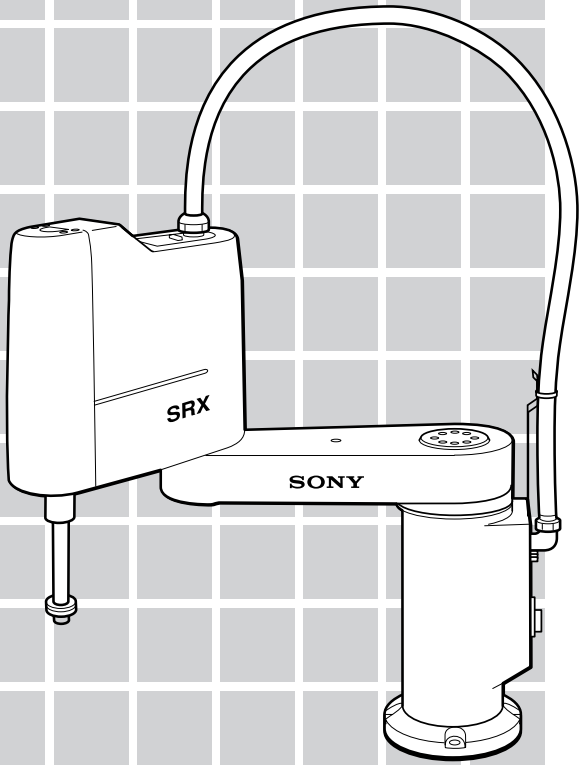
SRX-611

HIGH-SPEED
ASSEMBLY ROBOT

OPERATION MANUAL



SONY

3-859-091-11

Work Involved in Installing an SRX Series Robot

The following tasks must be performed without fail when switching on the robot for the first time:

1. Connect the robot specified on the controller's name plate.

A name plate with 'ASSEMBLY ROBOT' written on it is located at the back of the robot controller.

For example, a number, such as R.NO.82501 C.NO.C61-0001, will be written on the plate, and this represents the robot's model number (R.NO.) and the controller number (C.NO.).
In the above case, the controller is connected to the 82501 model robot.
Ensure that the connection with the robot mentioned on the name plate is definitely secure before switching on the mains power.

2. Home Return

The absolute decoder used with this robot is equipped with a battery back-up system. As the back-up battery is located within the controller, it is necessary to return to the home position when the feed-back cable between the robot and the controller is disconnected.

Perform the following procedures for returning to the home position when the electrical power has been switched on for the first time after installation or in the case that the feed-back cable has been disconnected.

Press the [MANAGE] key.
↓
Use the [↑] , [↓] cursor keys to select home return, and press [F4] key .
↓
Press [F1] OK key to start home return.

Settings for the home position and home return operation sequences are also performed in accordance with the robot installation conditions (refer to the operation guide for further details.)

3. Robot Data Back-up

The controller has data stored for each type of usable robot in order to enable other types of robot to be used.
This data includes individual robot data, such as servo parameters, etc., and user-amendable data, such as system offset, etc. Take a back-up of this robot data by observing the following procedures when switching on the electrical power for the first time.

Insert the LUNA5.0 system disk in the A drive of a personal computer, a formatted disk in the B drive, and run the following command:
RECALL_D_FB:
↓
A file named after the controller number with .RBT as the extension log will be created on the disk inserted into drive B.
C61_0001.RBT
(When the controller number is C61_0001)

Store this disk in a safe place.
It is also necessary to perform the same procedure when system offset, system limit or tool data has been amended.
This data can be restored to original values by transferring the file with the SEND command.
Refer to the LUNA Programming Unit Guide for further details on commands.

4. Clock

The date and time displayed when confirming error history are set with the internal clock. Ensure that the correct date and time are set when first using the robot.

Press the [MANAGE] key.
↓
Use the [↑], [↓] cursor keys to select clock, and press [F4] key.
↓
Press [F1] CHG key and enter the required numerals.
↓
Press [F1] WRITE key to save the amendments.

About this Operation Manual

About this Operation Manual

This Operation Manual is intended as a guide for users of the High-Speed Assembly Robot SRX series.

It contains the information that users are expected to read before operating. Read this manual before starting operation.

- This manual may not be replicated in whole or in part without the prior written authorization of Sony Corporation.
- The information described herein is subject to change without notice.
- The information described herein has been checked for both reliability and accuracy. However, if you have any questions, or notice any errors or omissions in this manual, please contact the following offices of Sony Corporation.

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New York Telephone : 914-365-6000 Fax : 914-365-6087
San Diego Telephone : 619-673-2701 Fax : 619-674-1853

Sony Precision Engineering Center Pte. Ltd.
Manufacturing Systems Division Service Engineering Dept.
Singapore Telephone : 8608416 Fax : 8608465

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Nagoya Telephone : 0564-63-0112 Fax : 0564-63-0113

Manual Configuration

The entire layout of this manual has been summarized below for ease of use.

Safety Instruction

Explains the precautions necessary to ensure the correct use of this device.

Installation Guide

1. Outline
   Provides an outline of the device.
2. Features
   Explains the features of the device.
3. Configuration
   Explains the configuration of the device.
4. Specifications
   Explains mechanics, control, language specifications and controller functions.
5. Outline Drawings and Work Envelopes
   Explains the outline drawings of the main unit, the controller and the teaching pendant, and the work envelopes for the robot.
6. Unpacking
   Explains how to unpack the main unit and the controller.
7. Installation
   Explains the methods of transportation, installation and connection.
8. System Task and Signal Control
   Explains emergency stops using the system task and system task I/O sample programs.

Operation Guide

1. Teaching Pendant (TP) Outline
   Explains the name and role of each teaching pendant part.
2. Main Operation System Diagrams
   Operation key flows explained with the use of flow charts.
3. Major Operation-Related Terminology
   Explains the terminology used during operation.
4. Basic Operations
   Explains basic operation methods.
5. Operations
   Explains the teach mode, the execution mode, management and I/O, etc.

Electrical Guide

1. Nomenclature
   Explains the names of each of the controller's parts.
2. Input/Output Specifications
   Explains the specifications relating to input and output, and circuits and connector pin assignment, etc.
3. Maintenance
   Provides details on the batteries and maintenance management, etc.

Mechanical Guide

1. Nomenclature
   Explains the names of each of the robot's parts.
2. Tooling
   Explains tool attachment, and user wiring and ducting, etc.
3. Maintenance
   Provides details in maintenance and inspections.
4. Internal Wiring Diagram
   Explains the device's internal wiring system.

Error Code Guide

Explains error displays, meanings and countermeasures.

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Safety Instruction

Installation Guide

8. System Task and Signal Control

Operation Guide

Electrical Guide

Mechanical Guide

Error Code Guide

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Appendix

Safety Instruction

Safety Instruction

Much care has been paid to machine safety during design and manufacture of this device. However, failure to carry out operations and maintenance in accordance with the safety rules may result in damage to the machine or injury to the operators. It is necessary for operators and maintenance personnel to observe these rules completely to prevent the occurrence of accidents.
Ensure that the following precautions have been read thoroughly prior to reading the remainder of this operation manual, and pay attention to the safety rules when operating or maintaining machine.

Observe all precautions to ensure safety.

Read the precautions on pages 2 and 17 thoroughly.

Perform regular inspections.

Ensure that inspections are carried out in accordance with directions outlined in Section 3 of the Electrical Guide, and Section 3 of the Mechanical Guide.

In the event of accidents.....

Contact us immediately.

Definition of warning symbols

The following symbols are used within this manual and with the product to ensure safe usage. Read and remember the following important safety precautions before using the machine.

《Machine Symbols》

Indicates the units and locations which are dangerous to touch when the electrical power is switched on as they contain high-voltages.

Indicates the grounding terminals connected to protection circuits on the equipment.

《Operation Manual Symbols》

Indicates that mis-operations or mis-handling may result in unexpected danger (fire, etc.,) and that the operator is at risk (of major injury).

Indicates that mis-handling may result in unexpected danger (electric shock, etc.,) and that the operator is at risk of injury or the equipment at risk of damage.

Warning

- *The drive units are subject to unexpected movement. Avoid coming within the range of movement except when performing maintenance or inspections.*
- *Switch off the mains power prior to performing maintenance or inspections. Failure to observe this may result in death or severe injury through electric shocks or unexpected movement of the robot.*
- *Mistakes during maintenance and inspections may result in accidents. Observe the following prior to starting maintenance or inspections:*
  1. *Read the operation manual thoroughly and following all instructions and warnings closely.*
  2. *Implement inspections on a daily basis to prevent accidents arising from damaged equipment.*
- *Ensure that the electrical earth should be connected. Avoid using intense electrical earths for more than one item, and connect to the line (AWG 14) or bigger independently. Electrical potential difference will occur with surrounding equipment if the electrical earth is not connected and may result in electrical leaks or electrical shocks.*

Caution

- *Heavy object. Use special equipment to move and transport and pay attention to safety measures.*
- *Do not make any conversions to the equipment in order to maintain safety. Contact Sony Corporation before attempting any conversions.*
- *Note that there may be cases when the equipment will fall over when carrying out work with the arm fully extended.*
- *Avoid installing in the following locations:*
  - ○ *In places which receive direct sunlight or which experience temperature ranges exceeding 0 degrees and 40 degrees.*
  - ○ *In places which experience relative humidity ranges exceeding 35% and 90%, and places in which condensation is generated by rapidly changing humidity.*
  - ○ *In places where corrosive gas or inflammable gas exists.*
  - ○ *In places where the unit will be subject to direct vibrations or impact.*
  - ○ *Close to machinery which emits electrical noise, such as welders, electric dischargers or high-frequency generators.*

Caution

It is recommended that robot operators attend the robot safety lectures held by Sony Corporation, or receive training from people who have attended the robot safety lectures.

The Sony High Speed Assembly Robot SRX-600 series have the safety functions to comply with the following safety regulations:

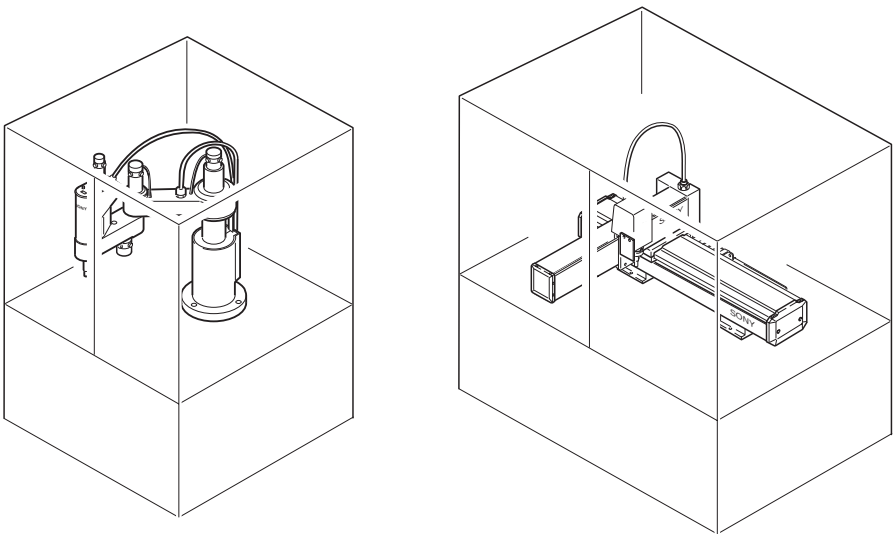
European safety regulations:	EN292-1, 2
	EN60204, EN775, EN60950
U. S. A. safety regulations:	RIA, NFPA79

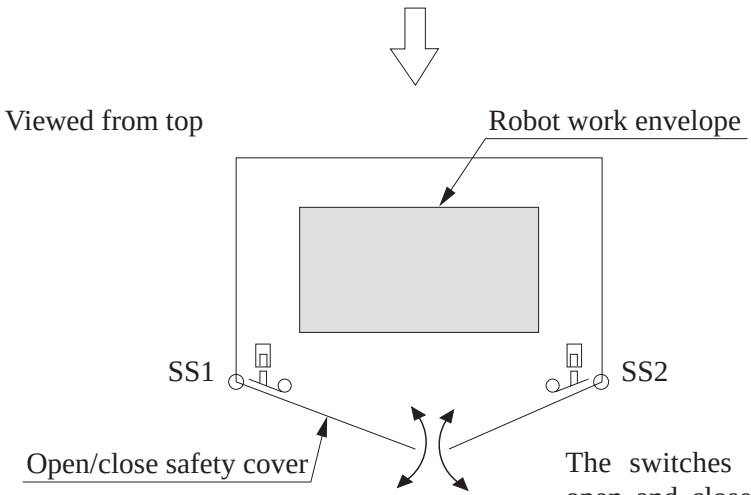
When users develop applications with this robot, setup a safety cover and design a safety circuit according to the instructions described in this manual.

For users in European counties, the safety functions of this robot must be realized in users' application so that the users' application including the robot satisfies safety requirements with "Machinery Directive", and put the "CE mark" on the system by users themselves.

1. Setting up safety cover

A safety cover must be setup around the work envelope of the robot. The open and close status output signals from the safety cover sensor switches must be connected direct to the BARSW connector of the robot controller without passing through software.





The switches SS1 and SS2 sense open and close of the safety cover, and must have a logic which turns ON when the safety door is closed. Use Approval switch of the safety regulation for SS1 and SS2.

The open and close status output signals from the safety cover sensor switches must be connected direct to the “BARSW” connector of the robot controller.

< For users in European countries >
Detailed specifications of the residual openings of the robot system when the safety cover is closed must satisfies the requirements of EN294 and EN349.

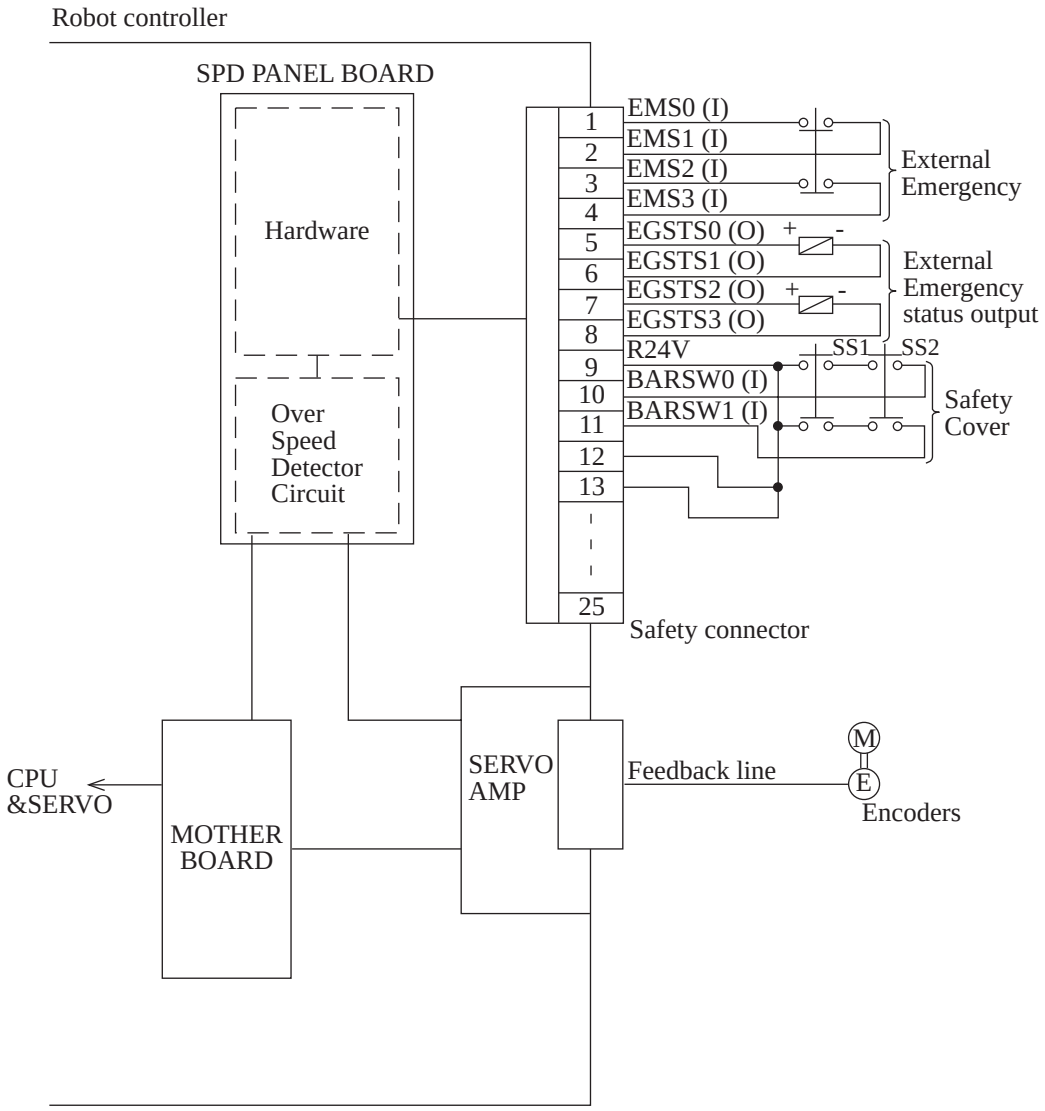
Safety when safety cover is installed.

If the safety cover is opened and “BARSW” signal remains OFF, the over speed detector circuit inside the robot controller is activated to monitor the robot if the operating speed of the robot should not exceed the safety speed (speed of robot tip: 250 mm/s). If the robot should exceed this speed, emergency stop is triggered. The over speed detector circuit is made by hardware only.

	BARSW signal	Environment	Over Speed Detector Circuit
Safety cover opened	OFF	Operator can enter the work envelope of the robot	ON
Safety cover closed	ON	Operator cannot enter the work envelope of the robot	OFF

This is to secure safety for teaching operator.
Be sure to install the safety cover.

2. How to connect a safety circuit



(I): Input
(O): Output

NOTE *Make short circuit between pins-9, -12 and -13 of the safety connector.*

BARSW0, 1 (Input) : Safety cover output signal (Do not pass the signal through software.)
The BARSW0 and the BARSW1 must be synchronized.

EMS0~3 (Input) : Stop the robot externally by emergency stop
If this emergency stop is triggered, the servo power control lines are shut OFF directly at the same time.
The EMS0-1 and the EMS2-3 must be synchronized.

EGSTS0~3 (Output) : This signal is output from hardware when the robot controller is in normal condition. If the emergency stop (inclusive of EMS0 to EMS3) is triggered, OFF signal is output to let the external peripherals know of the emergency status. The EGSTS0-1 and the EGSTS2-3 are synchronized during operation.
In the conventional SRX series robot (models SRX-400 and before), this signal used to be ON when an emergency stop is triggered. Pay attention to this change when using this output signal.

Detection of melting of safety circuit switch contact

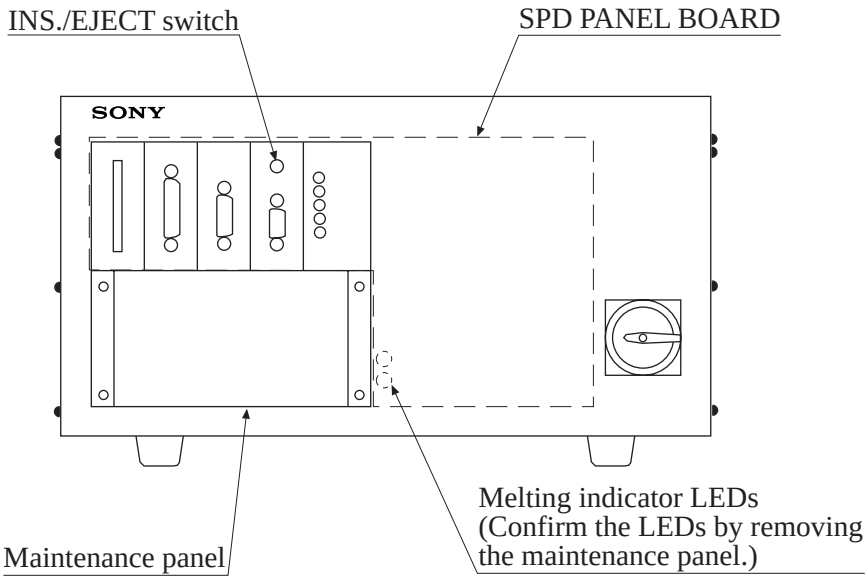
This controller has a built-in circuit which detects melting of the switch contact. This melting detection circuit consists of safety relays.
Melting of the contacts of the following relays is detected:

Emergency stop switches of the Teaching Pendant and the Safety Box, the external emergency stop input switch (EMS0-3), the barrier switches (BARSW0 and 1) and the drive safety switch (DSS0-1 used in SMART only).

NOTE

Be sure to use the double-pole switch when users connect external switches to the above switches.

If one contact in any of the above switches melts or is short-circuited, SERVO ON will not be possible.
Either one of the two melting indicator LEDs on the SPD PANEL lights and the remaining LED is turned off when melting occurs.
(Both LEDs turn on and off synchronously during normal operation.)
(The “E381 SERVO trap error” is displayed on the Teaching Pendant to indicate that a switch contact has melted.)



SRX-C61 front panel

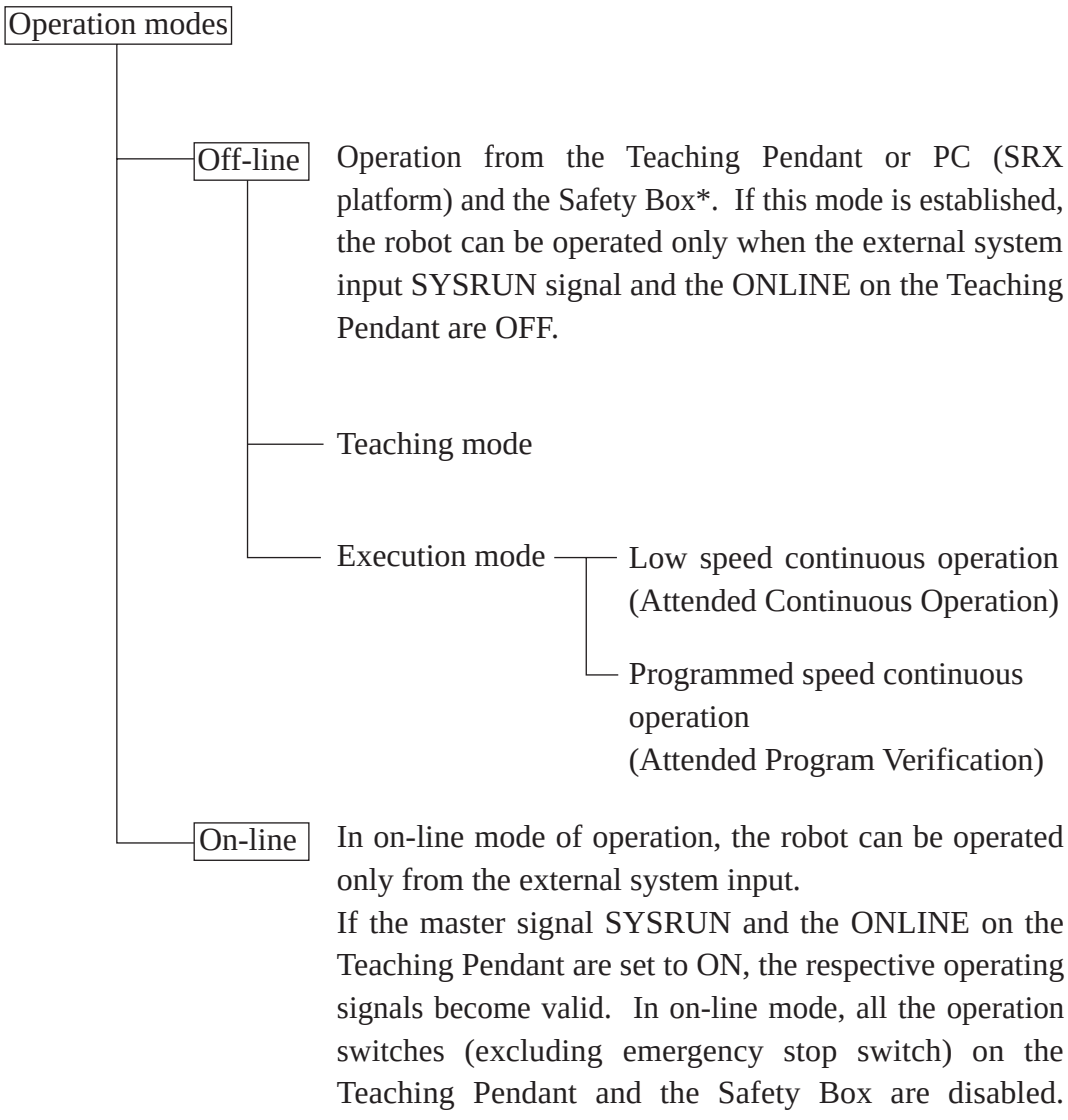
Caution

- *Perform attachment or removal of the Teaching Pendant or the Safety Box while pressing the INS./EJECT switch even during servo OFF.*
- *The melting detection circuit is effective only when the main power is ON. The melting detection information is cleared when the main power is turned OFF.*

3. Operation modes and safety functions

Description of this section follows the system program of the standard installation.

3-1 Operation modes



* When you control a robot using a PC which is operating on the SRX platform, be sure to use the Safety Box at the same time.

3-2 Safety functions

3-2-1 Off-line mode

a. Teaching mode

The robot will not move under the conditions below unless the safety switch of the Teaching Pendant or the Safety Box is pressed.

- Servo-on
  Press the SERVO key on the Teaching Pendant while pressing the safety switch, to turn the "Servo-on" of the robot.

- Motion of the arms of respective axes
  If a hand is detached from either the arm operational switch or safety switch, the arm is stopped immediately.

- Home return movement of arms
  If the safety switch is set OFF after arm has started the home return movement, the arm is stopped immediately. To re-start the robot, execute the home return movement again.

- Point GO movement
  This function enables a robot that the arm moves to the specified position automatically if a target point number or coordinate is input.
  If the safety switch is set OFF after arm started the home return movement, the arm is stopped immediately in this movement too.
  To re-start the robot, execute the Point Go movement again.

SAFETY COVER IS OPENED
⬇
OVER SPEED DETECTOR CIRCUIT IS TURNED ON

⚠ Caution

- *When operating the SRX-611 robot use either the Safety Box of the SRX platform or the Teaching Pendant.*
- *If the two devices are connected to the controller both the safety switches will have to be pressed in order to operate the robot.*

b. Low speed continuous operation
(Attended Continuous Operation)

This function is prepared to confirm the robot continuous operation (programmed operation) during debugging or other applications with the safety cover opened. This function can be selected from the Teaching Pendant or the SRX platform and cannot be controlled from external system input.

If only a robot is activated from the Teaching Pendant, the robot starts movement at the speed of 5% of the programmed set speed. The safety switch on the Teaching Pendant or the Safety Box must be kept pressed. If the switch is unhanded, the robot stops immediately. To re-start the robot, start the robot while the safety switch is being pressed.

The over-ride function can be used, but can be set in the range of 5% or less.

SAFETY COVER IS OPENED
⬇
OVER SPEED DETECTOR CIRCUIT IS TURNED ON

NOTE *During the off-line mode, the SRX-611 cannot enter the servo free state even though the STOP command in the LUNA robot language is executed.*

c. Programmed speed continuous operation
(Attended Program Verification)

This function is prepared to confirm the robot at the final stage of debugging if it work correctly at the designated specifications with the program set speed.
This operation is selected from the Teaching Pendant or the SRX platform. Be sure to close the safety cover.

SAFETY COVER IS CLOSED
⬇
OVER SPEED DETECTOR CIRCUIT IS TURNED OFF.

While pressing the safety switch on the Teaching Pendant or the Safety Box, change the over-ride setting of the Execution mode of robot only operation to 100%. (Default is 5%.) Operation at the programmed speed is now possible. Confirm robot operation in the Execution mode. If the safety switch is unhanded during the operation, the arm stops immediately. To re-start this operation, execute the over-ride setting again. If this operation is once stopped, the over-ride value returns to the default value of 5%.

3-2-2 On-line mode

This function is activated by the external system input. If the external system input SYSRUN and the ONLINE on the Teaching Pendant are set to ON, the other input signals become valid. If the SYSRUN and the ONLINE remains ON, all the operation switches excluding emergency stop switch on the Teaching Pendant and the Safety Box are disabled.

> ⚠ Caution
>
> *Be sure to close the safety cover to run the robot in on-line operation.*

On-line operation (SYSRUN + ONLINE + PSTART) — Open the safety cover ⇩

- Continuous operation (robot arm is being operating) — Emergency stop
  External user output SATDO ..... ON
- In step stop (robot arm is step-stopped) — Normal operation
  External user output SATDO ..... OFF

* While the robot is in step stop state, servo loops are opened to free state. If the safety cover is opened, the over-speed detector circuit starts functioning.

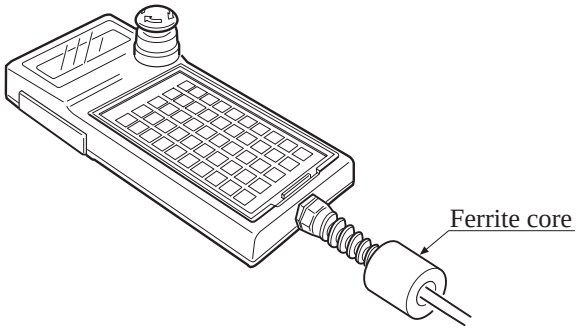
How to use the step stop (servo loops are opened to free state)

If a robot must be stopped during the on-line mode of operation due to operator's convenience such as out of parts, etc., not due to error of robot itself, the step stop → servo free state of the robot can be established by sending the step signal (PSTEP) to the user input from external source, or by executing the STOP command in the LUNA robot language. The normal on-line operation is executed with the safety cover closed. If the robot is stopped in the step stop, and the safety cover is opened to remove the defective parts, or correct the unwanted parts pickup or placement state manually by operator, then close the safety cover and start again. The effective system operation is available by this function.

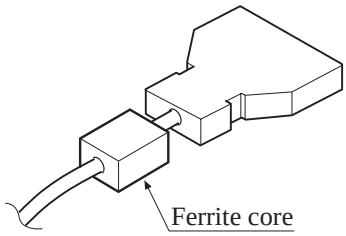
4. Supporting EMC Directive (89/336/EEC)
Generic Emission Standard EN50081-2/93
Generic Imunity Standard EN50082-2/95

This product is designed and manufactured exclusively for heavy industry. Follow the following items.

a. Never remove the ferrite core attached to the teaching pendant's cable , and feedback cable.



Teaching Pendant

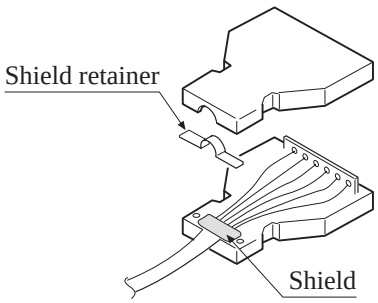


Feedback cable (robot side)

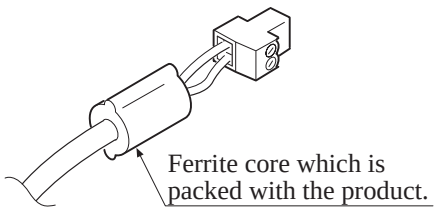
b. Be sure to use shielded cable for user input and output

		Work on the shielded wire	Work on the ferrite core	Cable length
CPU Board	RS232C	Required	Not required	3 m or less
I/O Board	Input connector Output connector	Required	Not required	–
	DC24V connector	Required	Required*	–
Safety connector		Required	Not required	–

* Use the cores supplied.



Input connector
Output connector
RS232C connector



DC24V connector

Note: The shielded wires of the input and output connectors of the I/O board, and those of the safety connector and RS232C connector must be connected to the inside of the metal housings supplied.

c. Be sure to use the supplied cables for the data transfer cable, feedback cable, motor power cable and AC power cable.

5. SMART specifications

The SMART specifications is the safety function which is applied to the SMART robot only. The Drive Safety Switch (DSS) function is added to the normal functions.

DSS function

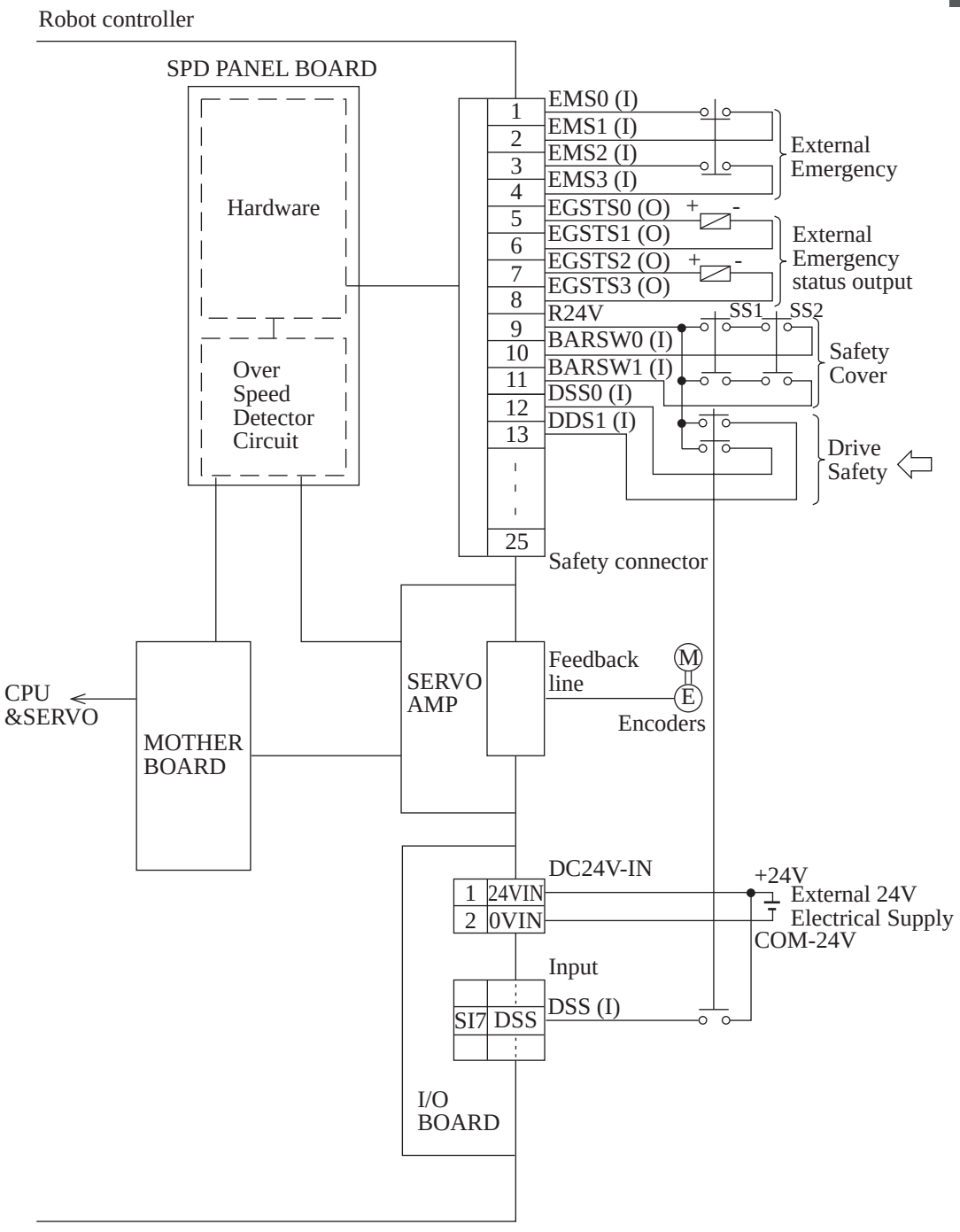
	DSS		
	ON →	OFF →	ON
Off-line mode	Operation possible with the servo power ON	The servo power is turned OFF once.	The servo power is turned ON and normal operation is possible.
On-line mode	During start-up During step stop (servo power OFF)	Emergency stop Normal operation (servo power OFF)	Starts from the initial state Re-start is possible successively.

Points which are different from the normal operation
During the step stop condition (servo free) in the on-line mode:

- Normal function - The safety cover can be opened and closed as it is.
- SMART robot function - After turning OFF the DSS, the safety cover can be opened and closed.

Use the three-pole switch for the Drive Safety Switch. (Refer to the following drawing.)
The DSS0 and DSS1 of the Safety connector shuts the servo down by means of hardware.
The DSS signal of external users input becomes the input signal to software.
Synchronize the switch contact for the DSS signal of external users input with the DSS0 and DSS1 of the Safety connector.

How to connect the SMART safety circuit



(I): Input
(O): Output

Installation Guide

Installation Guide

1. Outline

The Sony SRX-600 High-Speed Assembly Robot Series executes the assembly of small parts, inspections and handling, etc., at high speeds and high rates of efficiency, and also enables easy operation and easy maintenance.

The use of the AC servo motor equipped with an absolute encoder also enables maintenance-free and home-return-less operations. We have also attained high levels of rigidity and precision in a light and compact mechanical package (half the weight of the SRX-510). With a standard payload of 5kg (11 lbs.) and a cycle time of 0.6 seconds (payload: 2kg (4.4 lbs.)) , productivity will be increased.

Payload:	Maximum 5kg (11 lbs.)
Pose-repeatability: (Positioning Accuracy)	±0.01mm (XY plan)
Cycle time:	In the order of 0.6 seconds (with a payload of 2kg (4.4 lbs.))

The newly developed compact and lightweight controller has only half the weight of the SRX-510, and is a multi-function AC controller with a multi-task function and high performance capability owing to the mounted 32bit CPU.

Controller Dimensions:	430 (w) × 440 (d) × 240.5 (h) (excluding protruding parts) Equivalent to 5U of DIN specification
Multi-task:	LUNA 16 tasks (robot 8 tasks, peripheral 8 tasks) System task (1 task) PLC task (1 task)

Programs, input and output, and variables, etc., can be monitored with the LUNA Ver.5.0 debugging software (Windows edition), and the major improvements to the debugging environment enable the start-up of an efficient robot system. Programs can be made on personal computers available on the open market, and teaching can be carried out simply and speedily with the handy-type teaching pendant.

Full PLC functions have been included as standard in order to enable the control of equipment peripheral to the robot. Programs are run with the scan method with Boolean algebra expressions. I/O is shared with the robot's I/O, and I/O expansion is possible if necessary.
A single robot can control the entire robot station by using the PLC function.

2. Features

The features explained below will differ in accordance with variation and payload, etc. Refer to section 4. Specifications and 5. Outline Drawings and Work Envelopes of Operation for further details.

2-1 Robot

■ Mounted with an AC servo motor ⇨ Maintenance-free

The SRX-600 series is mounted with a brushless AC servo motor, so brush maintenance is not necessary.

■ Absolute encoder ⇨ Home return is not necessary under normal working circumstances

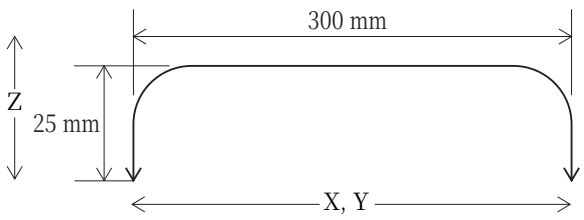
The SRX-600 series employs an absolute encoder. This means that there is no necessity to return to the home position when the unit is re-started after electrical power has been switched off.

> **NOTE**
>
> *The absolute encoder retains position data with its battery back-up. Home return is therefore required in the following cases:*
> *(1) When the cable connecting the robot controller and the robot has been disconnected.*
> *(2) When the mains power has been switched off for one month (a 24-hour recharge is necessary).*

■ World's top-level cycle time

0.6 seconds per unit: SRX-611 (L6015) 2kg (4.4 lbs.) specification

The world's top-level cycle time, which contributes greatly to increased work efficiency.



Cycle time

The shortest amount of time required to make a single return journey between the two points indicated on the diagram on the left.

■ High pose-repeatability (Positioning accuracy)

The high pose-repeatability levels correspond with high-accuracy applications.

X-Y plan: ±0.01mm
Z axis: ±0.02mm
R axis: ±0.03 degrees

■ Hollow-type Z axis shaft

A hollow-type Z axis shaft has been used. It is therefore possible for user wiring and ducting to be passed through the shaft and exit at the front edge of the Z axis.

2-2 Operability

■ Multi-task installation

Multi-tasks have been installed to improve ease of use. A variety of tasks, such as program transferral and the monitoring and amendment of I/O and variables, are possible during automatic operation. A maximum of 18 task which can be run by programs may be used. Each of the tasks are controlled in accordance with time allocations to ensure that operations are carried out under the most suitable conditions.

Robot tasks (8 tasks): Robot operation programs

Tasks which operate robots can be run at a rate of one task for each robot. 16 or 10 types (depending on the tasks) of robot operating programs can be stored for each task. Although it is possible to control a maximum of eight robots (eight tasks) with the software, usually only one robot and only one robot task is used. (The equivalent of conventional LUNA operation programs.)

Peripheral Tasks (8 tasks): Signal control programs for peripheral devices

Control which uses I/O with peripheral devices and serial communication and arithmetic calculation with computers, etc., is performed in parallel with robot operations. Sequential control is performed with peripheral tasks if slow processing is acceptable and if the system has a small number of I/O points for control.

PLC task (1 task): PLC function

A complete sequential control function for the scan method which programs in the Boolean algebra format.

System task (1 task): Total robot control program

A task which programs movements corresponding with the robot's status. This task defines the signal control for peripheral devices between the mains power being switched on and the start of automatic operations, and the special output control following emergency stops.

■ PLC functions

A complete sequential control function has been included as one of the multi-tasks. This can be used without adding any hardware by simple programming. The command system uses Boolean algebra, and the same scan method as normal sequential control has been adopted.

The processing speed will be faster than peripheral tasks as a special description format has been adopted. Control is performed for the internal relay and maintenance relay, the timer, counter and I/O relay, and it is possible to program so that complex functions can be processed while linked with peripheral tasks. PLC task make an efficient substitute for individual sequential controllers when the system is too large. I/O is split between the robot's user I/O and used. It is also possible to add an expansion I/O when many more I/Os than standard are necessary.

■ Newly developed compact controller

The structure of the controller was completely reviewed, and a compact controller half the size of conventional models developed (compared with other Sony models and excluding protruding parts).
The controller is equipped with three substrate slots to enable function expansion owing to its small body. The internal structure consists of units, so maintenance has also become easier.

■ Newly design Teaching Pendant

The Teaching Pendant's key layout has been newly designed to enable easy key operations. Improvements have not only been made to the key distribution, but also to operational response.

■ Direct teaching function

As direct teaching is possible with the servo switched off, rough teaching can be performed efficiently. (The Z axis brake can be released from the Teaching Pendant.)

■ Vast data storage capacity

Robot task and peripheral task programs are stored in a common 128kbyte memory. PLC task and system task programs are stored separately from the above-mentioned memory.

- Capacity for a single robot task program:
  Operation program (LUN): Maximum 64 kbytes
  Point program (PON): Maximum 64 kbytes
  Point count (for each program): Maximum 3072 points
- Capacity for a single peripheral task program: Maximum 64 kbytes
- Capacity for a PLC task program (total): Maximum 32 kbytes
- Capacity for a system task program: Maximum 16 kbytes

■ Memory card (PC Card) support

The standard memory cards (PC card, PCMCIA 2.1 type 1) used by the IBM-PC are supported. As the format registered on the memory card is the same as the personal computer being used, if a program creased with the personal computer is copied across to the memory card, the controller can read it as it is.
Also, if the memory area within the robot is insufficient, the data can be transferred from the memory card during automatic operation.

2-3 LUNA Robot Language

■ LUNA robot language version upgrade ⇨ LUNA5.0

Commands were added to enable the multi-task environment to be even easier to use. Functions for the commands related to robot operations were also improved.

■ Debugging environment on the Windows platform

Specialized software to be run on the Windows platform has been developed in order to improve the efficiency of program debugging.
Debugging can be carried out while viewing the program for not only the robot tasks, but also for the peripheral tasks, the PLC task and the system task.
Operations are performed with simple mouse clicks, which enables the following tasks to be completed easily:

- Starting or stopping automatic operations with an instruction sent from the personal computer.
- Program execution by each line or each step.
- Program partial execution
- Execution termination with variable values
- Monitoring of I/O and variables
- Enforced amendment of output status
- Amendment of variable numerals
- Monitoring of the relay status, etc., within the PLC

■ New CP control ⇨ Fixed speed, fixed accuracy

Two types of essential elements which become fixed are available when performing circular interpolation and direct linear interpolation; the conventional speed fixing specification and the newly prepared accuracy fixing specification.
These are selected from the program in accordance with the application.

NOTE

- ◆ *When specifying speed:* *There are cases where accuracy will be dispersed depending of the size of the specified speed and the movement location.*
- ◆ *When specifying accuracy:* *There are cases where speed will be dispersed depending of the size of the specified accuracy and the movement location.*

■ Overwrap Motion ⇨ Wide reductions of actual work time

It is possible to reduce actual work time by overwrapping two movements or by overwrapping a movement and any other process.
The start of overwrap can be specified in combination with the application between the specification of distance from the destination position and time before arrival, and immediately after movement has been started.

■ Minimal time stop function ⇨ Work amendments during robot movement

It is possible to stop the robot during movement in the shortest possible time by entering input signals. For example, this can be used when the work target position has been detected with the sensor, and the robot is to be stopped at this position and work started.

■ Palletizing function

The position of parts on the palette can be automatically calculated by the simple teaching of three or four points on the palette. The layout of the parts on the palette, including checked patterns, has been prepared in the standard manner.

NOTE

The absolute accuracy of the robot is not guaranteed. There will consequently be cases when the calculated positions and actual positions on the palette are different depending on the size and location of the palette and the accuracy of the palette. In this situation, improvements can be effected by dismantling the palette and creating a program.

■ Interruption processing function

Interruption processing is performed in accordance with signal input from external sources, RS232C communication, the time and other conditions.
Interruption processing is functional for both robot tasks and peripheral tasks.

2-4 Extended Functions

■ I/O additions

It is possible to add an I/O board for every 48 I/O points.
Increases up to a maximum of 184 points for each I/O is possible by adding three 48 point boards for every 40 I/O points.
All of these I/Os can be freely used by robot tasks, peripheral tasks, PLC task and system task.

> **NOTE** *The maximum number of I/O boards that can be added is three boards including additions for other boards.*

■ Tracking function ⇨ Work without stopping the conveyor belt

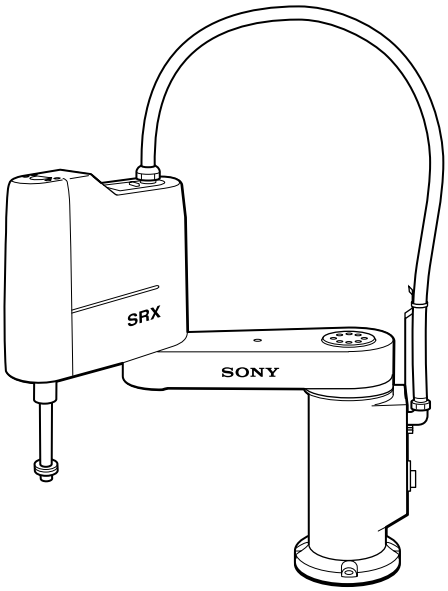
Obtains position data in the real time from objects involved in direct line movement, such as conveyor belts, and carries out work while tracking these movements.

> **NOTE** *Work accuracy with tracking will differ to the actual system. A special board (optional) to receive position information when tracking is being carried out is also necessary.*

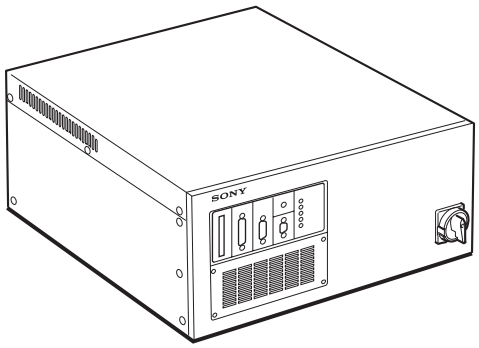
3. Configuration

SRX-611 (L60 15)

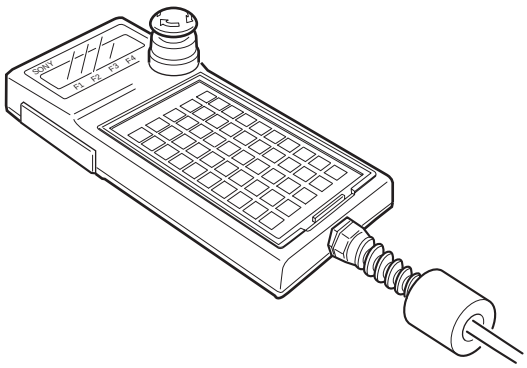
Series name	Arm length	Z axis stroke
	60 : 600 mm	15 : 150 mm
	40 : 400 mm	45 : 450 mm
	80 : 800 mm	*Optional



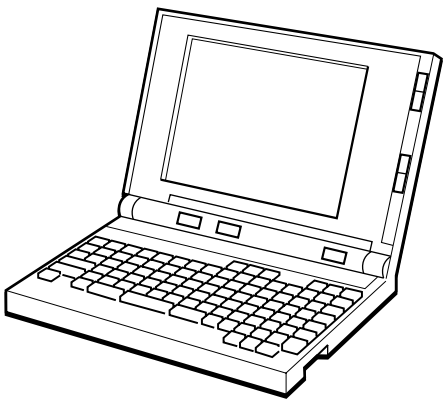
SRX-611



Controller



Teaching Pendant (optional)



Programing Device (personal computer available on the open market)

4. Specifications

4-1 Unit Specifications

SRX-611 (L6015)

Arm length	Total length	600 mm
	1st arm	350 mm
	2nd arm	250 mm
Work envelope	1st arm	220°
	2nd arm	±150°
	Z axis	150 mm
	R axis	±360°
Payload		2 kg (4.4 lbs.), 3 kg (6.6 lbs.) and 5 kg (11 lbs.)
Cycle time (when 2kg (4.4 lbs.))		0.6 seconds per unit
Maximum speed (when 2kg (4.4 lbs.))	Combination of 1 and 2 axis	5200 mm/sec
	Z axis	770 mm/sec
	R axis	1150°/sec
Pose-repeatability (Positioning accuracy)	XY plan	±0.01 mm
	Z axis	±0.02 mm
	R axis	±0.03 mm
Weight		35 kg (77 lbs.)
Tool items	Signal wiring	15 pieces
	Air ducts	3 pieces (external form ø6)

NOTE *Use the R axis load imager at $J=GD^2/4=6.0\times10^{-3}kgm^2$ or less.*

SRX-611 Variations

SRX-611 (L4015)	Total arm length	400 mm
	1st arm	200 mm
	2nd arm	200 mm
	1st arm work envelope	180°
	2nd arm work envelope	±130°
SRX-611 (L8015)	Total arm length	800 mm
	1st arm	450 mm
	2nd arm	350 mm
	1st arm work envelope	220°
	2nd arm work envelope	±150°
Long Z SRX-611 (L**45)	Z axis work envelope	450 mm

4-2 Control Specifications SRX-C61

Drive method	AC servo motor drive with an all-axis software servo
Position detection	Absolute method (battery back-up)
Movement method	PTP, CP, overlap motion, QM, QT
Control axis count	Simultaneous and individual control for axis 1 to 4
Applicable output	Motor power total maximum 1000 W
Speed control	Speed setting : 1 - 100% in 100 stages Override function : 1 - 100%
Interpolation function	3-dimensional direct linear interpolation, 3-dimensional circular interpolation
CPU	i486DX2 (50MHz inside)
Multi-task	LUNA : 16 tasks (robot : 8 tasks, peripheral : 8 tasks) System task : 1 task PLC task : 1 task
Data storage capacity	3072 points (for each program) total 176 kbytes for all tasks
Memory card	PC CARD STANDARD (PCMCIA2.1 type 1) support
Teaching	Teaching with the Teaching Pendant (optional) Direct teaching Position program creation when off line
Peripheral device control	40 points for each I/O, maximum 184 points for each
Serial I/F	RS232C : 3 systems 1 special TP, 1 special device for programing, general purpose : 1
Expansion	Expansion slot device : 3 slots Vision board, I/O board, etc.
Built-in PLC function (optional)	Program format: Boolean algebra Operational status: Independent from robot operations I/O : Robot user's I/O used
Power source	Single phase AC200V - 240V ± 10% 50/60 Hz
Consumed power	1.5 kVA
Momentary stop guarantee time	Normal operations for momentary power cuts within 20 ms
Insulation resistance	20MΩ or more between the covering and primary electrical source
Noise resistance	1000 Vp-p 1μs (With a noise simulator. Between the electrical source and chassis)
Ambient temperature	0°C - 40°C
Ambient conditions	Must not be any corrosive gas. Must be no condensation
Grounding	Connect to AWG 14 or more
Humidity	35 - 90%
External dimensions	430 (w) × 440 (d) × 240.5 (h) ※equivalent to 5U of DIN specification
Weight	25 kg (55 lbs.)

* Refer to section "7-7 Operations"

4-3 Controller Function Table

Type	Function name	Function
Data Transfer	Program transfer	Receipt of robot programs
	Program deletion	Deletion of specified program types
	Program data reverse transfer	Reverse transferal of position data to the programing device
	Stored program display	The name and length, etc., of stored programs
Manual operations	Home return	Return to the robot's home position
	Axes movement operation	Possible to operate each axis independently (low-speed, fast-forward)
	Cartesian movement operations	Possible to operate with XY coordinates (low-speed, fast-forward)
	Output operations	User output ON and OFF operations possible
	Program type selection	Selection of execution programs
	Current position storage	Current position data registered in the specification point number
	Point data display	Display of the data stored for each point
	Movement to stored points	Movement towards the positions for each point Save movement Direct movement Linear interpolation
	Coordinate input movement	Movement towards a point for which coordinates have been input
	System offset setting	Input of system offset values
	System limit setting	Input of system limit values
	Movement operation speed settings for each axis	Manual movement operation speed setting for each axis
	Servo ON/OFF	Used for servo OFF teaching, etc.
	Brake ON/OFF	Brake control during servo OFF teaching
	Tool coordinate setting	Parameter setting for tool coordinates
	Q stop	Possible to stop during movement between points
	Point movement speed setting	Speed setting during movement towards stored points
Auto operations	Automatic operation	Automatic operation with LUNA language programs
	Step termination	Possible to operated by command or by step
	Program display	Display of operational programs during operations
	Storage of latest type numbers	Storage of the latest run type numbers
	Variable reference and data change	Possible to refer to and amend integer variables, real variables and point variables
	Break point	Possible to set line numbers and variables during operational program pauses
	Speed override	Operations can be confirmed with speeds specified in programs in 1/100ths (1 - 100%)

Type	Function name	Function
Memory card	Program save	Robots programs stored on the memory card
	Program load	Robot programs re-loaded from the memory card
	Program deletion	Deletion of programs saved on the memory card
	Stored program display	Display of names and length of programs stored on the memory card
Diagnostics	External I/O signal display	Display of external input status
	Sensor check	Checks for limit and home position sensors
	Position counter check	Check for pulse input from the motor
Common functions	Error display	Display of the error number on the Teaching Pendant
	Emergency stop	Servo cancellation immediately after emergency stops
	Error history	Display of past error history
	Task list	Display of program names assigned to each task and the operation status
	Help	Display of operation descriptions

4-4 Robot Language Specifications

LUNA	Version 5.0
Supporting computer	• IBM-PC : DOS (ver.5.0 or higher)
Operational environment	Compilation, etc. : DOS Debugging environment : Windows
Functions	Compilation, transferral, reverse transferral, error history confirmation, etc.
Debugging environment	On-line robot operations (automatic operation, transferral, etc.) Operations by step or by line step when viewing the program Partial program operation in accordance with condition setting Monitoring of I/O and variables, enforced amendment of settings
Robot task commands, peripheral task commands	Robot operational commands, palletize commands I/O commands, communication commands, functions, vision commands, interruption commands
System task commands	Automatic operation start-up, memory card commands, etc.
PLC function commands (Boolean algebra orthography)	Relay : internal, keep, I/O, timer, counter, features (clock, errors, robot information) Operands, etc : Add-subtract, differentials, data comparisons, data transferral, bit extraction, (master control) jump

NOTE

- *A personal computer with DOS (ver.5.0 or higher) should be prepared for LUNA program compilation.*
- *To debug in the Windows environment the SRX Platform kit is required.*

4-5 Program Device Structural Examples

The program device is to be prepared by the user.

Hardware

Personal computer : IBM-PC

Disk units : 3.5 inch 2HD disk drive,
100 Mbyte hard disk
Memory capacity : 8 Mbytes or more

Program transferral cables
: SRX-H005 (D-sub9 pin connector

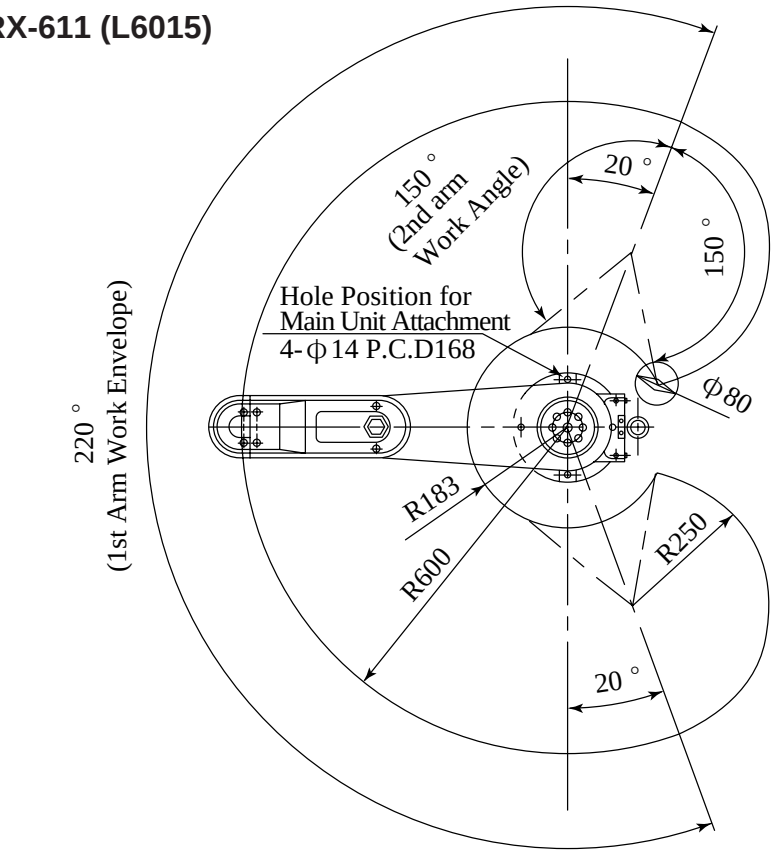
Software

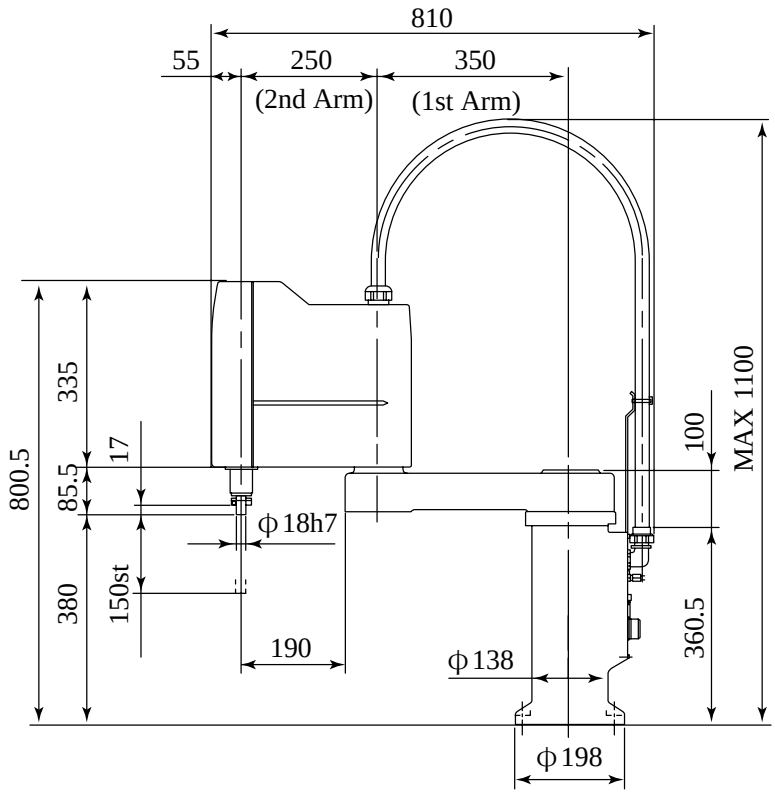
- OS : MS-DOS (ver.5.0 or higher) or Windows (ver.3.1 or higher)
- Robot language : LUNA5.0
- Editor : FINAL editor recommended

5. Outline Drawings and Work Envelopes

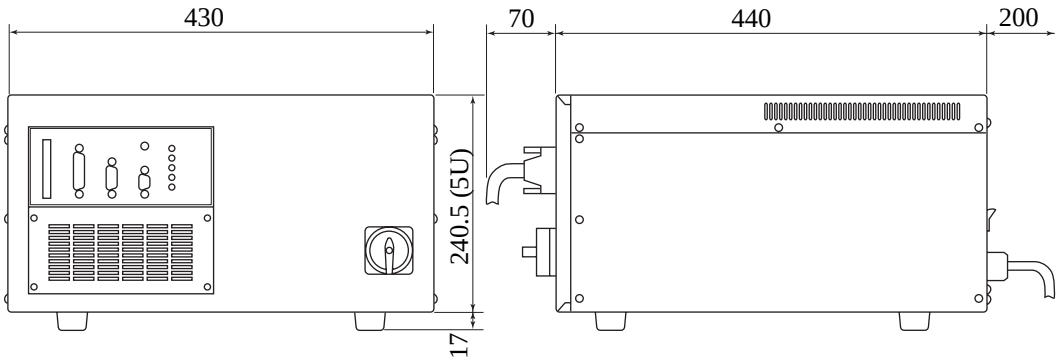
5-1 Outline Drawing and Work Envelope for the Main Unit

SRX-611 (L6015)



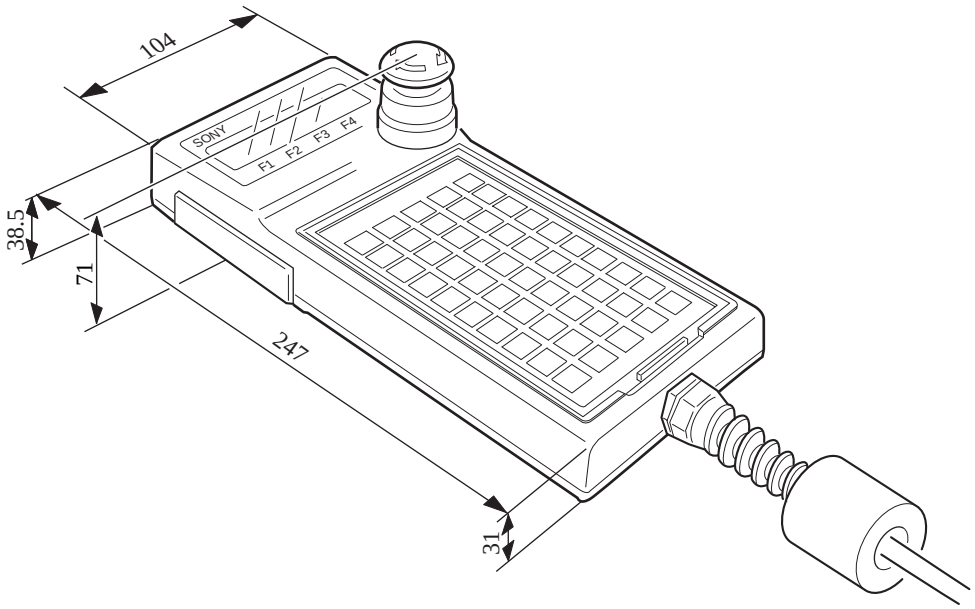


5-2 Outline Drawing for the Controller



NOTE *Dead space will appear on the front and rear panels of the controller when the cable is actually connected, so take care of this during installation.*

5-3 Outline Drawing for the Teaching Pendant (Optional)



6. Unpacking

6-1 Transportation

Caution

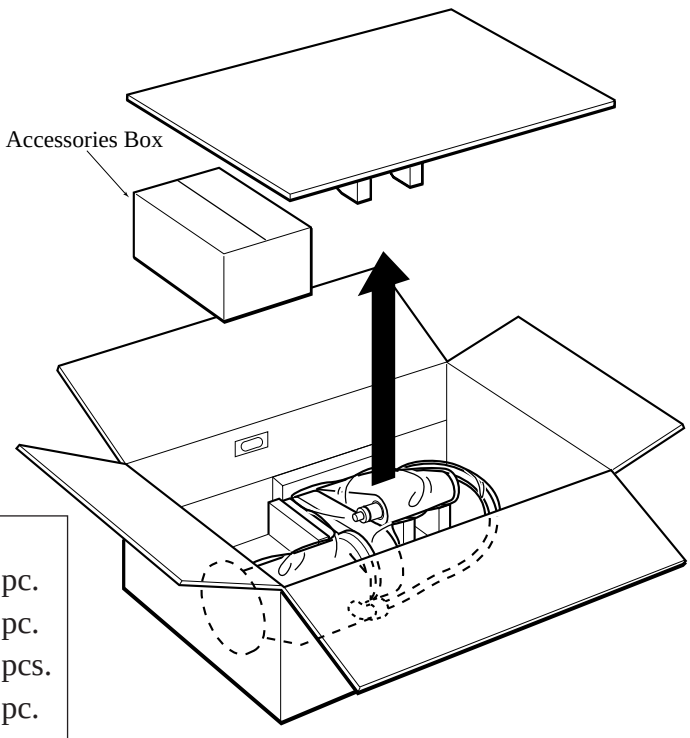
The main unit and the controller for the SRX-611 robot delivered by Sony Corporation are packed separately. Transport both packages to the place of installation without dropping them or allowing them to fall over. Special care must be taken when handling the controller to avoid vibrations and impact as it contains precision electrical components.

NOTE

Always use the packaging specified by Sony Corporation during transportation.

6-2 Unpacking the Robot

- Open the cardboard box as indicated in the diagram below and remove the accessories box.
- Confirm that all standard parts mentioned below and all parts ordered by the user are included.
- Remove the main unit from the box. Ensure that two or more people are involved in removing the main unit from the box.

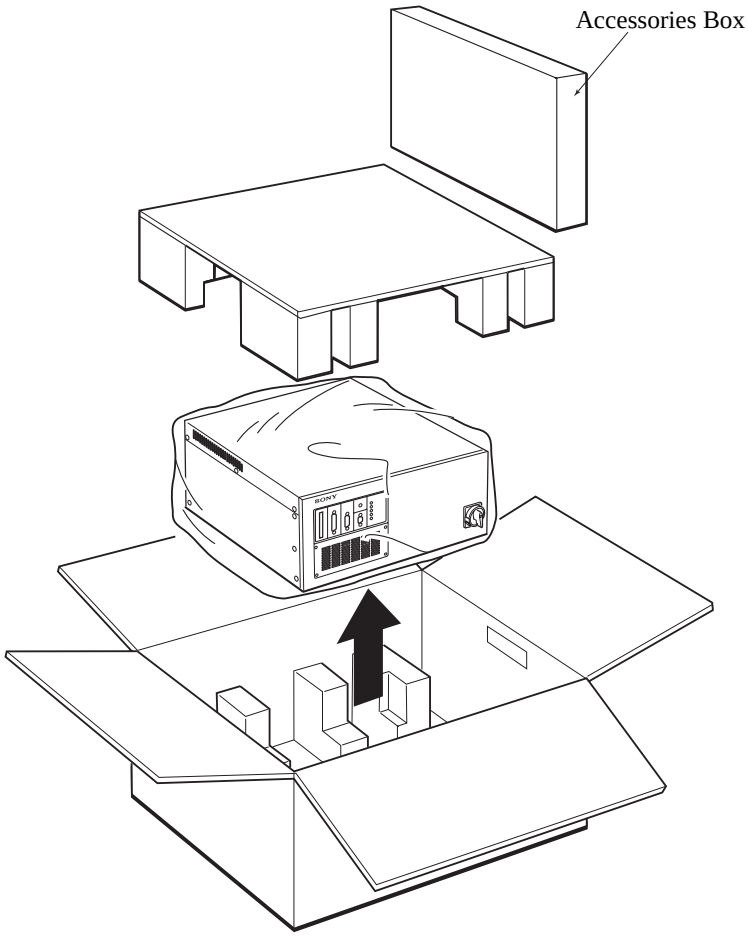


Standard accessories	
• Feedback cable	1 pc.
• Motor power cable	1 pc.
• Connector	2 pcs.
• Operation manual	1 pc.
Options	
• Teaching pendant	

6-3 Unpacking the Controller

> **Caution** *As the controller weighs approximately 25kg (55 lbs.), ensure that two or more people are involved with the following procedures for safety reasons.*

- Open the cardboard box as indicated in the diagram below and remove the accessories.
- Confirm that all standard parts mentioned below are included.
- Remove the top packing and take the main unit out of the box.



Standard accessories	
• Mains cable	1 pc.
• Input connector	1 pc.
• Output connector	1 pc.
• 24 V connector	1 pc.
• Safety connector	1 pc.
• Spare fuse	3 pcs.
• Ferrite core	1 pc.

7. Installation

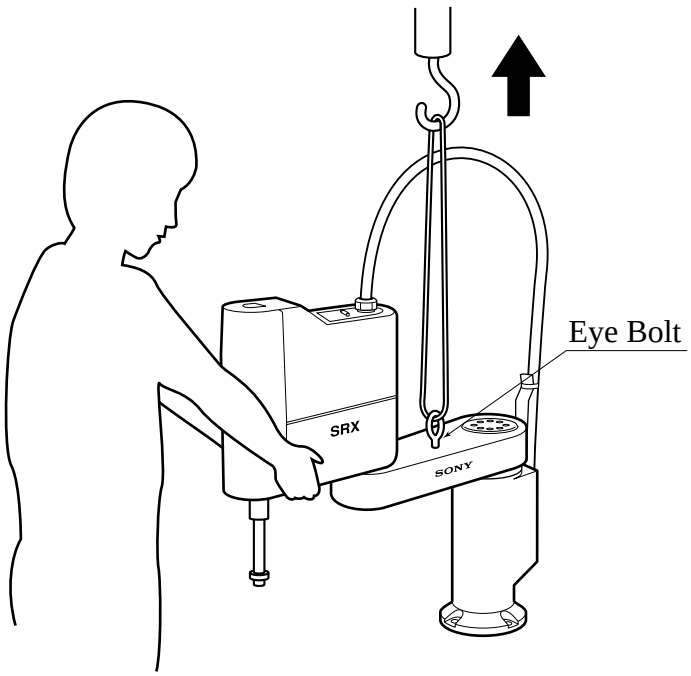
Caution

As the robot weighs approximately 35kg (77 lbs.), ensure that two or more people are involved in all lifting procedures. The arms are not fixed in place and will come off if lifted at a certain angle or pressure is applied in certain directions. Take extreme care when lifting. Also, the upper surface of the cover will become deformed if extreme pressure is applied, so support from the bottom surface.

7-1 Transportation Methods

When lifting with a crane, etc., remove the blind cap located in the central part of the 1st arm, screw an eye-bolt into the M10 tap hole and lift with a rope. Ensure that the rope used for lifting is of sufficient strength (ø6 wire rope or greater). Have one person support the unit to maintain balance during lifting. Place the unit gently on the attachment plate to avoid excessive impact.

The controller weighs approximately 25kg (55 lbs.). Avoid impacts during movement. Take special care to place it gently on the platform.

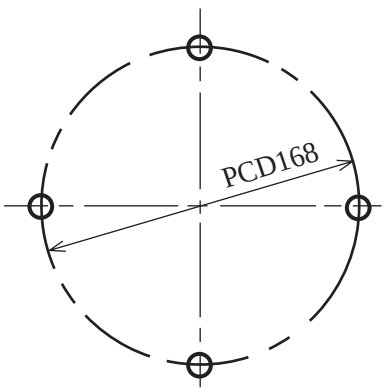


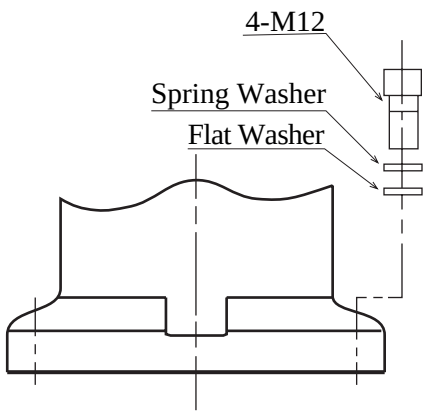
7-2 Installing the Robot

Firmly fix the unit in place with the M12 hexagonal bolt as shown in the diagram below. (Recommendation: Bolt in a strength class of 12.9T with a tightening torque of 1500kg-cm)
The operational range of the robot is indicated in section 5. Outline Drawings and Work Envelopes, so take care over the directional installation.
Pay attention to the following points during installation:

- Thoroughly review the installation location and provide safety manuals to ensure the safety of operators during use of the robot.
- Ensure that the installation location has sufficient rigidity and strength, and make sure that it is firmly fixed to avoid the effects of vibrations, etc.
  Example: SS41 thickness of t16mm or more
- Give thorough consideration to the robots range of operations, and pay special attention to avoid it overlapping peripheral equipment.
- Ensure that user wiring and peripheral equipment, etc., does not obstruct the movement of the robot unit or the robot cable.

> ⚠ Caution
>
> *The robot is unable to maintain balance on its own during installation and must be supported manually.*





7-3 Installing the Controller

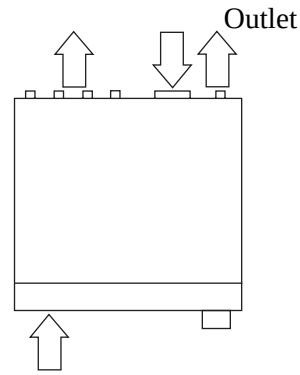
The controller contains many electrical parts and connectors, etc., and does not stand up well to vibrations and impact. It also generates heat, so ensure that it is installed in a well-ventilated and vibration-free location. Consult with Sony Corporation if an installation location in which strong electro-magnetic fields or electro-magnetic noise exist is unavoidable.

Caution

Items to beware off for controller installation and storage:

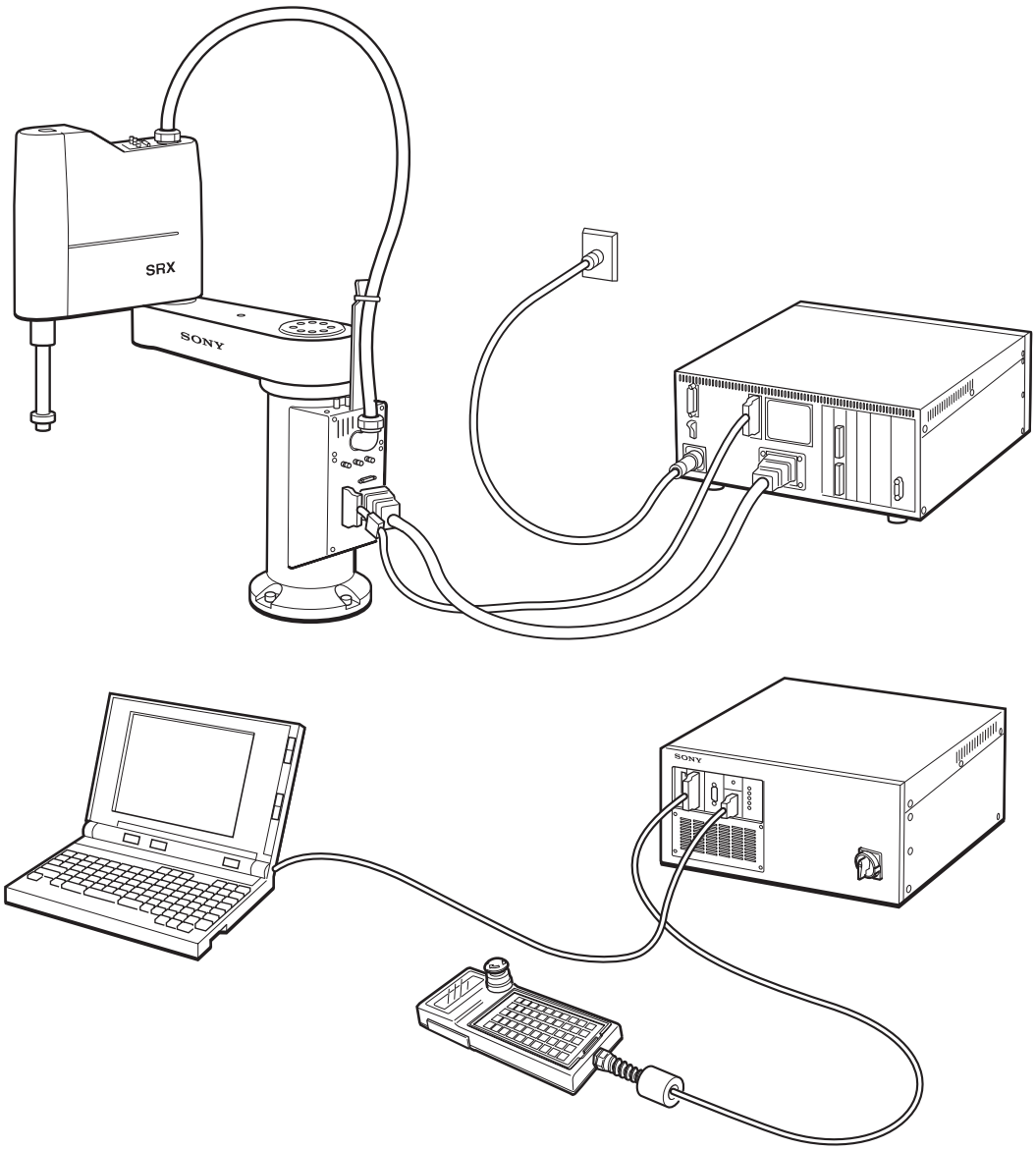
- *Connect a 3rd class earth or higher to the device's earth line.*
- *Avoid installing in the following locations:*
  - *In places which receive direct sunlight or which experience temperature ranges exceeding 0 degrees and 40 degrees.*
  - *In places which experience relative humidity ranges exceeding 35% and 90%, and places in which condensation is generated by rapidly changing humidity.*
  - *In places where corrosive gas or inflammable gas exists.*
  - *In places where the unit will be subject to direct vibrations or impact.*
  - *Close to machinery which emits electrical noise, such as welders, electric dischargers or high-frequency generators.*
- *The controller is equipped with lithium ion batteries for memory back-up purposes, and lead storage batteries for absolute position detector circuits, so avoid storing in locations with high temperatures or high humidity levels.*
- *There is a risk of excessive static electricity building up in extremely dry locations, so care must be taken when handling boards, etc.*
- *There is a risk of thinner, etc., changing the color of the surface panels, so do not use this for cleaning purposes.*
- *Avoid using excessive power when operating or removing switches and connectors.*
- *Ensure that protective circuits, such as noise killers and diodes, etc., are inserted when control is carried out by relays and solenoid valves with external output.*
- *Ensure that the main power is switched OFF when removing plugs, power connectors and sensor connectors.*

◆ *Ensure that 100mm or more of space is available around the inlets and outlets of heat dispersal fans.*



7-4 Connections

The robot and controller are adjusted in combination during shipping. Confirm that the serial numbers of the robot and the controller are the same when connecting cables. Care must especially be taken when multiple sets have been purchased. Observe the instructions in the following diagram for connections.



NOTE *Ensure that the serial numbers of the robot and the connector match when connecting together.*

7-5 Switching on the Mains Power

Switch on the POWER switch on the front panel of the controller to turn on the mains power.
Wait for at least five seconds before switching on the mains power immediately after switching it off.

> **NOTE** *A short break error (all five LEDs on the front panel flashing) may occur if the mains power is switched on within five seconds of turning off.*

7-6 Home Return

The absolute decoder used with this robot is equipped with a battery back-up system. As the back-up battery is located within the controller, it is necessary to return to the home position when the feed-back cable between the robot and the controller is disconnected.

Perform the following procedures for returning to the home position when the electrical power has been switched on for the first time after installation or after the feed-back cable has been disconnected.

Press the [MANAGE] key.
↓
Use the [↑], [↓] cursor keys to select home return, and press [F4] key.
↓
Press [F1] OK key to start home return.

Settings for the home position and home return operation sequences are also performed in accordance with the robot installation conditions (refer to the operation guide for further details.)

The battery back-up will last for one month when fully charged.
Note that it is necessary to return to the home position even when the battery voltage drops and position data can no longer be stored (E358-E361 is displayed when the voltage drops. Electricity must be supplied for 24 hours or more to acquire a full recharge.)

7-7 Operations

Grease will become glutinous, especially in cold regions, when the robot is started up cold, and there are cases where a torque limit error (E310-E313) will be triggered when speed operations (acceleration) are performed during normal use, and the robot stopped.
In this situation, set lower speeds and perform warming-up operations.
Carry out override at approximately 20%, perform warming-up every 20 minutes and gradually increase the speed.

8. System Task and Signal Control

Emergency stops, system input and other sequences can be controlled by programming the system task with the SRX-600 series. This section provides sample programs for emergency stops and system task input/output with the use of system task.

8-1 Sample Program Outline

1. System programs installed during delivery:
   a. Program contents
   b. Input/Output allocation
   c. Time chart

2. System programs which can be used in the same way as conventional robots:
   a. Program contents
   b. Input/Output allocation
   c. Time chart

3. System programs controlled from PLC:
   a. Program contents
   b. Input/Output allocation
   c. Time chart (same as 2.)

8-2 System Programs Installed During Delivery

8-2-1 Program Contents

This program is a system task sample program that can be used immediately after the SRX-600 series has been installed.

```
;
; System program
;
; Method of usage
;     Automatic operation execution
;           Set a type number between I33 and I36 (4 bit hexadecimal) and turn I38 on
;           to start program execution and switch on the L38 automatic operation
;           signal and the L39 automatic operation execution signal.
;
;     Continual automatic operation
;           Turn I39 on when in the automatic operation mode to start continual
;           execution and switch on the L39 automatic operation execution.
;
;     Step termination
;           Turn I37 on when in the automatic operation execution mode to terminate
;           the step and switch on the L37 step termination signal and switch off the
;           L39 automatic operation execution signal.
;
;     Home return (delete if not necessary)
;           Turn I40 on to switch L40 on and return to the home position.
;           L40 is switched off when finished.
;
;     Error reset
;           Turn I32 on to reset an error and cancel the error signal.

      INIT        ; Initialization (the program must have INIT as the header)
            INT:I,TYPE

            FOR I = 1 TO 5          ; L1-L40 turned off
                  POUT(I,0)
            NEXT
            INITEND                 ; Command to end initialization

      EMG               ; Processing for emergency stops
            DO L37(OFF)
            DO L38(OFF)
            DO L39(OFF)
            DO L40(OFF)
            RET         ; The module is ended with RET

      ERROR             ; Processing for errors
            DO L37(OFF)
            DO L38(OFF)
            DO L39(OFF)
            DO L40(OFF)
            RET
```

```
I37ON             ; Step termination
      IF L39(ON) THEN    ; Automatic operation being executed
            I = STEP(1)    ; Robot 1 step termination
            DO L39(OFF)    ; Automatic operation execution termination
            DO L37(ON)     ; Step termination
      ENDIF
      RET

I38ON             ; Automatic operation
      IF L39(OFF) AND L40(OFF) THEN  ; Not possible during automatic operation
                                     ; execution or during home return
            PIN(5,TYPE)  ; Type number acquisition (type number I33-I36)
            TYPE = TYPE&0FH    ; 4bit removed
            IF TYPESET(1,TYPE) = 0 THEN    ; Program type set in robot 1
            IF START(1) = 0 THEN           ; Program started
                  DO L38(ON)   ; Automatic operation
                  DO L39(ON)   ; Automatic operation execution
                  DO L37(OFF)  ; Step termination cancelled
            ENDIF
            ENDIF
      ENDIF
      RET

I39ON                          ; Continual running
      IF L38(ON) AND L39(OFF) AND L40(OFF) THEN  ; Not possible during automatic
                                     ; operation execution or
                                     ; during home return
            IF CONTINUE(1) = 0 THEN  ; Robot 1 continual operation
                  DO L39(ON)   ; Automatic operation execution
                  DO L37(OFF)  ; Step termination cancelled
            ENDIF
      ENDIF
      RET

I40ON                          ; Home return
      IF L39(OFF) AND L40(OFF) THEN  ; Not possible during automatic operation
                                     ; execution or during home return
            DO L37(OFF)        ; Step termination cancelled
            DO L38(OFF)        ; Automatic operation cancelled
            DO L40(ON)         ; Home return started
            I = HOMING(1)      ; Robot 1 home return
            DO L40(OFF)        ; Home return ended
      ENDIF
      RET

I32ON                          ; Error reset
      I=RSTERR
      RET

END
```

8-2-2 Input/Output Allocation

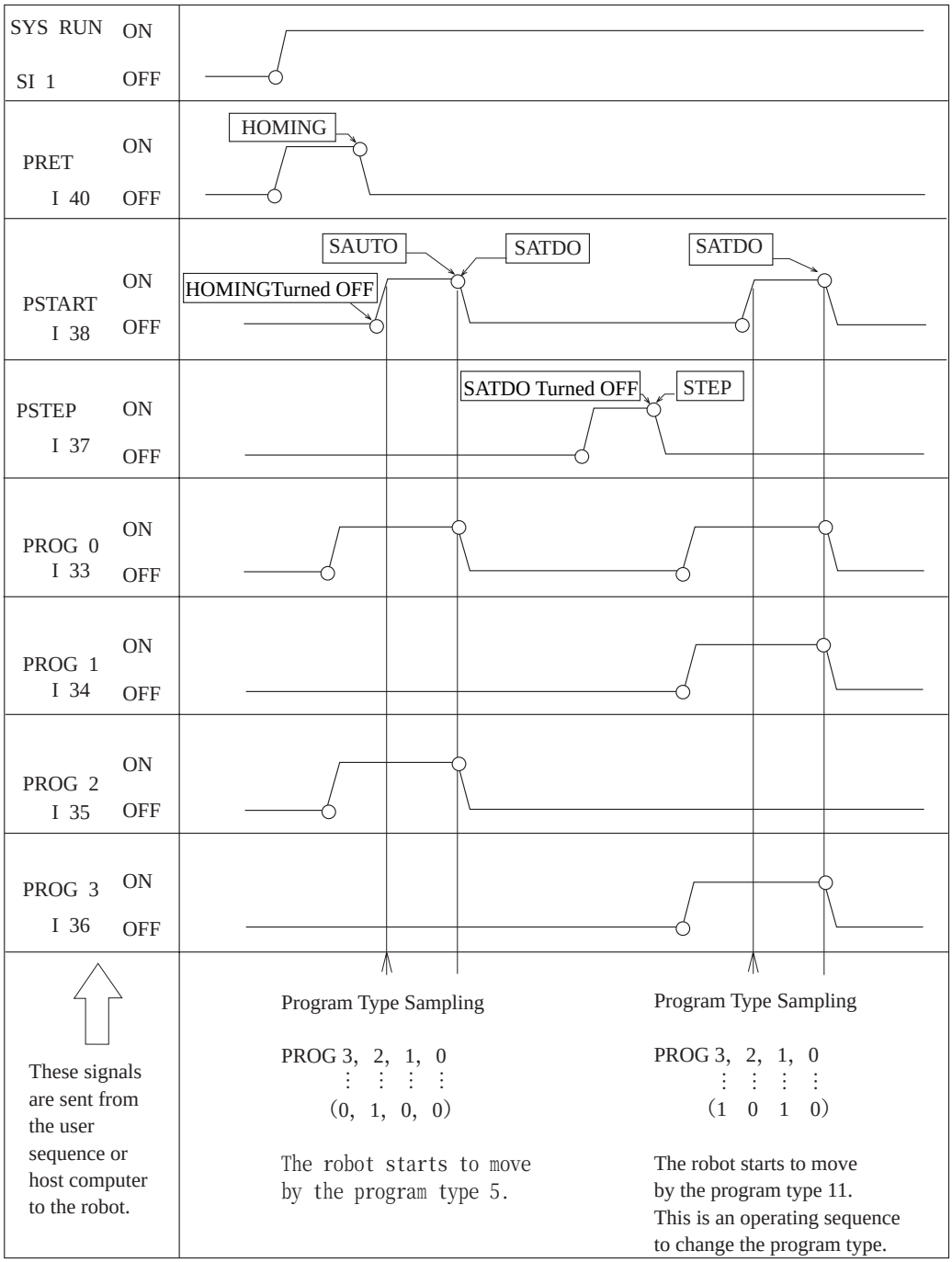
Input side

I32	ERRRST	(Error reset)
I33	PROG0	(Program type 0)
I34	PROG1	(Program type 1)
I35	PROG2	(Program type 2)
I36	PROG3	(Program type 3)
I37	PSTEP	(Program step termination)
I38	PSTART	(Program automatic operation execution)
I39	STPSTAT	(Program continual execution)
I40	PRET	(Robot home return start)

Output side

L37	STEP	(Program step being terminated)
L38	SAUTO	(Execution mode)
L39	SATDO	(Automatic operation being executed)
L40	HOMING	(Robot returning to home position)

8-2-3 Time Chart (Example of robot control with peripheral devices)



NOTE: Output signal from the robot to the user

8-3 System Programs which can be Used in the Same Way as Conventional Robots

8-3-1 Program Contents

This program is a sample program for controlling robots from peripheral devices in the same way as conventional SRX-500 series robots, etc. The sequence for conventional system I/O has been inherited into this system, and as settings have been made related to home return operations, the program can be re-written if necessary.

```
;***********************************************
;      System task sample program
;***********************************************
; Method of usage
;      Automatic operation execution
;            Set a type number between I33 and I36 (4 bit hexadecimal) and turn I39 on
;            to start program execution and switch on the L39 execution mode signal and
;            the L40 automatic operation signal.
;
;      Continual automatic operation
;            Turn the I39 automatic operation starting signal on when in the step
;            termination mode to execute continual operations and switch on the L40
;            automatic operation signal.
;

;      Step termination
;            Turn I40 step termination signal on when in the automatic operation mode
;            (SATDO ON) to terminate the step and switch off the L40 automatic
;            operation signal.
;
;      Home return (delete if not necessary)
;            The L37 peripheral device home return signal will be turned on two seconds
;            after the I37 home return start signal has been turned on, home return
;            will be started when the I38 peripheral device home return position signal
;            is turned on, and the L38 home return position signal will be turned on
;            when home return is ended.
;

      INT:I,TYPE,ERR,TUSK
INIT                              ;Initialization (the program must have INIT as the header)
      FOR  I=1  TO  5                   ;L1-L40 turned off
             POUT(I,0)
      NEXT
      RET
EMG                               ;Emergency stop process
      FOR  I=1  TO  5                   ;L1-L40 turned off
             POUT(I,0)
      NEXT
      DO  L35(ON)                       ;ERROR  ON
      RET
ERROR                                   ;Processing for errors
      GETERR(0,ERR,TUSK)                ;Most recent error information obtained from the
                                        ;error history
```

```
      IF  TUSK=1  THEN              ;Robot task 1 checked for an error
            DO  L35(ON)             ;ERROR  ON
      ENDIF
      DO  L37(OFF)                  ;PERET  OFF
      DO  L38(OFF)                  ;SHOME  OFF
      DO  L39(OFF)                  ;SAUTO  OFF
      DO  L40(OFF)                  ;SATDO  OFF
5       I=RSTERR                          ;Error checked for cancellation
      IF  I<>0  GO  5
      RET
I40ON                               ;Step termination
      IF  L40(ON)  THEN                   ;Automatic operation in progress
             IF STEP(1)=0 THEN            ;Robot task 1 step termination
              DO  L40(OFF)                ;SATDO  OFF
              DO  L39(ON)                 ;SAUTO  ON
         ENDIF
      ENDIF
      RET

I39ON                               ;Automatic operation
      IF  L40(OFF)  AND  L34(OFF)  THEN          ;Not possible during automatic
                                                 ;operation execution or during home
                                                 ;return
          PIN(5,TYPE)                ;Type number acquisition (type number I33-I36)
          TYPE = TYPE&0FH            ;4bit removed

          IF TYPESET(1,TYPE)=0 THEN        ;Program type set in robot task 1

               IF START(1)=0 THEN     ;Robot task 1 started
                    DO  L35(OFF)       ;ERROR  OFF
                    DO  L38(OFF)       ;SHOME  OFF
                    DO  L39(ON)        ;SAUTO  ON
                    DO  L40(ON)        ;SATDO  ON
               ENDIF
          ENDIF
      ENDIF
                                        ;Continual running
       IF  L40(OFF)  AND  L36(OFF)  AND  L39(ON)  THEN  ;Not possible during automatic
                                                        ;operation execution or during
                                                        ;home return
          IF CONTINUE(1) =0 THEN       ;Robot task 1 continual operation
          DO  L35(OFF)                 ;ERROR  OFF
          DO  L38(ON)                   ;SATDO  ON
          ENDIF
        ENDIF
        RET
I37ON                               ;Home return
      IF   L34(OFF)  THEN                  ;Not possible during automatic operation
                                           ;execution or during home return
          IF L40(ON) THEN                   ;Processing during automatic operation
               IF STEP(1)=0 THEN            ;Step termination
                    DO L40(OFF)             ;SATDO OFF
                    DO L39(OFF)             ;SAUTO OFF
                    DO L35(OFF)             ;ERROR  OFF
                    DO L36(OFF)             ;SMAN  ON
                    GO 10
               ENDIF
          ENDIF
```

```
            DO  L35(OFF)              ;ERROR OFF
            DO  L36(ON)               ;SMAN ON
            DO  L37(ON)               ;PERET ON
            DO  I34(ON)               ;PREADY confirmation
            DO  L37(OFF)              ;PERET OFF
            DO  L34(ON)               ;Home return started
            IF HOMING(1)=0 THEN             ;Robot task 1 home return
                  DO  L34(OFF)        ;Home return ended
                  DO  L38(ON)         ;SHOME  ON
            ENDIF
         ENDIF
10    RET
      END
```

8-3-2 Input/Output Allocation

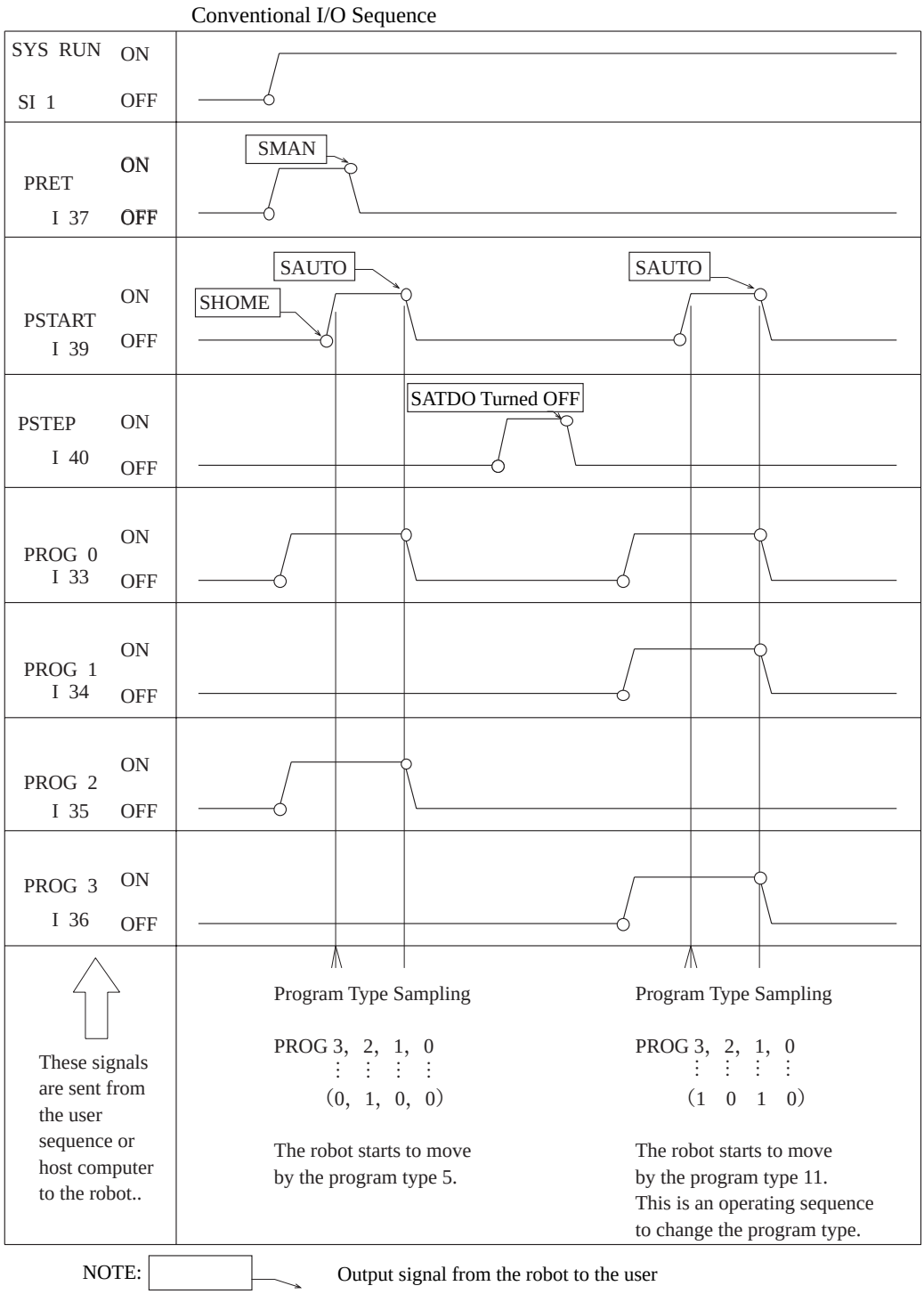
Input side

I33	PROG0	(Program type 0)
I34	PROG1	(Program type 1)
I35	PROG2	(Program type 2)
I36	PROG3	(Program type 3)
I37	PRET	(Home return start)
I38	PREADY	(Peripheral device home position)
I39	PSTART	(Automatic operation start)
I40	PSTEP	(Step termination)

Output side

L34	HOME	(Returning to home position)
L35	ERROR	(Robot error)
L36	SMAN	(Manual mode)
L37	PERET	(Peripheral device home return)
L38	SHOME	(Home position)
L39	SAUTO	(Execution mode)
L40	SATDO	(Automatic operation being executed)

8-3-3 Time Chart (Example of robot control with peripheral devices)



NOTE: Output signal from the robot to the user

8-4 System Programs Controled from PLC

8-4-1 Program Contents

This program is a sample program to control robot tasks from PLC task.

1. System task program

```
;************************************************
;      System task sample program
;************************************************
; Method of usage
;
;     Automatic operation execution
;           Set the type number in the PLC task's K01C keep channel and turn on the
;           PLC tasks's K0001 keep relay to start program execution and turn on the
;           L39 automatic operation execution signal.
;
;     Continual automatic operation
;           Turn the K0002 keep relay on when in the automatic operation mode to start
;           continual execution and switch on the L39 automatic operation execution
;           signal.
;
;     Step termination
;           Turn K0000 keep relay on when in the automatic operation execution mode to
;           terminate the step and switch on the L37 step termination signal and
;           switch off the L39 automatic operation execution signal.
;
;     Home return (delete if not necessary)
;           Turn the K0003 keep relay on to switch L40 and return to the home
;           position, and L40 is switched off when ended.
;
;     Error reset
;           Turn the K0004 keep relay on to reset an error and cancel the error
;           signal.
;

      INIT              ; Initialization (the program must have INIT as the header)
            INT:I,TYPE

            FOR I = 1 TO 5                ; L1-L40 turned off
                  POUT(I,0)
            NEXT
            INITEND                 ; Command to end initialization


      EMG                           ; Processing for emergency stops
            DO L37(OFF)
            DO L38(OFF)
            DO L39(OFF)
            DO L40(OFF)
            RET                     ; The module is ended with RET
```

```
ERROR                          ; Processing for errors
      DO L37(OFF)
      DO L38(OFF)
      DO L39(OFF)
      DO L40(OFF)
      RET

INP0.0ON                       ; Step termination
            IF STOP(1)=0 THEN  ; Robot 1 step termination
              DO L39(OFF)                ; Automatic operation execution
                                           termination
              DO L37(ON)             ; Step termination
            ENDIF
      RET

INP0.1ON                       ; Automatic operation
            TYPE=INP(1)&000F          ;Type number acquisition
            IF TYPESET(1,TYPE) = 0 THEN    ; Program type set in robot 1
                  IF START(1) = 0 THEN           ; Program started
                        DO L38(ON)               ; Automatic operation
                        DO L39(ON)               ; Automatic operation execution
                        DO L37(OFF)              ; Step termination cancelled
                  ENDIF
            ENDIF
      ENDIF
      RET

INP0.2ON                          ; Continual running
            IF CONTINUE(1) = 0 THEN    ; Robot 1 continual operation
                  DO L39(ON)               ; Automatic operation execution
                  DO L37(OFF)              ; Step termination cancelled
            ENDIF
      ENDIF
      RET



INP0.3ON                       ; Home return
            DO L37(OFF)        ; Step termination cancelled
            DO L38(OFF)        ; Automatic operation cancelled
            DO L40(ON)         ; Home return started
            I = HOMING(1)            ; Robot 1 home return
            DO L40(OFF)        ; Home return ended
      ENDIF
      RET

INP0.4ON                       ; Error reset
      RSTERR
      RET

END
```

2. PLC task program

```
;  ★Keep relay
;     K0000 Robot step termination
;     K0001 Robot automatic operation start
;     K0002 Robot step start
;     K0003 Robot home return
;     K0004 Robot error reset
;
;  ★Keep channel
;     K01C  Robot program type
;
;  ★Standard relays
;     K0100 PROG0
;     K0101 PROG1
;     K0102 PROG2
;     K0103 PROG3


;Automatic operation execution

      R0000=I38*~L39*~L40*~R0000     ;Program automatic operation execution input
                                     ;Not possible during automatic operation or
;                                    ;during home return
      BSET(K01C,0,I33)=  R0000       ;PROG0 substituted
      BSET(K01C,1,I34)=  R0000       ;PROG1 substituted
      BSET(K01C,2,I35)=  R0000       ;PROG2 substituted
      BSET(K01C,3,I36)=  R0000       ;PROG3 substituted
      T000(10)=R0000                 ;
      K0001=T000

;Step termination

      K0000=I37*L39                  ;Step termination input



;Continual running

      K0002=I39*L38*~L39*~L40        ;Continual running (Not possible during automatic
                                     ;operation execution or during home return)

;Home return

      K0003=I40*~L39*~L40            ;Home return (Not possible during automatic
                                     ;operation execution or during home return)

;Error reset

      K0004=I36               ;Error reset
```

8-4-2 Input/Output Allocation

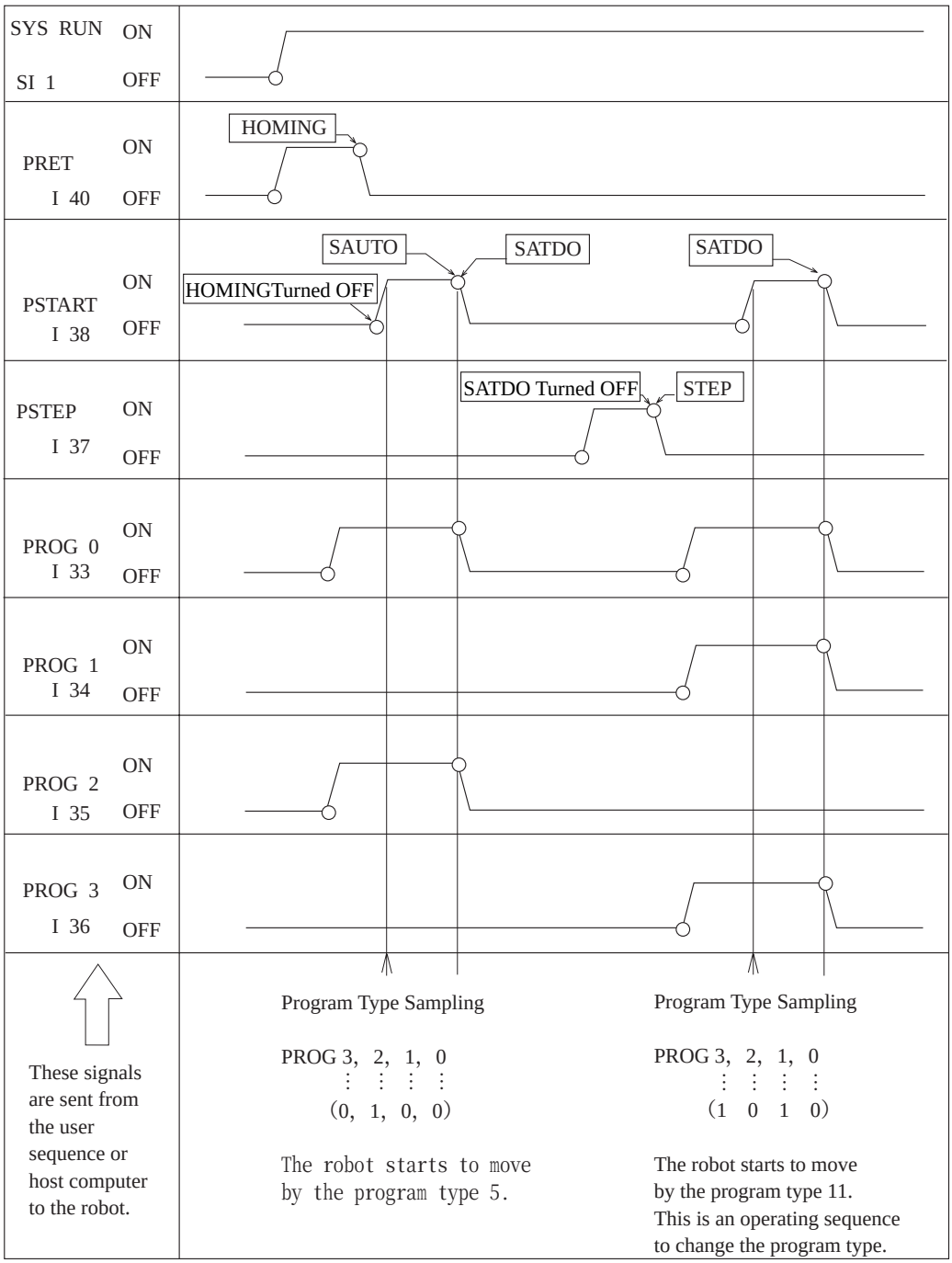
Input side

I32	ERRRST	(Error reset)
I33	PROG0	(Program type 0)
I34	PROG1	(Program type 1)
I35	PROG2	(Program type 2)
I36	PROG3	(Program type 3)
I37	PSTEP	(Program step termination)
I38	PSTART	(Program automatic operation execution)
I39	STPSTAT	(Program continual execution)
I40	PRET	(Robot home return start)

Output side

L37	STEP	(Program step being terminated)
L38	SAUTO	(Execution mode)
L39	SATDO	(Automatic operation being executed)
L40	HOMING	(Robot returning to home position)

8-4-3 Time Chart (Example of robot control with peripheral devices)



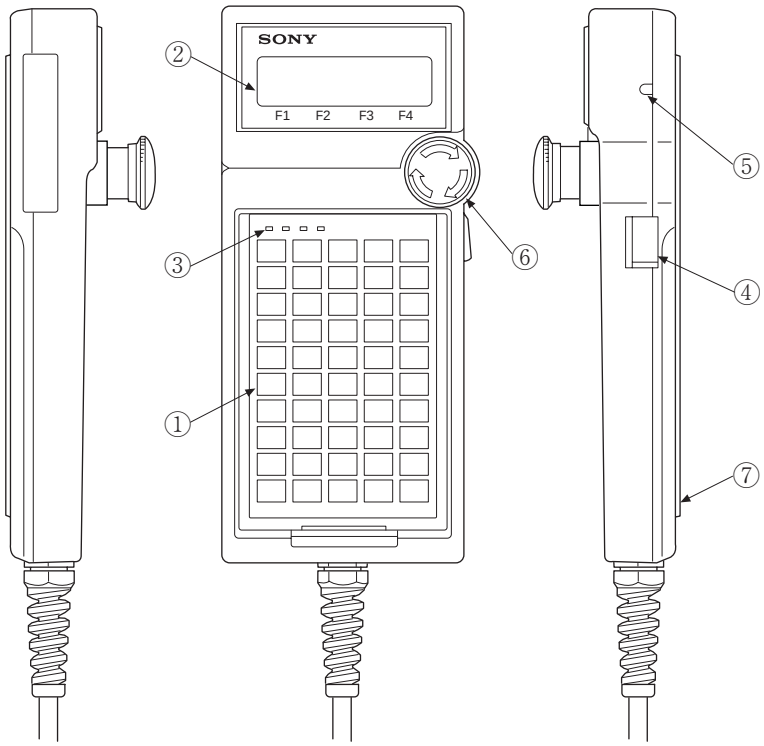
NOTE: Output signal from the robot to the user

Operation Guide

Operation Guide

1. Teaching Pendant (TP) Outline

1-1 Nomenclature

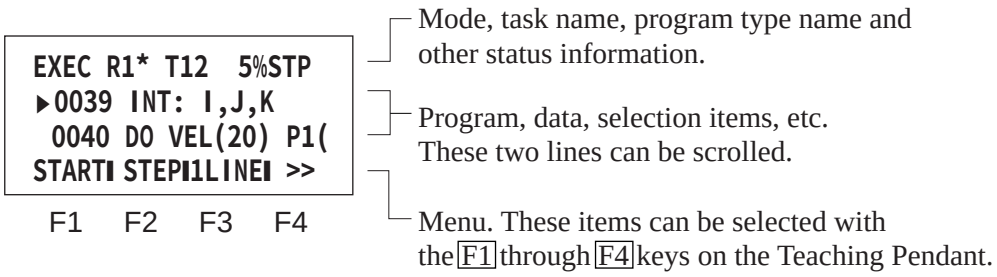


① Operation keys:	The entire area which can be removed is known as the key sheet. One side is in Japanese, and the other side in English.
② Liquid Crystal Display (LCD):	Explained later.
③ LED lamp area:	Explained later.
④ Safety switch:	Explained later.
⑤ Liquid crystal contrast adjustor:	Adjusts the liquid crystal's back-light.
⑥ Emergency stop switch:	A hard-wire logic type emergency switch.
⑦ Magnetic rubber sheet:	Enables the Teaching Pendant to be attached to the controller, etc.

NOTE *Remove and replace the Teaching Pendant by pressing the INS./EJECT switch on the front panel of the controller. Also, fix the controller to the connector with screws.*

1-2 Liquid Crystal Display Meanings

The main liquid crystal display (LCD) screen for each Teaching Pendant is as follows:



1-3 LED Lamp Meanings

ACTIVE TP: Indicates that the Teaching Pendant is able to operate the robot. Set with the Teaching Pendant's ONLINE key.

SERVO: Will be illuminated if even one of the robot's servos is enabled.

TASK RUN: Illuminated when even one task is operating.

ROBOT MANUAL: Illuminated when the robot is moved by press the robot operation keys.

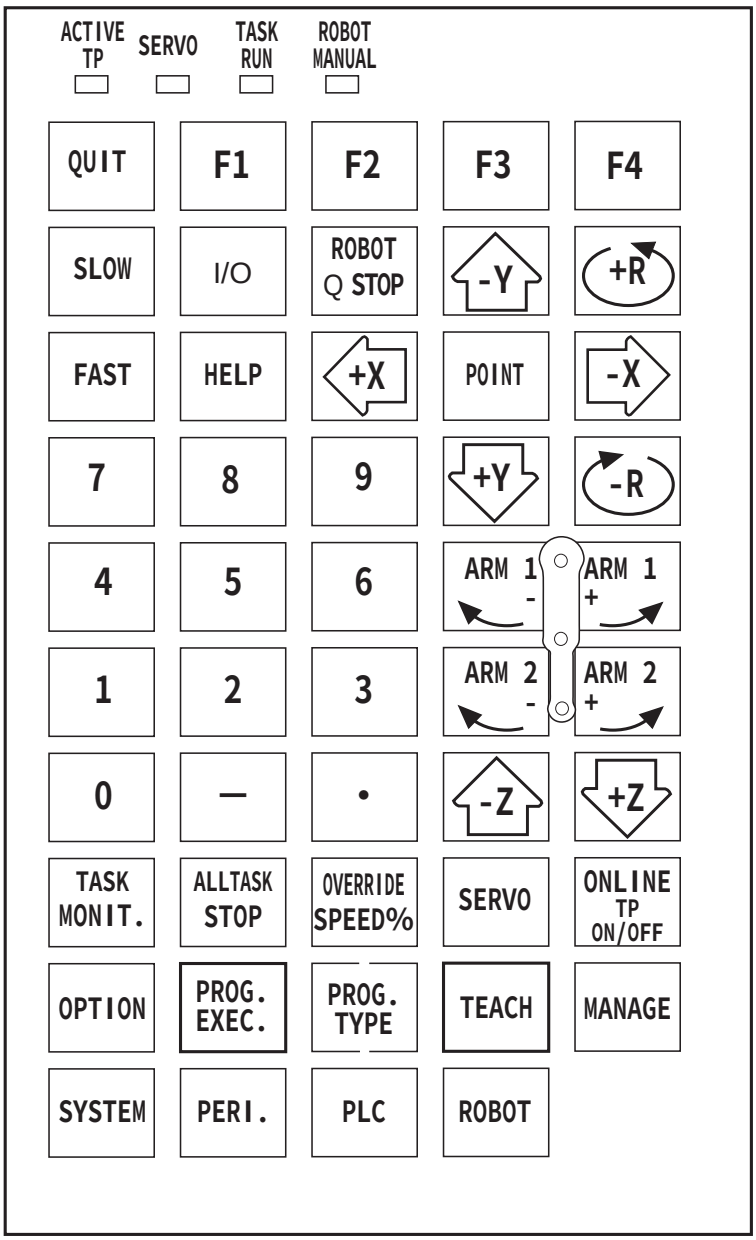
1-4 Safety Switch

Any operations which relate to the arm movement, become effective only when this switch is pressed.

- Servo-on
- Arm movement of each axis
- Home return movement
- Point GO movement

NOTE *If you remove your hand from the switch during movement, the arm stops at the position.*
Refer to section "Safety Instruction: 3-2 Safety functions".

1-5 Operation Keys



(1) Mode selection key

Operations with the Teaching Pendant can be largely divided in the teaching mode and the execution mode. Robot manual operations and point teaching is carried out in the teaching mode. Program debugging and continual operations are carried out in the execution mode.

TEACH

Enters the teaching mode. All tasks are stopped in general, but it is possible to avoid the deliberate stopping of tasks other than robot tasks by setting flags.
Refer to section 5-2 for further details on when the TEACH key is pressed.

PROG. EXEC.

Enters the execution mode. It is not possible to enter this mode if there are currently not task programs selected.
Refer to section 5-3 for further details on when the PROG. EXEC. key is pressed.

(2) Task selection key

There are four different types of tasks handled by the controller; robot tasks, PLC task, peripheral tasks and system task. The Teaching Pendant can only handle one task at a time, and that task is selected with this key. In other words, monitoring, speed, settings and program type selection operations are all related to the selected task.

ROBOT

Selects the robot task.

PLC

Selects the PLC task. Robot operations cannot be performed in the teaching mode when PLC task is being selected.

PERI.

Selects the peripheral tasks. As multiple peripheral tasks exist, a selection between 1 and 8 is carried out during peripheral selection. Robot operations cannot be performed in the teaching mode when peripheral tasks are being selected.

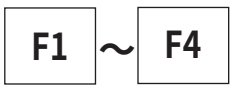
SYSTEM

Selects the system task. Robot operations cannot be performed in the teaching mode when system task is being selected.

(3) Menu selection keys

There are cases where menu F1 - F4 on the 4th line of the LCD screen are selected with the Teaching Pendant's basic operations. Selection in this situation is carried out with the F1 - F4 and QUIT keys at the top of the Teaching Pendant.

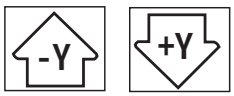
Ignores the various operations displays on the LCD and moves to the previous menu.



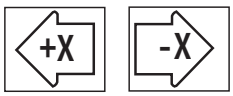
Selects items from the menu displayed on the 4th line of each LCD operation screen.

(4) Cursor keys

Most operations are performed with these cursor keys. These keys are used for scrolling, selection, cursor movement, speed setting and number setting, etc. It is possible to speed up scrolling by pressing the FAST key simultaneously. Continual pressure on the keys will also enable continual operations.



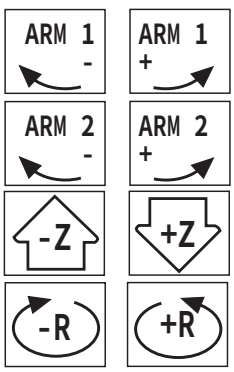
Manual robot operations are only possible when the 'ROBOT MANUAL' LED is illuminated. Horizontal articulated robots move in the Y coordinate direction, and Cartesian robots move with the Y axis.
Program scroll, selection item scroll, and 1-9 input for numerals and 1-9 and A-F input for hexadecimals is possible when the 'ROBOT MANUAL' LED is not illuminated. The symbols ↑ and ↓ represent these keys in this manual.



Manual robot operations are only possible when the 'ROBOT MANUAL' LED is illuminated. Horizontal articulated robots move in the X coordinate direction, and Cartesian robots move with the X axis.
The cursor can be moved left or right when the 'ROBOT MANUAL' LED is not illuminated. The symbols ← and → represent these keys in this manual.

(5) Robot operation keys

The following keys are for the specific use of manual robot operations in the teaching mode.



Rotates the 1st arm of the horizontal articulated robot.

Rotates the 2nd arm of the horizontal articulated robot.

Raises and lowers the robot's Z axis.

Rotates the robot's R axis.

(6) Shift keys

These keys will change the speed of each operation when pressed in combination with the curser keys or robot operation keys.

SLOW

The speed of movement will be reduced when pressed together with the robot operation key in the teaching mode.

FAST

The speed of movement will be increased when pressed together with the robot operation key in the teaching mode.
Scrolling and cursor movement will also be speeded up when pressed together with the cursor keys displayed on each operation screen.

(7) Numeral keys

0 ~ 9

Used for the numerical input of point data and variables.

•

Period point. Also used to separate the n and m values when inputing Pn(m) point data numbers.

—

Minus mark.

(8) Special teaching mode keys

The following keys are mostly used in the teaching mode.

POINT

Enters the menu in which robot point data is handled. It can also be used for point movement in addition to point data display, teaching, modification and copying, etc.
Refer to section 5-2-1 (3) for further details on when the POINT key is pressed.

SERVO

Switches the robot's servo on and off.

(9) Special execution mode keys

The following keys are mostly used in the execution mode.

TASK MONIT.

Enables variables and other values used in the program to be viewed during the program execution. INT variables, REAL variables and POINT variables, etc., can be monitored and amended for LUNA tasks (robot, peripheral, system).
It is possible to write the values for relay, keep relay, timer and counter, etc., when a PLC task has been selected.
Refer to section 5-3-1 (4) for further details on when the TASK MONIT. key is pressed.

ALLTASK STOP

Enters the menu in which all tasks can be stopped.

OVERRIDE SPEED%

Sets the override speed for robot operations. The speed becomes the percentage specified with the VEL operation speed in the program. Increase the speed gradually when in the debug mode having performed confirmation with 5% and 10%.
Refer to section 5-3-1 for further details on when the SPEED % key is pressed.

(10) Other keys

I/O

Displays or sets the controller's user I/O.
Refer to section 5-5 for further details on when the I/O key is pressed.

ROBOT Q STOP

Stops the robot in the shortest possible time. This can be used not only when the robot program is running, but also during home return movement and point GO movement.

HELP

Displays descriptions of teaching pendant operation methods.
Refer to section 5-6-2 for further details on when the HELP key is pressed.

OPTION

An operation switch for optional functions. Refer to the operation manual for further details on this.

PROG. TYPE

Enters the menu in which program type selection is performed. The robot tasks and PLC task store multiple programs, and it is possible to switch between them. In this case, an execution program is selected.

ONLINE TP ON/OFF

Selects the terminal from which to control the robot. Robots can be controlled from not only the Teaching Pendant, but also from personal computers and other external on-line devices, and this key switches between them. The Teaching Pendant has the top priority, so all control signals from personal computers or external devices will be ignored when the Teaching Pendant has selected itself.
Refer to section 5-6-1 for further details on when the ONLINE key is pressed.

MANAGE

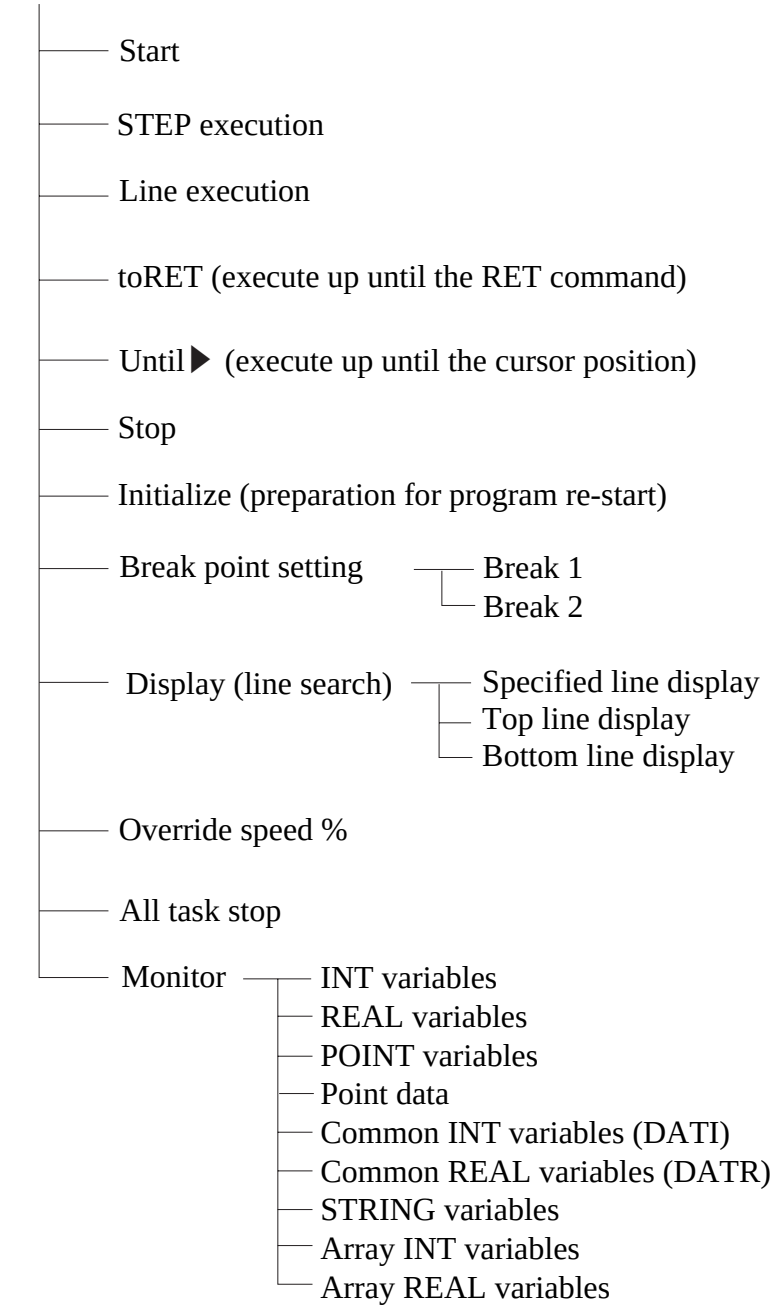
Handles robot initial settings and home return, and all controller settings and information such as error history and diagnostics.
Refer to section 5-4 for further details on when the MANAGE key is pressed.

2. Main Operation System Diagrams

- Teaching mode (during robot task selection)
  - Servo ON/OFF
  - Brake ON/OFF (only when the servo is OFF)
  - Manual operations for each robot axis (only when the servo is ON)
  - Settings
    - Manual movement speed setting
  - GO position specification
  - Point
    - Teach
    - GO (point raise stand-by movement)
    - Display
      - Amendment
      - Copy (copy between points)
    - Movement
      - Direct GO (direct point movement)
      - Line GO (point direct linear interpolation movement)
      - Speed (point movement speed)

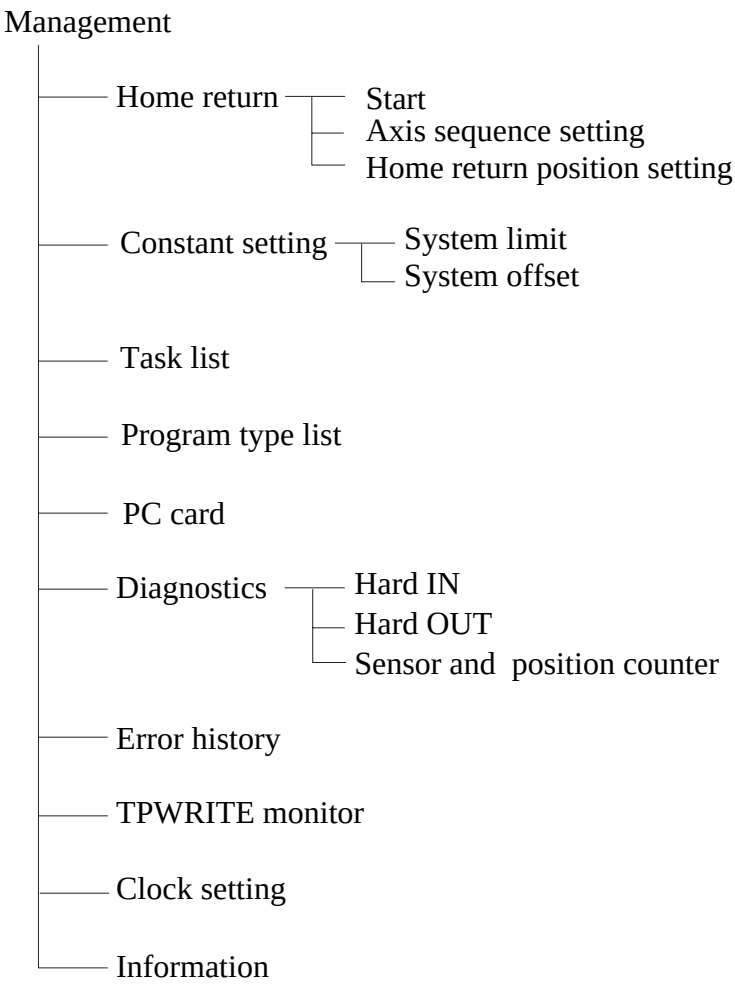
- Teaching mode (during PLC, peripheral and system task selection)
  - Settings
    - Stop/continual flag setting when get into the teaching mode.
    - Stop/continual flag setting when the emergency stop occurs.
    - Stop/continual flag setting when error occurs.

Execution mode (during robot, peripheral and system task selection)



Execution mode (during PLC task selection)

- Start
- 1 scan execution
- Line execution
- toEND (execute up until the END command)
- Until▶ (execute up until the cursor position)
- Stop
- Initialize (preparation for program re-start)
- Scan time (program operation distribution setting for PLC and the robot)
- Break setting
  - Relay selection for relevant break
  - Rising edge/falling edge selection
  - Counter value setting
- Display (line search)
  - Specified line display
  - Top line display
  - Bottom line display
- All task stop
- Monitor
  - Relay
  - Keep relay
  - Timer
  - Counter
  - Input relay
  - Output relay
  - Special relay
  - Label


Management
Home return
Start
Axis sequence setting
Home return position setting
Constant setting
System limit
System offset
Task list
Program type list
PC card
Diagnostics
Hard IN
Hard OUT
Sensor and position counter
Error history
TPWRITE monitor
Clock setting
Information

3. Major Operation-Related Terminology

3-1 Task

The term ‘task’ as it is used here is an independent program unit that is capable of control, and each task executes one user program. The types of available tasks are as follows.

Name	Abbreviation	Details
Robot tasks 1～8	R1～8	Executes LUNA programs in which robot operations are mentioned. Communication, I/O and other commands as well as robot commands can also be used. Tasks are stopped when emergency stop occurs and when errors occur within any task. One robot task is run for each robot unit, but a maximum of eight exist in accordance with the robot configuration. Usually only is used.
PLC task	PLC	Executes PLC programs written with Boolean algebra. Is used for control when the I/O is at high speed. Will not stop when emergency stop occurs or when errors occur within any task, but will continue operations.
Peripheral tasks 1～8	P1～8	Executes LUNA programs that use commands other than robot operations. Freely uses communication and simple I/O control, and data processing, etc. Depending on settings, it will not stop when emergency stop occurs or when errors occur within any task, but will continue operations.
System task	SYS	Tasks that automatically start executing the moment mains power is switched on with an external SYSRUN input signal. Executes LUNA programs that use commands other than robot operations. Also uses special system task commands, such as running other tasks and interruption processing during emergency stop, etc. Depending on settings, it will not stop when emergency stop occurs or when errors occur within any task, but will continue operations.

The Teaching Pendant will only allow one of the above tasks to be selected. When multiple tasks are required, task switching can be carried out by selecting the four task selection keys located at the bottom of the Teaching Pendant.

3-2 Program Type

Program types are the area numbers for storing user programs. Although the number allocation does not run sequentially from 0, the allocations are closely related to the tasks.

Program type	Task	Details
0～15	R1	Program area for robot task 1. Robot task 1 is between 0 and 15, and the program which exists for the selected type is executed.
20～29	R2	Program area for robot task 2
30～39	R3	Program area for robot task 3
40～49	R4	Program area for robot task 4
50～59	R5	Program area for robot task 5
60～69	R6	Program area for robot task 6
70～79	R7	Program area for robot task 7
80～89	R8	Program area for robot task 8 (Exists in accordance with robot configuration)
90～93	PLC	Program area for PLC task. PLC task execute the program which exists for the selected type between 90 and 93.
100	SYS	Program area for system task. Only one program area exists for system task.
110	P1	Program area for peripheral task 1
120	P2	Program area for peripheral task 2
130	P3	Program area for peripheral task 3
140	P4	Program area for peripheral task 4
150	P5	Program area for peripheral task 5
160	P6	Program area for peripheral task 6
170	P7	Program area for peripheral task 7
180	P8	Program area for peripheral task 8

Robot tasks and PLC task have multiple program types (program area) and can be used by switching between them.

3-3 Mode

Operations are available in the teaching mode or the execution mode.

(1) Teaching mode

The teaching mode is mainly for performing robot point teaching. Operations can therefore be carried out for most selected robot tasks. Flag setting to determine whether operations will be stopped or continued when emergency stop occurs or when errors occur in any task can only be carried out when other tasks have been selected (PLC task, peripheral tasks, system task). Point operations (movement, teaching, amendment, copy, movement speed setting), servo ON/OFF, brake ON/OFF (only when the servo is OFF) and manual operations for each axis, etc., can be performed when the robot task has been selected.

NOTE *Speed of tip of the arm is the safety speed (250 mm/s) or less during teaching mode.*

(2) Execution mode

The execution mode performs the execution and debugging of programs created by the user. Powerful functions are available for performing debugging, but user programs are necessary. The program is displayed when the execution mode has been entered, and start, step running, line execution, execution up until the cursor position, etc., and break point settings can be performed. A function to view the user program's variables during execution is also available, and INT, REAL and POINT variables can be written for LUNA programs, and relay and timer values can be written for PLC programs. In addition to this, an override speed % function is available to control the speed of robot operations when the robot task has been selected, and speeds set with the program can be controlled throughout 100 steps. For example, if a speed of 20 (VEL(20)) has been set with the program and an override of 10% is selected, a 2% speed is used for execution in accordance with the $0.2 \times 0.1 = 0.02$ equation. The safest settings during debugging is to start execution with an initial 5% override, and then gradually increase the speed.
When the safety cover which is connected to the safety connector of the controller, is opened, speed of tip of the arm is limited to 250 mm/s or less.
Operation at the programmed speed becomes possible when the safety cover is closed.

3-4 On-line/Off-line

The controller is equipped with an on-line status and an off-line status. The selected status is retained even when the mains power has been switched off.
On-line/Off-line selection can be performed by pressing the ONLINE key on the Teaching Pendant, etc., to switch between selection menus.

Off-line

This is the status in which operational control, such as task execution and stopping, is normally carried out with the Teaching Pendant or other man-machine interfaces (personal computers, etc.) by the user. System task cannot be automatically run with external signals (SYSRUN) as long as this status has been selected.
System task can, however, be run from the Teaching Pendant, etc., when in the execution mode.

Caution

- *Other tasks will be run immediately after system task execution when a command that runs other tasks exists in the system task, so care must be taken when running a system task. Ensure that the emergency stop switch can be immediately operated when performing system task execution.*
- *Operating speed of tip of the arm is the safety speed (250 mm/s) or less when the safety cover is opened with off-line.*

All tasks will continue running when switching from off-line to on-line.

On-line

Operational control, such as task execution and stopping, or writing operations for variables, etc., cannot be performed with the Teaching Pendant when on-line. When control is necessary, switch across to the safety of the off-line setting.
System task can be automatically run when the SYSRUN signal is ON in the on-line mode.
Consequently, system task is automatically run by SYSRUN signal control after the mains power has been switched on when in the on-line mode.

Ensure that system task has been stopped prior to switching from on-line to off-line. This is to prevent new tasks from running, as the system task has the right of executing other tasks. However, other robot tasks, PLC task and peripheral tasks can continue operations.

Caution

Note that system task will automatically begin continual operations if the SYSRUN signal is ON when switching across to the on-line mode. Ensure that the emergency stop switch can be immediately operated when performing system task execution.

4. Basic Operations

4-1 Operation Categories

Operations with the Teaching Pendant are categorized as follows:

Key name	Operation summary	Details
ROBOT PLC PERI. SYSTEM	Selection of the task to be operated by the Teaching Pendant.	These selection tasks are operable for all teaching mode, execution mode and management constant settings. Initialization is set with the robot task. (Refer to section 5-1 Basic Selections)
PROG. TYPE	Program switching	Selects program type numbers for execution when robot task or PLC task has been selected. (Refer to section 5-1 Basic Selections)
TEACH	Enters the teaching mode.	Enables brake ON/OFF, servo ON/OFF and manual operation for each axis. (When robot task has been selected). Point teaching, point movement and other position data operations are possible when the POINT key is pressed and user program exist. (Refer to section 5-2 Teaching Mode)
PROG. EXEC.	Enters the execution mode.	Enables program execution debugging. It is possible to execute a program bit-by-bit for line execution and break point settings, etc. Variables used within a program can also be viewed during program execution by pressing the TASK MONIT. key. The operational speed of the robot can be controlled to enable safe debugging by pressing the SPEED % key. (Refer to section 5-3 Execution Mode)
MANAGE	Enables operations not available in the modes.	Performs initial home return, constant setting, diagnostics, error history and other operations. (Refer to section 5-4 Management)
I/O	Enables I/O operations.	Performs input I status display, output O status display and enforced setting. I/O can be operated at any time and has no relation with modes or selected tasks. (Refer to section 5-5 I/O)
ONLINE	Sets operational priorities.	Assigns robot operation authority to system task and allows operation commands from personal computers with external commands. (Refer to section 5-6 Others)
HELP	Displays operation descriptions.	Displays descriptions of the Teaching Pendant operations. (Refer to section 5-6 Others)

4-2 Key Input

(1) Beeps

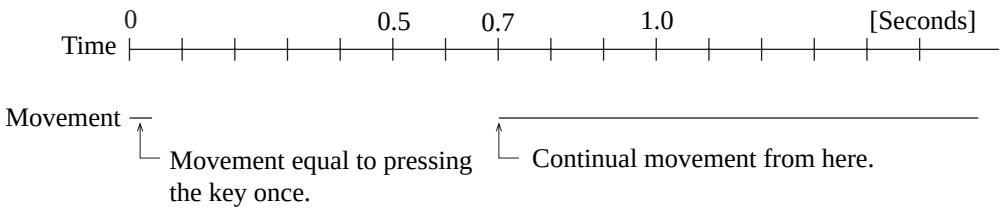
The following beeps for confirmation and warning purposes are sounded when keys are pressed:

Short beep: Indicates that input was carried out normally.

Two successive beeps: A warning to indicate that a key which is currently not acceptable has been pressed.

(2) Repeats

Repeated input is possible by applying pressure to each key for 0.7 seconds or longer. For example, by pressing the ARM1+ key continually in the teaching mode when a robot task has been selected, the following movement will occur:



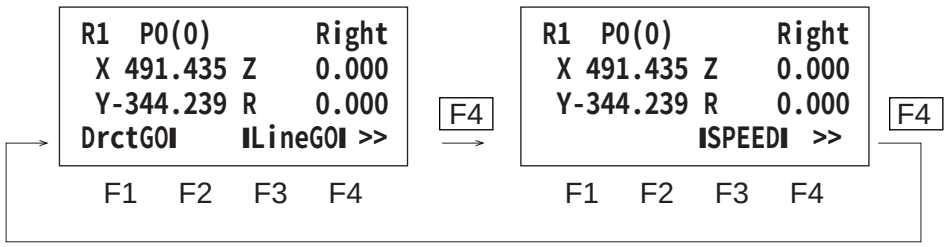
(3) Shift keys

The SLOW and FAST keys are used as shift keys. In other words, nothing will happen if they are pressed singularly. They are used in combination with other keys (especially cursor keys and robot operation keys).

4-3 Function Keys

Most operations are displayed in a selection menu at the bottom of the LCD. These menu items are selected with the function keys (F1 ～ F4) located at the top of the key sheet.

There is a case when ">>" is displayed on the right-hand edge of the function menu. This indicates that more functions can be displayed by pressing the F4 key. An example of this is shown below.



4-4 QUIT Key

The next menu or screen will be displayed when a selection is made from the menu. The display is returned to the original screen when processing is complete on this second screen. The display will return to the original screen without executing any processes when the QUIT key is pressed when on the second screen. The display will return to the previous screen whenever the QUIT key is pressed until there are no more previous screens. In other words, the QUIT key has the following meaning:

- Quit processing and return to the previous menu.

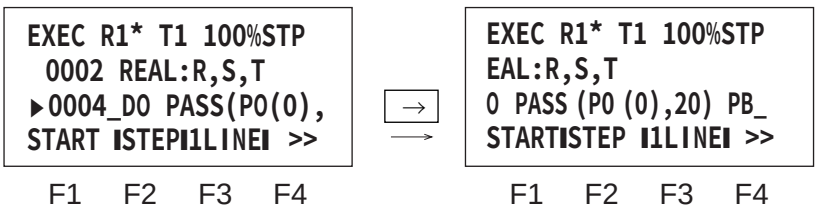
4-5 Scroll Selection

There are cases where selection can be made by scrolling the selection items and aligning the cursor with them when many items are available. In this situation a '↑ ↓' symbol will flash at the top right-hand corner of the LCD.
The LCD will scroll 2 or 3 lines when the [↑] or [↓] cursor keys are pressed, and selection is made by aligning the required item up with the ▶ symbol. In the following example, Home Return will be selected when the [F4] key is pressed.

The screen will scroll by 5 to 10 lines when the [↑] or [↓] keys are pressed in combination with the [FAST] key.

4-6 Display Scroll

Depending on conditions, it is possible to scroll up, down, left and right. This is available when programs, etc., are displayed.
The LCD will scroll 2 or 3 lines when the [↑] or [↓] cursor keys are pressed, and scroll to the left or right when the [←] or [→] cursor keys are pressed.

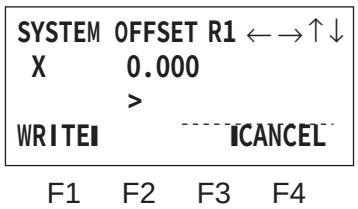


The screen will scroll by 5 to 10 lines when the [↑] or [↓] keys are pressed in combination with the [FAST] key. In the same way, the screen will scroll by approximately 5 characters when the [←] or [→] keys are pressed in combination with the [FAST] key.

4-7 Direct Writing

It is naturally possible to directly write each parameter and variable with the Teaching Pendant. The operations for this have been unified and are described below.

The following is an example of writing the management system offset. The current value is displayed on the 2nd line, and the numerals (or characters) for input are on the 3rd line. The numerals (or characters) are input on the _ _ _ _ area of the 3rd line, and they are saved when the [F1] WRITE key on the menu is pressed. The process will end without writing if the [F4] CANCEL or [QUIT] keys are pressed without the [F1] key.



The following two methods of input are available.

① Direct input with the use of the [0] ~ [9], [·] and [–] numeric keys.
For example, press [–], [0], [·], [4], [5] in order to input -0.45.

② Scrolling with the use of the [↑] and [↓] cursor keys.
The numeral on the cursor position will change in numerical order when the [↑] or [↓] cursor keys are pressed. Press the [→] key when the required numeral has been reached, and the cursor will move across to the next figure. This method is also used between A and F for hexadecimal input, D for REAL variable input, and alphabet strings.

Corrections can be made by pressing the [F4] CANCEL key to enable re-entry, or by moving the [←] or [→] cursor keys to the character that requires correction and using the above-mentioned method to amend the entry.

The [F4] CANCEL key is pressed to re-enter existing numerals (or characters), but if an entry does not exist, the [F4] CANCEL key has the same function as the [QUIT] key and will return to the previous menu.

5. Operations

5-1 Basic Selections

5-1-1 Task Selection

There is one part over which the user must have full awareness when using the Teaching Pendant. It has already been mentioned that the controller handles multiple tasks, and the Teaching Pendant selects and operates one of these. Consequently, the Teaching Pendant operates all selected task operations (execution, program display, constant setting, variable display, etc.) which rely on that task. It is therefore necessary for the user to maintain a constant aware of the task that is being handled. It does not matter which task is selected with regard to I/O operations, etc., which do not rely on the task and for which only one exists in the controller.

Selections are made with the selection keys to switch between operations when multiple tasks need to be handled.
Use the following keys to select the task for which operation is required:

ROBOT

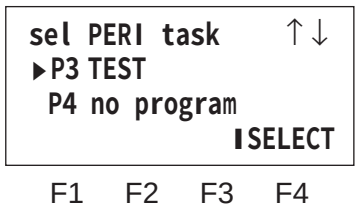
Selects the robot task. It is necessary to select the robot task for performing manual operations for each axis and for point operations.

PLC

Selects the PLC task. There is a slight difference between operations for other tasks in the execution mode when PLC task has been selected.

PERI.

Selects the peripheral tasks. As there are between 1 and 8 peripheral tasks, it is necessary to make a further selection between 1 and 8 with the following menu.



↑ ↓ Scrolls up and down with the cursor

F4 SELECT Selects the peripheral task on the cursor position

PERI.

Peripheral task 3 is displayed here, and this is the last peripheral task to have been selected. If the PERI. key is pressed once more, it has the same effect as making the selection with the F4 key.

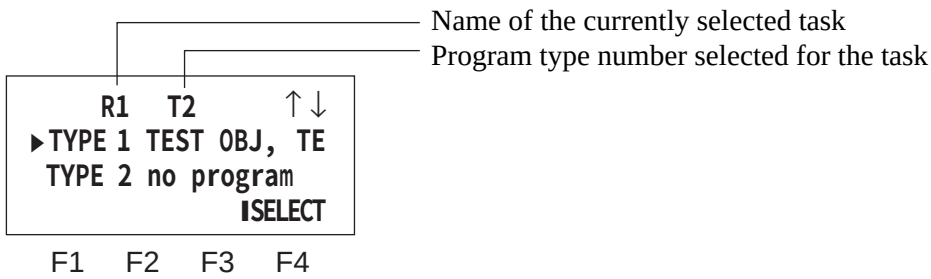
SYSTEM

Selects the system task.

5-1-2 Program Type Selection

It is necessary to be aware of what program type has been selected here also. Program type selection becomes necessary when robot task or PLC task has been selected. The Teaching Pendant operates all selected task program type operations (execution, program display, variable display, etc.) which rely on that program.
As system task and peripheral tasks have only one program type and switching is subsequently not possible, there is no concept of program type selection here.
It is necessary to maintain an awareness of the program type, as point data for the selected program type will be over-written when point teaching is performed.

The following menu will be displayed when the PROG. TYPE. key is pressed:



↑ ↓ Scrolls up and down with the cursor

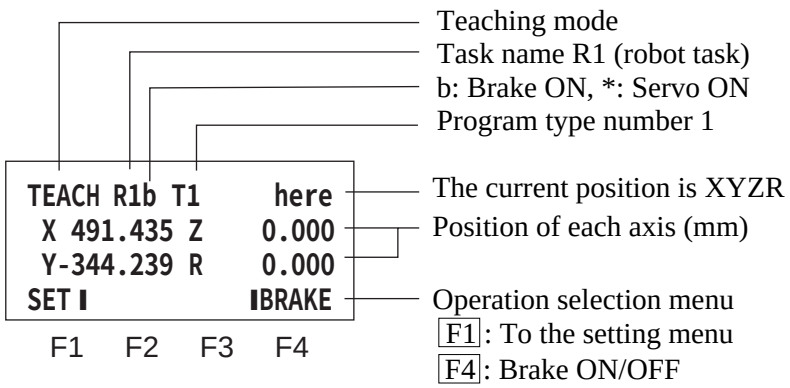
F4 SELECT Selects the program type number on the cursor position

5-2 Teaching Mode

5-2-1 When Selecting Robot Tasks

(1) Basic display (main)

The following screen will be displayed when TEACH key has been pressed to enter the teaching mode, ROBOT key has been pressed and a robot task selected:



■ **Valid keys**

F1 SET — Displays the menu for setting manual operation speeds for each axis. Refer to section 5-2-1 (2).

F4 BRAKE — Turns the brake ON and OFF. Operation not possible when the servo is on.

SERVO — Enables the servo to be turned on and off. Manual operation for each axis is possible when the servo is on. In this case the 'ROBOT MANUAL' LED on the Teaching Pendant will be illuminated, indicating that robot manual operations are possible.

POINT — Displays the menu from which point data-related operations are performed. Refer to section 5-2-1 (3).

F4 PosiGO — Moves to the XYZR position specified with numeric input with raise stand-by movement.
Having entered this menu the current position will be displayed, and it is possible to amend the value of each axis and GO. For example, it is possible to GO with X=300 and Y=300. The amended values will become the current position when this menu is exited.

The bellow keys are only valid when the servo is ON and the 'ROBOT MANUAL' LED is illuminated. The [FAST] and [SLOW] keys may also be pressed simultaneously.

[+X], [–X] Manually moves in the ±X direction. Movement is in the orthogonal ±X direction in the case of horizontal articulation arms.

[+Y], [–Y] Manually moves in the ±Y direction. Movement is in the orthogonal ±Y direction in the case of horizontal articulation arms.

[+Z], [–Z] Manually moves in the ±Z direction. Usually moves either up or down, with the down direction being '+'.
Becomes single-pulse movement when pressed in combination with the [SLOW] key.

[+R], [–R] Manually moves in the ±R direction. Usually moves in a rotary direction, with the counter-clockwise direction when seen from above being '+'.
Becomes single-pulse movement when pressed in combination with the [SLOW] key.

[ARM1+], [ARM1–] Manually rotates the 1st horizontal articulation arm in a ± direction. The counter-clockwise direction when seen from above is '+'. The 1st arm is the upper arm area when compared to a human arm. This has no meaning for cartesian robots.
Becomes single-pulse movement when pressed in combination with the [SLOW] key.

[ARM2+], [ARM2–] Manually rotates the 2nd horizontal articulation arm in a ± direction. The counter-clockwise direction when seen from above is '+'. The 2nd arm is the lower arm area when compared to a human arm.
Becomes single-pulse movement when pressed in combination with the [SLOW] key.

⚠ Caution

Take great care when operating robots and ensure that the emergency stop switch is within easy reach.

(2) Settings

The following item is available for setting.

Movement speed

Movement speed is the speed of operation during the manual operation of each axis. In other words, the actual speed of axis movement when the +Z or +X keys are pressed. Manual operation speeds can be temporarily amended to the initial value or less.

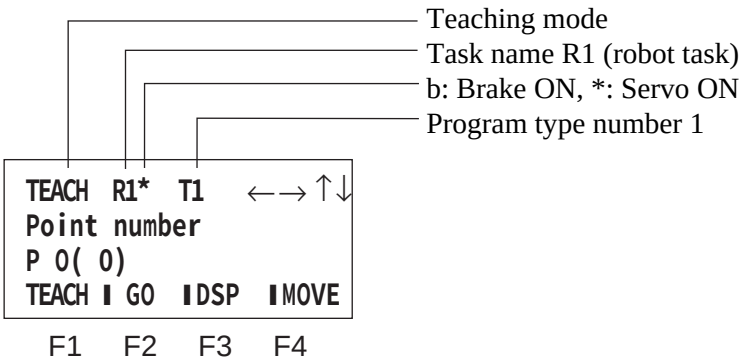
There will be relative changes in speed when these keys are pressed in combination with the FAST key.

↑ ↓	Amends the speed values.
F1 WRITE	Writes the speed.
0 ~ 9	Enters the speed values.

NOTE *Movement speed is temporary. All values will be initialized and reset when the mains power to the controller is switched off and on, and when the Teaching Pendant is returned and re-used.*

(3) Point

The menu from which operations relating to point data are performed. The following is displayed when the [POINT] key is pressed:



■ Valid keys

[0] ~ [9], [·] — Direct input of point data. For example, press [0], [·], [1] in order to input P0(1).

[↑], [↓] — Scrolls point numbers. Scrolling only possible for existing point data numbers.
Scrolling will increase in speed when the [FAST] key is pressed in combination with these keys.

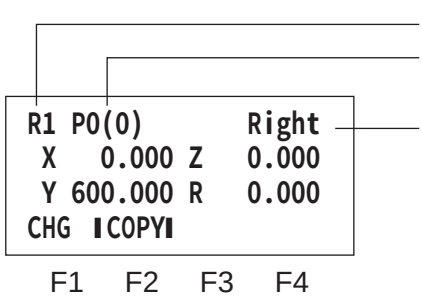
[←], [→] — Used for correcting point numbers. Moves the cursor.

[F1] TEACH — Teaches currently displayed point numbers the current robot position. Confirm the values after pressing the [F1] key, and press the [F1] OK key again to set the entry. For example, if P0(1) is to be taught the current position, press [Point], [0], [·], [1], [F1] Teach, [F1] OK.

[F2] GO — Moves the robot to the point number position currently displayed. Ensure that the robot has been moved to the top edge with raise → XY movement → lower.
For example, if the robot is to be moved to P0(1), press [Point], [0], [·], [1], [F2] GO .

> ⚠ Caution
> *Take extreme care when moving the robot by pressing GO. Ensure that the emergency stop switch can easily be reached.*

F3 DSP — The menu from which value amendment and copying is performed for currently displayed point numbers.



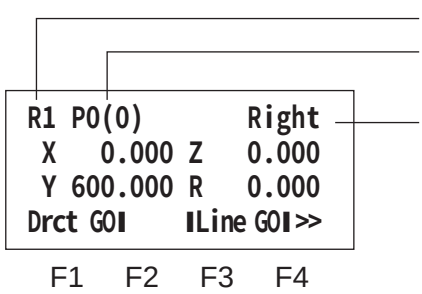
- Keys which are only valid when this menu is displayed:

F1 CHG — Amends the point data values for each axis. Select X, Y, Z or R in accordance with the axis to be amended, and write the new values.

F2 COPY — Copies point data values across to other point data.
In addition to copying current point data values across to other point data, it is also possible to copy other point data values across to the current point data.

These two keys are only valid when this menu is displayed.

F4 MOVE — Moves across to the currently displayed point number position in a variety of ways. The following menu is displayed.



If F4 >> is pressed, the circle and speed menu will be displayed.

- These keys are only valid when the movement menu is displayed.
<1st menu page>

F1 Drct GO — Moves across to the currently displayed point number position. Direct movement is performed without going through raise → XY movement → lower. The route of movement is not limited to a direct line.

F3 LineGO — Moves the robot across to the currently displayed point number position. Direct movement is performed without going through raise → XY movement → lower. The route of movement is direct line interpolation, so movement is in a direct line.

<2nd menu page>

F3 SPEED — Sets the speed of movement for point movement. Amend the value with the ↑ or ↓ cursor keys or by directly inputing the value with the 0～9 keys, and press F1 Write key. The speed will be set at the maximum 100 when setting has been performed with F3 MAX key. For example, if MAX is 50 (mm/s) and a value of 30 is input, the equation is 50 × 30/100 = 15 (mm/s).

NOTE

However, speed is only reflected accurately during LineGO with constant movement speed, and although changes will be apparent in other situations, movement is not possible with accurate speeds.
The operation speeds can be amended to the initial value or less when the safety cover is opened.
Close the safety cover to set the operation speeds higher than the initial value and operate a robot at the set speeds.

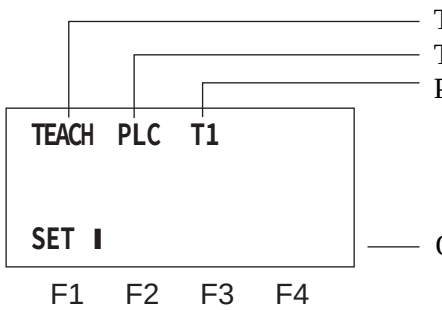
Caution

Take extreme care when moving the robot by pressing GO. Ensure that the emergency stop switch can easily be reached.

5-2-2 When Selecting PLC, Peripheral and System Task

(1) Basic display (main)

The following is displayed when the teaching mode has been entered by pressing the TEACH key, the PLC or PERI . keys have been pressed, and tasks other than robot tasks have been selected.



Teaching mode
Task name PLC (PLC task)
Program type number
Operation selection menu.
F1 key for the setting menu.

The only operation possible here is the setting of task flags. Task flags determine task execution, and the following three types of flags are available.

Teaching mode flag: The flag to determine whether tasks are to be stopped or not when switching from the execution mode to the teaching mode.

Error occurrence flag: The flag to determine whether tasks are to be stopped or not when errors occur.

Emergency stop flag: The flag to determine whether tasks are to be stopped or not when the emergency stop is triggered.

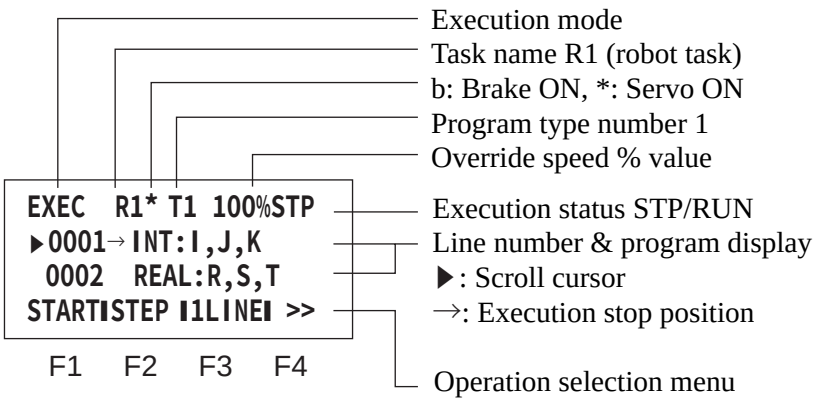
Choose the flag to be amended and select either RUN or STOP with the ↑ or ↓ cursor keys. The initial default is STOP.

5-3 Execution Mode

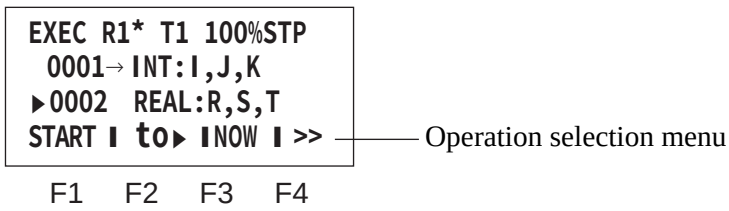
5-3-1 When Selecting Robot, Peripheral and System Task

(1) Basic display (main) during termination

The following is displayed when the execution mode has been entered by pressing the PROG. EXEC. key, and robot tasks have been selected with the ROBOT key.



The following menu will be displayed when the program is scrolled with the use of the ↑ or ↓ cursor keys. This menu is entered when ▶ scroll cursor and → execution stop position do not match.



If F4 >> is pressed, toRET, break, initialization and display , etc., will be displayed.

■ **Valid keys**

↑ ↓	Scrolls the program. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
← →	Scrolls the program from left to right. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
F1 START or CONTI	Continually executes the program from the current stop position (→line). It is necessary to perform initialization once again if initial running is required. START will be displayed after F1 INIT key is pressed.

F2 STEP — Performs step execution for the program from the current stop position (→ line). A step is a separate unit within a single line. For example, a line that includes DO VEL(10),PA,PB means that each of the VEL(10),PA,PB operations are a step, so this line includes three steps.

F3 1 LINE — Performs single line execution for the program from the current stop position (→ line).

F2 to ▶ — Performs execution from the current stop position (→ line) up until the position indicated with the scroll cursor ▶. Execution will stop immediately before the line indicated with the scroll cursor ▶.

F1 toRET — Performs execution from the current stop position (→ line) until the RET command has been discovered. This is convenient when it is necessary to leave a sub-routine. However, continual execution will be performed in the same way as START if a RET command is not found.

⚠ Caution

- *Take extreme care when executing programs. Ensure that the emergency stop switch can easily be reached.*
- *To activate any operation regarding robot movement, execute programs while pressing the safety switch in the off-line.*

F3 NOW — Displays the current stop position (→ line). This is used when the current stop position has been lost during program scrolling. This simply amends the display and is not used for execution purposes.

F3 BREAK — Enters the menu from which the break status can be viewed and set. The following two types of break are available:

Line specification break point
INT variable unified break

Refer to section 5-3-1 (3) for further details.

F1 INIT — Initializes program execution. START, STEP, line execution and toRET will all be performed from the top of the program after initialization has been carried out.

F3 DISP

Displays the specified program line. Selection is possible for the top of the program, the bottom of the program and specified lines.

NOTE

Comments (marked with ;) and blank lines are not displayed with the Teaching Pendant. If these types of line are selected, the display will be of the next executable line.

ALLTASK STOP

Stops all tasks that are being executed. If no tasks are being executed, a message to this effect is displayed and the process ended. This is consequently only valid when the TASK RUN LED is illuminated.

TASK MONIT.

This enables the variables used by the task program currently selected and common variables, etc., to be read and written regardless of whether the program is running or stopped.
Refer to section 5-3-1 (4) for further details.

The following key is only valid when a robot task has been selected.

OVERRIDE SPEED%

Controls the operation execution speed of the robot in percentages with the speed specified by the program (specified with VEL) as 100. For example, if the speed set by the program is 20 (VEL(20)) and an override of 10% is selected, the equation becomes $0.2 \times 0.1 = 0.02$, or 2%, and execution is performed at this speed.
It is safest to start debugging with an override of 5% and then gradually increase the speed.
The override returns to the initial value (5%) when an error such as emergency stop occurs, or the safety switch is released.

Caution

Take extreme care when amending override speeds. Ensure that the emergency stop switch can easily be reached.

NOTE

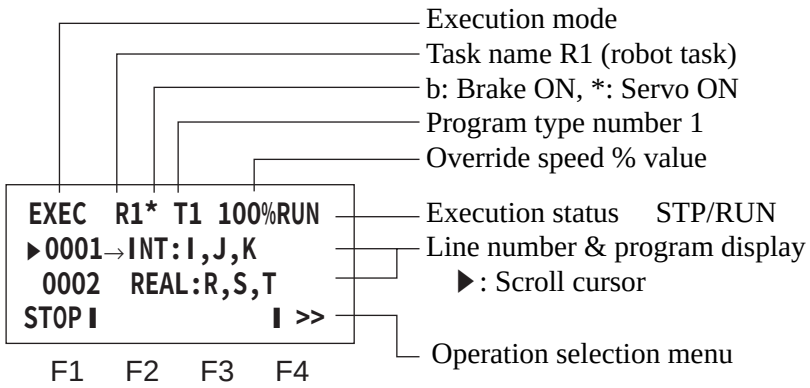
During the off-line mode, the override speed cannot be amended higher than the initial value (5%) when the safety cover is opened. Close the safety cover to operate a robot at the override speed of higher than the initial value.

ROBOT Q STOP

Stops only the robot task. The normal stop process is known as step termination and stops when the execution of one command has been completed (eg: DO P0(1)), but Q STOP means 'Quick Stop' and will terminate execution of P0(1) mid-way.
Execution will be re-started from the continuation of P0(1) when execution commands (START, STEP, etc.) are performed after the use of Q STOP.

(2) Basic display (main) during execution

The following is displayed when the execution mode has been entered by pressing the PROG. EXEC. key, and selected tasks are being executed.



If F4 >> is pressed, the brake and display, etc., will be displayed.

■ Valid keys

F1 STOP — Performs step termination for the currently selected task.

Refer to section 5-3-1 (1) basic display (main) during termination as the following keys are the same.

↑ ↓ — Scrolls the program.

← → — Scrolls the program from left to right.

F3 BREAK — Enables break status viewing and setting.
Refer to section 5-3-1 (3) for further details.

F3 DISP — Displays the specified program line.

ALLTASK STOP — Stops all tasks that are being executed.

TASK MONIT. — Enables variables and common variables, etc., to be read and written.
Refer to section 5-3-1 (4) for further details.

The following key is only valid when a robot task has been selected.

OVERRIDE SPEED% Controls the operation execution speed of the robot.

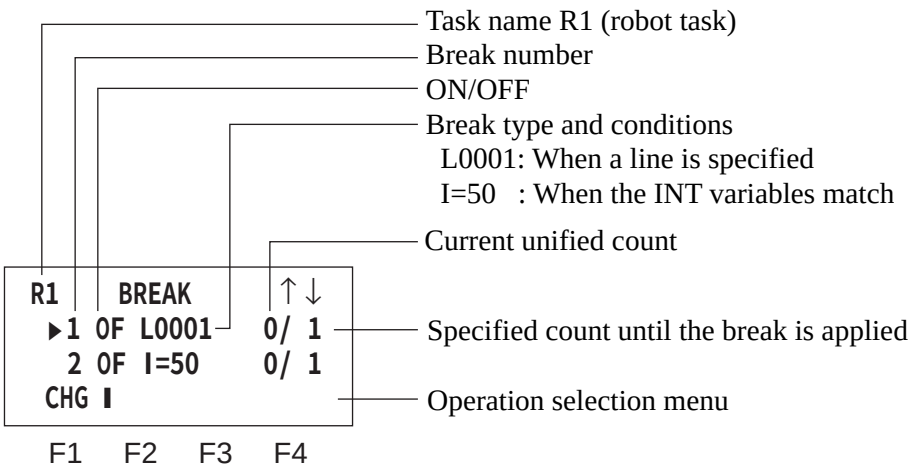
> **Caution** *Take extreme care when amending override speeds. Ensure that the emergency stop switch can easily be reached.*

> **NOTE** *During the off-line mode, the override speed cannot be amended higher than the initial value (5%) when the safety cover is opened. Close the safety cover to operate a robot at the override speed of higher than the initial value.*

ROBOT Q STOP Stops only the robot task.

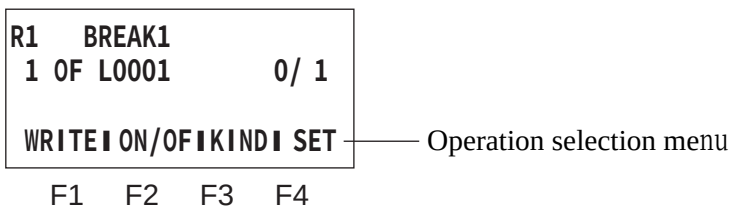
(3) Break

The following will be displayed for breaks:



Two breaks are available, and it is possible to set both with type, conditions and unified counts, etc. Further details on this are provided below. Use the ↑ or ↓ cursor keys to specify the breaks number only when the breaks is to be switched on or set conditions modified, and press the F1 CHG key to enter the amendment screen.

The amendment screen is as follows: The break 1 amendment screen will be displayed when break number 1 has been selected.



■ Valid keys

F1 WRITE — Writes break ON/OFF.

F2 ON/OF — Sets the break ON/OFF. Settings will toggle between ON and OFF every time this key is pressed. Settings will not be stored if the F1 WRITE key is not pressed after amendment.

F3 KIND — Displays the menu from which break type is selected. The following two types are available:

(1) Line unification break
The normal break point. A line number is specified, and when an attempt to execute that line is performed, the process will stop. It is also possible to set the number of arrivals until the specified line number.

(2) INT variable unification break
Stops the process when an INT variable changes to a specified value. As only changes are monitored, the number of times are not counted even if a match has already been found when the break is ON. It is also possible to set a unification count.

F4 SET — Sets the break conditions. The menu displayed when this is selected will differ in accordance with the selected type. An explanation of this is as follows:

The setting screen for when the line unification break has been selected is as follows:

```
R1   BREAK1
 1 OF L0001     0/ 1

 LINE ▮CNT▮
```

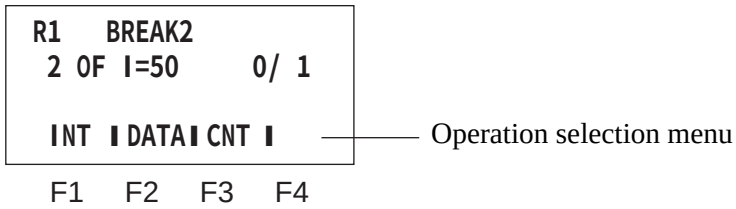
Operation selection menu

F1 F2 F3 F4

F1 LINE — Specifies the break point line number. The program can be scrolled when this key has been pressed. Align the cursor with the line for which a break is to be applied and press WRITE.

F2 CNT — Specifies the arrival count to the specified line number. 1 is set when the break is to be applied to the first count. 0 cannot be substituted. Settings are possible up to a maximum of 999.

The setting screen for when the INT variable unification break has been selected is as follows:



F1 INT

Selects the INT variable for which the break is to be applied. A list of all INT variables used by the program will be displayed, and selection is made by scrolling with the cursor and aligning the required variable. Switching between decimal and hexadecimal selection is also possible.

F2 DATA

Sets the value for which the INT variable is to match. Normal INT variables can be set within a range of -32767 and 32768. Setting when hexadecimal variables have been selected will be between hexadecimal 0000H and FFFFH.

F2 CNT

Specifies the unification count. As only changes are monitored, the number of times are not counted even if a match has already been found when the break is ON. 1 is set when the break is to be applied to the first count. 0 cannot be substituted. Settings are possible up to a maximum of 999.

(4) Monitor

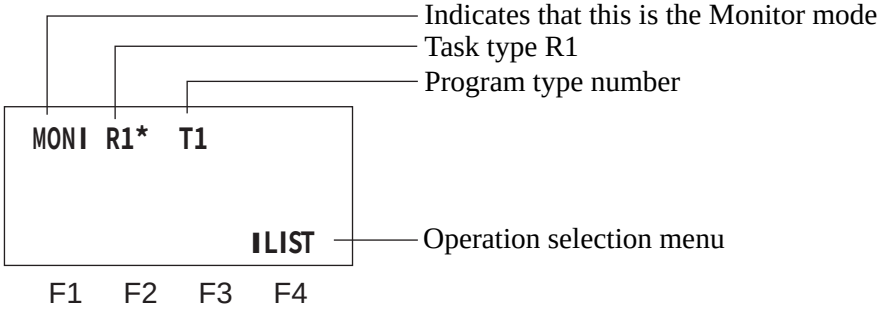
Monitor is a function to enable the variables and common variables used by a program to be viewed while the program is being executed. Each variable is displayed in the real-time as they change within the program. It is also possible to perform enforced writing.
As Monitor allows the viewing of changes in variables in an executing program, the differing variables for each task are also displayed. In other words, the program variables for currently selected tasks are monitored.

Monitor can be carried out in either of the following two ways in accordance with preference.

List display of variables by type: INT variables, REAL variables, point data and DATI common variables, etc., are available, and it is possible to select one of these for list display. For example, if DATI is selected, it is possible to scroll through the current values between DATI(0) and DATI(255).

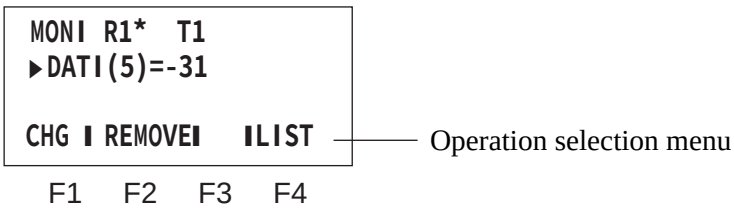
Mixed display of selected variables:
The mixed display of selected variables when the by-type selection is not suitable. For example, it is possible to simultaneously display I and J for INT variables, X1 and Y1 for REAL variables, and PO(1) for point data. A maximum of ten variables may be selected.

The following will be displayed when first entering the Monitor mode having pressed the TASK MONIT. key. This screen is known as the Monitor Main.



Lines 2 and 3 are left blank, but the variables selected from the list will be displayed here. In other words, this is the previously-mentioned ‘mixed display of selected variables’ screen.

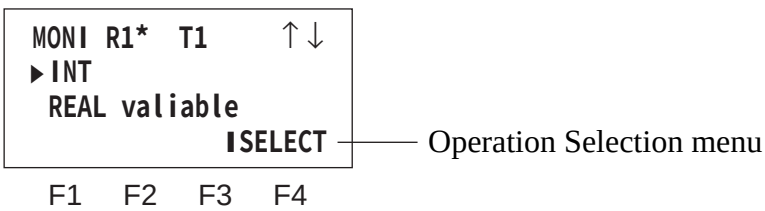
For example, the following will be displayed when the QUIT key is pressed several times after registering DATI(5) and returning to the Monitor Main screen.



■ Valid keys

↑ ↓	Scrolls the variables. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
F1 CHG	Enables writing of the variable value over which the cursor is currently located.
F1 REMOVE	Removes the specified variable and deletes it from registration.
F4 LIST	Moves to the list display of each variable. Selections can be made and registered here when necessary.

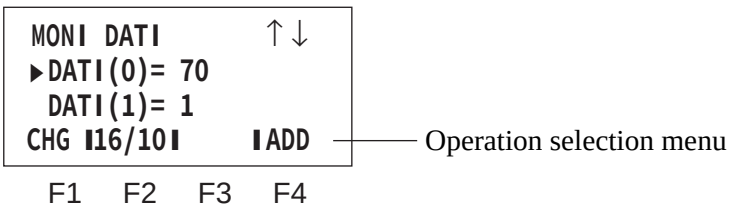
The list display of variable types is performed when the menu's LIST is selected.



The following types of variables are available:

INT variables
REAL variables
POINT variables
Pn(m) point data
DATI variables
DATR variables
OUTP values
STRING variables
Array INT variables
Array REAL variables

Refer to the Robot Language Guide in the LUNA5.0 Operation Manual for further details on the meanings on these variables.
For example, The following is displayed when DATI variables are selected. This is the previously-mentioned 'list display of variables by type' screen.



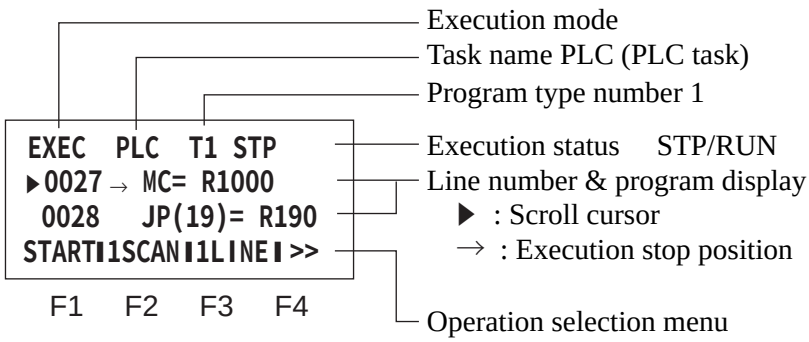
■ Valid keys

↑ , ↓	Scrolls the variables. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
F1 CHG	Enables writing of the variable value over which the cursor is currently located.
F2 16/10	Switches value display between hexadecimal and decimal.
F4 ADD	Registers the variable over which the cursor is currently located in Monitor Main. Registration will be performed in decimal when decimal has been selected, and hexadecimal when hexadecimal has been selected.

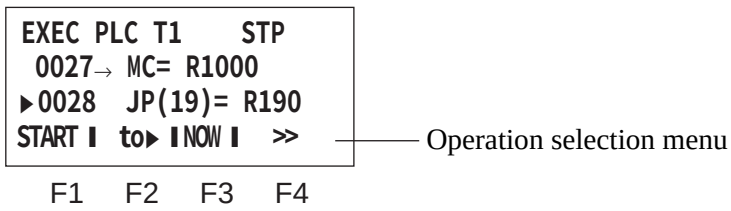
5-3-2 PLC Task

(1) Basic display (main) during termination

The following is displayed when the execution mode has been entered by pressing the PROG. EXEC. key, and PLC task has been selected with the PLC key.



The following menu will be displayed when the program is scrolled with the use of the ↑ or ↓ cursor keys. This menu is entered when ▶ scroll cursor and → execution stop position do not match.



If F4 >> is pressed, toEND, break, initialization, S time and display, etc., will be displayed.

■ Valid keys

↑ ↓	Scrolls the program. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
← →	Scrolls the program from left to right. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
F1 START or CONTI	Continually executes the program from the current stop position (→ line). It is necessary to perform initialization beforehand if initial running is required. START will be displayed after F1 INIT key is pressed.

F1 1 SCAN — Executes only one scan for the program from the current stop position (→ line). A scan is the execution of the entire program once. Execution will be started from the line at which the process has been stopped, jump to the top of the program and continue execution even when the END command has been passed, and finally stop at the line immediately prior to the starting line.

F3 1 LINE — Performs single line execution for the program from the current stop position (→ line).

F2 to ▶ — Performs execution from the current stop position (→ line) up until the position indicated with the scroll cursor ▶. Execution will stop immediately before the line indicated with the scroll cursor ▶.

F1 toEND — Performs execution from the current stop position (→ line) until the END command has been discovered.

> ⚠ Caution
>
> *Take extreme care when executing programs. Ensure that the emergency stop switch can easily be reached.*

F3 NOW — Displays the current stop position (→ line). This is used when the current stop position has been lost during program scrolling. This simply amends the display and is not used for execution purposes.

F3 BREAK — Enters the menu from which the break status can be viewed and set. The break will stop the process at the specified relay rising or falling point.
Refer to section 5-3-2 (3) for further details.

F1 INIT — Initializes program execution. START and 1 SCAN execution will all be performed from the top of the program after initialization has been carried out.

> NOTE
>
> *Everything with the exception of the keep relay will be set at OFF during initialization.*

F2 S TIME — Sets PLC task performance. As the scan time measured during execution is displayed (the time required to execute the program once from top to bottom), it is possible to make delicate performance settings.

> NOTE
>
> *As the performance of other tasks will drop in accordance with raising PLC task performance, consideration must be given to settings.*

F3 DISP

Displays the specified program line. Selection is possible for the top of the program, the bottom of the program and specified lines.

NOTE

Comments (marked with ;) and blank lines are not displayed with the Teaching Pendant. If these types of line are selected, the display will be of the next executable line.

ALLTASK STOP

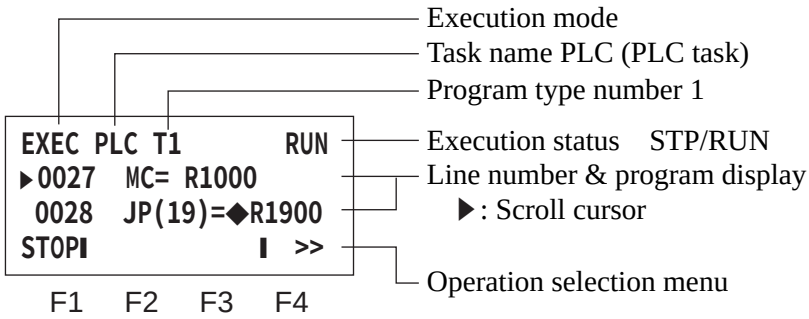
Stops all tasks that are being executed. If no tasks are being executed, a message to this effect is displayed and the process ended. This is consequently only valid when the TASK RUN LED is illuminated.

TASK MONIT.

This enables the variables used by the task program currently selected and common variables, etc., to be read and written regardless of whether the program is running or stopped. Refer to section 5-3-2 (4) for further details.

(2) Basic display (main) during execution

The following is displayed when the execution mode has been entered by pressing the PROG. EXEC. key, and the selected task is being executed with PLC. The ◆ symbol indicates that the next relay is ON.



If F4 >> is pressed, the break, S TIME and display, etc., will be displayed.

■ Valid keys

F1 STOP — Performs step termination for the currently selected task.

Refer to section 5-3-1 (1) basic display (main) during termination as the following keys are the same.

↑ , ↓ — Scrolls the program.

← , → — Scrolls the program from left to right.

F3 BREAK — Enables break status viewing and setting. Refer to section 5-3-2 (3) for further details.

F2 S TIME — Sets PLC task performance. Refer to section 5-3-2 (1) for further details.

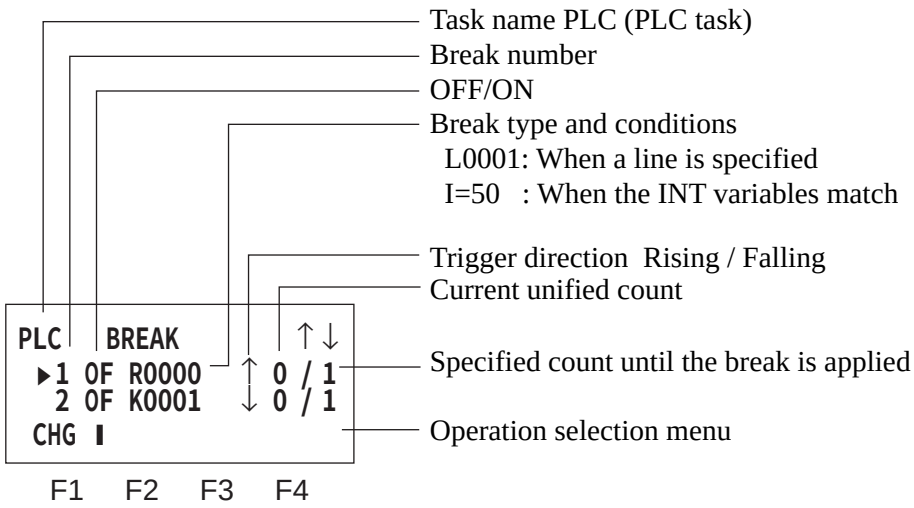
F3 DISP — Displays the specified program line.

ALLTASK STOP — Stops all tasks that are being executed.

TASK MONIT. — Enables variables and common variables, etc., to be read and written. Refer to section 5-3-2 (4) for further details.

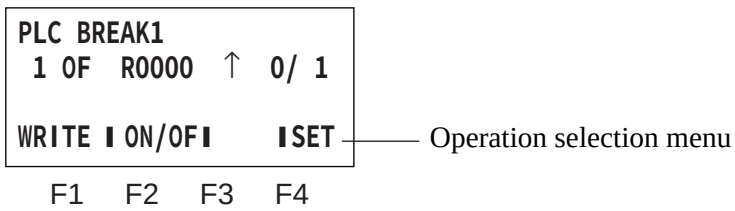
(3) Break

The following will be displayed for breaks:



Two breaks are available, and it is possible to set both with type, conditions and unified counts, etc. Further details on this are provided below. Use the ↑ or ↓ cursor keys to specify the break number only when the break is to be switched on or set conditions modified, and press the F1 CHG key to enter the amendment screen.

The amendment screen is as follows: The break 1 amendment screen will be displayed when break number 1 has been selected.



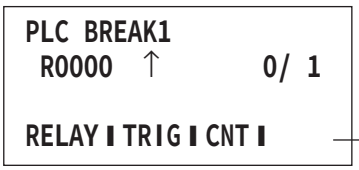
■ Valid keys

F1 WRITE — Writes break ON/OFF.

F2 ON/OF — Sets the break ON/OFF. Settings will toggle between ON and OFF every time this key is pressed.
Settings will not be stored if the F1 WRITE key is not pressed after amendment.

F4 SET — Sets the break conditions.

The following menue will be displayed when SET is selected.



F1 RELAY — Selects the relevant relay. The relay type selection screen will be displayed when this key is pressed, and a type is selected and then one relay is selected.

F2 TRIG — The following two types of break for each relay are as follows:

When switching from ON to OFF ↓
When switching from OFF to ON ↑

Select either one of these.

F3 CNT — Specifies the number of triggers until the break is applied. 1 is set when the break is to be applied to the first count. 0 cannot be substituted. Settings are possible up to a maximum of 999.

(4) Monitor

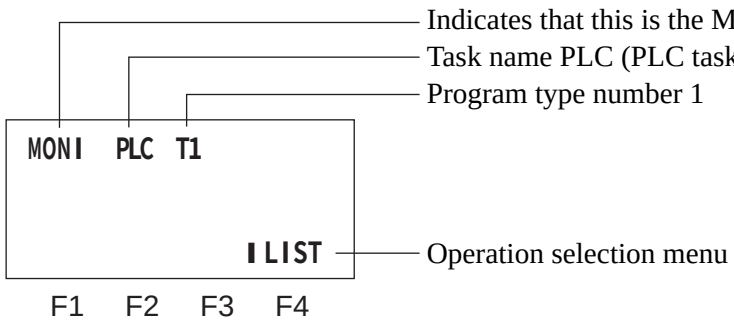
Monitor is a function to enable the relays and channel data used by a program to be viewed while the program is being executed. Each relay and channel data is displayed in the real-time as they change within the program. It is also possible to perform enforced writing.

Monitor can be carried out in either of the following two ways in accordance with preference.

List display of relays by type: Relays, keep relays, timer and counter, etc., are available, and it is possible to select one of these for list display. For example, if the timer is selected, it is possible to scroll through the current values between T000 and T255.

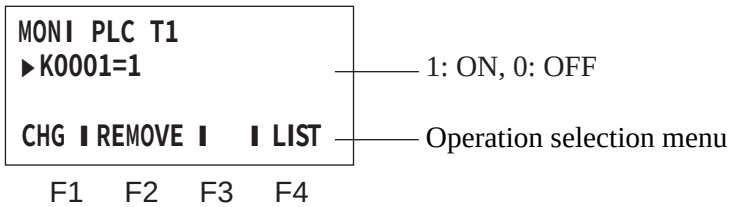
Mixed display of selected relays: The mixed display of selected relays when the by-type selection is not suitable. For example, it is possible to simultaneously display K0001 for the keep relay, T034 and T035 for the timer and C012 for the counter. A maximum of ten relays may be selected.

The following will be displayed when first entering the Monitor mode having pressed the TASK MONIT. key. This screen is known as the Monitor Main.



Lines 2 and 3 are left blank, but the variables selected from the list will be displayed here. In other words, this is the previously-mentioned ‘mixed display of selected relays’ screen.

For example, the following will be displayed when the QUIT key is pressed several times after registering K0001 and returning to the Monitor Main screen.



■ Valid keys

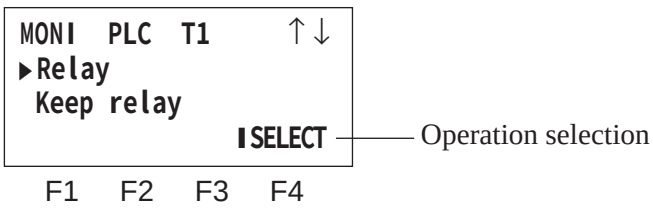
↑ , ↓ — Scrolls the variables.
Scrolling will increase in speed when these keys are pressed in combination with the FAST key.

F1 CHG — Enables writing of the variable value over which the cursor is currently located.

F2 REMOVE — Removes the specified variable and deletes it from registration.

F4 LIST — Moves to the list display of each variable. Selections can be made and registered here when necessary.

The list display of variable types is performed when the menu's LIST is selected.

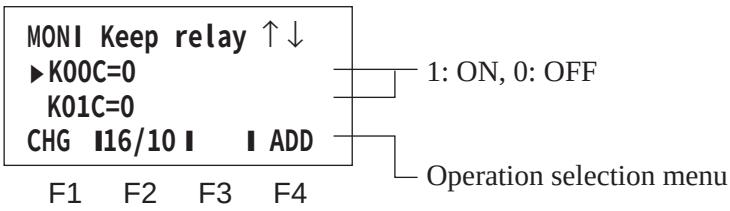


The following types of relays are available:

Relay
Keep relay
Timer
Counter
Input relay
Output relay
Special relay
Label

Refer to the Robot Language Guide in the LUNA5.0 Operation Manual for further details on the meanings on these variables.

For example, The following is displayed when the keep relay is selected.



■ Valid keys

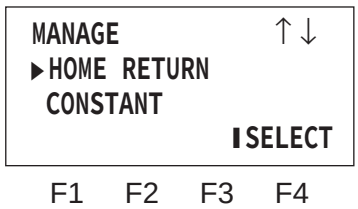
↑ , ↓	Scrolls the variables. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
F1 CHG	Enables writing of the variable value over which the cursor is currently located.
F2 16/10	Switches value display between hexadecimal and decimal.
F4 ADD	Registers the variable over which the cursor is currently located in Monitor Main. Registration will be performed in decimal when decimal has been selected, and hexadecimal when hexadecimal has been selected.

5-4 Management

A menu which provides operations not normally available in the teaching mode or execution mode will be displayed when the MANAGE key is pressed. The following items are available in the management menu:

- Home Return
- Constant Setting
- Task List
- Type List
- PC Card
- Diagnostics
- Error History
- TPWRITE Monitor
- Clock
- Information

Selection is made by scrolling to the required item with the use of the ↑ or ↓ cursor keys.



5-4-1 Home Return

Home return is the calculation of the relationship between the robot's position and the motor's encoder pulse, and is generally used for position searching. As your newly purchased robot employs a motor equipped with an absolute encoder, normal home return is not necessary. However, there is the necessity of performing home return once when using for the first time after purchase. This section explains the operations involved in home return. Setting modification for home return axis sequences and positions, etc., is also possible.

The following will be displayed when HOME RETURN is selected.

```
HOME RETURN
 Start?

 OK I     ISET ICANCEL
```

F1 F2 F3 F4

F1 OK — Starts home return.

> **Caution** *Take extreme care when starting home return and moving the robot. Ensure that the emergency stop switch can easily be reached.*

F3 SET — Enables the confirmation and setting modification of home return axis sequences and the position of each axis, etc. This is usually set during initialization, and is not necessary.

F4 CANCEL — Ends the procedure without starting home return.

The following menu will be displayed when SET is selected.

```
HOME       R1


ORDERIPOSII
```

F1 F2 F3 F4

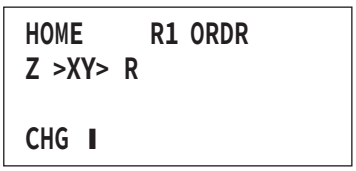
F1 ORDER — Displays the axis sequence of home return.

F2 POSI — Displays the home position of each home return axis.

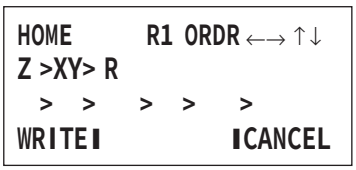
(1) Home return axis sequence

Home return axis sequence if the operational order for each axis when home return is to be performed. Although there are no reasons for amending this, settings can be performed in accordance with preference when tools have to be avoided.

The home return axis sequence is displayed as follows when ORDER is selected.



This display indicates that the sequence of execution is to be Z axis, XY axis simultaneously, and then R axis. The amendment screen will be displayed when CHG has been selected.

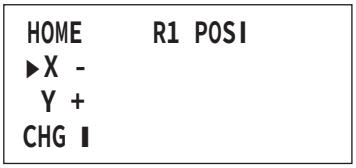


↑ ↓	Scrolls X, Y, XY, Z and R for selection.
← →	Moves the cursor to the right and left.

(2) Home return position

The home return position is the final stopping position for each axis for which home return is being performed. Although there are no reasons for amending this, settings can be performed in accordance with preference when tools have to be avoided.

The home return position for each axis is displayed as follows when POSI. is selected.

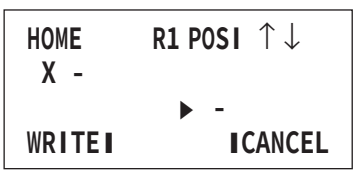


+, – and center are available as positions. In order words, when the X axis home return is completed on +, the X axis will stop at the + edge.

> **NOTE** *The X axis display represents the 1st arm (θ1) and the Y axis display represents the 2nd arm (θ2) when a horizontal articulated robots is being used.*

> **Caution** *Center is only valid for the horizontal articulated robot's 1st arm and 2nd arm. Setting should not be made for cartesian (X-Y) robots or the Z axis and R axis.*
> *The setting cannot be modified in some types of robot. Consult your sony dealer.*

The amendment screen will be displayed when CHG has been selected.



↑ ↓ Scrolls +,– and center for selection.

5-4-2 Constant Setting

Constants are individual parameters for each robot and may be amended as required.

The following constants are available:

- System limit
- System offset

(1) System limit

System limit restrict the range of robot movement for the X, Y, Z and R coordinates, and if these limits are exceeded during programed operations, an error is triggered and the robot stopped. In other words, these are known as software limits.
+ and – settings can be made for each coordinate.

The SYSTEM LIMIT display screen is as follows:

```
SYSTEM LIMIT R1      ↑↓
▶+X   600.000
 -X  -600.000
CHG ▮
```

F1 F2 F3 F4

F1 CHG — Amendments can be made by aligning the cursor with the parameter that requires modification and selecting CHG. All units are displayed in [mm].

NOTE

An immediate stop will be triggered when limits are exceeded during LINE and CIRCLE route for point movement commands within the program, but checks will only be carried out on normal movement commands, such as Do P0(1), when the final position has been attained. No check is implemented for limit excesses mid-route.

(2) System offset

System offset is the parameter that shifts the coordinates (X, Y, Z and R coordinates) held by the robot. In simpler terms, it is a parameter that interpolates the relationship between the positions handled by the robot (robot coordinates) and the spaces excluding the robot (frames and peripheral devices attached to the robot). The following five system offsets are available:

X: Shifts the XY plane home position (X=0, Y=0) handled by the robot towards the X axis for only the amount specified. (Units of mm)

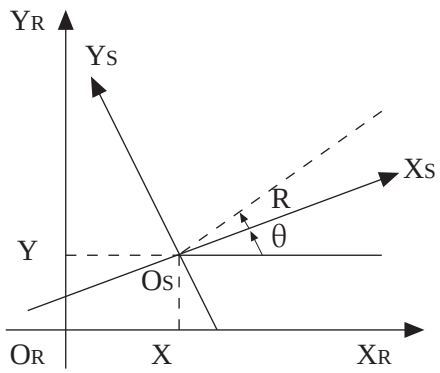
Y: Shifts the XY plane home position (X=0, Y=0) handled by the robot towards the Y axis for only the amount specified. (Units of mm)

Z: Shifts the Z value handled by the robot only for the amount specified. (Units of mm)
For example, if the setting is 20 and movement is performed to Z=30, movement is carried out to the Z=50 position prior to setting.

R: Rotates the R value handled by the robot only for the amount specified. (Units of degrees)

t: Rotates the XY plane value handled by the robot only for the amount specified. (Units of degrees)

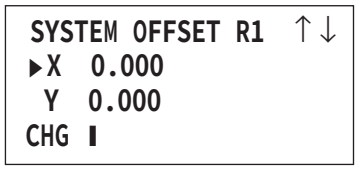
The following is indicated when X_R and Y_R are the coordinates prior to offset, and X_S and Y_S are the coordinate after offset.



NOTE

Note that all other teaching point positions may be mis-aligned when only one setting is made.
The most common method of use for robot coordinates is to match the settings to mis-align with the direction of the robot system (eg; the direction of the conveyor belt).

The SYSTEM OFFSET display screen is as follows:



F1 CHG — Amendments can be made by aligning the cursor with the parameter that requires modification and selecting CHG.

5-4-3 Task List

The execution status of the executable task names and type numbers, and program names when program exist, are displayed when the TASK LIST is selected.

The TASK LIST display screen is as follows:

The following flags can be set for each task other than robot tasks.

Teaching mode flags: The flag to determine if tasks should be stopped or not when switching between the execution mode and teaching mode.

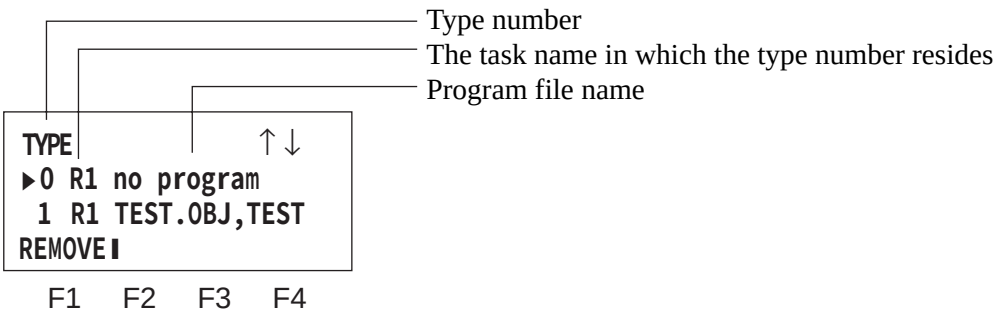
Error occurrence flags: The flag to determine if tasks should be stopped or not when an error occurs.

Emergency error flags: The flag to determine if tasks should be stopped or not when the emergency error occurs.

The flag for which amendment is to be carried out is selected, and RUN or STOP selected with the [↑] or [↓] cursor keys. The initial default is STOP.

5-4-4 Type List

The program names for each type are displayed when the TYPE LIST is selected.

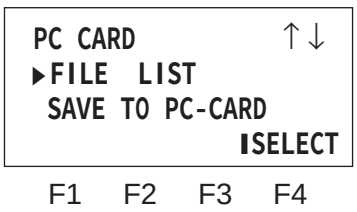


[↑], [↓] Scrolls the file names.
Scrolling will increase in speed when these keys are pressed in combination with the [FAST] key.

[F1] REMOVE Displays the menu for deleting the file name over which the cursor is currently located. A menu to select either OBJ or DAT will be displayed for robot tasks.

5-4-5 PC Card

The menu for handling PC cards will be displayed when PC CARD is selected. However, this menu will not be displayed if a PC card has not been inserted in the slot on the font panel of the controller.



Selections are available in four separate items. Use the ↑ or ↓ cursor keys to scroll to the selection required, and press the F4 SELECT key to make the selection.

FILE LIST: Displays all files names existing on the PC card. It is also possible to delete specified files.
Refer to page 5-40 for further details.

SAVE: User programs, point data and other various data is dropped off into a file and saved onto the PC card.
Refer to page 5-41 for further details.

LOAD: Downloads the file containing all user programs, point data and other various data stored on the PC card into the controller.
Refer to page 5-43 for further details.

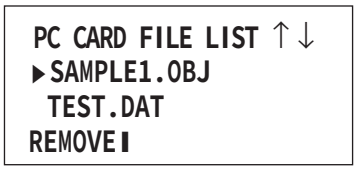
FORMAT: Formats PC card.

The following are simple descriptions of the major file types handled by the PC card.

*****.OBJ	LUNA programs. These files are generated when *****.LUN files are compiled with LUNA compiler.
*****.DAT	Point data files. These files are generated when *****.PON files are compiled with POINT compiler.
*****.COD	PLC programs. These files are generated when *****.PLC files are compiled with the PLC compiler.
*****.CDP	Common point data files. These files are generated when *****.CPN files are compiled with POINT compiler. These files consist of P10(0)-P11(255), DATI(0)-DATI(255) and DATR(0)-DATR(255) values.
*****.KEE	Files which contain the K00C-K255C keep relay channel values.
****.CTR	Controller parameter files. Controller parameters are the setting data used within the controller, and this file need not be opened by users. It is necessary to save this data when replacing CPU boards.
*****.ALL	An information file created when all data (including the above six files) is saved. All data contained in the above six files will be downloaded into the controller when this file is loaded.

File List

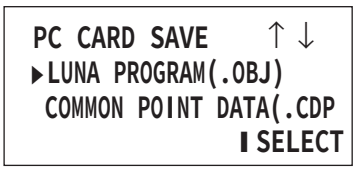
The file names for all files stored on the PC card are displayed as follows.



[↑], [↓]	Scrolls the file names. Scrolling will increase in speed when these keys are pressed in combination with the [FAST] key.
[F1] REMOVE	Displays the menu for deleting the file name over which the cursor is currently located.

Save

Saves the data existing within the controller onto the PC card. The display is as follows:



The following selections are possible.

LUNA PROGRAM (.OBJ): Saves LUNA programs onto the PC card. The type selection menu is displayed.

POINT DATA (.DAT): Saves point data onto the PC card. The type selection menu is displayed.

PLC PROGRAM (.COD): Saves PLC programs onto the PC card. The type selection menu is displayed.

COMMON POINT DATA (.CDP): Saves common point data onto the PC card. The controller's serial number becomes the file name.
Example: C61-0045.CDP

KEEP RELAY DATA (.KEE): Saves keep relay data onto the PC card. The controller's serial number becomes the file name.
Example: C61-0045.KEE

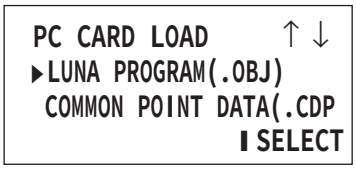
CONTROLLER PARAMETERS (.CTR): Saves controller parameters onto the PC card. The controller's serial number becomes the file name.
Example: C61-0045.CTR

ALL DATA (.ALL): Saves all of the above data onto the PC card. The controller's serial number becomes the file name. Example: C61-0045.ALL

NOTE *Files which share the same file name will be over-written.*

Load

Saves the data existing within the PC card into the controller. The display is as follows:



The following selections are possible.

LUNA PROGRAM (.OBJ): Loads LUNA programs on the PC card into specified types. The type selection menu is displayed.

POINT DATA (.DAT): Loads point data on the PC card into specified types. The type selection menu is displayed.

PLC PROGRAM (.COD): Loads PLC programs on the PC card into specified types. The type selection menu is displayed.

COMMON POINT DATA (.CDP): Loads common point data from the PC card.

KEEP RELAY DATA (.KEE): Loads keep relay data from the PC card.

CONTROLLER PARAMETERS (.CTR): Loads controller parameters from the PC card.

ALL DATA (.ALL): Loads all data saved with the ALL selection. The type number for each file will return to the values at the time of saving.

NOTE *All data existing prior to loading will be erased.*

5-4-6 Diagnostics

The main role of diagnostics is to check the controller's hardware. Functions are separated into three categories as follows:

Hard IN:	Displays the ON/OFF status of all types of signal read from the hardware. This enables the status of the PC card and the status of mains power supply, etc., to be monitored.
Hard OUT:	Displays the status of the various signals which issue commands to the hardware. ON/OFF is also possible. The status of the LED lamps on the front panel of the controller, etc., can be checked.
SENSOR & CNT:	Displays the status of the position counter values calculated with the encoder pulses transmitted from the motor, home position sensors and limit sensors, etc.

(1) Hard IN

Displays the status of control signals read from the hardware. This can be referred to when trouble arises with the controller.

The following is displayed when Hard IN is selected:

The following control signals can be read. 1 represents ON and 0 represents OFF in this display.

BATTERY DOWN ERR: The signal to check the voltage of the battery used for memory back-up. The battery is to be replaced if this signal is ON.

CPU WATCHDOG ERR: The CPU board is not operating correctly when this signal is ON.

SVO WATCHDOG ERR: The servo board is not operating correctly when this signal is ON. Check to ensure that the servo board is correctly located in the slot and firmly connected.

SLOT ACCESS ERR: A hardware error occurred when an attempt was made to access the servo board, the I/O board or any other optional slot.
Check to ensure that each board is correctly located in its specified slot and firmly connected.

24V POWER ERR: An error occurred in the 24V system of the power supply. This will arise when the 24V supplied from the controller with the user I/O has been over-used, or when a short circuit has occurred.

12V POWER ERR: An abnormality has occurred with the 12V power supply used within the controller.

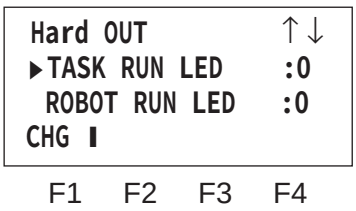
DC POWER ERR:	An abnormality has occurred in the DC system of the power supply. Both 24V power errors and 12V power errors can occur here.
SAFETY BOX LINE:	Not currently in use.
T.P SAFETY LINE:	Displays the status of the safety switch of the Teaching Pendant or the Safety Box which enables operational control from a personal computer.
BARRIER LINE:	Displays the input status of the BARSW of the safety connector located on the rear panel.
SAFETY BOX CONNECTION:	Displays the status of the Safety Box's connection which enables operational control from a personal computer.
TP CONNECTION:	Displays the Teaching Pendant's connection signal.
CARD Not Connect 1:	Displays whether a PC card has been inserted or not. Will be OFF when a PC card has been inserted. Corresponds with the card's signal line CD1.
CARD Not Connect 2:	Displays whether a PC card has been inserted or not. Will be OFF when a PC card has been inserted. Corresponds with the card's signal line CD2.
CARD ACCESS OK:	The RDY signal from the PC card. Only meaningful when a card has been inserted.
CARD BATTERY OK1:	Indicates that the voltage of the PC card's battery is 2.35 volts or higher. Only meaningful when a card has been inserted.
CARD BATTERY OK2:	Indicates that the voltage of the PC card's battery is 2.5 volts or higher. Only meaningful when a card has been inserted.
CARD WR PROTECT:	Becomes ON when PC card writing is not possible. Only meaningful when a card has been inserted.

EEPROM ACCESS OK:	The RDY/BUSY signal for the CPU board's EEPROM memory.
CHILD PCB EXIST:	Information on whether the CPU board's optional child PCB has been connected.

(2) Hard OUT

Displays the status of signals which can be controlled by software for the hardware. This can be referred to when trouble arises with the controller.

The following is displayed when Hard OUT is selected:



F1 CHG ON/OFF can be set forcibly.

The following control signals are available. 1 represents ON and 0 represents OFF in this display.

TASK RUN LED: The signal to illuminate the TASK RUN LED on the front panel of the controller.

ROBOT RUN LED: The signal to illuminate the ROBOT RUN LED on the front panel of the controller.

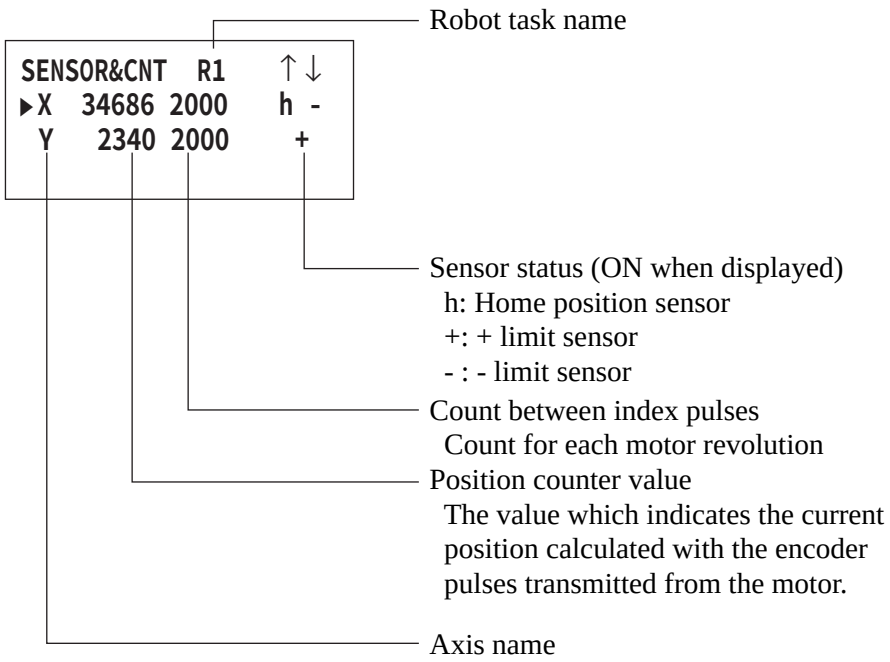
ONLINE LED: The signal to illuminate the ONLINE LED on the front panel of the controller.

ERROR LED: The signal to illuminate the ERROR LED on the front panel of the controller.

(3) Sensor & Counter

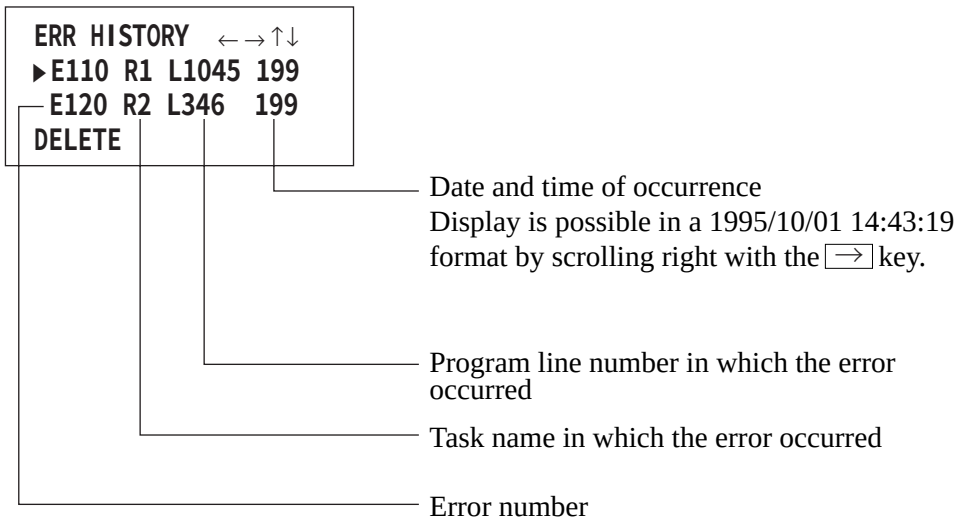
Displays the status of the position counter values calculated with the encoder pulses transmitted from the motor, home position sensors and limit sensors, etc.

The following is displayed when SENSOR & CNT is selected:



5-4-7 Error History

Displays the information related to errors that occurred during controller operation.
The following will be displayed when ERR HISTORY is selected.



Date of occurrence is displayed from the latest date.
New occurrences are registered at the top of the list, and the oldest information is deleted.

5-4-8 TPWRITE Monitor

Displays the character strings transmitted by the TPWRITE command available in the LUNA language. Refer to the Robot Language Guide in the LUNA5.0 Operation Manual for further details.

NOTE

- *Characters other than those used by the Teaching Pendant will not be displayed correctly. Usable characters are numerals, the alphabet and single-byte katakana. Double-byte katakana or kanji (Chinese characters) will not be displayed correctly.*
- *This only applies to the TPWRITE commands executed with the currently selected task program.*

5-4-9 Clock

Displays the clock built into the controller and performs time settings. Mostly used by the error history.

The following will be displayed when the CLOCK is selected.

```
CLOCK
 1955/10/20 13:43:56

CHG ▌
```

Press F1 CHG key when amendment is necessary, and enter the revised numerals as follows.

```
CLOCK
 1955/10/21 13:43:56
 1995/09/_    :  :
WRITE▌        ▌CANCEL
```

F1 F2 F3 F4

NOTE *It is recommended that the clock is checked approximately once per month.*

5-4-10 Information

Displays the information related to the controller. The following information is currently available.

① Controller serial number

The number individual to the controller displayed in a C00-0001 format. This character string is used when saving and loading controller parameters onto PC cards, etc.

② Model name

Displays the model name for the product type in a character string starting with SRX-, as in SRX-630.

③ Version

The software version mounted within the controller.

5-5 I/O

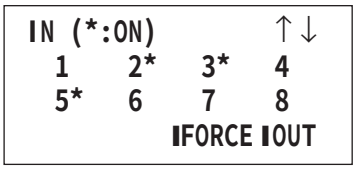
A user I/O status screen is displayed when the I/O key is pressed. The following four menus are available here. The IN menu will be displayed when the I/O key is initially pressed, but OUT can be selected from this menu in order to view OUT data.

IN:	Displays the status of user input.
OUT:	Displays the status of user output. Output ON/OFF is also possible.
OUT force set:	Performs the enforced setting of user output.
IN force set:	Performs the enforced setting of user input.

5-5-1 IN

Displays user input in order of number.

The display for IN is as follows:



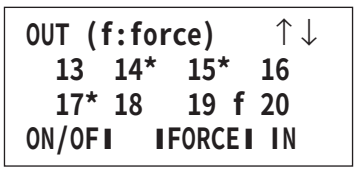
The numbers on the 2nd and 3rd lines are input numbers. These numbers are ON when an asterisk is displayed beside them, and OFF when no asterisk is displayed. This screen indicates that input 2, 3 and 5 are ON, and 1, 4, 6, 7 and 8 are OFF.

■ Valid keys

[↑], [↓]	Scrolls the 2nd and 3rd lines of input display up and down. Scrolling will increase in speed when these keys are pressed in combination with the [FAST] key.
[F4] OUT	Moves to the OUT (user output) menu.
[F3] FORCE	Moves to the IN enforced setting menu.

5-5-2 OUT

Displays user output in order of number.
The display for OUT is as follows:



The numbers on the 2nd and 3rd lines are output numbers. These numbers are ON when an asterisk is displayed beside them, and OFF when no asterisk is displayed. Enforced ON/OFF setting is possible for output, and an 'f' will be displayed when enforced setting has been performed. The output will not change even if F1 ON/OFF key is pressed in this situation. Refer to section 5-5-3. OUT Force Set for further details.

■ Valid keys

↑, ↓	Scrolls the 2nd and 3rd lines of output display up and down. Scrolling will increase in speed when these keys are pressed in combination with the FAST key.
←, →	Moves the location of the cursor which indicates ON/OFF eligibility by one position for the output display on the 2nd and 3rd lines.
1 ~ 9, 0	Toggles the output between ON and OFF for output numbers between 1 and 10 (press 0 for 10). If the setting is current ON it will be switched OFF, and if it is OFF it will be switched ON. ON/OFF control for output numbers over 10 cannot be used with this method.
F1 ON/OF	Toggles the output between ON and OFF for the output number over which the cursor is currently located.If the setting is current ON it will be switched OFF, and if it is OFF it will be switched ON.
F3 FORCE	Moves to the OUT enforced setting menu.
F4 IN	Moves to the IN (user input) menu.

> ⚠ Caution
> *OUT settings (user output) will normally be held as they are during emergency stops. Use system task for controlling each user output during emergency stop.*

5-5-3 OUT Force Set

The menu for performing enforced setting for user output. Enforced setting is the deliberate fixing of user output values at ON or OFF to ensure that ON/OFF amendments with LUNA programs or PLC programs, or ON/OFF amendment with the OUT menu are not accepted.
For example, this is particularly convenient during program debugging when a certain mechanical part of the system must not be moved at all costs.

The following two methods of enforced setting are available:

Enforced ON: Maintains normal output in the ON status, and will not accept OFF commands from programs, etc.

Enforced OFF: Maintains normal output in the OFF status, and will not accept ON commands from programs, etc.

The OUT force set display is as follows:

```
OUT force set    ↑↓
  13  14*  15*  16
  17* 18   19 f 20
fON▮fOFF▮CLR▮allCLR
```

F1 F2 F3 F4

The display on the 2nd and 3rd lines is the same as the OUT menu. It is from this screen that enforced setting is performed.

■ Valid keys

[↑], [↓] Scrolls the 2nd and 3rd lines of output display up and down. Scrolling will increase in speed when these keys are pressed in combination with the [FAST] key.

[←], [→] Moves the location of the cursor which indicates ON/OFF eligibility by one position for the output display on the 2nd and 3rd lines.

[F1] fON Forcibly sets the output of the output number over which the cursor is currently located to ON.

[F2] fOFF Forcibly sets the output of the output number over which the cursor is currently located to OFF.

F3 CLR — Deletes the enforced setting for the output number over which the cursor is currently located.

F4 all CLR — Deletes all enforced settings.

Caution

- *OUT force set will normally be held as they are during emergency stop. All settings will be cleared when the mains power for the controller is switched OFF.*
- *Output numbers for which OUT force set has been performed cannot be changed no matter how many times ON/OFF commands are issued by programs.*

5-5-4 IN Force Set

The menu for performing enforced setting for user input. Enforced setting is the deliberate fixing of user input values at ON or OFF, and values will be forcibly set when LUNA programs or PLC programs determine input ON/OFF regardless of the actual ON/OFF input.
The use of this enables program debugging without actual input.

The following two methods of enforced setting are available:

Enforced ON:	Under the assumption that the normal status is ON, the input status read by programs, etc., becomes ON regardless of the actual external input status.
Enforced OFF:	Under the assumption that the normal status is OFF, the input status read by programs, etc., becomes OFF regardless of the actual external input status.

The IN force set display is as follows:

```
IN force set      ↑↓
 13   14*  15*  16
 17*  18   19 f 20
fON▮fOFF ▮ CLR▮allCLR
```

F1 F2 F3 F4

The display on the 2nd and 3rd lines is the same as the IN menu. It is from this screen that enforced setting is performed.

■ Valid keys

[↑], [↓]	Scrolls the 2nd and 3rd lines of input display up and down. Scrolling will increase in speed when these keys are pressed in combination with the [FAST] key.
[←], [→]	Moves the location of the cursor which indicates ON/OFF eligibility by one position for the input display on the 2nd and 3rd lines.
[F1] fON	Forcibly sets the input of the input number over which the cursor is currently located to ON.
[F2] fOFF	Forcibly sets the input of the input number over which the cursor is currently located to OFF.

F3 CLR — Deletes the enforced setting for the input number over which the cursor is currently located.

F4 all CLR — Deletes all enforced settings.

NOTE

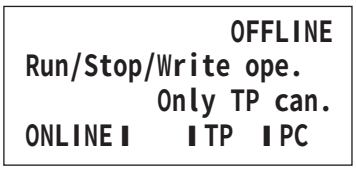
- *IN force set will normally be held as they are during emergency stop.*
- *All settings will be cleared when the mains power to the controller is switched OFF.*

5-6 Others

5-6-1 On-line

The menu which enables switching between on-line and off-line is displayed when the ONLINE key is pressed.
It is also possible to switch between operation systems which carry out the control for run and stop operations, etc., when the status is currently off-line.

The following menu is displayed when OFF-LINE.



—— Current on-line/off-line display

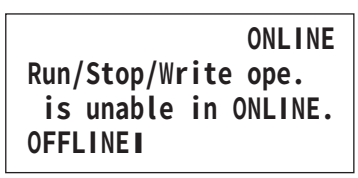
F1 ONLINE Moves across to the on-line status.

> **Caution** *Take note that continual operations for system tasks will automatically be started if the SYSRUN signal is on when moving across to the on-line status. Ensure that the emergency stop switch can easily be reached.*

F3 TP When the right of controlling operations is held by a personal computer, this right is removed and passed across to the Teaching Pendant.

F4 PC Passes the right of controlling operations held by the Teaching Pendant across to a personal computer.
Control from the personal computer is possible when this operation is performed or when the Teaching Pendant is disconnected from the controller. In other words, the personal computer is not able to remove the right of control from the Teaching Pendant when the Teaching Pendant is being used.

The following menu is displayed when ON-LINE.



—— Current on-line/off-line display

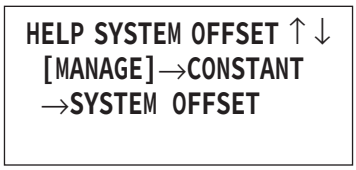
F1 OFFLINE Moves across to the off-line status and stops system task.

5-6-2 Help

The help screen displays a list of operation explanations for the Teaching Pendant. All operational items are displayed in alphabetical order, and can be scrolled up or down. This help screen will provide operational explanations when the operating methods of the Teaching Pendant are unknown.

The following will be displayed when entering the HELP screen.

For example, when details on setting system offset are required, the above screen is scrolled until SYSTEM OFFSET is displayed and selected. In this case, the following screen will be displayed.

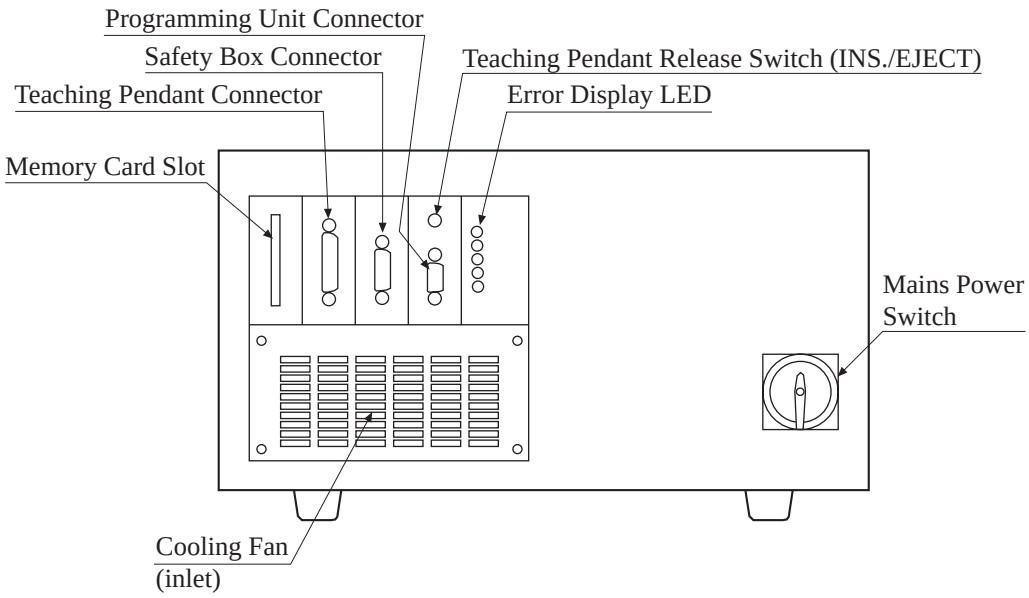


This screen explains the operation as pressing the [MANAGE] key, selecting the constant settings, and then selecting system offset. [ ] in the display represents keys on the Teaching Pendant, and → represents the flow of operations.

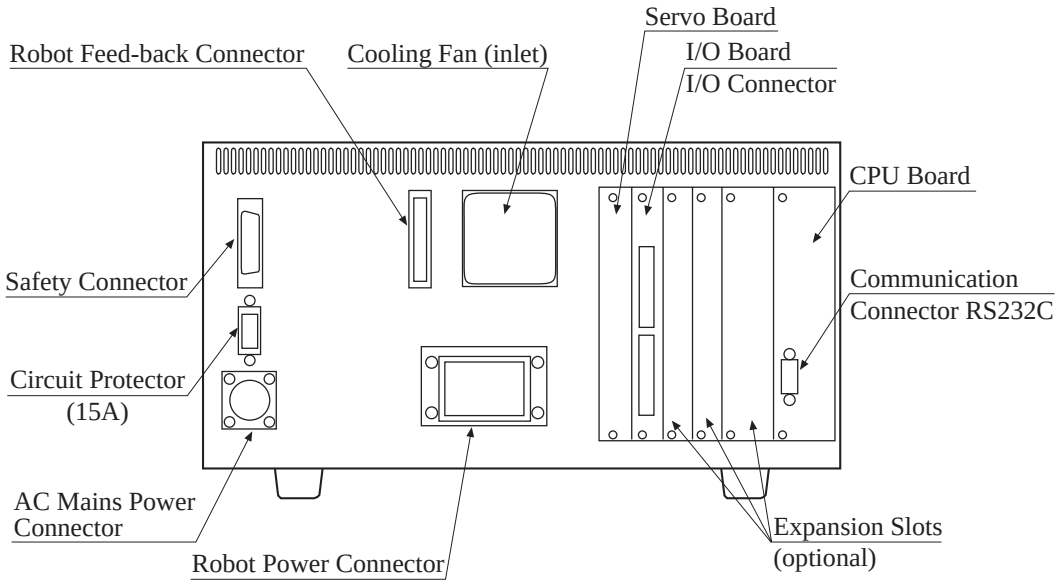
Electrical Guide

Electrical Guide

1. Nomenclature



Front Panel



Rear Panel

2. Input/Output Specifications

2-1 System and User I/O Specifications

Four types of I/O are available as follows:

System input (to control the robot from peripheral devices)
User input (for functions allocated optionally by the user)
System output (for sending robot information to peripheral devices)
User output (actuator drive signals or output signals allocated optionally by the user)

These are contained within the I/O board I/O connector located on the rear panel. Also, special settings have been performed prior to shipping with the system task for user input and user output to enable the device to be used in the same way as the conventional SRX series. Modify the system task program if these settings are not required.

System Input

Pin name	Signal name	Details
SI 1	SYSRUN	The master signal for when the robot is to be controlled by external signals.
SI 2		Reserved for future usage
SI 3		
SI 4		
SI 5		
SI 6		
SI 7	DSS	The Drive safety signal for the SMART system. Refer to section “Safety Instruction: 5. SMART specifications”.
SI 8		Reserved for future usage

User Input (Set prior to shipping)

Pin name	Signal name	Details	
I 32	ERRRST	Error reset	Control is enabled when the SYSRUN signal is ON
I 33	PROG0	Program type selection signal 0	
I 34	PROG1	Program type selection signal 1	
I 35	PROG2	Program type selection signal 2	
I 36	PROG3	Program type selection signal 3	
I 37	PSTEP	Program step termination	
I 38	PSTART	Program automatic operation execution	
I 39	STPSTAT	Program continual execution	
I 40	PRET	Robot home return start	

Refer to section 8 of the Installation Guide for further details.

System Output

Pin name	Signal name	Details
SO 1	EMC-OUT	Emergency stop switch stop status
SO 2	ERROR	Error signal
SO 3	BARRIER	Safety barrier signal
SO 4	DRIVE	Drive signal
SO 5 SO 6 SO 7 SO 8		Reserved for conventional usage

User Output (Set prior to shipping)

Pin name	Signal name	Details
L37	STEP	During program step termination
L38	SAUTO	Automatic mode
L39	SATDO	During automatic operation execution
L40	HOMING	During robot home return

Refer to section 8 of the Installation Guide for further details.

NOTE

- ◆ *System and user output specifications:*
  - *Ensure that the maximum electrical current for each point is 100mA or less.*
  - *Ensure that the protective element is used for induced load.*
- ◆ *Recommended noise protective devices*

  Diode: 1SR89-200 Shindengen Electric Mfg. Co., Ltd.

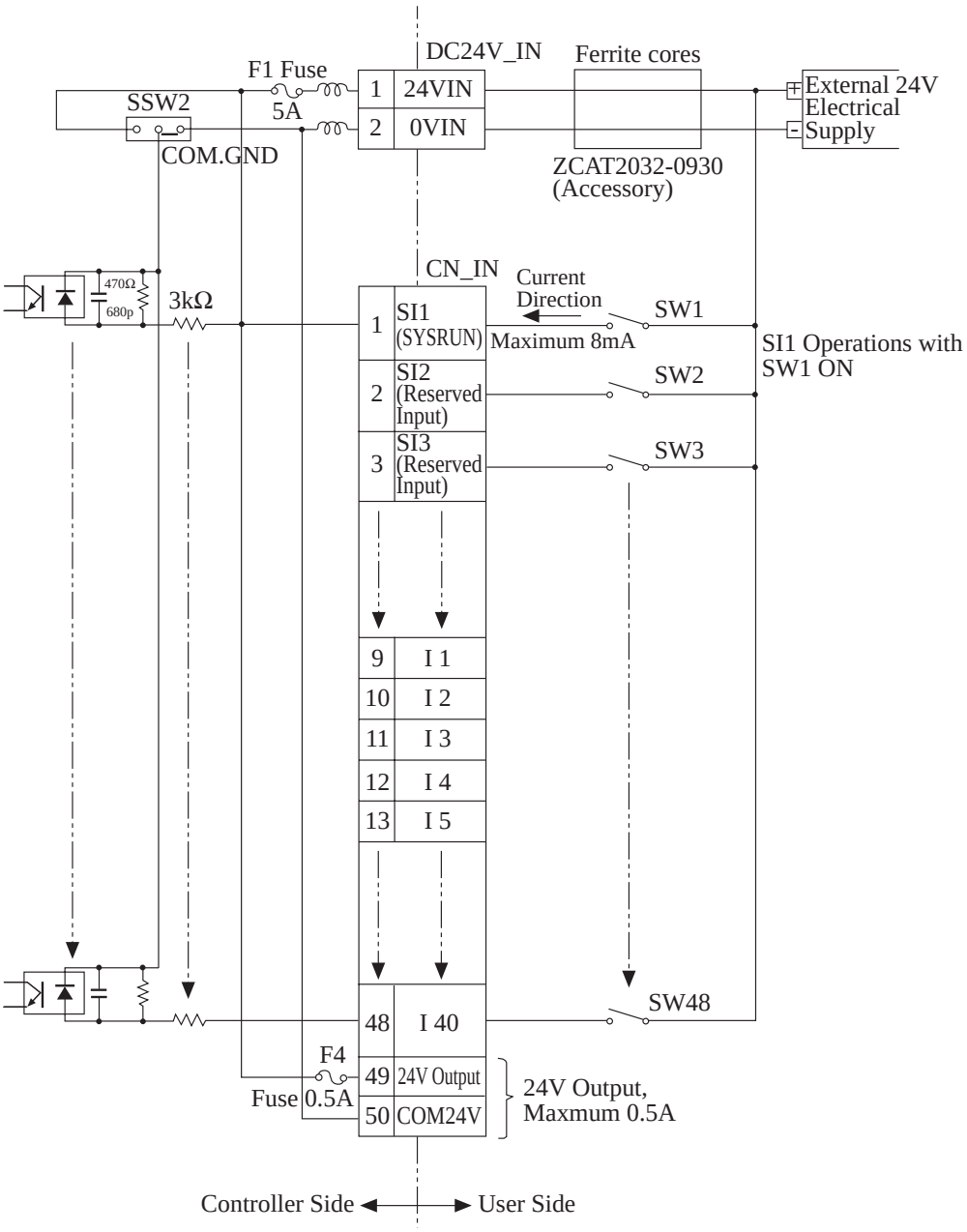
  Noise killer: SR.11201G Okaya Electric Industries. Co., Ltd.

2-2 I/O Circuits

2-2-1 I/O Boards and I/O Connectors

(1) Input Circuit, CN_IN

External 24V supply, GND common specification (standard settings)



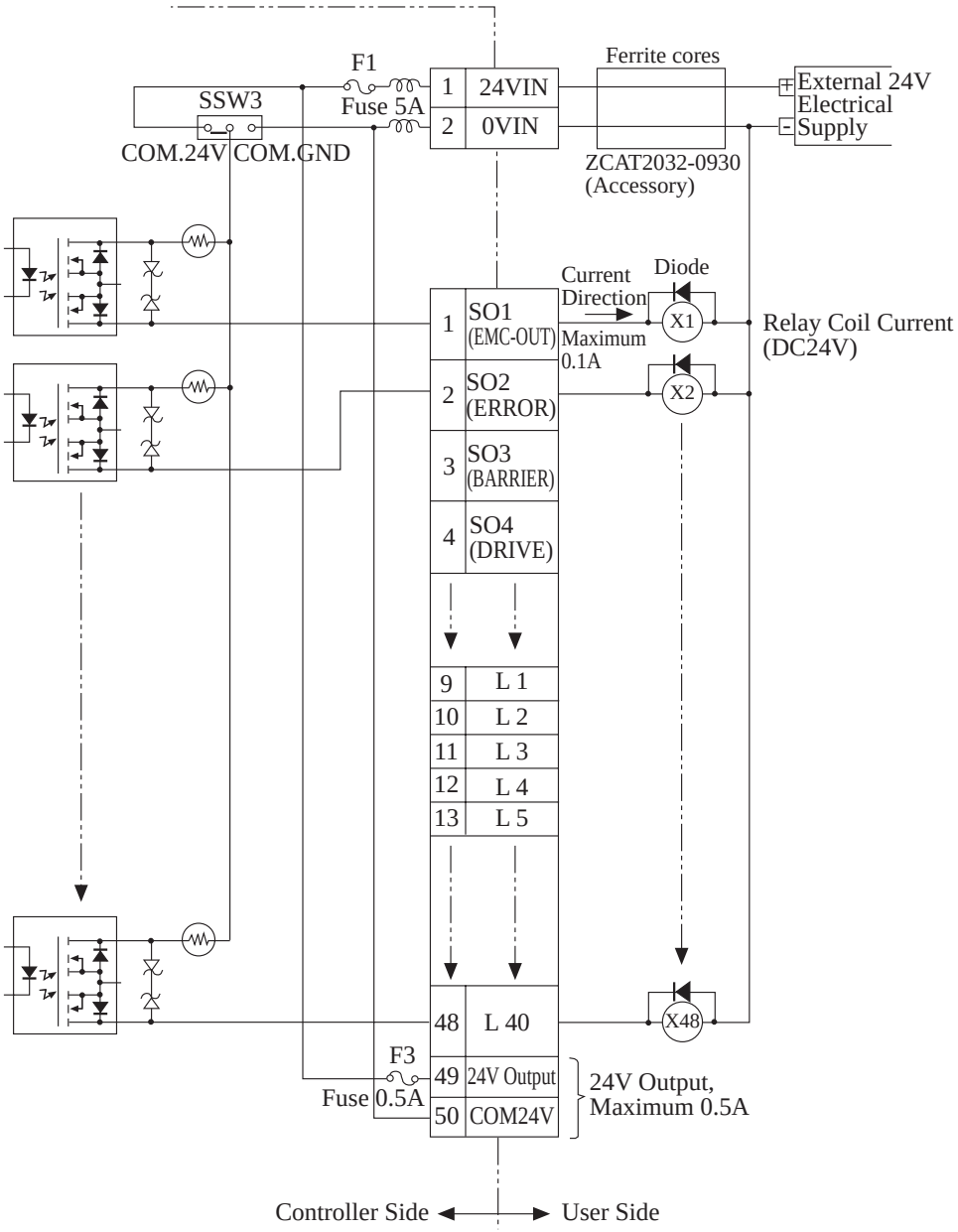
Slide Switch Settings

- SSW2: Set to the COM. GND side.

Refer to “3-3 I/O Board” on replacing the fuses F1 and F4.

(2) Output Circuit, CN_OUT

External 24V supply (standard settings)



Slide Switch Settings

- SSW3: Set to the COM. 24 V side.

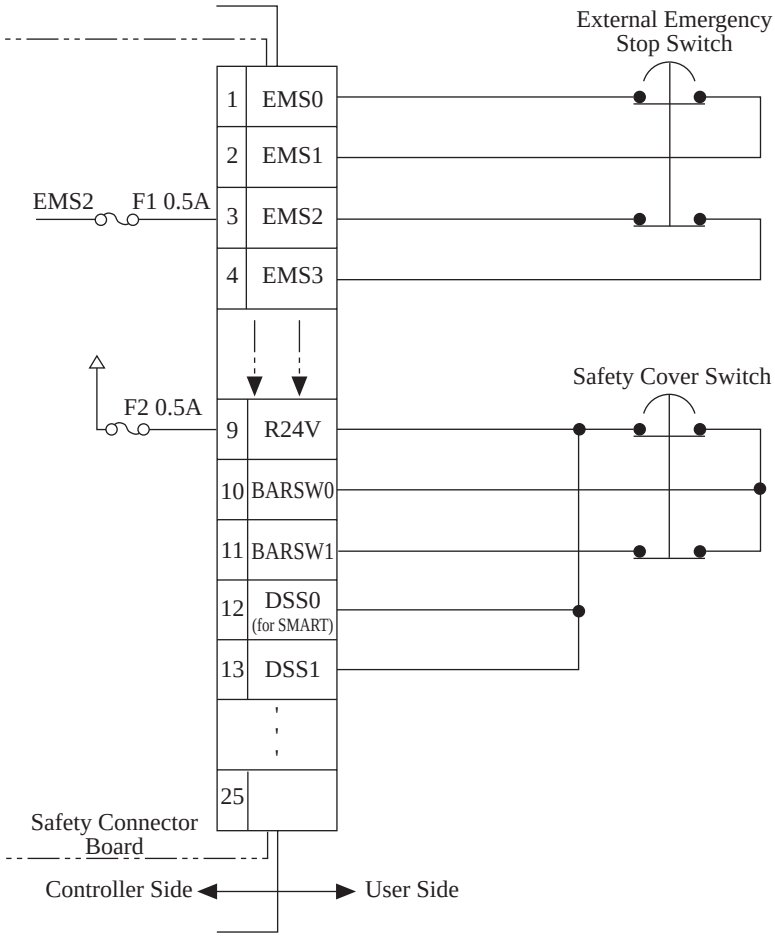
Refer to “3-3 I/O Board” on replacing the fuses F1 and F3.

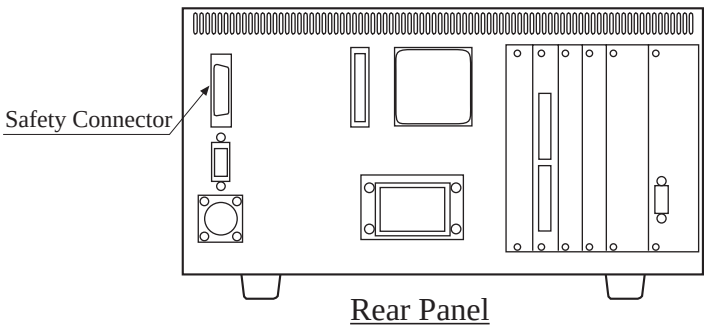
NOTE

- *Add a diode as indicated above when the output load is to be connected to the relay coil.*
- *The F3 and F4 fuses will blow is a current of 0.5A or more is used with a 24V output. Ensure that the fuses stipulated are used.*
  Fuse: 0.5ADC48V, Model: LM05, Manufacturer: Daito Communication Apparatus Co., Ltd.
- *If output current of 100 mA or more flows, the protection device operates to limit the output current.*

2-2-2 Safety Connector

External emergency stop and safety barrier switch input circuits





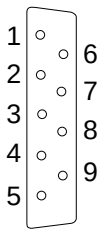
NOTE

The F1 and F2 fuses will blow is a current of 0.5A or more is used with a 24V output. Ensure that the fuses stipulated are used.
Fuse: 0.5ADC48V, Model: LM05, Manufacturer: Daito Communication Apparatus Co., Ltd.

2-3 Connectors and Pin Assignment

(1) Programming unit connector, RS232C port (front panel)

Pin number	Code	Name
1	NC	
2	TXD	Transmission data
3	RXD	Receiving data
4	DSR	Data set ready
5	SG	Signal ground
6	DTR	Data terminal ready
7	CTS	Clear to send
8	RTS	Request to send
9	NC	

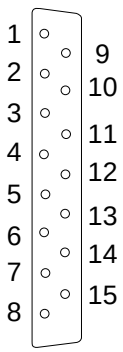


Model: FCN-674J009-L/F#VA-01 Manufacturer: FUJITSU LIMITED

(2) Safety box connector (front panel)

Do not connect as not normally used.

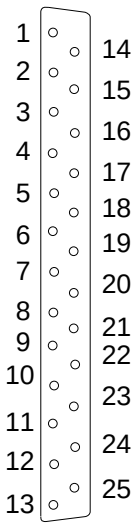
Pin number	Code	Name
1	EMS 9	Emergency stop
2	EMS 8	Emergency stop
3	EMSCN3	Safety Box identifier (2)
4	EMSCN2	Safety Box identifier (2)
5	EMSCN1	Safety Box identifier (1)
6	EMSCN0	Safety Box identifier (1)
7	EMSSAF1	Safety switch
8	EMSSAF0	Safety switch
9	EMSSAF3	Safety switch
10	EMSSAF2	Safety switch
11	FG	
12	FG	
13	FG	
14	EMS 11	Emergency stop
15	EMS 10	Emergency stop



Model: FCN-674J015-L/F#VA-01 Manufacturer: FUJITSU LIMITED

(3) Teaching pendant connector (front panel)

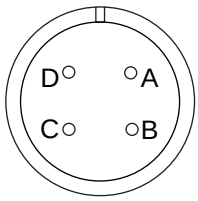
Pin number	Code	Name
1	FG	Frame ground
2	TXD	Transmission data
3	RXD	Receiving data
4	RTS	Request to send
5	CTS	Clear to send
6	DSR	Data set ready
7	SG	Signal ground
8	EMS 7	Emergency stop
9	EMS 6	Emergency stop
10	SG	Signal ground
11	TPSAF1	Safety switch
12	SG	Signal ground
13	TPSAF2	Safety swtich
14	NC	
15	NC	
16	EXS5	Emergency stop
17	EXS4	Emergency stop
18	TPCN1	Teaching pendant identifier
19	SG	Signal ground
20	DTR	Data terminal ready
21	TPCN2	Teaching pendant identifier
22	P5V	＋5V
23	TPSAF0	Safety switch
24	SG	Signal ground
25	P5V	＋5V



Model: FCN-674J025-L/F#VA-01 Manufacturer: FUJITSU LIMITED

(4) AC mains power connector (rear panel)

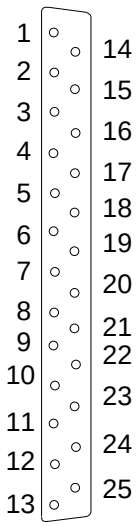
Pin number	Code	Name
A	ACP1	AC mains power
B	ACP2	AC mains power
C		(Not connected)
D	FG	Frame ground



Model: CS05-2A18-10PD-B Manufacturer: DDK Ltd.

(5) Safety Connector (rear panel)

Pin number	Name	Signal
1	EMS0	External Emergency Stop Input (2b)
2	EMS1	External Emergency Stop Input (2b)
3	EMS2	External Emergency Stop Input (2b)
4	EMS3	External Emergency Stop Input (2b)
5	EGSTS0	Emergency Stop Output (2b)
6	EGSTS1	Emergency Stop Output (2b)
7	EGSTS2	Emergency Stop Output (2b)
8	EGSTS3	Emergency Stop Output (2b)
9	R24V	Power Supply for Input Signal
10	BARSW0	Safety Barrier Switch Input (2b)
11	BARSW1	Safety Barrier Switch Input (2b)
12	DSS0	Drive Safety Switch (2b)
13	DSS1	Drive Safety Switch (2b)
14	ENBSW0	High Speed Movement Check Switch (2b)
15	ENBSW1	High Speed Movement Check Switch (2b)
16		Reserved for future usage
17		
18		
19		
20		
21		
22		
23		
24		
25		



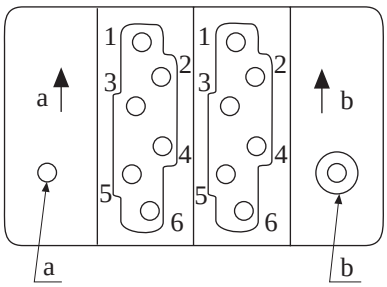
Model: FCN-675J025-L/C#PD Manufacturer: FUJITSU LIMITED

Caution

- *Use the pins from number 16 to number 25 without making any connection.*
- *Refer to section "Safety Instruction: 2. How to connect a safety circuit".*

(6) Motor Power Connector (rear panel)

Pin number	Code	Name
a-1	T1A	Motor 1A
a-2	T1B	Motor 1B
a-3	T1C	Motor 1C
a-4	T2A	Motor 2A
a-5	T2B	Motor 2B
a-6	T2C	Motor 2C
b-1	T3A	Motor 3A
b-2	T3B	Motor 3B
b-3	T3C	Motor 3C
b-4	T4A	Motor 4A
b-5	T4B	Motor 4B
b-6	T4C	Motor 4C
a	FG	Frame Ground
b	FG	Frame Ground



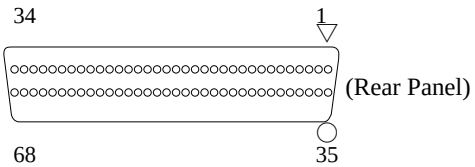
Model: Housing: 0930 006 0301
Frame for housing: 0914 006 0311
Modules for female contacts: 0914 006 3101
Female contacts: 0933 000 6205 (1 mm^2)

} Manufacturer: Harting

(7) Feed-back connector (rear panel)

Pin number	Code	Name	Pin number	Code	Name
1	SG	Signal ground	35	SG	Signal ground
2	＋S_OPT	Serial signal option ＋	36		
3	－S_OPT	Serial signal option －	37		
4	＋S_CW/CCW	Serial signal sensor ＋	38	SG	Signal ground
5	－S_CW/CCW	Serial signal sensor －	39	SG	Signal ground
6	＋S_ABS_CLR	Serial signal ABS control ＋	40	SG	Signal ground
7	－S_ABS_CLR	Serial signal ABS control －	41	SG	Signal ground
8	＋S_CLK	Serial signal clock ＋	42	SG	Signal ground
9	－S_CLK	Serial signal clock －	43	SG	Signal ground
10	SG	Signal ground	44	SG	Signal ground
11	＋AB1	Serial signal motor 1＋	45	＋AB5	Serial signal motor 5＋
12	－AB1	Serial signal motor 1－	46	－AB5	Serial signal motor 5－
13	＋AB2	Serial signal motor 2＋	47	＋AB6	Serial signal motor 6＋
14	－AB2	Serial signal motor 2－	48	－AB6	Serial signal motor 6－
15		(Reserved)	49		(Reserved)
16		(Reserved)	50		(Reserved)
17	＋AB3	Serial signal motor 3＋	51	＋AB7	Serial signal motor 7＋
18	－AB3	Serial signal motor 3－	52	－AB7	Serial signal motor 7－
19	＋AB4	Serial signal motor 4＋	53	＋AB8	Serial signal motor 8＋
20	－AB4	Serial signal motor 4－	54	－AB8	Serial signal motor 8－
21		(Reserved)	55		(Reserved)
22		(Reserved)	56		(Reserved)
23	SG	Signal ground	57	SG	Signal ground
24	P5V	＋5V	58	P5V	＋5V
25	P5V	＋5V	59	P5V	＋5V
26	E5VBAT	Back-up 5V	60	P5V	＋5V
27	＋S_OPT1	Serial signal option 1＋	61	SG	Signal ground
28	SG	Signal ground	62	＋S_OPT2	Serial signal option 2＋
29	－S_OPT1	Serial signal option 1－	63	－S_OPT2	Serial signal option 2－
30	R24V	＋24V	64	R24V	＋24V
31	ROV	24V ground	65	ROV	24V ground
32	BRK1＋	Brake 1＋	66	BRK2＋	Brake 2＋
33	BRK1－	Brake 1－	67	BRK2－	Brake 2－
34	FG	Frame ground	68	FG	Frame ground

Model: 10268-52A2JL Manufacturer: 3M



(8) I/O board, I/O connector, Input connector CN_IN (rear panel)

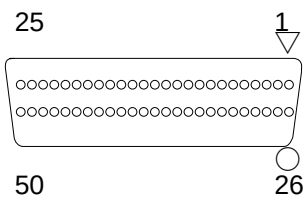
Pin number	Code	Name	Pin number	Code	Name
1	SI1	SYSRUN	26	I18	I18
2	SI2	Reserved input	27	I19	I19
3	SI3	Reserved input	28	I20	I20
4	SI4	Reserved input	29	I21	I21
5	SI5	Reserved input	30	I22	I22
6	SI6	Reserved input	31	I23	I23
7	SI7	Reserved input	32	I24	I24
8	SI8	Reserved input	33	I25	I25
9	I1	I1	34	I26	I26
10	I2	I2	35	I27	I27
11	I3	I3	36	I28	I28
12	I4	I4	37	I29	I29
13	I5	I5	38	I30	I30
14	I6	I6	39	I31	I31
15	I7	I7	40	I32	I32
16	I8	I8	41	I33	I33
17	I9	I9	42	I34	I34
18	I10	I10	43	I35	I35
19	I11	I11	44	I36	I36
20	I12	I12	45	I37	I37
21	I13	I13	46	I38	I38
22	I14	I14	47	I39	I39
23	I15	I15	48	I40	I40
24	I16	I16	49	24VOUT	DV24V output
25	I17	I17	50	COM24V	24V output GND

Model: 10250-52A2JL Manufacturer: 3M
Applicable plug: Model:10150-3000VE Manufacturer: 3M
Applicable shell: Model:10350-52F0-008 Manufacturer: 3M

(9) I/O board, I/O connector, Output connector CN_OUT (rear panel)

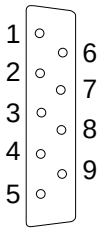
Pin number	Code	Name	Pin number	Code	Name
1	SO1	EMC-OUT	26	L18	L18
2	SO2	ERROR	27	L19	L19
3	SO3	BARRIER	28	L20	L20
4	SO4	DRIVE	29	L21	L21
5	SO5	Reserved output	30	L22	L22
6	SO6	Reserved output	31	L23	L23
7	SO7	Reserved output	32	L24	L24
8	SO8	Reserved output	33	L25	L25
9	L1	L1	34	L26	L26
10	L2	L2	35	L27	L27
11	L3	L3	36	L28	L28
12	L4	L4	37	L29	L29
13	L5	L5	38	L30	L30
14	L6	L6	39	L31	L31
15	L7	L7	40	L32	L32
16	L8	L8	41	L33	L33
17	L9	L9	42	L34	L34
18	L10	L10	43	L35	L35
19	L11	L11	44	L36	L36
20	L12	L12	45	L37	L37
21	L13	L13	46	L38	L38
22	L14	L14	47	L39	L39
23	L15	L15	48	L40	L40
24	L16	L16	49	24VOUT	DV24V output
25	L17	L17	50	COM24V	24V output GND

Model: 10250-52A2JL Manufacturer: 3M
Applicable plug: Model:10150-3000VE Manufacturer: 3M
Applicable shell: Model:10350-52F0-008S Manufacturer: 3M
(Sony specifications)



(10) Communication connector, RS232C port (rear panel)

Pin number	Code	Name
1	NC	
2	TXD	Transmission data
3	RXD	Receiving data
4	DSR	Data set ready
5	SG	Signal ground
6	DTR	Data terminal ready
7	CTS	Clear to send
8	RTS	Request to send
9	NC	



Model: CDS-3109-0122 Manufacturer: SMK
Applicable plug: Model: 17JE-23090-02 Manufacturer: DDK Ltd.
Applicable shell: Model: 17JE-09H-1A Manufacturer: DDK Ltd.

3. Maintenance

3-1 Accessories

The following accessories are available as consumable products. Additional accessories must be purchased.

Name	Model	Manufacturer	Remarks
Input connector	10150-3000VE (plug complete with solder)	3M	
	10350-52F0-008 (plastic shell)	3M	
Output connector	10150-3000VE (plug complete with solder)	3M	
	10350-52F0-008S (plastic shell complete with processor)	3M	Sony specifications
Fuses	LM05 (fuse 0.5A)	Daito Communication Apparatus Co., Ltd.	
	LM50 (fuse 5A)		
Safety connector	DB-25PF-N (with soldering plug)	JAE	
	DB-C4-J11 (metal case)		
I/O board 24V connector	MC1.5/2-ST-3.81	Phoenix Contact	
I/O board 24V Ferrite cores	ZCAT2032-0930	TDK	

3-2 Memory Card

A memory card with the following specifications has been prepared:

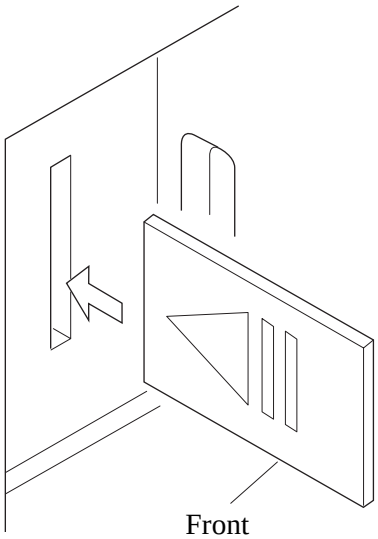
Standards: PC card standards
Type: Type 1
Capacity: 1 Mbyte SRAM (battery back-up type)

• Memory Card Selection Examples

IC memory card SRAM series 1MB Model: J41000SRMAD20-A Manufacturer: Mitsubishi Plastic, Inc.
IC memory card CSCJ series 1MB Model:CSCJ-001M-SM-461 Manufacturer: ITT Cannon
* Specifications as of September 1995

• Inserting the memory card

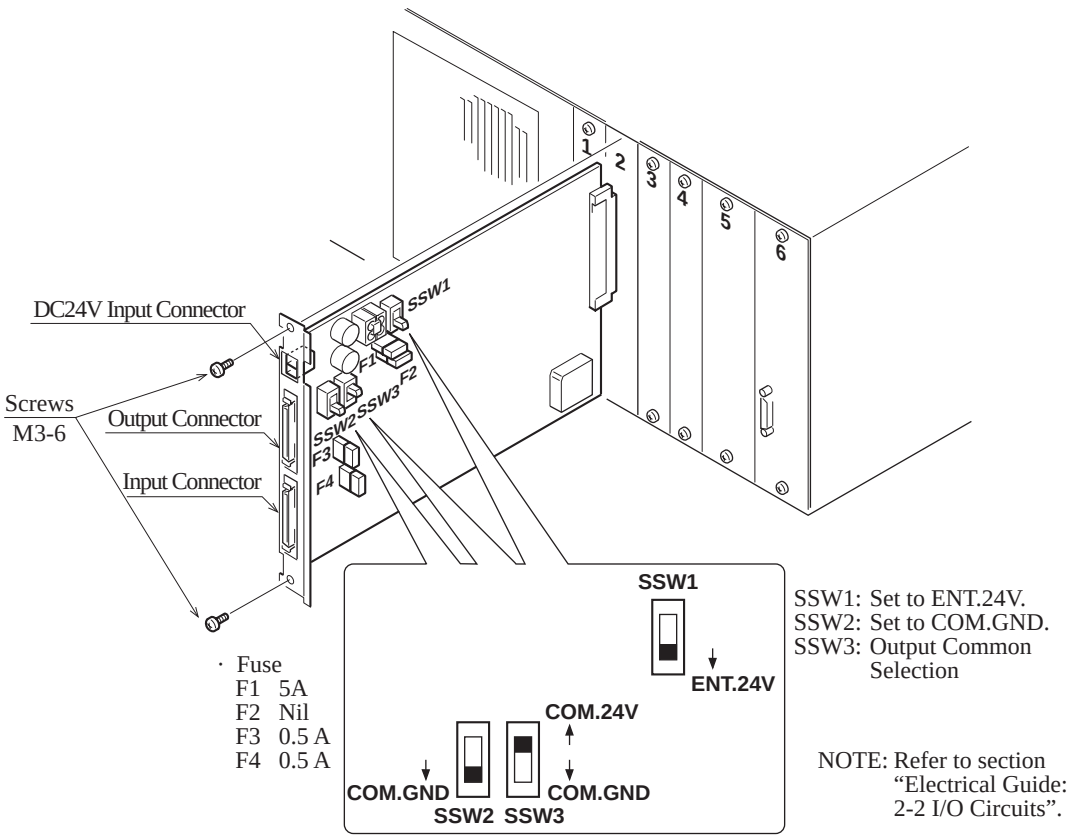
Insert the memory card in accordance with the direction indicated in the following diagram.



NOTE *Do not remove or replace the memory card during reading or writing processes.*

3-3 I/O Board

The I/O board is located on the rear panel.
Ensure that the mains power switch has been turned OFF prior to removing the I/O board.
The panel area can be removed by unscrewing the two bolts that hold the I/O board secure. The F1 to F4 fuses, and slide switches SSW1 to SSW3 are located on the I/O board as indicated in the following diagram and will require replacement in accordance with necessity.



I/O Board (rear panel)

3-4 Batteries

The following two types of batteries are built into the controller. (Refer to page 3-6).

1. Lithium ion battery Model: CR17335SE Manufacturer: SANYO Electric Co., Ltd. Used for the cpu board's memory back-up.
2. Lead storage cell battery Model: CYCLON, D cell Manufacturer: Hawker Energy Products INC. Used for backing up the absolute encoder circuit incorporated in the SRX robot's motor.

3-4-1 Handling Batteries

Caution

The mis-handling of lithium ion batteries and lead storage cell batteries is extremely dangerous. Avoid the following at all costs to maintain safety. Sony Corporation refuses all responsibility for trouble ensuing from the following cases.

(1) Short-circuits

Avoid short-circuiting the batteries at all costs.

Failure to observe this may result in damage to equipment or fire caused by generated heat.

(2) Dismantling

Never dismantle the batteries. Failure to observe this may result in respiratory problems caused by escaping gas or the leakage of lithium metal. Deforming the batteries or subjecting them to impact may also result in heat generation, splitting or the outbreak of fire.

(3) Subjecting to flames or water

Applying heat to the batteries may result in leakages or splitting and the outbreak of fire through internal short-circuiting. The batteries may split open when immersed in water, so avoid this at all costs. The function of the batteries will also be lost when immersed in water.

(4) Soldering

Never apply solder directly to the batteries. Applying heat to the batteries may result in leakages or splitting and the outbreak of fire through internal short-circuiting.

(5) Never insert the batteries with the positive and negative poles in the reverse position.

(6) Usage for other purposes

Never use the batteries in other equipment. Differing specifications may result in damage to the battery or equipment.

(7) Recharging

Do not attempt to recharge lithium ion batteries. Failure to observe this may result in internal gas emissions, splitting or the outbreak of fire.

(8) Disposing of lead storage cell batteries

Insulate the terminals of all lead storage cell batteries with insulating tape after use and return to the Sony Service Center or Sony Shop.

3-4-2 Recharging Lead Storage Batteries for Absolute Encoder Back-up Purposes

Recharging is performed by the recharging circuit when the robot controller's power supply is switched on. A current is supplied to the absolute encoder when the mains power has been cut. The absolute encoder can be backed up for approximately one month on a full charge. Recharging will take 24 hours when a battery is completely dead. The life span of lead storage cell batteries is reduced by repeated recharging.
This may lead to the loss of position data for the absolute encoder through reduced current within the above-mentioned period. In this event, replace the battery and perform the home return process.

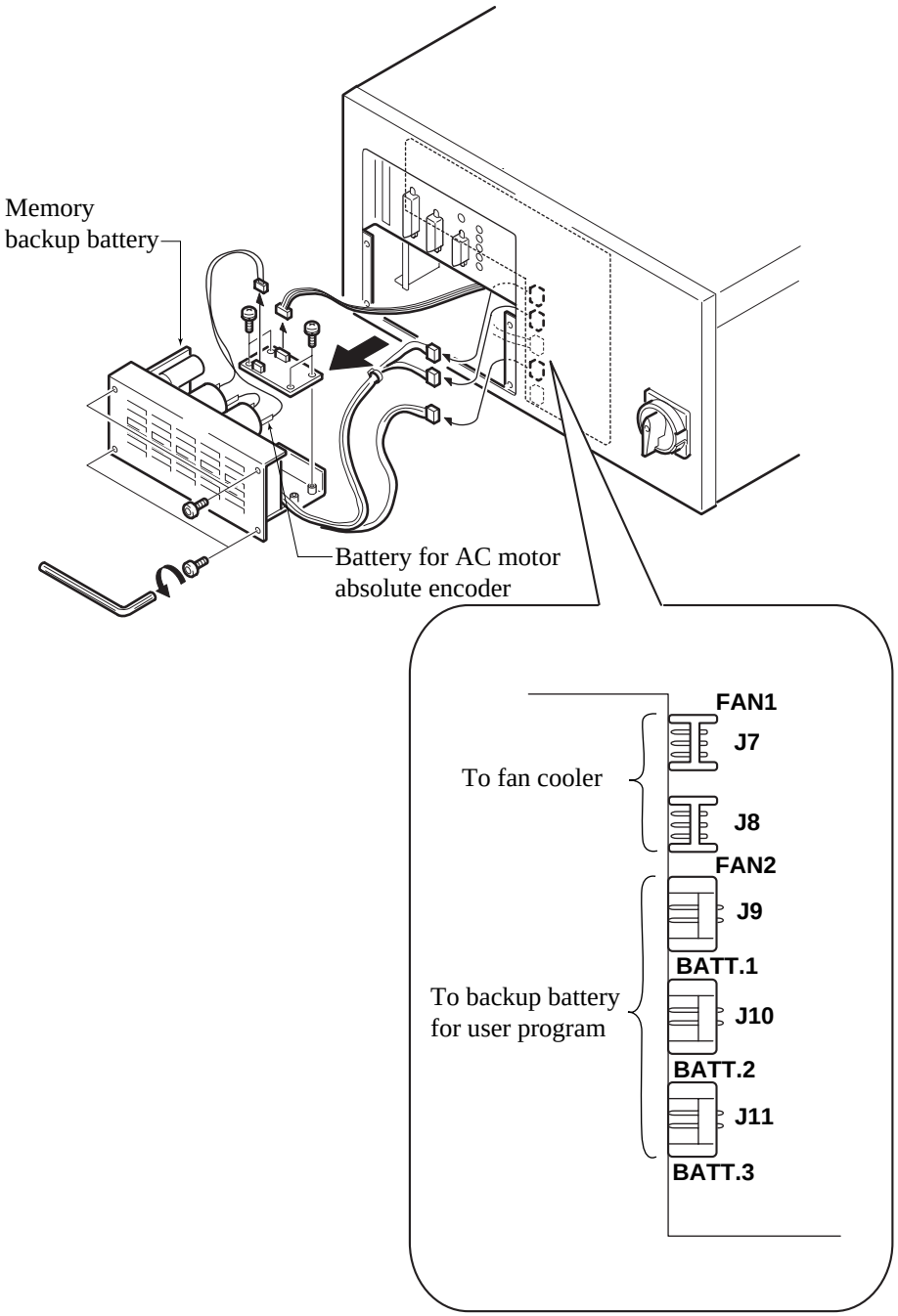
3-4-3 Battery Life and Replacement

The official life span of lithium ion batteries and lead storage cell batteries is six years. Replace these batteries once every six years. Place a new battery in the supplementary connector when replacing batteries and remove the old battery. The use of the supplementary connector will maintain the memory and absolute encoder circuits in a back-up status.
Note that all position data for the absolute encoder will be lost if the lead storage battery is completely removed from the connector.
There are cases where the official life span will not be reached depended on the environment in which the battery is used.

3-4-4 Protection Circuits

A fuse is connected to the recharging circuit as output short-circuit protection for the absolute encoder's lead storage cell battery. The circuit will be protected by the fuse blowing when a short-circuit occurs between the controller and the motor encoder. In this event, locate and remedy the cause, and then replace the fuse. Position data for the absolute encoder will be lost when this fuse blows, so home return must be performed once more in order to set the home position. (Refer to page 3-6).
Fuse: 0.5A DC48V Model: LM05 Manufacturer: Daito Communication Apparatus Co., Ltd.

Controller internal configuration



3-5 Maintenance Management

The following inspections are recommended on a regular basis of at least once every six months.

a) Operational check of the fan connected to the controller
The operations of the fan connected to the controller must be checked without fail when being used for the first time. If the fan is incapable of ventilating sufficient heat owing to the surrounding environment, heat will build up in the integrated circuits and cause wide-spread damage.

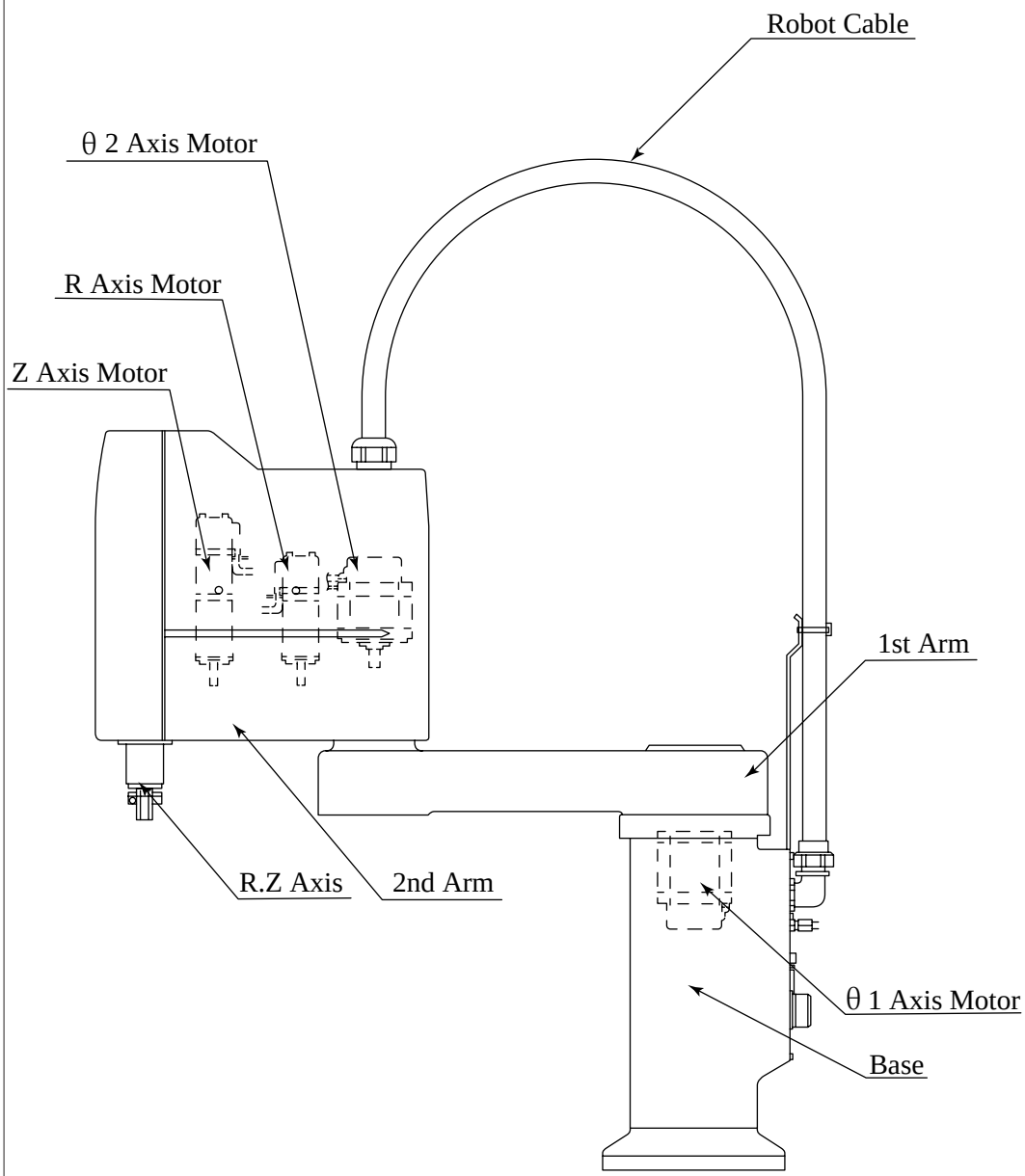
b) Relay cable damage and loose terminal connector checks
Perform visual checks on the relay cable between the controller and the robot for scratches or squashing, and on the cable terminal connectors for loosening.

c) Wiring connection checks for sensors
The limit and home position detectors for each axis use photo-micro sensors and must be checked for socket loosening or scratches on the wiring leading from socket solders.

Mechanical Guide

Mechanical Guide

1. Nomenclature



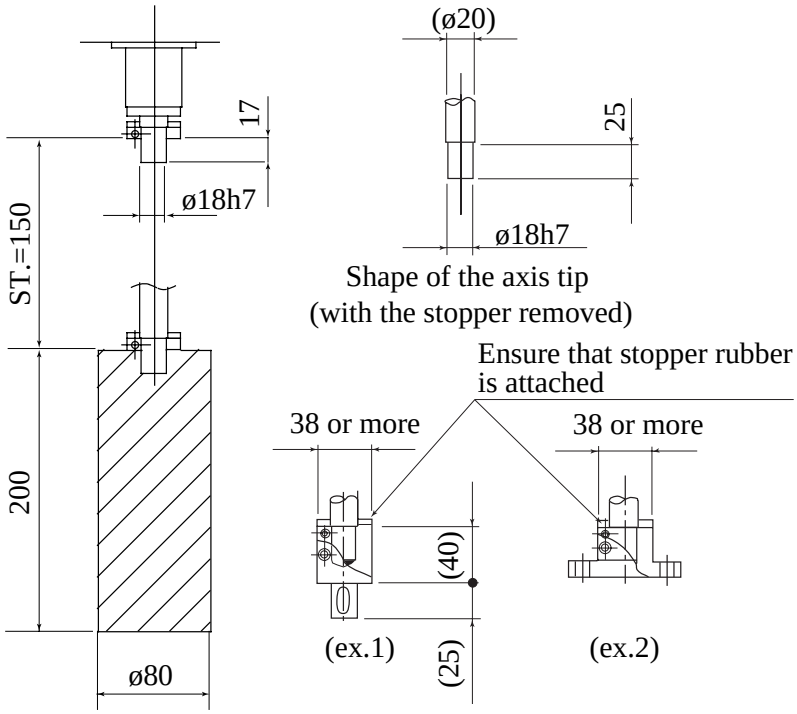
2. Tooling

2-1 Tool Attachment

The front tip of the RZ axis is shaped as indicated in the following diagram in order to enable tool attachment. The tip is also equipped with a part stopper, and with the exception of special cases, this should never be removed. The ball will disconnect when the ball spline is removed from the top, and replacement becomes impossible. Extreme caution is therefore required.
The maximum external shape of tools for the SRX-611 is as indicated in the following diagram. This range prevents the tools from interfering with the robot. When this maximum tool shape is exceeded, it is recommended that safety is maintained by adding software constraints over the range of operations when creating the robot program.

It is possible to attach flanges which incorporate stopper when the stopper proves to be an obstruction for user tooling requirements or for when large flanges, etc., are to be attached, but the diameter of the stopper must be ø38 or more and must be affixed with stopper rubber.

Consideration must be given to tightening tools during attachment and the firm setting of span rings, etc., in the design stage. Set screws are not recommended for attachment as they have unstable levels of strength.

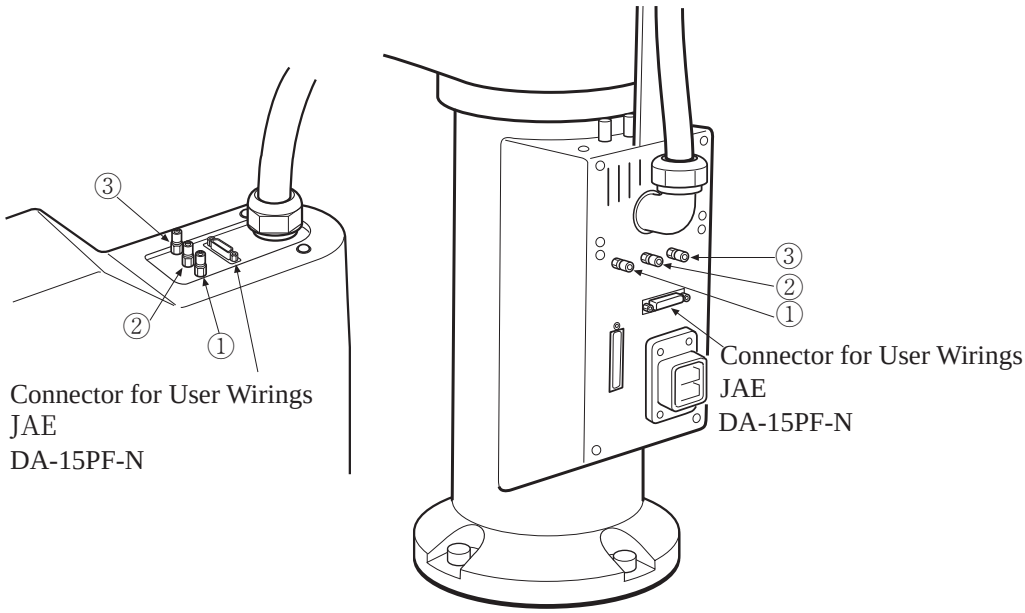


Caution

Never remove the RZ axis from the top. The ball of the ball spline will disconnect and replacement will become impossible. Special tools are required for dismantling.

2-2 User Wiring and Ducting

This device is equipped with user wiring and ducting. As indicated in the diagram below, 15 wires and 3 ø6 air tubes are connected from the connectors located on the rear panel of the base to the upper surface of the 2nd arm. These may be used in accordance with the ranges stipulated in the table below. A pair of D sub-connector for user wiring is provided as a standard accessory and is located in the mechanical accessory box.



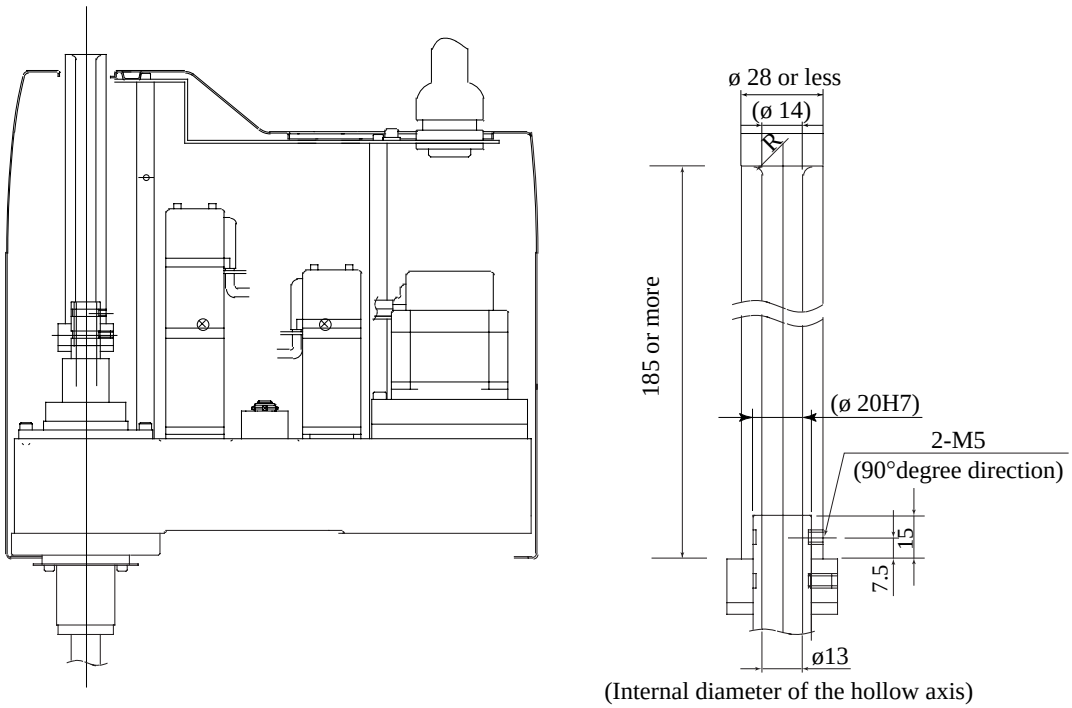
NOTE

- *User ducts must be used with 800KPa (8kgf/cm) or less.*
- *User wiring must be used within the following ranges.*

Pin number	Maximum current	Maximum voltage
1 ≀ 15	1.5A or less	DC24V or less

2-3 Hollow of the Axis for Wiring and Ducting

The RZ axis on the SRX-611 is hollow (ø13) to allow wiring and ducting to pass through. The following points must be taken into consideration during design.
The RZ axis moves 150mm up and down. Owing to this, the lowest position of the axis tip is below the cover. Attach a pole to the RZ axis' leading surface as indicated in the diagram below when using hollow wiring and ducting. Ensure that the diameter of the pole is ø28mm or less, otherwise it will react with the home position sensor and lead to mis-operations.
Also, the RZ axis rotates within a range of ± 290 degrees. In addition to providing sufficient leeway for the upper part, use cables and tubes which can endure twisting.



Pole for hollow axis wiring and ducting
(reference diagram)

Caution

Parts which protrude ø28mm or more above the top of the RZ axis will lead to mis-operations by the sensor. Ensure that designs include parts of ø28mm or less.

3. Maintenance

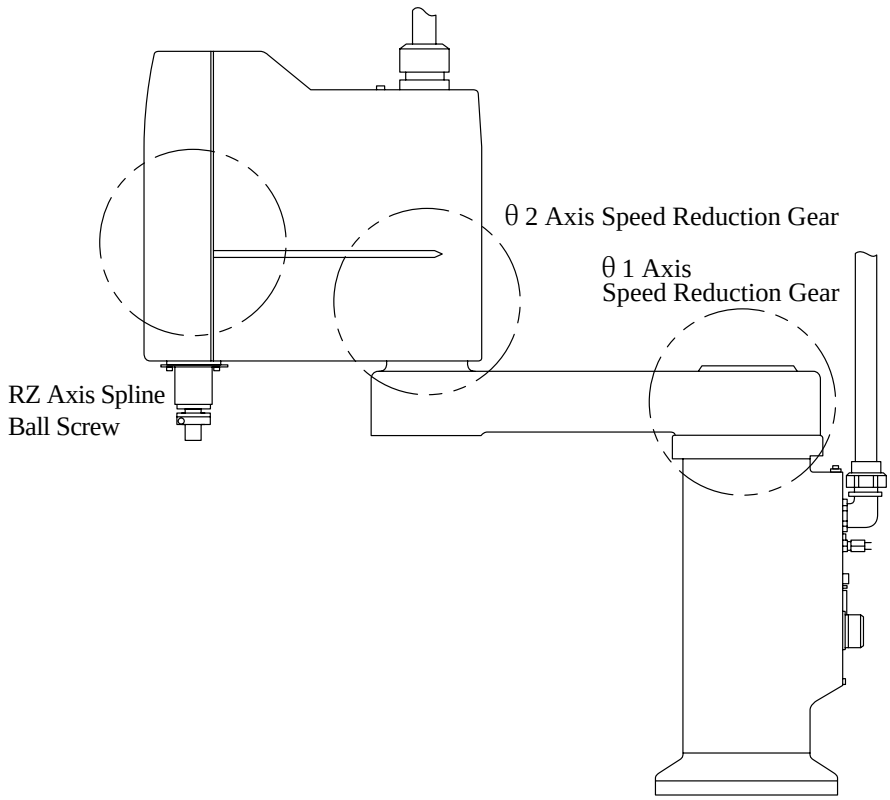
3-1 Lubrication

This device is equipped three grease lubrication areas with two on the speed reduction gear of θ1 and θ2 axis and one on the spline ball screw area. Ensure that regular maintenance is carried out based upon the following table.

Lubrication areas	Replacement yardsticks	Replacement oil (manufacturer names)	Quantity
θ1 axis speed reduction gear	8000 hours, or four years at 8 hours operation per day with 250 days per year.	Harmonic grease SK-1A (Harmonic Drive Systems)	15cc
θ2 axis speed reduction gear			13cc
RZ axis spline ball screw	Every six months	Maltemp LRL3 (Kyodo Oils)	Appropriate quantity

Caution

- *Implement an inspection three months after start of operations.*
- *It is necessary to apply appropriate quantities of lubrication and avoid dust or foreign objects becoming mixed with the oil in order to ensure high-speed and high levels of accurate operations over the long term.*
- *Confirm that foreign objects are not mixed in with the grease during lubrication.*
- *Confirm that the mains power has been switched off and the plug removed from the socket prior to starting lubrication.*



3-2 Lubricating the Speed Reduction Gear

Harmonic drives are used within the θ1 axis speed reduction gear and θ2 axis speed reduction gear. These are configured to be mechanically maintenance-free, and can be used for long periods of time (approximately 8,000 hours) without being lubricated. Observe the following points during lubrication.

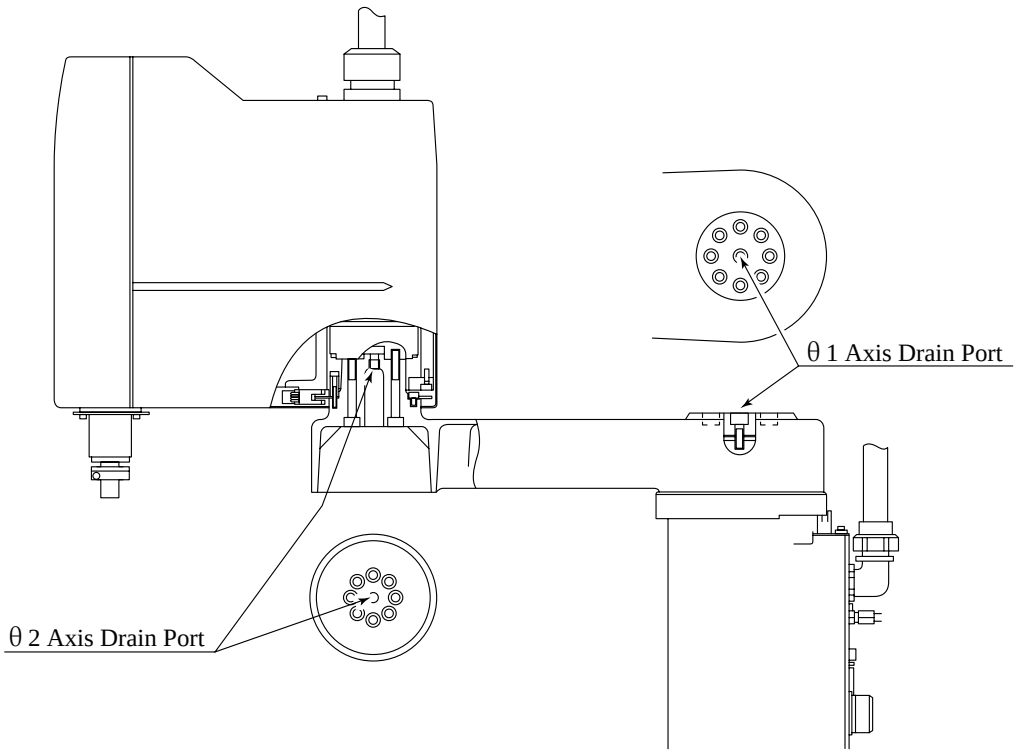
θ1 axis speed reduction gear:

The θ1 axis speed reduction gear is located at the base of the 1st arm's joint. The M10 hexagonal bolt hole in the center of the upper surface is the lubricant inlet. Remove the bolt and apply 15cc of Harmonic Grease SK-1A.

θ2 axis speed reduction gear:

The θ2 axis speed reduction gear is located at the top of the 1st arm's tip. The lubricant inlet is located on the lower surface of the tip. Remove the screw with a screwdriver and apply 13cc of Harmonic Grease SK-1A.

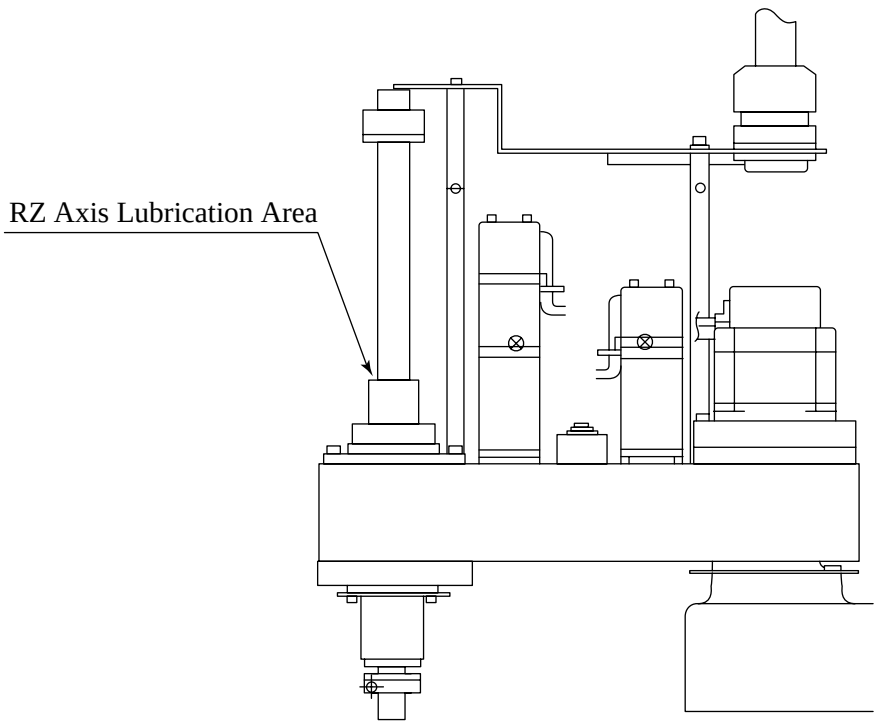
Lubrication areas	Quantity
θ1 axis speed reduction gear	15 cc
θ2 axis speed reduction gear	13 cc



3-3 Lubricating the RZ Axis

Carry out inspections and lubricate the RZ axis spline ball screw every six months in accordance with the following instructions.

① Remove the four hexagonal bolts holding the front cover of the 2nd arm in position, and pull the cover out horizontally to remove it.
② Confirm that no dust or foreign objects exist in the spline ball screw area.
③ Wipe the area with a cloth that will not generate dust of foreign objects, apply an applicable quantity of grease (Maltemp LRL3) and rub the grease equally over the area by hand.
④ Ensure that the cover is replaced in position after lubrication is complete.

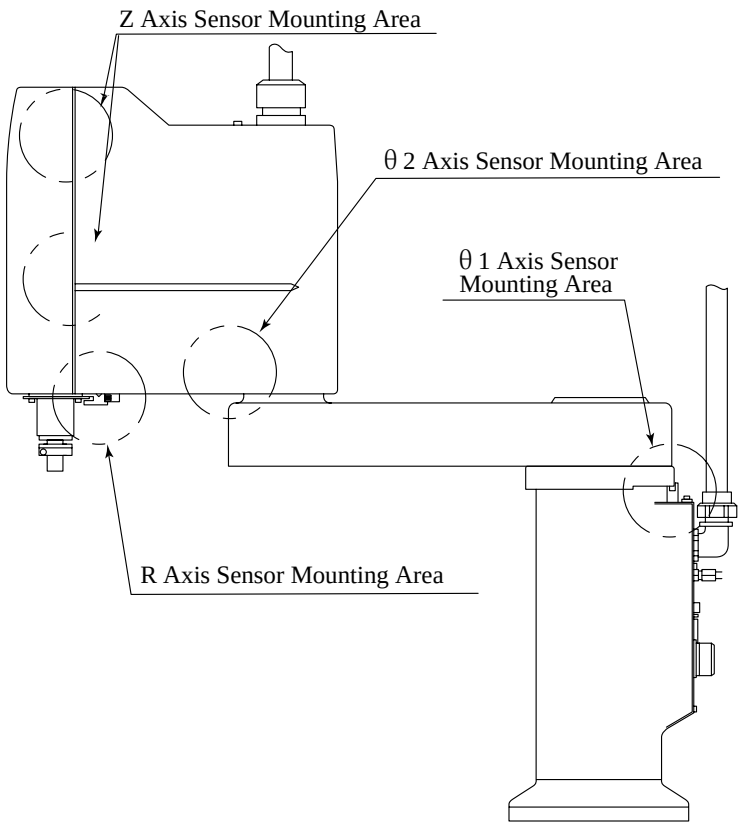


3-4 Sensors

Each robot axis is equipped with a home sensor and overrun limit sensor (excluding the R axis). Each of these sensors consists of the following configuration. The positions for attachment are indicated in the diagram below.
The sensors are adjusted in accordance with specifications prior to shipping. The robot's home position will change if the sensors are moved, so use care in handling. Consult with Sony Corporation when maintenance, such as replacement, etc., for the sensors is required.

Axis sensor table

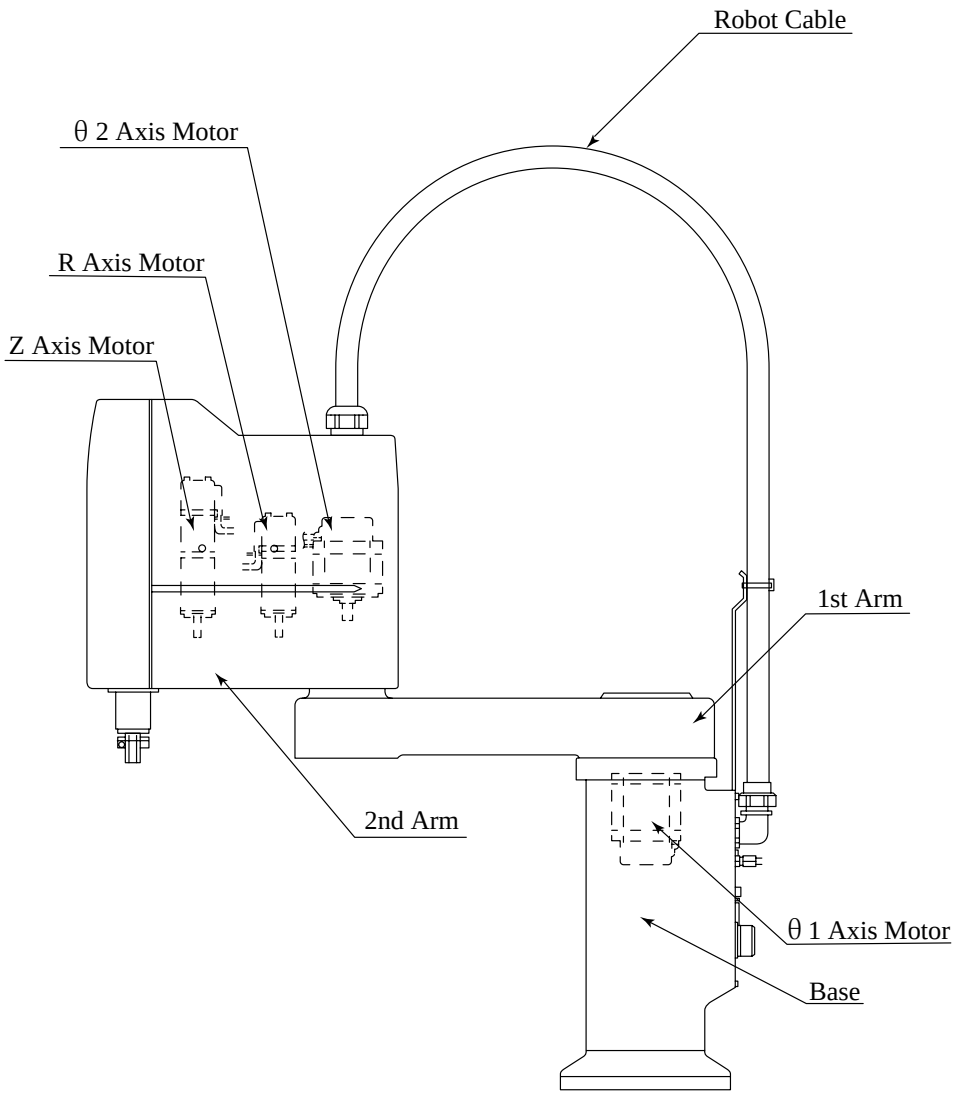
Axis	Name	Function	Model number	Manufacturer
θ1	T_1 HOME T_1 + LIMIT T_1 - LIMIT	Home position confirmation ⊕ overrun confirmation ⊖ overrun confirmation	EE-SX473	OMRON
θ2	T_2 HOME T_2 + LIMIT T_2 - LIMIT	Home position confirmation ⊕ overrun confirmation ⊖ overrun confirmation	EE-SX427	OMRON
Z	Z HOME Z + LIMIT Z - LIMIT	Home position confirmation ⊕ overrun confirmation ⊖ overrun confirmation	GXL-8FIB	SUNX
R	R HOME	Home position confirmation	EE-SX427	OMRON



3-5 Motors

This device uses the latest compact AC servo motors. Each motor has been adjusted to support the Sony SRX-C61 controller. These motors are not compatible with similar class AC servo motors available on the open market, so consult with Sony Corporation when maintenance, such as replacement, etc., for the motors is required.
The motor types and attachment positions are as follows.

Axis	Name	Output	Sony part number
θ1	AC servo motor	500W	1-698-655-12
θ2	AC servo motor	300W	1-698-656-12
Z	AC servo motor (with brakes)	100W	1-698-658-12
R	AC servo motor	100W	1-698-657-12

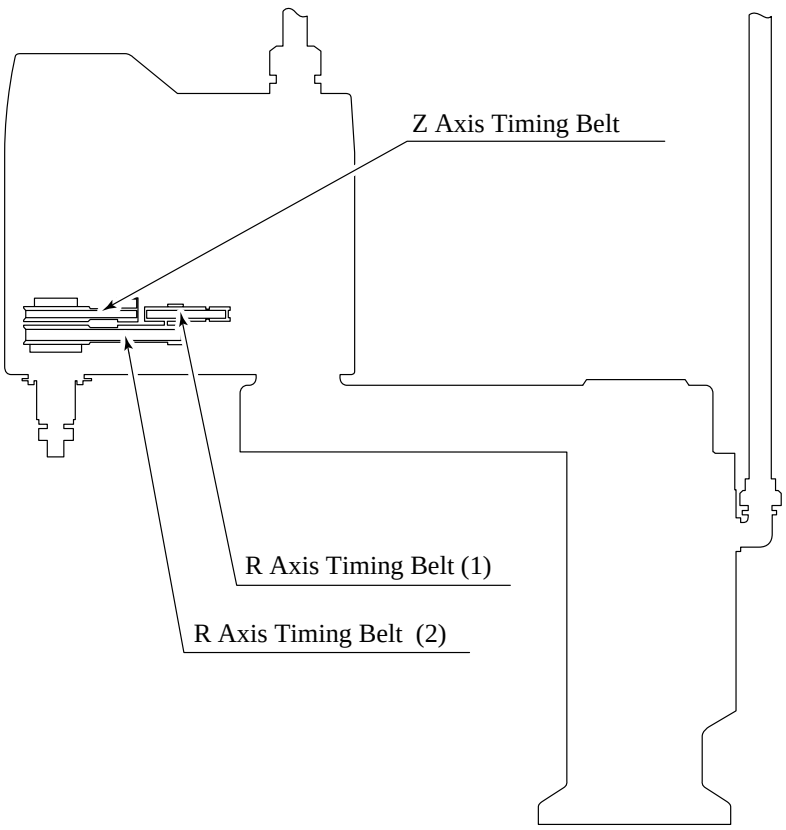


3-6 Timing Belts

A timing belt is used in this device's RZ axis drive. The appropriate amount of tension is applied to this timing belt prior to shipping in order to ensure high-speed and high levels of accurate operations for the RZ axis. If this tension is loosened, unsuitable effects will be reflected on accuracy and operations, etc. Ensure that regular inspections and adjustments are carried out in accordance with the following diagram.

Regular inspections should be implemented once every six months, and this should include visual inspections to ensure that soiling, cracking or loosening of the belt does not exists. Adjust belt tension is accordance with the instructions provided in section 3-7 if loosening is apparent. The belt must be replaced if it is cracked or damaged in any other way. Consult with Sony Corporation in this event.

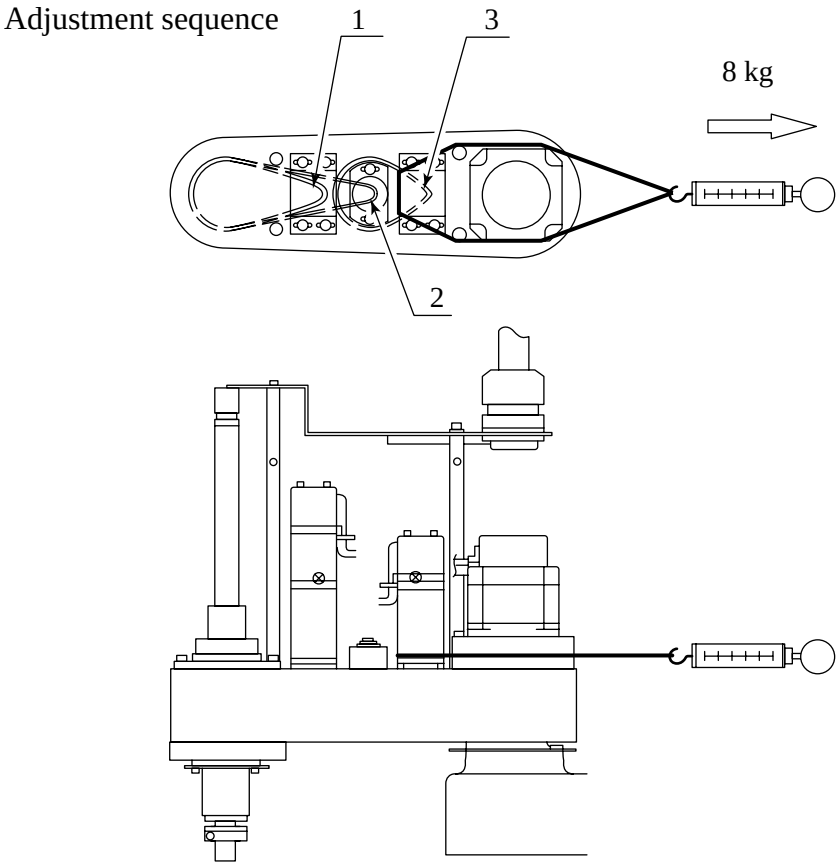
Position of usage	Sony part number	Model number	Manufacturer
1st stage of the R axis	4-712-886-01	STS 100S3M228V	Bando Chemical Industries Ltd.
2nd stage of the R axis	4-712-884-01	STS 150S3M372V	
Z axis	4-712-885-01	STS 100S3M288V	



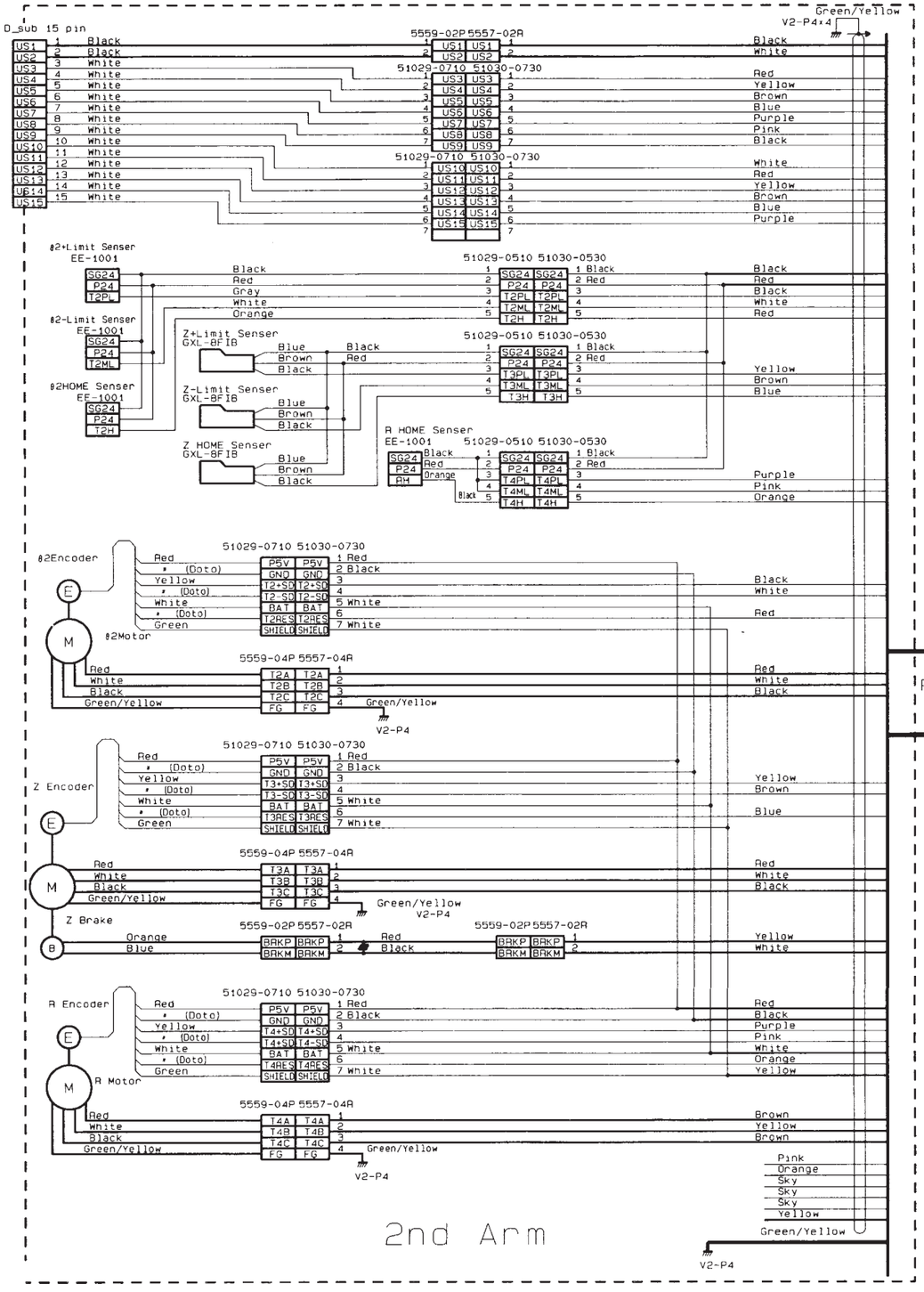
3-7 Tension Adjustment

Observe the following procedures when adjusting the timing belt:

① Remove the four M4 hexagonal bolts which hold the 2nd arm's side covers in position, and remove the cover by holding it at the bottom and pulling sideways while pressing upwards.
② Slightly loosen the screws (M5 hexagonal bolts) of the plate attached to the motor. Loosen just enough to allow the plate to be withdrawn from the gap.
③ Attach a firm length of string around the base of the motor, apply 8kg of tension to a spring balance as indicated in the diagram, and then tighten the bolts while maintaining the tension.
④ Perform the same procedure for each belt.
⑤ Replace the cover in its original position.



4. Internal Wiring Diagram



Motor drive connector MS3102A22-19P (DDK)

Pin number	Code	Name
A	T1A	Motor 1A
B	T1B	Motor 1B
C	T1C	Motor 1C
D	T2A	Motor 2A
E	T2B	Motor 2B
F	T2C	Motor 2C
G	T3A	Motor 3A
H	T3B	Motor 3B
J	T3C	Motor 3C
K	T4A	Motor 4A
L	T4B	Motor 4B
M	T4C	Motor 4C
N		
P	FG	Frame ground

(Mechanical unit side)

Feed-back connector (mechanical unit) 10268-52A2JL (3M)

Pins with inverted triangle (▽) mark			Pins with round (○) mark		
Pin number	Code	Name	Pin number	Code	Name
34	SG	Signal ground	68	SG	Signal ground
33	＋S_OPT	Serial signal option ＋	67		
32	– S_OPT	Serial signal option –	66		
31	＋S_CW/CCW	Serial signal sensor ＋	65	SG	Signal ground
30	– S_CW/CCW	Serial signal sensor –	64	SG	Signal ground
29	＋S_ABS_CLR	Serial signal ABS control ＋	63	SG	Signal ground
28	– S_ABS_CLR	Serial signal ABS control –	62	SG	Signal ground
27	＋S_CLK	Serial signal clock ＋	61	SG	Signal ground
26	– S_CLK	Serial signal clock –	60	SG	Signal ground
25	SG	Signal ground	59	SG	Signal ground
24	＋AB1	Serial signal motor 1 ＋	58	＋AB5	Serial signal motor 5 ＋
23	– AB1	Serial signal motor 1 –	57	– AB5	Serial signal motor 5 –
22	＋AB2	Serial signal motor 2 ＋	56	＋AB6	Serial signal motor 6 ＋
21	– AB2	Serial signal motor 2 –	55	– AB6	Serial signal motor 6 –
20		(Reserved)	54		(Reserved)
19		(Reserved)	53		(Reserved)
18	＋AB3	Serial signal motor 3 ＋	52	＋AB7	Serial signal motor 7 ＋
17	– AB3	Serial signal motor 3 –	51	– AB7	Serial signal motor 7 –
16	＋AB4	Serial signal motor 4 ＋	50	＋AB8	Serial signal motor 8 ＋
15	– AB4	Serial signal motor 4 –	49	– AB8	Serial signal motor 8 –
14		(Reserved)	48		(Reserved)
13		(Reserved)	47		(Reserved)
12	SG	Signal ground	46	SG	Signal ground
11	P5V	＋5V	45	P5V	＋5V
10	P5V	＋5V	44	P5V	＋5V
9	E5VBAT	Back-up 5V	43	P5V	＋5V
8	＋S_OPT1	Serial signal option 1 ＋	42	SG	Signal ground
7	SG	Signal ground	41	＋S_OPT2	Serial signal option 2 ＋
6	–S_OPT1	Serial signal option 1 –	40	– S_OPT2	Serial signal option 2 –
5	R24V	＋24V	39	R24V	＋24V
4	ROV	24V ground	38	ROV	24V ground
3	BRK1＋	Brake 1 ＋	37	BRK2＋	Brake 2 ＋
2	BRK1–	Brake 1 –	36	BRK2–	Brake 2 –
1	FG	Frame ground	35	FG	Frame ground

Error Code Guide

Error Code Guide

Error Code Lists

System Errors

E 0 0 0 : Divide error

【Contents】 The CPU executed a 0 division. The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 1 : Debug exception error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 2 : NMI Debug interruption error

【Contents】 Either the CPU board, mother board or mains power unit may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 3 : One byte interruption error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 4 : Interrupt on overflow error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 5 : Array bounds check error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

System Errors

E 0 0 6 : Invalid OP-CODE error

【Contents】 The CPU board or internal program may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 7 : FPU device not available error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 0 8 : Double fault error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 1 0 : Invalid TSS error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 1 1 : Segment not present error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 1 2 : Stack fault error

【Contents】 The CPU board or internal program may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 1 3 : General protection fault error

【Contents】 The CPU board or internal program may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

System Errors

E 0 1 4 : Page fault error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 1 6 : Coprocessor error

【Contents】 The CPU board may be considered faulty.
【Countermeasure】 Contact Sony Corporation.

E 0 3 0 : System error

【Contents】 An error occurred with the internal program.
【Countermeasure】 Contact Sony Corporation.

E 0 3 1 : System memory error

【Contents】 Insufficient work area within the internal RAM.
【Countermeasure】
1. Delete all peripheral task programs not being used.
2. Delete all variables not required by the program.
3. Contact Sony Corporation if recovery is not possible with the above two procedures.

LUNA Program Errors

E 1 0 0 : System task execution error

【Contents】 A system task program did not exist when the system task was run.
【Countermeasure】 Transfer the system task program.

E 1 1 0 : Object code error

【Contents】 A program code which cannot be interpreted exists.
【Countermeasure】 1. Check for low battery current with the diagnostic menu, and replace the battery if low current continues for several days.
2. Contact Sony Corporation if this continues to occur after the program has been re-compiled.

E 1 1 1 : System command error

【Contents】 The method of using the system task command is wrong.
【Countermeasure】 1. Confirm that an attempt has not been made to execute a command which cannot be used, apart from the movement commands, for a system task. (Serial communication commands while awaiting input, etc.)
2. Confirm that an attempt has not been made to execute a command that can only be used with system task with another task.

E 1 1 2 : Robot command error

【Contents】 An attempt was made to execute a robot task command with a peripheral task or a system task.
【Countermeasure】 Delete the robot task command and execute again.

E 1 1 3 : I/O number error

【Contents】 An unusable I/O number was used.
【Countermeasure】 Check the I/O point and ensure that no further I/O numbers are used.

LUNA Program Errors

E 1 1 4 : Point data error

【Contents】 The point data used does not exist.
【Countermeasure】 Check the existence of the point data.

E 1 1 5 : Point number error

【Contents】 The point data number specification is wrong.
【Countermeasure】 Confirm the program's point data number.

E 1 1 6 : Parameter error

【Contents】 The variable or command parameter specification is wrong.
【Countermeasure】 The parameter specification method with a variable or command is wrong and requires confirmation.

E 1 1 7 : Array number error

【Contents】 The specification of a variable array is wrong.
【Countermeasure】 Confirm the variable array.

E 1 1 8 : Integer error

【Contents】 The integer used exceeds the range of usable integers.
【Countermeasure】 Confirm the value of the integer.

E 1 1 9 : FOR loop error

【Contents】 The method of using the FOR statement is wrong.
【Countermeasure】
1. Confirm that the number of FOR statements nests does not exceed 10.
2. Confirm that the step count is not 0.
3. Confirm that the increase (decrease) of the step count is going towards the final value.
4. Confirm that a NEXT statement has not been used without a FOR loop.

LUNA Program Errors

E 1 2 0 : CALL nest error

【Contents】 The number of nests for a sub-routine exceeds 10.
【Countermeasure】 Confirm that the number of nests does not exceed 10, including sub-routines called from other sub-routines, operands and interruption functions.

E 1 2 1 : Branch error

【Contents】 The method of using the sub-routine is wrong.
【Countermeasure】
1. Confirm that an attempt is not being made to execute a sub-routine when the sub-routine has not been called.
2. Confirm that an attempt is not being made to execute a RET statement outside of a sub-routine.

E 1 2 2 : Interrupt error

【Contents】 The method of using the interruption function is wrong.
【Countermeasure】
1. Confirm that an interruption for a number not declared in an interruption sub-routine has not been authorized.
2. Confirm that a command that cannot be used within an interruption sub-routine is not being executed. (Movement command and input stand-by command, etc.)

E 1 2 3 : LN operand error

【Contents】 The method of using the LN command is wrong.
【Countermeasure】 Confirm that the LN command parameter is not below zero.

E 1 2 4 : SQRT operand error

【Contents】 The method of using the SQRT command is wrong.
【Countermeasure】 Confirm that the SQRT command parameter is not below zero.

LUNA Program Errors

E 1 3 0 : Axis 1 robot limit error

【Contents】 The 1st axis destination point is outside the robot's range of operations.
【Countermeasure】 Confirm the destination point.

E 1 3 1 : Axis 2 robot limit error

【Contents】 The 2nd axis destination point is outside the robot's range of operations.
【Countermeasure】 Confirm the destination point.

E 1 3 2 : Axis 3 robot limit error

【Contents】 The 3rd axis destination point is outside the robot's range of operations.
【Countermeasure】 Confirm the destination point.

E 1 3 3 : Axis 4 robot limit error

【Contents】 The 4th axis destination point is outside the robot's range of operations.
【Countermeasure】 Confirm the destination point.

E 1 3 4 : Axis 1 system limit error

【Contents】 The 1st axis destination point is outside the system limits.
【Countermeasure】 1. Confirm the system limits.
2. Confirm the destination point.

E 1 3 5 : Axis 2 system limit error

【Contents】 The 2nd axis destination point is outside the system limits.
【Countermeasure】 1. Confirm the system limits.
2. Confirm the destination point.

LUNA Program Errors

E136 : Axis 3 system limit error

【Contents】 The 3rd axis destination point is outside the system limits.
【Countermeasure】 1. Confirm the system limits.
2. Confirm the destination point.

E137 : Axis 4 system limit error

【Contents】 The 4th axis destination point is outside the system limits.
【Countermeasure】 1. Confirm the system limits.
2. Confirm the destination point.

E138 : Axis 1 point limit error

【Contents】 The 1st axis destination point is outside the point limits.
【Countermeasure】 1. Confirm the point limits.
2. Confirm the destination point data.

E139 : Axis 2 point limit error

【Contents】 The 2nd axis destination point is outside the point limits.
【Countermeasure】 1. Confirm the point limits.
2. Confirm the destination point data.

E140 : Axis 3 point limit error

【Contents】 The 3rd axis destination point is outside the point limits.
【Countermeasure】 1. Confirm the point limits.
2. Confirm the destination point data.

E141 : Axis 4 point limit error

【Contents】 The 4th axis destination point is outside the point limits.
【Countermeasure】 1. Confirm the point limits.
2. Confirm the destination point data.

PLC Program Errors

E 2 0 0 : PLC program code error

【Contents】 A program code which cannot be interpreted exists in the PLC program.
【Countermeasure】
1. Check for low battery current with the diagnostic menu, and replace the battery if low current continues for several days.
2. Contact Sony Corporation if this continues to occur after the program has been re-compiled.

E 2 0 1 : PLC CGET channel error

【Contents】 The specified reading channel exceeds 255 in the PLC program's CGET command.
【Countermeasure】 255 is exceeded when an offset count (2nd parameter) is added to the CGET command's standard channel number (1st parameter). As the maximum channel number allowed is 255, amend the program to fit within this range. Special care should be taken when a channel is used within an offset count (2nd parameter) and the channel value is offset.

E 2 0 2 : PLC CSET channel error

【Contents】 The specified writing channel exceeds 255 in the PLC program's CSET command.
【Countermeasure】 255 is exceeded when an offset count (2nd parameter) is added to the CSET command's standard channel number (1st parameter). As the maximum channel number allowed is 255, amend the program to fit within this range. Special care should be taken when a channel is used within an offset count (2nd parameter) and the channel value is offset.

E 2 0 3 : PLC BGET bit num error

【Contents】 The specified bit number exceeds the 0 - 15 range in the PLC program's BGET command.
【Countermeasure】 The BGET command's 2nd parameter is indicated by the bit number, so amend the program so the value is within the 0 - 15 range. Special care should be taken when a channel is used within the 2nd parameter and the channel value is used as a bit number.

PLC Program Errors

E 2 0 4 : PLC BSET bit num error

【Contents】 The specified bit number exceeds the 0 - 15 range in the PLC program's BSET command.

【Countermeasure】 The BSET command's 2nd parameter is indicated by the bit number, so amend the program so the value is within the 0 - 15 range. Special care should be taken when a channel is used within the 2nd parameter and the channel value is used as a bit number.

Robot Control Errors

E 3 0 0 : Emergency stop error

【Contents】 The emergency stop mode has been entered.
【Countermeasure】 1. Cancel the controller's emergency stop switch.
2. Cancel the teaching pendant's emergency stop switch.
3. Connect the emergency stop's input contact point.

E 3 0 1 : Axis 1 limit sensor error

【Contents】 The 1st axis has entered the limit sensor.
【Countermeasure】 1. Confirm that the teaching position is not too close to the limit sensor.
2. Confirm limit sensor input with the diagnostic menu. It may be assumed that the sensor signal line is disconnected if the operational boundary is not adjacent, but the limit sensor is ON.

E 3 0 2 : Axis 2 limit sensor error

【Contents】 The 2nd axis has entered the limit sensor.
【Countermeasure】 1. Confirm that the teaching position is not too close to the limit sensor.
2. Confirm limit sensor input with the diagnostic menu. It may be assumed that the sensor signal line is disconnected if the operational boundary is not adjacent, but the limit sensor is ON.

E 3 0 3 : Axis 3 limit sensor error

【Contents】 The 3rd axis has entered the limit sensor.
【Countermeasure】 1. Confirm that the teaching position is not too close to the limit sensor.
2. Confirm limit sensor input with the diagnostic menu. It may be assumed that the sensor signal line is disconnected if the operational boundary is not adjacent, but the limit sensor is ON.

E 3 0 4 : Axis 4 limit sensor error

【Contents】 The 4th axis has entered the limit sensor.
【Countermeasure】 1. Confirm that the teaching position is not too close to the limit sensor.
2. Confirm limit sensor input with the diagnostic menu. It may be assumed that the sensor signal line is disconnected if the operational boundary is not adjacent, but the limit sensor is ON.

E 3 0 5 : Barrier switch error

【Contents】 The barrier switch was switched off when in the execution mode.
【Countermeasure】 Connect the barrier switch's contact point.

E 3 0 6 : TP safety switch error

【Contents】 The teaching pendant's (TP) safety switch was switched off when in the execution mode.
【Countermeasure】 As the device conforms to overseas safety stipulations, an error will be triggered when the teaching pendant's (TP) safety switch has not been pressed when in the execution mode.

E 3 0 7 : PC safety switch error

【Contents】 The PC safety box's safety switch was switched off when in the execution mode.
【Countermeasure】 As the device conforms to overseas safety stipulations, an error will be triggered when the PC safety box's safety switch has not been pressed when in the execution mode.

Robot Control Errors

E 3 1 0 : SERVO Axis 1 torque limit error

【Contents】 The 1st axis load exceeded limits.
【Countermeasure】 Indicates that the torque command value for the servo amplifier has exceeded specified limit ranges during calculation in the servo board, which is composed of position and speed control programs.

The reason for this could be any of the following:

1. Mechanical loads have been exceeded
   Grease temperature in the speed reducer, quantity of grease, or a mechanical fault in the speed reducer.
   Re-confirm the structure of the robot in this event. This confirmation is especially necessary when mechanical impact has occurred.

2. Electrical connections
   Fault in the power cable between the controller and robot.
   Fault in the wiring within the robot.
   Confirm the condition of the power cable and the connection of all connectors used for internal wiring, especially when an impact has occurred. The chance of the fault being electrical is large when errors are continually triggered when the servo is turned ON after the initial error has occurred.

3. Workload
   A workload exceeding limits has been carried.
   Confirm that a workload that exceeds robot specifications has not been carried. If there are certain work processes where this kind of workload must be carried, it is necessary to reduce the speed of operation to a level where the error is not triggered.

E 3 1 1 : SERVO Axis 2 torque limit error

【Contents】 The 2nd axis load exceeded limits.
【Countermeasure】 Process in the same manner as explained in E310.

E 3 1 2 : SERVO Axis 3 torque limit error

【Contents】 The 3rd axis load exceeded limits.
【Countermeasure】 Process in the same manner as explained in E310.

E 3 1 3 : SERVO Axis 4 torque limit error

【Contents】 The 4th axis load exceeded limits.
【Countermeasure】 Process in the same manner as explained in E310.
In addition to workload, it is necessary to consider inertia.

E 3 1 4 : SERVO Axis 1 position error

【Contents】 The target position value for the 1st axis is abnormal.
The servo board acquires the position target for each unit of time from the higher-level CPU board. An abnormality is determined and operations stopped with an error when this value does not arrive within the time unit, even when the maximum speed of the motor defined by each axis is issued.
There is a good chance that the following LUNA program statements are responsible in this situation.

1. The FOS value is too large
   An excessive speed command is issued when the position points are aligned in the same direction, a large FOS value is added and a double positioning operation overruns.
2. The operational route specified within the program is incorrect.
   An error exists within the order of the positioning statements, which may lead to the situation explained in 1.
3. When an error in which the first and last R axis coordinates in the interpolating command are different has occurred in the 4th axis.

【Countermeasure】 Program statements or teaching should be performed again in accordance with the likely-hood of the above causes.

Robot Control Errors

E315 : SERVO Axis 2 position error

【Contents】 The target position value for the 2nd axis is abnormal.
【Countermeasure】 Process in the same manner as explained in E314.

E316 : SERVO Axis 3 position error

【Contents】 The target position value for the 3rd axis is abnormal.
【Countermeasure】 Process in the same manner as explained in E314.

E317 : SERVO Axis 4 position error

【Contents】 The target position value for the 4th axis is abnormal.
【Countermeasure】 Process in the same manner as explained in E314.

E318 : SERVO CPU Communication error

【Contents】 A communication error has occurred in the CPU board and servo board. Communication is carried out between the CPU board and the servo board at regular intervals, but an error will be triggered if discrepancies exist in the software communication flags.
【Countermeasure】 Confirm that the connection between the mother board and the servo board is firm if a watchdog timer error has not occurred in the CPU board.

E319 : SERVO program error

【Contents】 The servo board's program is not operating normally.
【Countermeasure】 Contact Sony Corporation after checking the status.

Robot Control Errors

E 3 2 0 : AMP Axis 1 current error

【Contents】 A current exceeding set permissible currents has occurred in the motor drive.
Indicates that a current exceeding the maximum limits for a given time set with the software has been detected in the AC servo amplifier by the software.
The cause of this is the same for errors E310 - E313, and means that a load heavier than normal has been applied. For example, it may be assumed that a workload heavier than standard loads has been handled.
There is also a slight change that, as the maximum current limits are set in accordance with device type, the error has been triggered by drive operations being performed by a controller set for a different device.

【Countermeasure】 Confirm that the load being carried does not exceed limits. Reduce the speed of operations if the load is considered to be large. It is also necessary to consider the combination of controller and robot.

E 3 2 1 : AMP Axis 2 current error

【Contents】 A current exceeding set permissible currents has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E320.

E 3 2 2 : AMP Axis 3 current error

【Contents】 A current exceeding set permissible currents has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E320.

E 3 2 3 : AMP Axis 4 current error

【Contents】 A current exceeding set permissible currents has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E320.

Robot Control Errors

E 3 2 4 : AMP Axis 1 speed error

【Contents】 A speed exceeding set permissible speeds has occurred in the motor drive.
Indicates that a speed exceeding the maximum permissible parameters set with the software has occurred in the AC servo amplifier.
The reason for the robot arm operating at excessive speeds is that excessive current has been supplied to the motor regardless of software commands, and there is a high chance of this error being triggered when this fatal fault arises. There are also cases when this error will be triggered even though excessive speeds are not apparent in the robot arm. This is owing to the fact that a fault has occurred in the encoder feed-back line between the robot and the controller, and the occurrence of excessive speeds has been determined through disturbances in the encoder signals.

【Countermeasure】 Confirm the wiring, including the encoder feed-back line, in the robot. It is also necessary to consider the combination of controller and robot.

E 3 2 5 : AMP Axis 2 speed error

【Contents】 A speed exceeding set permissible speeds has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E324.

E 3 2 6 : AMP Axis 3 speed error

【Contents】 A speed exceeding set permissible speeds has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E324.

E 3 2 7 : AMP Axis 4 speed error

【Contents】 A speed exceeding set permissible speeds has occurred in the motor drive.

【Countermeasure】 Process in the same manner as explained in E324.

E 3 2 8 : AMP Axis 1 rated current error

【Contents】 The R.M.S. current value exceeds motor stipulations.
An error in the AC servo amplifier's R.M.S. current value triggered by the electrical thermal detector calculated with software. The actual temperature of the motor will exceed motor stipulations if the R.M.S. current value is increased. This indicates that robot movement during operations exceeds the permissible limits of the motor.
【Countermeasure】 Reduce speed and stop the program at an appropriate location. Or, extend the stop time of the current program and reduce the R.M.S. current value.

E 3 2 9 : AMP Axis 2 rated current error

【Contents】 The R.M.S. current value exceeds motor stipulations.
【Countermeasure】 Process in the same manner as explained in E328.

E 3 3 0 : AMP Axis 3 rated current error

【Contents】 The R.M.S. current value exceeds motor stipulations.
【Countermeasure】 Process in the same manner as explained in E328.

E 3 3 1 : AMP Axis 4 rated current error

【Contents】 The R.M.S. current value exceeds motor stipulations.
【Countermeasure】 Process in the same manner as explained in E328.

E 3 3 2 : AMP Axis 1 encoder break error

【Contents】 Connection problems in the encoder line.
This error is confirmed during initial status detection when the mains power is switched on.
Excessive load errors, etc., will stop operations when a faulty encoder line occurs during operations. If this error is triggered the next time the mains power is switched on, it proves that the cause is a break in the encoder connection.
【Countermeasure】 Confirm the robot's encoder line.

Robot Control Errors

E 3 3 3 : AMP Axis 2 encoder break error

【Contents】 Connection problems in the encoder line.
【Countermeasure】 Process in the same manner as explained in E332.

E 3 3 4 : AMP Axis 3 encoder break error

【Contents】 Connection problems in the encoder line.
【Countermeasure】 Process in the same manner as explained in E332.

E 3 3 5 : AMP Axis 4 encoder break error

【Contents】 Connection problems in the encoder line.
【Countermeasure】 Process in the same manner as explained in E332.

E 3 3 6 : AMP Axis 1 IPM error

【Contents】 An IPM (Intelligent Power Module) error.
An error which occurs in the AC servo amplifier's drive module when the temperature and excessive electricity supply detection, etc., is OR.
【Countermeasure】 There is a chance that this will occur when the surrounding temperature is high. In this event, clean the internal ventilation inlets and outlets, and re-inspect the installation location. There is also the chance that the module within the AC servo amplifier is faulty, so contact Sony Corporation.

E 3 3 7 : AMP Axis 2 IPM error

【Contents】 An IPM (Intelligent Power Module) error.
【Countermeasure】 Process in the same manner as explained in E336.

E 3 3 8 : AMP Axis 3 IPM error

【Contents】 An IPM (Intelligent Power Module) error.
【Countermeasure】 Process in the same manner as explained in E336.

E 3 3 9 : AMP Axis 4 IPM error

【Contents】 An IPM (Intelligent Power Module) error.
【Countermeasure】 Process in the same manner as explained in E336.

E 3 4 0 : AMP WDT error

【Contents】 A watchdog timer error in the AC servo amplifier.
A watchdog timer error in the micro-computer built into the AC servo amplifier. Indicates that the micro-computer operations are faulty.
【Countermeasure】 The AC servo amplifier may be considered faulty, so contact Sony Corporation.

E 3 4 1 : AMP Ready error

【Contents】 Occurs when initialization is not completed after the mains power to the AC servo amplifier is switched on.
【Countermeasure】 The AC servo amplifier may be considered faulty, so contact Sony Corporation.

E 3 4 2 : AMP Main power error

【Contents】 Fluctuations occurred in the AC servo amplifier's main circuit voltage. Triggered when fluctuations occur in the AC servo amplifier's main circuit voltage that exceed 10% of standard voltage.
【Countermeasure】 Confirm the robot controller's power line.

Robot Control Errors

E 3 5 0 : ABE Axis 1 encoder thermal error

【Contents】 Indicates that the temperature of the motor or encoder is rising.
Rises in motor and encoder temperatures are acquired by the sensor located within the encoder. This error is triggered when the load on the motor is severe owing to operations of the axis in which the error occurred, and when the temperature of the surrounding atmosphere is abnormal.

【Countermeasure】 As this error is the result of actual temperature, it is necessary to wait until the temperature has dropped. The surrounding environment should also be considered.

E 3 5 1 : ABE Axis 2 encoder thermal error

【Contents】 Indicates that the temperature of the motor or encoder is rising.
【Countermeasure】 Process in the same manner as explained in E350.

E 3 5 2 : ABE Axis 3 encoder thermal error

【Contents】 Indicates that the temperature of the motor or encoder is rising.
【Countermeasure】 Process in the same manner as explained in E350.

E 3 5 3 : ABE Axis 4 encoder thermal error

【Contents】 Indicates that the temperature of the motor or encoder is rising.
【Countermeasure】 Process in the same manner as explained in E350.

E 3 5 4 : ABE Axis 1 encoder backup error

【Contents】 Triggered when switching the back-up voltage for the absolute encoder. This occurs when rapid acceleration is received during encoder back-up and a fault arises in the back-up count. (The arm impacting with obstacles.)

【Countermeasure】 Maintain the encoder's mains power supply when problematic rapid acceleration occurs.
Perform home return when this error is triggered.

E355 : ABE Axis 2 encoder backup error

【Contents】 Triggered when switching the back-up voltage for the absolute encoder.
【Countermeasure】 Process in the same manner as explained in E354.

E356 : ABE Axis 3 encoder backup error

【Contents】 Triggered when switching the back-up voltage for the absolute encoder.
【Countermeasure】 Process in the same manner as explained in E354.

E357 : ABE Axis 4 encoder backup error

【Contents】 Triggered when switching the back-up voltage for the absolute encoder.
【Countermeasure】 Process in the same manner as explained in E354.

E358 : ABE Axis 1 encoder power error

【Contents】 All mains power sources used by the absolute encoder are low.
Triggered when the mains power normally used by the absolute encoder's encoder and back-up is low (3.6V or less for both). In more detail, this error can occur in any of the following situations:

1. Back-up voltage dropped during back-up.
2. When the mains power for the encoder is switched on.
3. When the resistance value of the feed-back cable is high (effected by surrounding temperature, etc.)

【Countermeasure】 Low battery voltage or faulty connections can be assumed for cases 1 and 2. Confirm the battery harness in the controller and replace if necessary.
In the case of 3, ensure that the temperature of the surrounding environment is appropriate and that the correct length feed-back cable is being used between the controller and the robot.
Perform home return when this error is triggered.

E359 : ABE Axis 2 encoder power error

【Contents】 All mains power sources used by the absolute encoder are low.
【Countermeasure】 Process in the same manner as explained in E358.

Robot Control Errors

E 3 6 0 : ABE Axis 3 encoder power error

【Contents】 All mains power sources used by the absolute encoder are low.
【Countermeasure】 Process in the same manner as explained in E358.

E 3 6 1 : ABE Axis 4 encoder power error

【Contents】 All mains power sources used by the absolute encoder are low.
【Countermeasure】 Process in the same manner as explained in E358.

E 3 8 0 : SERVO CPU WDT error

【Contents】 The servo board has detected a CPU WDT error.
【Countermeasure】 The CPU board or servo board may be assumed as faulty. Contact Sony Corporation.

E 3 8 1 : SERVO trap error

【Contents】 An incorrect interruption arrived in the servo board
【Countermeasure】 The servo board or servo program may be assumed as faulty. Contact Sony Corporation.

E 3 8 2 : SERVO P/S interface error

【Contents】 An operational fault occurred in the sensor information communication board.
【Countermeasure】 Contact Sony Corporation.

E 4 0 0 : SPD over speed error

【Contents】 The robot operates at the speed higher than the safety operation speed during teaching mode or continuous mode.
【Countermeasure】 Operation error occurs in the robot due to broken encoder signal line, etc. Perform “Diagnostics” and check that the encoder signals of each motor are counted correctly in the “SENSOR & CNT” mode. (Refer to Operation Guide page 5-44.)

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Appendix

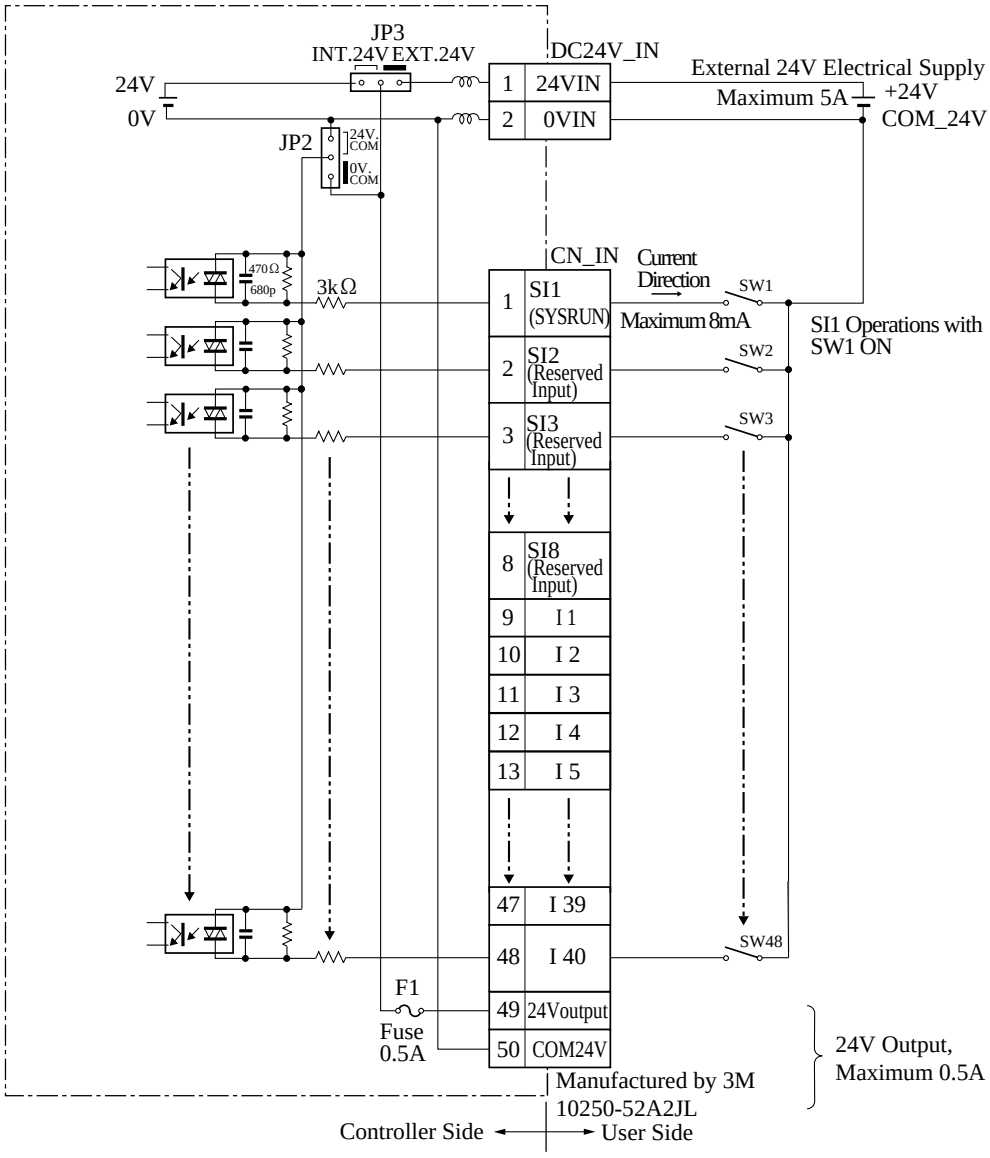
Appendix

I/O Circuits using the NPN logic

NPN logic I/O Boards and I/O Connectors

(1) Input Circuit, CN_IN

External 24V supply, OV common specification (standard settings)



Jumper Settings

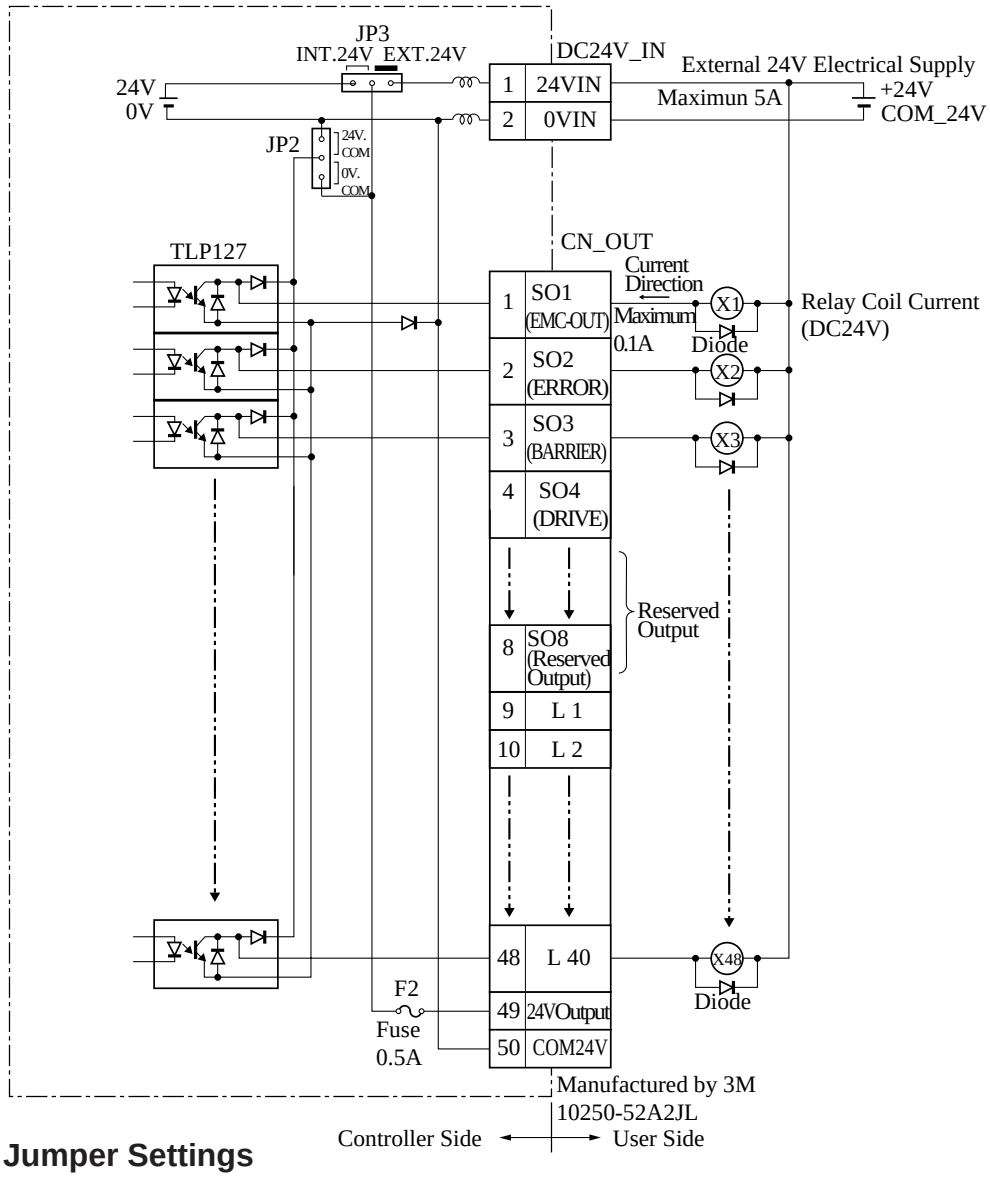
- JP2: Short on the 0V.COM side
- JP3: Short on the EXT.24V side

*1. JP2: 24V common specification with short on the 24V.COM side

*2. JP3: An internal DC24V power supply can be used with short on the INT.24V side

(2) Output Circuit, CN_OUT

External 24V supply (standard settings)



Jumper Settings

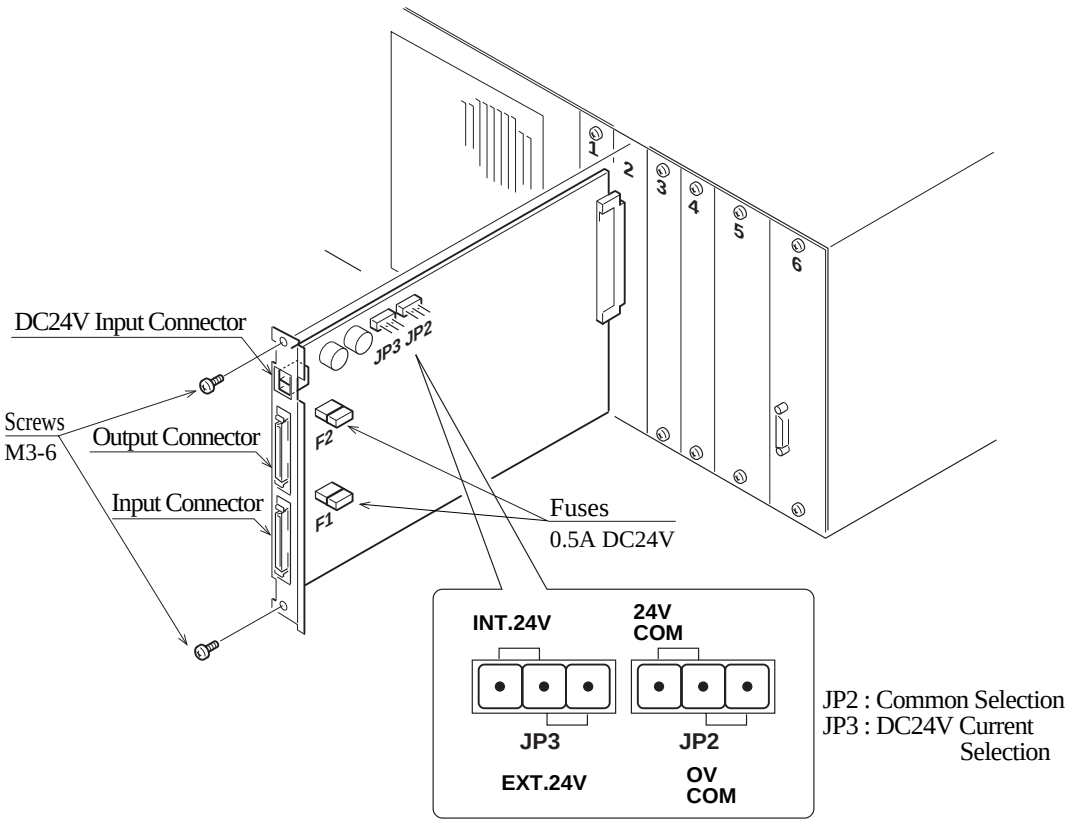
- JP3: Short on the EXT.24V side
  *1. JP2 settings are for input.
  *2. JP3 settings are the same as input.

NOTE

- *Add a diode as indicated above when the output load is to be connected to the relay coil.*
- *The F1 and F2 fuses will blow is a current of 0.5A or more is used with a 24V output. Ensure that the fuses stipulated are used.*
  Fuse: 0.5ADC48V, Model: LM05, Manufacturer: Daito Communication Apparatus Co., Ltd.

(3) Fuses and jumpers

The F1 and F2 fuses, and the JP2 and JP3 jumpers are located on the standard I/O board as indicated in the following diagram and will require replacement in accordance with necessity.



Setting the JP2 and JP3 Jumpers

NPN logic I/O Board (rear panel)

Supply Period of Repair Parts

The functional repair parts (parts needed to maintain product performance) of this machine will be supplied for up to ten years in principle after production is discontinued.

Because it may be possible to repair the machines depending upon the location of the problem even after this period, consult the service or sales representative from where you purchased the machine.

Contact : Sony Electronics Inc. Service Department

New York Telephone : 914-365-6000 Fax : 914-365-6087

San Diego Telephone : 619-673-2701 Fax : 619-674-1853

Sony Precision Engineering Center Pte Ltd.

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