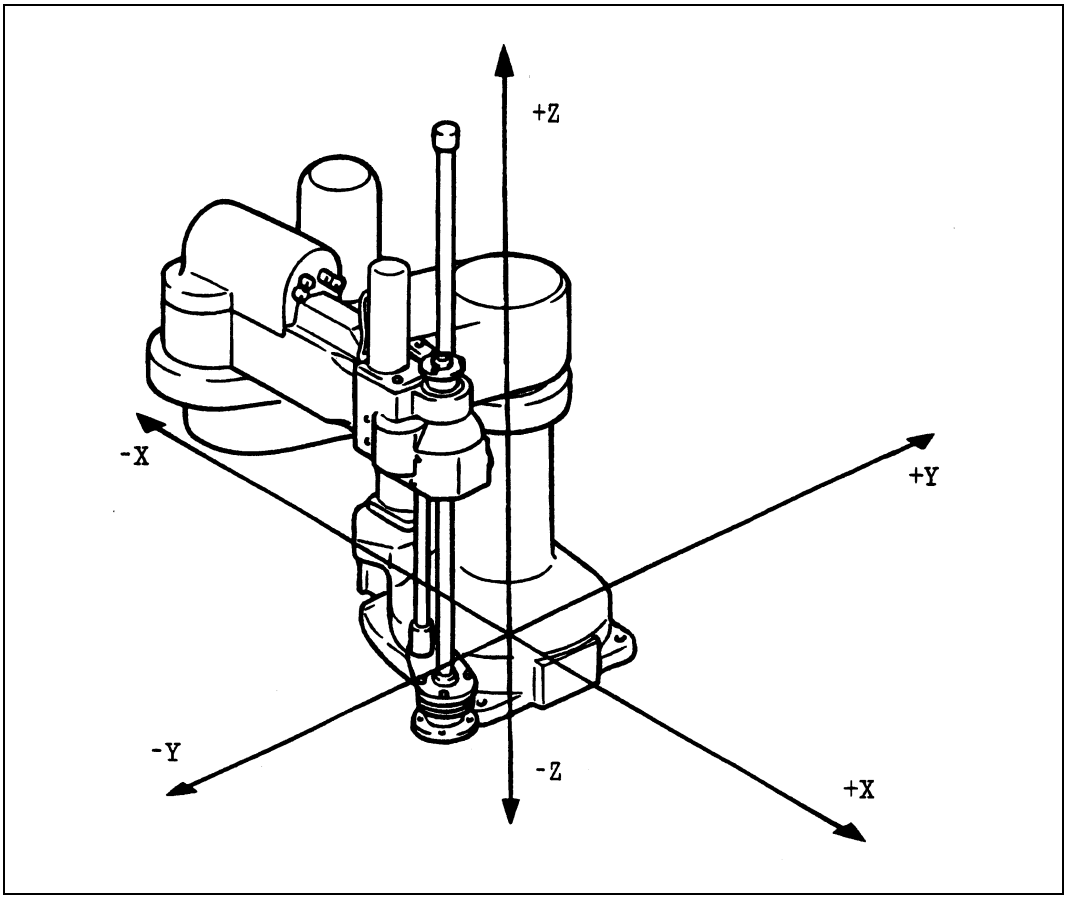
The figure below shows movement of the robot in joint mode, in which arms can be operated individually. This mode also enables each operation was carried out.



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.



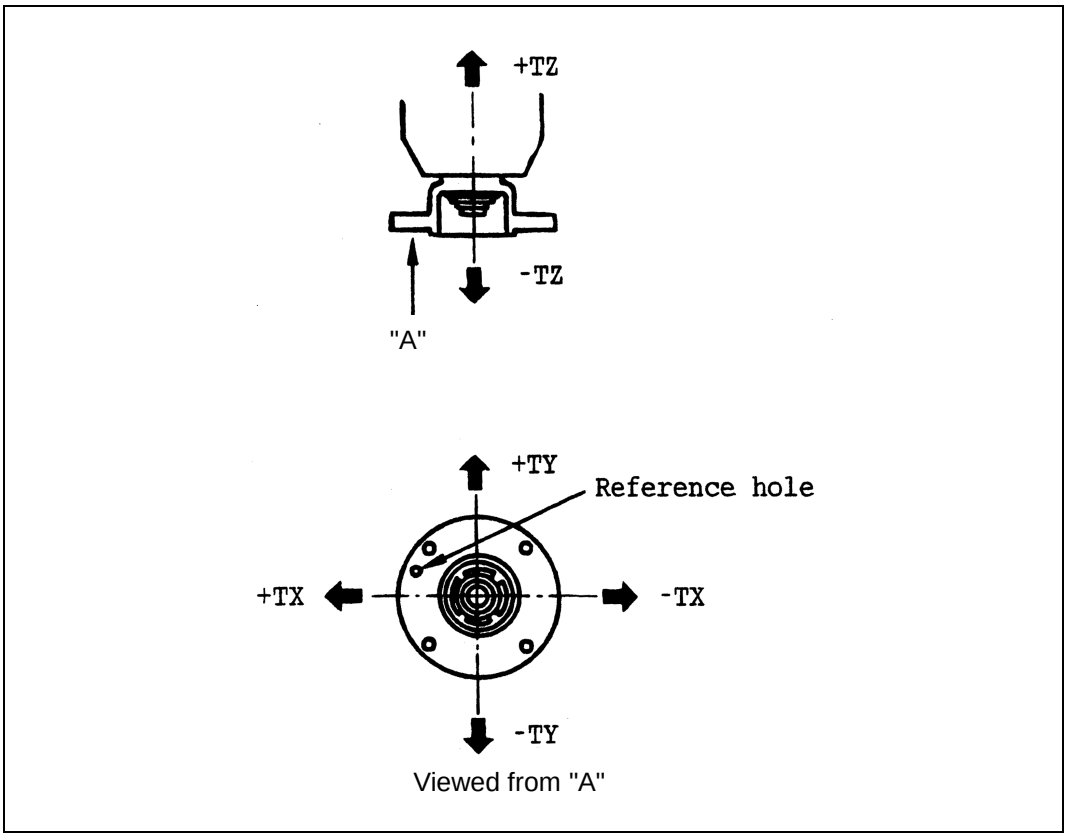
Movements in X-Y Mode

[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

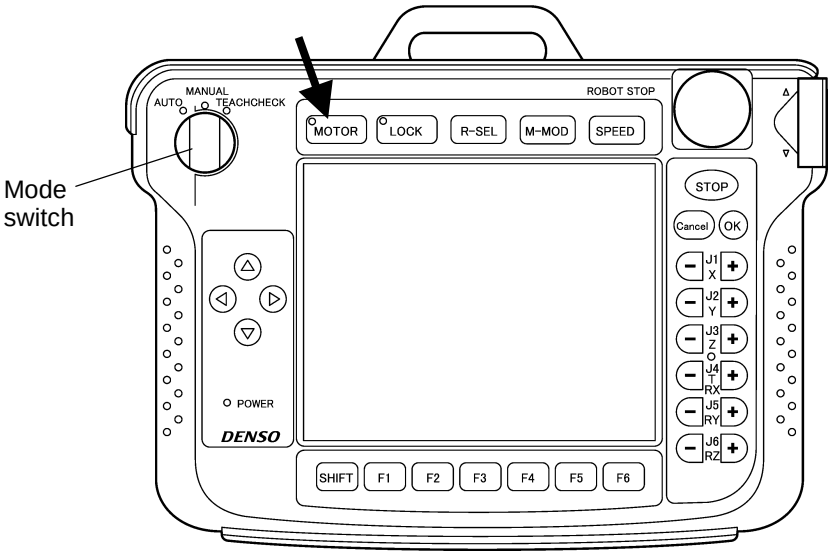
Operating procedure

⚠**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.

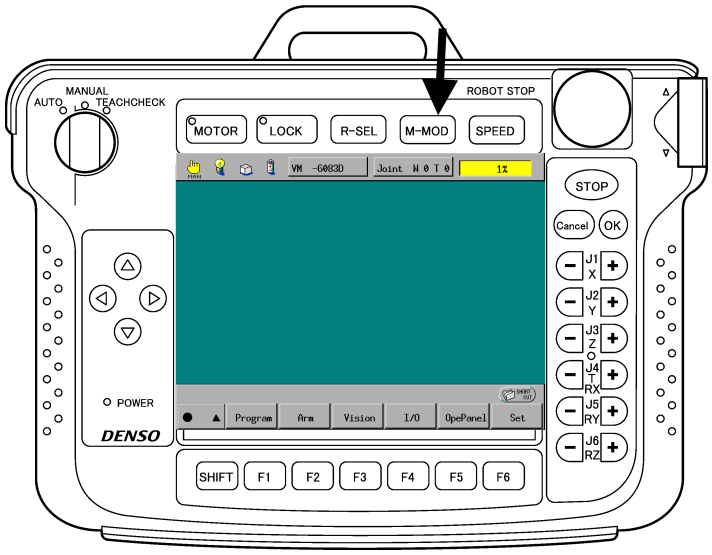
■ *From the teach pendant*

Step 1 Set the mode switch to the MANUAL position.



Step 2 Press the MOTOR key to turn the motor on.

Step 3 Press the M-MOD key.

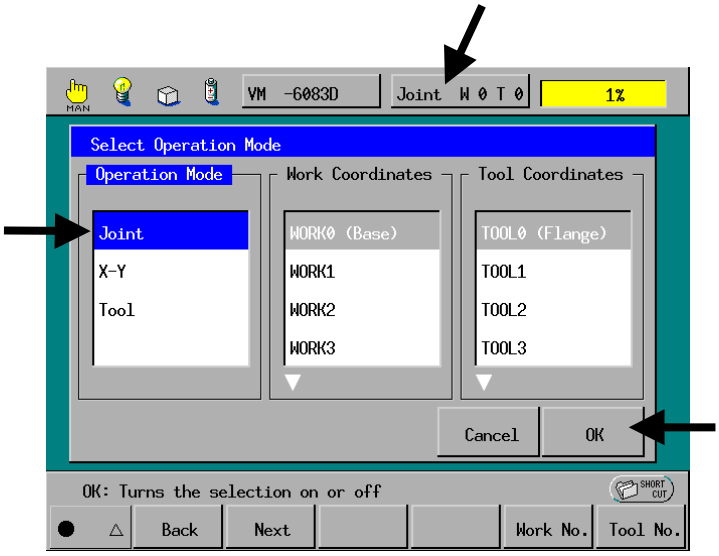


The Select Operation Mode window appears as shown in the next step.

Step 4

Select the desired operation mode by using the cursor keys or touching the screen directly.

In the mode area of the status bar appears the selected operation mode.



Step 5

While holding down the deadman switch, 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.

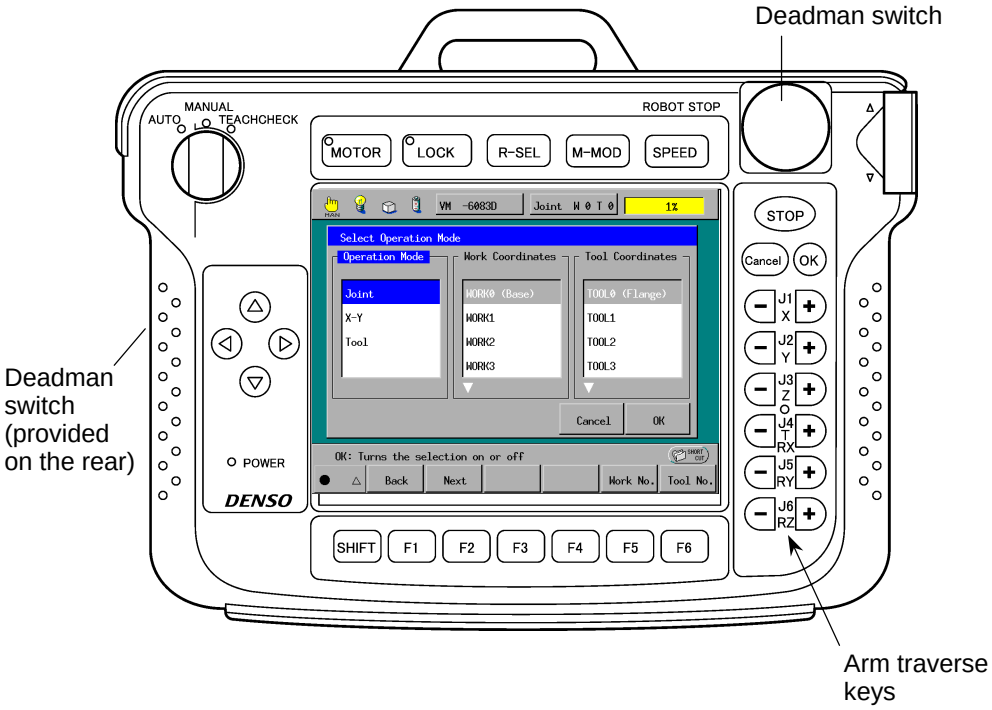


Table 3-1. Arm Traverse Keys and Driven Axes

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	

■ ***From the operating panel***

Step 1

Set the mode switch to the MANUAL position.

The MANUAL lamp comes on.

Step 2

Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 3

Press the M-MOD key to select the desired operation mode.

NOTE: The default when the robot controller is turned on is Joint mode.

NOTE: The most recently defined work coordinates or tool coordinates will apply and they cannot be changed from the operating panel.

Step 4

While holding down the deadman switch, 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 3-2.

TIP: You may press more than one arm traverse key at the same time.

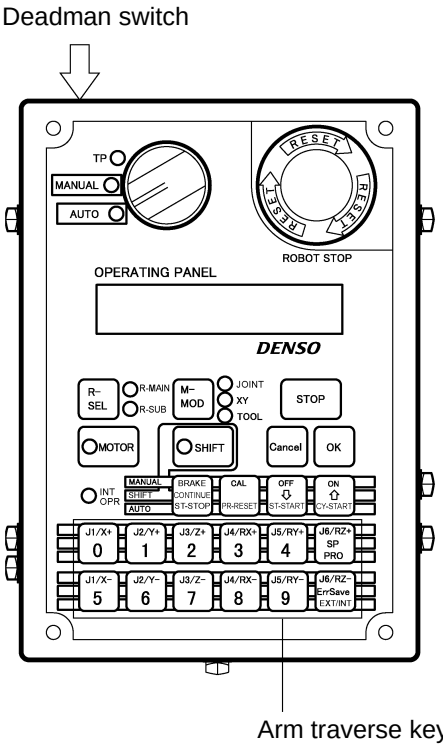


Table 3-2. Arm Traverse Keys and Driven Axes

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	

■ ***From the mini-pendant***

Step 1 Set the mode switch to the MAN position.

Step 2 Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 3 Select the desired operation mode and the desired work coordinates or tool coordinates.

Refer to Chapter 6, Subsections 6.2.4, 6.2.5 and 6.2.7.

Step 4 While holding down the deadman switch, 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 3-3.

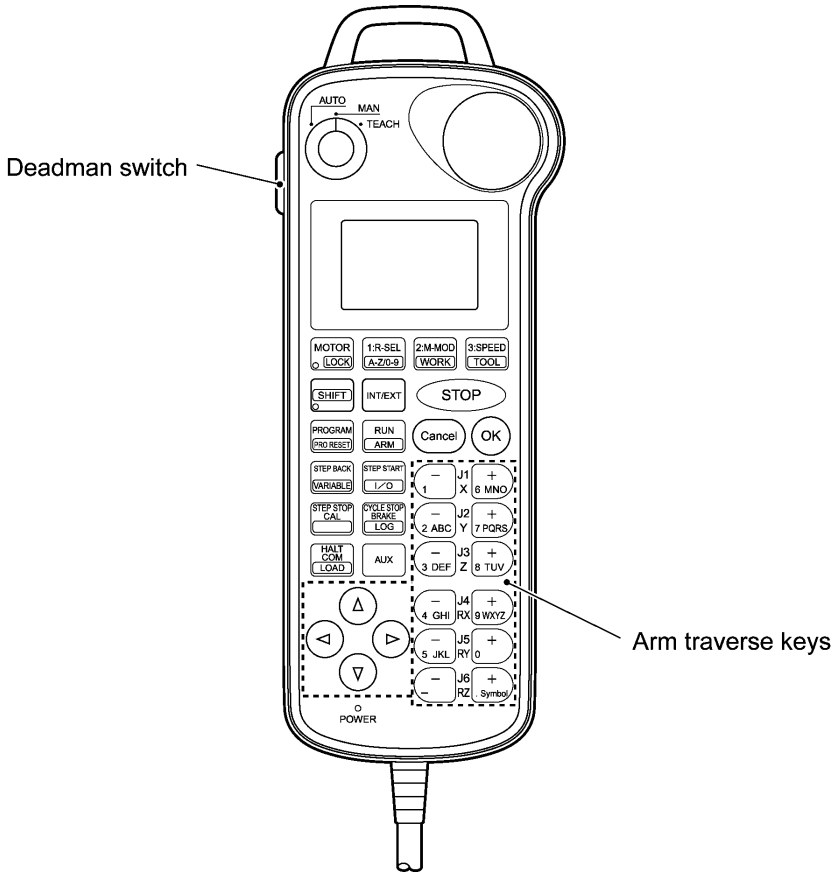


Table 3-3. Arm Traverse Keys and Driven Axes

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 (TP/OP/MP)

You may manually manage output signals from the robot controller (which is equipped with user-I/O ports and system-I/O ports), with the teach pendant, operating panel, or mini-pendant.

Manage robot controller output signals when

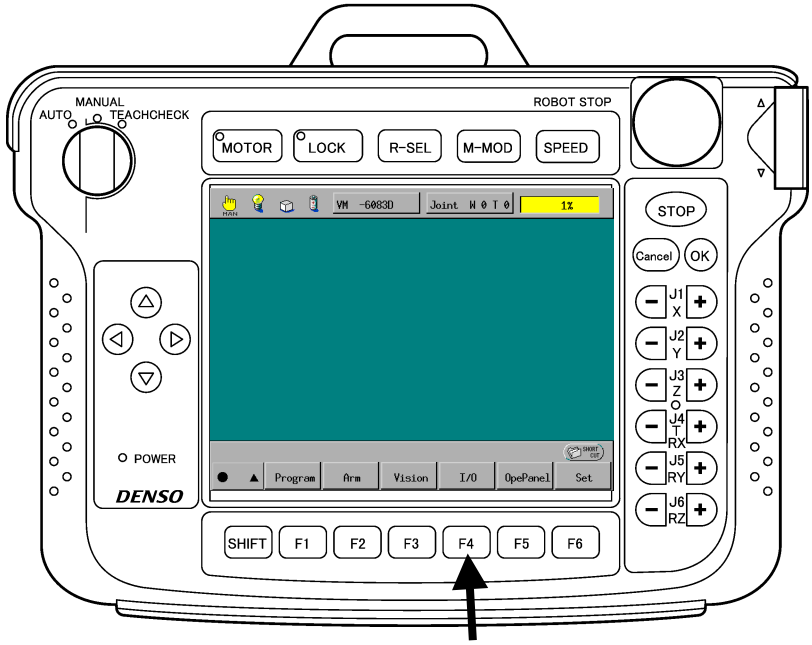
You need to turn output signals on or off without running programs.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the MANUAL position.

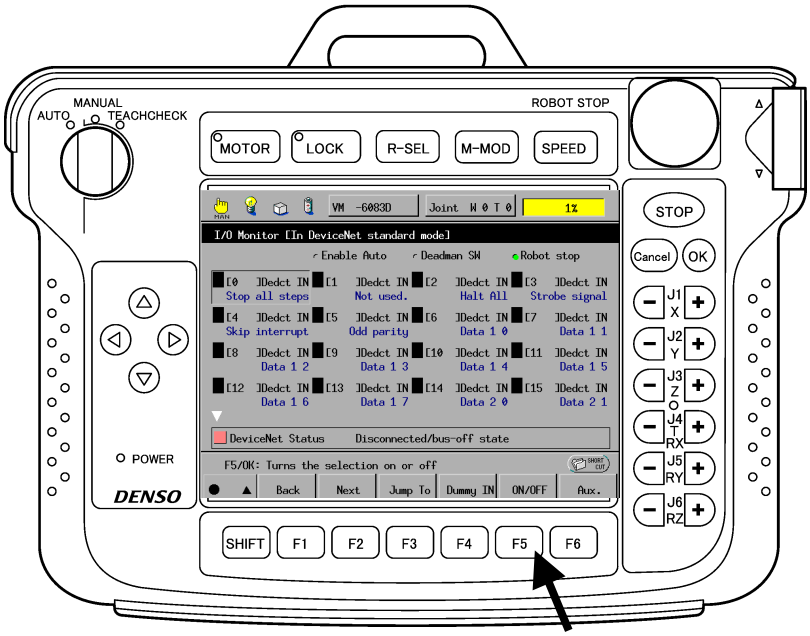
Step 2 Press [F4 I/O].



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

Step 3 Display a target output signal, by scrolling the screen with the cursor keys, jog dial, [F1 BACK], or [F2 NEXT].

TIP: You may press [F3 Jump To] to call up the numeric keypad where you may then enter the output port address. Doing so will directly call up the target output signal.

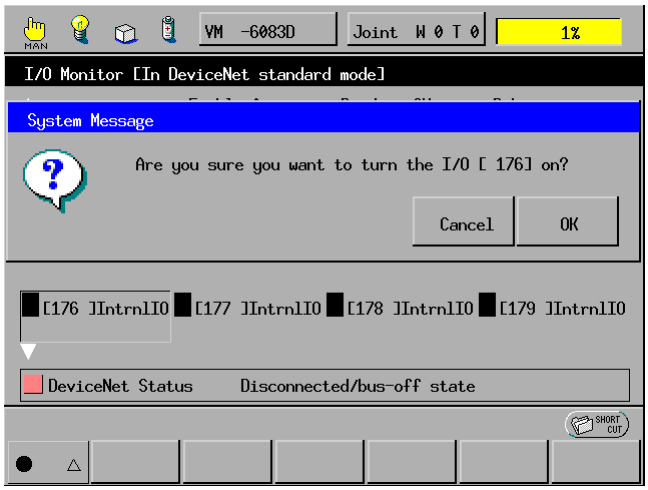


The I/O Monitor window appears as shown below.

Step 4 Select the target output signal by using the cursor keys or touching the screen directly.

Step 5 On the above window, press [F5 ON/OFF] (or OK key) to toggle the selected signal on or off.

The system message dialog box appears as shown below.



Step 6 Check the ON/OFF state of the target output signal, then press the OK button while holding down the deadman switch.

To manage other output signals, go back to Step 4.

To finish this procedure, press the Cancel button.

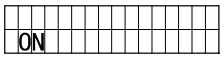
■ ***From the operating panel***

Step 1 Set the mode switch to the MANUAL position.

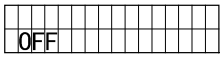
The MANUAL lamp comes on.

Step 2 Press the ON or OFF key to turn a target output signal on or off, respectively.

The LCD shows the following:

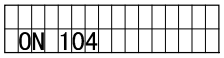


or



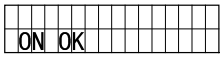
Step 3 Select the target output signal by using numerical keys.

Example: To turn on output port address 104, press the 1, 0, and 4 keys. Then the following appears on the LCD:



To cancel new entry, press the Cancel key.

Step 4 Check the ON/OFF state of the target output signal, then press the OK key while holding down the deadman switch.



■ ***From the mini-pendant***

Step 1 Refer to Chapter 6, Subsection 6.2.14.

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.

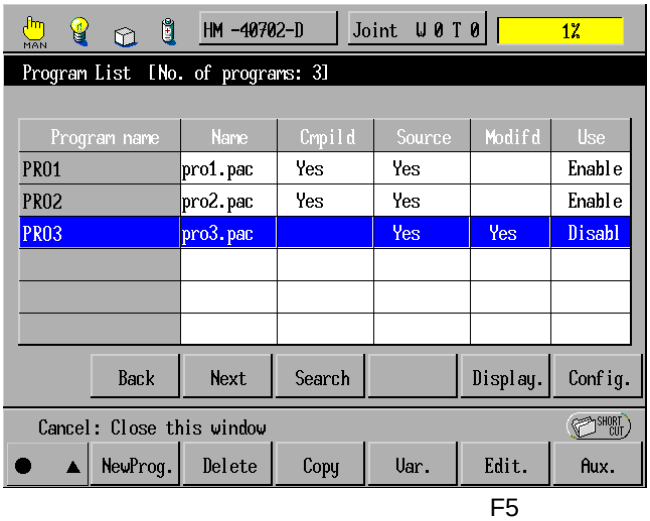
■ ***From the teach pendant***

Step 1 Set the mode switch to the MANUAL position.

Step 2 Press [F1 Program].

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

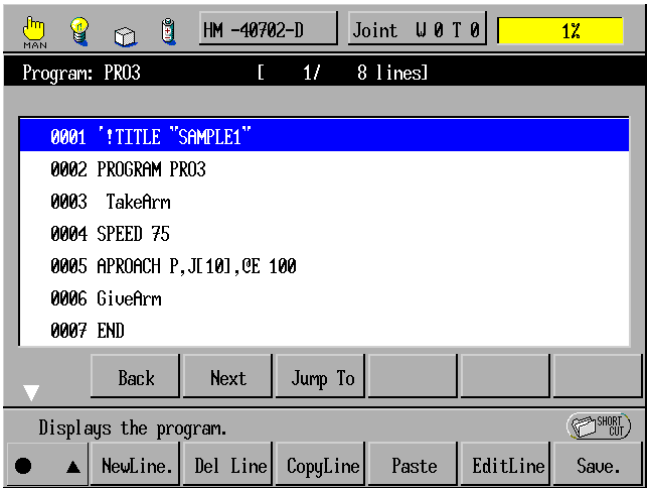
Step 3 Select the task program you want to edit, by using the cursor keys or jog dial or by touching the screen directly. Then press [F5 Edit.].



F5

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

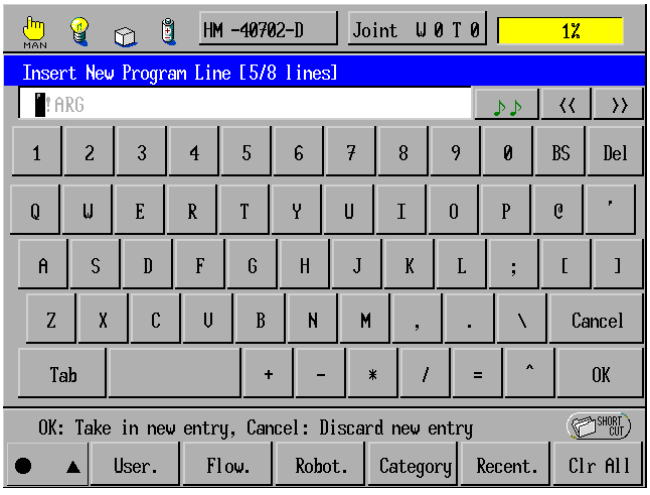
Step 4 Move the cursor to the line after which you want to insert a new line, then press [F1 NewLine.]. Or move the cursor to the line you want to edit, then press [F5 EditLine].



F1 F5

The program code entry window appears as shown below.

Step 5 Press [F4 Category].



F4

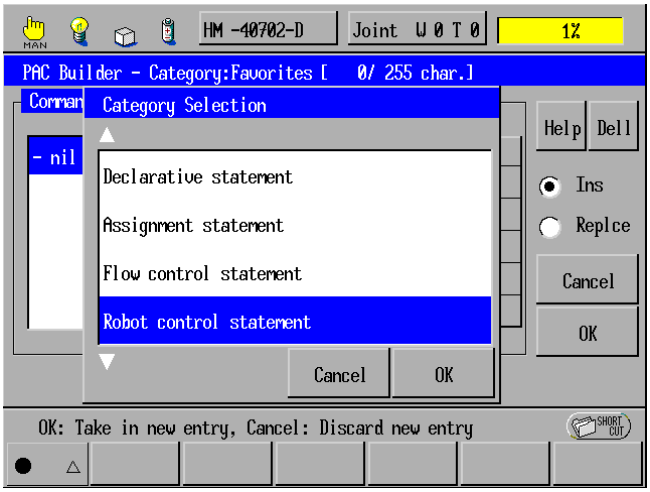
The Category Selection window appears as shown in the next step.

Step 6

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.

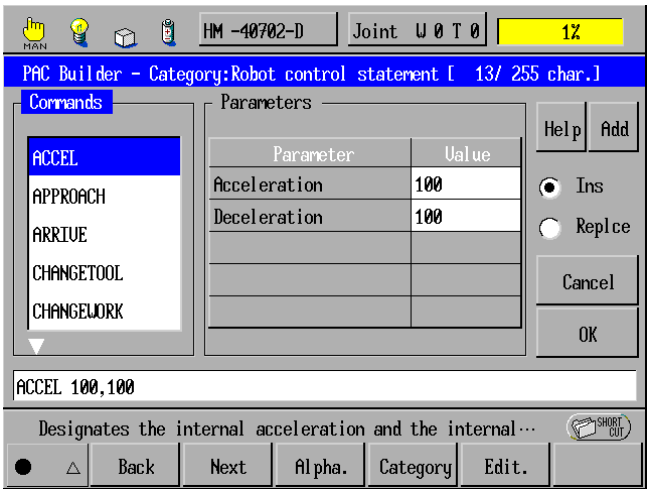


★Tip★ In step 5, on the Insert New Program Line window or on the Edit Program window:

- [F1 User.] is a shortcut key to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
- [F2 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).
- [F3 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).
- [F5 Recent.] is a shortcut key to a list of commands in the most recently selected category.

Step 7

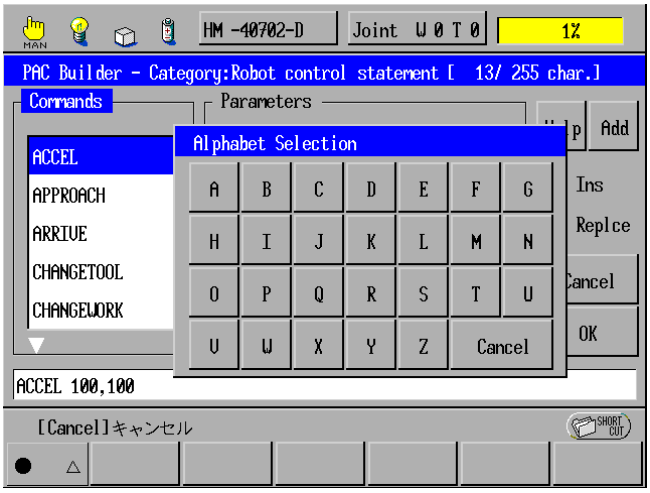
Scroll the Commands window that shows commands contained in the selected category and choose the desired command.



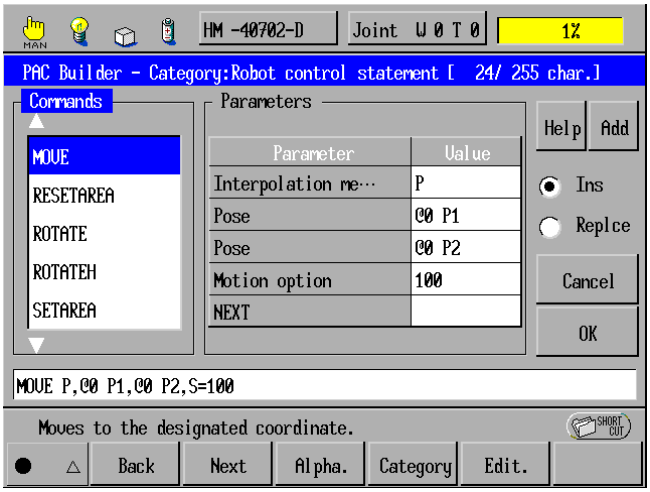
F3

If you do not remember the name of the necessary command, press [F3 Alpha.].

The Alphabet Selection window will appear as shown below.

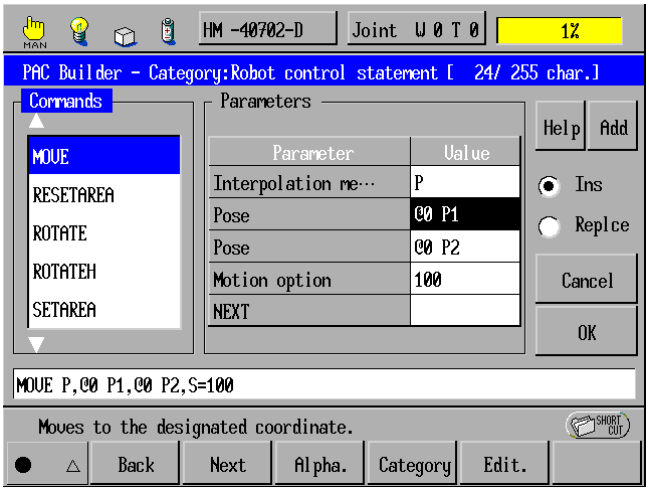


Choose a leading character of the desired command on the above window, and a command(s) starting with it will be automatically displayed.



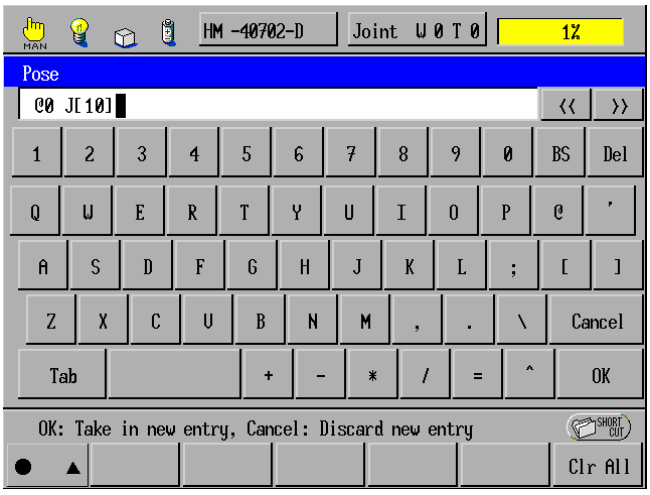
Step 8

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 [F5 Edit.].



F5

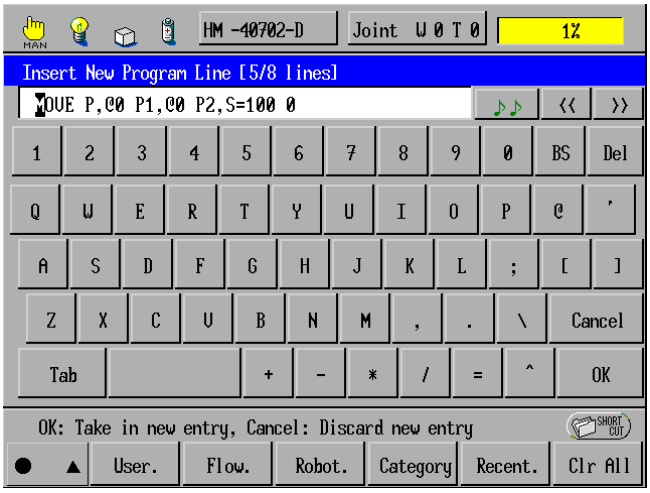
The parameter entry screen will appear as shown below, where you edit parameter values. (After editing, press the OK button, and the screen will return to the Commands window.)



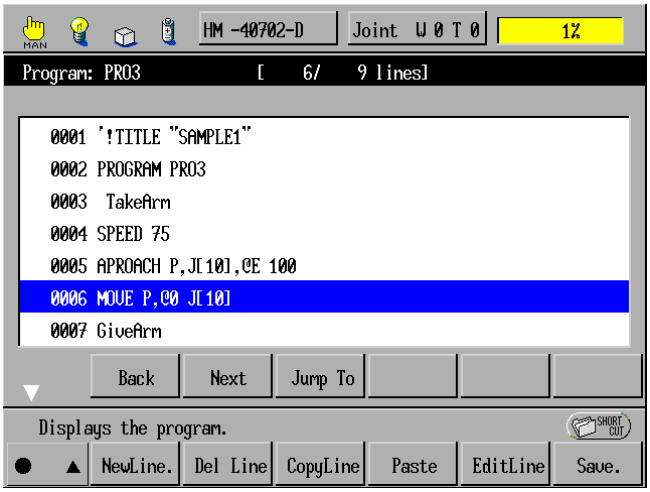
Some parameter values may not be cleared. Therefore, even if no specification of the initial value is required such as DEFINT ix=0, you need to enter for the initial value substitution area once.

If you do so, press the OK button and then delete unnecessary character strings in Step 9.

Step 9 If it is necessary to modify other parameter values, choose the target parameter and repeat Step 8. Upon completion of parameter editing, press the OK button. The screen will return to the program code entry screen.

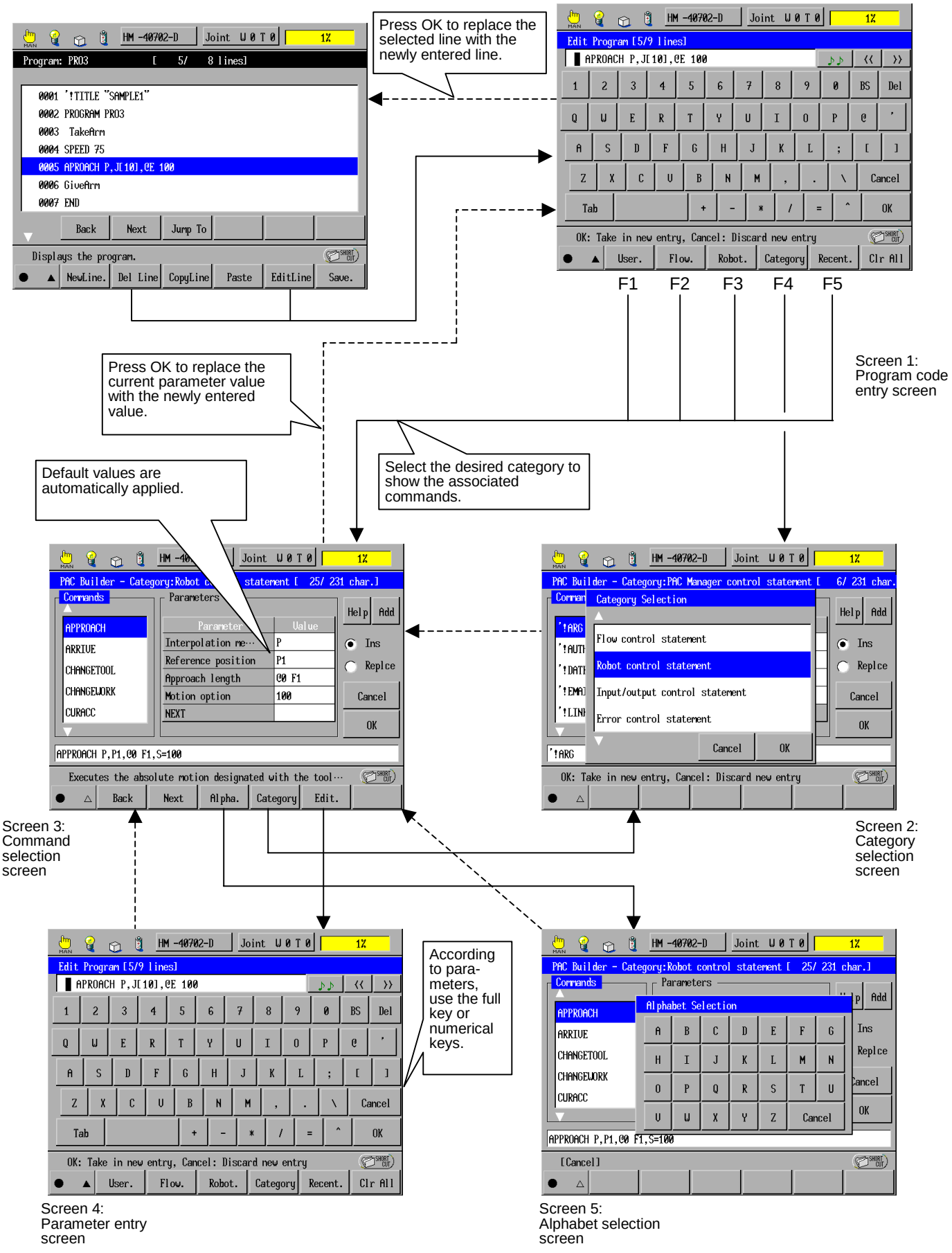


Step 10 Edit the program, e.g., by deleting unnecessary parameters, according to your needs. Then press the OK button, and the screen will return to the program coding list.



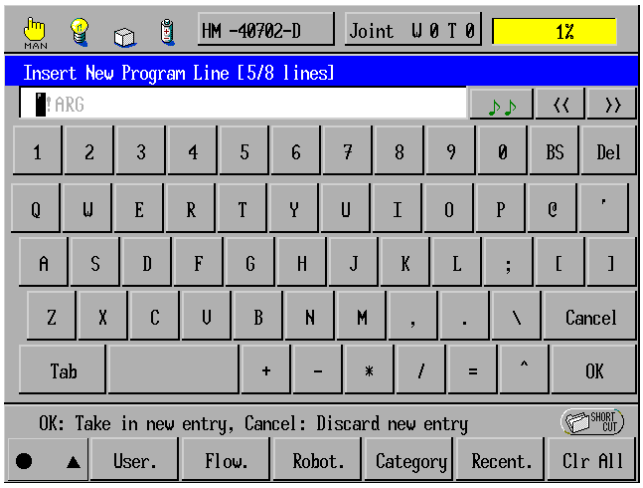
Command Builder

Operating flow of command builder



Program code entry screen

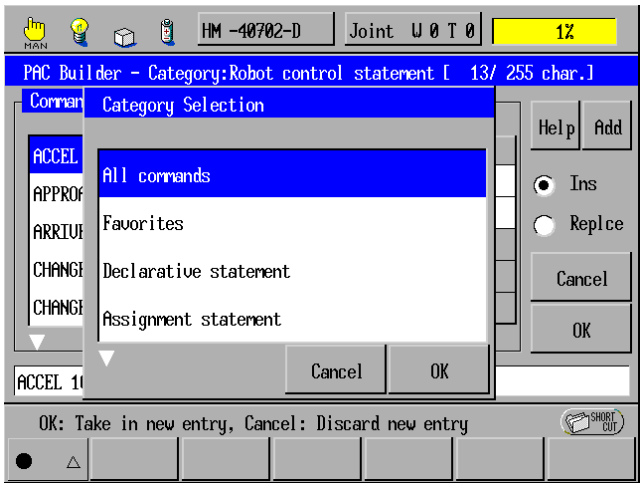
On the program code entry screen, you may edit character strings to be inserted as a new program line or to be replaced with the current program line.



[F1 User.]	Shortcut key to the favorite command window (that can be called up by choosing the "Favorites" on the Category Selection window).
[F2 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).
[F3 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).
[F4 Category]	Displays the Category Selection window.
[F5 Recent.]	Shortcut key to a list of commands in the most recently selected category.
[F6 Clr All]	Clears all characters being entered.

Category selection screen

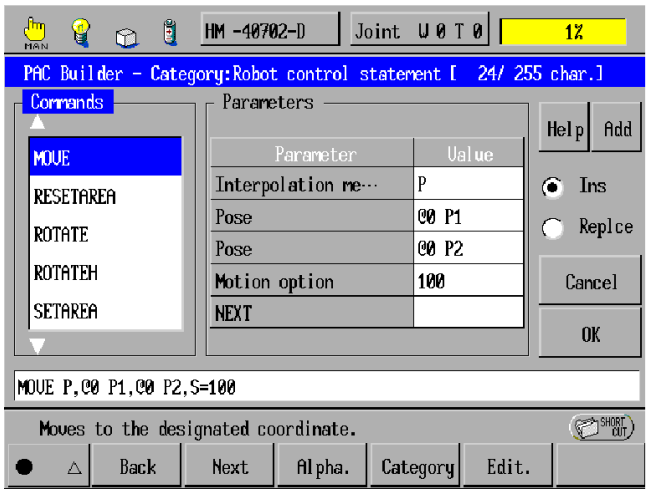
On the category selection screen, you may choose the type of commands you want to enter for the command builder.



- To choose the desired category, use the job dial or 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.

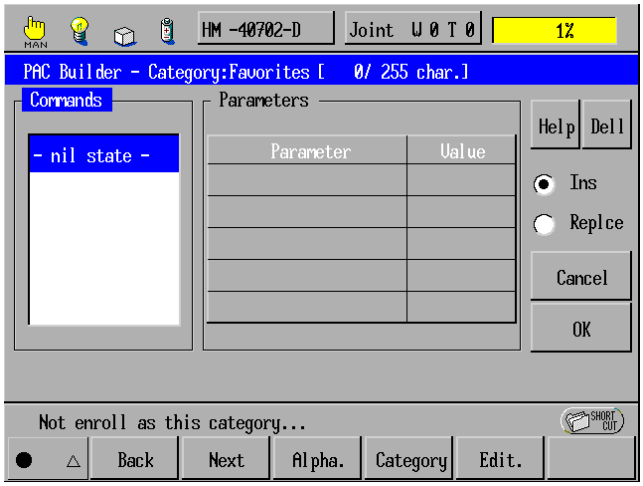
Command selection screen

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



[F1 Back]	Displays the previous page of the command/parameter selection screen.
[F2 Next]	Displays the next page of the command/parameter selection screen.
[F3 Alpha.]	Calls up the Alphabet Selection window.
[F4 Category]	Calls up the Category Selection window.
[F5 Edit.]	Calls up the Parameters window if a parameter value is selected with the cursor.

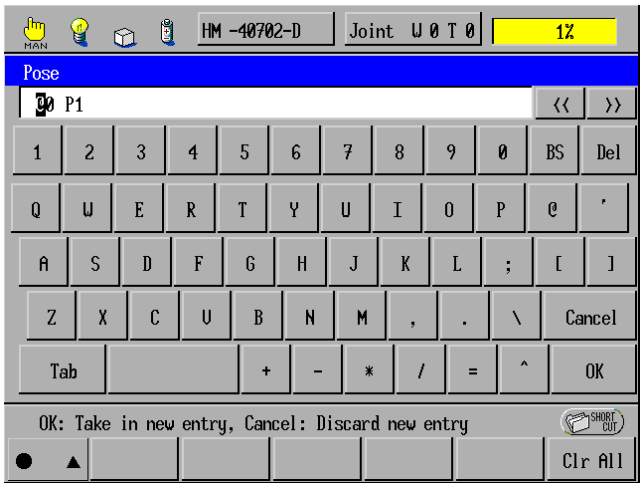
[Add]	Adds the currently selected command to the Favorites category. When the Favorites category window is displayed, the Del button will appear instead of Add. Up to 256 commands may be registered. If no commands are registered, "--Not registered--" will appear in the Commands window of the Favorites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

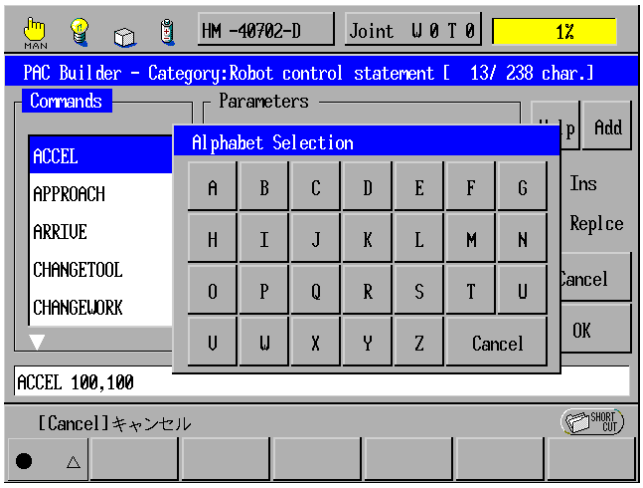
On the parameter entry screen, you may enter or edit parameters of the selected command.



- 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 [TP] [Ver.1.8 or later]

As an additional enhancement of the easy teaching facility implemented in Version 1.8 first, Version 1.9 enables you to:

- Specify global variables
- Write APPROACH and DEPART commands

This chapter covers an overall easy teaching including the above additional enhancement.

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.

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.

[1] Inserting a Motion Command

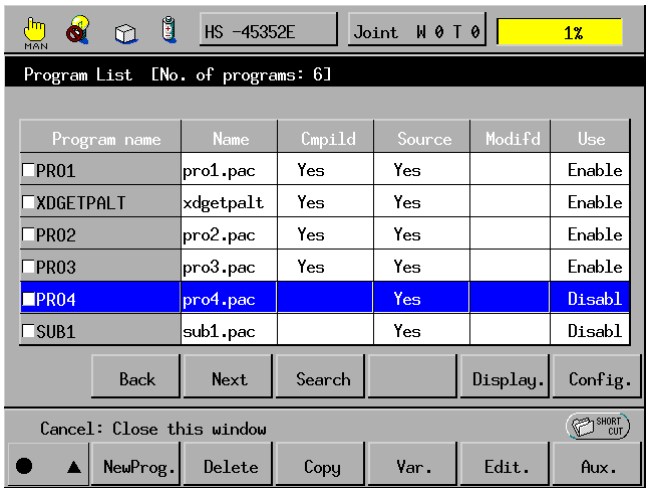
What follows is an operation flow for inserting a motion command by using the easy teaching facility.

■ Possible from the teach pendant only

Step 1 Set the mode selector switch to the MANUAL position.

Step 2 On the top screen, press [F1 Program].

The Program List window appears as shown below.



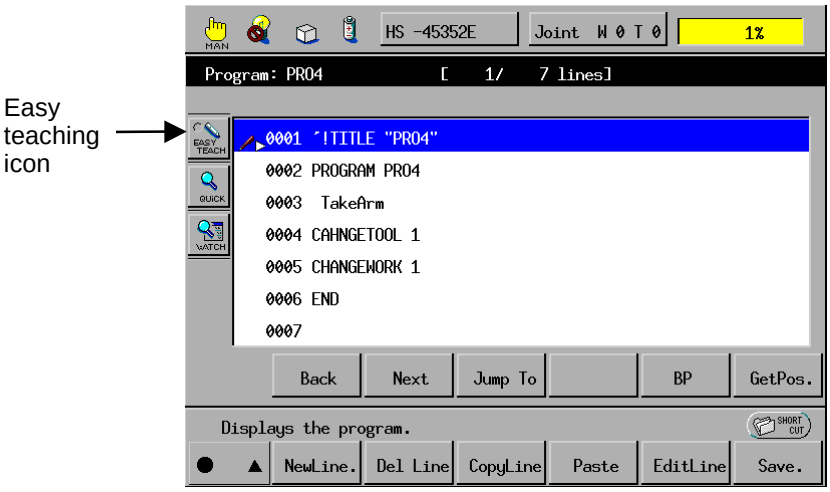
F5

Select a program you want to edit and then press [F5 Edit.] or [Display.] (or [F1 NewProg.].

NOTE: To edit existing programs, use [F5 Edit.]; to check them, use [Display.]. To edit a new program, use [F1 NewProg.].

Step 3

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

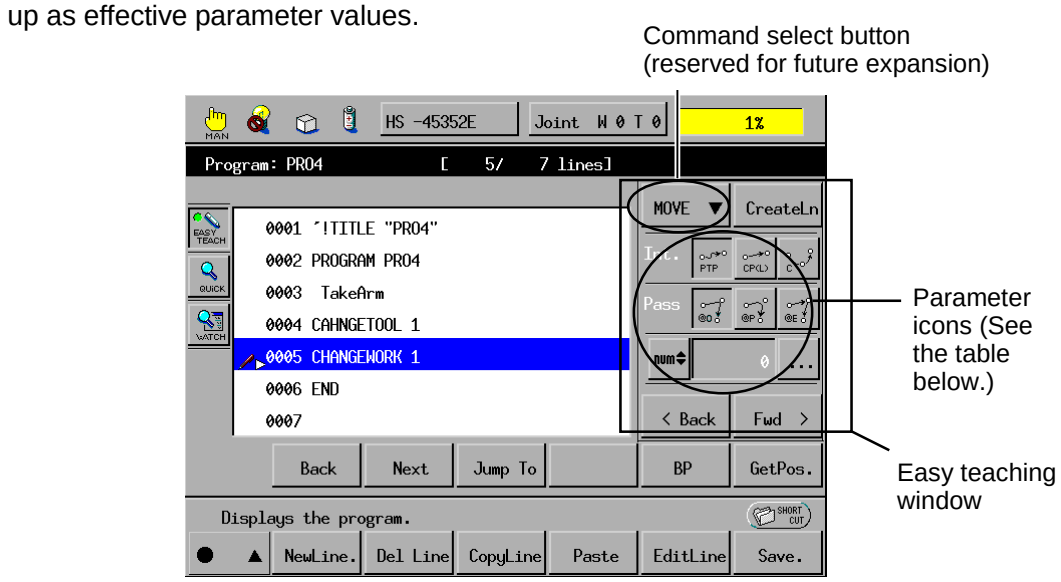


Press the easy teaching icon to call up the easy teaching window.

Step 4

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.

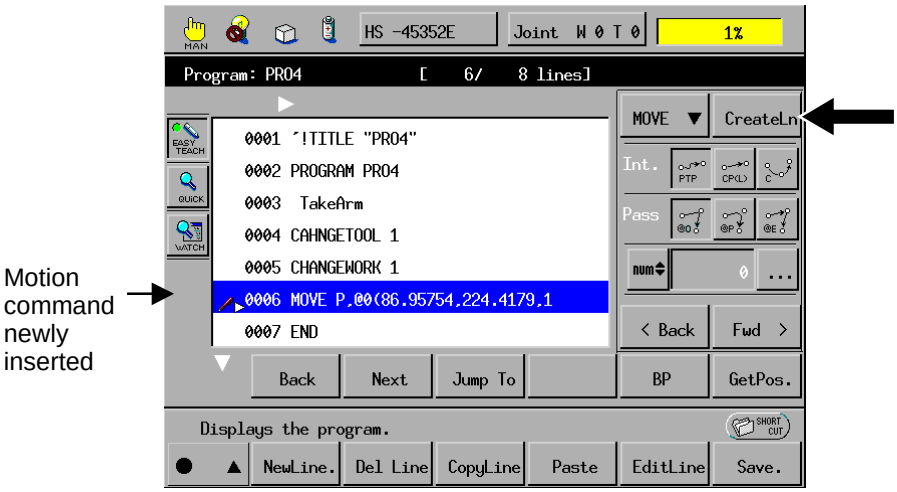
(Note 1) The feature implemented for the depressed icon takes effect.

(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 5

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.



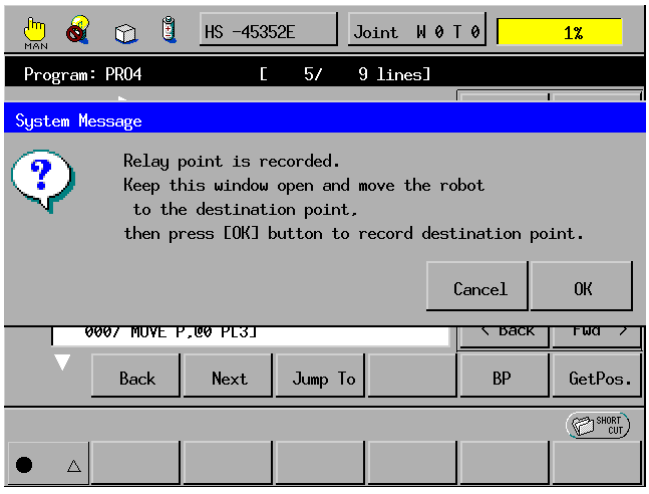
If you select an immediate value to specify the destination position, then the current position value will be written in the current motion command. For the procedure, go to Step 6.

If you select a global variable to specify the destination position, then the current position will be saved into the global variable. For the procedure, go to Step 7.

Step 6

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

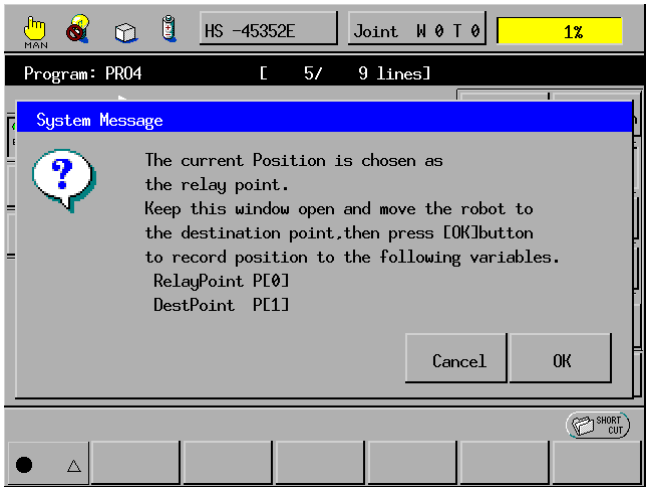
Keep this dialog open and move the robot arm to the destination position, then press [OK]. The command will be inserted.



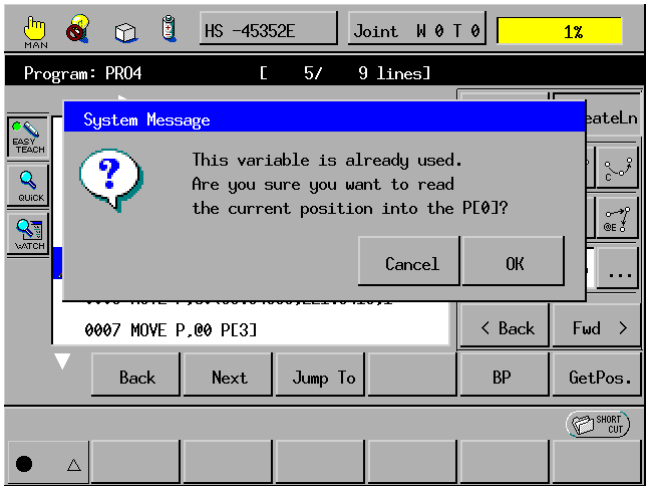
Step 7

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.

Keep this dialog open and move the robot arm to the destination position, then press [OK].



The following confirmation massage may appear informing that the global variable has already contained any value.



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

[2] Editing a Motion Command

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

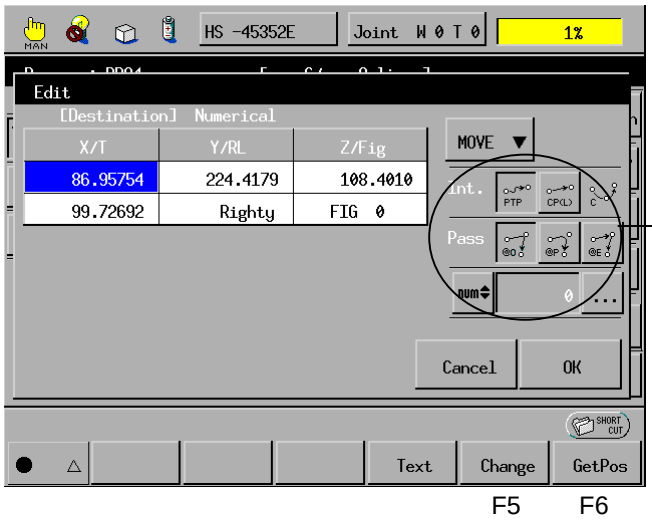
Step 1

Carry out Steps 1 through 3 in Section 3.1 to call up the easy teaching window.

Step 2

Move the blue cursor to a program line you want to edit, then press [F5 EditLine].

If the command on the selected line can be edited in the easy teaching window (refer to Section 3.5), then the parameter information will display according to the parameter icons.



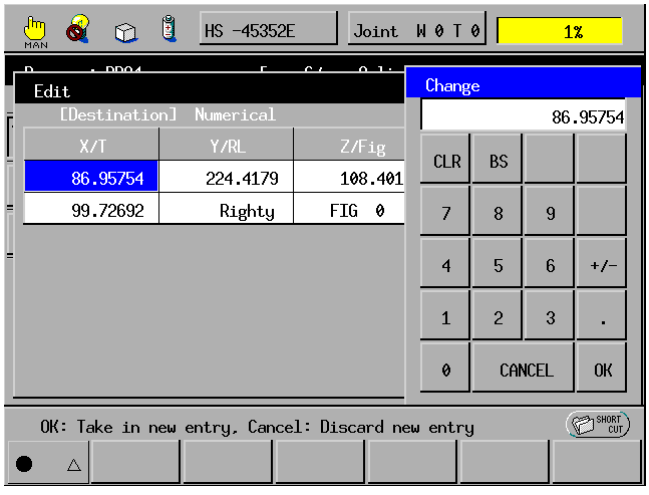
When the window is called up, the parameter icons reflect the command information on the selected line.

You may change the parameters by using the parameter icons or change the destination point (or passing points) by pressing [F5 Change] (see Step 3) or [F6 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 [F5 Change]:

Move the cursor to a field you want to change with the up-, down, left-, and right-arrow keys or jog dial, then press [F5 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 may define the passing points and destination points by using the up- and down-arrow keys or jog dial.

Step 4

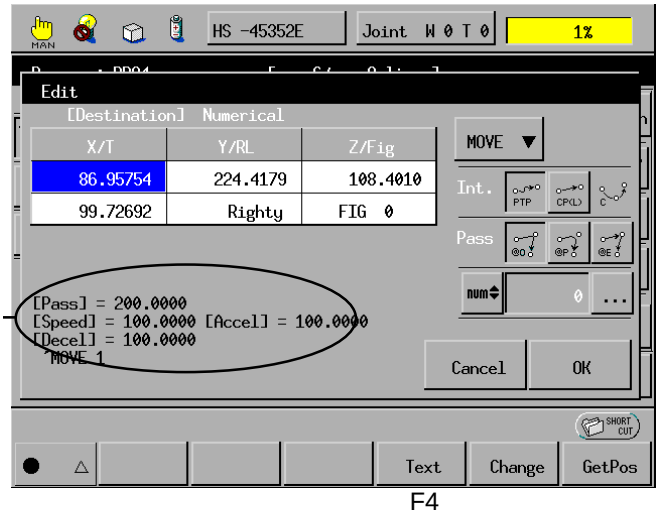
To get the current robot position by using [F6 GetPos]:

Press [F6 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 passing point or destination point. Choose either one.

Step 5

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



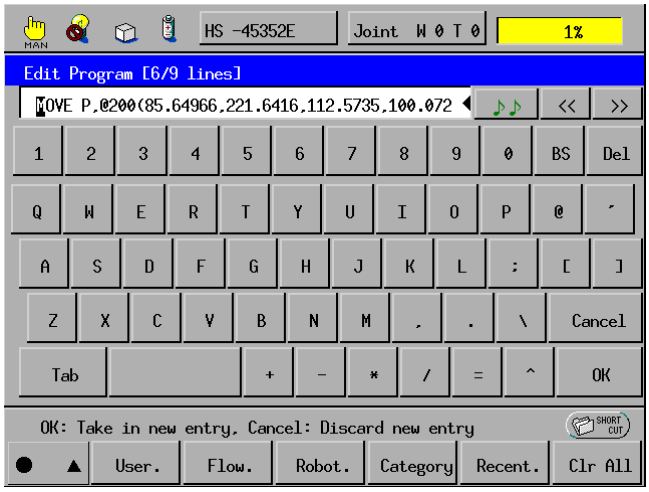
Parameters that cannot be edited here.

F4

To edit them, press [F4 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.



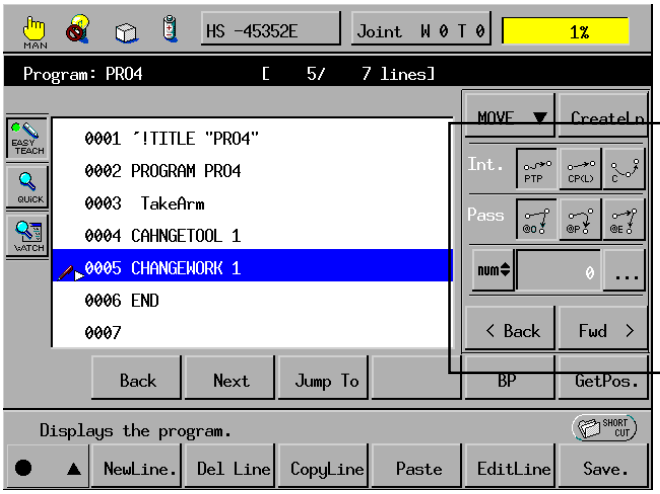
NOTE: Pressing [Cancel] in the above screen will cancel all settings made in the easy teaching window.

[3] 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 3 in Section 3.1 to call up the easy teaching window.



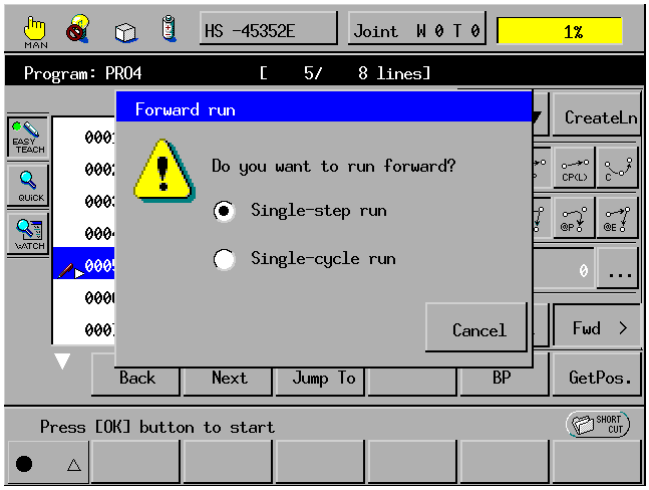
Move the blue cursor to a program line to be executed, then press [<Back] or [Fwd>].

[Fwd>]: If a command on the selected line can be edited in the easy teaching window (refer to Section 3.5), 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 the deadman switch, press the OK button. The program will execute. Releasing either one of the deadman switch and OK button will stop the running program.

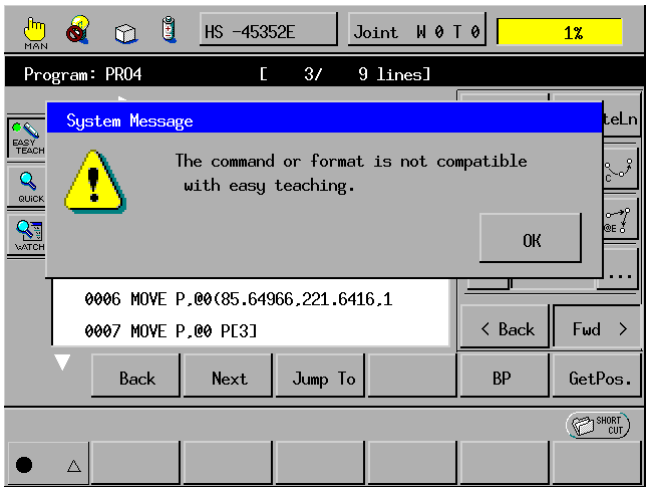
"Single-step run": Runs a single step of the selected program and stops the execution.

"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

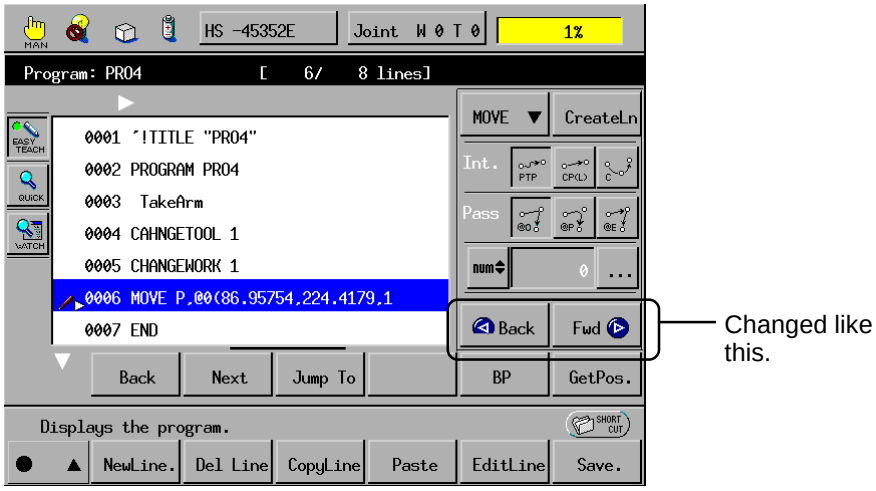
If you attempt to run any command that is not executable by easy teaching or contains a syntax error, then the following warning message will appear.



Tip

When the easy teaching window is displayed, pressing the deadman switch 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.

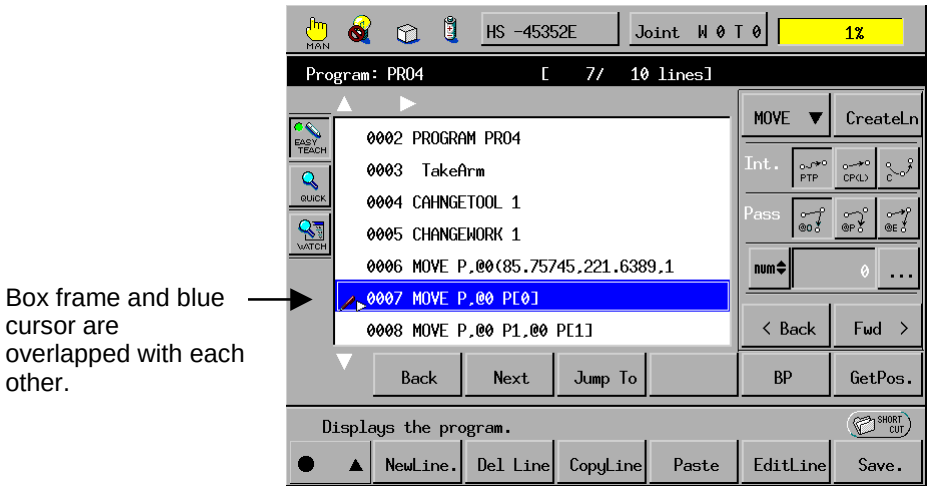


[4] Additional Explanation about Easy Teaching

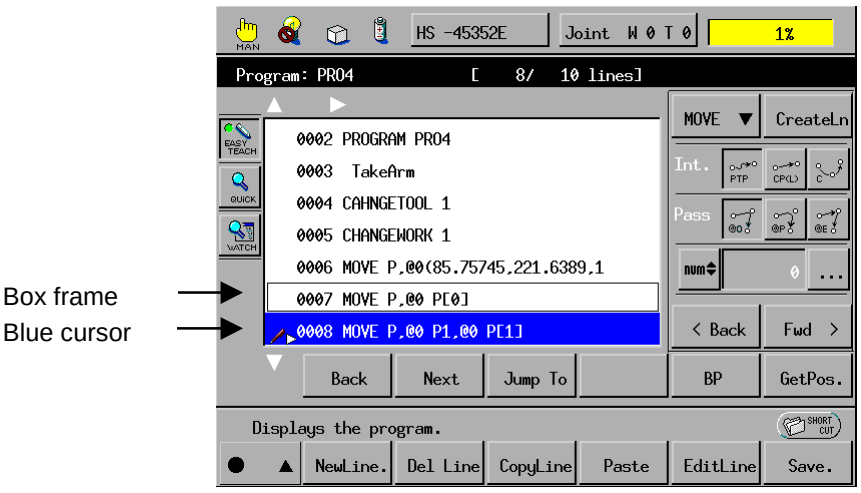
[4.1] Box frame on a program line

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.

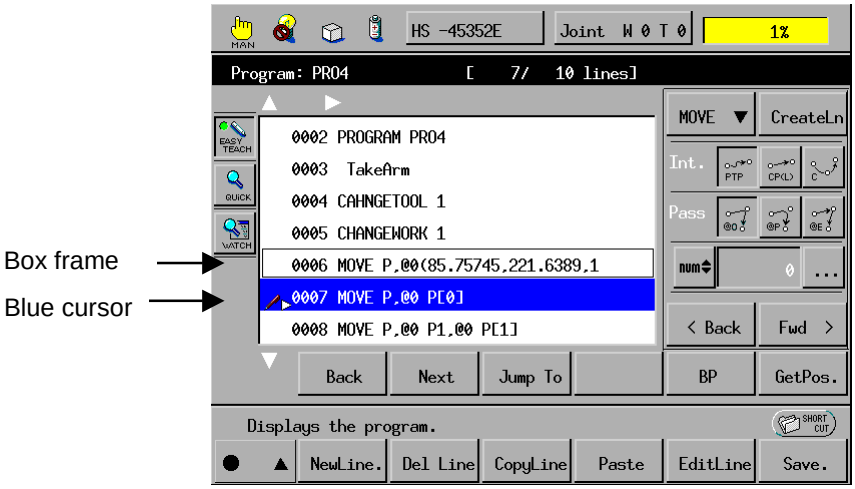
In the case of [Fwd>]: If you temporarily stop the following program at line 0007 being executed by [Fwd>], for example, then a box frame comes on line 0007 since the destination point obtained by the most recently executed motion command is written in line 0007.



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.



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.



[4.2] 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

[5] 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).

[6] 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 check, Auto, or External 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 [F8 ProgRst.] has been performed.
- In Teach check, Auto, or External mode, the [F7 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 you are using TP/MP/OP.
- 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 [F8 ProgRst.] in the Shortcut Menu.

[7] 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.

3.3 Teach Check Mode (TP/MP)

Teach check mode allows you to make a final check of programs (which have undergone teaching) with the teach pendant or mini-pendant in automatic operation under the following restrictions:

- The maximum robot speed is 10% or less of the maximum speed defined in Auto mode.
- To run a task program, hold down both deadman switch and OK key.

Two types of teach check are available--Cycle check and Step check.

Cycle check executes the selected task program from the current program line to the end by a single cycle; Step check executes the selected program from the current program line by a single step.

⚠**CAUTION**: Before starting teach check operation, be sure to confirm that all persons are out of the restricted space of the robot. The robot will automatically run.

CAUTION: Before proceeding to the teach check operation procedure, be sure to perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

NOTE: Two or more task programs cannot execute concurrently in Teach check mode. Therefore, any motion command specifying concurrent execution of other programs will be ignored.

Run the robot in Teach check mode when

You want to run the robot automatically using a task program while physically near the robot, in order to check or modify the object points and passes you have defined in teaching, while ensuring safety.

[1] Cycle check

To monitor the program contents during cycle check, press [F11 Display.] (after pressing the shift key if necessary) on the top screen or press the Display. button at the bottom of the Program List window.

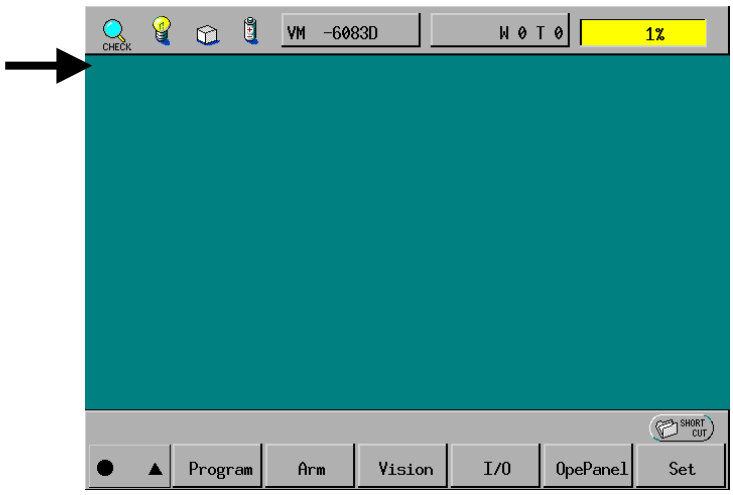
Operating procedure

■ ***From the teach pendant***

Step 1

Set the mode switch to the TEACHCHECK position.

The teach check icon appears in the leftmost area of the status bar.



F1

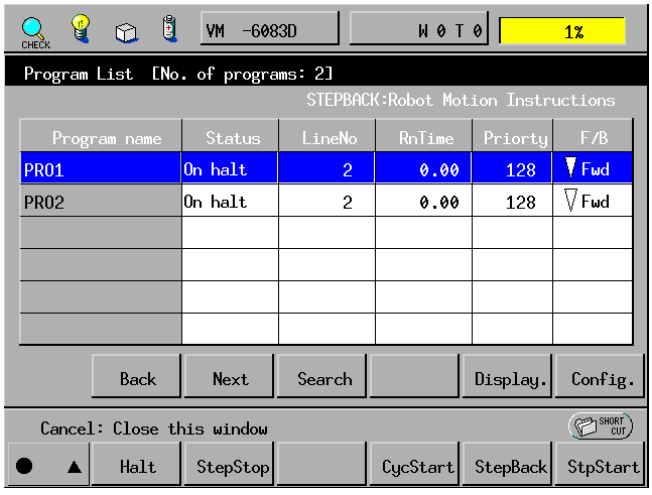
Step 2

Press [F1 Program].

The Program List window appears as shown below.

Step 3

Select the task program you want to check, by using the cursor keys or jog dial or by touching the screen directly.



F4

The selected program will become highlighted.

Step 4

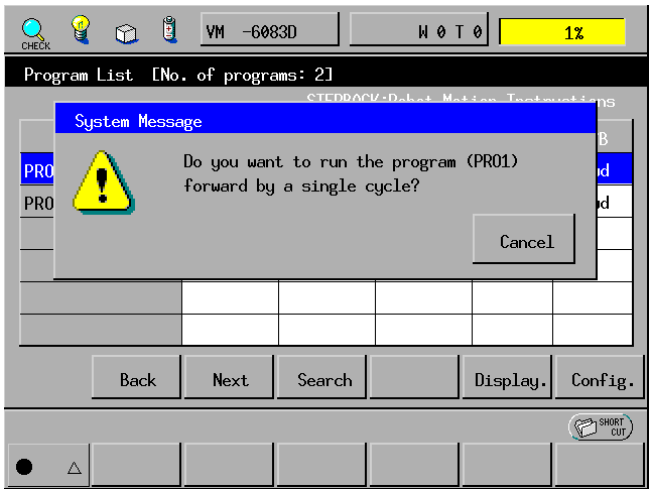
Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5

On the screen shown in Step 3, press [F4 CycStart].

The system message dialog box appears as shown below.



Step 6

While holding down the deadman switch, press the OK key, and then keep both of them depressed until the execution is completed.

If you release either one of the deadman switch and OK key, the robot comes to a halt.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.10, "(4.1) Cycle Start."

[2] Step check

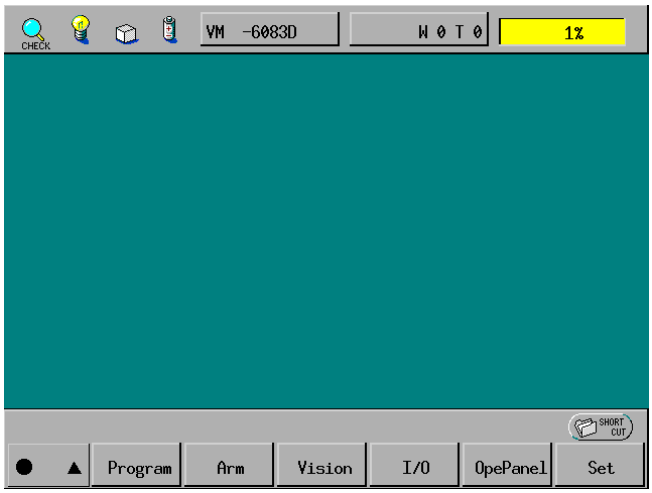
To monitor the program contents during step check, press [F11 Display.] (after pressing the shift key if necessary) on the top screen or press the Display. button at the bottom of the Program List window.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the TEACHCHECK position.

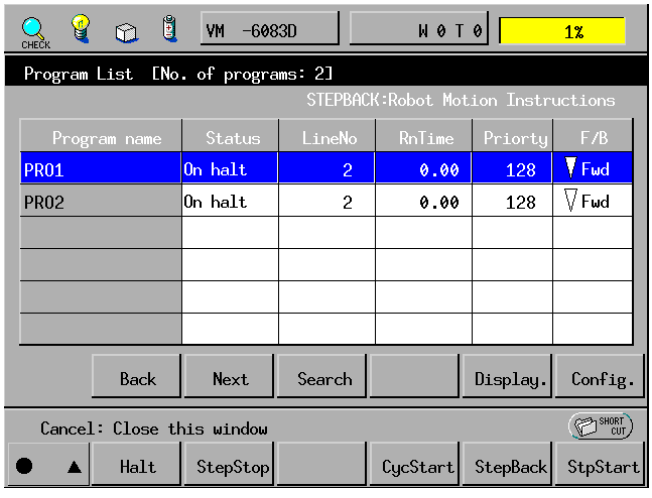
Step 2 Press [F1 Program].



F1

The Program List window appears as shown below.

Step 3 Select the task program you want to check, by using the cursor keys or jog dial or by touching the screen directly.



F6

The selected program will become highlighted.

Step 4

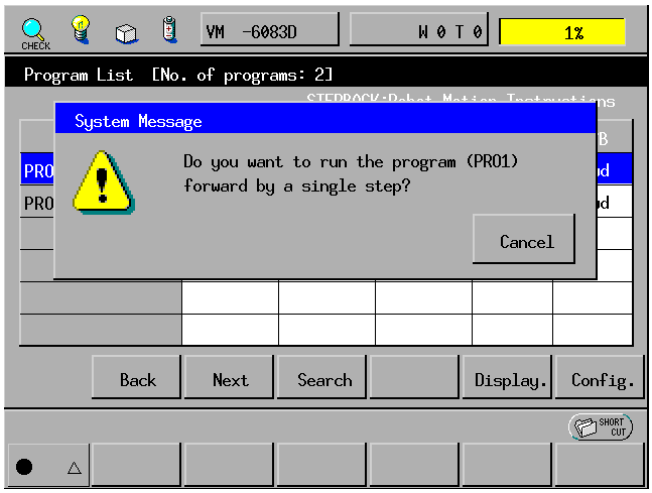
Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5

On the screen shown in Step 3, press [F6 StpStart] (or the right-arrow cursor key).

The system message dialog box appears as shown below.



Step 6

While holding down the deadman switch, press the OK key, and then keep both of them depressed until the execution is completed.

If you release either one of the deadman switch and OK key, the robot comes to a halt.

■ ***From the mini-pendant***

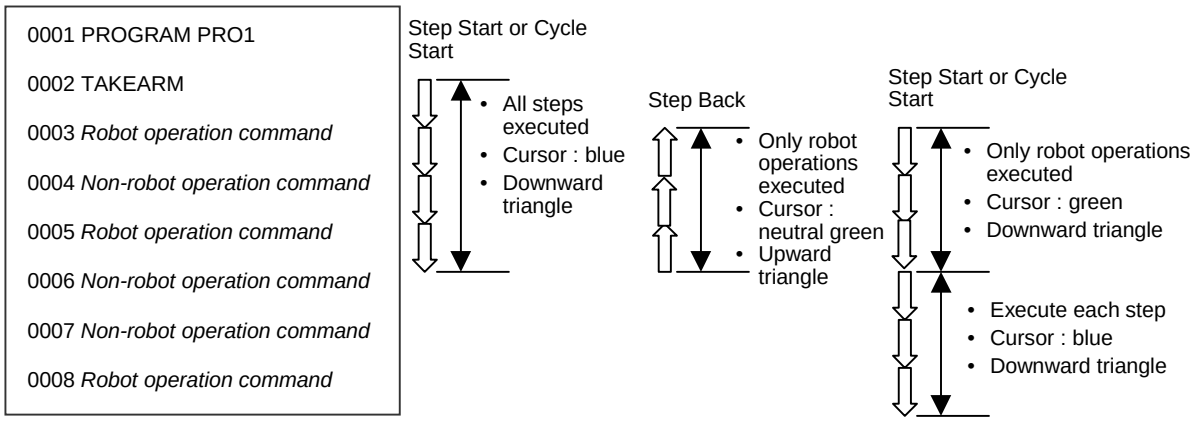
Step 1

Refer to Chapter 6, Subsection 6.2.10, "(4.2) Step Start and Step Back."

[3] Step Back Function

This function steps backwards the current program executed by Step Start or Cycle Start, one instruction at a time.

The Step Back function is diagrammatically shown below.



Executing Step Back command steps backwards the program. During Step Back operation, only robot motion commands, TAKEARM, and GIVEARM (Refer to the PROGRAMMER'S MANUAL.) will be executed. Other commands will not be actually executed, and only the line number will step back. The settings relating to end-effector, workpiece, and speed made when Step Start or Cycle Start was executed will be reflected on Step Back operation.

If control returns to TAKEARM, GIVEARM will be executed; if it returns to GIVEARM, TAKEARM will be executed.

If Step Start or Cycle Start is executed after Step Back, only robot motion commands, TAKEARM, and GIVEARM are executed until the step at which Step Back was executed (Tool, work and speed settings are as for Step Back). At subsequent steps, all commands will be executed.

Cursor color in the Program List window and in the coding table

- Neutral green in Step Back operation
- Green in Step Start and Step Start operation from Step Back until the Step Back started step
- Blue in cases other than the above two.

The triangle on the left of line number shows the direction of operation. Downward triangle indicates forward stepping and the upward triangle indicates backward stepping.

NOTE 1: Restrictions on Step Back

This function traces the commands when Step Start or Cycle Start is executed. Based on that data, the Step Back function executes those commands. However, there is a limit for recording data. A maximum of 100 commands can be recorded and when the limit is exceeded the old commands will be erased in sequence and new ones recorded.

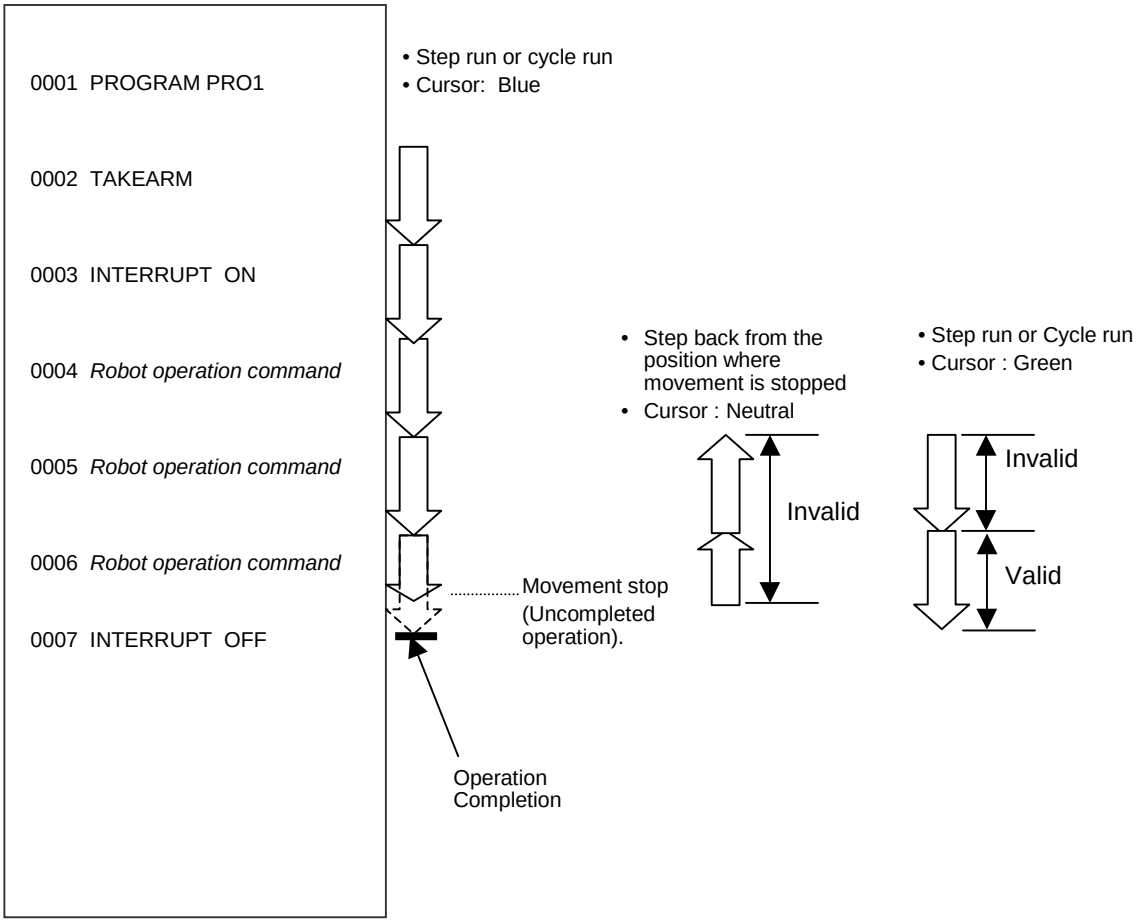
The Step Back function can work only within a program, since data that has been recorded will be cleared If any other program is selected and executed. Note that programs that are called by CALL or GOSUB are not be treated as other programs, so the Step Back function can work within those programs.

If a specified line is executed, the control cannot return to the lines preceding the specified line.

NOTE 2: About Skipping Interrupt

Skip Interrupt (See Installation and Maintenance 5.3.4.5 Skip Interruption (Input) and 5.5.4.10 Skip Interruption (Input)) is ineffective during Step Start or Cycle Start between two consequent Step Back commands, except in the following situation.

- When the robot action is temporarily stopped during Step Start or Cycle Start (when the program list or the program list cursor is blue), and the same robot action command is executed after Step Back command.



Operating procedure

■ ***From the teach pendant***

Step 1

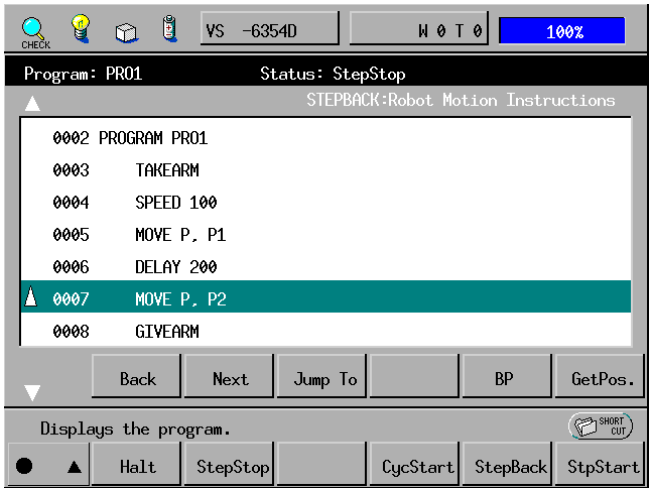
Set the mode switch to the TEACHCHECK position.

Run a single step or a single cycle of the program.

Step 2

Press [F5 StepBack]

You may step backwards the program by using the left-arrow cursor key.



F5

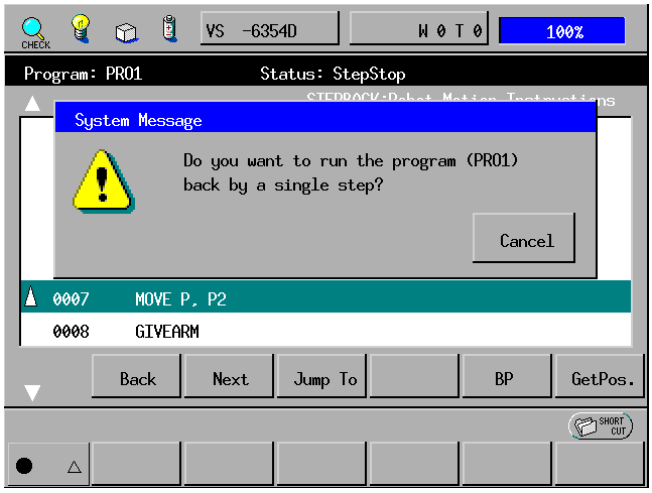
When the cursor moves to the line where you want to run Step Back, the cursor turns neutral green. Also, the triangle on the left of the line number comes upward.

Step 3

Press [F5 StepBack] again.

You may step backwards the program by using the left-arrow cursor key.

The system message dialog box appears as shown below.

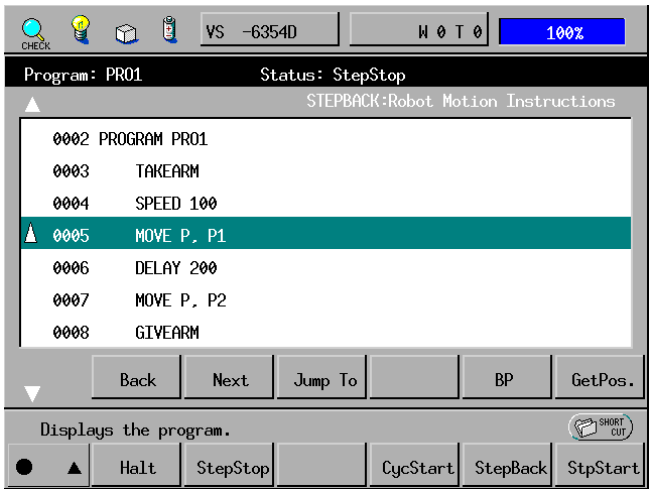


Step 4

While holding down the deadman switch, press the OK button.

Only when both of them are depressed, commands will be executed. If you release either one of the deadman switch and OK button, the program immediately stops.

NOTE: When running the robot for checking, always be ready to press the STOP key.



The cursor goes one step (command) back, and the cursor turns neutral green (The triangle on the left of the line number shows upward direction).

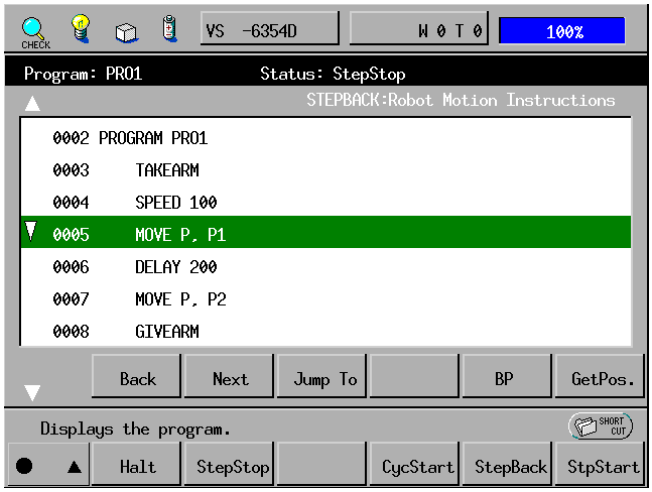
Step 5

Repeat Steps 3 and 4 to step backwards the program.

Step 6

After Step Back, press [F6 StpStart] (or the right-arrow cursor key) or [F4 CycStart].

The screen shows the following state.



The cursor moves to the line that performs Step Start or Cycle Start and triangle shows the downward direction.

Step 7

Press [F6 StpStart] (or the right-arrow cursor key) or [F4 CycStart] again.

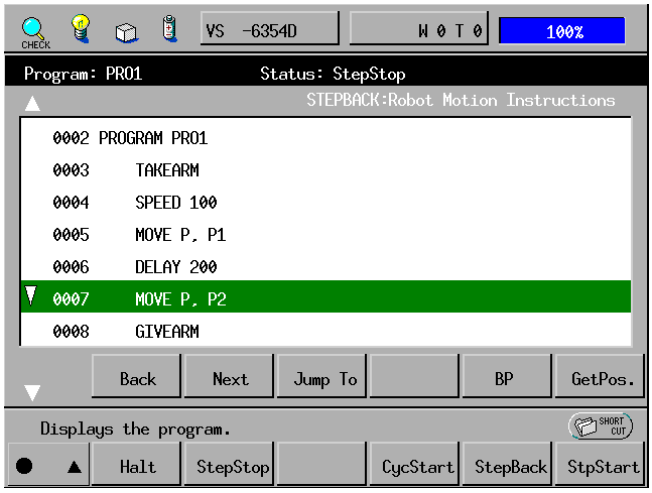
The system message dialog box appears as shown below.

Step 8

While holding down the deadman switch, press the OK button.

Only when both of them are depressed, commands will be executed. If you release either one of the deadman switch and OK button, the program immediately stops.

NOTE: When running the robot for checking, always be ready to press the STOP key.



Step 9

Repeat steps 7 and 8, all the time confirming that the program is running safely.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.10, "(4.2) Step Start and Step Back."

Selecting Commands To Be Executed During Step Back Operation

You may select commands to be executed during Step Back operation from the following two options:

1) Robot motion commands only

2) All commands

However, even if you select "All commands", only robot motion commands, TAKEARM, and GIVEARM will be executed during Step Back operation.

To change the current setting, turn the mode switch to the MANUAL position and call up the Step Back Setting window.

Access: [F1 Program]—[F6 Aux.]—[F9 StpBack.]

The setting you made here will go into effect when you restart the robot controller.

NOTE: With the mini-pendant, you cannot select commands to be executed during Step Back operation. The "Robot motion commands only" remains effective unless you change it with the teach pendant.

[4] Execution by Specifying Line

This function allows you to execute Teach Check from any line.

- You can execute cycle check and step check together.

This operation is necessary when

You want to confirm or correct the operation subsequent to the specified line, while executing teach check.

Note regarding line specification:

- If the specified line is a comment line or a blank line which cannot be executed, then that line will be ignored and the first executable line from that line is considered.
- When CALL command is executed and CALL destination program is displayed in the teach pendant, the line specification related to the displayed program is not possible.

  Before specifying the line, select the corresponding program from program list.
- When you use local variable without declaring local variables or initializing variables or without executing commands for getting semaphore, or perform calculation and motor operation, error may occur.

NOTE: Local variables are preserved in memory when memory is released when user programs are transferred from WINCAPSII and compiled in teach pendent and commands declaring local variables like DIM or DEFINT are executed. The local variables once preserved remain in memory till the memory is released. Hence it is possible to use these variables by executing local variable declaration commands just once.

Even if the memory for local variable is preserved, if the local variables are not initialized (or value substituted), the values are considered indeterminate.

NOTE: Two or more task programs cannot execute concurrently in Teach check mode. Therefore, any motion command specifying concurrent execution of other programs will be ignored.

NOTE: With the mini-pendant, you cannot specify a line for Teach Check.

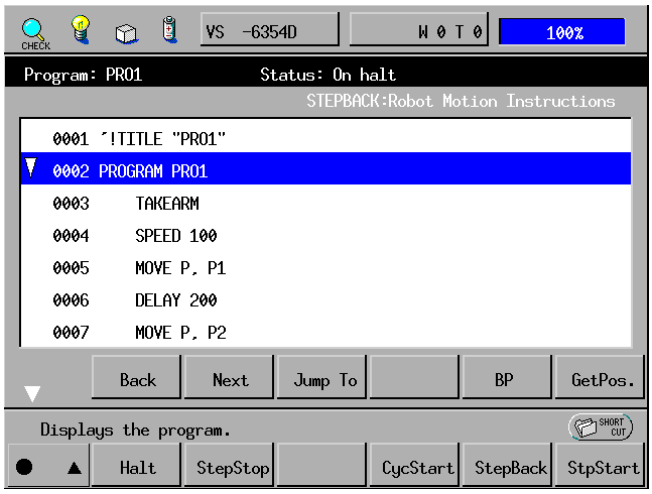
Executing by Specifying an Arbitrary Line

■ *From the teach pendant*

The operating procedure given below is common to Cycle Check and Step Check.

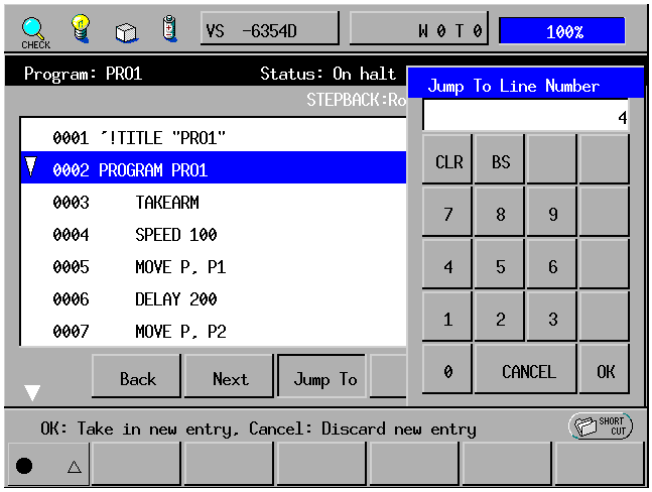
Step 1 Perform Steps 1 through 3 in [1] Cycle Check or [2] Step Check.

Step 2 Press [Display.] in the window, and the contents of the program appear as shown below.



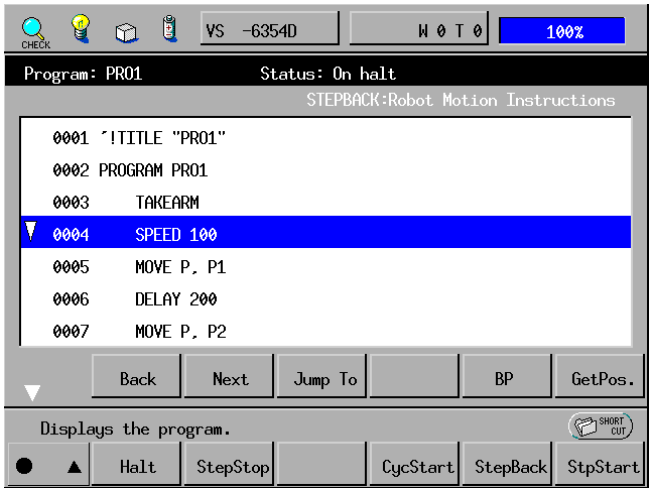
F3

Step 3 Press [F3] or select [Jump To] in the window, and the numeric keypad will appear.



Step 4 From the numeric keypad, enter the desired number and press the OK button.

The numeric keypad will disappear and the cursor will move to the specified line.



Step 5 Go to Step 4 in [1] Cycle Check or [2] Step Check.

3.4 Auto Mode (TP/OP/MP)

In Auto mode, you may run the robot automatically. You may do so by running the desired program in the robot controller from the teach pendant, operating panel, or mini-pendant, which is ***internal automatic operation***. You may switch the control to external equipment to run the robot from external equipment, which is ***external automatic operation***.

CAUTION: Before proceeding to automatic operation, be sure to perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

NOTE: To place the robot in Auto mode, system-input port "Enable Auto" on pin 4 of input connector CN8 is required to be short-circuited (ON).

If you turn the mode switch of the teach pendant, operating panel, or mini-pendant to the AUTO position with the "Enable Auto" port opened (OFF), then error message 21F3 appears. Confirm that no one is within the restricted space of the robot, short-circuit the "Enable Auto" port, remove the error, and then proceed to automatic operation. For details on "Enable Auto," refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.4.1 and 5.5.4.1.

3.4.1 Starting Internal Automatic Operation (TP/OP/MP)

You may run the selected task program from the teach pendant, operating panel, or mini-pendant in any of the three types--Single-cycle run, Continuous run, and Single-step run, which are described in the table below.

Table 3-3. Three Types of Runs in Internal Automatic Operation

	Types of Runs	Explanation
1	Single-cycle run	Executes the selected program from the beginning to the end once.
2	Continuous run	Executes the selected program continuously.
3	Single-step run	Executes the selected program from the current program line by a single step.

⚠**CAUTION**: Before proceeding to internal automatic operation, be sure to read SAFETY PRECAUTIONS, Section 3.7 "Precautions for automatic operation" (on page 8) given at the beginning of this manual. Starting internal automatic operation will run the robot.

Perform internal automatic operation when

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

[1] Single-cycle run

Before proceeding to a single-cycle run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

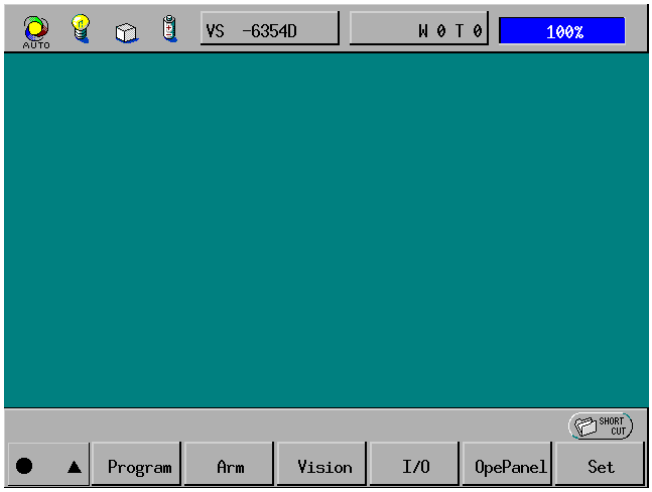
⚠**CAUTION**: At the start, set the reduced ratio of the programmed speed at 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the AUTO position.

Step 2 Press [F1 Program].

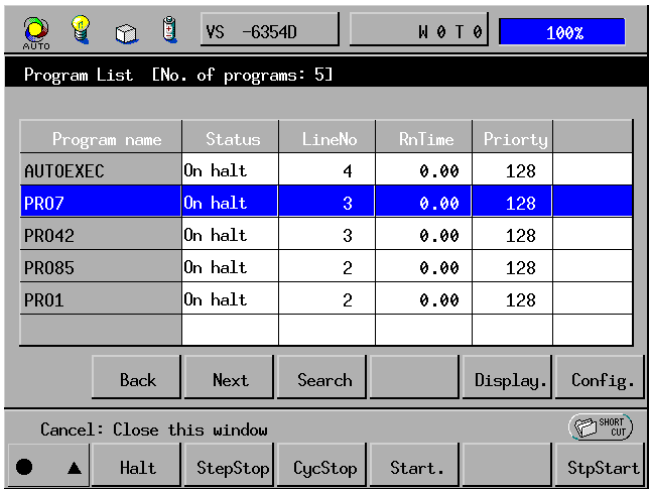


F1

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

Step 3

Select the task program you want to run, by using the cursor keys or jog dial or by touching the screen directly.



The selected program will become highlighted.

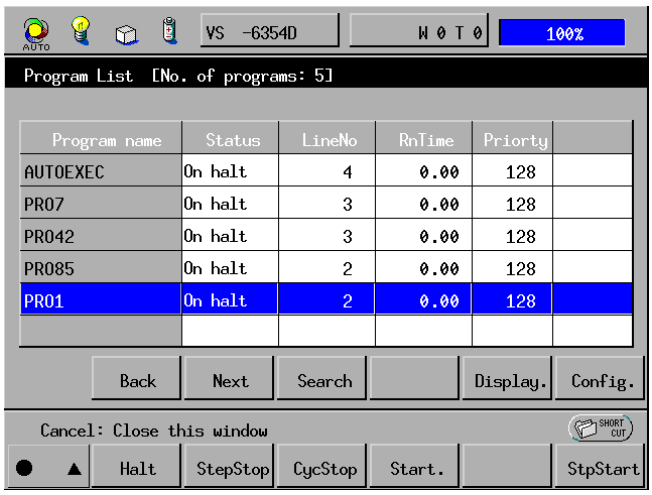
Step 4

Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5

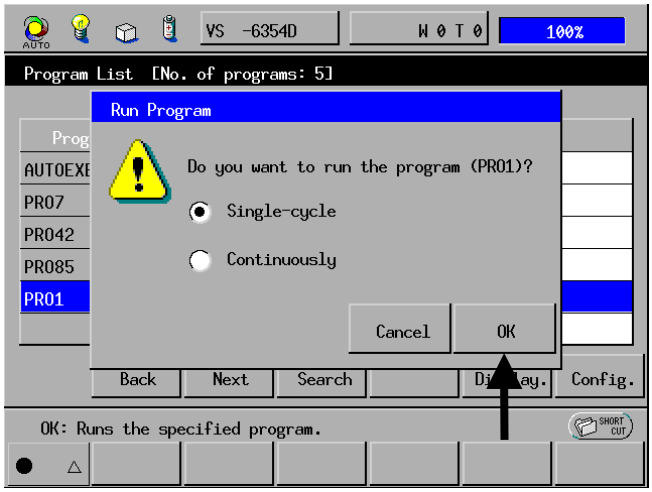
Check that the program you have selected is highlighted, press [F4 Start.].



F4

The system message dialog box appears as shown in the next step.

Step 6 In the system message dialog box, press the OK button to select Single-cycle.



After completion of a single-cycle run, to run the program again, go back to Step 2.

NOTE: The elapsed time on display refers to the time length from the start to end of the program including temporary stop time caused by Step stop or Halt.

■ ***From the operating panel***

Step 1

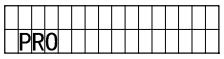
Set the mode switch to the AUTO position.

The AUTO lamp comes on.

Step 2

Press the PRO key.

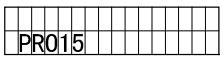
The LCD shows the following:



Step 3

Select the program number you want to run, by using numerical keys.

Example: To run PRO15, press the 1 and 5 keys. Then the following appears on the LCD:

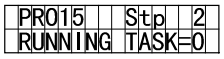


To cancel new entry, press the Cancel key.

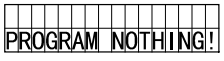
Step 4

Press the OK key.

The LCD shows the following:



If the selected program does not exist, the following appears on the LCD:



Step 5

Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 6

Press the CY-START key.

The LCD shows the following:

```
PRO15      Stp  2
CYCLE START?
```

Step 7

Press the OK key.

The LCD shows the following and the robot starts running.

```
PRO15      Pnd  3
RUNNING TASK=1
```

Upon completion of a single-cycle run, the robot will stop.

NOTE: After completion of a single-cycle run, to run the program again, repeat Steps 2 through 7.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.9, "(2) Starting a program."

[2] Continuous run

Before proceeding to a continuous run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

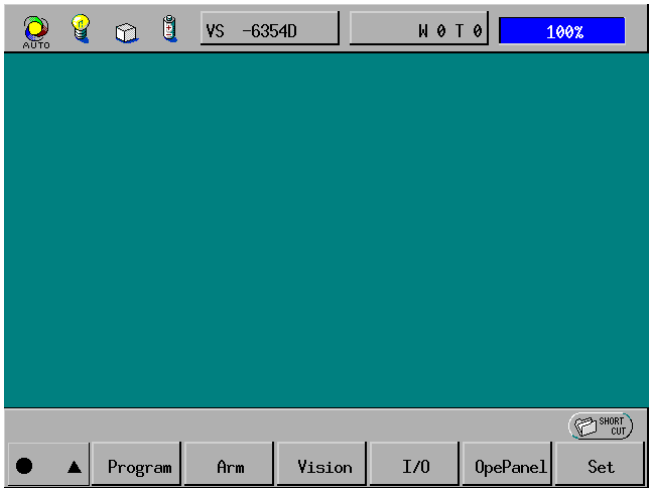
⚠**CAUTION**: At the start, set the reduced ratio of the programmed speed at 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the AUTO position.

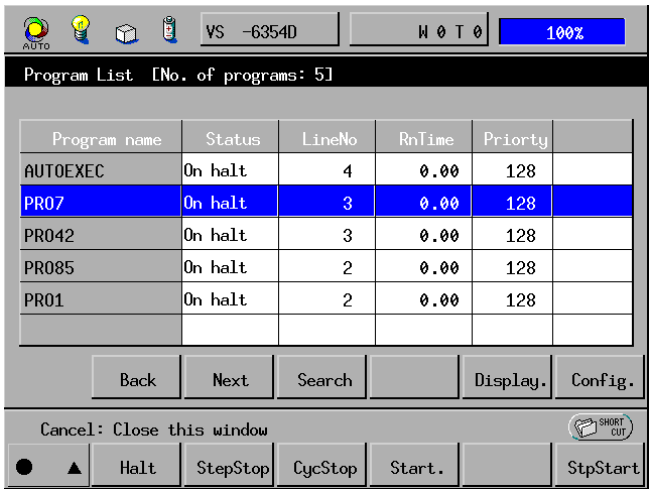
Step 2 Press [F1 Program].



F1

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

Step 3 Select the program you want to run, by using the cursor keys or jog dial or by touching the screen directly.



F4

The selected program will become highlighted.

Step 4 Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5 On the above screen, press [F4 Start.].

The system message dialog box appears as shown below.

Step 6 In the system message dialog box, select Continuously by using the cursor keys or jog dial or by touching the screen directly. Then press the OK button.

NOTE: The robot will continue to run unless you use any of robot stop, halt (or stop), step stop, and cycle stop. For details on those stop types, refer to Subsection 3.4.2.

NOTE: The elapsed time on display refers to the time length from the start to end of the program including temporary stop time caused by Step stop or Halt.

■ ***From the mini-pendant***

Step 1 Refer to Chapter 6, Subsection 6.2.10, "(2) Starting a program."

[3] Single-step run

Before proceeding to a single-step run, perform CAL operation and set the reduced ratios of the programmed speed, acceleration, and deceleration.

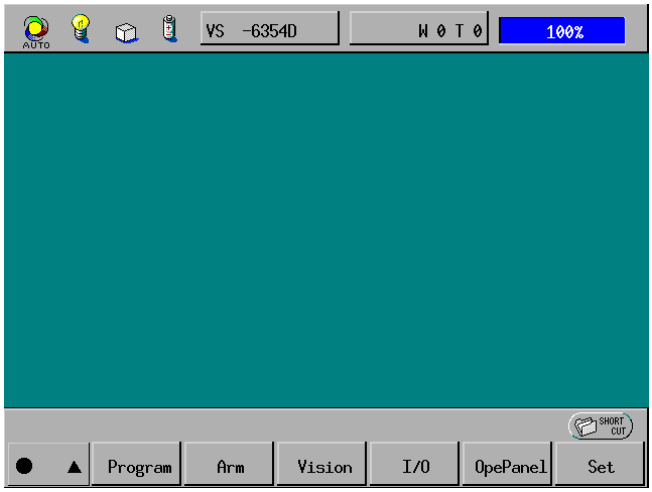
⚠**CAUTION**: At the start, set the reduced ratio of the programmed speed at 20% or less. If you run the robot manually at high speeds from the beginning, you may mistakenly strike the robot against the surrounding objects.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the AUTO position.

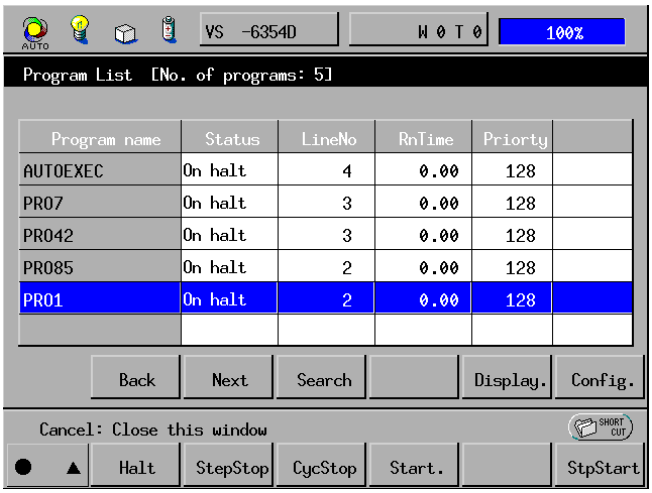
Step 2 Press [F1 Program].



F1

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

Step 3 Select the task program you want to run, by using the cursor keys or jog dial or by touching the screen directly.



F6

The selected program will become highlighted.

Step 4 Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 5 On the above screen, press [F6 StpStart] (or the right-arrow cursor key).

The system message dialog box appears as shown below.

Step 6

In the system message dialog box, press the OK button.

The selected program executes a single step.

NOTE: After completion of a single-step run, to repeat a single-step run, repeat Steps 5 and 6.

■ ***From the operating panel***

Step 1

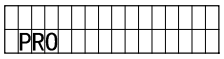
Set the mode switch to the AUTO position.

The AUTO lamp comes on.

Step 2

Press the PRO key.

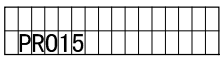
The LCD shows the following:



Step 3

Select the program number you want to run, using numerical keys.

Example: To run PRO15, press the 1 and 5 keys. The following appears on the LCD:

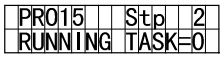


To cancel the new entry, press the Cancel key.

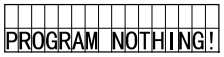
Step 4

Press the OK key.

The LCD shows the following:



If the selected program does not exist, the following appears on the LCD:



Step 5

Press the MOTOR key to turn the motor on.

The MOTOR lamp comes on.

Step 6

Press the ST-START key.

The LCD shows the following:

```
PRO15    Stp  2
STEP START?
```

Step 7

Press the OK key.

The LCD shows the following and the robot runs a single step of the selected program.

```
PRO15    Pnd  3
RUNNING TASK=1
```

NOTE: After completion of a single-step run, to repeat a single-step run, repeat Steps 6 and 7.

■ ***From the mini-pendant***

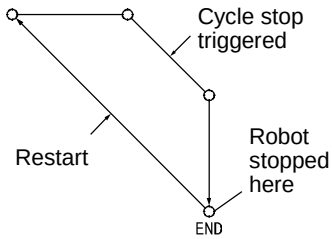
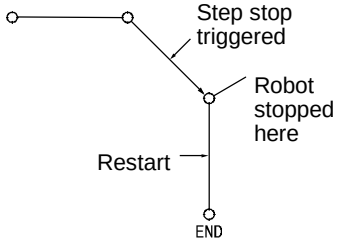
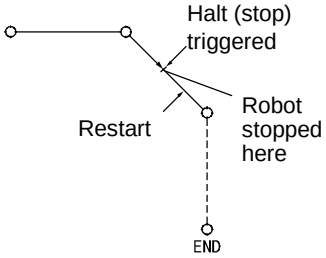
Step 1

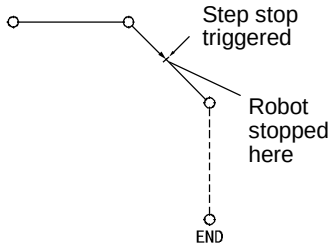
Refer to Chapter 6, Subsection 6.2.10, "(3) Step Start."

3.4.2 Stopping Internal Automatic Operation (TP/OP/MP)

You may stop internal automatic operation from the teach pendant, operating panel, or mini-pendant by any of Cycle stop, Step stop, Halt (Stop), and Robot stop, which are described in the table below.

Table 3-4. Four Types of Stops in Internal Automatic Operation

	Types of Stops	Explanation	When stopped			Restart
			Motor	Auto mode	Step No.	
1	Cycle stop TP: [F3 CycStop] MP: CYCLE STOP key 	Stops the robot after executing the last step of the task program.	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: [F3 StepStop] OP: ST-STOP key MP: STEP STOP key 	Interrupts the running task program midway after executing the step in which the step stop key is pressed.	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: [F1 Halt] or STOP key OP: STOP key MP: HALT key 	Immediately interrupts the running task program selected or all running task programs midway the moment [F1 Halt] or STOP key is pressed, respectively.	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	Robot stop TP: ROBOT STOP key OP: ROBOT STOP key MP: Robot stop button  	Immediately stops all running task programs midway and turns the motor off the moment the robot 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.

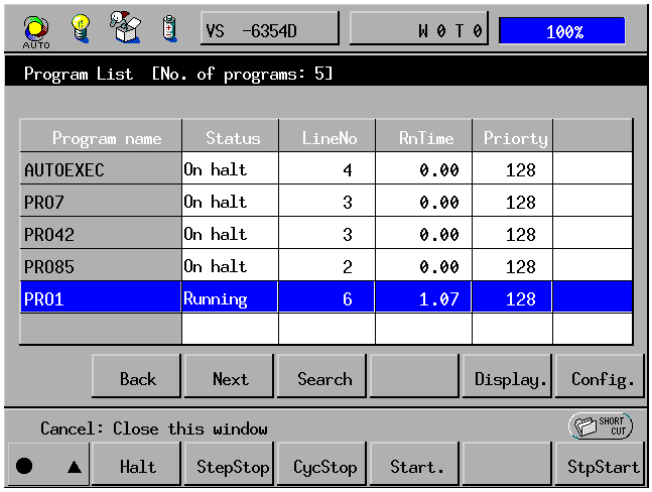
[1] Cycle Stop (TP/MP)

Cycle stop can only be triggered from the teach pendant or mini-pendant.

Operating procedure

■ ***From the teach pendant***

Step 1 Press [F3 CycStop].



F3

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

■ ***From the mini-pendant***

Step 1 Refer to Chapter 6, Subsection 6.2.10, "(2) Starting a program" and "(3) Step Start."

[2] Step Stop (TP/OP/MP)

Operating procedure

■ ***From the teach pendant***

Step 1 Press [F2 StepStop].

F2

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.

■ ***From the operating panel***

Step 1

Press the ST-STOP key.

The LCD changes from

to

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.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.10, "(2) Starting a program" and "(3) Step Start."

[3] Halt (Stop) (TP/OP/MP)

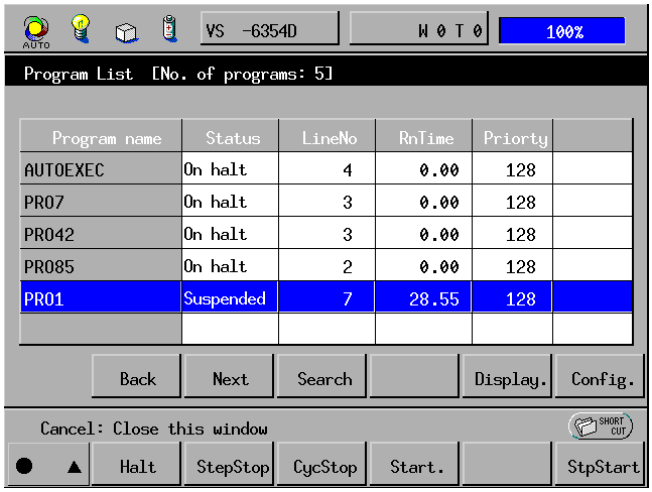
Operating procedure

■ ***From the teach pendant***

Step 1

Press [F1 Halt] or STOP key.

NOTE: Pressing [F1 Halt] immediately stops the task program selected on the Program List window; pressing the STOP key immediately stops all task programs.



F1

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

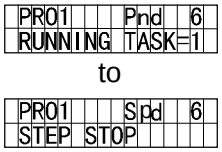
⚠**CAUTION:** Before restarting the robot after a Halt, confirm that there is no risk of bump or accident in the subsequent robot motion. Restarting the robot after a Halt as it was will execute the interrupted step.

■ ***From the operating panel***

Step 1

Press the STOP key.

The LCD changes from



All running programs will be immediately interrupted so that the robot comes to a halt.

⚠**CAUTION:** Before restarting the robot after a halt, confirm that there is no risk of bump or accident in the subsequent robot motion.

■ ***From the mini-pendant***

Step 1

Refer to Chapter 6, Subsection 6.2.10, "(2) Starting a program" and "(3) Step Start."

[4] Robot Stop (TP/OP/MP)

Operating procedure

■ ***From the teach pendant***

Step 1

Press the robot stop button.

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

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

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

■ ***From the operating panel***

Step 1

Press the ROBOT STOP button.

The LCD changes from

PRO1	Pnd 6
RUNNING	TASK=1

to

PRO1	Stp 3
RUNNING	TASK=0

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

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

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

■ ***From the mini-pendant***

Step 1

Press the robot stop button.

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

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

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

3.4.3 Switching to External Automatic Operation (TP/OP/MP)

You may switch from internal to external automatic operation from the teach pendant, operating panel, or mini-pendant. External automatic operation allows you to run the robot automatically from external equipment.

Switch to external automatic operation when

You run the robot automatically from external equipment.

Operating procedure

■ ***From the teach pendant***

Step 1 Set the mode switch to the AUTO position.

Step 2 Press the MOTOR key.

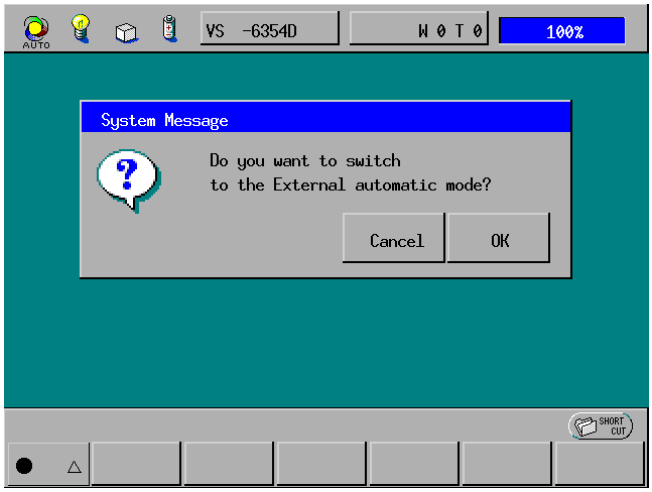
The MOTOR lamp comes on.

Step 3 Press the shift key on the top screen, and then press the called-up [F10 INT/EXT] instead of [F4 I/O].

F4
(F10)

The system message dialog box appears as shown in the next step.

Step 4 Press the OK button in the system message dialog box shown below.



Internal automatic operation has been switched to external automatic operation.

NOTE: After having carried out Steps 1 through 4, pressing [F10 INT/EXT] toggles between external and internal automatic operation.

■ ***From the operating panel***

Step 1 Set the mode switch to the AUTO position.

The AUTO lamp comes on.

Step 2 Press the EXT/INT key.

The LCD shows the following:

```
EXTERN. MODE  OK?
```

To cancel new entry, press the Cancel key.

Step 3 Press the OK key.

The LCD shows the following and the INT OPR lamp goes off.

```
EXTERN. MODE
```

NOTE: Once external automatic operation is selected, the operating panel no longer accepts entry except from the EXT/INT key and STOP key.

■ ***From the mini-pendant***

Step 1 Refer to Chapter 6, Subsection 6.2.9.

3.4.4 Stopping External Automatic Operation (TP/OP/MP)

You may stop external automatic operation from the teach pendant, operating panel, or mini-pendant using the same procedure as internal automatic operation. Refer to Subsection 3.4.2.

You may also stop external automatic operation from external equipment. For details, refer to the INSTALLATION & MAINTENANCE GUIDE, Subsections 5.3.3 and 5.5.3.

3.4.5 Continue Function

The Continue function can restart the robot operation from the current status when automatic operation is interrupted by any of:

"Halt (Stop)"
"Robot Stop" (set with parameters)
"Motor OFF"
"Error at Level 2."

This function is necessary when

The robot is stopped if the product is mishandled by robot during automatic operation and after rearranging the product further operation can be restarted using this function.

Structure of Continue Function

Continue function is divided into 2 functions as shown below.

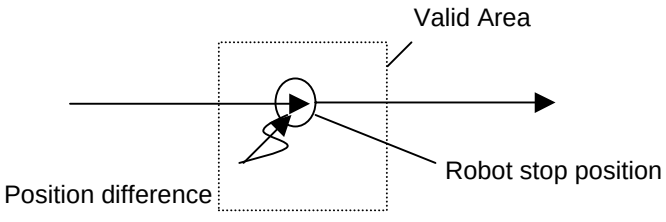
"Auto Position Correction"
"Restart Operation"

Auto Position Correction

When Continue Start is executed, this function moves the robot to position when operation is stopped. User can make this function effective or ineffective by changing the parameters.

When Continue Start is again executed after manually rearranging the mishandled product and the robot position, this function checks the robot position and if robot is in valid area, restarts the operation that was halted.

If it is out of the valid area, an error occurs. User may change valid area by changing parameters.



When Continue Start is pressed, operation is restarted after moving the robot to halt position.

NOTE:

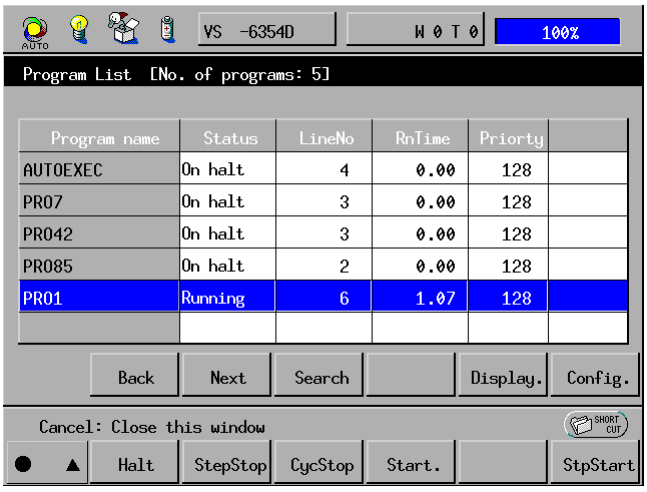
- This function will get executed even if Robot operation program is not run properly after pressing Continue Start.
- If CAL is not executed, an error occurs.
- If motor power is OFF, an error occurs.
- This function will get executed only after Continue Start.

  This function is not executed during "RUN" and "StpStart" of program

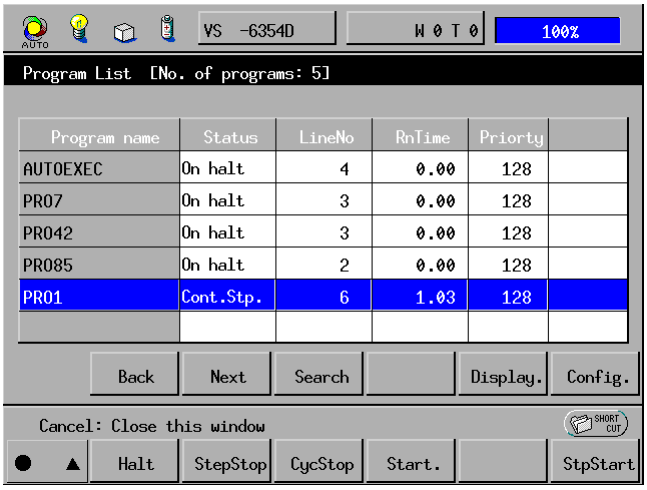
Operation Restart

This function restarts all the programs from the halt position. When operation is stopped, programs whose status is "Running", "On halt", and "On standby" can be restarted, and programs whose status is "Step Stop", "Temporarily stopping" and "On halt" cannot be restarted.

Transferring Program Status (Before stopping)



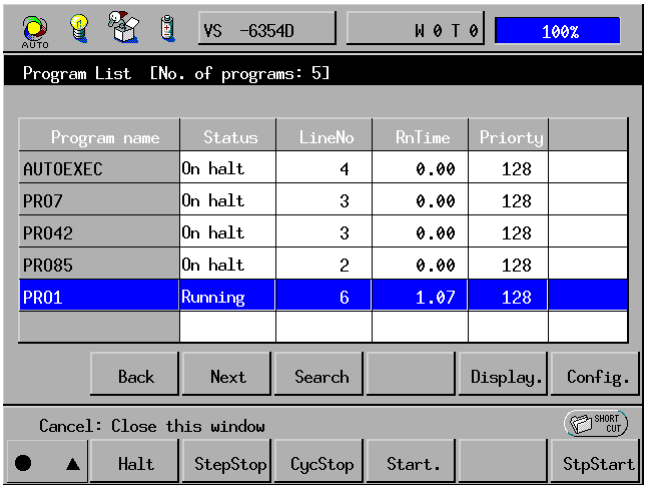
All task programs are temporarily stopped.



When Continue Start is executed, programs whose status is "Continue Stop" are restarted.

NOTE: In WINCAPSII, the task status of Continue Stop becomes 6.

Continue Start



User-changeable parameters

You can change the following parameters relating to the Continue Function.

"Robot Stop (Continue)"

If this parameter is set to 1, Continue Start becomes effective after Robot Stop. Even if Robot Stop button is pressed, program status is not changed to "stopping." And when parameter is set to 0, Continue Start becomes ineffective.

"Auto Position Correction"

If this parameter is set to 1, auto position correction takes place during Continue Start. Set 0 if this function is to be made ineffective.

"Valid range for Auto Position Correction 1 - 6 axis"

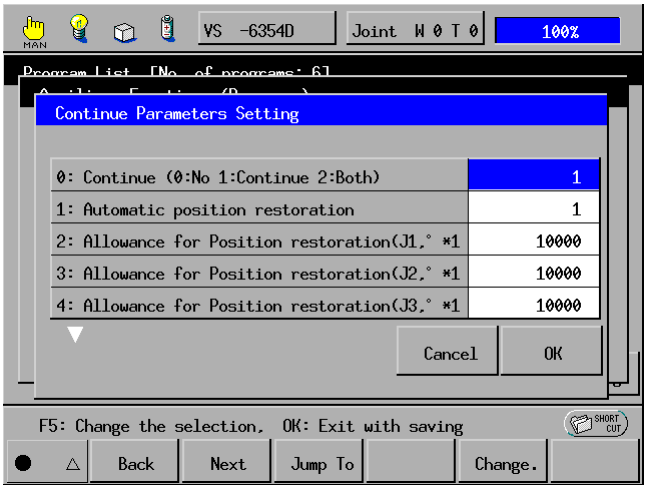
This parameter shows the valid area for performing Auto Position Correction. The unit is degree.

You can set parameters from the teach pendant or in WINCAPSII.

Parameters setting from the teach pendant (MANUAL mode)

Access : Top screen

[F1 Program]—[F6 Aux.]—[F7 Continue]



Setting from the Teach Pendant

NOTE:

Valid area of auto position correction arm is expressed by 10^3.

In the above example, 10000 expresses 10 degrees.

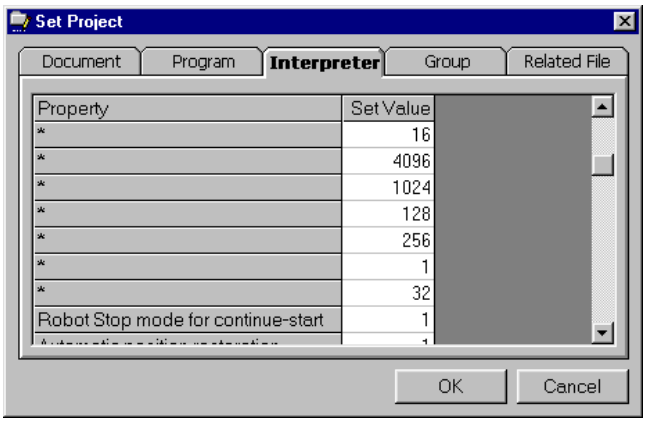
Valid area is calculated from (Position when robot is stopped – Valid area) to (Position when robot is stopped + Valid area).

Parameter setting in WINCAPSII

Log on at Programmer level.

Select [File]—[Set Project]—[Interpreter] in PAC manager.

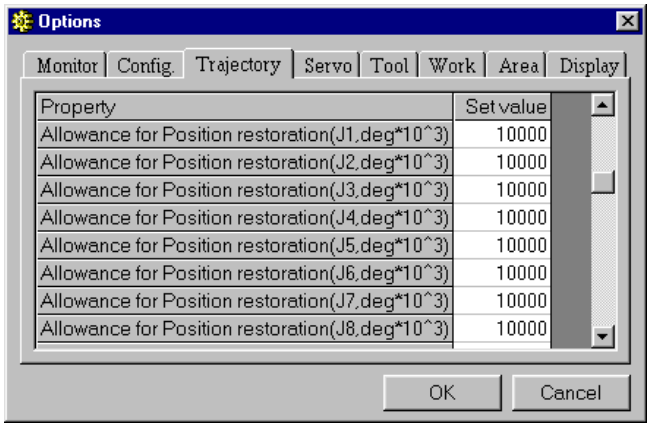
Change the parameters of Robot Stop (continue) and Auto Position Correction.



Changing parameters in WINCAPSII

Select [Tool]—[Settings]—[Create trajectory] from Arm Manger.

Change the parameters of valid area as shown in screen.



Parameter setting in WINCAPSII

Transfer to controller.

For details, see the WINCAPSII GUIDE.

Conditions Necessary for Continue Start

You can start the operation only so long as there is no change in the program status after halt. (However, if the program is stopped during Cycle Run from the teach pendant by pressing Cycle Stop, Continue Start will not work properly even if there is no change in the status. Continue start also becomes ineffective if a Level 3 error or higher occurs.)

NOTE: During the execution of Continue Start, if the program status is changed, an error will occur.

Operating Procedure of Continue Start

Continue Start can be executed from the teach pendant, operating panel, and I/O.

■ *From the teach pendant*

Only the program whose status is Continue Stop can be executed by pressing the "Continue Start."

Continue Start from the Teach Pendant

■ *From the operating panel*

Shift ON + Step Stop (Program above Step Stop in the above screen can be executed by Continue Start)

■ *From the I/O*

In I/O standard mode

Continue Start command

0001	00000100		
Program operation	Data Area 1	Program No.	Status Area

Continue Start permission signal:
No.10 of CN10 Continue Start permission signal

In I/O compatibility mode

Continue Start signal (No. 6 of CN8) + program start signal (If program start signal is entered with Continue Start signal, Continue Start will execute.)

NOTE:

If Continue Start signal is entered at the time of program start, the program number will get ignored.

Continue Start permission signal:
No. 16 of CN10 Continue Start permission signal

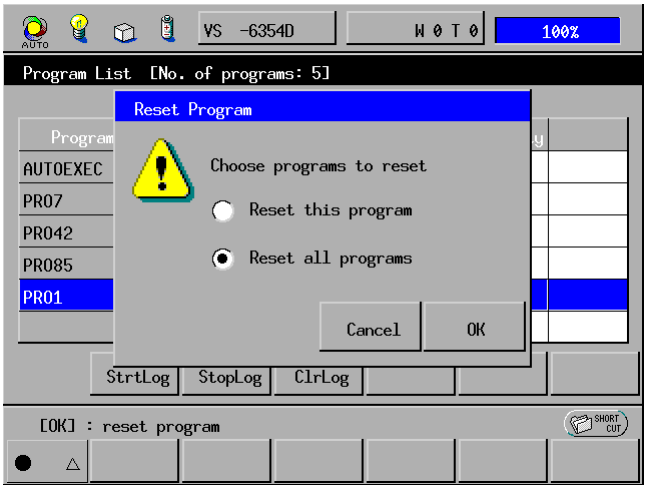
NOTE:

If Continue Start is executed in I/O compatibility, an error will occur except when Permit Continue Start permission signal is on.

Immediately after stopping all task programs, if Continue Start is executed even with Continue Start signal being ON, an error will occur.

Others

The function which resets all the programs is added in the teach pendant. This key stops programs. You can stop either the selected program or all programs by selecting "Reset this program" or "Reset all programs."

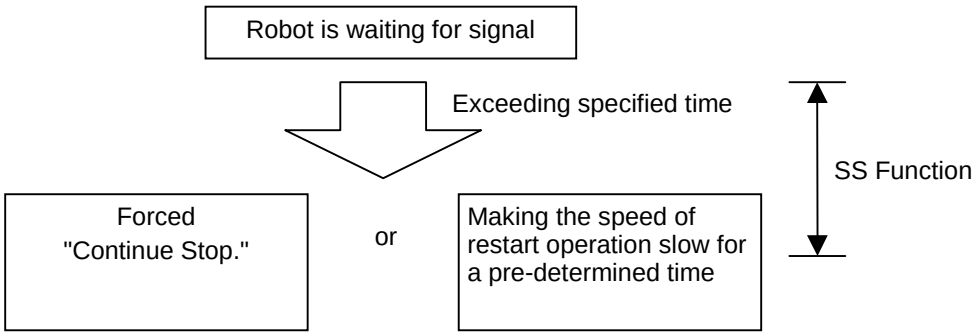


Resetting Program(s) from the Teach Pendant

Out of system-output signals (in compatible mode), the Single-Cycle End signal goes OFF also at the start of Continue Start.

3.4.6 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.



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.

Note (For SS (Safe Start)):

- 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.

Operation Mode

Types of mode

In SS function, there are two types of modes as given below.

(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.

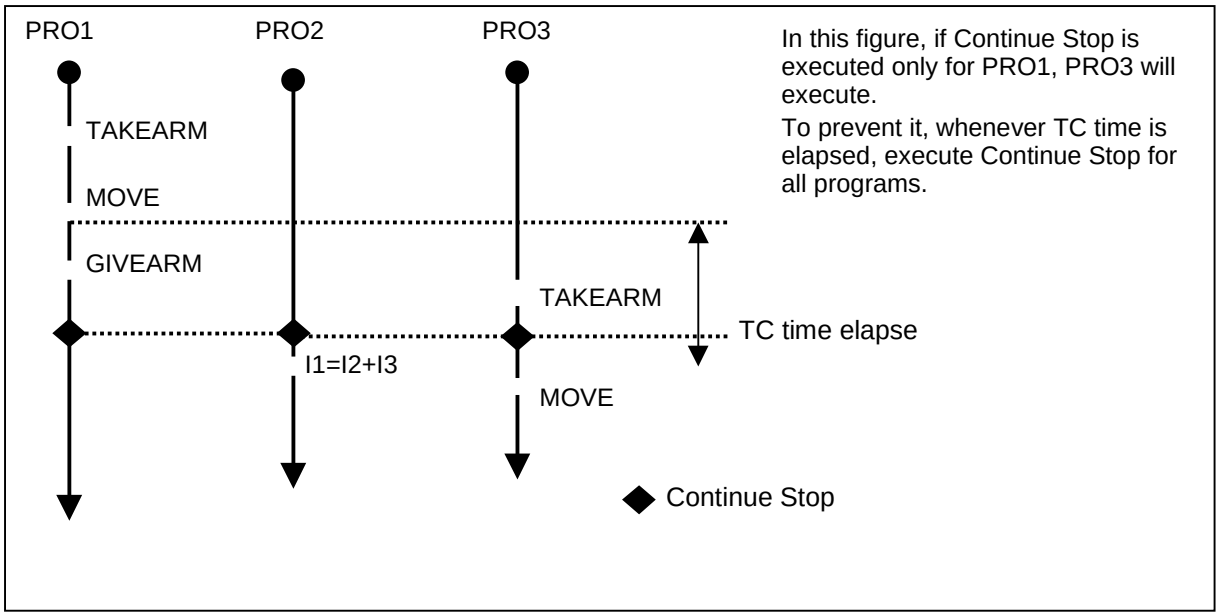
  This specific time is called as "TC period." Also, period of robot inaction is called "Inaction Period." The time is counted from 0 from the moment when the external device temporarily stops the operation of arm or tool. When TC period is exceeded, Continue Stop is carried out.

  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
- Example of operation

  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.



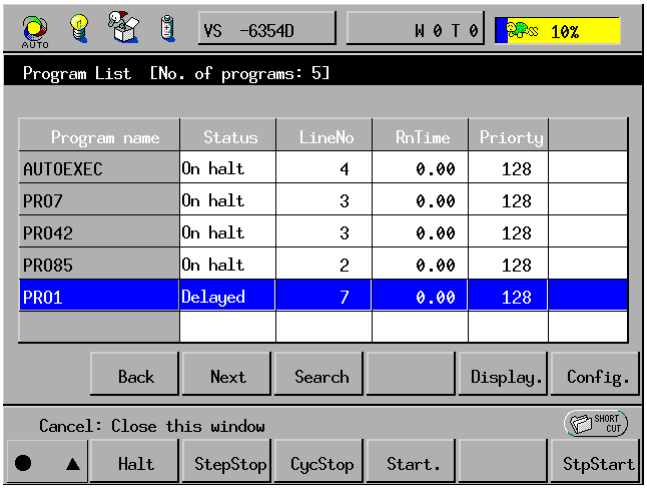
Slow Mode

- 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.



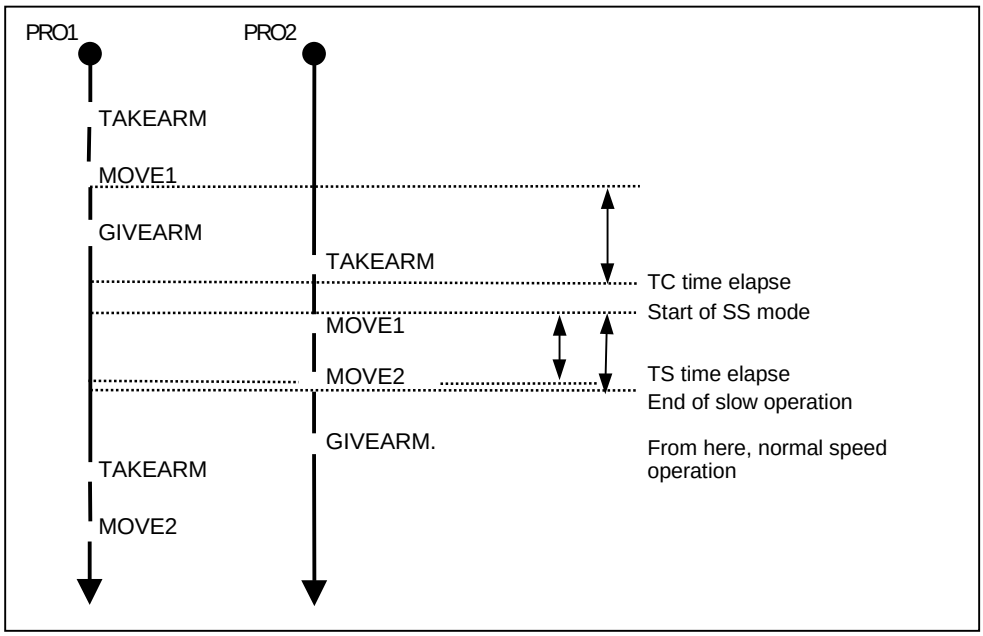
Example of Operation

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.

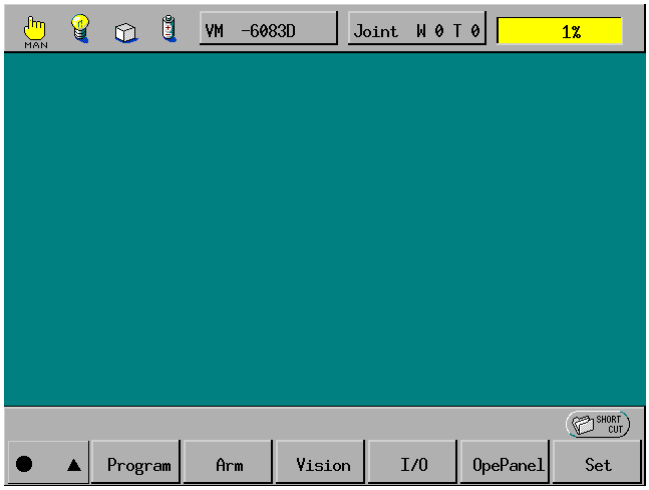
Then, the slow operation of MOVE1 of PRO2 is started. MOVE2 of PRO2 is carried out slowly because it is started in the TS period.

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



Setting procedure of SS function operation mode

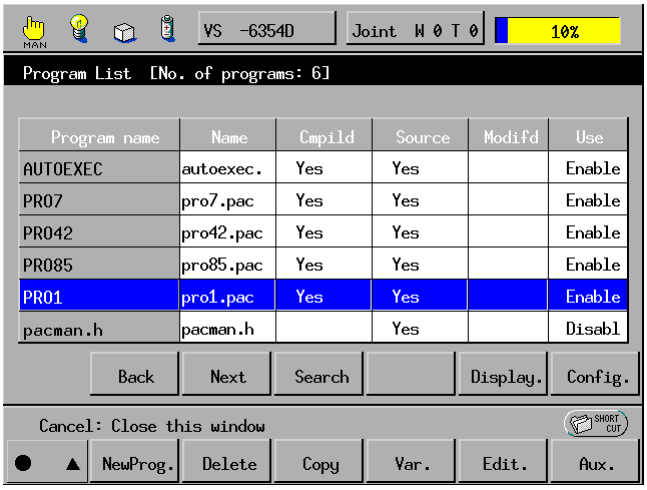
(1) Set the mode selector switch to the MANUAL position.



(2) Turn the motor off.

(3) Press [F1] or select [Program] in the window.

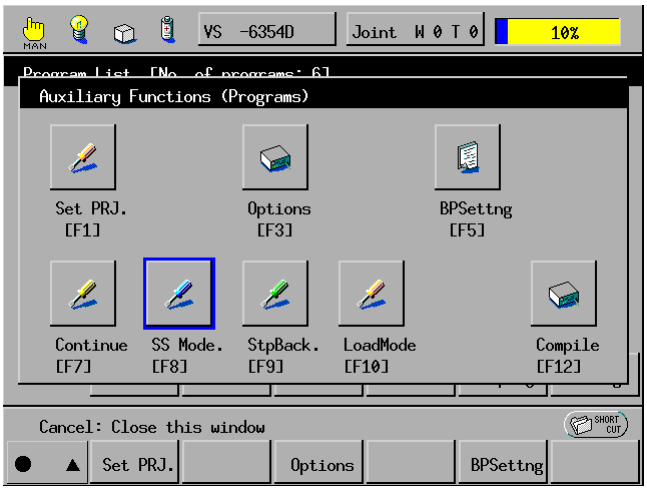
The Program List window appears as shown below.



F6

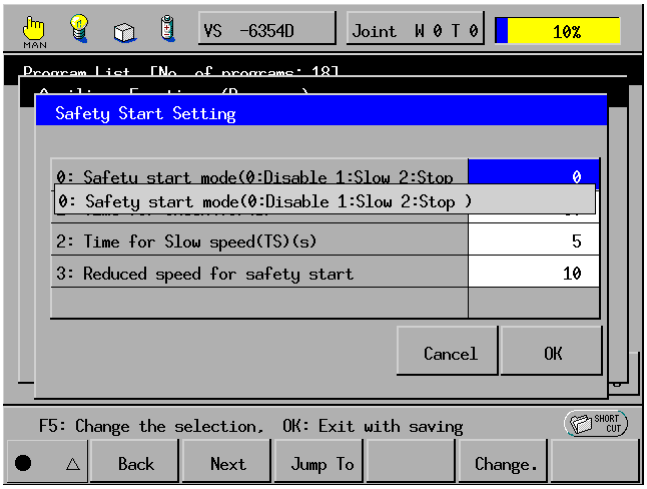
(4) In the Program List window, press [F6 Aux.].

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



(5) Press [F8 SS Mode.].

The Safety Start Setting window appears.



(6) Select the "Safety start mode" by using the cursor keys or jog dial or by touching the screen directly.

The "Safety start mode" will become highlighted.

(7) Set the desired value and press the OK button.

To disable the SS function : 0

Slow mode : 1

Stop mode : 2

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.

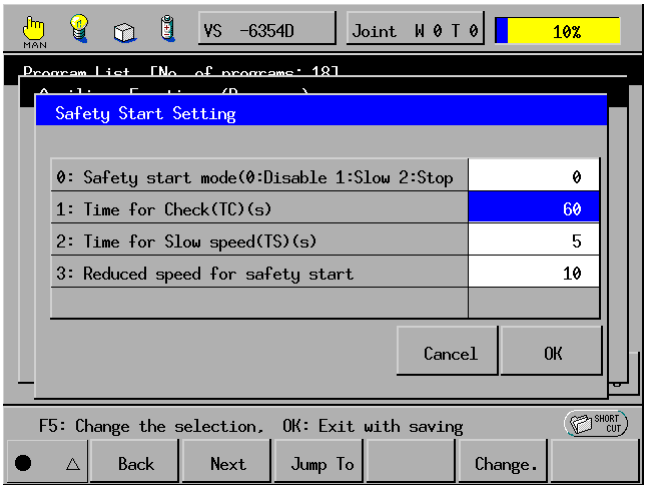
By direct entry of values

Setting the TC period

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "TC time" by using the cursor keys or jog dial or by touching the screen directly.

The "TC time" will become highlighted.



(7) Enter an arbitrary TC period and press OK.

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

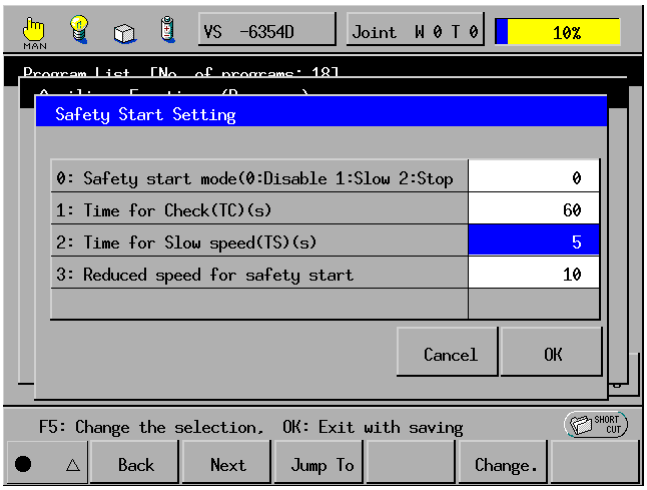
NOTE: Setting "0" will disable the SS function. The SS function is kept disabled until you enter a value other than 0 to the TC time.

Setting the TS period

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "TS time" by using the cursor keys or jog dial or by touching the screen directly.

The "TS time" will become highlighted.



(7) Enter any TS time and press OK.

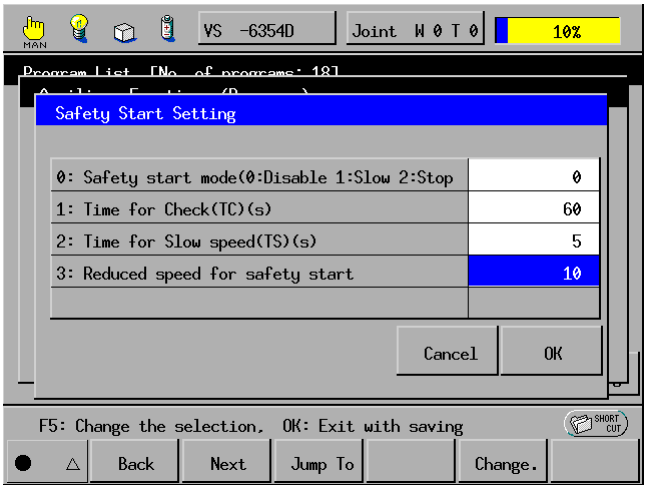
You may enter any value from 3 to 30 seconds. The factory default is 5 seconds.

Setting the Slow speed

(1) Follow steps (1) through (5) in "Setting procedure of SS function operation mode."

(6) Select the "Reduced speed for safety start" by using the cursor keys or jog dial or by touching the screen directly.

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



(7) 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

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.

3.4.7 Break Point Function [TP] [Ver. 1.4 or later]

You may set a break point at any program step in programs. If a program is running and encounters a break point, it will immediately stop. The step where a break point is set cannot be executed.

You can set a break point only from the teach pendant. (The operating panel cannot be used for this purpose.)

Max. number of break points that can be set	32 points in all programs	
Operation modes in break points take effect	External automatic	Cycle start
	Internal automatic	Cycle start
	Teach check	Cycle start
Requirements for setting break points	External automatic	Highlighted step
	Internal automatic	Highlighted step
	Manual	Any step
	Teach check	Highlighted step

Break point stop mode

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

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

(2) Immediate halt of all running 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)

(2) Continue Stop at BP (Break point): Control stops the program at the program step where Continue Start is possible

(Halt at the BP is functionally equivalent to Halt. Continue Stop at BP is functionally equivalent to Continue Stop.)

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 program is edited
- You delete the program
- You recompile the program with the teach pendant
- Data of PAC Manager is received from WINCAPSII
- The operation device is switched to the operating panel

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 either of the following two ways:

Halt at BP: Only the program in which the break point is set will be restart.

Continue Stop at BP: Programs will Continue Start if possible.

When this operation needed

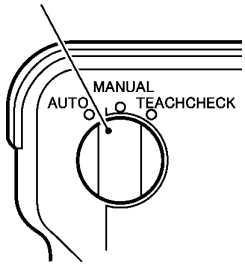
This operation is needed when you want to stop the program at any step in a program.

Setting a break point

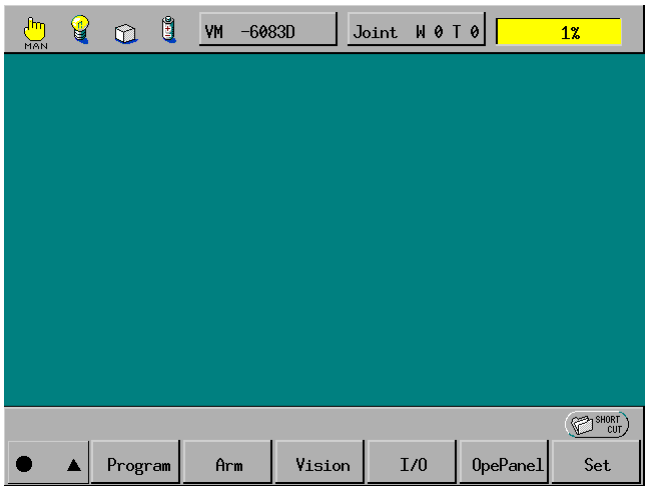
■ ***From the teach pendant***

Step 1 Set the mode selector switch to the MANUAL position.

Mode switch



Step 2 Press [F1 Program].



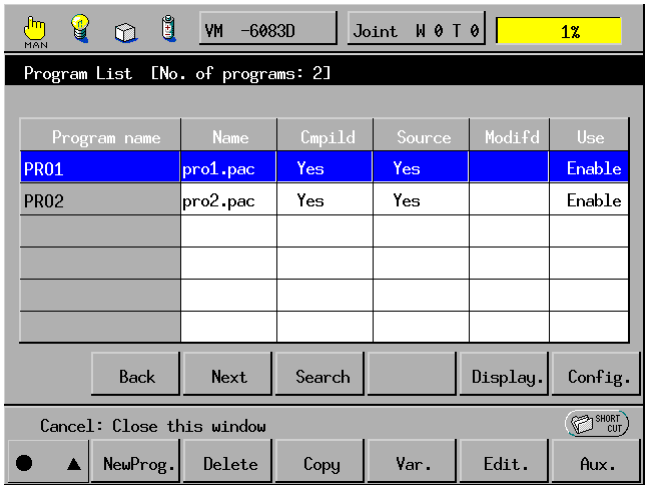
F1

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

Step 3

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

The selected program will become highlighted.

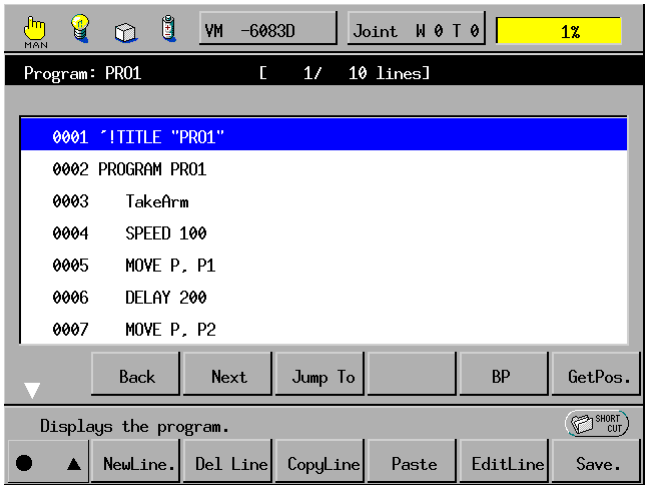


F5

Step 4

Press [F5 Edit.] or [Display].

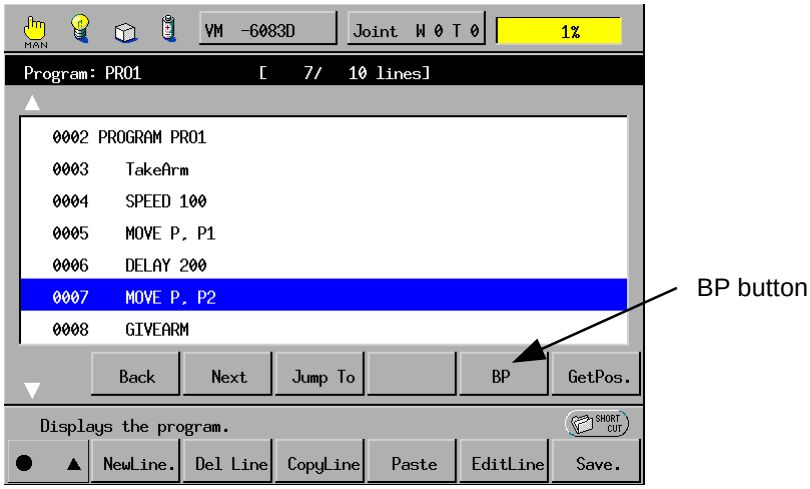
The program steps appears as shown below.



Step 5

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

The selected step will become highlighted.



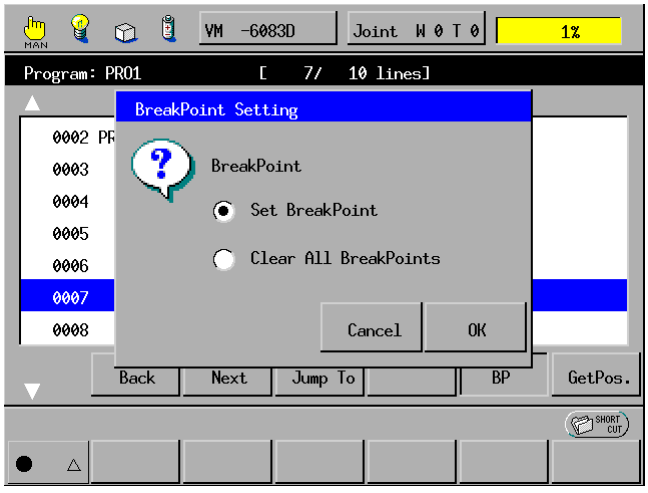
Step 6

Press [BP].

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

Step 7

Select "Set BreakPoint" and press the OK button.



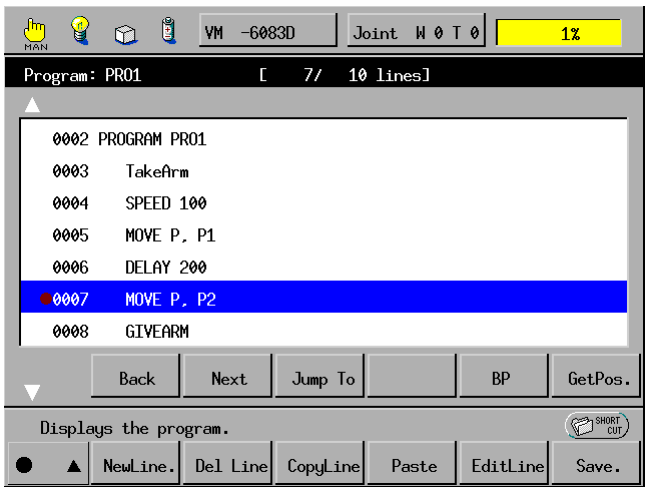
A red circle will appear at the left side of line number where the break point is set.

Clearing the break point

■ *From the teach pendant*

Step 1

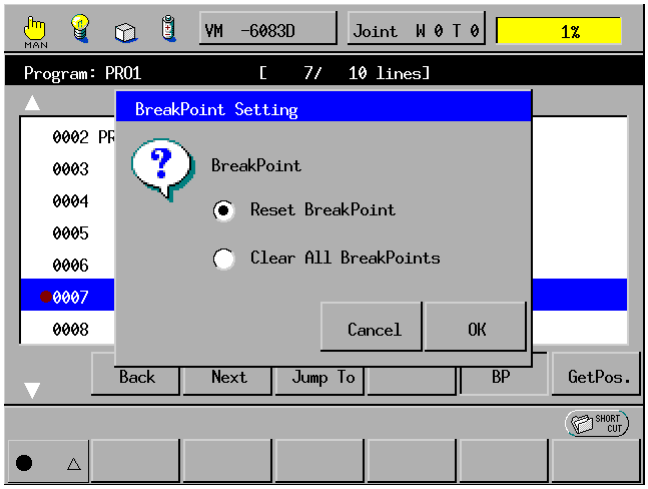
To clear the break point already set, choose the program step following Steps 1 to 5 given in the above section. The next screen will appear.



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

Step 2

Press [BP].



Step 3

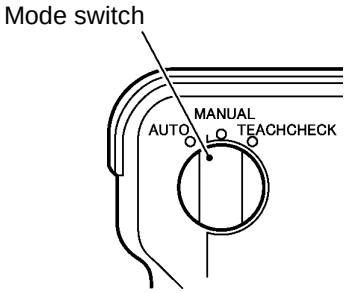
Select "Reset BreakPoint" and press the OK button.

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

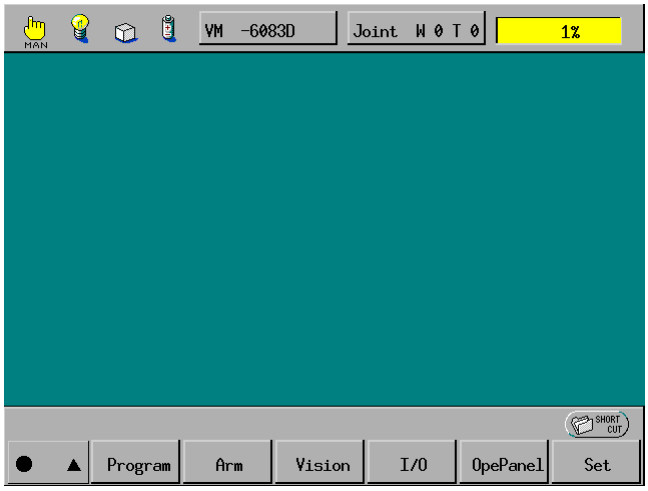
Setting the Break Point Stop mode

■ ***From the teach pendant***

Step 1 Set the mode selector switch to the MANUAL position.



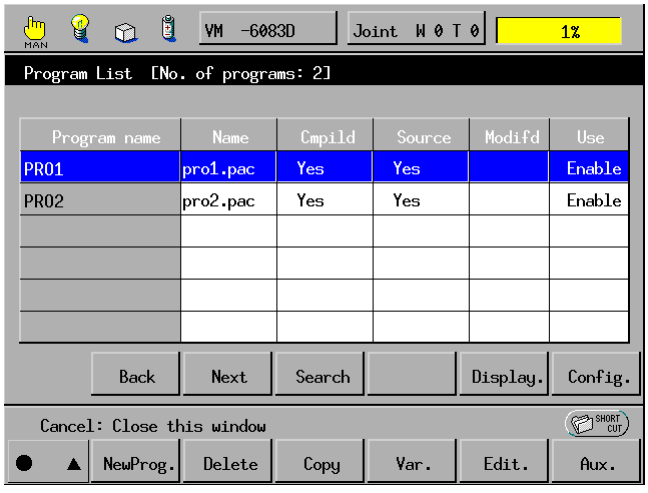
Step 2 Press [F1 Program] on the top screen.



F1

Step 3 The Program List window appears as shown below.

Press [F6 Aux.].

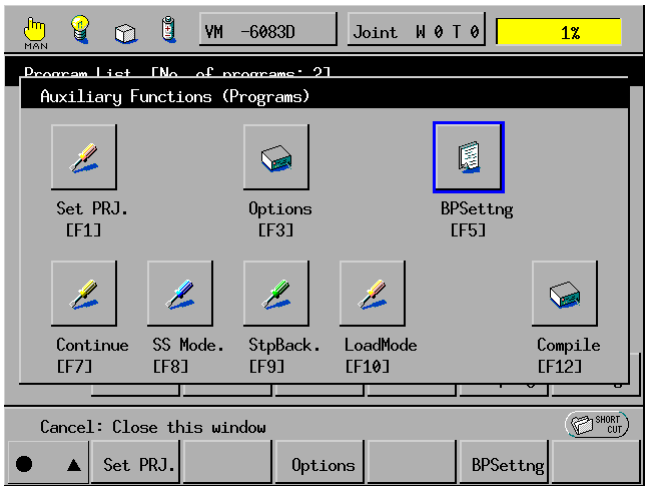


F6

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

Step 4

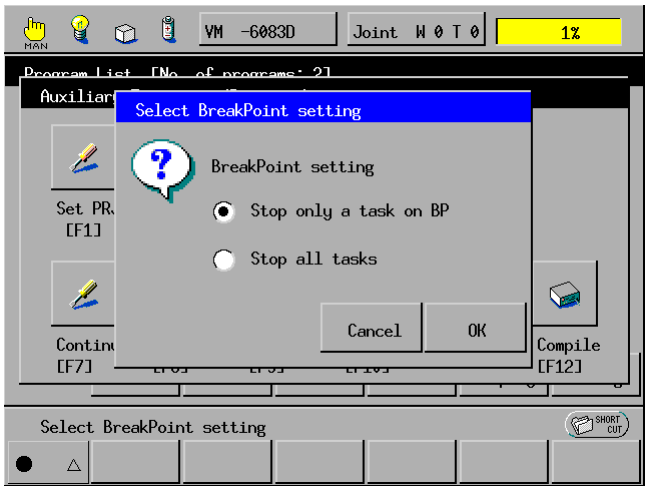
Press [F5 BP Settng].



The Select BreakPoint setting window appears as shown below.

Step 5

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***

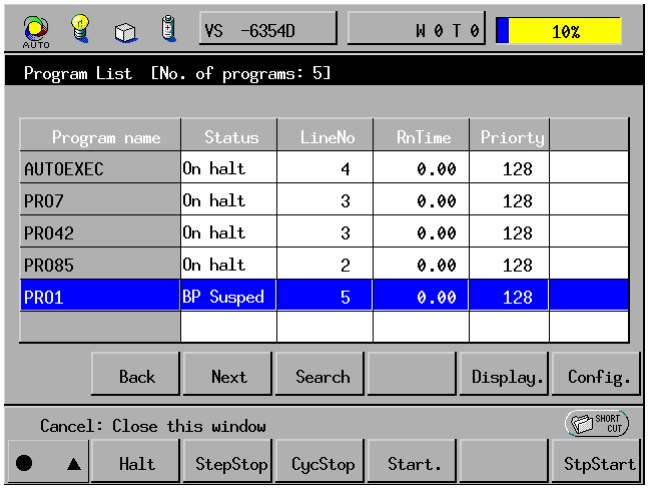
Step 1 Set a BP (break point) in any step you want to do so.

For the setting procedure, refer to Subsection 3.4.7 "Break Point Function."

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

For program starting, refer to Section 3.4 "Auto 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

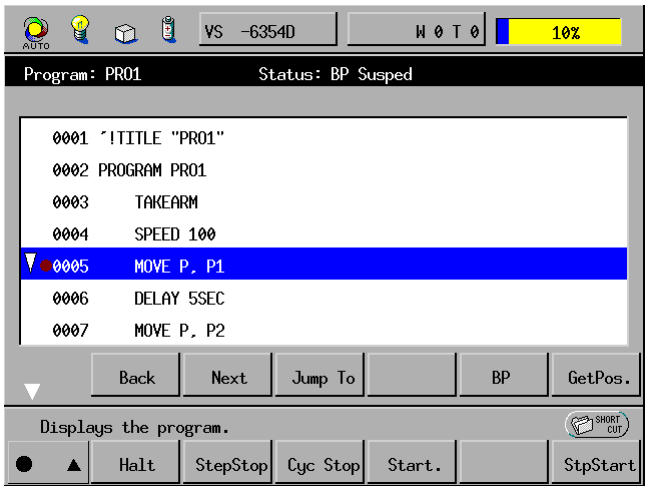
Step 1 Set a BP (break point) in any step.

For the setting, refer to 3.4.7 BreakPoint Function.

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

For program starting, refer to Section 3.3 "Teach Check 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 restarting it, the program temporarily stops at the BP.

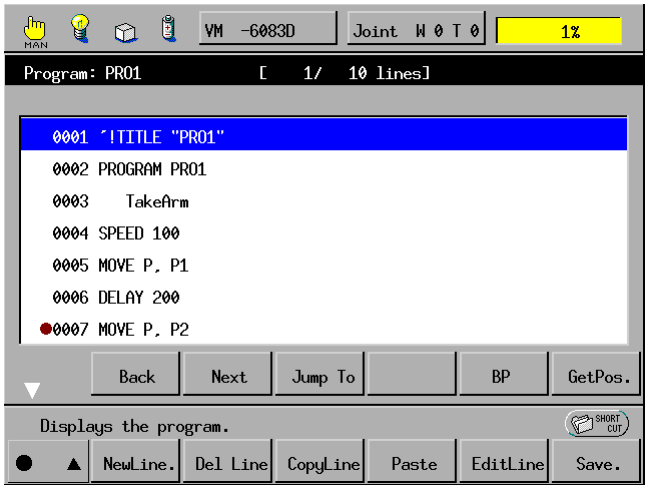
Note 2 Any program steps with a gray-circled BP-set will not stop at the BP step after CycleStarted or StepStarted..

Clearing all break points

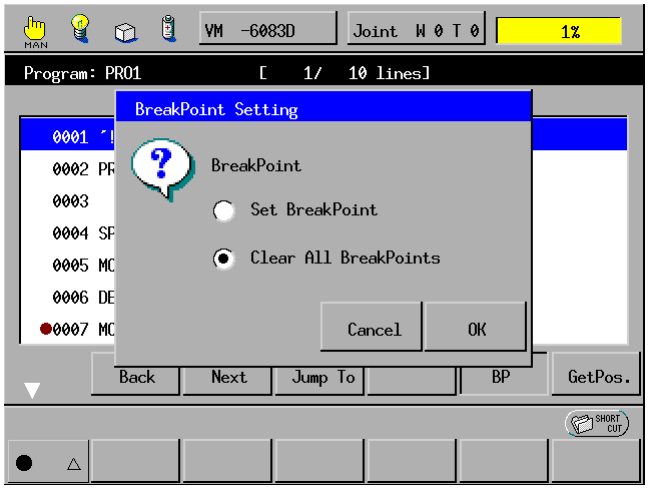
■ ***From the teach pendant***

Step 1 Follow Steps 1 to 4 in Break Point setting.

(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.

3.4.8 Local Variable-Related Enhancement [TP] [Ver.1.9 or later]

3.4.8.1 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 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))`.

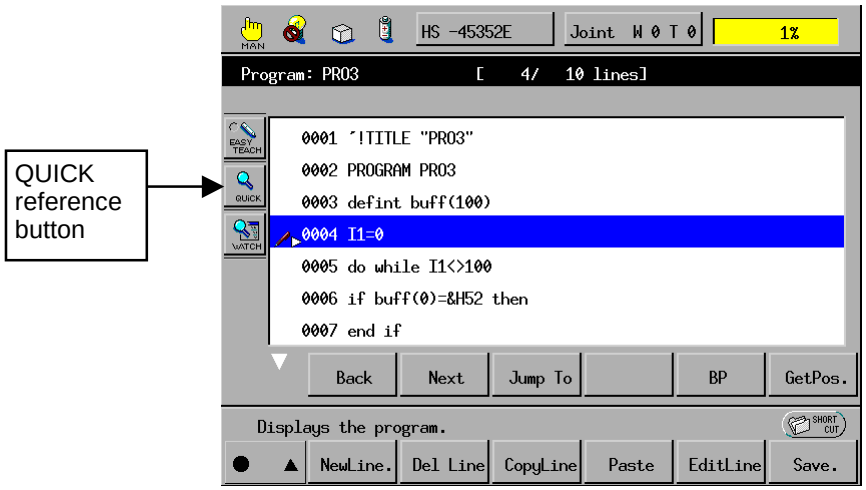
(4) Referring to or writing into local variables in WINCAPSII

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

NOTE: You may use the above facilities (1) through (3) with the teach pendant, not with the mini-pendant or operating panel.

3.4.8.2 Quick Reference

You may immediately refer to local variables defined in a program. To do so, specify a desired program line and press the **QUICK** reference button that is newly provided in the coding list window as shown below.

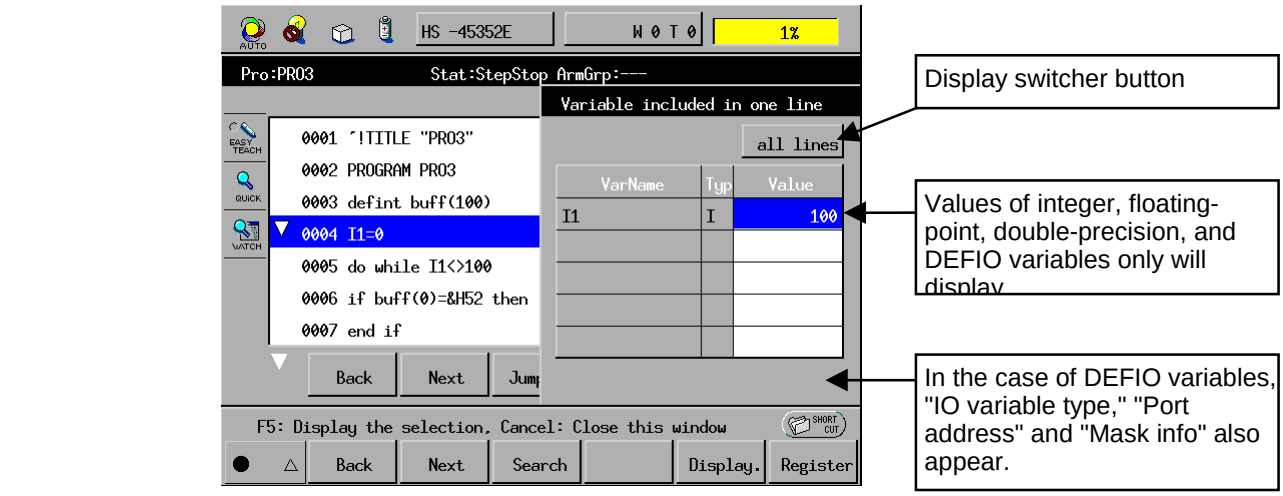


NOTE: Only in manual mode, you can highlight a desired program line or move the cursor to a desired line.

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.

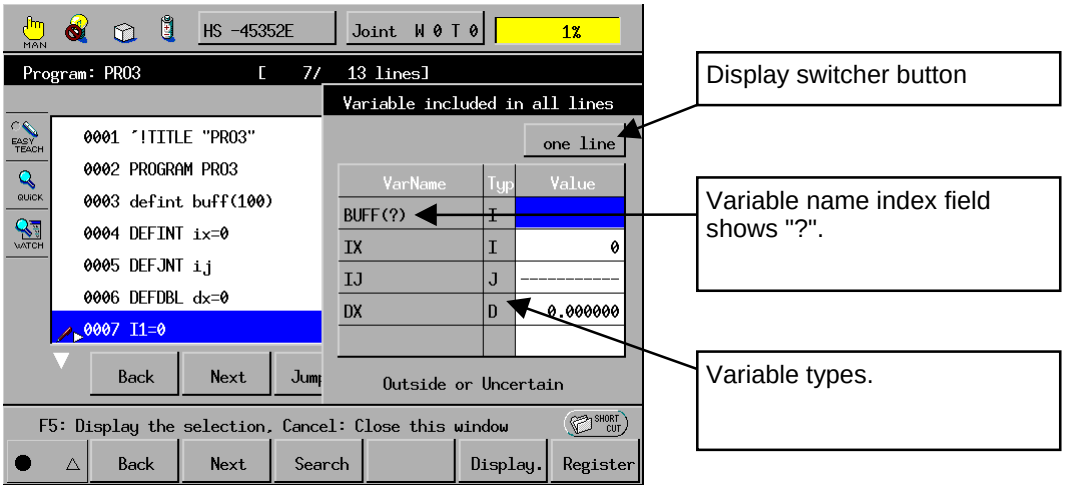
NOTE 2: If the port address of a referred-to DEFIO variable is out of the specified I/O range, then the DEFIO variable will display in gray.

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.

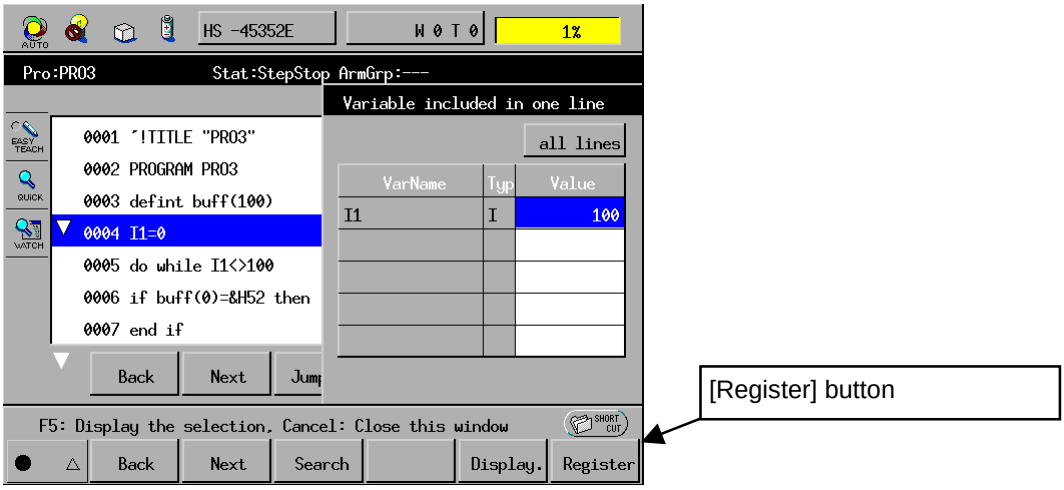


NOTE 1: While the "Variables included in one line" window displays not only local variables but global variables, the "Variables included in all lines" window cannot display global variables.

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.

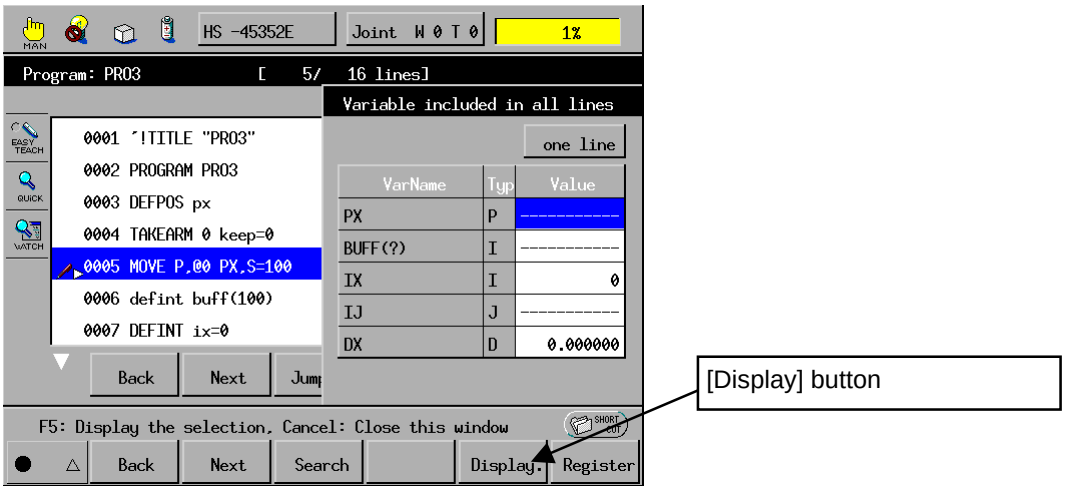


NOTE 1: If the index field of a variable name shows "?" on the above screen, the variable cannot be registered here.

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

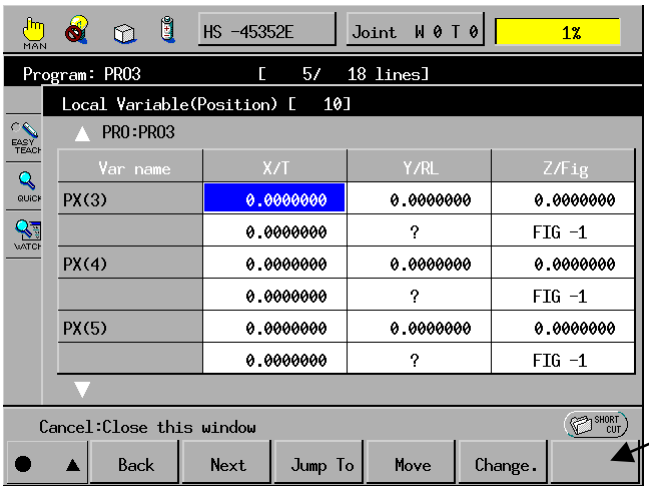
Press [Display] shown below to display the values of the selected variable (see the next page)

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 [F12 Register].



Press the Shift button to shift the menu bar and show [F12 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 the deadman switch, same way as modifying I/Os.

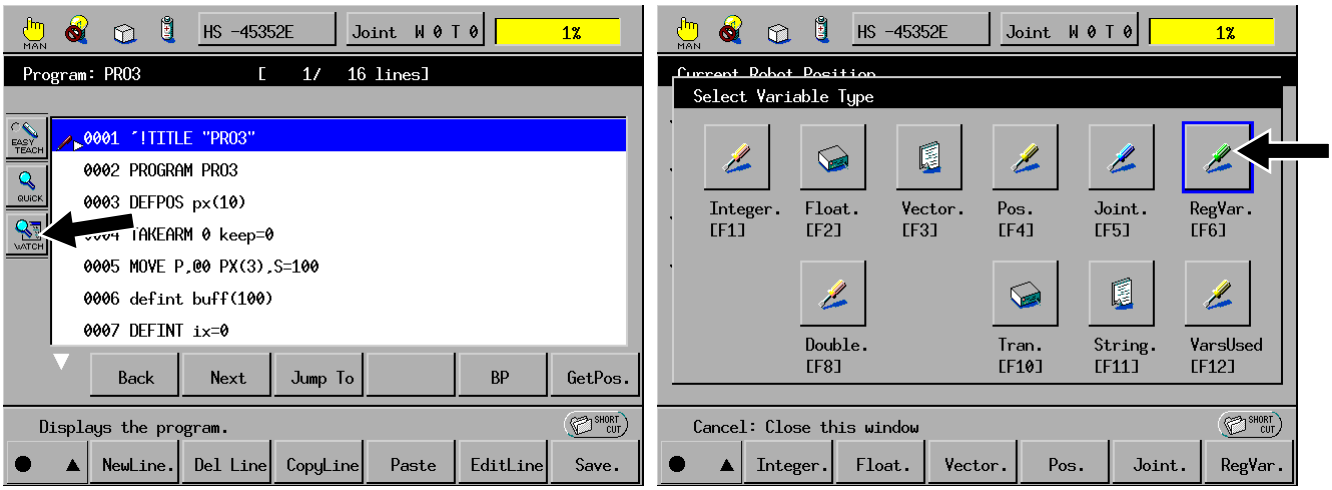
NOTE 3: This quick reference facility cannot take position data into local variables.

3.4.8.3 Referring to Registered Variables

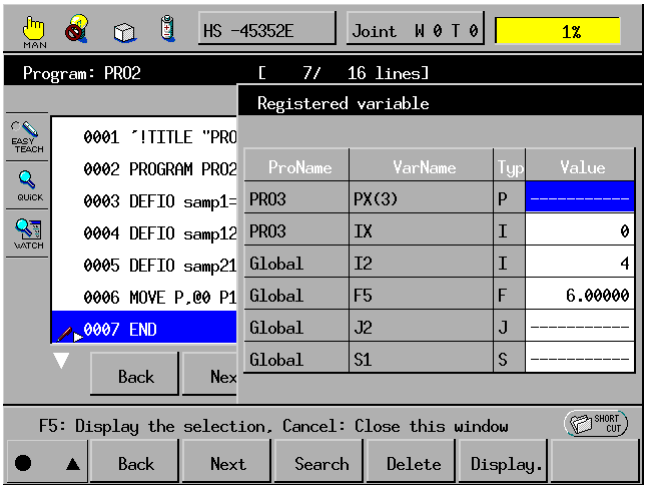
As described in Section 2.2, you may register variables with [Register] in the variable quick reference facility or [F12 Register] on the variable value screen.

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 [F6 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.

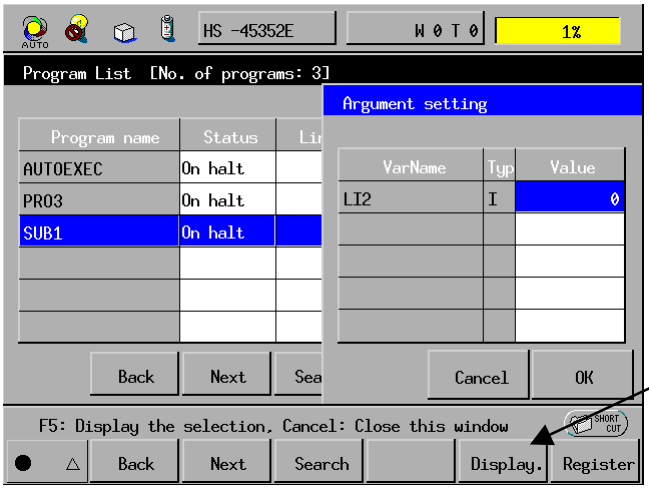
3.4.8.4 Running a Program with Local Variable Arguments

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].



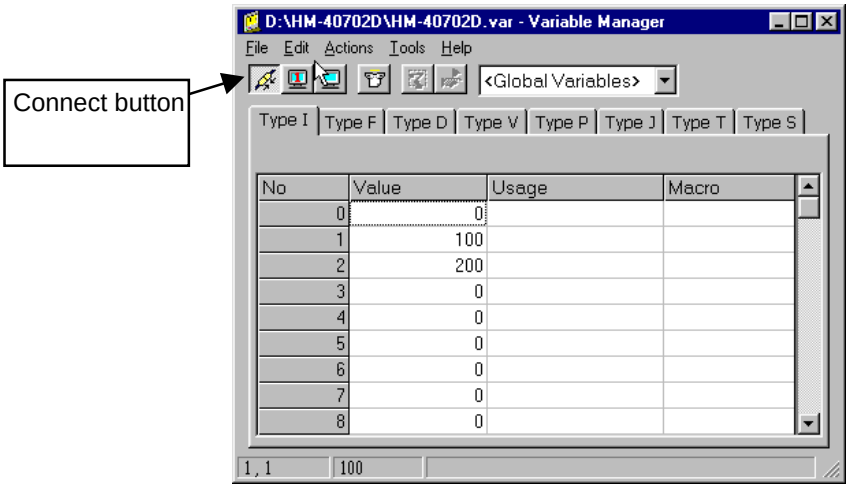
To modify arguments, press [Display]. You can modify it in the same way as for global variables.

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

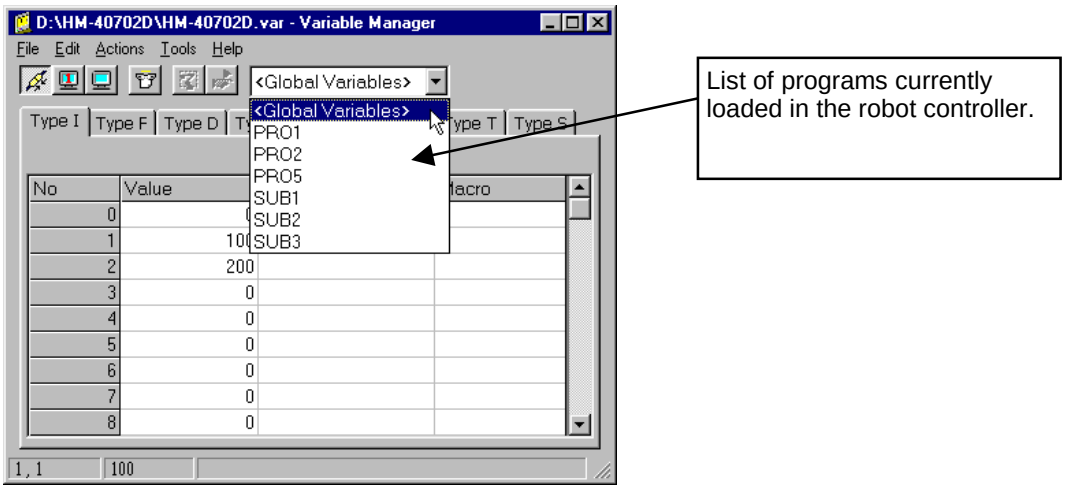
3.4.8.5 Referring To or Writing Into Local Variables in WINCAPSII

In WINCAPSII, you may refer to or write into local variables.

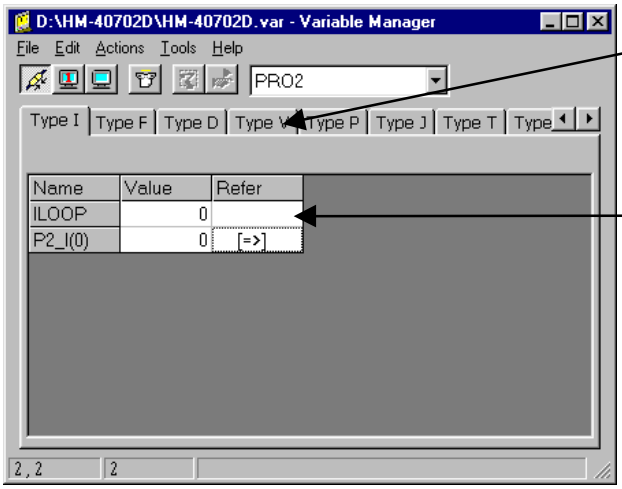
First, press the Connect button to make Variable Manager in WINCAPSII online with the robot controller.



Next, open the pull-down menu and select a program whose local variables should be referred to or modified.

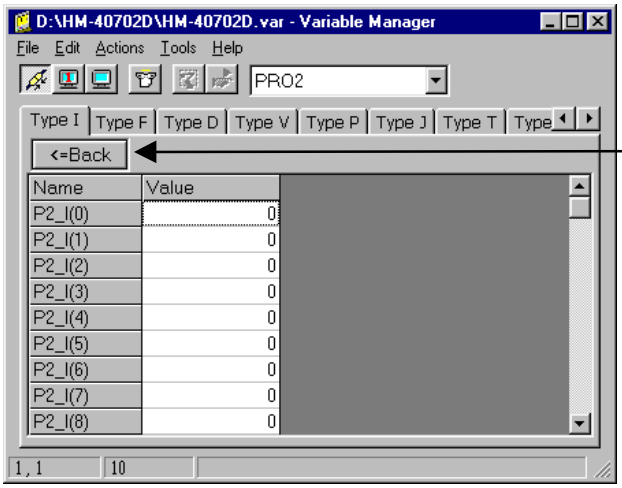


The sample window below displays local variables defined in program PRO3 and the contents of the array argument of the variable named BUFF.



Select a local variable type to display its contents. In this example, local integer variables in program PRO3 are displayed.

If the local variable has an array argument, => icon will appear in the reference column. Double-click this icon to display its contents.

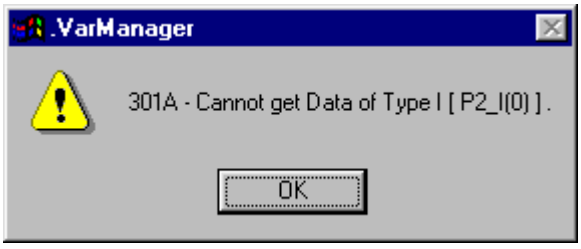


To return to the previous window, click here.

The subsequent value change procedure will be the same as for global variables.

NOTE 1: To modify DEFIO variables in WINCAPSII, you need to hold down the deadman switch of the teach pendant.

NOTE 2: When this facility is running in WINCAPSII online, if the controller loads any new programs, Variable Manager automatically goes offline, issues the following message, and no longer displays any variables.

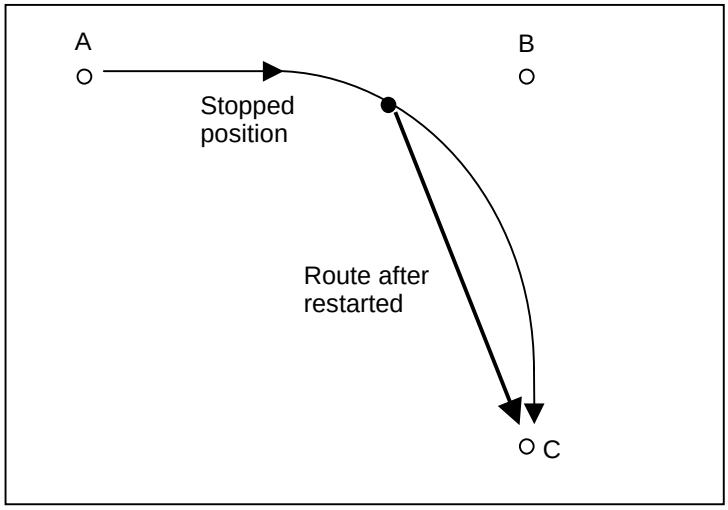


If so, make Variable Manager online again.

3.4.9 Changing Route in Restarting the Pass Motion [Ver. 1.4 or later]

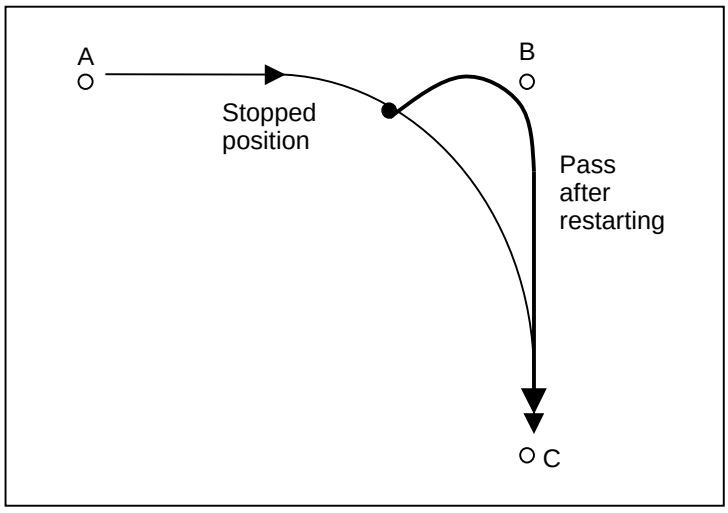
When stopped in the pass motion, for the route for the robot motion after restarting it, you can select one of the following two options.

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



Pass motion without any change (Traditional)

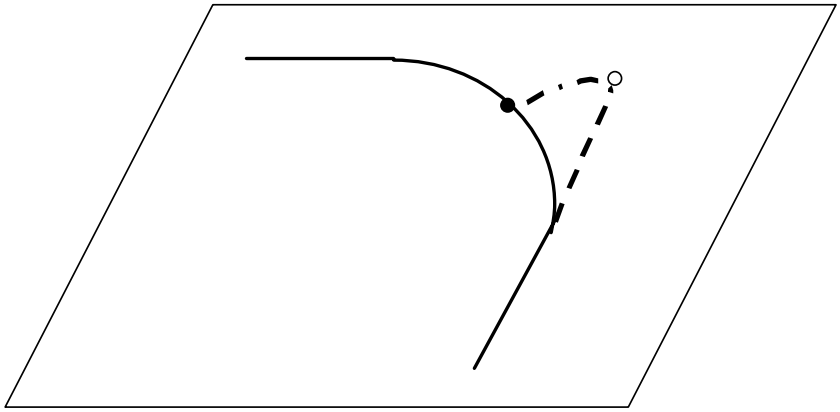
(2) The new feature can execute the pass motion to the target position on the path previously defined (PTP control) or to the target position on the path newly defined after restarting.



New pass motion, added in V 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.

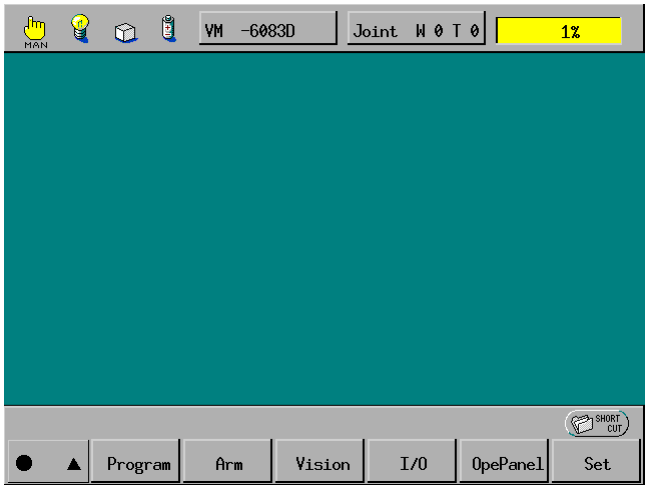
Changing the robot end route

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

Step 1

Set the mode selector switch to the MANUAL position.

Press [F2 Arm] on the top screen.

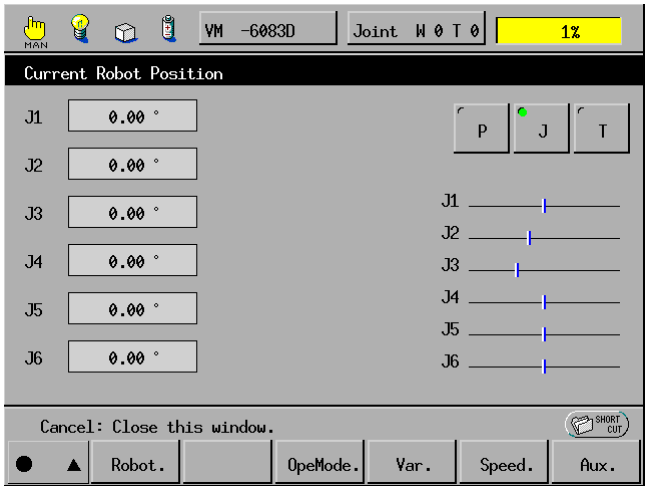


F2

The Current Robot Position window appears as shown below.

Step 2

Press [F6 Aux.].

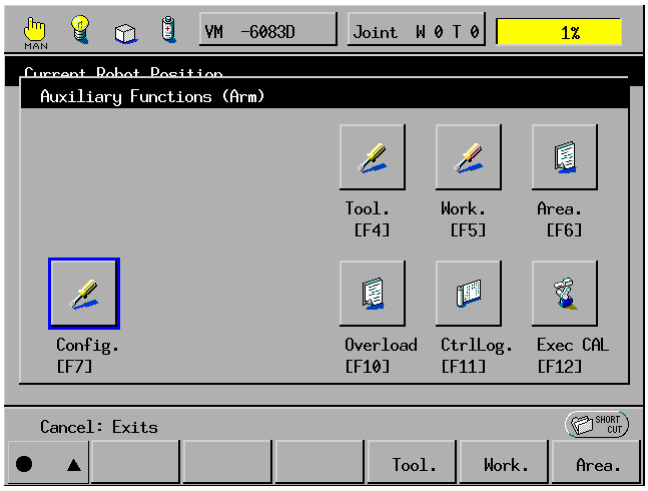


F6

The Auxiliary Functions (Arm) screen appears.

Step 3

Press [F7 Config].



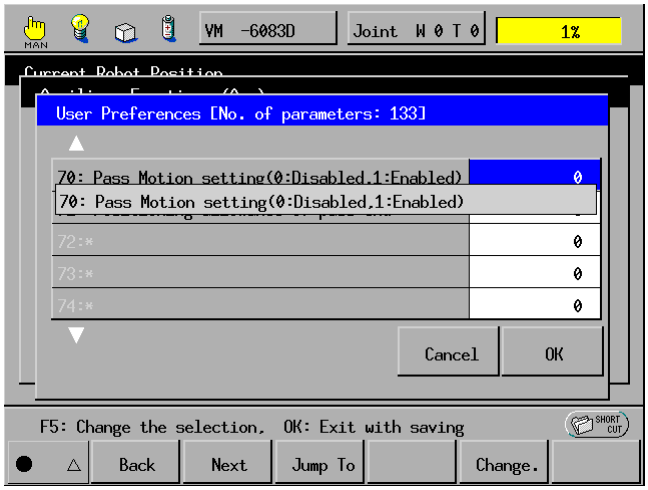
The User Preferences window appears.

Step 4

Select [70: Pass Motion setting (0: Disabled, 1: Enabled)] using the jog dial or buttons from [F1 Back] to [F3 Jump To].

The selected line will become highlighted.

Press [F5 Change].



F5

The numerical keypad will appear.

Step 5

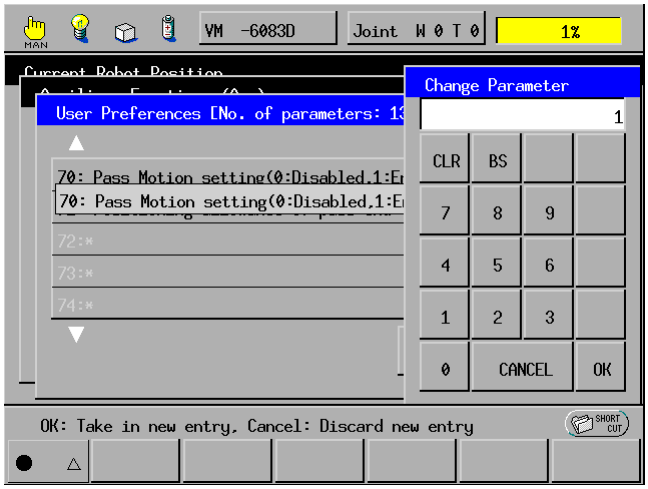
Enter 0 or 1 from the numeric keypad.

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 subsection 3.4.8).

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.

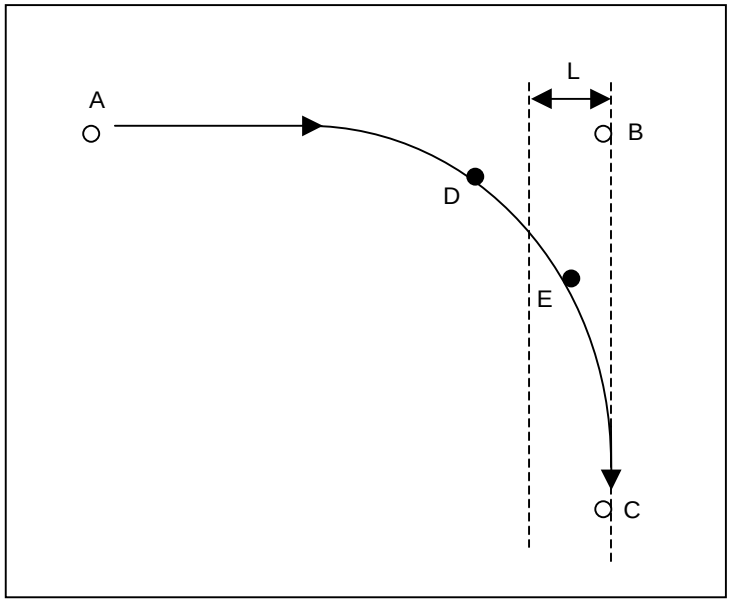
Press the OK button. To cancel the value, press the Cancel button.

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 in stead 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.

3.4.10 Software PLC (Supervisory Task) [Ver. 1.7 or later]

3.4.10.1 Outline of Software PLC

System software version 1.7 newly supports programmable logic control software (software PLC) that runs as a supervisory task. The software PLC 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 TSR9.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 TSR9.PAC and any motion-control programs are prohibited in 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, "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 10 programs may be defined and their names. are fixed to TSR0.PAC to TSR9.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) External 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 TSR9) exists.

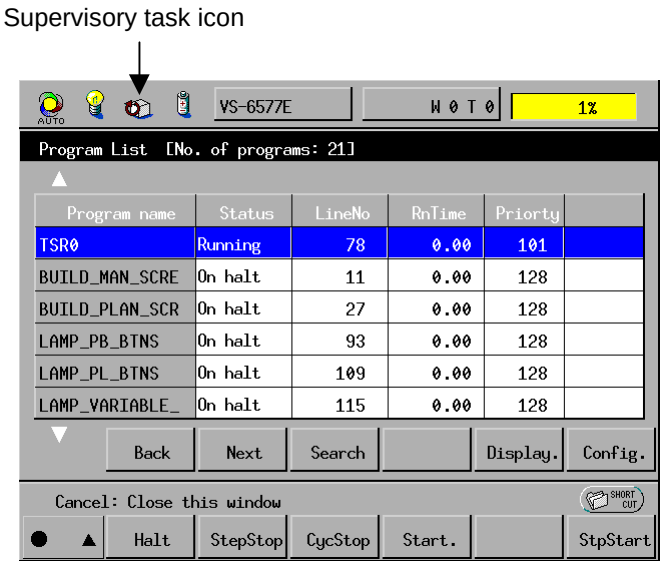
(1) Turning the robot controller on

(2) Switching the operation mode from Manual to Auto

(3) Pressing the [F1 START] in the Supervisor TASK Setting window

(4) Selecting and starting a supervisory task in the Program List window in Auto or Teach Check 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 [F6 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 floppy disk
(7) Receiving a file from WINCAPSII
(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.

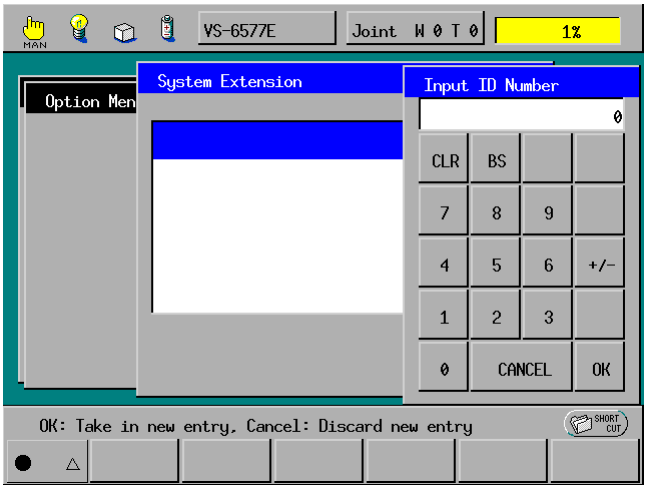
3.4.10.2 Using Supervisory Tasks

[1] Making the supervisory task mode active

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

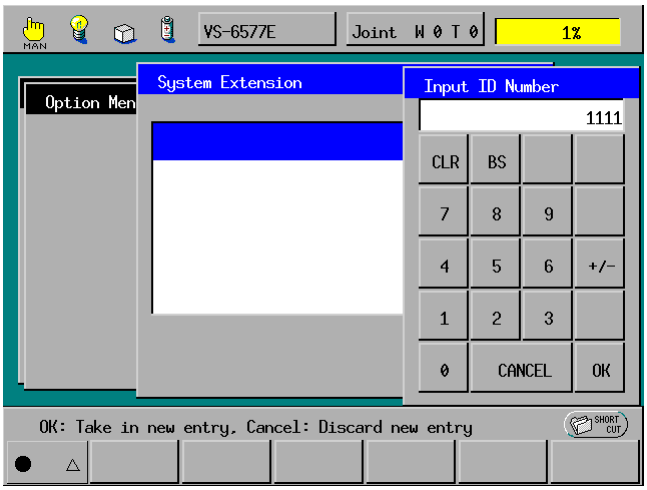
(1) Calling up the System Extension window

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F5 Input ID] from the top screen of the teach pendant

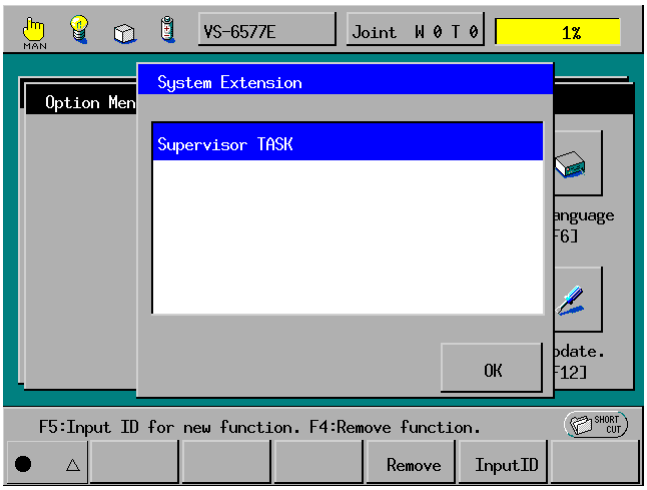


(2) Adding a supervisory task mode

Enter "1111" from the numeric keypad.



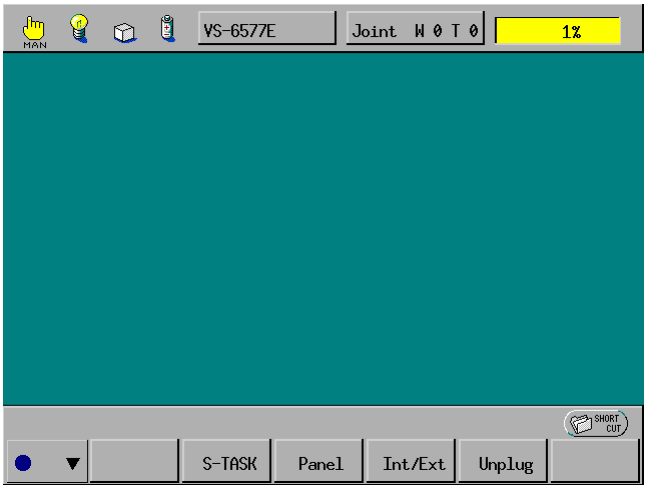
Press the OK button. The supervisory task mode will be added.



(3) Restarting the robot controller

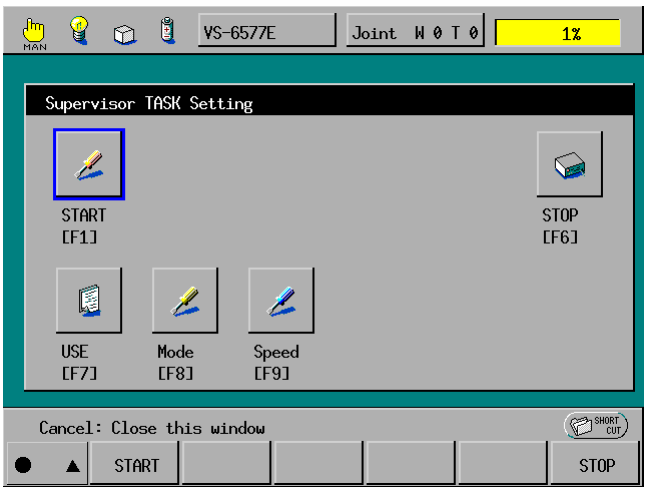
Turn the controller off and then on. The supervisory task mode becomes active and you may make supervisory task settings.

On the top screen, press the SHIFT key and check that the S-TASK is displayed in F8 of the menu bar.



F8

Press [F8 S-TASK]. The Supervisor TASK Setting window appears as shown below.



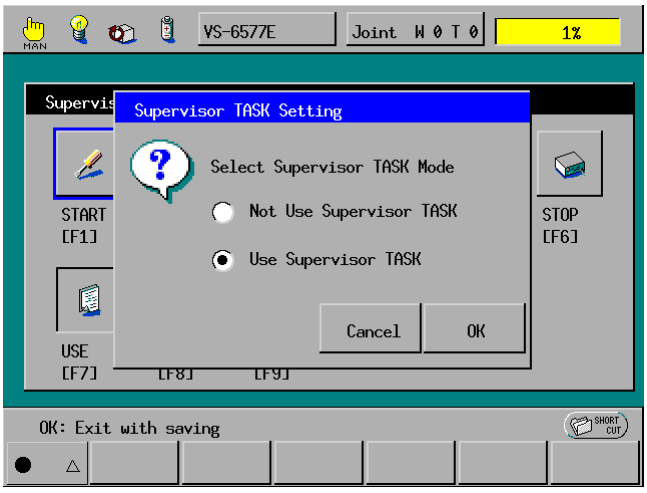
[2] Setting supervisory task parameters

(1) Supervisory task enable/disable parameter

This parameter enables or disables the supervisory task mode.

Access: [F8 S-TASK]—[F7 USE] from the top 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.

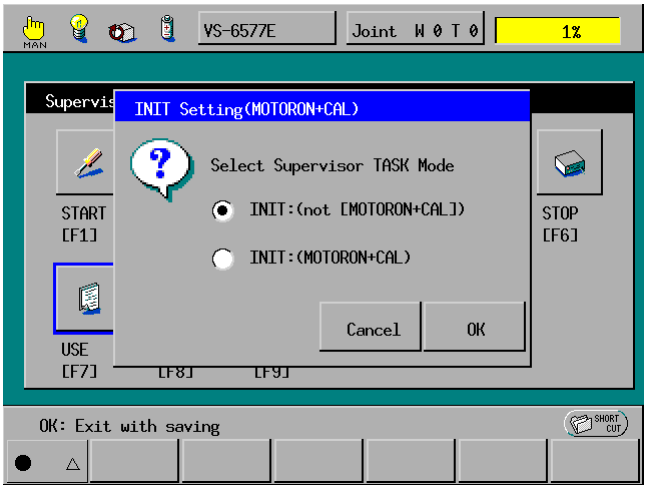


(2) INIT execution mode parameter

This parameter specifies whether or not the execution of the INIT command will involve turning on motors and performing CAL.

Access: [F8 S-TASK]—[F8 Mode] from the top screen of the teach pendant

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

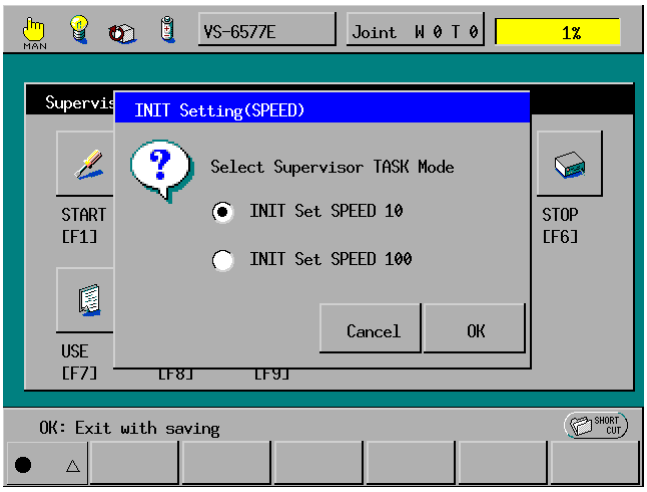


(3) INIT external speed parameter

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

Access: [F8 S-TASK]—[F9 Speed] from the top 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 TSR9) exists.

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

To start no supervisory task, turn the controller on while holding down the deadman switch.

Switch the operation mode from Manual to Auto from the teach pendant or an external I/O.

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 TSR9) exists.

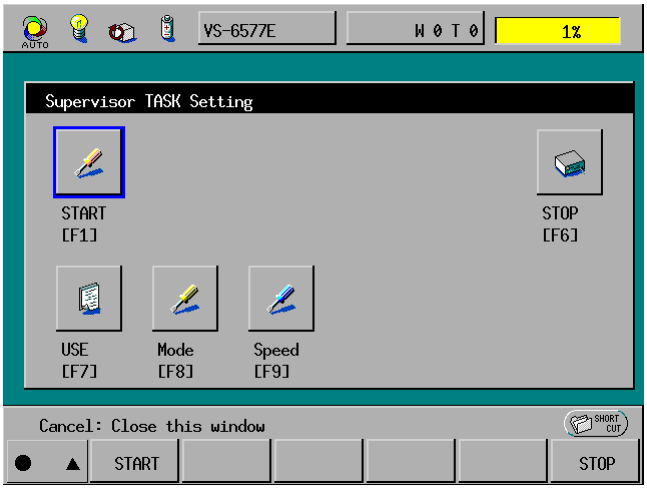
Switching the operation mode from an external I/O when the controller is placed in the external mode will also start supervisory tasks. Before doing this, make sure that no normal programs are running.

NOTE: Switching to Auto mode by using Enable Auto signal and 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 [F8 S-TASK]—[F1 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 TSR9) exists.



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

From the Program List window, choose a desired supervisory task program(s) (TSR0 to TSR9) and start it, provided that any supervisory task program(s) exists.

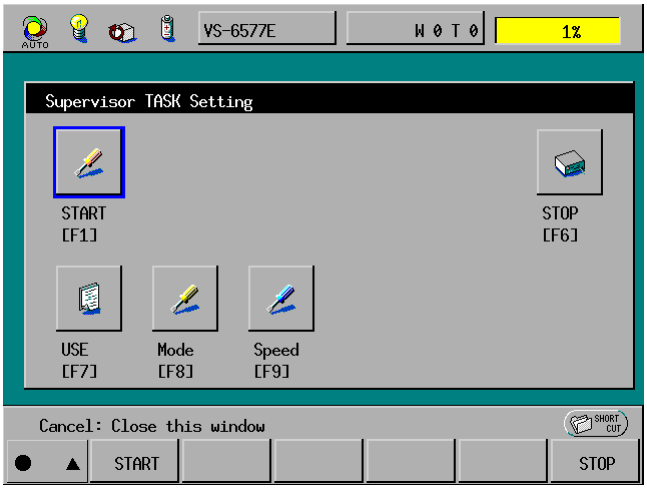
[4] Terminating supervisory tasks

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: [F8 S-TASK]—[F6 STOP] from the top screen of the teach pendant



Load or compile a project

Access: [F6 Set]—[F1 Load!] from the top screen of the teach pendant

or

Access: [F1 Program]—[F6 Aux.]—[F12 Compile] from the top screen of the teach pendant in Manual 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 floppy disk

Reading data stored in a floppy disk to the robot controller or writing data stored in the robot controller to a floppy disk will terminate the currently running supervisory task.

Access: [F6 Set]—[F3 FD.]—[F1 Read.] from the top screen of the teach pendant

Access: [F6 Set]—[F3 FD.]—[F2 Write.] from the top screen of the teach pendant

Receive a file from WINCAPSII

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

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

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F4 Remove] from the top screen of the teach pendant

Note that the supervisory task setting remains enabled.

3.4.10.3 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) In Teach Check mode, releasing the deadman switch will not stop running supervisory tasks.

(7) A supervisory task does not support Step check or Step back.

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

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

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

(11) 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 Auto mode or External mode, or
- design a supervisory task itself so that it will be terminated from external input.

Starting a user program during switching to External 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 TSR9 execute as normal task programs. To debug supervisory task programs, therefore, disable a supervisory task mode and use Teach Check mode or Break Point function.

3.4.10.4 Supervisory task commands

INIT

Function

Turns on motors, carrier out CAL, and sets the speed according to the preset supervisor task parameters.

Syntax

```
INIT
```

Descriptions

(1) If the supervisor task mode is disabled ("Not Use Supervisor TASK" parameter is selected), then the `INIT` command causes no operation.

(2) If the supervisor task mode is enabled ("Use Supervisor TASK" parameter is selected), then the `INIT` command causes the following:

When the INIT run mode is set to "without motor on and CAL":

If the INIT speed has been set to 10 or 100, this command sets the external speed of the robot controller to 10 or 100, respectively.

When the INIT run mode is set to "with motor on and CAL":

If the INIT speed has been set to 10 or 100, this command sets the external speed of the robot controller to 10 or 100, respectively, turns motors on and carries out CAL.

Example

```
'!TITLE "Initialization"
PROGRAM TSR1
      INIT                    'Turn motors on, execute CAL,
                              'and set the speed.
END
```

Notes

(1) Do not concurrently run robot motion programs and supervisory task programs that run only INIT commands. Doing so will enter the system in an infinite loop.

(2) During execution of an INIT command, the status display of running programs may show " On standby." Be careful with restart of those programs.

(3) Do not run INIT commands simultaneously in more than one supervisor task.

3.4.11 Supervisory task extension [Ver. 1. 95 or later]

Conventional supervisory tasks supported by the main system software version 1.7 or later are designed to terminate if Level 4 error or higher one occurs.

Main system software version 1.95 newly supports the supervisory task extension that prevents supervisory tasks from terminating if Level 4 error occurs except memory errors (errors 7000s).

3.4.11.1 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.

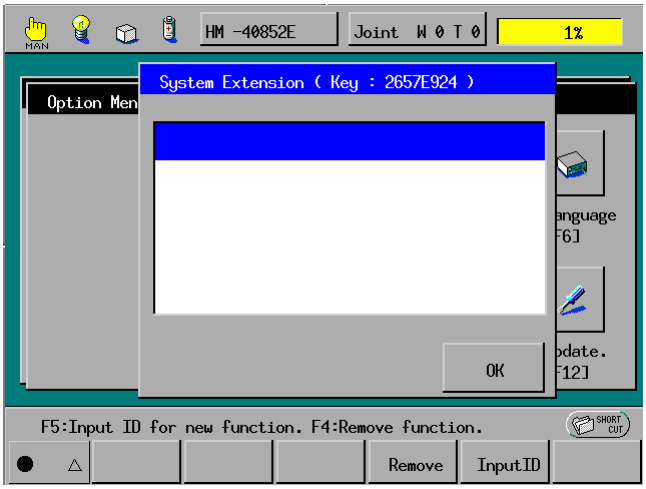
/: Not applicable.

3.4.11.2 Enabling the supervisory task extension

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

(1) Call up the System Extension window.

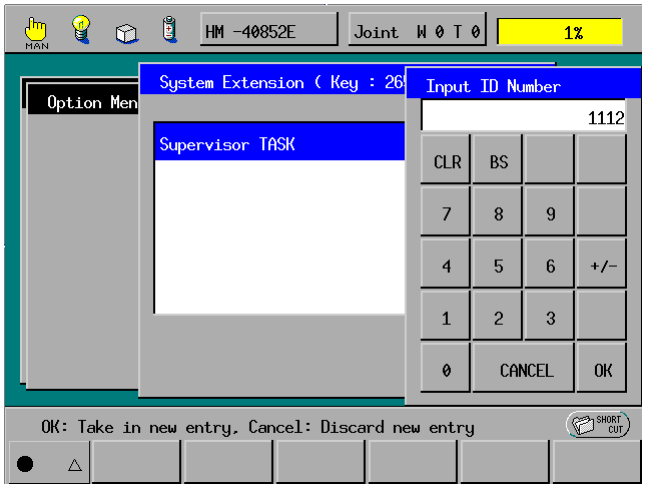
Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]



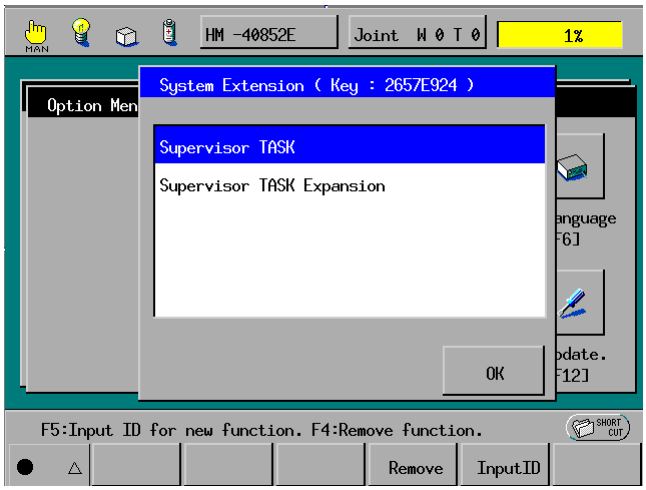
F5

(2) Press [F5 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.

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, operating panel, or mini pendant undergo any strong shocks, impacts, or vibrations.

NOTE 2: Touch the teach pendant, operating panel, or mini 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 V*-D/-E Series*

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 Subsection 3.2.1, "Running the Robot Manually,"[2] X-Y mode."

The work coordinates are defined relatively in base coordinates. The origin of the work coordinates should be laid at a corner of the cubic envelope of an object piece. It has components Xw, Yw, and Zw. You may define the work coordinates by the number of objects you want to handle in the same timeframe on the single robot.

Work coordinates are 3-dimensional Cartesian coordinates defined for each operation space of work. The origin can be anywhere. 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 axis, Y axis and Z axis of base coordinates. If work coordinates are not defined, base coordinates go into effect.

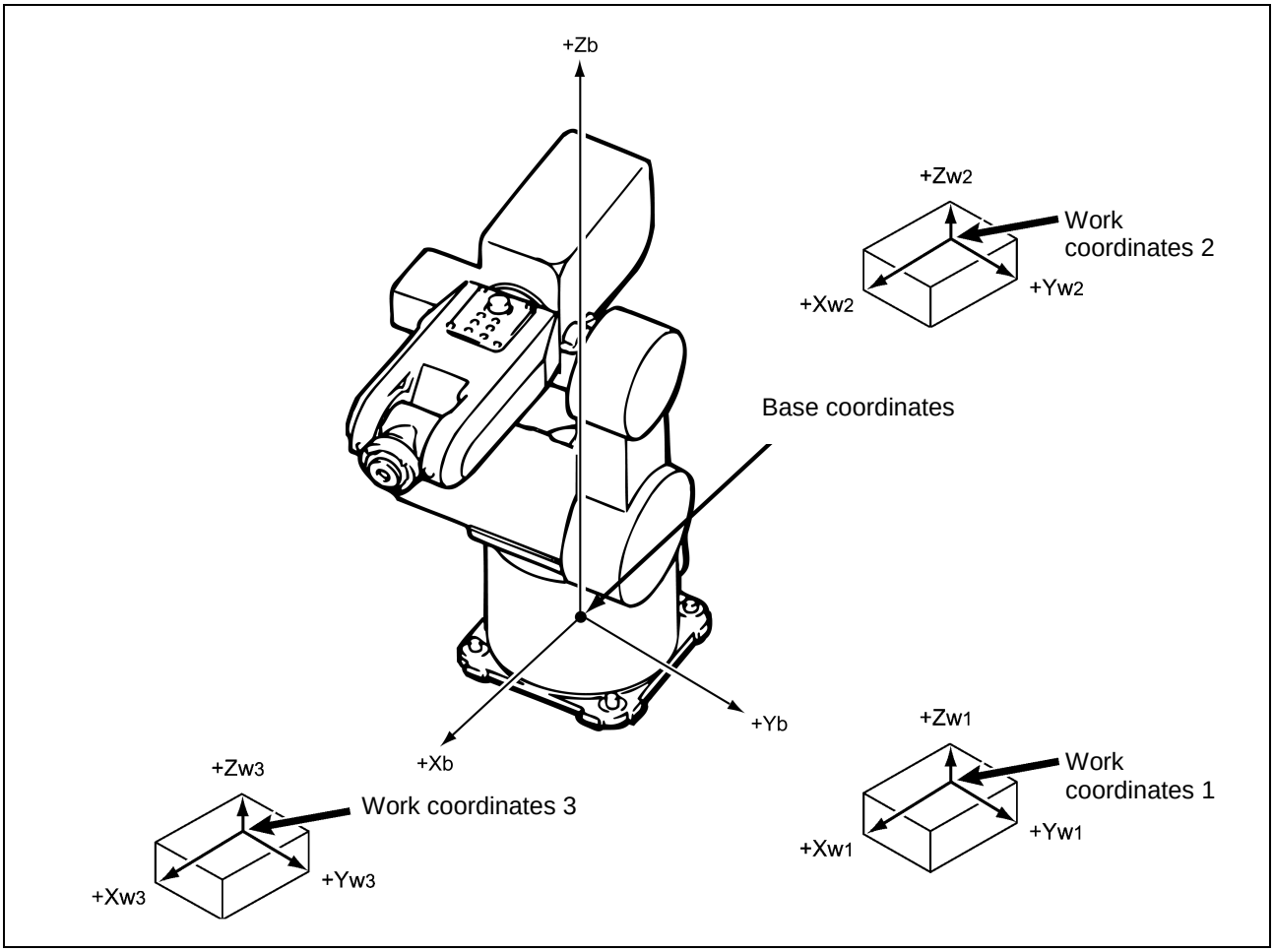


Figure 4-1. Base Coordinates and Work Coordinates

[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.

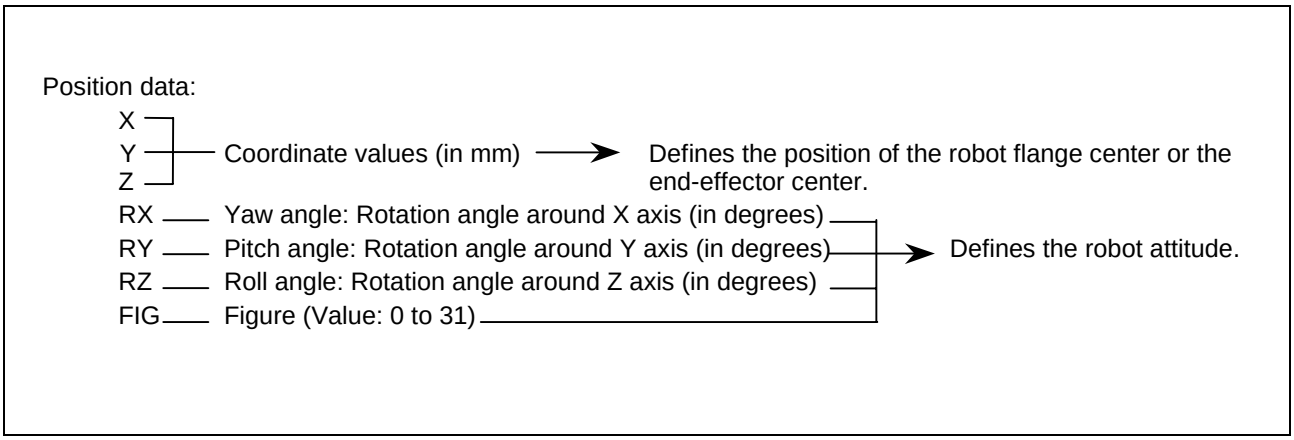


Figure 4-2. Components of Position Data

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 Subsection 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 Subsection 4.1.3, "Figures of the Shoulder, Elbow, and Wrist."

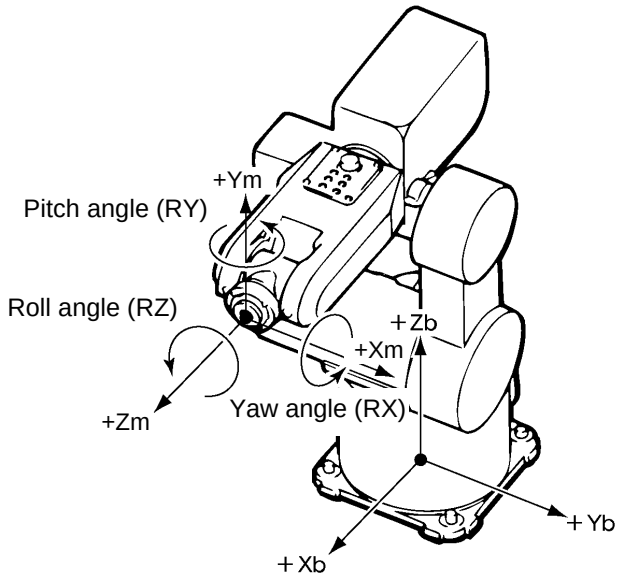
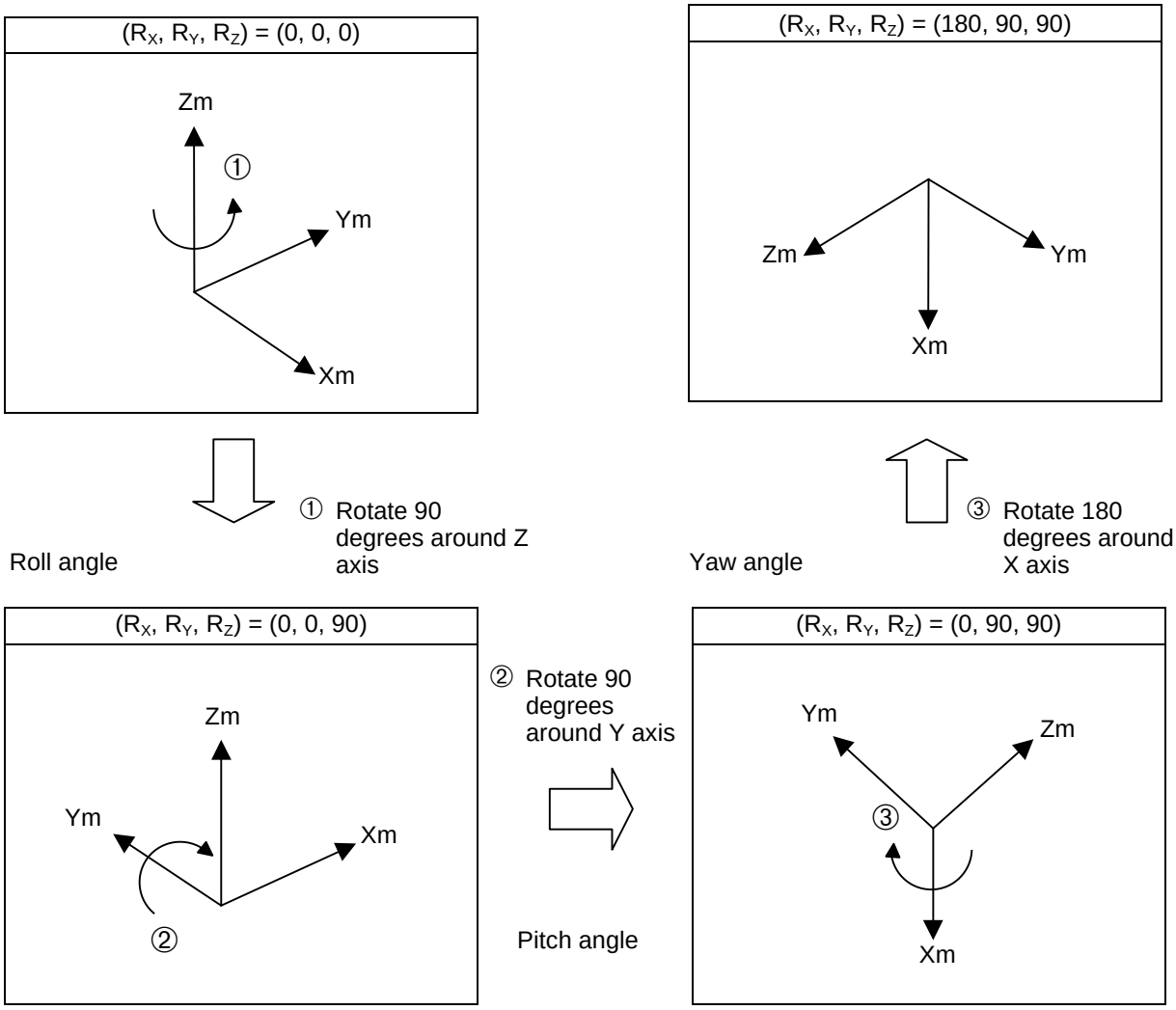


Figure 4-3. Roll, Pitch and Yaw Angles



(Rx, Ry, Rz) = Attitude of (180, 90, 90)

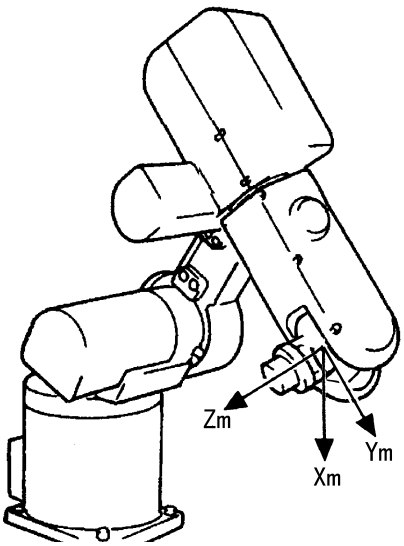


Figure 4-4. Examples of roll, pitch and yaw angle rotation

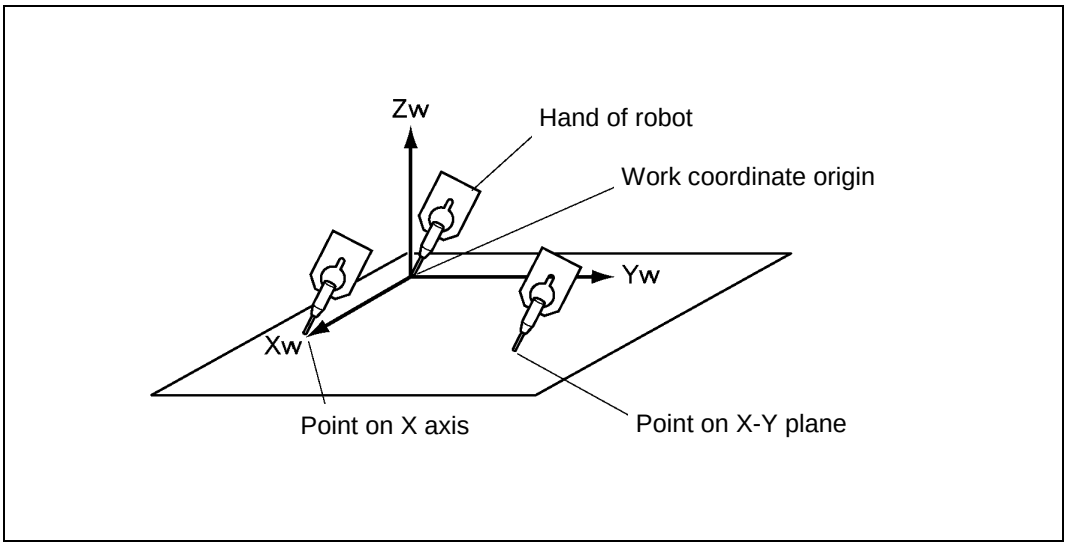
Attitude: (Rx, Ry, Rz) = (0, 0, 0) → (Rx, Ry, Rz) = (180, 90, 90)

[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
[F2 Arm]—[F6 Aux.]—[F5 Work]—[F4 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
[F2 Arm]—[F6 Aux.]—[F5 Work]—[F5 Change.]

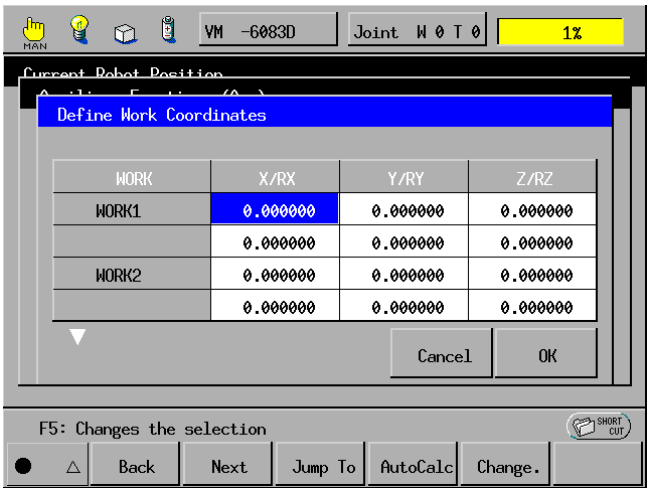
Enter the coordinate origin (X, Y, Z) corresponding to the base coordinates and rotation angles (Rx, Ry, Rz) around the X-axis, Y-axis and Z-axis of base coordinates.

■ Defining work coordinates by 3-point teaching

Step 1 On the top screen of the teach pendent, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

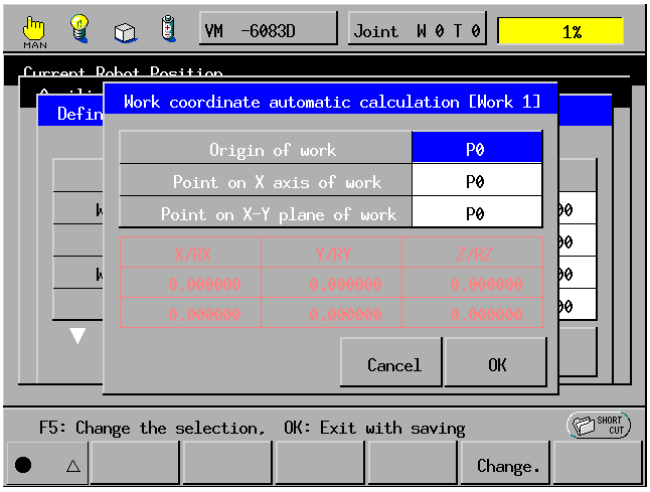
Step 3 Press [F5 Work] in the Auxiliary Functions (Arm) window.
The Define Work Coordinates window appears as shown below.



F4

Select the coordinates by using the cursor or jog dial, and then press [F4 AutoCalc].

Step 4 The Work coordinate automatic calculation window appears.

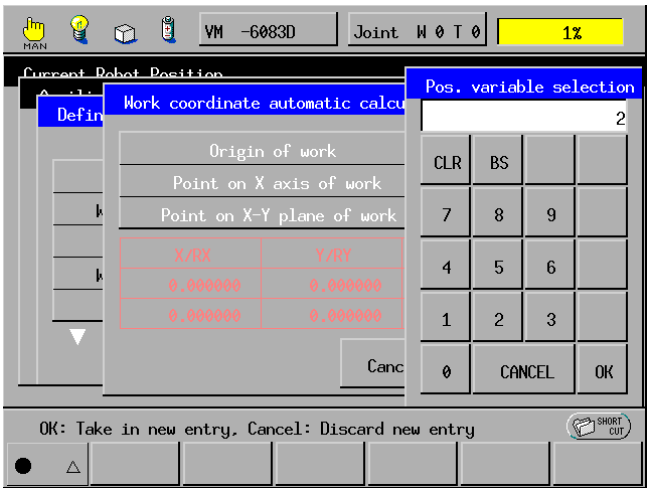


F5

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 [F5 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. 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 ([F2 Arm]—[F4 Var.]—[F4 Position.]) shown below.

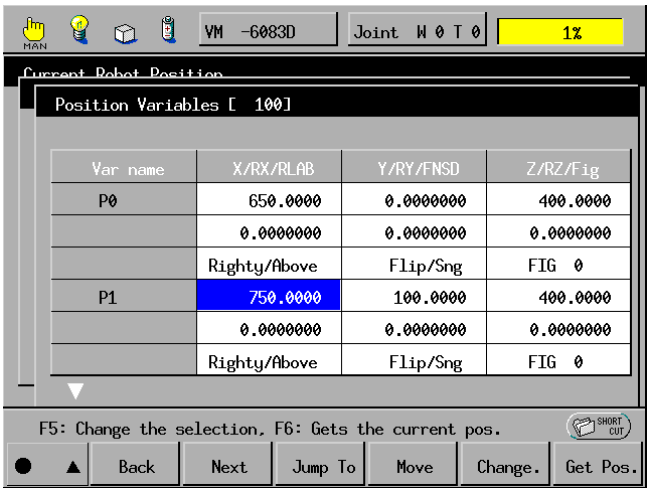
In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the three position variables you have set in Step 5.

(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 [F6 Get Pos.] in order to read in the current position of the tool end to the selected position variable.

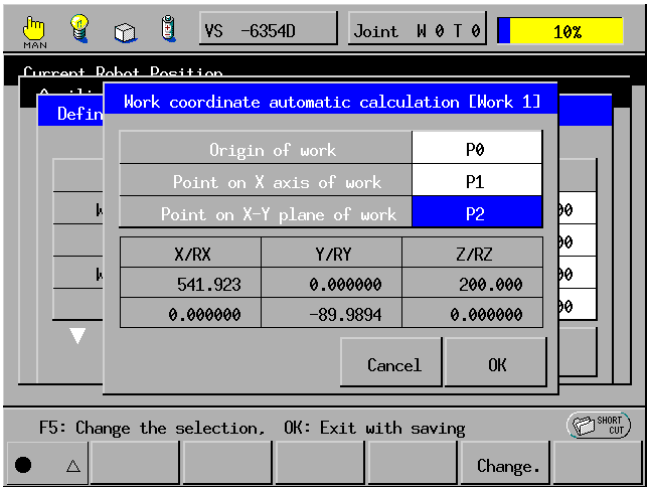
(4) Carry out Steps (1) through (3) above for each of the "Origin of work," "Point on X axis of work," and "Point on X-Y plane of work."



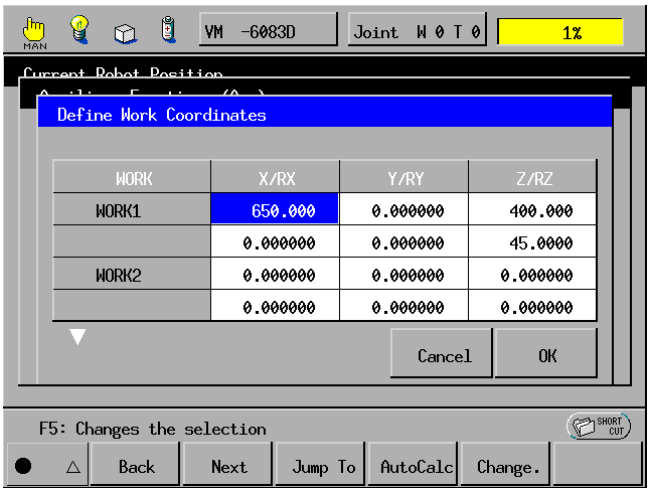
NOTE • Teach the "Origin of work" and "Point on X axis of work" precisely.
• Define work coordinates after establishing the tool definition.

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 top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in Current Robot Position window.

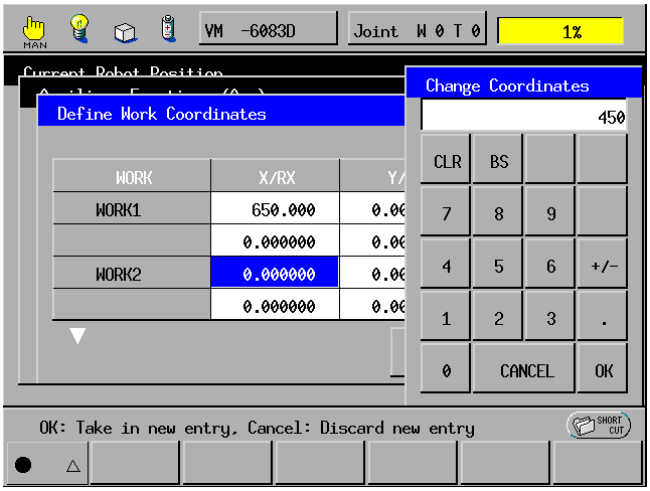
Step 3 Press [F5 Work.] in Auxiliary Functions (Arm) window.

The Define Work Coordinates window appears.

Select the work coordinates to be defined using the cursor or jog dial.

Step 4 Press [F5 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 4-3. 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 Subsection 3.2.1, "Running the Robot Manually," [3] Tool Mode."

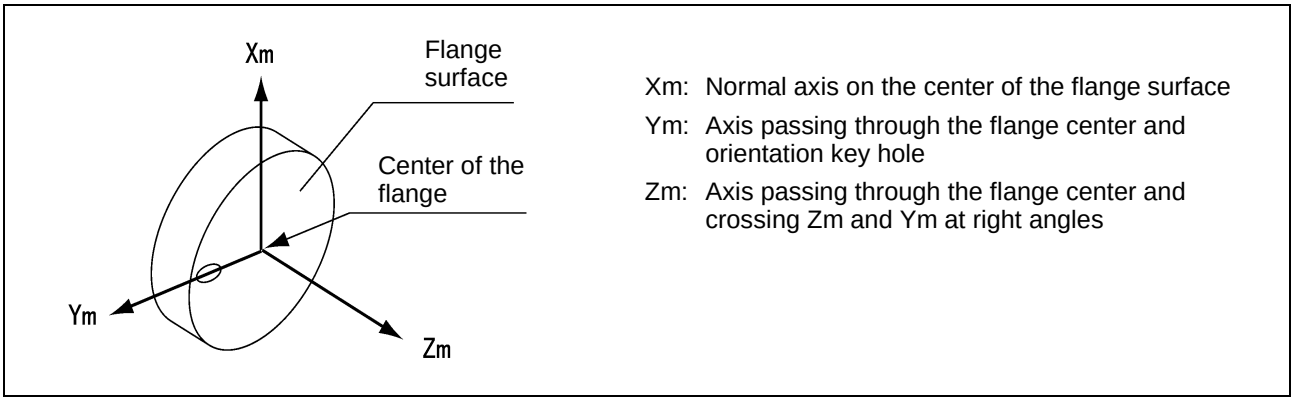


Figure 4-5. Definition of Mechanical Interface Coordinates

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

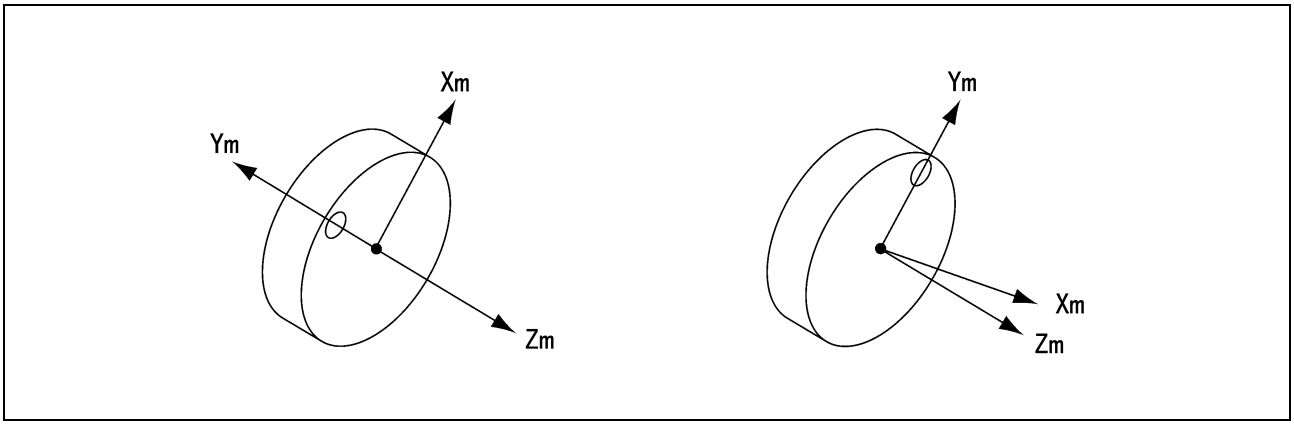


Figure 4-6. Rotation of Mechanical Interface Coordinates Following the Flange Rotation

[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.

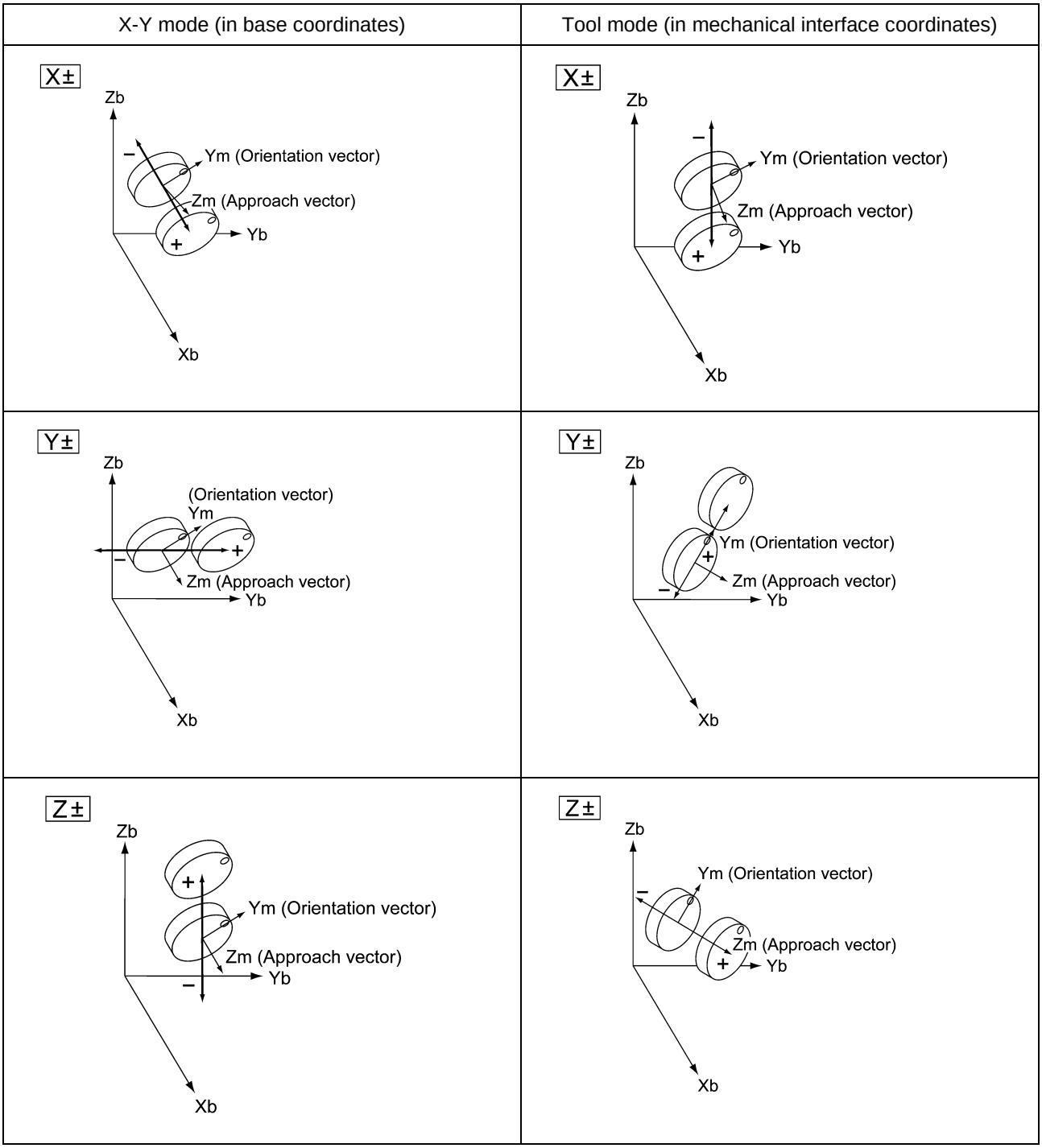


Figure 4-7. Robot Motion Manually Driven by X, Y, and Z Keys

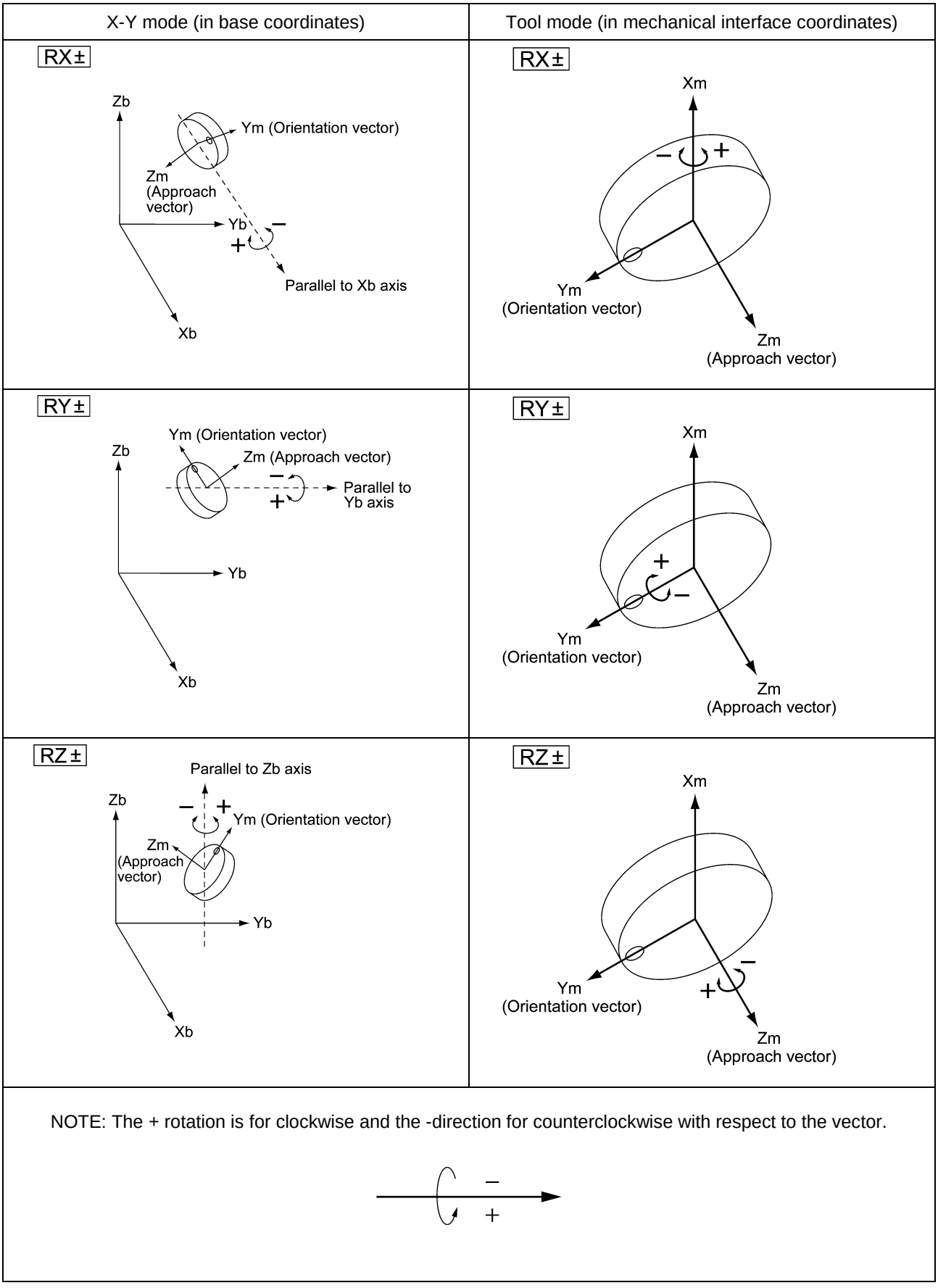


Figure 4-8. Robot Motion Manually Driven by RX, RY, and RZ Keys

[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.

You may define up to 63 tool coordinates (TOOL1 to TOOL63). 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.

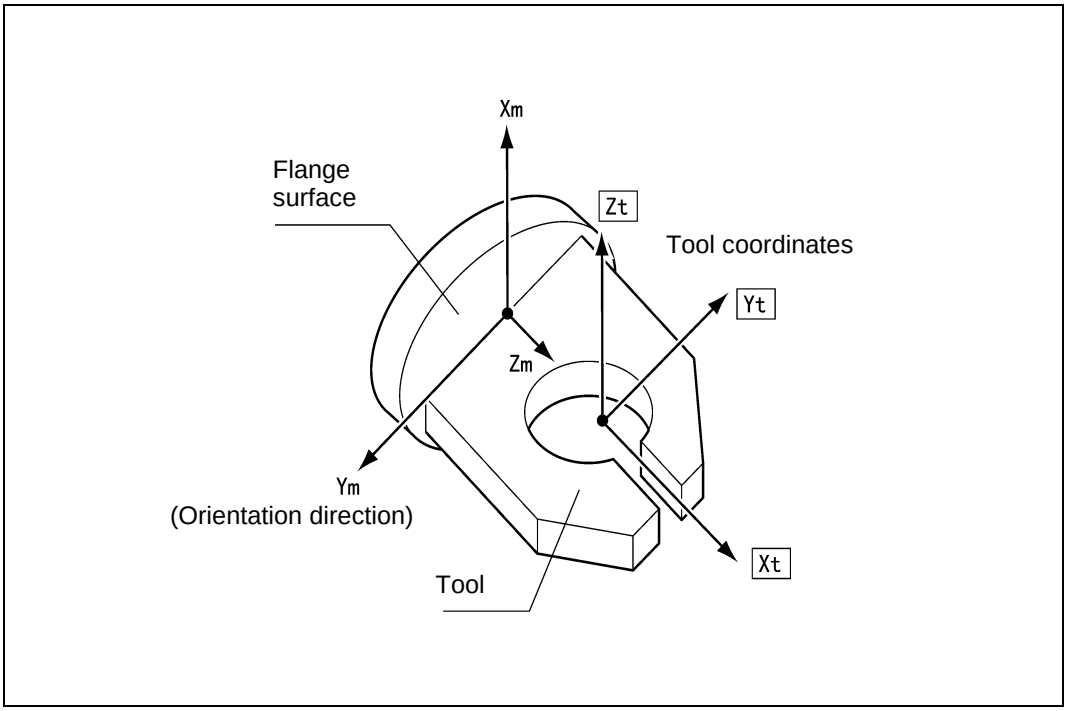


Figure 4-9. Mechanical Interface Coordinates and Tool Coordinates

[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.

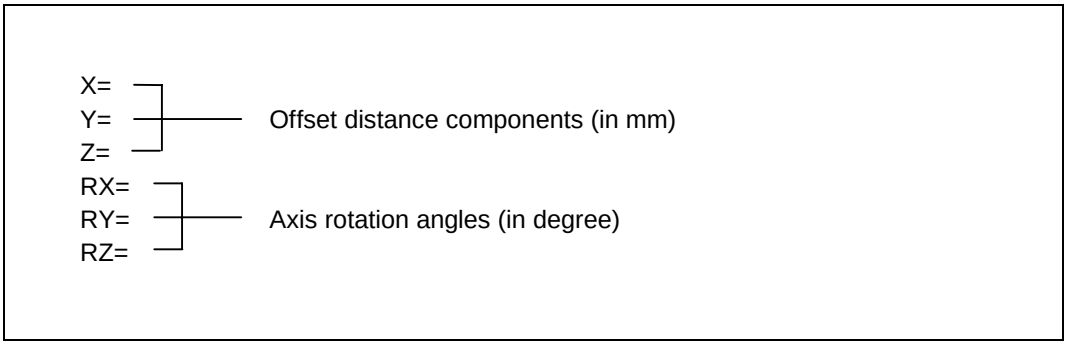


Figure 4-10. Definition Data for Tool Coordinates

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.

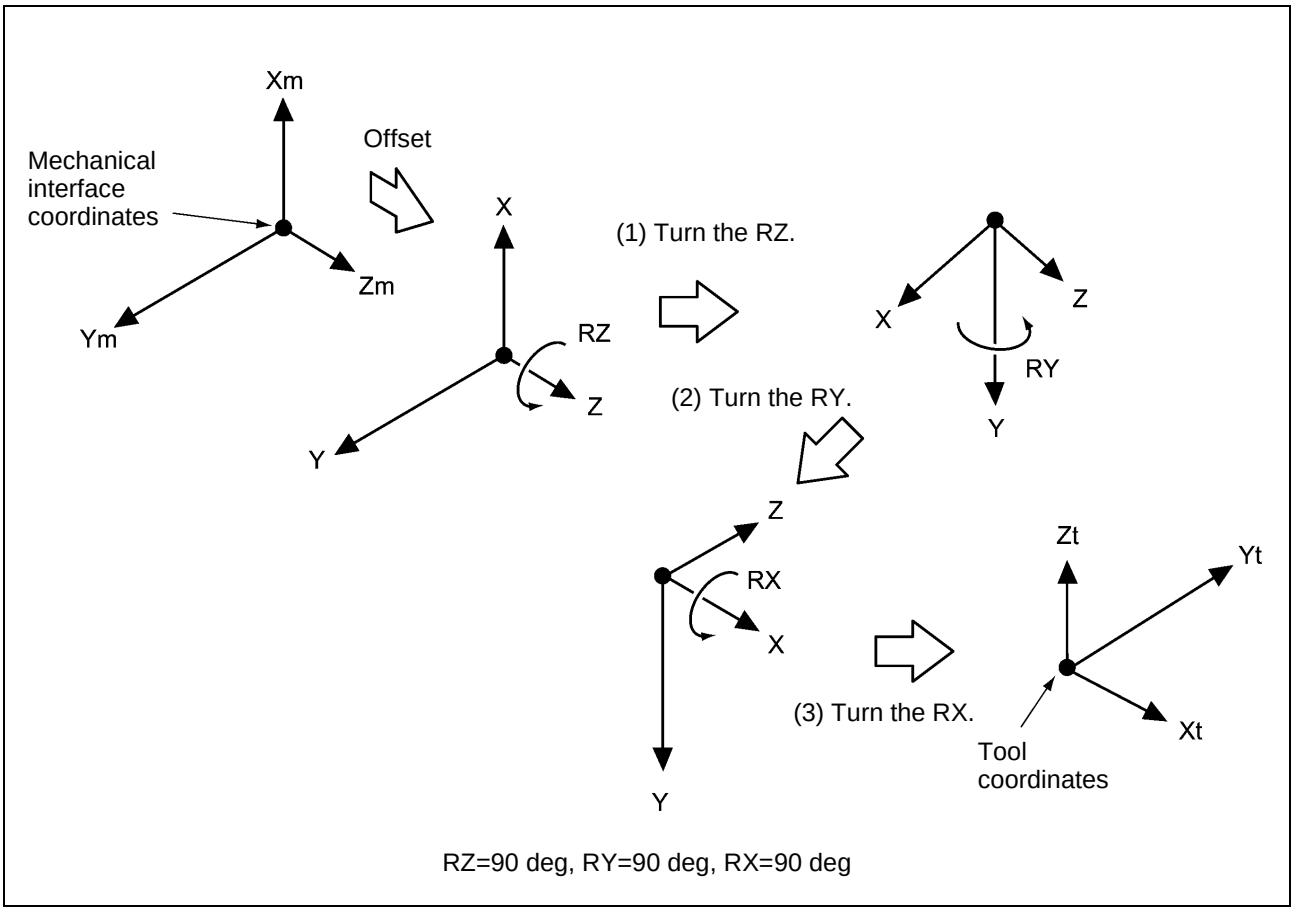


Figure 4-11. Example: Creating Tool Coordinates

[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 you specify undefined tool coordinates, the robot will run in TOOL0 coordinates and no error will occur in the V⁎-D SERIES, unlike other DENSO robots.

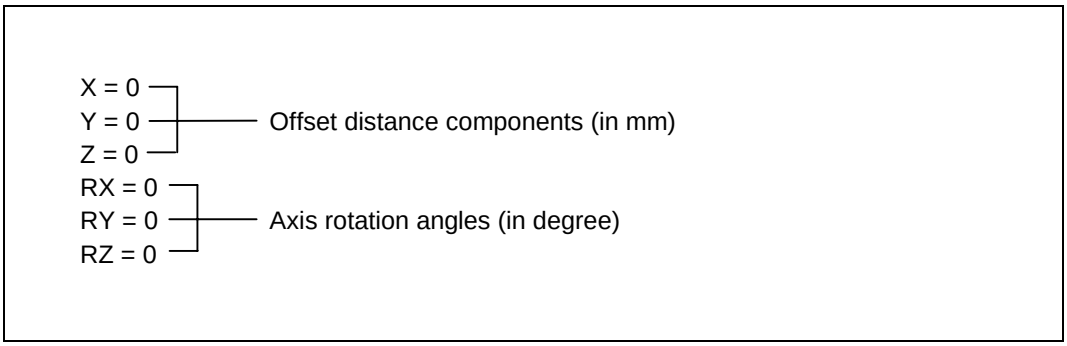


Figure 4-12. Definition Data for TOOL0

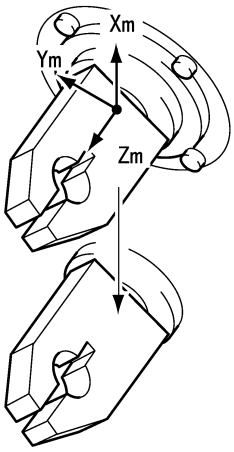
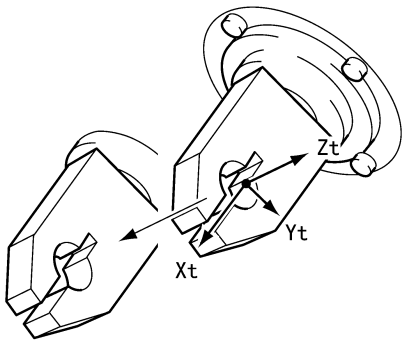
[2.6] Advantages of tool coordinates

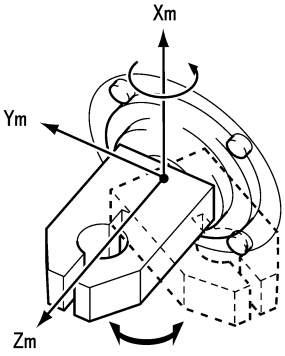
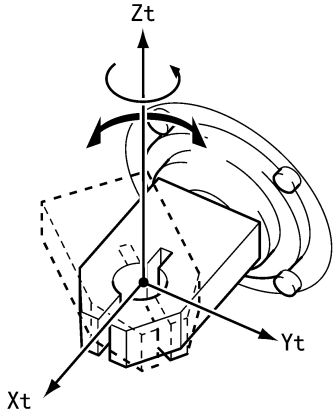
This section describes what advantages you may have by using tool coordinates.

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.

<table>
<tr><th>In mechanical interface coordinates (TOOL0)</th><th>In tool coordinates (TOOLn where n is any of 1 to 63)</th></tr>
<tr><td>If X- key is pressed:
 
</td><td>If Z- key is pressed:
 

Enables you to move the end-effector to your object point in teaching.</td></tr>
<tr><td>If RX+ key is pressed:
 
</td><td>If RZ+ is pressed:
 

Enables you to rotate the end-effector around the Zt axis.</td></tr>
</table>

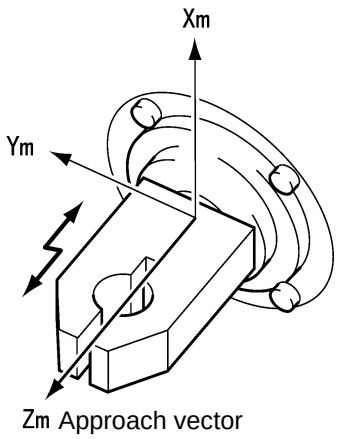
Figure 4-13. Example of Manual Robot Running in Tool Coordinates

In programmed running

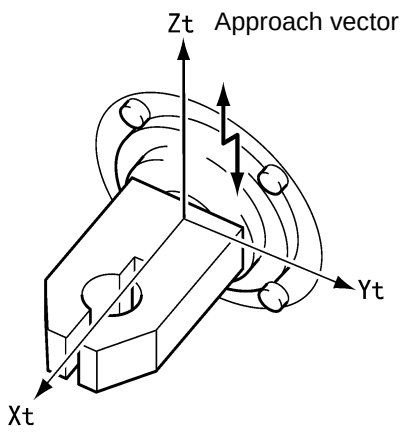
(1) Using APPROACH or DEPART command

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, Section 12.1, "Motion Control."



TOOL0 (mechanical interface coordinates)



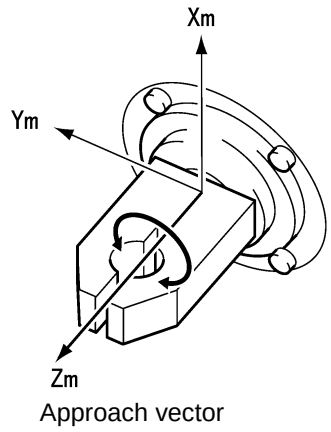
Changing the Z-axis orientation by tool coordinates definition

Figure 4-14. Example of APPROACH (DEPART) Execution in Tool Coordinates

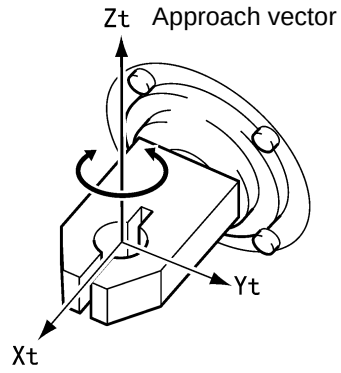
(2) Using ROTATEH command

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, 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

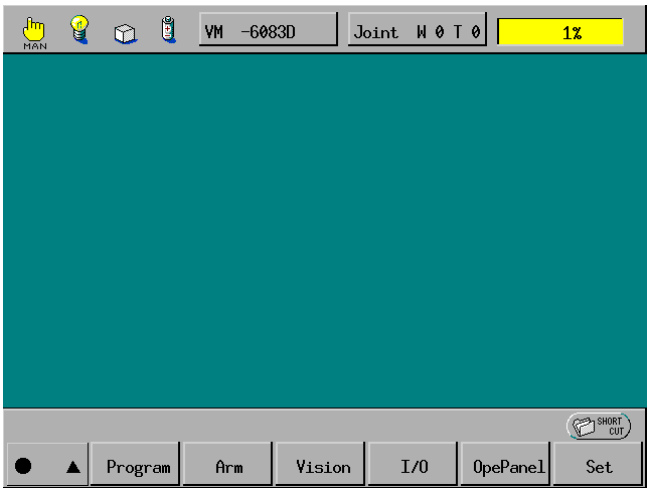
According to the procedure below, you may define arbitrary tool coordinates from the teach pendant. In this example, TOOL1 is defined. The same procedure would apply to TOOL2 through TOOL63.

With this procedure, you may also display or modify the current tool coordinates.

■ *From the teach pendant*

Step 1

On the top screen of the teach pendant, press [F2 arm].

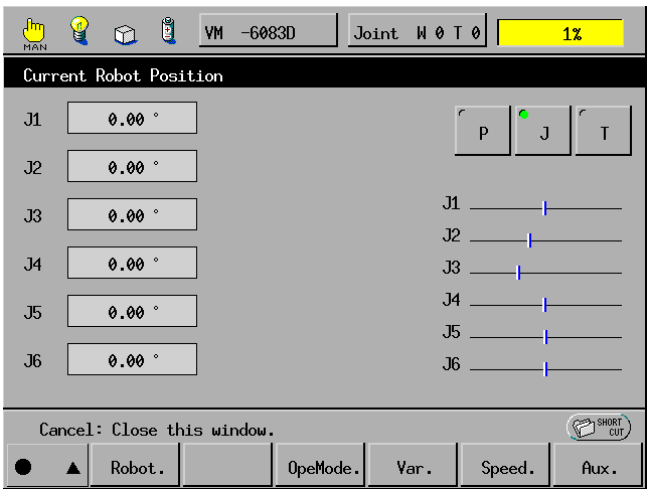


F2

The Current Robot Position window will appear as shown below.

Step 2

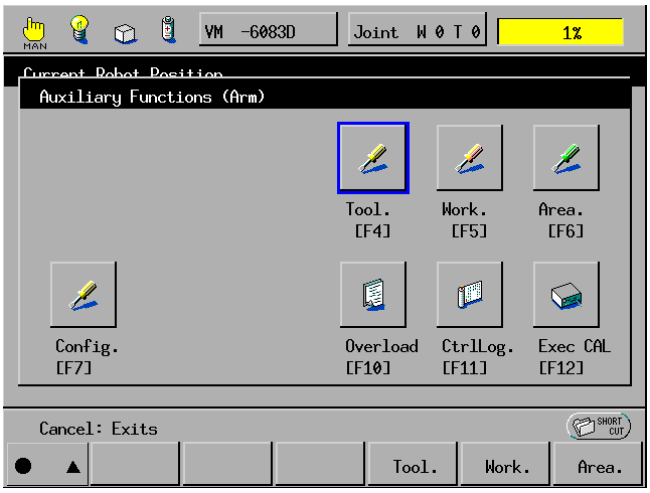
Press [F6 Aux.].



F6

The Auxiliary Functions (Arm) window will appear as shown in Step 3.

Step 3 Press [F4 Tool.].



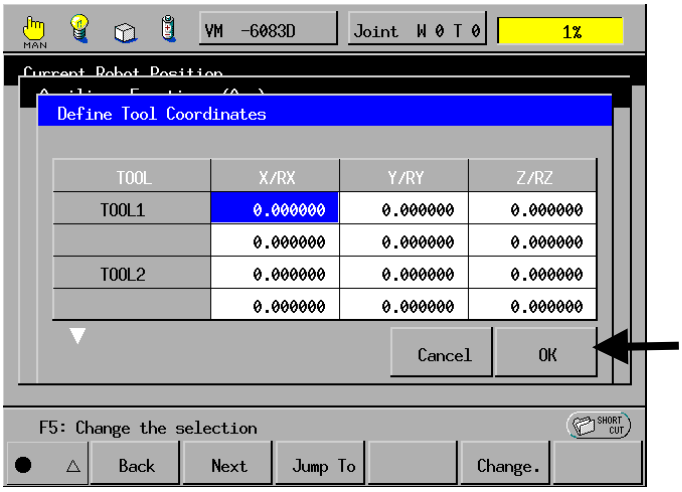
F4

The Define Tool Coordinates window will appear as shown below.

Step 4 Select the X area of TOOL1 by using the cursor keys or jog dial.

The X area of TOOL1 will become highlighted.

Then press [F5 Change.].

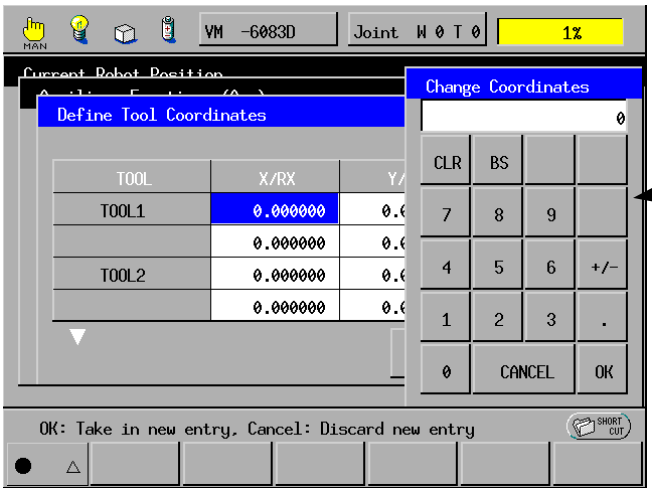


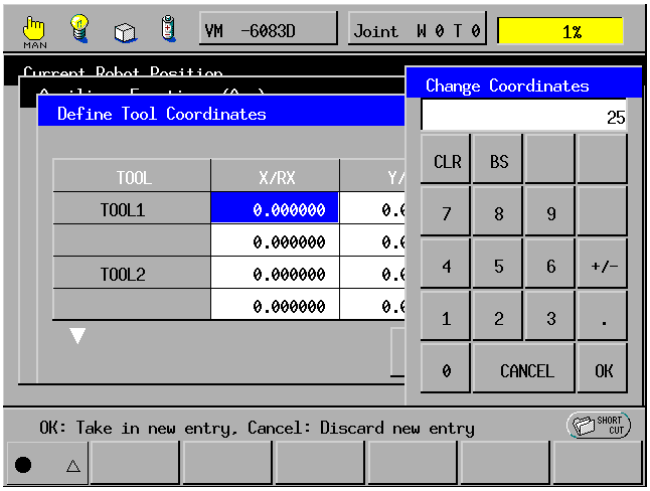
F5

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

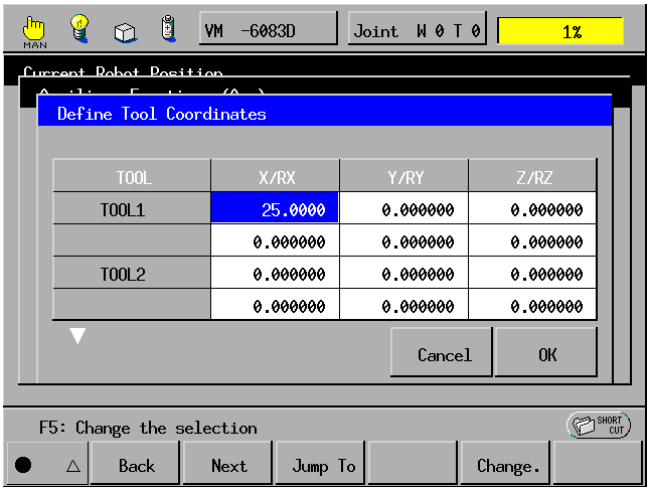




Step 6

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 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 p. 4-27.

For details about commands and tool definitions, refer to the PROGRAMMER'S MANUAL, Section 12.1, "Motion Control, APPROACH" and Section 9.5, "Tool Coordinates, TOOL." Also refer to Subsection 4.1.1, [2.7] Tool coordinates 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

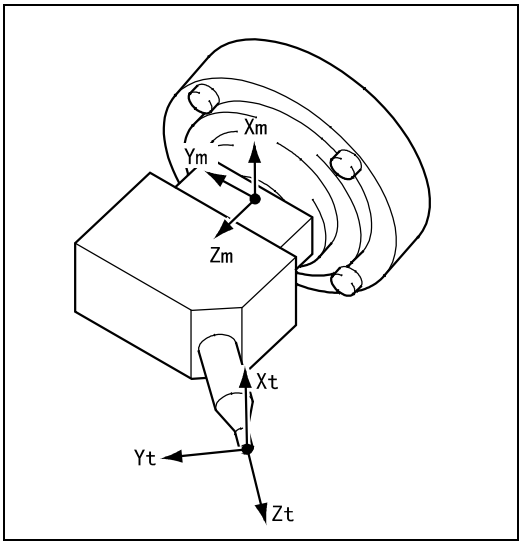


Figure 4-17. End-effector 1

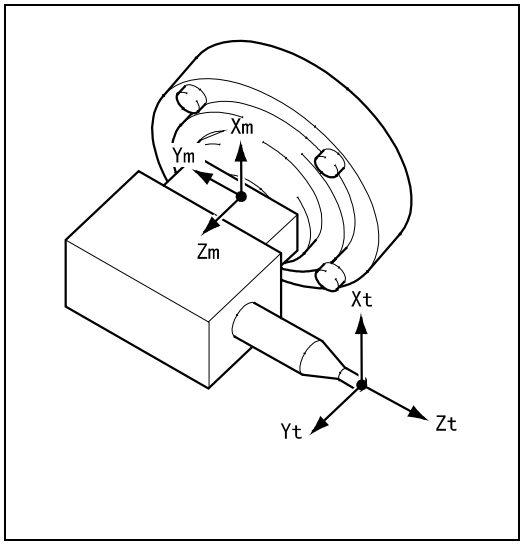


Figure 4-18. End-effector 2

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.

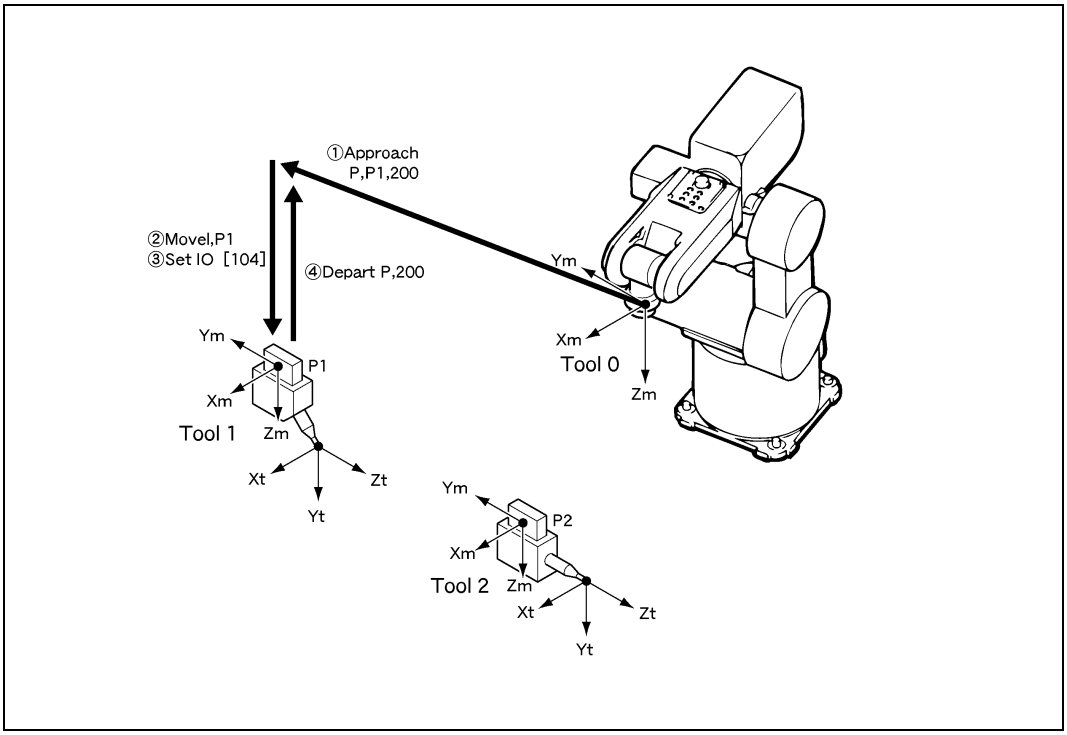


Figure 4-19. Moving Path for Setting End-effector 1

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.

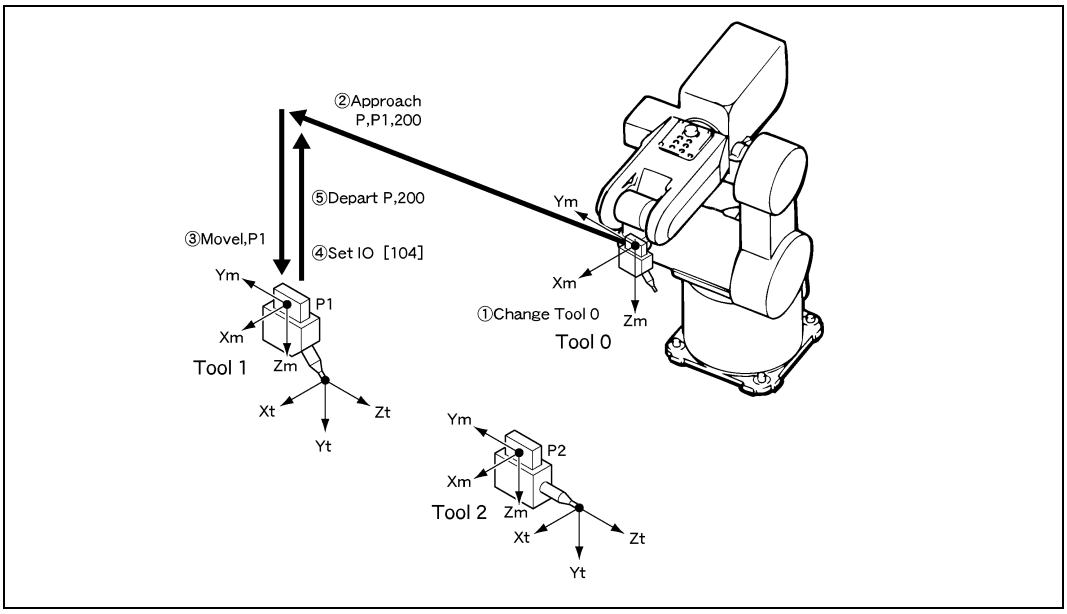


Figure 4-20. Moving Path for Releasing End-effector 1

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.

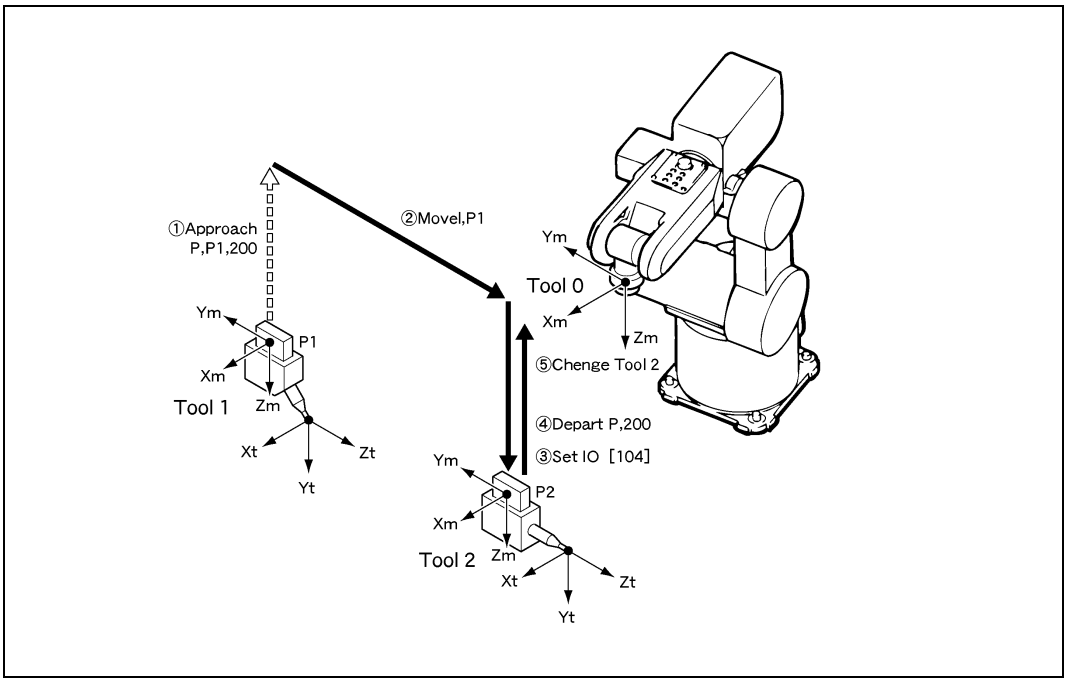
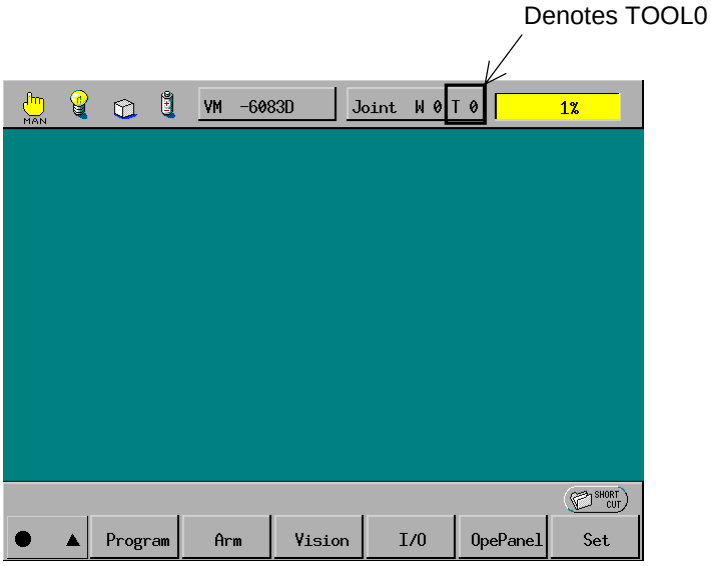


Figure 4-21. Moving Path for Setting End-effector 2

Displaying the current tool coordinates

The current tool coordinates are always shown in the status line of the screen on the teach pendant, independent of the operation modes (Auto, Manual, and Teach check 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.

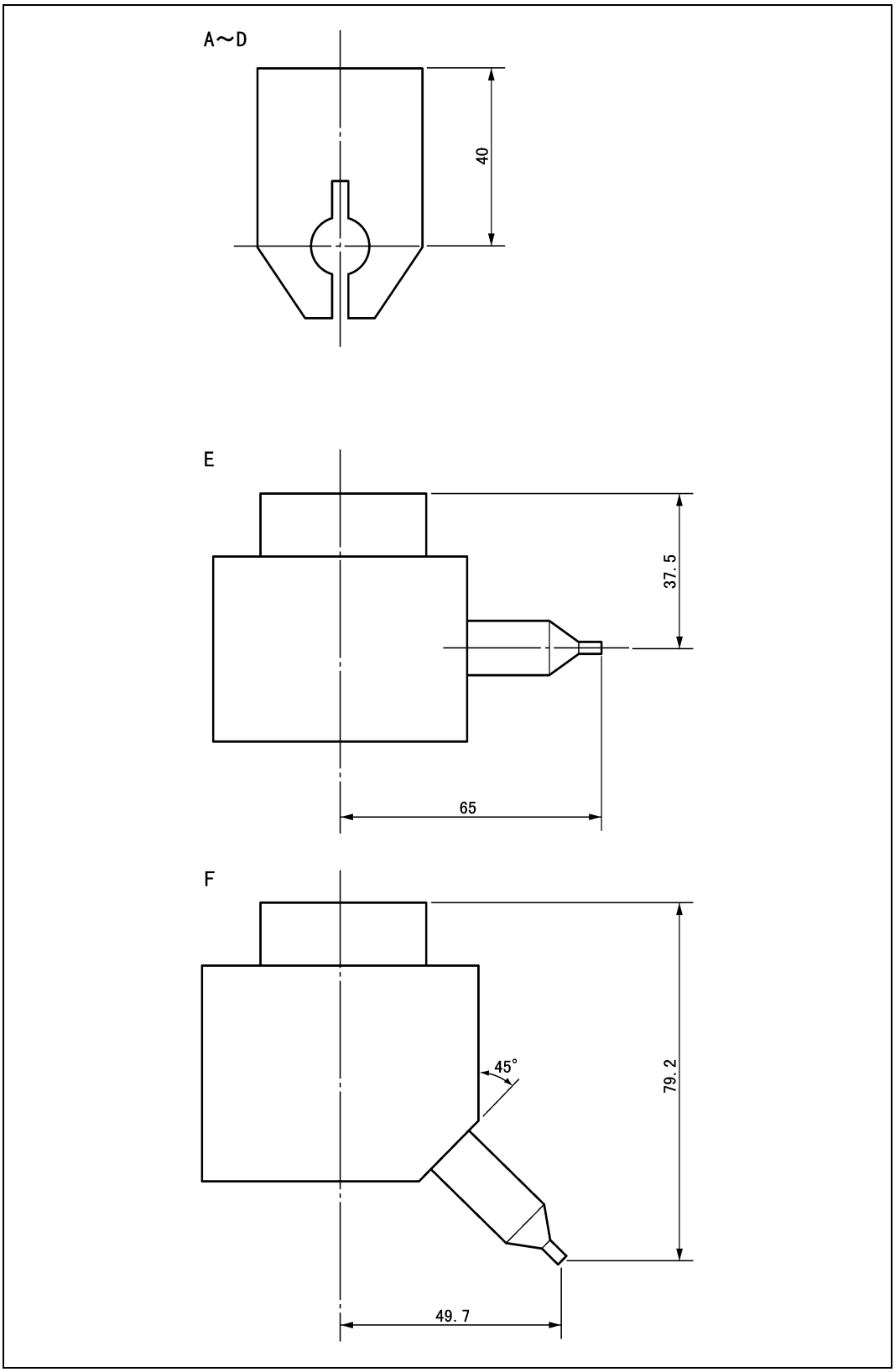
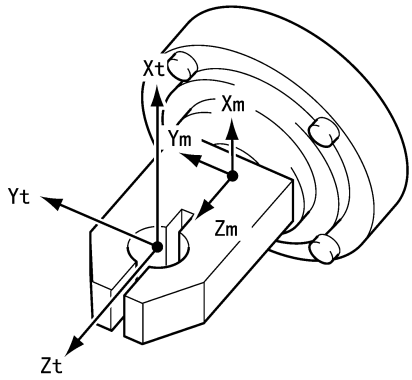


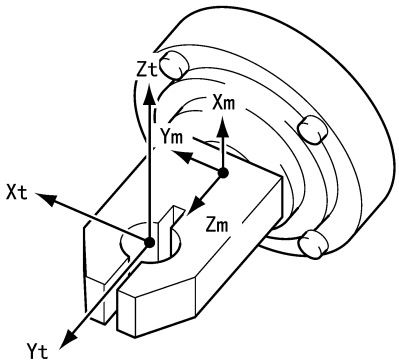
Figure 4-22. End-effector Types and Their Coordinate Origins

The chuck is mounted in parallel with the orientation vector of the flange. A



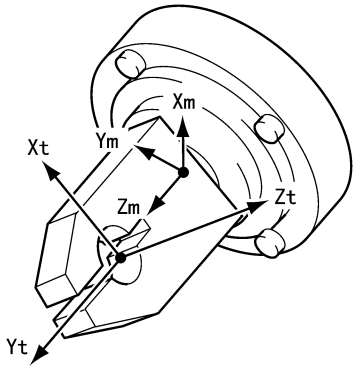
TX = 0
TY = 0
TZ = 40
RX = 0°
RY = 0°
RZ = 0°

The chuck is mounted in parallel with the orientation vector of the flange. B



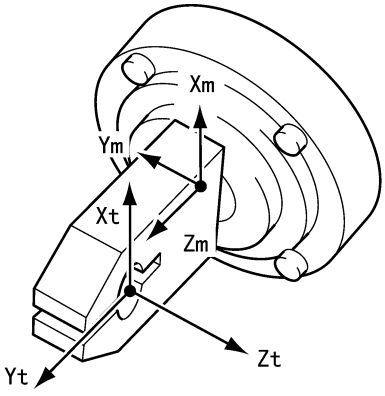
TX = 0
TY = 0
TZ = 40
RX = 90°
RY = 0°
RZ = 90°

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°

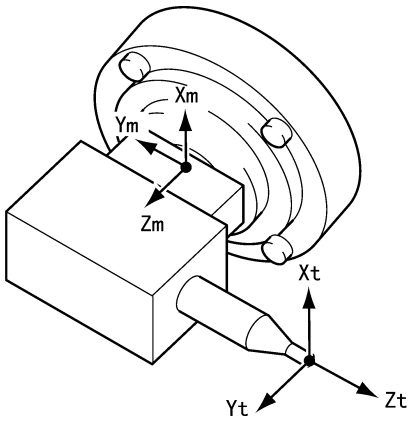
The chuck is mounted at right angles to the orientation vector of the flange. D



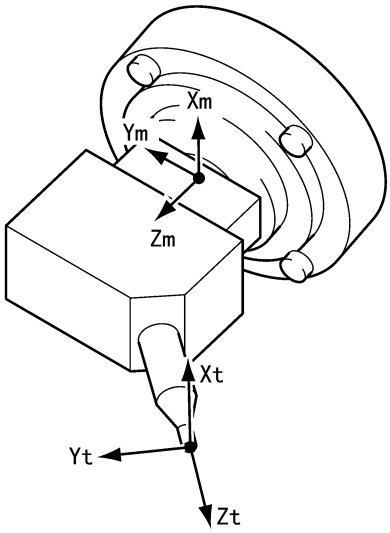
TX = 0
TY = 0
TZ = 40
RX = 90°
RY = 0°
RZ = 0°

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 may define an interference check area(s) to prevent the robot arm from interfering with other devices or facilities.

The interference check area may be defined based on the base coordinates and work coordinates shown below.

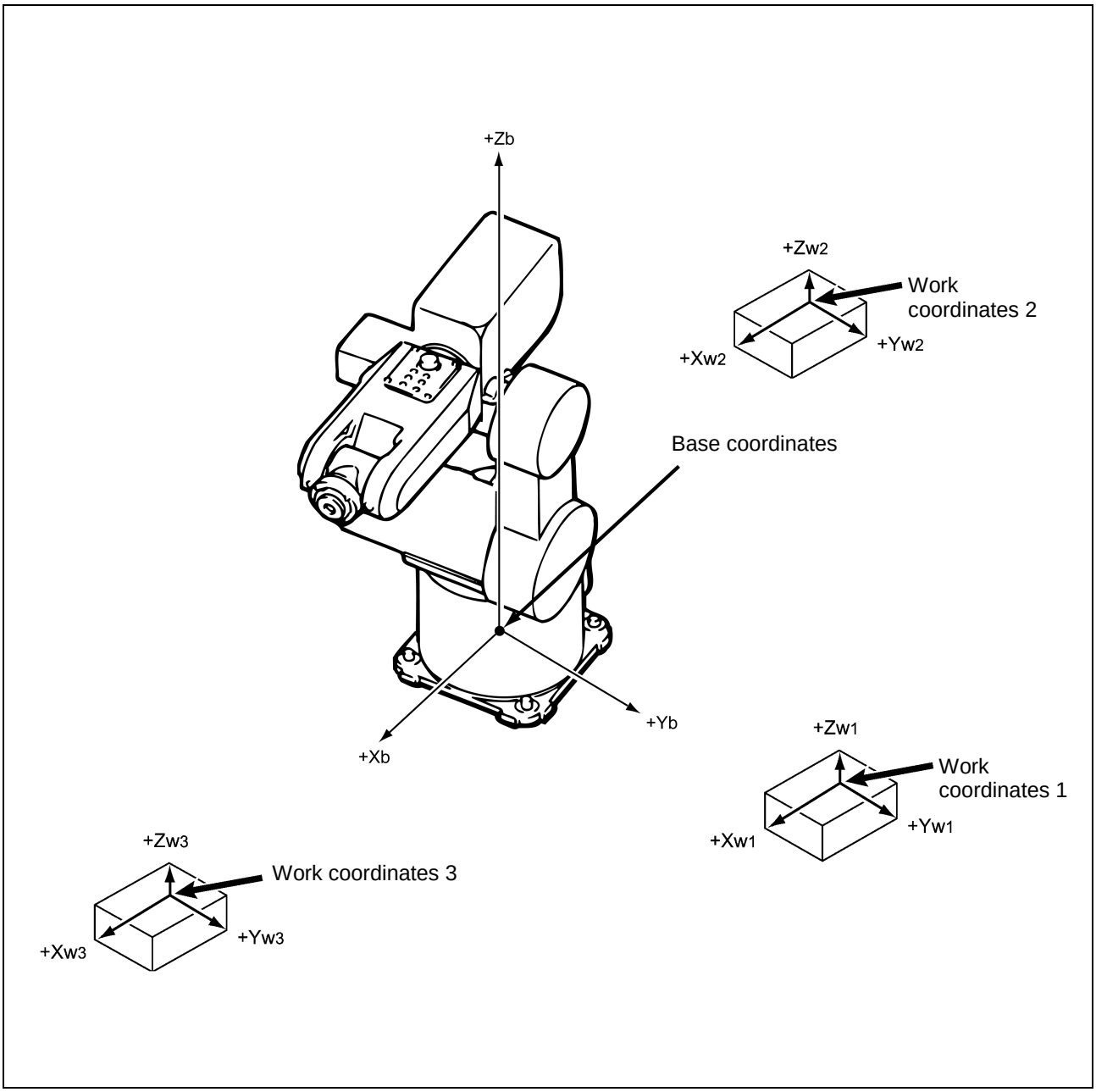


Figure 4-24.

[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

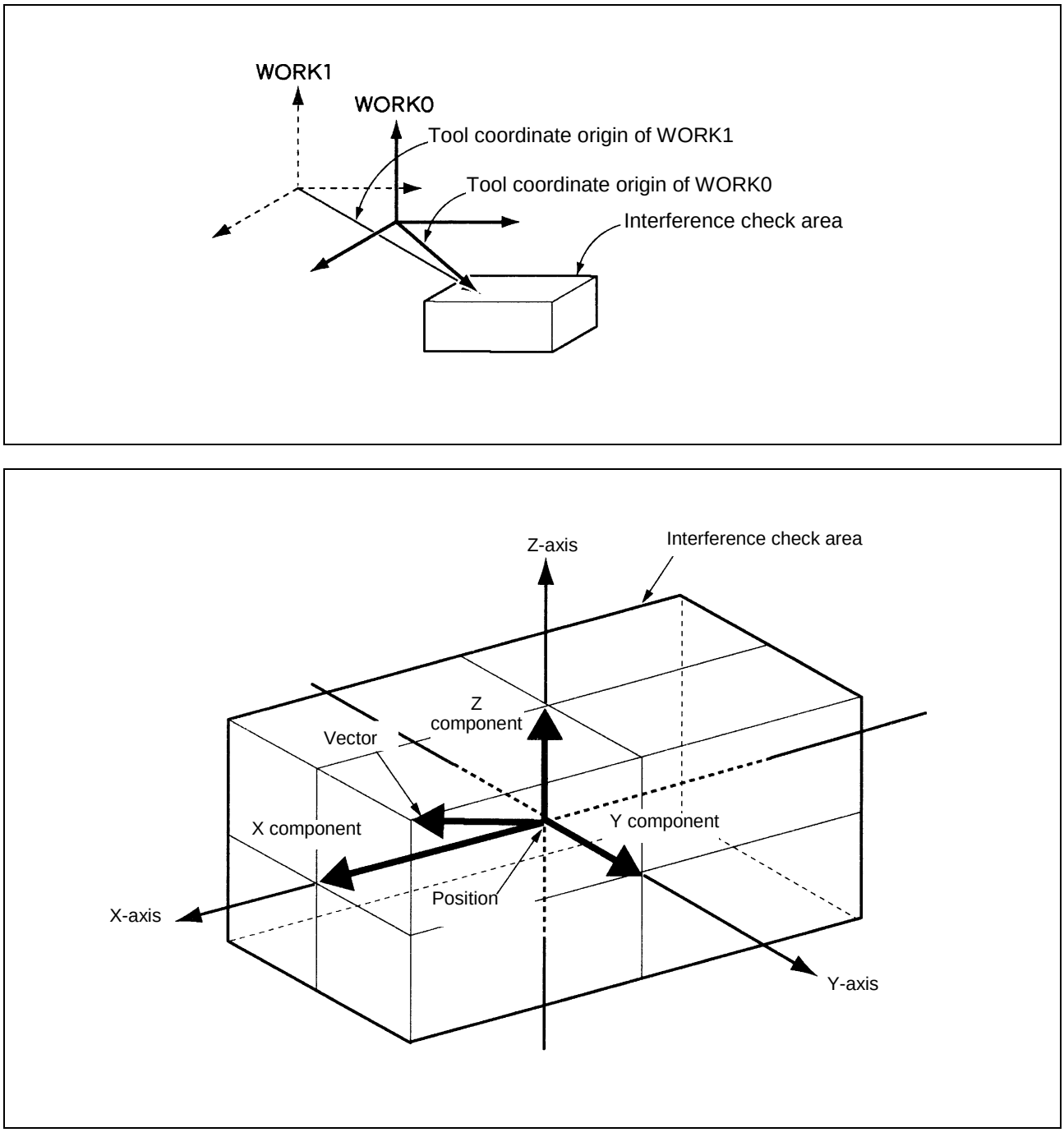


Figure 4-25. Interference Check Area

[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 [F4: 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.

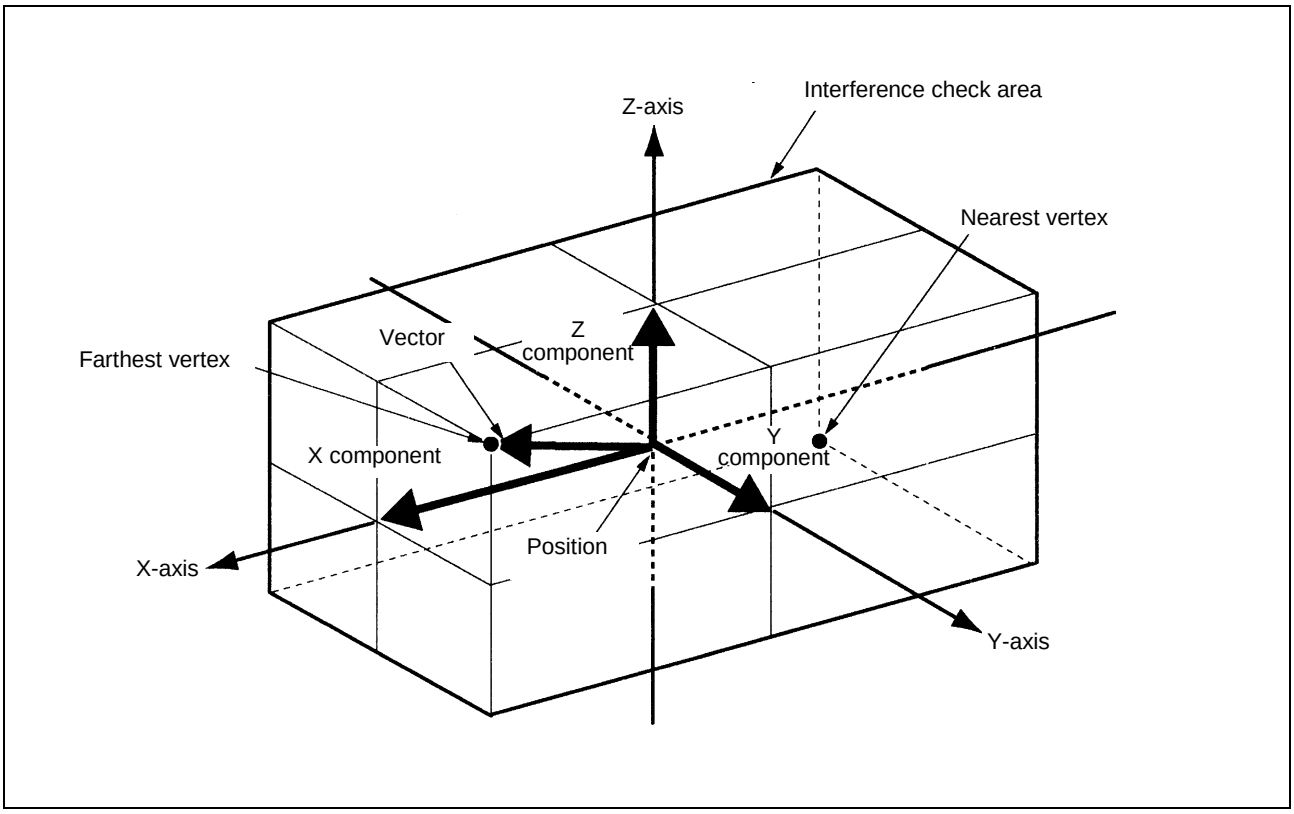


Figure 4-26. Defining an Interference Check Area by 2-point Teaching

Defining an interference check area by direct value entry [F5: 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.

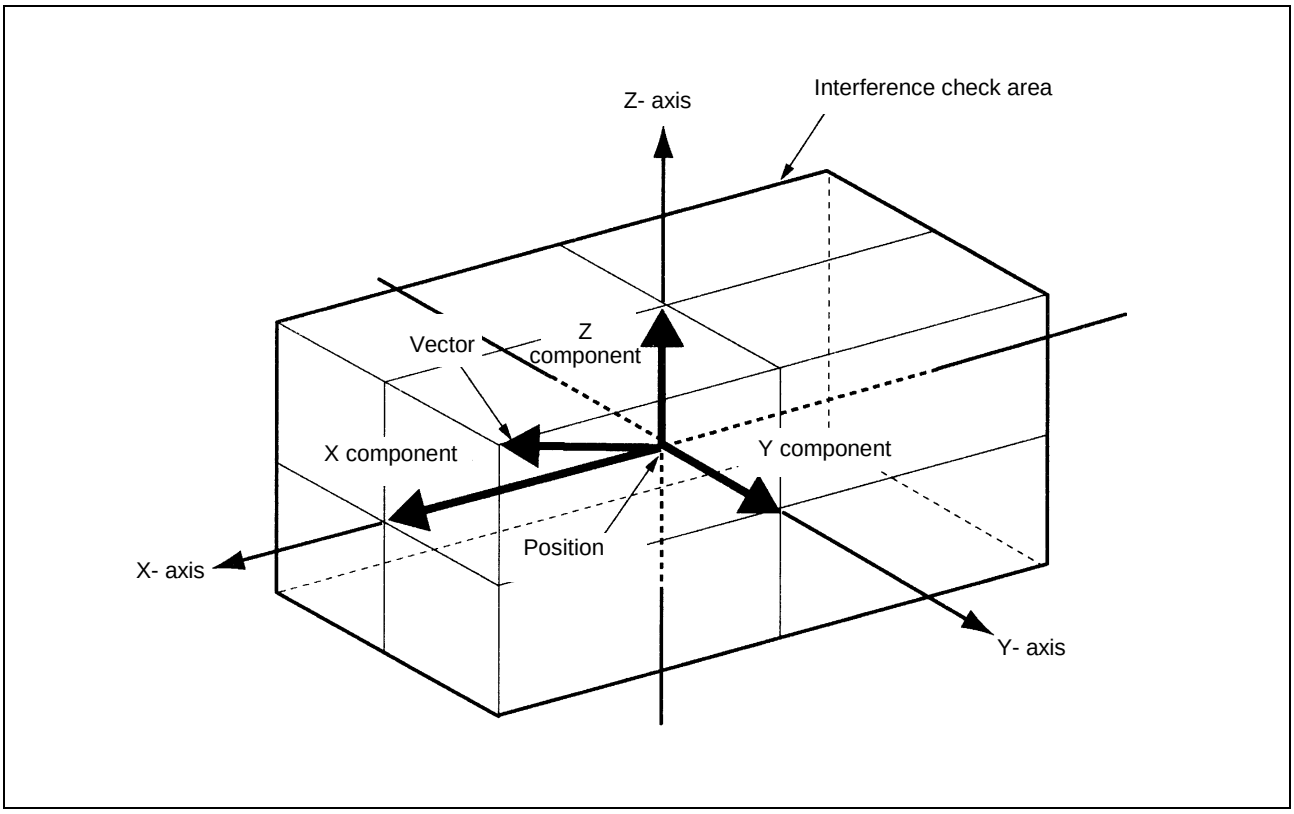


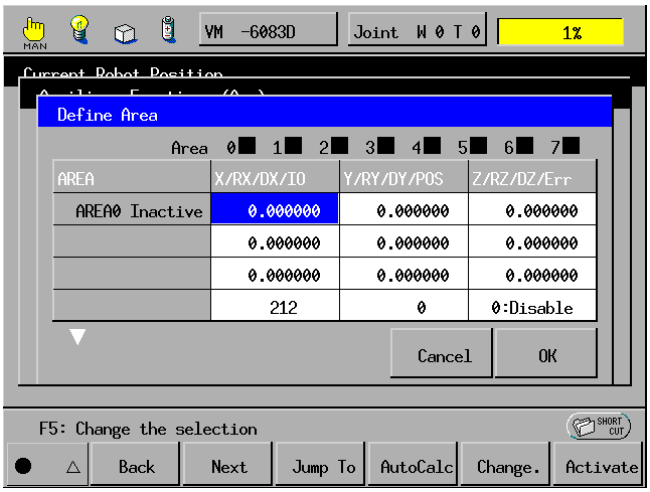
Figure 4-27. Defining an Interference Check Area by Direct Value Entry

[3] Defining an interference check area by 2-point teaching

Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

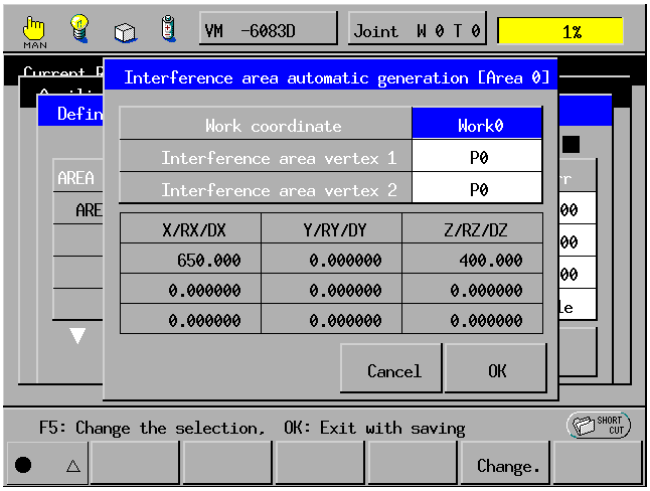
Step 3 In the Auxiliary Functions (Arm) window, press [F6 Area], and the Define Area window appears as shown below.



F4

Select the desired work coordinates using the cursor or jog dial, and then press [F4 AutoCalc].

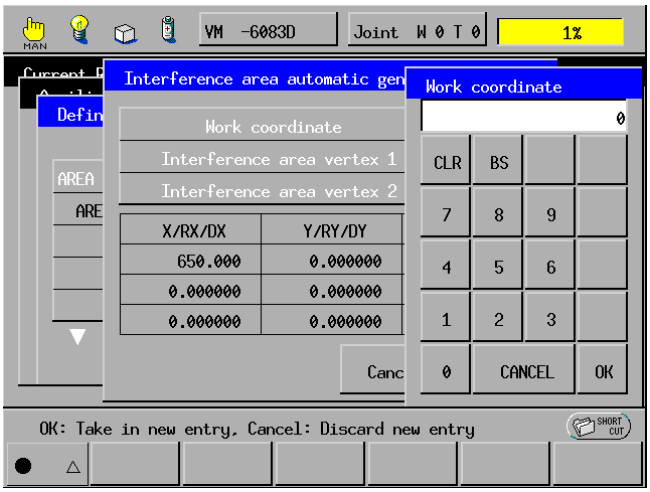
Step 4 The Interference area automatic generation window appears as shown below.



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 or jog dial and then press [F5 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 ([F2 Arm]—[F4 Var.]—[F4 Position]) shown below.

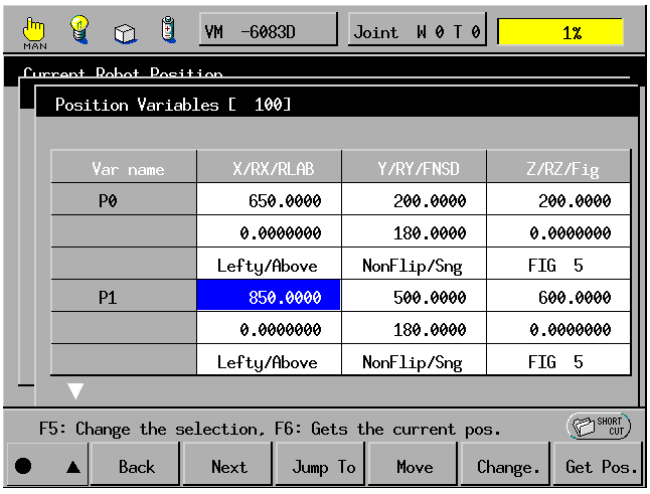
In the Position Variables assignment window, assign the value of the robot arm position to be taught to each of the two position variables you have entered for vertexes farthest and nearest to the origin of the base coordinates in Step 5.

(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 [F6 Get Pos.] in order to read in the current position of the tool end to the selected position variable.

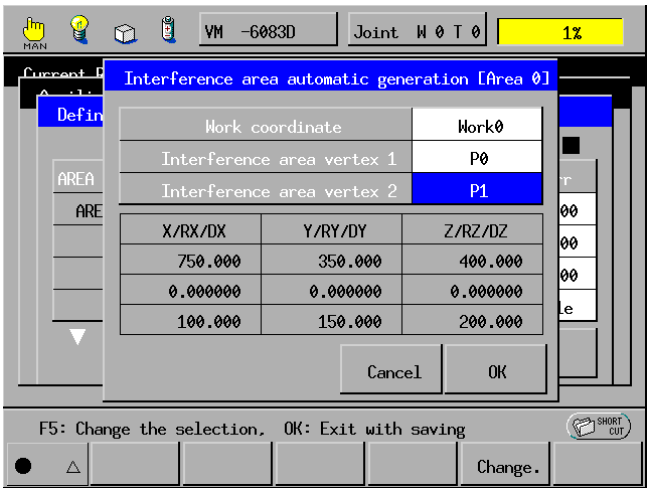
(4) Carry out (1) through (3) above for each of the farthest and nearest vertexes.



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.

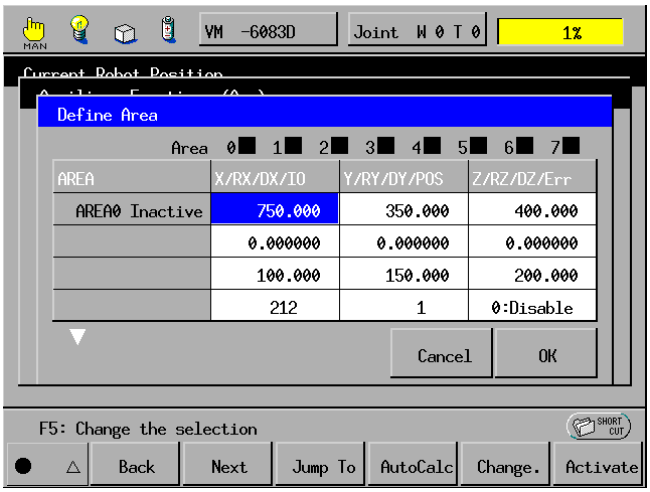
Step 7 Press the Cancel button twice to return to the Interference area automatic generation window.

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 top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window

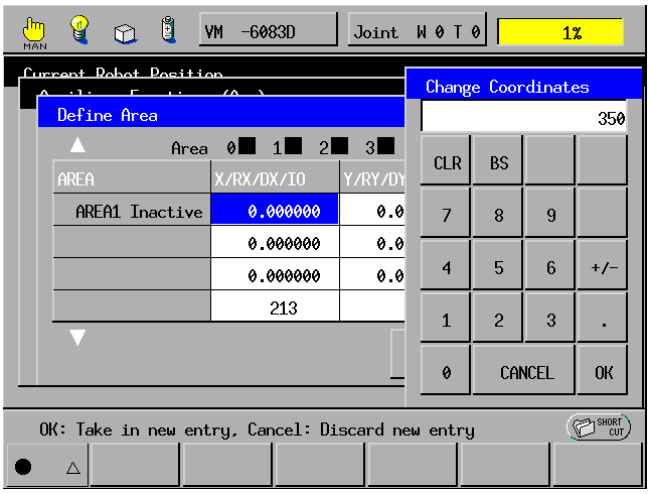
Step 3 Press [F6 Area] in the Auxiliary Functions (Arm) window.

The Define Area window appears.

Select an interference check area to be defined using the cursor keys or jog dial.

Step 4 Press [F5 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

You may define up to eight interference check areas. Out of those defined areas, you may select areas to be actually used according to the procedure given below.

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.

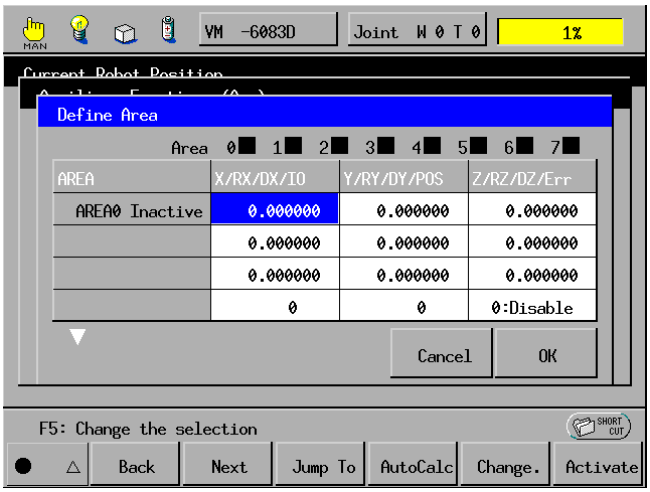
Operating procedure

■ ***From the teach pendant***

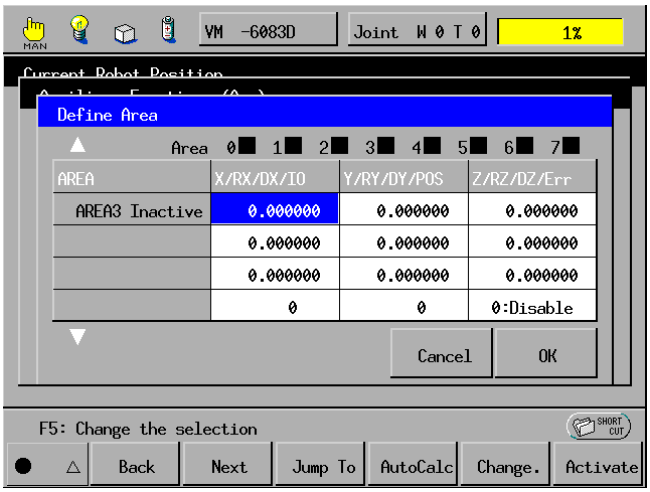
Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

Step 3 Press [F6 Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.



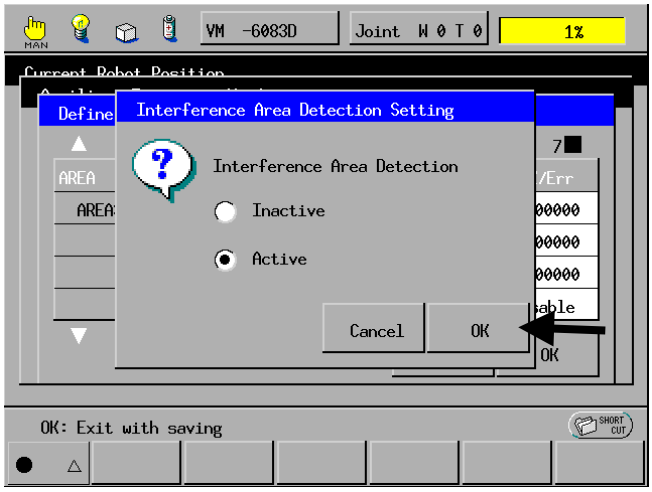
Step 4 Call up the defined interference check area to be modified with the cursor key or jog dial as shown below.



F6

Then press [F6 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.



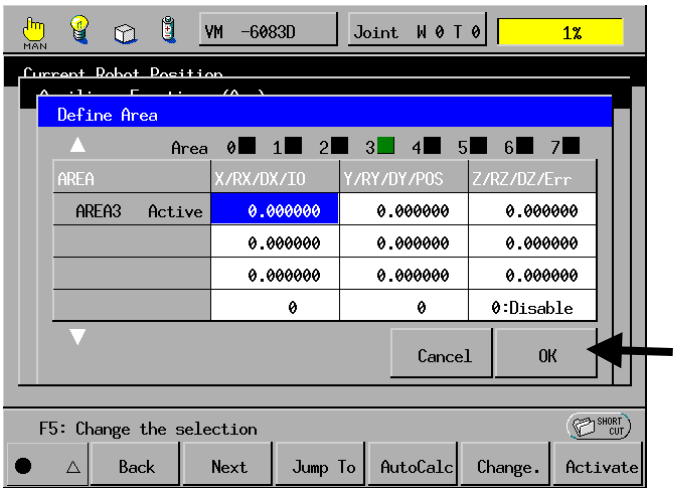
The screen will return to the Define Area window as shown on the next page.

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***

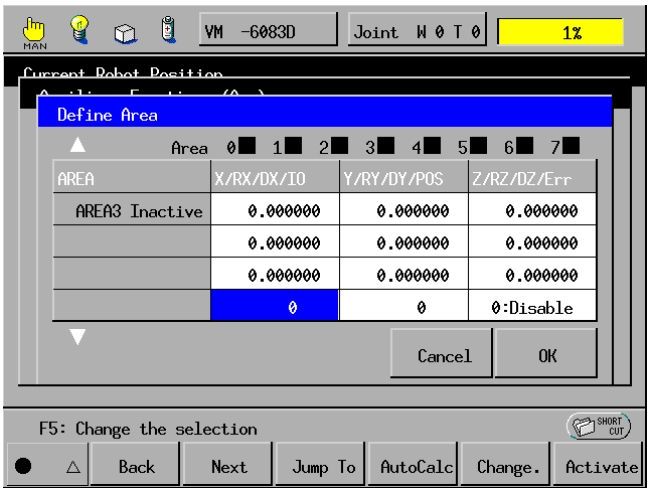
Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

Step 3 Press [F6 Area.] in the Auxiliary Functions (Arm) window.

Step 4 Call up the defined interference check area to be modified with the cursor key or jog dial.

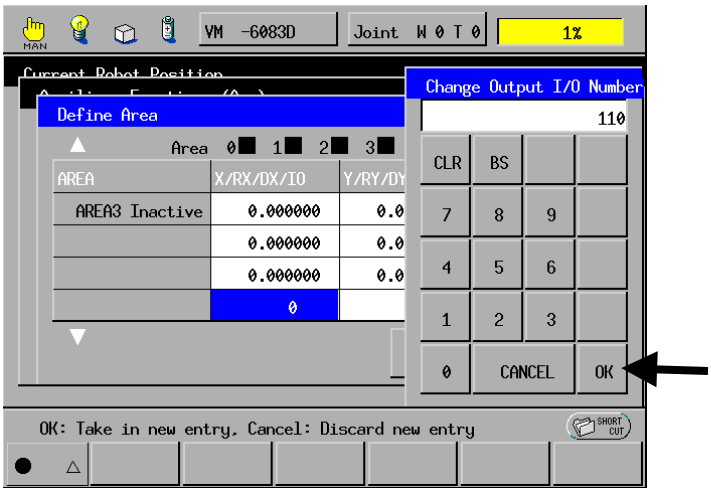
Step 5 In the Define Area window, select an entry field in the 1st column of the bottom line.



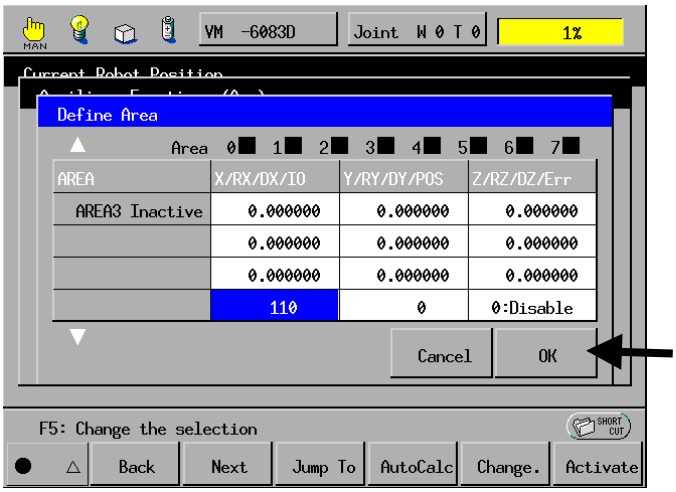
F5

Then press [F5 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.



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***

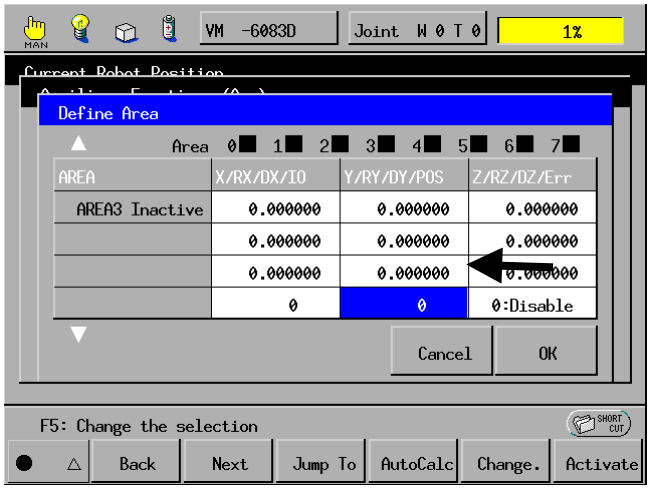
Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

Step 3 Press [F6 Area.] in the Auxiliary Functions (Arm) window.

Step 4 Call up the defined interference check area to be modified with the cursor key or jog dial.

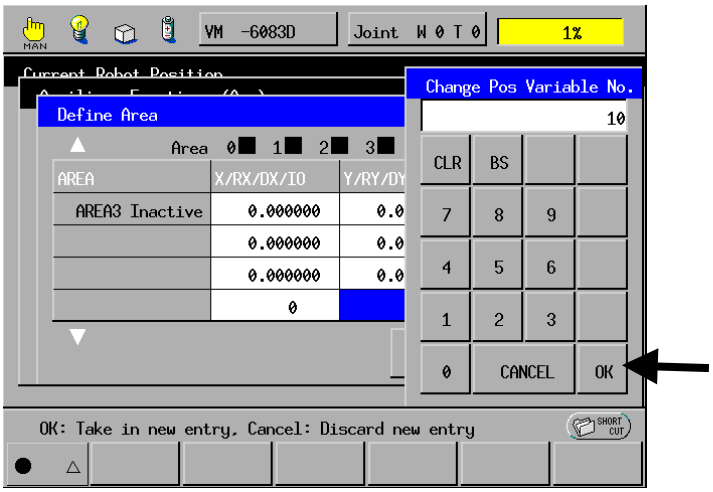
Step 5 In the Define Area window, select an entry field in the 3rd column of the bottom line.



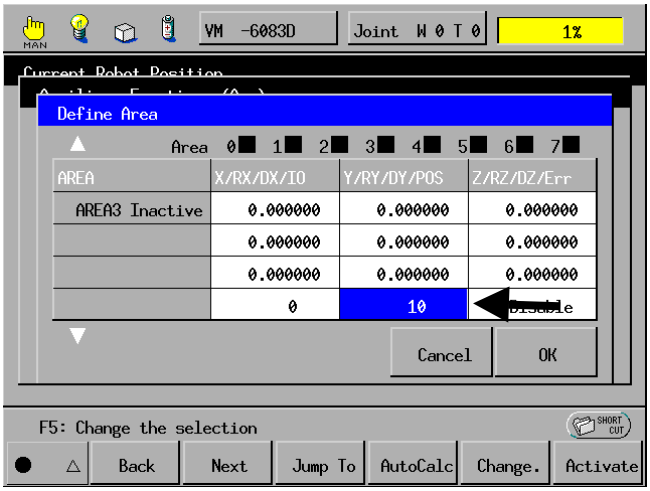
F5

Then press [F5 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

In earlier versions of the main system software, only when the origin of the tool coordinates invades the interference check area, the system interprets it as an error. In Version 1.8 or later, the system may detect also when the origin exits from the interference check area. You may choose either "invading the interference check area" or "exiting from it." This feature allows you to use the AREA statement for setting the motion area.

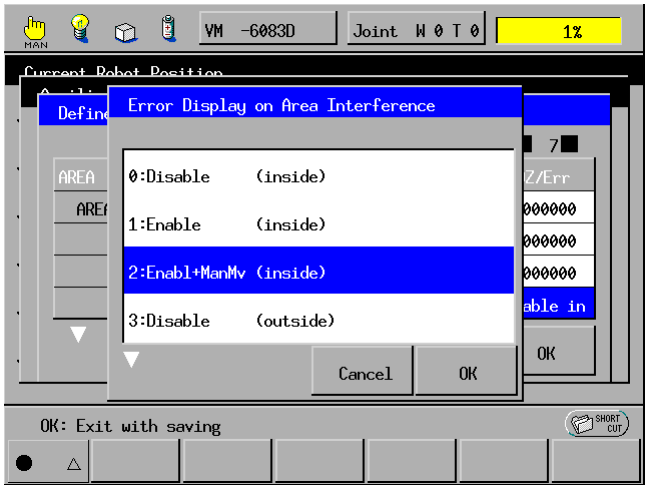
Interpreting a detected area interference as an error

The moment the origin of the tool coordinates interferes with the active interference area, the system may detect it as an error and cut the motor power off to prevent the arm from proceeding into the area further.

In Version 1.8 or later, you may 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: [F2 Arm]—[F6 Aux.]—[F6 Area.]



NOTE: 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.

In Version 1.8 or later, if you set 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 as a motion area. If no overlapped area exists, the robot cannot run, so you need to modify the settings.

For the setting procedure to enable or disable the error detection, refer to “ Operating procedure”.

Operating procedure

■ ***From the teach pendant***

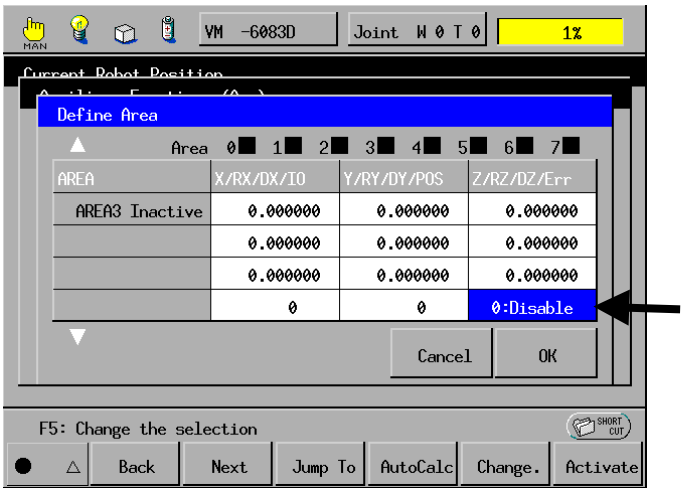
Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

Step 3 Press [F6 Area.] in the Auxiliary Functions (Arm) window.

Step 4 Call up the defined interference check area to be modified with the cursor keys or jog dial.

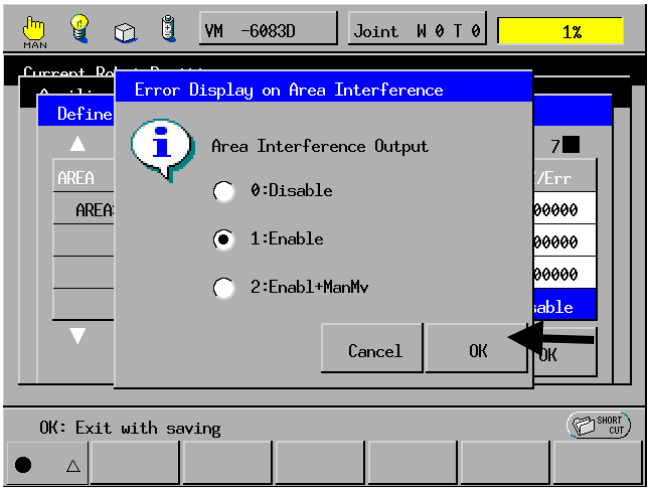
Step 5 In the Define Area window, select an entry field in the rightmost column of the bottom line.



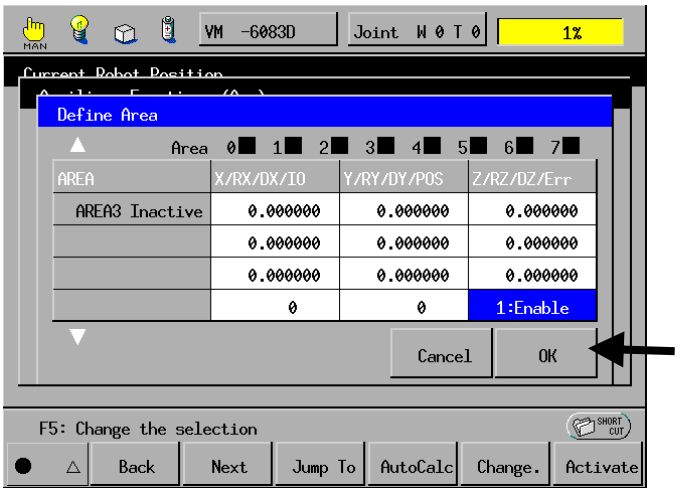
F5

Then press [F5 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.

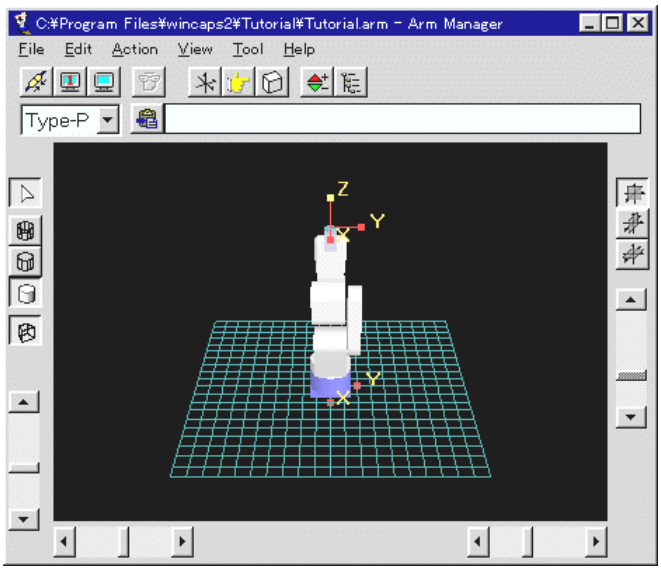


[9] Defining an interference check area in WINCAPSII

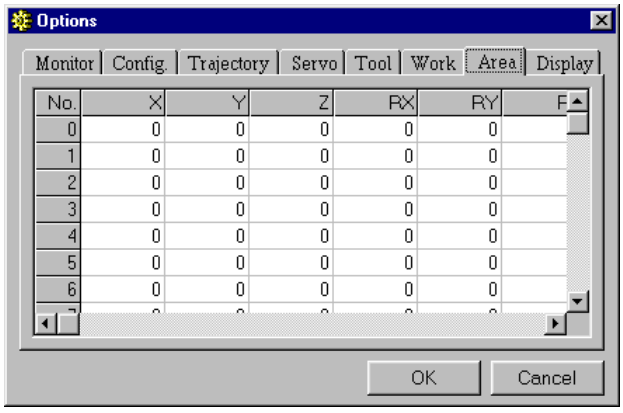
Operating procedure

■ ***From the operating panel***

Step 1 Start WINCAPSII at programmer level and run Arm Manager.



Step 2 On the Tool menu, select Options. Then select the Area tab.



Step 3 In the Area table, modify the interference check area related parameters.

X, Y, Z: Origin of the interference check area

RX, RY, and RZ: Rotation angles of the interference check area

DX, DY, and DZ: Vectors of the interference check area

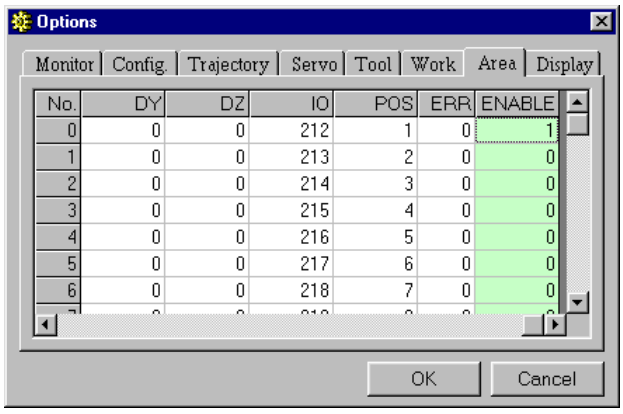
IO: I/O signal numbers which will turn on if the tip of the end-effector enters the interference check area.

POS: Name of a position variable (global variable) to which the position value of the tip of the end-effector will be assigned when the tip of the end-effector enters the area.

ERR: Determines whether a detected area interference will be interpreted as an error. (0: Not interpreted as an error, 1: Interpreted as an error)

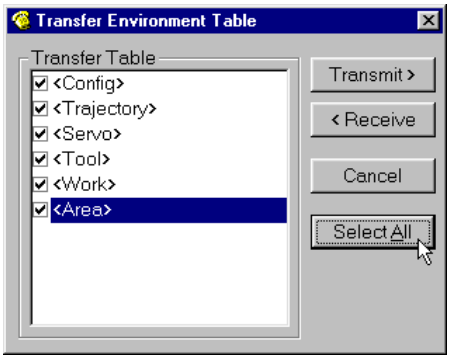
ENABLE: Determines whether an area interference will be detected or not. (0: Not Detected, 1: Detected)

Step 4 After making necessary settings, press the OK button.



Step 5 Connect Arm Manager. On the File menu, select Transfer.

Step 6 Select <Area> and press Transmit>. Immediately after the transmission, the new parameters will take effect.



[10] Escaping from the interference check area [Ver. 1.4 or later]

In Ver. 1.3 or earlier, the robot needs to be manually moved out of the interference check area whenever the robot enters any of prohibited areas 0 to 7. Entering prohibited areas will result in error (ERROR2490 to 2497).

In Ver. 1.4 or later, 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 operating panel 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]

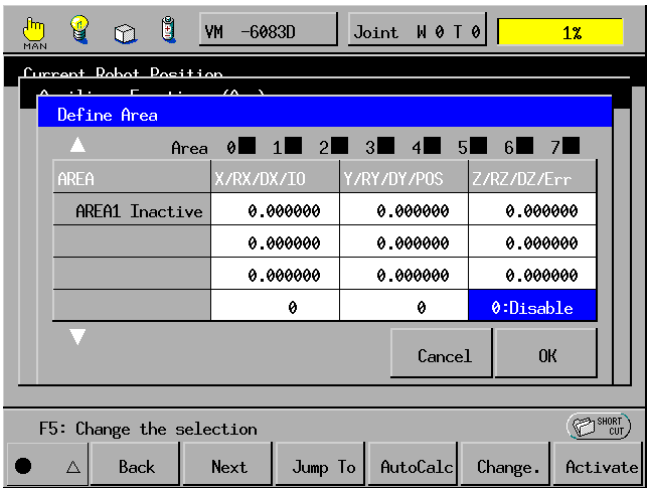
Step 1 On the top screen of the teach pendant, press [F2 Arm].

Step 2 Press [F6 Aux.] in the Current Robot Position window.

Step 3 In the Auxiliary Functions (Arm) window, press [F6 Area].

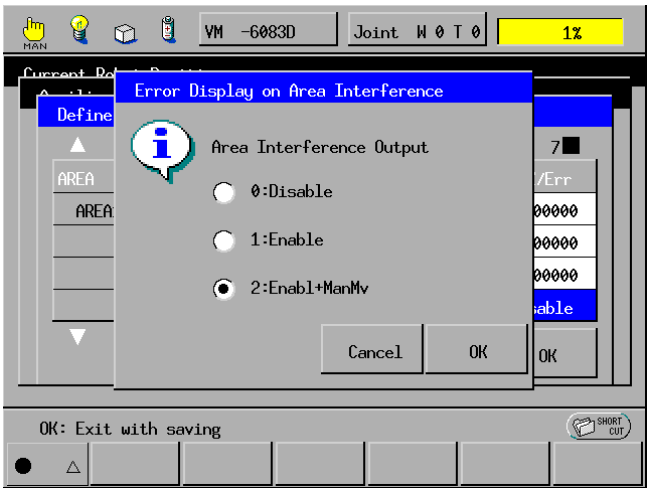
Step 4 Using the cursor keys or jog dial, select the area you want to change.

Step 5 Select the rightmost column of the table. Press [F5 Change.].

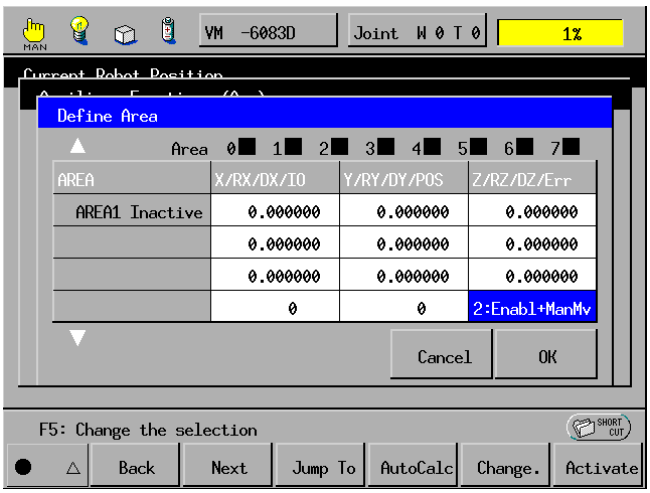


F5

Step 6 Select [2: Enable+ManMv] and press OK.

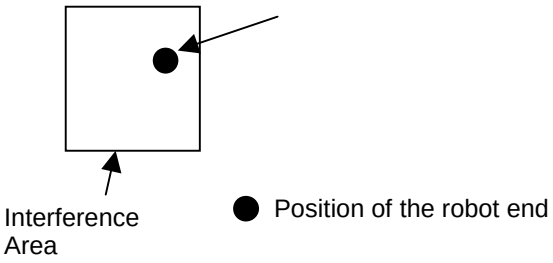


Step 7 You can change all the settings in the window for values you want. If you change any of them, confirm them and press OK.

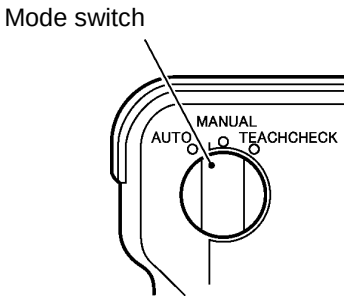


Escaping procedure

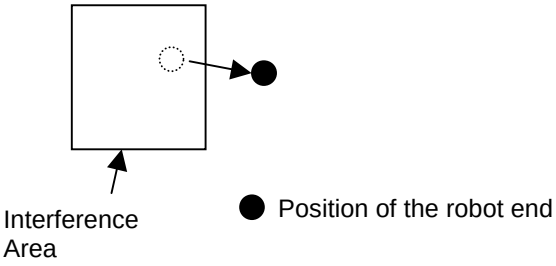
Step 1 Error will occur when the robot enters the interference area.



Step 2 Switch off AutoEnable to change the operation mode to Manual.



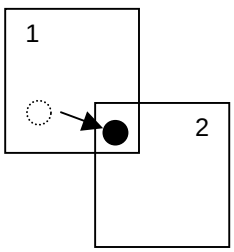
Step 3 Move the robot outside the interference area.



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 the V⋆-D series robot.

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).

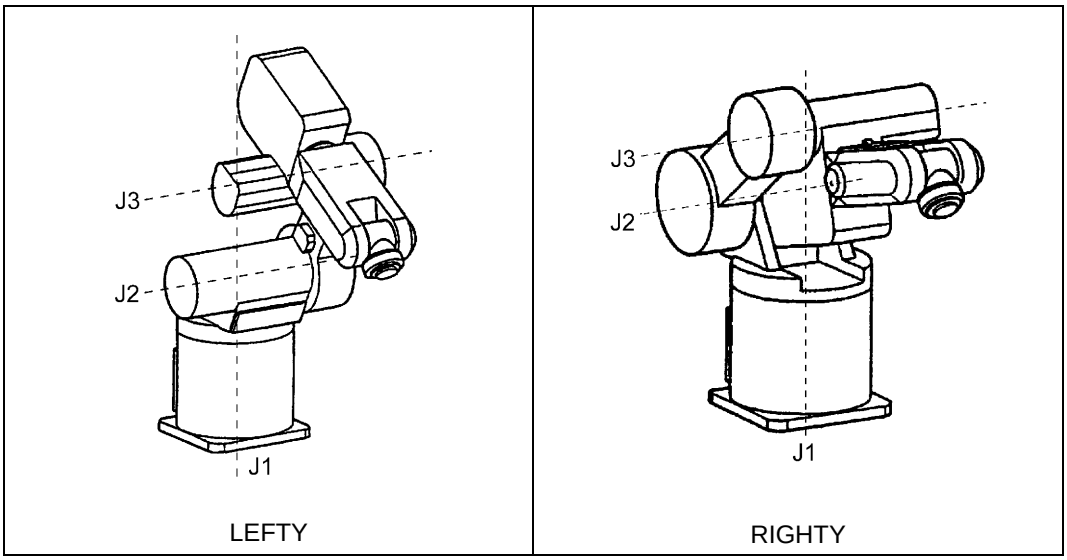


Figure 4-28. Shoulder Figure

(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).

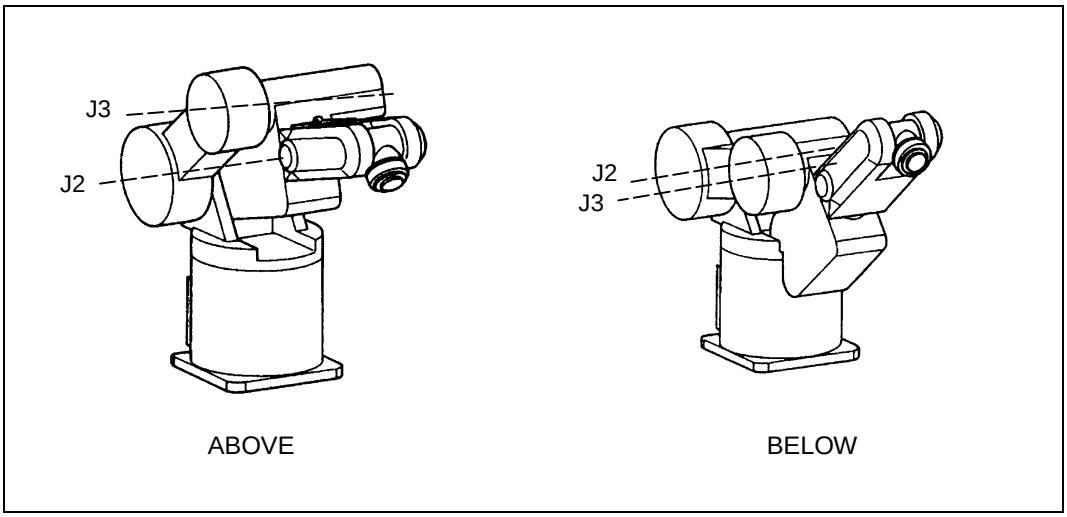


Figure 4-29. Elbow Figure

(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.

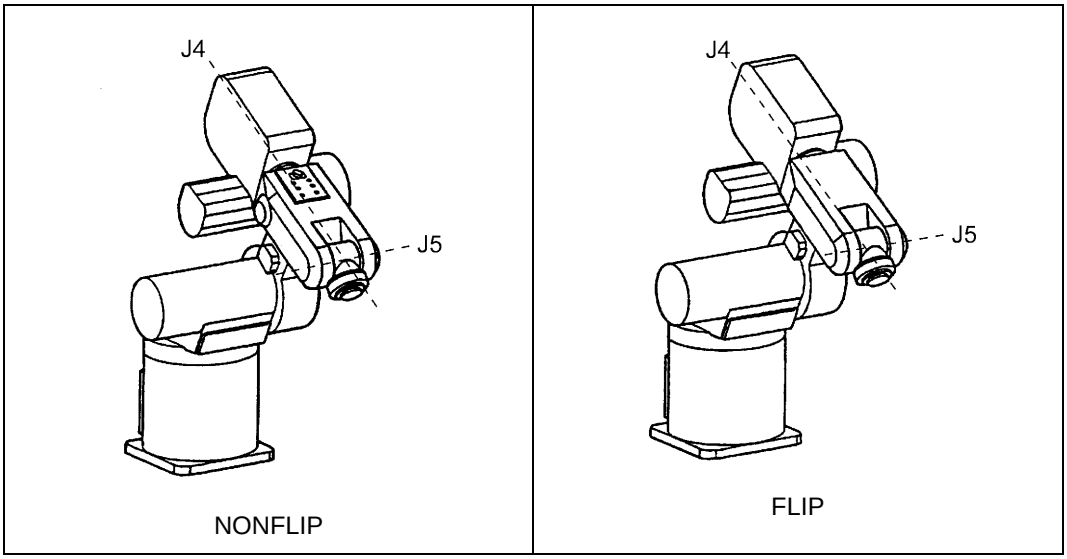


Figure 4-30. Wrist Figure

(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 $-180° < \theta_6 \leq 180°$ in mechanical interface coordinates, the figure is SINGLE; if it rotates by $180° < \theta_6 \leq 360°$ or $-360° < \theta_6 \leq -180°$, the figure is DOUBLE.

The robot takes quite different figures when θ_6 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 θ_6=181°, the robot will take the 6th-axis figure at θ_6=-179° if you make no figure modification.

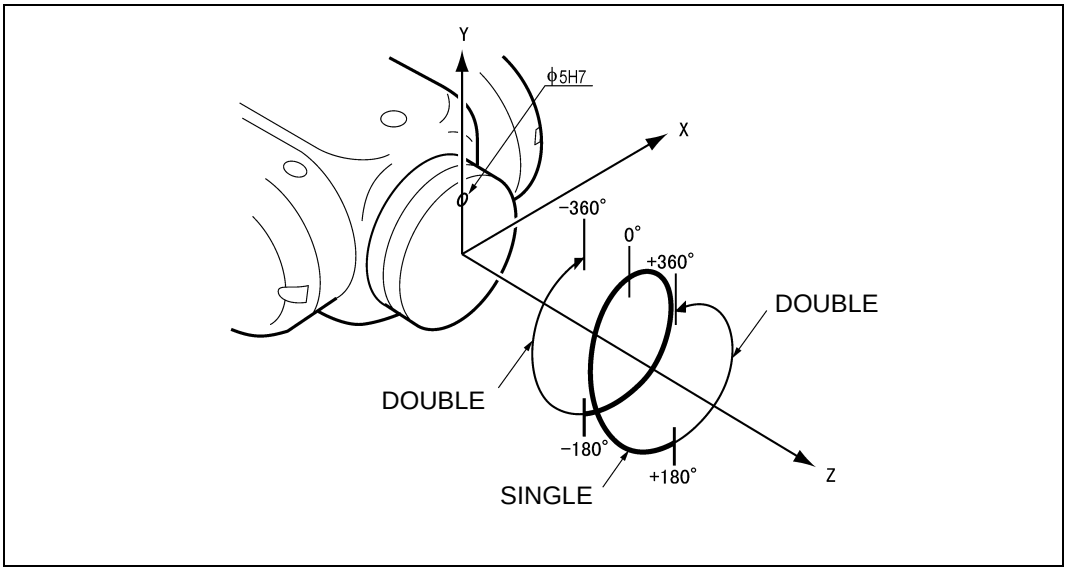


Figure 4-31. 6th-Axis Figure

(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.

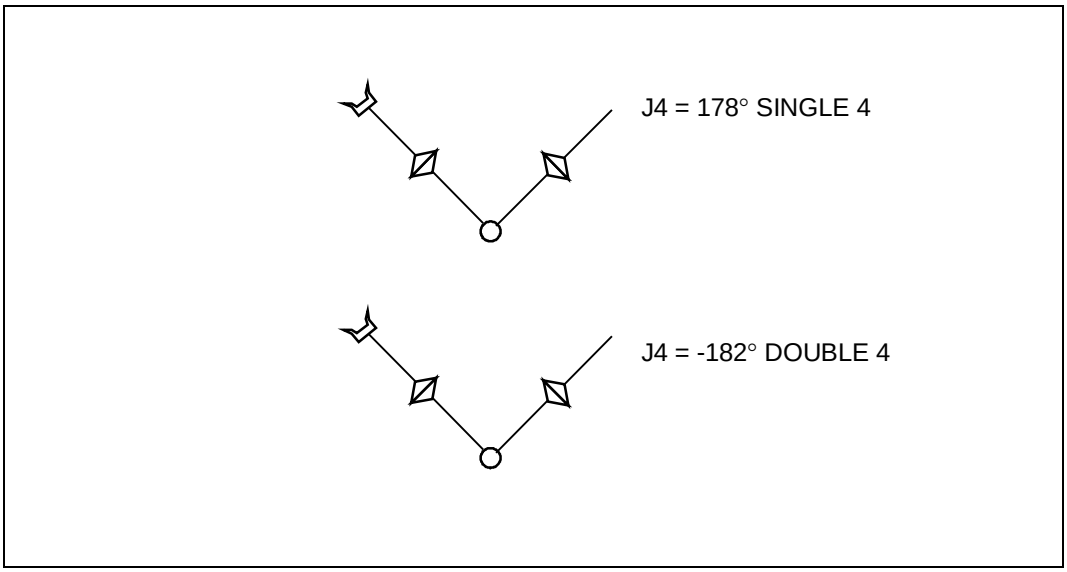


Figure 4-32. 4th-Axis Figure

Figure-1
LEFTY, ABOVE, and NONFLIP

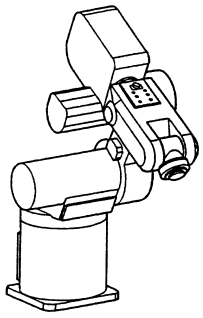


Figure-2
LEFTY, ABOVE, and FLIP

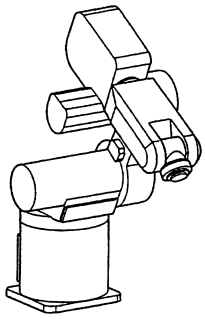


Figure-3
LEFTY, BELOW, and NONFLIP

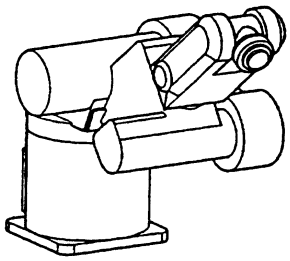


Figure-4
LEFTY, BELOW, and FLIP

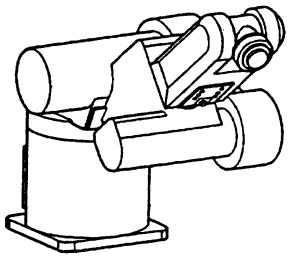


Figure-5
RIGHTY, ABOVE, and NONFLIP

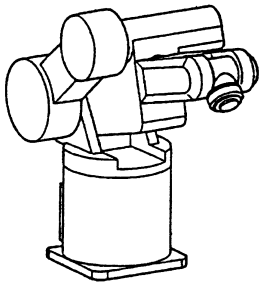


Figure-6
RIGHTY, ABOVE, and FLIP

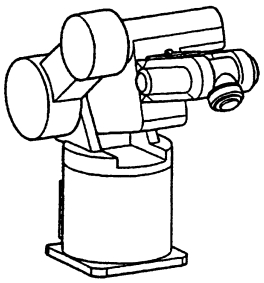


Figure-7
RIGHTY, BELOW, and NONFLIP

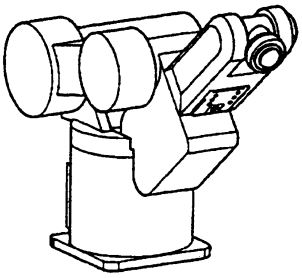


Figure-8
RIGHTY, BELOW, and FLIP

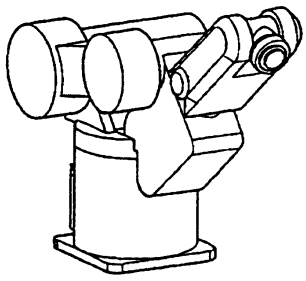
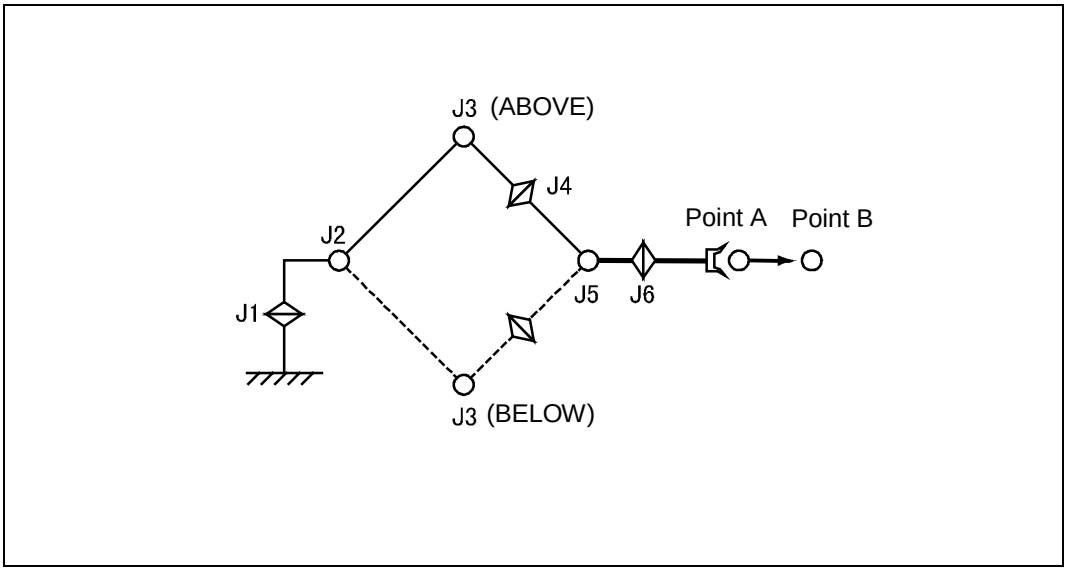


Figure 4-33. Possible Combinations of Robot Shoulder, Elbow, and Wrist Figures

⚠**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.

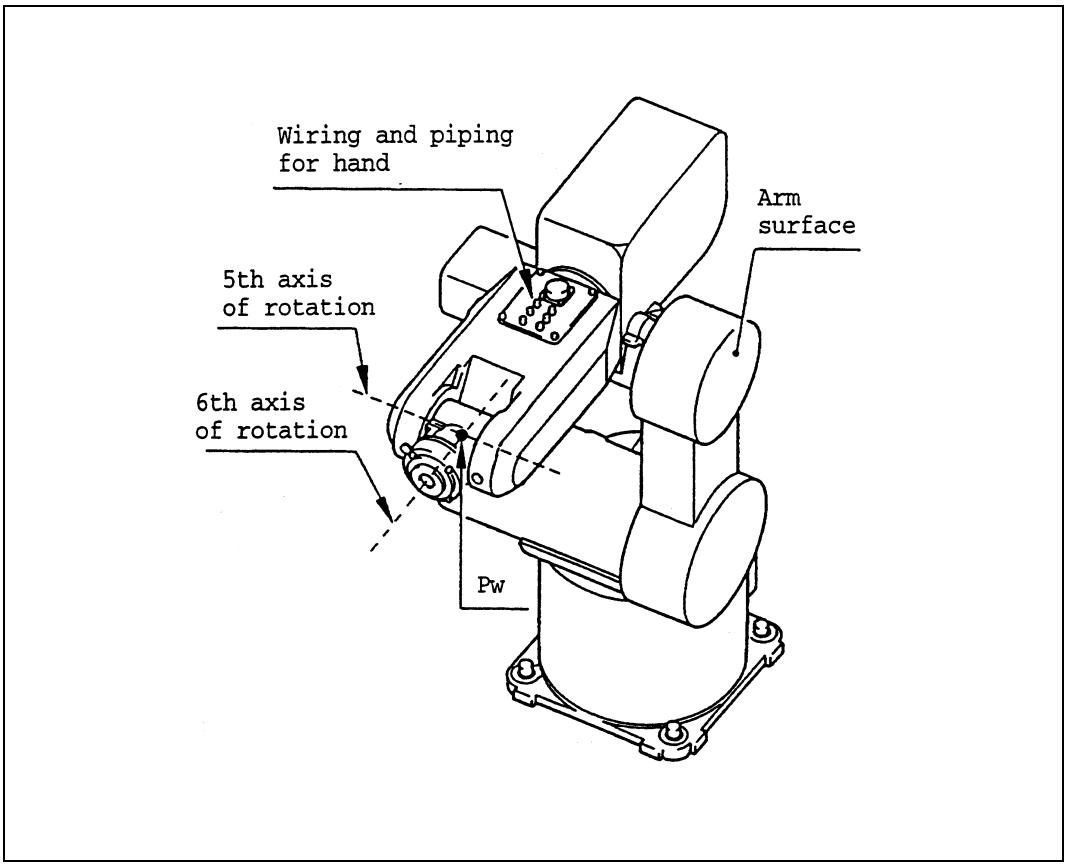


Figure 4-34. Location of Pw

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, 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.

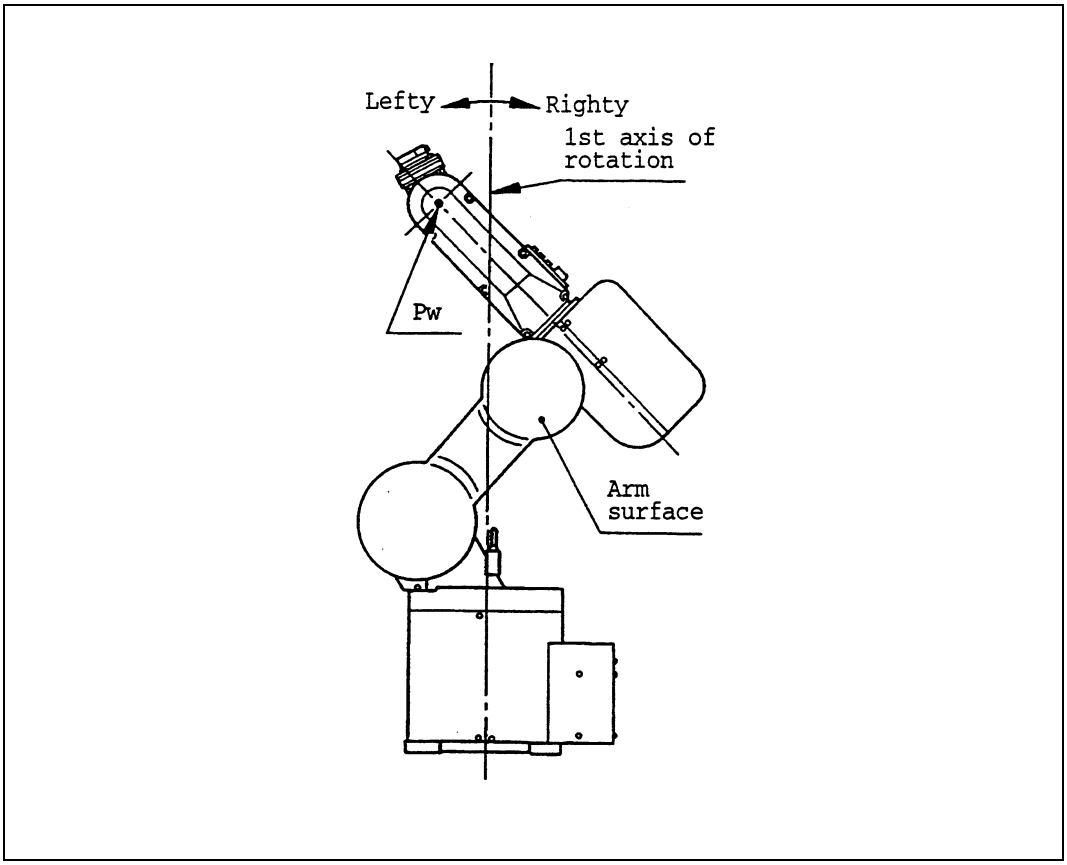


Figure 4-35. Boundary between LEFTY and RIGHTY

(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.

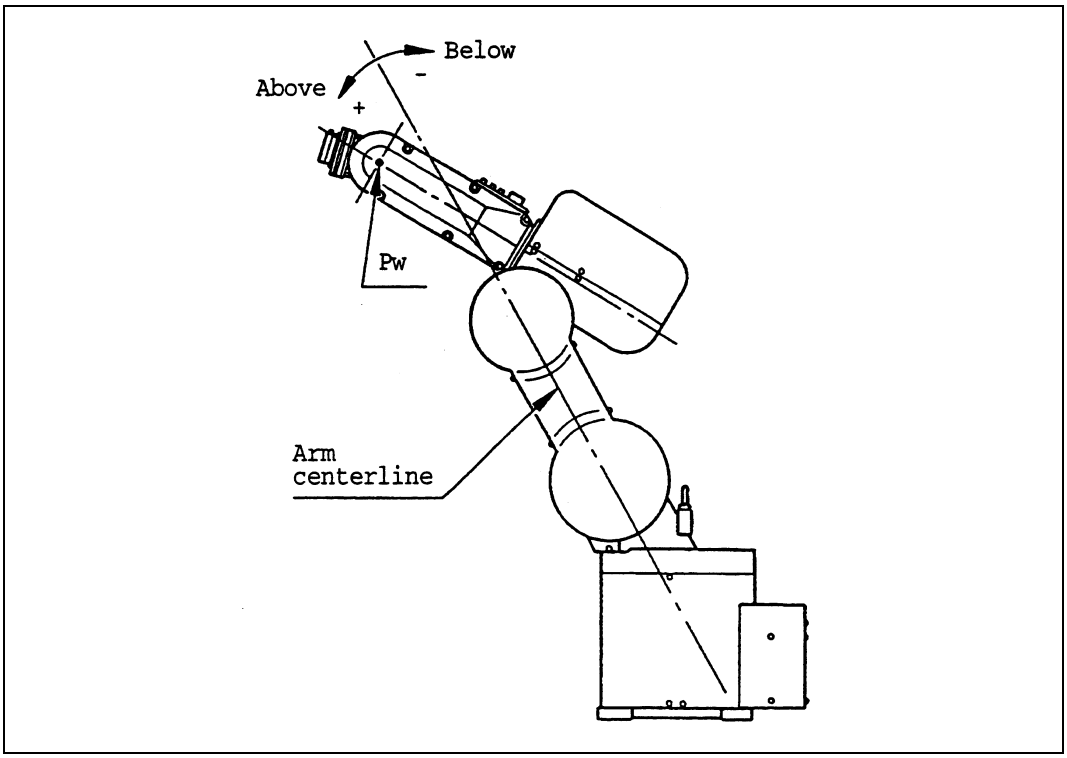


Figure 4-36. Boundary between ABOVE and BELOW for LEFTY

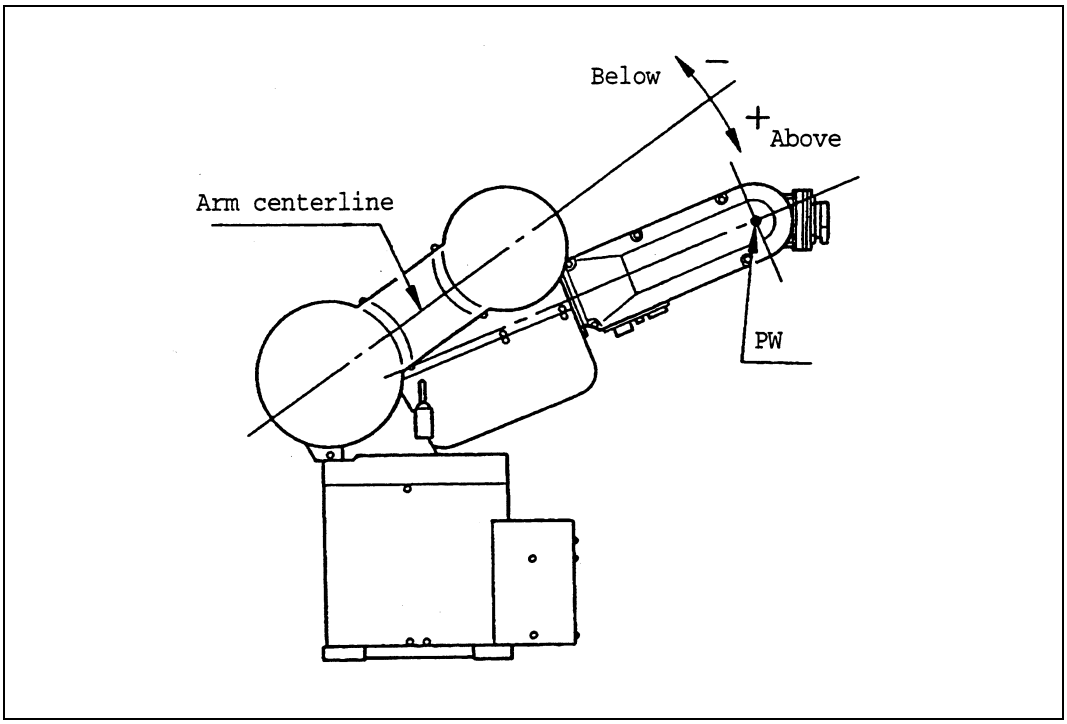


Figure 4-37. Boundary between ABOVE and BELOW for RIGHTY

(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.

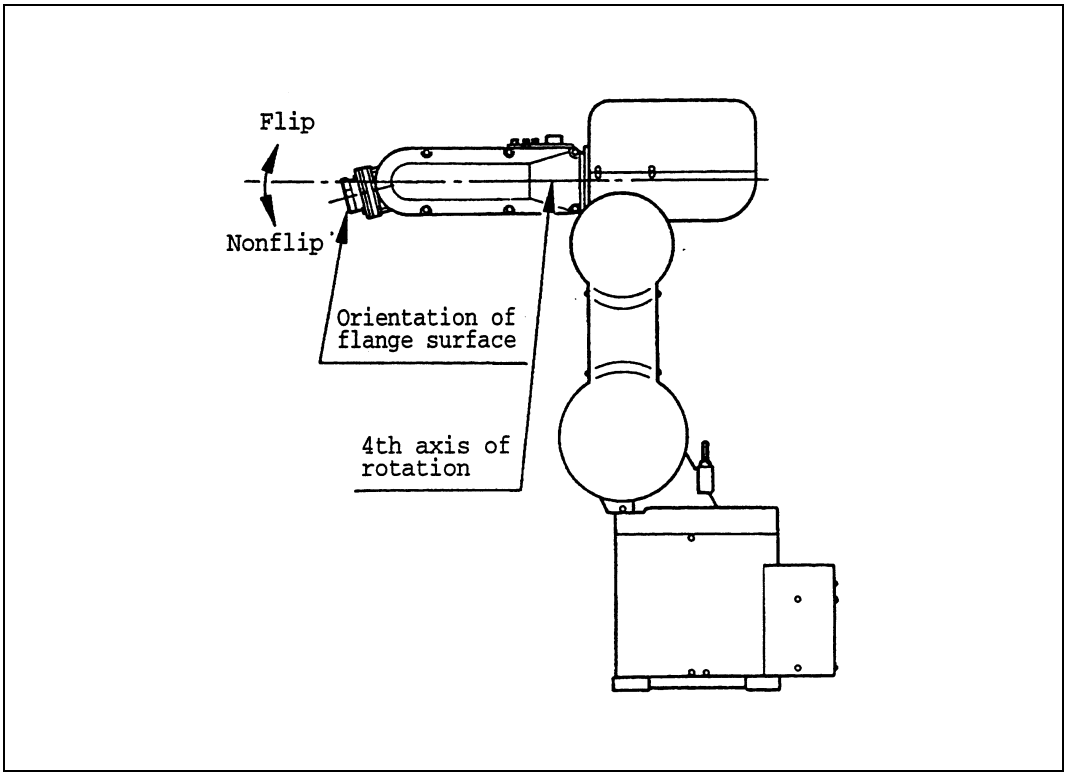


Figure 4-38. Boundary between FLIP and NONFLIP for LEFTY

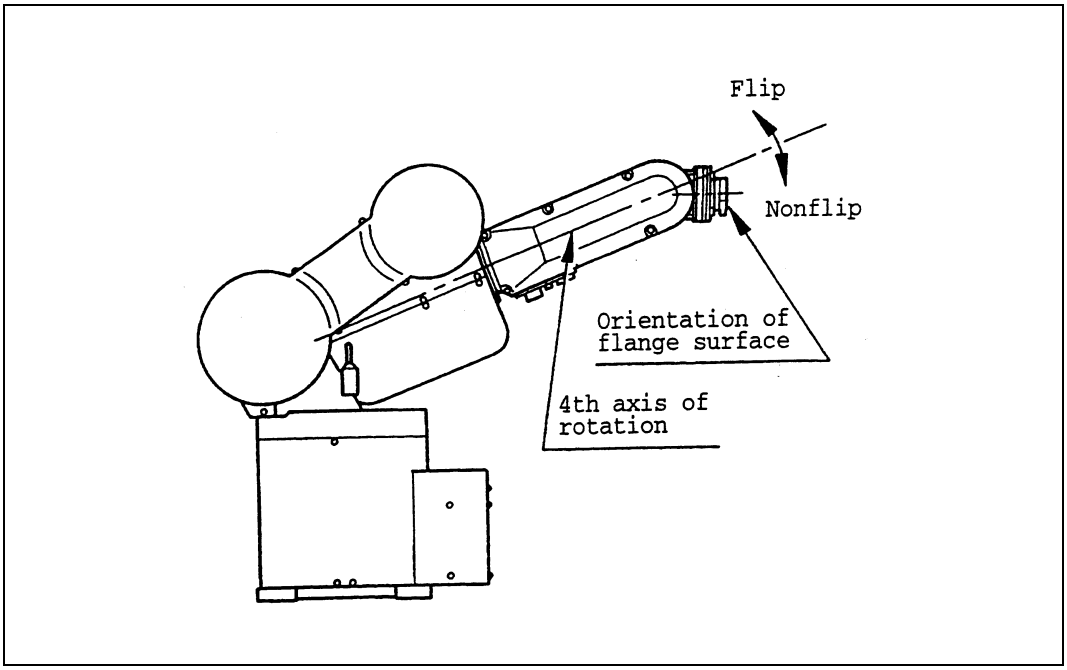


Figure 4-39. Boundary between FLIP and NONFLIP for RIGHTY

(4) SINGLE/DOUBLE (6th-axis figure)

If the rotation angle (θ6) of the 6th axis is within the range of -180°<θ6≤180° around the Z axis in mechanical interface coordinates, the figure is SINGLE; if it is within the range of 180°<θ6≤360° or -360°<θ6≤-180°, the figure is DOUBLE. Boundaries exist at -180° and +180°.

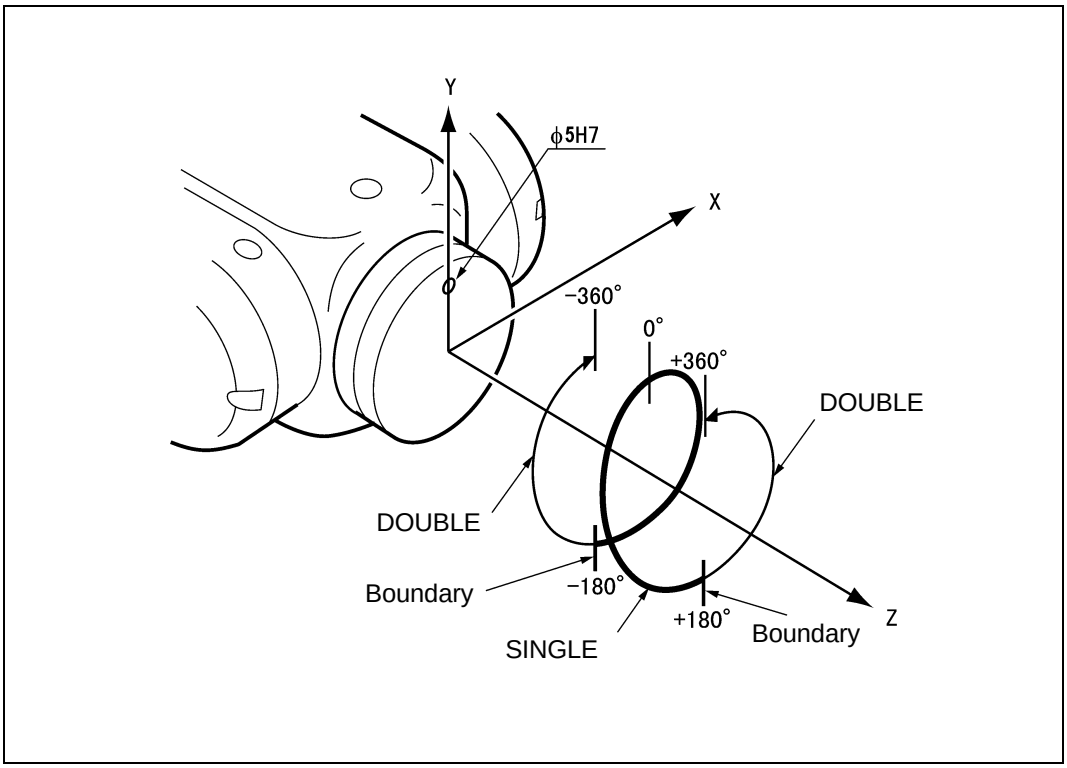


Figure 4-40. Boundary between SINGLE and DOUBLE

4.2 Coordinates, Interference Check Area, and Figures *in H*-D Series*

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 Subsection 3.2.1, "Running the Robot Manually," [2] X-Y mode."

The work coordinates are defined relatively in base coordinates. The origin of the work coordinates should be laid at a corner of the cubic envelope of an object piece. It has components Xw, Yw, and Zw. You may define the work coordinates by the number of objects you want to handle in the same timeframe on the single robot.

Work coordinates are 3-dimensional Cartesian coordinates defined for each operation space of work. The origin can be anywhere. 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 axis, Y axis and Z axis of base coordinates. If work coordinates are not defined, base coordinates come into effect.

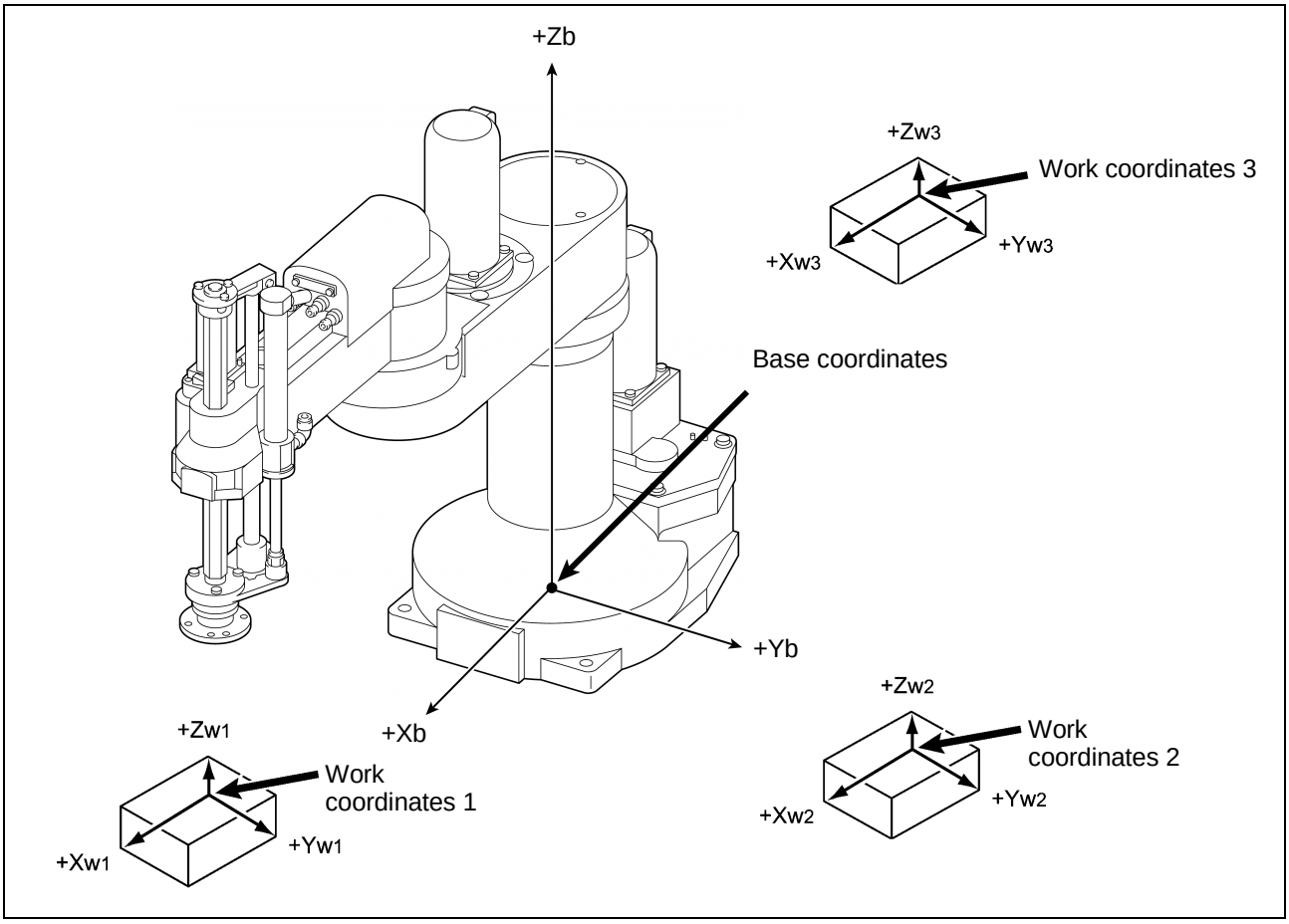


Figure 4-41. Base Coordinates and Work Coordinates

[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.

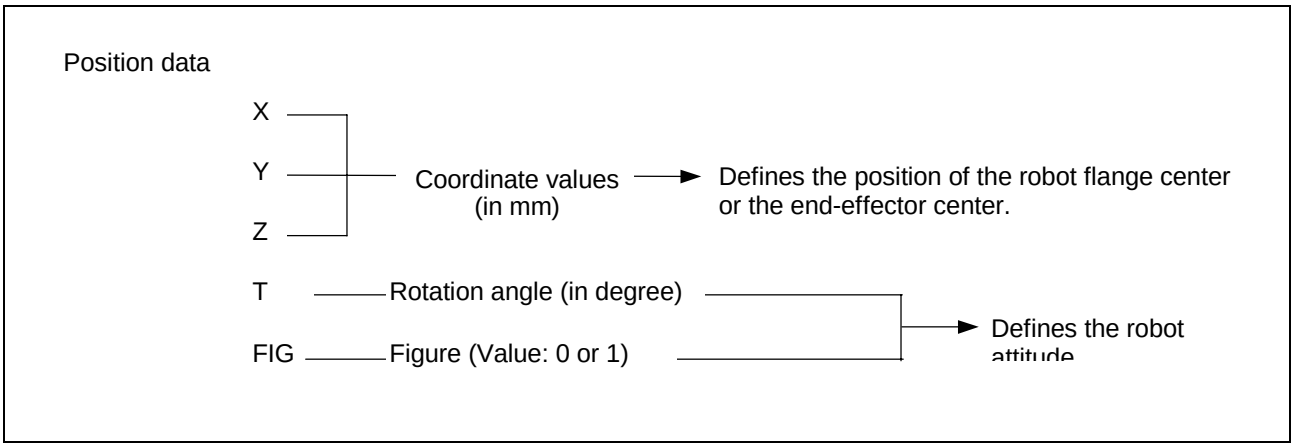


Figure 4-42. Components of Position Data

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 Subsection 4.2.3, "Figures of the Shoulder"

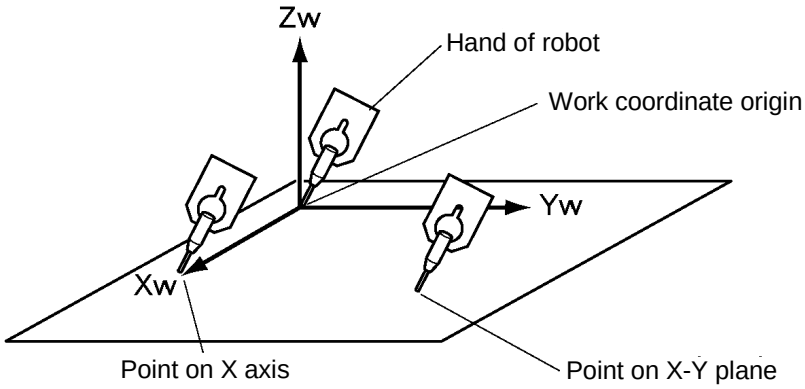
[1.3] Defining work coordinates

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

Defining work coordinates by 3-point teaching
[F2 Arm]—[F6 Aux.]—[F5 Work]—[F4 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.

For the operating procedure, refer to "■ Defining work coordinates by 3-point teaching" on page 4-6.



Defining work coordinates by direct value entry
[F2 Arm]—[F6 Aux.]—[F5 Work]—[F5 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.

For the operating procedure, refer to "■ Defining work coordinates by direct value entry" on page 4-9.

[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.

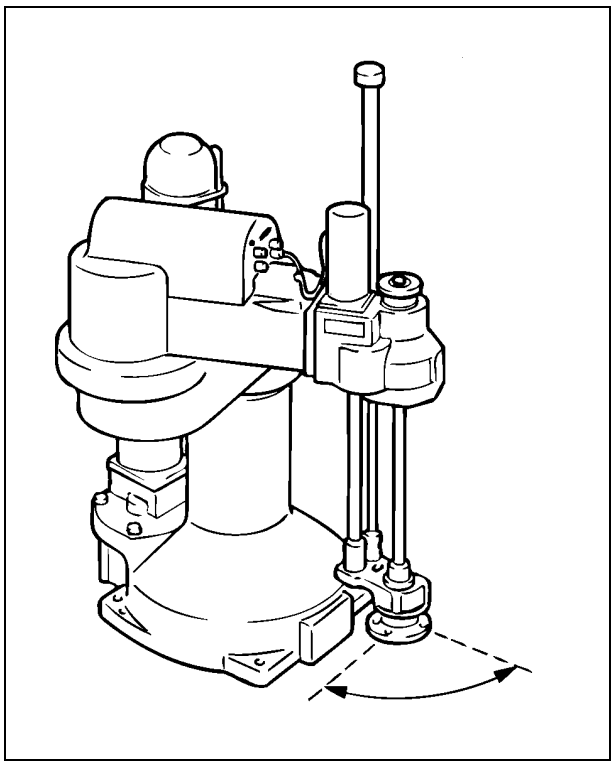


Figure 4-43. Manual Rotation of 4th Axis in X-Y mode, w/o Tool Definition

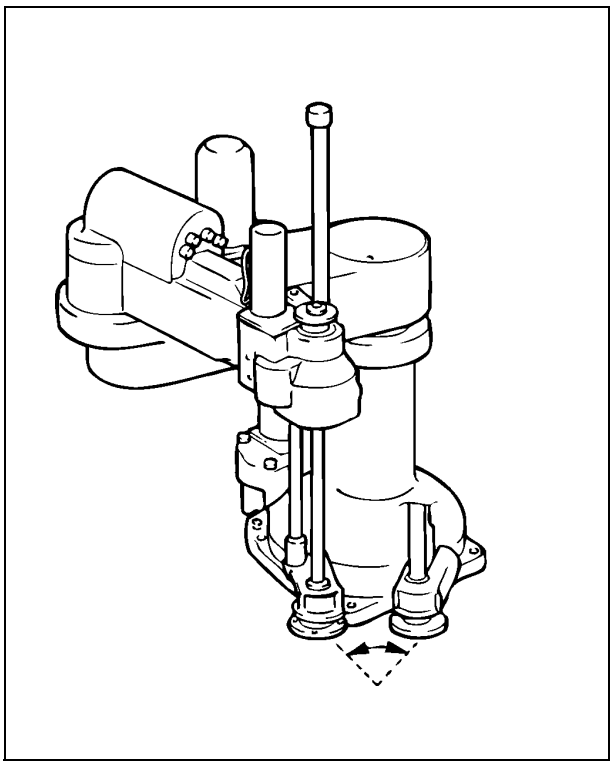


Figure 4-44. Manual Rotation of 4th Axis in X-Y mode, w/ Tool Definition

[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.

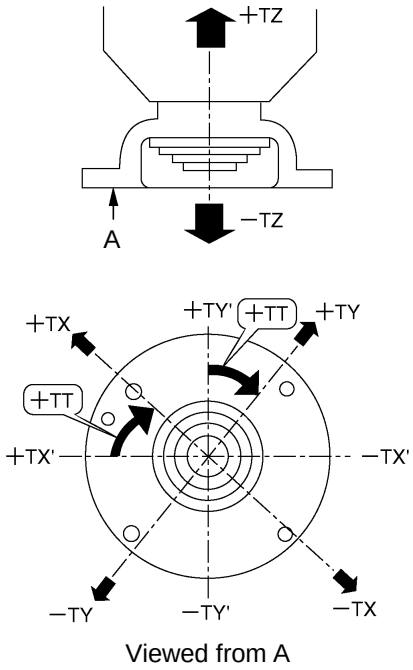


Figure 4-45. Tool Coordinates

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

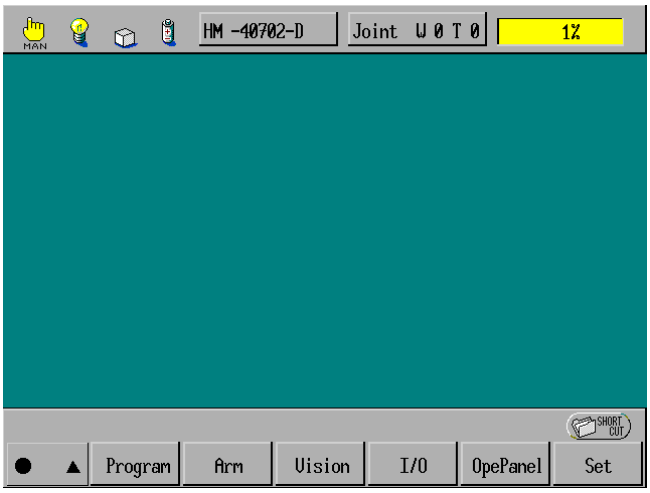
Operating procedure for tool definition

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***

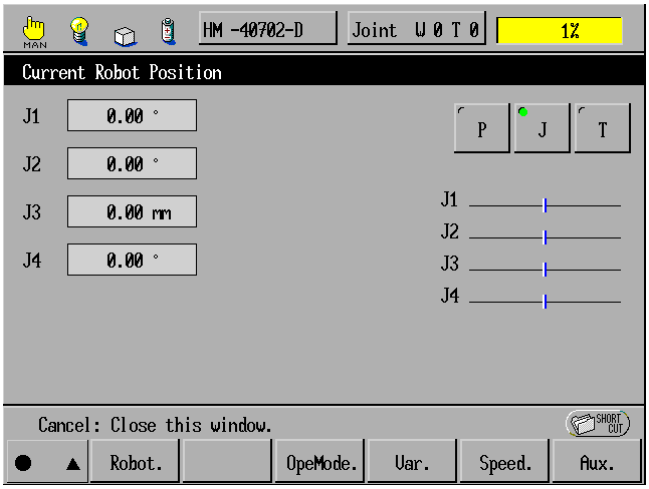
Step 1 On the top screen of the teach pendant, press [F2 Arm].



F2

The Current Robot Position window appears as shown below.

Step 2 Press [F6 Aux.].

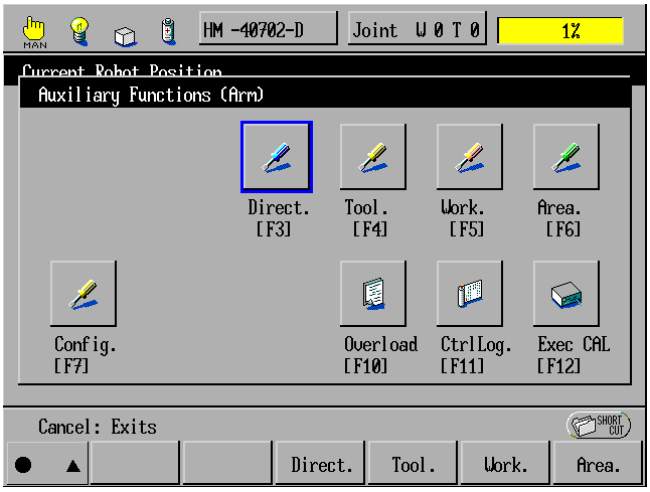


F6

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

Step 3

Press [F4 Tool.].



F4

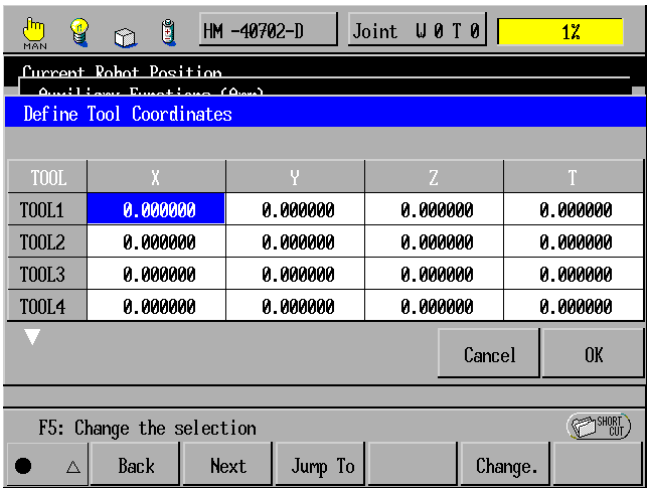
The Define Tool Coordinates window appears as shown below.

Step 4

Select the X column of TOOL1 row by using the cursor keys or jog dial.

The selected area will become highlighted.

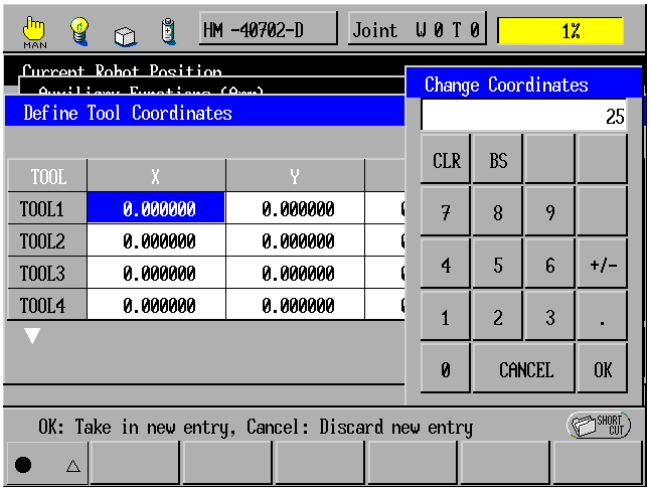
Then press [F5 Change.].



F5

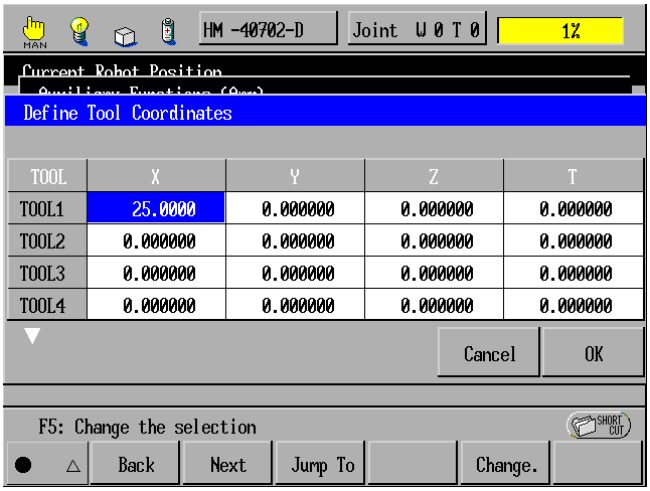
The numeric keypad appears as shown in the next step.

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 4-27.

For details about commands and tool definitions, refer to the PROGRAMMER'S MANUAL, Section 12.1, "Motion Control, APPROACH" and Section 9.5, "Tool Coordinates, TOOL." Also refer to Section 4.1, "[2.7] Tool definition."

4.2.2 Interference Check Area

You may define an interference check area(s) to prevent the robot arm from interfering with other devices or facilities.

The interference check area may be defined based on the base coordinates and work coordinates shown below.

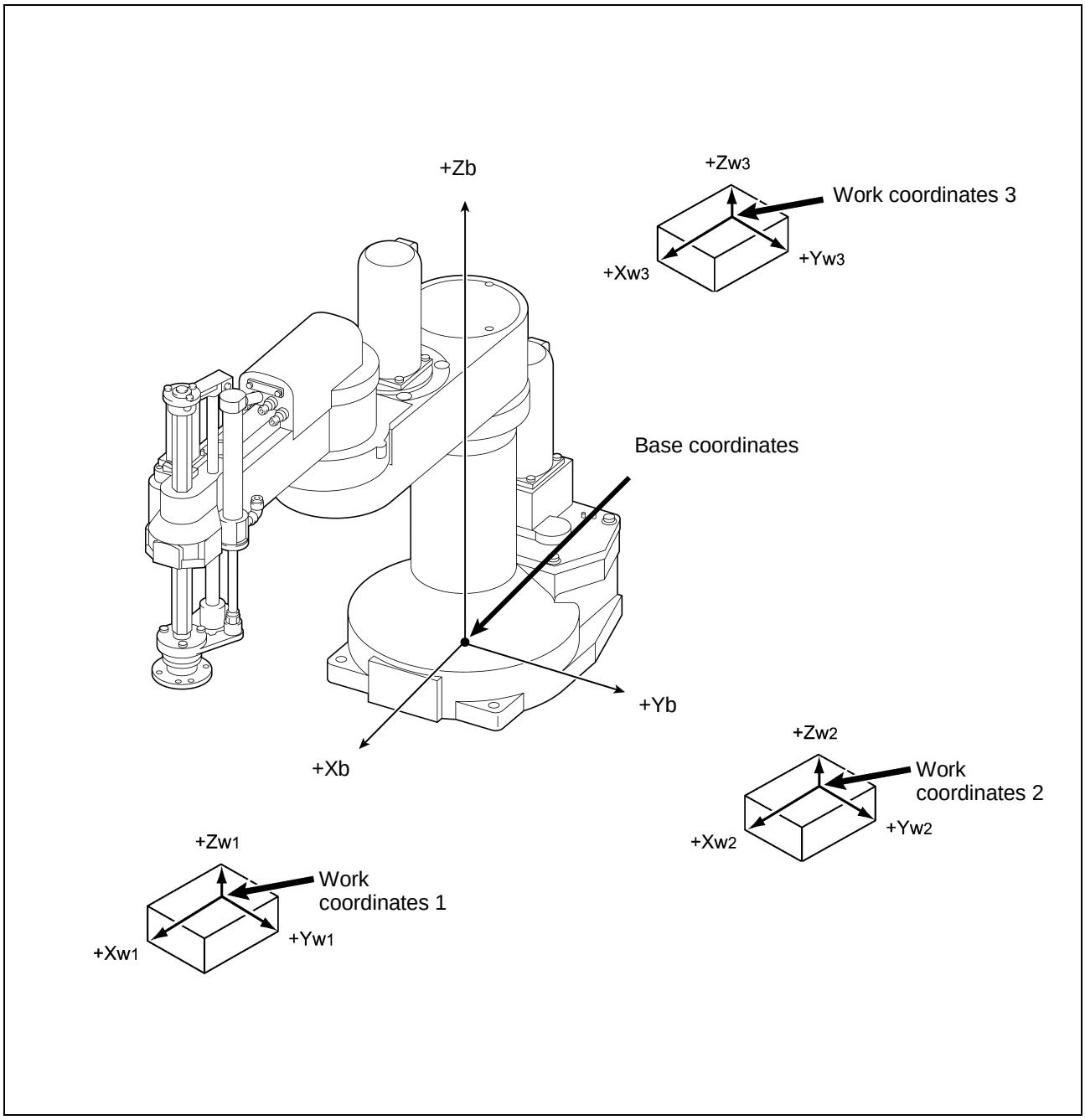


Figure 4-46.

[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

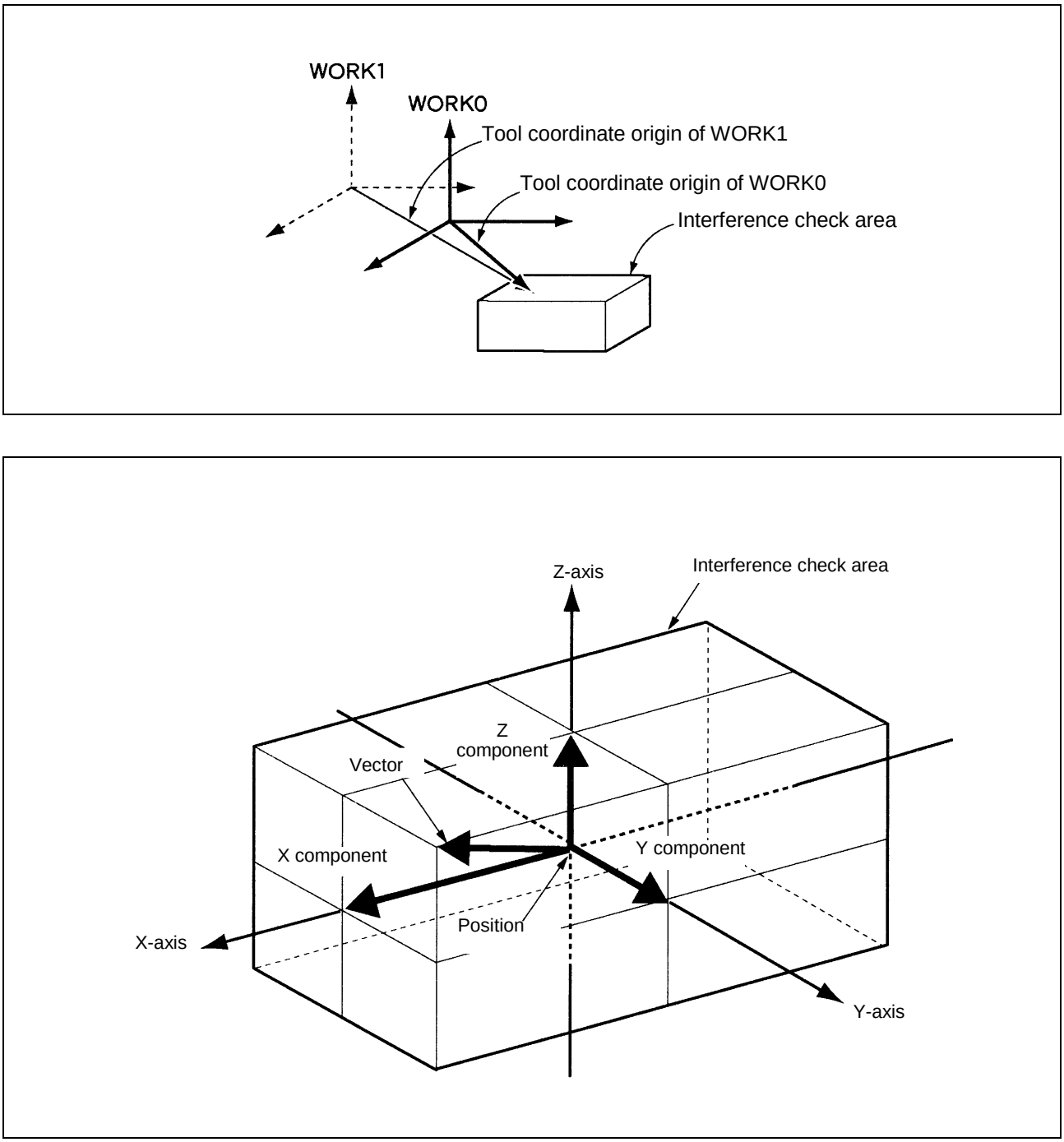


Figure 4-47. Interference Check Area

[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 [F4: 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 4-34.

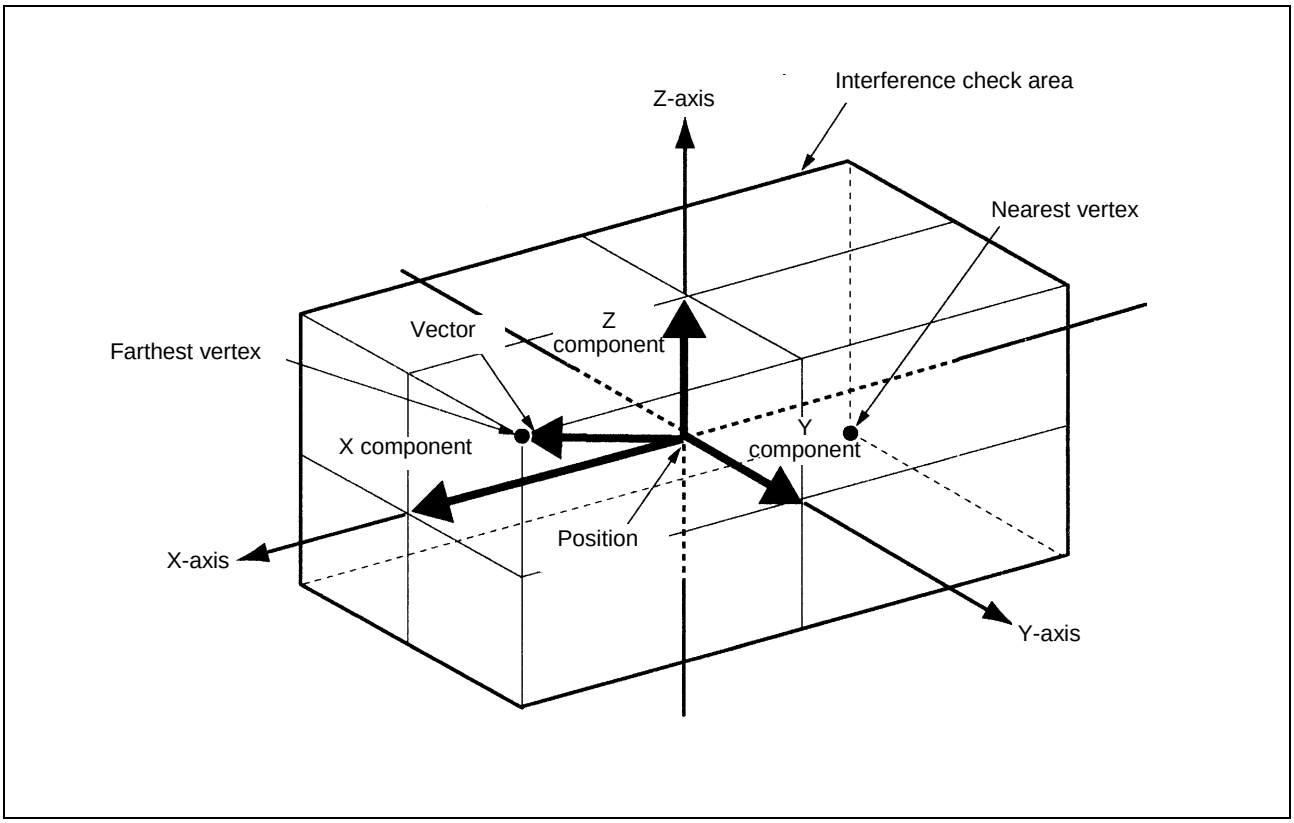


Figure 4-48. Defining an Interference Check Area by 2-point Teaching

Defining an interference check area by direct value entry [F5: 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 4-37.

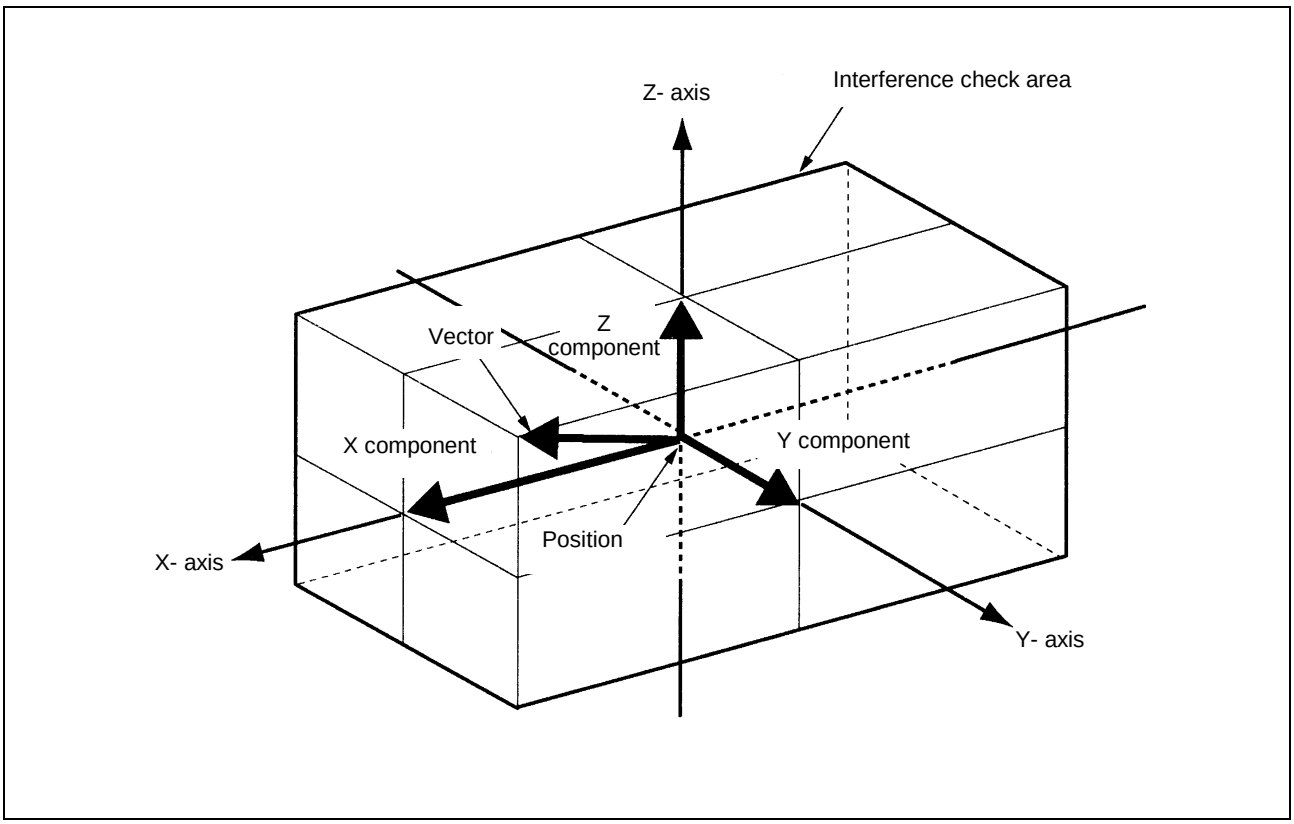


Figure 4-49. Defining an Interference Check Area by Direct Value Entry

[3] Making the interference area check active or inactive

For settings, refer to Section 4.1.2 [5] on Page 4-38.

[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] on Page 4-41.

[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] on Page 4-43.

[6] Interpreting a detected area interference as an error

For settings, refer to Section 4.1.2 [8] on Page 4-45.

[7] Making interference check area related settings in WINCAPSII

For settings, refer to Section 4.1.2 [9] on Page 4-47.

[8] Escaping from the interference check area [Ver. 1.4 or later]

For settings, refer to Section 4.1.2 [10] on Page 4-49.

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	

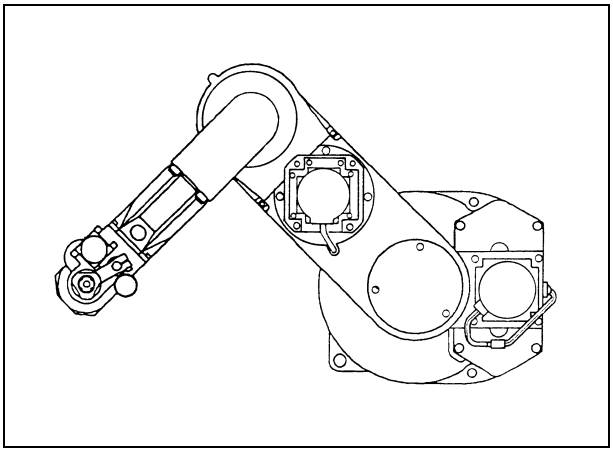


Figure 4-50. RIGHTY

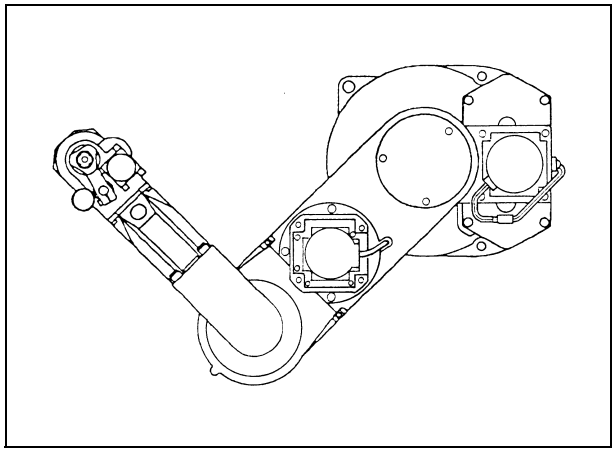


Figure 4-51. LEFTY

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 of the Teach Pendant

This chapter describes the variety of commands assigned to the function keys 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, operating panel, or mini pendant undergo any strong shocks, impacts, or vibrations.

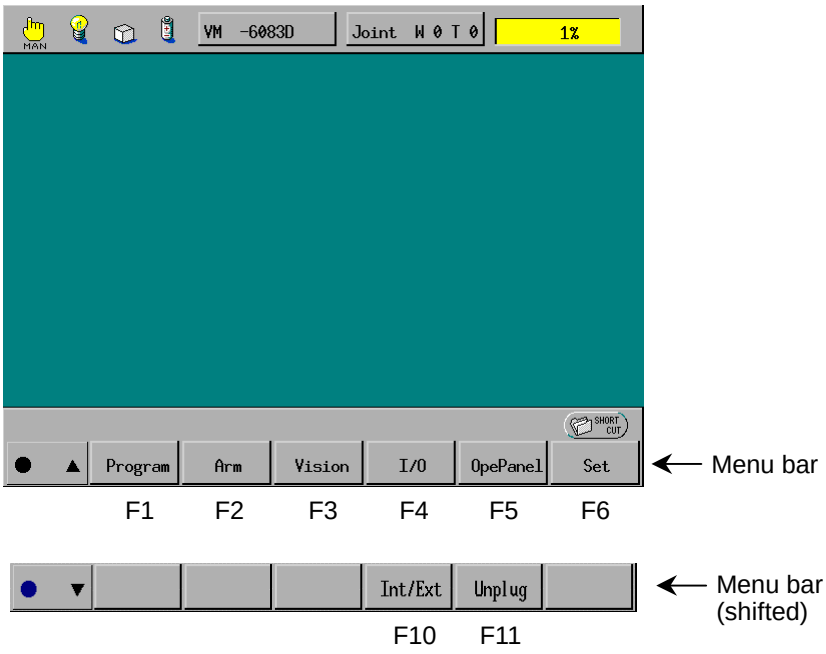
NOTE 2: Touch the teach pendant, operating panel, or mini pendant with your fingers only, never with the tip of a pen or any pointed object. Otherwise, the LCD may be broken.

5.1 Commands Menu

Using the keys, buttons, and switches on the 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.

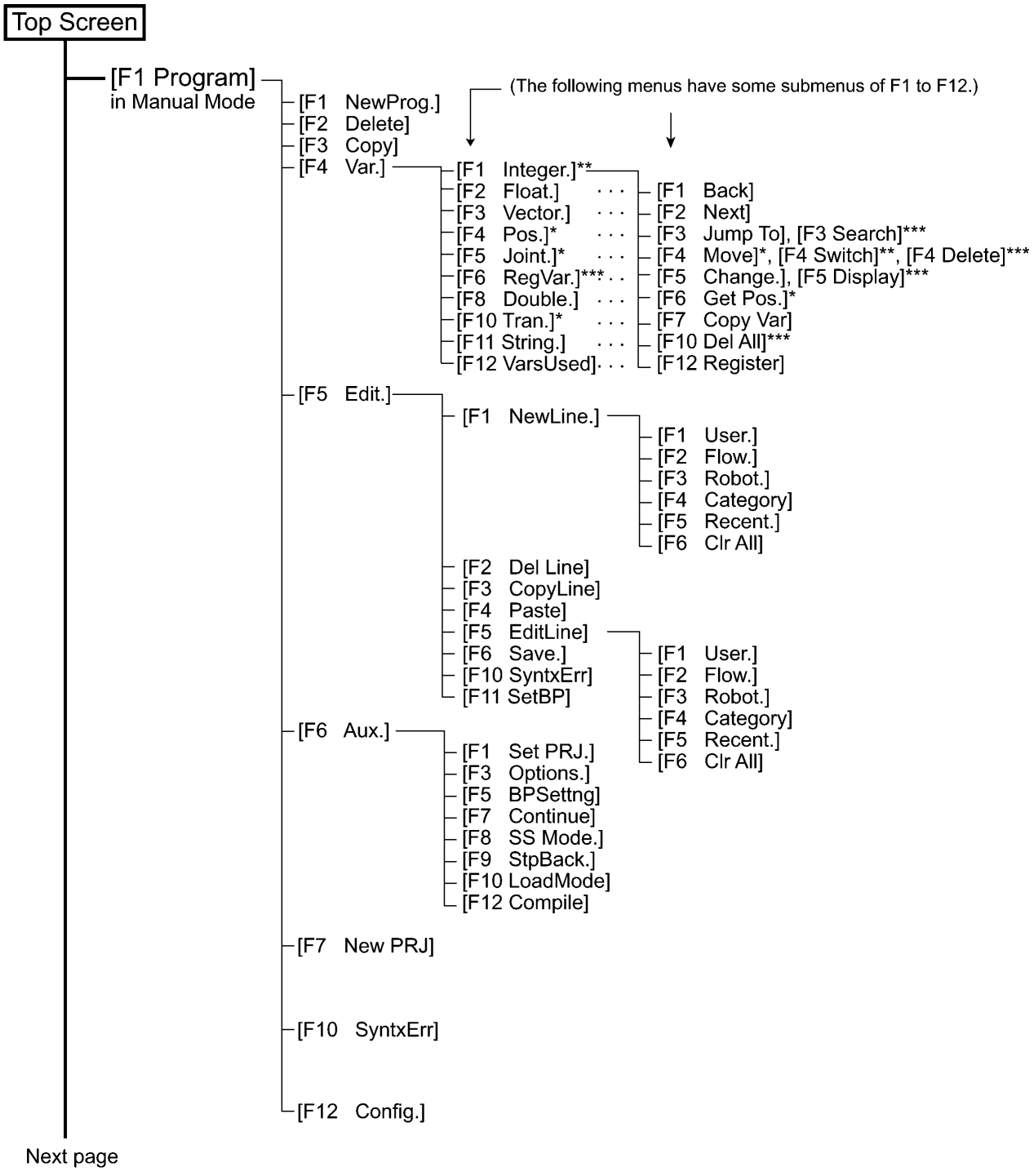
5.1.1 Top Screen

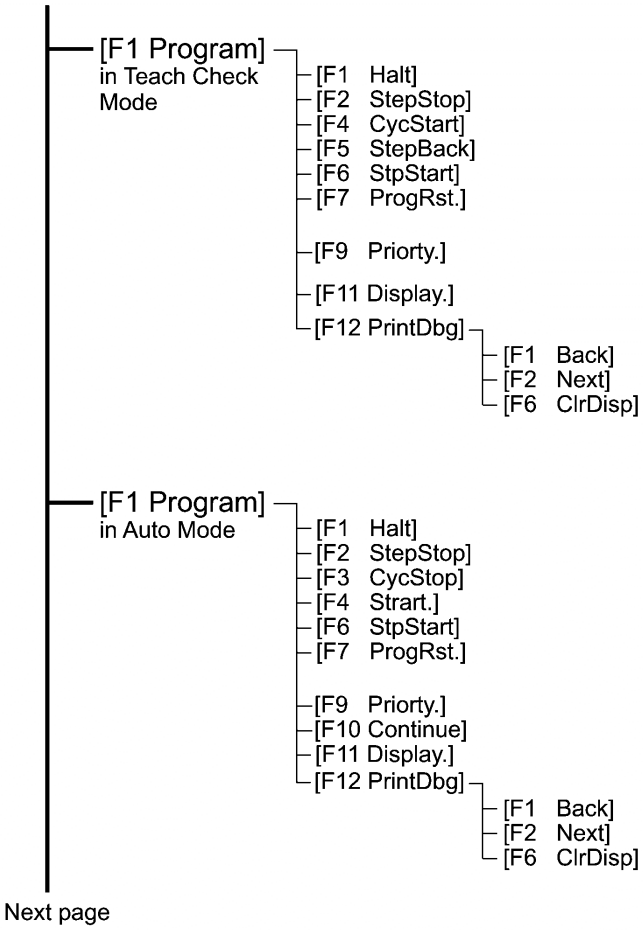
The top screen shown below appears first when you turn the robot controller on. Starting with this screen, you may access the function menu commands.



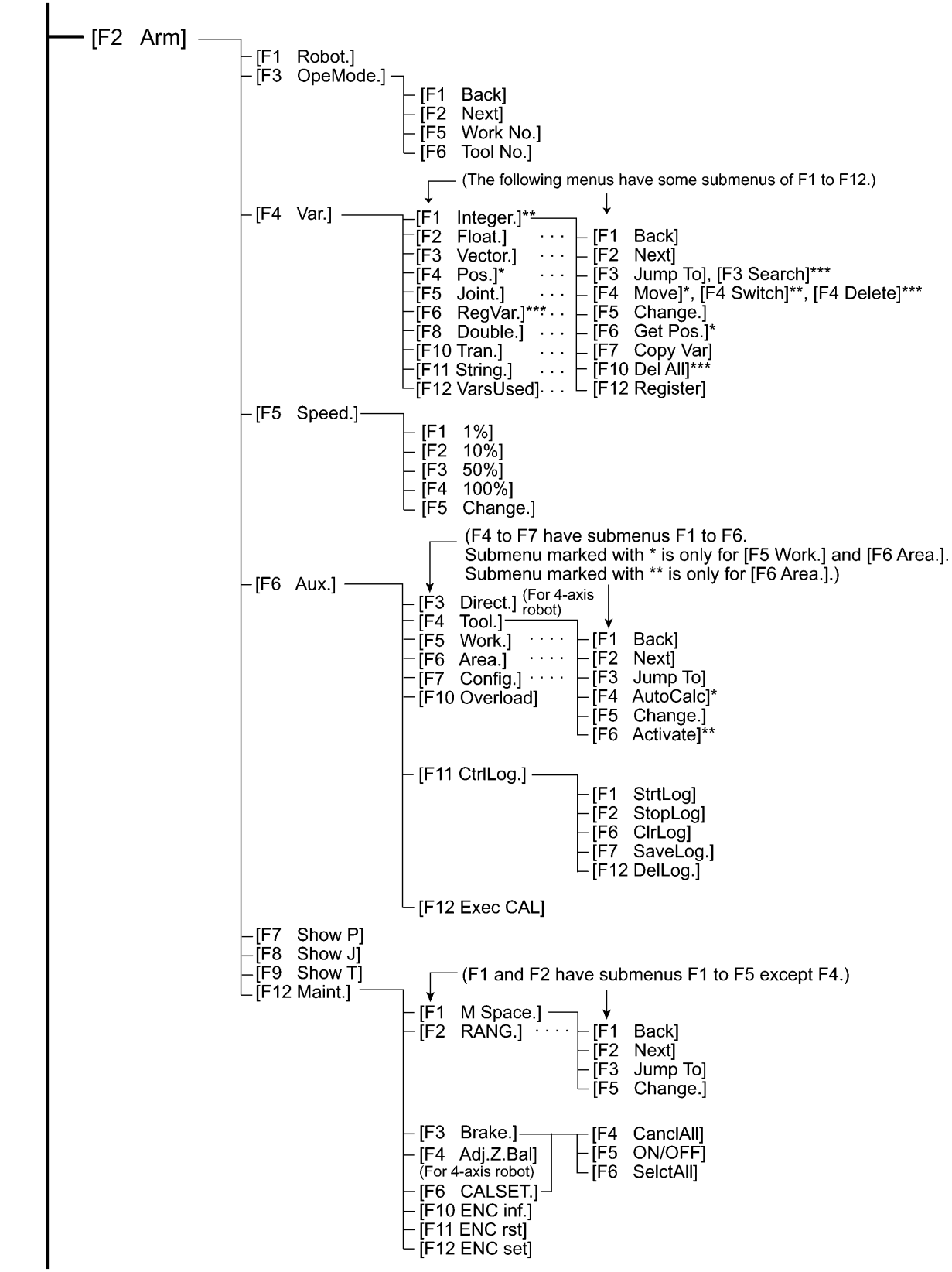
Menu on the Top Screen

5.1.2 Menu Tree

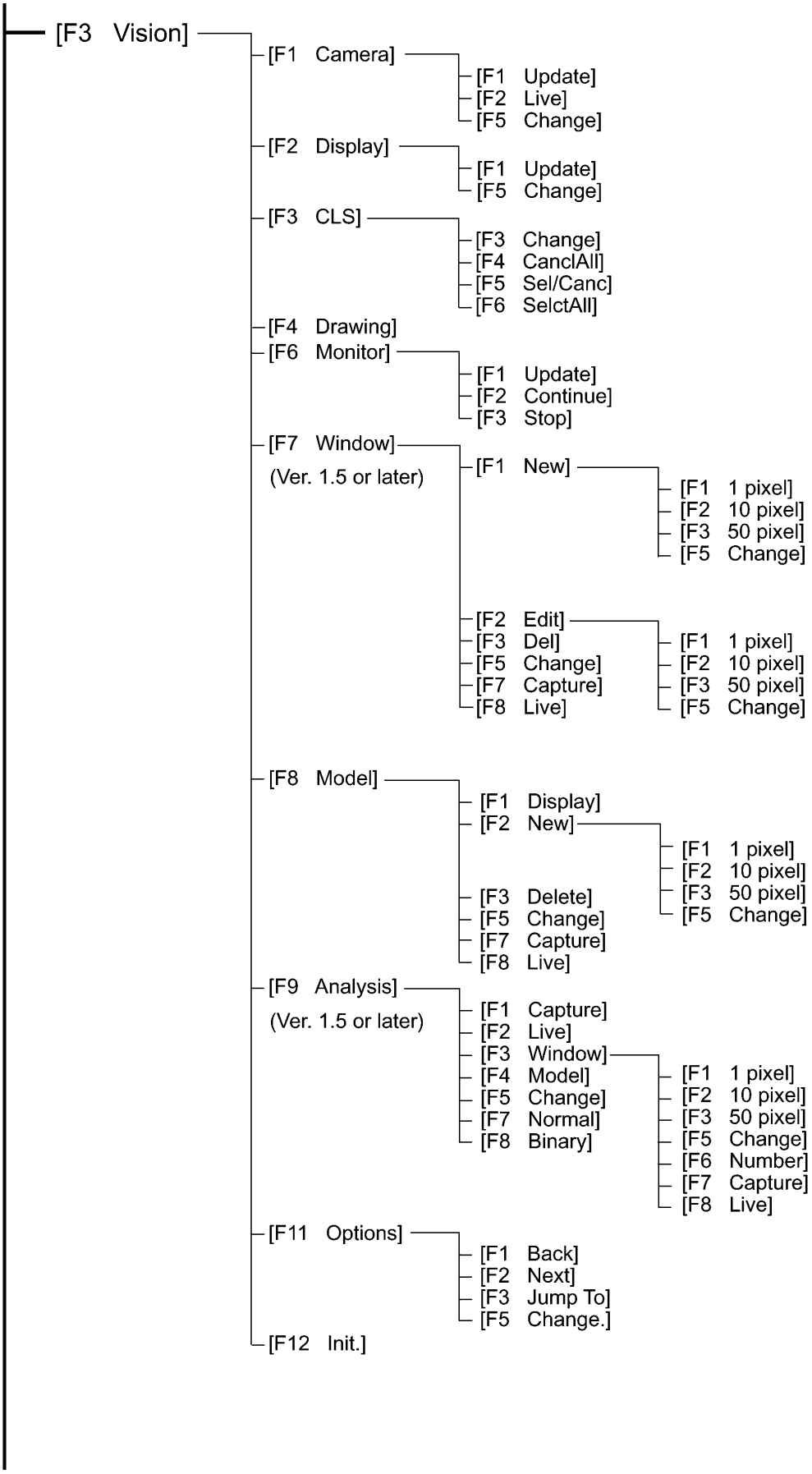



[F1 Program]
in Teach Check Mode
[F1 Halt]
[F2 StepStop]
[F4 CycStart]
[F5 StepBack]
[F6 StpStart]
[F7 ProgRst.]
[F9 Priorty.]
[F11 Display.]
[F12 PrintDbg]
[F1 Back]
[F2 Next]
[F6 ClrDisp]
[F1 Program]
in Auto Mode
[F1 Halt]
[F2 StepStop]
[F3 CycStop]
[F4 Strart.]
[F6 StpStart]
[F7 ProgRst.]
[F9 Priorty.]
[F10 Continue]
[F11 Display.]
[F12 PrintDbg]
[F1 Back]
[F2 Next]
[F6 ClrDisp]

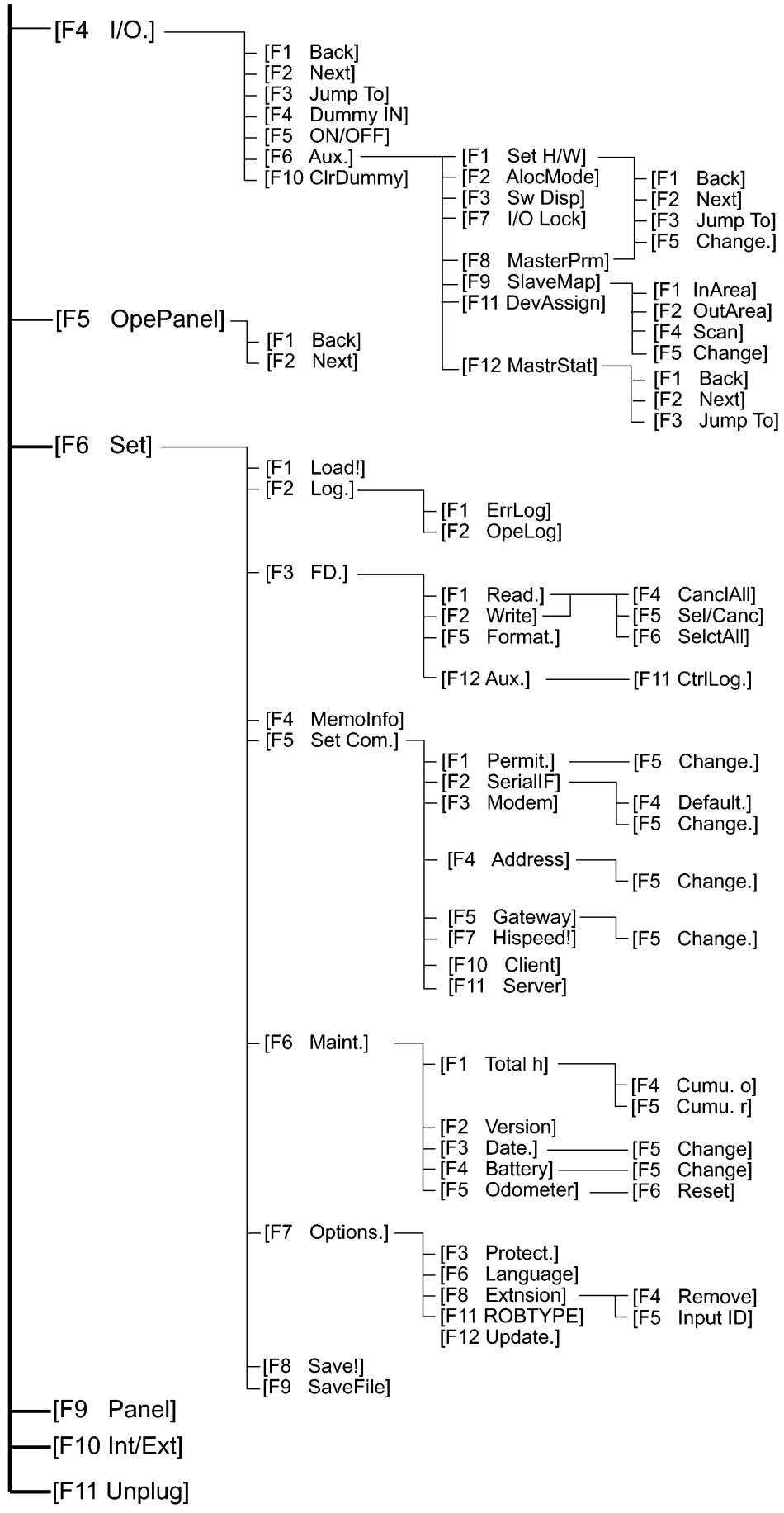
Next page


[F2 Arm]
[F1 Robot.]
[F3 OpeMode.]
[F1 Back]
[F2 Next]
[F5 Work No.]
[F6 Tool No.]
(The following menus have some submenus of F1 to F12.)
[F4 Var.]
[F1 Integer.]**
[F2 Float.]
[F3 Vector.]
[F4 Pos.]*
[F5 Joint.]
[F6 RegVar.]***
[F8 Double.]
[F10 Tran.]
[F11 String.]
[F12 VarsUsed]
[F1 Back]
[F2 Next]
[F3 Jump To], [F3 Search]***
[F4 Move]*, [F4 Switch]**, [F4 Delete]***
[F5 Change.]
[F6 Get Pos.]*
[F7 Copy Var]
[F10 Del All]***
[F12 Register]
[F5 Speed.]
[F1 1%]
[F2 10%]
[F3 50%]
[F4 100%]
[F5 Change.]
(F4 to F7 have submenus F1 to F6.
Submenu marked with * is only for [F5 Work.] and [F6 Area.].
Submenu marked with ** is only for [F6 Area.].)
[F6 Aux.]
[F3 Direct.]
[F4 Tool.]
(For 4-axis robot)
[F5 Work.]
[F6 Area.]
[F7 Config.]
[F10 Overload]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F4 AutoCalc]*
[F5 Change.]
[F6 Activate]**
[F11 CtrlLog.]
[F1 StrtLog]
[F2 StopLog]
[F6 ClrLog]
[F7 SaveLog.]
[F12 DelLog.]
[F12 Exec CAL]
[F7 Show P]
[F8 Show J]
[F9 Show T]
[F12 Maint.]
(F1 and F2 have submenus F1 to F5 except F4.)
[F1 M Space.]
[F2 RANG.]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]
[F3 Brake.]
[F4 Adj.Z.Bal]
(For 4-axis robot)
[F6 CALSET.]
[F10 ENC inf.]
[F11 ENC rst]
[F12 ENC set]
[F4 CanclAll]
[F5 ON/OFF]
[F6 SelctAll]

Next page


[F3 Vision]
[F1 Camera]
[F1 Update]
[F2 Live]
[F5 Change]
[F2 Display]
[F1 Update]
[F5 Change]
[F3 CLS]
[F3 Change]
[F4 CanclAll]
[F5 Sel/Canc]
[F6 SelctAll]
[F4 Drawing]
[F6 Monitor]
[F1 Update]
[F2 Continue]
[F3 Stop]
[F7 Window]
(Ver. 1.5 or later)
[F1 New]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F2 Edit]
[F3 Del]
[F5 Change]
[F7 Capture]
[F8 Live]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F8 Model]
[F1 Display]
[F2 New]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F3 Delete]
[F5 Change]
[F7 Capture]
[F8 Live]
[F9 Analysis]
(Ver. 1.5 or later)
[F1 Capture]
[F2 Live]
[F3 Window]
[F4 Model]
[F5 Change]
[F7 Normal]
[F8 Binary]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F6 Number]
[F7 Capture]
[F8 Live]
[F11 Options]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]
[F12 Init.]

Next page


[F4 I/O.]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F4 Dummy IN]
[F5 ON/OFF]
[F6 Aux.]
[F10 ClrDummy]
[F1 Set H/W]
[F2 AlocMode]
[F3 Sw Disp]
[F7 I/O Lock]
[F8 MasterPrm]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]
[F9 SlaveMap]
[F11 DevAssign]
[F1 InArea]
[F2 OutArea]
[F4 Scan]
[F5 Change]
[F12 MastrStat]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 OpePanel]
[F1 Back]
[F2 Next]
[F6 Set]
[F1 Load!]
[F2 Log.]
[F1 ErrLog]
[F2 OpeLog]
[F3 FD.]
[F1 Read.]
[F2 Write]
[F5 Format.]
[F4 CanclAll]
[F5 Sel/Canc]
[F6 SelctAll]
[F12 Aux.]
[F11 CtrlLog.]
[F4 MemoInfo]
[F5 Set Com.]
[F1 Permit.]
[F5 Change.]
[F2 SerialIF]
[F3 Modem]
[F4 Default.]
[F5 Change.]
[F4 Address]
[F5 Change.]
[F5 Gateway]
[F7 Hispeed!]
[F5 Change.]
[F10 Client]
[F11 Server]
[F6 Maint.]
[F1 Total h]
[F4 Cumu. o]
[F5 Cumu. r]
[F2 Version]
[F3 Date.]
[F5 Change]
[F4 Battery]
[F5 Change]
[F5 Odometer]
[F6 Reset]
[F7 Options.]
[F3 Protect.]
[F6 Language]
[F8 Extnsion]
[F4 Remove]
[F5 Input ID]
[F11 ROBTYPE]
[F12 Update.]
[F8 Save!]
[F9 SaveFile]
[F9 Panel]
[F10 Int/Ext]
[F11 Unplug]

5.2 Displaying the Program List Window

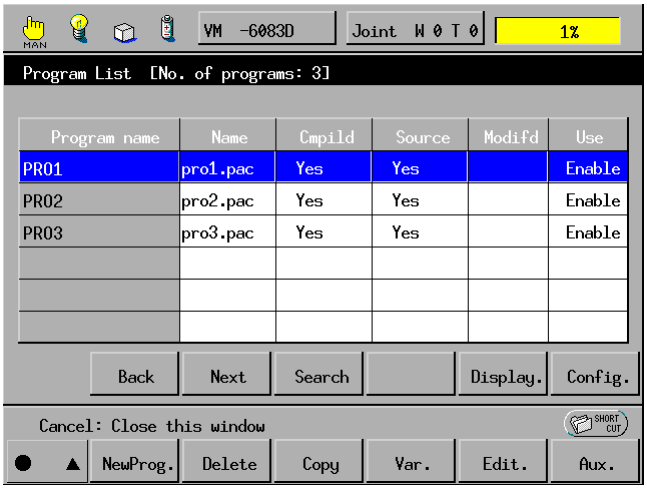
Access: [F1 Program]

The [F1 Program] command on the top screen has different three menu hierarchies for Manual, Teach Check, and Auto modes as shown in Subsection 5.1.2.

Subsections 5.2.1, 5.2.2, and 5.2.3 describe the function of the [F1 Program] command in Manual, Teach Check, and Auto modes, respectively.

5.2.1 Showing the Program List Window in Manual Mode

Pressing [F1 Program] on the top screen in Manual 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.

[Name] Shows the source file name of the listed program. The [Name] and [Program Name] are not always coincident with each other.

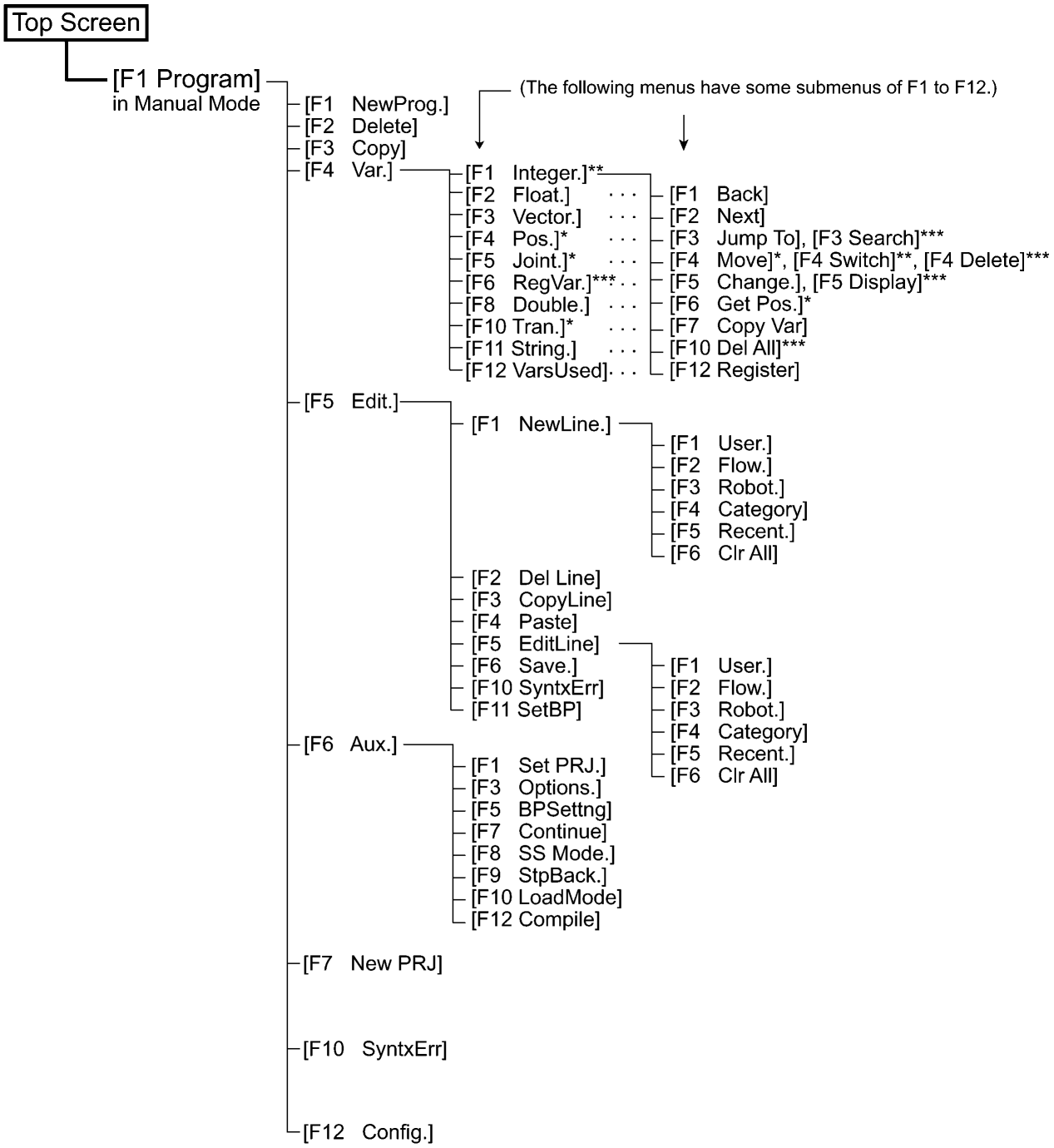
[Cmpild] Shows whether the listed file has been compiled into run-time format. PAC files are usually compiled.

[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 WINCAPSII 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 [F12 Config.] and make the compile flag active, this column will display "Enable" and the program will be compiled in compilation.

The hierarchy of the [F1 Program] menu in Manual mode is given on the next page.

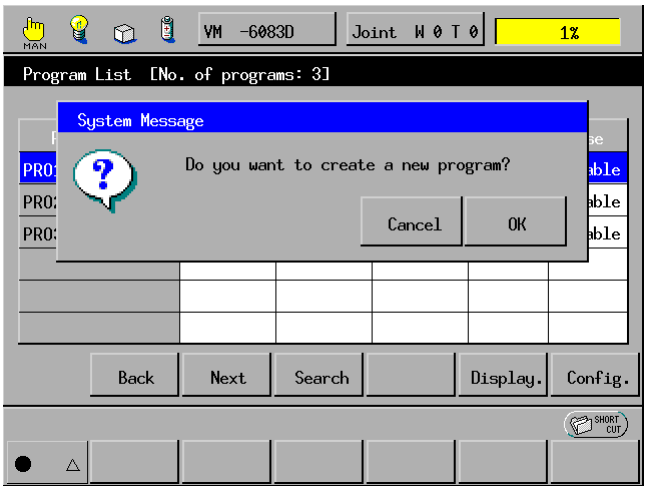

Top Screen
[F1 Program]
in Manual Mode
(The following menus have some submenus of F1 to F12.)
[F1 NewProg.]
[F2 Delete]
[F3 Copy]
[F4 Var.]
[F1 Integer.]**
[F2 Float.]
[F3 Vector.]
[F4 Pos.]*
[F5 Joint.]*
[F6 RegVar.]***
[F8 Double.]
[F10 Tran.]*
[F11 String.]
[F12 VarsUsed]
[F1 Back]
[F2 Next]
[F3 Jump To], [F3 Search]***
[F4 Move]*, [F4 Switch]**, [F4 Delete]***
[F5 Change.], [F5 Display]***
[F6 Get Pos.]*
[F7 Copy Var]
[F10 Del All]***
[F12 Register]
[F5 Edit.]
[F1 NewLine.]
[F1 User.]
[F2 Flow.]
[F3 Robot.]
[F4 Category]
[F5 Recent.]
[F6 Clr All]
[F2 Del Line]
[F3 CopyLine]
[F4 Paste]
[F5 EditLine]
[F6 Save.]
[F10 SyntxErr]
[F11 SetBP]
[F1 User.]
[F2 Flow.]
[F3 Robot.]
[F4 Category]
[F5 Recent.]
[F6 Clr All]
[F6 Aux.]
[F1 Set PRJ.]
[F3 Options.]
[F5 BPSettng]
[F7 Continue]
[F8 SS Mode.]
[F9 StpBack.]
[F10 LoadMode]
[F12 Compile]
[F7 New PRJ]
[F10 SyntxErr]
[F12 Config.]

Creating a new program in Manual mode

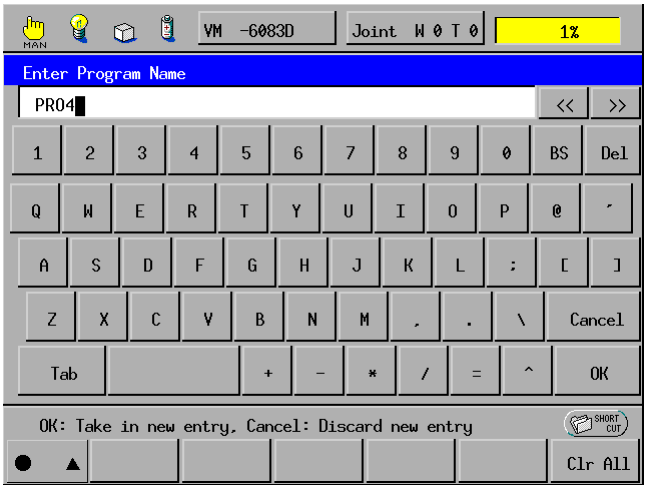
Access: [F1 Program]—[F1 NewProg.]

Creates a new program.

(1) Press [F1 NewProg.] in the Program List window, and the system message dialog box will appear as shown below.

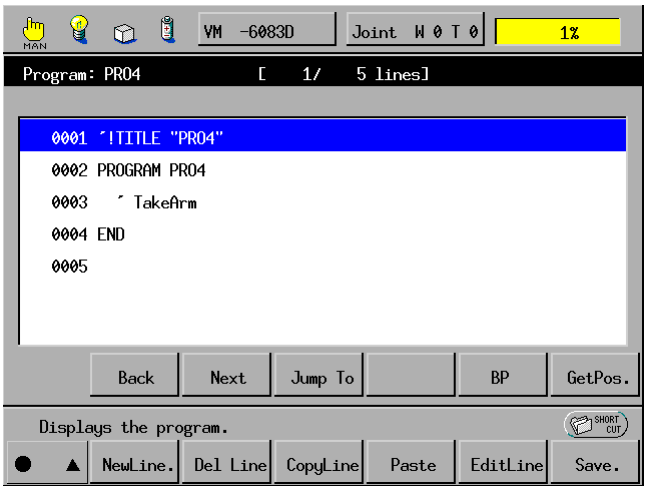


(2) Press the OK button in the system message dialog box to proceed, and the Enter Program Name window will appear as shown below.



(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.

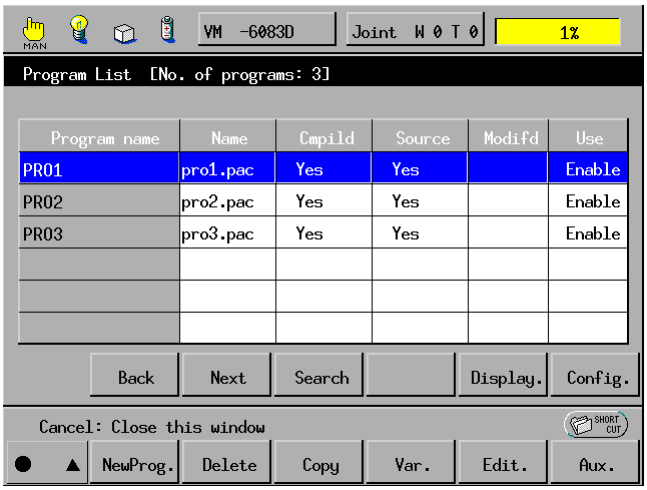


Deleting a program in Manual mode

Access: [F1 Program]—[F2 Delete]

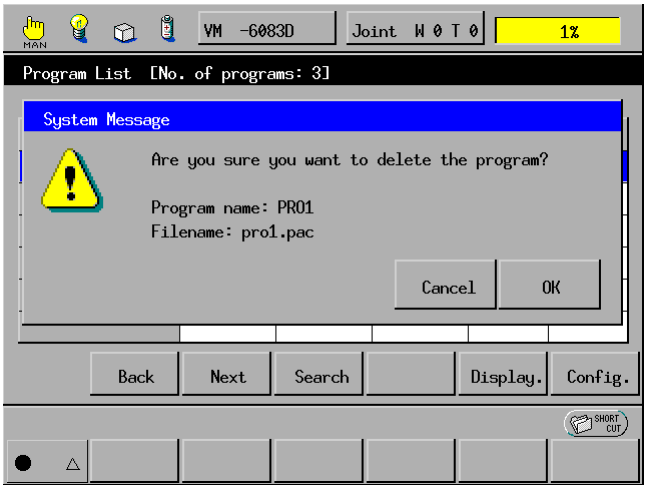
Deletes an existing program selected in the Program List window.

(1) In the Program List window, select the program to be deleted.



F2

(2) Press [F2 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.

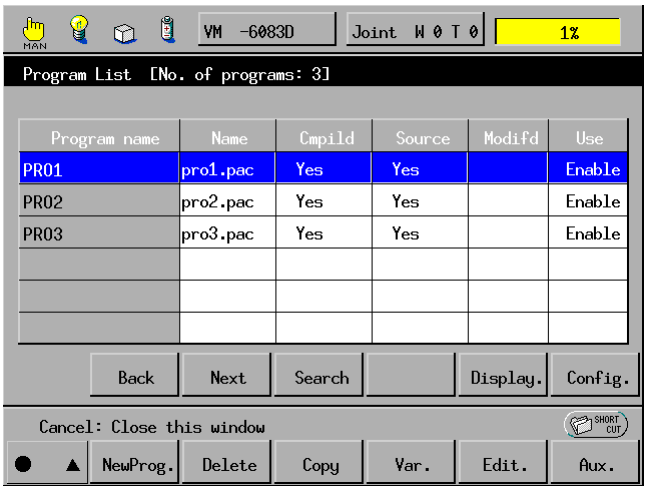
If you press the Cancel button, the program deletion will be cancelled and the screen will return to the Program List window.

Copying a program in Manual mode

Access: [F1 Program]—[F3 Copy]

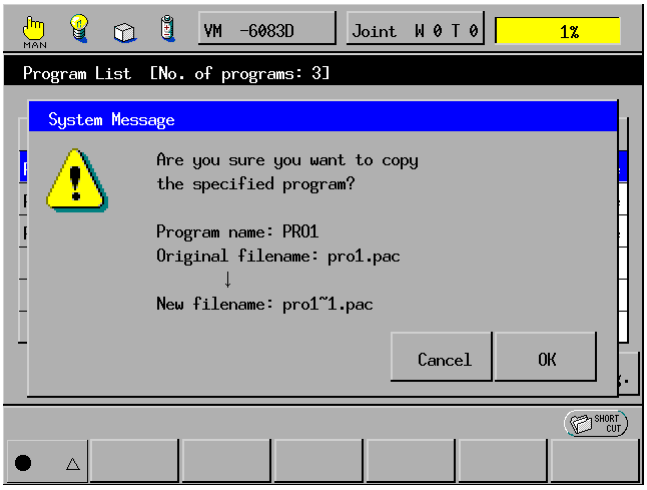
Copies an existing program selected in the Program List window.

(1) In the Program List window, select the program to be copied.



F3

(2) Press [F3 Copy], and the system message dialog box will appear as shown below.



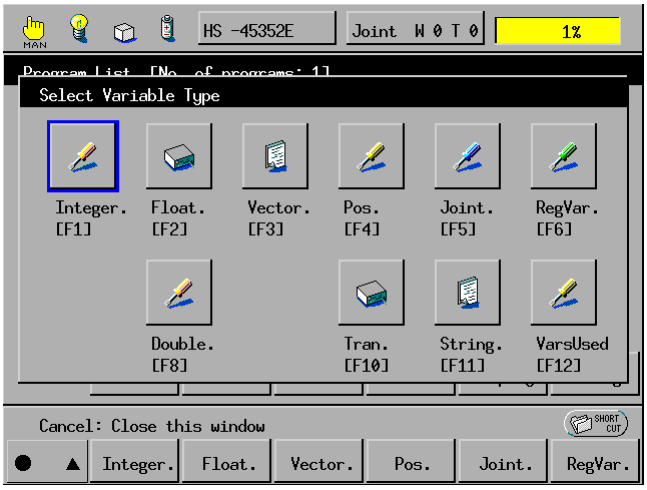
(3) Press the OK button to copy the selected program file. The system will automatically name the new file.

Displaying and modifying variable values in Manual mode

Access: [F1 Program]—[F4 Var.]

Displays values assigned to various types of variables, the number of variables used, and/or modifies them.

(1) Press [F4 Var.] in the Program List window, and the Select Variable Type window will appear as shown below.



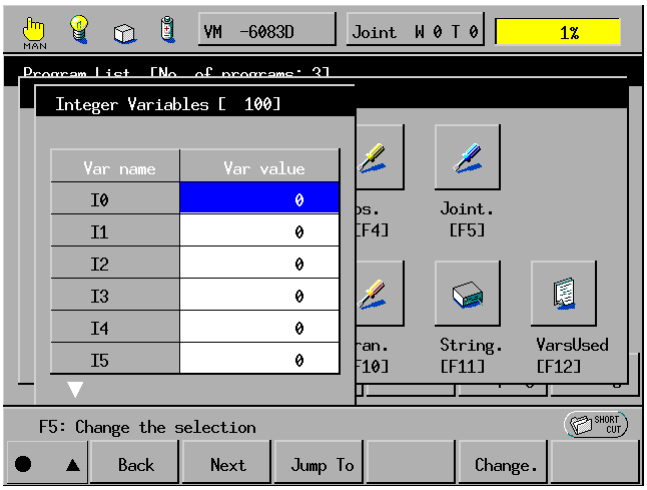
(2) Select the desired variable type or the number of variables used. The corresponding window will display as described on pages 5-15 through 5-25.

Displaying and modifying integer variable values

Access: [F1 Program]—[F4 Var.]—[F1 Integer.]

Displays values assigned to integer variables and/or modifies them.

Pressing [F1 Integer.] will display the Integer Variables window as shown below.



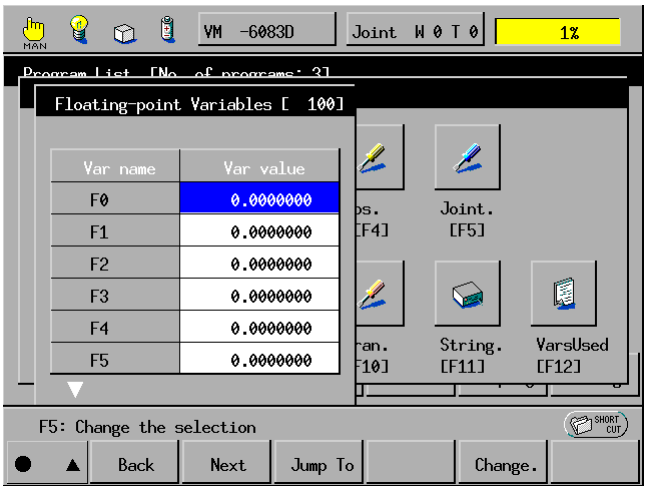
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F5 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.
[F7 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 floating-point variable values

Access: [F1 Program]—[F4 Var.]—[F2 Float.]

Displays values assigned to floating-point variables and/or modifies them.

Pressing [F2 Float.] will display the Floating-point Variables window as shown below.



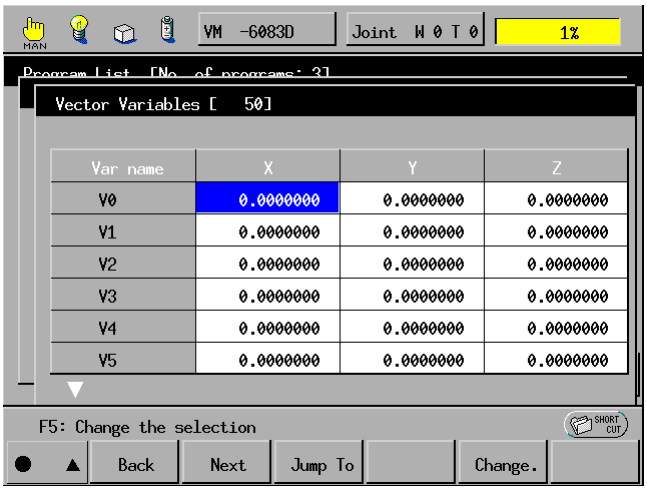
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F5 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.
[F7 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: [F1 Program]—[F4 Var.]—[F3 Vector.]

Displays values assigned to vector variables and/or modifies them.

Pressing [F3 Vector.] will display the Vector Variables window as shown below.



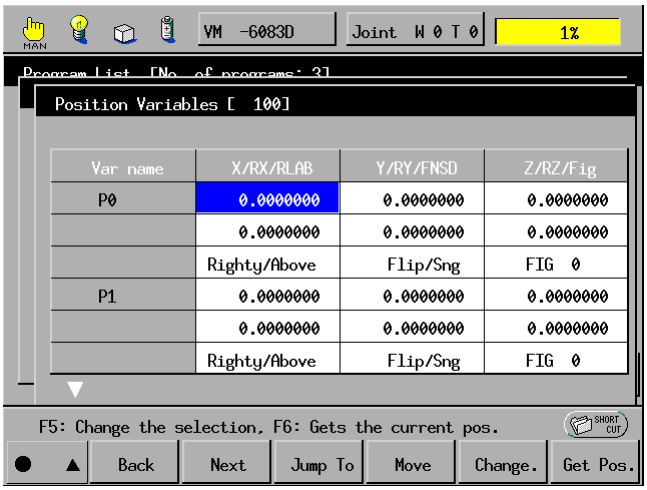
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F5 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.
[F7 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: [F1 Program]—[F4 Var.]—[F4 Pos.]

Displays values assigned to position variables and/or modifies them.

Pressing [F4 Pos.] will display the Position Variables window as shown below.



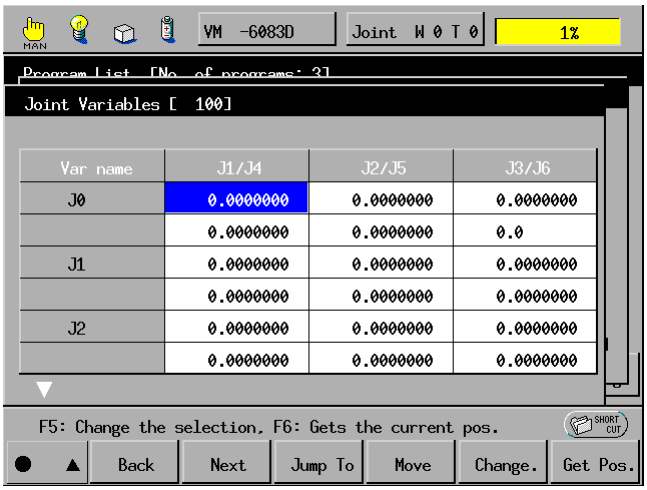
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F4 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.
[F5 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.
[F6 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.
[F7 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: [F1 Program]—[F4 Var.]—[F5 Joint.]

Displays values assigned to joint variables and/or modifies them.

Pressing [F5 Joint.] will display the Joint Variables window as shown below.



Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 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.
[F4 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.
[F5 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.
[F6 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.
[F7 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.

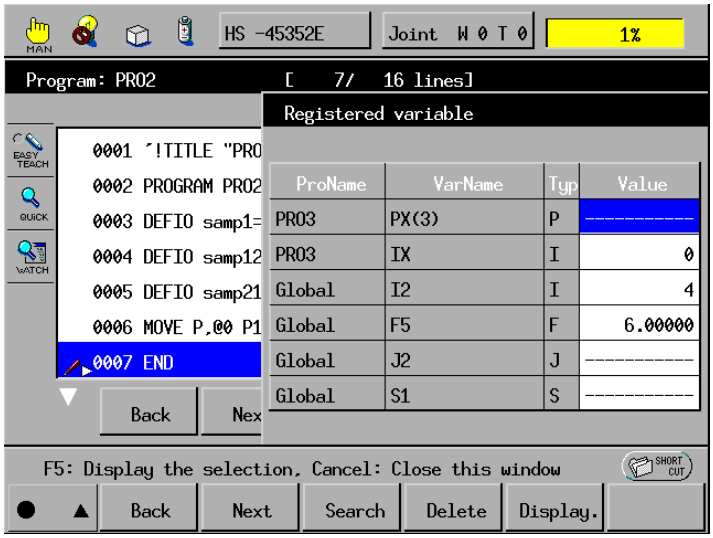
Displaying registered variable list [Ver1.9 or later]

Access: [F1 Program]—[F4 Var.]—[F6 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 [F6 RegVar.] in the Select Variable Type window. The Registered variable list window will appear as shown below.



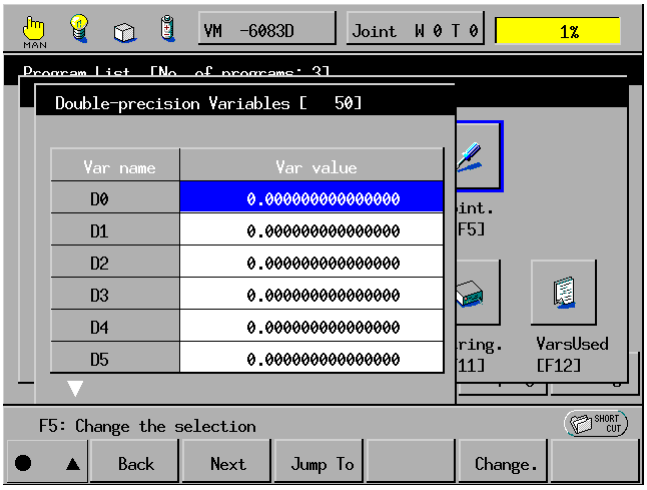
For details, refer to “3.4.8 Local Variable-Related Enhancement “.

Displaying and modifying double-precision variable values

Access: [F1 Program]—[F4 Var.]—[F8 Double.]

Displays values assigned to double-precision variables and/or modifies them.

Pressing [F8 Double.] will display the Double-precision Variables window as shown below.



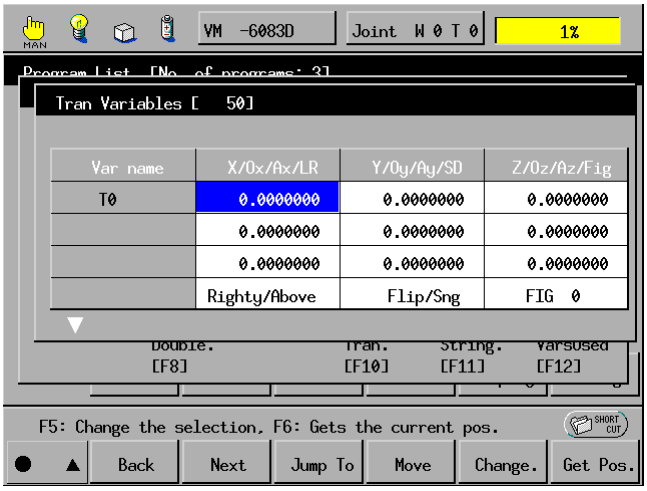
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F5 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.
[F7 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: [F1 Program]—[F4 Var.]—[F10 Tran.]

Displays values assigned to variables in homogeneous transform matrix and/or modifies them.

Pressing [F10 Tran.] will display the Tran Variables window as shown below.



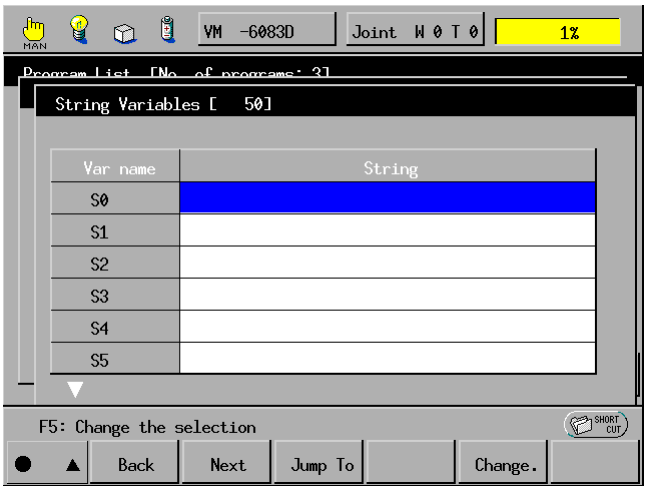
Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 Jump To]	Displays the Jump To Variable Number window where you may type a variable name you want to see with the numerical keys and press OK. Doing so will display the target variable name.
[F4 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.
[F5 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.
[F6 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.
[F7 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: [F1 Program]—[F4 Var.]—[F11 String.]

Displays values assigned to string variables and/or modifies them.

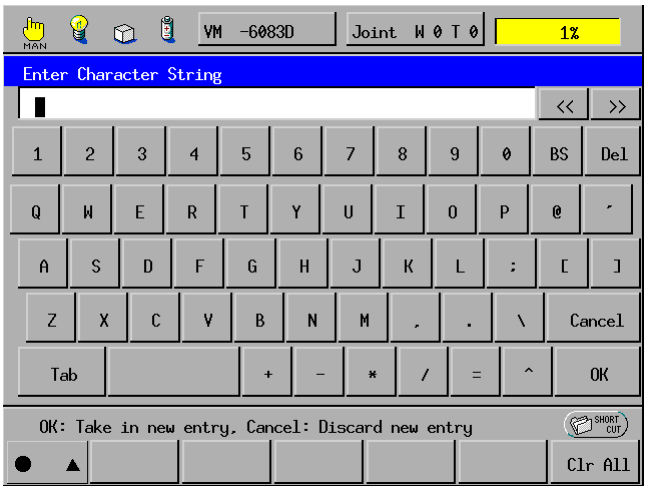
Pressing [F11 String.] will display the String Variables window as shown below.



Function keys available	
[F1 Back]	Displays the previous page of the variables list.
[F2 Next]	Displays the next page of the variables list.
[F3 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.
[F5 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.
[F7 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 [F5 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.

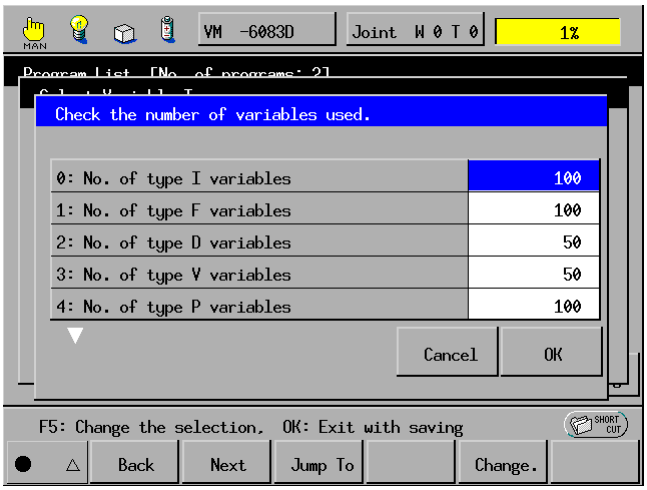


Displaying and modifying the number of variables used

Access: [F1 Program]—[F4 Var.]—[F12 VarsUsed.]

Displays the number of variables used for each type of variables and/or modifies them.

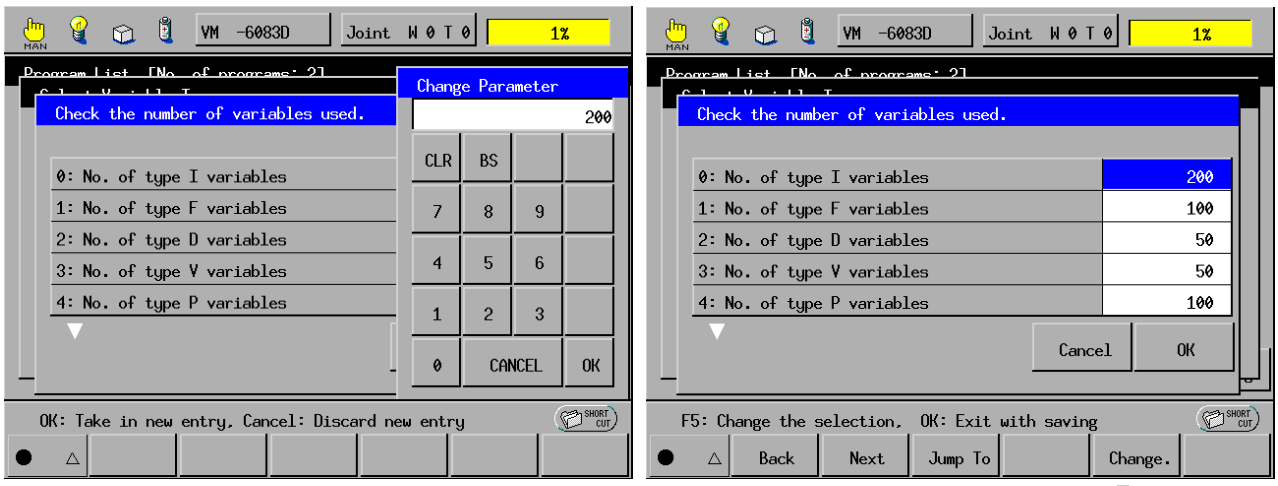
(1) Press [F12 VarsUsed.] to display the following window.



F5

(2) Select the item whose number of variables you want to change, then press [F5 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.

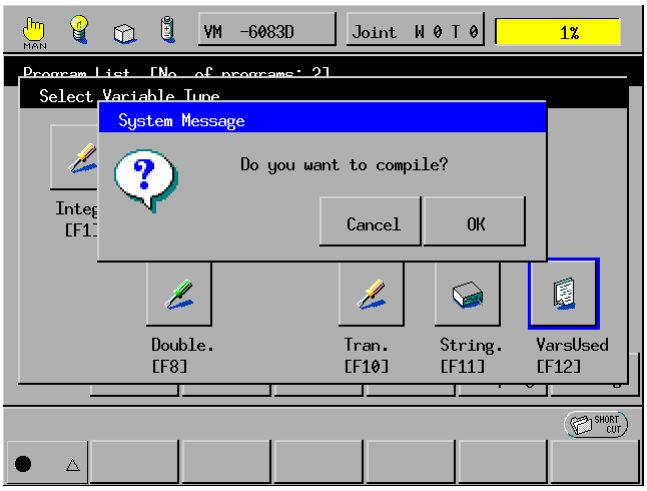


F5

(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 WINCAPS.

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.

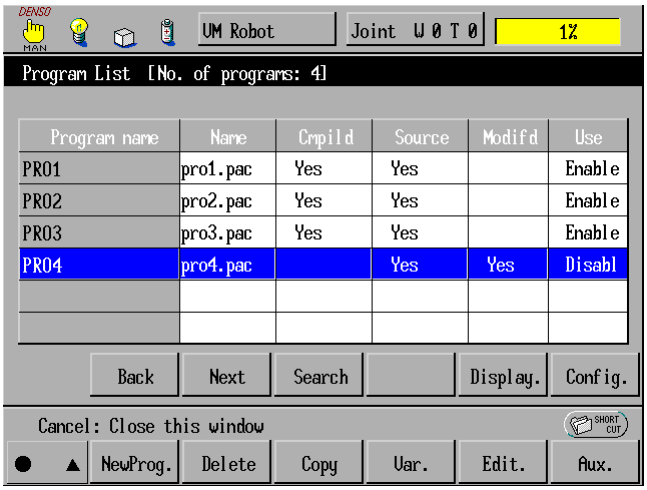
d) Return the back-up variables to the controller.

Editing a program in Manual Mode

Access: [F1 Program]—[F5 Edit.]

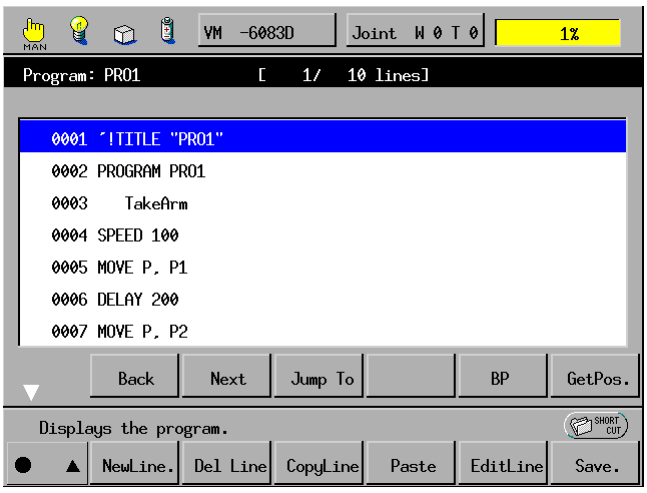
Edits a program you select in the Program List window.

(1) Select the program to be edited.



F5

(2) Press [F5 Edit.], and the program edit window of the selected program will appear as shown below.



F1 F2 F3 F4 (F10) F5 F6

(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 pages 5-27 through 5-33.

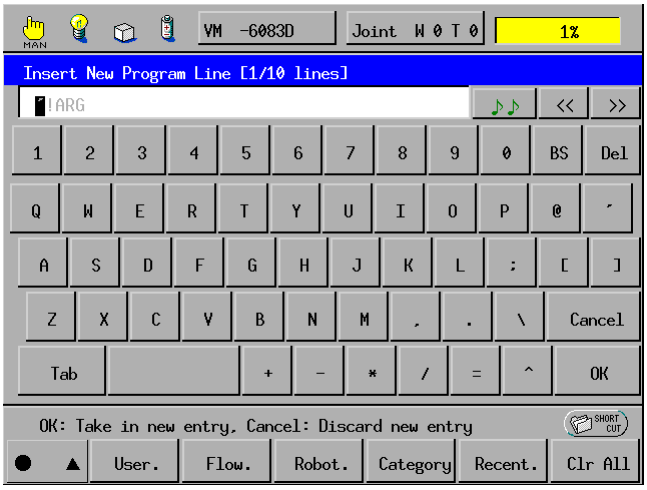
Inserting a new program line in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F1 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 [F1 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 [F6 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, F6: Save the modification"

Function keys available	
[F1 User.]	Shortcut to the favorite command window (that can be called up by choosing the “Favorites” on the Category Selection window).
[F2 Flow.]	Shortcut to the flow control statement screen (that can be called up by choosing the “Flow control statement” on the Category Selection window).
[F3 Robot.]	Shortcut to the robot control statement screen (that can be called up by choosing the “Robot control statement” on the Category Selection window).
[F4 Category]	Displays the Category Selection window.
[F5 Recent.]	Shortcut to a list of commands in the most recently selected category.
[F6 ClrAll]	Clears all characters being entered.

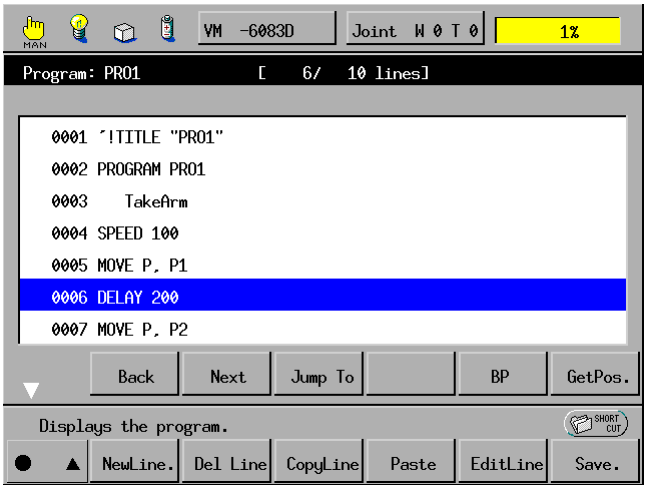
Deleting a program line in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F2 Del Line]

Deletes the program line you select in the program edit window.

(1) Select the program line that you want to delete.

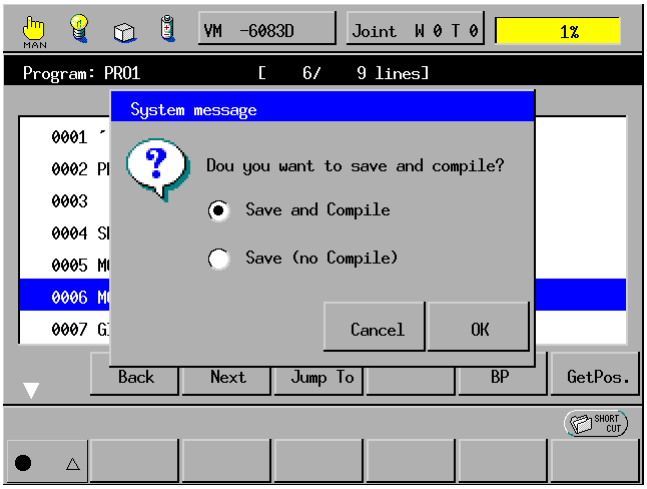
(2) Press [F2 Del Line] in the program edit window, and the selected line will be erased.



F6

(3) Press [F6 Save.].

The system message "Do you want to save and compile?" appears.



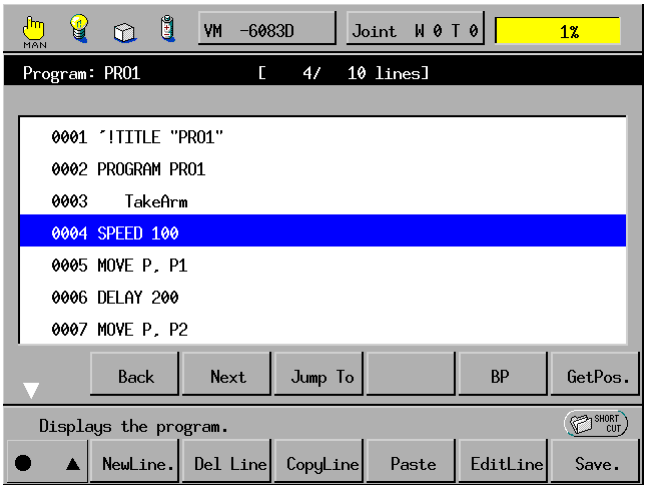
(4) Select whether to compile or not, then press the OK button.

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, F6: Save the modification"

Copying a program line in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F3 CopyLine]

Copies the program line selected in the program edit window (shown below), into the memory. The copied data will be used when [F4 Paste] command will execute.



F3

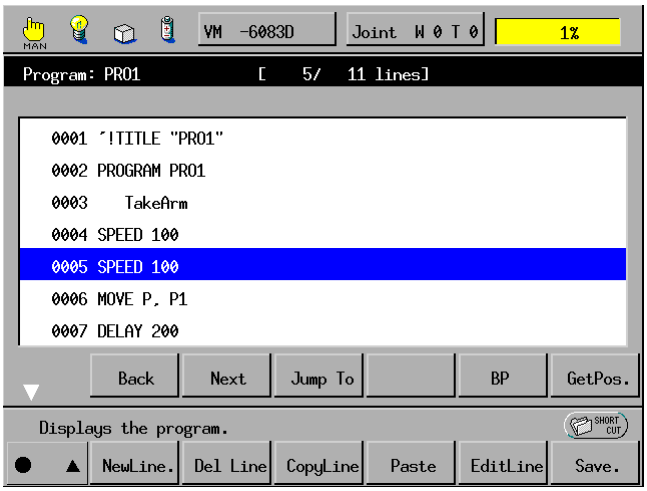
Pasting a program line in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F4 Paste]

Pastes the program line (that you copied with [F3 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 [F4 Paste].



F4

(3) Press [F6 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, F6: Save the modification"

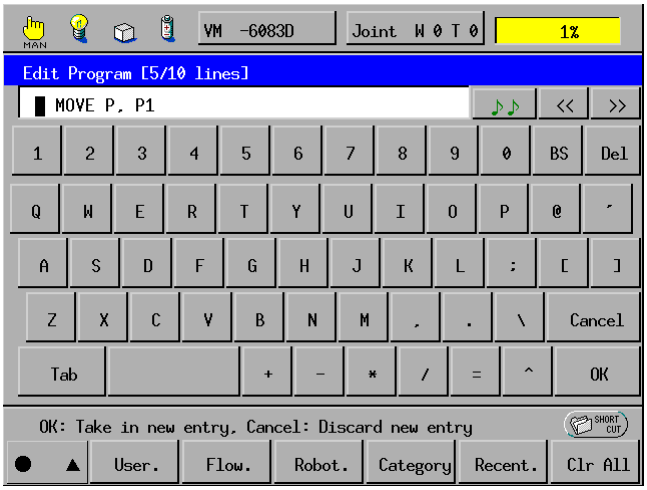
Editing a line of program code in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F5 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 [F5 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 [F6 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, F6: Save the modification"

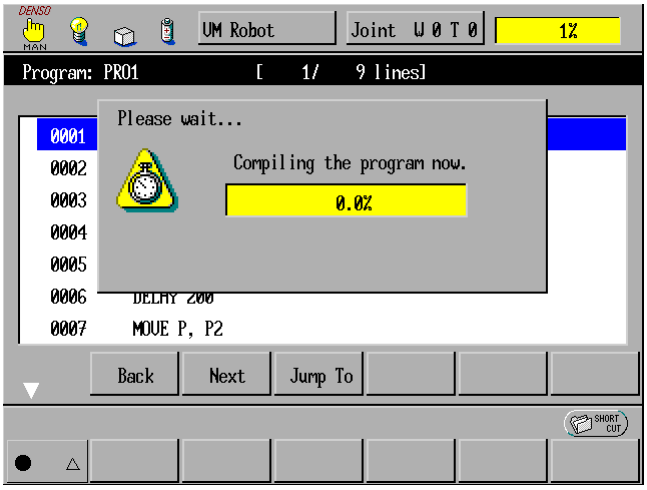
Function keys available	
[F1 User.]	Shortcut to the favorite command window (that can be called up by choosing the “Favorites” on the Category Selection window).
[F2 Flow.]	Shortcut to the flow control statement screen (that can be called up by choosing the “Flow control statement” on the Category Selection window).
[F3 Robot.]	Shortcut to the robot control statement screen (that can be called up by choosing the “Robot control statement” on the Category Selection window).
[F4 Category]	Displays the Category Selection window.
[F5 Recent.]	Shortcut to a list of commands in the most recently selected category.
[F6 ClrAll]	Clears all characters being entered.

Saving and compiling an edited program in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F6 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.

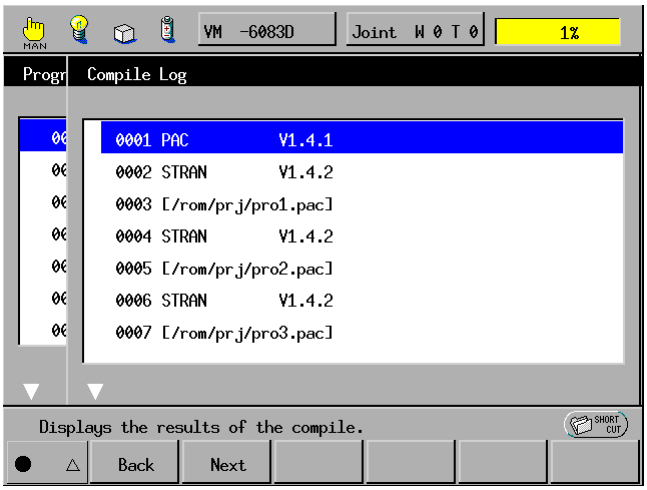
You may check anytime a compile log, by pressing [F1 Program]—[F10 SyntxErr] in Manual mode.

Displaying a compile log in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F10 SyntxErr]

Displays the compile log as shown below.

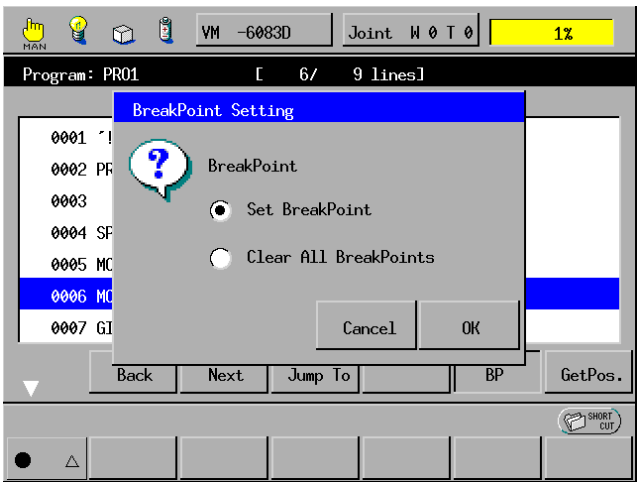
The compile log is useful when you correct syntax errors in programming. You must correct the program until no syntax errors are detected.



Setting a break point(s) in Manual mode

Access: [F1 Program]—[F5 Edit.]—[F11 SetBP]

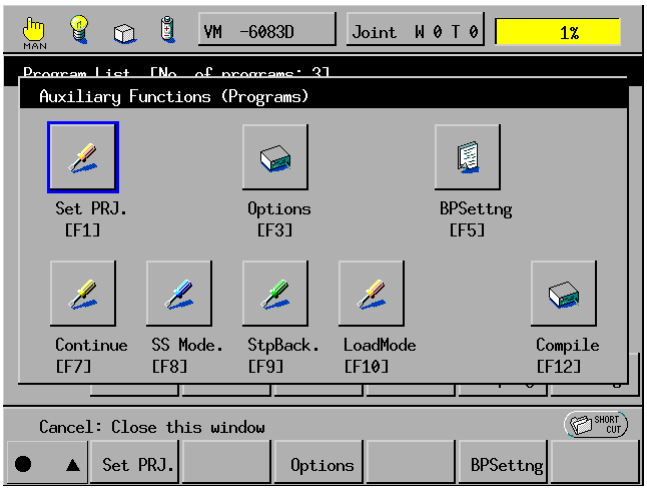
Sets a break point(s) at a desired program step(s). If the set break point is encountered during execution of program, the program will immediately stop.



Providing auxiliary functions in Manual mode

Access: [F1 Program]—[F6 Aux.]

Provides the following auxiliary functions for project editing.



F1 F3

When shifted

F7 F8 F9 F10 F12

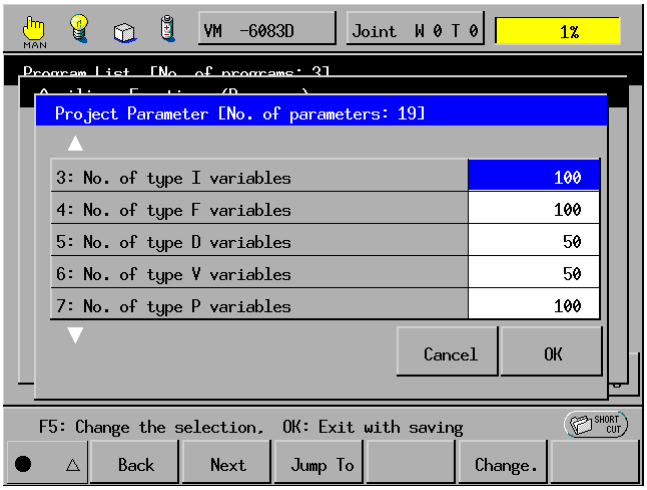
Setting project parameters in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F1 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, Appendix 4, "Using Condition Parameters."

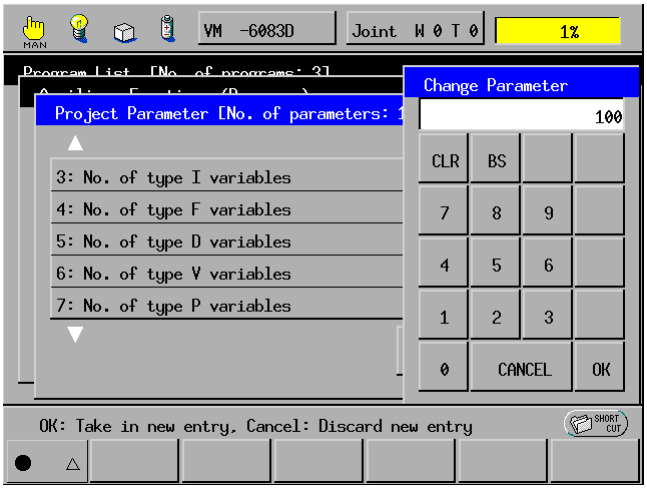
(1) Press [F1 Set PRJ.] in the Auxiliary Functions (Programs) window. The Project Parameter window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

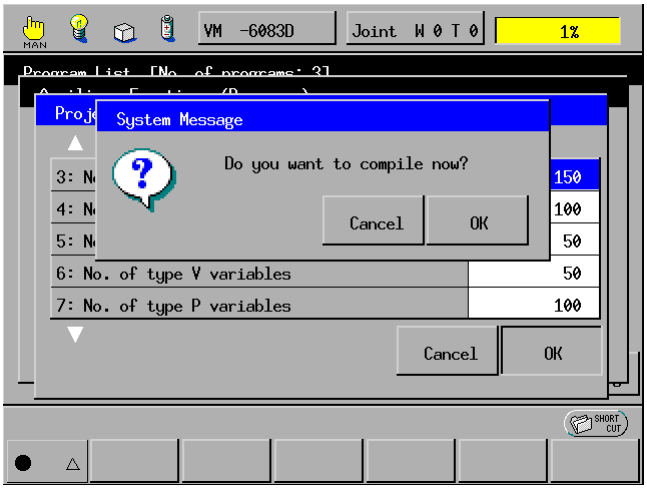
(4) Check the new settings. If they are satisfactory, press the OK button, and the system message dialog box will appear as shown below.

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.



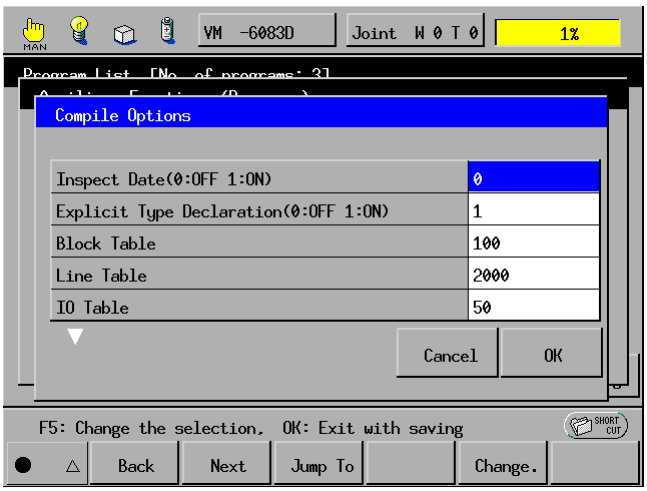
Setting compiling options in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F3 Options.]

Sets the compiling options.

For details about compiling options, refer to the WINCAPSII Guide, Chapter 5, Subsection 5.6.1.3, "Compiler."

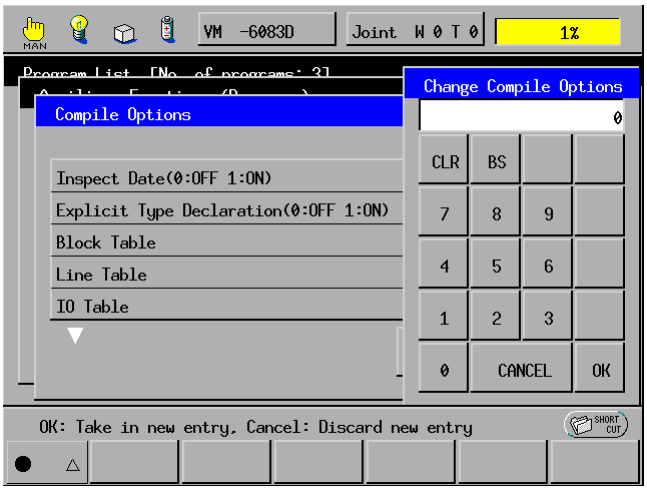
(1) Press [F3 Options] in the Auxiliary Functions (Programs) window. The Compile Options window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

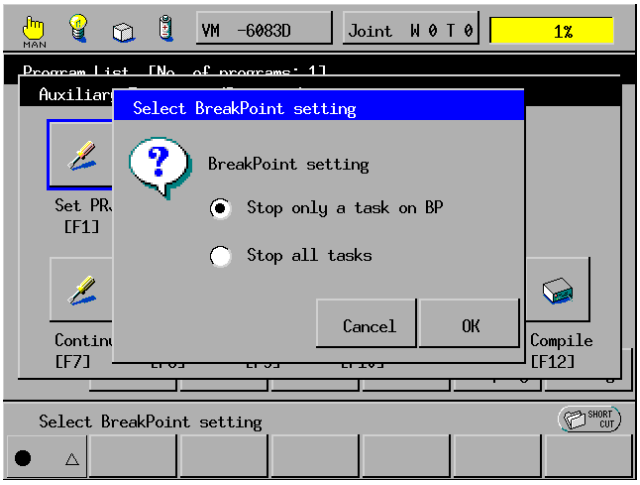
Setting the break point stop mode in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F5 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 [F5 BP Settng] in the Auxiliary Functions (Programs) window. The Select BreakPoint Setting window will appear as shown below.



(2) Select the desired option.

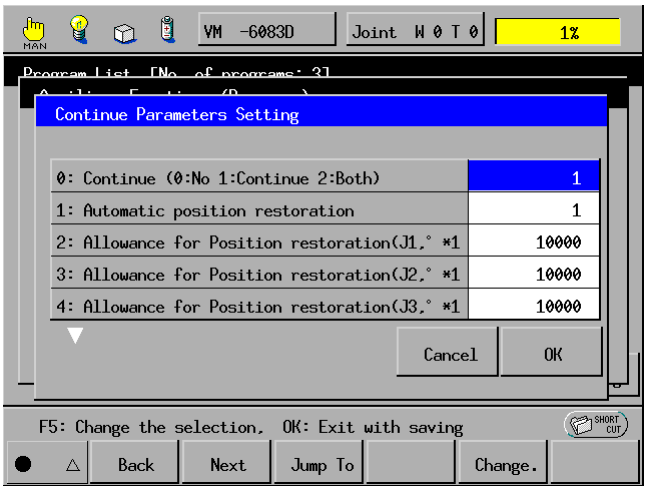
(3) Press the OK button to make the new setting effective. To cancel it, press the Cancel button.

Setting the resume-related parameters in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F7 Continue]

Sets the resume-related parameters for Continue Start.

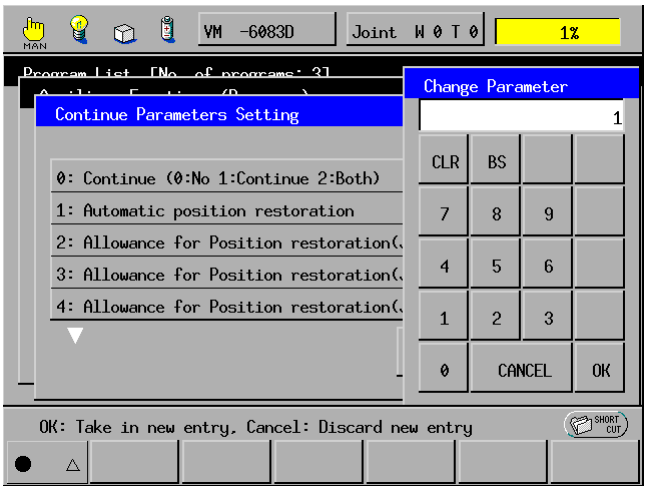
(1) Press [F7 Continue] in the Auxiliary Functions (Programs) window. The Continue Parameters Setting window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

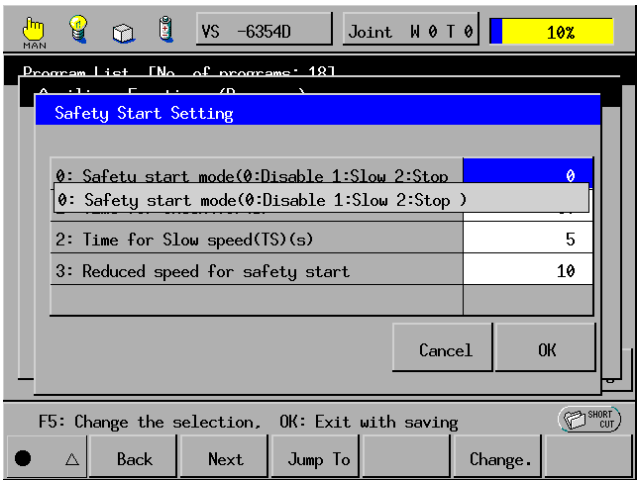
(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.

Setting the safe start related parameters in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F8 SS Mode.]

Sets the safe start related parameters.

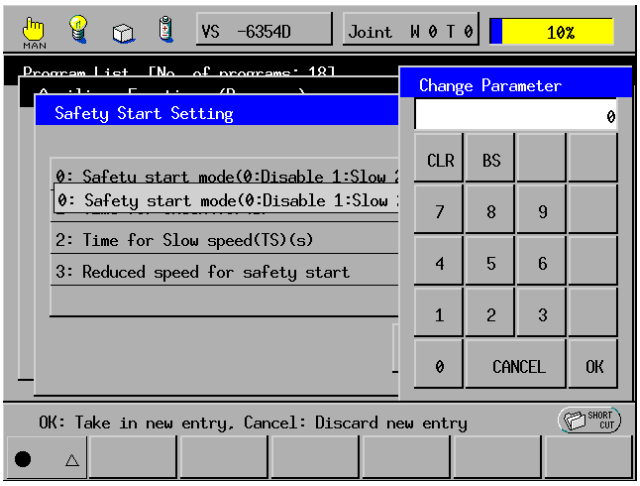
(1) Press [F8 SS Mode.] in the Auxiliary Functions (Programs) window. The Safety Start Setting window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

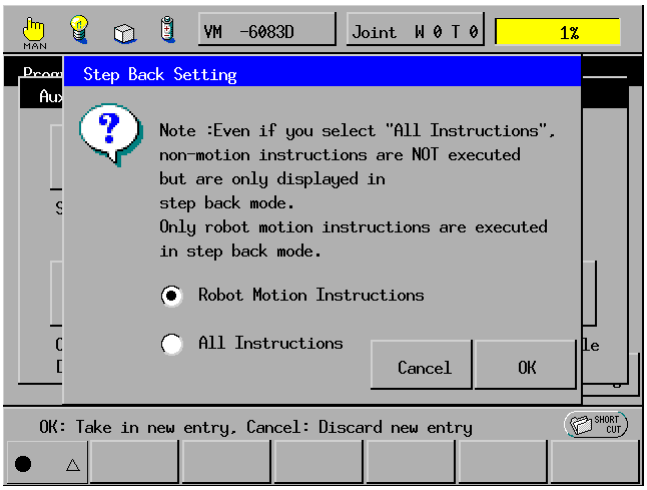
(4) Check the new settings. If they are satisfactory, press the OK button to make them take effect. To clear those settings, press the Cancel button.

Setting the step return options in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F9 StpBack.]

Sets the step return options.

(1) Press [F9 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.

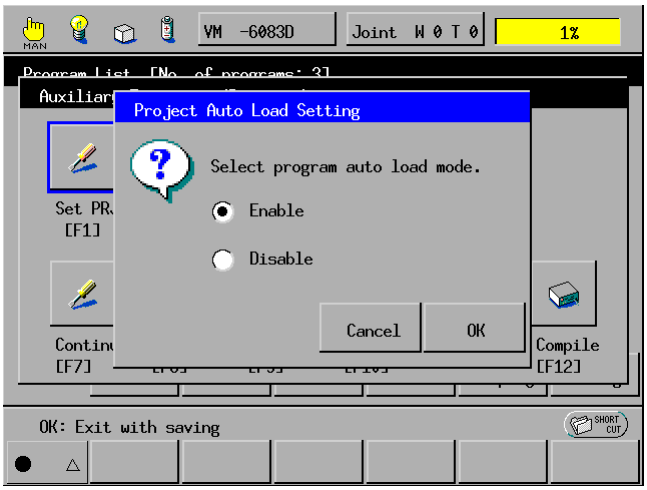
Restarting the controller will make this setting go into effect.

Enabling/disabling the automatic loading of a project in Manual mode

Access: [F1 Program]—[F6 Aux.]—[F10 LoadMode]

Enables or disables the automatic loading of a project.

(1) Press [F10 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.

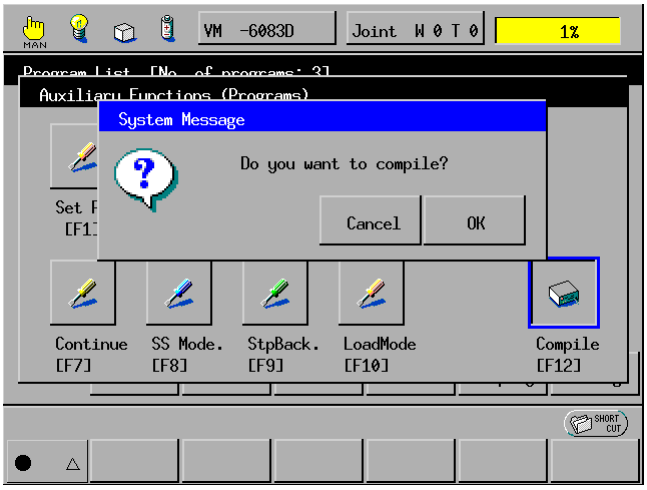
Restarting the controller will make this setting go into effect.

Compiling a project

Access: [F1 Program]—[F6 Aux.]—[F12 Compile]

Compiles a project or all programs which are set to "Enable" in the Program List window.

(1) Press [F12 Compile.] in the Auxiliary Functions (Programs) window. The system message will appear as shown below.

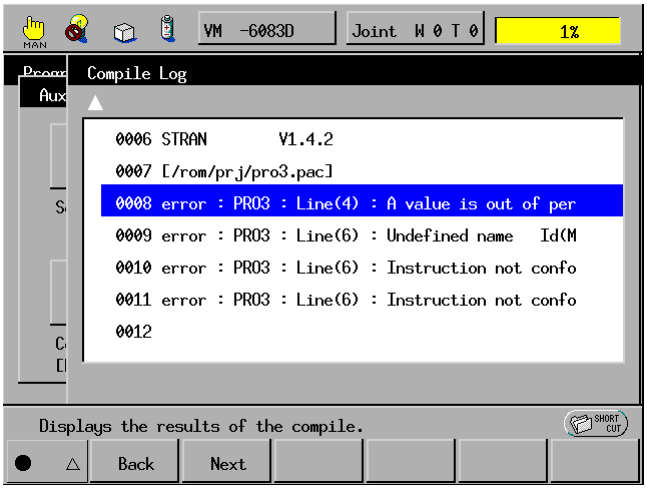


(2) To cancel compiling and return to the Auxiliary Functions (Programs) window, press the Cancel button.

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.



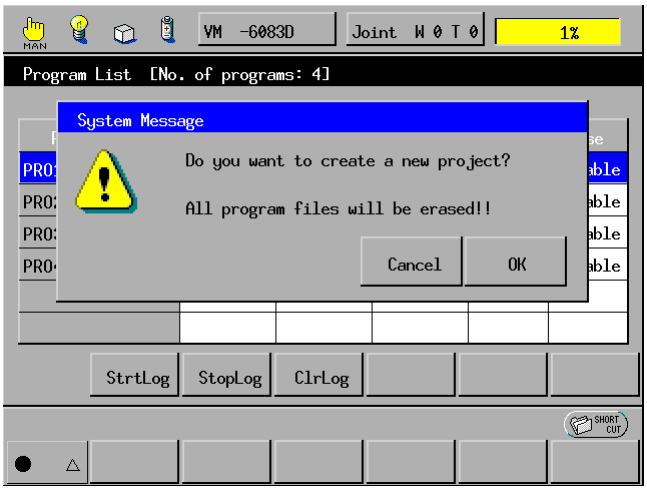
Creating a new project in Manual mode

Access: [F1 Program]—[F7 New PRJ]

Erases all task programs stored in the robot controller and will then create a new project.

(1) Press [F7 New PRJ] in the Program List window. The system message dialog box will appear as shown below.

(2) Press the OK button.



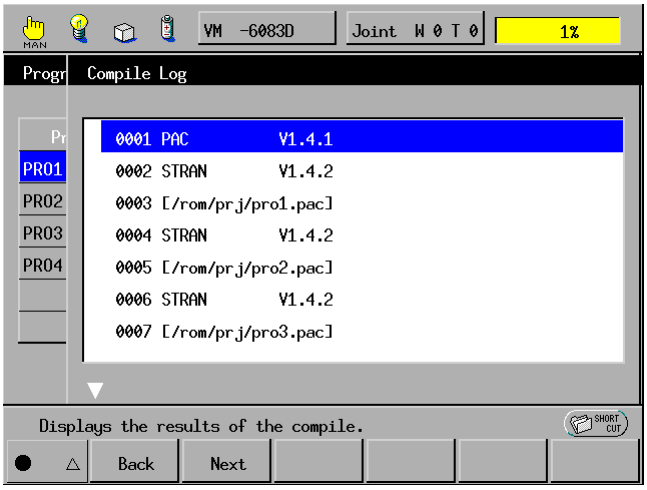
Displaying syntax errors in Manual mode

Access: [F1 Program]—[F10 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 [F10 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: [F1 Program]—[F12 Config.]

Enables a selected program to get compiled or disables it from getting compiled.

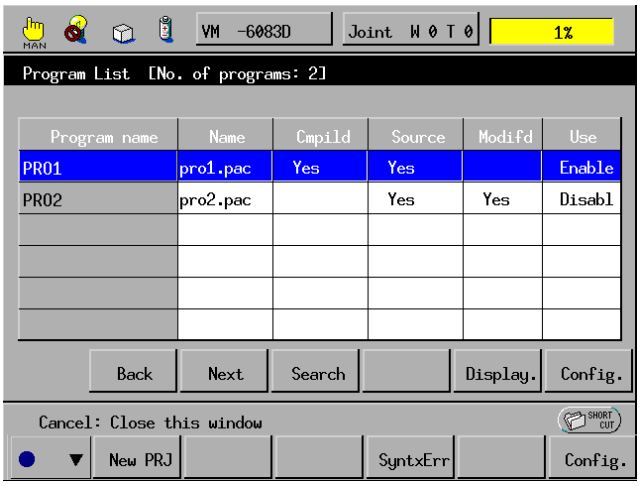
In compilation, the system will first check the enable/disable flags of programs and then compile only those programs whose flags are set to "Enable."

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.

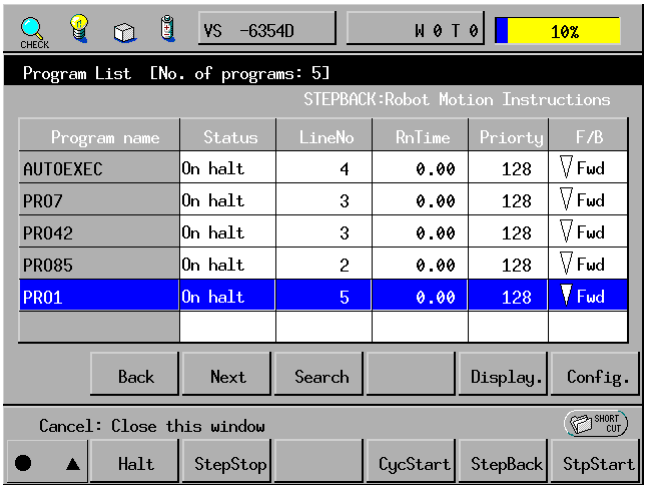
(2) Press [F12 Config.] (or the Config. button located at the bottom of the Program List window). This switches the selected program between "Enable" and "Disable."



F12

5.2.2 Showing the Program List Window in Teach Check Mode

Pressing [F1 Program] on the top screen in Teach check 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.

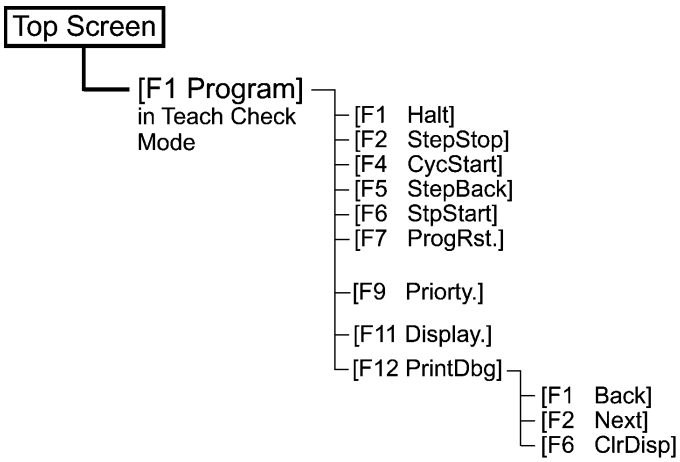
[RnTime] Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.

If the listed program runs continuously, the run time required for every cycle will appear.

[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 [F1 Program] menu in Teach check mode is given on the next page.

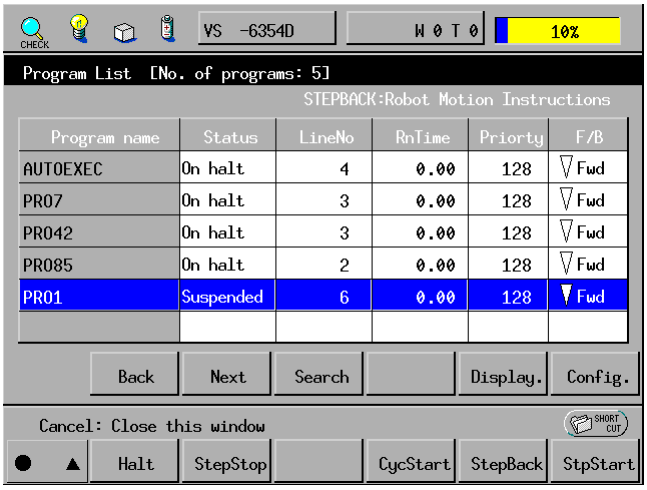

Top Screen
[F1 Program]
in Teach Check
Mode
[F1 Halt]
[F2 StepStop]
[F4 CycStart]
[F5 StepBack]
[F6 StpStart]
[F7 ProgRst.]
[F9 Priorty.]
[F11 Display.]
[F12 PrintDbg]
[F1 Back]
[F2 Next]
[F6 ClrDisp]

Halting the selected program in Teach check mode

Access: [F1 Program]—[F1 Halt]

Halts the task program selected in the Program List window.

Pressing [F1 Halt] in the Program List window (shown below) will immediately interrupt the selected program.



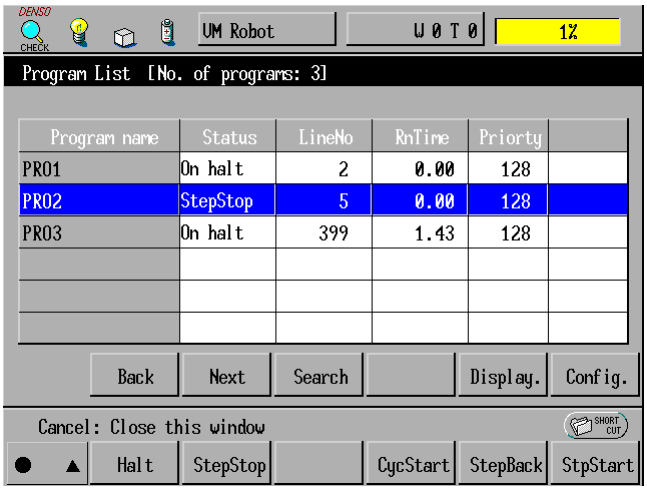
F1

TIP: While pressing [F1 Halt] halts the selected program only, pressing the STOP key stops all task programs.

Causing a step stop in Teach check mode

Access: [F1 Program]—[F2 StepStop]

Interrupts the task program selected in the Program List window as shown below, after executing the current program step.



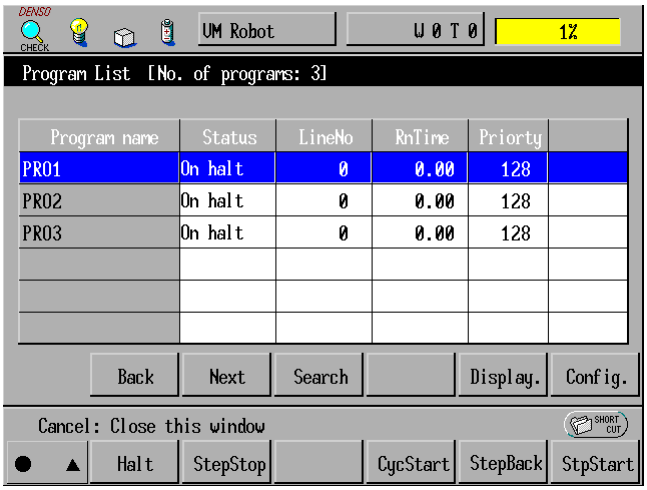
F2

Causing a single-cycle run in Teach check mode

Access: [F1 Program]—[F4 CycStart]

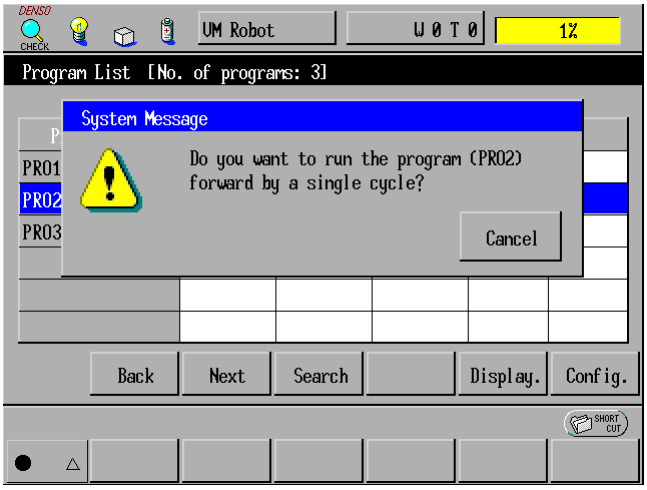
Runs a single cycle of the program selected in the Program List window.

(1) Select the program to be run in the Program List window (shown below).



F4

(2) Press [F4 CycStart], and the system message dialog box will appear as shown below.



(3) While holding down the deadman switch, press the OK key. Make sure to keep both switches depressed until the execution completes.

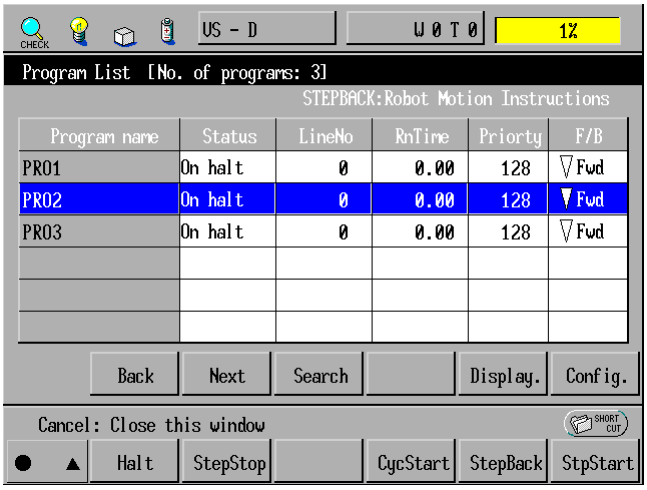
NOTE: The elapsed time on display refers to the time length from the start to end of the program, including temporary stop time caused by Step stop or Halt.

Returning the selected program by a single step in Teach check mode

Access: [F1 Program]—[F5 StepBack]

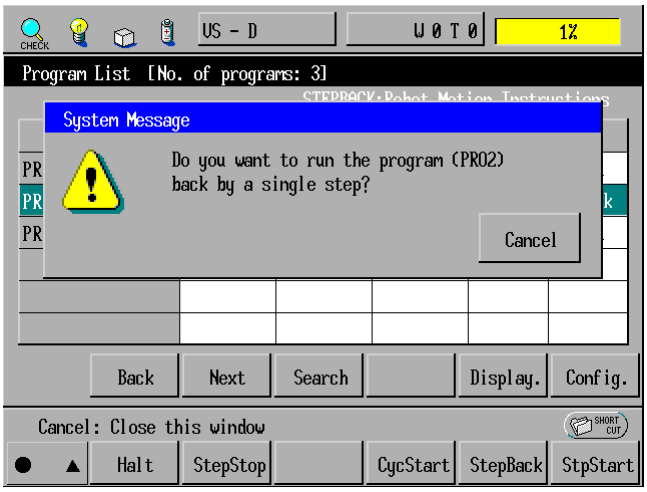
Returns the program selected in the Program List window by a single step at a time.

(1) Press [F5 StepBack] in the Program List window.



(2) The system message appears as shown below.

Holding down the deadman switch, press the OK button to move back the program by one step.

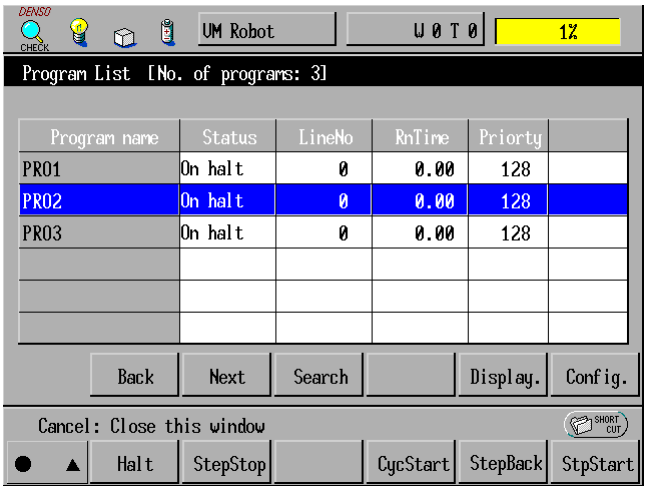


Causing a single-step run in Teach check mode

Access: [F1 Program]—[F6 StpStart]

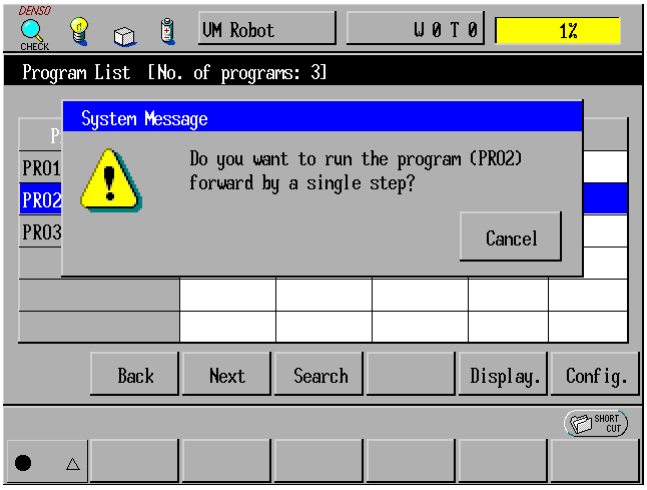
Runs a single step of the program selected in the Program List window.

(1) Select the program to be run in the Program List window (shown below).



F6

(2) Press [F6 StpStart], and the system message dialog box will appear as shown below.



(3) While holding down the deadman switch, press the OK key. Make sure to keep both switches depressed until the execution completes.

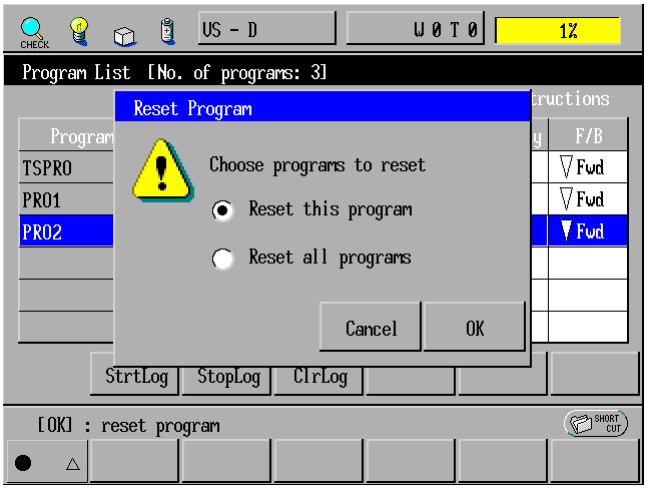
Stopping the program(s) in Teach check mode

Access: [F1 Program]—[F7 ProgRst.]

Stops the program(s).

(1) Press [F7 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.



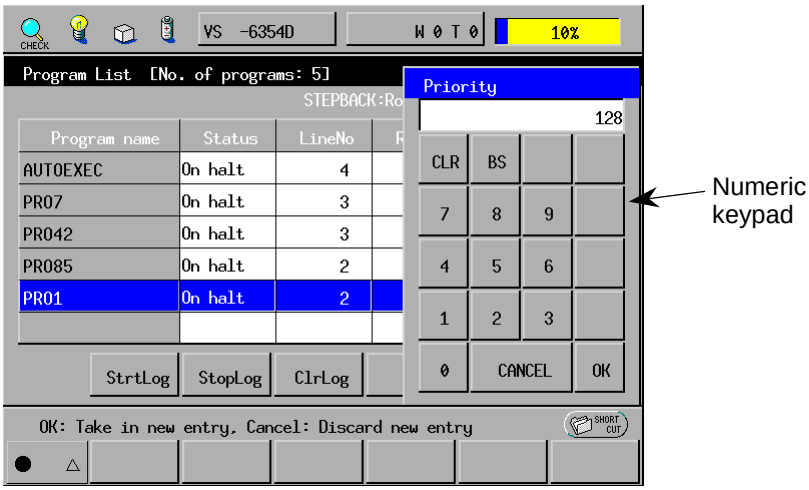
Setting the priority order of programs in Teach check mode

Access: [F1 Program]—[F9 Priorty.]

Sets the priority order of a program you select in the Program List window.

(1) Select the target program.

(2) Press [F9 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 over of the supervisory task cannot be changed.

(4) Press the OK button.

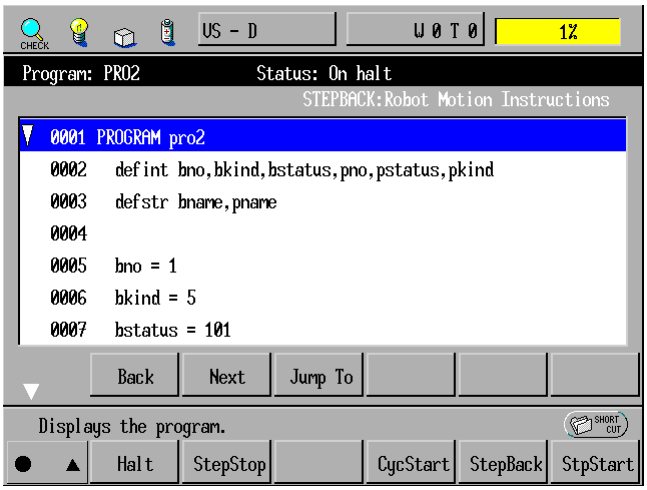
Displaying codes of the selected program in Teach check mode

Access: [F1 Program]—[F11 Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.

(2) Press [F11 Display.], and the program code window will appear as shown below.



When the program code window is displayed, the following commands are still effective: [F1 Halt], [F2 StepStop], [F4 CycStart], [F6 StpStart], [F7 ProgRst.], [F9 Priorty.], and [F12 PrintDbg].

Displaying a debug window in Teach check mode

Access: [F1 Program]—[F12 PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

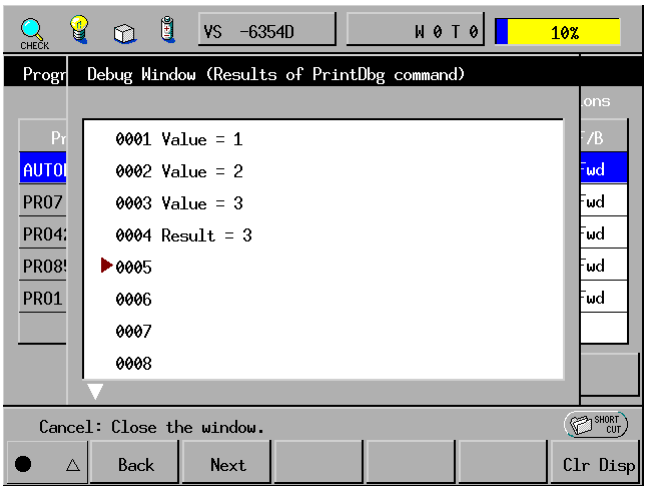
This command allows you to check the execution result of a program or the intermediate result of the computation.

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.

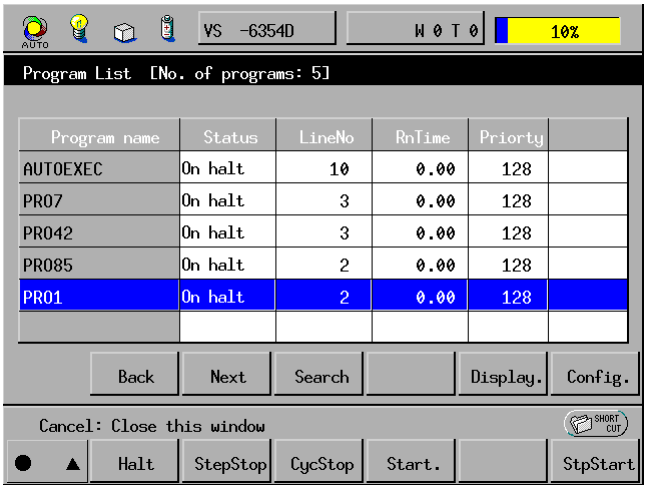
If a sample program shown below is executed, the debug window will display the results as shown below.

```
'!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 [F1 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.

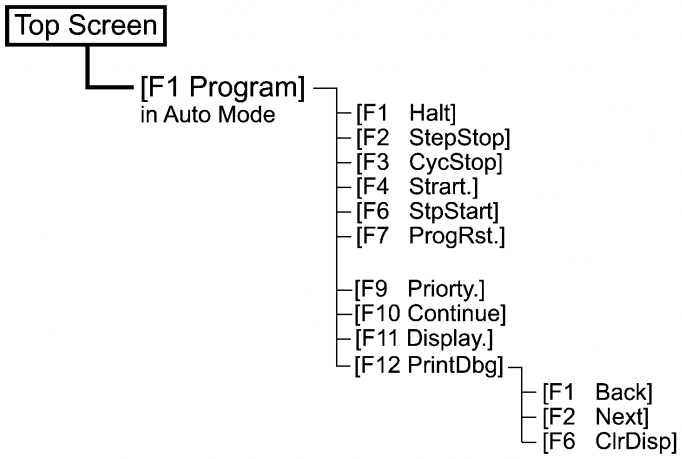
[RnTime] Shows the run time that the listed program takes to run. Note that programs named PROxx (where xx is a numeral) only may show the run time.

If the listed program runs continuously, the run time required for every cycle will appear.

Note: From Ver. 1.4 upward 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 [F1 Program] menu in Auto mode is given on the next page.

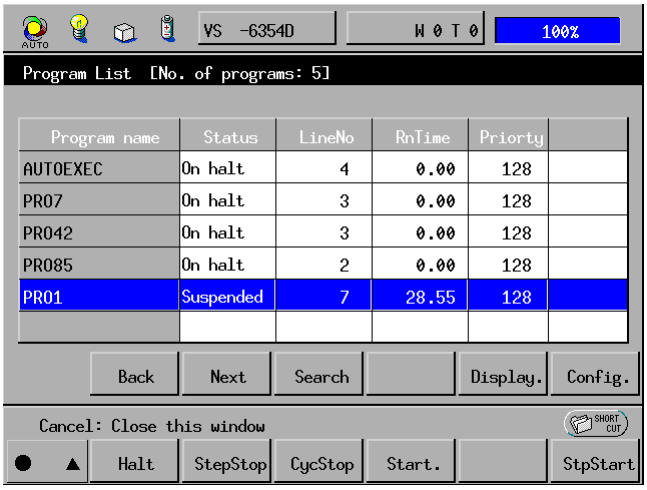

Top Screen
[F1 Program]
in Auto Mode
[F1 Halt]
[F2 StepStop]
[F3 CycStop]
[F4 Strart.]
[F6 StpStart]
[F7 ProgRst.]
[F9 Priorty.]
[F10 Continue]
[F11 Display.]
[F12 PrintDbg]
[F1 Back]
[F2 Next]
[F6 ClrDisp]

Halting the selected program in Auto mode

Access: [F1 Program]—[F1 Halt]

Halts the task program selected in the Program List window.

Pressing [F1 Halt] in the Program List window (shown below) will immediately interrupt the selected program.



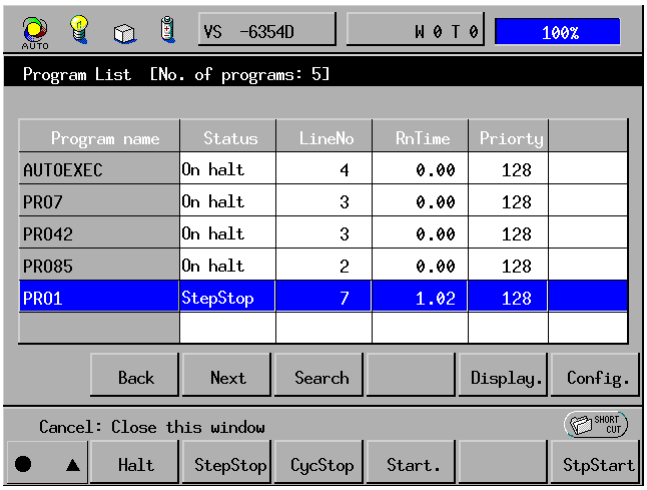
F1

TIP: While pressing [F1 Halt] halts the selected program only, pressing the STOP key stops all task programs.

Causing a step stop in Auto mode

Access: [F1 Program]—[F2 StepStop]

Interrupts the program selected in the Program List window as shown below, after executing the current program step.

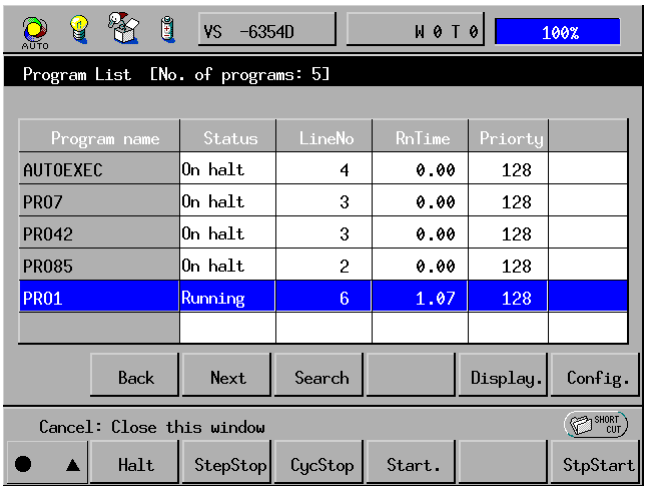


F2

Causing a cycle stop in Auto mode

Access: [F1 Program]—[F3 CycStop]

Stops the task program selected in the Program List window as shown below, after executing the current program up to the last step.



F3

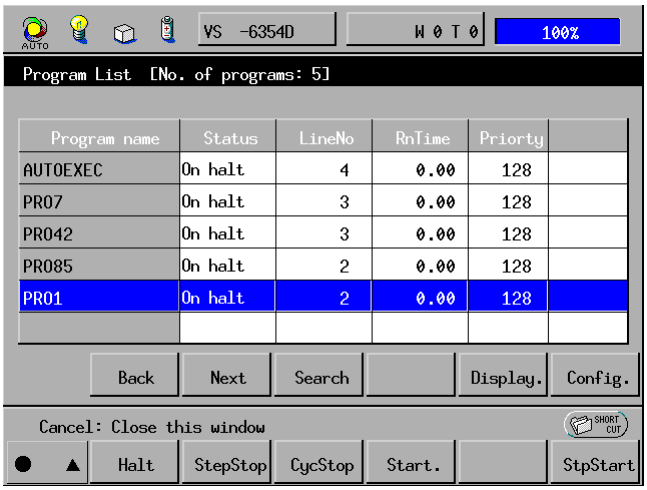
NOTE: The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.

Running the selected program in Auto mode

Access: [F1 Program]—[F4 Start.]

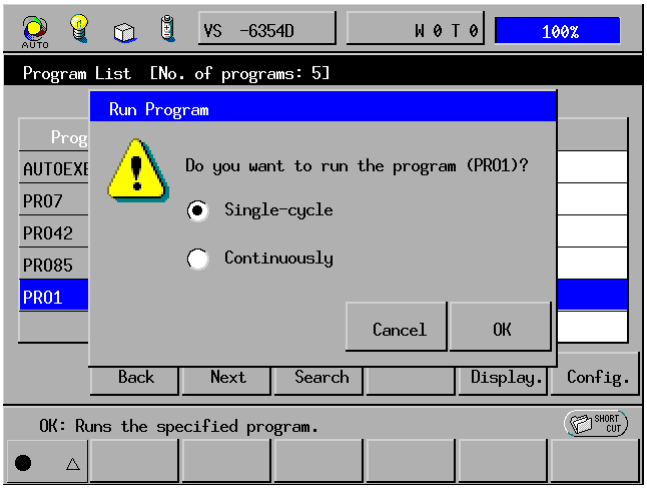
Runs the task program selected in the Program List window, by a single cycle or continuously.

(1) Select the program to be run in the Program List window (shown below).



F4

(2) Press [F4 Start.], and the system message dialog box will appear as shown below.



(3) Select Single-cycle or Continuously, then press the OK button to proceed.

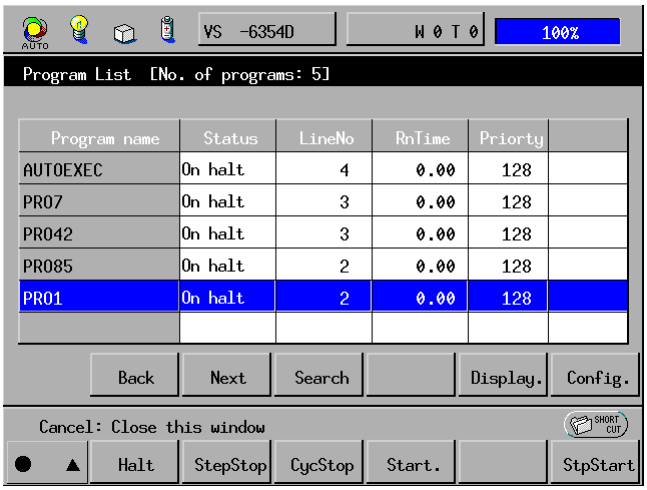
NOTE: The elapsed time on display refers to the time length from the start to the end of the program, including temporary stop time caused by Step stop or Halt.

Causing a single-step run in Auto mode

Access: [F1 Program]—[F6 StpStart]

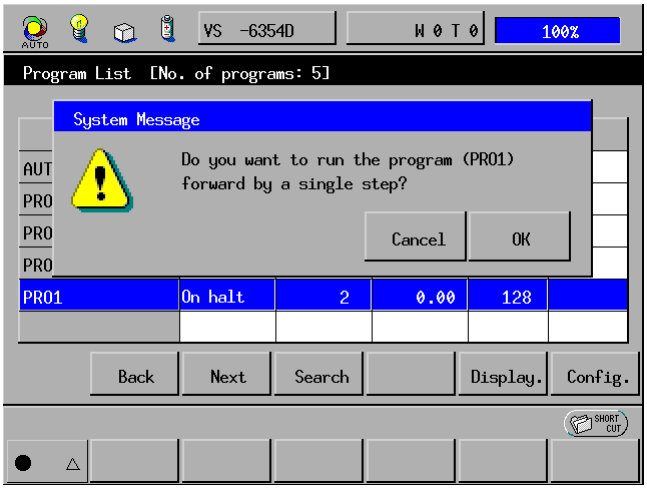
Runs a single step of the task program selected in the Program List window.

(1) Select a program to be run in the Program List window (shown below).



F6

(2) Press [F6 StpStart], and the system message dialog box will appear as shown below.



(3) Press the OK button to proceed.

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.

The actual elapsed time is +0.00 to +0.03 more than the elapsed time, to include the time required for starting and ending the step. [Ver. 1.4 or later]

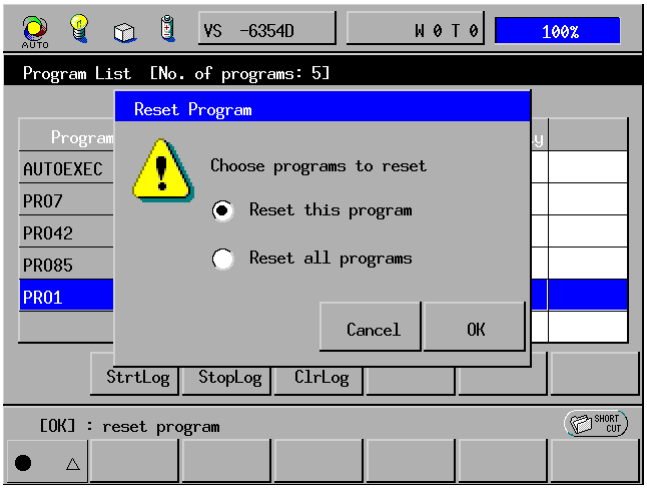
Displaying the Reset Program window in Auto mode

Access: [F1 Program]—[F7 ProgRst.]

Displays the Reset Program windows.

(1) Press [F7 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.



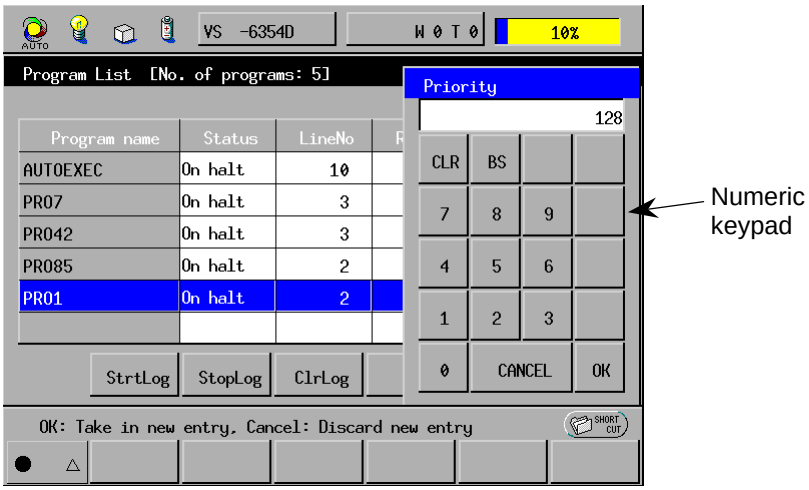
Setting the priority order of programs in Auto mode

Access: [F1 Program]—[F9 Priorty.]

Sets the priority order of the task programs selected in the Program List window.

(1) Select the target program.

(2) Press [F9 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 over of the supervisory task cannot be changed.

(4) Press the OK button.

Resuming selected program(s) in Auto mode

Access: [F1 Program]—[F10 Continue]

Resumes program(s) that has been stopped with "Cont.Stp." and selected in the Program List window.

(1) Select programs you want to resume and press [F10 Continue] in the Program List window.

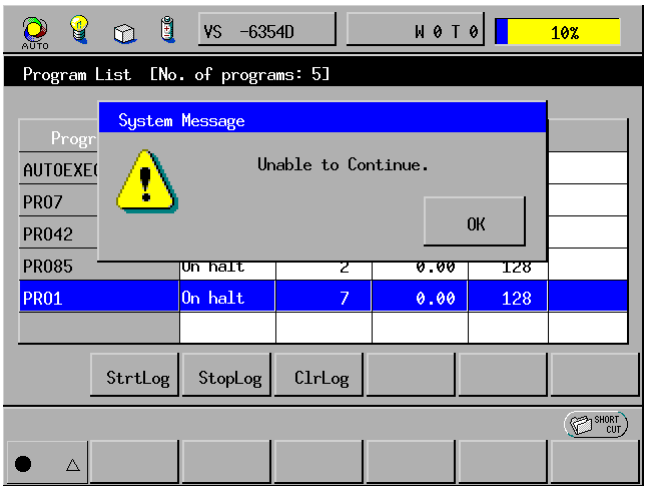
NOTE: Programs that can be resumed show Continue Stop in the Status column.

The system message will appear if programs that can resume are present.

(2) Press the OK button to resume the program you have selected.

To cancel resuming, press the Cancel button.

If programs that can be resumed do not exist, the system message will appear as shown below.



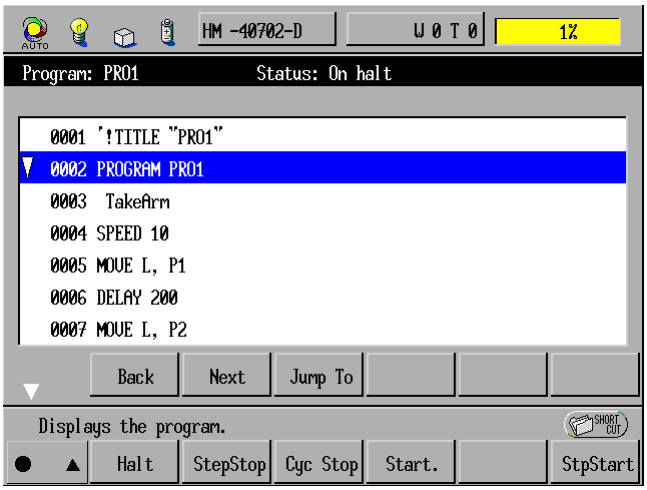
Displaying codes of the selected program in Auto mode

Access: [F1 Program]—[F11 Display.]

Displays codes of the program selected in the Program List window.

(1) Select the target program.

(2) Press [F11 Display.], and the program code window will appear as shown below.



When the program code window is displayed, the following commands are still effective: [F1 Halt], [F2 StepStop], [F3 Cyc Stop], [F4 Start], [F6 StpStart], [F7 ProgRst.], [F9 Priorty.], and [F12 PrintDbg].

Displaying a debug window in Auto mode

Access: [F1 Program]—[F12 PrintDbg]

Displays the debug window where you may view the result of executing the PRINTDBG command in PAC language.

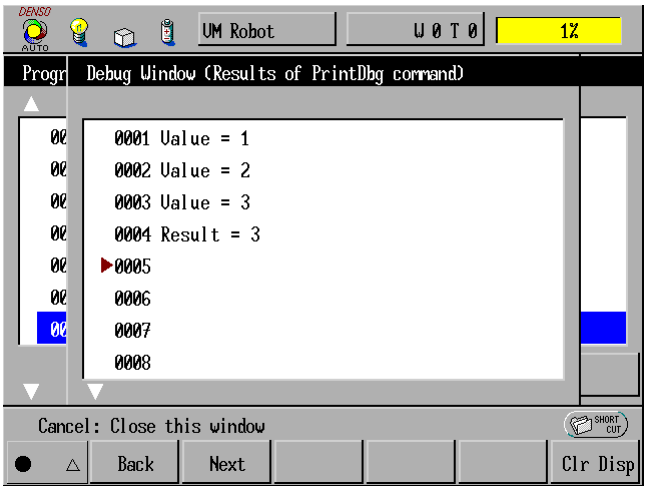
This command allows you to check the execution result of a program or the intermediate result of the computation.

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.

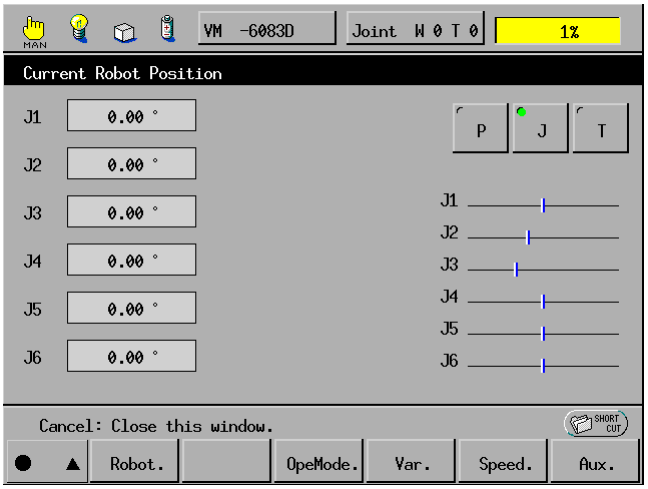
```
'!TITLE "PrintDbg test program"
PROGRAM TEST
  DIM COUNTER AS INTEGER

  FOR COUNTER = 1 TO 5
    PRINTDBG "Value =";COUNTER
    IF COUNTER = 3 THEN EXIT FOR
  NEXT

  PRINTDBG "Result = ";COUNTER
END
```



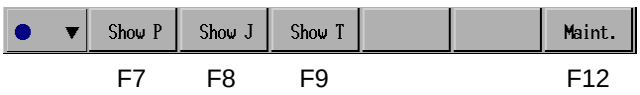
5.3 Displaying the Current Robot Position

Access: [F2 Arm]

Pressing [F2 Arm] on the top screen will display the Current Robot Position window as shown below.



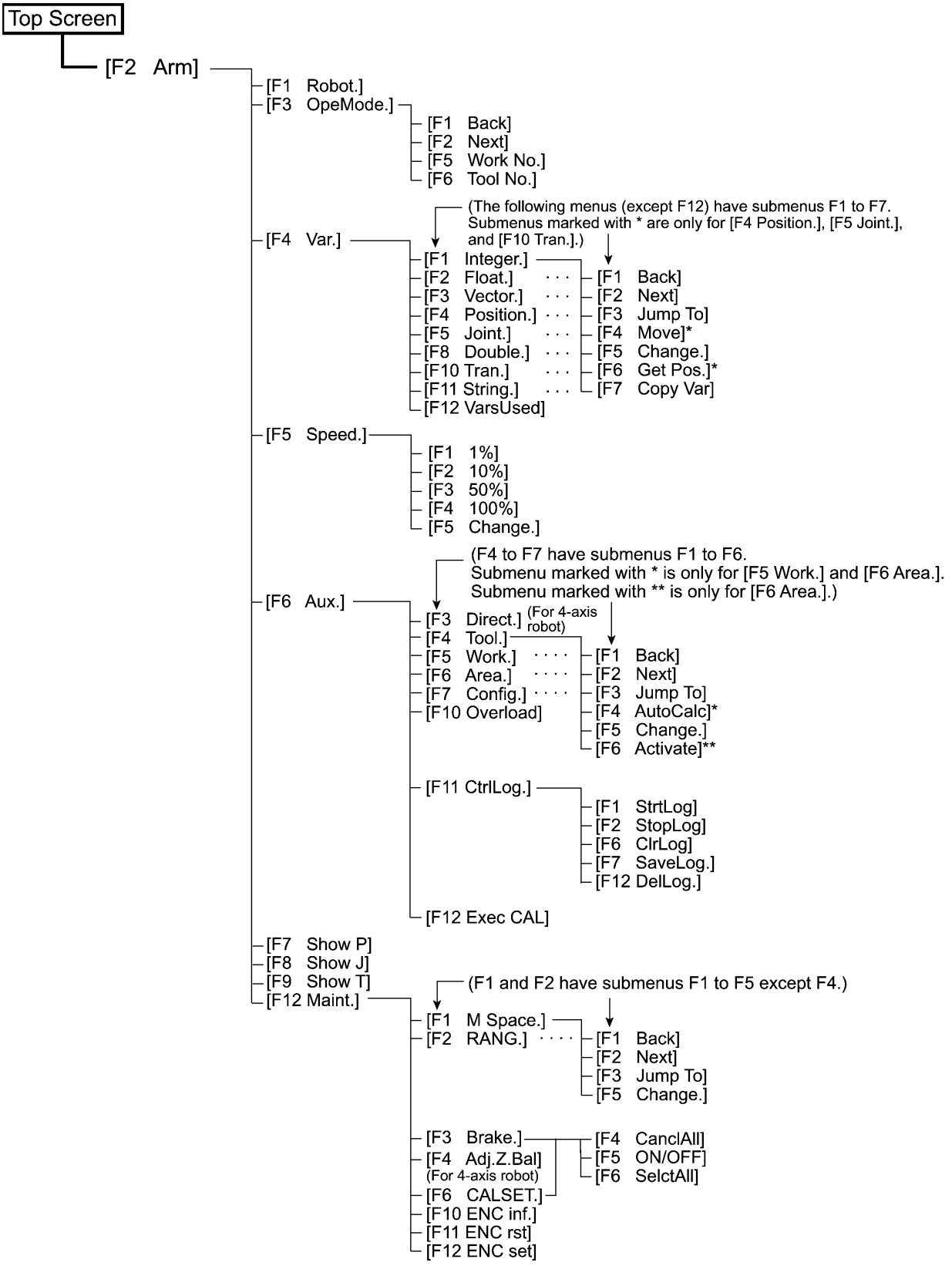
When shifted



Pressing [F7 Show P] (or P button), [F8 Show J] (or J button), or [F9 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 [F2 Arm] menu is given on the next page.


Top Screen
[F2 Arm]
[F1 Robot.]
[F3 OpeMode.]
[F1 Back]
[F2 Next]
[F5 Work No.]
[F6 Tool No.]
(The following menus (except F12) have submenus F1 to F7.
Submenus marked with * are only for [F4 Position.], [F5 Joint.],
and [F10 Tran.].)
[F4 Var.]
[F1 Integer.]
[F2 Float.]
[F3 Vector.]
[F4 Position.]
[F5 Joint.]
[F8 Double.]
[F10 Tran.]
[F11 String.]
[F12 VarsUsed]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F4 Move]*
[F5 Change.]
[F6 Get Pos.]*
[F7 Copy Var]
[F5 Speed.]
[F1 1%]
[F2 10%]
[F3 50%]
[F4 100%]
[F5 Change.]
(F4 to F7 have submenus F1 to F6.
Submenu marked with * is only for [F5 Work.] and [F6 Area.].
Submenu marked with ** is only for [F6 Area.].)
[F6 Aux.]
[F3 Direct.]
(For 4-axis robot)
[F4 Tool.]
[F5 Work.]
[F6 Area.]
[F7 Config.]
[F10 Overload]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F4 AutoCalc]*
[F5 Change.]
[F6 Activate]**
[F11 CtrlLog.]
[F1 StrtLog]
[F2 StopLog]
[F6 ClrLog]
[F7 SaveLog.]
[F12 DelLog.]
[F12 Exec CAL]
[F7 Show P]
[F8 Show J]
[F9 Show T]
[F12 Maint.]
(F1 and F2 have submenus F1 to F5 except F4.)
[F1 M Space.]
[F2 RANG.]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]
[F3 Brake.]
[F4 Adj.Z.Bal]
(For 4-axis robot)
[F6 CALSET.]
[F4 CanclAll]
[F5 ON/OFF]
[F6 SelctAll]
[F10 ENC inf.]
[F11 ENC rst]
[F12 ENC set]

Selecting the robot type (reserved)

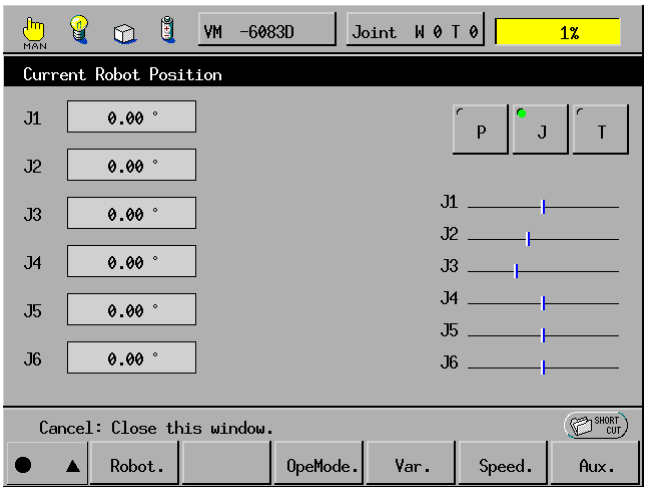
Access: [F2 Arm]—[F1 Robot.]

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.

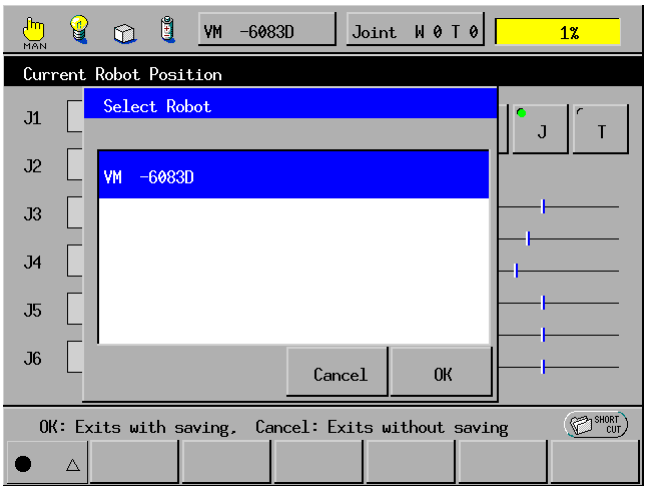
This command is functionally equivalent to the R-SEL key.

(1) In the Current Robot Position window shown below, press [F1 Robot.].



F1

(2) The Select Robot window will appear as shown below. Select the type of your robot and then press the OK button.



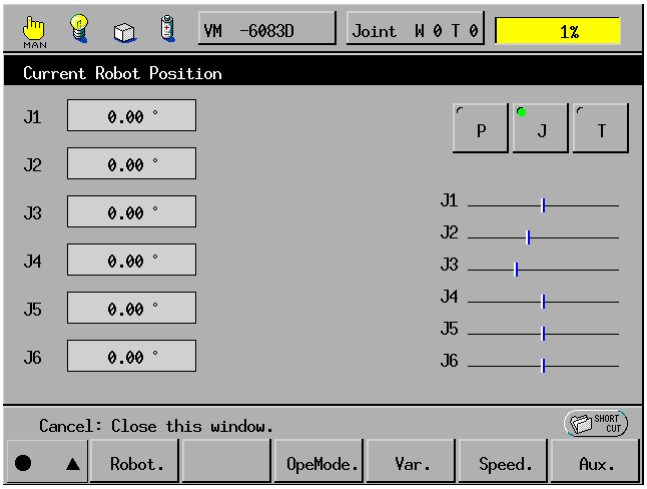
Switching the operation modes, work coordinates and tool coordinates

Access: [F2 Arm]—[F3 OpeMode.]

Switches the operation modes, work coordinates and tool coordinates.

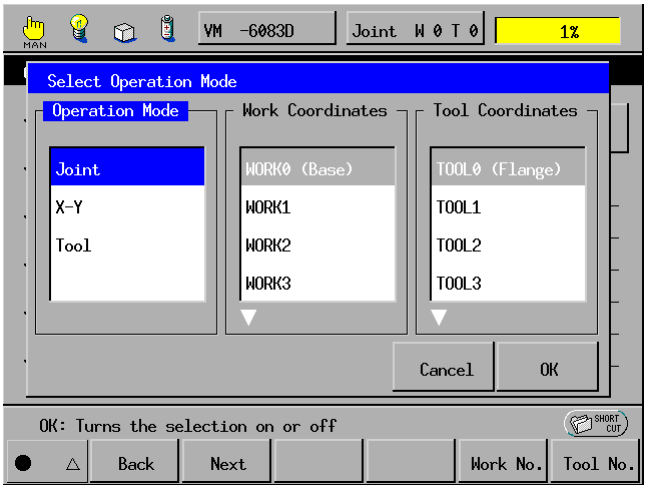
This command is functionally equivalent to the M-MOD key.

(1) In the Current Robot Position window shown below, press [F3 OpeMode.].



F3

(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.



Displaying and modifying variable values

Access: [F2 Arm]—[F4 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 [F1 Program]—[F4 Var.] in Manual mode.

Displaying and modifying integer variable values

[F2 Arm]—[F4 Var.]—[F1 Integer.]

Refer to page 5-15.

Displaying and modifying floating-point variable values

[F2 Arm]—[F4 Var.]—[F2 Float.]

Refer to page 5-16.

Displaying and modifying vector variable values

[F2 Arm]—[F4 Var.]—[F3 Vector.]

Refer to page 5-17.

Displaying and modifying position variable values

[F2 Arm]—[F4 Var.]—[F4 Pos.]

Refer to page 5-18.

Displaying and modifying joint variable values

[F2 Arm]—[F4 Var.]—[F5 Joint.]

Refer to page 5-19.

Displaying registered variable list. [Ver. 1.9 or later]

[F2 Arm]—[F4 Var.]—[F6 RegVar.]

Refer to page 5-20.

Displaying and modifying double-precision variable values

[F2 Arm]—[F4 Var.]—[F8 Double.]

Refer to page 5-21.

Displaying and modifying variable values in homogeneous transform matrix

[F2 Arm]—[F4 Var.]—[F10 Tran.]

Refer to page 5-22.

Displaying and modifying string variable values

[F2 Arm]—[F4 Var.]—[F11 String.]

Refer to page 5-23.

Displaying and modifying the number of variables used

[F2 Arm]—[F4 Var.]—[F12 VarsUsed.]

Refer to page 5-25.

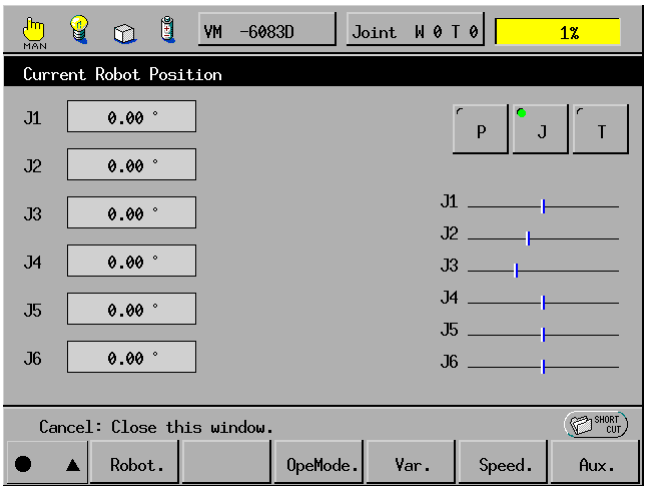
Setting the reduced ratios of the programmed speed, acceleration, and deceleration

Access: [F2 Arm]—[F5 Speed.]

Sets the reduced ratios (percentage) of the programmed speed, acceleration, and deceleration, as well as selecting speed-running or inching.

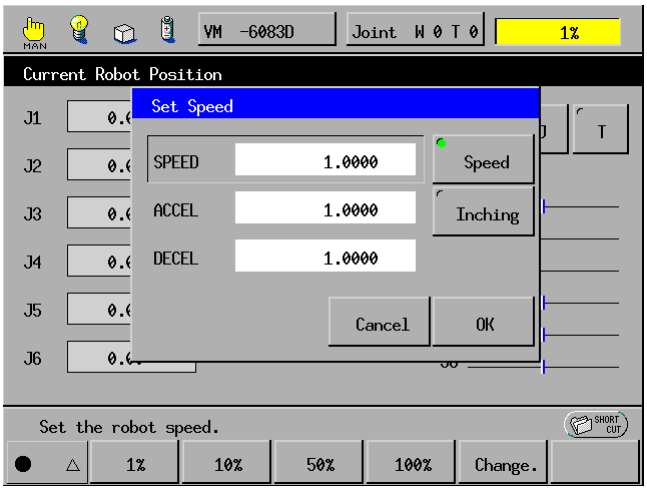
This command is functionally equivalent to the SPEED key.

(1) In the Current Robot Position window shown below, press [F5 Speed.].



F5

(2) The Set Speed window will appear as shown below. Set the desired ratios of the programmed speed, acceleration and deceleration. Additionally, select speed-running or inching. Then press the OK button.



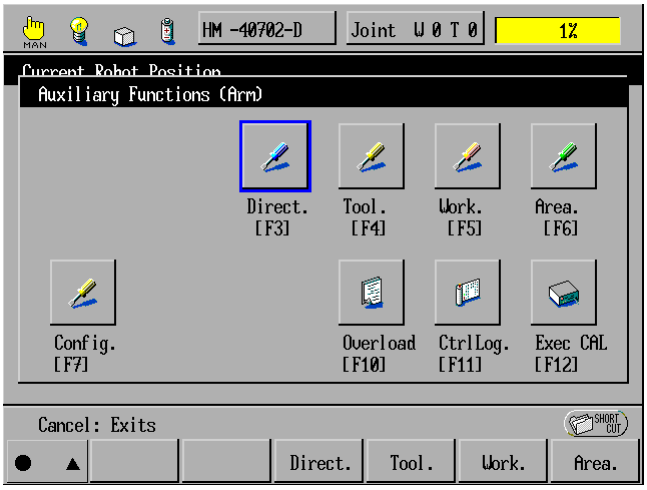
TIP: For the detailed operating procedure about setting of the reduced ratios, refer to Chapter 2, Section 2.7.

Providing auxiliary functions

Access: [F2 Arm]—[F6 Aux.]

Provides the auxiliary functions concerning coordinates definition, interference area definition, user preferences, overload anticipation, and CAL operation.

(1) Press [F6 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 pages 5-78 through 5-89.

Entering the direct teaching mode (For 4-axis robots)

Access: [F2 Arm]—[F6 Aux.]—[F3 Direct.]

The direct teaching mode allows you to move the robot arm by hand (without using the teach pendant) with the motor 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-E & HM-E-W series has 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.

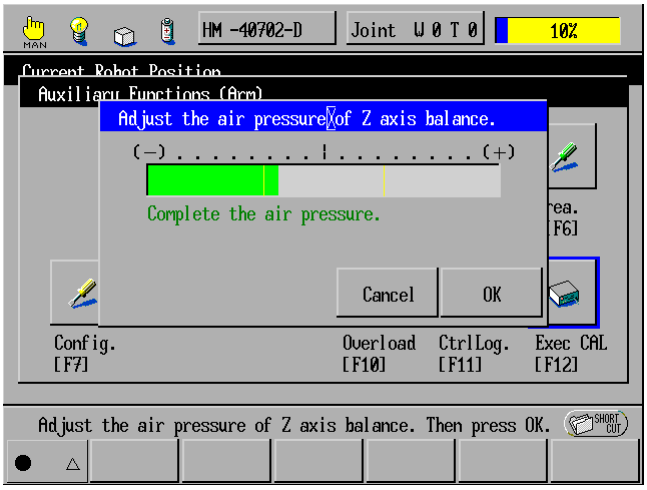
Note 2: The HM-4A***E-W series robots (; *20kg payload type)* have not the function of the direct teaching mode.

[1] For Conventional 4-Axis Robots Except the HS-E & HM-E-W Series

(1) In the Auxiliary Functions (Arm) window, press [F3 Direct.]. The air balance adjustment window will appear.

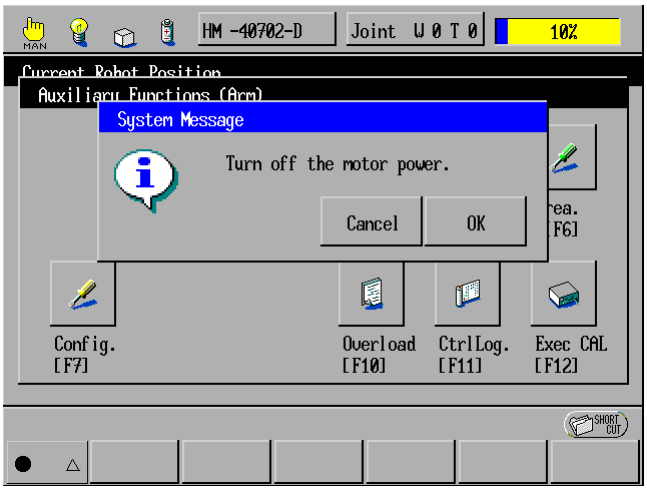
NOTE: The air pressure adjustment for Z-axis balance is required only when you make the robot enter the direct teaching mode at the first time after turning the robot controller ON.

(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.

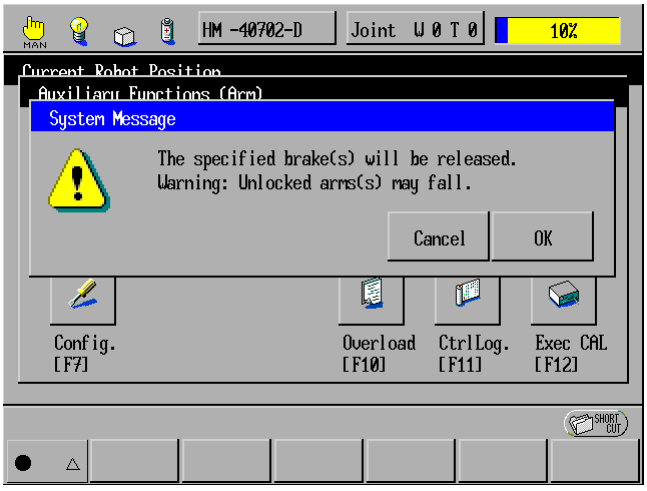


(3) The following window will appear.
Press the OK button.

(4) The following window will appear.
Turn the motor OFF and then press the OK button.



(5) The following window will appear.
Check the message and press the OK button.



The robot is placed in the direct teaching mode.

[2] For the HS-E & HM-40***E-W Series [Ver.1.9 or later]

The HS-E & HM-E-W series has 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.

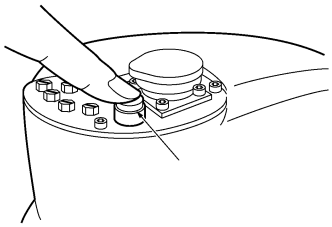
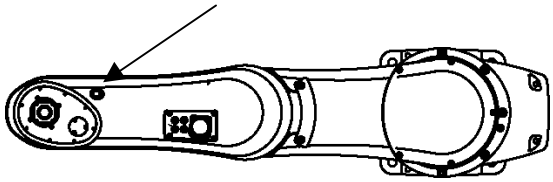
(1) In the Auxiliary Functions (Arm) window, press [F3 Direct.].

The following message will appear.

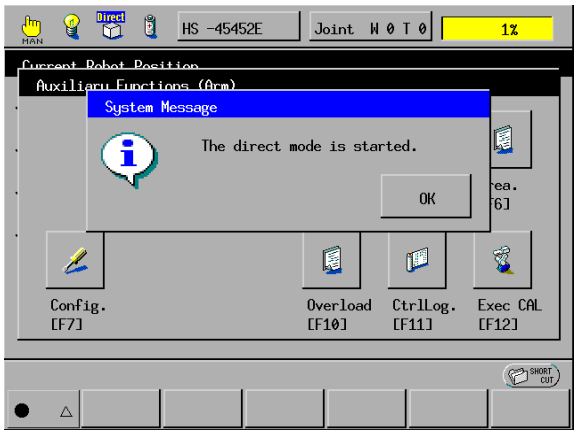
(2)Hold down the brake release button provided on the top of the 2nd arm, and then press the OK button in this window. (In other robot series, only press the OK button.)

Note: The brake release button is effective only in the direct teaching mode.

> ⚠**Caution:** **If the brake is released, the Z-axis will drop downward because that the robot has no air balance cylinder on the Z-axis. Be sure that the brake releasing will not cause damage to person or equipment.**

Brake release button for the 3rd-axis	Brake release button for the 3rd-axis
	
<HS-E series>	<HM-40***E-W series>

(3) In the following start window, press the OK button.

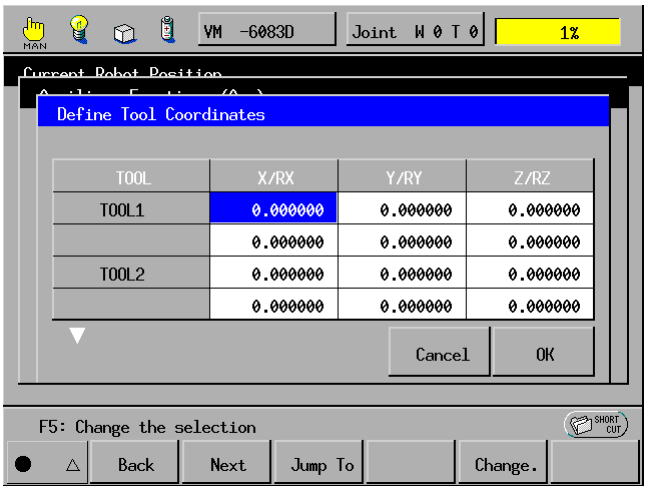


Defining tool coordinates

Access: [F2 Arm]—[F6 Aux.]—[F4 Tool.]

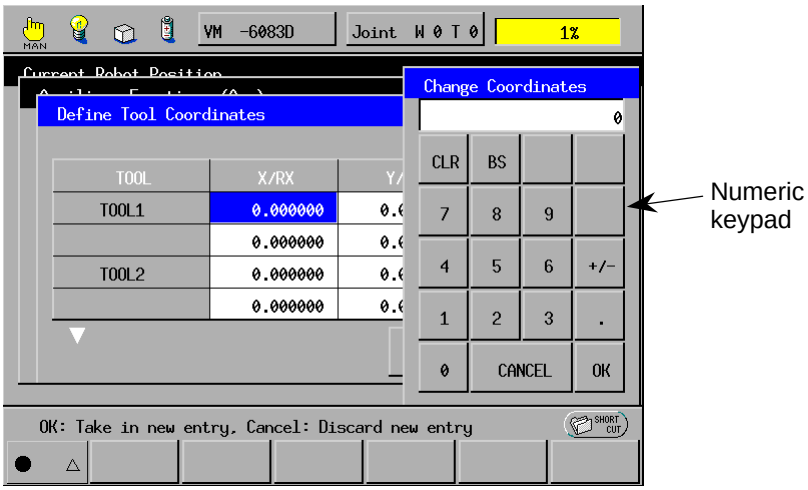
Defines tool coordinates.

(1) Press [F4 Tool.] in the Auxiliary Functions (Arm) window, and the following window will appear.



F5

(2) In the above window, select the item to be defined and then press [F5 Change.]
The numeric keypad will appear as shown below.



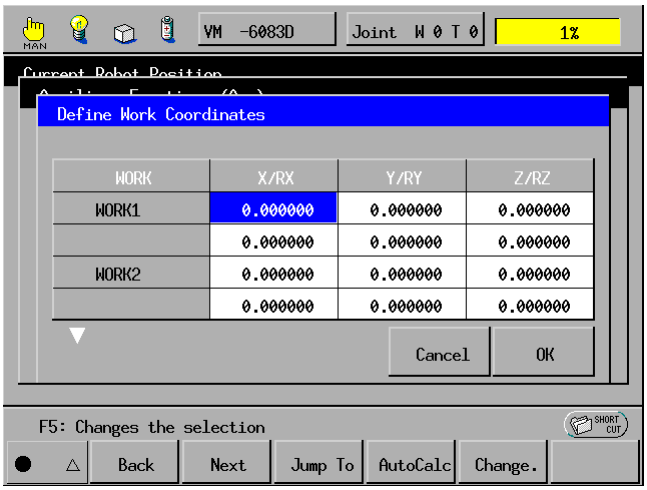
(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Defining work coordinates

Access: [F2 Arm]—[F6 Aux.]—[F5 Work.]

Defines work coordinates.

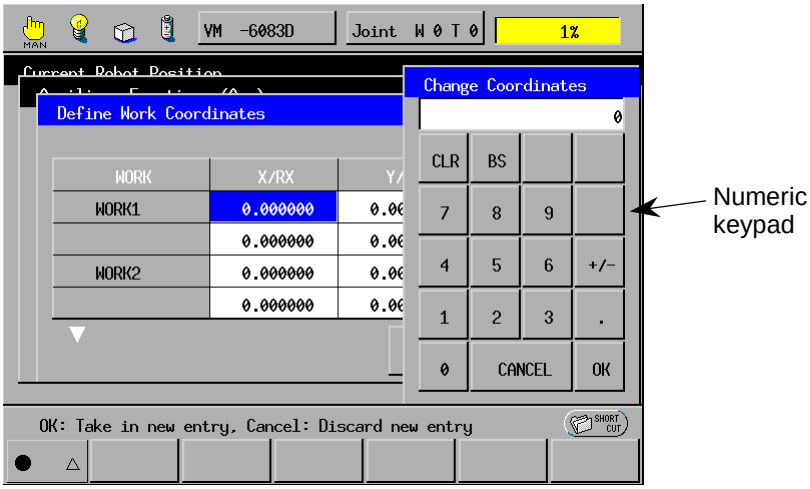
(1) Press [F5 Work.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [F5 Change.].

NOTE: For automatic calculation of work coordinates, press [F4 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.

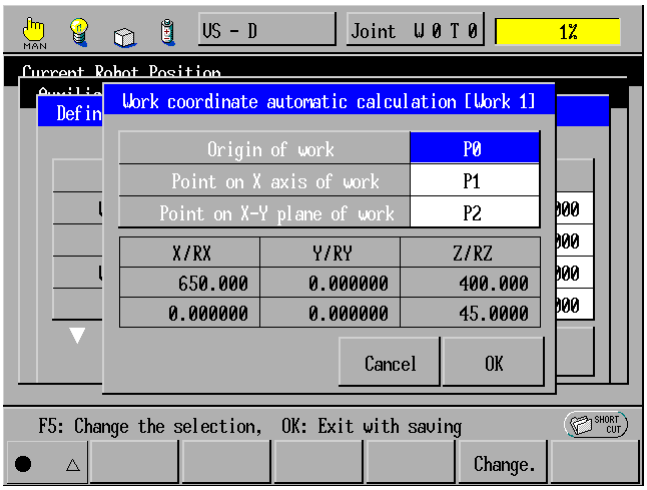
Calculating work coordinates automatically in Manual mode

Access: [F2 Arm]—[F6 Aux.]—[F5 Work.]—[F4 AutoCalc]

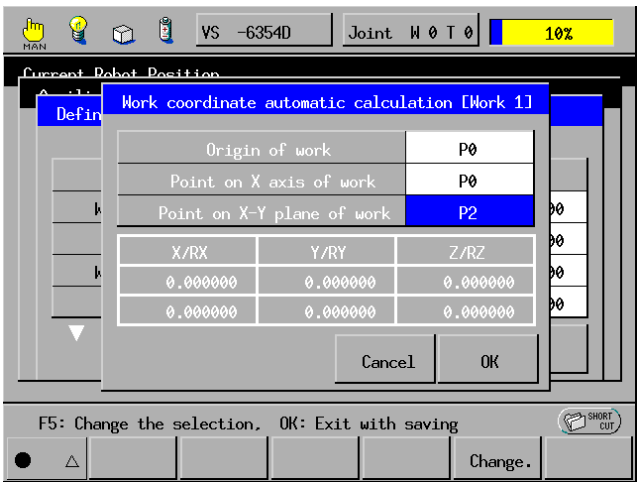
Calculates work coordinates automatically if you merely specify three points--Origin of work coordinates, point on the X axis of work coordinates and point on the X-Y plane of work coordinates.

For details regarding work coordinates definition, refer to Subsection 4.1.1, [1.3] and Subsection 4.2.1, [1.3] for 6-axis and 4-axis robots, respectively.

(1) Press [F4 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.

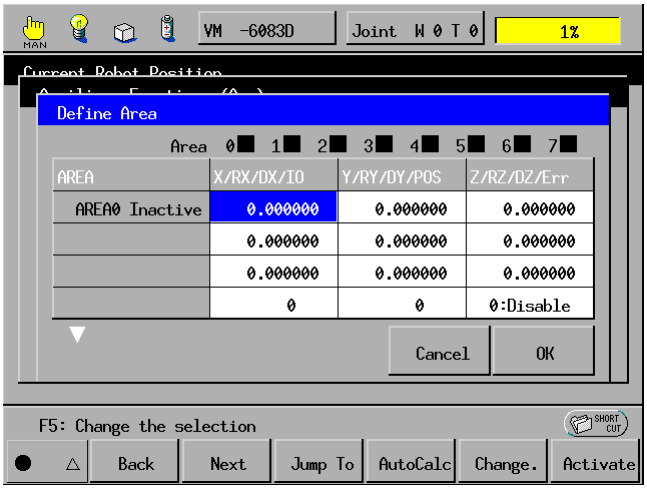


Defining an interference check area

Access: [F2 Arm]—[F6 Aux.]—[F6 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 may activate specified tasks preprogrammed if an I/O port address is set.

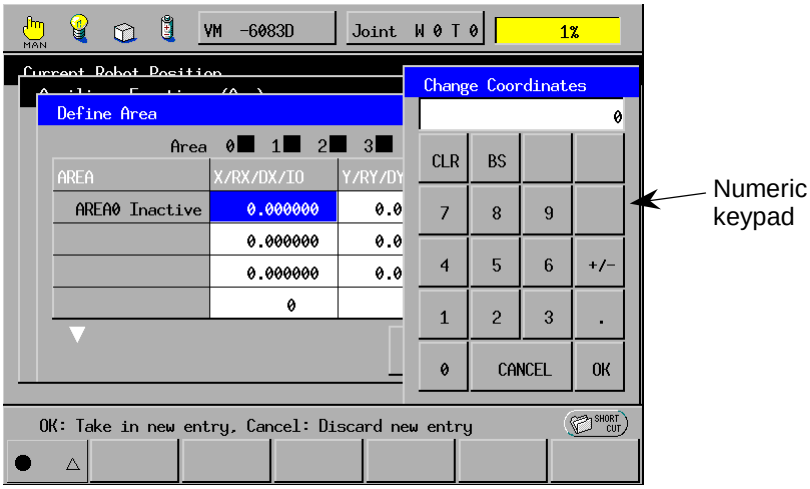
(1) Press [F6 Area.] in the Auxiliary Functions (Arm) window, and the following window will appear.



(2) In the above window, select the item to be defined and then press [F5 Change.].

NOTE: For automatic calculation of the interference check area, press [F4 AutoCalc]. For details, refer to the next page.

The numeric keypad will appear as shown below.

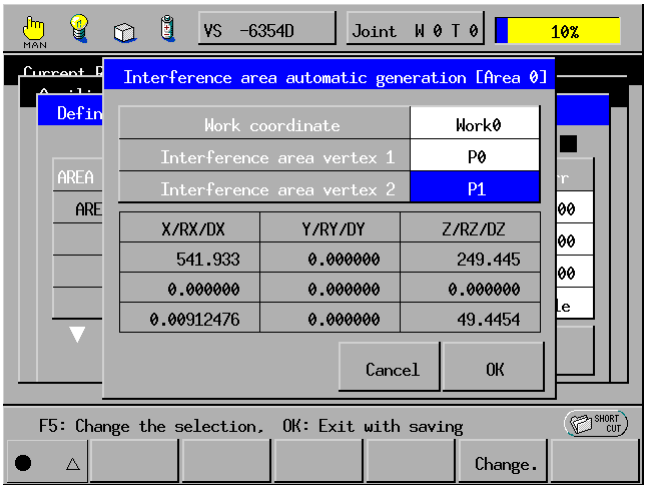


(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Calculating the coordinates of an interference check area automatically in Manual mode

Access: [F2 Arm]—[F6 Aux.]—[F6 Area.]—[F4 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.

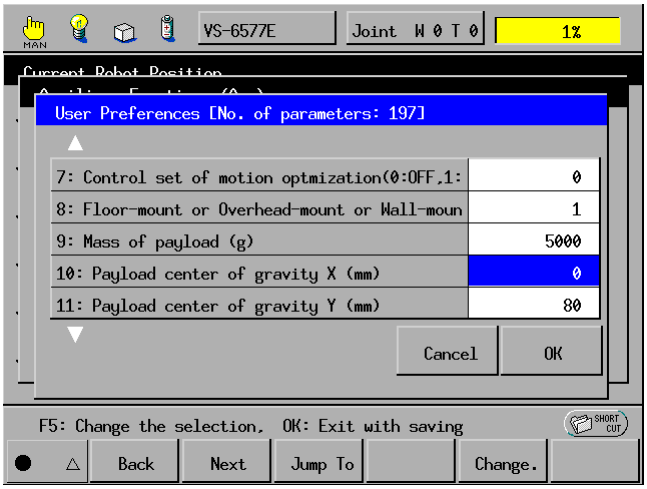


Setting the user preferences

Access: [F2 Arm]—[F6 Aux.]—[F7 Config.]

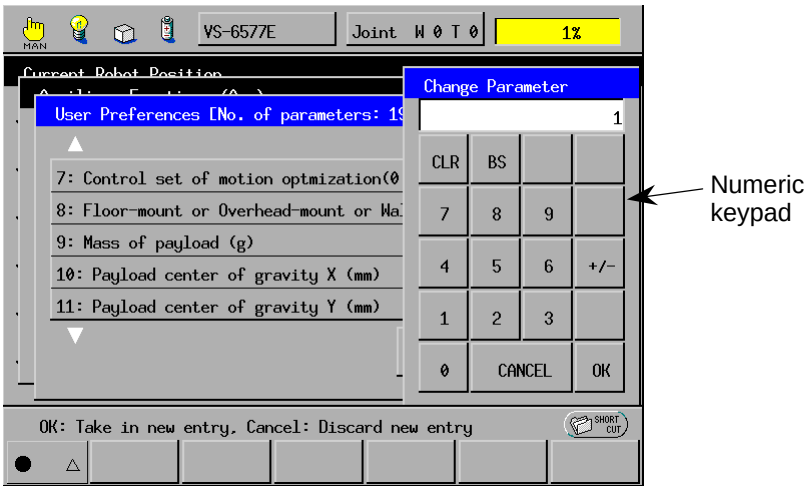
Sets or modifies the user preferences such as the control set of motion optimization, robot mounting style, mass of payload, and payload center of gravity (as master control parameters).

(1) Press [F7 Config.] in the Auxiliary Functions (Arm) window, and the following window will appear.



F5

(2) In the above window, select the item to be defined and then press [F5 Change.].
The numeric keypad will appear as shown below.



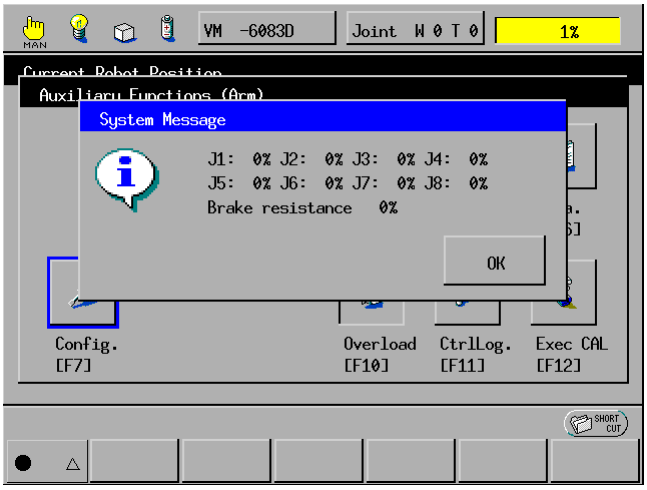
(3) Enter the desired value with the numerical buttons in the above window, and then press the OK button.

Displaying anticipated overloads to the capacity of motors and brake resistance of the robot controller

Access: [F2 Arm]—[F6 Aux.]—[F10 Overload]

Displays anticipated overloads (percentages) to the capacity of joint-drive motors and to the brake resistance of the robot controller.

(1) Press [F10 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
```

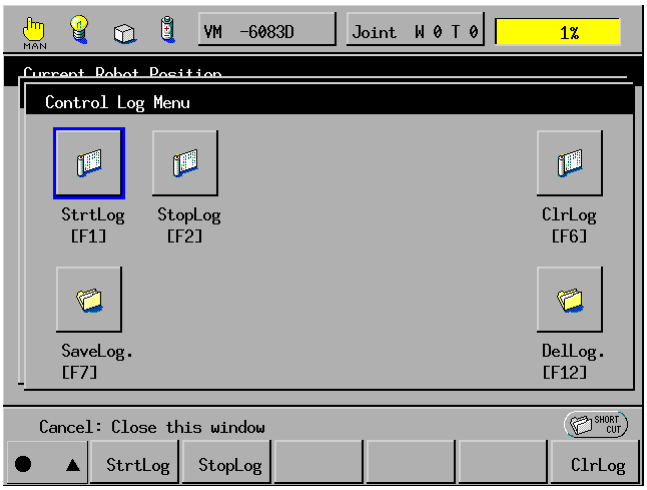
(If STOPLOG executes within 10 seconds from STARTLOG, the anticipated overloads for that time will appear.)

Saving or deleting control log to/from the flash memory

Access: [F2 Arm]—[F6 Aux.]—[F11 CtrlLog.]

Saves or deletes control log preserved in the flash memory.

(1) Press [F11 CtrlLog.] in the Auxiliary Functions (Arm) window, and the following window appears.



F1 (F7) F2 F6 (F12)

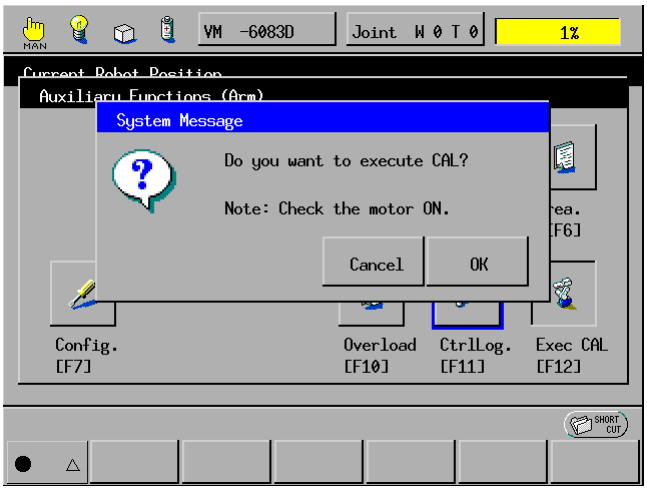
Function keys available	
[F1 StrtLog]	Starts keeping a control log.
[F2 StopLog]	Stops keeping a control log.
[F6 ClrLog]	Clears the current log so as to allow a new log.
[F7 SaveLog.]	Saves the current log stored in the work memory into the flash memory. If the controller is turned OFF, data stored 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 WINCAPSII.
[F12 DelLog.]	Deletes the current log stored in the flash memory.

Executing CAL operation

Access: [F2 Arm]—[F6 Aux.]—[F12 Exec CAL]

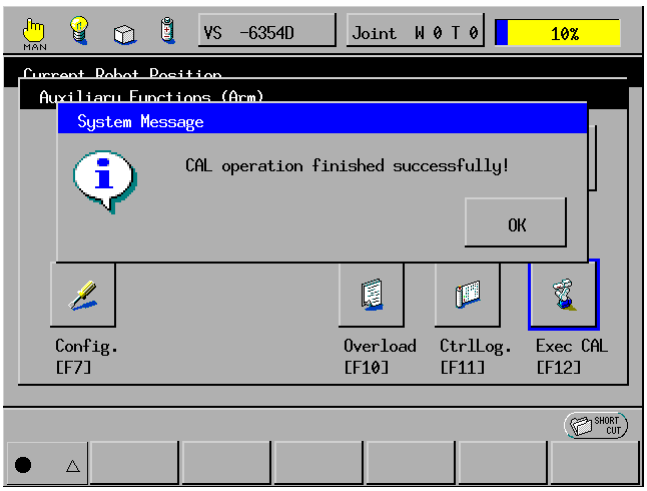
Executes CAL operation.

(1) Press [F12 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.

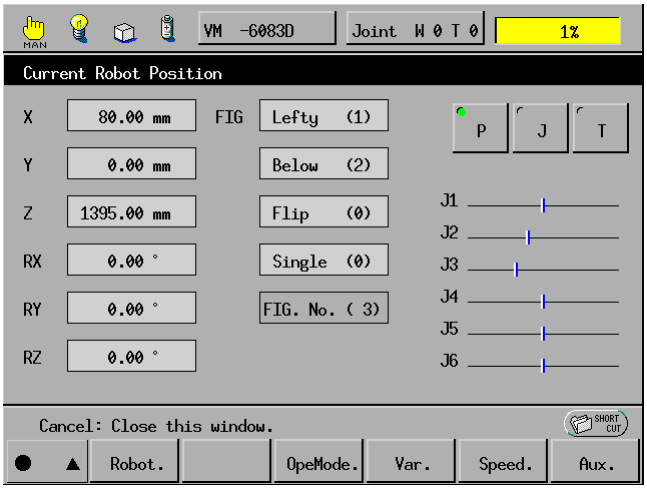
Switching the expression of the current robot position to the position variable type

Access: [F2 Arm]—[F7 Show P]

Switches the expression of the current robot position to the position variable type.

Press [F7 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.



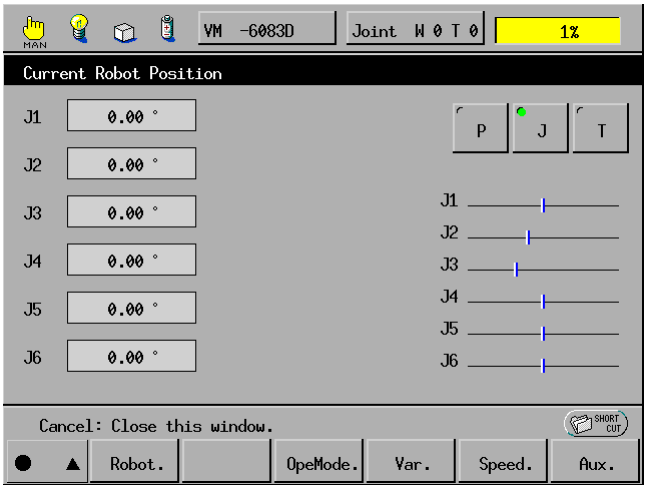
Switching the expression of the current robot position to the joint variable type

Access: [F2 Arm]—[F8 Show J]

Switches the expression of the current robot position to the joint variable type.

Press [F8 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.



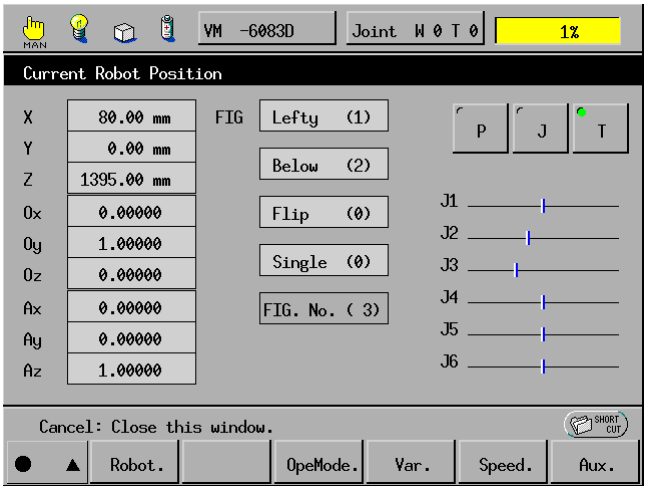
Switching the expression of the current robot position to the tran. variable type

Access: [F2 Arm]—[F9 Show T]

Switches the expression of the current robot position to the homogeneous transform matrix variable type.

Press [F9 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.



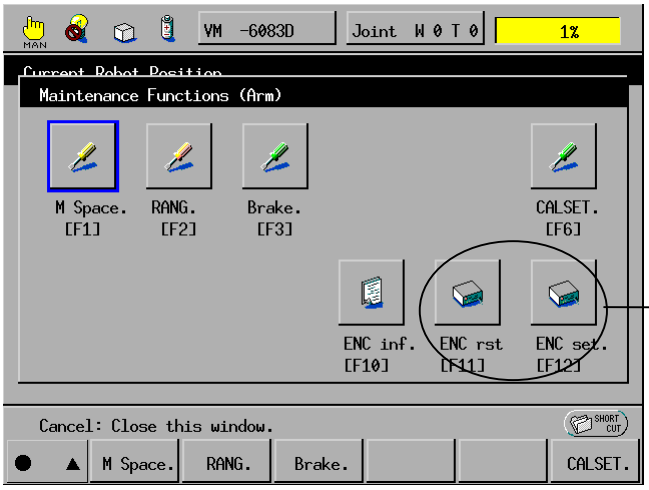
Displaying the Maintenance Functions (Arm) window

Access: [F2 Arm]—[F12 Maint.]

Displays the Maintenance Functions (Arm) window.

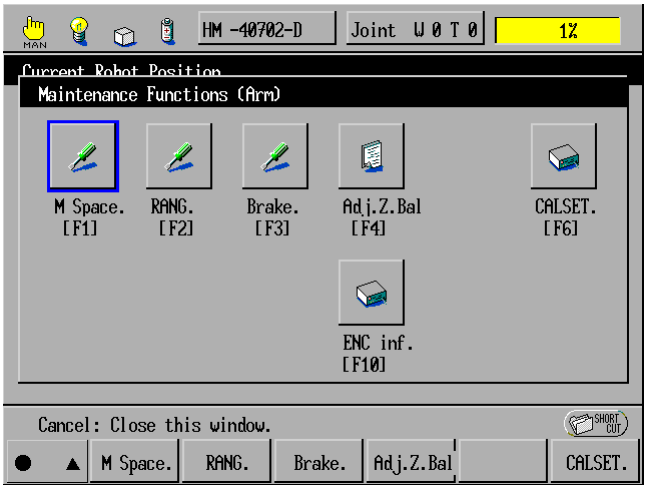
(1) Press [F12 Maint.] in the Current Robot Position window, and the Maintenance Functions (Arm) window will appear as shown below.

■ V⋆-D series



(For the VM-D series only)

■ H⋆-D series



(2) Select the desired maintenance function. The corresponding window will display as described on pages 5-94 through 5-103.

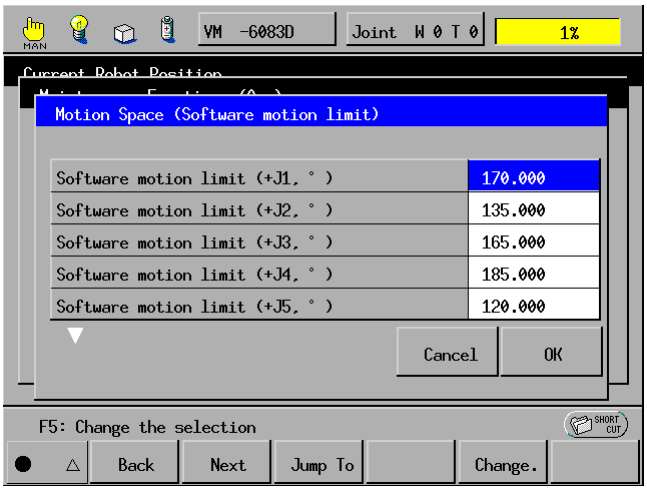
Setting the motion space (software motion limit)

Access: [F2 Arm]—[F12 Maint.]—[F1 M Space.]

Sets the motion space or software motion limit.

(1) Press [F1 M Space.] in the Maintenance Functions (Arm) window.

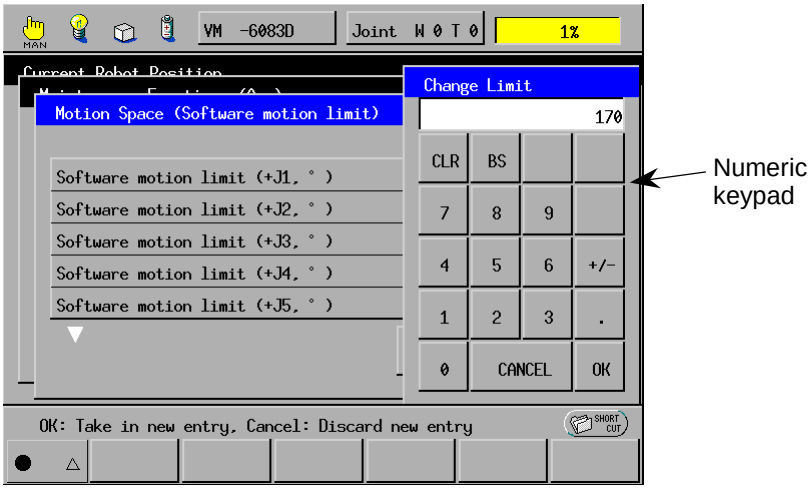
The Motion Space (Software motion limit) window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

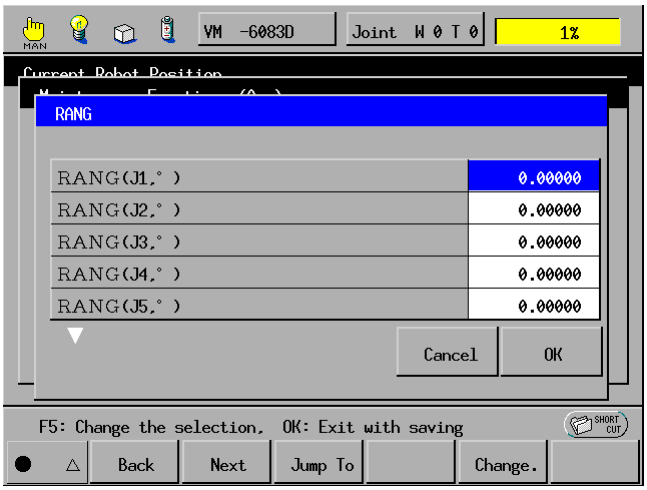
To cancel the new entry, press the Cancel key.

Setting the ready angle

Access: [F2 Arm]—[F12 Maint.]—[F2 RANG.]

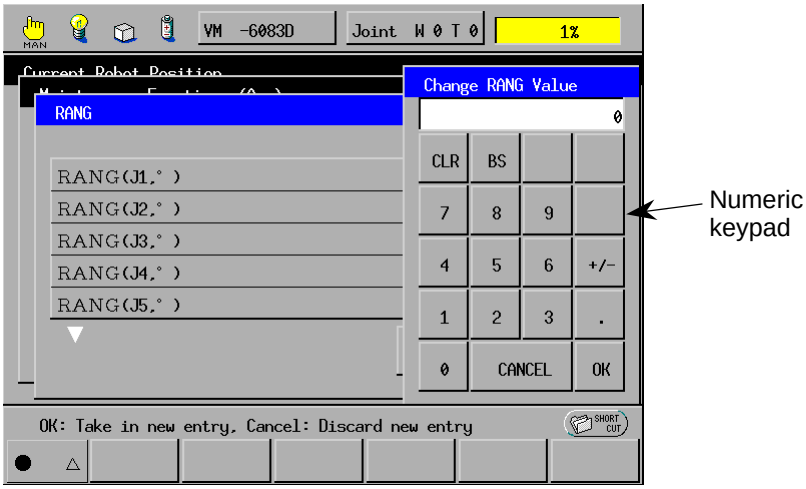
Sets the ready angle (RANG).

(1) Press [F2 RANG.] in the Maintenance Functions (Arm) window.
The RANG window will appear as shown below.



F5

(2) Select the item to be modified and then press [F5 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.

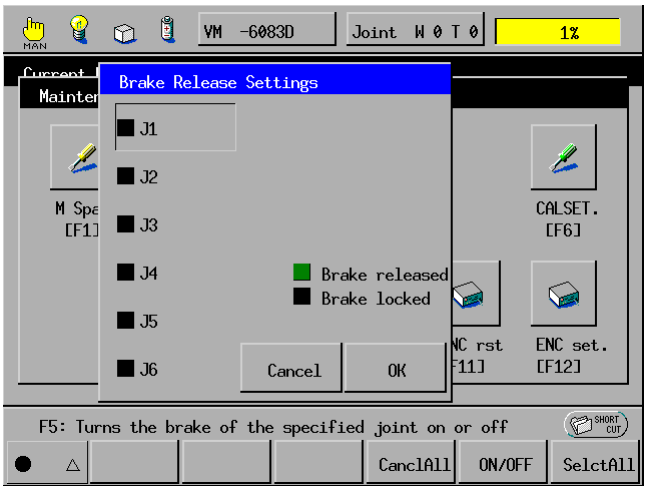
Releasing or locking brakes

Access: [F2 Arm]—[F12 Maint.]—[F3 Brake.]

■ VM-D series

Releases and/or locks J1 to J6 brakes in the V⁎-D series.

(1) Press [F3 Brake.] in the Maintenance Functions (Arm) window.
The Brake Release Settings window will appear as shown below.



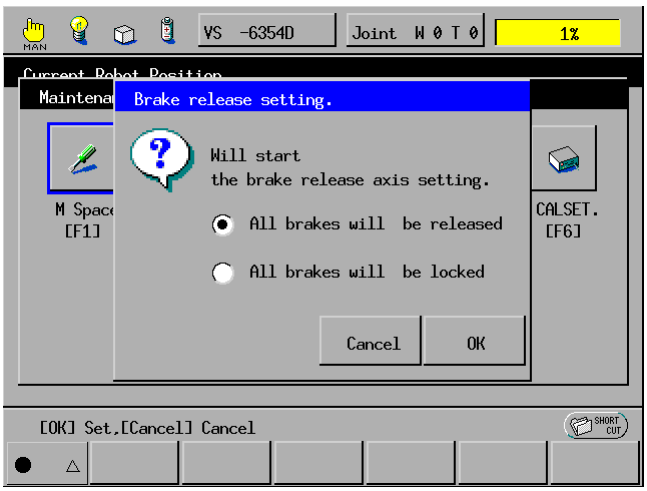
(2) Select the target brake.

(3) Press [F5 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 [F4 CanclAll]; to release them, press [F6 SelctAll].

(4) Check the brake status, and then press the OK button to make the new entry take effect.

■ VS-D series

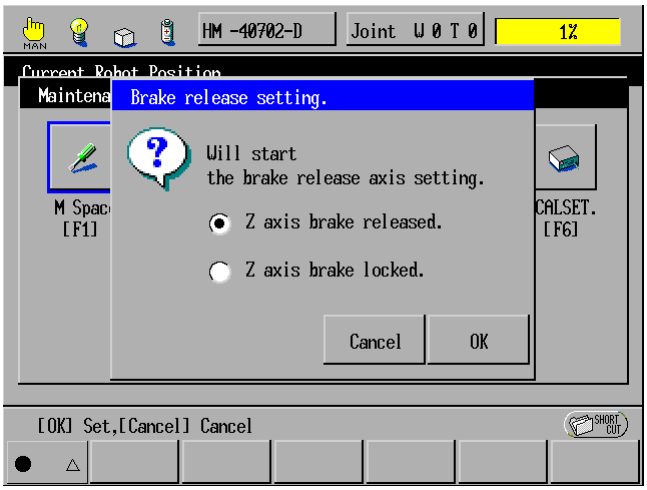
Releases and locks the play keys of all the axes in VS-D series.



■ H*-D series

Releases or locks the Z-axis brake in the H*-D series.

(1) Press [F3 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.

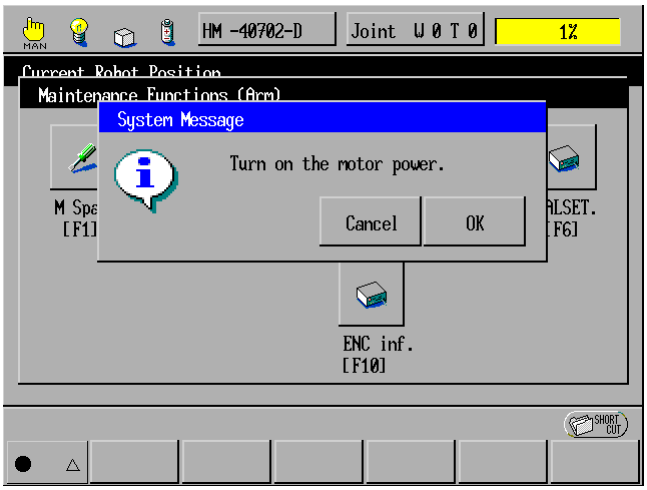
Adjusting the air pressure balance of the Z axis (in the H-D series)*

Access: [F2 Arm]—[F12 Maint.]—[F4 Adj.Z.Bal]

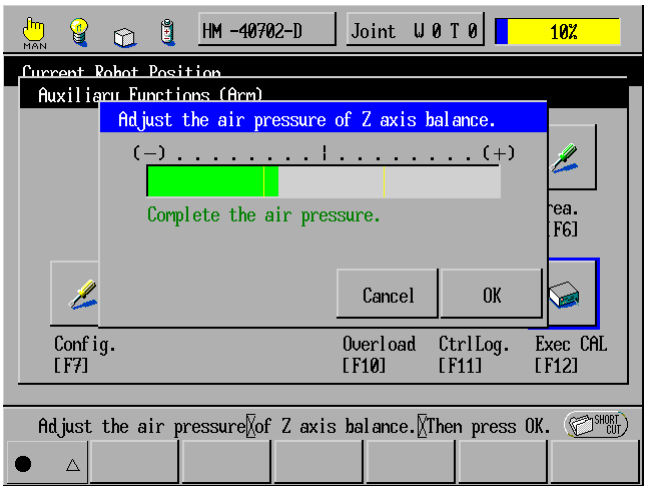
Adjusts the air pressure balance of the Z axis in the H*-D series. (This command cannot apply to the V*-D series.)

(1) Press [F4 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.



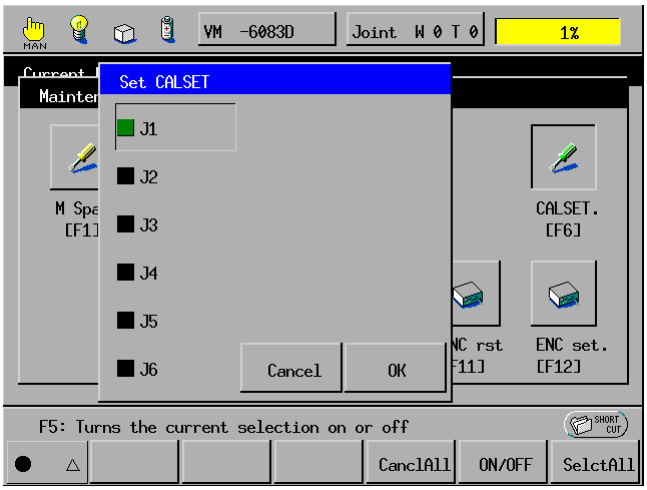
(3) When the following window appears, press the OK button.

Selecting and deselecting joints to be calibrated

Access: [F2 Arm]—[F12 Maint.]—[F6 CALSET.]

Selects and/or deselects joints to be calibrated.

(1) Press [F6 CALSET.] in the Maintenance Functions (Arm) window.
The Set CALSET window will appear as shown below.



(2) Select the target joint.

(3) Press [F5 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 [F4 CanclAll]; to select them for calibration, press [F6 SelctAll].

(4) Check the joint status, and then press the OK button to make the new entry take effect.

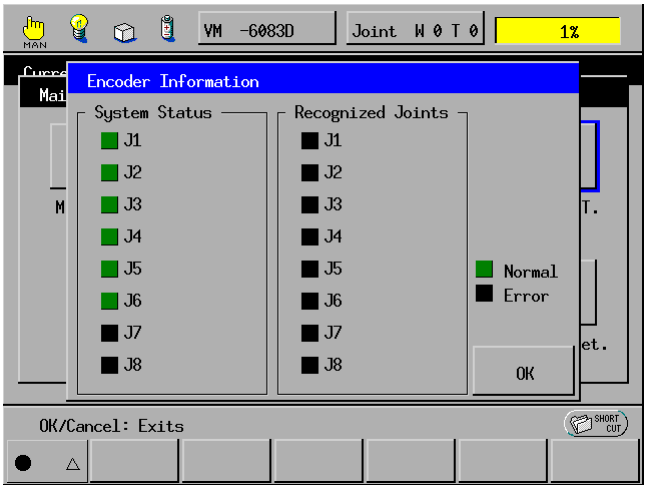
TIP: For details about the CALSET procedure, refer to the INSTALLATION & MAINTENANCE GUIDE, Chapter 4, "CALSET."

Displaying encoder information

Access: [F2 Arm]—[F12 Maint.]—[F10 ENC inf.]

Displays encoder information.

Pressing [F10 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

(For the encoder model connected via bus : VM-D,VS-E and H*-E series)

Access: [F2 Arm]—[F12 Maint.]—[F11 ENC rst]

You need to reset encoders and perform CALSET if:

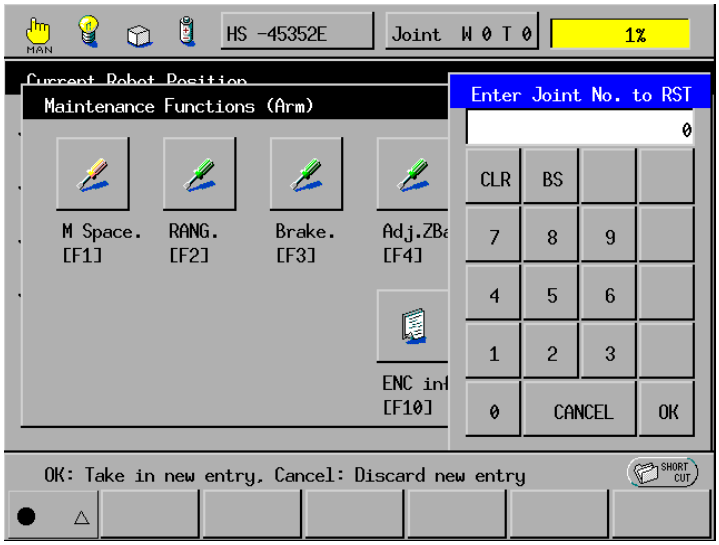
-Error 641* occurs due to run-down encoder backup batteries, or

-Error 677* occurs due to a great impact applied to the robot when the power is off.

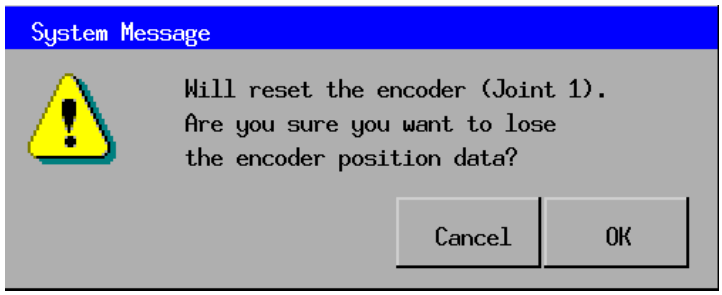
(* is any of 1 to 6 denoting the object axis.)

This section describes how to reset encoders. (This procedure can apply only to the VM-D, VS-E and H*-E series.)

(1) Pressing [F11 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, and press [OK]. System Message appears.



(3) Pressing [OK], the encoder of the selected axis will be reset.

Setting ID data of motor encoders

(For the encoder model connected via bus : VM-D,VS-E and H*-E series)

Access: [F2 Arm]—[F12 Maint.]—[F12 ENC set]

Sets the ID data of motor encoders. (This command can apply only to the VM-D , VS-E and H*-E series.)

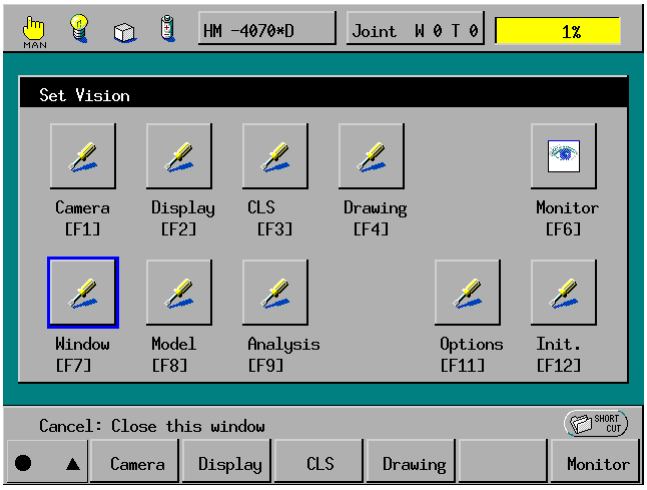
This command is intended for DENSO WAVE service personnel only. Do not use this command.

5.4 Displaying the Vision Menu

Access: [F3 Vision]

Pressing [F3 Vision] on the top screen will display the Set Vision menu as shown below.

The [F7 Window] and [F9 Analysis] are newly supported in Version 1.5 or later.

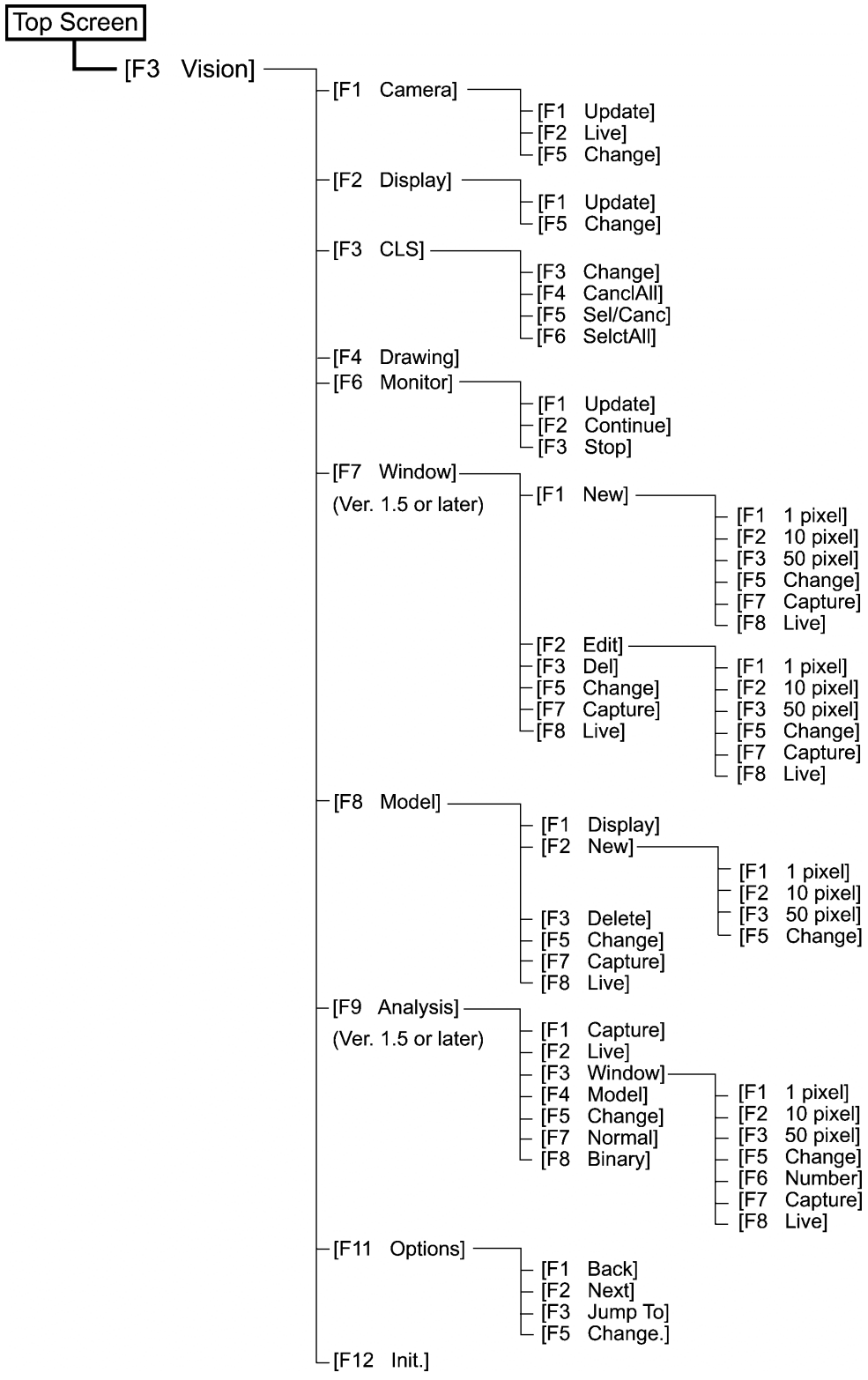


When shifted

NOTE: Before using the vision control [F3 Vision], 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 [F3 Vision] menu is given on the next page.

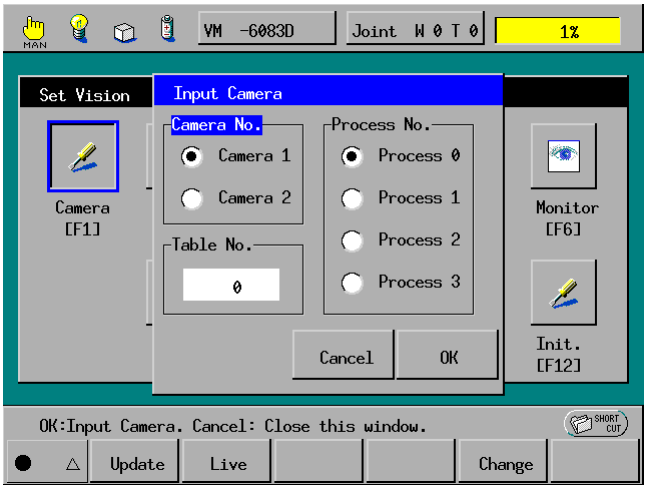

Top Screen
[F3 Vision]
[F1 Camera]
[F1 Update]
[F2 Live]
[F5 Change]
[F2 Display]
[F1 Update]
[F5 Change]
[F3 CLS]
[F3 Change]
[F4 CanclAll]
[F5 Sel/Canc]
[F6 SelctAll]
[F4 Drawing]
[F6 Monitor]
[F1 Update]
[F2 Continue]
[F3 Stop]
[F7 Window]
(Ver. 1.5 or later)
[F1 New]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F7 Capture]
[F8 Live]
[F2 Edit]
[F3 Del]
[F5 Change]
[F7 Capture]
[F8 Live]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F7 Capture]
[F8 Live]
[F8 Model]
[F1 Display]
[F2 New]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F3 Delete]
[F5 Change]
[F7 Capture]
[F8 Live]
[F9 Analysis]
(Ver. 1.5 or later)
[F1 Capture]
[F2 Live]
[F3 Window]
[F4 Model]
[F5 Change]
[F7 Normal]
[F8 Binary]
[F1 1 pixel]
[F2 10 pixel]
[F3 50 pixel]
[F5 Change]
[F6 Number]
[F7 Capture]
[F8 Live]
[F11 Options]
[F1 Back]
[F2 Next]
[F3 Jump To]
[F5 Change.]
[F12 Init.]

Getting image signals from the specified camera into the vision board

Access: [F3 Vision]—[F1 Camera]

Sets the camera input parameters and gets image signals sent from the specified camera into the μVision board.

(1) Press [F1 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 [F1 Update] to get image signals from the specified camera.

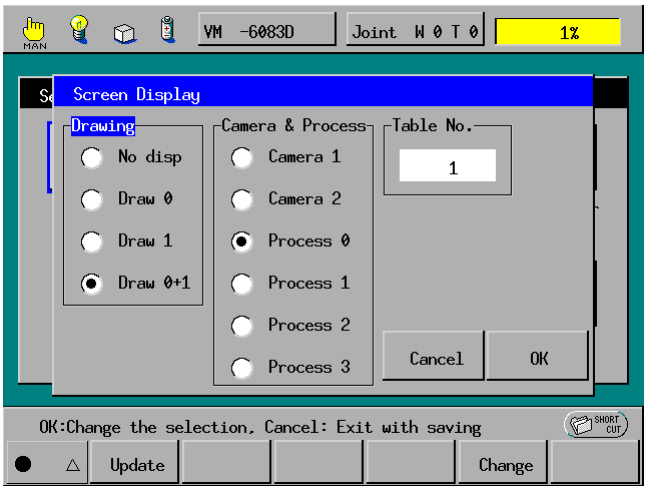
Function keys available	
[F1 Update]	Updates camera input parameters and reads image signals from the camera. The Camera Input window remains open.
[F2 Live]	Displays the image of the camera selected on the monitor by lookup table 0 (fixed).
[F5 Change]	Displays the numeric keypad where you may modify the table number.

Displaying the specified image on the monitor

Access: [F3 Vision]—[F2 Display]

Sets the monitor display parameters and displays the specified image on the monitor.

(1) Press [F2 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

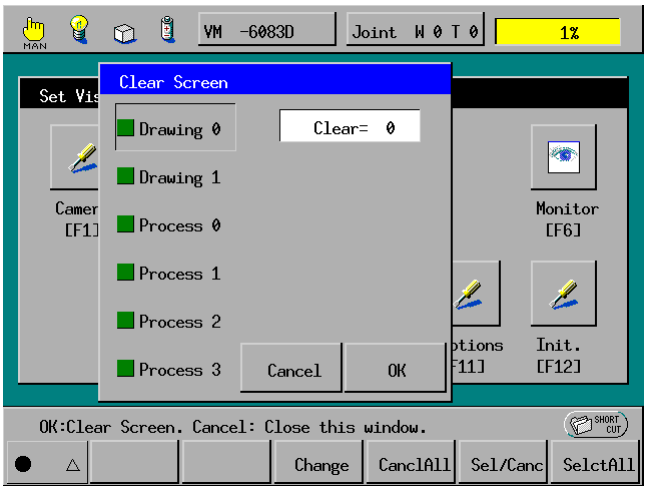
Function keys available	
[F1 Update]	Updates monitor display parameters and calls up the specified image on the monitor. The Screen Display window remains open.
[F5 Change]	Displays the numeric keypad where you may modify the table number.

Clearing the drawing screen or process screen

Access: [F3 Vision]—[F3 CLS]

Clears data on the specified drawing screen or process screen.

(1) Press [F3 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.

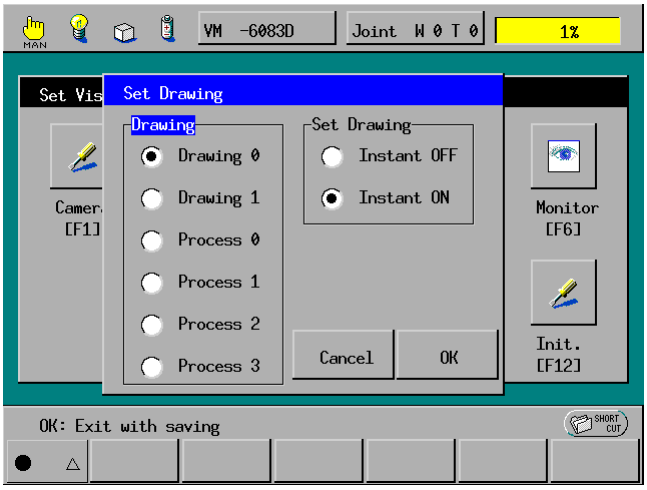
Function keys available	
[F3 Change]	Displays the numeric keypad where you may modify the clear value.
[F4 CanclAll]	Cancels all the selections of the screen.
[F5 Sel/Canc]	Selects/cancels selection of the screen to be cleared.
[F6 SelctAll]	Selects all the screens.

Setting the drawing destination screen

Access: [F3 Vision]—[F4 Drawing]

Sets the drawing destination screen. The settings of the µVision board appear as the selected values when the menu is selected.

(1) Press [F4 Drawing] in the Set Vision window, and the Set Drawing window will appear as shown below.



The drawing destination screen remains the same as the one specified in this menu, unless it is specified again by VISSCREEN when the programs is running.

When "VISSCREEN 1, 0, 1" is executed, the resultant screen will look like the one shown above.

Displaying the camera input screen and process screen

Access: [F3 Vision]—[F6 Monitor]

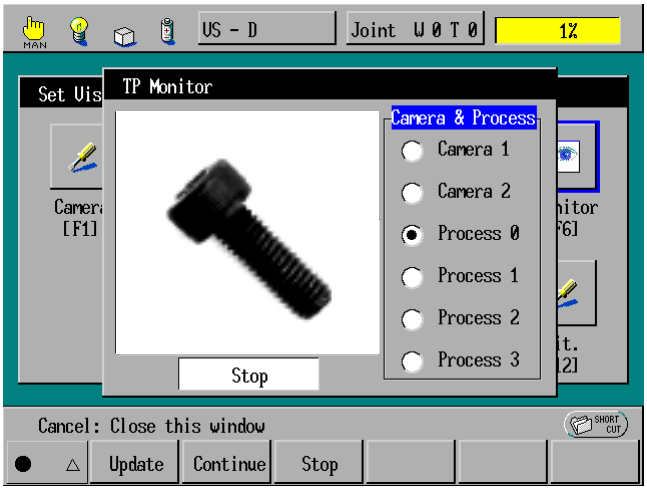
Displays a camera image and process screen image on the LCD of the teach pendant (TP).

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 [F4 Drawing] in the Set Vision window, and the Set Drawing window will appear as shown below.



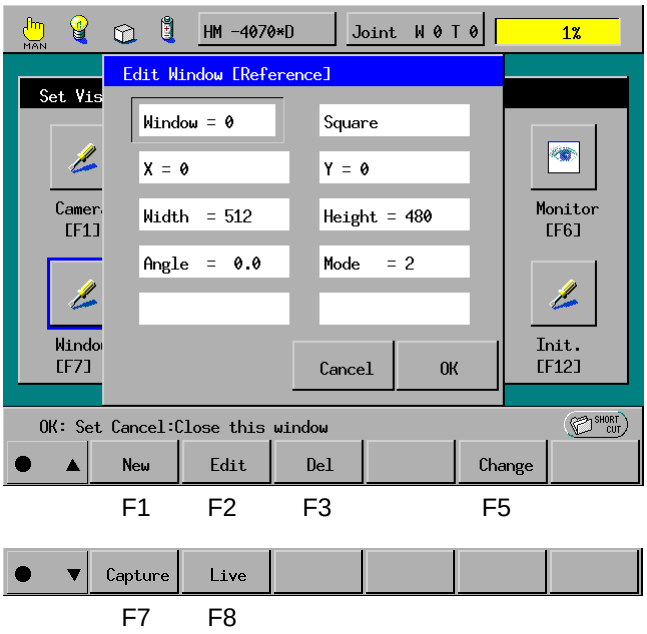
Function keys available	
[F1 Update]	Updates the teach pendant screen according to the settings.
[F2 Continue]	Gets camera images continuously. If Camera 1 or 2 is selected, the images will be get at a rate of two frames per second (and updated once every 0.5 second).
[F3 Stop]	Stops continuous reading.

Browsing windows to be used in image analysis [Ver. 1.5 or later]

Access: [F3 Vision]—[F7 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 [F7 Window] in the Set Vision window, and the Edit Window will display as shown below.



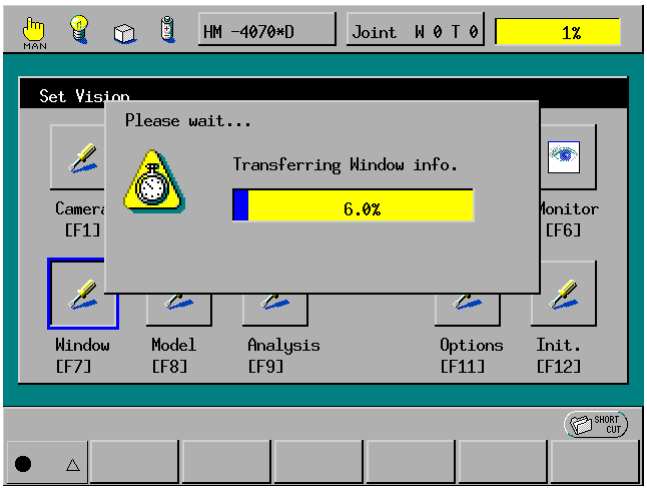
Parameters		Description
Window No.	:	Number assigned to a window (0 to 255)
Window type	:	Shape of a window (Square, line, circle, ellipse, or sector)
X origin	:	X-coordinate origin of a stored window (0 to 511)
Y origin	:	Y-coordinate origin of a stored window (0 to 480)

Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL.

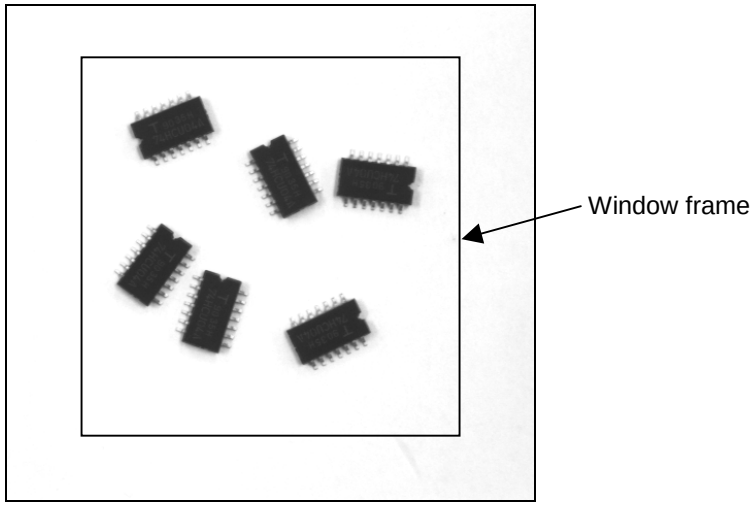
Function keys available	
[F1 New]	Creates, edits, and saves a new window (Edit mode)
[F2 Edit]	Edits a window already stored (Edit mode)
[F3 Del]	Deletes data of the selected window number. The deleted data will be completely lost.
[F5 Change]	Changes the window number.
[F7 Capture]	Captures a camera image and displays it on the process screen.
[F8 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).



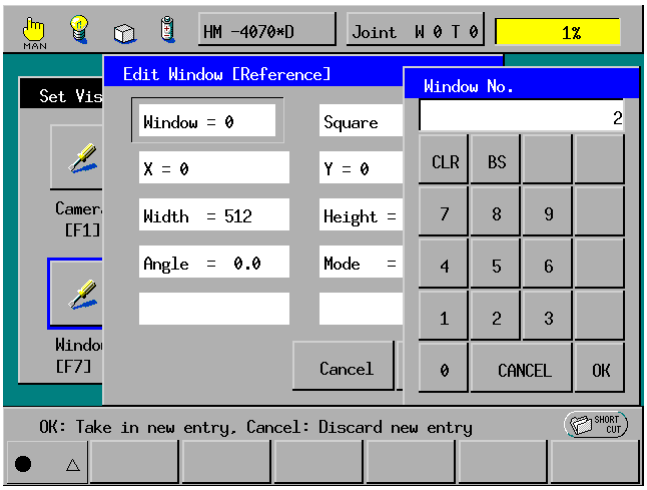
Creating, editing and saving a new window (Edit mode) [Ver. 1.5 or later]

Access: [F3 Vision]—[F7 Window]—[F1 New]

Creates, edits and saves a new window.

(1) Press [F1 New] in the Edit Window, and the numeric keypad will appear as shown below.

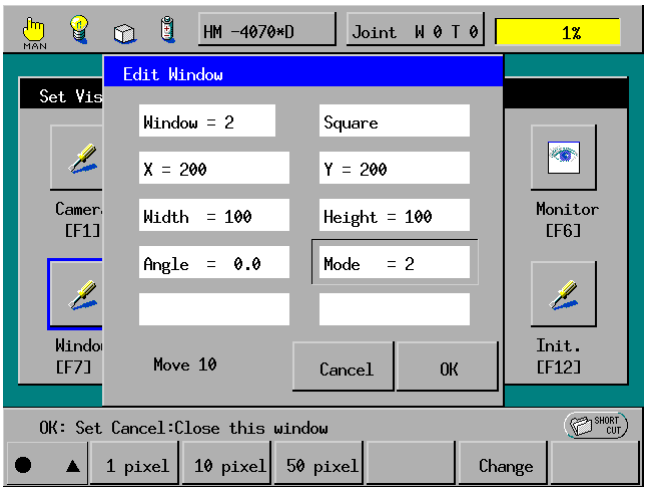
(2) Enter the number of a new window to be created.



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)

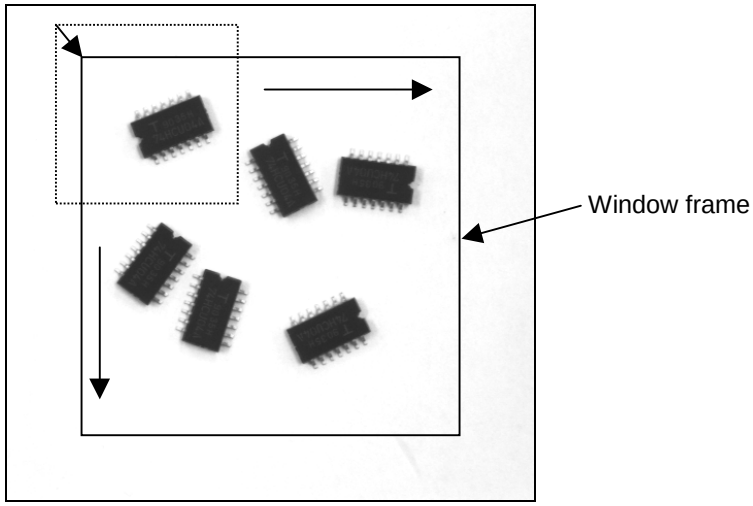
Other parameters differ depending upon window shapes. For further details regarding window shapes, refer to "WINDMAKE" in the PROGRAMMER'S MANUAL.

(3) Press OK. The system message will appear and then the following Edit Window will display.



Function keys available	
[F1 1 pixel]	Specifies the movement quantum in units of 1 pixel.
[F2 10 pixel]	Specifies the movement quantum in units of 10 pixels.
[F3 50 pixel]	Specifies the movement quantum in units of 50 pixels.
[F5 Change]	Changes each model data.
[F7 Capture]	Captures a camera image and displays it on the process screen.
[F8 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.

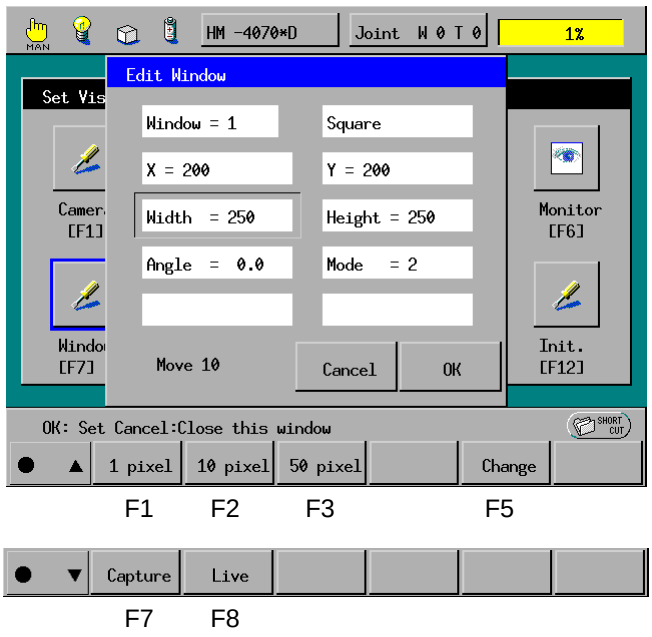


Editing and saving an existing window (Edit mode) [Ver. 1.5 or later]

Access: [F3 Vision]—[F7 Window]—[F2 Edit]

Edits and saves a new window.

(1) Press [F2 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.

(2) Other operating procedure is the same as in [F1 New].

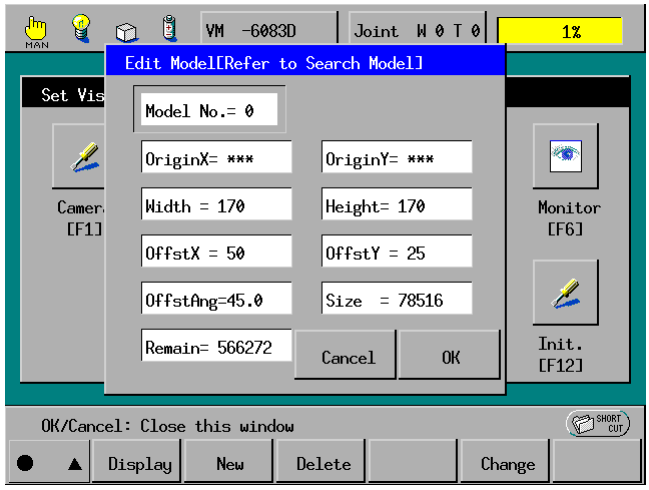
Function keys available	
[F1 1 pixel]	Specifies the movement quantum in units of 1 pixel.
[F2 10 pixel]	Specifies the movement quantum in units of 10 pixels.
[F3 50 pixel]	Specifies the movement quantum in units of 50 pixels.
[F5 Change]	Changes each model data.
[F7 Capture]	Captures a camera image and displays it on the process screen.
[F8 Live]	Switches to a camera image.

Browsing the stored model data

Access: [F3 Vision]—[F8 Model]

Browses the stored model data that is required in search function.

(1) Press [F8 Model] in the Set Vision window, and the Edit Model window will appear as shown below.



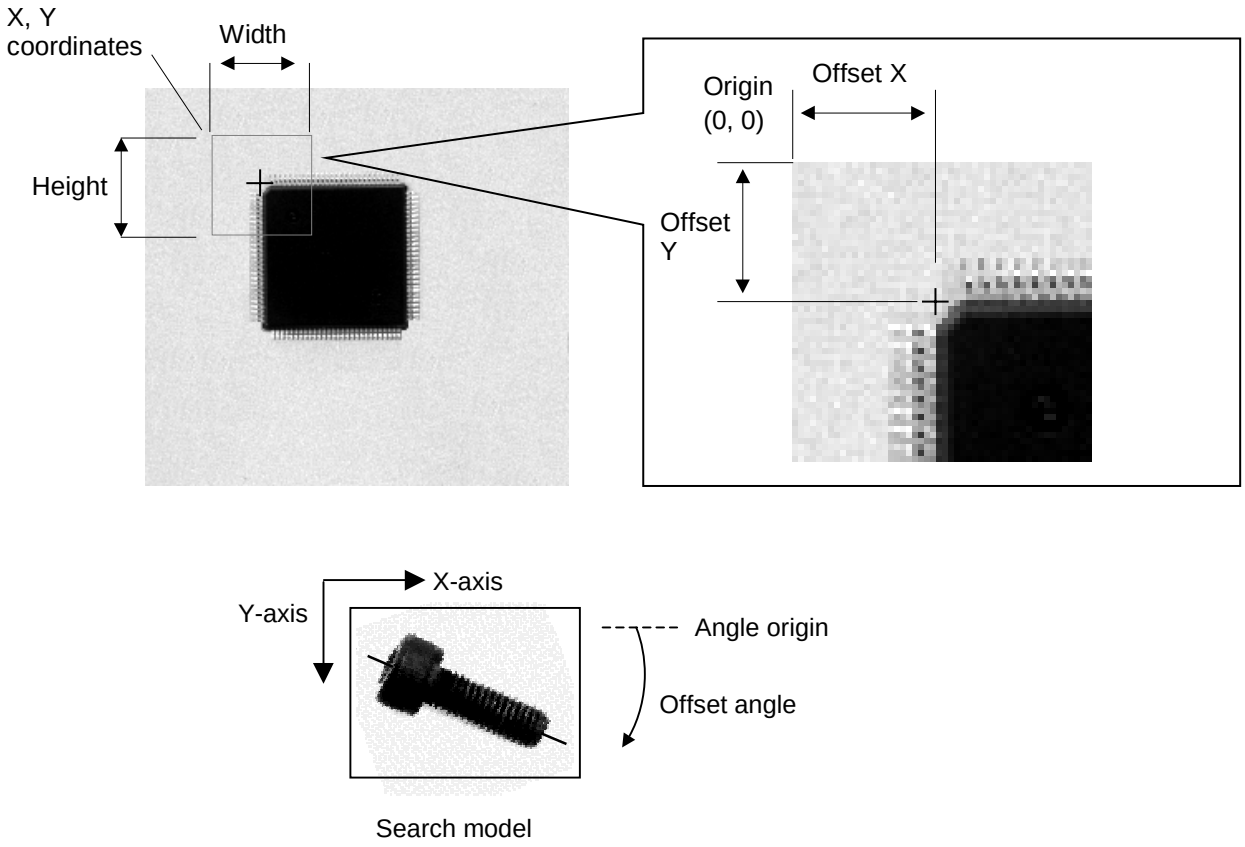
When shifted

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 453)
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 "***."

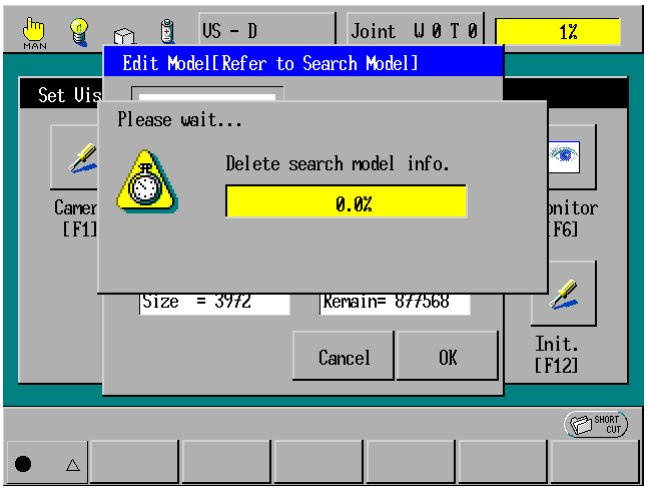
When a new model is created, process screen 3 is used as a work area and hence the contents of the screen will change.

Function keys available	
[F1 Display]	Displays the image of the selected model number on the monitor.
[F2 New]	Creates and stores a new model (in Edit mode).
[F3 Delete]	Deletes the data of the selected model number. The deleted data is lost completely.
[F5 Change]	Allows you to modify model numbers.
[F7 Capture]	Captures a camera image and displays it on the process screen.
[F8 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.

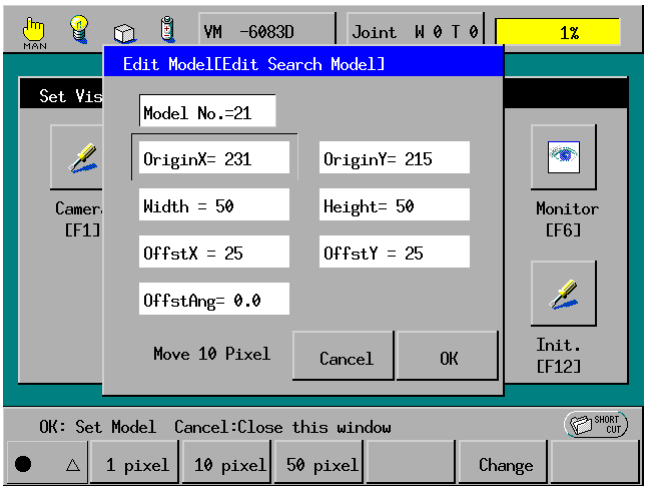


Creating a new model

Access: [F3 Vision]—[F8 Model]—[F2 New]

Creates a new model and stores it.

(1) Press [F2 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 463)
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	
[F1 1 pixel]	Specifies the movement quantum at the rate of 1 pixel.
[F2 10 pixel]	Specifies the movement quantum at the rate of 10 pixels.
[F3 50 pixel]	Specifies the movement quantum at the rate of 50 pixels.
[F5 Change]	Allows you to modify model data.

Analyzing images [Ver. 1.5 or later]

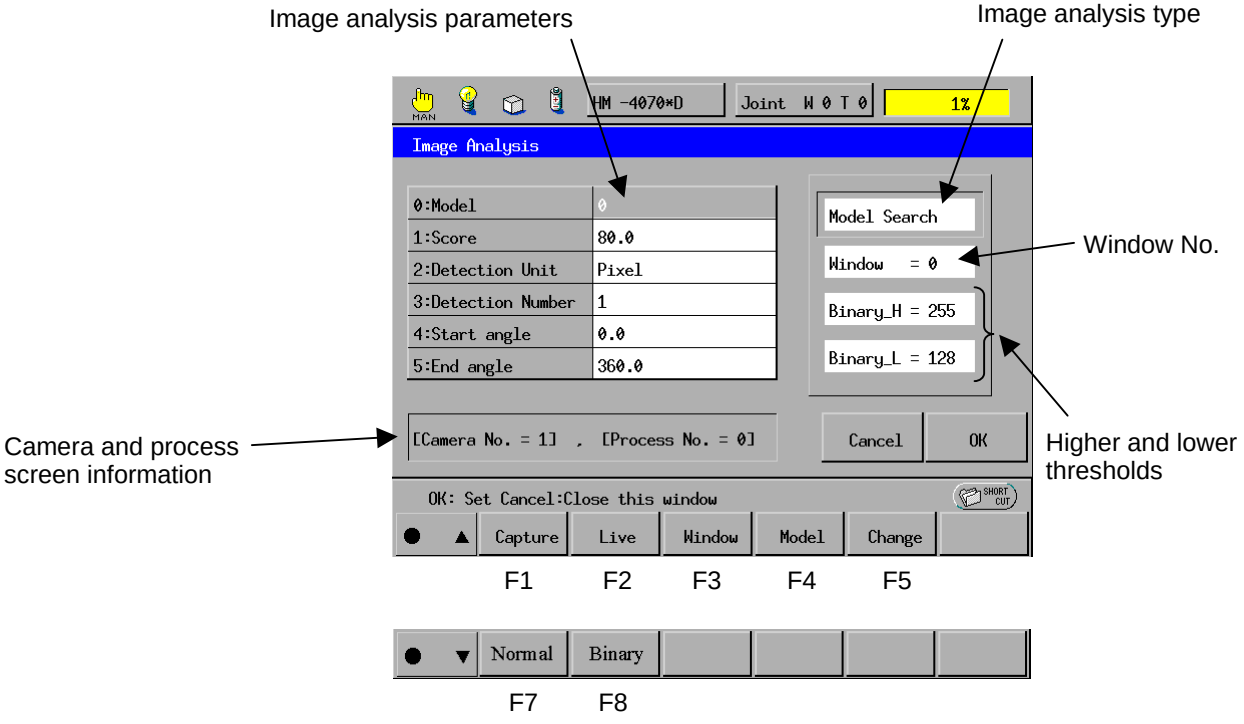
Access: [F3 Vision]—[F9 Analysis]

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	
Edge finding	VISEDGE	
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 codes.
Filter processing	VISFILTER	Filters input screens.
Circle search	SHCIRCLE	
Corner search	SHCORNER	

(1) Press [F9 Analysis] in the Set Vision window, and the Image Analysis window will display as shown below.



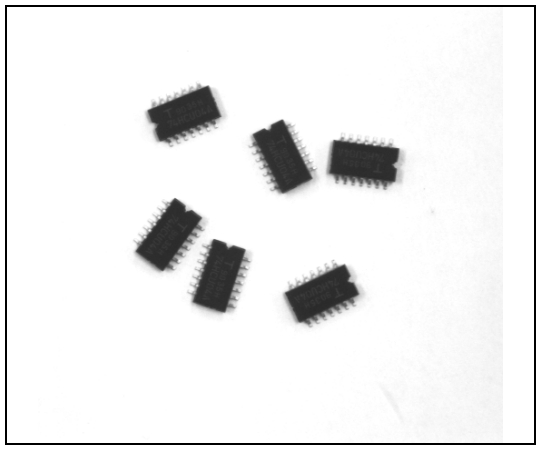
Window No. : Number of the target window to be processed.
Binary vision parameters : Specifies the upper and lower limits for binary vision.

Function keys available	
[F1 Capture]	Captures a camera image and displays it on the process screen.
[F2 Live]	Switches to a camera image.
[F3 Window]	Sets the shape and size of a temporary window.
[F4 Model]	Temporarily displays the image of the model to be searched in model search.
[F5 Change]	Changes parameter values.
[F7 Normal]	Switches to the normal vision where a grayscale image displays in 256-tone.
[F8 Binary]	Switches to the binary vision where a binary image displays in 2-tone.

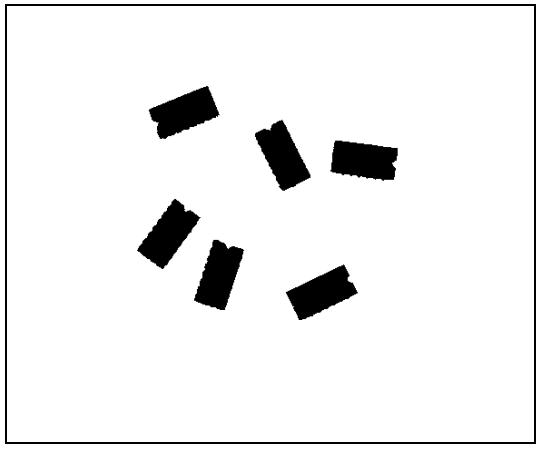
(2) Select the desired image analysis.

Pressing [F8 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

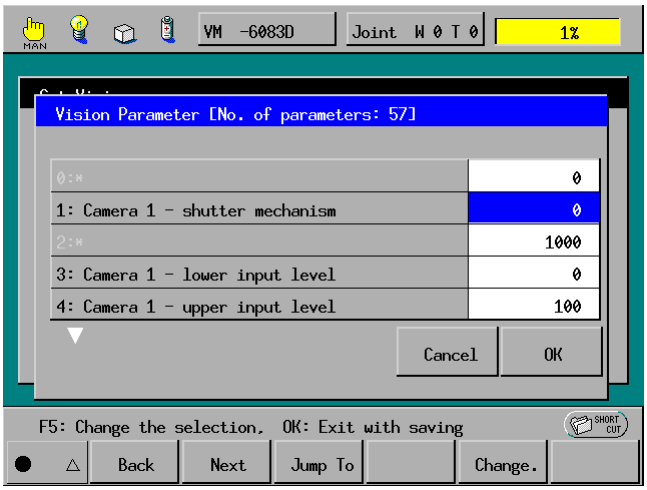


Setting or modifying vision board parameters

Access: [F3 Vision]—[F11 Options]

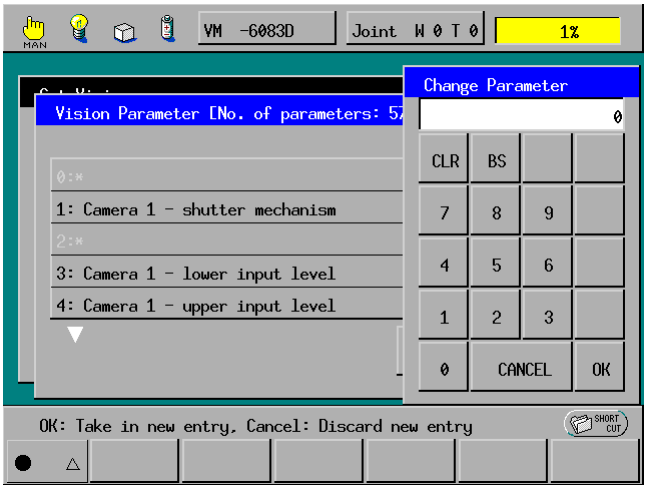
Sets or modifies vision board parameters.

(1) Press [F11 Options] in the Set Vision window, and the Vision Parameters window will appear as shown below.



Function keys available	
[F1 Back]	Displays the previous page of the parameter list.
[F2 Next]	Displays the next page of the parameter list.
[F3 Jump To]	Displays the setup data of the specified number.
[F5 Change.]	Displays the numeric keypad where you may enter a new parameter.

(2) To modify the parameters, press [F5 Change.]. The numeric keypad will appear as shown below.



Initializing the vision board

Access: [F3 Vision]—[F12 Init.]

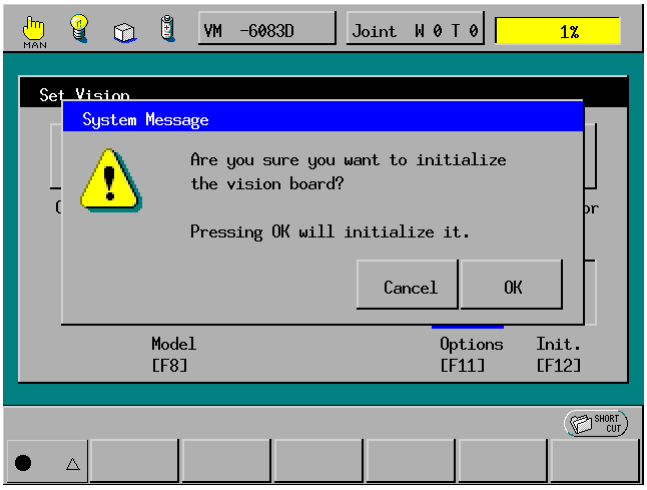
Initializes the vision board to the default settings. This is equivalent to the powering-on reset. This function resets settings made in programs, such as temporary window data, drawing-related settings made in programs, image data in the process screen memory.

Use this function 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 WINCAPSII or with the teach pendant. Doing so will initialize the vision board so that no correct setting may be made.

(1) Press [F12 Init.] in the Set Vision window, and the system message will appear as shown below.

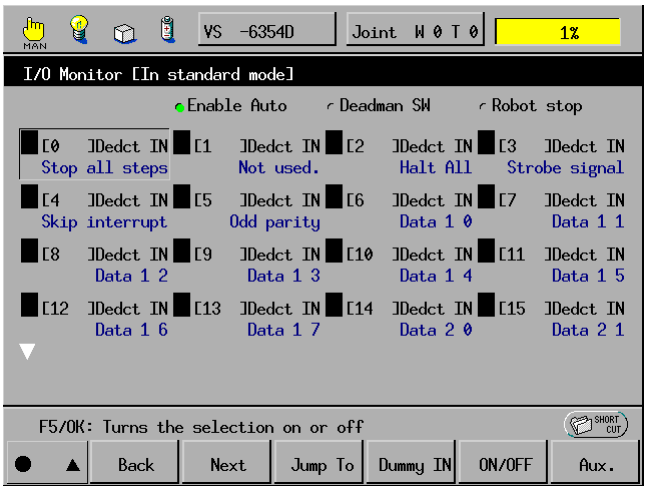


5.5 Displaying I/O Signals and Simulating Robot Motion

Access: [F4 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 [F4 I/O] on the top screen will display the I/O Monitor window as shown below.



F1 F2 F3 F4 (F10) F5 F6

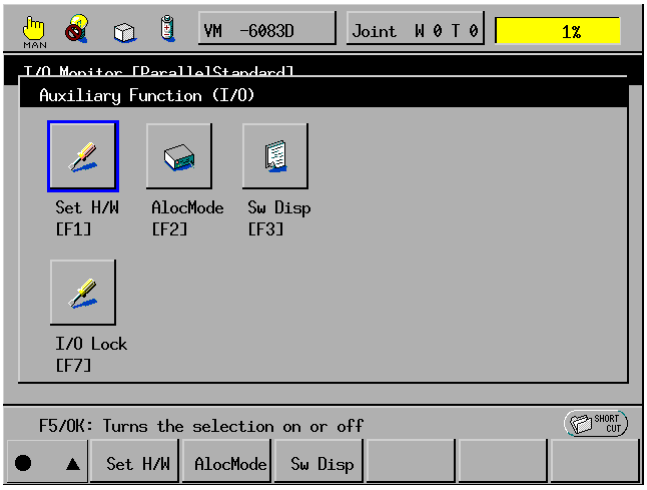
Function keys available	
[F1 Back]	Displays the previous page of the I/O signal list.
[F2 Next]	Displays the next page of the I/O signal list.
[F3 Jump To]	Displays the Jump to I/O No. window where you may type an I/O port address you want to see with the numerical keys and press OK. Doing so will display the target input or output signal.
[F4 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 function is useful for testing programs.
[F5 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).
[F6 Aux.]	Details are given on the next page.
[F10 ClrDummy]	Clears the dummy input setting.

Providing auxiliary functions

Access: [F4 I/O]—[F6 Aux.]

Provides the auxiliary functions concerning I/Os.

Pressing [F6 Aux.] in the I/O Monitor window will display the Auxiliary Function (I/O) window as shown below.

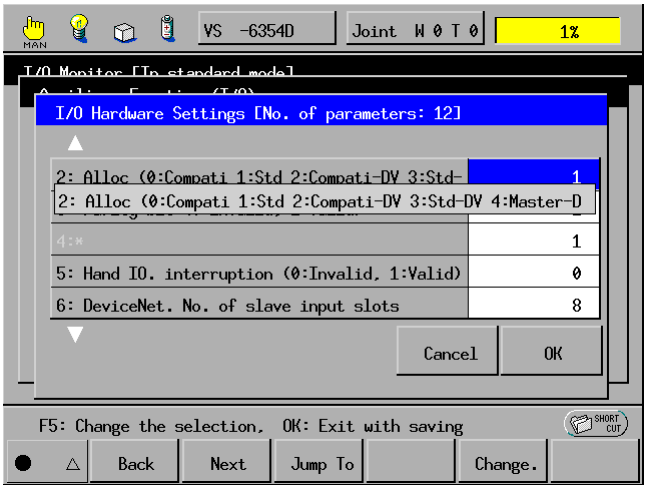


Configuring hardware

Access: [F4 I/O]—[F6 Aux.]—[F1 Set H/W]

Configures hardware such as I/O assignment mode and DeviceNet expansion.

(1) Press [F1 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 [F5 Change.]. You may modify the setting.

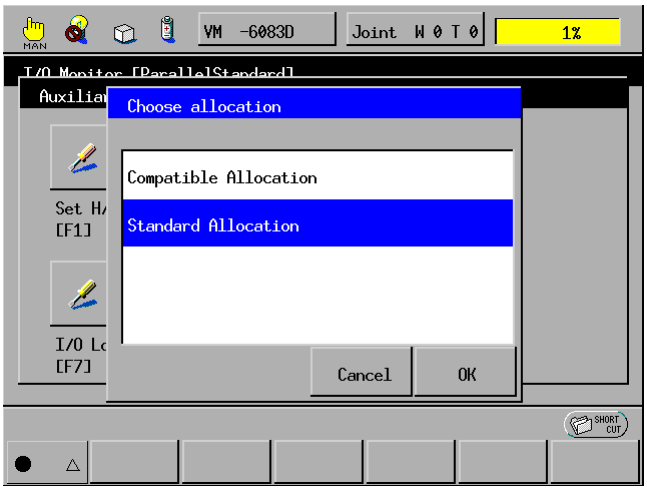
Switching between standard and compatible allocation modes [Ver. 1.6 or later]

Access: [F4 I/O]—[F6 Aux.]—[F2 AlocMode]

Switches between the standard and compatible allocation modes from the teach pendant.

(1) Press [F2 AlocMode] in the Auxiliary Functions (I/O) window. The Choose allocation window appears as shown below.

NOTE: If your controller is equipped with a DeviceNet master board, the "Choose dedicated port allocation" window will appear instead. For details, refer to User's Manual of the DeviceNet Master Unit, Chapter 3 "I/O Allocation."



(2) Using the jog dial or 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.

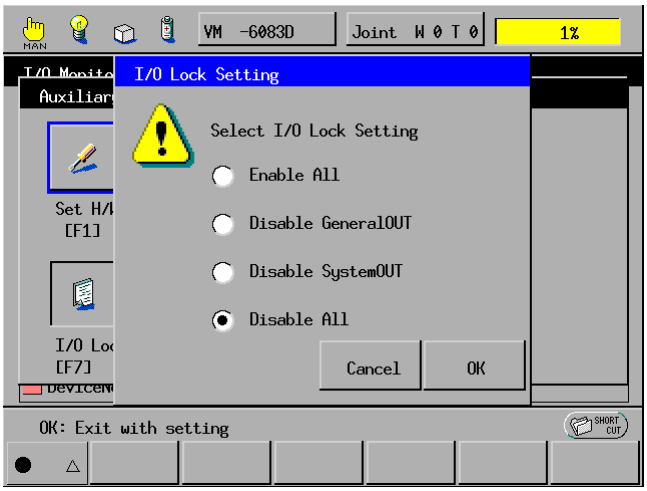
The I/O allocation mode is changed.

Setting I/O output restrictions when machine is locked [Ver. 1.4 or later]

Access: [F4 I/O]—[F6 Aux.]—[F7 I/O Lock]

Sets the I/O output restriction range when machine is locked.

(1) Press [F7 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.

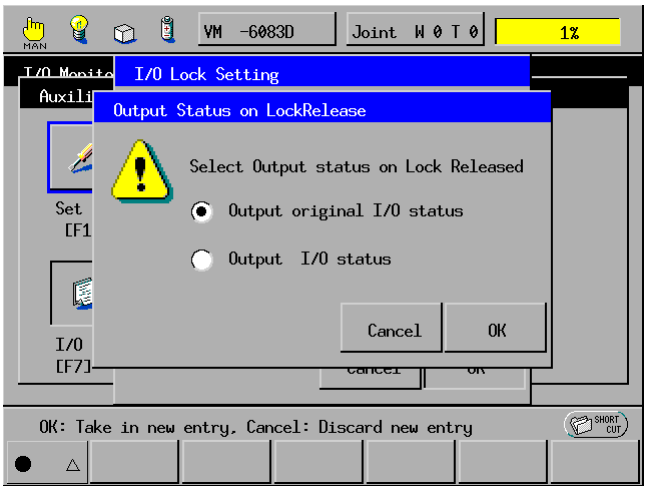
Then, the Output Conditions Setting When Machine Lock is released window will appear.

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.

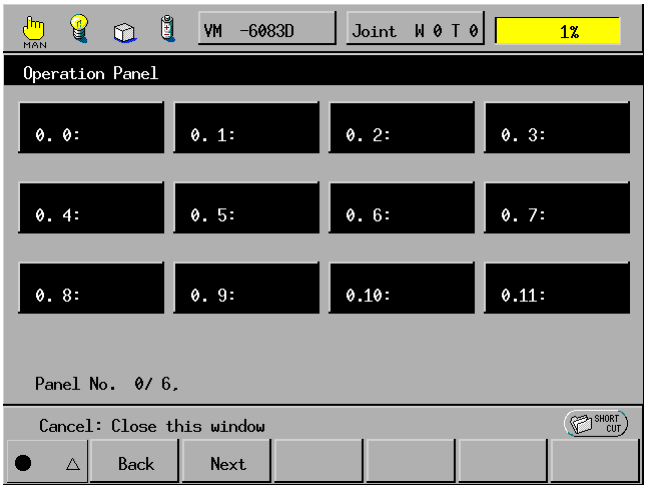
5.6 Displaying the Operation Panel

Access: [F5 OpePanel]

Displays the operation panel on the teach pendant screen.

Pressing [F5 OpePanel] on the top 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.



F1 F2

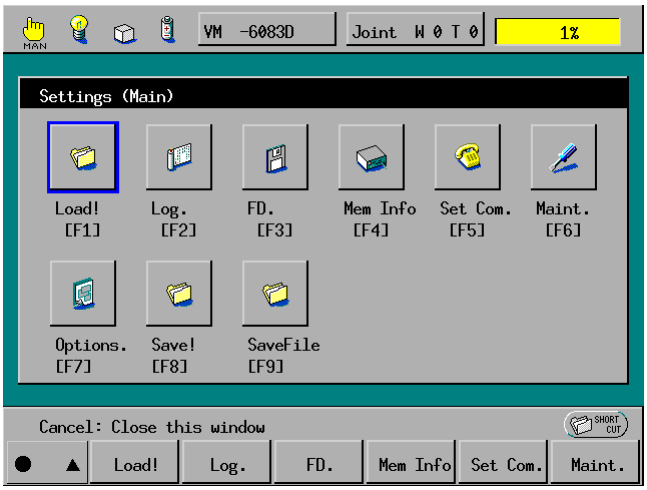
Function keys available	
[F1 Back]	Displays the previous page of the operation panel.
[F2 Next]	Displays the next page of the operation panel.

5.7 Displaying the Settings (Main) Window

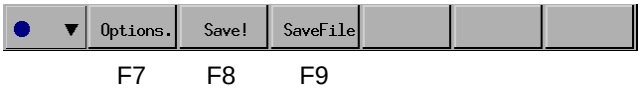
Access: [F6 Set]

Displays the Settings (Main) window.

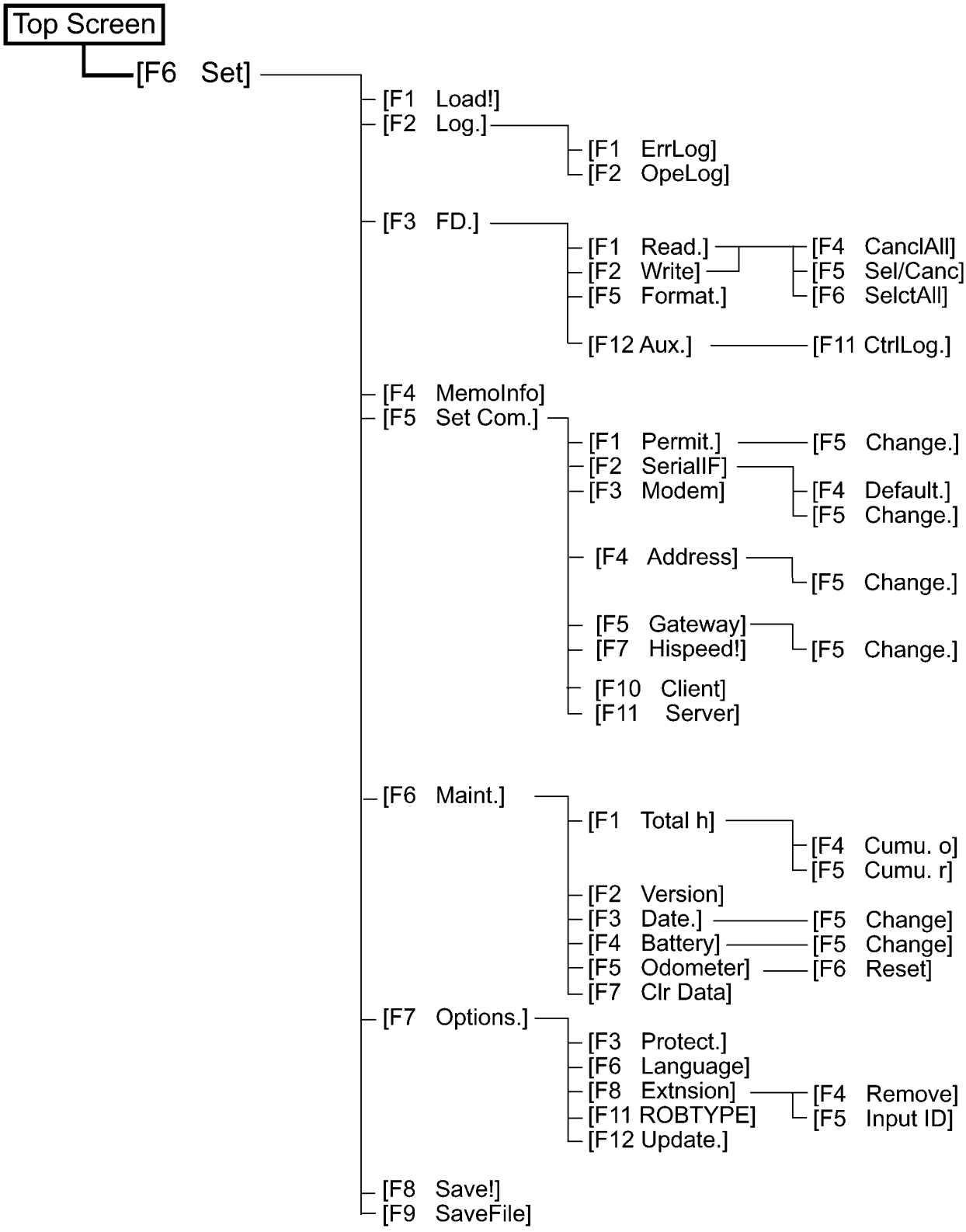
(1) Press [F6 Set] on the top screen, and the following window will appear.



When shifted



(2) Select the desired setting function. The corresponding window will display as described on pages 5-132 through 5-171.

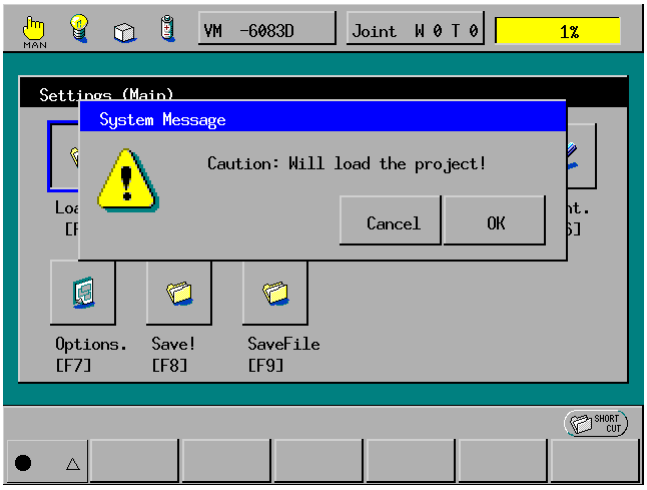

Top Screen
[F6 Set]
[F1 Load!]
[F2 Log.]
[F1 ErrLog]
[F2 OpeLog]
[F3 FD.]
[F1 Read.]
[F2 Write]
[F5 Format.]
[F4 CanclAll]
[F5 Sel/Canc]
[F6 SelctAll]
[F12 Aux.]
[F11 CtrlLog.]
[F4 MemoInfo]
[F5 Set Com.]
[F1 Permit.]
[F5 Change.]
[F2 SerialIF]
[F3 Modem]
[F4 Default.]
[F5 Change.]
[F4 Address]
[F5 Change.]
[F5 Gateway]
[F7 Hispeed!]
[F5 Change.]
[F10 Client]
[F11 Server]
[F6 Maint.]
[F1 Total h]
[F4 Cumu. o]
[F5 Cumu. r]
[F2 Version]
[F3 Date.]
[F5 Change]
[F4 Battery]
[F5 Change]
[F5 Odometer]
[F6 Reset]
[F7 Clr Data]
[F7 Options.]
[F3 Protect.]
[F6 Language]
[F8 Extnsion]
[F4 Remove]
[F5 Input ID]
[F11 ROBTYPE]
[F12 Update.]
[F8 Save!]
[F9 SaveFile]

Loading a project

Access: [F6 Set]—[F1 Load!]

Loads a project sent from the PC teaching system, enabling the robot controller to execute it.

(1) Press [F1 Load!] in the Settings (Main) window, and the following system message dialog box will appear.



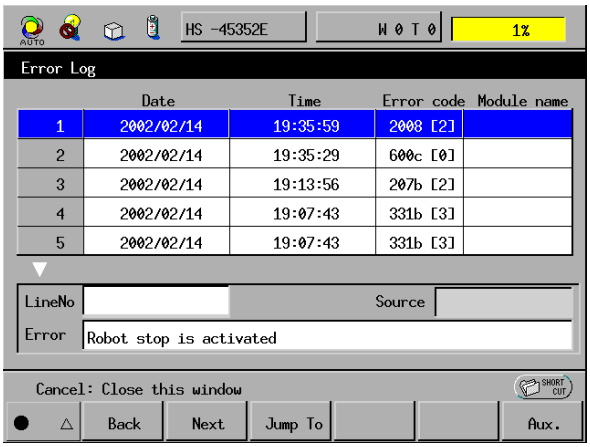
(2) Press the OK button to start loading.

Displaying the error log

Access: [F6 Set]—[F2 Log.]—[F1 ErrLog]

Displays the error log.

(1) Press [F6 Set] - [F2 Log.] - [F1 ErrLog], and the Error Log window will appear as shown below.



F1 F2 F3

In the bottom line of the log list appears the error details of the selected error number.

The LineNo and Source areas show nothing.

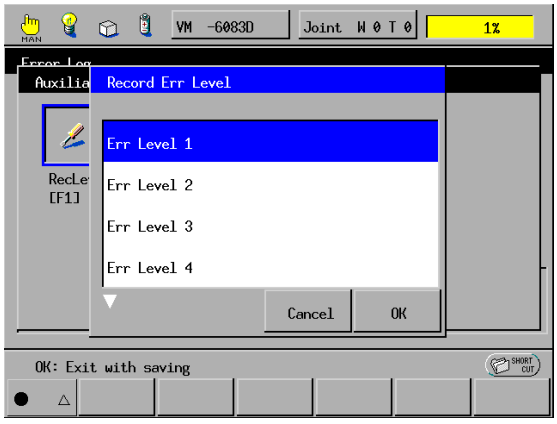
(2) To check older log, scroll the log list with the cursor keys, jog dial, [F1 BACK], or [F2 NEXT]. Or, press [F3 Jump To] to call up the numeric keypad where you enter the line number of the desired error log. Doing so will directly call up the target log.

(3) In Version 1.8 or later, you may choose which level errors should be logged. In the Error Log window shown on the previous page, press [F6 Aux.] and [F1 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.

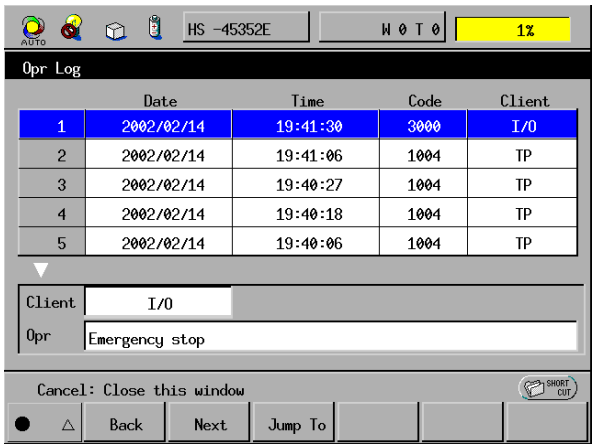


Displaying the operation log [Ver.1.9 or later]

Access: [F6 Set]—[F2 Log.]—[F2 OpeLog]

Displays the error log.

(1) Press [F6 Set] - [F2 Log.] - [F2 OpeLog], and the Operation Log window will appear as shown below.



F1 F2 F3

(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 WINCAPSII
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 environmental 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."

NOTE 3: The operation logging maintains a record of processing operations required for maintenance and does not maintain all operation records.

Displaying the FDD Access Menu

Access: [F6 Set]—[F3 FD.]

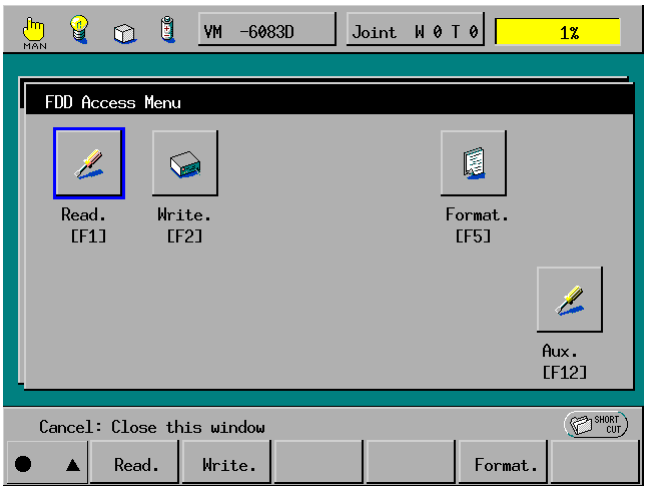
Displays the FDD access menu from which you may access the optional FDD built in the robot controller.

To activate the FDD, the following conditions are necessary:
- The robot controller is placed in Manual mode.
- The motor power is turned off.
- No program is running.

NOTE: If you activate any of the FDD operations without loading a floppy disk in the FDD, the FDD will no longer be used until the robot controller will be turned off and then on again.

NOTE: Use highly reliable floppy disks. No defective sector checker is embedded in the FDD driver.

(1) Press [F9 FD.] in the Settings (Main) window, and the FDD Access Menu will appear as shown below.



F1 F2 F5 (F12)

(2) Select the desired function. The corresponding window will display as described on pages 5-137 through 5-144.

Data which can be handled by the FDD

The table below lists data which the FDD is capable of handling.

When reading or writing data from/to floppy disks, you may select data to be handled according to the data type (program data, variables data, I/O data, arm data, visual-related data, log data, and executable data).

Data Type	File Name (File Contents)	Remarks
Source program data	*.pac file (Source program file)	Only files set to "Enable" can be written to floppy disks.
	*.h file (Header file)	—
	itpcnf.dat file (Interpreter table)	—
	paccnf.dat file (Program table)	—
Variables data	ivar.dat file (Integer variables)	When variable files are read from a floppy disk to the robot controller, the number of variables used in the robot controller will also be changed to the same number as that used in the floppy disk.
	fvar.dat file (Floating-point variables)	
	dvar.dat file (Double-precision variables)	
	vvar.dat file (Vector variables)	
	pvar.dat file (Position variables)	
	jvar.dat file (Joint variables)	
	tvar.dat file (Homogeneous transform matrix variables)	
	svar.dat file (Character string variables)	
I/O data	dioinf.dat file (I/O hardware settings)	—
Arm data	armcnf.dat file (Trajectory settings)	• Never read in arm data prepared for other robots. • Tool and work data modified by TOOL and WORK commands will not be updated when written onto the FD. If you need to write updated data, save system parameters (see p. 5-170) and then write data onto the FD.
	srvcnf.dat file (Servo settings)	
	spdcnf.dat file (Configuration data)	
	toolcnf.dat file (Tool coordinates definition data)	
	workcnf.dat file (Work coordinates definition data)	
	areacnf.dat file (Area coordinates definition data)	
Visual-related data	viscnf.dat file (Visual equipment settings)	—
Log data	comcnf.dat file (Communications settings)	—
	ctrl.log file (Control log)	Write (to floppy disk) only.
	error.txt file (Error log)	
	opration.txt file (Operation log)	
	version.txt file (Version information)	
Executable data (Compiled)	*.nic file (Executable file)	If the total data size exceeds 1MB, writing to floppy disk not possible.
	*.map file (Cross-reference table)	

Data exchange between the robot controller and WINCAPSII

Data (except for executable data) may be exchanged between the robot controller and WINCAPSII by means of floppy disks.

For the operating procedures in WINCAPSII, refer to the WINCAPSII Guide, Chapter 4, Subsections 4.3.4 and 4.3.5.

FD data modification not allowed

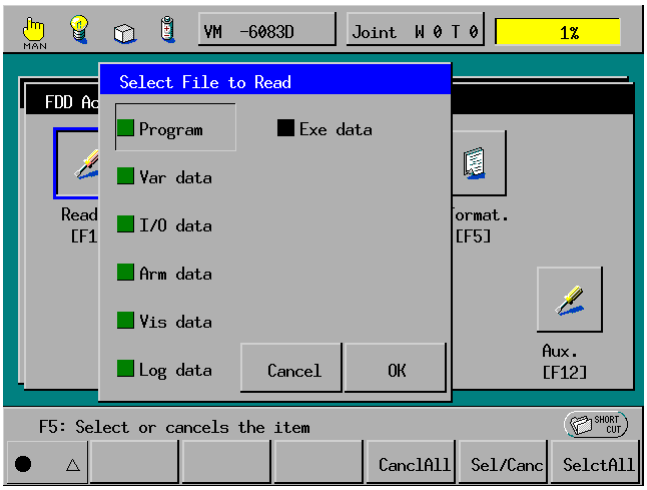
Never modify data stored in floppy disks from the robot controller. Any modification will make it impossible to access that FD data because FD data contains check codes used for checking data corruption and for accurate data read/write.

Reading FD data to the robot controller

Access: [F6 Set]—[F3 FD.]—[F1 Read.]

Reads data stored on a floppy disk to the robot controller.

(1) Press [F1 Read.] in the FDD Access Menu, and the Select File to Read window will appear as shown below.



(2) Select data to be read from the floppy disk, and then press the OK button.

⚠**CAUTION:** Never read in arm data prepared for other robots. Doing so will cause the robot to malfunction. It is very DANGEROUS.

The FDD will start reading the FD data.

NOTE: If data is split and stored into more than one floppy disk, insert those disks in an ascending order of the volume numbers (assigned when data has been written onto those disks).

(3) After reading, be sure to restart the robot controller.

If you read program data, refer to "Note for reading *program* data from FD" given on the next page.

⚠**CAUTION:** Without restarting, the robot may not run normally.

Notes for reading *program* data from FD

When reading *program* data from the inserted floppy disk into the robot controller, the system will first remove all program data and executable data stored in the robot controller and then start reading *program* data from the floppy disk.

If selected data to be read contains program data but not executable data; therefore, you need to compile and load the read program data according to the steps below.

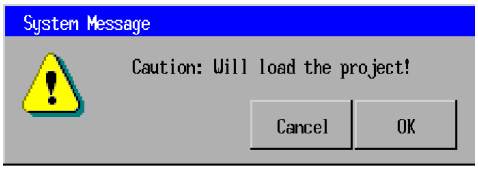
1) On the top screen of the teach pendant, press [F1 Program] to display the Program List window.

2) Press the Config. button in the bottom of the Program List or press [F12 Config.] in the menu bar. In the system message window shown below, select "All programs are active." to set all programs to "Enable" and then press the OK button to proceed.

3) On the top screen, press [F1 Program]—[F6 Aux.]—[F12 Compile] to compile all programs.

The following system message appears. Press the OK button to proceed.

Upon completion of compiling, the following system message appears. Press the OK button to proceed.



4) Restart the robot controller.

Notes for reading new *variables* data from FD

Reading new variables data from the inserted floppy disk will replace the current variable set stored in the robot controller with the variable set stored in the floppy disk.

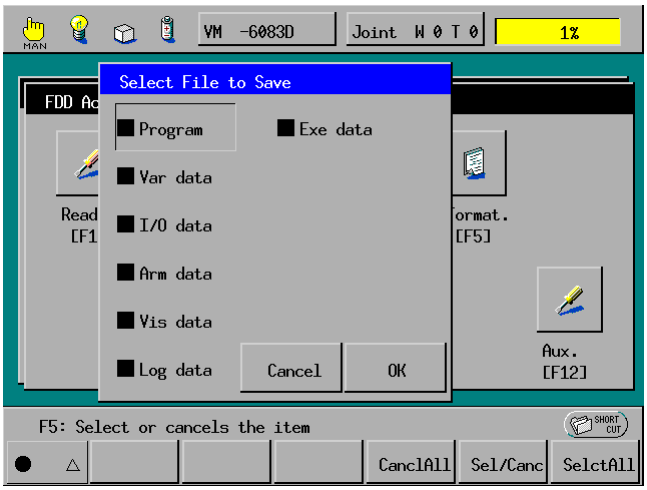
If the count of the current integer variables is 50 and that of integer variables stored in the floppy disk is 30, for example, the newly read variable set will contain 30 integer variables and 31st to 50th variables will be lost, after completion of this reading operation.

Writing data stored in the robot controller to FD

Access: [F6 Set]—[F3 FD.]—[F2 Write.]

Writes (Saves) data stored in the robot controller to a floppy disk.

(1) Press [F2 Write.] in the FDD Access Menu, and the Select File to Save window will appear as shown below.



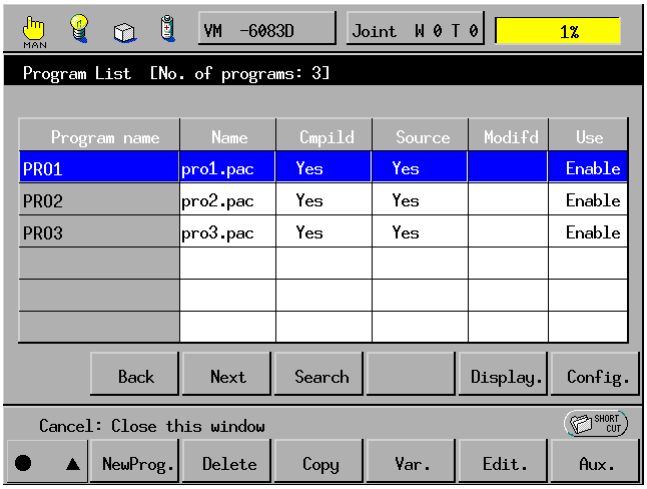
(2) Select data to be written onto the floppy disk, then press the OK button to start writing.

Listed below are probable causes of writing failures and actions to be taken.

File type	Probable cause	Actions to be taken
Program	The loaded executable data and PAC program may not be matching	If the executable data is vital, do not write the program on it. If the PAC program and the executable data are matching, see "The relation between executable data and program data" given two pages later.
Executable data	The executable data may not be in existence	Create the executable data by compiling or send the executable data over to the compiler from WINCAPSII or FD.

Notes for writing *program* data onto FD

When writing *program* data stored in the robot controller onto the inserted floppy disk, the system will write only program source files which are set to "Enable" in the Program List window.



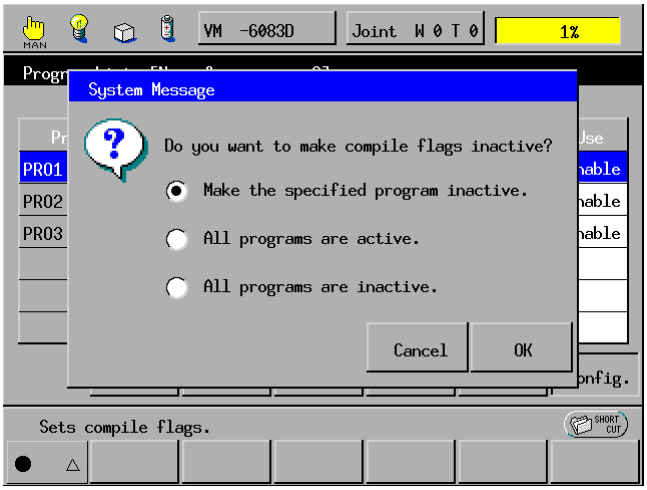
In either of the following cases, program source files will be set to "Enable":

1) When a project is loaded in the robot controller. (All of the program source files used in the project will be set to "Enable.")
2) When you set the selected program(s) to "Enable" in the Program List window of the teach pendant.

If you want to write all program source files of the newly loaded project onto a floppy disk, do not change those files from "Enable" to "Disable" or do not edit programs after loading the project. For details refer to "Relationship between executable data and program data," cases 4) through 7) given on the next page.

If you want to write arbitrary program source files onto a floppy disk, select those files by setting programs to "Enable" or "Disable" according to the steps below.

1) On the top screen of the teach pendant, press [F1 Program] to display the Program List window.
2) Press the Config. button in the bottom of the Program List or press [F12 Config.] in the menu bar. In the system message window shown below, make the desired settings and press the OK button to proceed.



Relationship between executable data and program data

If there are discrepancies between executable data (compiled) and source program data (program source), the robot will not run as programmed.

The discrepancy will result when:

1) The PC sends executable data (executable file and cross-reference table) to the robot controller, but it does not send their source program data (except interpreter table and program table).
2) The PC sends source program data to the robot controller, but it does not send executable data.
3) Executable data is read from the floppy disk(s) into the robot controller but its source program data is not.
4) Any part of the source program is edited after compiling.
5) A new project is created.
6) A new program having the same name as already loaded program file is added.
7) Any program is deleted.
8) The Use state of any program(s) is switched between "Disable" and "Enable."

In the above cases except 1) and 3), you may make executable data and source program data coincident with each other by compiling and loading.

If data size is larger than the volume size of a floppy disk

The system will split data so that large data will be written onto more than one floppy disk. At the time, you follow the guidance messages on the teach pendant. Putting serial numbers on the floppy disks will make it easier to read the FD data into the robot controller.

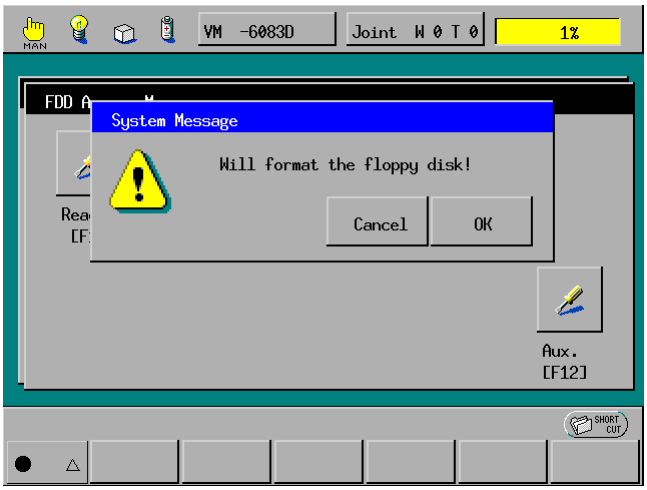
Note that executable data cannot be split; therefore, it should always be saved on a single floppy disk. If you want to write source program data, variables data, and executable data onto floppy disk(s), use one floppy disk for source program data and variables data, and use the other floppy disk for executable data.

Formatting a floppy disk

Access: [F6 Set]—[F3 FD.]—[F5 Format.]

Formats a floppy disk inserted into the floppy disk drive.

(1) Press [F5 Format.] in the FDD Access Menu, and the following system message will appear.



(2) Press the OK button to start formatting.

Saving a control log to FD

Access: [F6 Set]—[F3 FD.]—[F12 Aux.] —[F11 CtrlLog.]

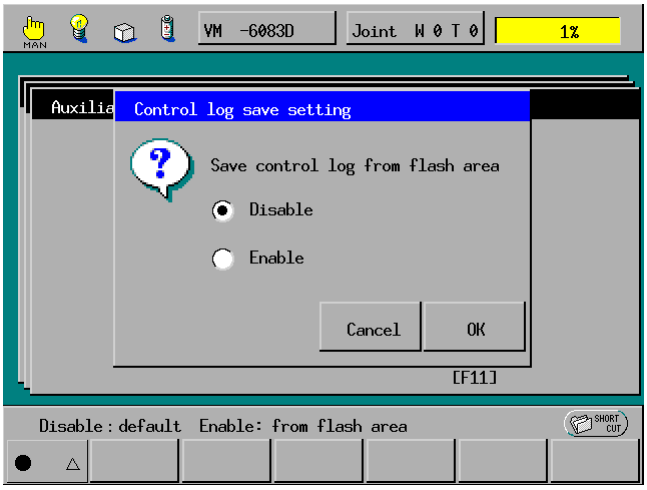
Determines whether a control log will also be saved to a floppy disk when you save data stored in the robot controller to the floppy disk.

A control log is large in data size and is not required as backup of facility data. So, enable this command only when you need to save a control log to a floppy disk.

(1) In the FDD Access Menu, press [F12 Aux.].

(2) Press [F11 CtrlLog.], and the following window will appear.

(3) Select "Disable" or "Enable," then press the OK button.

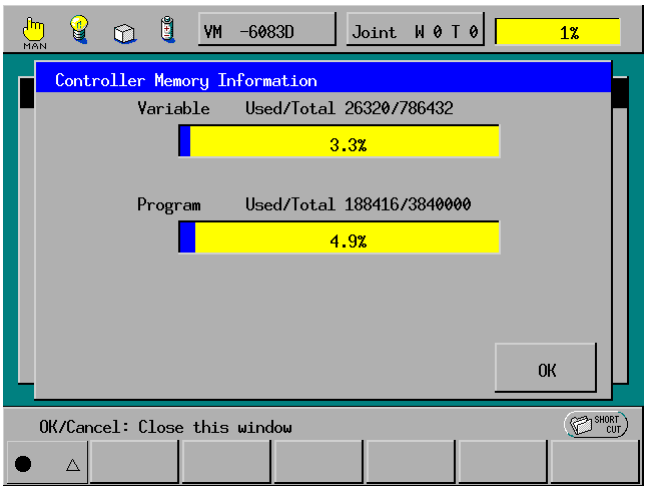


Displaying the memory information of the robot controller

Access: [F6 Set]—[F4 Mem Info]

Displays the memory information of the robot controller.

(1) Press [F4 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.

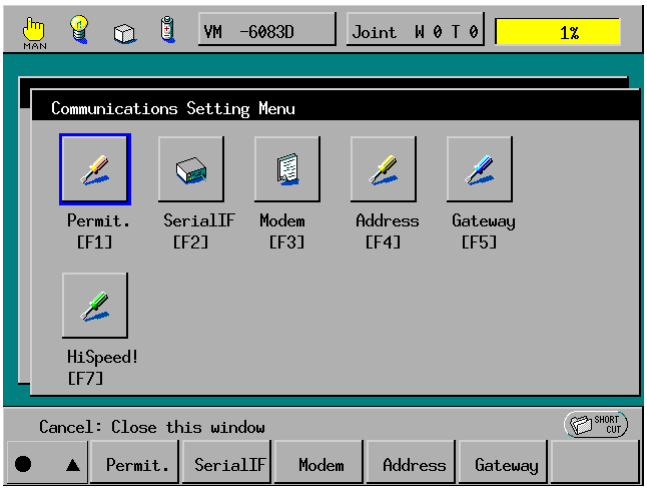
(2) To close the Controller Memory Information window, press the OK button.

Displaying the Communications Setting Menu

Access: [F6 Set]—[F5 Set Com.]

Displays the communications setting menu.

(1) Press [F5 Set Com.] in the Settings (Main) window, and the Communications Setting Menu will appear as shown below.



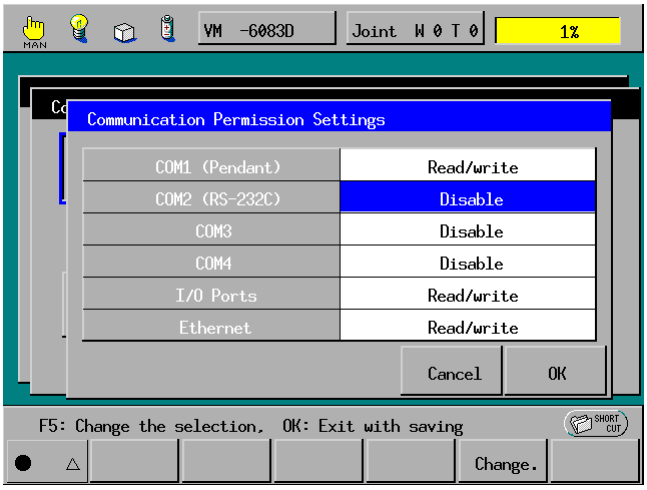
(2) Select the desired setting function. The corresponding window will display as described on pages 5-147 through 5-154.

Setting the communication permission

Access: [F6 Set]—[F5 Set Com.]—[F1 Permit.]

Sets the communication permission or the read/write permission for each communications port.

(1) Press [F1 Permit.] in the Communications Setting Menu, and the Communication Permission Settings window will appear as shown below.

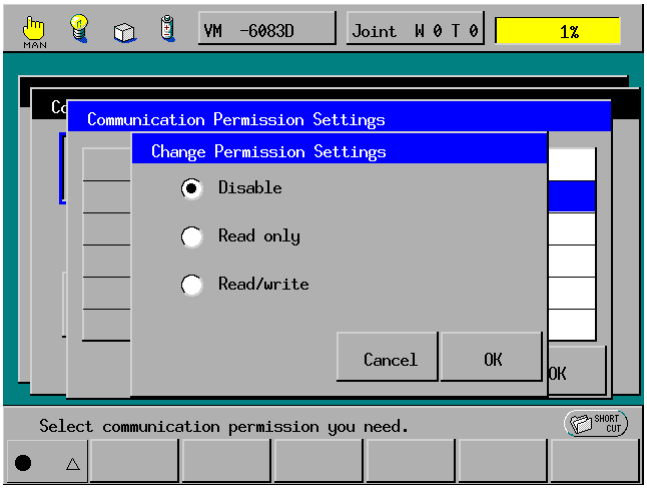


F5

NOTE: COM1 is occupied by the teach pendant, 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 [F5 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.

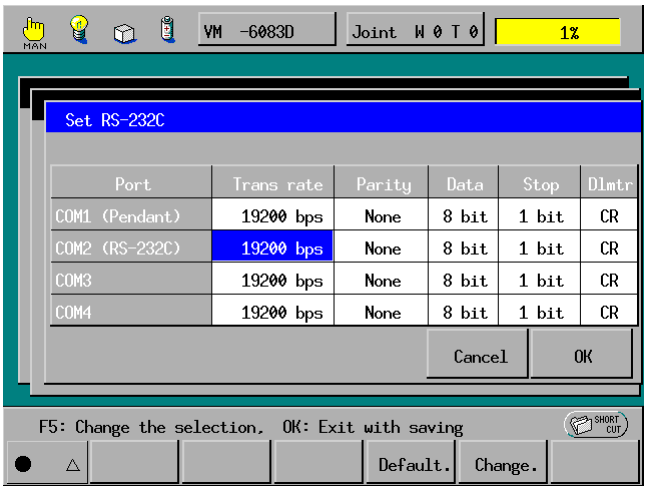
If you press the Cancel button instead of the OK button, the new entry will be cancelled.

Setting the transmission rates for RS-232C serial interface ports

Access: [F6 Set]—[F5 Set Com.]—[F2 Serial IF]

Sets the transmission rate for each of the RS-232C serial interface ports.

(1) Press [F2 Serial IF] in the Communications Setting Menu, and the Set RS-232C window will appear as shown below.

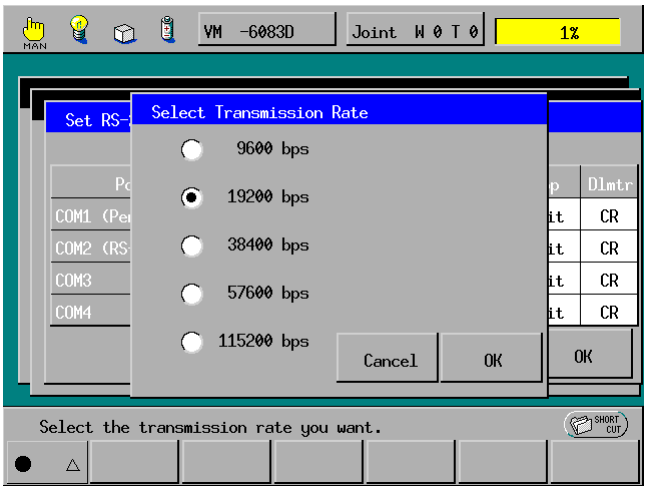


F4 F5

NOTE: COM1 is occupied by the teach pendant, 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 [F5 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 [F4 Default.] in the Set RS-232C window, the following defaults will be restored:

The default of the COM1 (Teach pendant) cannot be changed.

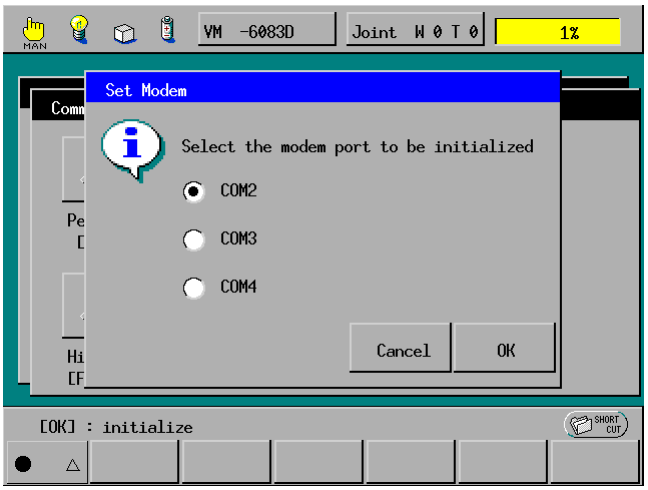
Port	Transmission rate (bps)	Parity	Data (character length)	Stop bit	CR/LF code
COM1 (Teach pendant)	19200	None	8 bits	1 bit	CR
COM2 (RS-232C)	19200	None	8 bits	1 bit	CR
COM3	19200	None	8 bits	1 bit	CR
COM4	19200	None	8 bits	1 bit	CR

Initializing modem

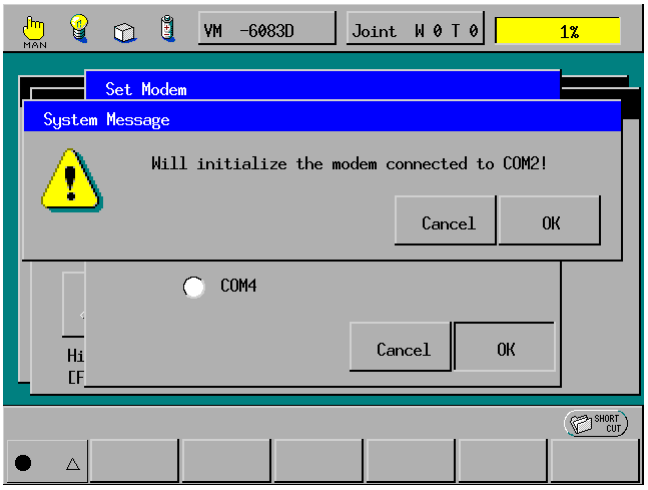
Access: [F6 Set]—[F5 Set Com.]—[F3 Modem]

Initializes the modem connected to the selected modem port.

(1) Press [F3 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.

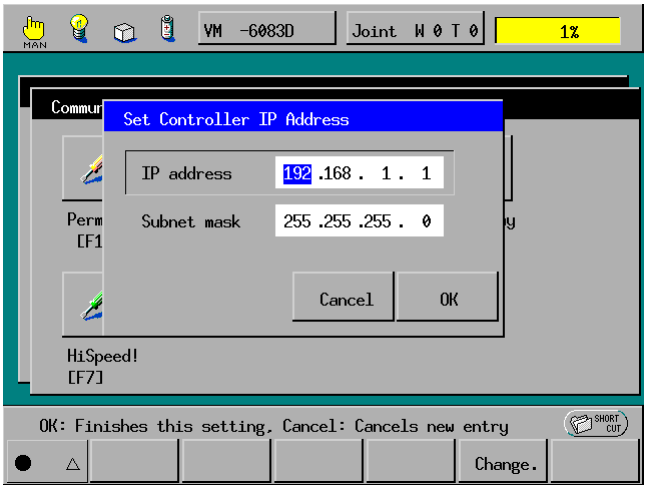
(4) Press the OK button to close the system message dialog box.

Setting the IP address of the robot controller

Access: [F6 Set]—[F5 Set Com.]—[F4 Address]

Sets the IP address of the robot controller.

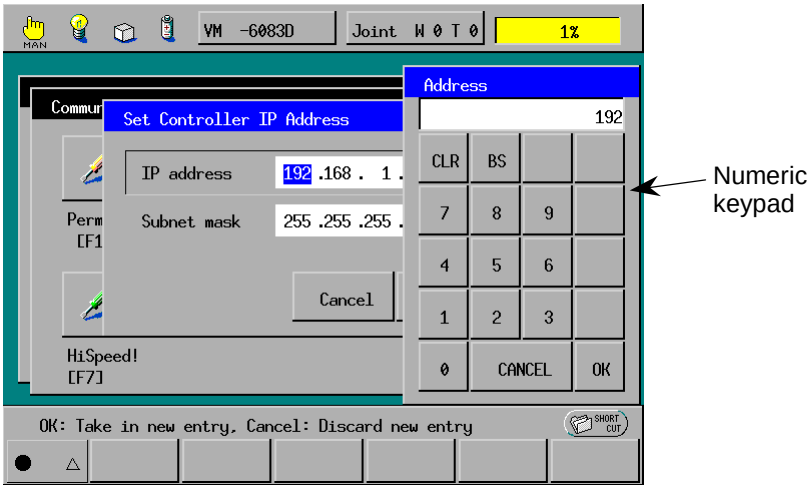
(1) Press [F4 Address] in the Communications Setting Menu, and the Set Controller IP Address window will appear as shown below.



F5

(2) Select the item to be set, and then press [F5 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.

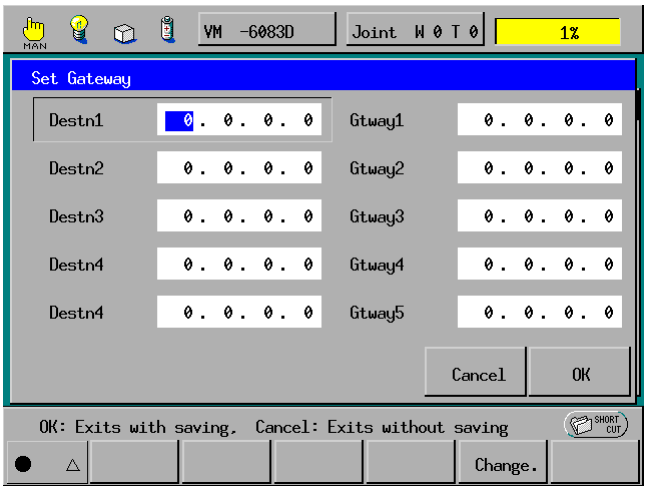
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Controller IP Address window, press the OK or Cancel button.

Setting gateways

Access: [F6 Set]—[F5 Set Com.]—[F5 Gateway]

Sets the gateways and destinations.

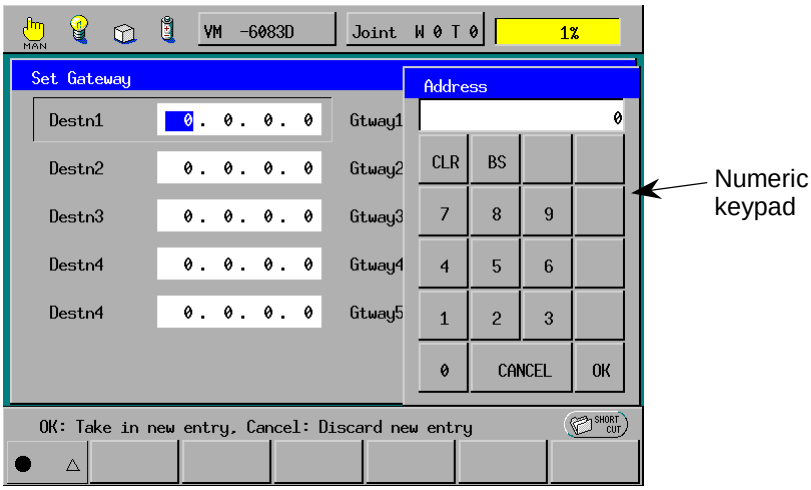
(1) Press [F5 Gateway] in the Communications Setting Menu, and the Set Gateway window will appear as shown below.



F5

(2) Select the item to be set, and then press [F5 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.

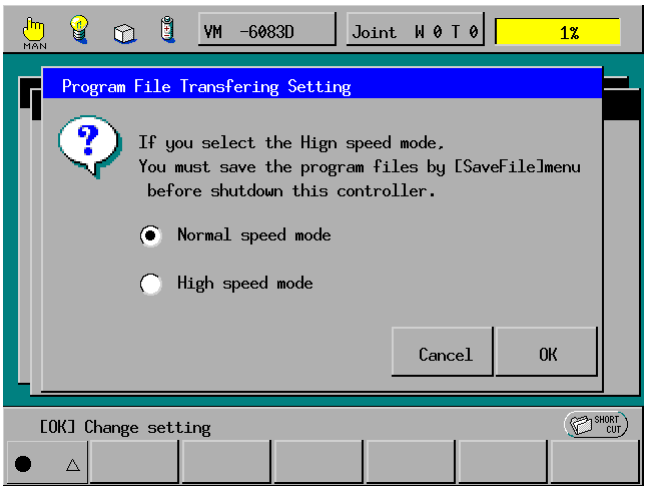
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Set Gateway window, press the OK or Cancel button.

Setting high speed program file transmission [Ver. 1.4 or later]

Access: [F6 Set]—[F5 Set Com.]—[F7 HiSpeed!]

Sets the action of sending projects from the instruction system of the PC.

(1) Press [F7 HiSpeed!] in [Set Com.] menu. This opens [Program File Transferring settings] window.



(2) Select either 'Normal speed mode' or 'High speed mode' and press [OK].

When "High speed mode" is selected

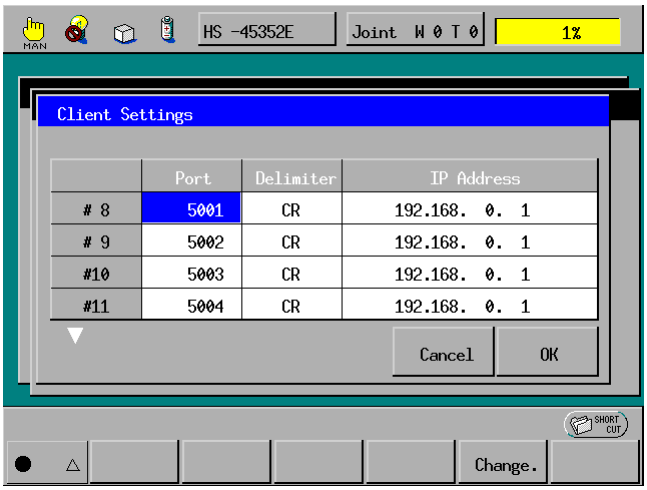
When "High speed mode" is selected, the received data is not saved. Therefore the data is lost once power is switched off. To avoid this, make sure you save the received data by pressing [F9 SaveFile] in the [Set (Main)] window.

Setting the Client of the Robot Controller [Ver.1.9 or later]

Access: [F6 Set]—[F5 Set Com.]—[F10 Client]

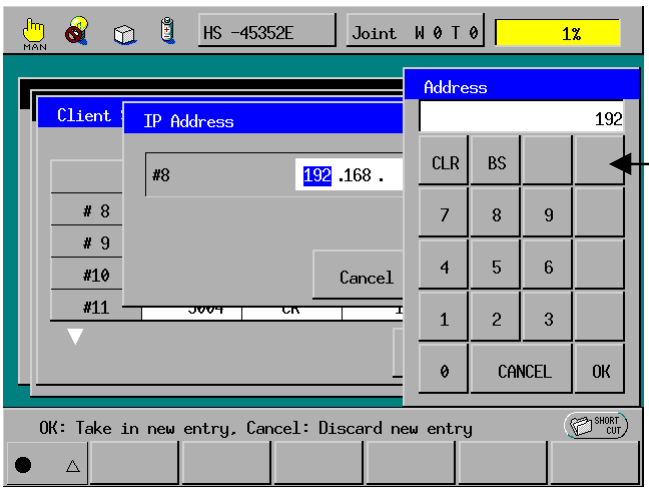
Configures the client port of the robot controller.

(1) In the Communications Setting Menu, press [F10 Client], and the Client Settings window will appear as shown below.



(2) To set the IP address of the port, select the IP Address field to be set and press [F5 Change.] and then [F5 Edit].

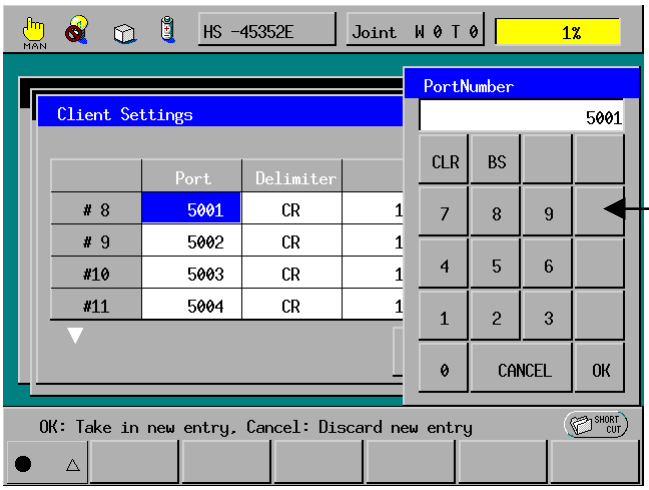
The numeric keypad will appear as shown below.



(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 port number, select the Port field to be set and press [F5 Change.].

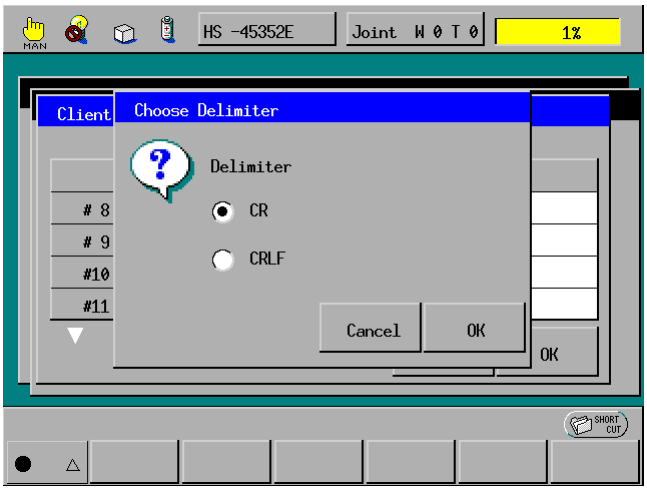
The numeric keypad will appear as shown below.



(5) Enter the desired value to the target 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 [F5 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.

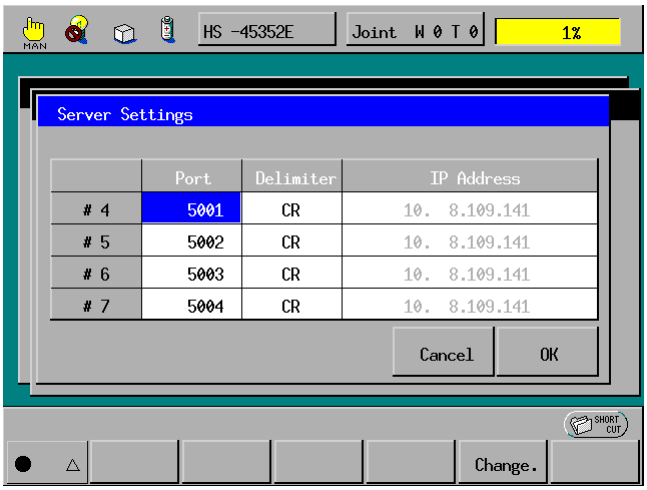
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Client Settings window, press the OK or Cancel button.

Setting the Server of the Robot Controller [Ver.1.9 or later]

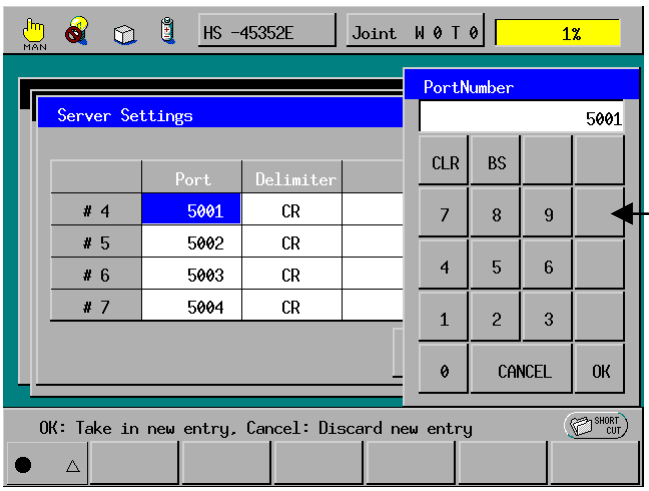
Access: [F6 Set]—[F5 Set Com.]—[F11 Server]

Configures the server port of the robot controller.

(1) In the Communications Setting Menu, press [F11 Client], and the Server Settings window will appear as shown below.



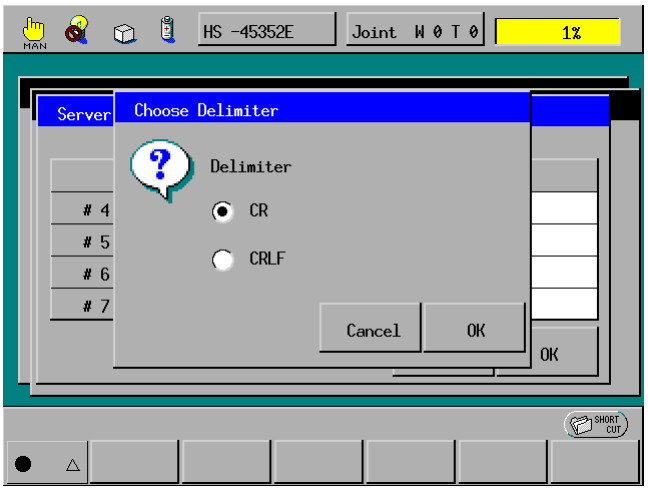
(2) To set the port number, select the Port field to be set and press [F5 Change.].
The numeric keypad will appear as shown below.



(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 [F5 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 [Ver.1.95 or later]

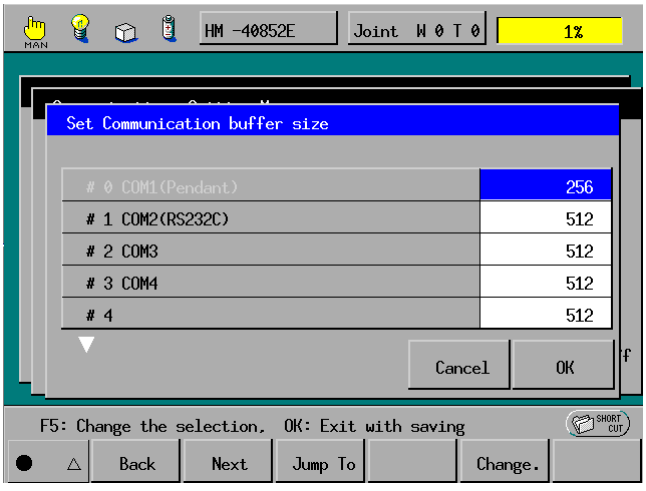
Access: [F6 Set]—[F5 Set Com.]—[F12 Comm.buff]

Main system software version 1.95 newly supports communications buffer resizing function. It 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 function.

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 to save the data stored in the buffer, and then resize the communications buffer.

(1) In the Communications Setting Menu, press [F12 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: Used for communication with the teach pendant. No access is allowed.

#1 COM2: Used for communication with WINCAPSII.

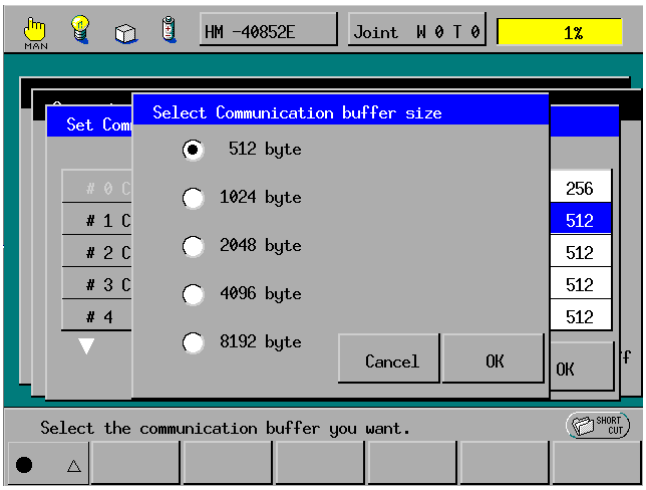
#2 COM3 and #3 COM4: Reserved for function extension.

#4 through #7: For servers.

#8 through #15: For clients.

(2) Select the desired port and press [F5 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.

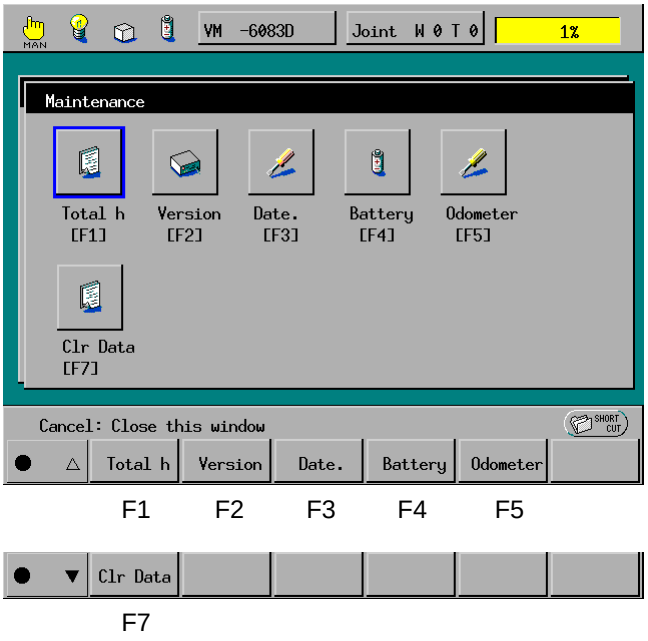
NOTE: Pressing the OK button to make the new setting go into effect will discard the buffer data.

Displaying the Maintenance menu

Access: [F6 Set]—[F6 Maint.]

Displays the Maintenance menu.

(1) Press [F6 Maint.] in the Settings (Main) window, and the Maintenance menu will appear as shown below.



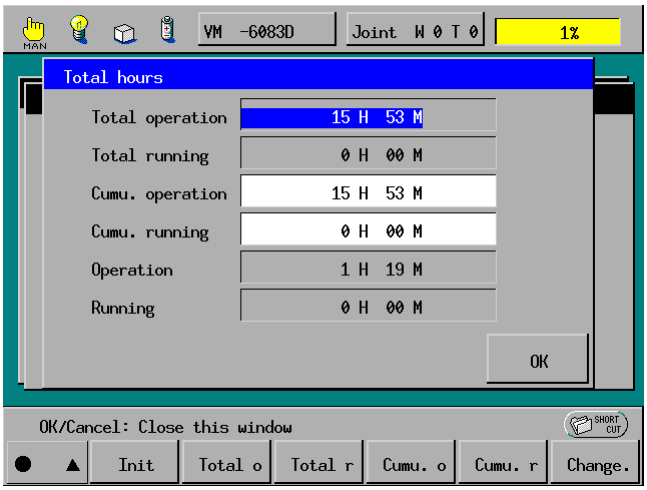
(2) Select the desired setting function. The corresponding window will display as described on pages 5-156 through 5-164.

Displaying the robot controller ON-time and the robot running time

Access: [F6 Set]—[F6 Maint.]—[F1 Total h]

Displays the robot controller ON-time and the robot running time.

(1) Press [F1 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.

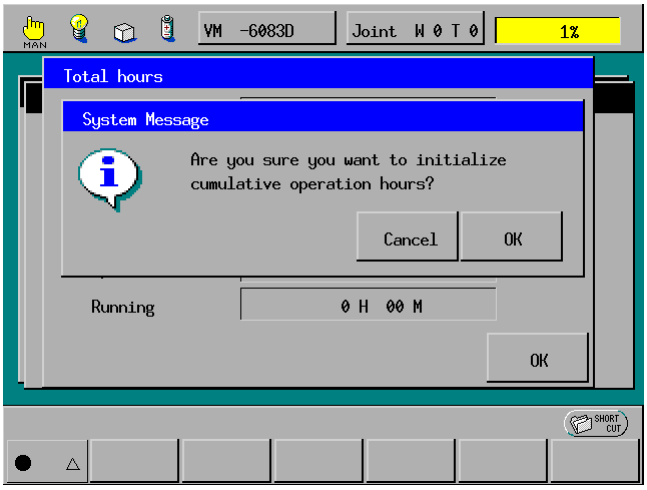
[Operation] Shows the total of the robot controller ON-time counted after you reset the user counter to zero.

[Running] Shows the total of the robot running time counted after you reset the user counter to zero.

Function keys available	
[F4 Cumu. o]	Calls up the system message dialog box where you may reset the user counter of the robot controller ON-time.
[F5 Cumu. r]	Calls up the system message dialog box where you may reset the user counter of the robot running time.

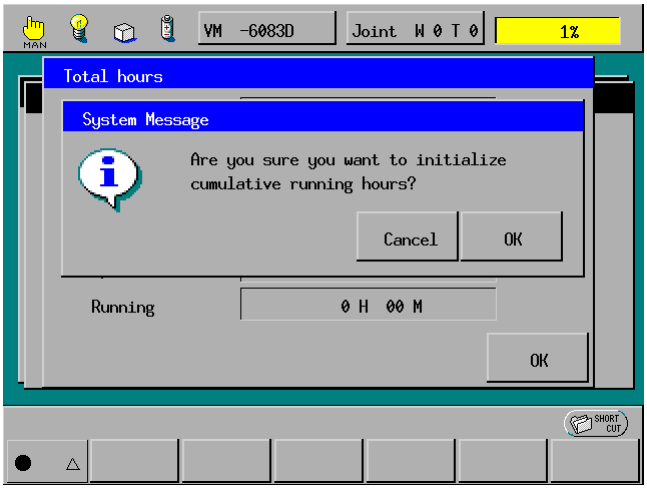
(2) To reset the user counter of the robot controller ON-time to zero, press [F4 Cumu. o] in the Total hours window.

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 [F5 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.

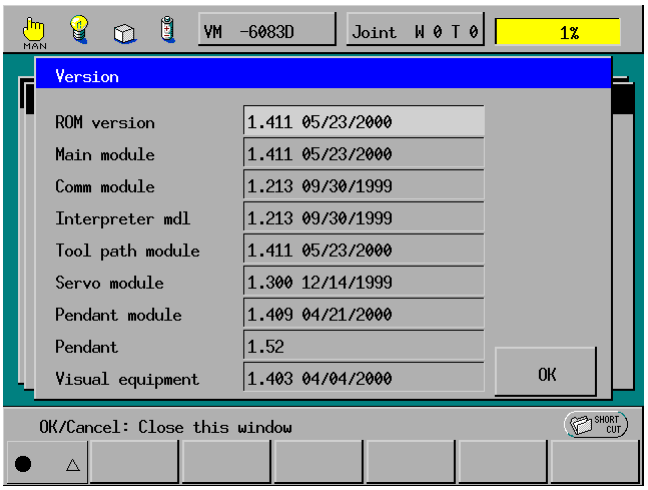


Displaying the version information of each module

Access: [F6 Set]—[F6 Maint.]—[F2 Version]

Displays the version information of each module in the robot controller.

(1) Press [F2 Version] in the Maintenance menu, and the Version window will appear as shown below.



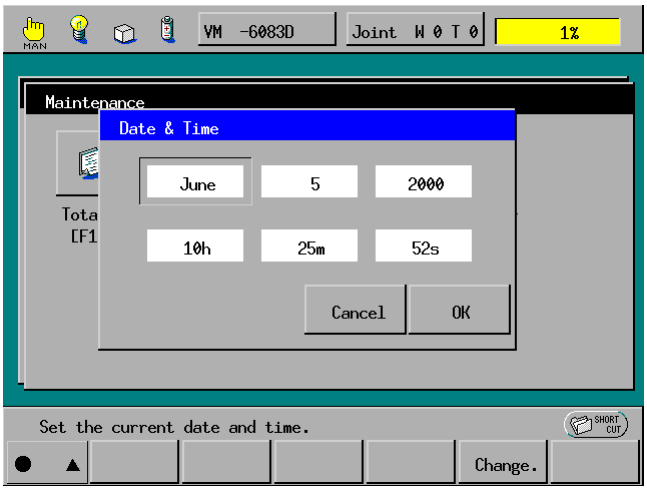
(2) Press the OK button or Cancel key to close the Version window.

Setting the calendar clock built in the robot controller

Access: [F6 Set]—[F6 Maint.]—[F3 Date.]

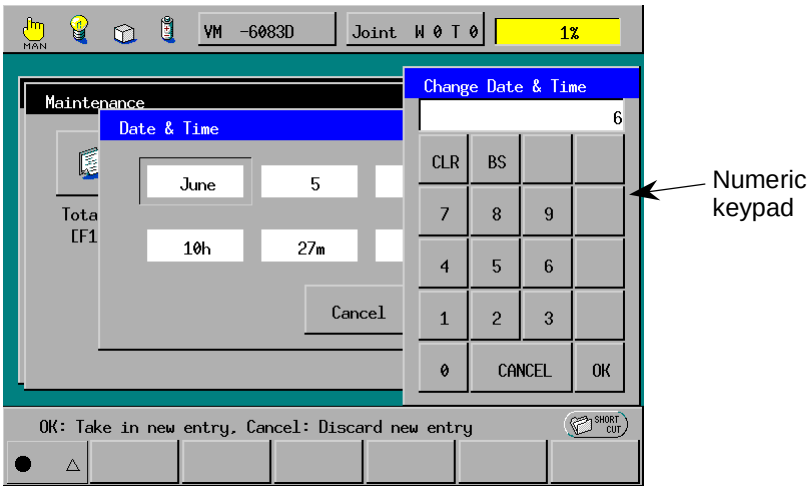
Sets the calendar clock built in the robot controller.

(1) Press [F3 Date.] in the Maintenance menu, and the Date & Time window will appear as shown below.



F5

(2) Select the item to be set, and then press [F5 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: [F6 Set]—[F6 Maint.]—[F4 Battery]

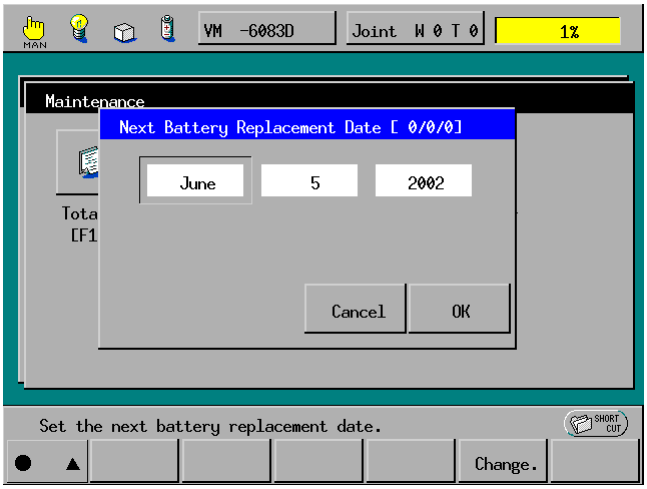
Sets the next replacement date of the memory backup battery of the robot controller.

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 [F4 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.

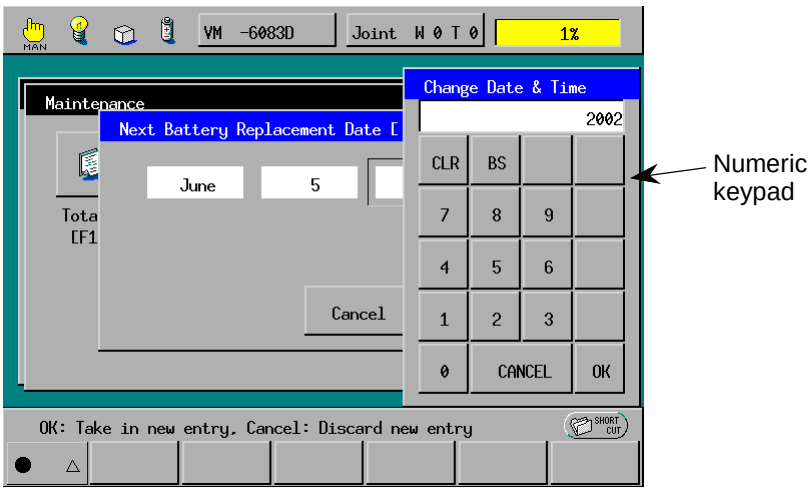
The date entry areas display the default replacement date (June 5, 2002) that is two years later the current date (June/5/2000) at which you open this window, assuming that the battery service life is two years.



(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 [F5 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.

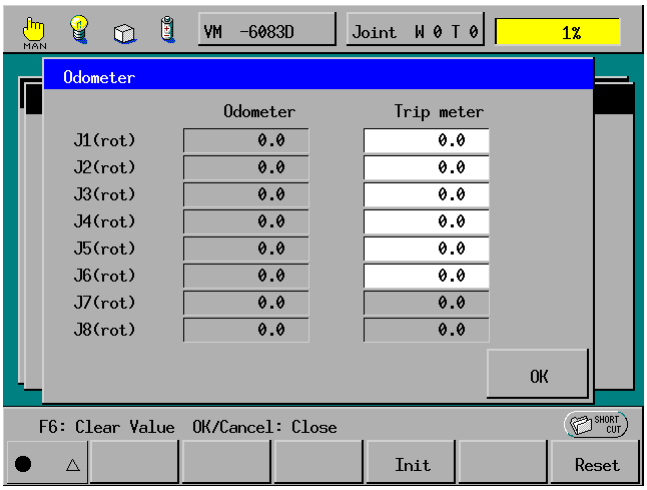
If you press the Cancel button instead of the OK button, the new entry will be cancelled. To close the Next Battery Replacement Date window, press the OK or Cancel button.

Displaying the odometer and trip meter for each axis

Access: [F6 Set] —[F6 Maint.]—[F5 Odometer]

Displays the odometer and trip meter which count traversed distance of each axis.

(1) Press [F5 Odometer] in the Maintenance menu, and the following window will appear.



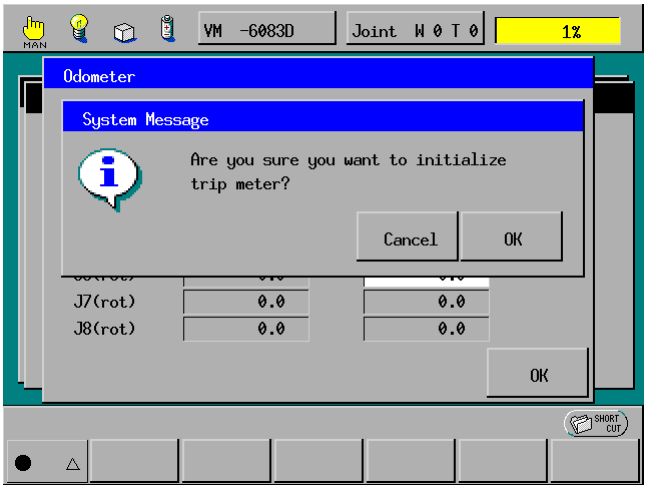
F6

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 [F6 Reset]. The following window will appear. If you want to reset the trip meter to zero, press the OK button.



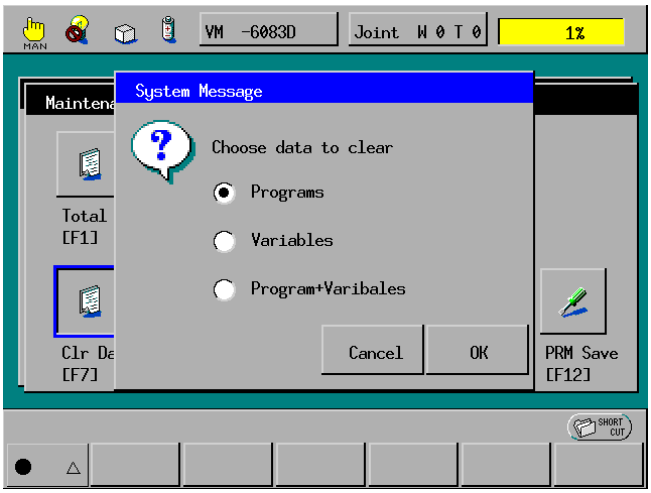
Clearing User Programs and Variables [Ver. 1.6 or later]

Access: [F6 Set] —[F6 Maint.]—[F7 Clr Data]

Version 1.6 or later allows you to delete all user programs stored and clear all global variables to zero.

(1) In the Maintenance window, press [F7 Clr Data].

(2) The choice screen appears where you may choose data type to be cleared.



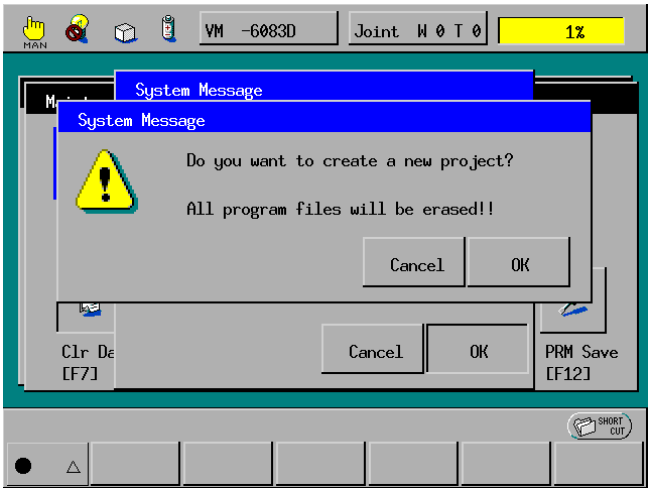
Choose either one of the following three choices and press OK.

- Programs: Delete all user programs.
- Variables: Clear all global variables to zero.
- Programs + Variables: Delete all user 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)



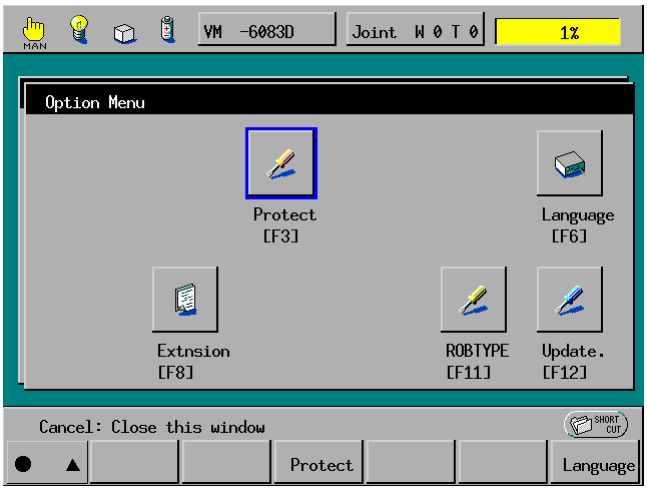
(Variable Clearing Confirmation Message)

Displaying the Option Menu

Access: [F6 Set]—[F7 Options.]

Displays the option menu.

(1) Press [F5 Options.] in the Settings (Main) window, and the Option Menu window will appear as shown below.



(2) Select the desired setting function. The corresponding window will display as described on pages 5-166 and 5-169.

Setting the protection mode

Access: [F6 Set]—[F7 Options.]—[F3 Protect.]

Sets the protection mode which protects programs and/or parameters from getting modified from the teach pendant.

(1) Press [F3 Protect.] in the Option Menu, and the Protection Mode Setting window will appear as shown below.

(2) Select the desired protection mode and press the OK button. The selected mode goes into effect.

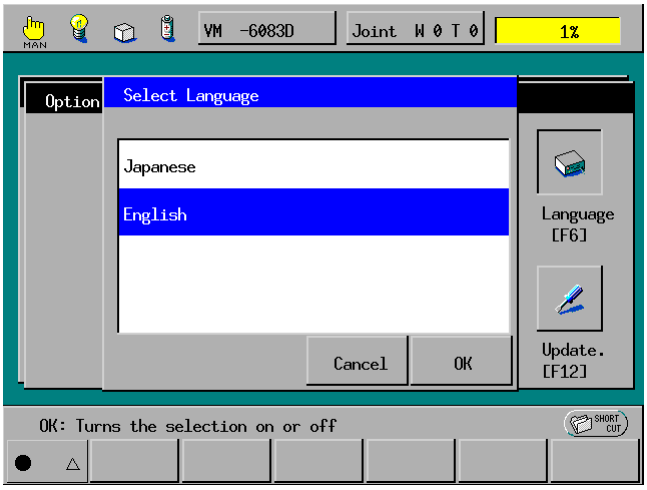
Selecting language

Access: [F6 Set]—[F7 Options.]—[F6 Language]

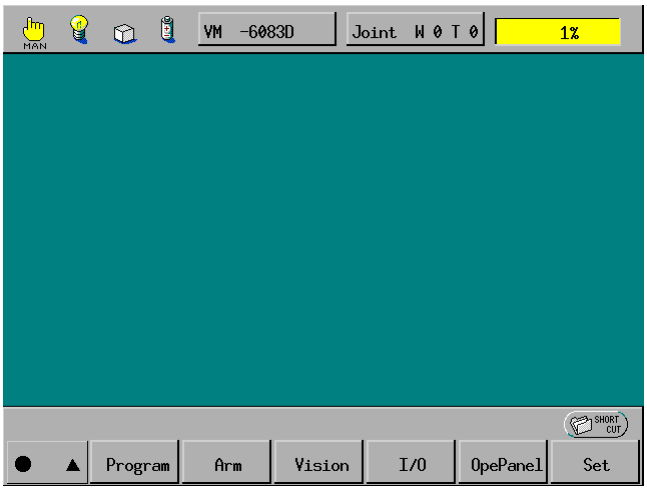
Switches the pendant screen language version to the language you select.

(1) Press [F6 Language] in the Option Menu, and the Select Language window will appear as shown below.

(2) Select the desired language and then press the OK button.



(3) To make the new entry take effect, close all opened windows to call up the top screen. Then the top screen is expressed in the selected language (Japanese in this example).



Enabling extension functions

Access: [F6 Set]—[F7 Options.]—[F8 Extnsion]—[F5 Input ID]

Enables extension functions.

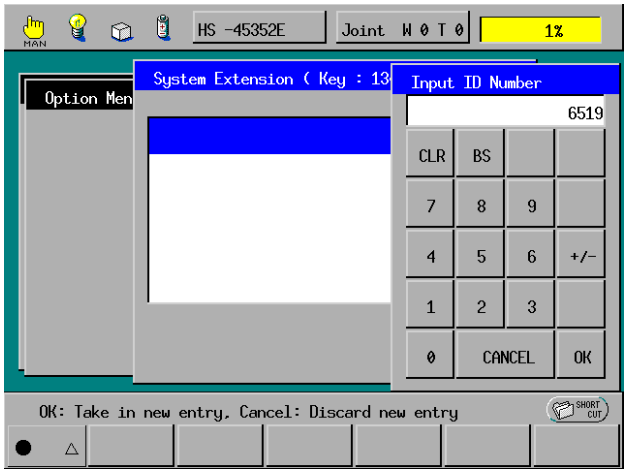
Once enabled, the setting will be retained even if the controller power is turned off and on.

(1) Press [F5 Input ID] on the System Extension window, and the Input ID Number window appears.

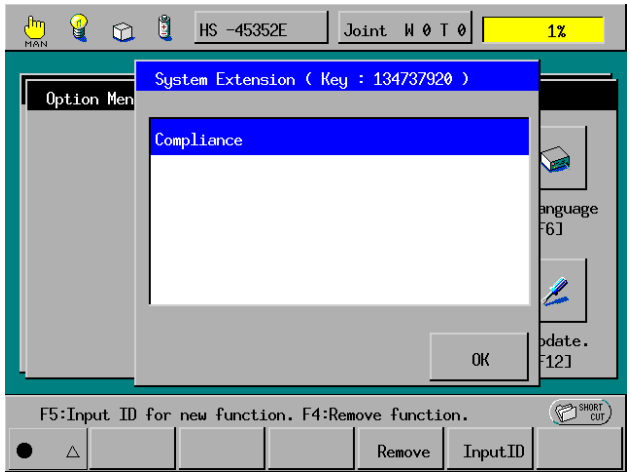
(2) Enter the ID number and press [OK].

ID Number List

Extension function	ID No.	Reference
Tip compliance control	6519	PROGRAMMER'S MANUAL 1, section 3.5.3
Supervisory task	1111	Chapter 3, Section 3.4.10
Supervisory task extension	1112	Chapter 3, Section 3.4.11
Error code saving feature	3237	PROGRAMMER'S MANUAL 1, section 8.13.2
Extension board function	Attached password	OPTION'S MANUAL, " Preface"



(3) System message appears and press [OK]. The extended function displays.



NOTE: When removing the extended function, press [Remove], and then input the ID number.

Setting the robot type for the controller

Access: [F6 Set]—[F7 Options.]—[F11 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: [F6 Set]—[F7 Options.]—[F12 Update.]

Updates the controller system version.

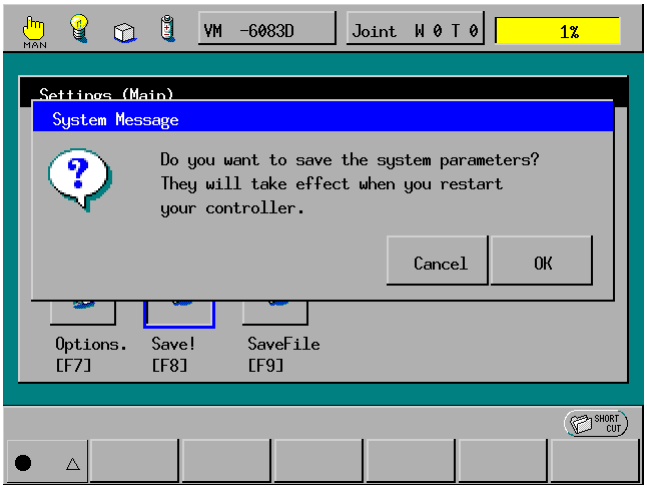
This command is intended for DENSO WAVE service personnel only. Do not use this command.

Saving system parameters

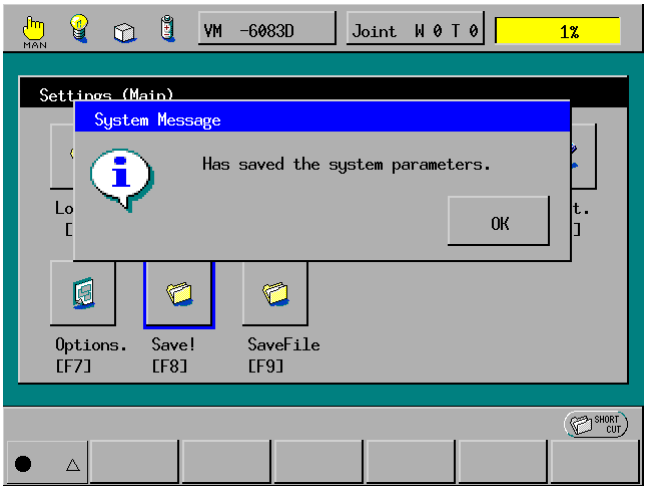
Access: [F6 Set]—[F8 Save!]

Saves the system parameters stored in the robot controller so that turning the robot controller off will not lose those parameter values.

(1) Press [F8 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.



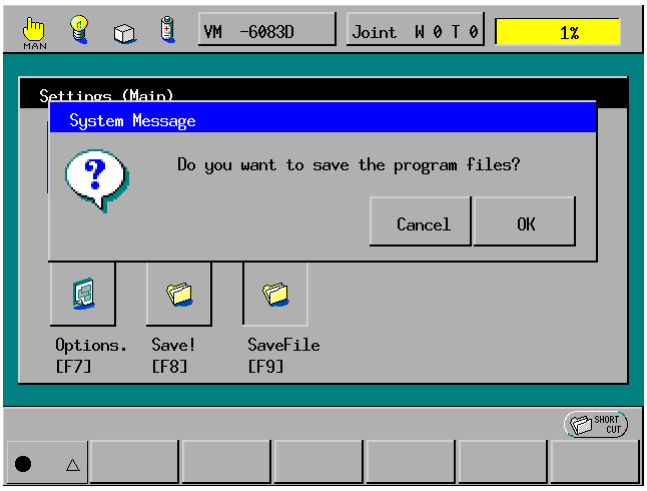
(3) Press the OK button to close the system message dialog box.

Saving a program

Access: [F6 Set]—[F9 SaveFile]

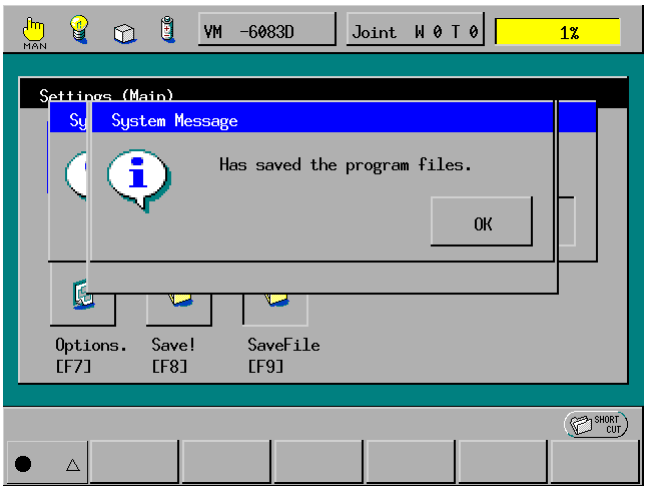
Saves the programs stored in the robot controller. This way the programs can be maintained even when power to the robot controller is switched off.

(1) Press [F9 SaveFile] in [Set (Main0) 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

[Ver.1.5 or later]

Access: [F9 Panel]

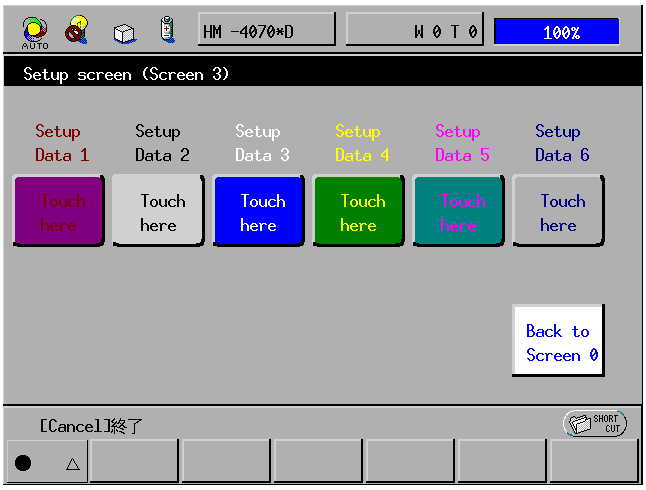
Main software version 1.5 or later allows you to easily customize your own operation screens on the teach pendant for facilitating control of the robot by the robot controller in stand-alone mode.

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 "PROGRAMMER'S MANUAL 1, Section 13.5" and "PROGRAMMER'S MANUAL 2, PAC library".

(1) Displays TP Operation Screen by pressing [F9 Panel].



Sample Screen

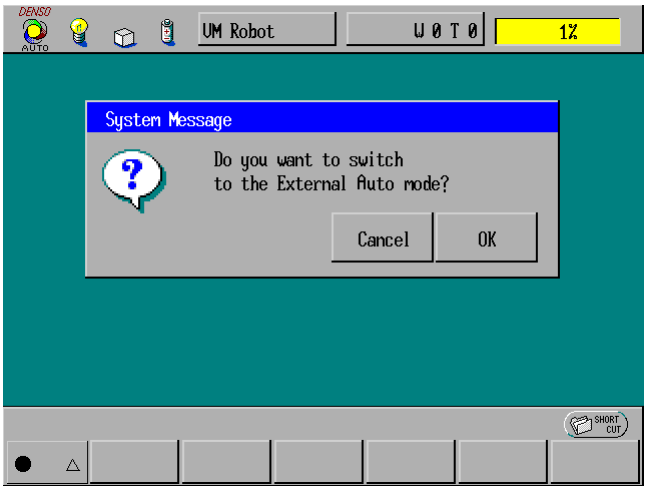
5.9 Switching between Internal and External Auto Modes

Access: [F10 Int/Ext]

Switches between the internal and external Auto modes.

When this command is to be executed, the robot controller should be placed either in internal Auto mode or external Auto mode.

(1) Press [F10 Int/Ext] on the top screen, and the following window will appear.



(2) Press the OK button to switch.

5.10 Preparing the Robot Controller to Unplug the Teach Pendant

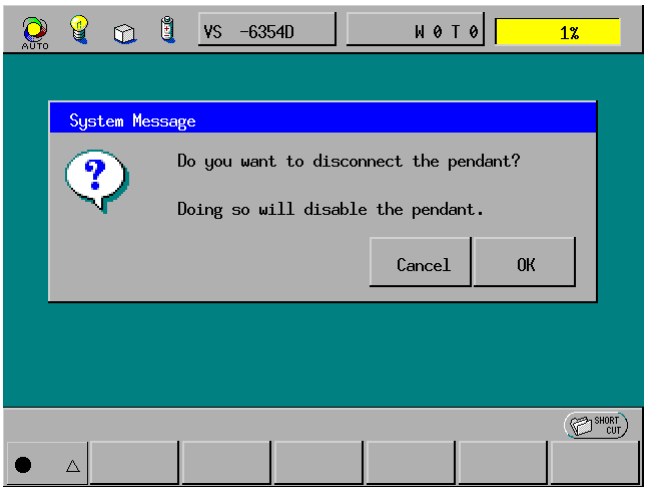
Access: [F11 Unplug]

Prepares the robot controller so that you may unplug the teach pendant. Before unplugging the teach pendant from the robot controller or operating panel, be sure to use this command.

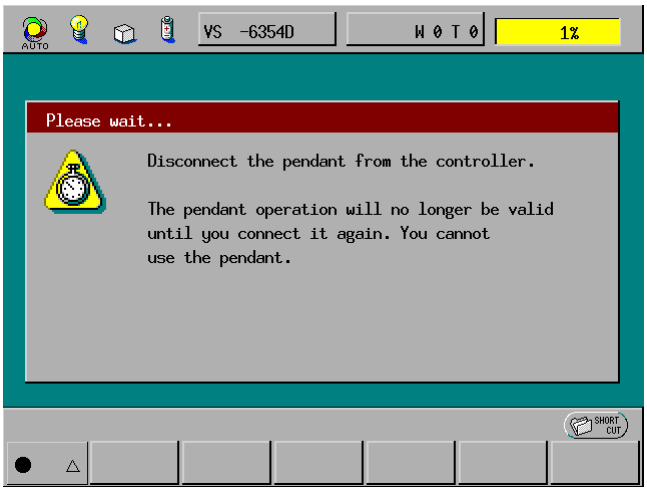
Before carrying out this command, ensure that:

1) The robot controller should be placed in Auto mode and
2) An emergency stop signal should be inputted.

(1) Press [F11 Unplug] on the top screen, and the following window will appear.



(2) Press the OK button to proceed.
The following window will appear.



(3) Unplug the teach pendant from the robot controller or operating panel.

Chapter 6

Using the Mini-Pendant

This chapter describes how to control the robot using the mini-pendant.

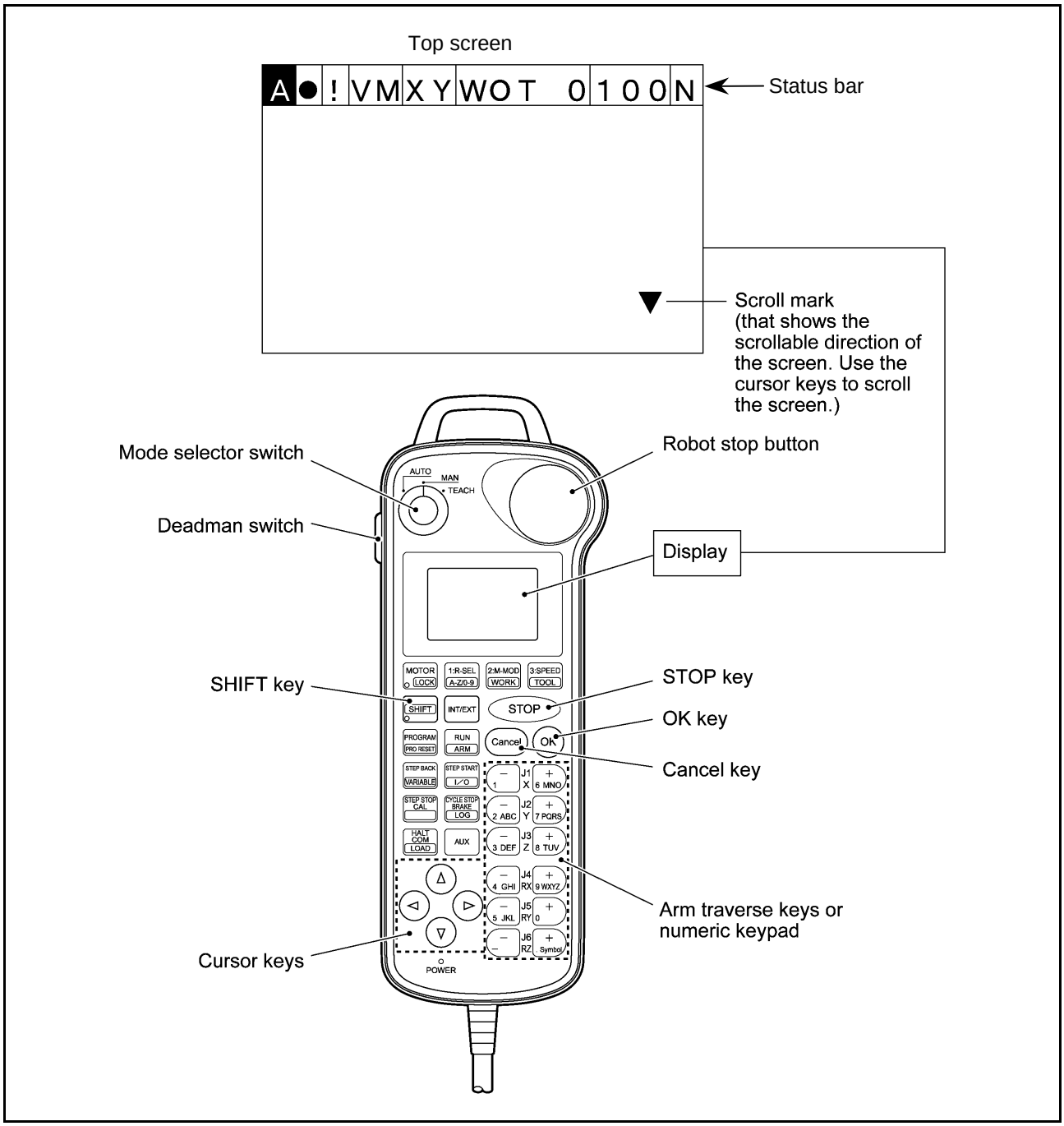
NOTE 1: Avoid letting the mini-pendant undergo any strong shocks, impacts, or vibrations.

6.1 Commands Menu

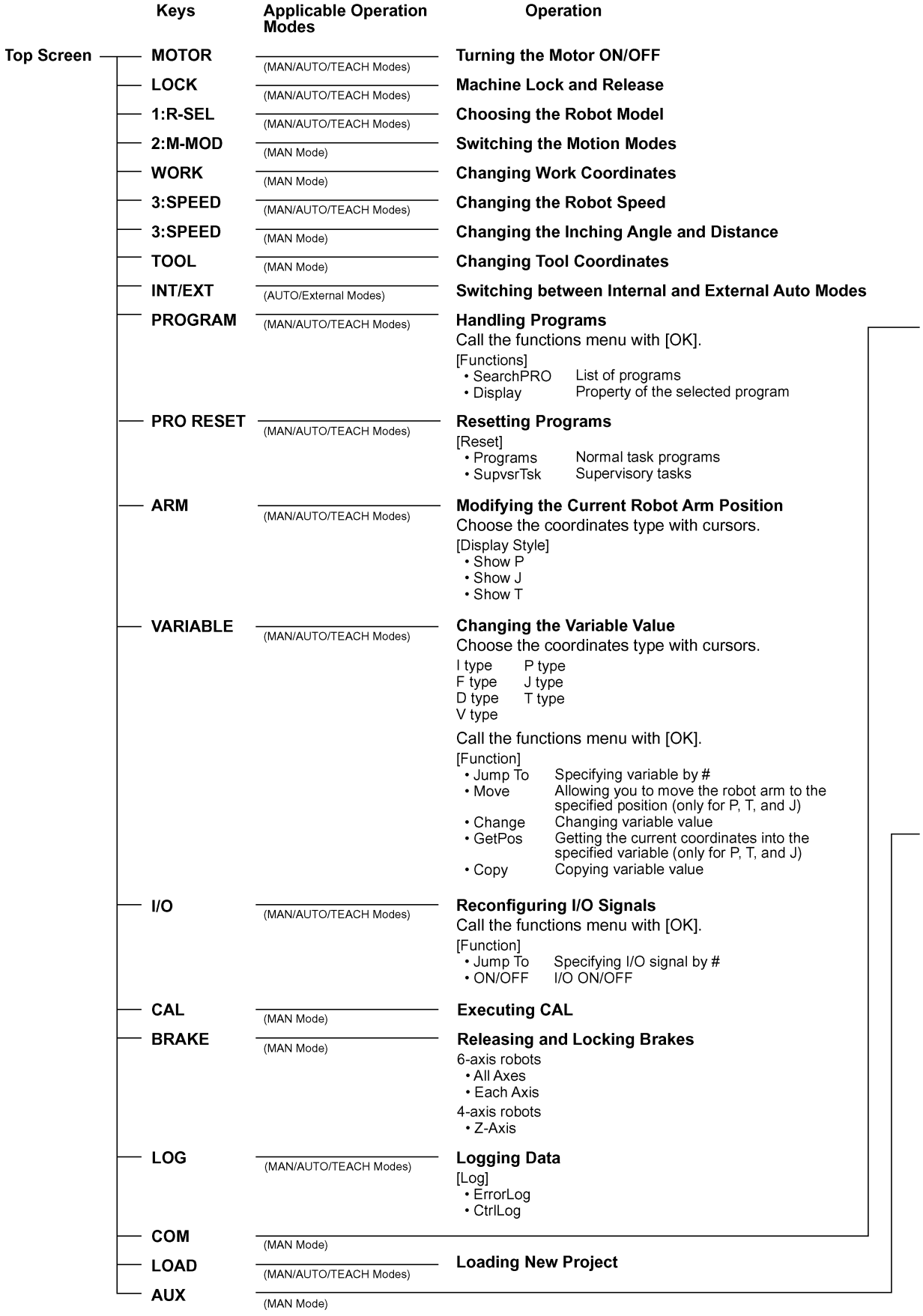
Using the keys, buttons, and switches on the mini-pendant allows you to call up a variety of screens on the LCD. This section guides you through the menu tree and then gives you detailed operations.

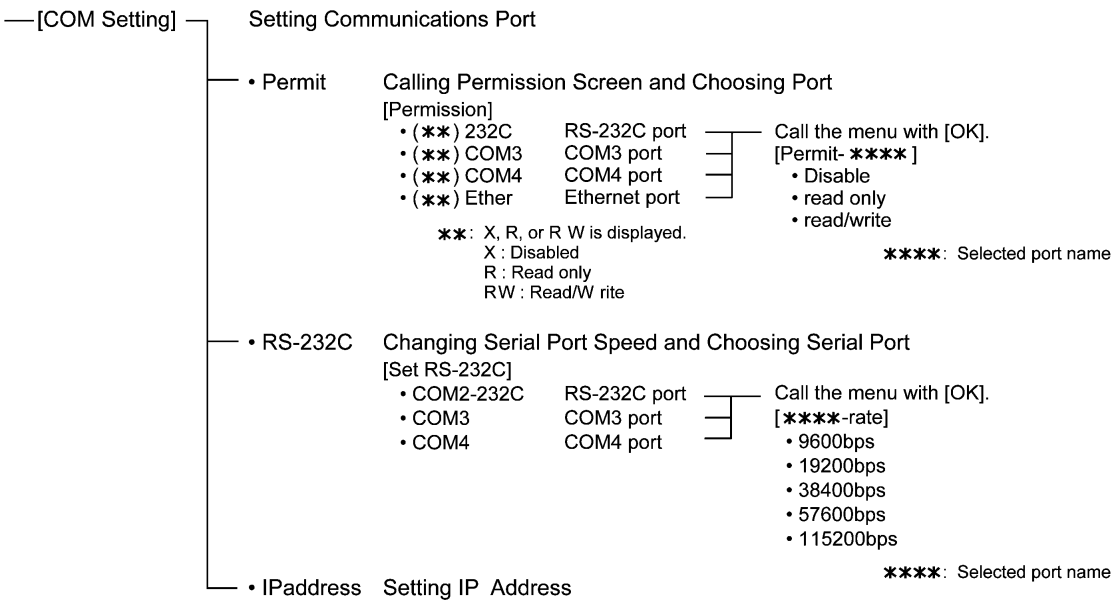
6.1.1 Keypad and Top Screen

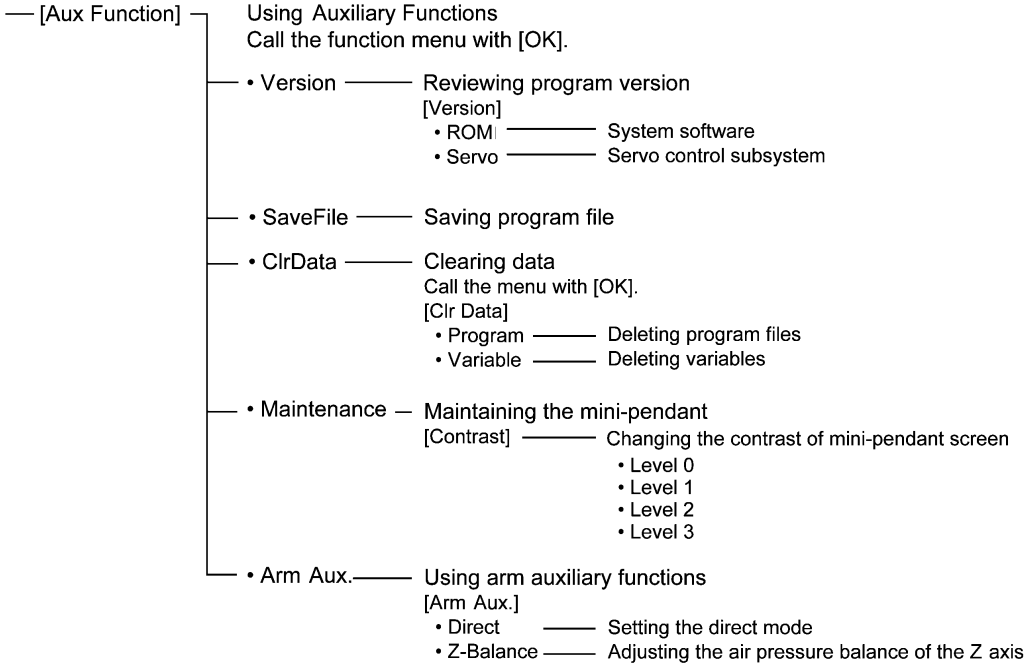
When the power is first applied to the robot controller, the mini-pendant displays the top screen shown below. In the top line of the screen is a status bar which always displays the current operation mode, program status, connected robot model, motion mode, speed, and other information. For details about the top screen, refer to Chapter 1, Subsection 1.4.



6.1.2 Menu Tree




[COM Setting]
Setting Communications Port
• Permit
Calling Permission Screen and Choosing Port
[Permission]
• (**) 232C
• (**) COM3
• (**) COM4
• (**) Ether
RS-232C port
COM3 port
COM4 port
Ethernet port
Call the menu with [OK].
[Permit- ****]
• Disable
• read only
• read/write
**: X, R, or R W is displayed.
X : Disabled
R : Read only
RW : Read/W rite
****: Selected port name
• RS-232C
Changing Serial Port Speed and Choosing Serial Port
[Set RS-232C]
• COM2-232C
• COM3
• COM4
RS-232C port
COM3 port
COM4 port
Call the menu with [OK].
[****-rate]
• 9600bps
• 19200bps
• 38400bps
• 57600bps
• 115200bps
****: Selected port name
• IPaddress
Setting IP Address


[Aux Function]
Using Auxiliary Functions
Call the function menu with [OK].
• Version
Reviewing program version
[Version]
• ROM
• Servo
System software
Servo control subsystem
• SaveFile
Saving program file
• ClrData
Clearing data
Call the menu with [OK].
[Clr Data]
• Program
• Variable
Deleting program files
Deleting variables
• Maintenance
Maintaining the mini-pendant
[Contrast]
Changing the contrast of mini-pendant screen
• Level 0
• Level 1
• Level 2
• Level 3
• Arm Aux.
Using arm auxiliary functions
[Arm Aux.]
• Direct
• Z-Balance
Setting the direct mode
Adjusting the air pressure balance of the Z axis

6.2 Operation Using the Mini-Pendant

6.2.1 Turning the Motor ON/OFF

Key: [MOTOR] 

Operation

Pressing [MOTOR] toggles the joint-drive motors on and off.

Pressing this key when the LED is off will turn the motors on and switch the LED on. Pressing it when the LED is on will turn the motors off and switch the LED off.

6.2.2 Machine Lock and Release

Key: [LOCK] **[SHIFT] + [MOTOR]** 

Operation

Pressing [LOCK] toggles between the machine lock and release.

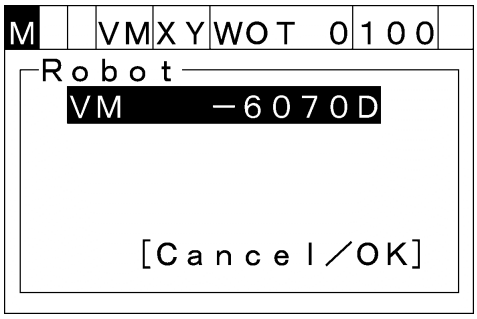
Pressing this key when the LED is off will lock the machine. When the machine is locked, the LED blinks. Pressing this key with the LED blinking will release the lock.

6.2.3 Choosing the Robot Model

Key: [1: R-SEL]

Operation

(1) Press [1:R-SEL] to call up the Robot screen as shown below, which lists all robot models you can choose.



(2) When the power is first applied to the robot controller, the mini-pendant shows robot models preset by default. Use up and down cursor keys to choose the robot model you want to run and then press [OK].

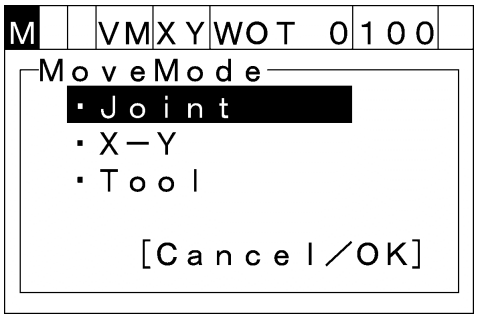
To discard the new choice, press [CANCEL].

6.2.4 Switching the Motion Modes

Key: [2: M-MOD]

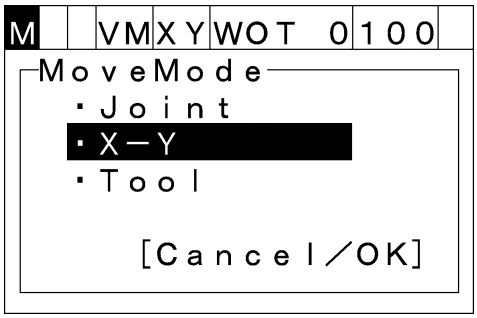
Operation

(1) Press [2:M-MOD] to call up the "MoveMode" screen as shown below, which lists the motion modes you can choose for your robot.



(2) From the Joint, X-Y, and Tool modes, choose one in which you want to run your robot in Manual operation, by using up and down cursor keys. Then press [OK].

To discard the new choice, press [Cancel].

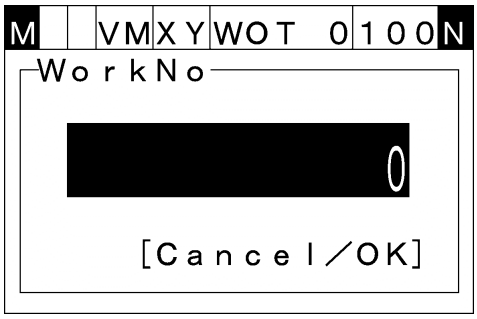


6.2.5 Changing Work Coordinates

Key: [WORK] **[SHIFT] + [2: M-MOD]**

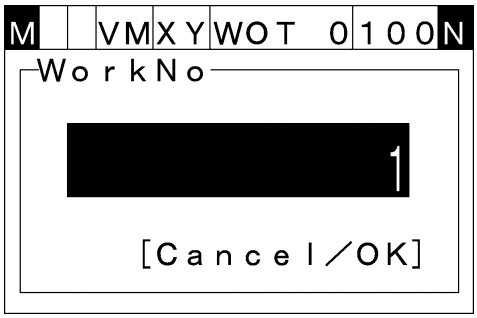
Operation

(1) Press [WORK] to call up the "WorkNo" screen as shown below, which shows the current work coordinates number.



(2) When the power is first applied to the robot controller, the WORK0 (Base coordinate) is set by default. Enter a number indicating the desired work coordinates, and then press [OK].

To discard the new setting, press [CANCEL].

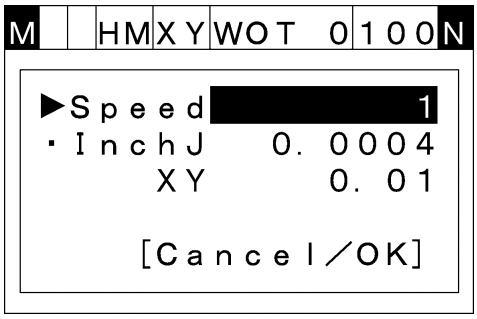


6.2.6 Changing the Robot Speed

Key: [3: SPEED]

Operation

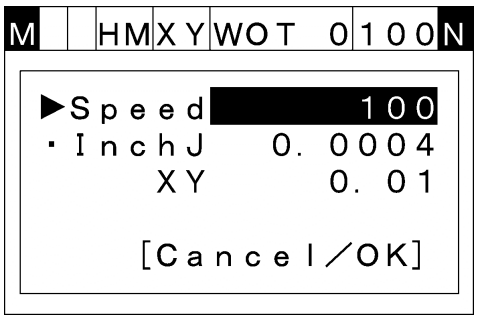
(1) Press [3:SPEED] to call up the speed setting screen shown below where you can change the robot speed.



(2) Choose "Speed" with the up and down cursor keys, enter the desired speed (from 0.1 to 100) from the numeric keypad, then press [OK].

If you use the right or left cursor key instead of the numeric keypad, the speed will increase or decrease in units of 5, respectively.

To discard the new setting, press [CANCEL].

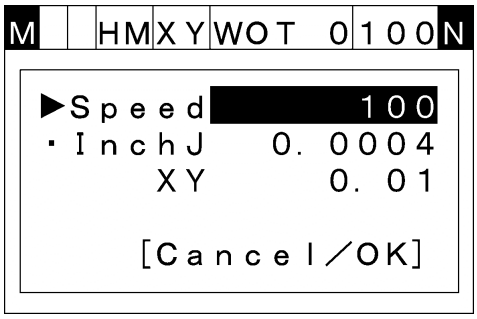


6.2.7 Changing the Inching Angle and Distance

Key: [3: SPEED]

Operation

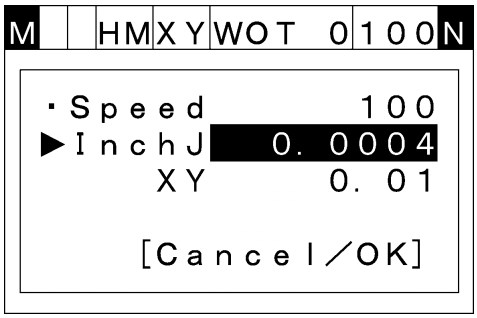
(1) Press [3:SPEED] to call up the speed setting screen shown below where you can change the inching angle and distance.



(2) To change the inching angle:

Choose "InchJ" with the up and down cursor keys, enter the desired angle from the numeric keypad, then press [OK].

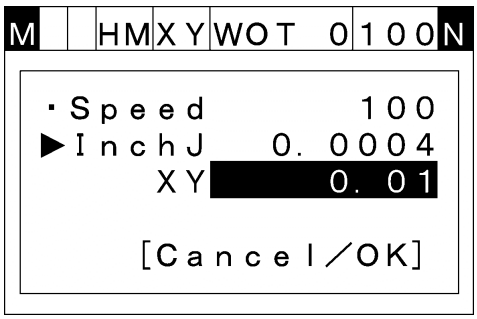
To discard the new setting, press [CANCEL].



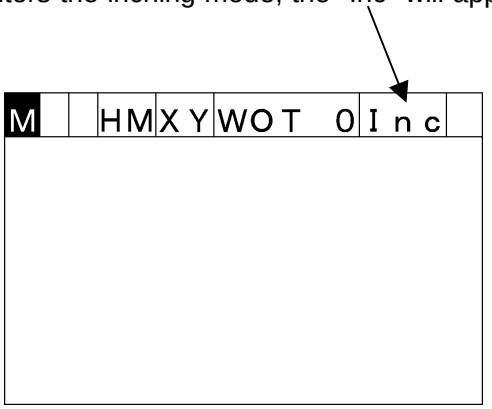
(3) To change the inching distance:

Choose "XY" with the up and down cursor keys, enter the desired distance from the numeric keypad, then press [OK].

To discard the new setting, press [CANCEL].



If the robot enters the inching mode, the "Inc" will appear in the rightmost area of the status bar.

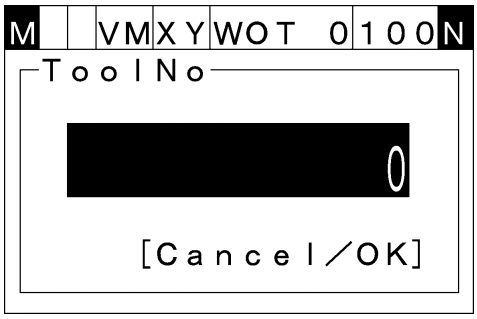


6.2.8 Changing Tool Coordinates

Key: [TOOL] [SHIFT] + [3: SPEED]

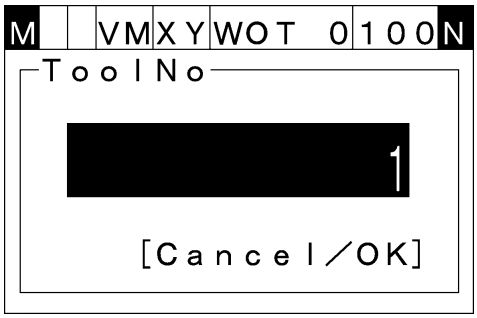
Operation

(1) Press [TOOL] to call up the "ToolNo" screen as shown below, which shows the current tool coordinates number.



(2) When the power is first applied to the robot controller, the TOOL0 (Flange) is set by default. Enter a number indicating the desired tool coordinates. Then press [OK].

To discard the new setting, press [CANCEL].

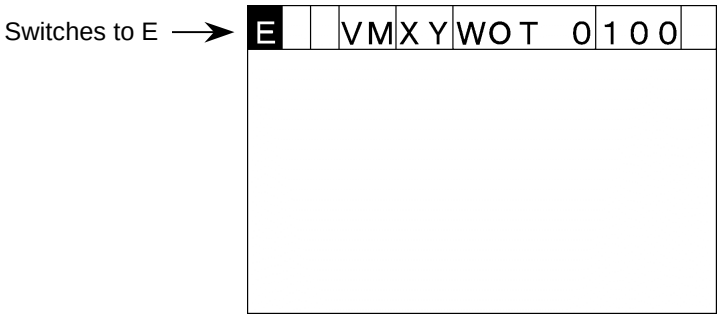


6.2.9 Switching between Internal and External Auto Modes

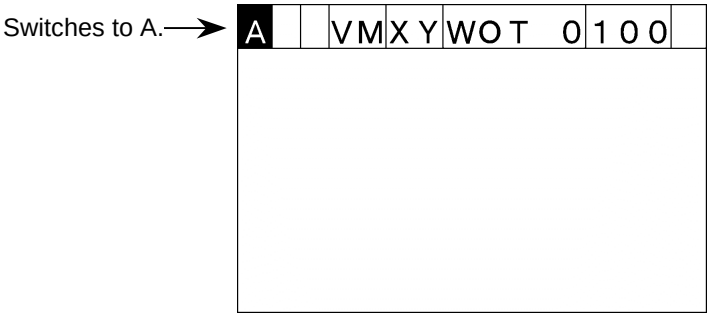
Key: [INT/EXT]

Operation

(1) With the top screen displayed, press [INT/EXT] in Internal Auto mode to switch to External Auto mode.



(2) With the top screen displayed, press [INT/EXT] in External Auto mode to switch to Internal Auto mode

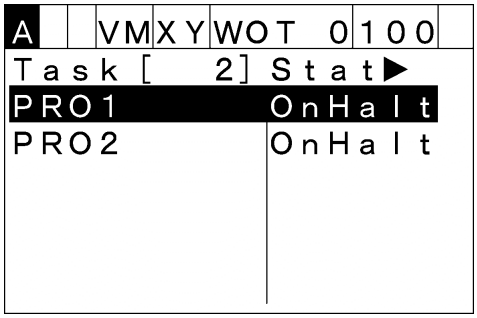


6.2.10 Handling Programs

Key: [PROGRAM]

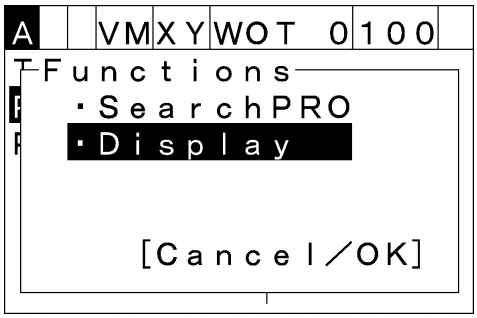
Operation

(1) Press [PROGRAM] to call up the program list as shown below.

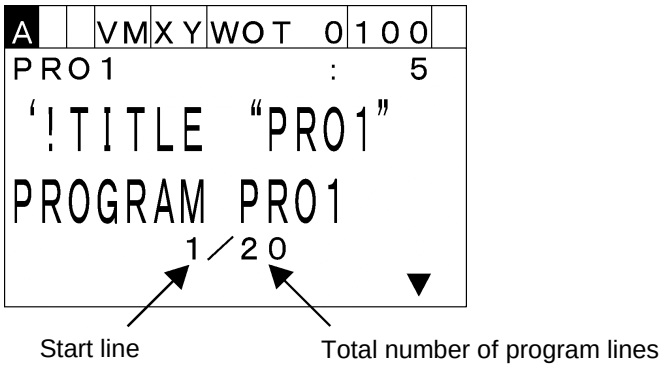


(2) Press [OK] to call up the "Functions" screen that lists program handles.

- SearchPRO: Search program names.
- Display: Show the property of the selected program.



(3) Choose the "Display" handle with the up and down cursor keys and then press [OK]. The property of the selected program appears as shown below, including the program number, title, the number of steps, and others.



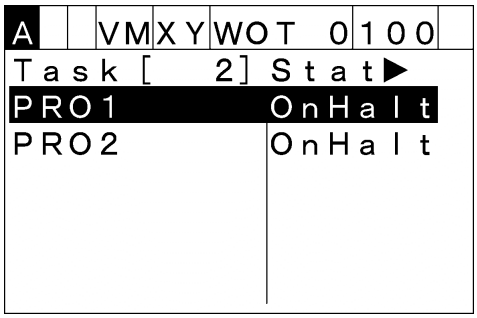
(4) To display other program information, scroll the screen vertically with the up and down cursor keys.

(1) Checking programs in details

On the program list window called up by the [PROGRAM], you may check the program details--execution status, currently running program line, execution time, and execution priority by scrolling the screen horizontally with the right and left cursor keys.

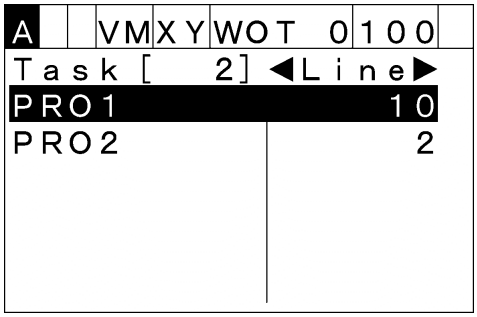
(1.1) Displaying the program execution status

You can check the execution status of programs currently loaded.



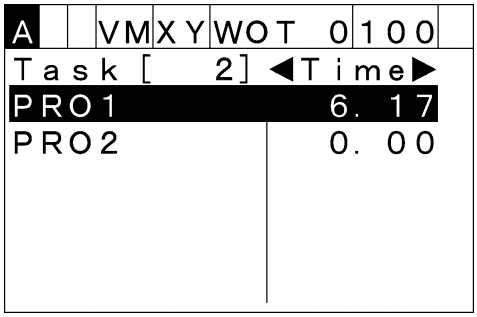
(1.2) Displaying the currently running program line

You can check the currently running program line.



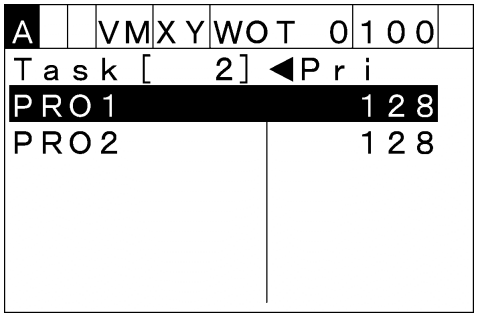
(1.3) Displaying the program execution time

You can check the execution time (in seconds) of loaded programs.



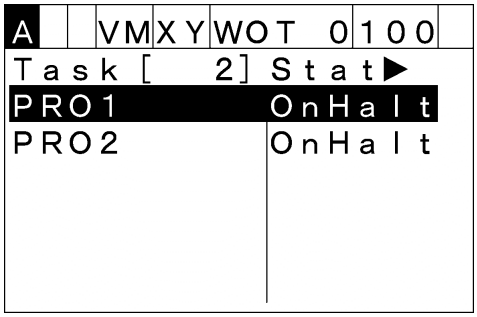
(1.4) Displaying the program execution priority

You can check the execution priority level of each program currently loaded.



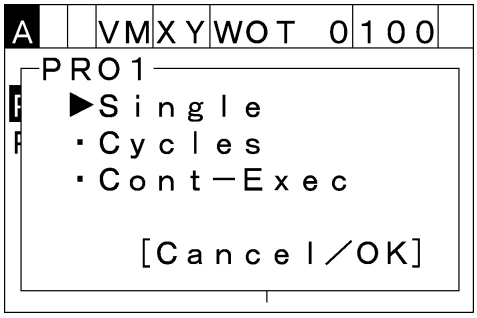
(2) Starting a program

(1) On the program list window called up by the [PROGRAM], you may choose a program to run with the up and down cursor keys.



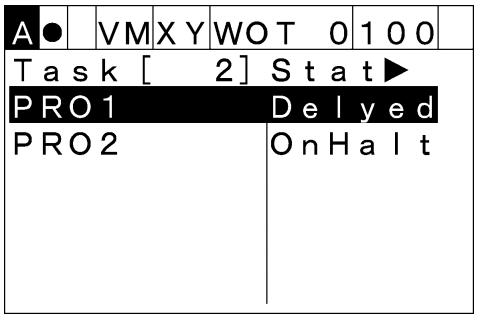
(2) Press [RUN] to show the program running mode menu.

- Single: Single-cycle run (Execute the selected program from the beginning to the end once.)
- Cycles: Continuous run (Repeat the selected program.)
- Cont-Exec: Continue start (Start the program whose status is Continue Stop.)



(3) Choose a program running mode with the up and down cursor keys, then press [OK]. The selected program will run.

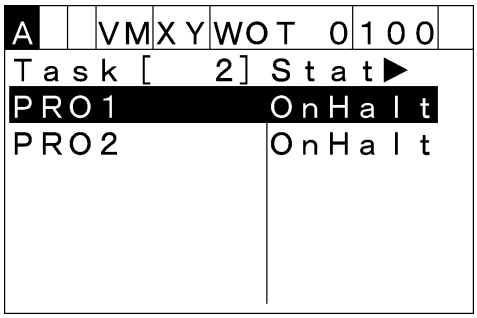
NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.



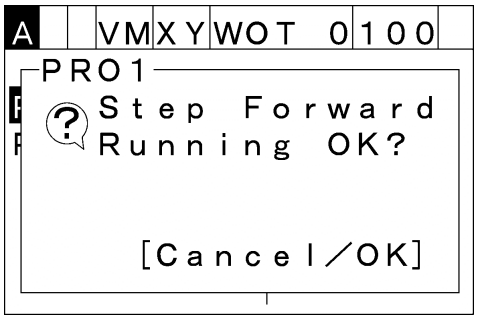
(4) If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT] to halt the currently running program.

(3) Step Start

(1) On the program list window called up by the [PROGRAM], you may choose a program to run with the up and down cursor keys.



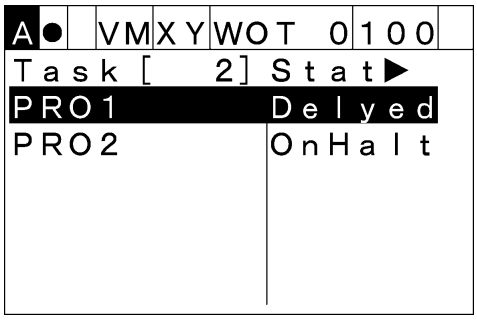
(2) Press [STEP START] to call up the Step Forward screen as shown below.



(3) Press [OK] to step-start the selected program.

NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.

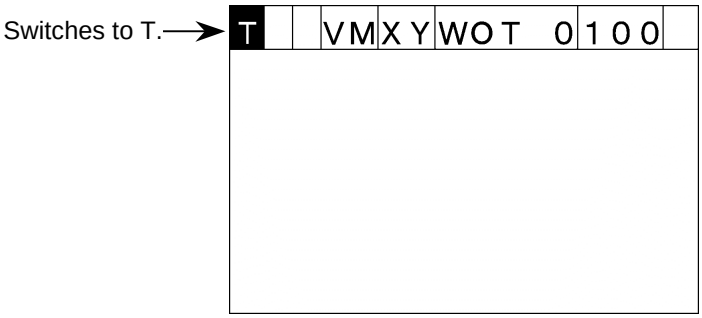
(4) If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT] to halt the currently running program.



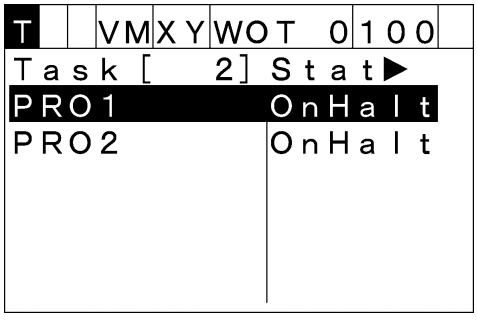
(4) Teach Check

(4.1) Cycle Start

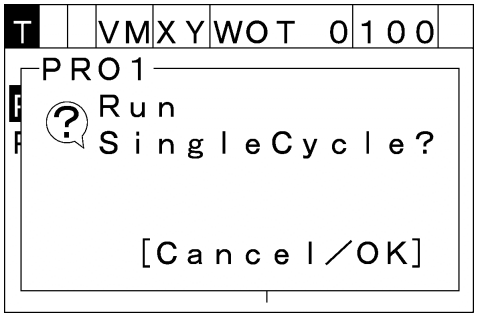
(1) Turn the mode selector switch to the TEACH position to switch to Teach Check mode.



(2) Press [PROGRAM] to call up the program list window as shown below. Choose a program to run with the up and down cursor keys.

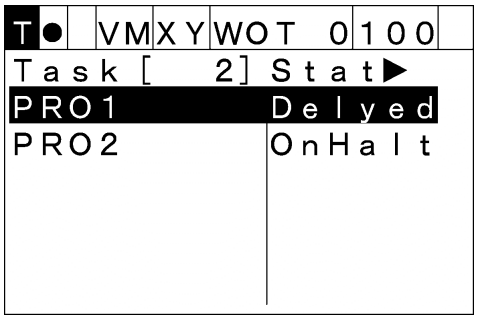


(3) Press [RUN] to call up the Single Cycle screen.



(4) While holding down the deadman switch, press [OK]. The program will run a single cycle. Keep holding them down until the program will finish.

NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.

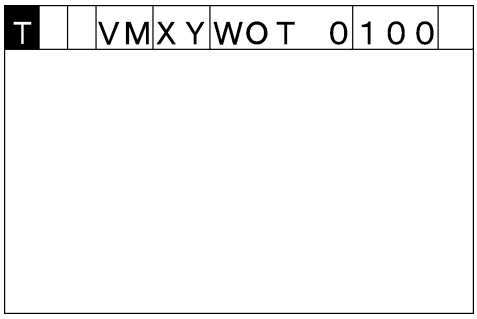


(5) If you release either one of the deadman switch and [OK], then the robot running by programs will immediately stop.

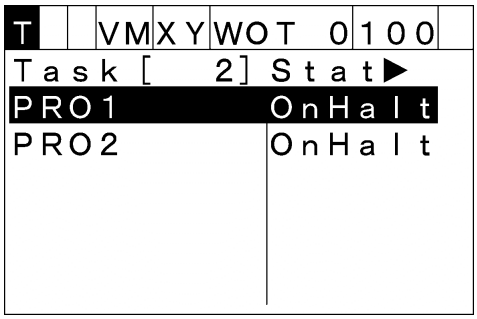
If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].

(4.2) Step Start and Step Back

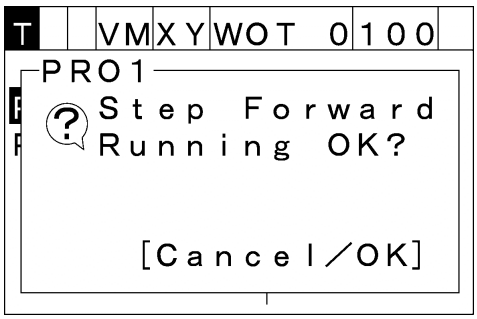
(1) Turn the mode selector switch to the TEACH position to switch to Teach Check mode.



(2) Press [PROGRAM] to call up the program list window as shown below. Choose a program to run with the up and down cursor keys.

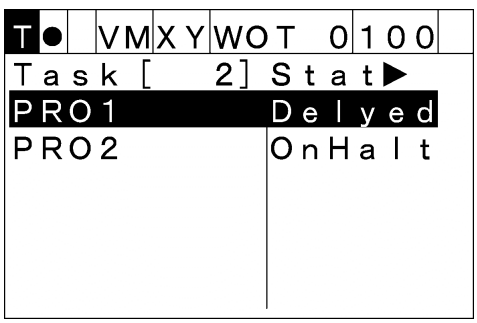


(3) Press [STEP START] to call up the Step Forward screen.



(4) While holding down the deadman switch, press [OK]. The program will run a single step. Keep holding them down until the program will finish.

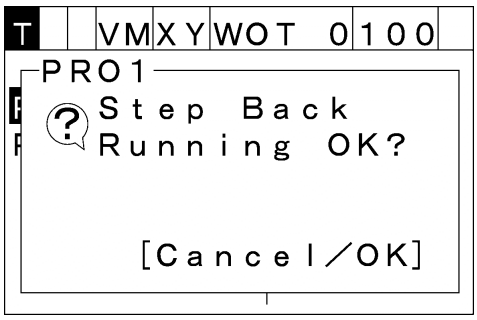
NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.



(5) If you release either one of the deadman switch and [OK], then the robot running by programs will immediately stop.

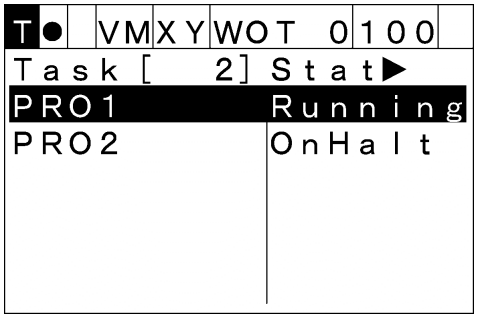
If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].

(6) Press [STEP BACK] to call up the Step Back screen.



(7) While holding down the deadman switch, press [OK]. The program will step backwards . Keep holding them down until the program will finish.

NOTE: Make sure that CAL has been completed and the motor power is on before starting any programs.



(8) If you release either one of the deadman switch and [OK], the robot running by programs will immediately stop.

If you want to stop the current robot motion immediately, press [STEP STOP], [CYCLE STOP] or [HALT].

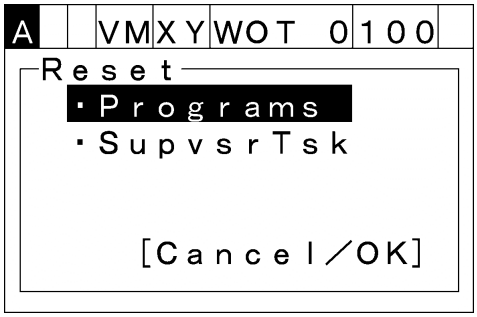
6.2.11 Resetting Programs

Key: [PRO RESET] [SHIFT] + [PROGRAM]

Operation

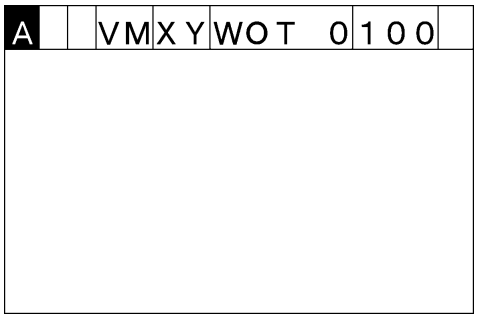
(1) Press [PRO RESET] to call up the "Reset" screen as shown below. Choose one of items listed on the screen by using the up and down cursor keys.

- Programs: Normal task programs
- SupvsrTsk: Supervisory task programs



(2) Press [OK] to reset the selected programs to the beginning. Those programs will become on halt.

To discard the new choice, press [CANCEL]. The display will return to the top screen.

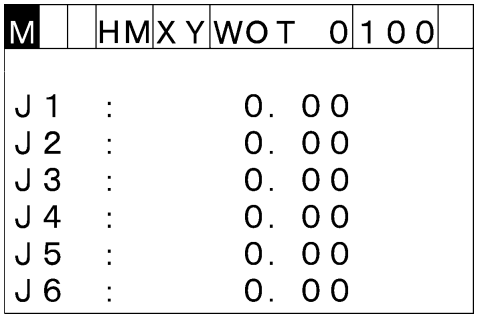


6.2.12 Displaying the Current Robot Arm Position

Key: [ARM] **[SHIFT] + [RUN]**

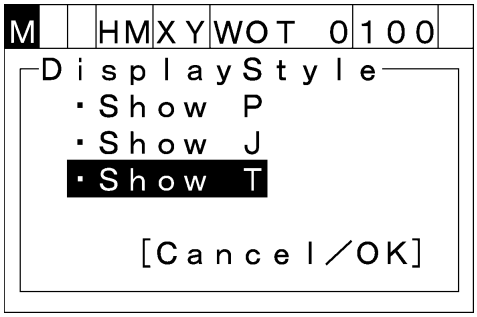
Operation

(1) Press [ARM] to call up the current robot position window.



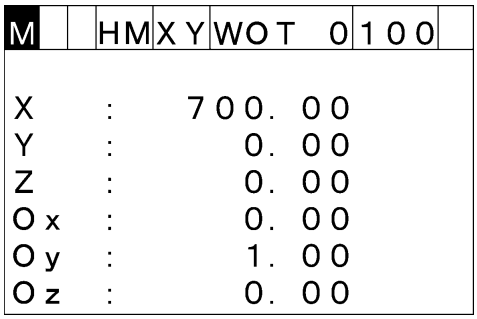
(2) When the robot controller is turned on, the coordinates is expressed in joint variables by default as shown above.

Press [OK] to call up the Display Style window where you can select the desired expression.



(3) Choose the desired expression by using the up and down cursor keys, then press [OK].

To discard the new choice, press [CANCEL].



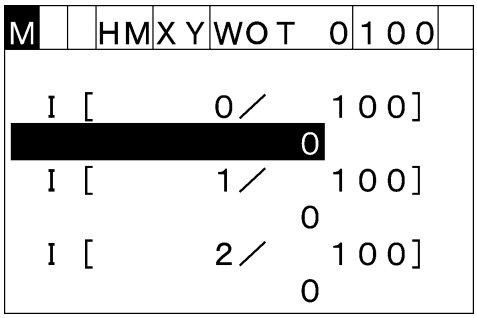
On the current robot position window, using the right and left cursor keys may switch the expression of the current robot position between the position variable type, joint variable type, and homogeneous transform matrix variable type.

6.2.13 Displaying Variable Values

Key: [VARIABLE] **[SHIFT] + [STEP BACK]**

Operation

(1) Press [VARIABLE] to call up the screen which lists variables used in your robot controller.



When the robot controller is turned on, the integer variables are displayed by default as shown above.

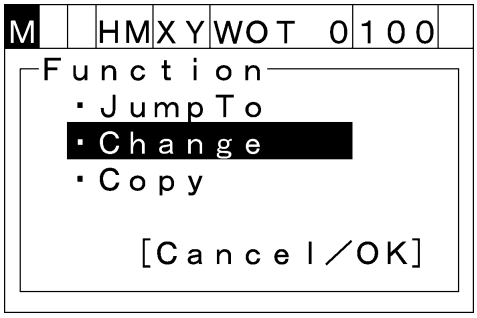
(2) You can cycle through variable types to be displayed by using the right and left cursor keys.

(The screen will cycle through "I → F → D → V → P → J → T → I")

(3) With the desired variable type displayed, press [OK] to call up the "Function" screen to handle the selected variable.

To discard the new setting, press [CANCEL].

NOTE: There are two types of "Function" screens. For I, F, D, and V variables, three items (JumpTo, Change, and Copy) will display; for P, J, and T variables, five items (JumpTo, Move, Change, GetPos, and Copy) will display.

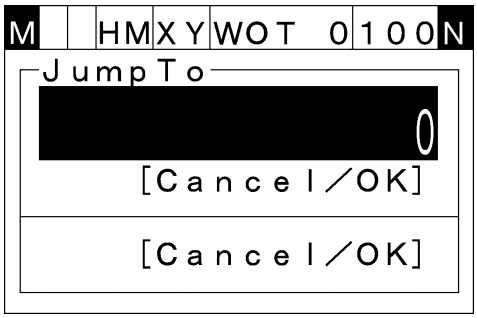


(4) Choose one of the items with the up and down cursor keys, then press [OK]. To discard the new choice, press [CANCEL].

(4.1) **JumpTo**

If you choose "JumpTo" with the up and down cursor keys and press [OK], then the following JumpTo screen appears. Enter the variable number you want to jump to, into the highlighted line and press [OK].

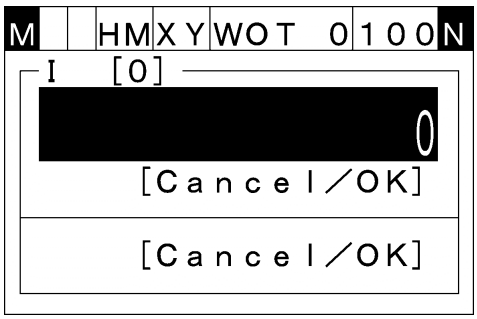
To discard the new setting and return to the previous screen, press [CANCEL].



(4.2) **Change**

If you choose "Change" with the up and down cursor keys and press [OK], then the following variable setting window appears. Enter the desired value to be assigned to the variable and press [OK].

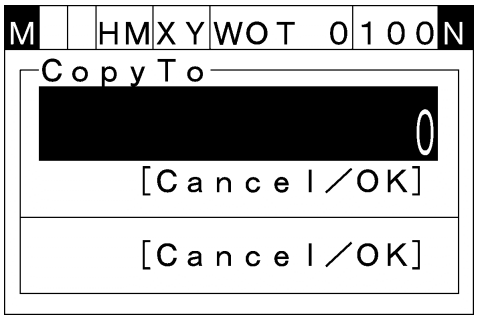
To discard the new setting and return to the previous screen, press [CANCEL].



(4.3) **Copy**

If you choose "Copy" with the up and down cursor keys and press [OK], then the CopyTo window appears. Enter an arbitrary variable number which the value of the variable will be copied to, then press [OK].

To discard the new setting and return to the previous screen, press [CANCEL].

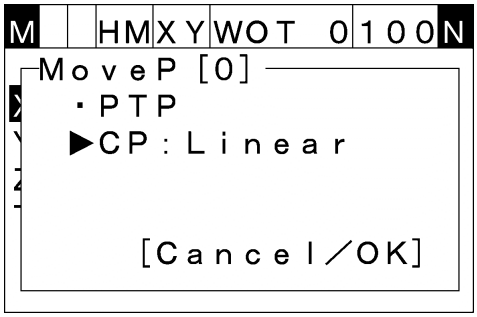


(4.4) **Move**

If you choose "Move" with the up and down cursor keys and press [OK], then the PTP/CP selection window appears.

To discard the new choice and return to the previous screen, press [CANCEL].

After selecting the PTP or CP motion, press [OK] while holding down the deadman switch. The robot arm will move to the specified position (in Manual mode or Teach Check mode).

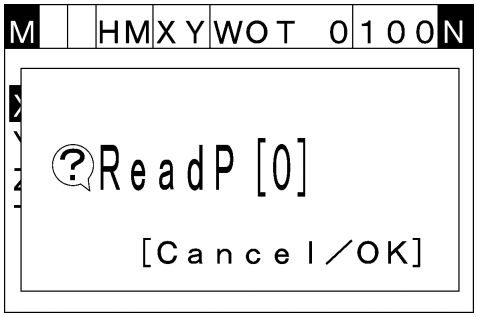


(4.5) **GetPos**

If you choose "GetPos" with the up and down cursor keys and press [OK], then the current position reading window appears as shown below.

To discard the new choice and return to the previous screen, press [CANCEL].

Press [OK] to get the current robot position into the specified variable.

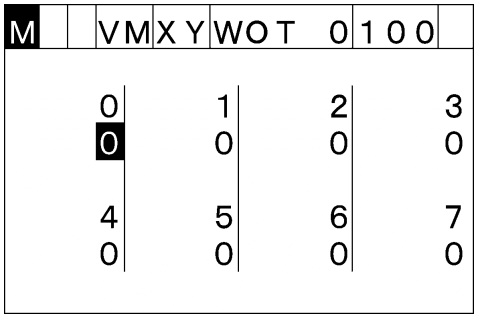


6.2.14 Reconfiguring I/O Signals

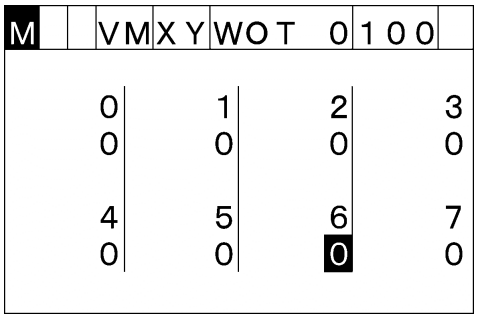
Key: [I/O] **[SHIFT] + [STEP START]**

Operation

(1) Press [I/O] to call up the I/O signal truth table as shown below.

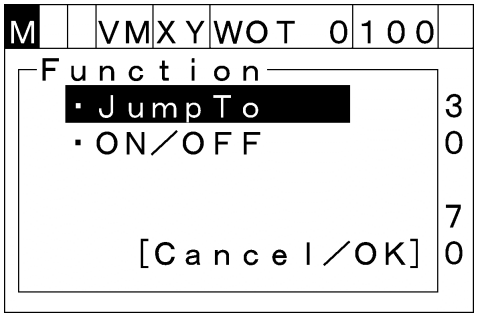


(2) To change the truth status assigned to I/O lines, choose the line with the up, down, left, and right cursor keys.



(3) Press [OK] call up the "Function" screen that handles I/O signals.

To return to the I/O signal truth table, press [CANCEL].

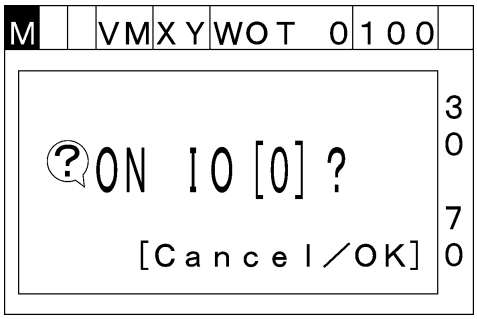


(4) Choose one of handles with the up and down cursor keys, then press [OK].

(4.1) **ON/OFF**

If you choose "ON/OFF" with the up and down cursor keys and press [OK], then the following screen appears where you may reverse the truth assignment of the line.

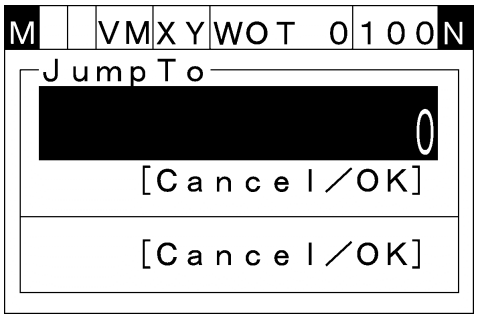
To discard the new setting and return to the I/O signal truth table, press [CANCEL].



(4.2) **JumpTo**

If you choose "JumpTo" with the up and down cursor keys, the JumpTo screen appears. Enter an I/O line number you want to jump to, into the highlighted line and then press [OK].

To discard the new setting and return to the I/O signal truth table, press [CANCEL].



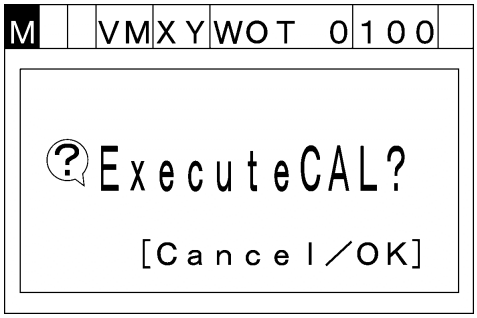
On the I/O signal truth table, using the up, down, right, and left cursor keys with the [SHIFT] held down may shift the screen.

6.2.15 Executing CAL

Key: [CAL] (Effective in Manual mode)

Operation

(1) Press [CAL] to call up the CAL confirmation window as shown below.



(2) Check that the motor power is on, then press [OK] to execute CAL.
To abort it and return to the previous screen, press [CANCEL].

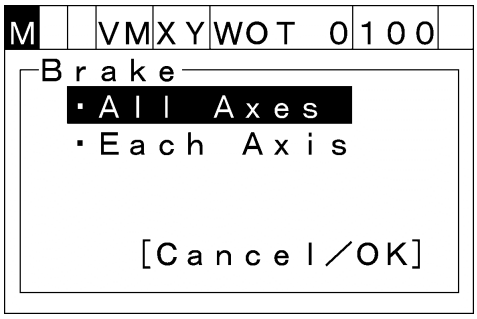
6.2.16 Releasing and Locking Brakes

Key: [BRAKE] (Effective in Manual mode)

Operation

For 6-axis robots

(1) Press [BRAKE] to call up the "Brake" window as shown below.

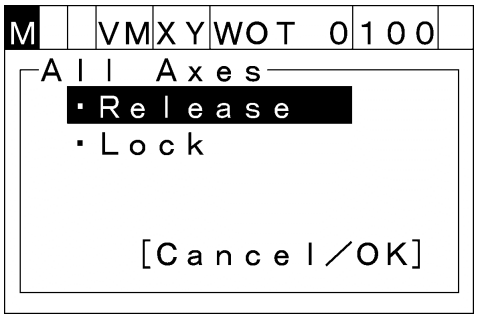


(2) Choose the All Axes or Each Axis to handle by using the up and down cursor keys, then press [OK]. The display will proceed to the brake control screen.

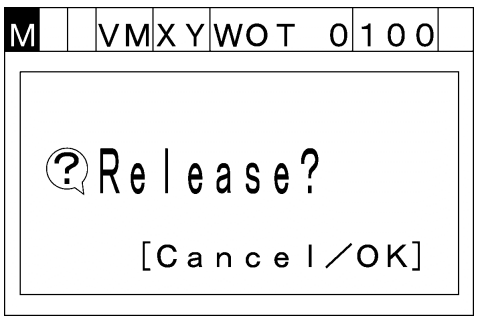
(2.1) **All Axes**

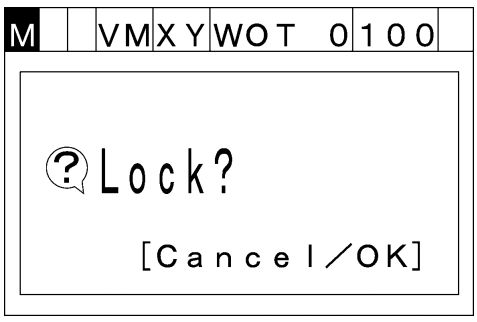
If you choose "All Axes" with the up and down cursor keys and press [OK], then the following All Axes screen will appear where you can control the brakes.

To return to the previous screen, press [CANCEL].



Choose "Release" or "Lock" with the up and down cursor keys, then press [OK]. The following confirmation dialogs will appear, respectively.





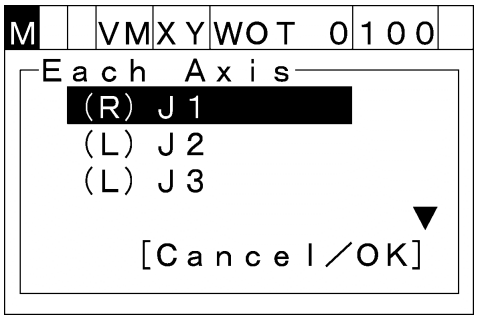
Press [OK] to release or lock all axes.

To abort brake setting and return to the previous screen, press [CANCEL].

(2.2) **Each Axis**

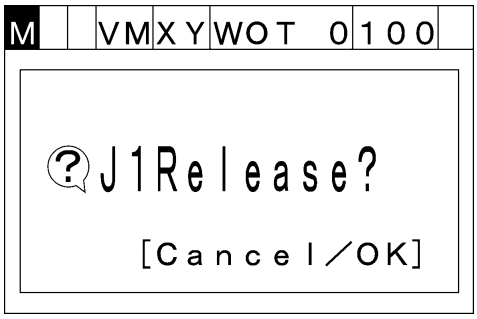
If you choose "Each Axis" with the up and down cursor keys and press [OK], then the following Each Axis screen appears where you can control the brake for each joint. The letters, R and L, stand for current Release and Lock status of each joint brake, respectively.

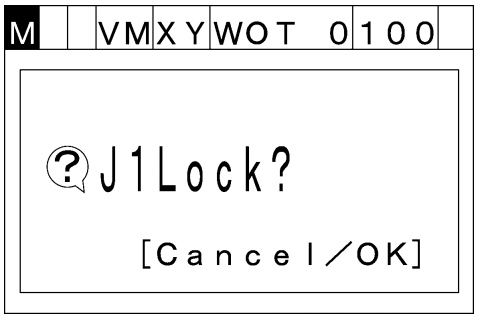
To abort brake setting and return to the previous screen, press [CANCEL].



Choose an arbitrary joint with the up and down cursor keys. (You may vertically scroll the screen with those keys.)

Then press [OK]. Either of the following windows will appear.

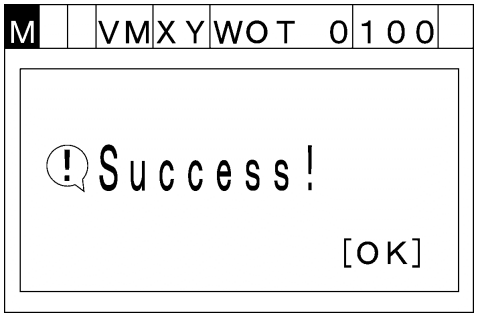




To switch the selected joint brake between Release and Lock status, press [OK].

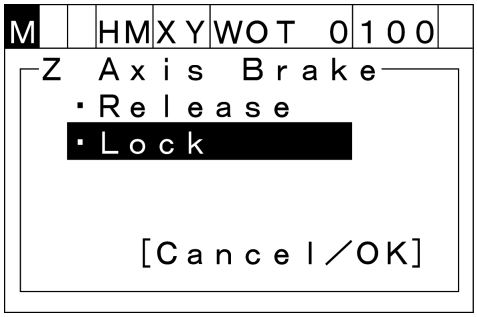
To abort brake setting and return to the previous screen, press [CANCEL].

If the selected brake is released or locked successfully as specified, the following message will display.

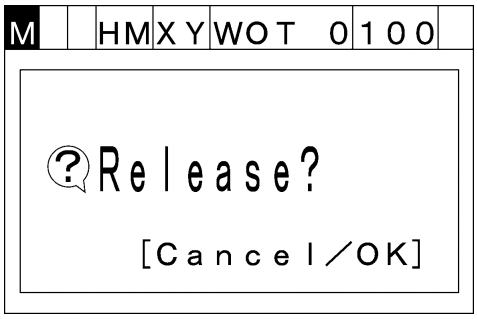


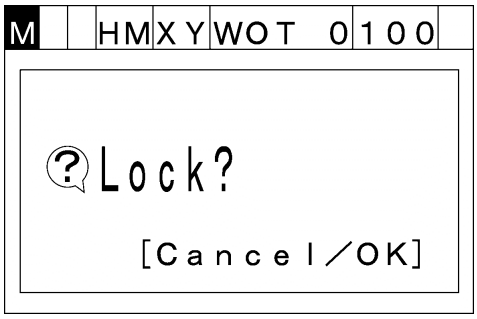
For 4-axis robots

(1) Press [BRAKE] to call up the "Z Axis Brake" window as shown below.



(2) Choose "Release" or "Lock" with the up and down cursor keys, then press [OK]. The following confirmation dialogs will appear, respectively.

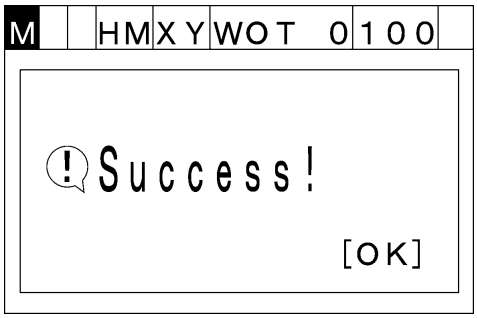




(3) Press [OK] to release or lock the Z-axis brake.

To abort brake setting and return to the previous screen, press [CANCEL].

If the Z-axis brake is released or locked successfully as specified, the following message will display.

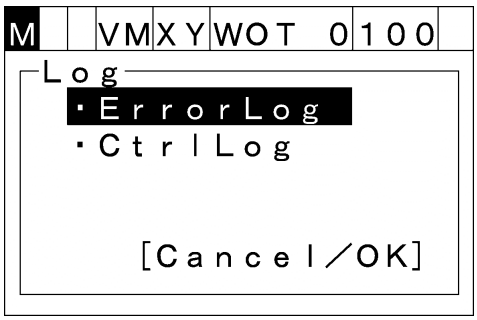


6.2.17 Logging Data

Key: [LOG] [SHIFT] + [BRAKE]

Operation

Press [LOG] to call up the Log screen as shown below where you can handle the error and control logging.

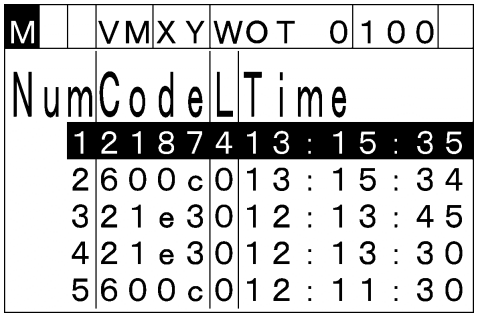


(1) Checking error log

Choose "ErrorLog" with the up and down cursor keys, then press [OK] to call up the error log as shown below. You can check errors in your robot controller.

You may vertically scroll the screen with the up and down cursor keys.

To escape from error logging, press [CANCEL].

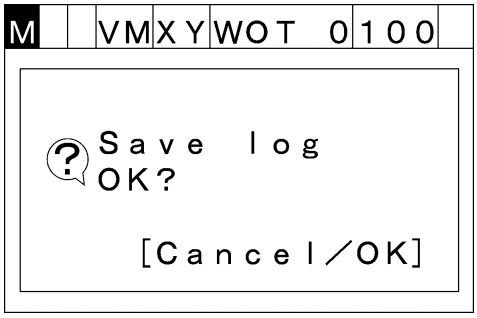


(2) Handling control log

Choose "CtrlLog" with the up and down cursor keys, then press [OK] to call up the Save log confirmation dialog as shown below.

Press [OK] to save the control log.

To discard the control log, press [CANCEL].

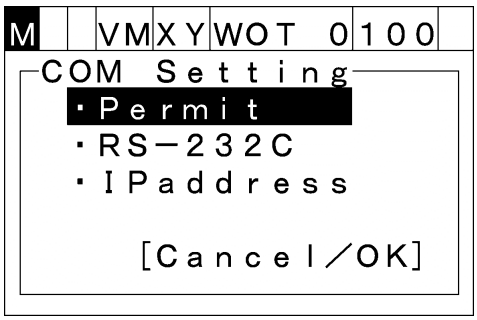


6.2.18 Setting Communications Port

Key: [COM] (Effective in Manual mode)

Operation

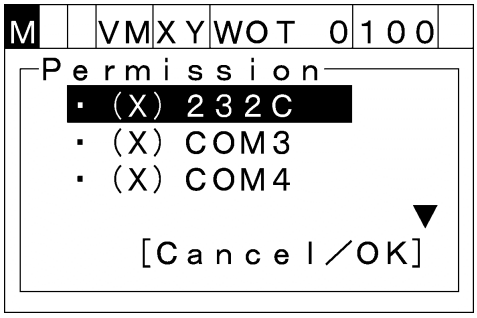
(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications settings for the robot controller.



(2) Choose "Permit" with the up and down cursor keys and then press [OK]. The Permission screen appears as shown below.

(X): Not permitted, (R): Only read permitted, (RW): Read/write permitted

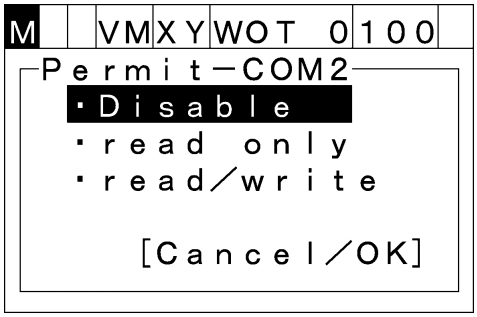
To abort setting, press [CANCEL].



(3) Choose any port whose communications permission should be changed, from the 232C, COM3, COM4 and Ether ports, by using the up and down cursor keys. (You may vertically scroll the screen with those keys.)

Then press [OK] to proceed to the "Permit-COMx" setting as shown below.

To abort setting, press [CANCEL].



Choose any of "Disable", "read only" and "read/write," and then press [OK] to establish the new setting.

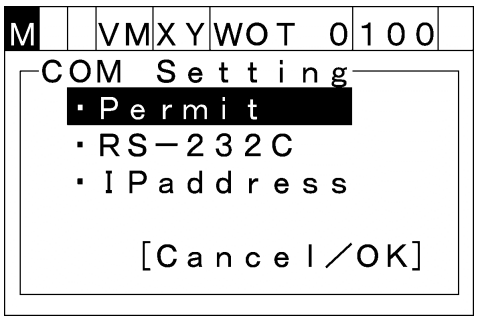
To cancel the new setting, press [CANCEL].

6.2.19 Changing Serial Port Speed

Key: [COM] (Effective in Manual mode)

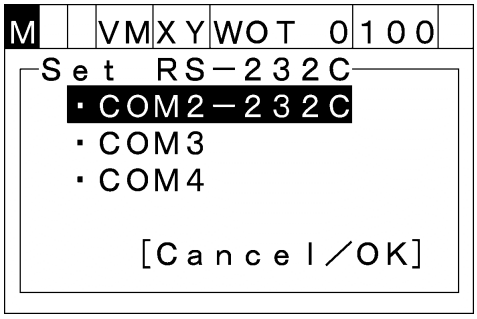
Operation

(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications setting for the robot controller.



(2) Choose "RS-232C" with the up and down cursor keys, then press [OK]. The communications ports window appears as shown below which lists the communications ports available in your robot controller. (You may vertically scroll the screen with those keys.)

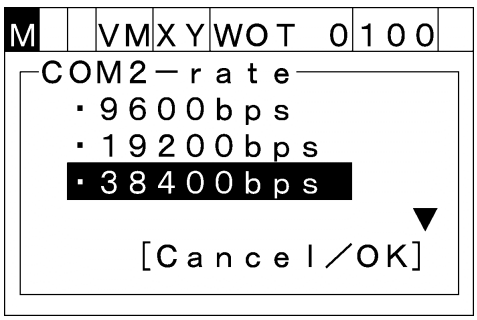
To abort setting and return to the previous screen, press [CANCEL].



(3) Choose any port whose communications speed should be changed, from the COM2-232C, COM3 and COM4 ports, by using the up and down cursor keys.

Then press [OK] to proceed to the communications rate setting shown below.

To abort setting and return to the previous screen, press [CANCEL].



(4) Choose any of "9600bps", "19200bps", "38400bps", "57600bps" and "115200bps" with the up and down cursor keys, then press [OK] to establish it.

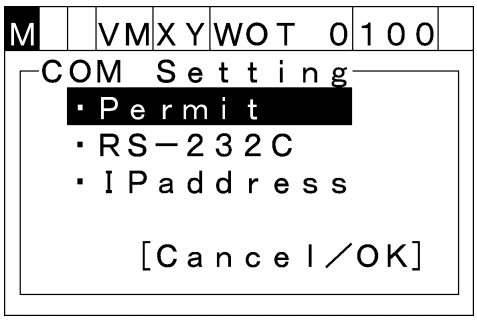
To discard the new setting, press [CANCEL].

6.2.20 Setting IP Address

Key: [COM] (Effective in Manual mode)

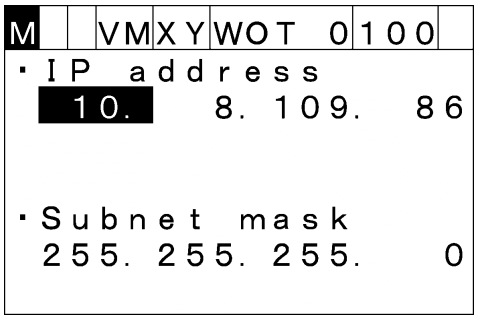
Operation

(1) Press [COM] to call up the "COM Setting" screen shown below which lists communications setting for the robot controller.



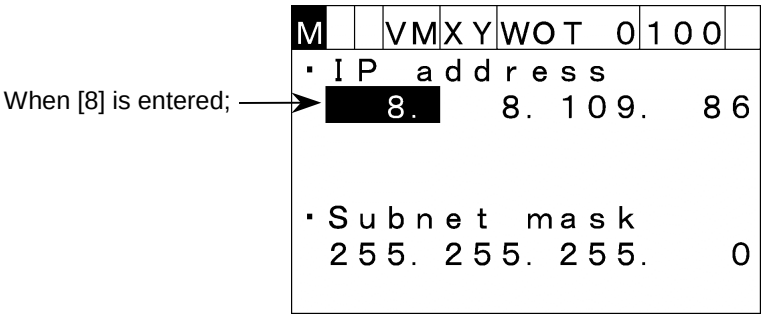
(2) Choose "IPaddress" with the up and down cursor keys, then press [OK]. The IP address setting window appears as shown below where you can set the IP address of your robot controller.

To abort setting and return to the previous screen, press [CANCEL].



(3) Choose an input field with the up, down, right, and left cursor keys, then enter a new address plus a dot (as a field delimiter).

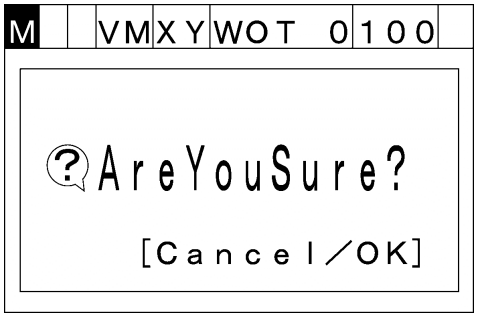
To discard the new setting, press [CANCEL]. Generally, the "Subnet mask" fields will require no change.



(4) After filling up the field, press [OK]. The following confirmation message will appear.

Press [OK] to establish the new setting.

To discard the new setting, press [CANCEL].

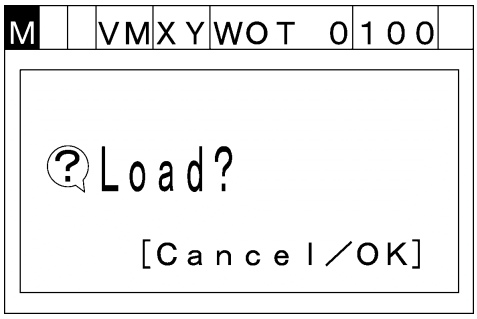


6.2.21 Loading New Project

Key: [LOG] **[SHIFT] + [COM]**

Operation

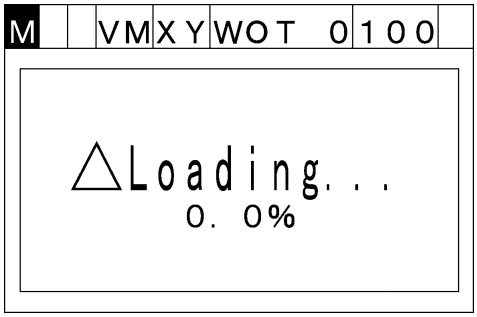
(1) Press [LOAD] to load a new project into your robot controller. The load confirmation message will appear as shown below.



(2) Press [OK] to proceed. During loading, the message shown below is displayed.

NOTE: Loading a new project may take few minutes.

To abort it, press [CANCEL].

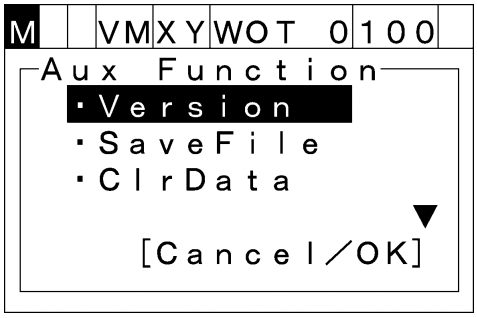


6.2.22 Using Auxiliary Functions (Common to 4-axis and 6-axis robots)

Key: [AUX]

Operation

(1) Press [AUX] to call up the "Aux. Function" menu shown below.

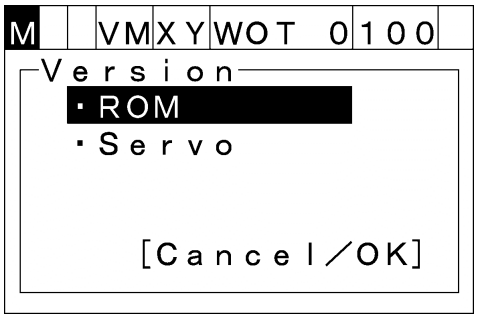


(2) Choose the desired function with the up and down cursor keys. (You may vertically scroll the screen with those keys.) Then press [OK] to proceed.

(2.1) **Version**

If you choose "Version" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following Version menu appears.

To abort setting, press [CANCEL].



Choose "ROM" and press [OK], and the version of the system software currently loaded in your controller will appear.

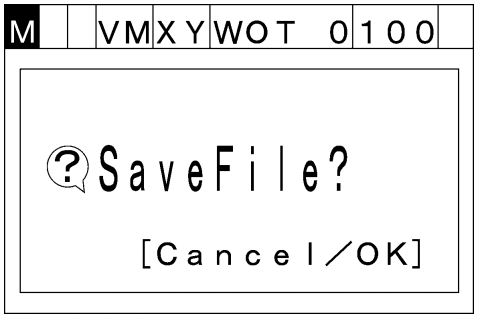
Choose "Servo" and press [OK], and the version of the servo control subsystem will appear.

(2.2) **Save File**

If you choose "SaveFile" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following confirmation message will appear.

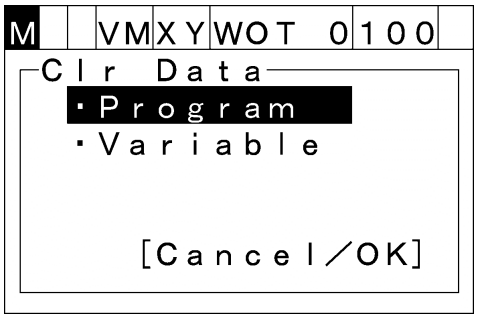
Press [OK] to save the program files that are currently active.

To abort saving, press [CANCEL].



(2.3) **Clear Data**

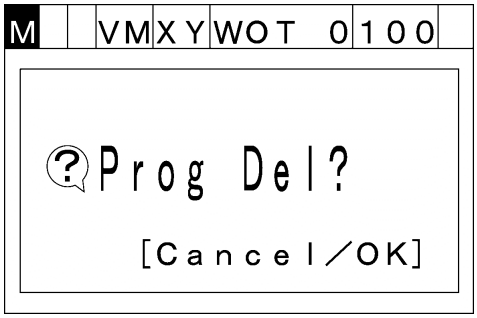
If you choose "ClrData" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following Clr Data menu appears.



Deleting program files

Choose "Program" in the "Clr Data" menu with the up and down cursor keys, and then press [OK]. The following confirmation message will appear.

To abort deleting, press [CANCEL].



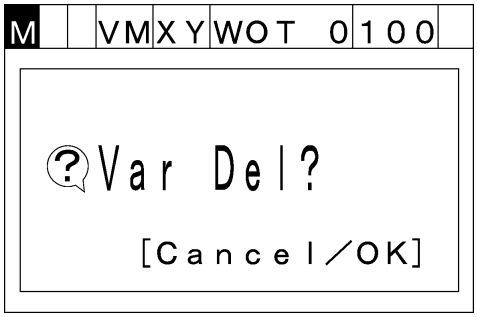
Press [OK] to delete all program files currently loaded in your controller.

To abort deleting, press [CANCEL].

Deleting variables

Choose "Variable" in the "Clr Data" menu with the up and down cursor keys, and then press [OK]. The following confirmation message will appear.

To abort deleting, press [CANCEL].

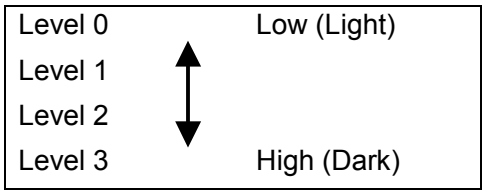


Press [OK] to delete all variables currently loaded in your controller.

To abort deleting, press [CANCEL].

(2.4) **Maintenance [Adjusting contrast of the mini pendant screen]**

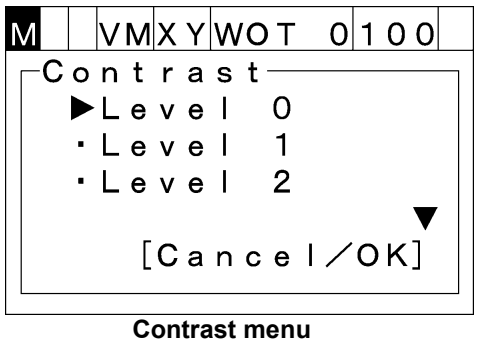
Before shipment from the factory, the contrast of LCD-screen is adjusted adequately by selecting one level among 4 levels shown in the figure below.



Contrast level

Although you need not adjust the contrast usually, it may be adjustable as follows.

(1) If you choose "Maintenance" in the "Aux Function" menu with the up and down cursor keys and press [OK], then the following Contrast menu will appear.



Contrast menu

(2) Choose your favorite contrast level with the up and down cursor keys. (You may vertically scroll the screen with those keys.) Then press [OK] to make the setting effective after a few seconds.

NOTE: The current level No. is not displayed on the contrast menu. When appearing the contrast menu, the cursor key positions Level 0. But it does not mean Level 0.

To discard the new setting, press [CANCEL].

6.2.23 Entering the Direct Teaching Mode (For 4-axis robots)

Key: [AUX] (Effective in Manual mode)

Operation

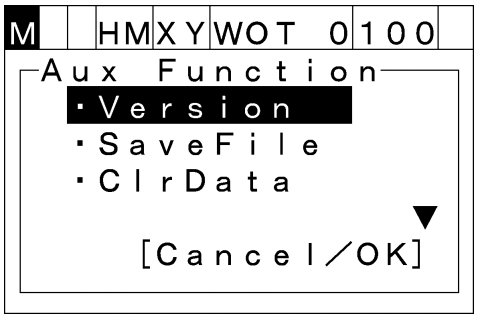
In the direct teaching mode, you may move the robot arm by hand (without using the mini-pendant) with the motor OFF and teach the current position to variables.

Before making the robot enter the direct teaching mode, make sure that the motor power is OFF and the CAL has been completed.

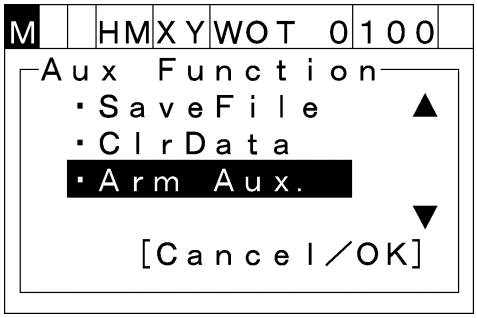
NOTE: Only when you make the robot enter the direct teaching mode at the first time after turning the robot controller ON, the air pressure adjustment for Z-axis balance is required so that you need to turn the motor power ON.

Entering the direct teaching mode

(1) Press [AUX] to call up the "Aux. Function" menu shown below.

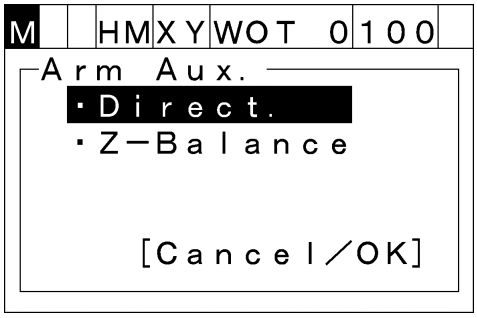


(2) Vertically scroll the screen with the up and down cursor keys to choose the "Arm Aux."



(3) Press [OK]. The "Arm Aux." window appears.

To abort setting and return to the previous screen, press [CANCEL.]

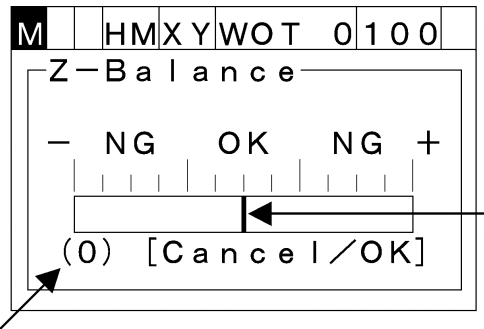


NOTE: Steps (4) through (6), which adjust the air pressure balance of the Z-axis, are required only when you make the robot enter the direct teaching mode at the first time after turning the robot controller ON.

(4) If you choose "Direct" and press [OK], then the "Z-Balance" window appears as shown below.

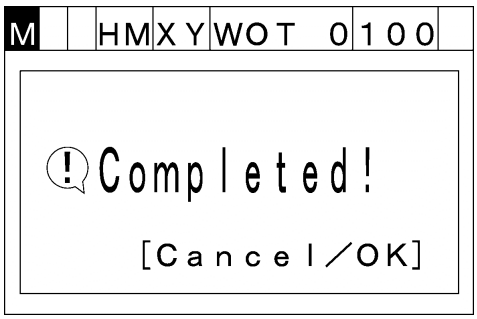
To abort air balance setting and return to the previous screen, press [CANCEL.]

Adjust the air pressure so that the indicator line comes within the OK range of the gauge.



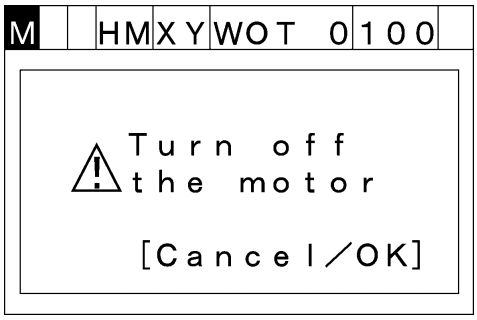
This mark shows the current air balance state.
0: Appropriate
▲: Increase the air pressure
▼: Decrease the air pressure

(5) Press [OK]. The following screen will appear.

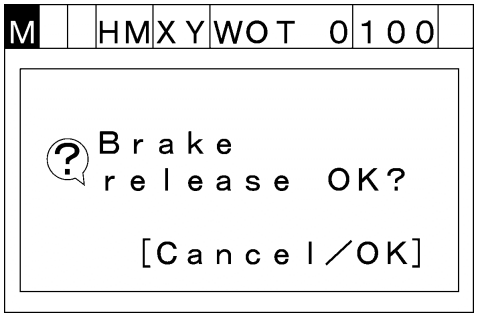


(6) Press [OK]. The following message appears, prompting you to turn the motor power off.

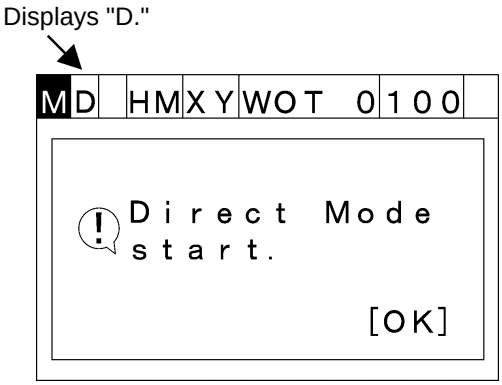
To abort setting, press [CANCEL].



(7) Turn the motor power off and press [OK]. The Brake release confirmation screen will appear.



(8) Press [OK]. The Z-axis brake will be released and the robot will enter the direct teaching mode. In the direct teaching mode, the "D" appears in the status bar.

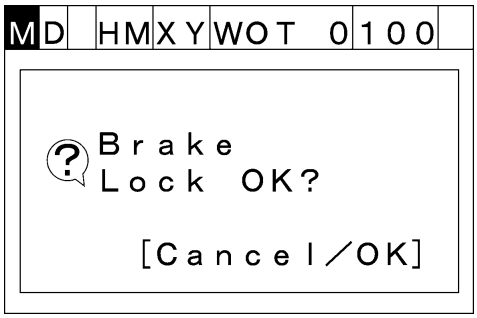


Escaping from the direct teaching mode

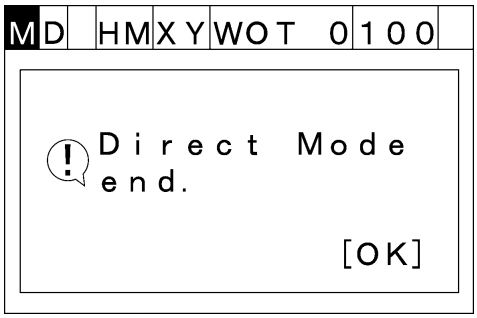
(1) Perform steps (1) through (3) in the direct teaching mode entry procedure.

In the "Arm Aux." screen, choose "Direct" and then press [OK]. The Brake lock confirmation screen appears as shown below.

To abort setting, press [CANCEL].



(2) Press [OK]. The Z-axis brake will be locked and the robot will escape from the direct teaching mode.



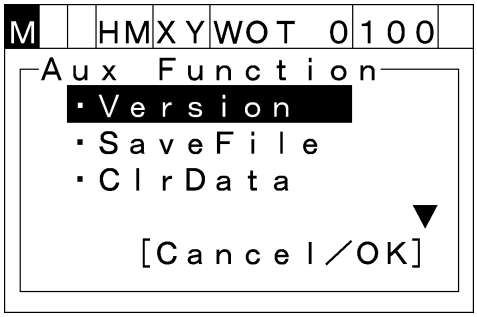
6.2.24 Adjusting the Air Pressure Balance of the Z-Axis (For 4-axis robots)

Key: [AUX] (Effective in Manual mode)

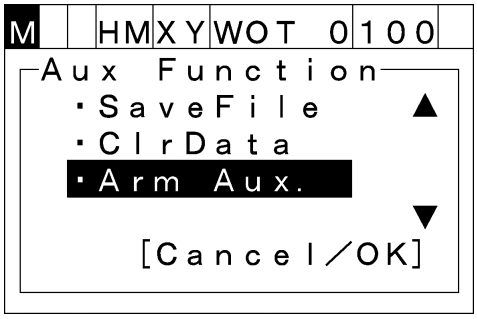
Operation

To adjust the air pressure balance of the Z-axis, you need to turn the motor power on.

(1) Press [AUX] to call up the "Aux. Function" menu shown below.

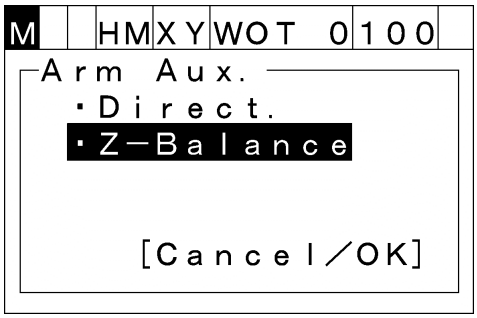


(2) Vertically scroll the screen with the up and down cursor keys to choose the "Arm Aux."



(3) Press [OK]. The "Arm Aux." window appears.

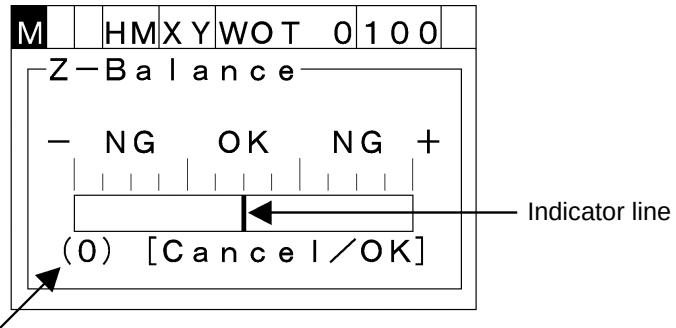
To abort setting and return to the previous screen, press [CANCEL.]



(4) If you choose "Z-Balance" and press [OK], then the "Z-Balance" window appears as shown below.

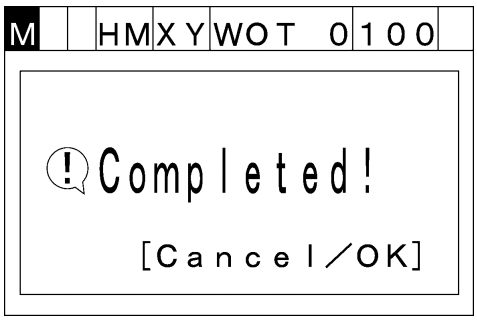
To abort air balance setting and return to the previous screen, press [CANCEL].

Adjust the air pressure balance so that the indicator line comes within the OK range of the gauge.



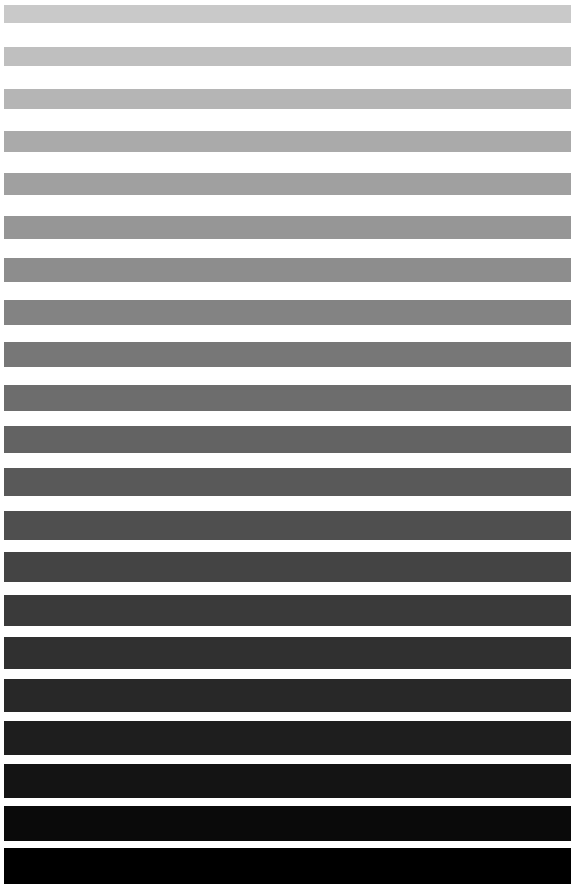
This mark shows the current air balance state.
0: Appropriate
▲: Increase the air pressure
▼: Decrease the air pressure

(5) Press [OK]. The following screen will appear.



(6) Press [OK] or [CANCEL] to complete the air balance adjustment procedure.

Index



Symbols

A

B

C

D

E

DENSO ROBOT
Vertical Articulated, V∗-D/-E Series
Horizontal Articulated, H∗-D/-E Series
Cartesian Coordinate, XYC-4D Series

SETTING-UP MANUAL (Ver. 1.98)

First Edition April 2000
Ninth Edition May 2003

DENSO WAVE INCORPORATED
Factory Automation Division

5E**C

The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feed 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.