

HD-3814E-3
3

ROBOT CONTROLLER USER'S GUIDE



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HNC-544
USER'S GUIDE (HD-3814E-3)

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CHAPTER 1 INTRODUCTION

1.1 General

This manual describes the controller HNC-544 which controls AC servo motor from 1 to 4 axes.

Position data of robot can be entered by optional Teach Pendant. Manual Data Input (MDI) by numeric keys and teaching/Off-line programming is available as entering method of the data.

Automatic operation executed to confirm the programmed positions in CHECK mode using the Teach Pendant after entering the position data. Refer to separate volume of "OPERATION MANUAL" for the detail to use of the Teach Pendant

HNC controller performs automatic operation by exchanging the signals with an external programmable controller through DI/DO interface.

Read carefully before use of this machine.

1.2 Notice on Operation

- (1) Before switch on the main power, confirm all the cable between the robot and the controller are firmly connected. Also, confirm the cable connection for Emergency Stop connector.
- (2) Do not use the controller at higher than 50 deg. C and high humidity. The surroundings must be no dust, no smoke, no combustion, and no corrosion.
- (3) Confirm the operation conditions, such as power supply frequency or dielectric strength, and use the robot in the specified conditions.
- (4) Do not operate the robot except as described in the instruction manual for avoiding the wrong movement of the robot.
- (5) The robot must be operated by a trained person.
- (6) Before operating the robot, make sure all the personnel and obstructions are outside of the maximum reach of the robot.
- (7) During teaching or maintenance of the robot, put a warning sign saying "The robot is in use. Do not touch it." around the robot.
- (8) Do not drop or throw the Teach Pendant. Do not carry the Teach Pendant by holding its cable. Hold the Teach Pendant body firmly.
- (9) Dead-man switch is attached on the Teach Pendant for the safety of the robot operator. Therefore, do not lock the dead-man switch by tape and so on. This switch works in TEACH mode and CHECK mode. In case the dead-man switch is not pressed, the robot is in emergency stop status and does not move.

- (10) Before performing the automatic operation, confirm the location of Emergency Stop (E.S.) button. The controller provided with an external connector for E.S. signal, and the Teach Pendant is provided with E.S. button. Put the controller to the position you can press or input E.S. immediately upon occurrence of abnormal status of the robot.
- (11) Do not enter the working area of the robot during automatic operation.
- (12) Before starting the automatic operation, confirm the peripheral devices are ready to start.
- (13) The controller is equipped with self-diagnosis function. When abnormal states occur, the contents of the states are displayed on the Teach Pendant. Restore the robot according to this manual. (If overrun occurs during automatic operation, the code according to the error is output.)
- (14) Dust filter replacement (if necessary)

The controller is cooled by forced air circulation. The controller cabinet is provided with a dust filter at air intake and exhaust ports. If the dust filter is clogged, air intake will be hampered and cause overheating. This can produce erratic behavior in the robot. Replace the dust filter depends on the environment the controller is used.

Check it regularly every one or two weeks at dusty place or at least once a month in normal situation. In case the filter is dirty, clean it by detaching the filter cover from the controller.

- (15) Servo driver inspection

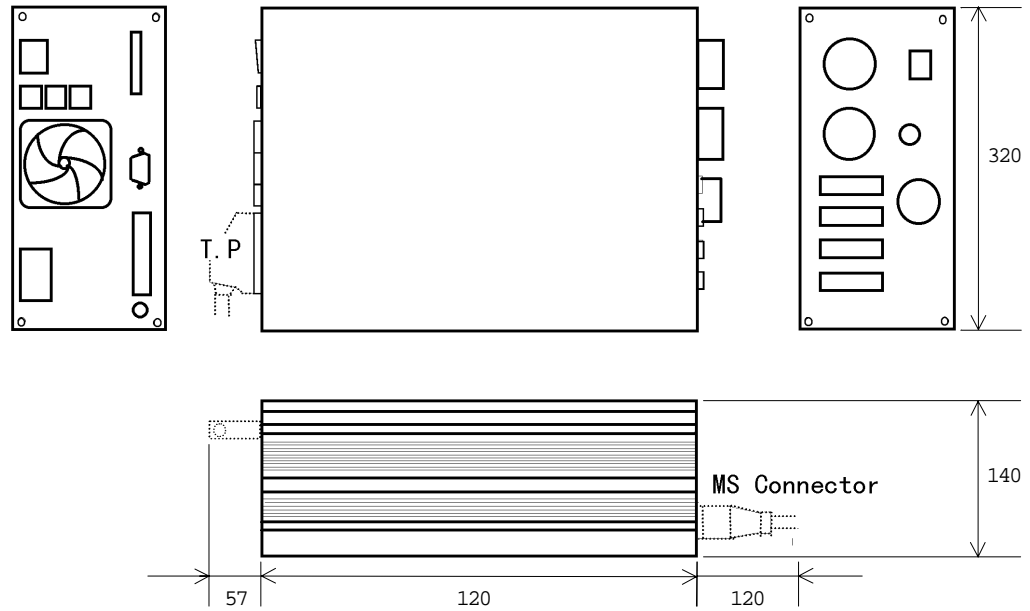
Servo drivers are adjusted before shipment of the robot. However, if the conditions of using robot is changed, noise or error may happen. Adjust the trimmers on servo driver. Refer to later chapter for detail.



Do not touch the controller enclosure at least five minutes after unplugged.
This may hurt the operator by high voltage.

CHAPTER 2 SPECIFICATIONS

2.1 Dimensions



Consider the space for the Teach Pendant and MS connectors.

Fig. 2.1 HNC-544 Dimensions

2.2 Weight

HNC-544 : 12.5 kg

2.3 Cooling

The controller is cooled by forced air circulation. The locations of the air intake and exhaust openings are shown in below.

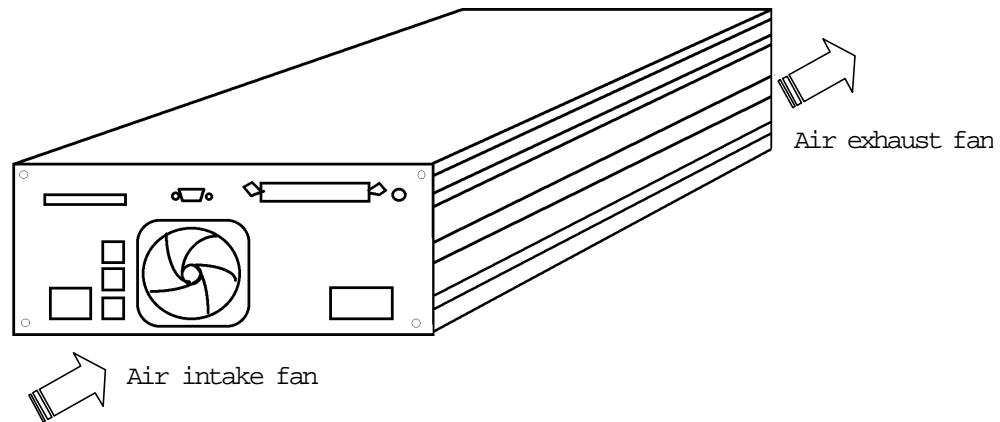


Fig. 2.2 Cooling Method



CAUTION

At least 30cm clearance must be reserved in front of the air intake and exhaust

2.4 Power Supply

Table 2.1 Power Supply

| | |
|---------------|----------------------------|
| Primary power | Single phase AC200V (±10%) |
| Frequency | 50Hz/60Hz |



CAUTION

Do not touch the controller enclosure at least five minutes after unplugged. This may hurts the operator by high voltage.

The power cable is attached when factory shipment. Connect the AC power supply to light blue and brown lines. The spiral of yellow and green lines is connected to the controller cabinet. Connect this line to the earth.

2.5 Environmental and Facility Requirements

Table 2.2 Facility Ambient Air Quality

| | |
|-------------------|--|
| Temperature | -15 -60 (at storage) 5 -40 (during operation) |
| Relative humidity | 10%-90% (at storage) non-condensing 20%-80% (during operation) non-condensing |
| Vibration | Maximum 0.5G, 120Hz continuous (during operation) |

2.6 Specifications

Table 2.3 Specifications

| Item | Specifications |
|-------------------------------|--|
| Applicable robot | Cartesian type robot, SCARA type robot, etc. |
| Control axis | 1 to 4 axes |
| Control method | Numeric control by microprocessor. |
| Positioning method | PTP: Gate motion, Arch motion, Insert motion, Pass motion etc. CPC: Linear interpolation, Circular interpolation |
| Number of programmed position | 1,000 points (max. 2,500 points: with an optional memory card) |
| Memory back-up | Battery back-up by C-MOS-RAM Memory back-up by optional memory card |
| Programming resolution | 0.01mm |
| Operation mode | KEY-IN, RO-TECH, LI-TEACH, CHECK, AUTO |
| External interface | Input : SELECT, START, NEXT, POS/INCHING, STOP, HOLD, Address number Output : READY, ERROR, PCA, BP, ZONE, CPOUT, A-CAL, M-data RS-232C 1,200bps, 2,400bps, 4,800bps, 9,600bps |
| Data input | MDI system and teaching system by optional Teach Pendant. Data load from optional memory card Data communication by optional HRCS through RS-232C |

CHAPTER 3 Hardware Composition

3.1 Outside Structure

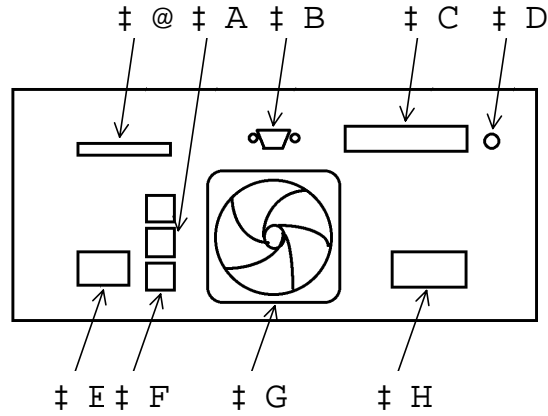


Fig.3.1 Front Panel

Table 3.1 Parts List

| No. | Item |
|-----|-----------------------------|
| | Memory card port |
| | DC24V power fuse holder |
| | Serial I/F connector |
| | Teach Pendant I/F connector |
| | Pendant remove switch |
| | Power switch |
| | AC power fuse holder |
| | Motor power fuse holder |
| | Cooling fan |
| | Time counter |

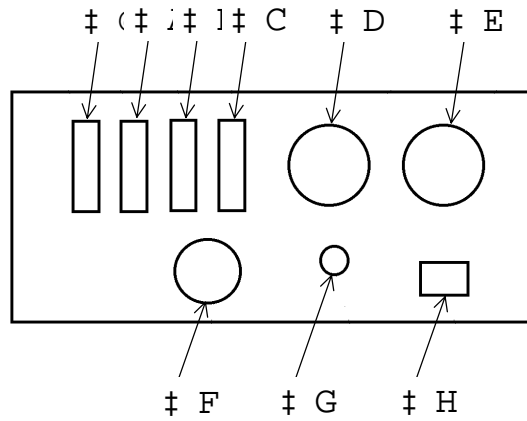


Fig.3.2 Back Panel

Table 3.2 Parts List

| No. | Item |
|-----|--|
| | D0-1connector |
| | DI -1 connector |
| | D0-2 connector |
| | DI -2 connector |
| | Encoder/sensor connector for Z/W-Axis |
| | Encoder/sensor connector for X/Y(A/B)-Axis |
| | Motor connector |
| | E.S. connector |
| | Power inlet |

3.2 Inside Structure

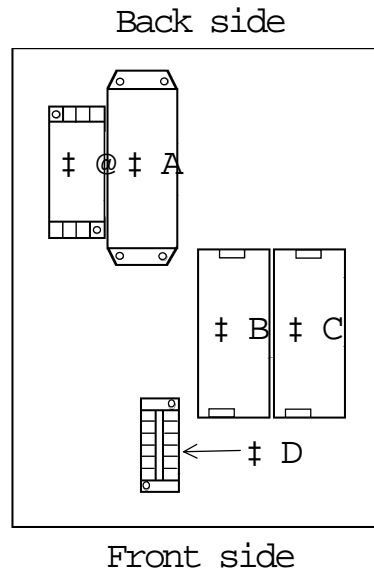


Fig.3.3 Inside Structure (Base Plate)

Table 3.3 Parts List

| No. | Item |
|-----|-------------------------------------|
| | Noise filter |
| | Regenerative register |
| | Switching regulator (24V) |
| | Switching regulator (5V) |
| | Terminal board for power connection |

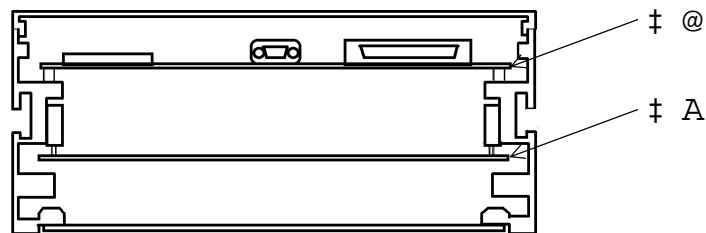


Fig.3.4 Inside Structure

Table 3.4 Parts List

| No. | Item |
|-----|---------------------------------------|
| | System/servo control board (HPC-740A) |
| | Servo power board (HPC-741A) |

3.3 Block Composition

The hardware mainly comprise the following 8 blocks.

- (1) System control (System board HPC-740A)
 - Controls the entire robot motion.
 - Stores the position and the system data.
 - Interfaces motor drivers.
- (2) Servo interface
Interfaces system board and motor drivers.
- (3) DI/DO interface
Interfaces signal from the controller and input signal from PLC.
- (4) Memory card interface
Data load from memory card to system board(RAM), and data save from system board(RAM) to memory card.
- (5) RS-232C interface
Interfaces the external device PC via RS-232C.
- (6) Teach Pendant interface
Determines the operation mode and handle transactions with Teach Pendant.
- (7) Servo driver control
Interfaces with servo drivers.
- (8) Servo driver power generation
Drives the motor.

3.4 Connection Composition

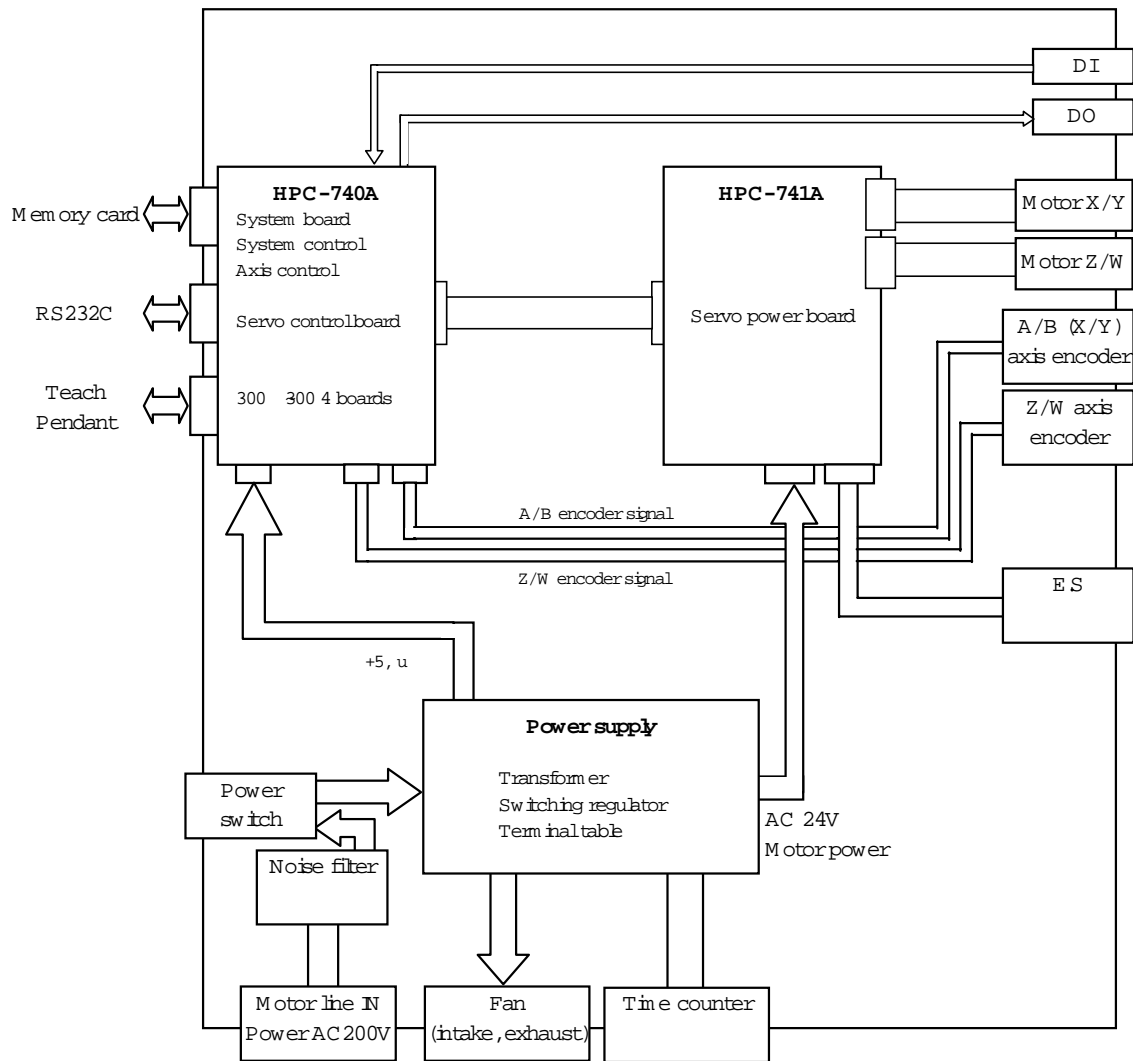


Fig.3.5 Connection Composition

CHAPTER 4 FUNCTION

The basic function of the controller is to move the robot to programmed position. To operate the robot easily, the controller has necessary function as following below.

4.1 Basic Functions

- (1) Automatic origin calibration
- (2) Store the programmed position
- (3) Display the current position of the robot
- (4) Move the robot to a target position
- (5) Communicate with external PLC or HARL-
- (6) Position data handling
- (7) Data transfer through RS-232C
- (8) Self-diagnosis

When an error occurs in AUTO mode, displays the error message on the Teach Pendant, and outputs the error signals to the external device through the robot interface (OUT signal and ERROR signal corresponding to the error message). When an error occurs in ON-LINE mode, the error code can be obtained from the external device, such as PLC.

- (9) Stops the robot immediately by Emergency Stop signal
- (10) Monitoring parallel(DI/DO) communication
- (11) Memory card (option)

Save the position and system data (Refer to the separated volume of Operation Manual) memory card via memory card port.



The controller has 1,000 position data, 000 to 999. These numbers are called position data address or just address.

4.2 Emergency Stop (E.S.) Function

To stop the robot immediately upon occurrence of abnormal status of the robot, the controller is provided with an emergency stop(E.S) function.

(1) Emergency stop

E.S. will be activated at following condition.

- E.S. switch on the Teach Pendant is pressed when the power is ON.
- Deadman switch is not pressed in TEACH or CHECK mode when the power is ON.
- External E.S. input (ES-IN: 1-4 pin connectors) terminals are opened.
- DC24 fuse is opened (blown).
- Neither of the Teach Pendant nor the dummy connector is connected.
- Encoder error.
- Servo alarm occurrence.

When the all of above condition occurred, E.S function is activated.

- Shut OFF the power supply to the motor.
- Turn OFF the all output signals.
- Ignores the all input signals and command.
- Contact outputs of the external E.S. output (ES-OUT: 2-3 pin connectors) terminals are opened.
- The E-STOP indicator on the Teach Pendant lights up and a buzzer sounds.

The back panel is provided with an external E.S connector(10P) as shown following figure.

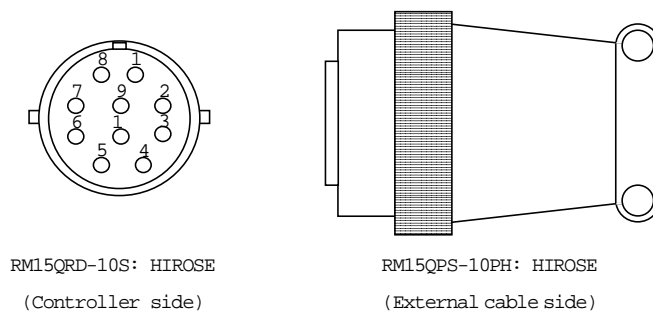


Fig.4.1 External E.S. Connector

Arrange the E.S button outside of the robot working envelope and make sure that an operator can access easily. When the abnormal status occurs, press the E.S button to stop the robot.



System safeguard should be prepared for your safety. Unless having the device may result sever injury.

(2) Wiring for the E.S. connector

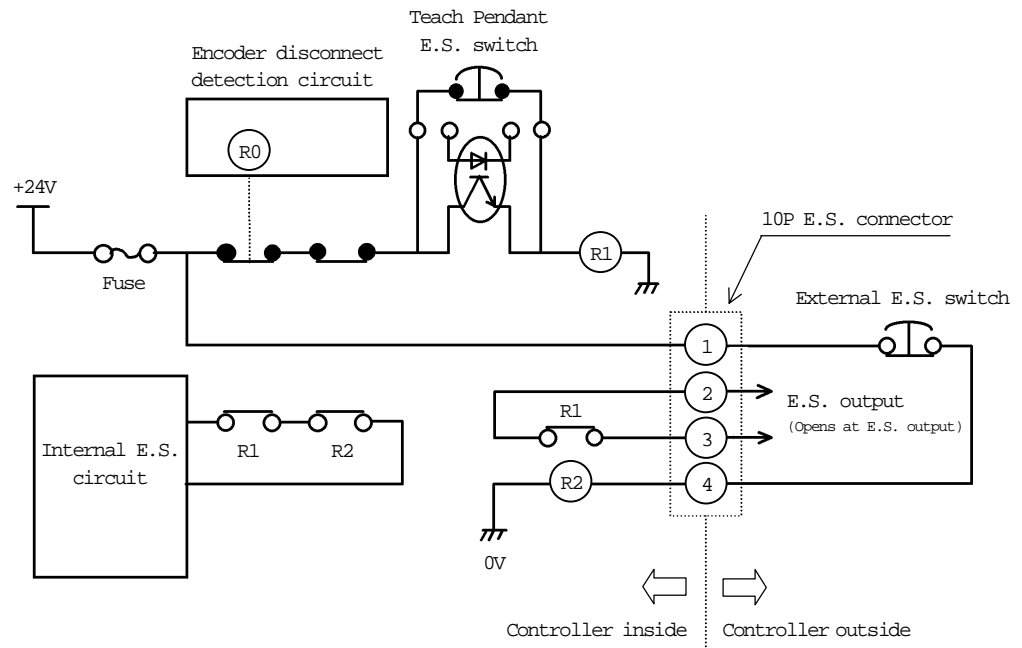


Fig.4.2 E.S. Wiring

and pins connect to external E.S. Close (Short) and pins unless you use. The current 40mA runs on the line if shorting the pins. E.S. will be activated when and pins are opened.

and pins are the relay contact output to generate a status signal to an external device when the E.S. is activated. It is closed in normal status. The relay is closed (turns ON) when the power source of the controller is supplied and it is not in E.S. status. The relay is opened (turns OFF) when E.S. is activated or the power is OFF.

- Specification for the relay contact output (and pins)
G6A-434P-U (OMRON) DC24V(1A)

CHAPTER 6 Hardware Setting

6.1 DIP Switch (SW2) on HNC System Board

There is a DIP switch on the system board (HPC-740A.) Refer to the following table below for the DIP switch function.

SW2

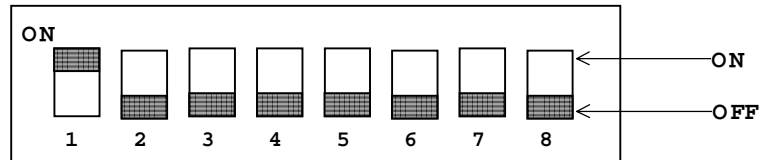


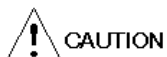
Fig.6.1 DIP Switch (SW2)

Table 6.1 DIP Switch Function

| Switch NO. | Meaning |
|------------|--|
| 1 | Turn ON switch 1 when using 1 or 2 axes configuration. |
| 2 | Turn ON switch 1 and 2 when using 3 or 4 axes configuration. |
| 3 | Normally OFF |
| 4 | Normally OFF |
| 5 | Normally OFF |
| 6 | I/O setting for DI/DO OFF: DI 1 0-15 DI 2 16-31 DO1 0-15 DO2 16-31 ON : DI 1 16-31 DO1 16-31 DO2 0-15 |
| 7 | Normally ON |
| 8 | Normally OFF |

The setting of the switch 1, 2, and 4 varies according to the number of axis to control.

- 1 or 2 axes configuration : Turn ON switch 1.
- 3 or 4 axes configuration : Turn ON switch 1 and 2.
- Turn OFF the switch 3 and 4 normally.
- Turn OFF the switch 5 except using the absolute encoder motor.



CAUTION

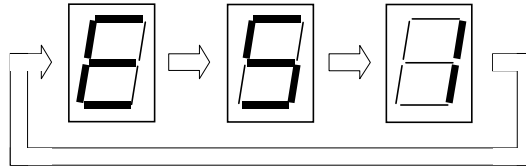
These switches are set before factory shipment. Unless otherwise necessary or instructed, do not change the switch setting.

6.2 System Indicator

An error code will be displayed on the system indicator on system board(HPC-740A) in case of the error .

- Example : Overrun

Indicator will display “E51” repeatedly.



The display above is repeated.

Table 6.2 Error code

| Error message | Meaning | ON-LINE mode output |
|--------------------|---|---------------------|
| POS. ERROR XXXX | Positioning is not completed. | 09 |
| EMERGENCY STOP | Emergency stop status | 10 |
| A-CAL ERROR N... | A-CAL is not completed correctly. | 20 |
| ADDRESS ERROR | Address over the restriction is designated. | 30 |
| M DATA ERROR | M DATA is invalid. | 31 |
| SENSOR NOT FIND | W-Axis does not stop by the sensor input. | 32 |
| SPLINE DATA ERROR | The data of free curve movement is invalid. | 33 |
| AREA ERROR XXXX | Position data is out of area. | 40 |
| OVERRUN XXXX | Overrun | 51 |
| SYSTEM DATA ERROR | System data is corrupted. | 63 |
| POINT DATA ERROR | Position data is corrupted. | 64 |
| FORMAT ERROR XXXX | Communication format is invalid. | 60 |
| COMMAND ERROR | Communication command is invalid. | 61 |
| UNKNOWN COMMAND | Illegal command. | 62 |
| SERVO ERROR XXXX | Servo error | 70 |
| DUPLICATE COMMAND | Receiving another command while processing a command. | 80 |
| Scene set Error | Scene set is out of range with vision. | 81 |
| Work not Find | Work-piece is not found. | 82 |
| Measurement Error | Measurement conditions are invalid. | 83 |
| Out of range | Measured data is out of the range. | 84 |
| Vision not ready | “NAK” transmission continued. | 88 |
| Vision not Online | No response from the vision. | 89 |
| IMPOSSIBLE ERROR | The distance for PASS motion is too short. | 90 |
| M NUMBER ERROR | M number is not correct. | 94 |
| XY CONVERT ERROR | Position data is destroyed. | 95 |
| POSITIONING ERROR | Positioning is not completed. | 96 |
| START MOTION ERROR | Motor does not rotate. | 99 |
| DRIVER ERROR XXXX | Abnormal status occurs in the driver. | A0 (A0) |
| ENCODER DISCONNECT | Encoder signal is lost. | B0 (B0) |

6.3 Pendant Remove Switch

The Pendant remove switch is used for connecting or disconnecting while the power is supplied to the controller. This feature allows you to read the error message when any event of error occurrence.

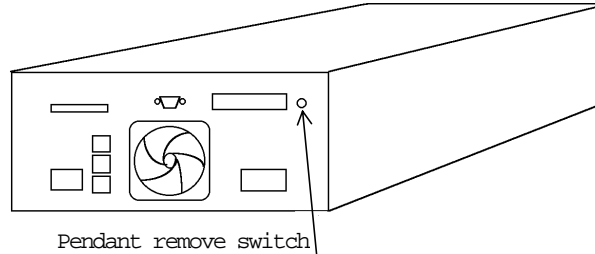




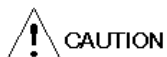
Fig.6.2 Pendant Remove Switch

- (1) When disconnecting the Teach Pendant from the controller
 - 1 Keep pressing the pendant remove switch.
 - 2 Disconnect the Teach Pendant while pressing the pendant remove switch.
 - 3 Connector the dummy connector while pressing the remove switch.
 - 4 Detach your finger from the pendant remove switch.



This operation will interrupt the outer mode signal. Thus, the robot may stop if it is in automatic mode. Do not connect/disconnect the Teach Pendant except for error verification purpose.

- (2) When connecting the Teach Pendant :
 - 1 Keep pressing the pendant remove switch.
 - 2 Disconnect the dummy connector while pressing the remove switch.
 - 3 Connect the Teach Pendant with pressing the pendant remove switch. (The mode on the Teach Pendant must be in the ON-LINE mode.)
 - 4 Detach your finger from the pendant remove switch.
 - 5 Press the  key or  key. The display on the Teach Pendant normally shows;
 - 6 If the monitor display is not normal, press the pendant remove switch and connect the Teach Pendant again.



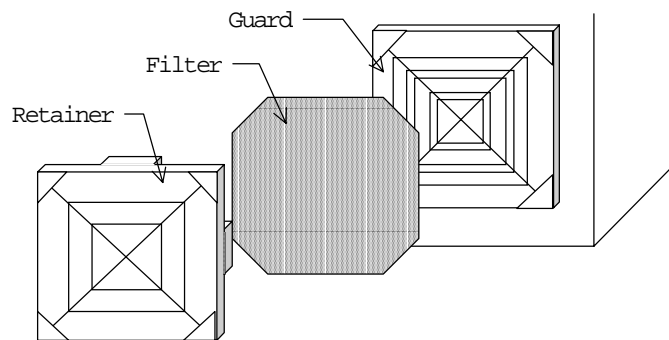
Connecting and disconnecting the Teach Pendant during the automatic operation may interrupt the PLC communication. Unless otherwise necessary, do not connect or disconnect the Teach Pendant. Neither the Teach Pendant nor the dummy connector is connected, the controller is in Emergency Stop (E.S.) status.

CHAPTER 7 Preventive Maintenance

Confirm that surroundings meet specifications; frequency, dielectric strength, etc. Periodical maintenance is highly recommended for full performance and longer life time. If malfunction happens, follow the “troubleshooting flowchart” in later chapter.

7.1 Dust Filter

The controller is cooled by forced air circulation. To prevent overheating of system, the control cabinet is provided with an air vent. A fan-operated aspirator section is installed on its front. Clean up the filter to maintain smooth air circulation.



7.2 Servo Driver

Adjustment of the servo driver is described at later section. Although they are adjusted before shipment, adjust the servo drivers if the erratic sound or malfunction should occur because of surrounding changes. Refer to the next chapter for more detail.

7.3 Battery Voltage

A battery is provided to back-up the position data and other motion parameter. Lower voltage may cause losing data. Measure the voltage between VMEM and GND on system board (HPC-740A) two minutes after shut down.

Replace the battery when it turns lower than 3.2V or after 4 years or 7,000 hours operation.

7.4 Others

Confirm the operation conditions, such as power supply frequency or dielectric strength, and use the robot in the specified conditions. Daily and periodically maintenance is essential to maintain the performance and lifetime.

Follow the instruction which is described in later chapter of “Trouble Shooting” in case of abnormal occurrence.

CHAPTER 8 Servo System Adjustment

This controller has a servo driver as a peripheral device that needs to be adjusted to function as the robot controller. This chapter describes the adjustment procedure of the servo driver.

The motor rotates with an operation speed command sent from the controller and received at the servo driver unit. When the motor starts rotating, it starts outputting pulses corresponding to the rotation amount as the encoder signal. The servo driver detects the motor rotation speed by the number of feedback pulses from the encoder. Also, the controller calculates the current position of the motor rotation by counting the number of pulses.

All the servo driving parameter is programmed and stored in the EEPROM system memory. All the setting is predetermined and adjusted at Hirata Factory. You may need to readjust some of the parameters as the mechanical characteristic such as friction changes.

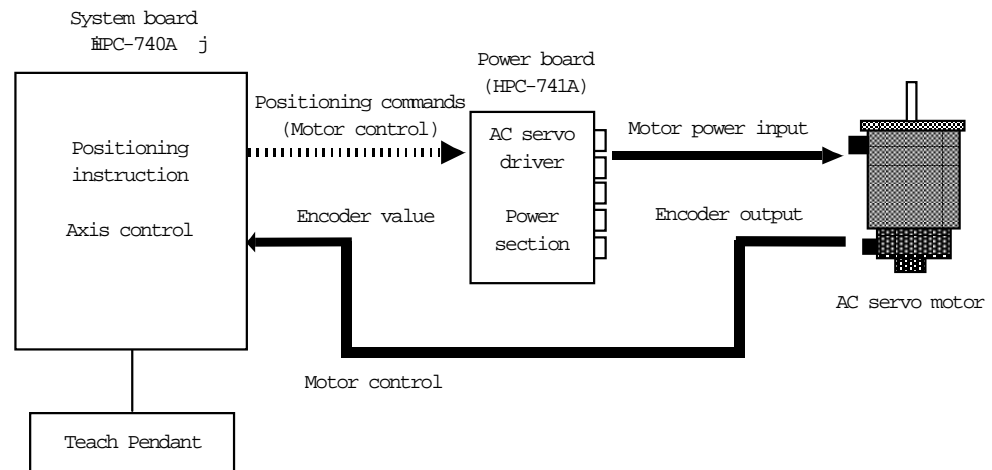
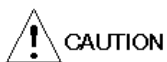


Fig.8.1



High voltage is charged to the controller. Do not touch the transformer, capacitor, and wherever unnecessary when tuning.

Because of H8CPU version up from 1.21 to 1.30 inside of the servo driver, some of servo parameters are revised. Refer to later section for details.

To have compatibility between the servo driver and controller, use the controller with 2.41 version (and after) P-ROM when using servo driver with H8CPU 1.30 version.

The parameter value for "OverCur. Level" and "OverCur. Time" may be replaced when loading the servo parameters from the version 1.21 to 1.30 for same controller. If the parameters are replaced, it will cause an "Over Load" error. Make sure to confirm these value after loading the parameters.

OFFSET value may be changed when loading the parameters from another controller. Make sure to execute the OFFSET ADJ. command after loading the parameters.

8.1 Servo Parameter Setting and Adjustment

All the parameters are preset before shipment at the factory. However, it will be allowed to adjust the servo parameters only if abnormal noise or hunting is occurred.


Adjust the servo parameters using with the Teach Pendant referring instructions below.

- (1) Turn the mode of Teach Pendant to KEY-IN.

- (2) Press the  key while pressing the  key. Then, display shows;

```


, q n a n s , b ; k b t k ; s d , s t m d
, P D b ; k b , Q D n e e r d s
, R D l d l n q x , S D c h r o D
, T D r d q u n , s t m d
    
```


- (3) Press the  key to select 5. SERVO TUNE . Then, display shows;

```


, r d q u n , p ; q ; l , s t m d
, P D ` , p ; q ; l D , Q D a , p ; q ; l D
, R D y , p ; q ; l D , S D v , p ; q ; l D
    
```


- (4) Press the numeric key corresponding to the parameter you want to adjust.

 : A (X)-Axis

 : B (Y)-Axis


 : Z-Axis


 : W-Axis

If you press the  key, following display shows:

```

, ` i w j , r d q u n , p ; q ; l d s d q
, j 7 , Q Q Q $ O
, j 7 % , Q Q Q P O
, j 7 † † , Q Q Q Q O
    
```

- (5) Move the cursor to the desired parameter by pressing the  key, and adjust the parameter value.

If you press the  key at this time, the cursor move to the first parameter.

If you press the  key, the cursor move to the last parameter.


Following parameter is displayed in order by pressing the  key.


Table 8.1 Parameter List

| Parameter | Default value | Specification | Adjustment |
|-------------------|---------------|-------------------------------------|-----------------------|
| Kvp | 00050 | Speed control proportional gain | Allowed |
| Kvi | 00050 | Speed control integral gain | Allowed |
| Kvff | 00000 | Feed forward gain | Reserved |
| Kip(%) | 00100 | Current amplifier proportional gain | Allowed (Conditional) |
| Cur. Out Filter | 00050 | Current directive filter | Allowed (Conditional) |
| Cur. Sen Filter | 00000 | Current detection filter (Not used) | Reserved |
| UVW Out Filter | 00050 | UVW phase PWM filter | Allowed (Conditional) |
| Over Load Limit | 00040 | Overload detection level | Allowed |
| Current Limit | 00115 | Current directive output limiter | Allowed |
| Expansion1 | 00000 | Used | Allowed |
| Expansion2 | 00000 | Not used | Reserved |
| Expansion3 | 00000 | Not used | Reserved |
| Delay msec | 00060 | Interval from brake ON to servo OFF | Allowed |
| Rotation rpm | 03600 | Motor rated revolution count | Allowed |
| Rotation Dir | 00000 | Motor revolution direction | Allowed |
| I/F Mode | VELOCITY | Command mode | Allowed (Conditional) |
| Enc Pulse ppr | 01500 | Encoder pulse count | Not allowed |
| Pole Number | 00008 | Motor magnetic pole number | Not allowed |
| Err6 | | Error history 6 | Verification only |
| Err5 | | Error history 5 | Verification only |
| Err4 | | Error history 4 | Verification only |
| Err3 | | Error history 3 | Verification only |
| Err2 | | Error history 2 | Verification only |
| Err1 | | Error history 1 (Latest error) | Verification only |
| Serv Version X.XX | | Version of H8CPU of servo driver | Verification only |

Ex Cmd [SERVO TUNE]

(6) Parameter setting and execution

Move the cursor to the last parameter "Ex.Cmd[SERVO TUNE]."

Press the  key. Every time pressing the key, item inside of [] will be changed in order as below.

[SERVO TUNE] [ALARM RESET] [OFFSET ADJ.]

[DEFAULT SET] [ERR.HIST.CL]

- SERVO TUNE

This is the command for selecting the servo parameter as the procedure above.

- ALARM RESET

This is the command to check the servo alarm condition referring to the current error history, Err1, when servo alarm is occurred. Because E.S. status continues even when the alarm is stopped, use this command to stop the alarm without rebooting the power.

Pressing the alarm reset switch on the front panel of the controller is same as this function.

- OFFSET ADJ.





This is the command for current feedback offset adjustment on HPC-741A. The current feedback which interface the motor current to CPU through A/D converter. This command adjust the time lag between software setting 0 and hardware setting 0. It effect motor revolution and an abnormal noise is occurred because of this time lag. Use this command under these condition.

- DEFAULT SET

This is the command for the default setting of servo parameter. Once execute this command, all of parameter will be replaced to the default value.

- ERR.HIST.CL

This is the command to clear all of error (alarm) history. Every time alarm is occurred, the error data will be stored at the "Err1" as the newest error history. The rest of the error histories are shifted up and the history is updated.

- (7) After setting the parameter value, press the  key. Then, you can hear the beep sound.
- (8) Press the  key again.
- (9) Press the  +  keys after complete the parameter setting.
- (10) Done.



NOTE

Unless pressing the  +  keys after completing the parameter setting, each command will not be executed.

Execute the steps from (1) to (5) described above to confirm the parameter setting.

8.1.1 Parameters

- Kvp, Kvi

| | | |
|------------|---|---|
| Kvp | Speed control proportional gain Default: 50 Setting range: 0 to 300 | Increase the value when overshooting because of overload. Setting the value excessively may cause an abnormal noise. Adjust properly. |
| Kvi | Speed control integral gain Default value: 50 Setting range: 0 to 300 | Decrease the value when hunting. Adjust properly. |



Servo parameters are adjusted properly before the shipment at the factory. Do not change unless instructed. Servo parameter value differs depending on robot configuration and mechanical structure. Recommended (standard) value is described in “HIRATA Servo Driver Parameter List” which is attached to this manual. If the data recovery is required because of any reason, contact us before referring the parameter list attached.

- Kvff (Feed forward gain)

Reserved for the system.

- Kip (Current amplifier proportional gain)

Default value : 100
Standard value : 100
Setting range : 50 to 400

Effects to the difference between the torque command and actual torque.

Current feedback gain will be increased with entering the greater number.

The value changes depending on the rated torque of motor driven. Every 50 input changes the setting.

Allows you to replace the value by specifying the “Expansion1” to 64. However, do not change this value unless instructed.

- Cur.OutFilter Current directive filter

Default value : 50
Standard value : 30 to 70
Setting range : 0 to 100

Eliminates excessive change for the current directive value.

Allows you to replace the value by specifying the “Expansion1” to 64.

- Cur. Sen Filter Current detection filter

Default value : 0
Standard value : 0
Setting range : 0 to 100

Effects to the actual current value detected.

Reserved for the system. (Currently not used.)

- UVW Out Filter (UVW phase PWM filter)

Default value : 0
 Standard value : 0
 Setting range : 0 to 100

Effects to PWM output which is in proportion to the deference between the current command value and actual current value.

Allows you to replace the value by specifying the “Expansion1” to 64.

- Over Load Limit Overload detection level

Default value : 40
 Standard value : 40
 Setting range : 3 to 115

Specifies the rated current value. Detects “Over Load” error when the motor current exceed this value for 30 seconds as total.

- Current Limit Current directive output limiter

Default value : 115
 Standard value : 115
 Setting range : 3 to 115

Limits the current value which is flown to motor.

“Over Load” error will be occurred when the current exceeding the value specified by “Current Limit” flows for more two seconds continuously.

The motor may not rotate if you specify this value too small.

- Expansion 1

Default value : 0
 Standard value : 0

Allows you to replace the parameter value which is described as a conditional in the table 8.1, “Parameter List“ by specifying this value to 64.

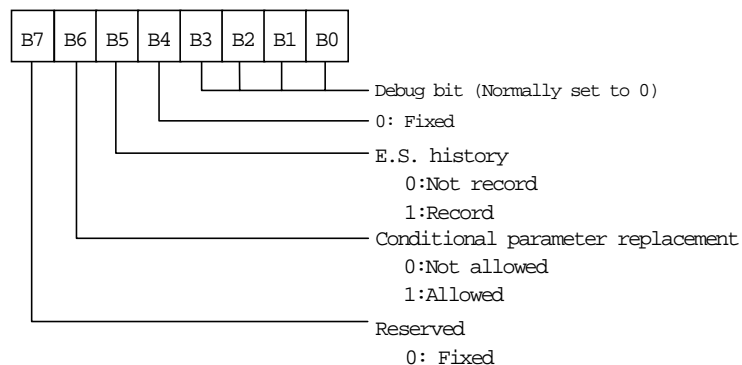
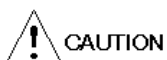


Fig.8.2 Bit Assignment



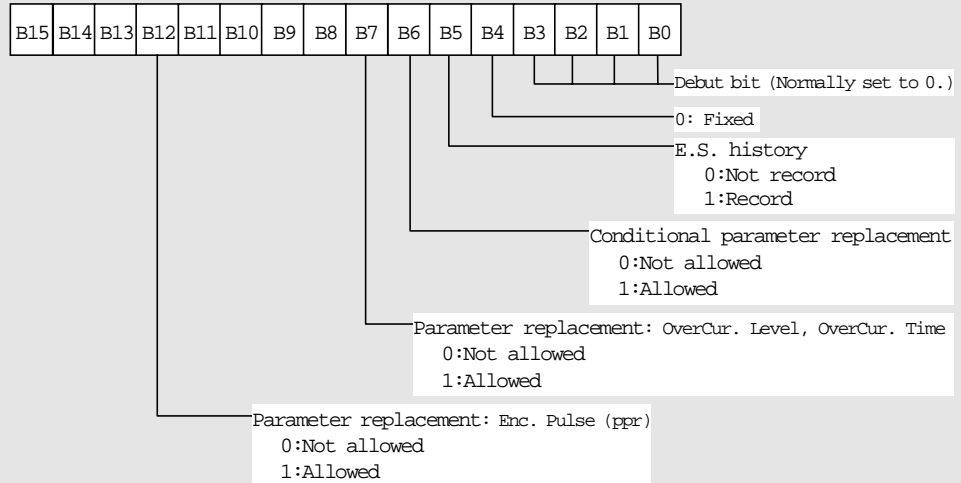
Normally, this parameter, “Expansion 1,” is set to 64 at the shipment at the factory. This is only for HIRATA maintenance; therefore, do not change the value unless instructed.

According to H8CPU version up from 1.21 to 1.30 inside of the servo driver, following setting are added. (Use the controller with 2.41 version (and after) P-ROM when using servo driver with H8CPU 1.30 version.)

Allows you to replace “OverCur. Level” and “OverCur. Time” by specifying the value to 128. (Refer to “Expansion2” and “Expansion3” for details.)

Allows you to replace “Enc. Pulse” by specifying the value to 4096. (Refer to “Enc. Pulse” for details.)

Bit map is as follows.



● Expansion 2

Reserved for the system.



According to H8CPU version up from 1.21 to 1.30 inside of the servo driver, this parameter is changed from “Expansion 1” to “OverCur. Level.” (Use the controller with 2.41 version (and after) P-ROM when using servo driver with H8CPU 1.30 version.)

OverCur. Level

Default value : 100
 Standard value : 100
 Setting range : 3 to 115

Makes the setting severely for “Over Load” error detection value. Checks the time for overload when the current command value is exceeding the set value. (“Over Load” error is occurred by comparing the measured time and “OverCur. Time.”)

Allows you to replace “OverCur. Level” by specifying “Expansion 1” to 128. After replacing “OverCur. Level” value, it is recommended to set “Expansion 1” to the previous setting to avoid unnecessary overwriting to the “OverCur. Level.”

- Expansion 3
Reserved for the system.



CAUTION

According to H8CPU version up from 1.21 to 1.30 inside of the servo driver, this parameter is changed from “Expansion 2” to “OverCur. Time.” (Use the controller with 2.41 version (and after) P-ROM when using servo driver with H8CPU 1.30 version.)

OverCur. Time

Default value : 500

Standard value : 500

Setting range : 3 to 2000

Setting unit : msec

Makes the time setting severely for “Over Load” error detection.

“Over Load” error is occurred when the current command value exceeds “OverCur. Level” continuously for longer time which is set.

Allows you to replace “OverCur. Time” by specifying “Expansion 1” to 128. After replacing “OverCur. Time” value, it is recommended

to set “Expansion 1” to the previous setting to avoid unnecessary overwriting to the “OverCur. Time.”

- Delay

Default value : 60

Standard value : 60msec

Specifies the interval (time) from brake ON to servo OFF.

The magnetic brake may be employed to avoid the up/down axis (Z axis) drop down. Normally it turns the brake ON before turn the servo OFF. It activates when switching the mode from TEACH to KEY-IN.

It is available only for magnetic brake, not for dynamic brake. Enter large value if the up/down axis (Z-Axis) drop down when switching the mode from TEACH to KEY-IN.

(Z-Axis brake release)

Replace the following parameters in System Generation.

Z HOLD = OFF

EMP SELECT = 256

DELAY (for all of the servo axis) = 0



CAUTION

When all axes is set to 0, brake will always be in OFF condition.

- Rotation

Default value : 3600

Standard value : 3000rpm

Setting range : 0 to 4500

Specifies the rated motor revolution.

- Rotation Dir

Default value : 0
Standard value : 0
Setting range : 0 or 1

Specifies direction for the motor revolution.

Rotates reversibly by specifying the value "1."

- I/F Mode

Default value : VELOCITY
Standard value : VELOCITY
Setting summary : VELOCITY (Speed command mode)
POSITION (Position command mode)
TORQUE (Torque command mode)
NOT USE (Axis not in use mode.)

Specifies command mode. Normally, set the value to "VELOCITY."
"POSITION" and "TORQUE" are not used currently.

Allows you to replace the value by specifying the "Expansion1" to
64.

It is required to change the System Generation data when setting
the value to NOT USE, refer to the following steps for the setting.

- 1) Set "I/F MODE" to NOT USE for the axis not to be used af-
ter selecting 5.SERVO TUNE in ROBOT CALCULATE
MODE screen.
- 2) Reboot the controller.
- 3) Set AXIS SELECT to "NOT USE" in System Generation.
- 4) Reboot the controller again.

If the value has already set to NOT USE;

- 1) Set AXIS SELECT to USE in System Generation.
- 2) Reboot the controller.
- 3) Set "I/F MODE" to VELOCITY for the axis to be used after
selecting 5.SERVO TUNE in ROBOT CALCULATE
MODE screen.
- 4) Reboot the controller again.

- Enc. Pulse
 - Default value : 1500
 - Standard value : 1500ppr
 - Setting range : 1500 or 2500

Displays the encoder pulse count per a motor revolution.

The value is fixed and not changeable.



CAUTION

According to H8CPU version up from 1.21 to 1.30 inside of the servo driver, this parameter setting is changed. (Use the controller with 2.41 version (and after) P-ROM when using servo driver with H8CPU 1.30 version.)

Enc. Pulse

- Default value : 2500
- Standard value : 2500ppr
- Setting range : 1500 or 2500

Allows you to replace this parameter value by specifying “Expansion 1” to 4096. After replacing “Enc. Pulse” value, it is recommended to set “Expansion 1” to the previous setting to avoid unnecessary overwriting to the “Enc. Pulse.”

- Pole Number

- Default value : 8
- Standard value : 8

Displays the number of the motor pole.

The value is fixed and not changeable.

- Err6 Err1

Displays six of past error history. When an error is occurred, the newest error is stored and displayed as Err1. The rest of the error histories are shifted up and the history is updated. Details are described in Table 8.2 “Cause and Solution for the Abnormal Servo.”

- Serv Version X.XX

Version of H8CPU of servo driver.

8.2 Servo Driver Protection

If an alarm is occurred under the servo driver protection, it is possible to confirm the alarm status ("Err1" at the servo parameter display) with Teach Pendant.

Once an abnormal status is detected, E.S. is activated. It intercept the motor power, and the Teach Pendant display the error message and output the servo alarm.

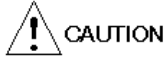
Error message: DRIVER ERROR xxxx

(xxxx describes X, Y, Z, W or A, B, Z, W axis.)

Table 8.2 Cause and Solution for the Abnormal Servo

| Error | Meaning | Cause and solution |
|-------------------|---|---|
| No message | No error | - |
| Over Load (OL) | Over the load | Error occurs when the rated current value for the servo driver is exceeded continuously. Check the following items. (1)Heavy motion or overload interfere defect which is lock the motor. (2)Acceleration/deceleration time is too short. (To make the time longer, decrease the value for acceleration.) |
| Over Current (OC) | Over the current | Error occurs when current specified is exceeds and runs on the main circuit. (1)Confirm each motor line for U, V, and W are not shorted mutually after turn OFF the power. (2)Confirm the insulation resistance between the motor line of U, V, W, and motor earth E becomes low (3)If the over current status continues even if the power is reboot, IGBT in the driver unit may be damaged. Execute the ALARM RESET command or reboot the power for alarm resetting. (4)Confirm the motor is not defective. In case of the motor oscillation because of the excessive servo gain(kvp), over current may be occurred. LED for each axis on HPC-741A is lit. X axis = XOC(D91), Y axis = YOC(D69) Z axis = ZOC(D68), W axis = WOC(D67) |
| Over Heat (OH) | Overheat (Not used.) | This error is occurred when the driver unit(IGBT) is overheated. (1)Confirm the cooling condition and temperature inside of the controller. (2)Confirm the load is not over the setting range. LED(D106) on HPC-741A is lit. |
| Over Voltage (OV) | Over the voltage | (This is optional function.) Error occurs when the main power voltage exceeds 395V because of the regenerative energy is increased by the inertia moment. (1) Too much frequency of regenerative braking. (2) Make longer the deceleration time or reduce the load inertia. (2)Consider the process for regenerative resistor referring later section "Regenerative Processing." LED(D107) on HPC-741A is lit. |
| Ini t. PhaseEr | Initial encoder signal loading error | Confirm the connection for the encoder line. (Disconnection, wrong connection, etc.) |
| System DataEr | Abnormal servo parameter data (destroyed) | Reset the servo parameter referring to the default value. |

| Error | Meaning | Cause and solution |
|---------------|--|---|
| Bus Unconnect | Abnormal bus control line (Bus connection error between CPU and servo) | (1) Confirm if the fuse break or not (2) Confirm the power is supplied to the HPC-741A. (3) Confirm the connection for the H8/534 CPU on the HPC-741A, and P-ROM. |



CAUTION

Reboot the controller to restore from the error above.
Wait over 10 seconds when you reboot the controller.

8.2.1 Regenerative Processing

Over voltage error is occurred (D107 LED is lit) when the power supply exceeds 395V unless otherwise the regenerative braking energy is absorbed by the capacitor of the main power. Therefore, the regenerative register can consume this exceeded energy to avoid the over current. It is adjusted to execute regenerative processing when the motor main power supply voltage (normally 280V) is over 380V.

When the over voltage error occurred, connect the regenerative resistance for regenerative processing to J5 connector on the power board HPC-741A.

CHAPTER 9 Trouble Shooting

9.1 Error Message

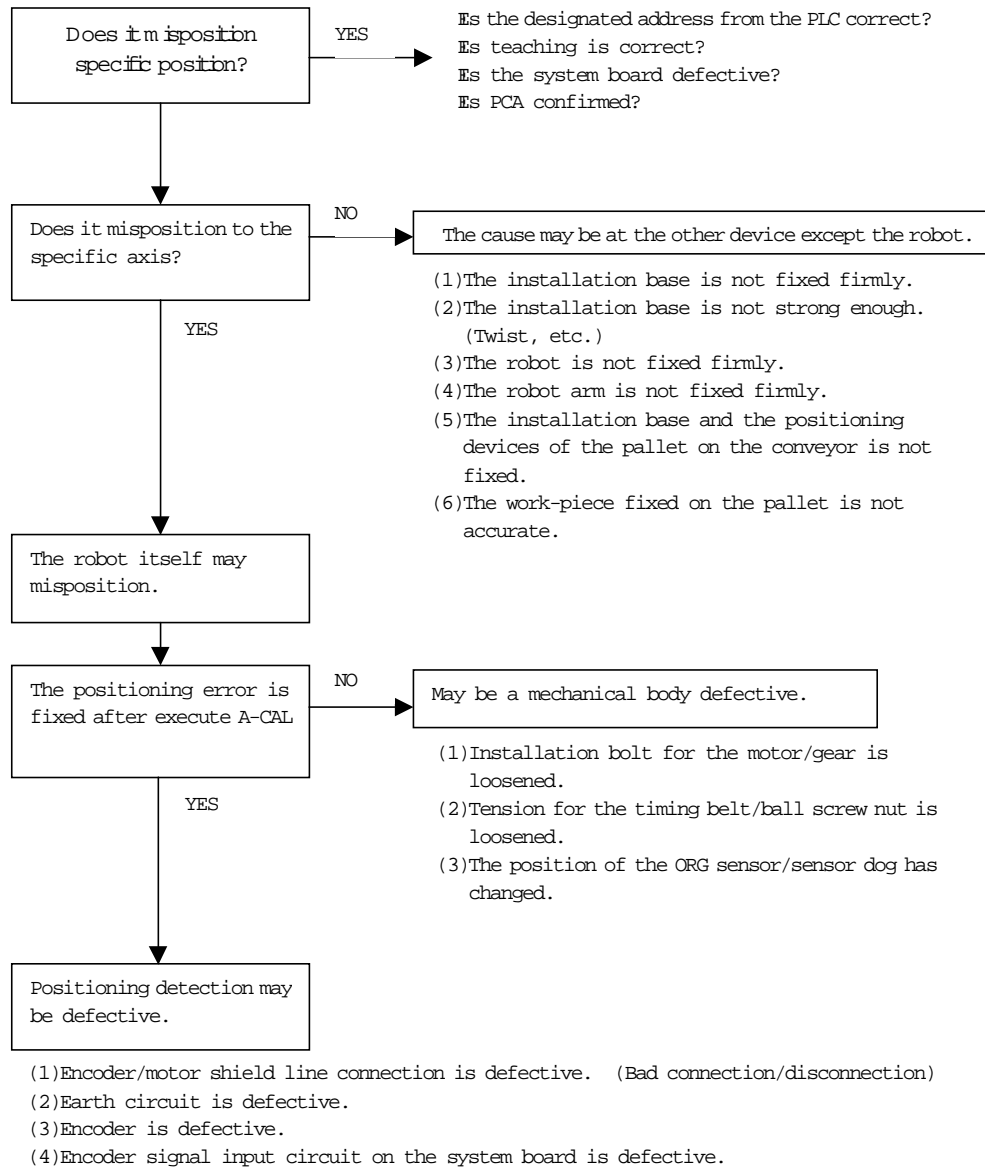
An error message is displayed to the Teach Pendant. Also the error is expressed by the error code on the Teach Pendant during the operation. Refer to separated volume "OPERATION MANUAL" for details of error code.

9.2 Trouble Shooting Hints

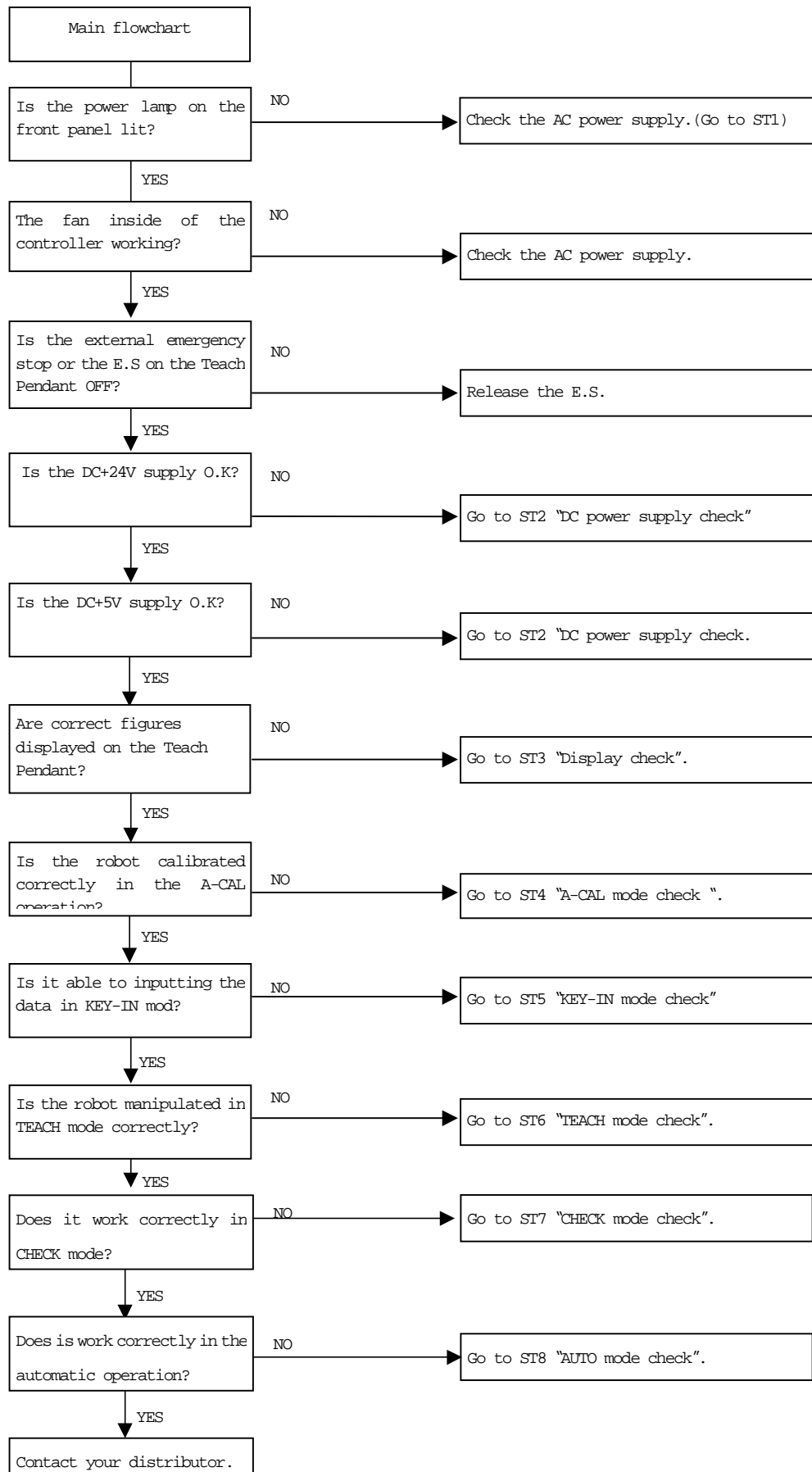
Table 9.1 Trouble Shooting Hints

| Check item | Check point |
|--|---|
| Power supply | Matches specified voltage $\pm 10\%$? Maintains stable voltage? Supplied through proper cable? |
| Installation base | Keeps the specified level? Vibrating abnormally? Affected from surroundings? |
| Ambient temperature | Stays within the specification(5 40 ? |
| Ventilation filter | Keeps good breathability? |
| Cable and pneumatic hose | Maintains enough play? |
| End effector and work-piece | Secured firmly? Designed within the specification(Weight/inertia)? |
| Motor segment | Maintains good shape? Burnt out? |
| axis balancer | Balancing properly? |
| Transmission and sliding part | Moves smoothly? Being lubricated well? |
| Servo amplifier parameter and speed timing | Being tuned properly? |
| Acceleration | Set properly in system generation? (Refer to separated volume "OPERATION MANUAL".) |
| External interface | Outputs and receives all the signal properly? Being connected properly? |

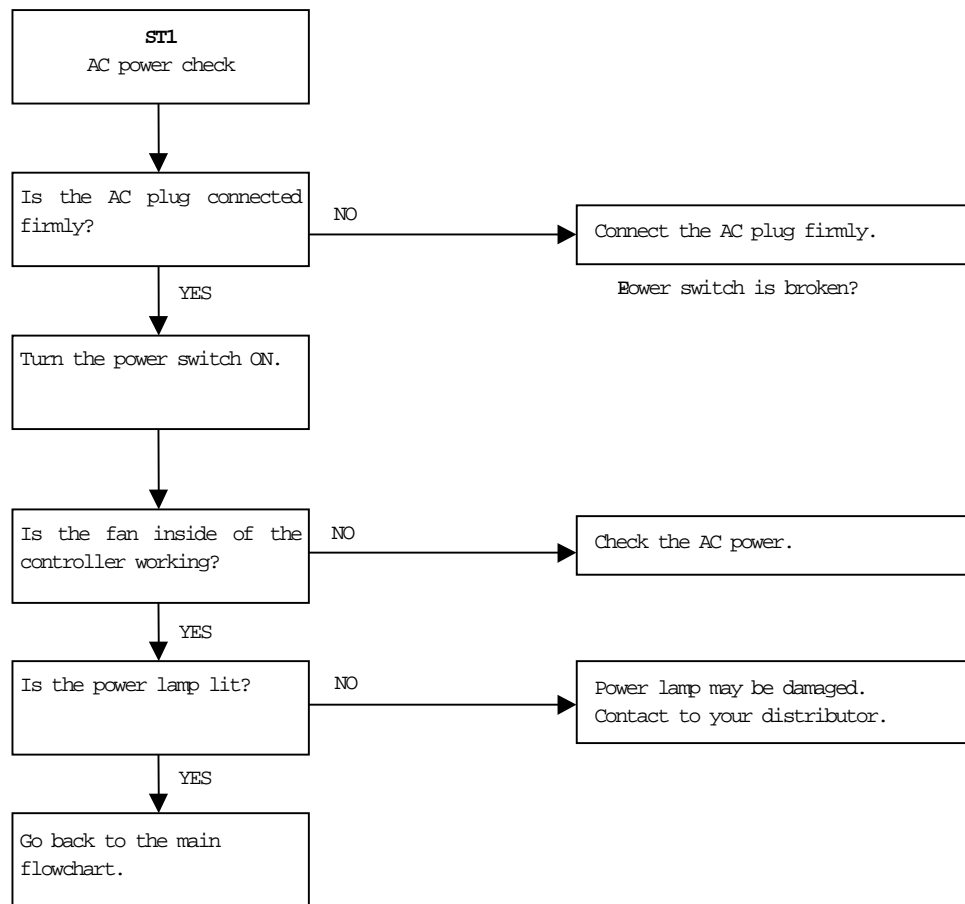
9.2.1 Positioning Error



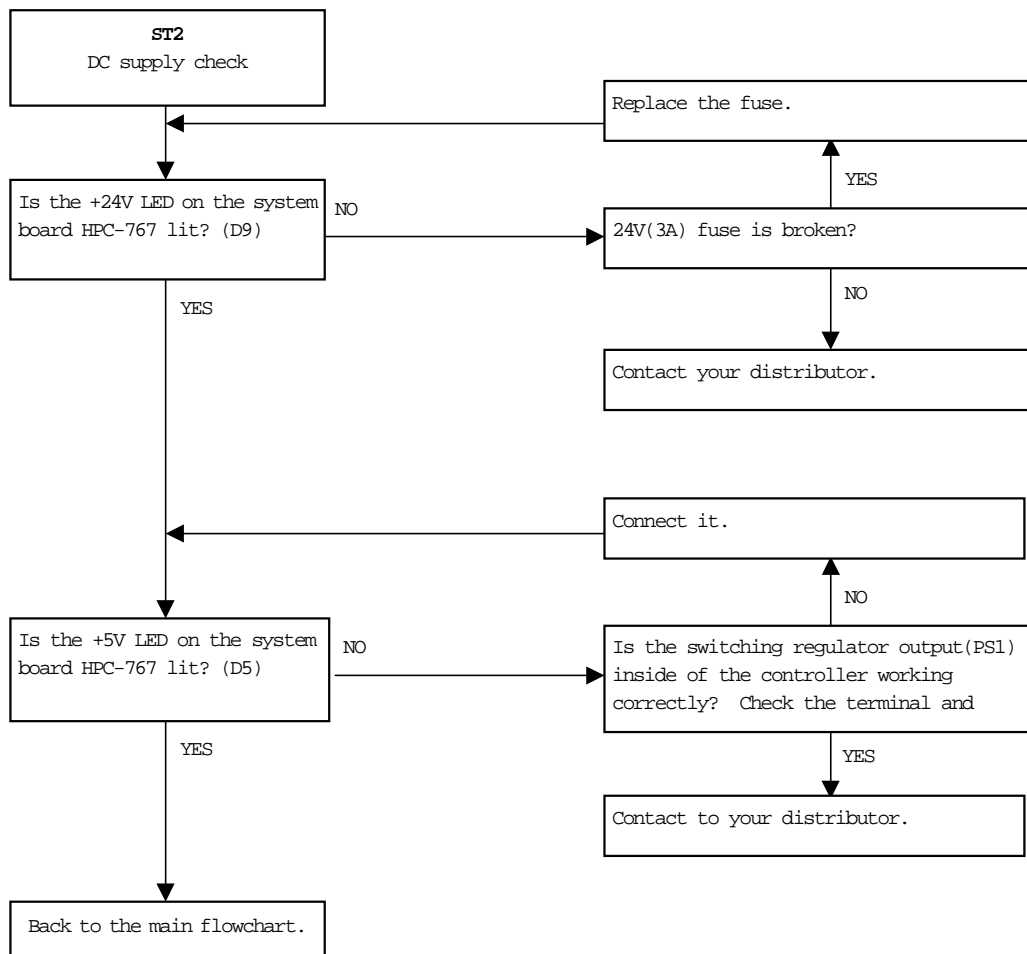
9.2.2 Main Flowchart



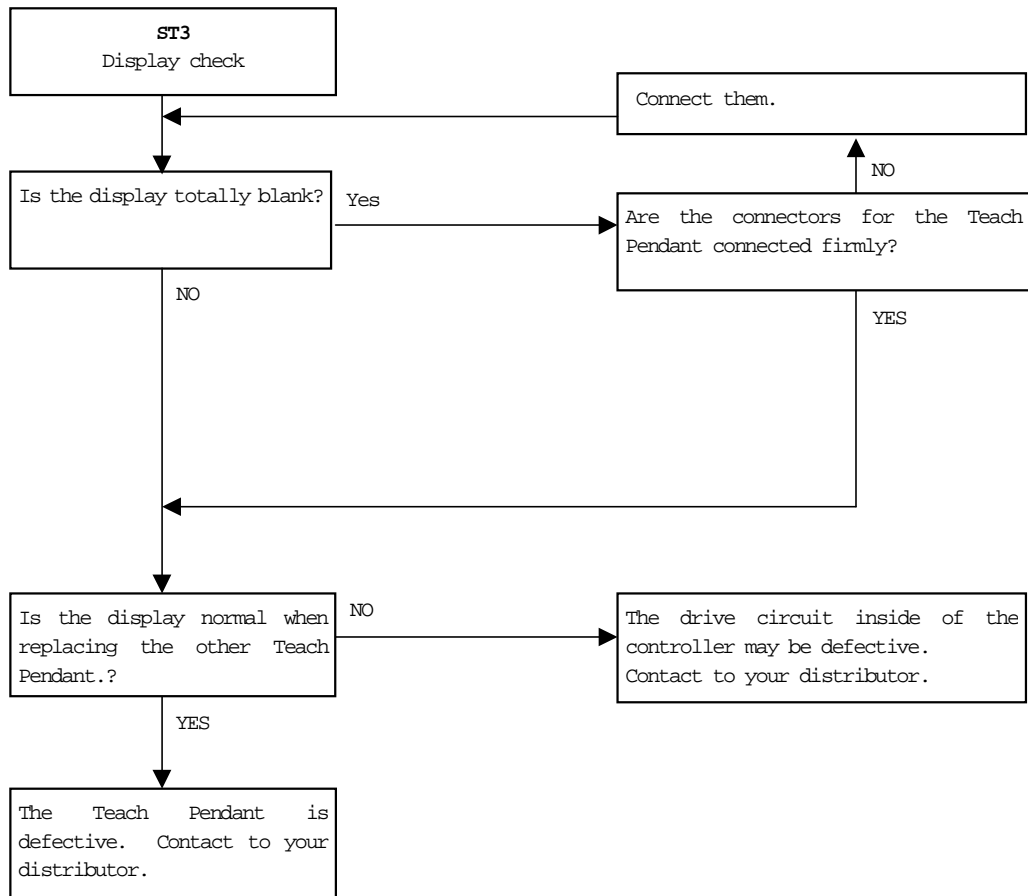
9.2.3 AC Power Check



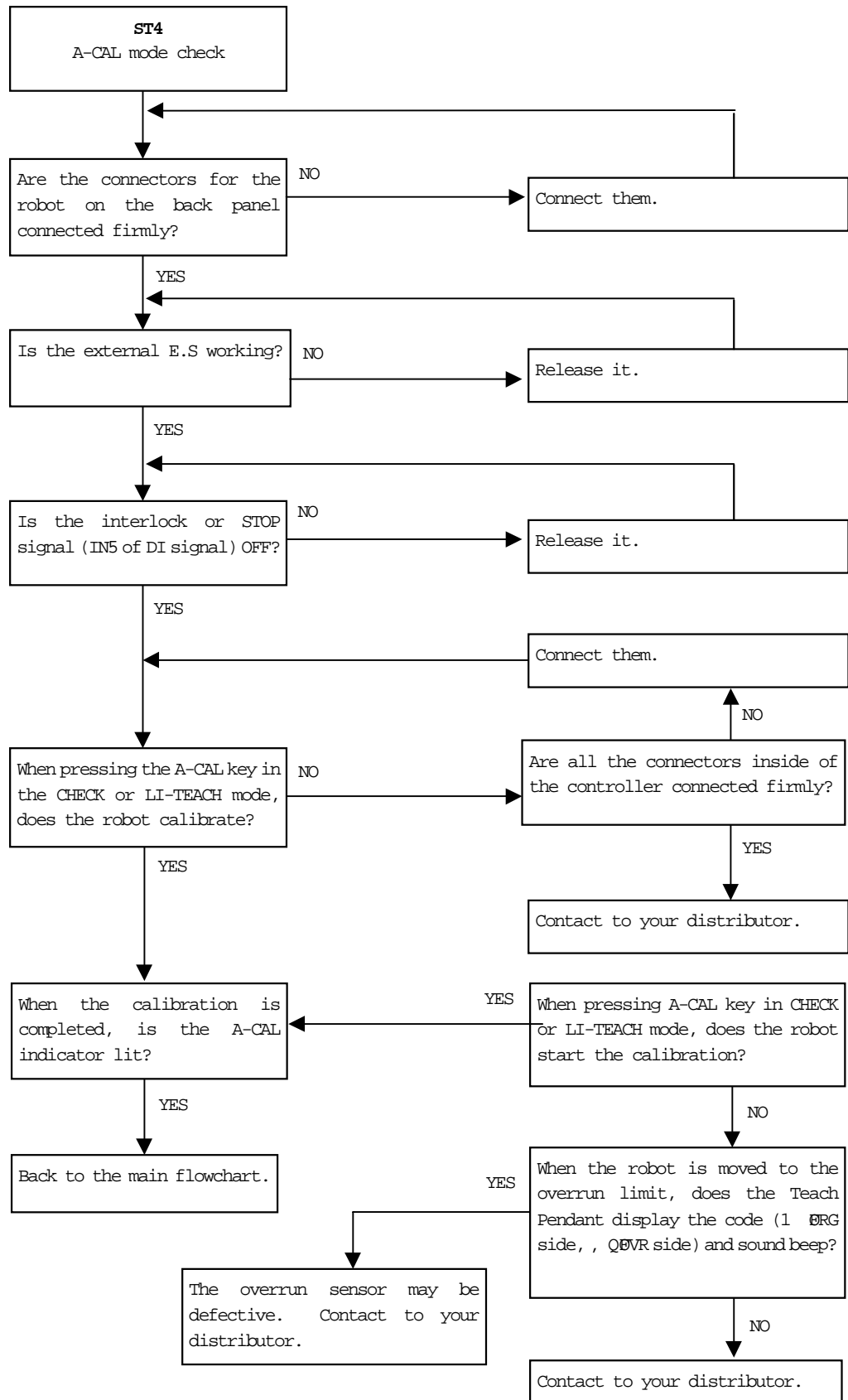
9.2.4 DC Supply Check



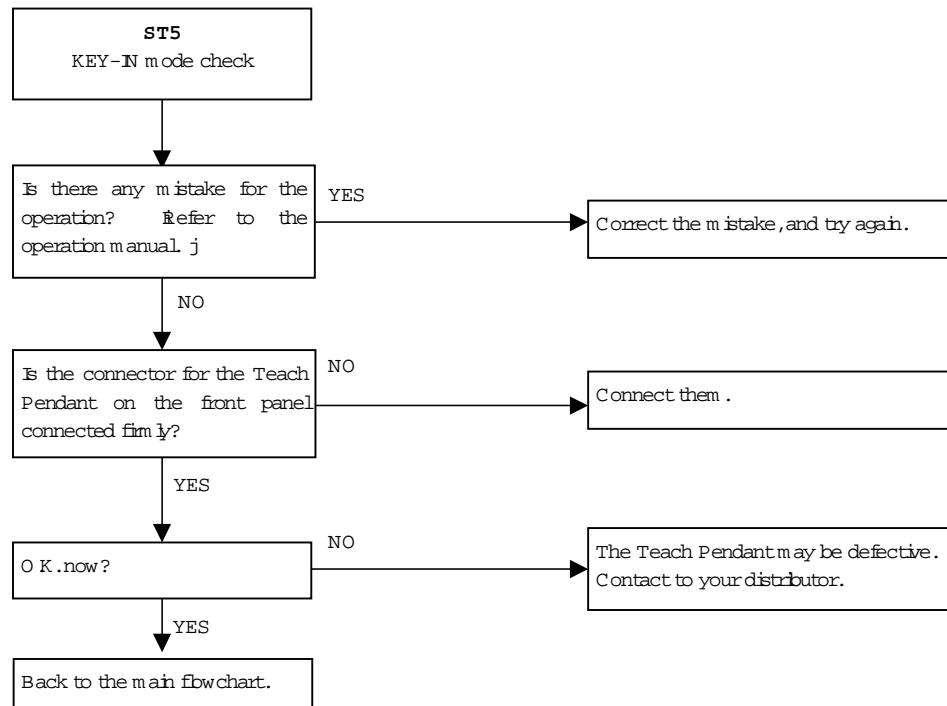
9.2.5 Display Check



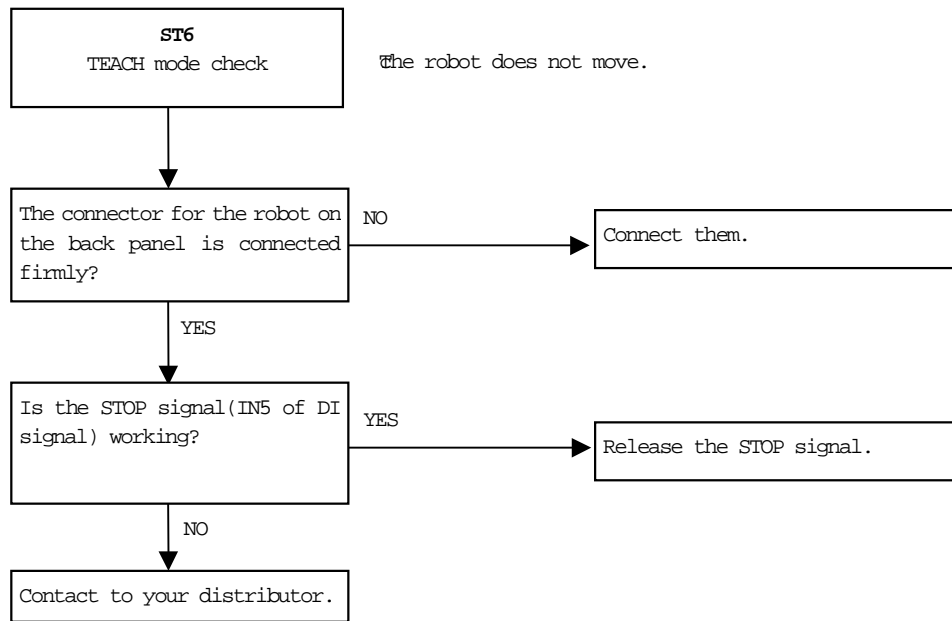
9.2.6 A-CAL Mode Check



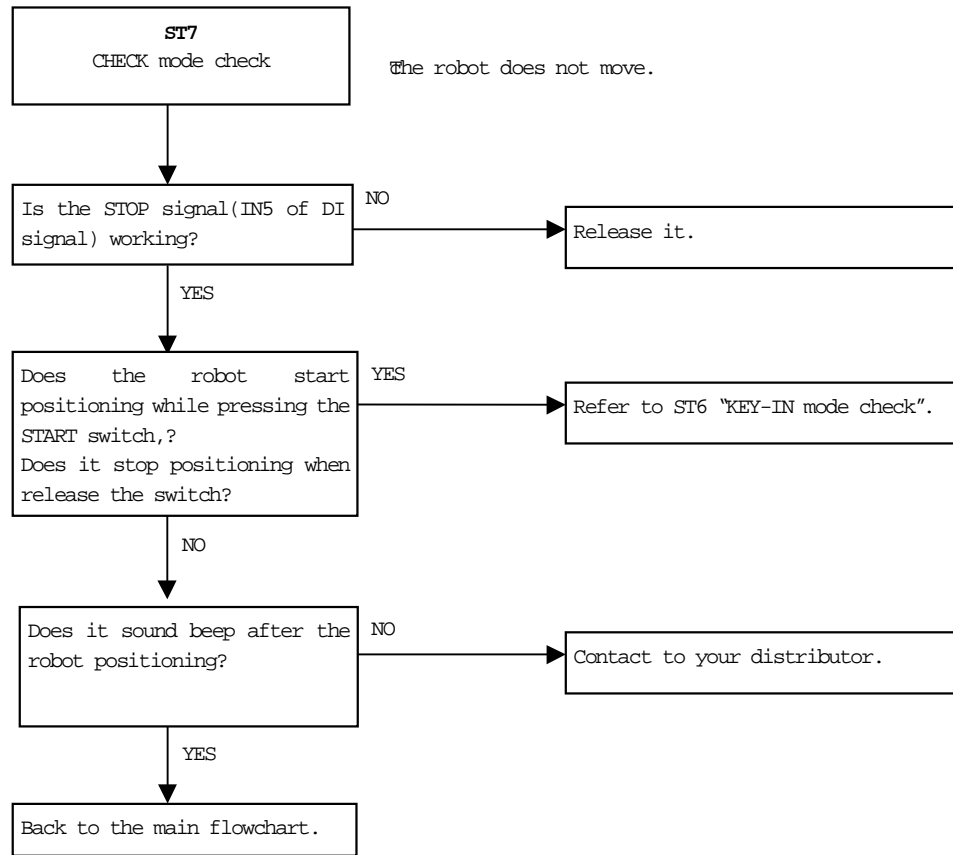
9.2.7 KEY-IN Mode Check



9.2.8 TEACH Mode Check



9.2.9 CHECK Mode Check

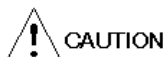
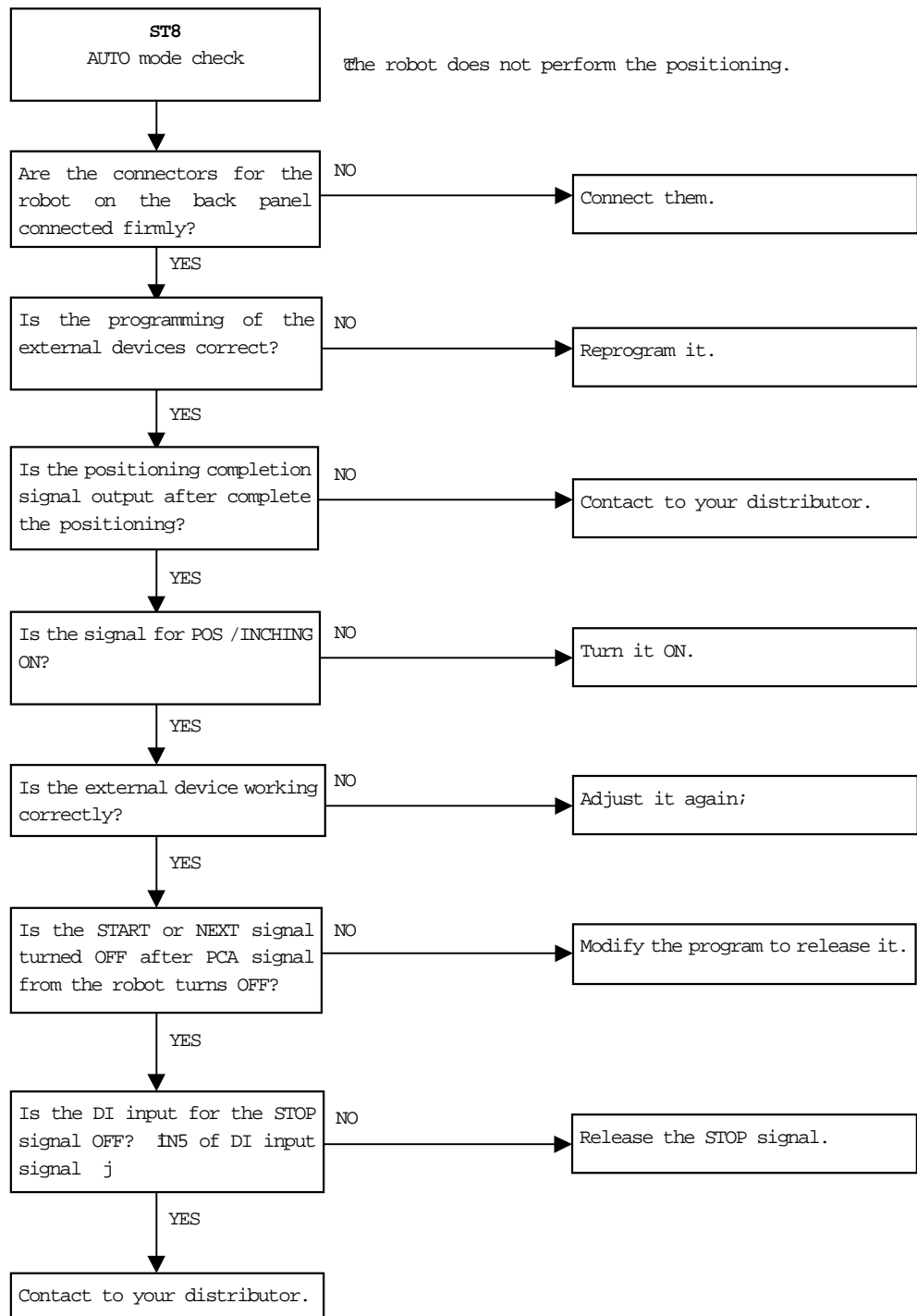


NOTE

At "M = ??", the robot does not perform positioning even if pressing the key. Set the M number in the KEY-IN mode.



9.2.10 AUTO Mode Check



CAUTION

If the error occurs during the automatic operation, error signal and code will be output to the PLC.

APPENDIX

APPENDIX A Check Pin and Indicators

APPENDIX A.1 System Board•HPC-740A•

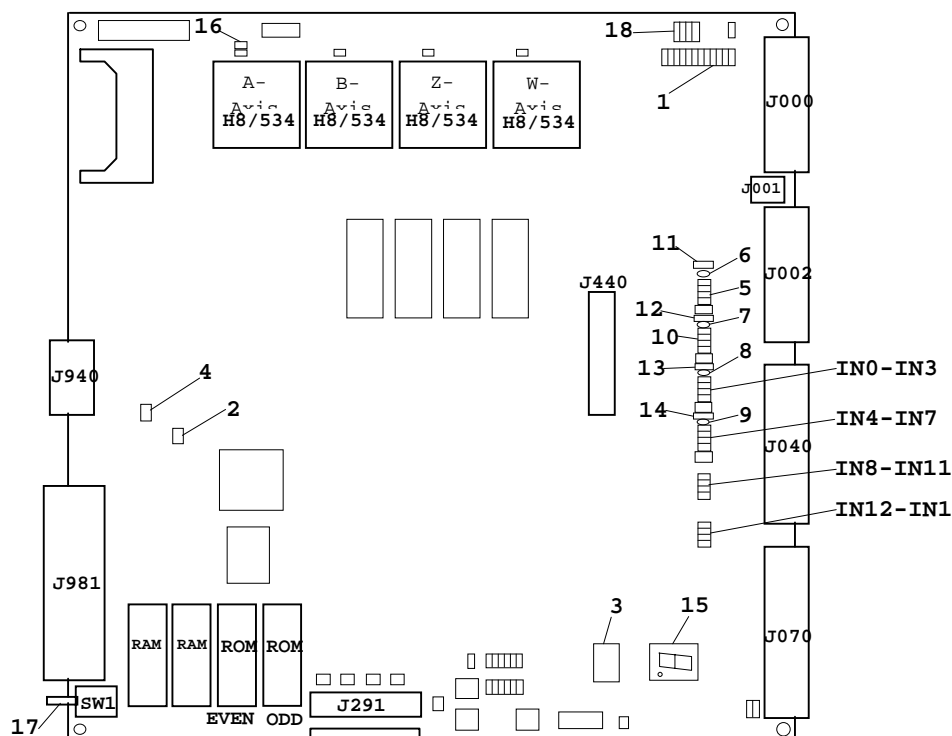


Fig.A.1 System Board•HPC-740A•

Table A.1 Function for the Indicators

| NO. | Parts | Function | NO. | Parts | Function |
|-----|------------------|-------------------------------|-----|------------------|----------------------------------|
| 1 | 1-Encoder signal | X-Axis encoder signal monitor | 10 | 3-OVR (LED) | Z-Axis overrun monitor |
| 1 | 2-Encoder signal | Y-Axis encoder signal monitor | 10 | 3-ORG (LED) | Z-Axis origin monitor |
| 1 | 3-Encoder signal | Z-Axis encoder signal monitor | 10 | 4-OVR (LED) | W-Axis overrun monitor |
| 1 | 4-Encoder signal | W-Axis encoder signal monitor | 10 | 4-ORG (LED) | W-Axis origin monitor |
| 2 | ENCALM (LED) | Encoder signal error monitor | 11 | M1(X -Axis) | Encoder M (X-Axis) signal switch |
| 3 | SW2 | System switch | 12 | M2(Y -Axis) | Encoder M (Y-Axis) signal switch |
| 4 | ES (LED) | E.S. monitor | 13 | M3(Z -Axis) | Encoder M (Z-Axis) signal switch |
| 5 | 1-OVR (LED) | X-Axis overrun monitor | 14 | M4(W -Axis) | Encoder M (W-Axis) signal switch |
| 5 | 1-ORG (LED) | X-Axis origin monitor | 15 | System indicator | Error code |
| 5 | 2-OVR (LED) | Y-Axis overrun monitor | 16 | WDT (LED) | CPU error (Watch dog timer) |
| 5 | 2-ORG (LED) | Y-Axis origin monitor | 17 | Pendant remove | Pendant remove switch |
| 6 | 1x2 | X-Axis encoder resolution | 18 | 1UD | X-Axis A-CAL direction |
| 7 | 2x2 | Y-Axis encoder resolution | 18 | 2UD | Y-Axis A-CAL direction |
| 8 | 3x2 | Z-Axis encoder resolution | 18 | 3UD | Z-Axis A-CAL direction |
| 9 | 4x2 | W-Axis encoder resolution | 18 | 4UD | W-Axis A-CAL direction |

1) Encoder signal error LED is lit when the error is detected. •

- 2) WDT LED is lit when the error is detected.
- 3) Parallel input monitor is lit when input is ON.

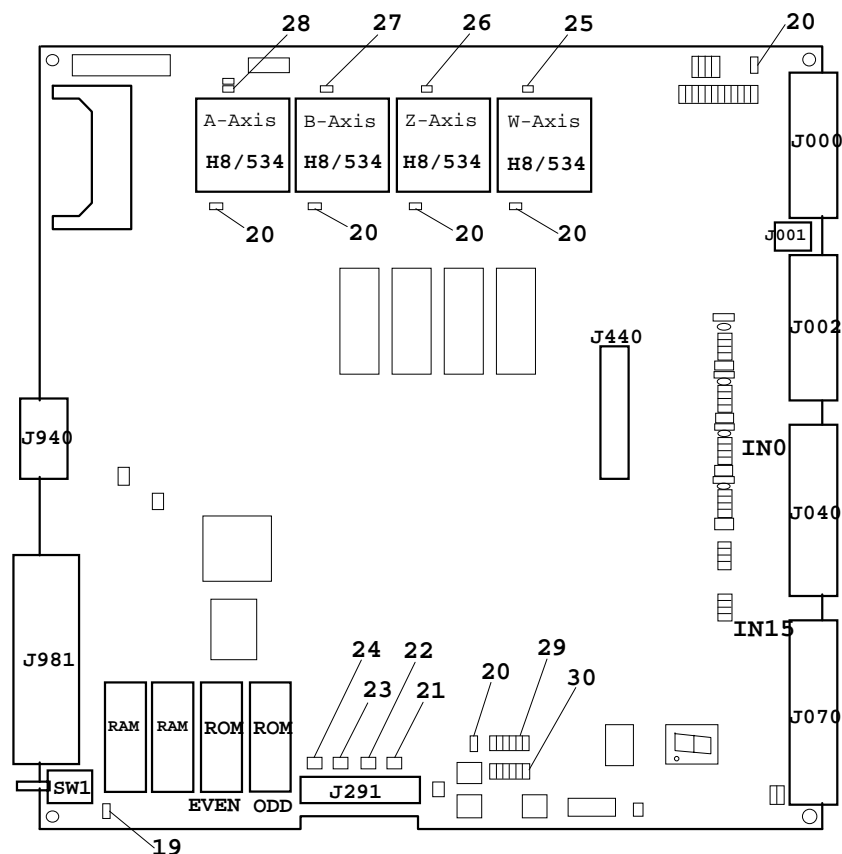


Fig.A.2 System Board•HPC-740A•

Table A.2 Function for the Indicators

| No. | Parts | Function | No. | Parts | Function |
|-----|-------|--------------------------|-----|-------|--------------------------|
| 19 | +5V | +5V power monitor | 20 | GND | GND power monitor |
| 21 | XRDY | Lit when X-Axis is ready | 22 | YRDY | Lit when Y-Axis is ready |
| 23 | ZRDY | Lit when Z-Axis is ready | 24 | WRDY | Lit when W-Axis is ready |
| 25 | D7 | X-Axis CPU indicator LED | 26 | D6 | Y-Axis CPU indicator LED |
| 27 | D5 | Z-Axis CPU indicator LED | 28 | D4 | W-Axis CPU indicator LED |
| 29 | XM | X-Axis encoder M monitor | 30 | YM | Y-Axis encoder M monitor |
| 29 | XA | X-Axis encoder A monitor | 30 | YA | Y-Axis encoder A monitor |
| 29 | XB | X-Axis encoder B monitor | 30 | YB | Y-Axis encoder B monitor |
| 29 | ZM | Z-Axis encoder M monitor | 30 | WM | W-Axis encoder M monitor |
| 29 | ZA | Z-Axis encoder A monitor | 30 | WA | W-Axis encoder A monitor |
| 29 | ZB | Z-Axis encoder B monitor | 30 | WB | W-Axis encoder B monitor |

APPENDIX A.2 Servo Driver Power Board (HPC-741A●)

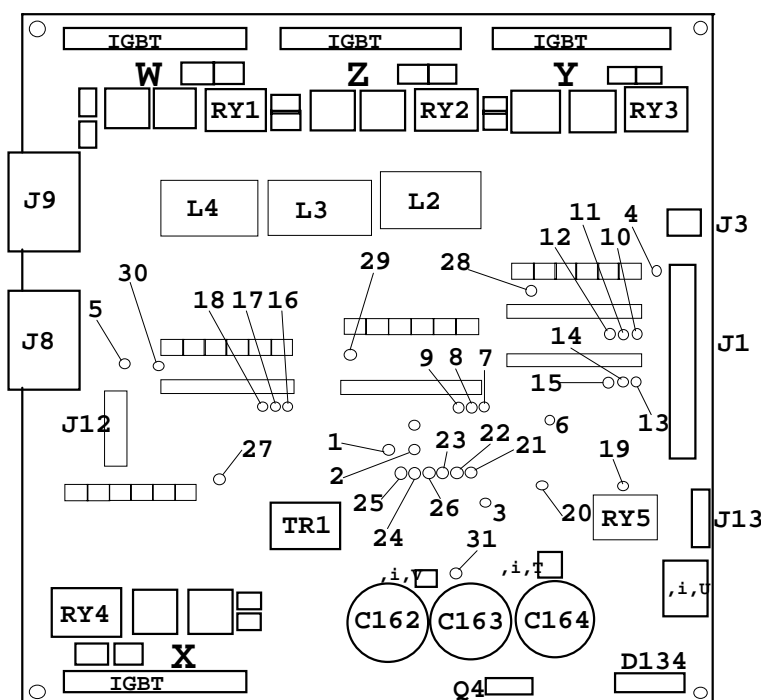


Fig.A.3 Servo Driver Power Board (HPC-741A●)

Table A.3 Function for the Indicators

| No. | Parts | Function | No. | Parts | Function |
|-----|--------------|--------------------------------|-----|---------------|--------------------------------|
| 1 | XW0V (CH17) | XW0V power monitor | 2 | XZ0V (CH18) | XZ0V power monitor |
| 3 | A0V (CH19) | A0V power monitor | 4 | +5V (CH7) | +5V power monitor |
| 5 | +12V (CH1) | +12V power monitor | 6 | 2.5V (CH2) | 2.5V power monitor |
| 7 | XUIF (CH15) | X-Axis current U phase monitor | 8 | XVIF (CH14) | X-Axis current V phase monitor |
| 9 | XWIF (CH16) | X-Axis current W phase monitor | 10 | YUIF (CH11) | Y-Axis current U phase monitor |
| 11 | YVIF (CH12) | Y-Axis current V phase monitor | 12 | YWIF (CH13) | Y-Axis current W phase monitor |
| 13 | ZUIF (CH8) | Z-Axis current U phase monitor | 14 | ZVIF (CH9) | Z-Axis current V phase monitor |
| 15 | ZWIF (CH10) | Z-Axis current W phase monitor | 16 | WUIF (CH3) | W-Axis current U phase monitor |
| 17 | WVIF (CH4) | W-Axis current V phase monitor | 18 | WWIF (CH5) | W-Axis current W phase monitor |
| 19 | D22 (ZBK) | Z-Axis brake control LED | 20 | D23 (ESALO) | ES indicator LED |
| 21 | D107 (VTALM) | Over voltage LED | 22 | D106 (OVERHT) | Overheat LED |
| 23 | D105 (+15V) | +15V power indicator LED | 24 | D104 (YZ20V) | YZ20V power LED |
| 25 | D103 (XW20V) | XW20V power LED | 26 | D102 (+12V) | +12V power |
| 27 | D91 (XOC) | X-Axis over current LED | 28 | D69 (YOC) | Y-Axis over current LED |
| 29 | D68 (ZOC) | Z-Axis over current LED | 30 | D67 (WOC) | W-Axis over current LED |
| 31 | D133 (GATE) | Regenerative voltage error LED | - | - | - |

1) Z -Axis brake control LED is lit when brake is ON.

2) ES indicator LED is OFF when ES is activated.

3) Over voltage, overheat, and over current LED is lit in the abnormal status.

APPENDIX B Spare Parts List

Fig.A.4 Spare Parts List

| Item | Part No. | Maker |
|-----------------|----------|--------|
| Lithium battery | H-3339 | HIRATA |
| CPU board | HPC-740A | HIRATA |
| Power board | HPC-741A | HIRATA |
| | | |
| | | |
| | | |

CHAPTER 3 A-CAL

3.1 Outline of A-CAL

When you start operating the robot, the 『A-CAL (Automatic origin calibration)』 LED must be lit. Detection of the position of each robot axis is done by the counter in the controller, which counts the pulses generated by the encoder connected to each axis motor. As the encoder and the counter are operated by electricity, the count will not be performed if power is not supplied to the controller. To enable the robot to be positioned to the same position each time and to let the controller detect the position of the robot correctly, it is necessary to match the reference point of the robot to that of the controller.

A-CAL means automatic origin calibration (return to origin) of both the robot and the controller in order to match their reference points.



You do not need to execute A-CAL repeatedly unless the 『A-CAL』 LED turns off.

Once you have executed A-CAL after turning on the power, it is not necessary to execute it repeatedly unless the power is shut off. (You can specify whether A-CAL should be executed after the restoration from emergency stop, by setting the data of the System Parameterⁱ 「SET-UP」 → 「SYSTEM」 → 「EMERGENCY STOP」.)

ⁱ You can jump to it with the  +  keys.



3.2 A-CAL Parameter

The following table shows the data that are referred to when A-CAL is performed.

For details, refer to Chapter 18 “DETAILS OF SYSTEM GENERATION” and Chapter 19 “DETAILS OF SYSTEM PARAMETER.”

Table 3. 1 A-CAL setting data

| Parameter | Description | Setting data |
|---|---|--|
| System Generation ⁱ → 「MAINTE」→ 「MAINTENANCE DATA」→ 「A-CAL CHECK」 | Specifies the type of A-CAL operation. 0 : Performs normal A-CAL using sensors and makers. 1 : Gives a warning when the origin point of the robot is outside the prescribed area, but continues processing. 2 : Ignores the error that occurs when the origin point of the robot is outside the prescribed area. 8 : Performs A-CAL on a specified axis. (When both the ABS motor ⁱⁱ and the Incre. Motor ⁱⁱⁱ are mounted.) 16 : Compares the position with the stored ZERO signal position in the sensor. (Z-axis only) (Available only to a special robot.) 32 : Used for special robot only. 64 : A-CAL without axis operation ^{iv} 128 : Stores the ZERO signal position in the sensor. (For ZERO signal adjustment, Z-axis only) (Available only to a special robot.) 256 : Used when two turns of W-axis operating range are used. (Available only to a special robot.) | When you wish to select multiple A-CAL operations, add up respective setting values. For example, when you set this parameter to 17, it means 16 + 1; the robot position when the ORIGIN sensor is turned on will be regarded as the origin point, and a warning will be given when the origin point of the robot is outside the prescribed area, but processing will be continued. |

ⁱ You can jump to it with the  +  keys.



ⁱⁱ ABS motor: Absolute encoder type motor

ⁱⁱⁱ Incre. motor: Incremental encoder type motor


^{iv} The present position will be the origin point with no operation of an axis.

| Parameter | Description | Setting data |
|---|---|--|
| System Generation→ 「ORIGIN」→ 「AXIS DIRECTION」→ 「A-CAL SEQ」 | Specifies the sequence of axes in A-CAL. Each digit corresponds to each axis as shown below. <pre> O O O O O O O O ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ A B Z W A B Z W </pre> When you wish to perform A-CAL on multiple axes simultaneously, specify the same number for them. The shaded area is used in the second ⁱ . | The setting value ranges from 0000: No sequence specification. A-CAL will be performed in a standard sequence. To 6666: A-CAL will be performed simultaneously on all axes. Standard setting is 2212: A-CAL will be performed first on the Z-axis, and then on the remaining axes upon completion of A-CAL of the Z-axis. |
| System Parameter ⁱⁱ → 「RESPONSE」→ 「RESPONSE」→ 「A-CAL SPEED」 | Specifies the speed of the robot during A-CAL. The speed shall be specified as a percentage of the maximum speed. | The setting value ranges from 1 through 999. (0.1%-99.9%) Standard setting value is 250. |

ⁱ For details, refer to (1) A-CAL SEQ in 18.3.2 “AXIS DIRECTION.”

ⁱⁱ You can jump to it with the  +  keys.

3.3 Flow of A-CAL Operation

When the system is in the TEACH or CHECK mode, press the  key of the Teach Pendant to execute A-CAL. During automatic operation, use a command inputted from an external device (AUTO mode: SELECT signal, ON-LINE mode: A-CAL command).

In a standard A-CAL operation, A-CAL is performed first on the Z-axis (the axis for up-and-down motion) to prevent interference with the other equipment; then the A (X), B (Y), and W axes will move slowly toward their respective ORIGIN sensors. After these ORIGIN sensors for the A (X), B (Y), and W axes have turned ON, these three axes will move inside the operating range and then move toward the ORIGIN sensors again, for the sake of checking the motors and the sensors. When the ORIGIN sensors have turned ON for the second time and an M signal is generated from the encoder, the position counter in the control panel will be reset to “0,” and the origin points of the robot and the controller will be matched.

After this, each axis will return inside the operating range, and then move toward the ORIGIN sensor again. The readout of the counter at the time when the sensor turns ON will be checked.

After the checking of the counter readout, each axis will return inside the operating range and stop, otherwise the axes will remain in an overrun state and the robot cannot be operated. Then A-CAL is completed.

A-CAL of each axis is performed in accordance with the following flow.

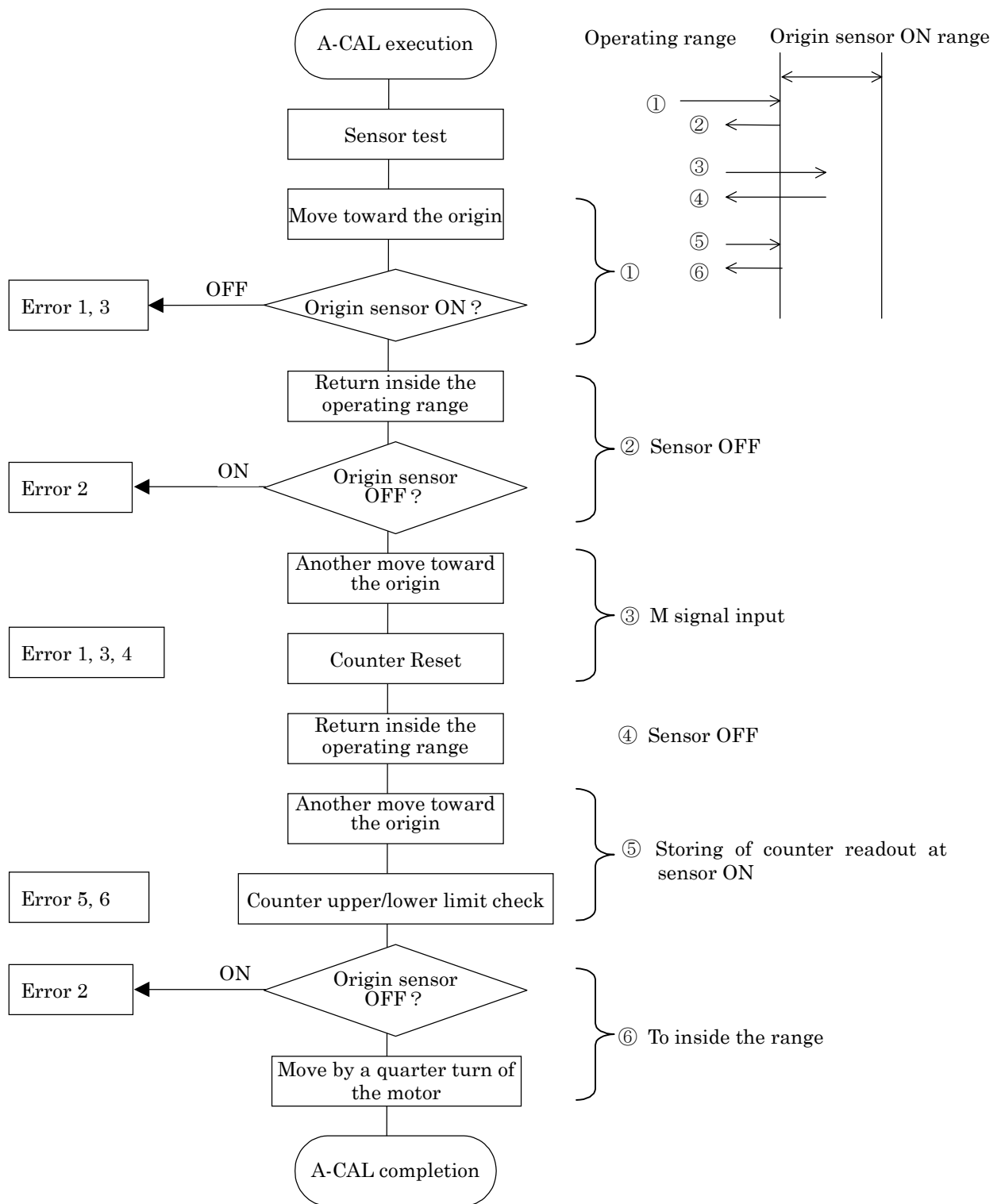


Fig. 3. 1 Flow of A-CAL



NOTE

Position of the robot after the completion of A-CAL is not based on precise positioning data.

3.4 A-CAL Speed

The axis speed for A-CAL is obtained by the following expression.

$$\text{Axis speed} = \text{Maximum axis speed (catalog value)} \times \frac{\text{Output speed value}}{1023}$$

The output speed value varies depending on the A-CAL operation. The following is the list of the output speed values.

Table 3. 2

| Operation order | Operation | Output speed value |
|-----------------|--|--------------------|
| 1 | Movement to origin | Can be changed. |
| 2 | Movement to operation area side | 10 |
| 3 | Movement to operation at counter reset | 8 |
| 4 | Movement to operation area side at counter reset | 8 |
| 5 | Movement to origin at counter check | 8 |
| 6 | Movement to operation area side at counter check | 10 |

To set the output speed during the movement to the origin in the operation order 1, select the System Parameter 「RESPONSE」→「RESPONSE」→「A-CAL SPEED」 (referred to as A-CAL speed). The output speed is obtained by the following expression.

$$\text{Output speed value} = (\text{Maximum output speed value}^i - 10) \times \frac{\text{A-CAL speed}}{999} + 10$$




CAUTION

When the maximum output speed value is smaller than 40, the maximum output speed value shall be 40.

ⁱ Refer to 26.1 “Robot Speed during Manual Operation.”


3.5 A-CAL Procedure

When the system is in the TEACH or CHECK mode, press the  key of the Teach Pendant to execute A-CAL. During automatic operation, use a command inputted from an external device (AUTO mode: SELECT signal, ON-LINE mode: A-CAL command).

The following is the procedure for executing A-CAL manually.

3.5.1 Executing A-CAL on All Axes

This operation is possible only for the incremental encoder type motor.

- (1) Set the mode selector switch of the Teach Pendant to RO-TEACH, LI-TEACH, or CHECK. A-CAL can be executed when any of these modes is selected. The A-CAL procedure is the same in any case.
- (2) Hold down the Deadman switch of the Teach Pendant during all the steps described below. If you release the Deadman switch, Emergency Stop will be activated.
- (3) Press the  key. The A-CAL axis selection screen will appear.

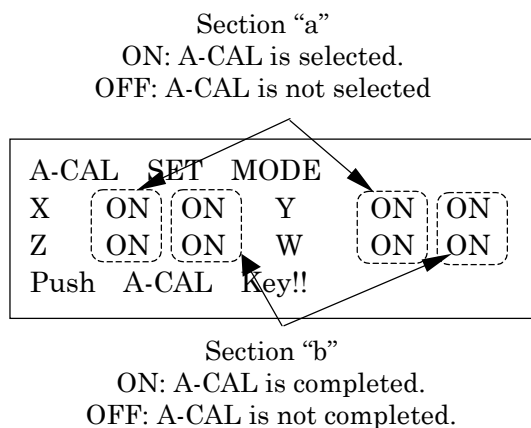

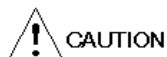



Fig. 3. 2 A-CAL axis selection screen

- (4) Hold the  key down until A-CAL is completed.
- (5) When A-CAL is completed, the message "A-CAL COMPLETED" will appear and a buzzer will sound.



When A-CAL of all the axes is completed, the 『A-CAL』 LED will light up.










If you release the  key before the completion of A-CAL, A-CAL will be interrupted with a buzzer and the message "A-CAL INCOMPLETE."

As the A-CAL of the selected axes remains incomplete, go back to step (2) and execute A-CAL again.

3.5.2 Executing A-CAL on Specific Axes

This operation is possible for both the incremental encoder type motor and the absolute encoder type motor. The procedure explained here is the one for the incremental encoder type motor.

- (1) Set the mode selector switch of the Teach Pendant to RO-TEACH, LI-TEACH, or CHECK. A-CAL can be executed when any of these modes is selected. The A-CAL procedure is the same in any case.
- (2) Hold down the Deadman switch of the Teach Pendant during all the steps described below. If you release the Deadman switch, Emergency Stop will be activated.
- (3) Press the  key. The A-CAL axis selection screen will appear.

Then select axes on which you wish to perform A-CAL with the ,   and  key (or , ). "ON" will be displayed in the section "a" of the selected axes, and A-CAL will be performed only on these axes. All the axes should be selected in ordinary cases.

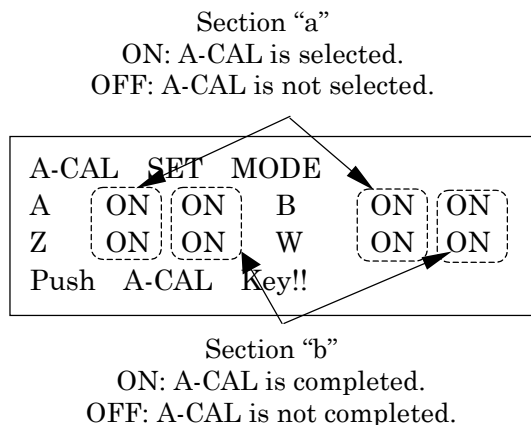









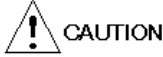
Fig. 3. 3 A-CAL axis selection screen


-  key: Selects the A axis.
 -  key: Selects the B axis.
 -  key: Selects the Z axis.
 -  key: Selects the W axis.
 -  key: Selects the R axis when a special ROM is used.
 -  key: Selects the R axis when a special ROM is used.
- (4) When the selection of axes is completed, hold the  key down until A-CAL is completed.

- (5) When A-CAL is completed, the message
“A-CAL COMPLETED”
will appear and a buzzer will sound.




When A-CAL of all the axes is completed, the 『A-CAL』 LED will light up.



If you release the  key before the completion of A-CAL, A-CAL will be interrupted with a buzzer and the message “A-CAL INCOMPLETE.”
As the A-CAL of the selected axes remains incomplete, go back to step (2) and execute A-CAL again.

3.5.3 A-CAL of Absolute Encoder Type Motor Manufactured by Sanyo Denki Co., Ltd.



1. When executing A-CAL, be sure to follow the procedure described below.
2. Reset of the absolute encoder required at system start-up and such must be performed after the completion of adjustments such as sensor adjustment following temporary A-CAL. The robot can be operated even if A-CAL is executed without the reset of the absolute encoder. However, this A-CAL will be a temporary one, and displacement of the robot may occur in the case where the power is turned off and on again. For proper A-CAL, execute A-CAL together with the reset of the absolute encoder.
3. In the following cases, displacement of the robot may occur after the power is turned off and on again
 - A-CAL is executed without the reset of the encoder (step (4) below).
 - The encoder is reset, but an axis of the robot is moved before the execution of A-CAL.
 - A-CAL is interrupted halfway through the operation.
 - A-CAL is executed after the power is turned on with no battery connected.
4. When displacement of the robot occurs after the power of the controller is turned off and on even though the 『A-CAL』 LED is lit, execute A-CAL again following the procedure described below.
5. When the system cannot be started up normally, turn on the power while holding down the  key of the Teach Pendant, and release it when normal display appears.

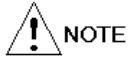
- (1) Set the mode selector switch of the Teach Pendant to KEY-IN.
- (2) Turn on the power of the controller.
- (3) Select System Generation 「MAINTENANCE」 → 「MAINTENANCE DATA」 → 「EMP SELECT」, and set this parameter to 255. When a value other than 255 is given, a servo error will occur during A-CAL.



CAUTION

Be sure to record the original data. The data must be restored to the original one after the completion of A-CAL.

- (4) Reset the encoders of all the axes by the following procedure.



NOTE

The encoder must be reset even when the 7-segment LED of the servo driver displays “U.” A-CAL is required after the “U” error is remedied.

- ① Check that a 2-pin connector exists in the controller.

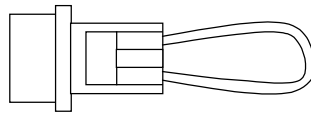


Fig. 3. 4 2-pin connector

- ② Check that the servo driver that requires encoder reset has a connector with mark tubes bearing inscriptions “**CLR” and “24N.” The “**” in the mark tube inscription shows the name of each axis.
- ③ Connect the 2-pin connector to the connector of the servo driver. Wait for four seconds, and then disconnect the connectors.

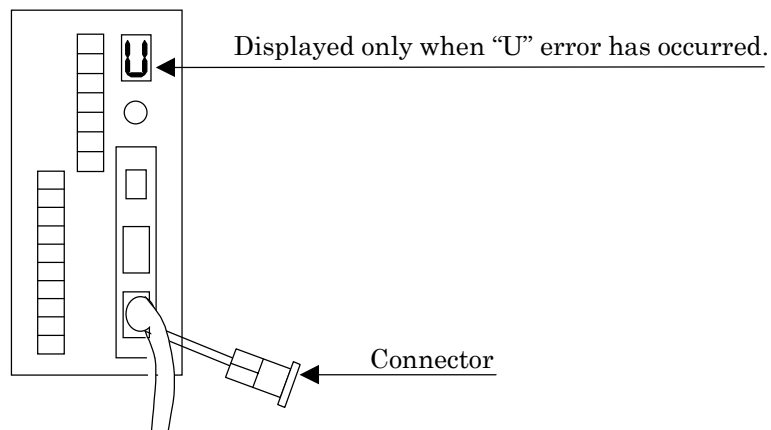




Fig. 3. 5 Connector connection

- (5) Turn off the power of the controller.
- (6) Turn on the power of the controller again.
- (7) Press the  +  keys to switch the system to the ROBOT CALCULATE mode (the mode for automatic creation of position data and parameters). Each axis' pulse data at the time when the power is turned on is displayed in “ABS.ENC.A” through “ABS.ENC.W”ⁱ of the ABS.DATA in the MEMORY mode. (For

ⁱ “ABS.ENC.R” and “ABS.ENC.C” will be added when a special ROM is used.

details, refer to 12.3.2 “ABS.DATA SET (Absolute encoder data).”) If the pulse data is within ± 8192 , reset of the absolute encoder is complete.

- (8) Set the mode selector switch of the Teach Pendant to RO-TEACH.
- (9) Display pulse data for the position data.

- ① Press the

| |
|------|
| FUNC |
| HIGH |

 +

| |
|-------|
| local |
| F |

 keys
- ② Press the

| |
|-------|
| s. ed |
| 4 |

 key.
- ③ Press the

| |
|------|
| READ |
|------|

 key.

- (10) Hold down the Deadman switch of the Teach Pendant during all the steps described below. If you release the Deadman switch, Emergency Stop will be activated.

- (11) Press the

| |
|-------|
| A-CAL |
|-------|

 keys. The A-CAL axis selection screen will appear.

Then select axes on which you wish to perform A-CAL with the

| |
|------|
| +R/R |
| +X |

,

| |
|----|
| +C |
| +Y |

,

| |
|----|
| ↑Z |
|----|

 and

| |
|----|
| +W |
|----|

 (or

| |
|------|
| +R/R |
| +X |

,

| |
|----|
| +C |
| +Y |

) keys. “ON” will be displayed in the section “a” of the selected axes, and A-CAL will be performed only on these axes. All the axes should be selected in ordinary cases.

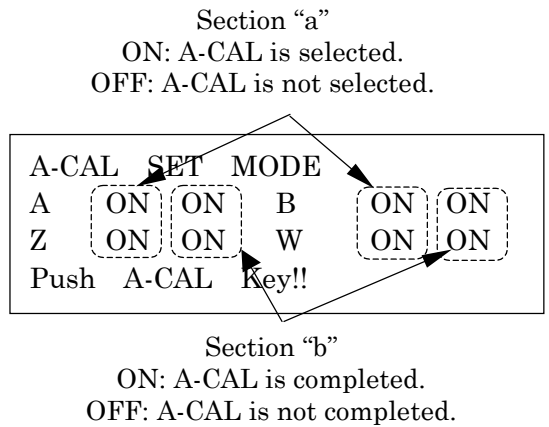


Fig. 3. 6 A-CAL axis selection screen

- | |
|------|
| +R/R |
| +X |

 key: Selects the A axis.
- | |
|----|
| +C |
| +Y |

 key: Selects the B axis.
- | |
|----|
| ↑Z |
|----|

 key: Selects the Z axis.
- | |
|----|
| +W |
|----|

 key: Selects the W axis.
- | |
|-------|
| SHIFT |
|-------|

,

| |
|------|
| +R/R |
| +X |

 key: Selects the R axis when a special ROM is used.
- | |
|-------|
| SHIFT |
|-------|

,

| |
|----|
| +C |
| +Y |

 key: Selects the R axis when a special ROM is used.

- (12) When the selection of axes is completed, hold the

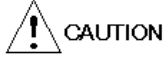
| |
|-------|
| A-CAL |
|-------|


 key down until A-CAL is completed.

- (13) When A-CAL is completed, the message
“A-CAL COMPLETED”
will appear and a buzzer will sound.









When A-CAL of all the axes is completed, the 『A-CAL』 LED will light up.



If you release the  key before the completion of A-CAL, A-CAL will be interrupted with a buzzer and the message “A-CAL INCOMPLETE.”
As the A-CAL of the selected axes remains incomplete, go back to step (4) and execute A-CAL again.

- (14) Move the axes that have finished A-CAL by approx. 100 mm toward the operating range. Then check and record the current axis position data by means of pulse data.

The following is the procedure for displaying pulse data.


- ① Press the  +  keys.
 - ② Press the  key.
 - ③ Press the  key.
- (15) Switch the system to the KEY-IN mode.
- (16) Turn off the power of the controller.
- (17) Turn on the power of the controller again.
- (18) Switch the system to the RO-TEACH mode, and let the screen display position data in pulses.
- (19) Compare the current position data on the display with the data recorded in step (14) (before the power is turned off). A-CAL can be considered to be successful if the difference between the two data is within 100 pulses. If the difference exceeds 100, go back to step (4) and execute A-CAL again on the axis in question.
- (20) If A-CAL has been performed successfully, press the  +  keys to switch the system to the ROBOT CALCULATE mode (the mode for automatic creation of position data and parameters). Then record the data in “A-CAL DIS.A” through “A-CAL DIS.Wⁱ” of the ABS.DATA in the MEMORY mode. This data is used for restoration in case system data is corrupted.
- (21) Select System Generation 「MAINTENANCE」 → 「MAINTENANCE DATA」 → 「EMP SELECT」 and restore the data of this parameter to the original one in step (3).

ⁱ “A-CAL DIS.R” and “A-CAL DIS.C” will be added when a special ROM is used.

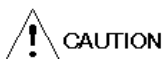
3.5.4 A-CAL of Absolute Encoder Type Motor Manufactured by Yasukawa Electric Corp.



CAUTION

1. When executing A-CAL, be sure to follow the procedure described below.
2. Reset of the absolute encoder required at system start-up and such must be performed after the completion of adjustments such as sensor adjustment following temporary A-CAL. The robot can be operated even if A-CAL is executed without the reset of the absolute encoder. However, this A-CAL will be a temporary one, and displacement of the robot may occur in the case where the power is turned off and on again. For proper A-CAL, execute A-CAL together with the reset of the absolute encoder.
3. In the following cases, displacement of the robot may occur after the power is turned off and on again
 - A-CAL is executed without the reset of the encoder (step (3) below).
 - The encoder is reset, but an axis of the robot is moved before the execution of A-CAL.
 - A-CAL is interrupted halfway through the operation.
 - A-CAL is executed after the power is turned on with no battery connected.
4. When displacement of the robot occurs after the power of the controller is turned off and on even though the 『A-CAL』 LED is lit, execute A-CAL again following the procedure described below.
5. When the system cannot be started up normally, turn on the power while holding down the  key of the Teach Pendant, and release it when normal display appears.

- (1) Select System Generation 「MAINTENANCE」 → 「MAINTENANCE DATA」 → 「EMP SELECT」 and set this parameter to 255. When a value other than 255 is given, a servo error will occur during A-CAL.



CAUTION

Be sure to record the original data. The data must be restored to the original one after the completion of A-CAL.

- (2) Turn off the power of the controller.
- (3) Disconnect the battery from the encoder of the robot. Then connect the supplied connector for encoder reset to the connector to which the battery has been connected.

Be sure to use the connector for resetting all axes. For the position of the battery, refer to the operation manual for the robot.

- (4) Leave the system for a specified time period with the encoder reset connector connected. The counter set in the encoder will then be reset to 0.

The specified time varies depending on the type of the controller used.

HNC-194 controller (AR-Z651)

Z axis: 5 - 10 minutes

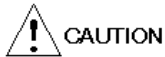
A, B, and W axes: 3 seconds (Σ-series servo driver)

HNC-394 controller (AR-K400CL)

All axes: 3 seconds (Σ-series servo driver)

The specified time for other Yasukawa-made absolute encoders (excl. the Σ-series servo driver) is 10 minutes. Although it causes no harm to the encoder if you leave it for a longer time, we recommend that you follow the specified time period.



- (5) Remove the encoder reset connector, and connect the battery.



CAUTION

If you turn on the power with the encoder reset connector connected, the encoder board may be broken. Be extremely careful not to forget to remove the connector.


- (6) Turn on the power of the controller.


- (7) Press the  +  keys to switch the system to the ROBOT CALCULATE mode (the mode for automatic creation of position data and parameters). Each axis' pulse data at the time when the power is turned on is displayed in “ABS.ENC.A” through “ABS.ENC.W” of the ABS.DATA in the MEMORY mode. (For details, refer to 12.3.2 “ABS.DATA SET (Absolute encoder data).”) If the pulse data is 0, reset of the absolute encoder is complete.

- (8) Set the mode selector switch of the Teach Pendant to “RO-TEACH.”

- (9) Display pulse data for the position data.







① Press the  +  keys

② Press the  key.

③ Press the  key.

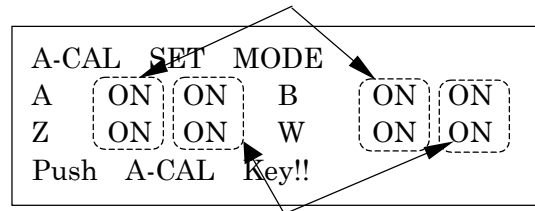
- (10) Hold down the Deadman switch of the Teach Pendant during all the steps described below. If you release the Deadman switch, Emergency Stop will be activated.

- (11) Press the  keys. The A-CAL axis selection screen will appear.

Then select axes on which you wish to perform A-CAL with the , ,  and  (or , ) keys. “ON” will be displayed in the section “a” of the selected axes, and A-CAL will be performed only on these axes. All the axes should be selected in ordinary cases.

ⁱ “ABS.ENC.R” and “ABS.ENC.G” will be added when a special ROM is used.

Section “a”
 ON: A-CAL is selected.
 OFF: A-CAL is not selected.



Section “b”
 ON: A-CAL is completed.
 OFF: A-CAL is not completed.

Fig. 3. 7 A-CAL axis selection screen

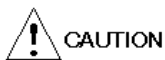
- key: Selects the A axis.
- key: Selects the B axis.
- key: Selects the Z axis.
- key: Selects the W axis.
- key: Selects the R axis when a special ROM is used.
- key: Selects the R axis when a special ROM is used.

(12) When the selection of axes is completed, hold the key down until A-CAL is completed.

(13) When A-CAL is completed, the message
 “A-CAL COMPLETED”
 will appear and a buzzer will sound.



When A-CAL of all the axes is completed, the 『A-CAL』 LED will light up.



If you release the key before the completion of A-CAL, A-CAL will be interrupted with a buzzer and the message
 “A-CAL INCOMPLETE.”
 As the A-CAL of the selected axes remains incomplete, go back to step (4) and execute A-CAL again.

(14) Move the axes that have finished A-CAL by approx. 100 mm toward the operating range. Then check and record the current axis position data by means of pulse data.

The following is the procedure for displaying pulse data.

- ① Press the + keys.
- ② Press the key.
- ③ Press the key.

- (15) Switch the system to the KEY-IN mode.
- (16) Turn off the power of the controller.
- (17) Turn on the power of the controller again.
- (18) Switch the system to the RO-TEACH mode, and let the screen display position data in pulses.
- (19) Compare the current position data on the display with the data recorded in step (14) (before the power is turned off). A-CAL can be considered to be successful if the difference between the two data is within 100 pulses. If the difference exceeds 100, go back to step (4) and execute A-CAL again on the axis in question.
- (20) If A-CAL has been performed successfully, press the

| |
|------|
| FUNC |
| HIGH |

 +

| |
|-----|
| cal |
| 1 |

 keys to switch the system to the ROBOT CALCULATE mode (the mode for automatic creation of position data and parameters). Then record the data in “A-CAL DIS.A” through “A-CAL DIS.Wⁱ” of the ABS.DATA in the MEMORY mode. This data is used for restoration in case System Data is corrupted.
- (21) Select System Generation 「MAINTENANCE」 → 「MAINTENANCE DATA」 → 「EMP SELECT」 and restore the data of this parameter to the original one in step (1).

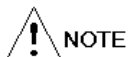
ⁱ “A-CAL DIS.R” and “A-CAL DIS.C” will be added when a special ROM is used.

3.6 A-CAL Related Errors

A-CAL is the most basic operation in the robot operations. Because it is possible to check the proper control and functioning of the motor encoders and the sensors through A-CAL, error detection is performed at each step of A-CAL. The following is the list of errors that can be detected during A-CAL.

Table 3. 3 List of A-CAL related errors





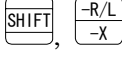

| Error code | Message | Description |
|------------|--------------|--|
| * 0 | * 0 Not Find | The ORIGIN sensor does not turn on even though the axis has moved to the origin point. |
| * 1 | * 1 Not OFF | The ORIGIN sensor does not turn off. The axis does not return to the operating range. |
| * 2 | * 2 Other ON | The OVERRUN sensor turned on when the axis moved to the origin point. |
| * 3 | * 3 Not Zero | The counter IC is not reset to 0. |
| * 4 | * 4 Lower | The counter was reset at a lower point than that specified. |
| * 5 | * 5 Upper | The counter was reset at an upper point than that specified. |
| * 6 | * 6 Minus | The readout of the pulse counter is minus. |
| * 7 | * 7 Error | Same as the following error “* 8” |
| * 8 | * 8 Abs. Rst | The absolute encoder has not been reset. |



NOTE

“*” represents each axis. (A = A (X) axis, B = B (Y) axis, Z = Z axis, W = W axis, R = R axis, C = C axis)

3.6.1 User action for “* 0 Not Find”

- (1) Check that the robot has been actuated. If it has not, the coupling might be loosened or the timing belt might have a break.
- (2) Move the robot to check that the ORIGIN sensors turn ON.
 - ① Switch the system to the RO-TEACH mode.
 - ② Press the key for moving an axis in a minus direction to move each axis toward the ORIGIN sensor.
 -  key: Moves the A axis toward the ORIGIN sensor.
 -  key: Moves the B axis toward the ORIGIN sensor.
 -  key: Moves the Z axis toward the ORIGIN sensor.
 -  key: Moves the W axis toward the ORIGIN sensor.
 -  keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.
 -  keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.





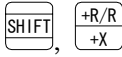

- ③ Check that the robot operates and the ORIGIN sensors turn ON. Also check that the message “OVER RUN ****(**)” will be displayed on the Teach Pendant when the sensors turn ON. In the “****(**)” of this message, the state of respective sensors is shown by means of the four numerals shown below. The data is arranged in the sequence of XYZW(RC).

Table 3. 4 Description of “**(**)”**





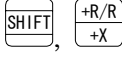







| Numeral | Description |
|---------|---|
| “0” | No sensor is ON. |
| “1” | The ORIGIN sensor is ON. |
| “2” | The OVERRUN sensor is ON. |
| “3” | Both the ORIGIN sensor and the OVERRUN sensor are ON. |

- ④ Check that “1” is displayed in the part of “****(**).” For example, when the ORIGIN sensor of the X axis has turned ON, the display will be “1000(00).” If this message is not displayed or a wrong number is displayed, there is a possibility that the ORIGIN sensor and the OVERRUN sensor are incorrectly wired, or the sensor is faulty.

3. 6. 2 User Action for “* 1 Not OFF”


- (1) Check that the robot has been actuated. If it has not, the coupling might be loosened or the timing belt might have a break.
- (2) Move the robot to check that the ORIGIN sensors turn OFF.
 - ① Switch the system to the RO-TEACH mode.
 - ② As the ORIGIN sensors have been ON, check that the message “OVER RUN ****(**)” appears and “1” is displayed in the part of “****(**).” For example, when the ORIGIN sensor of the X axis has turned ON, this display will be “1000(00).”
 - ③ Press the key for moving an axis in a plus direction to move each axis away from the ORIGIN sensor (toward the OVERRUN sensor).
 -  key: Moves the A axis toward the OVERRUN sensor.
 -  key: Moves the B axis toward the OVERRUN sensor.
 -  key: Moves the Z axis toward the OVERRUN sensor.
 -  key: Moves the W axis toward the OVERRUN sensor.
 -  keys: Move the R axis toward the OVERRUN sensor when a special ROM is used.
 -  keys: Move the C axis toward the OVERRUN sensor when a special ROM is used.
 - ④ Check that the robot operates and the ORIGIN sensors turn OFF.
 - ⑤ When the ORIGIN sensors turn OFF, the message on the Teach Pendant will disappear.

3.6.3 User Action for “* 2 Other ON”

- (1) Check that the robot has been actuated. If it has not, the coupling might be loosened or the timing belt might have a break.
- (2) Press the keys shown below to check the operation of each axis.
 - ① Switch the system to the RO-TEACH mode.
 - ② Check the operation of each axis.
 -  key: Moves the A axis toward the OVERRUN sensor.
 -  key: Moves the B axis toward the OVERRUN sensor.
 -  key: Moves the Z axis toward the OVERRUN sensor.
 -  key: Moves the W axis toward the OVERRUN sensor.
 -  keys: Move the R axis toward the OVERRUN sensor when a special ROM is used.
 -  keys: Move the C axis toward the OVERRUN sensor when a special ROM is used.
 -  key: Moves the A axis toward the ORIGIN sensor.
 -  key: Moves the B axis toward the ORIGIN sensor.
 -  key: Moves the Z axis toward the ORIGIN sensor.
 -  key: Moves the W axis toward the ORIGIN sensor.
 -  keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.
 -  keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.
- (3) Check that the ORIGIN sensor and the OVERRUN sensor of each axis turn ON/OFF by the key operations mentioned above. When they turn ON/OFF erroneously, there is a possibility that the ORIGIN sensor and the OVERRUN sensor are incorrectly connected.

3.6.4 User Action for “* 3 Not Zero”

When this error occurs, the ORIGIN sensor(s) might not turn ON or M signals (marker signals or Zero signals) might not be inputted from the motor.

- (1) Move the robot to check that the ORIGIN sensors turn ON and the on-state is maintained.
 - ① Switch the system to the RO-TEACH mode.
 - ② Press the key for moving an axis in a minus direction to move each axis toward the ORIGIN sensor.
 -  key: Moves the A axis toward the ORIGIN sensor.

- $\begin{matrix} -C \\ -Y \end{matrix}$ key: Moves the B axis toward the ORIGIN sensor.
- $\begin{matrix} 1Z \end{matrix}$ key: Moves the Z axis toward the ORIGIN sensor.
- $\begin{matrix} -W \end{matrix}$ key: Moves the W axis toward the ORIGIN sensor.
- $\begin{matrix} \text{SHIFT} \\ -R/L \\ -X \end{matrix}$ keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.
- $\begin{matrix} \text{SHIFT} \\ -C \\ -Y \end{matrix}$ keys: Move the R axis toward the ORIGIN sensor when a special ROM is used.

- (2) Otherwise, M signals might be interrupted or the motor might be faulty. In this case, contact HIRATA Corporation Robotics Division.

3.6.5 User Action for “* 4 Lower”

The sensor or the sensor dog is not properly adjusted. The count of pulses from ORIGIN sensor ON to the first M signal is smaller than a quarter of one turn of output pulses.

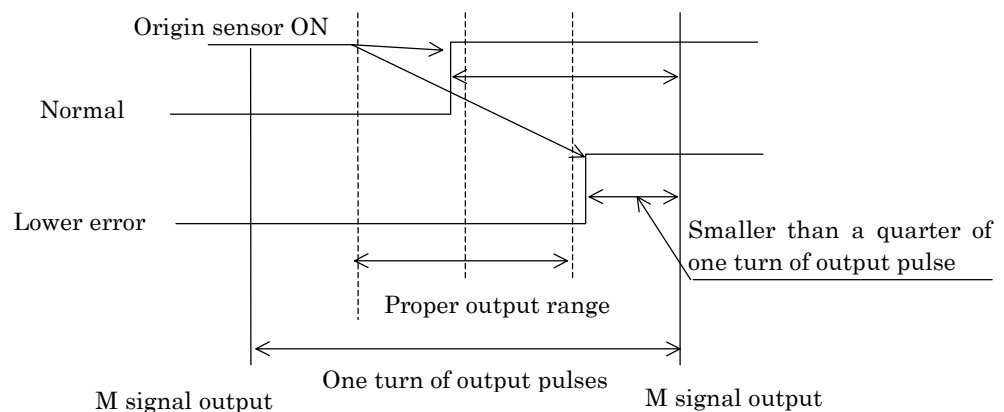


Fig.3. 8 Diagram of lower error

The proper output range for the ORIGIN sensor ON is from one quarter to three quarters of one turn of output pulses. Adjust the sensor or the sensor dog so that the sensor will turn ON within the proper range.

If the $\begin{matrix} \text{A-CAL} \end{matrix}$ key is held down after the completion of A-CAL, the count of pulses from ORIGIN sensor ON to M signal output is displayed. Adjust the sensor or the sensor dog while checking this data.

3.6.6 User Action for “* 5 Upper”

The sensor or the sensor dog is not properly adjusted. The count of pulses from ORIGIN sensor ON to the first M signal is greater than three quarters of one turn of output pulses.

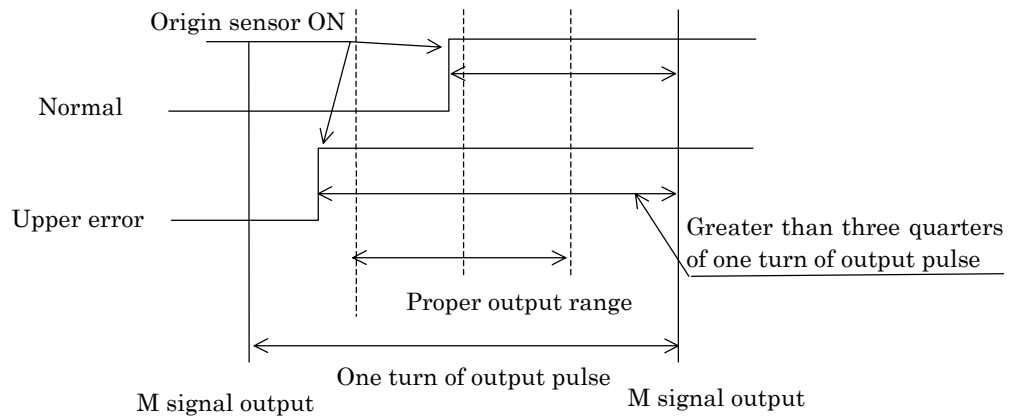


Fig. 3. 9 Diagram of upper error

The proper output range for the ORIGIN sensor ON is from one quarter to three quarters of one turn of output pulses. Adjust the sensor or the sensor dog so that the sensor will turn ON within the proper range.

If the A-CAL key is held down after the completion of A-CAL, the count of pulses from ORIGIN sensor ON to M signal output is displayed. Adjust the sensor or the sensor dog while checking this data.

3. 6. 7 User Action for “* 6 Minus”

- (1) The direction of A-CAL might not match the Up/Down switching of the hardware counter. In this case, adjust the direction of A-CAL. (Refer to 3.7 “Setting A-CAL Direction.”)
- (2) M signals from the motor might be outputted by the negative logic. Check the orientation of the switching jumper, and set it in a proper orientation.

3. 6. 8 User Action for “* 7 Error”

The error is displayed under the following “* 8 Abs. Rst” error occurrence depending on the software version of the controller.

3. 6. 9 User Action for “* 8 Abs. Rst”

This error occurs when the absolute encoder type motor is used and the absolute encoder has not been reset properly. Reset the absolute encoder referring to 3.5 “A-CAL Procedure.”

If the error persists, there is a possibility that the absolute reset connector wire have a break.






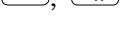


3. 6. 10 User Action for “OVER RUN ****(**)”

The OVERRUN sensor might have a broken wire. Check the OVERRUN sensor. However, the “OVER RUN ****(**)” error that occurs during the corrective actions for A-CAL related errors (mentioned above) is a normal message.

3.7 Setting A-CAL Direction



If the direction of A-CAL is not proper, the robot does not operate correctly. This section shows the procedure for setting the direction of A-CAL.









To set the A-CAL direction, first adjust the origin point side (the ORIGIN sensor) and the limit side (the OVERRUN sensor) of each axis. Then set the values of System Data for each axis and the orientation of the jumper switchⁱ for hardware counter up/down switching on the CPU boardⁱⁱ accordingly.

- (1) Set the data of the System Generation 「ORGIN」 → 「AXIS DIRECTION」 → 「A-CAL DIR.A (X)」 - 「INCH DIR W」 to “PLUS.”
- (2) Turn off the power of the controller and turn it on again.
- (3) Switch the system to the RO-TEACH mode.
- (4) Move each axis in a plus direction to check that it moves in a direction to turn on the OVERRUN sensor.
 -  key: Moves the A axis toward the OVERRUN sensor.
 -  key: Moves the B axis toward the OVERRUN sensor.
 -  key: Moves the Z axis toward the OVERRUN sensor.
 -  key: Moves the W axis toward the OVERRUN sensor.
 -  keys: Move the R axis toward the OVERRUN sensor when a special ROM is used.
 -  keys: Move the C axis toward the OVERRUN sensor when a special ROM is used.
 - ① If a servo error occurs before the axis is actuated by the press of the axis key of the Teach Pendant, the Up/Down switching of the hardware counter is improperly set. Turn off the power of the controller, and switch the jumper switch for hardware counter up/down switching on the CPU board. Turn on the power of the controller, and then perform the above check again.
 - ② If the axis moves in a direction to turn ON the ORIGIN sensor, set the data of the System Generation 「ORGIN」 → 「AXIS DIRECTION」 → 「A-CAL DIR. *」 to “MINUS.” Turn off the controller and on again, and perform the above check again.
- (5) Repeat step (4) until all the axes move correctly in a direction to turn on the OVERRUN sensor.
- (6) Display pulse data for the position data.
 - ① Press the  +  keys.

ⁱ It is referred to as “System board” in some controller operation manuals.

ⁱⁱ Before proceeding with the setting, refer to the operation manual for your controller and check the position of the jumper switch for hardware counter Up/Down switching (A-CAL direction switch) on the CPU board.

- ② Press the  key.
- ③ Press the  key.
- (7) Move each axis in a plus direction to check that the count of pulses increases.

-  key: Increases the pulse count of the A axis
-  key: Increases the pulse count of the B axis.
-  key: Increases the pulse count of the Z axis.
-  key: Increases the pulse count of the W axis.
- ,  keys: Increase the pulse count of the R axis when a special ROM is used.
- ,  keys: Increase the pulse count of the R axis when a special ROM is used.

If the pulse count of the specified axis decreases, turn off the power. Switch the jumper switch for hardware counter Up/Down switching on the CPU board of the axis in question. Then turn on the power and perform this check again.

- (8) Repeat step (7) until the pulse count of all the axes increases when they are moved in a plus direction.
- (9) When all of the above operation is completed, turn off the power and on again.
- (10) Setting of A-CAL direction is completed.