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YAMAHA ROBOT CONTROLLER

YAMAHA
YAMAHA MOTOR CO., LTD.

SRC/A SERIES

Owner's Manual

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Table of Contents

Chapter 1: AN OVERVIEW

1-1 Features of the SRC Controller ..... 1 - 2
1-2 Setting Up for Operation ..... 1 - 3
1-3 Exterior ..... 1 - 4
1-4 System Configuration ..... 1 - 8
1-5 Accessories and Options ..... 1 - 11

Chapter 2: INSTALLATION AND WIRING

2-1 Installing the SRC Controller ..... 2 - 2
2-2 Connecting the Power Supply ..... 2 - 2
2-3 Grounding Construction ..... 2 - 3
2-4 Connecting the SRC to the Control Unit ..... 2 - 4
2-5 Connecting the SRC to the Robot ..... 2 - 4
2-6 Connecting the SRC to the I/O Connector ..... 2 - 6

Chapter 3: I/O Interface

3-1 I/O Connector Signals ..... 3 - 2
3-2 Description of the I/O Signals ..... 3 - 3
3-3 I/O Circuits ..... 3 - 9
3-4 I/O Connection Diagrams ..... 3 - 13
3-5 I/O Circuit Timing Charts ..... 3 - 16

Chapter 4: BASIC OPERATION OF THE DPB

4-1 Connecting the DPB to the SRC Controller and Detaching It ..... 4 - 2
4-2 Basic Operation ..... 4 - 4

Chapter 5: PARAMETERS

5-1 Description of Parameters ..... 5 - 2
5-2 Setting Parameters Used by the DPB ..... 5 - 8
5-3 Japanese / English Display Switching ..... 5 - 9

Chapter 6: PROGRAMMING

6-1 Basic Contents ..... 6 - 2
6-2 Editing Programs ..... 6 - 4
6-3 Editing Point Data ..... 6 - 16
6-4 Robot Instructions ..... 6 - 24
6-5 Sample Programs ..... 6 - 31

Chapter 7: OPERATING THE ROBOT

7-1 Returning to the Origin ..... 7 - 2
7-2 Using Step Operation ..... 7 - 3
7-3 Using Automatic Operation ..... 7 - 5
7-4 Emergency Stop Function ..... 7 - 8
7-5 Changing Programs ..... 7 - 10

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Chapter 8: OTHER OPERATIONS

8-1 Initialization ..... 8 - 2
8-2 DIO Monitor ..... 8 - 3
8-3 Viewing the System Version Number ..... 8 - 4
8-4 Using Memory Cards ..... 8 - 5

Chapter 9: COMMUNICATIONS WITH A PERSONAL COMPUTER

9-1 Setting the Communication Parameters ..... 9 - 2
9-2 Communication Cable Specifications ..... 9 - 2
9-3 Communication Commands ..... 9 - 3
9-4 Details Concerning Communication Commands ..... 9 - 7

Chapter 10: MESSAGE TABLES

10-1 Error Messages ..... 10 - 2
10-2 Stop Messages ..... 10 - 7

Chapter 11: TROUBLESHOOTING

11-1 Breakdowns ..... 11 - 2
11-2 Handling Alarms ..... 11 - 3
11-3 Handling Other Types of Breakdowns ..... 11 - 6

Chapter 12: MAINTENANCE AND WARRANTY

12-1 Warranty ..... 12 - 2
12-2 Changing the Power Supply Voltage Specifications ..... 12 - 3
12-3 Replacing the Battery ..... 12 - 6
12-4 Replacing the ROM ..... 12 - 6
12-5 Replacing Fuses ..... 12 - 7

Chapter 13: SPECIFICATIONS

13-1 SRC Controller ..... 13 - 2
13-2 DPB ..... 13 - 5

Chapter 14: INSTRUCTIONS FOR HANDLING OPTIONS

14-1 Handling the Memory Card ..... 14 - 2
14-2 Handling the I/O Checker ..... 14 - 3

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CHAPTER 1

AN OVERVIEW

Thank you for purchasing the Yamaha Single-Axis Robot Controller (SRC Controller). The following pages describe the special features built into this equipment, as well as how to operate the equipment for optimum results.
The SRC Series can be used for various machine part and device positioning and pick-and-place work when used in combination with the single-axis FLIP series.
This first chapter contains basic information regarding the use of this equipment, such as the names and functions of the various parts, the steps necessary to prepare the robot for operation, and the architecture of the system itself. Please read this chapter carefully for a basic overview of the SRC Controller.

Note that the details of this instruction manual are subject to change without notice.

SAFETY

Please follow the rules and instructions related to safety to ensure that the Yamaha Robot is used safely and correctly.
(While Yamaha addresses safety issues throughout this manual, the user is solely responsible for his/her own safety and the safety of others.)

When using this robot in Europe, please refer to the following European Standards related to the safety of machinery, and take appropriate measures for safety.
Do not use the robot until the entire system complies with the European Machinery Directives listed below.

EN292-2
EN294
EN60204-1
89/392/EEC
91/368/EEC
93/44/EEC
93/ 68/EEC (as of March 1995)

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1-1 Features of the SRC Controller

The SRC Controller is a robot controller, that uses a high-performance single-chip CPU, designed to control the single-axis FLIP series robots manufactured by Yamaha Motor Corporation.

The SRC Series Controller can handle: (1) servo control of the robot; (2) control of I/O devices such as valves and sensors; and (3) control of communications between the robot and a personal computer. For simple applications such as picking and placing of electronic parts, one controller is needed to design a complete system.

The SRC Controller offers the following features:

- Three controller models (SRC-1, SRC-2 and SRC-3) can be selected for the DC servo series, and three models (SRCA-2, SRCA-3 and SRCA-4) can be selected for the AC servo series depending on the robot motor capacity.
- A high-performance single-chip CPU is used for high-speed, high-precision software servo control.
- The I/O interface provides 9 input points, 5 output points, and as standard, a 24 V power supply for I/O functions.
- The DPB programming device (optional) uses a menu driven style of operation that allows immediate usage.
- The robot can be operated easily with a personal computer in the same manner as the DPB by using the support software POPCOM (optional).
- Programs are written in easy-to-learn robot instructions that closely resemble BASIC.
- For users who are not accustomed to the robot language, a PLC can be used to move the robot directly, through a point trace function.

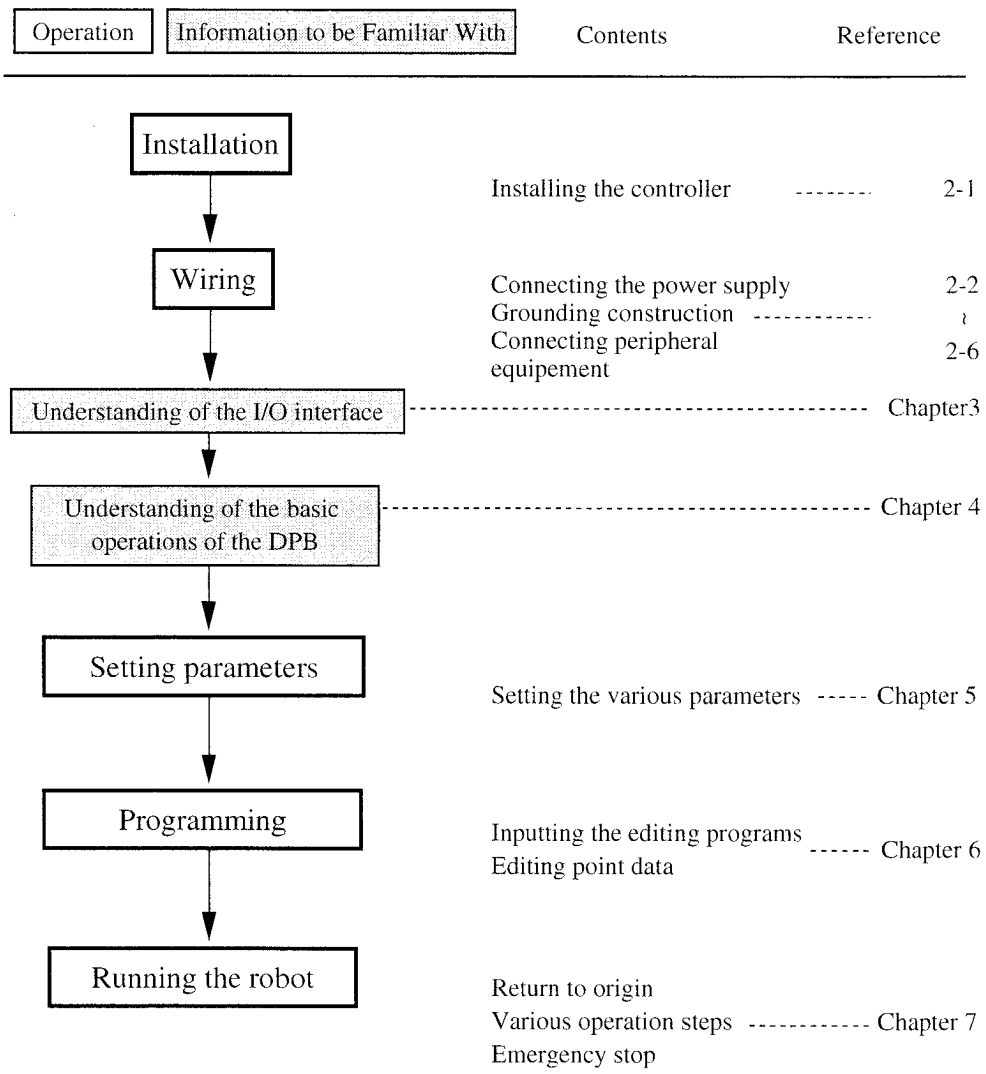
CAUTION

With the SRC Controller, either the DPB programming unit or a personal computer can be operated, depending on how connections are made. This instruction manual describes operations using the DPB. If you are using a personal computer, please refer to Chapter 9 for the pertinent information. Refer to the POPCOM manual for details on operation with POPCOM.

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1-2 Setting Up for Operation

The chart below illustrates the basic steps to follow from the time of purchase of this equipment until it is ready for use. The chapters of this instruction manual are organized in accordance with the operation procedures, and allow first time users to proceed one step at a time.



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1-3 Exterior

The names of the parts found on the exterior of the SRC Controller and the DPBs are described below, along with their functions. Note that the exterior is subject to change without notice.

1-3-1 SRC Controller

The parts on the exterior of the SRC Controller are shown in Figure 1-1 and three sides of this controller are shown in Figure 1-2. The three sides of the SRCA controller are shown in Figure 1-3.

1. Escape Switch (ESC switch)
   This switch is held down while plugging in and unplugging the connectors of the DPB. (See Section 4-1-2, "Connecting the DPB to the SRC Controller".)

2. DPB Connector
   This is used to connect the DPB or the RS-232C terminal of a personal computer.

3. Robot I/O Connector
   This connector is used for input and output from peripheral equipment such as an encoder, an origin point sensor, and brakes.

4. I/O Connector
   This is used to connect external equipment such as a PLC.

5. Power Display Lamp
   These green lamp lights to indicate that power is being supplied.

6. Terminal Bases
   The grounding terminal FG, and is used if it is difficult to make grounding connections on the power supply inlet side of the SRC Controller.
   The terminal bases MA and MB connect the motor wires for the robot cable. Make sure that the MA and MB mark on the motor wires are matched to the correct terminals.

7. I/O Power Supply Fuse
   This is a built-in, 24 V, power supply protection fuse for input and output use.
   1 A/250 V

8-1. Power Supply Inlet
   AC power is supplied through this inlet. Grounding construction of the ground terminal should always be done to protect against electrical shock and to boost the reliability of the equipment.

8-2. AC Power Supply Fuse
   This contains the fuse for the AC power supply.

8-3. Power Supply Switch
   This is the on and off switch to the main. The upwards position is the "ON" position.

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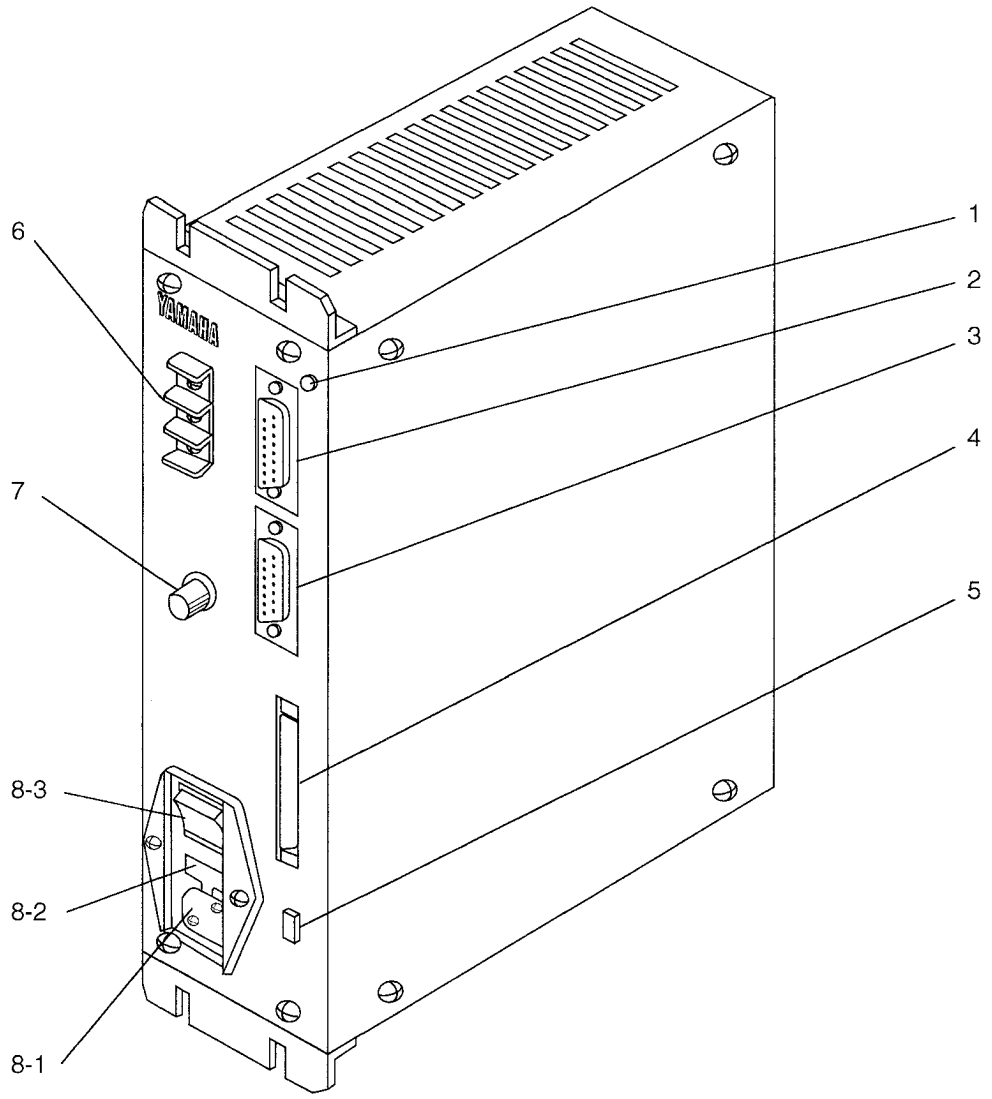


Fig. 1-1 Exterior of the SRC Controller

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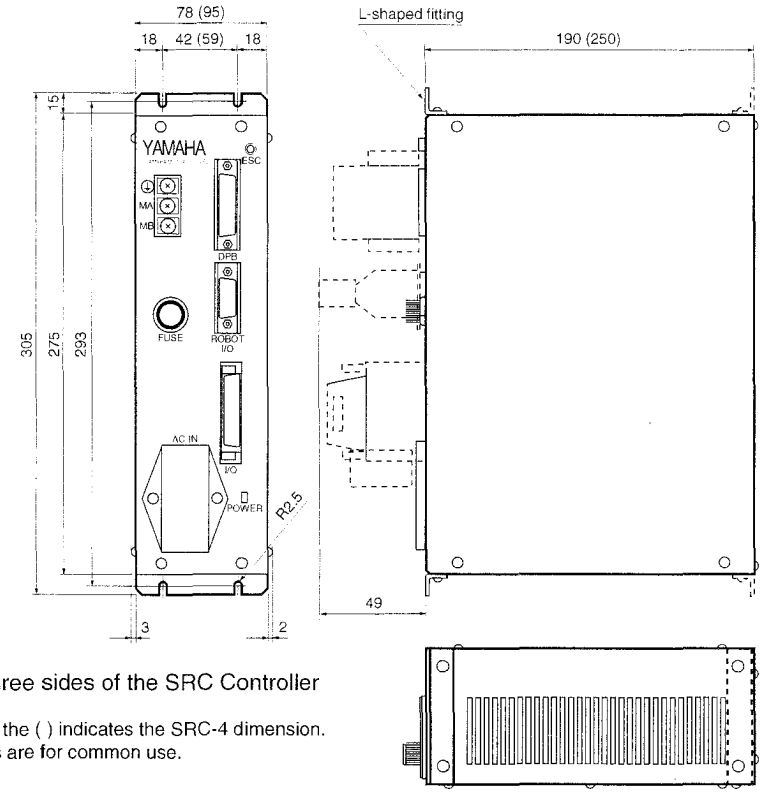


Fig. 1-2 Three sides of the SRC Controller

The figure in the ( ) indicates the SRC-4 dimension.
Other figures are for common use.

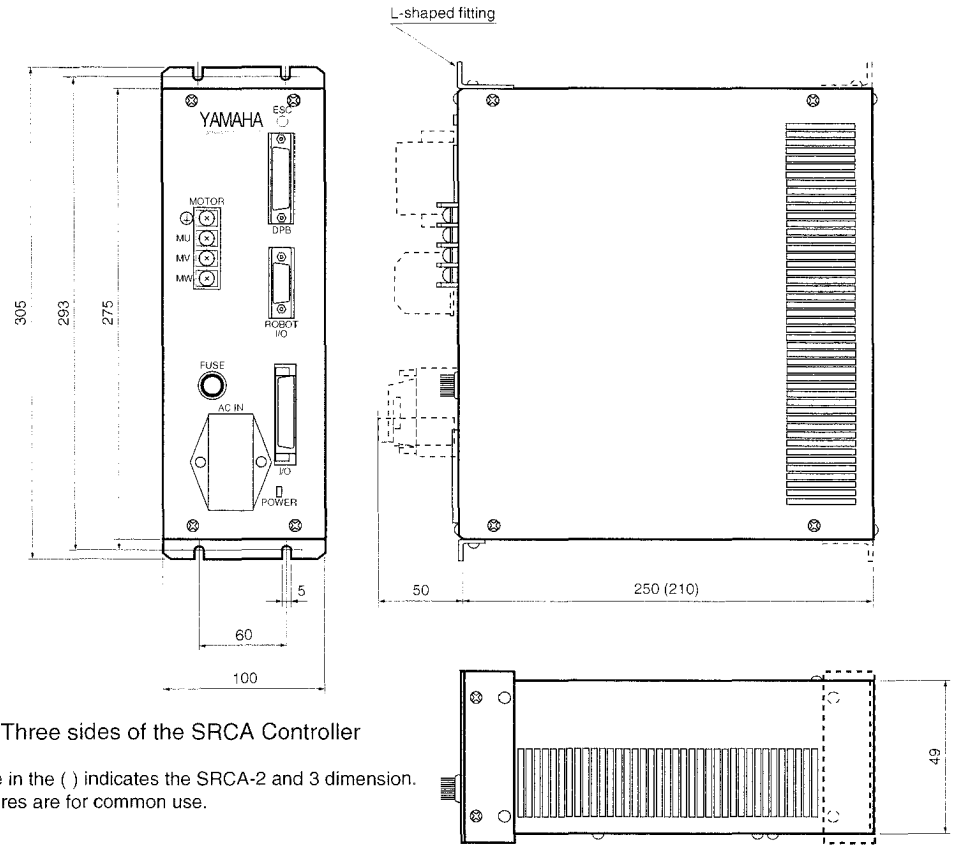


Fig. 1-3 Three sides of the SRCA Controller

The figure in the ( ) indicates the SRCA-2 and 3 dimension.
Other figures are for common use.

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1-3-2 DPB

The exterior of the DPB is shown in Figure 1-4 and three sides of the DPB are illustrated in Figure 1-5.

1. Liquid Crystal Display
   This display has four lines of twenty characters each, and is used as a program console.
2. Option Card Connector
   An IC memory card or printer card can be inserted here. Be careful not to insert the card upside-down.
3. Sheet Keys
   The DPB can be manipulated using menu driven operation. Instructions are input through the sheet keys while reading the contents of the liquid crystal display. There are a total of 28 keys but the Y+ and Y- keys are not used.
4. Connection Cable
   This is the cable used to connect the SRC Controller with the DPB.
5. DC Power Supply Inlet
   Not used.
6. Emergency Stop Switch
   This is the Emergency Stop switch. When pressed, it locks in the depressed position. It is released by turning it in the clockwise direction.
   To cancel the emergency stop first release the switch and then use signal input through the I/O port (see Chapter 3) or DPB operation (see Chapter 7).

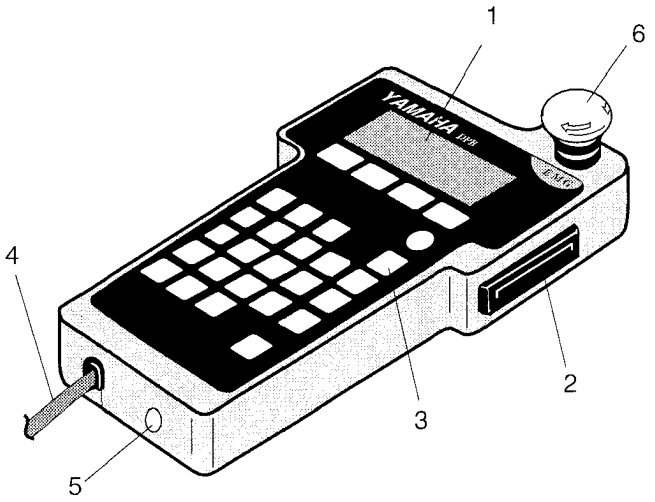


Fig. 1-4 Exterior of the DPB

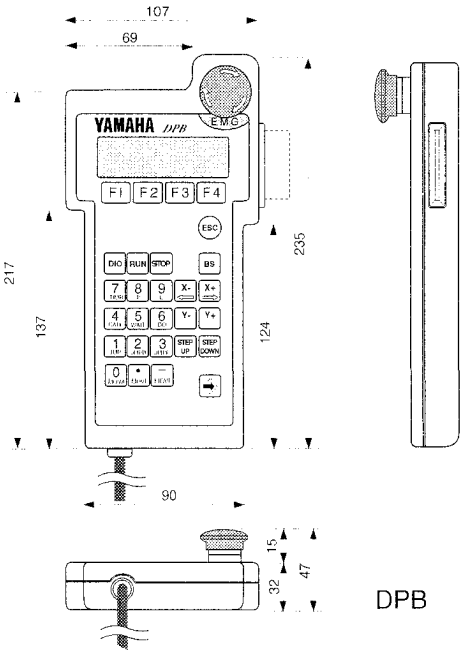


Fig.1-5 Exterior of the DPB

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1-4 System Configuration

The SRC Controller is composed of various main components like those shown in Figure 1-6. For further reference, please see Figures 1-7 and 1-8, which shows the main block diagram of the SRC Controller and SRCA Controller, respectively.

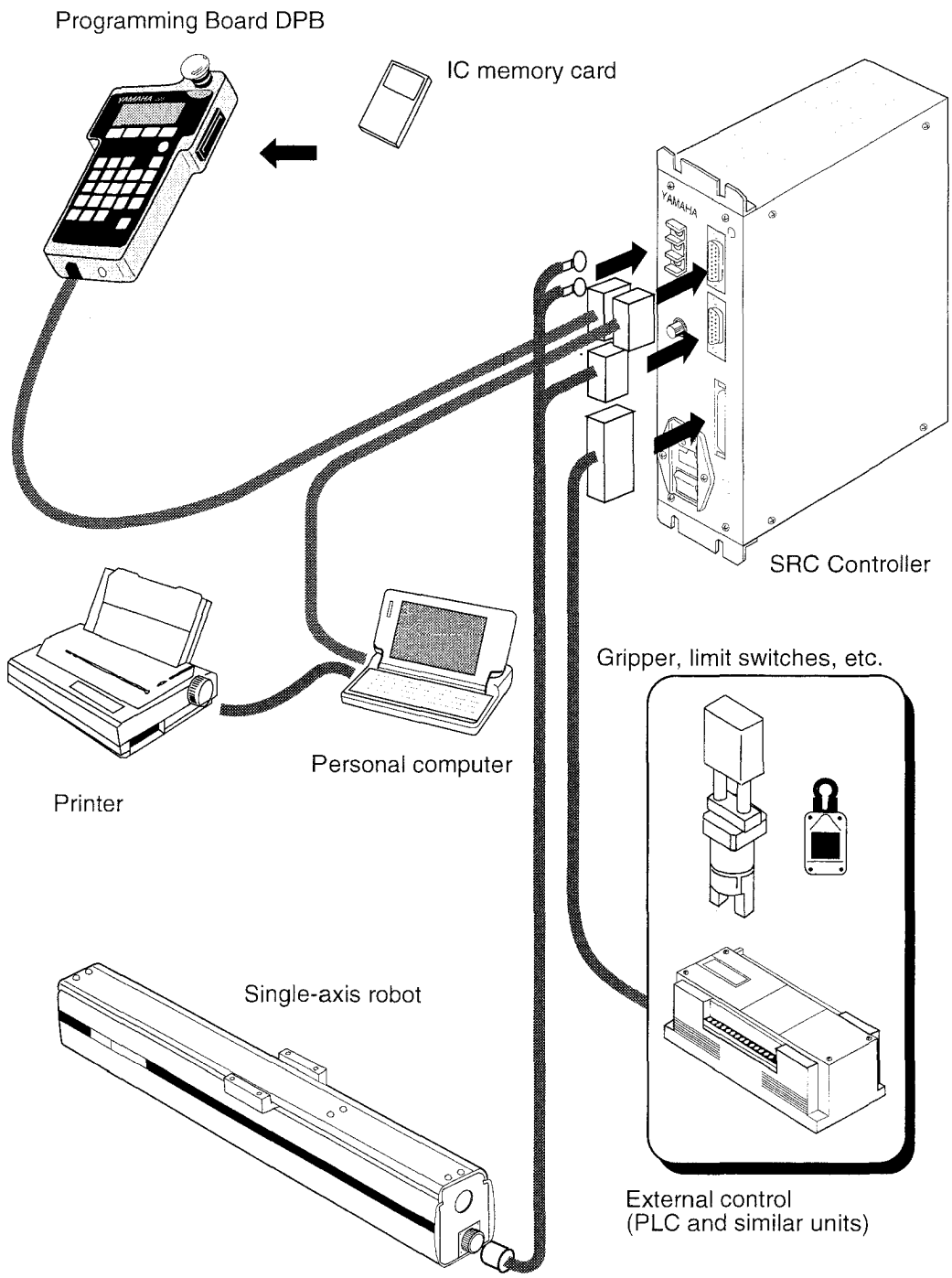


Fig. 1-6 System Configuration Diagram

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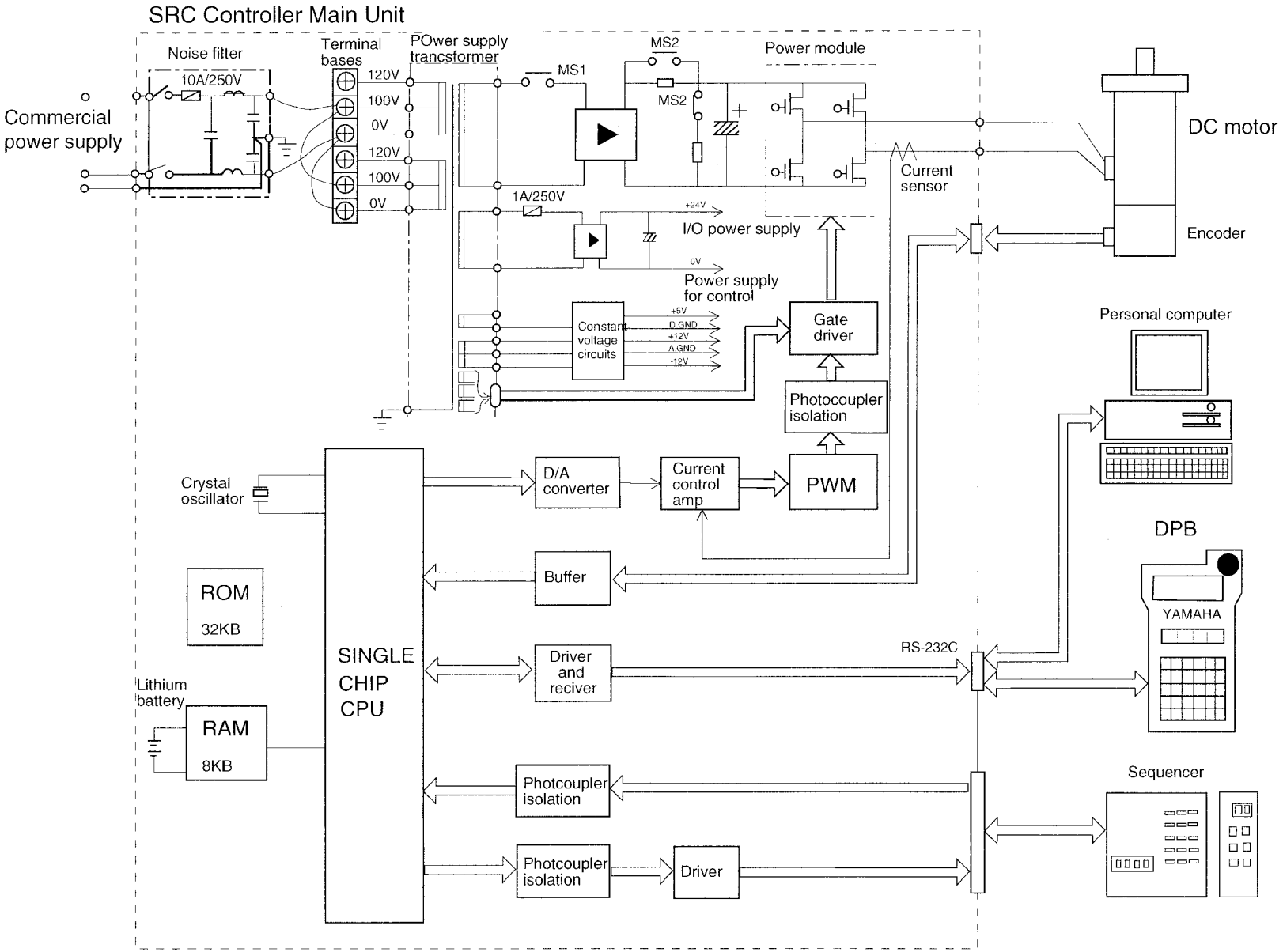


Fig. 1-7 Main Unit Block Diagram

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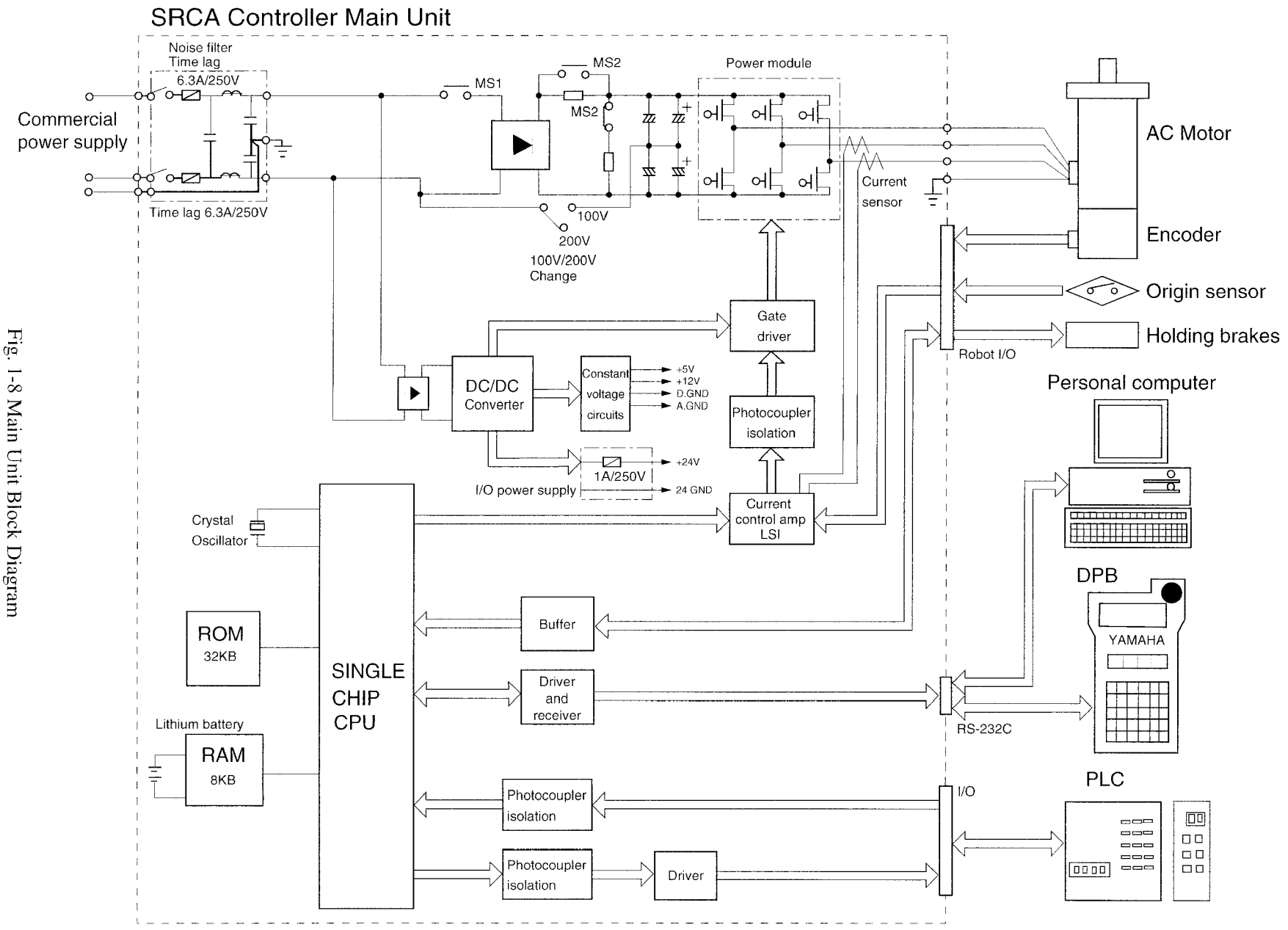


Fig. 1-8 Main Unit Block Diagram

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1-5 Accessories and Options

1-5-1 Accessories

The following accessories should be supplied with the SRC Controller. Please check, when you purchase your unit, to make sure all of the accessories are included. (The accessories are common for the DC series and AC series.)

1. I/O connector
   Connector: One FCN-361P032-AG, made by Fujitsu
   Connector cover: One FCN-360C32-B, made by Fujitsu

2. Power supply connector : 4204,4240-07, made by OTTO HEIL

1-5-2 Peripheral Options

The following options are available for the SRC Controller:

1. IC memory card
   This is used when the DPB is connected, to back up programs, point data, and parameter settings.

2. I/O checker
   A simulation device called an I/O checker can force inputs and monitor outputs.

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MEMO

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CHAPTER 2 INSTALLATION AND WIRING

This chapter contains precautions that should be observed when installing the controller, as well as procedures and precautions for wiring the controller to the robot and to external equipment.

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2-1 Installing the SRC Controller

2-1-1 Installation Method

The two L-shaped fittings can be used to mount the controller from a front or rear position. (See Figures 1-2 and 1-3.)

2-1-2 Installation Location

Table 2-1 Installation Location

Item	Item
1 Ambient temperature	0 ~ 40°C
2 Humidity	35~85% (with no condensation)
3 Other conditions	1) Location with good ventilation 2) Location where no corrosive gases such as sulfuric acid and hydrochloric acid are generated 3) Area largely free of dust and dirt 4) Location where the equipment will be kept well away from oil and water

2-2 Connecting the Power Supply

2-2-1 Connection Method

Using the special power supply plug provided as an accessory, connect the power supply (as shown in Figure 2-1. Check the seal affixed to the front panel of the SRC Controller for the power supply voltage specifications and make sure the voltage is appropriate. The special power supply plug has separate terminals marked for hot (H) and neutral (N). For safety purposes, check the H and N markings on the AC power supply side before wiring. (The DC series fuse is inserted only on the H side, so always confirm the marking.)

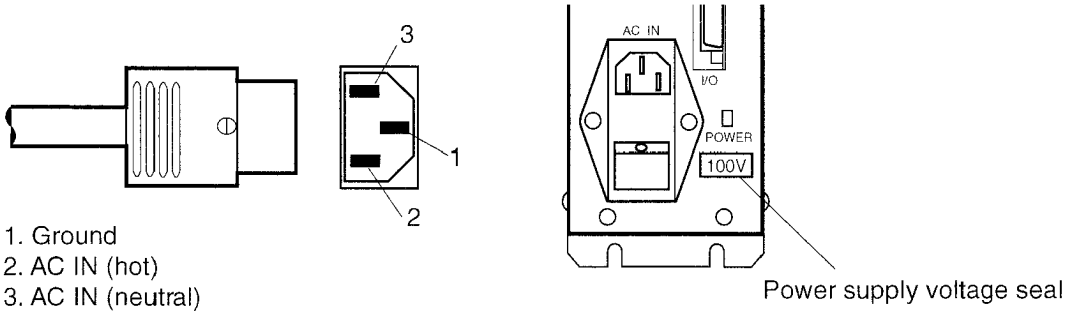


Fig. 2-1 Power Supply Connections

– – – Special notice regarding European Specifications – – –

The robot controllers power supply switch does not function as the EN60204-1 supply disconnecting (isolating) device. Thus, install a supply disconnecting (isolating) device suitable for the entire external machine devices of the robot controller.

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2-2-2 Power Supply and Power Consumption

Table 2-2 Power Supply and Power Consamption

Type and Item	Power supply voltage	No. of phases	Frequency	Max. power consumption
SRC-1	AC100/120/200/220/240V ± 10%	Single-phase	50/60 Hz	200 VA or less
SRC-2	AC100/120/200/220/240V ± 10%	Single-phase	50/60 Hz	400 VA or less
SRC-4	AC100/120/200/220/240V ± 10%	Single-phase	50/60 Hz	1000 VA or less
SRCA-2	AC100/110/200/220V ± 10% AC100–120/200–240V ± 10% *)	Single-phase	50/60 Hz	400 VA or less
SRCA-3	AC100/110/200/220 ± 10% AC100–120/200–240V ± 10% *)	Single-phase	50/60 Hz	1000 VA or less
SRCA-4	AC100/110/200/220 ± 10% AC100–110/200–220V ± 10% *)	Single-phase	50/60 Hz	1000 VA or less

*) The voltage specifications for these controllers are not indicated on a label but directly printed on the front panel.

CAUTION

(1) The power supply voltage is set to one of above specification when it is shipped from the factory. If it is necessary to change the voltage, please contact a Yamaha dealer or representative.
(2) If the power supply voltage drops below the above range during operation, an alarm circuit will deactivate the SRC Controller. To avoid problems, a stable power supply with less than ±10% fluctuation should be provided.
(3) The controller has a capacitor input type of power supply, therefore, when the power is turned on a large supply of current flows. Quick-blow circuit breakers and fuses should be avoided.
(4) For the same reason, avoid turning the power off and on again repeatedly in intervals of less than 10 seconds. This could lead to deterioration of the main circuit elements in the controller.

2-3 Grounding Construction

Grounding construction should always be done to ensure safety in the event of electrical leakage. Grounding protects humans against electrical shock and can help prevent malfunction of the equipment due to noise.

Note that grounding of Class 3 or higher (grounding resistance of 100 Ω or less) is recommended.

For grounding the controller, the ground terminal of the terminal base or the ground pin of the power supply plug should be used.

– – – Special notice regarding European Specifications – – –

If the robot controller is part of a machine facility for Europe, install a terminal, marked with the characters PE, on the general protective conductor, and connect to the external protective conductor. Securely connect the robot controllers earth terminal (symbol 417-IEC-5019) to the protective conductor.



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2-4 Connecting the SRC to the Control Unit

The SRC Controller can be operated either through the DPB programming unit or through a personal computer equipped with an RS-232C terminal. When using the DPB, connect the DPB male connector to the SRC Controller's RS-232C femal port marked "DPB". When using a personal computer, connect the personal connector to hte RS-232C female port marked "DPB" with a special cable. (For DPB connections, please see Chapter 4, Section 4-1.)

Serial communication cable specifications

There is an emergency stop input between pin nos. 18 and 21 on the controller side. Under normal circumstances this contact is closed (it is a B-type contact).
When you want to be able to use an emergency stop signal, connect a switch retard for 50 mA or gerater. If this circuit is open, an emergency stop is performed.
Input response: 5 msec or less
Input current: 33.3 mA/DC 24V

9 pins-25 pins (For IBM-PC/AT or compatibles)

Controller isde (25pin) — Computer isde (9pin)

Name	Pin no.
F. G	1
TXD	2
RXD	3
RTS	4
CTS	5
D. G	7
HSTCK	12
HSES1	18
HSES2	21

PC frame	
Name	Pin no.
TXD	3
RXD	2
RTS	7
CTS	8
D. G	5
DSR	6
DCD	1
DTR	4

25 pins-25 pins (For NEC PC98 series)

Controller isde (25pin) — Computer isde (25pin)

Name	Pin no.
F. G	1
TXD	2
RXD	3
RTS	4
CTS	5
D. G	7
HSTCK	12
HSES1	18
HSES2	21

Signal	Pin no.
F. G	1
TXD	2
RXD	3
RTS	4
CTS	5
D. G	7
DSR	6
DCD	8
DTR	20

NOTE

The DPB and personal computer may not be used simultaneously.

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2-5 Connecting the SRC to the Robot

Connect the accessory robot cable to the controller as shown in Figure2-3. Make all electrical connections with the power OFF. The output cable to the motor has a round shaped terminal. Using the marking on the cable end and the marking on the terminal block correctly and securely fasten the cable by tightening with a machine screw. Also connect the robot cable connector to the robot encoder connector on the front panel of the SRC Controller. If this connector is not properly attached the robot will move in uncontrolled motions. Fasten this cable securely to the unit with setscrews.

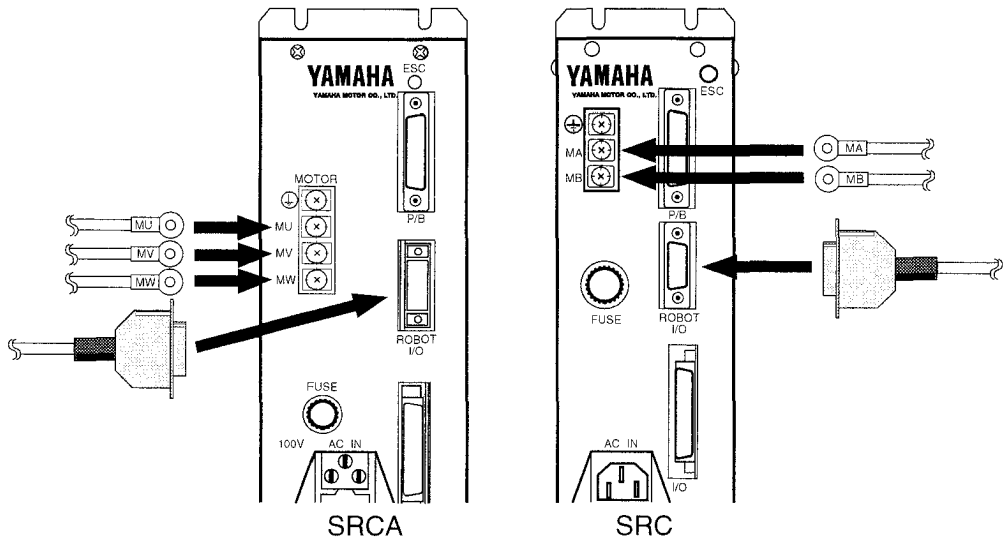


Fig. 2-3 Connection of the SRC Controller to the Robot

The robot encoder connector that can be used with the SRC Controller is listed below.

SRC
Applicable connector number : JAZ-15P-90 (made by JST)
Applicable connector cover number : J-C15-2V (made by JST)
SRCA
Applicable connector cover number : MR-20LM (made by HONDA TSUSIN)

– – – Special notice regarding European Specifications – – –
The robot controller cabinet is not designed as the EN60204-1 enclosure. When using the controller as part of a machine work cell, note that the robot controller must be stored in a cabinet having a protective class of IP54 or higher.

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Table 2-3 Robot Encoder Signals

Pin No.	Signal Name	Description of Signal
1	SHIELD	Shield (motor case)
2	PA	Encoder A-phase pulse input
3	PB	Encoder B-phase pulse input
4	5V	Encoder power supply 5V
5	DGND	Encoder power supply 0V
6	ORG	Origin sensor signal
7	+24V	+24V power supply for origin sensor
8	0V	0V power supply for origin sensor
9	N.C.	Not connected
10	PZ	Encoder Z-phase pulse input
11	PR	No usage applications at present
12	5V	Encoder power supply 5V
13	DGND	Encoder power supply 0V
14	BK (+)	Brake signal (+)
15	BK (-)	Brake signal (-)

Table 2-4 Robot Encoder Signals-SRCA

Pin No.	Signal Name	Description of Signal
1	SHIELD	Shield (motor case)
2	PA (+)	Encoder A-phase (+) pulse input
3	PA (-)	Encoder A-phase (-) pulse input
4	PB (+)	Encoder B-phase (+) pulse input
5	PB (-)	Encoder B-phase (-) pulse input
6	PC (+)	Encoder C-phase (+) pulse input
7	PC (-)	Encoder C-phase (-) pulse input
8	5V	Encoder power supply 5V
9	5V	Encoder power supply 5V
10	DGND	Encoder power supply 0V
11	DGND	Encoder power supply 0V
12	N. C.	Not connected
13	ORG	Origin sensor signal
14	+24V	+24V power supply for origin sensor
15	+24V	+24V power supply for origin sensor
16	0V	+0V power supply for origin sensor
17	0V	+0V power supply for origin sensor
18	BK (+)	Brake signal (+)
19	BK (-)	Brake signal (-)
20	N. C.	Not connected

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2-6 Connecting the SRC to the I/O Connector

Fasten the accessory I/O connector as shown in Fig 2-4 below.
Fig. 2-5 shows the exploded view of the I/O Connector.

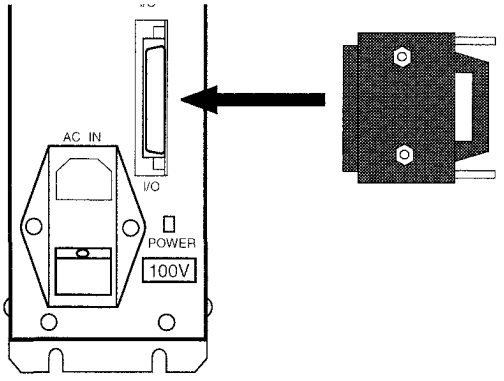


Fig. 2-4 Connection of the SRC to the I/O Connector

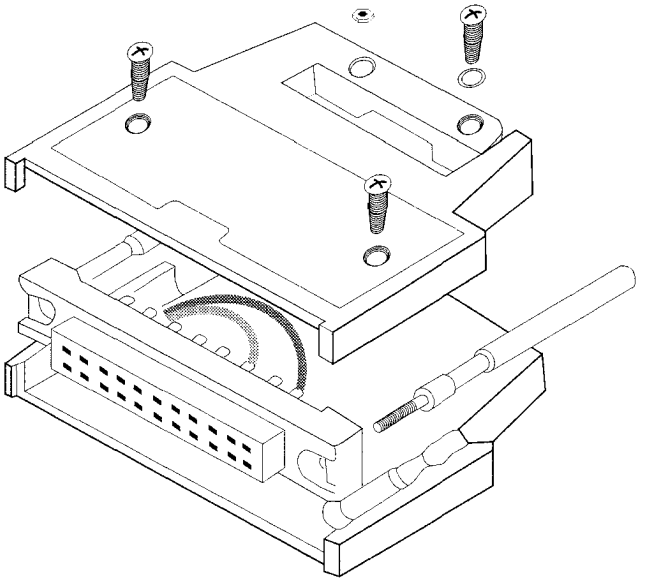


Fig. 2-5 Exploded View of the I/O Connector

The I/O connector is used to connect the SRC Controller to external equipment such as a PLC. The signals assigned to each of the I/O connector terminals and their functions are described in detail in Chapter 3. Wire the signals necessary for operation to the terminals to which they are assigned. Then plug in the I/O connector. Listed below are the precautions that should be taken when connecting the wiring. The I/O connector that is compatible with the SRC Controller is listed below.

Connector number : FCN-361P032-AG (made by Fujitsu)
Connector cover number: FCN-360C32-B (made by Fujitsu)

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CAUTION

Even if not using I/O control, the I/O connector should be plugged in after completing the following wiring. (This wiring has already been done on the I/O connector provided as an accessory, so the connector can be used just as it is.)

1. Short pin numbers A11 and B12.
2. Short pin numbers B4 and A9 or B10.

If Step 1 is not completed, an emergency stop will occur. If Step 2 is not completed, an interlock will be applied. In either case, the controller cannot be operated (see Chapter 3).

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CHAPTER 3

I/O Interface

The SRC Controller is equipped with an I/O interface, consisting of nine general-use input points, five general-use output points, a 24 V I/O power supply, and other components. Through this I/O interface, commands and data can be exchanged between the controller and external equipment, and actuators such as valves and sensors can be directly connected and controlled. To construct a system utilizing the many features of the SRC Controller, it is necessary to have a basic knowledge of the I/O interface and how it works. Chapter 3 covers this fundamental information.

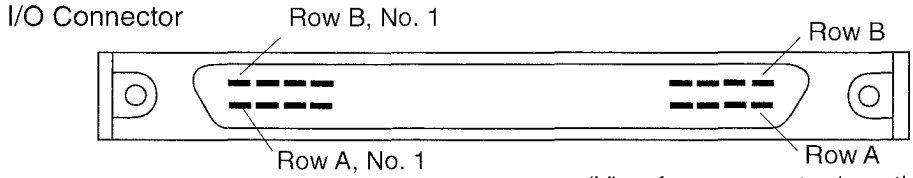
This chapter also provides examples of I/O circuit connections and timing charts, which are necessary for reference when expanding the system by using a PLC or other similar components. Please refer to these diagrams and examples when writing PLC programs.

In Chapter 3, the terms "ON" and "OFF" refer to turning on and off the switches connected to the input, in the case of input, and to the output transistor in the case of output.

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3-1 I/O Connector Signals

The I/O connector used as standard equipment in the SRC Controller is constructed of 32 pins (Fig. 3-1), with an individual signal assigned to each pin. Table 3-1 shows the pin numbers and the name and description of the signal assigned to that pin. For a more detailed description of each of the signals, please refer to Section 3-2.



(View from connector insertion side)

Table 3-1 I/O Connector Signals

Pin No.	Signal	Description
A-1	ABS-PT	Point movement command with absolute
B-1	INC-PT	Point movement command with incremental
A-2	AUTO-R	Automatic operation start command
B-2	STEP-R	Step operation start command
A-3	ORG-S	Origin return command
B-3	RESET	Reset command
A-4	+24V	+ 24 V power supply output
B-4	LOCK	Interlock
A-5	DI 0	General-use input 0
B-5	+24V	+ 24 V power supply output
A-6	DI 2	General-use input 2
B-6	DI 1	General-use input 1
A-7	DI 4	General-use input 4
B-7	DI 3	General-use input 3
A-8	DI 6	General-use input 6
B-8	DI 5	General-use input 5
A-9	0V	Reference 0 V for input/output
B-9	DI 7	General-use input 7
A-10	DI 8	General-use input 8
B-10	0V	Reference 0 V for input/output
A-11	EMG 1	Used for Input 1 for emergency stop and EMG2 as set
B-11		Not connected
A-12		Not connected
B-12	EMG 2	Used for Input 2 for emergency stop and EMG1 as set
A-13	DO 1	General-use output 1
B-13	DO 0	General-use output 0
A-14	DO 3	General-use output 3
B-14	DO 2	General-use output 2
A-15	END	Normal end of execution
B-15	DO 4	General-use output 4
A-16	READY	Preparation completed (Alarm)
B-16	BUSY	Command execution in progress

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3-2 Description of the I/O Signals

3-2-1 Input Signals

Input signals consist of the following types: interlock, six special-use input points, nine general-use input points, and the emergency stop input.

All input circuits, except emergency stop input uses photocoupler insulation input circuit specifications. However, only the emergency stop input circuit serves as contact input to which a relay excitation circuit (used for direct switching of the internal motor power supply) is connected. (See Chapter 3-5, "I/O Connection Diagram".)

1. Interlock (LOCK)

This input is used to temporarily interrupt robot movement.

During execution of special-use commands from the I/O interface (i.e.; when programming using the DPB, a personal computer, or during a return to the origin position), robot movements can be stopped by turning off (contact open) the Interlock signal. (This also interrupts the running of the program.)

However, turning off this signal inhibits execution of special I/O commands and DPB (or personal computer) programs, as well as execution of a return to the origin. For this reason, the Interlock signal is normally left on (contact closed).

The only exception to this is the reset input, which can be executed regardless of whether the Interlock signal is on or off.

When the interlock input is turned off, the robot will be stopped, even after the input has been turned back on, until another command is input. These commands include: a command to start automatic operation or to carry out a return to the origin position.

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2. Special-Use Command Input

Special-use command input is used to accept instructions from a PLC or other external equipment. When using special-use commands, the signals READY, BUSY and LOCK must be set to the conditions listed below:

READY : ON
BUSY : OFF
LOCK : ON

If the above conditions are not satisfied, special-use command input cannot be accepted. However, if LOCK is turned off the reset command can be accepted.

* For example, when BUSY is turned on, the controller is in the process of executing special-use commands, and no other special-use commands can be accepted until it has finished. If LOCK input is turned OFF, a command also can not be accepted since Interlock is executing. As an exception, if READY and BUSY satisfy the above condition, reset command will execute even if LOCK is OFF.

Input is accepted when the special-use command input is switched from off to on, and confirmation can be made using the BUSY output.
Please be aware that this input cannot be used as data in a program.

NOTE

The special-use commands are all pulse input. The special-use input should always be turned OFF (contact open).

1. Point movement command with absolute (ABS-PT)

When the coordinates for the origin point are set to 0, the robot's speed is selected by DI8 and its position is specified by the data in DI0 to DI7 (see Section 3-5 , "General-Use Input").

2. Point movement command with incremental (INC-PT)

Starting from the current position, the robot moves at the speed selected by DI8 to the position specified by the data in the point numbers indicated by DI0 to DI7.

* Current position is not necessarily the actual position of robot. It is the data of the position that is saved internally in the controller. On each execution of a movement command, the point that was the target position changes to the current position. Therefore, when the robot is moved manually to another position, it does not make a relative move based on this position. Instead, it makes a relative move based on the previous target position of a robot movement command. Once reset is executed (including when the program is changed manually), the robot, in current position, is cleared to 0. (The robot will not move.)

The current position and robot position differ when:
- The reset is executed (including when the program is changed);
- The axis is moved manually;
- The axis is move manually in the servo OFF state (including emergency stop state); and
- When emergency stop or interlock (STOP) is applied during axis movement.

* The DI0 to DI8 status must be confirmed before ABS-PT or INC-PIT is executed. Always refer to the timing chart in Section 3-5.

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3. Automatic Run Start command (AUTO-R)

The program is run continuously, starting from the current step.

4. Step Run Start command (STEP-R)

The program is run step by step, starting from the current step.

5. Return to origin command (ORG-S)

This command returns the robot to its origin position and must always be executed immediately after the power is turned on.
Once executed, origin return does not need to be re-executed unless the power is turned off.

6. Reset command (RESET)

The program step returns to the No. 1 step of the lead program and DO0 to DO4 are all turned off. If the servo is turned off prior to initiating reset the emergency stop condition is canceled and the servo goes on.

Note that if the RESET execution condition selection parameter (PRM40) is set to 1, LOCK will be input, and execution of only servo ON will be possible without resetting the program. (Refer to following table.)

* The head program refers to the program selected the last time the program is changed from the DPB or personal computer.

Operation at RESET input

PRM40	Status at RESET input		Controller process details
	EMG input	LOCK input	
0	OFF	Both ON/OFF	Program reset is executed
	ON	Both ON/OFF	Servo is turned ON and program is reset
1	OFF	OFF	Nothing is executed
		ON	Program is reset
	ON	OFF	Servo is turned ON
		ON	Servo is turned ON and program is reset

EMG input OFF: Emergency stop state, ON: Non-emergency stop state
LOCK input OFF: Interlock state, ON: Lock released state

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3. General-Use Input (DI0 to DI8)

(1) This is input which can be freely utilized as data in programs written by the user. It should be used when sensors and switches are connected. Of course, it can also be connected directly to the PLC output circuit (See 3-4 I/O Connection Diagram).
(2) This is also used as the point number setting input or speed setting input when the point movement commands (ABS-PT, INC-PT) which are custom input command input.

PRM7* (%)	Number of point No. setting inputs	Number of speed setting inputs
1 to 100	8 points (DI0 to DI7)	1 point (DI8)
0	7 points (DI0 to DI6)	2 points (DI7, DI8)

1. When PRM 7 = 1 to 100%

Only DI8 is used to set the speed of the point movement commands. The speed becomes 100% when DI8 is OFF and is set to the level indicated by the PRM7 when DI8 is ON. (The default setting is 30%.)
With the DI0 to DI7 inputs, point numbers from 0 to 254 can be specified in binary code, as shown in the table below.

DI No.	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
P0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
P1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
P3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
P7	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
P15	OFF	OFF	OFF	OFF	ON	ON	ON	ON
P31	OFF	OFF	OFF	ON	ON	ON	ON	ON
P63	OFF	OFF	ON	ON	ON	ON	ON	ON
P127	OFF	ON	ON	ON	ON	ON	ON	ON
P254	ON	ON	ON	ON	ON	ON	ON	OFF

2. When PRM7 = 0

The speed setting can be changed by using DI7 and DI8.

DI8	DI7	Movement speed (%)
OFF	OFF	100
OFF	ON	PRM41 (10)
ON	OFF	PRM42 (30)
ON	ON	PRM43 (70)

Digits in parentheses are the default setting of each parameter.

DI7 does not affect the point number setting, so the valid point numbers will be P0 to P127.
For details on the input timing, refer to "3-5-6 When point movement commands are being executed" in "Timing chart".

4. Emergency Stop Input 1 and Emergency Stop Input 2 (EMG1, EMG2)

An emergency stop should be used to initiate an emergency stop of the robot from an external safety device (for example, a safety fence or a manual switch). The relay contact used should have a current capacity of at least 50 mA. When an emergency stop is

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initiated, the contact point between EMG1 and EMG2 is turned off, and at the same time the servo turns off because its power supply is cut off.

To restart operation, close (turn on) the contact between EMG1 and EMG2, and then Turn on the reset input.
When the DPB is connected to a SRC Controller, operation can be restored from the emergency stop state using the DPB or personal computer.

3-2-2 Output Signals

There are three special signals for output, READY, BUSY and END, as well as five general-use output signals. In this section, we will use the terms "ON" and "OFF" to refer to turning the output transistor on and off.

1. Special Output

This output is used for signal interaction between the SRC Controller and a device such as a PLC.

1. "Preparation completed" output (READY)

This output is kept on as long as the controller system is functioning normally. It is turned off if any of the conditions noted below occurs, in which case the motor enters "free" status.
• Emergency stop status
After the emergency stop is cancelled, operation can be restarted by the input servo command.
• A non-emergency stop alarm occurs.
When the READY signal turns off and the unit is not in emergency stop, a break-down has probably occurred. In this case, see Chapter 11, "Trouble-shooting". The power supply should be turned off before restarting operation.

2. "Command execution in progress" output (BUSY)

This signal is on during execution of special-use command input or when commands from the DPB or a personal computer are being executed. Because it is turned on when special-use command input is received, special-use command input should be turned off when this BUSY signal goes on. The signal will go off again when command processing ends and all special-use command input has been turned off.

Special-use command input cannot be accepted when this signal is on. Therefore, the DPB should not be operated while commands from the I/O interface are being executed.

3. "Execution ended" output (END)

This signal goes off when the special-use command input is received. It goes back on when command execution has ended normally. This signal does not turn on when an error occurs during execution or during an Interlock status. When the reset or movement command (specifying a very small amount of movement) is used, the execution time is very short (1 ms or less). Hence the period that the END signal remains off, is very short (1 ms or less).
Note that the signal will not change when operating with the DPB or the personal computer).

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2. General-use Output (DO0-DO4)

This is output that is available to the user and can be turned on and off within the program. In combination with the 24 V power supply built into the controller, it can be used to drive the load for electromagnetic valves, lamps, and other components. It can also be connected directly to the input circuit of the PLC.

The load capacity of the built-in 24 V power supply is 600 mA. However, for perpendicular robots (e.g., LTV, LSV, HSV) a 300 mA load capacity is used by the brakes, so the load capacity that can be used by I/O functions is reduced to 300 mA.

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3-3 I/O Circuits

The specifications of the input and output circuits of the SRC Controller are listed in Table 3-3, and some examples of how the circuits should be connected are provided in Figures 3-2 and 3-3. Please refer to this material when connecting external equipment such as a PLC.

Table 3-3 I/O Circuit Specifications

Input Circuit (excluding emergency stop input. See Note below)

Isolation method:	Photocoupler isolation
Input terminal:	Relay contact or NPN open collector transistor connected between input terminal and 0 V terminal.
Input response:	30 ms max.
Input current:	5 mA/24 VDC
Input sensitivity:	Current on: 3 mA min. Current off: 1 mA max.

Note 1: Input Circuit specifications for emergency stop input

Input terminal:	Relay contact connected between emergency stop inputs 1 and 2.
Input response:	5 ms max.
Input current:	33.3 mA/24 VDC

Output Circuit

Isolation method:	Photocoupler isolation between internal circuit and output transistor
Output terminal:	NPN open collector output of all collective output common terminals (0 V side)
Output response:	1 ms max.
Max. output current:	0.5 A/24VDC per output
Residual ON voltage:	1.5 V max.

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Input Circuit and Connection Examples

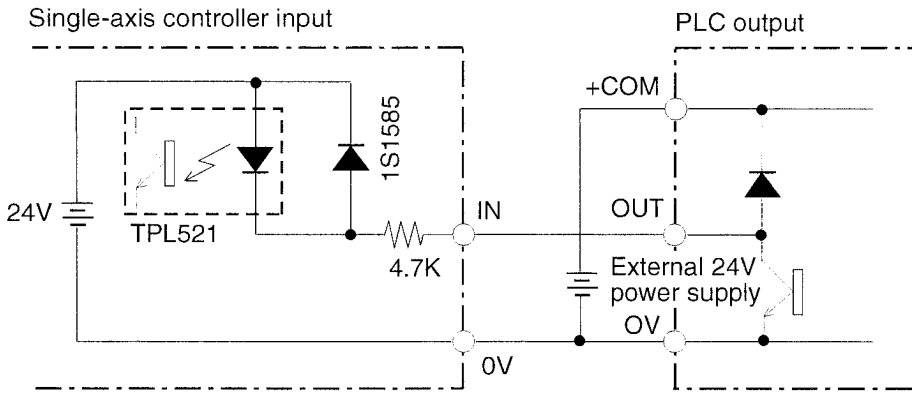


Fig. 3-2a: Input circuit and external connection

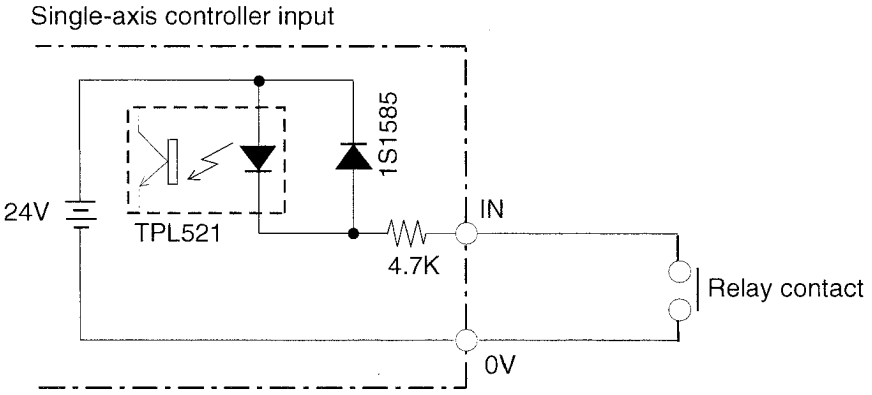


Fig. 3-2b: Input circuit and external connection

Output Circuit and Connection Examples

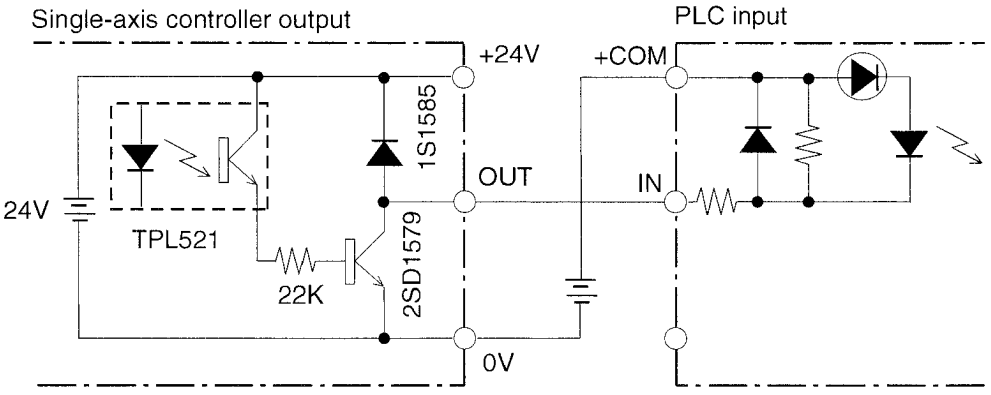


Fig. 3-3a: Output circuit and external connection (when an external power supply is used as the PLC driving power supply)

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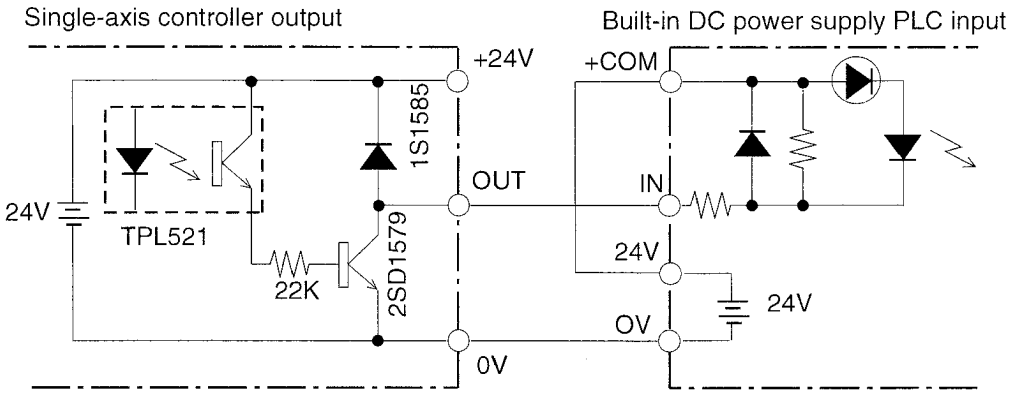


Fig. 3-3b: Output circuit and external connection (when a PLC has a built-in DC power supply)

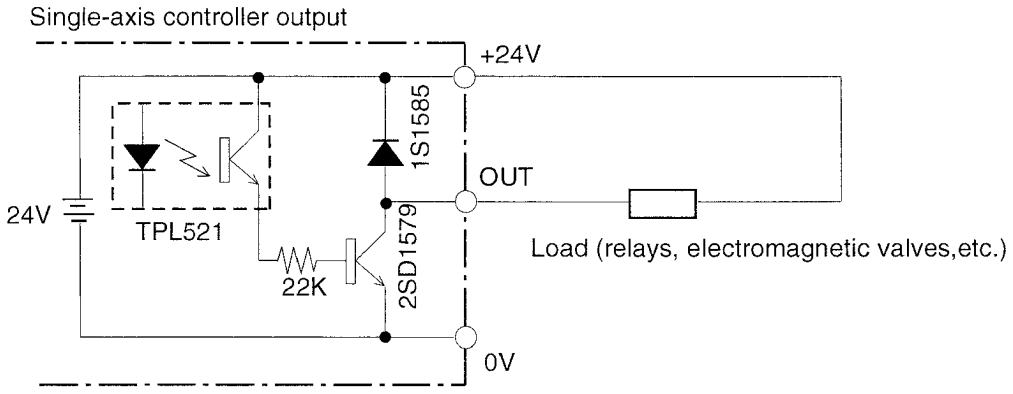


Fig. 3-3c: Output circuit and external connection
(When an internal power supply is being used as the load driving power supply)

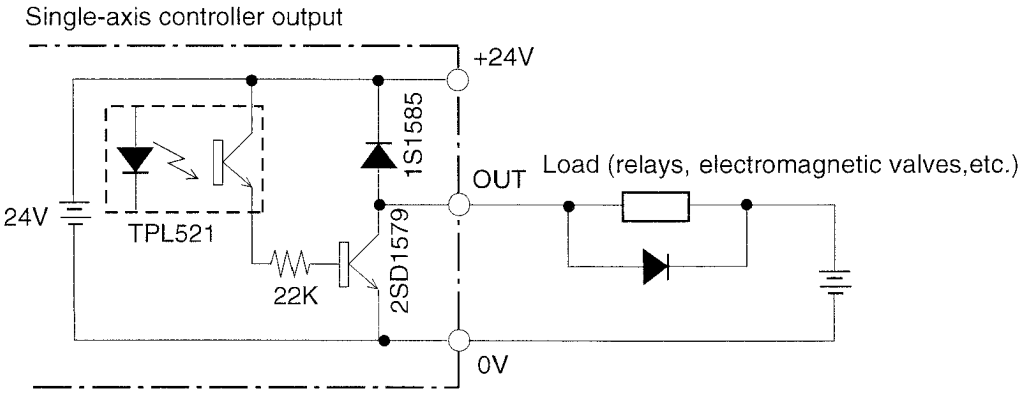


Fig. 3-3d: Output circuit and external connection (when an external power supply is being used as the load driving power supply)

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Caution

1. Do not short the DC24V output of an external device to the 24V output of the controller. This may cause equipment breakdown.
2. Do not short the output terminal to the DC24V terminal. This may cause equipment breakdown.
3. When using an inductive load (such as a solenoid valve) as the output load, connect a high-speed diode as a surge killer in parallel and near to the load to reduce noise.
4. When using a 2-wire type proximity sensor as an input signal, malfunctioning could occur if the residual voltage during ON/OFFchanges is great. Confirm that the sensor is within the standards of the input signal specifications.
5. Depending on the Load on the Unit, the initial current may be too large and exceed the macimum of the internal power supply. If this happens, a protective circuit will turn the power output off.
6. Keep the wires separated from the drive lines of other machines or shield the wires to prevent noise.
7. The supply current capacity of the internal DC24V power supply will differ according to the robot specifications.
   * Non-vertical type robot Max. 600mA
     Vertical type robot Max. 300mA

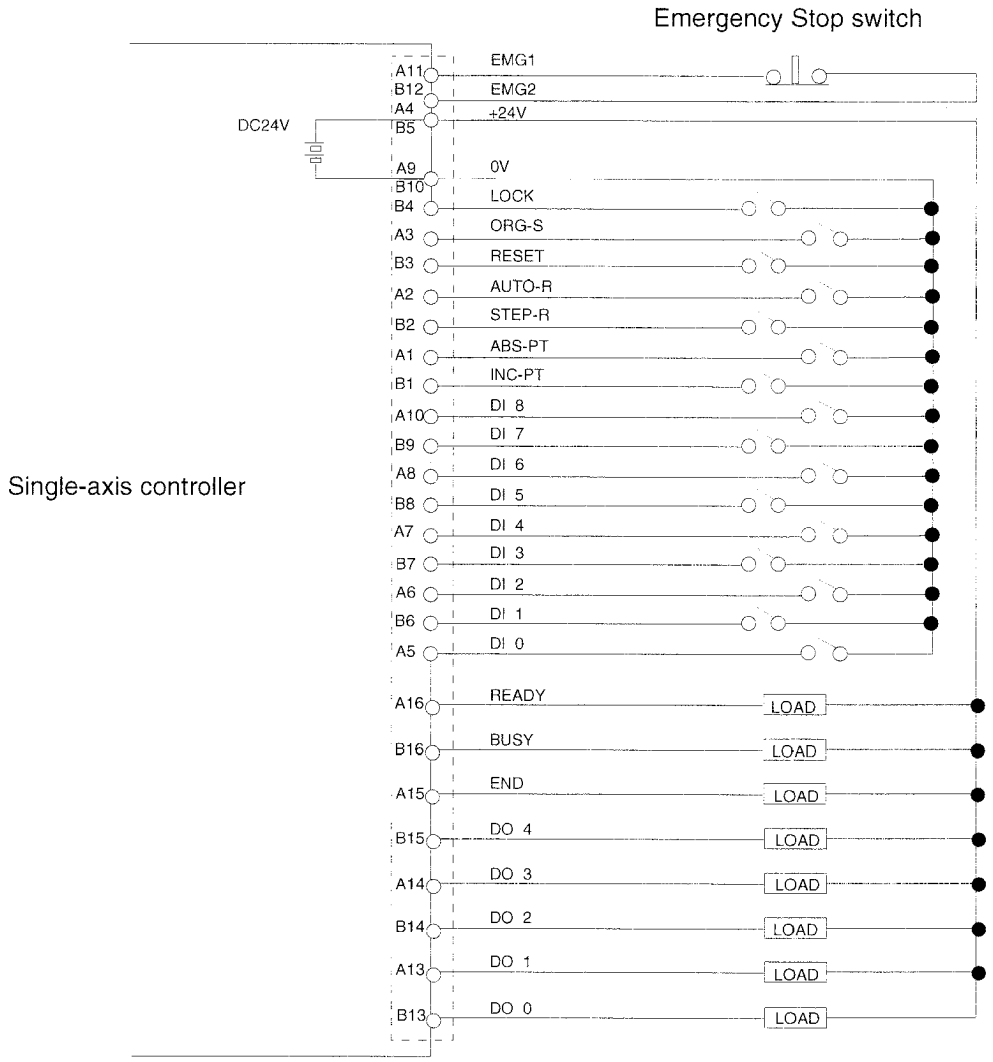
* The vertical type robot refers to the robot in which the sliding section moves vertically and which has holding brakes.

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3-4 I/O Connection Diagram

Example of I/O connection diagrams are provided below in Figures 3-4 through 3-6.

Fig. 3-4 I/O Connection Diagram

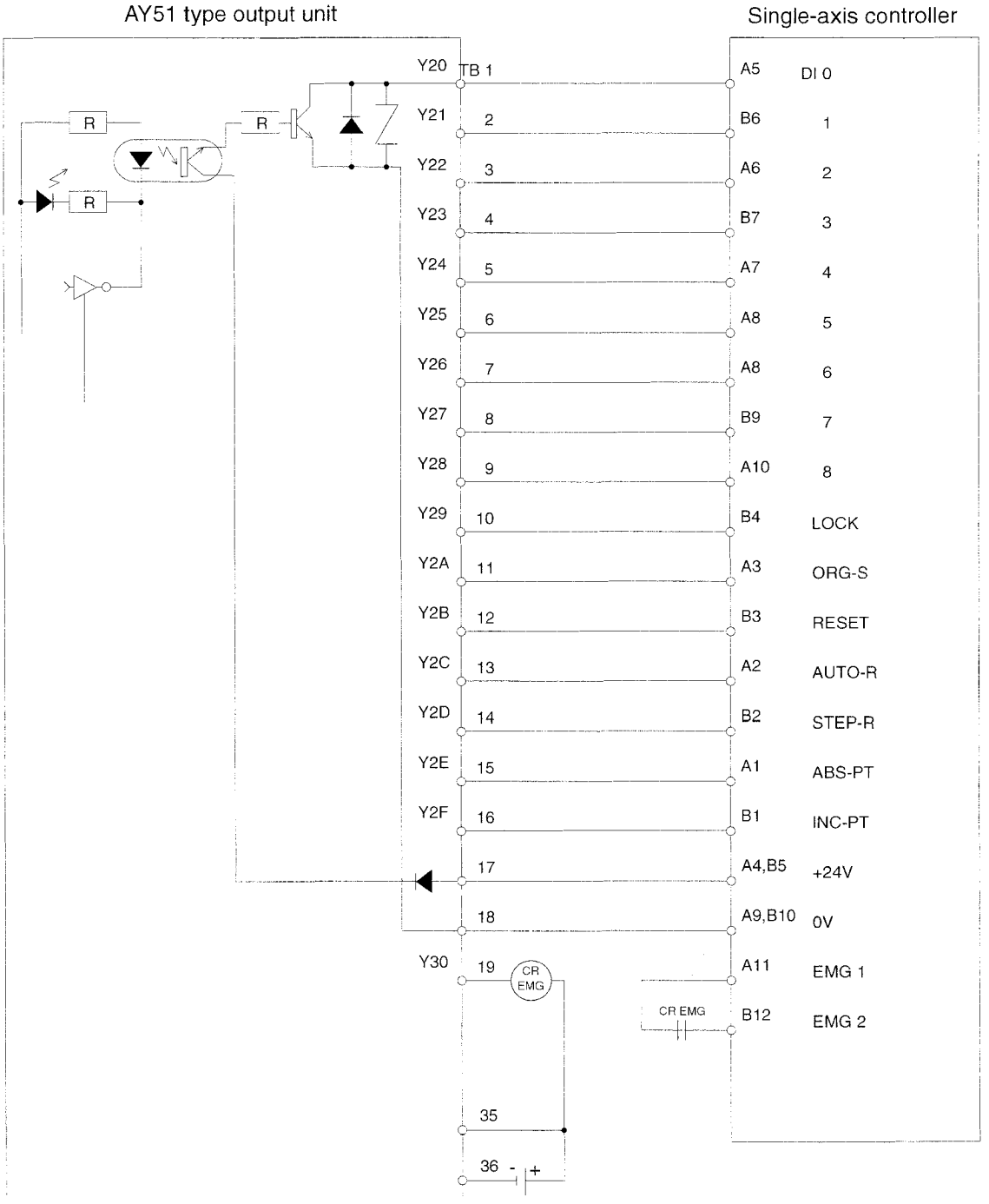


Emergency stop input		EMG 1 ENG 2
Interlock		LOCK
Special-use input	Return to Origin command	ORG-S
	Reset command	RESET
	Auto Run Start command	AUTO-R
	Step Run Start command	STEP-R
	Point movement command with absolute	ABS-PT
	Point movement command with incremental	INC-PT
	General-use input, 9 points	DI0 to DI8

Special-use output	Preparation completed (Alarm)	READY
	Command execution in progress	BUSY
	Execution ended normally	END
	General-use output, 5 points	DO0 to DO4

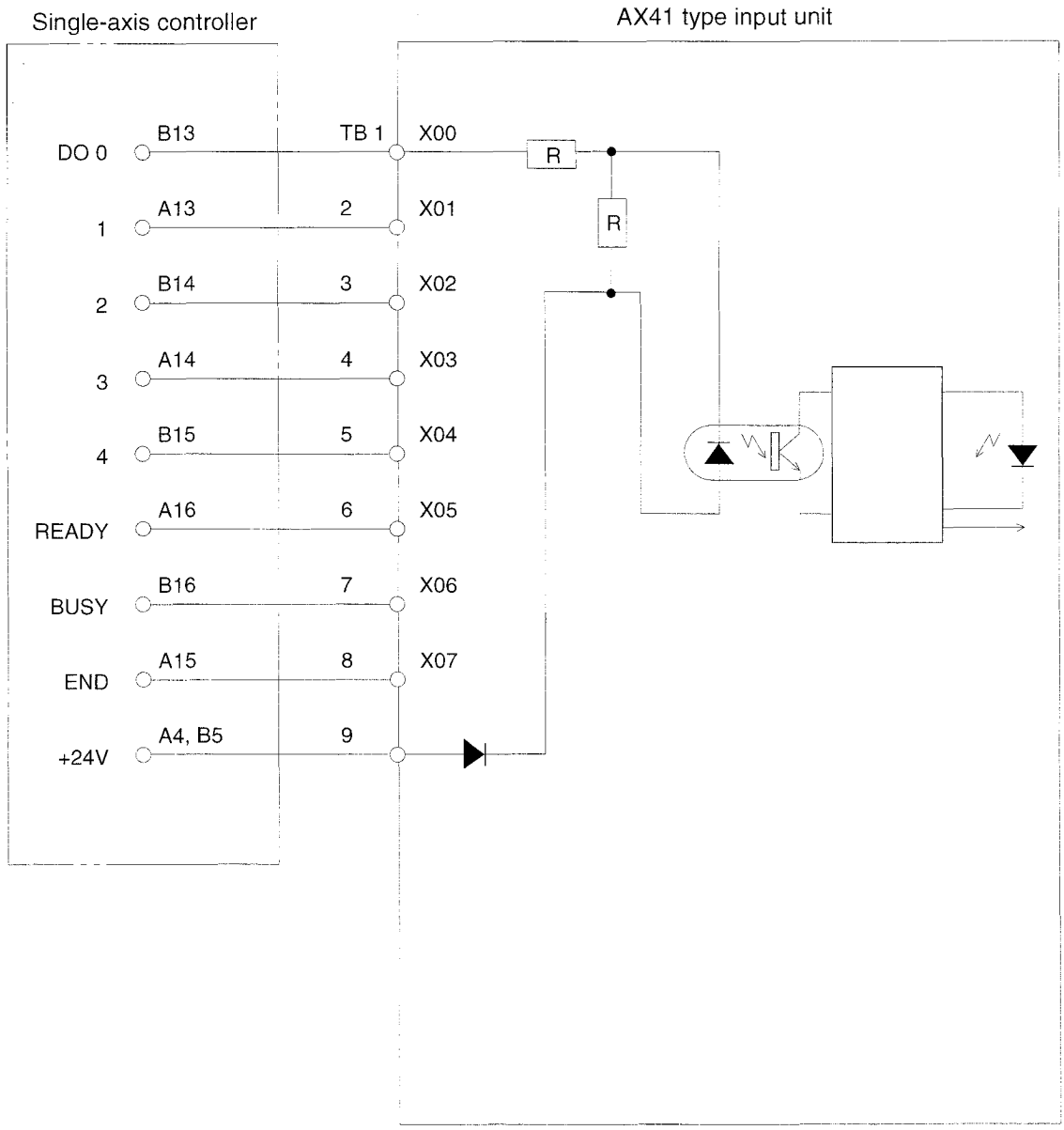
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Fig. 3-5 Connection to the Mitsubishi© PLC Output Unit



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Fig. 3-6 Connection to the Mitsubishi PLC Input Unit



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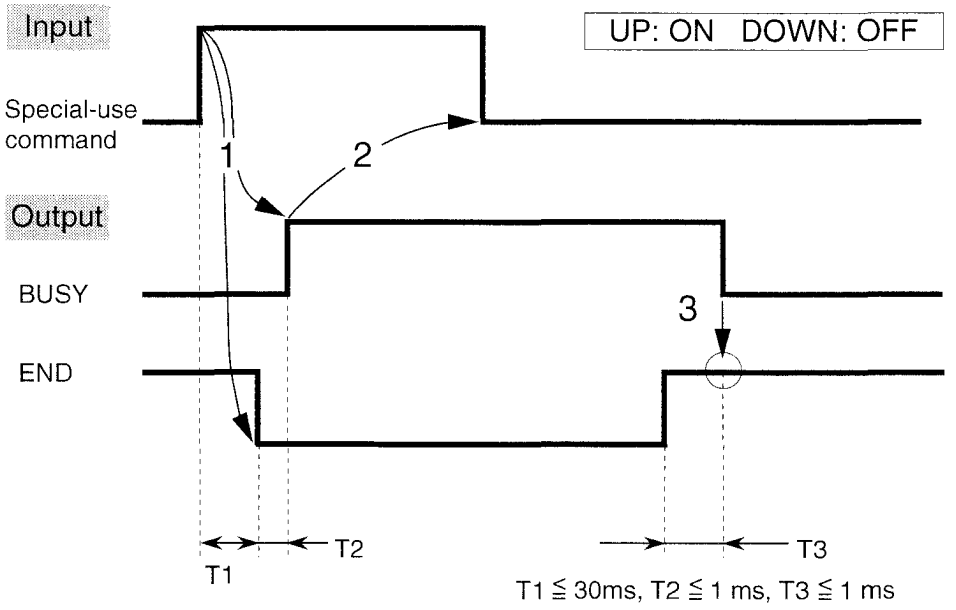
3-5 I/O Circuit Timing Charts

The illustrations below (Figures 3-7 through 3-12) show examples of timing charts.These examples should be referenced when writing PLC programs.

For special-use command processing (Figures 3-7a through 3-7d), excluding the Reset Commands the completion is indicated by the BUSY signal being turned off. If the end of command execution is normal at that point, the END signal is turned on, whereas if execution has not ended normally, the END signal remains off.

When a special-use command with a long execution time is carried out and execution ends normally, the special-use command input is turned off (contact open) and the END signal remains off while the command is being executed (Fig. 3-7a).

Fig. 3-7a Special-Use Command Execution with Long Execution Time (Excluding the Reset Command)



1 At the rise of the special-use command input, the END signal goes off and the BUSY signal goes on.
2 Turn off (contact open) the special-use command input after the BUSY signal goes on.
3 When the BUSY signal is turned off, execution has ended normally if END goes on.

CAUTION

1) With the Auto Run Start command, the END signal goes on and the BUSY signal goes off if the program ends or the STOP instruction is executed.
2) When the power is turned on the END signal goes on after the READY signal turns on.

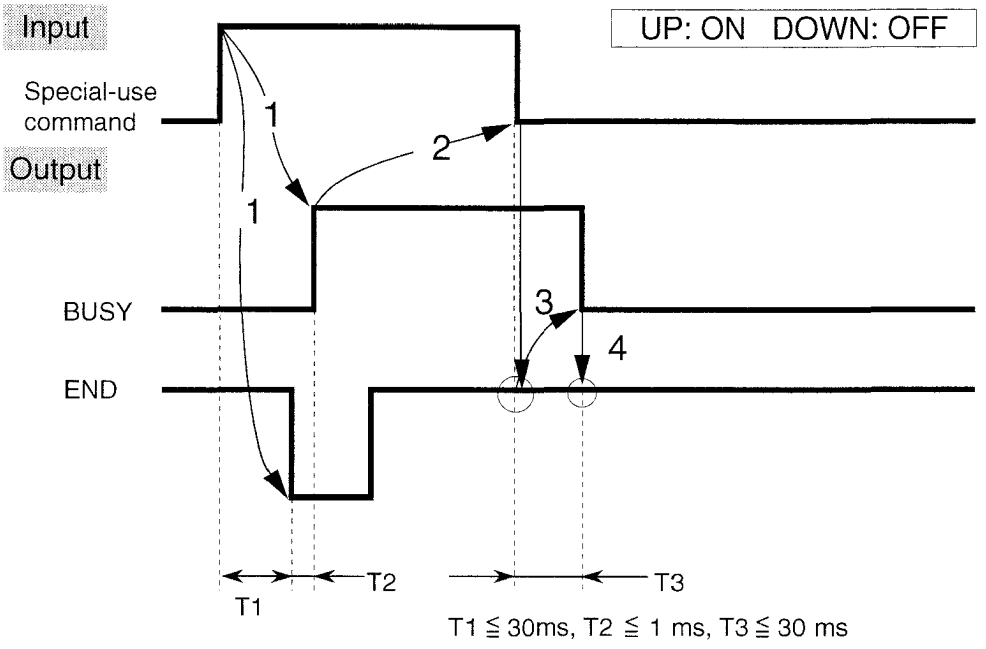
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When a special-use command with a short execution time is run, and execution ends normally, the END signal has already been turned on when the special-use command input goes off (Fig. 3-7b).

Conditions that result in a short execution time are:

- When executing movement commands with an extremely short movement distance
- When carrying out step execution of commands other than MOVA, MOVI, MOVF, TIMR, and WAIT

Figure 3-7b Special-Use Command Execution with Short Execution Time (Excluding the Reset Command)



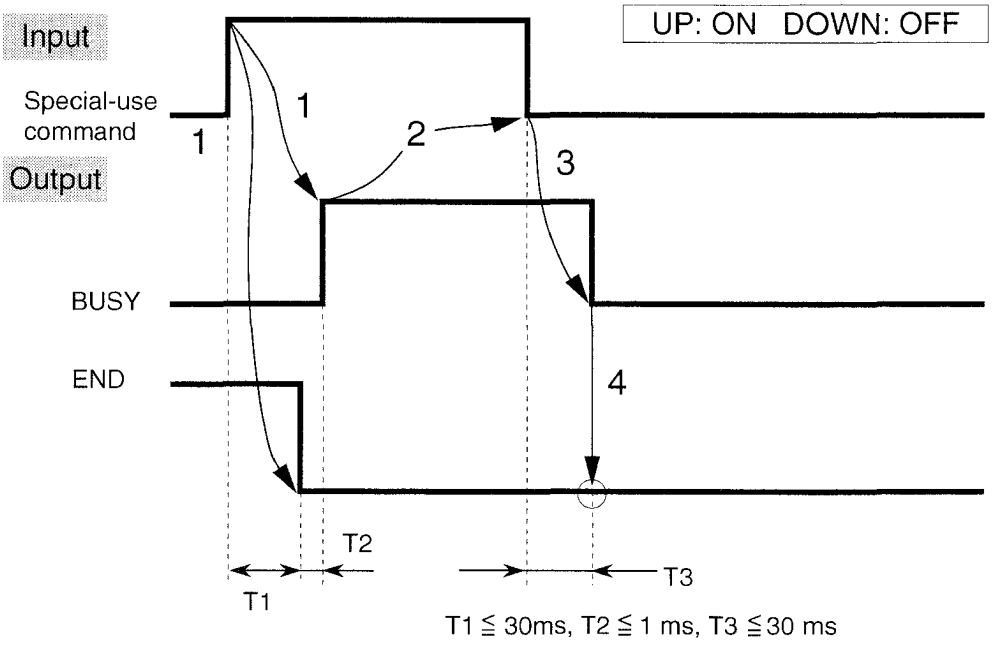
1 At the rise of the special-use command input, the END signal goes off and the BUSY signal goes on.
2 Turn off (contact open) the special-use command input after the BUSY signal goes on.
3 The BUSY signal is turned off at the point where the special-use command input goes off, because the END signal has gone on and command execution has ended.
4 At this point, the END signal is turned on, indicating that execution has ended normally.

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For the reasons listed below, command execution is impossible from the start (See Fig. 3-7c).

- A movement command (AUTO-R, STEP-R, ABS-PT, INC-PT) was executed without a return to origin being completed first.
- A point number was specified for which no data has been registered, and a movement command (AUTO-R, STEP-R, ABS-PT, INC-PT) was executed.
- The operator attempted to run a program that contains no programming code.

Figure 3-7c Failure of the Special-Use Command from the Initiation of the command



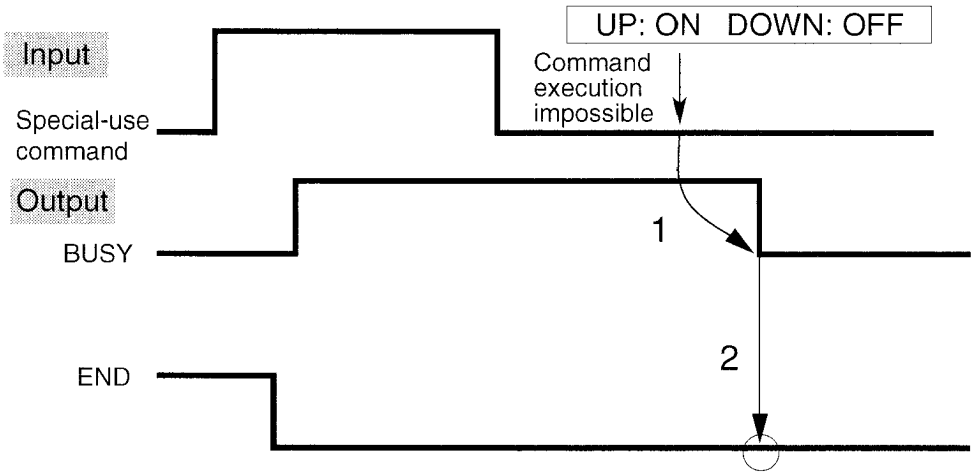
1 At the rise of the special-use command input, the END signal goes off and the BUSY signal goes on.
2 Turn off (contact open) the special-use command input after the BUSY signal goes on.
3 The BUSY signal is turned off at the point where the special-use command input goes off, because command execution was impossible.
4 At this point, the END signal remains off.

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For the reasons listed below, command execution becomes impossible before the command is fully executed (See FIg. 3-7d).

- A jump to an unregistered program is indicated during automatic running.
- A movement command (MOVA, MOVI, MOVF) specifying an unregistered point number is executed during automatic running.

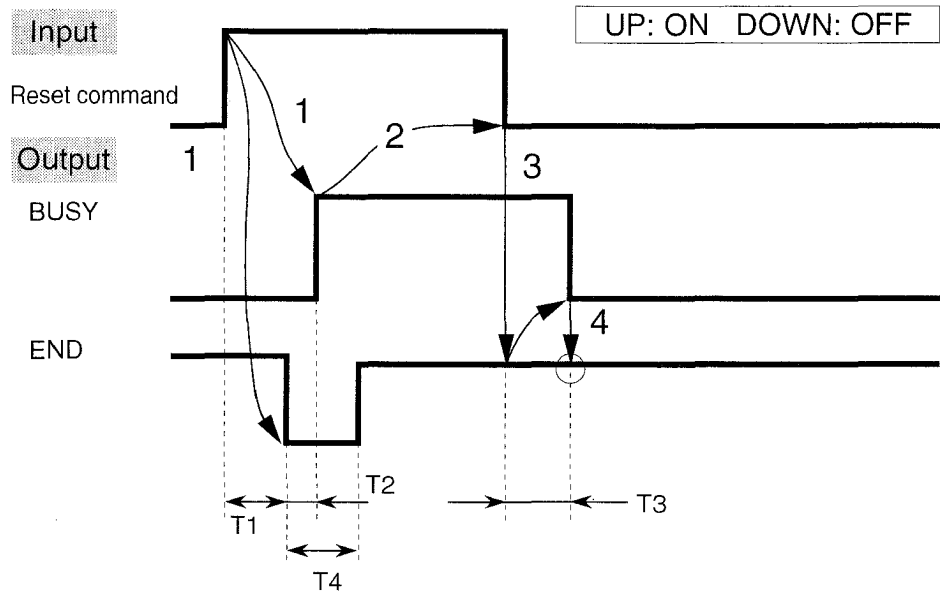
Figure 3-7d Failure of Special-Use Command During Program Execution



1 The BUSY signal is turned off because command execution is no longer possible.
2 At this point, the END signal remains off.

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Figure 3-8 Execution of a Reset Command

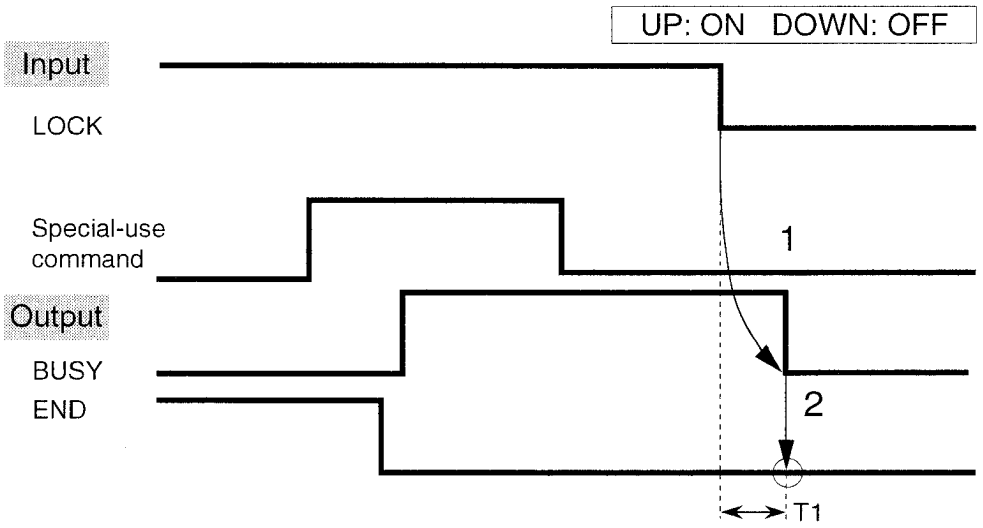


T1 ≦ 30ms, T2 ≦ 1 ms, T3 ≦ 30 ms, T4 ≦ 1 ms

1 At the rise of the RESET signal, the END signal goes off and the BUSY signal goes on.
2 Turn off (contact open) the RESET input after the BUSY signal goes on.
3 The BUSY signal is turned off at the point where the RESET command input goes off, because the END signal has gone on and command execution has ended.
4 At this point, the END signal is turned on, indicating that execution has ended normally.

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Figure 3-9 Interlock (LOCK) signal is received during execution of a Special-Use Command

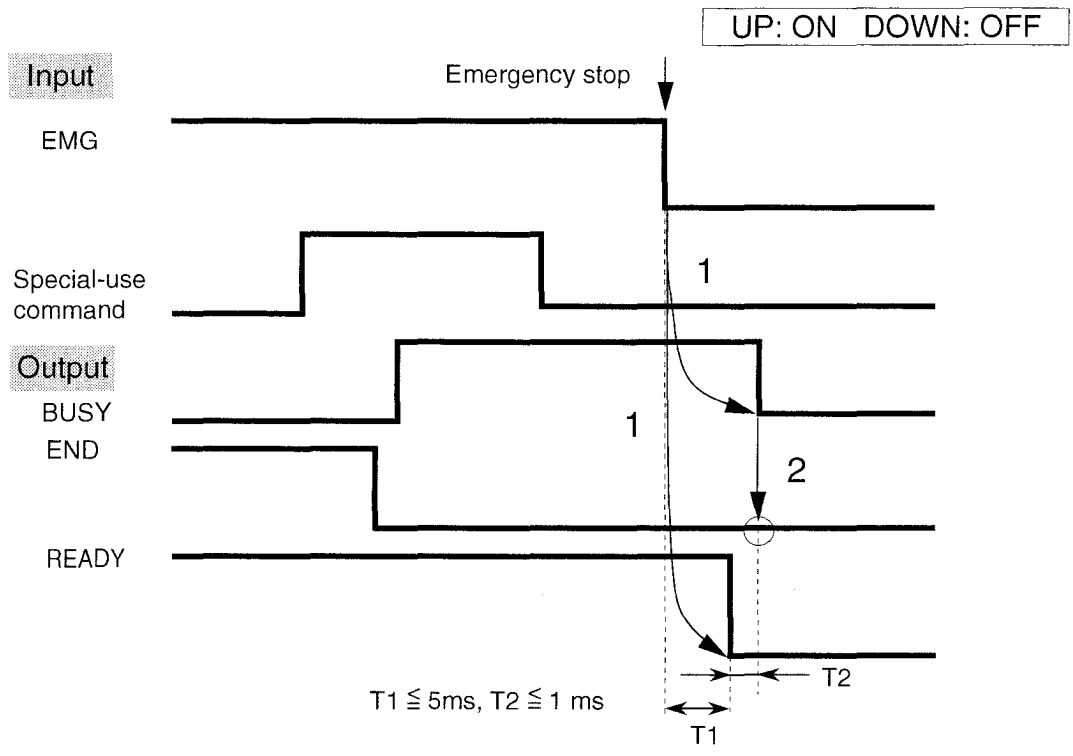


T1 : Differs according to execution command.

1 The BUSY signal is turned off because an interlock signal was received during command execution.
2 At this point, the END signal remains off.

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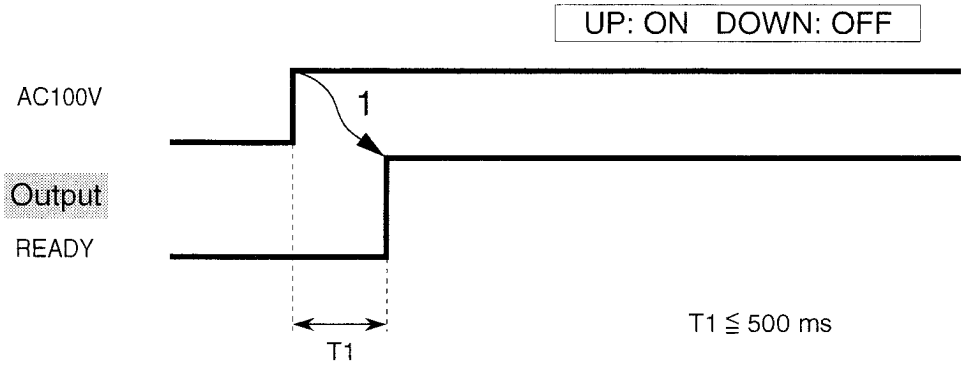
Figure 3-10 An Emergency Stop or Alarm Occurs During Special-Use Command Execution



1 The READY and BUSY signals both go off because an emergency stop (or alarm stop) has been initiated during command execution.
2 At this point, the END signal remains off.

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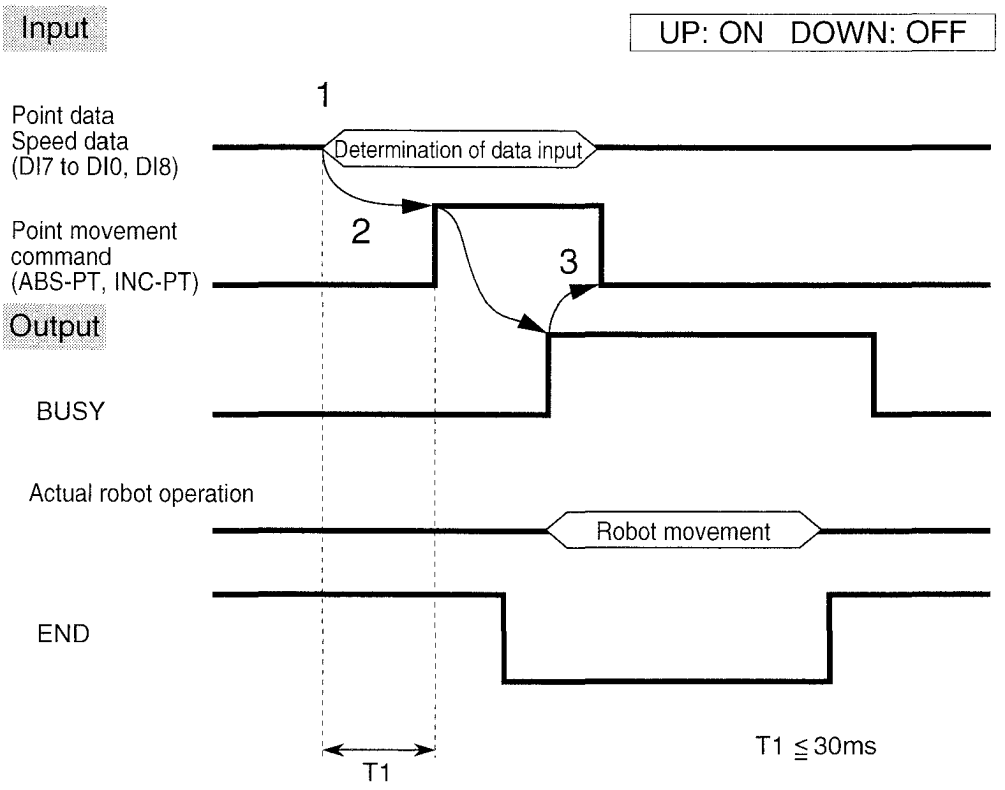
Figure 3-11 When the Power Supply is Turned On



1 When the power supply is turned on, the READY signal should be turned on before special-use commands is input.

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Figure 3-12 When Point Movement Commands Are Being Executed



Among the special-use input commands, point movement commands require that the data input be determined before the command is input.

1 The point data and speed data are set, using the general-use input DI0 to DI8. These input conditions should be kept until the BUSY signal goes on.
2 A delay of 30 ms or longer is introduced, and then the point movement command is input.
3 Turn off (contact open) the point movement command after the BUSY signal goes on. Then the data (DI0 to DI8) can be changed for next movement.

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CHAPTER 4 BASIC OPERATION OF THE DPB

The DPB is a specially designed operation box that is connected to the SRC Controller and used for functions such as the editing and execution of programs.

Operation is handled through a menu-driven interaction with the screen displays, so that even persons using the unit for the first time will find it easy to operate.

This chapter covers the basic operation of the DPB.

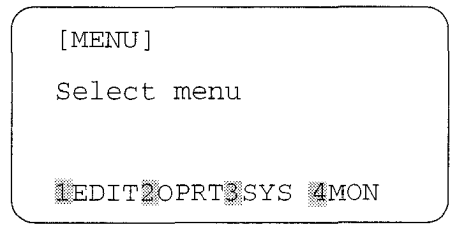
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4-1 Connecting the DPB to the SRC Controller and Detaching It

Items that require special attention when connecting the DPB to the SRC Controller, or detaching it, are listed below.

4-1-1 Connecting the DPB to the SRC Controller

1) When the power supply to the controller is turned off, connect the DPB connector to the connector labelled "DPB" on the front panel of the controller and turn on the power supply switch on the controller. A beep sounds for approximately 1 second and then the screen shown in right appears. This screen will be referred to as the "Initial screen" from this point on.



2) The DPB can also be connected to the SRC Controller if the power supply to the controller is on. In this case, hold down the ESC switch on the front panel of the controller as you plug in the DPB connector. If you forget to hold down the ESC switch while plugging in the connector, an emergency stop of the controller will be initiated and the servo will be turned off. Also, if the DPB is connected while the controller is executing a program, execution will be interrupted regardless of whether or not the ESC switch is held down.

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CAUTION

(1) The power to the controller should be turned off if any of the following messages are displayed on the DPB "PRM DATA DESTROY," "PNT DATA DESTROY," "PGM DATA DESTROY," or "OVER LOAD." Then turn on the power again while holding down the Emergency Stop switch of the DPB. In this state, the servo of the robot remains off, but the initial screen appears on the DPB, so that data initialization can be executed. If the message displayed is "Over Load" the data may have been damaged (see Chapter 11-2, "Handling Alarms.")

(2) If the power is turned on and the message "BATT LOW-VOLTAGE" is displayed on the DPB, turn off the power to the controller. Then turn on the power again while holding down the Emergency Stop switch of the DPB. In this state, the servo of the controller remains off, but the initial screen appears on the DPB, so that backup of the data can be performed. Back up the data, and then replace the lithium battery in the controller (the lithium battery should last five years). (See Chapter 12-3, "Replacing the Battery".)

(3) If the message "SIO ERROR" is displayed on the DPB, check whether the I/O special-use command input is on. If the special-use command input is on, the DPB cannot be used, so always set the special-use input to a pulse input (turn the special-use input off when busy turns on.)
(Refer to section 3-2 Description of the I/O Signals.)

(4) To connect the DPB directly to the SRC Controller, use the connector provided as an accessory. Do not alter the cable in any way or connect any relay units to it.

4-1-2 Detaching the DPB From the SRC Controller

Always hold down the ESC switch on the front panel of the controller if you are going to unplug the DPB while the controller is operating. Failing to hold down the ESC switch will initiate an emergency stop in the controller and turn off the servo.

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4-2 Basic Operation

This Chapter describes the basic operational procedures when using the DPB.

4-2-1 Key Layout and Functions

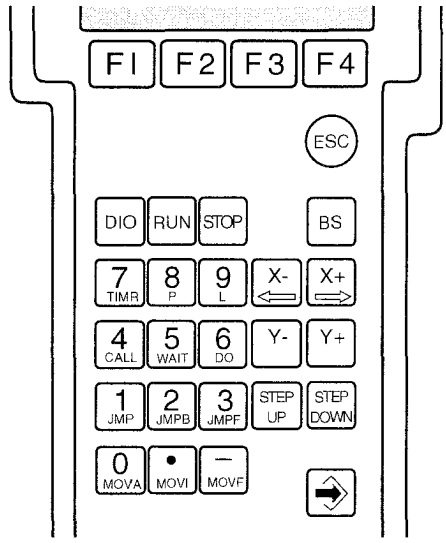


Figure 4-1 Key Layout

F1 to F4

These keys select the modes.
The currently selectable modes are shown on the 4th line of DPB liquid crystal display.

ESC

This key returns operation to the previous mode.
This key also performs error reset when an error occurs.

DIO

This key monitors DI and DO status for OPRT and EDIT modes.

RUN

This key starts program execution.

STOP

This key halts program execution.

BS

This key cancels the immediately prior, numerical key entry.

0 MOVA to 9 L , • MOVI , — MOVF

These keys are for data entry (numerical key). They are also used during program editing and for selecting robot instructions.

X+ , X-

These keys move the robot manually. They are also used during program editing and for moving the cursor left and right.

Y+ , Y-

Not used.

STEP UP , STEP DOWN

These keys scroll the screen up and down.

→

Enter key.

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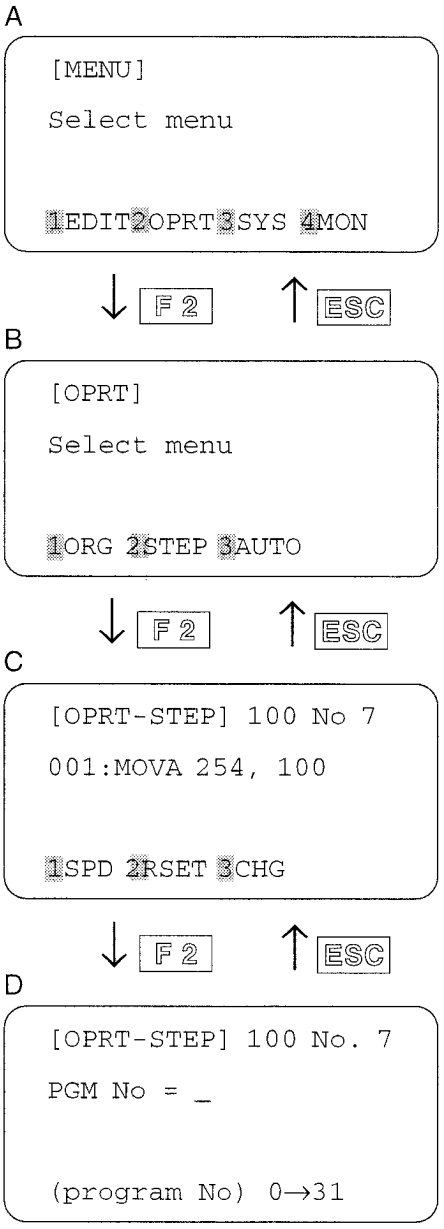
4-2-2 Basic Key Operation

1) The selection of modes is displayed on the 4th line of the liquid crystal display on the DPB.
In Example A (showing the initial screen), the following modes can be selected:

1 EDIT
2 OPRT
3 SYS
4 MON

The numbers listed in front of the modes correspond to function keys [F1] to [F4].

2) Each time one of the function keys on the screen shown in A is pressed, the next deepest level is accessed (A →B→ C→ D).
To return to the previous level, press the ESC key.
(See Figure 4-2, "Branching Menu Diagram".)



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3) If an error occurs during operation, a buzzer will sound for approximately 1 second and a message as that shown in Example E will appear on the 3rd line of the screen. If this happens, check the contents of the message and then press the ESC key to continue operation. To take care of errors, please refer to the message tables in Chapter 10.

E

```
[OPRT-AUTO]

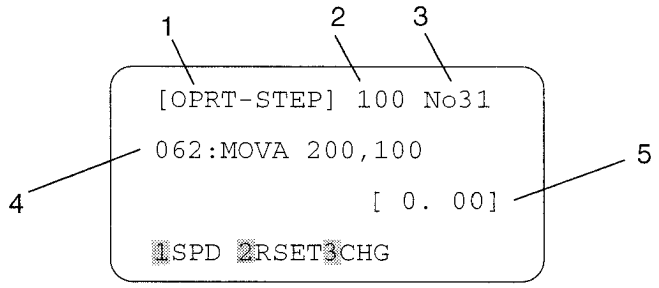

32:origin incomplete
```

4) If an alarm occurs on the controller side during operation, an alarm message will be displayed on the 3rd line of the screen, and further operation will be inhibited. Turn off the power and take steps to solve the problem, referring to Chapter 11-2, "Handling Alarms."

```
[OPRT-AUTO]
running...
01:OVER LOAD
```

4-2-3 Reading the Screen

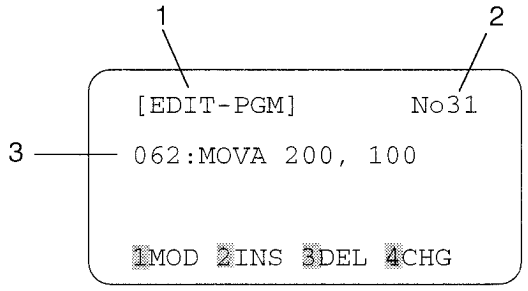
1) Program execution screen



1. Mode
2. Execution speed
3. No. of program being executed
4. Step no. being executed
5. Current position

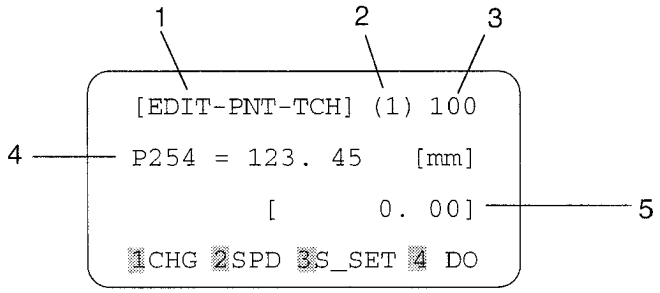
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2) Program edit screen



1. Mode
2. No. of program being edited
3. No. of step being edited

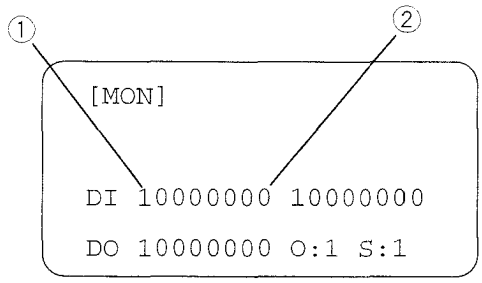
3) Point edit screen (teaching playback)



1. Mode
2. Type of movement parameter
3. Movement parameter
4. Point no.
5. Current position

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4) DIO monitor screen



DI: From left side
- General-use input 7 ①
- General-use input 6
- General-use input 5
- General-use input 4
- General-use input 3
- General-use input 2
- General-use input 1
- General-use input 0 ②

Interlock (LOCK)
- 0: Locked state (robot movement not possible)
- 1: Unlocked state (robot movement possible)

Return to Origin Command (ORG-S)
Reset Command (RESET)
Automatic Run Start Command (AUTO-R)
Step Run Start Command (STEP-R)
Point movement command with absolute (ABS-PT)
Point movement command with incremental (INC-PT)
General-use input 8

DO: From left side
- READY
- BUSY
- END
- General-use output 4
- General-use output 3
- General-use output 2
- General-use output 1
- General-use output 0

O: Origin sensor status
- 0: Off (Closed)
- 1: On (Open)

S: Servo status
- 0: Servo off
- 1: Servo on

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4-2-4 Branching Menu Diagram

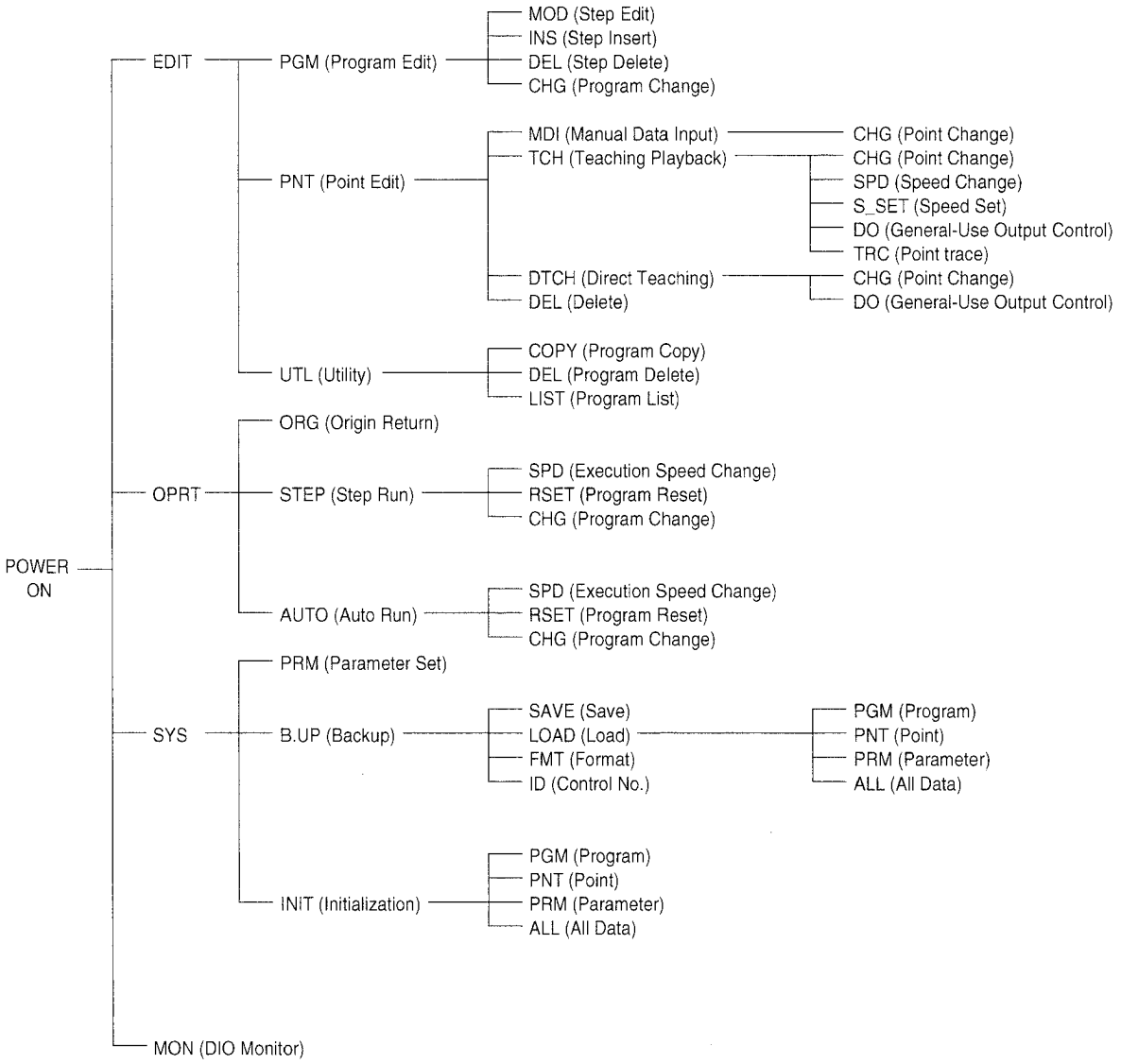


Fig. 4-2 Branching Menu Diagram

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MEMO

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CHAPTER 5

PARAMETERS

The SRC Controller uses a software servo system, so that no adjustments of hardware components such as potentiometers or DIP switches are required. Instead, parameters are used whose settings can be easily changed, using the DPB (or a personal computer).

This chapter contains a detailed description of each of the parameters, and explains how to use the DPB to change and specify parameter settings.

SAFETY

Errors such as motor overload are detected by the software, so the controller parameters must be set correctly to match the connected robot model. The parameters are initialized to match the robot when the robot is shipped, so confirm these before starting use. If there is any trouble, please contact your Distributor or YAMAHA ROBOTICS.

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5-1 Description of Parameters

The 37 parameters are described in order below.

PRM 0: Robot Type

The type of robot being used is indicated by a robot initialization number. (See Chapter 13 Tables 13-2 and 13-4.)
This is the one parameter that can be only read and not written. To change the robot type or when the memory has been destroyed for any reason, this parameter must be initialized. (See Chapter 8-1 "Initialization".)

PRM 1: (+) soft limit

The + side robot movement range is set.
Set a suitable number for safety purposes.
Input range: -9999 to 9999 (mm)
or -360 to 360(°)
Default value: Depends on robot type.

PRM 2: (-) soft limit

The - side robot movement range is set.
Set a suitable number for safety purposes.
Input range: -9999 to 9999 (mm)
or -360 to 360(°)
Default value: Depends on robot type.

CAUTION

The soft limit will not function if the origin return has not been completed.

PRM 3: Transport weight

Input the workpiece weight plus the tool weight.
Input range: 0 to 80 (kg)
Default value: Maximum transfer weight of that robot

NOTE

Always set the correct weight for safety purposes. If the setting is not correct, the robot and controller may malfunction.

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PRM 4: Acceleration

The optimum acceleration will be automatically set according to the robot type and end weight. Change this parameter when the acceleration is to be decreased beyond this state.
Input range: 1 to 100 (%)
Default value: 100

PRM 5: Origin return direction

When this parameter is set to 0, the return to origin is performed on the motor side.
When the parameter is 1, the return to origin is performed on the side opposite the motor.

PRM 6: Positioning completed pulse

When an axis movement command is executed, this parameter specifies the number of pulses at which positioning should end before reaching the target position. Thus allowing execution of the command.
Input range: 1 to 4000 (pulses)
Default value: 20

PRM 7: Point trace speed

Input range: 0 to 100 (%)
Default value: 30

(1) When point trace speed is 1 to 100%
PRM 7 sets the movement speed when general-use input 8 is on and a point trace is executed.
* The actual speed will be the value obtained by multiplying the execution speed displayed in the AUTO or STEP mode (see 4-2-3 Reading the Screen).

Example: When the execution speed display in the AUTO or STEP mode is 50 and this parameter is set to 30, the actual speed will be 3000rpm x 50/100 x 30/100 = 450rpm.

(2) When point trace speed is 0% (Speed change with the DPB is available for DPB ROM V1.15 or later version)
The number of inputs that specify the point trace speed is 2 (general-purpose inputs 7 and 8). (General-purpose inputs 0 to 6 are used to specify each point.) At this time, the point trace speed applies to the parameter data settings shown in the table below.

DI8	DI7	Movement speed (%)
OFF	OFF	100
OFF	ON	PRM41
ON	OFF	PRM42
ON	ON	PRM43

PRM 8: No. of conditional input points

When the robot language JMPF instruction is executed, this indicates the number of effective points for the No. 3 data conditional input (i.e., PRM 8 = 4, the status of DI4 to DI8 is ignored.)
Input range: 1 to 8 (points)
Default value: 4

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PRM 9: MOVF speed
This sets the speed for execution of the program language MOVF command.
Input range: 1 to 1000 (mm/sec)
Default value: 10

PRM 10: Return to origin speed
Input range: 1 to 100 (mm/sec)
Default value: 20

CAUTION

If the origin returns speed is increased, an alarm may occur at the origin return depending on the robot. Keep the initial state when possible.

Parameters PRM 11 through PRM 43 are set automatically for each robot type when parameter initialization is carried out. Normally the settings do not need to be changed and they are not displayed on the DPB LCD. (However, this excludes PRM20: OUT valid position, PRM 22: Message type and PRM 35: Origin shift.) When making changes for special reasons, press ESC on the DPB or turn the controller power switch ON. With normal operations, the following parameters can be changed.

CAUTION

The robot or controller may malfunction or the safety of the robot movement may be adversely affected if some of these parameters are changed carelessly. Should changes in these parameters be required, please call your Distributor or YAMAHA ROBOTICS.

PRM 11: No. of encoder pulses (after being multiplied four times)
This varies depending on the robot type.
Unit: pulses/rev

PRM 12: Lead length
This varies depending on the robot type.
Unit: 0.01mm (FROP is 0.01deg.)

PRM 13: Origin return method
This varies depending on the robot type.
0: Sensor detection method
1: Stroke end detection method

PRM 14: Overload current
This varies depending on the robot type.

PRM 15: Overload time
This varies depending on the robot type.

PRM 16: Current limit
This varies depending on the robot type.

PRM 17: Speed ratio gain
This varies depending on the robot type.

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PRM 18: Speed integration gain
This varies depending on the robot type.

PRM 19: Position ratio gain
This varies depending on the robot type.

PRM 20: OUT valid position
When executing the axis movement command, this parameter indicates whether to regard the command as completed several millimeters (degrees) before the target position. Thus, the next command can be executed before the moving axis enters the positioning completed pulse. (DO command, etc.) However, if the next command is an axis movement command, it cannot be executed until the moving axis enters the positioning completed pulse (PRM 6).
If the position completion range is larger than the OUT valid position range, the axis will not be regarded as having entered the positioning completed pulse range until it reaches the OUT valid position.
Input range: 1 to 9999 (mm)
1 to 360 (°)
Default value: 1

PRM 21: Switching between millimeters/degrees
0: Millimeters
1: Degrees

PRM 22: Switching between English/Japanese
Set the language for the response messages displayed on the DPB and RS-232C.
0: English
1: Japanese

PRM 23: Acceleration coefficient depending on transport weight
The value calculated from PRM 0 and PRM 3 is set for this parameter.

PRM 24: Teaching frequency data (DPB entry)

PRM 25: Not used

PRM 26: Teaching movement data
Unit: %
Default value: 100

PRM 27: Teaching movement data 1 (for DPB)
Unit: %
Default value: 100

PRM 28: Teaching movement data 2 (for DPB)
Unit: %
Default value: 50

PRM 29: Teaching movement data 3 (for DPB)
Unit: %
Default value: 10

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PRM 30: Maximum program speed

Unit: %

Default value: 100

The speed data defined by the MOVA or MOVI instruction in the program is multiplied by this value to determine the maximum speed when the robot is actually moving. This is then used to lower the speed of the overall program. Any speed changes in the AUTO and STEP modes will also change this value when using the DPB.

$$\text{Max. speed (\%)} = \frac{\text{No. 2 data (\%) of MOVA command x PRM 30}}{100} \quad (\%)$$

Table 5-2 provides the maximum and minimum speed for each robot. If the maximum speed during movement is 100%, each robot will move at the maximum speed shown below. The minimum value shown below is the minimum speed that can be controlled. Thus, the minimum speed or lower limit value of the maximum speed is 0.1% for BS and FT type and is 0.05% for all other types.
The unit is deg/sec for FROP and mm/sec for all other types

Table 5-2 Maximum and Minimum Program Speed

	BS	FT/FTV	FS/FSV	LTI/LSI	BFS	BLS II	FROP
Max. value	1800	600	400	500	1200	1200	225
Min. value	1.8	0.6	0.2	0.25	1.2	0.5	0.1125

	Other horizontal types	Other vertical types
Max. value	1000	500
Min. value	0.5	0.25

The unit is deg/sec for FROP and mm/sec for all other types

PRM 31: Broken wire detection level

This parameter sets the sensitivity for detecting a broken wire. The upper limit is 255, and the larger the value is the duller the sensitivity will be.

Input range: 0 to 255

Default value: 0

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PRM 32: Alarm no. output selection (corresponds to ROM versions V1.08 and subsequent versions)
0: No output
1: Output
Default value: 0

When an alarm is issued, PRM 32 selects whether the alarm number is to be output to the general-use output. The alarm number is output as 5-bit binary data, to DO0 to DO4.

Table 5-3 Alarm Number Output Selection

Alarm No.	Alarm Message	DO4	D03	DO2	DO1	DO0
01	OVERLOAD	0	0	0	0	1
02	OVERCURRENT	0	0	0	1	0
03	OVERHEAT	0	0	0	1	1
04	POWER DOWN	0	0	1	0	0
05	BATT. LOW VOLTAGE	0	0	1	0	0
06	WIRE TROUBLE	0	0	1	1	0
07	P.E. COUNTER OVER	0	0	1	1	1
08	PNT DATA DESTROY	0	1	0	0	0
09	PRM DATA DESTROY	0	1	0	0	1
10	PGM DATA DESTROY	0	1	0	0	0
11	SYSTEM FAULT	0	1	0	1	1
12	NOT USED	0	1	1	0	0
13	NOT USED	0	1	1	0	1
14	FEEDBACK ERROR 1	0	1	1	1	0
15	FEEDBACK ERROR 2	0	1	1	1	1
16	ABNORMAL VOLTAGE	1	0	0	0	0
17	SYSTEM FAULT 2	1	0	0	0	1

PRM 33: Origin return completed output selection
(corresponds to ROM versions V1.11 and subsequent versions)
Selects the operation to be executed simultaneously with the completion of origin return. A signal can be output to the general-use output indicating that return to origin has been completed, or the program can be reset.
Input range: 0 to 3
Definition: 0: Nothing is executed
1: DO4 is turned on
2: Program reset is executed
3: DO4 turns on after program reset
Default value: 0
* If program reset is executed after origin return, or if DO4 is executed with the program command, DO4 will turn off even in the origin reset completed state.

PRM 34: Not used

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PRM 35: Origin shift
The current position will be set to this value when origin return is completed.
Input range: -9999 to 9999 (0.01mm)
or -360 to 360 (0.01°)
Default value: 0

PRM 36: Broken wire resistance
This varies depending on the robot type.

PRM 37: QP band width
Pulse width that compensates the frictional resistivity during deceleeration.
Input range : 100 to 1000

PRM38: Speed delay compensation gain
This differs according to the robot type.

PRM39: No. of motor poles
This differs according to the motor.

PRM40: RESET execution conditions selection
When the I/O RESET dedicated command is executed, the validity of the LOCK input can be selected.
The I/O RESET input uses both the servo ON and program reset. If the parameter is 0, the program will always be reset regardless of the LOCK input state. If the parameter is set to 1, resetting of the program can be prohibited according to the LOCK input state.
Thus, by setting the parameter to 1, the program can be executed from midway even after an emergency stop is reset. Refer to the RESET command in the section 3-2-1 "Input signals" for details.
Input range: 0 to 1
Meaning: 0: LOCK invalid
1: LOCK valid
Default value: 0

PRM41: Point trace speed 1
This is valid only when PRM7=0.
Input range : 1 to 100 (%)
Initial value : 10

PRM42: Point trace speed 2
This is valid only when PRM7=0.
Input range : 1 to 100 (%)
Initial value : 30

PRM43: Point trace speed 3
This is valid only when PRM7=0.
Input range : 1 to 100 (%)
Initial value : 70

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5-2 Setting Parameters Used by the DPB

1) Press [F3] (SYS) on the initial screen.

```
[MENU]
Select menu

1EDIT 2OPRT 3SYS  4MON
```

2) Then press [F1] (PRM).

```
[SYS]
Select menu

1PRM 2B. UP 3INIT 4PRNT
```

3) The current setting for PRM 0 (robot type) is displayed on the screen.
Use the [STEP UP] and [STEP DOWN] keys to scroll the parameters until you find the setting you want to change.

```
[SYS-PRM]
PRM0 = 10
Robot type
read only
```

4) When the desired parameter is displayed, use the numerical keys to input the new value and then press [→].

```
[SYS-PRM]
PRM1 = 450_ [mm]
(+)Soft limit
range -9999→9999mm
```

5) If processing ends normally, the screen shown in Step 3 is displayed.

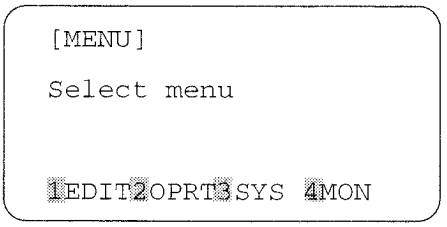
```
[SYS-PRM]
PRM1 = 450 [mm]
(+)Soft limit
range -9999→9999mm
```


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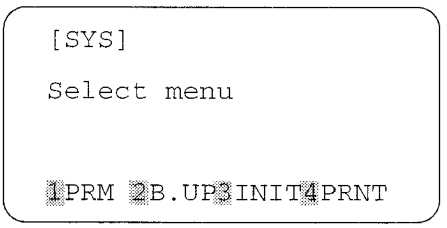
5-3 Japanese / English Display Switching

The DPB display switches to English immediately after parameters are set to default values. The following describes procedure from switching between the English-Japanese displays for DPB messages.

1) Press [F3] (SYS) on the initial screen.

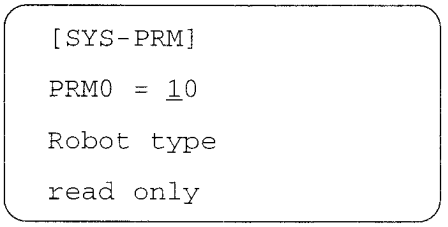


2) Then press [F1] (PRM).

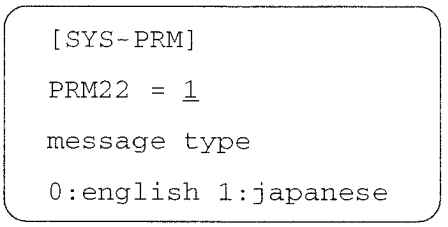


3) The current setting for the PRM 0 (robot type) is displayed on the screen.

Pressing [STEP UP] scrolls the screen and PRM22 is displayed.



4) Input data with the numerical keys and when finished press the [→] key. Input 0 for English and 1 for Japanese display. The display is normally in English only for the PRM22 display.



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CHAPTER 6

PROGRAMMING

In this chapter, we will try programming some operations. First, you will learn how to input a program using the DPB programming device. Then we will explain the commands used in the robot language and what they mean. The SRC Controller uses a simple robot language developed by YAMAHA, so that it is easy to write programs.

At the beginning of the chapter, you will find a convenient table (Table 6-1) of robot language instructions. At the end of the chapter there is a sample program that can be used as a reference.

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6-1 Basic Contents

6-1-1 Table of Robot Language Instructions

Instruction	Description and Format
MOVA	Moves to point data position. MOVA <point no.>, <max. speed>
MOVI	Moves from current position by amount of point data. MOVI <point no.>, <max. speed>
MOVF	Moves until specified DI input is received. MOVF <point no.>, <DI no.>, <parameter>
JMP	Jumps to a specified label in a specified program. JMP <label no.>, <program no.>
JMPB	Depending on the ON/OFF status of the specified input, jump is executed to the specified label. JMPB <label no.>, <DI no.>, <1 or 0>
JMPF	Depending on an input condition, jumps to a specified label in a specified program. JMPF <label no.>, <program no.>, <input condition>
L	Defines the destination for a JMP or JMPF instruction. L <label no.>
CALL	Executes a separate program. CALL <program no.>, <no. of times>
DO	Turns general-use output on and off. DO <DO no.>, <parameter>
WAIT	Waits until specified DI input is received. WAIT <DI no.>, <parameter>
TIMR	Waits the specified amount of time before advancing to the next step. TIMR <time>
P	Defines a point variable. P <point no.>
P+	Increments a point variable. P+
P-	Decrements a point variable. P-
SRVO	Turns a servo on and off. SRVO <parameter (0 or 1)>
STOP	Temporarily interrupts program execution. STOP
ORGN	Executes return to origin. ORGN

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6-1-2 Robot Instructions and Point Data

The SRC Controller uses a command language very similar to BASIC, so that it is very easy to create program. With these robot instructions, data relating to the position of the robot (absolute position, amount of movement) is not expressed in terms of direct numeric values in the program. Instead, point numbers are used to express information indirectly. Data concerning the point numbers and the positions corresponding to them are stored separately from the program, as point data. Therefore, changing a position in a program can be done simply by editing the point data, without rewriting the program.

Example

Program	Point Data
005 MOVA 0, 100	P0 = 50
006 MOVI 1, 50	P1 = 100

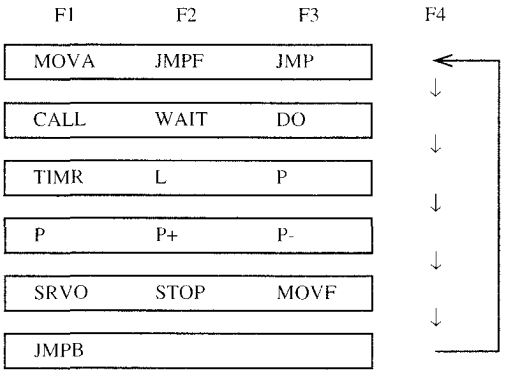
In the above example, the robot first moves to a position 50 mm from the origin point, and then moves to another point 100 mm away from that one.

6-1-3 DPB and Robot Instructions

In the DPB, 2 methods are available for selecting robot instructions during program editing.

1. Selecting with the function key

During program editing when the screen displays the robot language selection, the lowest level of the liquid crystal display shows the robot command. Three commands are shown on one display and each one can be selected with the matching function keys F1 to F3. When F4 is pressed the next commands are displayed.



2. Selecting with the numerical keys

Frequently used robot commands are printed on the lower part of the numerical keys. Pressing the numerical key during the robot language selection display selects the robot command for that key.



Fig. 6-1 Selection of Robot Instructions using the DPB

6-1-4 Memory Capacity

The SRC Controller has the following memory capacity:

Total no. of programs:	32
Max. no. of steps per program:	255
Max. no. of steps in all programs together:	1024
Max. no. of points:	255

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6-2 Editing Programs

"Program editing" refers to operations such as creating a program after initializing the values, creating new programs, changing an existing program, and deleting or copying a program. In this section, you will learn the basic components of program editing using the DPB.

"Creating a new program following initialization" refers to creating a program for the first time after purchasing the equipment, and after initializing all values, before any programs have been created (see Chapter 8-1, "Initialization.").

"Creating a new program" is completed when at least one program has already been created and you are creating or editing another new program.

"Editing an existing program" means correcting, adding, deleting, or inserting steps in a program to change only part of it.

In this chapter, in addition to describing all of the above program editing functions, we will explain how to determine the number of steps left in a program, as well as other information.

6-2-1	Creating Programs After Initialization	6-5
6-2-2	Creating a New Program	6-6
6-2-3	Correcting a Step	6-8
6-2-4	Adding a Step	6-10
6-2-5	Deleting a Step	6-11
6-2-6	Inserting a Step	6-12
6-2-7	Copying a Program	6-13
6-2-8	Deleting a Program	6-14
6-2-9	Viewing the Program Information	6-15

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6-2-1 Creating Programs After Initialization

1) On the initial screen, press the [F1] (EDIT) key.

```
[MENU]
Select menu

1EDIT 2OPRT 3SYS 4MON
```

2) Next press the [F1] (PGM) key.

```
[SYS]
Select menu

1PGM 2PNT 3UTL
```

3) No programs have been created following the initialization, so an error message is displayed on the screen.

```
[EDIT]
Select menu
43:cannot find PGM
1PGM 2PNT 3UTL
```

4) Press the [ESC] key to reset the error. Program No. 0 is selected automatically and a confirmation message is displayed. To select Program No. 0 and proceed with editing, press [F1] (YES). To select a program other than No. 0 and edit it, press [F2] (NO).

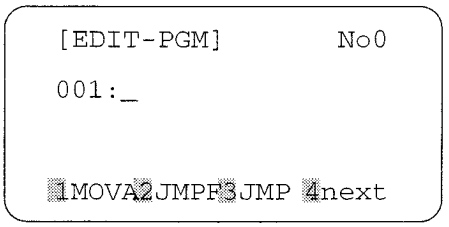
```
[EDIT]
PGM No = 0
New entry OK ?
1yes 2no
```

5) If you selected [F2] in Step 4, input the number of the program to be edited, using the numerical keys, and press the → key. The screen returns to that shown in Step 4. If the program number is the correct one, press [F1] (YES).

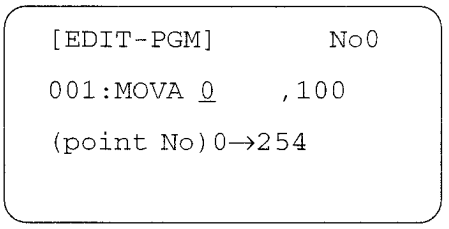
```
[EDIT-PGM]
PGM No = _
(Program No) 0→31
```


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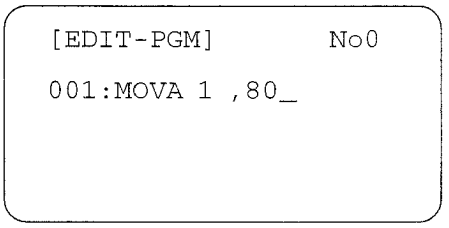
6) Use [F1] to [F3] to select the robot instructions.
When [F4] (NEXT) is pressed, the displayed robot instructions are switched to the next display.
When the [ESC] key is pressed, the display switches back to the previous screen.



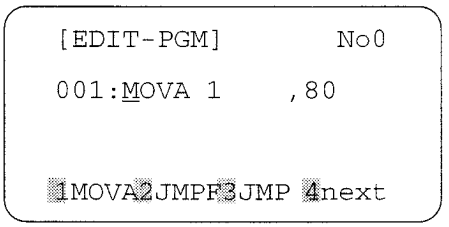
7) When F1 (MOVA) is selected the cursor moves to Command Data 1.
Use the numerical keys to input the data.
(Do not press the → key yet.)
Use the [X-] and [X+] keys to move the cursor and input different command data.



8) When all of the command data has been entered, press the → key.



9) If the input process is completed normally, the cursor moves to the robot instructions.
To edit the next step, press [STEP UP] and scroll the steps. Then repeat the process from Step 6.



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6-2-2 Creating a New Program

1) On the initial screen, press the [F1] (EDIT) key.

```
[MENU]
Select menu

1EDIT2OPRT3SYS 4MON
```

2) Next press the [F1] (PGM) key.

```
[EDIT]
Select menu

1PGM 2PNT 3UTL
```

3) The program number and last step executed are displayed on the screen. Press [F4] (CHG).
(For instructions on how to interpret the editing screen, see Chapter 4-2-3.)

```
[EDIT-PGM]        No.13
017:MOVA 254, 100

1MOD 2INS 3DEL 4CHG
```

4) Input the new program number with the numerical keys and press the [→] key.

```
[EDIT-PGM]
PGM No = _
(Program No) 0→31
```

5) A confirmation message is displayed. If the program number is correct, press [F1] (YES).

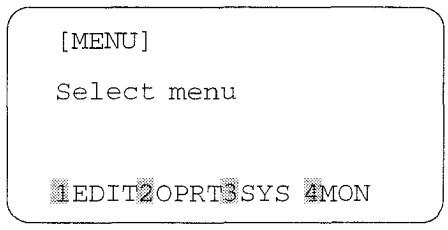
```
[EDIT]
PGM No = 14
New entry OK ?
1yes 2no
```

6) Proceed with program editing, starting with Step 6 in "6-2-1 Creating Programs After Initialization."

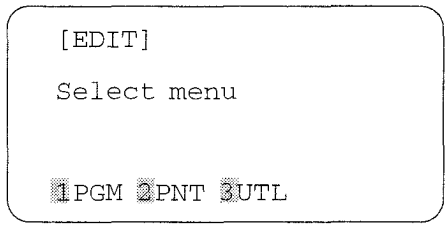
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6-2-3 Correcting a Step

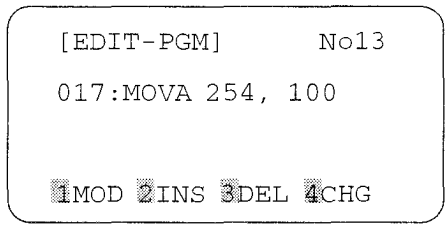
1) On the initial screen, press the [F1] (EDIT) key.



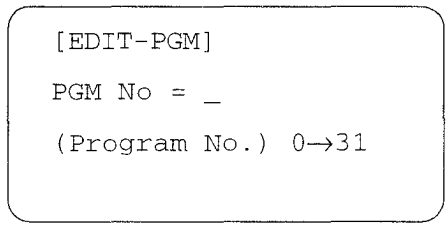
2) Next press the [F1] (PGM) key.



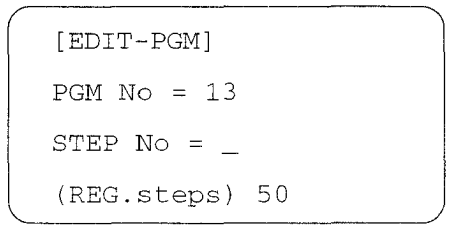
3) The program number and last step executed are displayed on the screen. If the program to be edited is different, press [F4] (CHG).
If the displayed program is the one you want to edit, proceed with editing beginning at Step 6.



4) Input the number of the program to be edited with the numerical keys and press the → key.



5) Input the number of the step to be edited with the numerical keys and press the → key.



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6) Press [F1] (MOD).

```
[EDIT-PGM]        No13
017:MOVA 254, 100


1MOD 2INS 3DEL 4CHG
```

7) Select the robot instruction, using the [F1] to [F3] keys.
Pressing [F4] (next) will display the next screen of robot instructions.
When the [ESC] key is pressed, the display switches back to the previous screen.
If the robot instruction is not to be changed, press the [X+].

```
[EDIT-PGM]        No13
017:MOVA 254,100


1MOVA2JMPF3JMP 4next
```

8) The cursor moves to command data 1. Use the numerical keys to input a value. (Do not press the [→] key yet.)
Press the [X-] and [X+] keys to move the cursor and correct other command data.

```
[EDIT-PGM]        No13
017:JMPF 0 , 13 ,1
(labelNo)0→255
```

9) When all of the desired changes have been made to the command data, press the [→] key.

```
[EDIT-PGM]        No13
017: JMPF 10, 31, 5_
(condition) 0→255
```

10) If the editing process has been completed normally, the cursor moves to the robot instructions. To edit another step, use the [STEP UP] and [STEP DOWN] keys to scroll the steps, and repeat the process starting with Step 6.

```
[EDIT-PGM]        No13
017:JMPF 10, 31, 5


1MOVA2JMPF3JMP 4next
```


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6-2-4 Adding a Step

1) The process for adding a step is the same as that for "6-2-3 Correcting a Step," up to Step 4.

2) Input the last step number with the numerical keys and press the ➡ key.

```
[EDIT-PGM]
PGM No = 13
STEP No = _
(REG.steps) 50
```

3) Press the STEP UP key.

```
[EDIT-PGM]       No13
050:WAIT 3 , 1

1MOD 2INS 3DEL 4CHG
```

4) Continue the process, starting with Step 7 of "6-2-3 Correcting a Step."

```
[EDIT-PGM]       No13
051:_

1MOVA2JMPF3JMP 4next
```


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6-2-5 Deleting a Step

1) The process for deleting a step is the same as that for "6-2-3 Correcting a Step," up to Step 4.

2) Input the number of the step to be deleted with the numerical keys and press the → key.

```
[EDIT-PGM]
PGM No = 13
STEP No = _
(REG steps) 50
```

3) Press F3 (DEL).

```
[EDIT-PGM]       No13
017:MOVA 254, 100


1MOD 2INS 3DEL 4CHG
```

4) A confirmation message is displayed. To delete the step, press F1 (yes). To cancel the deletion and leave the step as it is, press F2 (no).

```
[EDIT-PGM]       No13
017:MOVA 254, 100
delete OK ?
1yes 2no
```

5) When the deletion has been completed normally, the screen returns to that shown in Step 3.

```
[EDIT-PGM]       No13
017:WAIT 3, 1


1MOD 2INS 3DEL 4CHG
```


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6-2-6 Inserting a Step

1) The process for inserting a step is the same as that for "6-2-3 Correcting a Step," up to Step 4.

2) Input the number of the step where the insertion is to be made with the numerical keys and press the → key.

```
[EDIT-PGM]
PGM No = 13
STEP No = _
(REG steps) 50
```

3) Press F2 (INS).

```
[EDIT-PGM]      No13
017:MOVA 254, 100


1MOD 2INS 3DEL 4CHG
```

4) Continue with Step 7 of "6-2-3 Correcting a Step."

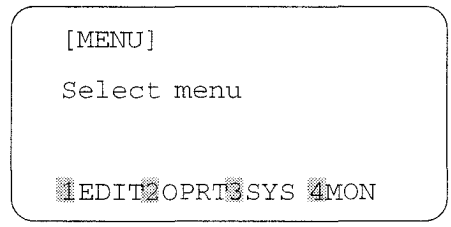
```
[EDIT-PGM]      No13
017:_


1MOVA2JMPF3JMP 4next
```

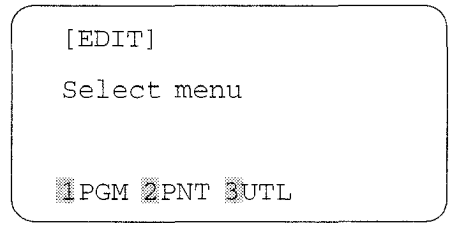

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6-2-7 Copying a Program

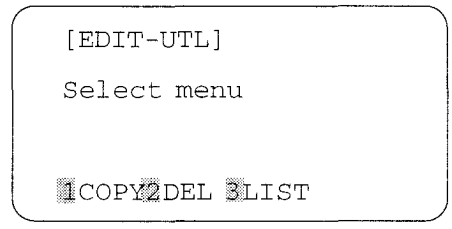
1) On the initial screen, press [F1] (EDIT).



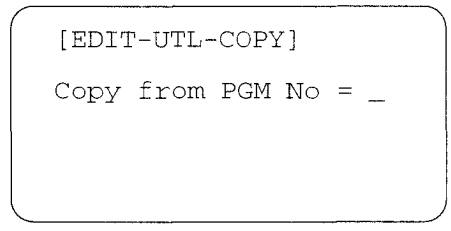
2) Press [F3] (UTL).



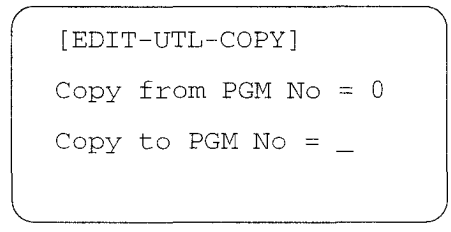
3) Press [F1] (COPY).



4) Input the program number from which the step is to be copied, using the numerical keys. Then press the → key.



5) Input the program number to which the step is to be copied, using the numerical keys. Then press the → key.



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6) If the number of the program to which the step is to be copied already exists, a confirmation message will be displayed, asking if it is all right to overwrite the existing program.
To overwrite the program, press [F 1] (yes). To cancel the copy process without copying anything, press [F 2] (no).

```
[EDIT-UTL-COPY]
Copy from PGM No = 0
No 1 Overwrite OK ?
1yes 2no
```

7) If the copying process has been completed normally, the screen returns to that shown in Step 3.

```
[EDIT-UTL]
Select menu


1COPY2DEL 3LIST
```

6-2-8 Deleting a Program

1) The process for deleting a program is the same as that for "6-2-7 Copying a Program," up to Step 2.

2) Press [F 2] (DEL).

```
[EDIT-UTL]
Select menu


1COPY2DEL 3LIST
```

3) Input the number of the program to be deleted with the numerical keys and press the [→] key.

```
[EDIT-UTL-DEL]
delete PGM No = _
```


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4) A confirmation message will be displayed, asking if it is all right to delete the program.
To delete the program, press [F1] (yes). To cancel the deleting process without deleting anything, press [F2] (no).

```
[EDIT-UTL-DEL]
delete PGM No = 22
delete ?
1yes 2no
```

5) If the deleting process has been completed normally, the screen returns to that shown in Step 2.

```
[EDIT-UTL]
Select menu

1COPY2DEL 3LIST
```

6-2-9 Viewing the Program Information

1) The process for viewing program information is the same as that for "6-2-7 Copying a Program," up to Step 2.

2) Press [F3] (LIST).

```
[EDIT-UTL]
Select menu

1COPY2DEL 3LIST
```

3) The program number is displayed on the screen, along with the number of existing steps and the number of free steps remaining.
Press the [STEP UP] and [STEP DOWN] keys to scroll the screen and move to other program numbers, where the number of existing steps for those programs can be viewed.

```
[EDIT-UTL-LIST]
free 678 steps
No 0 57 steps
No 1 255 steps
```

* In addition to the number of existing steps, steps equivalent to the number of programs are consumed internally as the program control steps. For example, if two programs are registered, and there are 50 steps and 100 steps existing respectively, the number of free steps remaining will be as follows.
1024 - 2 - 50 - 100 = 872

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6-3 Editing Point Data

There are three ways to input point data: Manual Data In (MDI), Teaching Playback, and Direct Teaching. Manual Data In consists of using the numerical keys of the DPB and directly inputting numeric values. Teaching Playback uses manual operation to move the robot to the desired position and then stores that position as point data. Direct Teaching is basically the same as Teaching Playback, except that the robot is moved by hand.

6-3-1 Manual Data In

1) On the initial screen, press [F1] (EDIT).

```
[MENU]
Select menu

1EDIT2OPRT3SYS 4MON
```

2) Press [F2] (PNT).

```
[EDIT]
Select menu

1PGM 2PNT 3UTL
```

3) Press [F1] (MDI).

```
[EDIT-PNT]
Select menu

1MDI 2TCH 3DTCH4DEL
```

4) The currently selected point number in the program being executed is displayed on the screen.
If the point number to be edited is different from that displayed, press the [STEP UP] and [STEP DOWN] keys to scroll the point numbers.
To switch directly to a certain point number, press the [F1] (CHG) key.

```
[EDIT-PNT-MDI]
PO = 0. 00          [mm]
input data [_         ]
1CHG
```


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5) Input the point number to be edited with the numerical keys, and press the → key.

```
[EDIT-PNT-MDI]
Pn : n = _
(pointNo)0→254
```

6) Input the point data with the numerical keys, and press the → key.

```
[EDIT-PNT-MDI]
P199 = -19.27    [mm]
input data[21. 76_ ]
1CHG
```

7) The input data is registered as point data.

```
[EDIT-PNT-MDI]
P199 = 21.76     [mm]
input data[_       ]
1CHG
```

6-3-2 Teaching Playback

1) The process for teaching playback is the same as that for "6-3-1 Manual Data In," up to Step 2.

2) Press F2 (TCH).

```
[EDIT-PNT]
Select menu


1MDI 2TCH 3DTCH4DEL
```

3) The currently selected point number in the program being executed is displayed on the screen.
If the point number to be edited is different from that displayed, press the STEP UP and STEP DOWN keys to scroll the point numbers.
To switch directly to a certain point number, press the F1 (CHG) key.

```
[EDIT-PNT-TCH] (1) 50
P0 = 0.00 [mm]
[ 0.00 ]
1CHG 2SPD 3S_SET4 next
```


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4) Input the point number to be edited with the numerical keys, and press the → key.

```
[EDIT-PNT-TCH]
Pn : n = _
(pointNo)0→254
```

5) Move the robot to the position where teaching is to take place, using the X- or X+ keys. Each time the X- or X+ or key is pressed, the robot moves a fixed amount in that direction and then stops. Holding down the X- or X+ key moves the robot continuously in that direction at a fixed speed until the key is released.

```
[EDIT-PNT-TCH] (1) 50
P199 = -19.27    [mm]
              [     0.00 ]
1CHG 2SPD 3S_SET4 next
```

The amount of movement that the robot moves in fixed-amount movement, and the speed of continuous movement, are shown as a proportion at the upper right side of the screen (this is the speed parameter). In the example at the right, the movement parameter is 50, so that if the X- or X+ key is pressed once, the robot will move 0.5 mm, which is calculated as follows:

50×0.01 mm (constant) = 0.5 mm

If the X- or X+ key is held down, the robot will move at a speed of 50 mm/sec, as demonstrated by the following calculation:

50×1 mm/sec (constant) = 50 mm/sec

To change the value set for the movement parameter, press F3 (S_SET). (See Step 6.)

Three different speed settings, SPEED (1), SPEED (2), and SPEED (3), can be assigned to the movement parameter. Each time F2 (SPD) is pressed, the settings change in the order of 1 →2→ 3→ 1.

6) Input the movement parameter with the numerical keys, and press the → key to return to Step 5.

```
[EDIT-PNT-TCH]
SPEED(1) = _
(speed)1→100
```

7) In this way, move the robot to the teaching position and press the → key. The current position is input as point data.

```
[EDIT-PNT-TCH] (1)100
P199 = 167.24     [mm]
              [ 167.24]
1CHG 2SPD 3S_SET4 next
```


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6-3-3 Direct Teaching

1) The process for direct teaching is the same as that for "6-3-1 Manual Data In," up to Step 2.

2) Press [F3] (DTCH).

```
[EDIT-PNT]
Select menu

1MDI 2TCH 3DTCH4DEL
```

3) As instructed by the message, press the Emergency Stop switch on the DPB.

```
[EDIT-PNT-DTCH]
Press EMG. button
```

4) The currently selected point number in the program being executed is displayed on the screen.
If the point number to be edited is different from that displayed, press the [STEP UP] and [STEP DOWN] keys to scroll the point numbers.
To switch directly to a certain point number, press the [F1] (CHG) key.

```
[EDIT-PNT-DTCH]
P0 = 0.00          [mm]
       [       0.00]
1CHG 2 DO
```

5) Input the point number to be edited with the numerical keys, and press the [→] key.

```
[EDIT-PNT-DTCH]
Pn : n = _
(pointNo)0→254
```

6) Move the robot to the teaching position by hand.

```
[EDIT-PNT-DTCH]
P199 = 19.27       [mm]
       [       0.00]
1CHG 2 DO
```


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7) When the → key is pressed, the current position is input as data. When all of the points have been edited in the same way, press the ESC key.

```
[EDIT-PNT-DTCH]
P199 = 300.27    [mm]
          [ 300.27]
1CHG 2 DO
```

8) As instructed by the message, release the Emergency Stop switch on the DPB.

```
[EDIT-PNT-DTCH]
Release EMG. button
```

9) A confirmation message asking if it is all right to turn the servo on appears on the screen. To turn the servo on, press F1 (yes). To leave the servo off, press F2 (no).

```
[EDIT-PNT-DTCH]
Servo on OK?

1yes 2no
```

10) The screen returns to that shown in Step 2.

```
[EDIT-PNT]
Select menu

1MDI 2TCH 3DTCH4DEL
```


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6-3-4 Manual Control of General-Use Output

(This corresponds only to controllers with a ROM version of V1.08 or later.)

When using Teaching Playback and Direct Teaching with systems that use the general-use output of the I/O interface to operate the grippers and other components, the position should be confirmed by moving the workpiece to the position being taught.

For this reason, the SRC Controller is designed to allow manual control of general-use output from the DPB.

1) The procedure for manual control of the general-use output is the same as that for "6-3-2 Teaching Playback" up to Step 5 or "6-3-3 Direct Teaching" up to Step 6.
* Hereafter, teaching playback screens will be used to illustrate the steps.

2) When the robot has arrived at the point where the general-use output is to be manipulated, stop the operation and press the [F4] (DO) key.

```
[EDIT-PNT-DTCH] (1) 50
P199 = 19.27      [mm]
          [   0.00 ]
1CHG 2SPD 3S_SET4DO
```

3) The status of the current general-use output is shown on the screen. To change the status of the output (i.e., ON=1, OFF=0), press the function key where the DO number to be controlled appears.
Pressing the [F4] key allows you to select DO3 and DO4.

```
[EDIT-PNT-TCH]
DO0=0 DO1=0 DO2=0
DO3=0 DO4=0
1DO0 2DO1 3DO2 4next
```


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6-3-5 Deleting Point Data

1) The process for deleting point data is the same as that for "6-3-1 Manual Data In," up to Step 2.

2) Press [F4] (DEL).

```
[EDIT-PNT]
Select menu

1MDI 2TCH 3DTCH4DEL
```

3) Input the number of the point where the deletion is to begin, with the numerical keys, and press the → key.

```
[EDIT-PNT-DEL]
DEL range P_-P
(point No)0→254
```

4) Input the number of the point where the deletion is to end, with the numerical keys, and press the → key.

```
[EDIT-PNT-DEL]
DEL range P123-_
(pointNo)0→254
```

5) A confirmation message will be displayed, asking if it is all right to delete the data.
To delete the data, press [F1] (yes).
To cancel the deleting process without deleting anything, press [F2] (no).

```
[EDIT-PNT-DEL]
DEL range P123-P200
delete OK ?
1yes 2no
```

6) If the deleting process has been completed normally, the screen returns to that shown in Step 2.

```
[EDIT-PNT]
Select menu

1MDI 2TCH 3DTCH4DEL
```


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6-3-6 Tracing points

The robot moves to the absolute position indicated by the deta in the point register.

1) The procedure for tracing points is the same as that for "6-3-2 Teaching Playback" up to step 3.

2) Press [F4] (next) to switch the function display. Then press [F2] (TRC).

```
[EDIT-PNT-TCH] (1) 100
P0     = 350.00    [mm]
               [     0.00]
1DO 2TRC 3    4next
```

3) The screen will switch, and the coordinate values of the movement destination and the movement speed will be displayed. When the robot is to be moved, press [F1] (yes) and if not press [F2] (no). The movement speed will be 10% of the number (speed parameter) displayed at the upper right of the screen.

```
[EDIT-PNT-TCH] (1) 100
P0     = 350.00    [mm]
will move at 10% speed
1yes  2no
```

4) When the movement is completed, the screen will change to that displayed in step 2.

```
[EDIT-PNT-TCH] (1) 100
P0     = 350.00    [mm]
[350.00]
1DO 2TRC 3    4next
```


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6-4 Robot Instructions

With the SRC Controller, programs are written in a simple language that closely resembles BASIC. This makes it easy to program even complex peripheral robot operations. The instructions used in this language are described below.

6-4-1 MOVA

Function: Moves to the point specified by the number (absolute position of the origin point reference).

Format: MOVA <point no.>, <Max. speed%>

Example: MOVA 51, 80
Moves to P51 at speed 80.

Explanation: This command moves the robot in relation to an absolute coordinate that sets the origin position as 0.

(1) Point numbers
Point numbers range from 0 to 254. Character "P" can be used as a variable and a number can be set by the "P" instruction..

(2) Maximum speed
When the execution speed parameter is 100 and the speed setting in the robot will move at the maximum RPM setting for that unit.

6-4-2 MOVI

Function: Moves from the current position by only the point data specified by the number (incremental position of the current position reference).

Format: MOVI <point no.>, <speed>

Example: MOVI 10, 80
Moves from the current position by only the point data defined in P10, at speed 80.

Explanation: This command moves the robot in relation to a relative coordinate that sets the current position as 0.

(1) Point numbers
Point numbers range from 0 to 254. Character "P" can be used as a variable and a number can be set by the "P" instruction..

(2) Maximum speed
When the execution speed parameter is 100 and the speed setting in the robot will move at the maximum RPM setting for that unit.

Note: The MOVI statement allows movement relative to "0" immediately after performing any operation which resets the program. Use the MOVI statement after executing an absolute position movement command such as MOVA statement.

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6-4-3 MOVF

Function: Moves until the specified DI number input is received.

Format: MOVF <point no.> <DI no.> <parameter>

Example: MOVF 1, 2, 1
This command moves the robot towards Point 1 until DI2 goes on, at which time the program advances to the next step.

Explanation: This is used when searching for a target position using sensors or other devices.

(1) Point numbers
Point numbers range from 0 to 254. Character "P" can be used as a variable and a number can be set by the "P" instruction..

(2) DI number
This indicates one of the eight (0 to 8) general-use inputs.

(3) Parameter
"1" indicates "on" while "0" indicates "off".

Other: PRM 9 sets the speed of MOVF movement. (Refer to "5-1 Description of the various parameters") Note that this will not be affected by the OPRT mode execution speed. PRM9 is set in mm/sec.

6-4-4 JMP

Function: Jumps program execution to a specified step.

Format: JMP <label no.>, <program no.>

Example: JMP 10, 8
Jumps to label 10 in program 8.

Explanation: This command is used to control the flow of program execution.

(1) Label number
The label number is a number defined by the "L" instruction, (see Chapter 6-4-6), and indicates the destination to which program execution is to jump.

(2) Program number
The program number is used to specify an individual program among the 32 available programs, ranging from 0 to 31.

Other: If the program number is changed by means of the JMP instruction, it can be reset during execution to return to the original program number when program execution begins.

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6-4-5 JMPF

Function: If the conditional jump input matches the set value, program execution jumps to the label of the designated program number.

Format: JMPF <label no.>, <program no.>, <input condition value>

Example: JMPF 12, 3, 5
If the conditional jump input is 5, execution jumps to label 12 of program 3. If the jump input is not 5, execution advances to the next step.

Explanation: This command is used to control the flow of program execution in response to the conditional jump input.

(1) Label number
The label number is a number defined by the "L" instruction, (see Chapter 6-4-6), and indicates the destination to which program execution is to jump.

(2) Program number
The program number is used to specify an individual program among the 32 available programs, ranging from 0 to 31.

(3) Input condition value
A number from 0 to 255 is input, and the conditional jump input which initiates a jump is set.

Conditional input can be selected from among 1-8 points by changing Parameter 8 (see Chapter 5-1). As an example, Table 6-2 at the left illustrates the relation between the status of the general-use input and the input condition value when the number of conditional input points is 4. Table 6-3 at right shows the relation between the number of conditional input points and the input condition value, as well as the general-use input being used.

Table 6-2 Status of the General-Use Input when the number of conditional Input Points is 4

General use DI Input				Input Condition Value
DI3 (2^3)	DI2 (2^2)	DI1 (2^1)	DI0 (2^0)	
OFF	0	0	0	0
OFF	0	0	1	1
OFF	0	1	0	2
OFF	0	1	1	3
OFF	1	0	0	4
OFF	1	0	1	5
OFF	1	1	0	6
ON	1	1	1	7
ON	0	0	0	8
ON	0	0	1	9
ON	0	1	0	10
ON	0	1	1	11
ON	1	0	0	12
ON	1	0	1	13
ON	1	1	0	14
ON	1	1	1	15

Table 6-3 Number of conditional Input Points, Input conditional value and General-Use Input

No. of Conditional Input Points	Input Condition Value	General-Use Input Used
1	0 to 1	DI0
less than 2	0 to 3	DI0 to DI1
less than 3	0 to 7	DI0 to DI2
less than 4	0 to 15	DI0 to DI3
less than 5	0 to 31	DI0 to DI4
less than 6	0 to 63	DI0 to DI5
less than 7	0 to 127	DI0 to DI6
less than 8	0 to 255	DI0 to DI7

CAUTION

When selecting the number of conditional input points, the actual number of input conditions to be used should be considered. This will insure that the number of conditional input points selected will be large enough to accommodate all of the necessary points. If an error is made in setting the number of conditional input points, there will be a discrepancy between the input condition value required by the program and that recognized by the controller. This could keep the program from working properly.

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6-4-6 L

Function: Defines the jump destination for JMP, JMPF and JMPB instructions.

Format: L <label no.>

Example: L 100

Explanation: This command is used to define the destination to which program execution jumps on JMP, JMPF and JMPB instructions. The label number may be any number between 0 and 255. Label numbers may be duplicated within different programs.

6-4-7 CALL

Function: Calls and executes another program.

Format: CALL <program no.>, <no. of times>

Example: CALL 5, 2
After program 5 is executed twice, execution advances to the next step.

Explanation: When repeating an operation a number of times, a separate program can be created as a subroutine and the subroutine can be executed when necessary.

(1) Program number
The program number is used to specify an individual program among the 32 available programs, ranging from 0 to 31.

(2) Number of times
This is the number of times that the program is to be repeated, witch can be specified from 1 to 255.

Other:

- The nesting level is 6 (i.e., Only 6 successive call statements can be used within a call statement).
- When the end of the program is detected (initiated by the CALL instruction), execution advances to the step following the CALL instruction in the main program.
- An error occurs, and execution will stop, if the program summoned by the CALL instruction is the same program containing the CALL statement.
- If the program number is changed by means of the CALL instruction, it can be reset during execution to return to the original program number when program execution begins.

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6-4-8 DO

Function: Executes ON/OFF control of general-use output.

Format: DO <DO no.>, <parameter>

Example: DO 3, 1
This turns on general-use output 3.

Explanation: This command turns the general-use output available to the user on and off.

(1) DO number
This specifies the general-use output 0, 1, 2, 3, or 4 (5 points altogether).

(2) Parameter
"1" turns the output on, and "0" turns it off.

6-4-9 WAIT

Function: Waits until the specified DI number input is received.

Format: WAIT <DI no.>, <parameter>

Example: WAIT 5, 1
Waits until the input of DI number 5 goes on.

Explanation: This command controls program execution in response to the status of the general-use input available to the user.

(1) DI number
Specifies one of the general-use input numbers from 0-8.

(2) Parameter "1" means the input on, and "0" means the input is off.

6-4-10 TIMR

Function: Waits for the specified amount of time before advancing to the next step.

Format: TIMR <time>

Example: TIMR 100
This advances execution to the next step after waiting one second.

Explanation: This command is used when it is necessary to adjust time within the program itself. Time may be specified in lengths from 1 to 65535, in units of 10 milliseconds; thus, time may be specified from 0.01 seconds up to 655.35 seconds. Units are in 10s of milliseconds.

Caution: The TIMR should not be used in place of a wait statement. The location of liner slide, rotary actuator or gripper should always be monitored by a sensor tied directly to the SRC.

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6-4-11 P

Function: Sets a point variable.

Format: P <point no.>

Example: P 200
Sets a point variable to 200.

Explanation: The point variable can be set to any point data register, 0 to 254. By using a MOVA statement, MOVI statement or MOVF statement and a P+, P- statement, the number of program steps might be reduced.
(See Chapter 6-5 Sample Programs.)

Other: The contents of point variable "P" are held even when the controller power is turned off, but when the program is reset or when the program reset is applied by switching the execution program, etc., the point variable"P" will be initialized to 0.

6-4-12 P+

Function: Increments a point variable (P = P + 1)

Format: P+

Example: P+

6-4-13 P-

Function: Decrements a point variable (P = P - 1)

Format: P-

Example: P-

6-4-14 SRVO

Function: Turns the servo on and off.

Format: SRVO <1 or 0>

Example: SRVO 1
This turns the servo on.
SRVO 0
This turns the servo off.

Explanation: When the position of the robot is locked mechanically, this instruction is used to prevent an overload status on the motor.

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6-4-15 STOP

Function: Temporarily interrupts program execution.

Format: STOP

Example: STOP

Explanation: This is used to interrupt execution of a program, and can be used at any point in the program. Execution will be restarted at the step following the STOP instruction.

6-4-16 JMPB
(Valid for controllers from ROM version number V1.14 onwards.)

Function: Jumps to the specified label when the specified DI number input is ON or OFF.

Format: JMPB <label no.>, <DI no.>, <1 or 0>

Example: JMPB 12, 8, 1
Will jump to label 12 when DI8 input is ON.
If DI8 is OFF the robot will proceed to the next step.

JMPB 21, 3, 0
Will jump to label 21 when DI3 input is OFF.
If DI3 is ON the robot will proceed to the next step.

Explanation: Controls the flow of the program according to the general-use input.

(1) Label number
The label number is a number defined by the "L" instruction, (see Chapter 6-4-6), and indicates the destination to which program execution is to jump.

(2) DI number
This indicates one of the nine general-use inputs, 0 to 8.

(3) 1 or 0
"1" indicates "on" while "0" indicates "off".

6-4-17 ORGN

Function: Return to origin movement is executed.

Format: ORGN

Example: ORGN

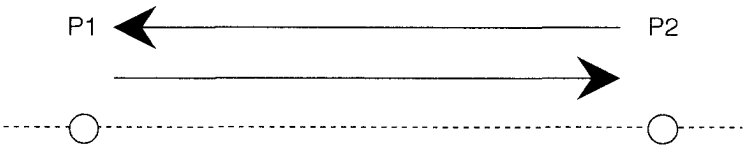
Explanation: This command executes return to origin operation based on the specification parameters.

Others: Execute return to origin at least one time after the power is turned on. Unless the main power supply is turned off, there is no need to execute return to origin again, even if the servo was off due to emergency stop condition etc.

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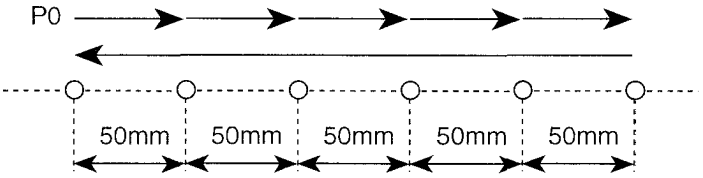
6-5 Sample Programs

6-5-1 Movement back and forth between two points



Program		Comments
[NO0]		
001: L	0	Label definition
002: MOVA	1,100	Moves to P1
003: MOVA	2,100	Moves to P2
004: TIMR	100	Enters a delay of 1 second
005: JMP	0,0	Returns to L0

6-5-2 Even-pitch movement



Points

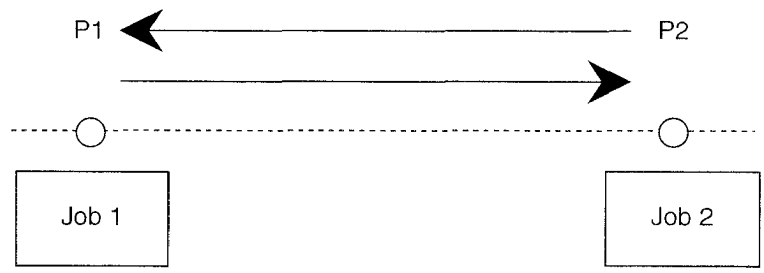
P0	Start position
P1	Distance 50 mm

Program		Comments
[NO0]		
001: L	0	Label definition
002: MOVA	0,100	Moves to P0
003: MOVI	1,100	Moves 5 times, 50 mm each time
004: MOVI	1,100	
005: MOVI	1,100	
006: MOVI	1,100	
007: MOVI	1,100	
008: JMP	0,0	Returns to L0

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6-5-3 Inputs and Outputs

Fixes the positions of two points and outputs job commands for a PLC or a similar unit at each position.



Points

P1	Position where Job 1 takes place
P2	Position where Job 2 takes place

General-Use Input

DI1	Job 1 End — 1: Ended, 0: Not Ended
DI2	Job 2 End — 1: Ended, 0: Not Ended

General-Use Output

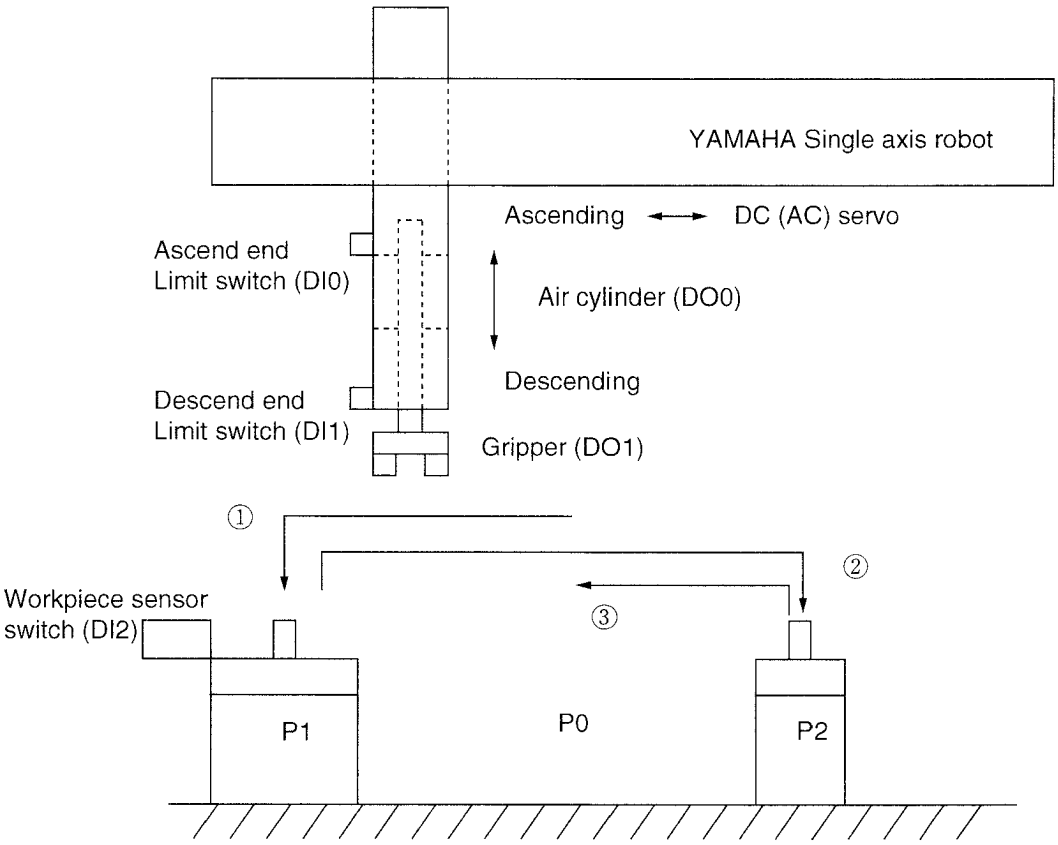
DO1	Job 1 Command — 1: Output, 0: Cancel
DO2	Job 2 Command — 1: Output, 0: Cancel

Program		Comments
[NO0]		
001: DO	1,0	Cancels Job 1 command
002: DO	2,0	Cancels Job 2 command
003: L	1	Defines Label 1
004: MOVA	1,100	Moves to P1
005: DO	1,1	Outputs Job 1 command
006: WAIT	1,1	Waits for Job 1 to end
007: DO	1,0	Cancels Job 1 command
008: MOVA	2,100	Moves to P2
009: DO	2,1	Outputs Job 2 command
010: WAIT	2,1	Waits for Job 2 to end
011: DO	2,0	Cancels Job 2 command
012: JMP	1,0	Returns to L1

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6-5-4 Pick & Place

Sets the robot in standby status at P0 and moves the workpiece supplied at P1 to P2.



Operations

q Move from standby position to supply position and pick up workpiece
w Move to mounting position and set down workpiece
e Return to standby position

Points

P0	Robot standby position
P1	Workpiece supply position
P2	Workpiece mounting poosition

Actuators

Horizontal direction	Servo motor
Vertical direction	Air cylinder
Grip	Gripper

General-Use Input

DI0	Ascend end limit switch	1: ON	0: OFF
DI1	Descend end limit switch	1: ON	0: OFF
DI2	Workpiece sensor switch	1: YES	0: NO

General-Use Output

DO0	Air cylinder 1: Descend 0: Ascend
DO1	Gripper 1: Close 0: Open

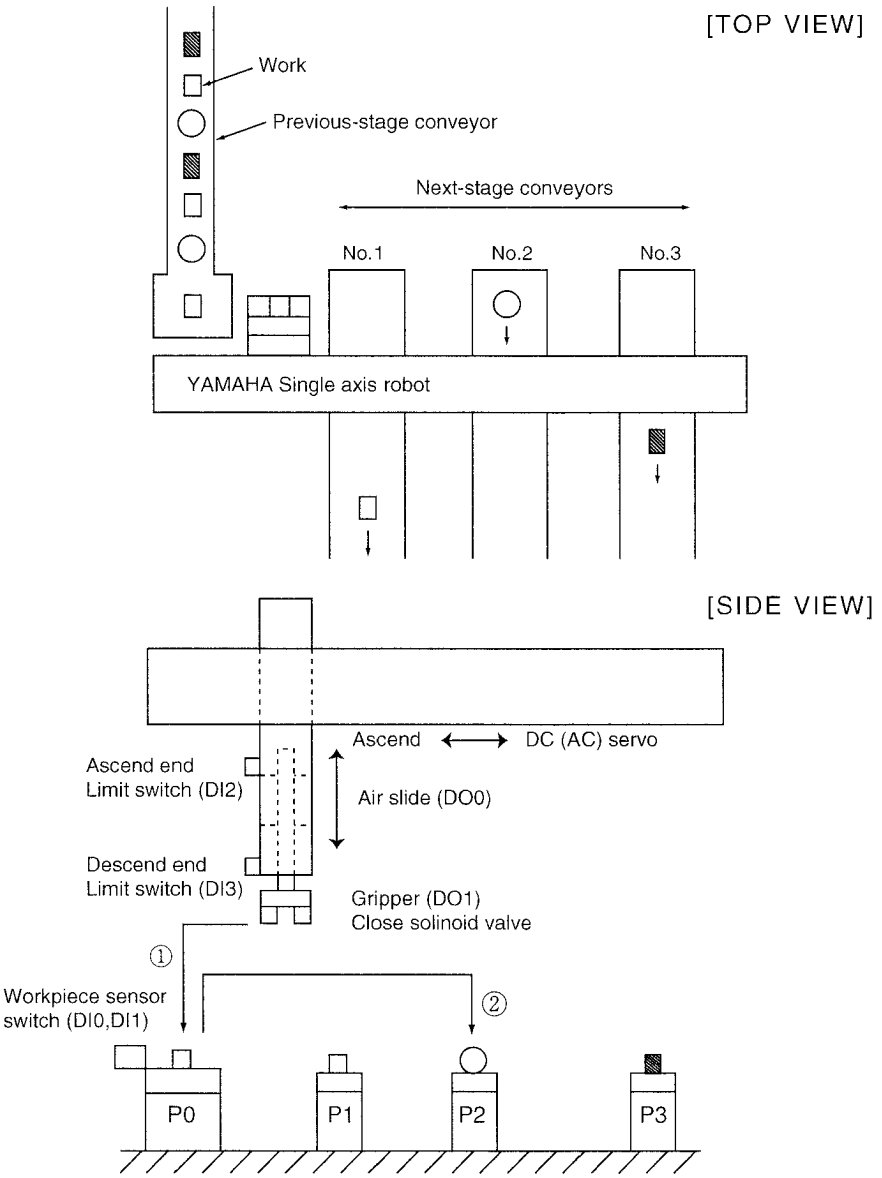
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Program		Comments	
[NO1]			
001: L	1	Label definition	
002: MOVA	0,100	Moves to standby position	
003: WAIT	2,1	Waits for workpiece	
004: MOVA	1,100	Moves to workpiece supply position	
005: DO	0,1	Cylinder descends	Grips workpiece
006: WAIT	1,1	Cylinder waits at descend end	
007: DO	1,1	Gripper closes	
008: TIMR	100	Enters a delay of 1 second	
009: DO	0,0	Cylinder ascends	
010: WAIT	0,1	Cylinder waits at ascend end	
011: MOVA	2,100	Moves to workpiece mounting position	
012: DO	0,1	Cylinder descends	Sets down workpiece
013: WAIT	1,1	Cylinder waits at descend end	
014: DO	1,0	Gripper opens	
015: TIMR	100	Enters a delay of 1 second	
016: DO	0,0	Cylinder ascends	
017: WAIT	0,1	Cylinder waits at ascend end	
018: JMP	1,1	Returns to L1	

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6-5-5 Subroutine Example

Workpieces coming in from previous-stage conveyor are sent to three next-stage conveyors in sequential order.



Operations

① Move to supply position and pick up workpiece
② Move to mounting position and set down workpiece

Actuators

Horizontal direction	Servo motor
Vertical direction	Air slide
Grip Gripper	

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General-Use Input

DI0	Identifies 3 types of work
DI1	00: WORK A 01: WORK B 10: WORK C
D12	Ascend end limit switch 1: ON 0: OFF
D13	Descend end limit switch 1: ON 2: OFF
DI4	PLC and handshake input

General-Use Output

DO0	Air slide 1: Descend 0: Ascend
DO1	Gripper 1:Open 0: Close
DO2	PLC and handshake output

Points

P0	Workpiece supply position on previous-stage conveyor
P1	Workpiece mounting position on No.1 next-stage conveyor
P2	Workpiece mounting position on No.2 next-stage conveyor
P3	Workpiece mounting position on No.3 next-stage conveyor

```
Program                          Coments
[NO0]
001:DO          2,0              Default values for general-use outputs
002:L           0                Label definition
003:WAIT        4,1
004:DO          2,1
005:WAIT        4,0
006:DO          2,0
007:JMPF        1,0,0            If work is type A, jump to L1
008:JMPF        2,0,1            If work is type B, jump to L2
009:JMPF        3,0,2            If work is type C, jump to L3
010:JMP         0,0              Return to L0
011:L           1                Label definition
012:CALL        3,1              Execute "PICK" subroutine
013:MOVA        1,100
014:CALL        4,1              Execute "PLACE" subroutine
015:JMP         0,0
016:L           2                Label definition
017:CALL        3,1              Execute "PICK" subroutine
018:MOVA        2,100
019:CALL        4,1              Execute "PLACE" subroutine
020:JMP         0,0              Return to L0
021:L           3                Label definition
022:CALL        3,1              Execute "PICK" subroutine
023:MOVA        3,100
024:CALL        4,1              Execute "PLACE" subroutine
025:JMP         0,0              Return to L0
```


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[NO3]		Execute "PICK" subroutine
001:MOVA	0,100	
002:DO	0,1	Cylinder descends
003:WAIT	3,1	Cylinder waits at descend end
004:DO	1,1	Gripper open
005:TIMR	100	
006:DO	0,0	Cylinder ascends
007:WAIT	2,1	Cylinder waits at ascend end
[NO4]		Execute "PLACE" subroutine
001:DO	0,1	Cylinder descends
002:WAIT	3,1	Cylinder waits at descend end
003:DO	1,0	Gripper close
004:TIMR	100	
005:DO	0,0	Cylinder ascends
006:WAIT	2,1	Cylinder waits at ascend end

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6-5-6 Changing Programs From I/O

With the SRC Series, there is no Special Use Input reserved for switching programs. When switching programs from the I/O side, the program selection signal should be used as conditional jump input, and the program switching handled as described below.

The following example describes switching between 16 types of programs.

General-Use Input

DI0	Program Selection 0
DI1	Program Selection 1
DI2	Program Selection 2
DI3	Program Selection 3
DI8	Program Selection Determined

General-Use Output

DO0	Program Selection Start

Parameters

Since the number of programs being selected is 16, PRM 8 (the number of conditional input points) is set to 4.

Caution: PRM 8 and the general-use input being used may change in response to the number of programs being selected, as shown in the table.

No. of Programs	No. of DI Points Used	DI No.
2 or less	1 point	DI0
4 or less	2 points	DI0, DI1
8 or less	3 points	DI0-DI2
16 or less	4 points	DI0-DI3
32 or less	5 points	DI0-DI4

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Program		Comments	
[NO. 0]			
L	0	Defines Label 0	Handshake operation
WAIT	8,1	Waits for Program Selection End to go ON	
DO	0,1	Program Selection Start goes ON	
WAIT	8,0	Waits for Program Selection End to go OFF	
DO	0,0	Program Selection Start goes OFF	
JMPF	1,1,0	If input is 0, jumps to L1 of No. 1	
JMPF	1,2,1	If input is 1, jumps to L1 of No. 2	
JMPF	1,3,2	If input is 2, jumps to L1 of No. 3	
JMPF	1,4,3	If input is 3, jumps to L1 of No. 4	
JMPF	1,5,4	If input is 4, jumps to L1 of No. 5	
JMPF	1,6,5	If input is 5, jumps to L1 of No. 6	
JMPF	1,7,6	If input is 6, jumps to L1 of No. 7	
JMPF	1,8,7	If input is 7, jumps to L1 of No. 8	
JMPF	1,9,8	If input is 8, jumps to L1 of No. 9	
JMPF	1,10,9	If input is 9, jumps to L1 of No. 10	
JMPF	1,11,10	If input is 10, jumps to L1 of No. 11	
JMPF	1,12,11	If input is 11, jumps to L1 of No. 12	
JMPF	1,13,12	If input is 12, jumps to L1 of No. 13	
JMPF	1,14,13	If input is 13, jumps to L1 of No. 14	
JMPF	1,15,14	If input is 14, jumps to L1 of No. 15	
JMPF	1,16,15	If input is 15, jumps to L1 of No. 16	
[NO. 1]			
L 1		Defines Label 1	
....			
.. (Actual operation program)			
....			
JMP 0,0		Returns to L0 of Program No.0	
[NO.2]			
L 1		(Defines Label 1)	
....			
.. (Actual operation program)			
....			
JMP 0,0		Returns to L0 of Program No.0	
.			
.			
.			
.			
[NO.16]			
L 1		(Defines Label 1)	
....			
.. (Actual operation program)			
....			
JMP 0,0		Returns to L0 of Program No.0	

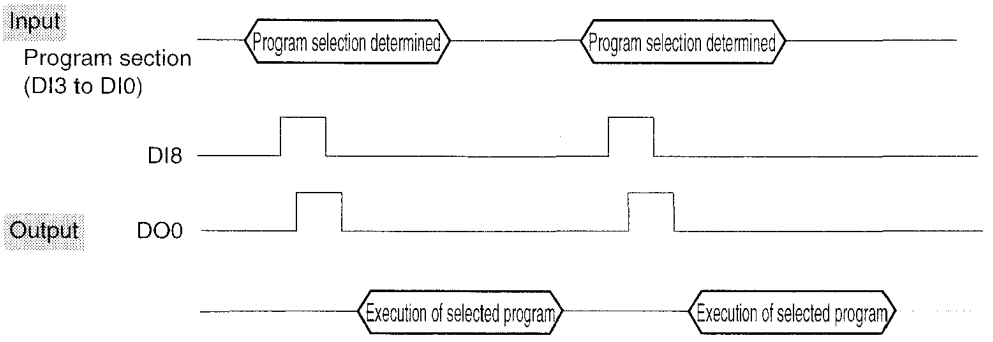
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<Explanation of Program>

Before executing the program with the JMPF instruction, general-use input is used one point at a time (in this case, DI8 and DO0) to carry out a handshake. The purpose of this is to synchronize the program of the external equipment such as a PLC with the SRC Controller program.

If this step is omitted, when program selection is executed with the JMPF instruction, the program selection input may be switched, and there is a chance of an erroneous program being selected.

When the execution of each program selection has been completed, execution will return to the beginning of the program (L0 of Program No. 0).



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CHAPTER 7 OPERATING THE ROBOT

This chapter will explain how the robot is actually operated. If the program has already been completed, you will be able to operate the robot by the time you finish reading this chapter.

There are two types of robot operation: step and automatic. With step operation, the program is executed one step at a time, with a step being carried out each time the RUN key is pressed on the DPB unit. This is used when you want to check the program as it is being carried out. With automatic operation, the entire program is executed without stopping, from beginning to end.

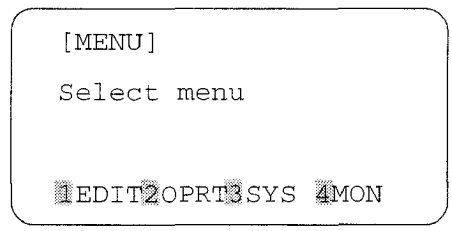
This chapter also covers how to initiate and recover from an emergency stop.

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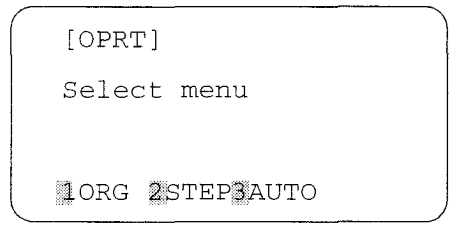
7-1 Returning to the Origin

The origin return operations are described in this section. Origin return must be executed once after the controller power is turned on. After being executed once, origin return does not need to be re-executed unless the power is turned off.

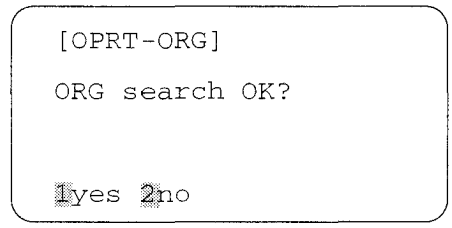
1) Press F2 (OPRT) on the initial screen.



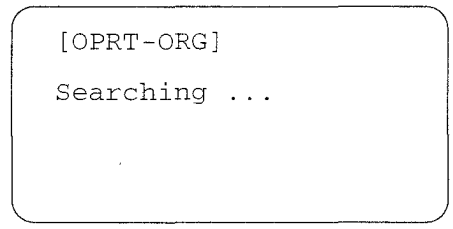
2) Next, press F1 (ORG).



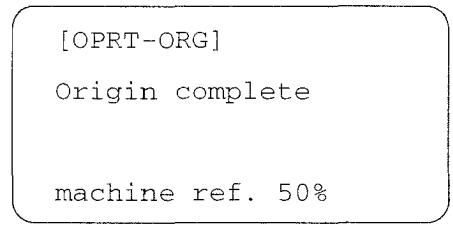
3) To carry out a return to origin, press F1 (yes). To cancel the operation, press F2 (no).



4) This is the screen displayed during an origin position return. Pressing STOP during the operation brings the robot to a halt and displays a message.
Pressing the ESC key returns execution to Step 2.



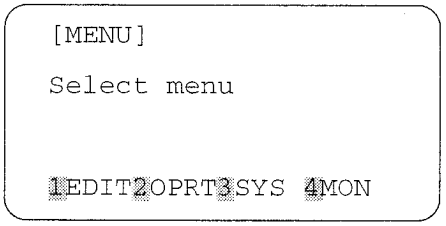
5) If the return to origin ends normally, the machine reference is displayed at the lower right. Pressing the ESC key returns execution to Step 2.



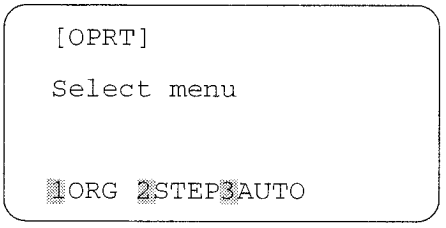
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7-2 Using Step Operation

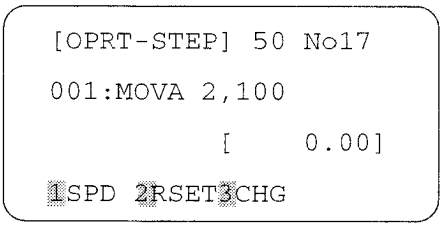
1) Press [F2] (OPRT) on the initial screen.



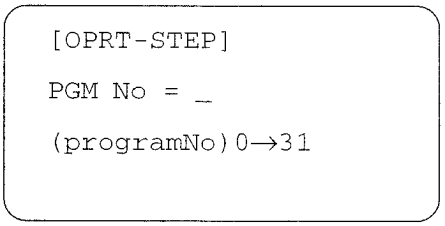
2) Then press [F2] (STEP).



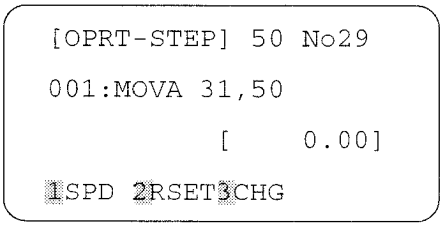
3) If the program number displayed on the screen is not the one to be run, press [F3] (CHG).
(See Chapter 4-2-3 for information on how to read the program screen.)



4) Using the numerical keys, input the number of the program to be executed, and then press [→].



5) The first step of the selected program is displayed on the screen. To change the execution speed, press [F1] (SPD).



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6) Input the execution speed using the numerical keys, and press the → key.

```
[OPRT-STEP] 50 No29
SPEED = _
(speed)1→100
```

7) The screen returns to that shown at Step 5. Pressing RUN at this point executes the first step.

```
[OPRT-STEP] 100 No29
001:MOVA 31,50
              [    0.00]
1SPD 2RSET3CHG
```

8) This is the screen displayed while the program is being executed.

```
[OPRT-STEP]
Running ...
```

9) Pressing STOP during execution brings the robot to a halt and displays a message on the screen. To return to Step 7, press the ESC key. Press RUN again to execute the interrupted step.

```
[OPRT-STEP]100 No29
001:MOVA 31,50
              [  164.89]
1SPD 2RSET3CHG
```

10) When execution is finished, the second step is displayed. Each time RUN is pressed from this point on, the next step is executed. When the last step has been executed, the message "program end" is displayed. To return to Step 1 from the program end, press the ESC key.

```
[OPRT-STEP]


70:program end
```


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11) To return to Step 1 from any other step and initiate execution again, press [F2] (RSET).

```
[OPRT-STEP] 100 No29
042:TIMR 100
           [   48.08]
1SPD 2RSET3CHG
```

12) The screen returns to that shown at Step 5, and the process is repeated from that point.

```
[OPRT-STEP] 100 No29
001:MOVA 31,50
           [    48.08]
1SPD 2RSET3CHG
```

7-3 Using Automatic Operation

1) Press [F2] (OPRT) on the initial screen.

```
[MENU]
Select menu

1EDIT2OPRT3SYS 4MON
```

2) Press [F3] (AUTO).

```
[OPRT]
Select menu

1ORG 2STEP3AUTO
```

3) If the program number displayed on the screen is not the one to be run, press [F2] (CHG).
(See Chapter 4-2-3 for information on how to read the program screen.)

```
[OPRT-AUTO] 50 No17
001:MOVA 2,100
           [   0.00]
1SPD 2RSET3CHG
```


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4) Using the numerical keys, input the number of the program to be executed, and then press →.

```
[OPRT-AUTO]
PGM No = _
(program No)0→31
```

5) The first step of the selected program is displayed on the screen. To change the execution speed, press F1 (SPD).

```
[OPRT-AUTO] 50 No29
001:MOVA 31,50
            [    0.00]
1SPD 2RSET3CHG
```

6) Input the execution speed using the numerical keys, and press the → key.

```
[OPRT-AUTO] 50 No29
SPEED = _
(speed)1→100
```

7) The screen returns to that shown at Step 5. Pressing RUN at this point executes the first step.

```
[OPRT-AUTO] 100 No29
001:MOVA 31,50
            [    0.00]
1SPD 2RSET3CHG
```

8) This is the screen displayed while the program is being executed.

```
[OPRT-AUTO]
Running...
```


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9) Pressing STOP during execution brings the robot to a halt and displays the message "program end". Press the ESC key to display the step where execution was interrupted.
Pressing RUN will cause execution to resume from the step where it was interrupted. When the last step has been executed, the message "program end"is displayed. Pressing the ESC key returns the screen to that shown in Step 7.

```
[OPRT-AUTO]


70:program end
```

10) To return to Step 1 from any other step and initiate execution again, press F2 (RSET).

```
[OPRT-AUTO] 100 No29
042:TIMR 100
           [   48.09]
1SPD 2RSET3CHG
```

11) The screen returns to that shown at Step 5, and the process is repeated from that point.

```
[OPRT-AUTO] 100 No29
001:MOVA 31,50
           [   48.09]
1SPD 2RSET3CHG
```


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7-4 Emergency Stop Function

With the SRC Controller, there are two ways to input an emergency stop: one is by using the push-button on the DPB, and the other is to use the I/O emergency stop input. In either case, for safety reasons, a B contact input is used (when the contact is cut, an emergency stop is initiated).

The SRC Controller is designed so that recovery from an emergency stop status can be done without turning off the power. Origin return does not need to be executed.

We will describe, in this section, how to initiate and recover from an emergency stop.

7-4-1 Initiating an Emergency Stop

During DPB operation, to initiate an emergency stop of the robot for any reason, press the Emergency Stop switch on the DPB. The switch locks in the depressed position, and can be released by turning it to the right.

In an emergency stop status, the robot assumes free status, and commands initiating robot movement (for example, the origin return command) cannot be executed.

7-4-2 Recovering From an Emergency Stop

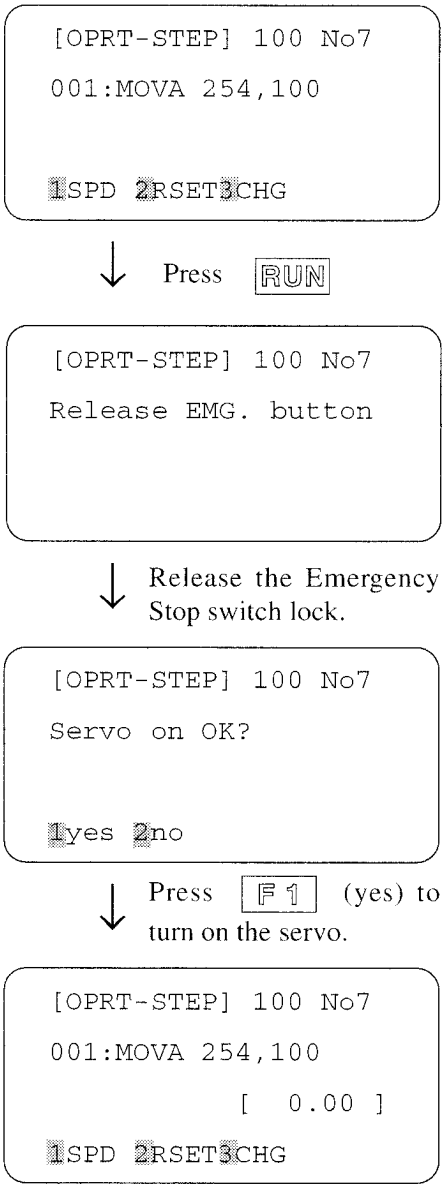
When recovery is required during DPB operation, the procedure is automatically displayed on the DPB itself. Follow the displayed instructions to recover from the emergency stop status.

Recovery through DPB operation will be necessary in the following cases:
1) When a return to origin is to be carried out;
2) When step operation is to be used;
3) When automatic operation is to be used;
4) When carrying out point editing using teaching playback; and
5) When exiting the Direct Teaching Mode.

An example of recovery is given on the next page.

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The example at the right illustrates recovery from an emergency stop status when step operation is to be used. As can be seen in the example, the emergency stop status can be canceled simply by releasing the Emergency Stop switch and servo on operation.



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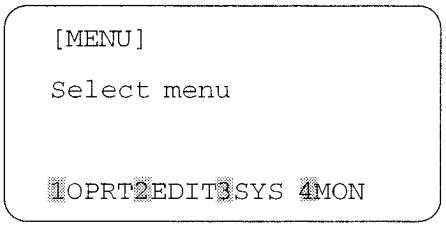
7-5 Changing Programs

A lead program is the very first program to be executed right after the program is reset in auto operation or step operation. The SRC Controller sets up the first edited program as the lead program right after reset (default value) is performed. Therefore, program switching is necessary if the customer has edited programs other than the lead program.
Lead program switching is carried out with the DPB. The procedure is explained below.

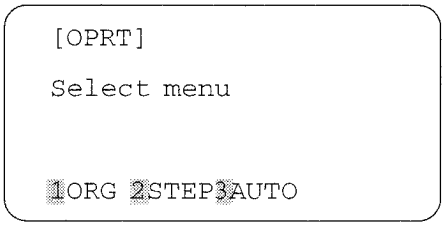
CAUTION

If the program is switched, the reset will be applied forcibly, so all general-use outputs will be turned off.

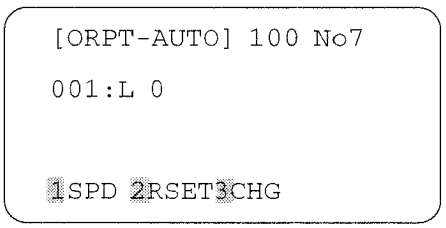
1) Press F1 (OPRT)



2) Press F2 (STEP) or F3 (AUTO).



3) Press F3 (CHG).



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4) Input the lead program number with the numerical keys and finally press [→].

```
[OPRT-AUTO] 100 No7
PGM No = _
(program No)0→31
```

5) Changing of the lead program is complete.

```
[OPRT-AUTO] 100 No0
001:DO 0 ,0


1SPD 2RSET3CHG
```

NOTE

This item explained changing the lead program while in operate mode but edit mode program switching is also provided in the DPB (refer to "Chapter 6-2-3" Correcting a Step). Please note that even if this edited program is switched the lead program is not changed.

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MEMO

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CHAPTER 8

OTHER OPERATIONS

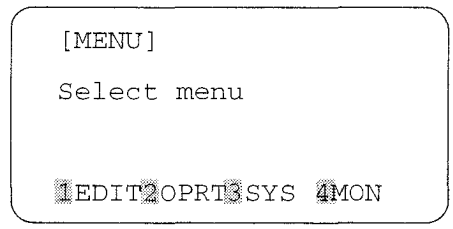
The DPB has many convenient functions in addition to those already covered. For example, memories can be initialized, and options such as memory cards and printer card can be used. This chapter will describe these additional functions.

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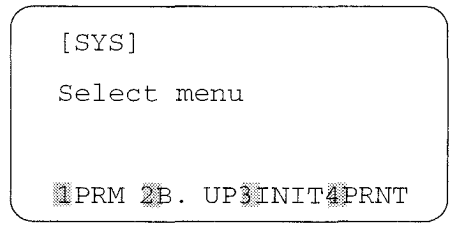
8-1 Initialization

Initialization of programs and points means that all programs and points currently stored in the controller will be erased.
Initialization of parameters resets the initial values for all of the parameters.

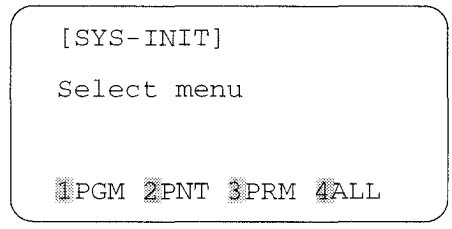
1) On the initial screen, press [F3] (SYS).



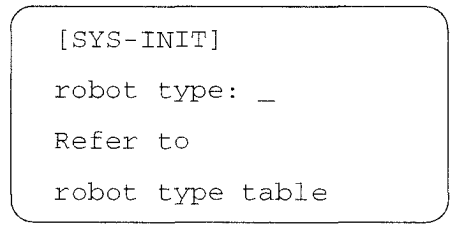
2) Next, press [F3] (INIT).



3) Select the data to be initialized.
Pressing [F1] (PGM) selects program data.
Pressing [F2] (PNT) selects point data.
Pressing [F3] (PRM) selects parameter data.
Pressing [F4] (ALL) selects all program, point and parameter data.



4) If [F3] (PRM) or [F4] (ALL) was selected in Step 3, the robot type must be input.
Use the numerical keys to input a number, and then press the [→] key.
For a table of numbers corresponding to the robot types, see the "Robot type number table" in Chapter 13-1.



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5) A confirmation message is displayed on the screen.
To execute the initialization, press F1 (yes).
To cancel the initialization, press F2 (no).

```
[SYS-INIT]
[parameter data]
initialize OK?
1yes 2no
```

6) When the initialization process ends, the screen returns to that shown at Step 3.

```
[SYS-INIT]
Select menu

1PGM 2PNT 3PRM 4ALL
```

8-2 DIO Monitor

The data indicating whether the I/O signals are on or off can be displayed on the screen. The operation procedure is outlined below.

8-2-1 Monitor Operation

1) On the initial screen, press F4 (MON).

```
[MENU]
Select menu

1EDIT2OPRT3SYS 4MON
```

2) The ON/OFF status of input and output is shown on the display. (See Chapter 4-2-3 for instructions on how to read the screen.)

```
[MON]

DI 00000000 10000000
DO 10000000 O:1 S:1
```

3) To return to the initial screen, press the ESC key.

```
[MENU]
Select menu

1EDIT2OPRT3SYS 4MON
```


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8-2-2 DIO Key Operation

1) Hold down the DIO key on the screen.

```
[OPRT-AUTO]
Running...
```

2) The ON/OFF status of I/O signals continues to be displayed on the screen as long as the DIO key is held down.

```
[OPRT-AUTO]
Running ...
DI 00000000 10000000
DO 10000000 O:1 S:1
```

3) When the key is released, the screen returns to the original screen.

```
[OPRT-AUTO]
Running ...
```

CAUTION

The DIO Monitor key does not function during system operation or terminal operation.

8-3 Viewing the System Version Number

1) On the initial screen, press the ESC key.

```
[MENU]
Select menu

1EDIT 2OPRT 3SYS 4MON
```

2) The version number of ROM of controller and DPB, and robot types are displayed. The screen returns to the initial screen after approximately two seconds.

```
[INFORMATION]
Controller  V 1. 01
DPB         V 1. 01
Robot type    20
```


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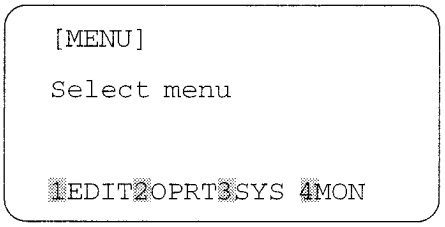
8-4 Using Memory Card

A memory card is made available to store backup SRC data set in DPB mode. With one 8K card enough data for 1 SRC units can be stored. With one 64K card enough data for 10 SRC units can be stored.

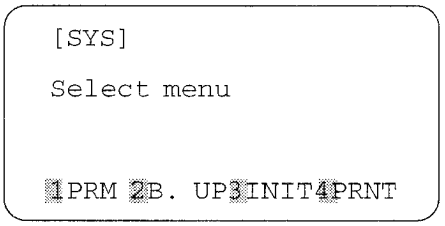
8-4-1 Saving Controller Data to a Memory Card

1) Insert the memory card in the DPB.

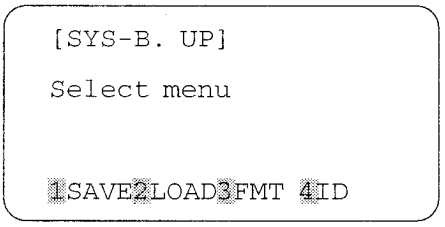
2) On the initial screen, press [F3] (SYS).



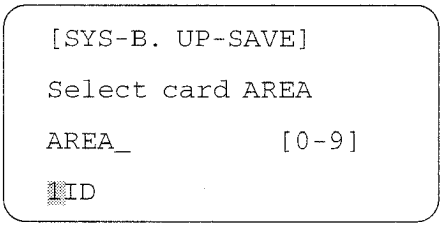
3) Next, press [F2] (B.UP).



4) Press [F1] (SAVE).



5) Specify the save area in the memory card. Use the numerical keys, and press the → key.



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6) If the data is stored in the selected card area, a confirmation message is displayed, asking if it is all right to overwrite previously existing, data.
Press [F1] (YES) for erasing. Press [F2] (NO) to cancel.

```
[SYS-B. UP-SAVE]
AREA 7 already saved
initialize OK?
1YES 2NO
```

7) This creates an ID number for the data being saved. Using the numerical keys (0-9), the "-" (minus) key, and the "." (period) key, enter a number of up to eight characters and then press the [→] key.

```
[SYS-B. UP-SAVE]AREA7
Make Identification
ID = _
Effective key[0→9-.]
```

8) A confirmation message asking if the data is to be saved as appears on the screen is shown to the right. To save the data, press [F1] (yes). To cancel the procedure without saving the data, press [F2] (no).

```
[SYS-B.UP-SAVE]AREA7
Save OK?
ID = 92.03.24
1YES 2NO
```

9) This screen is displayed while the data is being saved.

```
[SYS-B.UP-SAVE]AREA7
Saving...
```

10) When the saving procedure has been completed normally, the screen returns to that shown at Step 3.

```
[SYS-B. UP]
Select menu

1SAVE2LOAD3FMT 4ID
```

CAUTION

Never eject the memory card while data is being saved.
Do not store the DPB with the memory card set. The life of the backup batteries will be shortened.

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8-4-2 Downloading Data From a Memory Card

1) Operations for downloading data are the same as those for "8-5-1 Saving Controller Data to a Memory Card," up to Step 3.

2) Press [F2] (LOAD).

```
[SYS-B. UP]
Select menu

1SAVE2LOAD3FMT 4ID
```

3) Specify the load area in the memory card. Use the numerical keys, and press the [→] key.

```
[SYS-B. UP-LOAD]
Select card AREA
AREA_              [0-9]
1ID
```

4) Select the data to be loaded.
Pressing [F1] (PGM) selects program data.
Pressing [F2] (PNT) selects point data.
Pressing [F3] (PRM) selects parameter data.
Pressing [F4] (ALL) selects all program, point, and parameter data.

```
[SYS-B. UP-LOAD]AREA3
Select menu

1PGM 2PNT 3PRM 4ALL
```


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5) If either [F1] (PGM) or [F2] (PNT) was selected in Step 4, a confirmation message is displayed. This message asks if it is all right to overwrite previously existing data.. If [F1] (yes) is pressed, the program and point data that will not be overlapped by new data will remain as they are.
If [F2] (no) is selected, all of the controller data will be initialized before the data is loaded. If [F4] (ALL) is selected in Step 4, the controller data will also be initialized.

```
[SYS-B. UP-LOAD]AREA3

Overwrite OK ?
1yes 2no
```

6) A confirmation message is displayed on the screen, asking if it is all right to load the data. Press [F1] (yes) to load the data. To cancel the operation without loading the data, press [F2] (no).

```
[SYS-B. UP-LOAD]AREA3

Load OK ?
1yes 2no
```

7) This screen is displayed while the data is being loaded.

```
[SYS-B. UP-LOAD]AREA3
Loading ...
```

8) If the loading process is completed normally, the screen returns to that shown at the right.

```
[SYS-B. UP]
Select menu

1SAVE2LOAD3FMT 4ID
```

CAUTION

Never eject the memory card while loading data.
Do not store the DPB with the memory card set. The life of the backup batteries will be shortened.

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8-4-3 Formatting a Memory Card

1) Operations for formatting a memory card are the same as those for "8-5-1 Saving Controller Data to a Memory Card," up to Step 3.

2) Press F3 (FMT).

```
[SYS-B. UP]
Select menu


1SAVE2LOAD3FMT 4ID
```

3) A message like that at the right appears on the screen. To format the card, press F1 (yes).
To cancel the operation without formatting the card, press F2 (no).

```
[SYS-B. UP]
Format OK?


1yes 2no
```

4) This screen is displayed while the memory card is being formatted.

```
[SYS-B. UP]
Formatting


```

5) If the formatting process is completed normally, the screen returns to that shown at the right.

```
[SYS-B. UP]
Select menu


1SAVE2LOAD3FMT 4ID
```

CAUTION

Never eject the memory card while formatting it.
Do not store the DPB with the memory card set. The life of the backup batteries will be shortened.

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8-4-4 Viewing the ID Number for Memory Card Data

1) Operations are the same as those for "8-5-1 Saving Controller Data to a Memory Card," up to Step 3.

2) Press F4 (ID).

```
[SYS-B.UP]
Select menu

1SAVE2LOAD3FMT 4ID
```

3) Only the AREA 0 control number is displayed when the 8 kilobyte memory card is used. When the 64 kilobyte memory card is used, pressing STEP UP displays the control numbers in sequence, from 3 onwards.

```
[SYS-B.UP-ID]
AREA 0 : 92.03.24
AREA 1 :
AREA 2 : 92-02-24
```


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CHAPTER 9 COMMUNICATIONS WITH A PERSONAL COMPUTER

With the SRC Controller, a personal computer can be used instead of the DPB for program and point data editing and robot operation.

This chapter describes how to set the communication parameters required in order to carry out communications between the personal computer and the SRC Controller. The terms used in communication are also covered.

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9-1 Setting the Communication Parameters

The communication parameters on the personal computer side should be set as follows:

• Baud rate	9600 bps
• Stop bit length	1 bit
• Parity setting	Odd
• Parity check	On
• Data bit length	8 bits
• Communication method	Full duplex
• X parameter	Effective
• Return key transmission	CR code
• CR code reception	For CR/LF reception: Return + line feed For CR reception: Return

9-2 Communication Cable Specifications

A) Connector Model

Applicable connector no.: JBZ-25P-90 (made by J.S.T.)
Applicable connector cover no.: J-C25-2V (made by J.S.T.)

B) Connections

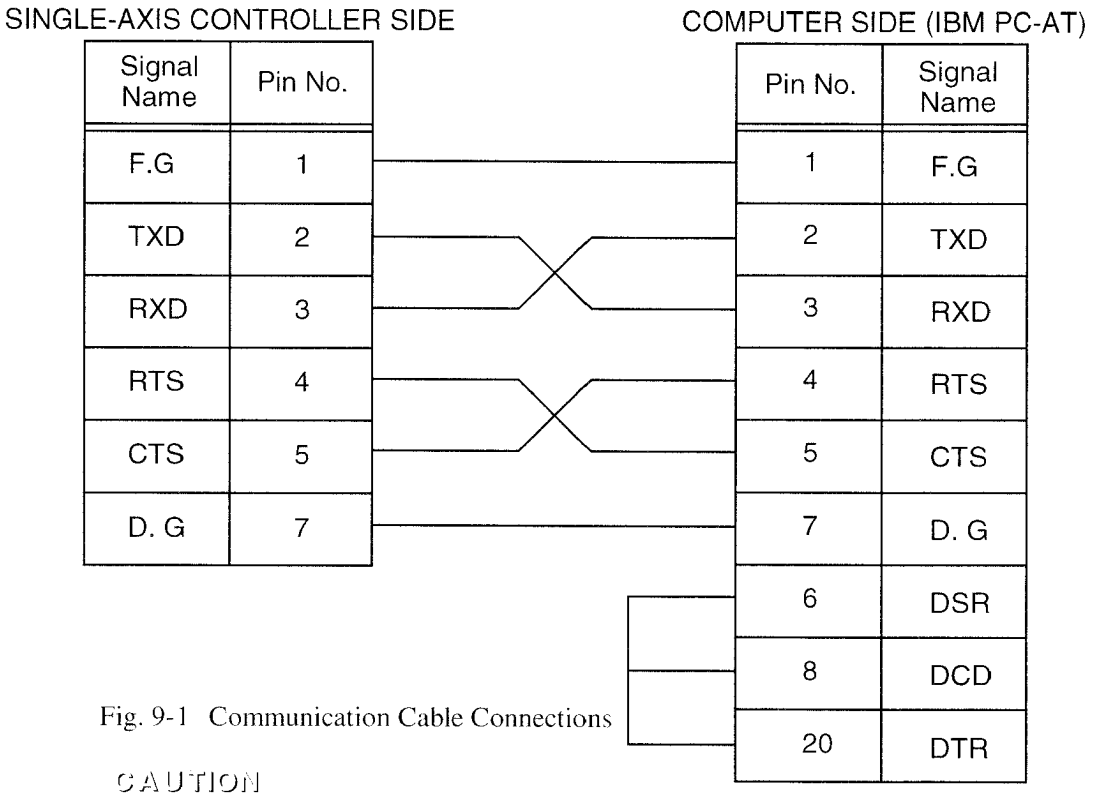


Fig. 9-1 Communication Cable Connections

CAUTION

Pins 10, 12, 18 and 21 of the RS-232-C are used for DPB connection. To prevent accidents, do not wire these pins.

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9-3 Communication Commands

With the SRC Controller, a command interface that resembles the BASIC programming language is provided as standard, to facilitate easy communication with a commercial personal computer.

Communication commands are divided into the following four categories:

1) Robot movements
2) Data handling
3) Utilities
4) Special codes

Basically, all of the commands begin with the start code '@' (=40H) and end with the code c/r (=0DH) l/f (=0AH). These two codes signal the controller that the instructions between them constitute one command line. (The special codes are the only ones that do not require a start or an end code.)
The character codes used in the SRC series, are the JIS8 unit system codes (ASCII codes with katakana characters added).

Format:

@ [Command] [_] <Extension 1> <Extension 2> <Extension 3> c/r l/f

@ : ---------- 40H, start code
[_] : ---------- Space
Command : --- See Table 9-1 Commands.
Option :-------- See Table 9-1 Commands. (May be omitted depending on the command.)
c/r l/f: ---------- OAH, end code
The code to distinguish Extensions is ',' (2CH).

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Table 9-1 Command List

Category	No.	Command	Extension 1	Extension 2	Extension 3	Command details
Robot Move-ment	1.	ORG/ORGN				Executes origin return
	2.	RESET				Program and I/O reset
	3.	RUN				Automatic run start
	4.	SRUN				Step run start
	5.	SRVO	0 1			Servo off execution Servo on execution
	6.	X+/X-				Axis jog movement (including inching)
	7.	XINC/XDEC				Axis jog movement
	8.	MOVD	Coordinate values (mm)	, Speed		Executes direct movement to a specified position (Coordinate)
	9.	MOVA	Point number	, Speed		Executes movement to an absolute position at a specified speed
	10.	MOVI	Point number	, Speed		Executes movement at an increment at a specified speed A
	11.	MOVF	Point number	, DI number	, 0 or 1	conditional move to a specified point unless or until the specified state of a specified input occures
	12.	DO	General-use output number	, 0 , 1		General-use output off General-use output on
	13.	WAIT	General-use input number	, 0 or 1		General-Use input on General-Use input off
	14.	TIMR	Time			Wait for specified time
	15.	P	Point variable			Point variable P definition
	16.	P+				Point variable P increment
	17.	P-				Point variable P decrement

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Table 9-1 Command List (Continued)

Category	No.	Command	Extension 1	Extension 2	Extension 3	Command details
Data Handling	1.	?POS				Reads current position
	2.	?NO				Reads current program number
	3.	?SNO				Reads current step number
	4.	?PNO				Reads current point number
	5.	?STP	Program number			Reads total number of steps in specified program
	6.	?MEM				Reads number of steps that can be added
	7.	?VER				Reads ROM version number
	8.	?EMG				Confirms emergency stop status
	9.	?SRVO				Confirms servo status
	10.	?ORG				Confirms status of return to origin
	11.	?MODE				Confirms movement mode
	12.	?PVA				Reads current point variable P
	13.	?DI	General-use input number			Reads general-use input status
	14.	?DO	General-use output number			Reads general-use output status
	15.	?PRM	Parameter number Parameter number	 ,Parameter number		Reads specified parameter data Reads specified multiple parameter data
	16.	?P	Point number Point number	 , Point number		Reads specified point data Reads specified multiple point data
	17.	READ	Program number PGM PNT PRM ALL DIO INF	, Step no.	, number of step	Reads specified program data Reads specified all program data Reads all point data Reads all parameter data Batch reads all program, point and parameter data Reads input/output information Reads program register information
	18.	WRITE	PGM PNT PRM ALL			Writes program data Writes point data Writes parameter data Batch writes all program, point and parameter data

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Table 9-1 Command List (Continued)

Category	No.	Command	Extension1	Extension 2	Extension 3	Command details
Utility	1.	INIT	PGM PNT PRM			Initializes program data Initializes point data Initializes parameters
	2.	SWI	Program no.			Switches no. of program to be run
	3.	SINS	Program no.	, Step no.		Inserts one program step
	4.	SDEL	Program no.	, Step no.		Deletes one program step
	5.	SMOD	Program no.	, Step no.		Modifies one program step
	6.	COPY	Original program no.	, Destination program no.		Copies program
	7.	DEL	Program no.			Deletes specified program
	8.	PDEL	Point number	, No. of points		Deletes point data

Category	No.	Code	Command details
Special codes	1.	^C (=03H)	Interrupts RUN, SRUN, ORG, etc.
	2.	^Z (=1AH)	Ends data transmission

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9-4 Details Concerning Communication Commands

9-4-1 Robot Movements

(1) @ORG or @ORGN

This executes a return to origin movement.
If execution ends normally, the machine reference amount is output.

Transmission example: @ORGc/r l/f

Response example 1: OK c/r l/f
50%c/r l/f
OKc/r l/f

Response example 2: NGc/r l/f
31: running____c/r l/f
The robot is running. Execute the command after stopping the robot.

(2) @RESET

This returns the program execution step to the first step of the program selected with the '@SWI' statement, and turns all general-use outputs (DO0 to DO4) off. The "current position in the program", used as a reference for the relative movement command (MOVI), and the point variable "P" are also cleared to 0.

Transmission example: @RESETc/r l/f

Response example 1: OK c/r l/f

Response example 2: NGc/r l/f
31: running____c/r l/f
The robot is running. Execute the command after stopping the robot.

(3) @RUN

This executes a program all the way to the last step.

Transmission example: @RUNc/r l/f

Response example 1: STOP c/r l/f
60: program_end___c/r l/f
The last step of the program has been executed.

Response example 2: NGc/r l/f
32:origin_incomplete____c/r l/f
A return to origin has not been carried out. Execute the command again after returning the robot to its origin position.

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(4) @SRUN

This executes only one step of a program.

Transmission example: @SRUNc/r l/f

Response example 1: OKc/r l/f

Response example 2: STOP c/r l/f
60: program_end___c/r l/f
The last step of the program has been executed.

Response example 3: NGc/r l/f
32: origin_incomplete____c/r l/f .
A return to origin has not been carried out.
Execute the command again after returning the robot to its origin position.

(5) @SRVO <parameter>

This is used to turn the servo on and off.

Parameter: 0 turns the servo off, while 1 turns it on.

Transmission example: @SRVO_0c/r l/f
This turns the servo off.

Response example: OKc/r l/f

(6) @X+, (@X-)

This moves the robot to the + or - side, based on the following equation.

Movement distance = PRM26 x 0.01 (mm)

PRM26: Teach movement data

Transmission example: @X + c/r l/f
The axis moves in the + direction by the distance equal to the movement amount specified above.

Response example: OKc/r l/f

Note: If the robot is a rotary axis, the unit is (deg).

(7) @XINC, @XDEC (when ROM version is V1.11 or subsequent)

@XINC moves the robot to the + side and XDEC to the - side, at the movement speed calculated by the equation below. The robot continues moving until the ^C code is input or the robot arrives at the soft limit.

Movement speed = PRM 25 x PRM 26 (mm/sec)

Transmission example: @XINC c/r l/f
The axis keeps moving in the + direction at the speed specified above.

Response example: OKc/r l/f

Note: If the robot is a rotary axis, the unit is (deg).
The soft limit will not function unless a return to origin has first been carried out.

(8) @MOVD <coordinate value (mm data)> , <speed>

This moves the robot to a specified coordinate position.

Coordinate value: The position to be moved to is directly specified. If the robot is a rotary axis, the unit is (deg).

Speed: A 100-step speed from 1 to 100 can be set, but if PRM30 (program execution speed) is set to 100, 100 will be the maximum rpm.

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Transmission example: @MOVD_50.37,100c/r l/f
Moves the robot to the position at 50.37 mm, at 100% speed.

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
30: soft_limit_over___c/r l/f
The soft limit has been exceeded. Change the point data or the soft limit parameter.

(9) @MOVA <point no.> , <speed>

This moves the robot to the position indicated by the data of the specified point number.

Point no.: This is a number assigned to any of the 255 points from 0 to 254. These points are edited with '@WRITE_PNT'. The point variable "P" can also be used.

Speed: A 100-step speed from 1 to 100 can be set, but if PRM30 (program execution speed) is set to 100, 100 will be the maximum rpm.

Transmission example: @MOVA_123,100c/r l/f
Moves the robot to Point 123 at 100% speed.

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
30: soft_limit_over___c/r l/f
The soft limit has been exceeded. Change the point data or the soft limit parameter.

(10) @MOVI <point no.> , <speed>

This moves the robot from the current position by only the distance specified by the point number data.

Point no.: This is a number assigned to any of the 255 points from 0 to 254. These points are edited with '@WRITE_PNT'. The point variable "P" can also be used.

Speed: A 100-step speed from 1 to 100 can be set, but if PRM30 (program execution speed) is set to 100, 100 will be the maximum rpm.

Note : No matter where the robot is, the current position immediately after RESET is executed will be (0.00). The current position immediately after stop (^C) is applied will not always be the same position as where the robot is mechanically located. Thus, always use the MOVI statement after an absolute position specified movement command such as MOVD or MOVA statement is executed.

Transmission example: @MOVI_123,100c/r l/f
Moves the robot by the distance defined by the data of Point 123, at 100% speed. (If the current position is 100.00 and P123 = 50.00, the target position is 150.00.)

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
30: soft_limit_over___c/r l/f
The soft limit has been exceeded. Change the point data or the soft limit parameter.

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(11) @MOVF <Point no.>, <DI no.>, <parameter>

The robot continues movement to the specified point position until the specified DI input enters the parameter state. Even if the specified DI input does not enter the parameter state, the command will end correctly when the specified point is reached. The movement speed is set with PRM9 (MOVF speed), and is not affected by MRP30 (program execution speed).

Point no.: This is a number assigned to any of the 255 points from 0 to 254. These points are edited with '@WRITE_PNT'. The point variable "P" can also be used.

DI no.: One of the general-use inputs 0 to 8 is indicated.

Parameter: 1 indicates on and 0 indicates off.

Transmission example: @MOVF–2,5,1c/r,1/f ... Moves to point 2 until DI5 becomes 1.

Response example: OKc/r l/f

(12) @DO <general-use output no.> , <parameter>

This is used to turn the general-use output on and off.
General-use output number: There are five general-use outputs, indicated by numbers 0 to 4.

Parameter: 0 turns the output off, while 1 turns it on.

Transmission example: @DO_3,1c/r l/f
This turns general-use output 3 on.

Response example: OKc/r l/f

(13) @WAIT <General-use input no.>, <parameter>

Waits until the specified general-use input enters the parameter state.

General-use input number: One of the general-use inputs 0 to 8 is indicated.

Parameter: 1 indicates on and 0 indicates off.

Transmission example: @WAIT_1,1c/r l/f ... Waits until DI1 becomes 1.

Response example: OKc/r l/f

(14) @TIMR <Time>

Waits until the specified time.

Time: Set between 1 and 65535 in 10ms increments.

Transmission example: @TIMR_100c/r l/f ... Waits one second.

Response example: OKc/r l/f

(15) @P <Point variable>

This sets the point variable P.

Point variable: A value between 0 to 254 can be specified.

Transmission example: @P_100c/r l/f ... Set point variable P to 100.

Response example: OKc/r l/f

Note: The contents of point variable "P" are held even when the controller power is turned off, but when the program is reset or when the program reset is applied by switching the execution program, etc., the point variable "P" will be initialized to 0.

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(16) @P+

Increments the point variable P. (P=-P+1)

Transmission example: @P+c/r l/f

Response example: OKc/r l/f

(17) @P-

Decrements the point variable P. (P=-P-1)

Transmission example: @P-c/r l/f

Response example: OKc/r l/f

9-4-2 Data Handling

(1) @?POS

Reads the current position.

Transmission example: @?POSc/r l/f

Response example: 321.05c/r l/f
OKc/r l/f

(2) @?NO

Reads the current program number.

Transmission example: @?NO c/r l/f

Response example 1: 31c/r l/f ... Program NO31 is being executed.

Response example 2: 10/lc/rl/f ... The NO1 program is the head program (program selected with @SW1 statement), and currently program NO10 is being executed with the JMP or CALL statement, etc.
OKc/r l/f

(3) @?SNO

Reads the current step number.
@RUN and @SRUN are executed from the step read here.

Transmission example: @?SNOc/r l/f

Response example: 170c/r l/f
OKc/r l/f

(4) @?PNO

Reads the currently selected point number. This is used to find which point data is being used for movement, or to find the point that caused an error when an error occurs.

Transmission example: @?PNOc/r l/f

Response example: 57c/r l/f
OKc/r l/f

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(5) @?STP <program no.>

Reads the total number of steps in the specified program.

Program no.: One of 32 numbers ranging from 0 to 31 which may be assigned to a program.

Transmission example: @?STP10c/r l/f
Reads the total number of steps for Program No. 10.

Response example: 140c/r l/f
OKc/r l/f

(6) @?MEM

Reads the number of steps that can be added.

Transmission example: @?MEMc/r l/f

Response example: 1001c/r l/f
OKc/r l/f

Note: In addition to the number of existing steps, steps equivalent to the number of programs are consumed internally as the program control steps. For example, if one program is registered having 50 steps exists, the number of free steps remaining will be as follows.
1024 - 1 - 50 = 973

(7) @?VER

Reads the controller ROM version.

Transmission example: @?VERc/r l/f

Response example: 2.75 c/r l/f
OKc/r l/f

(8) @?EMG

Reads the emergency stop status.

Transmission example: @?EMGc/r l/f

Response example 1: 0c/r l/f
OKc/r l/f
Emergency stop is off.

Response example 2: 1c/r l/f
OKc/r l/f
Emergency stop is on.

(9) @?SRVO

Reads the servo status.

Transmission example: @?SRVOc/r l/f

Response example 1: 0c/r l/f
OKc/r l/f
Servo is off.

Response example 2: 1c/r l/f
OKc/r l/f
Servo is on.

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(10) @?ORG

Reads whether or not a return to origin has been completed.

Transmission example: @?ORGc/r l/f

Response example 1: 0c/r l/f
OKc/r l/f
Return to origin not completed.

Response example 2: 1c/r l/f
OKc/r l/f
Return to origin completed.

(11) @?MODE

Reads the robot status.

Transmission example: @?MODEc/r l/f

Response example 1: 0c/r l/f
OKc/r l/f
Robot is stopped.

Response example 2: 1c/r l/f
OKc/r l/f
Program from DPB or computer is being run.

Response example 3: 2c/r l/f
OKc/r l/f
Program from I/O is being run.

(12) @?PVA

Reads the point variable P

Transmission example: @?PVAc/r l/f

Response example: 0c/r l/f
OKc/r l/f

Note: The contents of point variable "P" are held even when the controller power is turned off, but when the program is reset or when the program reset is applied by switching the execution program, etc., the point variable "P" will be initialized to 0.

(13) @?DI <General-use input no.>

Reads the general-use input status of the specified number.

General-use input no.: One of the nine general-use inputs from 0 to 8.

Transmission example: @?DI_lc/r l/f

Response example 1: 0c/r l/f
OKc/r l/f
Input status off

Response example 2: lc/rl/f
OKc/r l/f
Input status on

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(14) @?DO <general-use output no.> (when ROM version is V1.08 or later)

Reads the general-use output status.

Transmission example: @?DO_2c/r l/f

Response example 1: 1c/r l/f
OKc/r l/f
Output is on.

Response example 2: 0c/r l/f
OKc/r l/f
Output is off.

(15-1) @?PRM <Parameter no.>

Reads the specified parameter data.

Parameter no.: Characteristic number from 0 to 37 assigned to each parameter.

Transmission example: @?PRMl crl/f
Reads the parameter 1 data.

Response example 1: 350c/r l/f
OKc/r l/f

Response example 2: c/r l/f
OKc/r l/f
When parameter is not registered.

(15-2) @?PRM <Parameter no.>, <Parameter no.>

Reads multiple data from the first parameter number to the latter parameter number.

Non-registered parameters are not displayed.

Parameter no.: Characteristic number from 0 to 37 assigned to each parameter.

Transmission example: @?PRMl,5crl/f
Reads the data from parameters 1 to 5.

Response example: PRM1=350c/r l/f
PRM2=0c/r l/f
PRM3=30c/r l/f
PRM4=100c/r l/f
PRM5=0c/r l/f
OKc/r l/f

(16-1) @?P <Point no.>

Reads the specified point data.

Point no.: Characteristic number from 0 to 254 assigned to each point.

Transmission example: @?P254crl/f
Reads the point 254 data.

Response example 1: -0.05c/r l/f
OKc/r l/f

Response example 2: c/r l/f
OKc/r l/f
When point data is not registered.

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(16-2) @?P <Point no.>, <Point no.>

Reads multiple point data from the first point number to the latter point number. If a non-registered point exists, it will be skipped.

Point no.: Characteristic number from 0 to 254 assigned to each point.

Transmission example: @?P15,22crl/f

Reads the data from points 15 to 22.

Response example:
P15=100.00c/r l/f
P16=32.11c/r l/f
P20=220.00c/r l/f
P22=0.50c/r l/f
OKc/r l/f

(17-1) @READ <program no.> , <step no.> , <no. of steps>

Reads the specified step number data for the specified program number.

Transmission example: @READ_3,50,1

Reads one step of data from step 50 in Program No. 3.

Response example 1:
MOVA_29,100c/r l/f
^Z(=1AH)
OKc/r l/f

Response example 2:
NGc/r l/f
42: cannot_find_step____c/r l/f
The specified step number has not been registered.

(17-2) @READ PGM

Reads all of the program data.

Transmission example: @READ_PGMc/r l/f

Response example:
NO0c/r l/f
MOVA_0,100c/r l/f
JMPF_0,31,13c/r l/f
NO31c/r l/f
STOPc/r l/f
^Z(=1AH)
OKc/r l/f

(17-3) @READ PNT

Reads all point data.

Transmission example: @READ_PNTc/r l/f

Response example:
P0=0.00c/r l/f
P1=350.00c/r l/f
P2=196.47c/r l/f
P254=-0.27c/r l/f
^Z(=1AH)
OKc/r l/f

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(17-4) @READ PRM

Reads all parameter data.

Transmission example: @READ_PRMc/r l/f

Response example:
PRM0=20c/r l/f
PRM1=350.00c/r l/f
|
|
PRM31=100c/r l/f
^Z(=1AH)
OKc/r l/f

(17-5) @READ ALL

Batch reads all data (parameters, programs, points). The data groups (parameters, programs, points) are distinguished only when there is a carriage return.

Transmission example: @READ_ALLc/r l/f

Response example:
PRM0=20c/r l/f
PRM1=350c/r l/f
|
|
PRM37=100c/r l/f
c/r l/f
NO0c/r l/f
MOVA_0, 100c/r l/f
MOVA_1, 100c/r l/f
NO10c/r l/f
CALL_0, 10c/r l/f
STOPc/r l/f
c/r l/f
P0=0.00c/r l/f
P1=550.00c/r l/f
^Z (=1AH)
OKc/r l/f

(17-6) @READ DIO

Reads the ON/OFF status for DIO.

Transmission example: @READ_DIOc/r l/f

Response example:
DI_00000000_00000000c/r l/f
DO_10000000_O:1_S:1_c/r l/f
OKc/r l/f

(17-7) @READ INF

Reads the status registered for the program.

Transmission example: @READ_INFc/r l/f

Response example:
NO0-_43_stepsc/r l/f
NO1-_52_stepsc/r l/f
|
|
NO31-_21_stepsc/r l/f
^Z(=1AH)
OKc/r l/f

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(18-1) @WRITE PGM

Writes the program data. The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the program data. Always transmit ^Z (=1AH) at the end of the data.

Transmission example:

Send	Receive
@WRITE_PGMc/r l/f	
	READYc/r l/f
NO0c/r l/f	
MOVA_0,31,12c/r l/f	
JMPF_0,31,12c/r l/f	
NO31c/r l/f	
STOPc/r l/f	
^Z(=1AH)	
	OKc/r l/f

Note: When WRITE_PGM is executed, previous data is left as it is as long as the program number being written does not overlap a previous program number.

(18-2) @WRITE PNT

Writes the point data. The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the program data. Always transmit ^Z (=1AH) at the end of the data.

Transmission example:

Send	Receive
@WRITE_PNTc/r l/f	
	READYc/r l/f
P0=0.00c/r l/f	
P1=350.00c/r l/f	
P254=-0.27c/r l/f	
^Z(=1AH)	
	OKc/r l/f

Note: When WRITE_PNT is executed, previous data is left as it is as long as the point number being written does not overlap a previous point number.

(18-3) @WRITE PRM

Writes the parameter data. The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the program data. Always transmit ^Z (=1AH) at the end of the data.

Transmission example:

Send	Receive
@WRITE_PRMc/r l/f	
	READYc/r l/f
PRM1=550.00c/r l/f	
PRM2=10.00c/r l/f	
^Z(=1AH)	
	OKc/r l/f

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(18-4) @WRITE ALL

Batch writes all data (parameters, programs and points). The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the program data. Always transmit ^Z (=1AH) at the end of the data.

Transmission example:	Send	Receive
	@WRITE_ALLc/r l/f	
		READYc/r l/f
	PRM0=20c/r l/f	
	PRM1=350c/r l/f	
	c/r l/f	
	NO10c/r l/f	
	CALL_0, 20c/r l/f	
	STOPc/r l/f	
	c/r l/f	
	P1=550.00c/r l/f	
	^Z(=1AH)	
		OKc/r l/f

Note: Always leave one or more blank space to distinguish the data groups (parameters, programs, points). There is no specification in the data group row. There can be data groups that are not written in. When WRITE_ALL is executed, if the write block is not duplicated with the previous program number and if the previous program number and write point number are not duplicated, the previous data will not be lost.

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9-4-3 Utilities

(1-1) @INIT PGM

Initializes all program data.

Transmission example: @INIT_PGMc/r l/f

Response example: OKc/r l/f

(1-2) @INIT PNT

Initializes all point data.

Transmission example: @INIT_PNTc/r l/f

Response example: OKc/r l/f

(1-3) @INIT PRM <robot type no.>

Initializes parameter data.

Transmission example: @INIT_PRM20c/r l/f
Parameter data is initialized for the LT standard type.

Response example: OKc/r l/f

(2) @SWI <program no.>

Switches the execution program number. When program reset is executed hereafter, the first step of the program selected here will be returned to. The program will be reset when the '@SWI' command is executed.

Transmission example: @SWI_31c/r l/f

Response example: OKc/r l/f

(3) @SINS <program no.> , <step no.>

Inserts data in a specified step of a specified program. The data following the specified step will be shifted behind the inserted data. If the step following the last step is specified, a new step will be added. If the first step of a program that does not exist is specified, a new program will be created. The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the insertion data.

Transmission example 1:	Send	Receive
	@SINS_19,4c/r l/f	
		READYc/r l/f
	TIMR_50c/r l/f	
		OKc/r l/f

Transmission example 2:	Send	Receive
	@SINS_19,4c/r l/f	
		NGc/r l/f
		43: cannot_find_PGM____c/r l/f

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(4) @SDEL <program no.> , <step no.>

Deletes a step.

Transmission example: @SDEL_31,99 c/r l/f
Deletes Step 99 of Program No. 31.

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
The specified step number has not been registered.
42: cannot_find_step____c/r l/f

(5) @SMOD <program no.> , <step no.>

Modifies data in a specified step. The controller will transmit READY when this command is received. Confirm that READY is received, and then transmit the modification data.

	Send	Receive
Transmission example 1:	@SMOD_0,5c/r l/f	
		READYc/r l/f
	TIMR_50c/r l/f	
		OKc/r l/f

	Send	Receive
Transmission example 2:	@SMOD_0,5c/r l/f	
		NGc/r l/f
		43: cannot_find_PGM____c/r l/f

(6) @COPY <no. of original program> , <no. of destination program>

Copies a program. If a program exists in the copy destination, the program will be rewritten.

Transmission example: @COPY_0,1c/r l/f
Copies Program No. 0 to Program No. 1.

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
43: cannot_find_PGM____c/r l/f
The program to be copied has not been registered.

(7) @DEL <Program no.>

Deletes a program.

Transmission example: @DEL_10c/r l/f
Deletes Program No. 10.

Response example 1: OKc/r l/f

Response example 2: NGc/r l/f
43: cannot_find_PGM____c/r l/f
The program to be deleted has not been registered.

(8) @PDEL <point no.> , <no. of points>

Deletes point data Deletes the specified number of points starting with the point number specified.

Transmission example: @PDEL_16,10c/r l/f
Deletes 10 points starting from Point 16 (up to Point 25).

Response example 1: OKc/r l/f

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CHAPTER 10

MESSAGE TABLES

This section lists all of the messages that can be displayed on the DPB or sent to the personal computer to inform the operator of an error in operation or to relate a current status. For a list of the alarm messages displayed if your equipment breaks down, please refer to Chapter 11.

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10-1 Error Messages

Message transmission format:

[Error No.] : [Error message] cr/lf

The length of the [error message] character string is 17 characters. (Spaces are added until the message contains 17 characters.) Thus, the character string length containing the cr/lf will be 22 characters.

Table 10-1 Error Messages Related to Commands

Error No. 20	Message	no start code
	Cause	The start code (@) has not been added at the beginning of the command.
	Remedy	Always made sure the command begins with a start code (@).
Error No. 21	Message	illegal type
	Cause	The command is erroneous.
	Remedy	Use the correct command.
Error No. 22	Message	line buf over
	Cause	The number of characters in one line exceeds 30.
	Remedy	Limit the number of characters per line to 30 or less.
Error No. 23	Message	data error
	Cause	There is an error in numeric data.
	Remedy	Correct the data.

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Table 10-2 Error Messages Related to Operations

Error No. 30	Message	soft limit over
	Cause	When a command is executed, the robot's position exceeds the soft limit set by the parameter.
	Remedy	Review the point data or soft limit parameter.
Error No. 31	Message	running
	Cause	Another command is already being executed, so the command cannot be accepted.
	Remedy	Wait until execution of the current command finishes before inputting another command.
Error No. 32	Message	origin incomplete
	Cause	The command cannot be executed because a return to origin has not yet been completed.
	Remedy	Complete a return to origin first.
Error No. 33	Message	emergency stop
	Cause	The command cannot be executed because an emergency stop is in effect.
	Remedy	Cancel the emergency stop.
Error No. 34	Message	servo off
	Cause	The command cannot be executed because the servo is off.
	Remedy	Turn the servo on.

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Table 10-3 Error Messages Related to the Program

Error No. 40	Message	stack overflow
	Cause	More than six successive call statements have been used within a call statement.
	Remedy	Call statements can only be used up to 5 times within a call statement.
Error No. 41	Message	cannot find label
	Cause	The specified label cannot be located.
	Remedy	Create the required label.
Error No. 42	Message	cannot find step
	Cause	The specified step cannot be located.
	Remedy	Check whether the step number is the wrong one.
Error No. 43	Message	cannot find PGM
	Cause	The specified program cannot be located.
	Remedy	Check whether the program number is the wrong one.
Error No. 44	Message	PGM memory full
	Cause	The total number of steps in all of the programs has exceeded 1024.
	Remedy	Delete unnecessary programs or steps.
Error No. 45	Message	step over
	Cause	The total number of steps in one program has exceeded 255.
	Remedy	Delete unnecessary steps or split the program into two parts.

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Table 10-4 Error Messages Related to the System

Error No. 50	Message	system error
	Cause	An unexpected error without a logical cause.
	Remedy	Contact Yamaha and describe the problem.
Error No. 51	Message	illegal opecode
	Cause	There is an error in a registered program.
	Remedy	Check the program.
Error No. 52	Message	no point data
	Cause	No data has been registered for the specified point number.
	Remedy	Register the point data.
Error No. 53	Message	PRM0 data error
	Cause	The robot type number has been set incorrectly.
	Remedy	Check the robot type number table and correct the parameter initialization.
Error No. 54	Message	PRM8 data error
	Cause	The number of conditional input points is set to something other than 1-8.
	Remedy	Correct the setting for the PRM 8 parameter.

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Table 10-5 DPB Error Messages

The following messages are displayed only during DPB operation.

1	Message	SIO error
	Cause	1. Parity error in data received from controller. 2. DPB was connected when special-use command input was on.
	Remedy	1. Contact Yamaha for consultation. 2. Turn all special-use command inputs off before connecting the DPB.
2	Message	bad format
	Cause	The memory card is not formatted.
	Remedy	Format the memory card.
3	Message	save error
	Cause	Error in writing to the memory card.
	Remedy	Replace the memory card.
4	Message	load error
	Cause	The memory card data is damaged.
	Remedy	Replace the memory card.
5	Message	checksum error
	Cause	The memory card data is damaged.
	Remedy	Replace the memory card.
6	Message	battery error
	Cause	The memory card battery voltage dropped.
	Remedy	Replace the memory card battery.
7	Message	printer busy!!
	Cause	The printer is not ready.
	Remedy	Set the printer in the PRINT status.

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10-2 Stop Messages

Message transmission format:

[Error No.] : [Stop message] cr/lf

The length of the [stop message] character string is 17 characters. (Spaces are added until the message contains 17 characters.) Thus, the character string length containing the cr/lf will be 22 characters.

Table 10-6 Error Messages for Stop Commands

No. 60	Message	program end
	Meaning	Execution has stopped because the program has ended.
No. 61	Message	stop key
	Meaning	Execution has stopped because the Stop key on the DPB was pressed.
No. 62	Message	interlock
	Meaning	Execution has stopped because an I/O interlock was applied.
No. 63	Message	stop command
	Meaning	Execution has stopped because the STOP command was received.

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CHAPTER 11

TROUBLESHOOTING

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11-1 Breakdowns

The steps to be taken when a breakdown occurs are divided into two general categories, depending on whether or not a controller alarm is output. When contacting Yamaha regarding a breakdown, please include the following information, in as much detail as possible.

Table 11-1 Information Needed to Asses a Breakdown

Item	Content (Example)
What is the name of the model?	• Controller model name: SRC-1-100... • Robot type name: LT, BS, LS...
When did the problem happen?	• Did the problem occur right after the unit was purchased? • How long was it used for, and under what conditions, when the problem occurred? • Did it happen when the power was turned on? One hour after the power was turned on?
Under what conditions did it happen?	• During automatic operation • While writing a program • The position of the robot when the problem occurs
What happened when the problem occurred?	• The servo doesn't lock. • An alarm is output. • The motor makes an unusual sound. • A program disappeared.
How frequently does the problem occur?	• The problem always occurs. • It occurs once an hour. • It can't be reproduced.

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11-2 Handling Alarms

Whenever the READY signal goes off, if the equipment is not in emergency stop status, an alarm is judged to have been output. If this happens, please leave the power on and connect the DPB, in order to check the contents of the alarm. An alarm message will be displayed on the DPB to let you know the content.

(Example)



The Table 11-2 lists the alarm number, the corresponding message, the probable cause of the alarm, and indicates what to do in case of an alarm. After an alarm has occurred, operation cannot be restarted until the power has been turned off and then on again.

Table 11-2 Alarm Solutions

Alarm No.	Alarm Message	Meaning	Probable Cause	Remedy
01	OVER LOAD	Excessive load on motor	(1) The current flowing to the motor has exceeded the rated value. (2) Defective motor (3) Defective parameter	(1) Lower the operational load on the robot. Reduce the acceleration parameter. (2) The armature resistance of the motor is too low. If the motor feels unusually heavy and resists being turned by hand, replace it. (3) Initialize the parameter.
02	OVER CURRENT	Excessive current to motor	(1) Shorted motor cable (2) Defective motor (3) Defective controller (4) Defective parameter	(1) Test the motor cables for conductivity, and replace any that have problems. (2) Replace the motor if there are any internal short circuits. (3) If the resistance between motor terminals MA and MB is less than 1 kΩ, the output transistor is broken and the controller should be replaced. (4) Initialize the parameter (check the robot type).
03	OVER HEAT	Transistor has heated to 90°C or above.	(1) Rise in ambient temperature (within 40°C) (2) Excessive load on motor (3) Defective transistor	(1) Correct the ambient environmental conditions. (2) Lower the operational duty on the robot. (3) If the equipment is being used correctly, the transistor may be defective, so the controller should be replaced.

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Table 11-2 Alarm Solutions (Continued)

Alarm No.	Alarm Message	Meaning	Probable Cause	Remedy
04	POWER DOWN	Power supply voltage has dropped to less than 90% of rated value.	(1) Insufficient capacitance of power supply line (2) Wrong power supply voltage being used	(1) Check the power supply capacitance and increase it if necessary. (2) Check the voltage specifications of the controller on the seal affixed to it.
05	BATT.LOW-VOLTAGE	Low voltage in backup battery	(1) Battery life is up. (2) Defective battery	(1) Replace battery. (2) Replace battery.
06	WIRE TROUBLE	Motor or encoder cable is disconnected or wired incorrectly.	(1) Motor cable is disconnected or improperly wired. (2) Encoder cable is disconnected or improperly wired. (3) Defective or disconnected electromagnetic brake	(1) Check motor cable connections. (2) Check encoder cable connections. (3) Apply 24 V to brake line and check brake release.
07	P.E. COUNTER OVER	Overflow in position deviation	(1) Mechanical lock (2) Motor cable is disconnected or improperly wired. (3) Defective or disconnected electromagnetic brake (4) Abnormal parameter	(1) Check whether mechanism in movable part of robot is locked. (2) Check encoder cable connections. (3) Apply 24 V to brake line and check brake release. (4) Initialize parameter.
08	PNT DATA DESTROY	Point data has been damaged.	(1) Defective backup circuit (2) Power was turned off while writing data.	(1) (2) In emergency stop status, turn on the power supply and check the point data. If part of the data is defective, correct it. If all of the data is defective, initialize the point data and then reload it. If there is no problem with the data, any data can be used, so substitute different data for the damaged points.
09	PRM DATA DESTROY	Parameter data has been damaged.	(1) Defective backup circuit (2) Power was turned off while writing data.	(1) (2) In emergency stop status, turn on the power supply and initialize the parameters.
10	PGM DATA DESTROY	Program data has been damaged.	(1) Defective backup circuit (2) Power was turned off while writing data.	(1) (2) In emergency stop status, turn on the power supply and check the point data. If part of the data is defective, correct it. If all of the data is defective, initialize the point data and then reload it. If there is no problem with the data, any data can be used, so substitute different data for the damaged points.

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Table 11-2 Alarm Solutions (Continued)

Alarm No.	Alarm Message	Meaning	Probable Cause	Remedy
11	SYSTEM FAULT	Software problem	(1) External noise or other factors have disrupted software program. (2) Reception buffer overflow When communicating with a personal computer, the XON/ XOFF control communication parameter has not been selected on the personal computer side.	(1) Check the environment for noise. (2) Select XON/XOFF control
12	BAD ORG-SENSOR	Origin sensor defect	(1) Origin sensor wire breakage (2) Origin sensor defect (3) Incorrect origin dog adjustment	(1) (2) Replace the origin sensor ass'y (3) Readjust
13	BAD PZ	Encoder Z-phase defect	(1) Encoder PZ-phase wire breakage (2) Encoder defect	(1) Repair wiring or replace motor ass'y. (2) Replace motor ass'y.
14	FEEDBACK ERROR1	Reverse connection of motor and encoder wires	(1) Reverse connection of motor wire (2) Reverse connection of encoder wire (3) Incorrect parameter	(1) Check motor wire connection. (2) Check encoder wire connection. (3) Initialize parameters.
15	FEEDBACK ERROR2	Breakage in mode or encoder wire	(1) Motor wire breakage (2) Encoder wire breakage (3) Defect or wire breakage in magnetic brakes Brake defect (4) Incorrect parameter (5) Drop in voltage at stopper origin	(1) Check motor wire connection. (2) Check encoder wire connection. (3) Apply 24V on brake wire, and confirm that brakes are released. (4) Initialize parameters. (5) Check power capacity.
16	ABNORMAL VOLTAGE	Regenerative circuit did not function and abnormal overvoltage occurred	(1) Rise in regenerative absorption resistor temperature(over 120°C). (2) Controller defect	(1) Lower the robot rotation duty. Install a forced cooling fan. (2) If there is no problem in the usage, the regenerative circuit is defective. Replace the controller.
17	SYSTEM FAULT 2	Detection of controller internal LSI error	(1) Internal LSI is defective or malfunctioning	(1) If the fault occurs after an emergency stop or servo ON/OFF, turn the power ON again. If the fault occurs frequently, the LSI is defective so replace the controller.

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CAUTION

(1) If an alarm listed on the previous page occurs when the power is turned on, try turning on the power while an emergency stop is in effect. Alarm detection is not carried out under these circumstances, so data can be checked, corrected, and initialized. Alarm detection will resume once the emergency stop is canceled and the servo is turned on.

(2) The one exception to the above is detection of low voltage in the backup battery. Use the DPB operations or the I/O Reset signal to turn on the servo during an emergency stop if this alarm occurs when the power is on and the battery can not be replaced immediately. This alarm is the only one for which detection is not carried out when the servo is turned on after canceling an emergency stop. However, the battery should be replaced as quickly as possible.

11-3 Handling Other Types of Breakdowns

If any problems develop while the equipment is being used, check the items below for the appropriate way to handle them. If the problem cannot be corrected using the steps listed below, please contact a Yamaha dealer or representative right away.

Table 11-3 Breakdowns and Solutions Involving Robot Movement

No	Symptom	Probable Cause	Items to Check	Remedy
1	The servo of the robot does not lock when the power is turned on.	1) Power is not being supplied.	Check whether the "POWER" lamp on the controller panel is lighted.	Check the power supply plug voltage. Check whether the fuse for the 100 VAC in the power supply switch unit has blown. (See Chapter 12-5 for instructions on replacing fuses.)
		2) An emergency stop is in effect.	If the READY signal of the I/O connector is off and no alarm has been issued, an emergency stop is in effect.	Check whether the Emergency Stop switch of the DPB or the I/O emergency stop input (between EMG1 and EMG2) is on. Check the fuse in "FUSE" on the controller panel.
		3) The servo is off.	Check whether the servo has been turned off in the program, and whether the ESC switch has been held down when the DPB connector was unplugged.	Turn on the servo using either the I/O Reset signal or DPB operation.
		4) An alarm has occurred.	Connect the DPB and check whether an alarm is displayed.	Take the appropriate measures for handling the alarm.
2	Abnormal noise or vibration is occurring.	1) A coupling has not been tightened properly.	1) Check parts that should be tightened.	1) If any couplings are loose, tighten them.
		2) A screw is loose in the cover.	2) Check the locations where the cover is attached.	2) If screws are loose, tighten them.

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Table 11-3 Breakdowns and Solutions Involving Robot Movement (Continued)

No	Symptom	Probable Cause	Items to Check	Remedy
2	Abnormal noise or vibration is occurring.	3) Surfaces where the robot is attached are not flat and even.	Measure degree of leveling.	Correct if outside the tolerance limit.
		4) Guide abnormality	Check for foreign matter, damage, or deformation.	Replace the guide. Check to make sure guide is being used properly.
		5) Ballscrew abnormality	Check for foreign matter, damage, or deformation.	Replace the ballscrew. Check to make sure the robot is being used properly.
		6) Bearing abnormality	Inspect for noise or vibration around the axes.	Replace the bearing
		7) Defective encoder	Try replacing the motor.	If operation returns to normal, replace the motor.
		8) Defective motor case grounding	Measure to see if the resistance between the motor case and the E terminal of the controller is 1 or less.	If the resistance value is too high, repair any places where the robot cable is disconnected or not connected properly.
		9) Defective controller	Try using a different controller.	If operation returns to normal, replace the controller. Check the controller model
3	When a position offset occurs, at first leave the power on and execute a return to origin. Depending on the results of the return to origin, there are two possible causes of the problem: If the position offset is not corrected by the return to origin: ↓ Mechanical offset-see causes 1 to 3 If the position offset is corrected by the return to origin: ↓ Electrical offset-see causes 4 to 6	1) A coupling is not tightened correctly.	Check the coupling that should be tightened.	If loose, tighten.
		2) A ballscrew is loose.	Check the ballscrew that should be tightened.	If loose, tighten.
		3) Defective robot attachment	Make sure there are no loose parts where the robot is attached.	If loose, tighten.
		4) Defective encoder	Try replacing the motor.	If operation returns to normal, replace the motor.
		5) Erroneous movement because of noise	Check whether the motor case is grounded. Measure the resistance between the motor case and the E terminal of the controller to see if it is 1 or less. Check whether the E terminal of the controller is grounded.	Check connections or cable and connectors. Also, if using the equipment near a unit that generates noise, such as welding machines and electric discharge machines, move it as far away as possible. If the entire unit cannot be moved, at least move the power supply away. Noise filters and isolating transformers can also be inserted.
		6) Defective controller	Try using a different controller.	If operation returns to normal, replace the controller.

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Table 11-3 Breakdowns and Solutions Involving Robot Movement (Continued)

No	Symptom	Probable Cause	Items to Check	Remedy
4	When a return to origin is carried out, the alarm stops after the robot bumps into the stroke end (overload). * With the FT, BS, LT, LR, and LS types, no origin point sensor is used, so cause 1 cannot apply. * With the FROP, MT, MS, HS and HSL types, cause 3 cannot apply.	1) Defective origin point sensor	Remove the cover and check the sensor operation by looking at the LED. Origin position: LED goes out. Other positions: LED lights.	If the LED does not respond, replace the origin point sensor.
		2) Defective encoder or encoder cable	Check the zero signal of the encoder (robot I/O PZ signal) with an oscilloscope. Zero position:0 V Other positions: 5 V	If PZ is not output, replace the motor.
		3) Erroneous or defective setting of parameter	Sub-parameter PRM 13 should be set to 1.	If PRM 13 is abnormal, try initializing the parameter.
5	When the power is turned on, the robot moves at high speed. * The controller has a built-in sensor to detect disconnected cables, but the items at the right should be checked anyway.	1) Motor cables have been reversed.	Check connections of MA and MB on controller terminal base.	Make the connections correctly.
		2) Defective encoder	Remove the motor cover and check the encoder signals (PA, PB, 5V, 0V) with an oscilloscope.	If 5V and 0V are normal but PA or PB is not output, the encoder is defective, and the motor should be replaced. In any other instances, see the following item.
		3) Defective connection of encoder cable or connector	Check the encoder signals (PA, PB, 5V, 0V) of the robot I/O connectors with an oscilloscope.	If 5V and 0V are normal but PA or PB is not output, see the previous item. If 5V or 0V is abnormal, check for improperly connected cables or connectors and correct them.
6	The robot speed is abnormally fast or slow.	1) Erroneous setting of parameter	Make sure the robot type parameter (PRM 0) and the actual robot type match.	If they do not match, initialize the parameter and input the correct value.

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Table 11-4 I/O-Related Breakdowns and Corrective Action

No	Symptom	Probable Cause	Items to Check	Remedy
1	OUT signal cannot be controlled.	1) Error in external wiring	Check wiring.	Referring to the diagram in the instruction manual, connect the wiring correctly.
		2) Error in program	Connect the DPB and check the program.	Change the program.
		3) Output transistor has broken down.	Measure the voltage at the PLC input terminal. ON: 0.5 V max. OFF:+24 V	Replace the controller.
		4) Fuse for 24 VDC has blown.	Check for blown fuse.	Check whether there is a short in the 24 VDC circuit, and then replace the fuse (see Chapter 12-5 for instructions on fuse replacement).
2	The robot does not move even though the DI command signal is input.	1) Return to origin has not been completed.		Execute the return to origin properly.
		2) Program cannot be executed.	Connect the DPB and check the conditions.	
		3) Signal pulse width is too narrow.		Input does not turn OFF until BUSY turns ON.
		4) Interlock signal has remained off.	Check the signal (PLC output LED, etc.).	
		5) Another DI command signal is on somewhere.	Check the signal (PLC output LED, etc.).	

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CHAPTER 12 MAINTENANCE AND WARRANTY

For safety purposes, always turn the power off before starting maintenance, cleaning or repairs, etc., of the robot.

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12-1 Warranty

The following warranty is provided to cover any problems that may arise with the Yamaha robot you have purchased.

Warranty Content:

Any breakdowns occurring as a result of genuine Yamaha parts used in the construction of Yamaha robots, in the materials used in those parts, or in the construction of the robot itself, will be repaired at no expense to the purchaser. (This is hereafter referred to as "Guaranteed Repair".)

Warranty Period:

This Warranty remains in effect until any of the following occur:
1) Eighteen months have passed since the date of shipping.
2) One year has passed since the date of installation.
3) 2400 hours of running time have passed.

Items Not Covered by Warranty

The following items are not covered by the terms of this Warranty.

1) Problems occurring as a result of time passing or wearing down after extensive usage (natural discoloration of the paint, plating, and other materials; deterioration of consumable parts, etc.).
2) Minor and abstract phenomena which have no effect upon the quality or functions of the robot (noise generated by the computer, motor rotation noise, etc.).

Repair of problems attributed to the following causes is not covered under the terms of this Warranty.

1) Damage incurred as a result of earthquake, typhoon, flood damage, lightning, and other natural disasters; accident, fire, etc.
2) Improvement or additions not authorized by Yamaha or a Yamaha dealer or representative
3) Use of parts other than genuine Yamaha parts or application of grease other than the specified type of lubrication grease
4) Deficient or erroneous maintenance and inspection
5) Servicing by other than a specified dealer or agent

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12-2 Changing the Power Supply Voltage Specifications

If the controllers power supply voltage specifications must be changed, refer to the following description.
Incorrect wiring could cause trouble, so take special care when wiring.

12-2-1 SRC DC servo series

1. Disconnect all connectors from the controller, and remove the upper cover.
2. The control board (PCB with RS-232-C connector and I/O connector) will be visible. Remove this control board.
3. The power supply terminal block will be visible, refer to Figs. 12-1 and 12-2 to change the power supply voltage specifications.
4. Install the control board.
5. Install the upper cover, and change the power supply voltage label on the front of the controller.

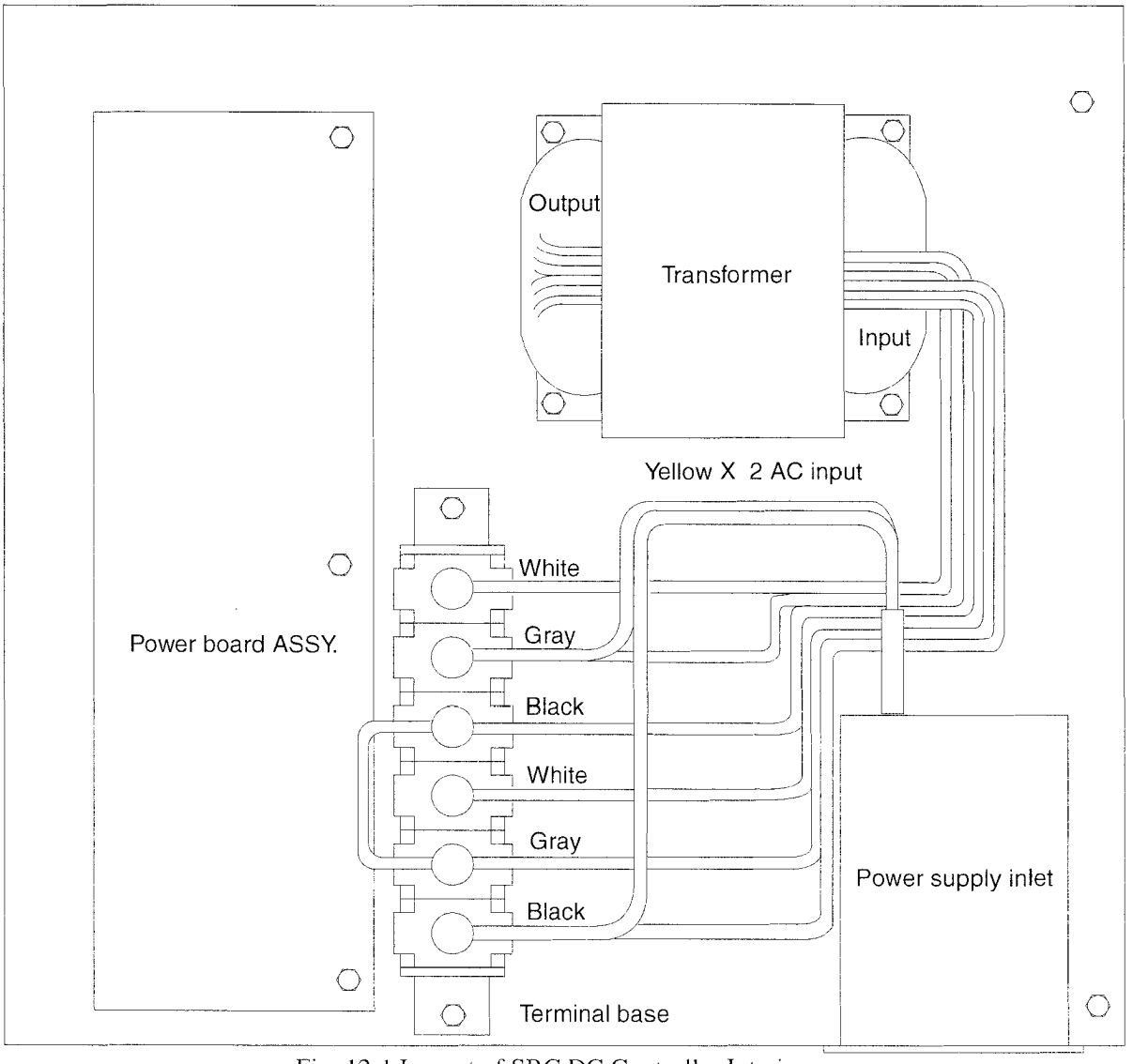
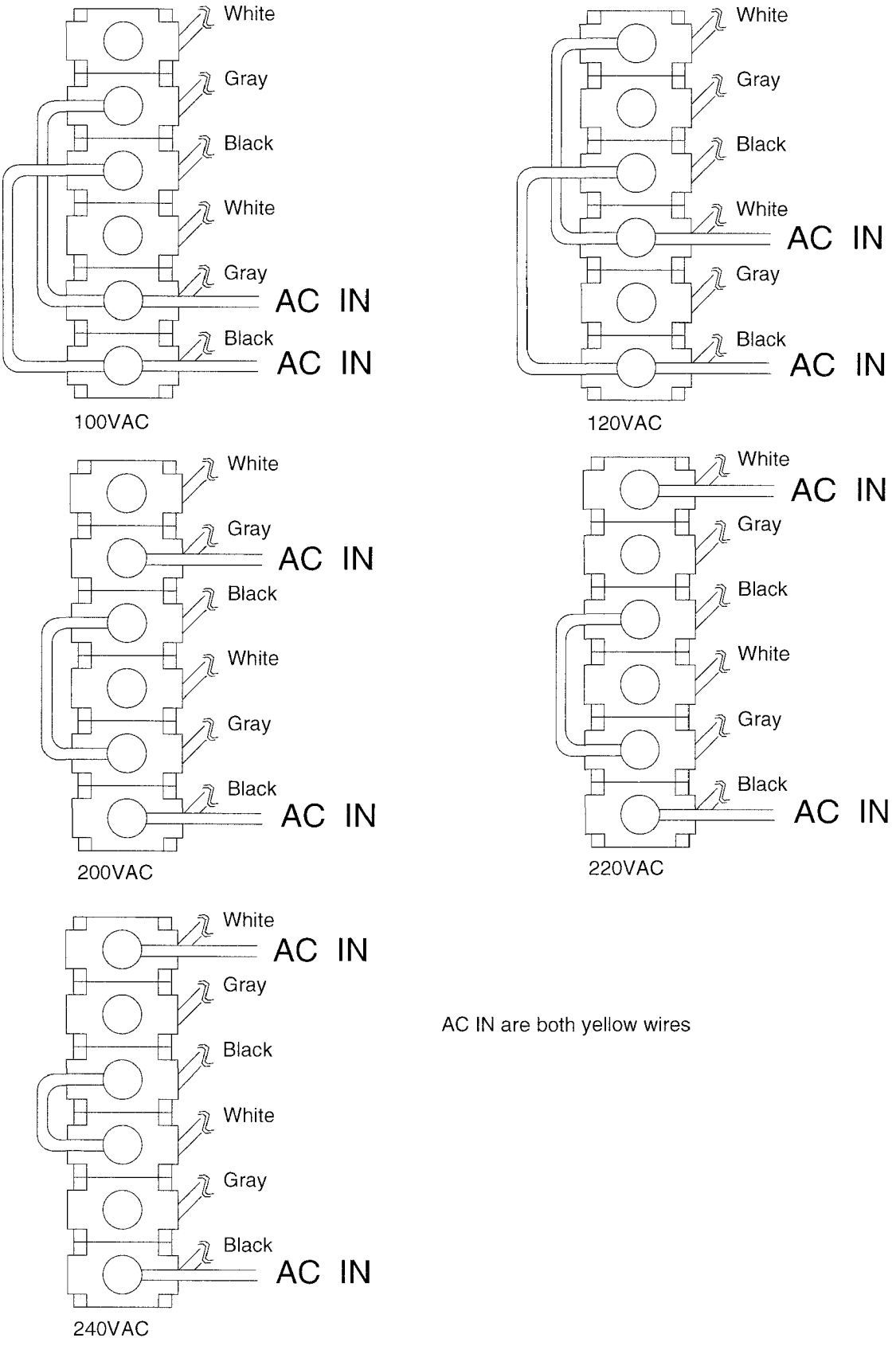


Fig. 12-1 Layout of SRC DC Controller Interior

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AC IN are both yellow wires

Fig. 12-2 Terminal Base Connections

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12-2-2 SRC AC servo series

1 Disconnect all connectors from the controller, and remove the upper cover.
2 The control board (PCB with RS-232-C connector and I/O connector) will be visible. Remove this control board.
3 The power supply terminal block will be visible, refer to Fig. 12-3 to change the power supply voltage specifications. There is a terminal for switching the power supply at the center of the power board. To change the specifications to 100/100V, move the harness to the 100V side, and to change to 200/220V, move the harness to the 200V side.
4 Install the control board.
5 Install the upper cover, and change the power supply voltage label on the front of the controller.

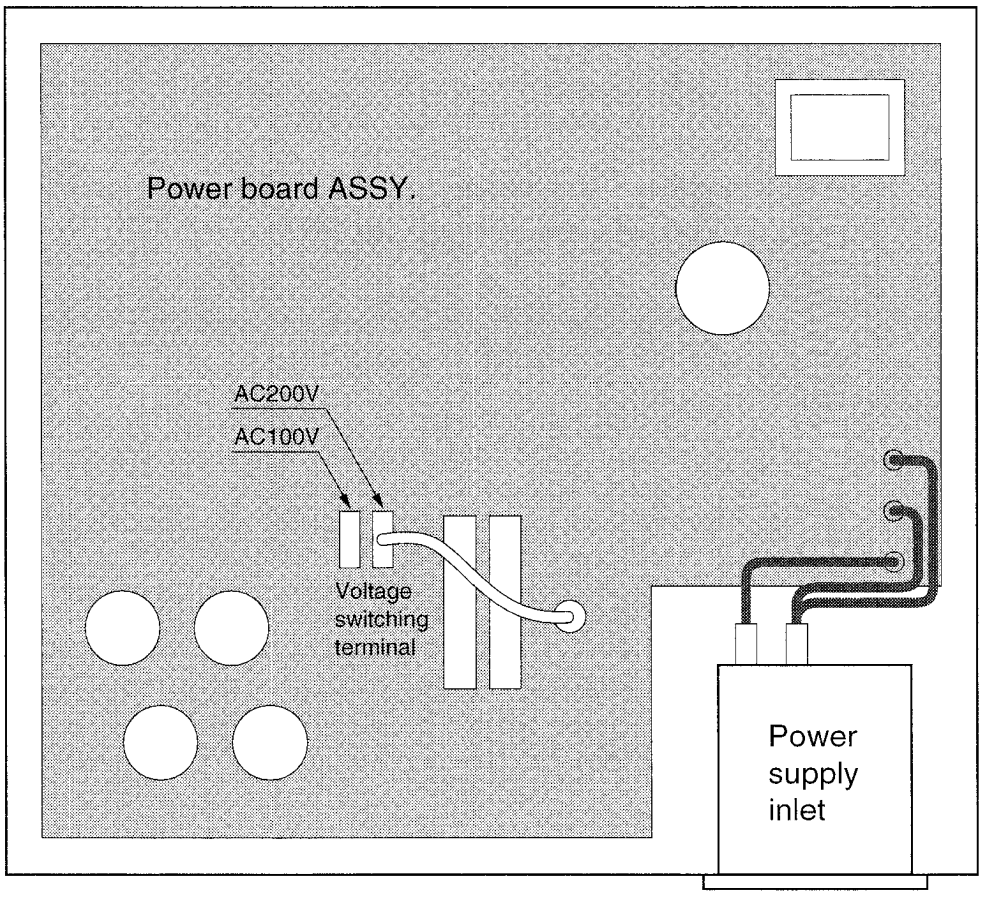


Fig. 12-3 Layout of the SRCA AC Controller Interior
(SRCA AC servo series)

100-120V 200-240V	100-110V 200-220V

Controller having the signs above can be used for the range of ±10% of each voltage shown.
Tap setting change not needed for the inlet voltage difference of 100V- and 200V-.

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12-3 Replacing the Battery

The following describes how to replace the battery if an alarm is issued indicating that the battery voltage is low.

- Battery product number: ER4/VC, made by Toshiba
- Please refer to Fig. 12-4 when replacing the battery.
- When the battery is replaced, it is possible that all data in the controller will be lost. Please make sure data has been backed up on an IC memory card before replacing the battery.

Replacement Procedure

1. Disconnect the connector that connecta the control board and the lithium battery.
2. Cut the Insulock tie fixing the battery, and replace the battery.
3. Securely fix the battery with a new Insulock tie, and insert the connector until a click is heard.

After replacing the battery, all data should be initialized.

12-4 Replacing the ROM

Yamaha may request, on occasion, that you replace the ROM in your equipment. The method for doing this is described below.

- Refer to Fig. 12-4 while replacing the ROM.
- When the ROM is replaced, it is possible that all data in the controller will be lost. Please make sure data has been backed up on an IC card before replacing the ROM.
- When removing the ROM, use tweezers or a similar tool, being careful not to damage the ROM or the socket.
- When inserting the new ROM, pay attention to which way it is facing, and be careful not to bend the pins.

After replacing the ROM, all data should be initialized.

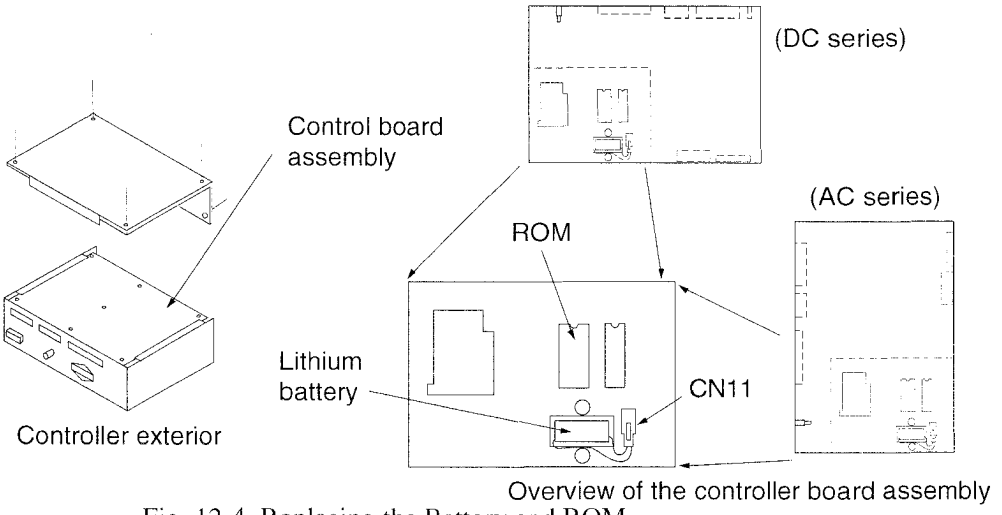


Fig. 12-4. Replacing the Battery and ROM

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12-5 Replacing Fuses

Two types of fuses are used in the controller, one for the AC power supply and one for the 24 VDC power supply. The product numbers and locations of the fuses are listed below.

	Specifications
For 24 VDC	250 V 1 A f 6.3
For AC power	For SRC-1, 2 250 V 6 A f 5.2
	For SRC-4 250 V 10 A f 5.2
	For SRCA-2, 3 250 V T6.3A f 5.2

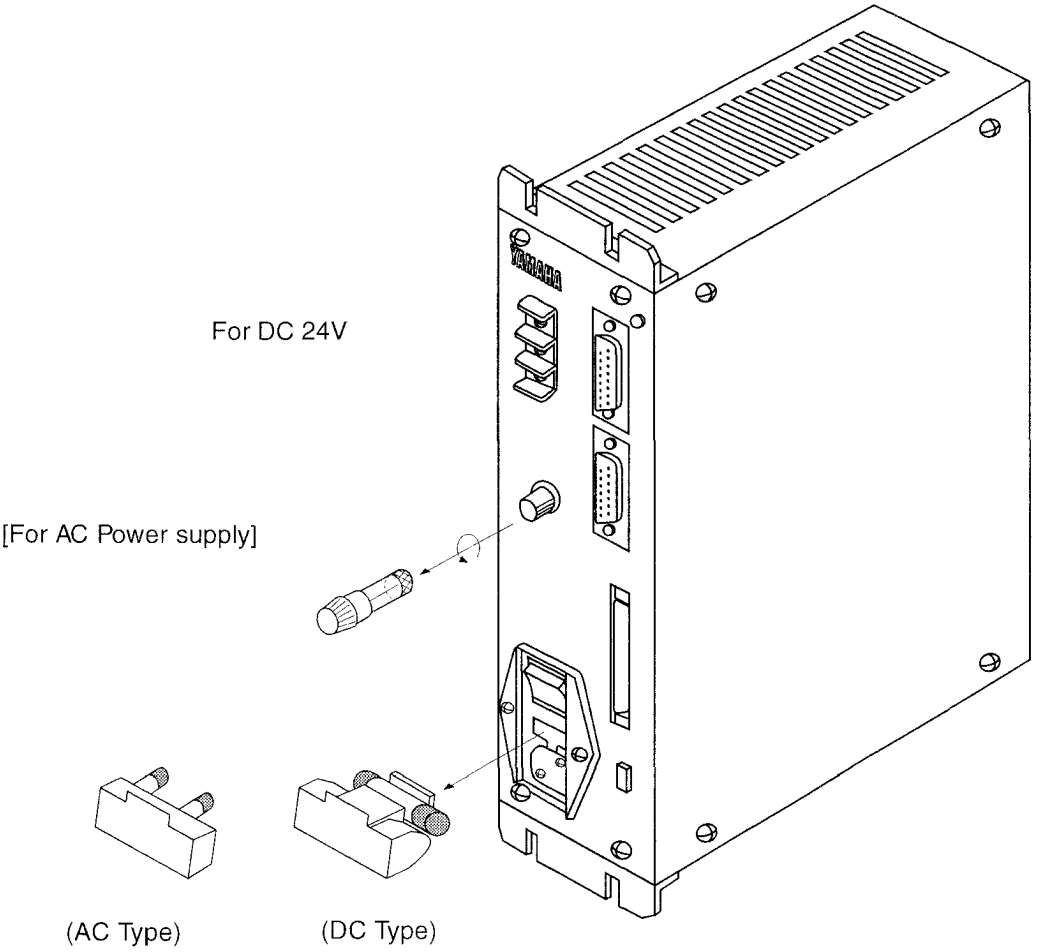


Fig. 12-4 Replacing Fuses

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CHAPTER 13

SPECIFICATIONS

SAFETY

Considerations are made for the Yamaha robot controller for export to Europe so that the following safety standards are complied with.

①EN 292-2 :Set. 1991
Safety of machinery- Basic concepts, general principles for design
Part 2: Tecnical principles and specifications

②60204-1 :Oct. 1992 (IEC 204-1)
Safety of machinery- Electrical equipment of machines
Part 1: General requirements

③775 :Oct. 1992 (ISO 10218)
Manipulating industrial robots- Safety

④ISO 9946 :1991
Manipulating industrial robots-Presentation of characteristics

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13-1 SRC Controller

Table 13-1 Specifications Listed by Controller Model (DC Servo)

Specifi-cation Item \ Model	SRC-1	SRC-2	SRC-4
Applicable motor capacitance	24 V 40 W max.	75 V 110 W max.	75 V 400 W max.
Max. power consumption	200VA	400VA	1000VA
External dimensions (mm)	W78 x H275 x D190		W95 x H275 x D250
Weight	4.5kg		6.5kg
Used power supply voltage	Single-phase AC 100/120/200/220/240 V, within ±10% 50/60Hz		

Table 13-2 Robot Type Number Table

	BS	FT	FS	LT	LTI	LSI	LSII	LR	BFS	BFSII	MT	MS	HS	HSL
Standard structure	12	10	14	20	28	28	20	22	24	26	32	30	40	42
-B		10		20	28	28	20	22			32	30		
-V			15	21	21	21	21	23				31	41	
-BV		11		21	21	21	21	23				31		

BFS: Revised name of BLS (From Jan. 1, '94)

FROP	
F	16
(M)	33

ZD	RD	ZS	ZH
1	2	3	4

Table 13-3 Applicable Robots Listed by Controller Model

	Robot \ Model	SRC-1	SRC-2	SRC-4
Single-axis robot	BS	○	×	×
	FT	○	×	×
	FS	×	○	○
	LT	×	○	○
	LT I	×	○	○
	LS I	×	○	○
	LS II	×	○	○
	LR	×	○	○
	BFS	×	○	○
	BLS II	×	○	○

	Robot \ Model	SRC-1	SRC-2	SRC-4
Single-axis robot	MT	×	×	○
	MS	×	×	○
	HS	×	×	○
	HSL	×	×	○
	FROP-F	×	○	○
	FROP-M	×	×	○
Others	ZD	×	○	○
	RD	×	○	○
	ZS	×	○	○
	ZH	×	×	○

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Table 13-4 Specifications Listed by Controller Model (AC Servo)

Specifi-cation Item \ Model	SRCA-2	SRCA-3	SRCA-4
Applicable motor capacitance	200 V 100 W max.	200 V 400 W max.	200 V 400 W max. with regenerator
Max. power consumption	400VA	1000VA	1000VA
External dimensions (mm)	W100 x H275 x D210		W100 x H275 x D250
Weight	3.6kg		
Used power supply voltage *)	Single-phase AC 100/110/200/220 V Single-phase AC 100–120/200–240 V, within ±10% 50/60Hz		Single-phase AC 100/110/200/220 V Single-phase AC 100–110/200–220 V, within ±10% 50/60Hz

*) Upper : The controllers whose voltage specifications are shown on a label on the front panel.
Lower : The controllers whose voltage specifications are directry printed on the front panel.

Table 13-5 Robot Type Number Table

Robot models currently sold (as of Dec. 1, 1997)

	BSt	PS	BPS	FTt	FSt	LSt	LTt	LRt	BFSt	BLSt	BLSHt	LSHt	LTHt	MSt
Standard structure	12	10	13	10	28	20	20	22	25	26	27	32	32	30
-B			13	10	28	20	20	22				32	32	
-V				11	72	21	21	23				76	76	31
-BV				11	72	21	21	23				76	76	

	HSt	HSLt	BHS	MSC	HSC
Standard structure	40	42	44	30	40
-B					
-V	41			31	41
-BV					

FROP	
Ft	16
St	17
Mt	33

ZP	ZF	ZS	ZL	ZH
70	72	73	76	77

Previous robot models (sold prior to Sept. 1, 1997)

	FTA	FSA	LSA	LTA	LRA	BFSA	BLSA	MTA	MSA	HSA	HSLA
Standard structure	10	14	20	20	22	24	26	32	30	40	42
-B	10		20	20	22			32			
-V	11	15	21	21	23				31	41	
-BV	11		21	21	23						

FROP	
FA	16
MA	33
HA	34

ZFA	ZSA	ZLA	ZHA
15	73	76	77

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Table 13-3 Applicable Robots Listed by Controller Model

	Robot \ Model	SRCA-2	SRCA-3	SRCA-4
Single-axis robot	BSt	○	○	○
	PS	○	○	○
	BPS	○	○	○
	FTt	○	○	○
	FSt	○	○	○
	LSt	○	○	○
	LTt	○	○	○
	LRt	○	○	○
	BFSt	○	○	○
	BLSt	○	○	○
	BLSHt	×	○	○
	LSHt (Normal)	×	○	○
	LSHt (-V)	×	×	○
	LTHt (Normal)	×	○	○
	LTHt (-V)	×	×	○
	MSt (Normal)	×	○	○
	MSt (-V)	×	×	○
	HSt (Normal)	×	○	○
	HSt (-V)	×	×	○
	HLSt	×	○	○
	BHS	×	×	○
	MSC (Normal)	×	○	○
	MSC (-V)	×	×	○
	HSC (Normal)	×	○	○
	HSC (-V)	×	×	○
	FROP-Ft	○	○	○
	FROP-St	○	○	○
	FROP-Mt	×	○	○

	Robot \ Model	SRCA-2	SRCA-3	SRCA-4
Single-axis robot	FTA	○	○	○
	FSA	○	○	○
	LSA	○	○	○
	LTA	○	○	○
	LRA	○	○	○
	BFSA	○	○	○
	BLSA	○	○	○
	MTA	×	○	○
	MSA (Normal)	×	○	○
	MSA (-V)	×	×	○
	HSA (Normal)	×	○	○
	HSA (-V)	×	×	○
	HSLA	×	○	○
	FROP-FA	○	○	○
	FROP-MA	×	○	○
	FROP-HA	×	○	○
Others	ZP	○	○	○
	ZF	○	○	○
	ZS	○	○	○
	ZL	×	×	○
	ZH	×	×	○
	ZFA	○	○	○
	ZSA	○	○	○
	ZLA	×	×	○
	ZHA	×	×	○

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Table 13-5 Sbared Controller Specifications

Specification item		Details
Axis control	No. of controllable axes	1 axis
	Control method	Software servo PTP
	Position detection method	Incremental pulse encoder with zero pulse
	Speed setting	100-step setting possible per program step
	Acceleration/deceleration setting	Automatically set according to robot type and transportation weight. 100-step setting is also possible with acceleration parameter.
	Servo adjustment	Handled with parameters (special). Servo gain, current limit, etc.
	No. of encoder pulses	Set with parameters (special). (500P/R to 2500P/R)
	Lead length	Set with parameters (special). (5mm to 36mm)
Memory	ROM	32Kbytes
	RAM	8Kbytes with lithium battery backup (5-year life)
	No. of program steps	1024 steps/total or less, 255 steps/program
	No. of programs	32
	No. of points	255 points
	Teaching method	MDI (coordinate value input), teaching playback, direct teaching
	Auxiliary memory unit	IC memory is available as DPB option
I/O	I/O input	General-use 9 points, special-use 7 points
	I/O output	General-use 5 points, special-use 3 points Open collector output, internal 24V can be used up to 600mA
	Brake output	Relay output (24/300mA for brake) Battery (24V) is built-in
	Origin sensor input	Connection of DC24V sensor is possible. Note that depending on the motor specifications, origin search with stroke end detection can be used with the parameters.
	Emergency stop input	Normal closed contact input (origin return not required after emergency stop is released)
	Serial interface	One RS-232C channel (for communication with DPB or general purpose personal computer)
General specifications	Ambient temperature	0 to 40 degrees
	Storage temperature	-10 to 65 degrees
	Ambient humidity	35 to 85%RH (with no condensation)
	Noise withstand level	1500V, 1μsec

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13-2 DPB

Table 13-6 DPB Specifications

Specification Item	Details
Keyboard	28 keys, membrane switch + Emergency Stop switch
Display	Liquid crystal, 20 characters x 4 lines
Auxiliary memory device	Memory card (8 KB/64KB SRAM, battery backup system)
Serial interface	RS-232C, one channel, for communications with controller
Power supply	Supplied by controller or AC adapter (9 V)
Power consumption	5 V 200 mA max.
Ambient temperature	0°C to 40°C
Ambient humidity	35 to 85% RH (with no condensation)
External dimensions	W 107 x H 235 x D 47
Weight	590 g
Cable length	Standard 3.5 m

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CHAPTER 14
INSTRUCTIONS FOR HANDLING OPTIONS

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14-1 Handling the Memory Card

The memory card is a device that can be connected to the DPB programming unit, which is used with the SRC controller, so that program data can be backed up.
With one 8K card enough data for 1 SRC units can be backed up. With one 64K card enough data for 10 SRC units can be backed up.

1. Using the card

a) Insert the card in the DPB as shown in Fig. 14-2.
b) For the backup procedure, please refer to Chapter 8-5 "Using Memory Card".

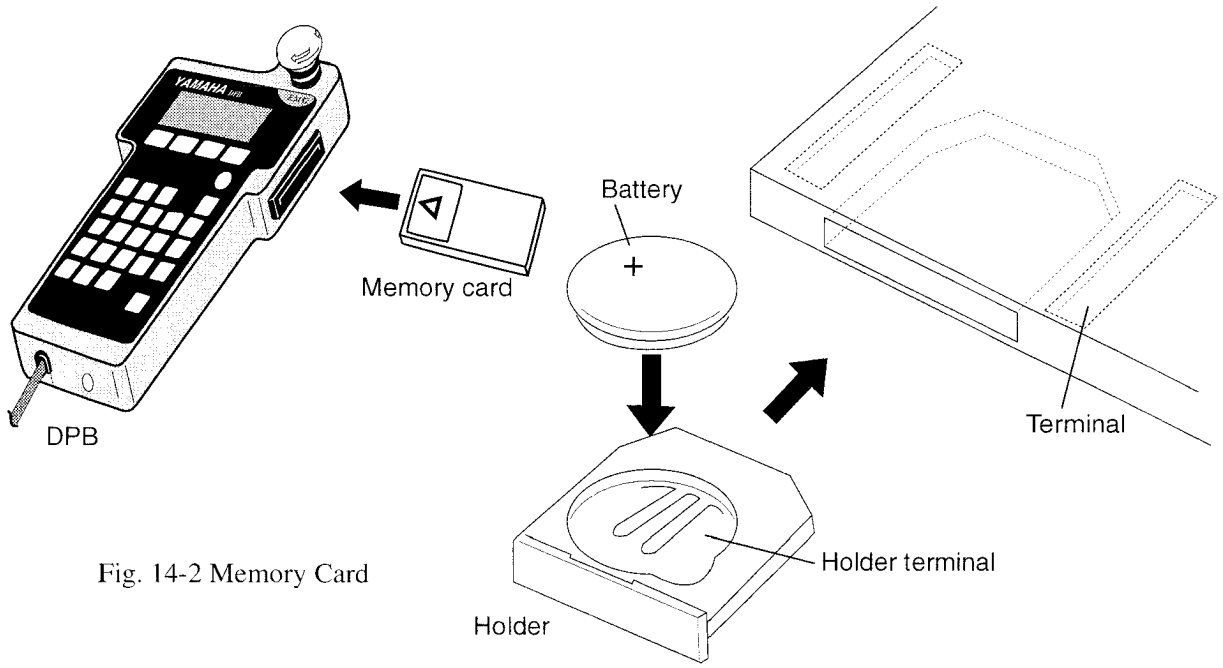


Fig. 14-2 Memory Card

Fig. 14-3 Battery Holder (viewed from rear)

2. Precautions when using the card

a) Make sure the card is inserted all the way, until some resistance is felt.
b) Be careful not to insert the card facing the wrong direction. The YAMAHA seal should be facing upward. (A pin is provided on the card to keep it from being inserted the wrong way.)
c) The card should only be withdrawn while the power to the DPB is on.
d) Never eject the card while backing up data.
e) The card should be used under the following environmental conditions:
   Ambient temperature range : -10 to 40°C
   Ambient humidity range : Relative humidity 85% max.
   Storage temperature range : -20 to 60°C
f) Do not leave the card stored inside the DPB, as this can shorten the life of the battery.
   The battery life is approximately 5 years at an ambient temperature of 25°C.
   If the battery voltage drops, a message appears on the DPB. Refer to Fig. 14-3 to replace the battery.

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14-2 Handling the I/O Checker

1. An overview

This device is connected to the I/O connector of the SRC Controller made by Yamaha Motor Corporation. When connected, the unit functions as a monitor for pseudo-input created by means of switches, and for LED monitoring input and output.

2. Connecting the I/O checker

(1) Connector marked <Fujitsu>
Connect this to the connector marked <I/O> on the control panel.

(2) Connector marked <JAE 34P>
Connect this to the <CN1> connector at the right of the I/O board, and make sure it locks.

(3) To the <CN2> connector on the left of the I/O board, plug in the connector that will be joined to the <I/O> connector of the SRC Controller.

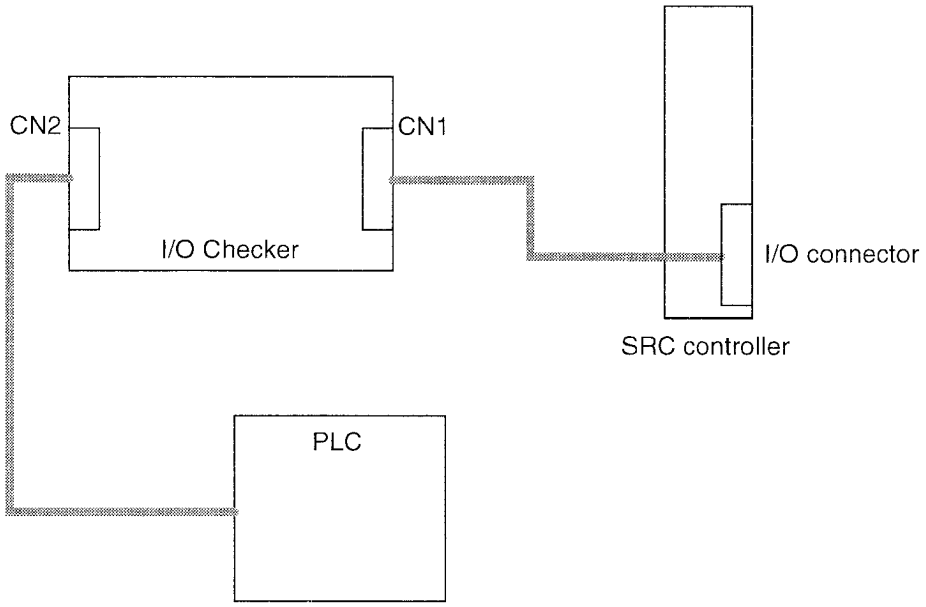


Fig. 14-4 Connecting the I/O Checker

3. Operation method

(1) The LED monitor goes on (lights) and off (goes out) in conjunction with the input and output.

(2) The pseudo-input switch is on when set to the upper side and off when set to the lower side.
However, the <INTERLOCK> and <EMG> switches are opposite; they are on when set to the lower side and off when set to the upper side.
Thus, if all of the switches are set to the lower side at first, the unit can be used for pseudo-input and as an I/O monitor.

(3) The input changeover switch should be set to the <EXTERNAL> (upper) side to receive external input from a PLC or a similar unit.
If the switch is set to the <INTERNAL> (lower) side, the switch signals from the I/O board are input. In either case, the input monitor is handled by means of LEDs.

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YAMAHA SINGLE-AXIS ROBOT CONTROLLER SRC Series

INSTRUCTION MANUAL

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