

INSTRUCTION MANUAL

INDUSTRIAL ROBOT SR SERIES

OPERATING MANUAL

Notice

1. Make sure that this Instruction Manual is delivered to the final user of the Toshiba Industrial Robot.
2. Please read this manual before installing or operating the Toshiba Industrial Robot, and keep the manual nearby for further reference during use of the robot.

TOSHIBA MACHINE CO.,LTD.

1998- 3

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PREFACE

This Manual describes how to utilize various robot system functions in order to manually guide the robot with the teach pendant, edit programs, compile data and carry out automatic operation.

This manual is directed at the robot operator. Before reading this manual, he or she should first read the Introductory Manual and the Start-up Manual.

This Manual is divided into fourteen chapters:

Chapter 1	"Before Operating Your Robot"
Chapter 2	"Basic Operation"
Chapter 3	"Manual Operation"
Chapter 4	"Auxiliary Signals"
Chapter 5	"Program Editing"
Chapter 6	"Data Editing"
Chapter 7	"Test Operation"
Chapter 8	"Internal Automatic Operation"
Chapter 9	"External Automatic Operation"
Chapter 10	"System Control"
Chapter 11	"File Management"
Chapter 12	"Utilities"
Chapter 13	"Self Diagnosis"
Chapter 14	"Joint Limit Setting"

NOTE! FOR EUROPEAN UNION (EU)

In the European Union (EU), there are following limitations and notes to approve the CE Marking EMC Direction. In other countries and areas, it is not necessary to apply to these limitations and notes.

(1) Setup conditions

- ◆ The following type of power line transformer must be used.

Frequency:	50 or 60 Hz
Secondary voltage:	3-phase, 200~230 VAC
Power capacity:	Min. 2.7 kVA

(2) Input power condition

- ◆ Core wires: 3.5 mm² ~ 5.5 mm²
- ◆ Voltage short interruption: 0.5 cycle

(3) Ground

- ◆ Core wires: 3.5 mm² ~ 5.5 mm²
- ◆ Ground condition: Exclusive ground line for robot ground impedance must be less than 100Ω

(4) External input/output line/Optional input/output line

- ◆ Core wires: 0.08 mm² ~ 0.5 mm²
- ◆ Shield: Ground shield
- ◆ Cable length: Max. 10 m
- ◆ Manufacturing method: Refer to Figure A.
- ◆ Signal ground: Voltage potential between signal ground PGBA and controller frame ground F.G. must be same.

(5) Serial communication line

- ◆ Only 1 of 4 serial communication ports (connector name; J1~J4) can be used at the same time.
- ◆ Core wires: 0.08 mm² ~ 0.5 mm²
- ◆ Shield: Ground shield
- ◆ Cable length: Max. 10 m
- ◆ Twisted pair: Not required for RS-232C, required for RS-422
- ◆ Manufacturing method: Refer to Figure A.

- (6) Limitation on the robot specifications
- ◆ Cable length from robot to controller: Max. 8 m
 - ◆ Cable length of teach pendant: Max. 8 m
 - ◆ Optional axis 5: Can not be used.
 - ◆ Optional input/output signals (type; SR-5500IO): Only one optional board can be used.
 - ◆ Optional relay output signals (type; SR-5500RO): Can not be used.
 - ◆ Optional conveyer tracking system (type; SR-5500CV): Can not be used.
 - ◆ Separated operation panel: Can not be used.

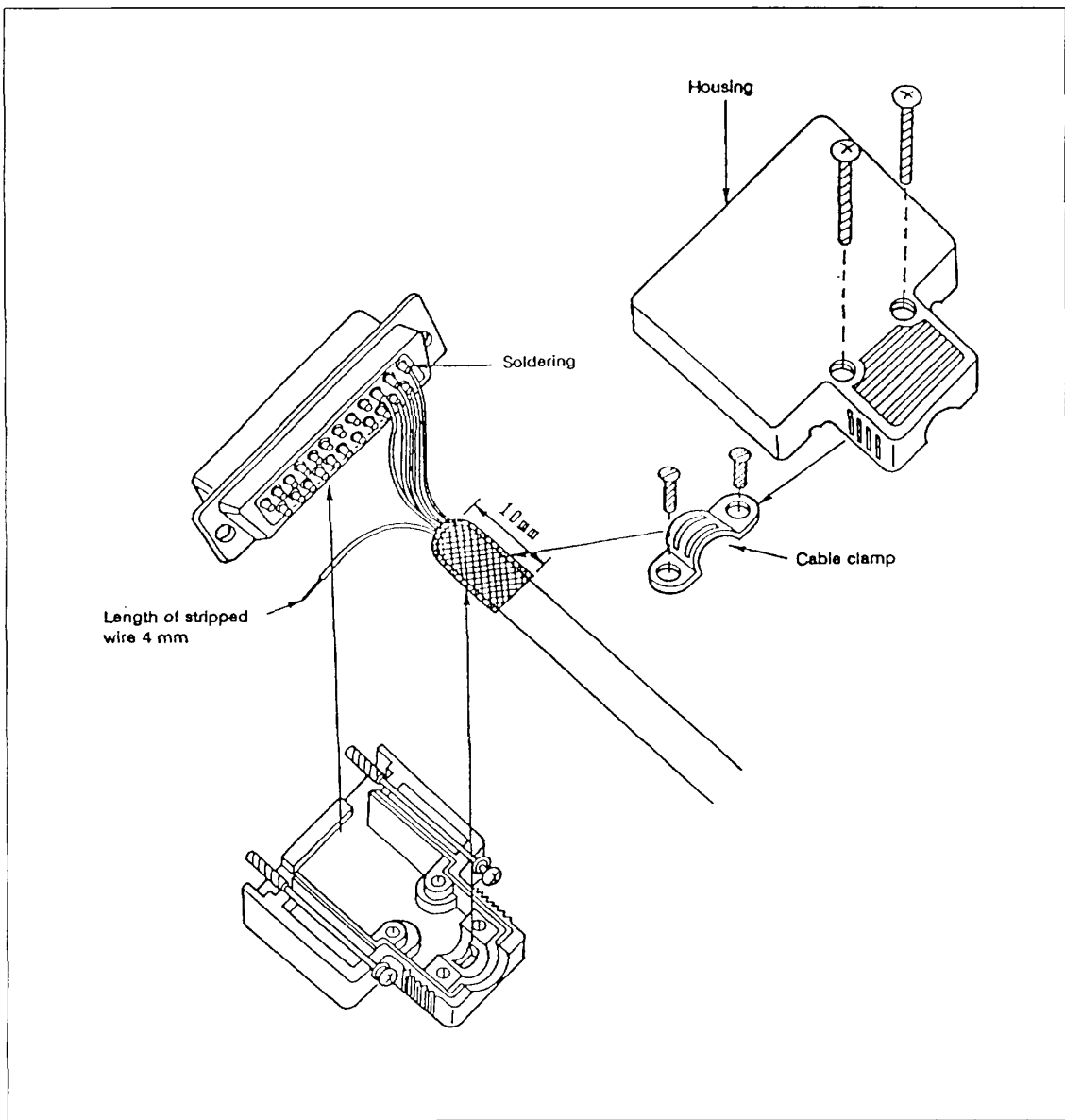


Figure A

This Manual describes how to utilize various robot system functions in order to manually guide the robot with the teach pendant, edit programs, compile data and carry out automatic operation.



This manual is directed at the robot operator. Before reading this manual, he or she should first read the Introductory Manual and the Start-up Manual.

Cautions on Safety

This manual contains the important information on the robot and controller to prevent injury to the operators and persons nearby, to prevent damage to assets and to ensure correct use.

Make sure that the following details (indications and symbols) are well understood before reading this manual. Always observe the information that is noted.





[Explanation of indications]

Indication	Meaning of indication
 Danger	This means that "incorrect handling will lead to fatalities or serious injuries."
 Caution	This means that "incorrect handling may lead to personal injuries *1) or physical damage *2)."




*1) Injuries refer to injuries, burns and electric shocks, etc., which do not require hospitalization or long-term medical treatment.




*2) Physical damage refers to damages due to destruction of assets or resources.

[Explanation of symbols]

Symbol	Meaning of symbol
	This means that the action is prohibited (must not be done). The details of the actions actually prohibited are indicated with pictures or words in or near the symbol.
	This means that the action is mandatory (must be done). The details of the actions that must be done are indicated with pictures or words in or near the symbol.
	This means danger. The details of the actual danger are indicated with pictures or words in or near the symbol.
	This means caution. The details of the actual caution are indicated with pictures or words in or near the symbol.

[Operation]

 Danger	
 Prohibited	<ul style="list-style-type: none"> • During operation, NEVER enter the dangerous area of the robot. Otherwise, you will be injured seriously. • DO NOT leave in the working range any machinery or materials which will hinder the operation. If the equipment went wrong, a person nearby will be injured or involved in an accident. • Anyone other than the operator MUST NOT approach the equipment. Should he negligently touch a dangerous part of the equipment, he will get injured or involved in a serious accident. • NEVER perform an inappropriate operation which is not described in the instruction manual. Otherwise, the equipment will start by mistake, resulting in personal injury or serious accident.
 Danger	<ul style="list-style-type: none"> • If you feel even a little that you are exposed to danger or the equipment works abnormally, press the EMERGENCY STOP pushbutton switch to stop the equipment. If the equipment is used as it is, you will be injured or involved in a serious accident. When this happens, ask our after-sale service agent for repair. • During operation, be sure to close the equipment cover. Should the cover be opened during operation, you will be struck by an electric shock or get injured. • Only a well-trained and qualified person is allowed to perform the operation. Should the equipment be operated improperly, it will start by mistake, causing a personal injury or serious accident. • If the equipment has malfunctioned, turn the power off, identify and remove the cause of the abnormality, maintain the peripheral equipment and completely restore the malfunctioned equipment. Then start the equipment at a low speed. If the equipment starts, leaving the abnormality, you will be involved in a serious accident.

 Caution	
 Prohibited	<ul style="list-style-type: none"> • DO NOT change the data of the system structure file. Otherwise, the robot will operate abnormally, resulting in damage or an accident.
 Mandatory	<ul style="list-style-type: none"> • In principle, teaching operation should be performed outside the dangerous area of the robot. If it should be performed inevitably within the dangerous area, strictly observe the following matters. <ol style="list-style-type: none"> (1) The teaching operation should be always performed by two (2) persons. One person performs the job and the other person watches outside the dangerous area. Also, both persons should try to prevent mis-operation with each other. (2) The operator should do the job in an attitude ready to press the EMERGENCY STOP pushbutton switch at any time. Also, he should perform the job at a position from which he can evacuate immediately at the time of an emergency after confirming the robot working range and shields nearby. (3) The supervisor should keep watch on the job at a position where he can see the entire robot system and operate the EMERGENCY STOP pushbutton switch at the time of an emergency. Also, he should keep anyone from entering the dangerous area. Unless an operator or other person follows the instructions of the supervisor, accidents will be caused. • If an abnormality has generated or the POWER LED lamp on the control panel remains off after the main power switch of the equipment was turned on, turn off the main power immediately and confirm the wiring. Otherwise, you will be struck by an electric shock or a fire will break out. • Unless the robot operates toward a designated direction at manual guide, turn off the servo power. Otherwise, the robot will be damaged or you will be involved in an accident. When this happens, call us at the after-sale service agent. • Pushbutton operations of the control panel and teach pendant should be confirmed visually. Otherwise, you will be involved in an accident due to mis-operation. • Before the hot start in automatic operation, be sure to reset a program. If the program is executed continuously, the robot will interfere with the peripheral equipment, resulting in damages or accidents.




 Caution	
 Mandatory	<ul style="list-style-type: none"> • Before operating the equipment, perform the following inspection. <ol style="list-style-type: none"> (1) Make sure that visual appearance of the robot, controller, peripheral equipment and cables is in good condition. (2) Make sure that no obstacle stands in or near the operating range of the robot and peripheral equipment. (3) Make sure that the emergency stop and other safety devices operate properly. (4) Make sure that no abnormal noise or vibration is involved in the robot operation. <p>If the above prior inspection is skipped, the equipment will be damaged or you will be involved in an accident.</p>
 Caution	<ul style="list-style-type: none"> • The speed of test operation is initially set at 25 % of the maximum robot speed. • The speed of automatic operation is initially set at 100 % of the maximum robot speed. • Once a cold start has been executed, all data saved in the controller memory, such as user program, position data, user parameter and system parameter files are initialized.

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CHAPTER 1

BEFORE OPERATING YOUR ROBOT

1.1 OVERVIEW OF CONTROL FUNCTIONS

Function	Description	Control Panel	Teaching pendant	External control signals
Main power ON/OFF	Used to turn the main power on or off.	○		
Servo power ON/OFF	Use to turn the power for the servo on or off.	○	△ (On only)	○
Master mode selection	Used to select either the Manual Mode, the External Automatic Mode or the Internal Automatic Mode.	○		
Start-up and stop	Used to start up or stop automatic operation.	○	○	○
Cycle completion	Used to stop automatic operation (after the completion of one cycle).	○	○	○
Feed hold	Used to temporarily stop automatic operation.		○	
Emergency stop	Used to immediately stop automatic operation.	○	○	○
Manual operation	Used to manually guide the robot by jogging, inching and other such movement.		○	
Auxiliary signal operation	Used to control pneumatic drive shafts (for grippers, etc.)		○	
Program editing	Used to create and edit programs.		○	
Data editing	Used to create and edit positional data, coordinate data and load data.		○	
File management	Used to manage files by such operations as loading, saving, copying and deleting.		○	
Reset	Used to reset output signals and execution conditions.		○	○
Date setting	Used to set the data for use by the system.		○	
The setting	Used to set the time for use by the system.		○	
Channel selection	Used to select a communication channel.		○	
Error display	Used to display errors which have not yet been reset.		○	
Error reset	Used to reset errors that have been corrected.		○	
Error history display	Used to display a historical list of errors which have been corrected.		○	
Work coordinate selection	Used to select a work coordinate system.		○	
Tool coordinate selection	Used to select a tool coordinate system.		○	

Function	Description	Control Panel	Teaching pendant	External control signals
Present position monitor	Used to display the present position of the robot in terms of the various coordinate system.		○	
External I/O signal monitor	Used to display the status of digital I/O signals.		○	
File selection	Used to select a file for execution.		○	○
Move	Moves the robot to a point which has been taught.		○	

○: Complete operation

△: Partial operation

1.2 MODE STRUCTURE

Master Mode	External Automatic Mode (EXT)	The External Automatic Mode is used to automatically operate the robot by program. This operation is performed with external control signals or signals from a host computer.
	Internal Automatic Mode (INT)	The Internal Automatic Mode is used to automatically operate the robot by program. This operation is carried out from either the control panel or the teach pendant.
	Manual Mode (MANU)	The Manual Mode is used to perform such operations as teaching, guiding, file management and program test runs. All such operations are carried out with the teach pendant.
Utility Mode		The Utility Mode is used to perform such operations as coordinate selection, position monitoring and signal monitoring. The Utility Mode is carried out from the teach pendant and is unrelated to the master mode.
Error Display Mode		The error display mode is used to display and reset errors with the teach pendant. The error display mode has nothing to do with the Master Mode.

The emergency stop and servo off operations can be used regardless of the present mode.

1.2.1 External Automatic Mode

External Automatic Mode (EXT)	External Operation Signal Mode (SIG)	This mode is used to perform the program automatic operation. This operation is carried out with external operation signals. For details, see the Interface Manual.
	Host Mode (HOST)	This mode is used to perform the program automatic-operation, file uploading and file downloading. All operations are carried out by the host computer through serial communication channel(s). For details, see the Communications Manual.

The mode with which external automatic operation is carried out is defined in the system configuration file. See the Start-up Manual for details.

All file selections, execution mode selections, speed override settings and speed limit settings made in either the Internal Automatic Mode or the Test Operation Mode are also valid in the External Automatic Mode.

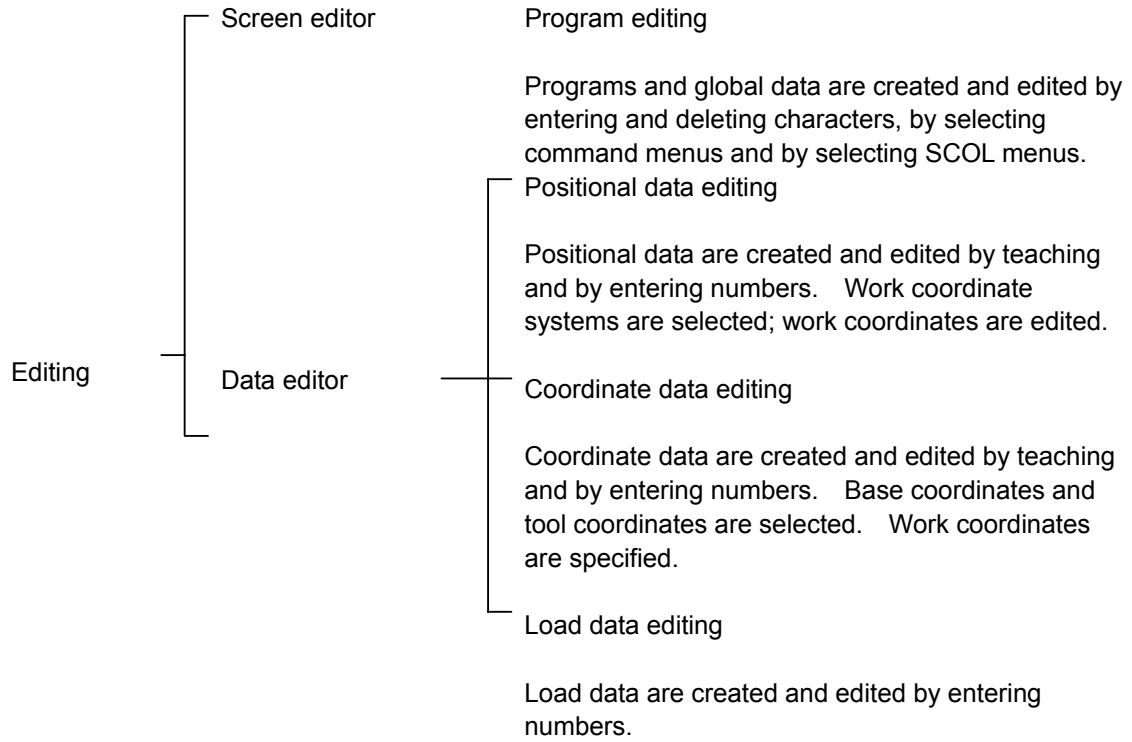
1.2.2 Internal Automatic Mode

Internal Automatic Mode (INT)	Program Selection (SELECT)	Selects a program for execution.
	Operation Mode Selection (MODE)	Selects an operation mode.
	Speed Override (MSPEED)	Selects the speed override.
	Speed Limit (LSPEED)	Selects the speed limit.
	Start-up	Starts program execution from the control panel.
	Stop (STOP,BREAK)	Suspends or cancels program execution.
	Direct Execution (DO)	Directly executes a SCOL command.
	Reset (RESET)	Resets the program execution step, variables and digital output signals.

1.2.3 Manual Mode

Manual Mode (MANU)	—	Edit (EDIT)	Edits programs and data (positional data, coordinate data and load data).
	—	Test Operation (TESTRUN)	Checks to see that programs run properly.
	—	File Load (LOAD)	Loads a file from the disk into the RAM drive.
	—	File Save (SAVE)	Saves a file in the RAM drive onto the disk.
	—	Disk Initialization (FORMAT)	Formats either the disk or the RAM drive.
	—	Directory Display (DIR)	Displays a list of all the files contained in either the RAM drive or the disk.
	—	File Copy (COPY)	Copies a file in the RAM drive and stores the copy in a separate file.
	—	File Comparison (VERIFY)	Compares the contents of two files in units of bytes to see that they are the same.
	—	File Renaming (REN)	Renames a file.
	—	File Deletion (DEL)	Deletes an unneeded file.
	—	File Printing (PRINT)	Prints out the contents of a file on a printer.
	—	Date Setting (DATE)	Sets the current date.
	—	Time Setting (TIME)	Sets the current time.
	—	Channel Selection (CHANNEL)	Switches over between serial channels.
	—	Reset (RESET)	Resets the program execution step, variables and digital output signals.
		Guidance	In conjunction with the control key, the guide teach speed key and the guide coordinate key, the guide keys are used to move the end effector. Guidance is effective only in the Manual Mode; it is not effective in the Test Operation Mode.

1.2.4 Edit



1.2.5 Test Operation

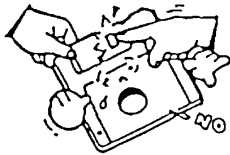
Test Operation (TESTRUN)	Program Selection (SELECT)	Selects a program for execution.
	Operation Mode Selection (MODE)	Selects an operation mode.
	Speed Override (MSPEED)	Selects the speed override.
	Speed Limit (LSPEED)	Sets the speed limit.
	Machine Lock (MACHINE)	Enables and disables the machine lock.
	Step Execution (STEP)	Executes the program one step at a time.
	Start-up (RUN)	Starts program execution from a desired step in the program.
	Stop (STOP,BREAK)	Suspends or cancels program execution.
	Direct Execution (DO)	Directly executes a SCOL command.
	Reset (RESET)	Resets the program execution step, variables and digital output signals.

1.3 PRECAUTIONS FOR USE

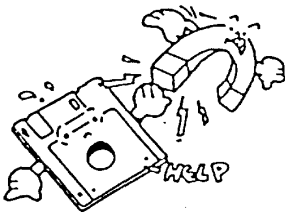
For the connection of FDD unit (option), see the Interface Manual.

1.3.1 Handling Disks

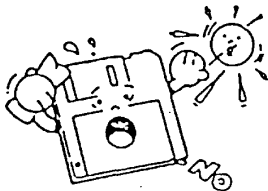
(1) General precautions



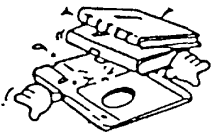
- (a) Don't open the shutter section. The disk will be unusable should any dirt get on the magnetic surface.



- (b) Keep away from speakers or other devices which create strong magnetic fields. If you don't, the contents of your disks may get erased.



- (c) Keep out of direct sunlight and away from hot objects.

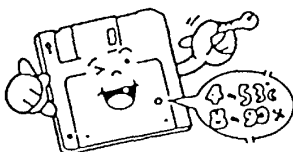


- (d) Don't stack books or folders on top of a disk.

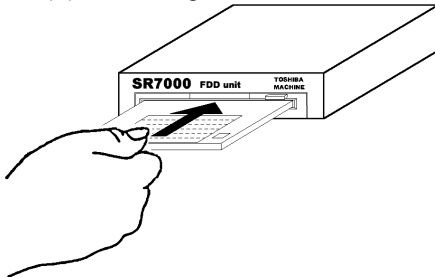
- (e) Stick the label on in the correct position. If you put on a new label, be sure to take the old label off first.

- (f) Store your disk in a location having the following temperature and humidity range:

Storage temperature	: 4 to 53° C
Storage humidity	: 8 to 90 %

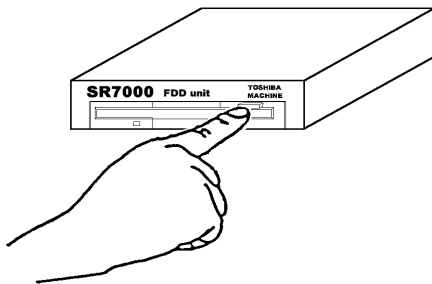


(2) Inserting a disk

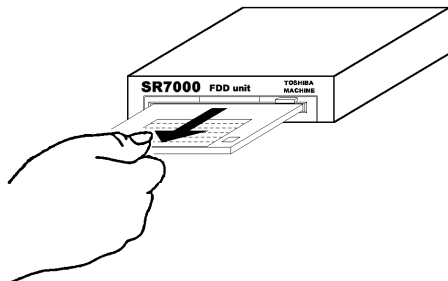


(a) With the label up and the metal shutter forward, insert the disk straight and slowly into the slot until you hear it click into place.

(3) Removing a disk



(a) Push the push button. The floppy disk should pop out a little ways from the slot.



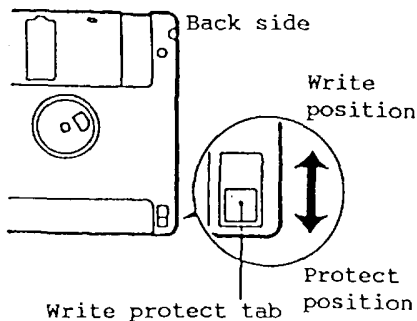
(b) Grip the disk with your fingers at the label section and draw it straight out.



Caution

Do not try to remove the disk while the disk drive light is still lit. Data is either being written to or read from the disk while the light is lit, and if you remove the disk at this time you may lose or damage your files.

(4) Disk write protection



All 3.5" disks have a write protect tab to prevent files from being accidentally erased.

(a) Write protect

Slide the write protect tab toward the edge of the disk (protect position).

(b) Write enable

Slide the write protect tab away from the edge of the disk (write position).

1.4 GENERAL OPERATION

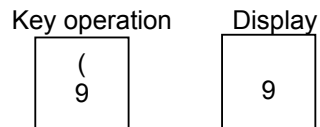
Only one key can be input at a time with the teach pendant.

1.4.1 Use of the Shift Key

When a key is pushed while the "shift" key is held down, the upper character on that key will be input.

(1) Entering the lower character

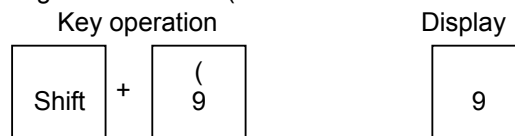
To enter the lower character on a key, simply push that key.
Example) Entering the character "9".



(2) Entering the upper character

To enter the upper character, push down that key while holding down the "shift" key.

Example) Entering the character "(".



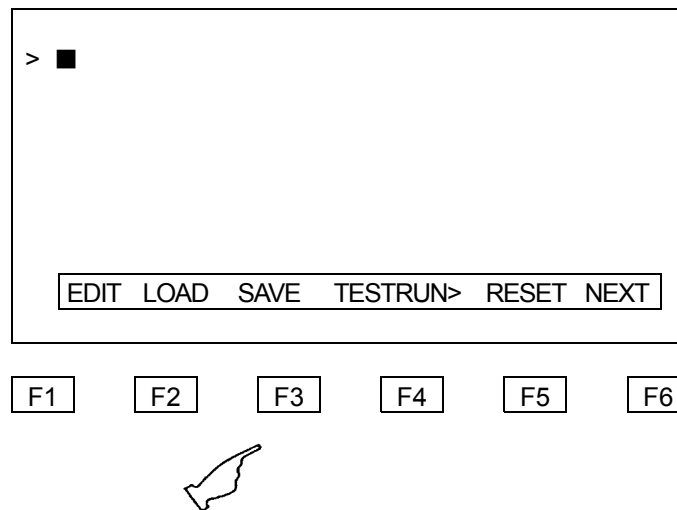
1.4.2 Use of the Function Keys

In order to make it easier to input data, the teach pendant is provided with six function keys, i.e., "F1" to "F6".

The functions to which "F1" to "F5" correspond will change depending on the mode. The names of these functions will appear above the corresponding function key. By pushing the appropriate key, commands can be executed without having to type in each letter making up that command.

The "F6" key is the NEXT key. When there are more than five commands in a particular mode, the NEXT key allows one to display the additional commands.

Example: Selecting the "SAVE" command



Command names followed by a ">" symbol indicate commands which are executed immediately when the, corresponding function key is pushed.



Caution

The function keys work differently when editing with the screen editor or data editor. For more information, refer to Chapter 5 "Program Editing" and Chapter 6 "Data Editing."

1.4.3 Repeating an Entry

The repeat operation is available for the following keys.

[Bs], [Esc], [Exec]

Guide key

[Move]

Cursor keys

[Coordinates], [Teach Speed], [Control]

1.4.4 Correcting Incorrect Entries

Use the "Bs" key to erase any characters which were incorrectly entered.

Example:

(Correct) TIME 13:50:00

Push the "Bs" key.

Push the "Bs" key.

(Incorrect) TIME 13:60:__



TIME 13:6__



TIME 13:__

Keep on pushing the "Bs" key until the incorrect characters are erased. Then type in the correct characters.



Caution

The "Ins", "Del" and cursor keys may not be used when entering a command.

1.4.5 Cancelling an Entry

If you wish to cancel the command you are entering, simultaneously push the "ESC" key.

This will cancel the command you entered and allow you to write the next command on the following line.

Should an error message or other such message appear while entering a command, that command line will be negated.

1.4.6 Use of Wild Cards

You may use the wild cards * and ? when specifying files with the directory [DIR], delete [DEL], print [PRINT], file save [SAVE] or file load [LOAD] command.

Wild cards are used to simultaneously specify multiple files. Using wild cards correctly can save time and increase efficiency when specifying files.

(1) The asterisk wild card "*"

The asterisk wild card (*) can take the place of a file name or an extension. For example, the specification "A*.*" refers to all files having a name starting with A and having any type of extension (or no extension at all). All of the following files would apply:

```
ADATA. BAT
ABC.PAR
AFILE
```

(2) The question mark wild card "?"

The question mark wild card "?" can take the place of any single character in a name or extension. For example, the specification "A??.*" refers to all files that have a name starting with A, are three characters long or less. A space or null character is also treated as one character. All of the following files would apply:

```
ABC.PAR
ACD.DAT
AAA
```

In order to be able to use wild cards effectively, you should pay attention to how you assign file names and extensions.

1.4.7 Format for Operating Instructions

The following format is used in this manual to explain how to use commands.

Title [command name]

(1) Function

Explains the purpose of the command and what it does.

(2) Input format

Explains the input format for operation. An input consists of a command and parameters. Listed below are notation used to describe the input format.

[] Indicates an item (or items) that may be specified if necessary and omitted if not.

< > Indicates an item (or items) to be input.

<d:> Specifies the drive name. One must enter either A or R.

A : FDD unit (option)

R : RAM drive

<file name> Specifies the file name. <file name> may consist of a name having up to eight alphanumeric characters and an extension having up to three characters. For example, CONSTRUC.SYS is a valid <file name>.

{ } Indicates that one parameter is to be chosen from among the multiple parameters enclosed.

... Indicates that multiple parameters may be specified.

Note that the characters [], < >, { } and ... are themselves not to be entered. They are merely symbols use to describe the input format.

(3) Comments

Explains restrictions and things to keep in mind.

(4) Procedure

Explains procedures and system responses for various operations.

(5) Related functions

Explains related functions.

1.5 ASSIGNING NAMES

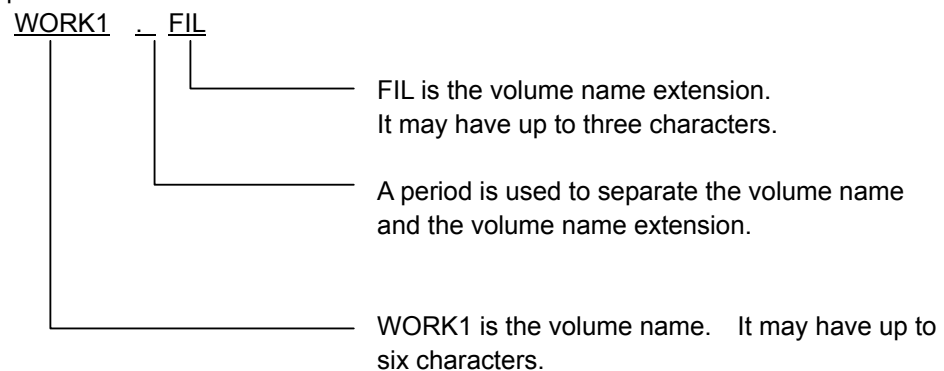
1.5.1 Assigning the Volume Name

When a disk is initialized, you can assign a name to that disk. This is the volume name.

In order to simplify disk handling, you should keep your files sorted by task and put related files on the same disk. Also, be sure to give the disk a descriptive, easy to understand name.

The volume name can be checked by looking at the directory display.

Volume names consist of a volume name proper, a period, and a volume name extension. An example is shown below:



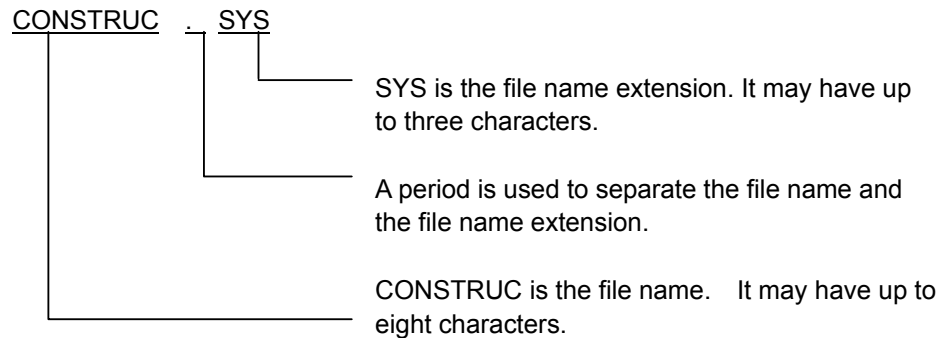
The following characters may be used in the volume name and its extension:

Alphabetic characters:	A to Z
Numerals:	0 to 9

The volume name extension may be omitted. In such a case, the period becomes unnecessary.

1.5.2 Assigning a File Name

Every file in a disk or in the RAM drive has its own name. This is called the file name. File names consists of a file name proper, a period, and a file name extension. An example is shown below:



The following characters may be used in the file name and its extension:

Alphabetic characters: A to Z
 Numerals: 0 to 9

The file name extension is used to identify the nature (type) of the file. By using different extensions on the same file name, you can keep related files together while still being able to differentiate between them by purpose.

The following extensions are used for the following type of special purpose files.

Extension	Purpose
SYS	Identifies system files.
BAT	Identifies batch files.
PAR	Identifies parameter files.
LIB	Identifies library files.
LOG	Identifies maintenance files.

The file name extension may be omitted. In such a case, the period becomes unnecessary.

When specifying a file having a file name extension, you may not omit that extension. If you do, the controller will treat that file as a completely different file.

1.5.3 Assigning a Point Name

When entering positional data for a point, you have to assign a name to that point. This name will be used later in the program when telling the robot where to go.

Point names generally have a format like that shown in the example below:

PNT100
|
|
|_____ PNT100 is the point name (in this example).
The point name may have up to ten characters.

The following characters may be used in the point name. (The first letter of a point name must be an alphabetic character.)

Alphabetic characters:	A to Z
Numerals:	0 to 9

Note: You may not use an identifier reserved for the SCOL language to name a point. See Appendix B of Robot Language Manual for a list of such identifiers (reserved words).

If you try to enter more than ten characters when inputting a point name, an error message ("name over") will be displayed and that entry will be invalidated.

If you try to enter anything other than an alphabetic character for the first character of the point name, an error message ("illegal key!") will be displayed and that entry will be invalidated.

If you try to enter anything other than an alphanumeric character when inputting the point name, an error message ("illegal key!") will be displayed and that entry will be invalidated.

1.5.4 Assigning a Name to Coordinate Data

When entering coordinate data for a work coordinate system, a tool coordinate system or the base coordinate system, you have to assign a coordinate name to that data. This name will be used later in the program when telling the robot which coordinate system to use.

Coordinate names generally have a format like that shown in the example below:

TABLE1
|
|_____ TABLE1 is the coordinate name (in this example).
The name may have up to ten characters.

The following characters may be used in the coordinate name. (The first letter must be an alphabetic character.)

Alphabetic characters:	A to Z
Numerals:	0 to 9

Note: You may not use an identifier reserved for the SCOL language to name coordinate data. See Appendix B of Robot Language Manual for a list of such identifiers (reserved words).

If you try to enter more than ten characters when inputting a coordinate name, an error message ("name over") will be displayed and that entry will be invalidated.

If you try to enter anything other than an alphabetic character for the first character of the name, an error message ("illegal key!") will be displayed and that entry will be invalidated.


If you try to enter anything other than an alphanumeric character when inputting the name, an error message ("illegal key!") will be displayed and that entry will be invalidated.

1.5.5 Assigning a Name to Load Data

When entering load data, you have to assign a load name to that data. This name will be used later in the program when telling the robot which load value to use.

Load names generally have a format like that shown in the example below:

SAMPLE1



SAMPLE1 is the load name (in this example).
The name may have up to ten characters.

The following characters may be used in the load name. (The first letter must be an alphabetic character.)

Alphabetic characters:	A to Z
Numerals:	0 to 9

Note: You may not use an identifier reserved for the SCOL language to name load data. See Appendix B of Robot Language Manual for a list of such identifiers (reserved words).

If you try to enter more than ten characters when inputting a load name, an error message ("name over") will be displayed and that entry will be invalidated.

If you try to enter anything other than an alphabetic character for the first character of the name, an error message ("illegal key!") will be displayed and that entry will be invalidated.

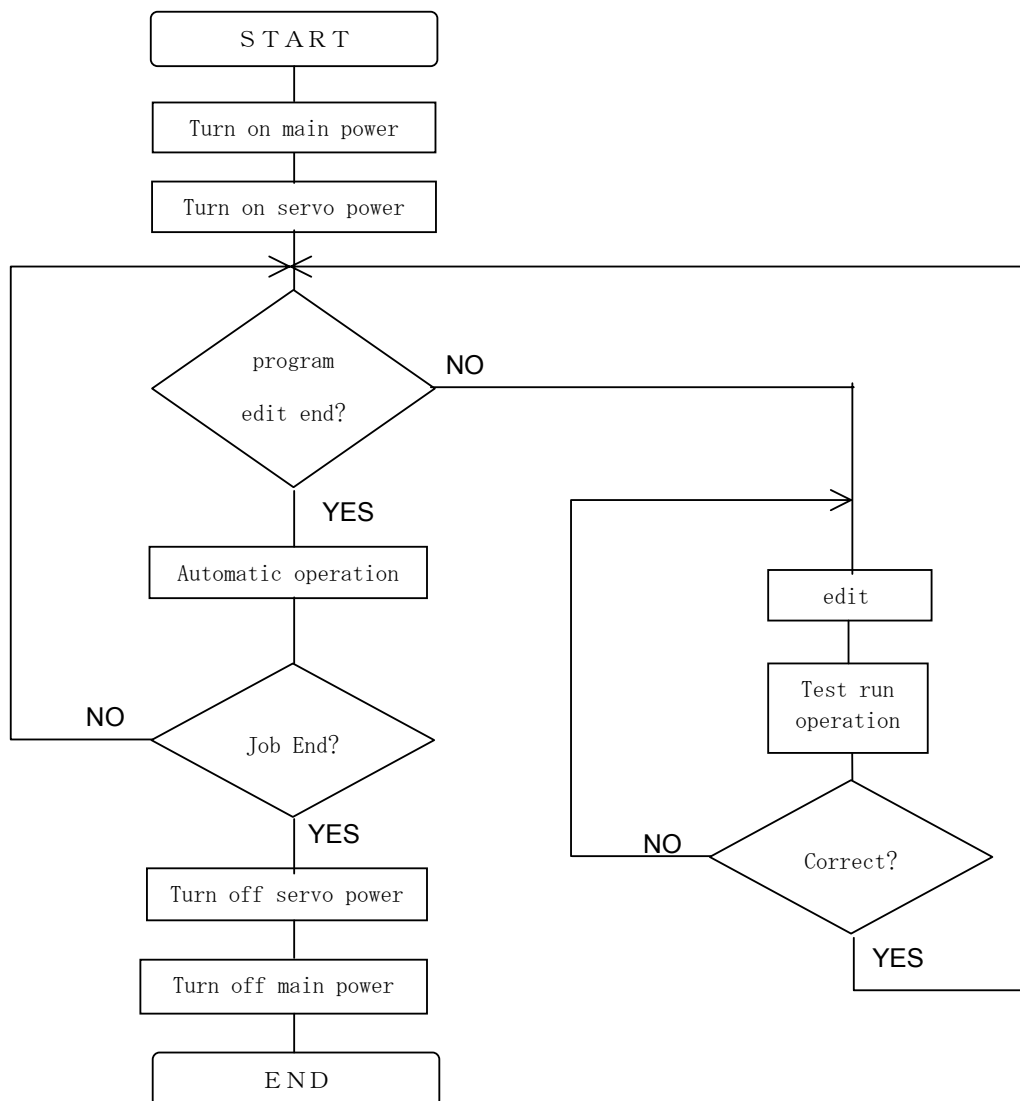
If you try to enter anything other than an alphanumeric character when inputting the name, an error message ("illegal key!") will be displayed and that entry will be invalidated.

CHAPTER 2

BASIC OPERATION

2.1 BASIC OPERATING PROCEDURE

The following flowchart shows the basic operating procedure for automatic operation. It covers all operations from turning on the power to turning off the power.



2.2 TURNING ON THE MAIN POWER

There are two ways to start up the controller - cold starting and hot starting. Normally, only the hot starting is required. For details, see Para. 2.2.2.

2.2.1 Cold Starting



Danger

If an abnormality has generated or the POWER LED lamp on the control panel remains off after the main power switch of the equipment was turned on, turn off the main power immediately and confirm the wiring. Otherwise, you will be struck by an electric shock or a fire will break out.



Caution

Once a cold start has been executed, all data saved in the controller memory, such as user program, position data, user parameter and system construction files are initialized.

- (1) Function
System programs contained on a disk inserted in the FDD unit (option) are loaded into the RAM drive. The RAM drive is thereby initialized and the controller is booted (started up).
- (2) Input format: None
- (3) Comments
 - Normally, you should hot start the system. Only cold start the system when you cannot hot start it.
 - After you have completed a cold start, remove the system disk from the controller disk drive. Should you leave the system disk in the disk drive, all the files in the RAM drive will be erased should the power go out and turn back on again.
 - Copies of all files necessary for the RAM drive should be kept on disks for safekeeping. For information on how to save files on disks, see the Section "Saving files."
 - The system disk must contain the following system programs and subscription files.

System programs:

SVPMTX. SYS
MCPMTX. SYS

Subscription files:

CONSTRUC. SYS	EXTRNSEL. SYS *
ALARM. MES *	SCOL. LIB *
SYSTEM. PAR	AUTOSTR. BAT *
USER. PAR	

Files marked by an asterisk are not absolutely necessary to run the system. However, you will get an error if you try to execute a function dependent on a missing file. For more information on these files, see the Start-up Manual.

(4) Procedure

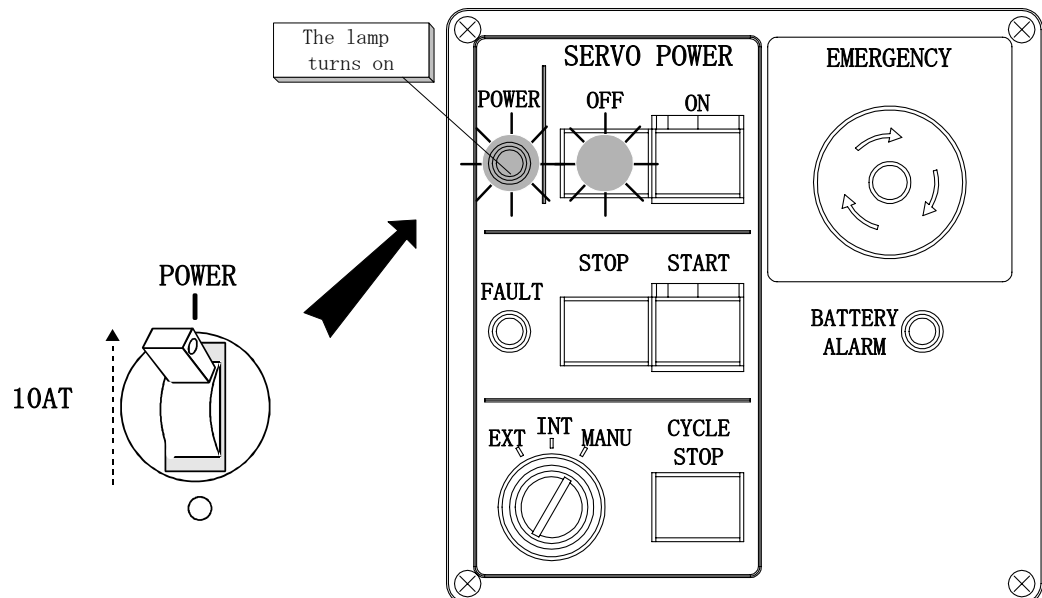
(a) Step 1: Insert the system disk

Insert the system disk into the FDD unit (option).

(b) Step 2: Turn on the main power.

Turn on the main power switch located on the controller.

The POWER lamp and SERVO POWER OFF lamp should light up.



The light on the disk drive should also light up around this time. This shows that the system programs are being loaded into the RAM drive. While these programs are being loaded, the START lamp on the control panel blink. When loading is complete, the SERVO POWER OFF lamp, the START lamp, the STOP and the CYCLE STOP lamp will all momentarily light up at once. The LCD (liquid crystal display) of the teach pendant will display the initial mode selection menu. The STOP lamp and the SERVO POWER OFF lamp on the control panel will be lit. Following this, parameters will be automatically read in from the disk in the disk drive. When this is completed, the disk drive light will go out. This marks the end of the cold start operation.

(c) Step 3: Remove the system disk

Once the cold start is completed, the system is booted and ready to operate.

After checking to make sure that the disk drive light is out, remove the system disk from the disk drive.

2.2.2 Hot Starting



Caution

If an abnormality has generated or the POWER LED lamp on the control panel remains off after the main power switch of the equipment was turned on, turn off the main power immediately and confirm the wiring. Otherwise, you will be struck by an electric shock or a fire will break out. When hot starting has been done, the controller enters a program reset status.

- (1) Function
Starts up the controller with files contained in the RAM drive.
- (2) Input format
None
- (3) Comments
The following subscription files must be in the RAM drive:

CONSTRUC. SYS	EXTRNSEL. SYS *
ALARM. MES *	SCOL . LIB *
SYSTEM. PAR	AUTOSTR. BAT *
USER. PAR	

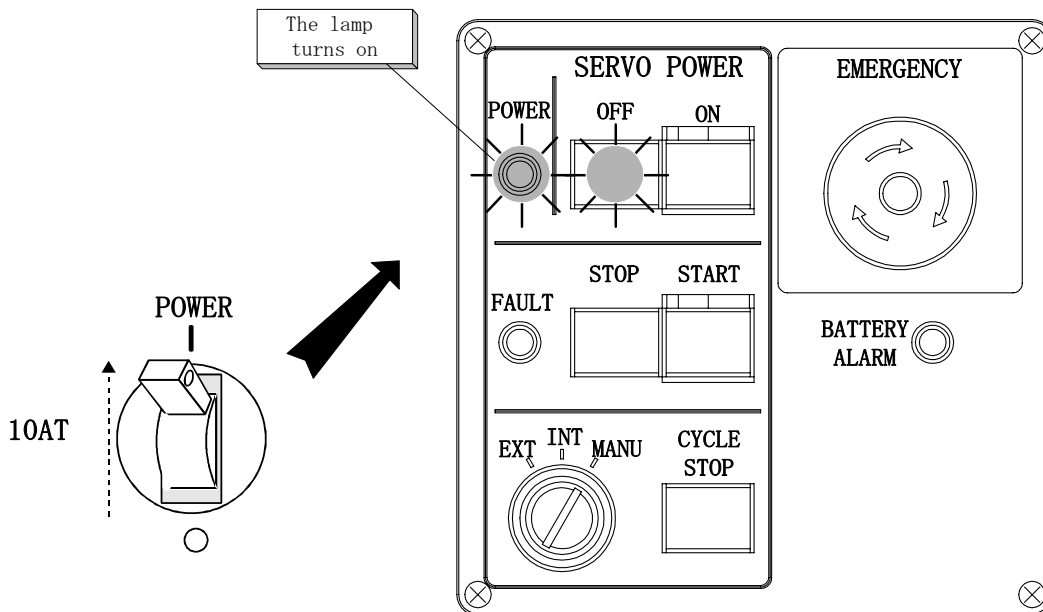
Files marked by an asterisk are not absolutely necessary to run the system. However, you will get an error should you try to execute a function dependent on a missing file.

For more information on these files, see the Start-up Manual.

(4) Procedure

(a) Step 1: Turn on the main power

First, make sure that the system disk is not in the FDD unit (option). Then, turn on the controller main power. The POWER lamp and the SERVO POWER OFF lamp on the control panel will light up.



The controller will start initializing the system. The disk drive light will blink for about 15 seconds.

When the hot start operation is completed, the STOP lamp on the control panel will light up and the LCD (liquid crystal display) of the teach pendant will display the initial mode selection menu.

2.3 TURNING ON THE SERVO POWER



Caution

- If the robot moves abnormally at the servo power ON, press the EMERGENCY STOP switch immediately to turn the servo power off.
- If anyone enters the robot dangerous area, turn the servo power off beforehand.

(1) Function

Turns on the main power circuit for the servo drivers. Servo control axes will change over to the servo-lock state, and any brakes will be released.

(2) Input format: None

(3) Comments

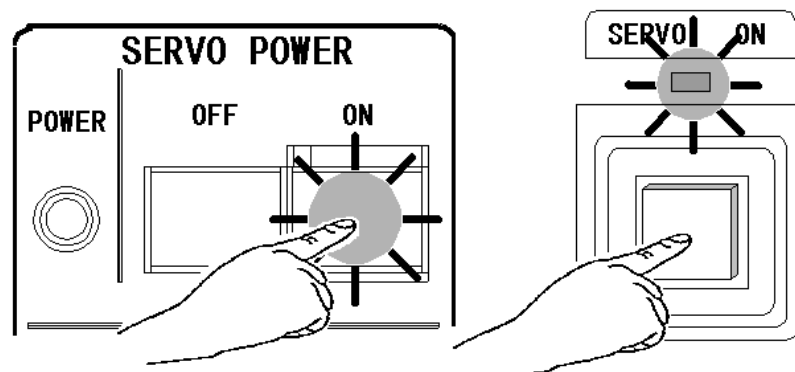
You will not be able to turn on the servo power if the emergency switch is pushed down. Release the switch first.

In order to turn on the servo power with an external operation signal, the teach pendant connector (or the dummy connector) must be attached to the control panel. Also, the contacts for the Emergency Stop and Servo OFF external signals must be open. For more information, refer to the Interface Manual.

(4) Procedure

(a) Step 1: Turn on the servo power

Push either the SERVO POWER ON switch on the controller or the teach pendant. The controller SERVO POWER ON lamp should turn on and the OFF lamp should turn off. The teach pendant SERVO ON lamp should light up.



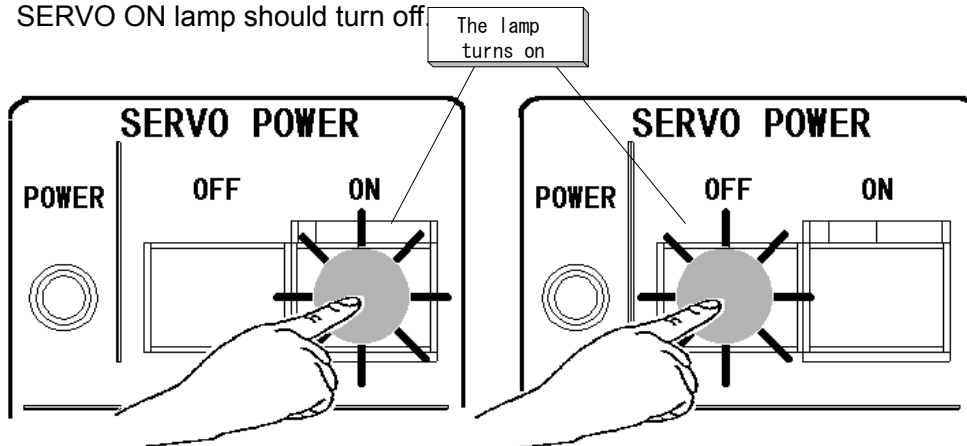
2.4 TURNING OFF THE SERVO POWER

- (1) Function
Turns off the main power circuit for the servo drivers. Servo control axes will change over to the servo-free state, and any brakes will be activated.
- (2) Input format: None
- (3) Comments
Do not turn the servo power off while the robot is running. When you wish to stop the robot in a hurry, push an emergency stop switch instead.

When about to enter the robot work-space envelope, or when no operator is to be present, turn off the servo power for safety reasons. (Note that this does not apply to automatic operation.)

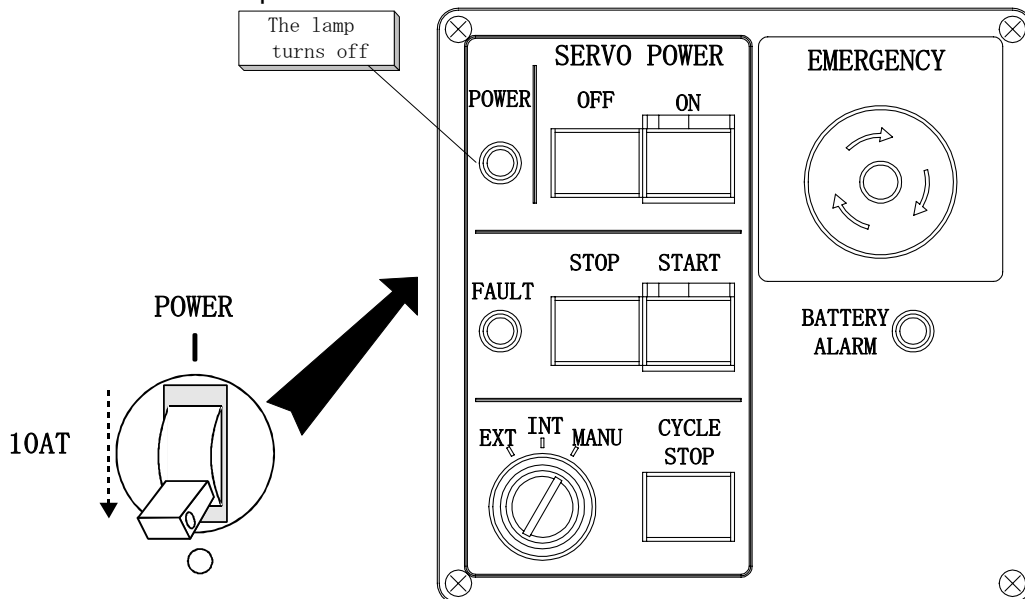
For information on how to turn off the servo power with an external operation signal, see the Interface Manual.

- (4) Procedure
 - (a) Step 1: Turn off the servo power
Push the SERVO POWER OFF switch on the controller. The SERVO POWER OFF lamp should turn on and the ON lamp should turn off. The teach pendant SERVO ON lamp should turn off.



2.5 TURNING OFF THE MAIN POWER

- (1) Function
Turns off the main power and stops controller processing.
- (2) Input format: None
- (3) Comments
Do not turn off the main power while the servo power is on or while the controller is either processing data or manipulating files. Before turning off the main power, make sure that the servo power is off and that the controller is not running.
- (4) Procedure
 - (a) Step 1: Remove the disk, if any, from the disk drive
If there is a disk in the FDD unit (option), check to see that the disk drive light is off and then remove the disk.
 - (b) Step 2: Turn off the main power
Turn off the main power switch located on the controller.



The POWER lamp on the controller should turn off.

CHAPTER 3

MANUAL OPERATION

3.1 SELECTING THE MANUAL MODE

(1) Function
Changes over to the Manual Mode in which the robot is manually guided, points are taught, files are managed and the system is controlled. All of these operations are performed with the teach pendant.

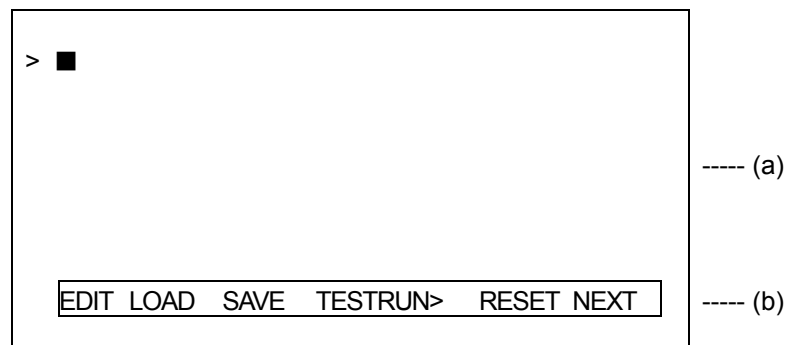
(2) Input format
None

(3) Comments
The Test Operation Mode is classified as a manual mode. However, the Test Operation Mode is treated as completely separate in this manual.

For information on the Test Operation Mode, see Chapter 7, "Test Operation."

(4) Procedure

(a) Step 1: Select the Manual Mode
Turn the master mode switch on the control panel to MANU. The following menu should appear on the teach pendant display.



a) Display field for command input and messages

b) Display field for function key menu

EDIT	Edit
LOAD	File load
SAVE	File save
TESTRUN	Test operation
RESET	Reset
DIR	Directory display
COPY	File copy
DEL	File deletion
REN	File renaming
PRINT	File printing
FORMAT	Disk initialization
VERIFY	File comparison
ZEROP	Zero point teaching
JLMIT	Soft limit teaching
CHANNEL	Channel selection
DATE	Date setting
TIME	Time setting

3.2 GUIDANCE COORDINATES

- (1) Function
Selects a coordinate system in which to guide the robot from among the joint coordinates, tool coordinates, work coordinates and world coordinates.

- (2) Input format
None

- (3) Comments
Refer to the Introductory Manual for information on robot coordinate systems.

If a tool, base or work coordinate system has not been taught to the robot, the robot will assume:

- (a) The tool coordinate system coincides with the surface of the hand mounting flange.
- (b) The work and world coordinate systems coincide with the base coordinate system.

When using the tool or work coordinate system, make sure you have selected the right one.

- (4) Procedure

- (a) Step 1: Select the tool and work coordinates
It is possible to have several work and/or tool coordinate systems. Therefore, you must select which ones you are going to use with the WORK and TOOL utilities. For details, see Chapter 12, "Utilities."

If you are using joint or world coordinates, this operation is unnecessary.

- (b) Step 2: Select the coordinates
Push the "Coordinate" key on the teach pendant. Each time you push this key, the lamp will cycle one step between World, Work, Tool and Joint.

The initial setting is Joint.

3.3 GUIDE MOVEMENT

There are three types of guide movement: jog, inching and free.

In the jog mode, the robot will move in the specified direction at the specified speed in the specified coordinate system for as long as you hold down the corresponding guide key. The jog mode is useful for rough positioning of the robot to get it near the target position.

In the inching mode, the robot will move in the specified direction at the specified displacement in the specified coordinate system. The inching mode is useful for fine positioning of the robot near the target position.

In the free mode, you may release the servo lock on the desired axes and move around the robot by hand. The free mode is useful for fine positioning of the robot near workpieces and other such objects.

- (1) Function
Selects the guide movement mode.
- (2) Input format: None
- (3) Comments
When changing from the free mode to another mode, the servo mechanism on all axes will lock-up (change to the locked state).
- (4) Procedure
 - (a) Step 1: Select the Manual Mode
Turn the master mode switch on the control panel to "MANU".
 - (b) Step 2: Select the guide movement mode
Push the "Control" key on the teach pendant. Each time you push this key, the lamp will cycle one stop between Jog, Inching and Free.
The initial setting is Jog.

3.4 GUIDE SPEED

(1) Function

Selects the guide speed or the guide displacement.

Guide speed will be set if the guide movement mode is set to jog. Guide displacement will be set if the guide movement mode is set to inching.

Set the guide speed or guide displacement in accordance with how far the robot is from the target position.

(2) Input format: None

(3) Comments: None

(4) Procedure

(a) Step 1: Select the guide speed mode

Push the "Teach Speed" key on the teach pendant. Each time you push this key, the lamp will cycle one step between High, Med. and Low.

The initial setting is Low.

3.5 GUIDANCE



Caution

- If the guidance is performed manually, do not enter the robot dangerous area.
- If the robot moves abnormally, immediately effect an emergency stop.
- If the robot will not move in the specified direction, consult Toshiba Machine.

(1) Function

The robot can be moved in the desired direction by pushing the appropriate guide keys when the guide movement mode is set to inching or jog.

(2) Input format

The guidance coordinates, guide movement mode and guide speed do not have to be set in any particular order. However, they all must be set before pushing any guide keys.

(3) Comments

When the guide movement mode is set to free, the guide keys do not specify the direction the robot is to move; rather, they specify axes for which the servo lock is to be released.

The guide keys will only work while at least one of the deadman switches (on the back of the teach pendant) is pushed down. This is to prevent accidents.

(4) Procedures

(a) Step 1: Select the Manual Mode

Turn the master mode switch on the control panel to "MANU".

(b) Step 2: Set the guidance conditions

Set the guidance conditions (guidance coordinates, guide movement and guide speed) as necessary.

(c) Step 3: Guidance

Push the guide keys as appropriate while holding down at least one deadman switch (on the back of the pendant). The robot will move as directed in the specified coordinate system.

3.6 SERVO FREE

(1) Function

Servo locks can be released for axes as desired when the guide movement mode is set to free. Axes in the servo free (i.e., unlocked) state can be moved freely by hand. This is convenient when moving the robot near workpieces and other such objects.

(2) Input format

None

(3) Comments

If You change from the servo free state to either the Test Operation Mode, the Internal Automatic Mode or the External Automatic Mode, the servo lock will be set for all axes.

The guide keys will only work while at least one of the deadman switches (on the back of the teach pendant) is pushed down.

If you move the robot by hand in the servo free state, other joints may move as well due to axial interference.

You cannot cancel the servo free state while in Feed Hold.

You can cancel the servo free state while displaying the Error History.

(4) Procedure

(a) Step 1: Select the Manual Mode

Turn the master mode switch on the control panel to "MANU".

(b) Step 2: Select the guide movement mode

Push the Guide Movement key on the teach pendant as many times as necessary to select "Free".

(c) Step 3: Release the servo locks

While pushing down on a deadman switch, push the guide keys on the minus (-) side to release the servo locks for the desired axes. Such axes will change over to the servo free state.

(d) Step 4: Guide the robot

Guide the robot by hand to where you want it to go.

(e) Step 5: Set the servo locks

While pushing down on a deadman switch, push the guide keys on the plus (+) side for those axes in the servo free state. Such axes will then change over to the servo lock state.

CHAPTER 4

AUXILIARY SIGNALS

- (1) Function
Manages auxiliary signals used to control the hand, the air control axes, etc.

- (2) Input format
None

- (3) Comments
The output signal port and solenoid type corresponding to each function key must be defined (specified) in the system configuration file. For more information, see the Start-up Manual.

Press the "Esc" key to exit the Auxiliary Signal Operation Mode and return back to the original menu.

While under emergency stop or in feed hold, auxiliary signals may be turned on and off.

The initial state including signals which is set for double solenoids in the power ON state is turned off.

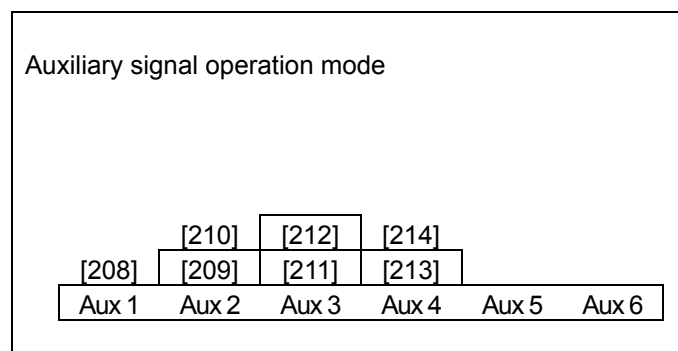
(4) Procedure

(a) Step 1: Select the Manual Mode

Turn the master mode switch on the control panel to "MANU".

(b) Step 2: Select the Auxiliary Signal Operation Mode

Push the "Aux. Signal" key on the teach pendant. The Auxiliary Signal Operation Mode menu should then appear.



The numbers on the screen correspond to the output signal ports. Auxiliary signals having two output signal ports are set for double solenoids, and those having one output signal port are set for single solenoids. Those having no output signal ports are not set for anything.

Ports that are highlighted in the display are on and ports that are not are off.

(c) Step 3: Turn ports on and off as appropriate

Each time you push a function key corresponding to a port, the status of the solenoid will change from on to off or from off to on. For double solenoids, the status of the two ports will be transposed.

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