

KATO

Automatic Crane Stopper

ACS

SERVICE MANUAL

MS-10E

“Compuload”

With

Voice Alarm

KATO WORKS CO.,LTD.

PREFACE

(S151-000000E)

This is the maintenance manual for the new digital-type "Automatic Crane Stopper" (ACS) automatic overload-prevention equipment installed in KATO cranes.

Unlike past analog ACS systems, the microprocessor-equipped digital type ACS has a self-diagnosis function to facilitate maintenance, as well as the automatic overload-prevention function. The maintenance data which could be found only in the analog ACS service manual are conveniently accessible through the new self-diagnosis function. In addition to which the condition of the automatic overload-prevention system itself is automatically monitored, therefore increasing reliability. However, crane control governed by such advanced electronic technology cannot be expected to perform to its full capacity without the careful follow up of a service technician.

KATO is confident that you will be able to provide prompt, effective service using this manual.

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3. REPLACEMENTS (S151-030000E)

SYMBOLS AND TERMS

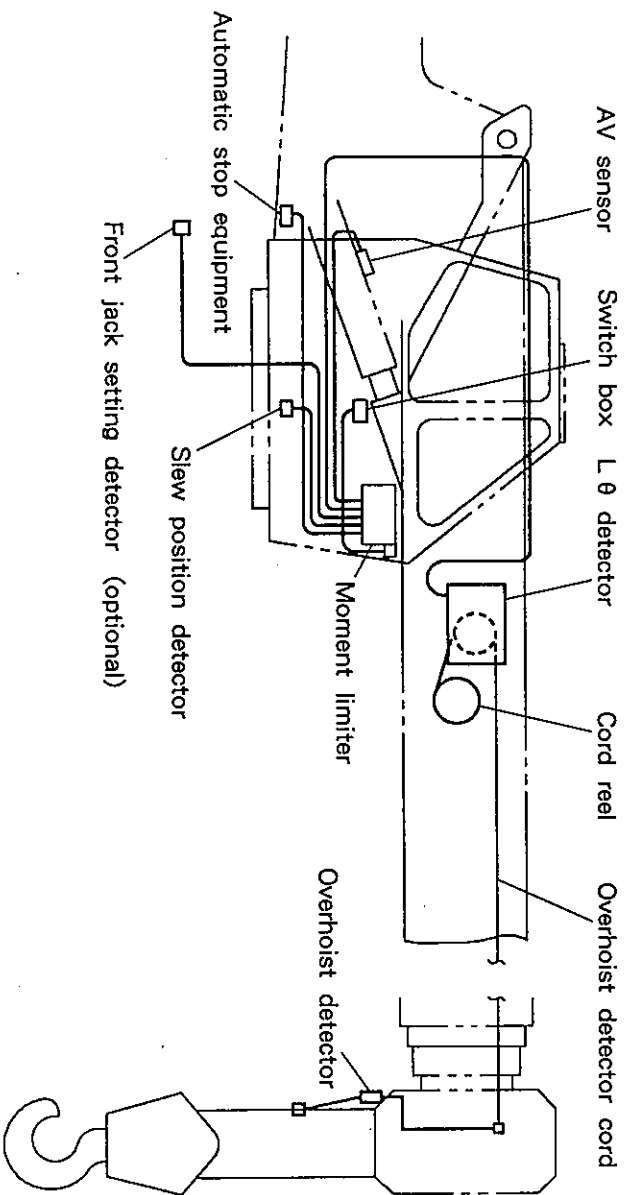
| | |
|---|--|
| L | Boom length |
| θ | Boom angle |
| P ₁ | Derrick cylinder head pressure |
| P ₂ | Derrick cylinder rod pressure |
| α | Slewing angle |
| OP | Operation condition |
| W _R | Limit/reference load (total) |
| W _A | Actual load (total) |
| R | Work radius |
| H | Max. lift |
| L θ | Boom length • Boom angle |
| Software | The set of programs recorded onto ROM that control what happens in what order, to the computer and therefore the equipment. |
| Hardware | Tangible electronic circuitry and elements, such as CPU, ROM. |
| CPU | Central Processing Unit. Computer system element which reads and executes programs. |
| ROM | Read Only Memory. Computer system memory element which allows retrieval of information. Contains program information. |
| RAM | Random Access Memory. Computer system memory element which allows both retrieval and storage of information. |
| I/O | Input/Output. An element or circuit for input or output. |
| A/D | Analog/Digital. Element which converts analog signals (e.g. sensor signals) to digital signals which can be used by the CPU. |
| LED | Light Emitting Diode. |
| LCD | Liquid Crystal Display. |
|  | Hazard lamp. |
| STOP I | Moment increase automatic stop. |
| STOP II | Upper angle limit automatic stop. |
| JS | Jibset |

1. CONFIGURATION AND FUNCTIONS

(S151-010000E)

CONFIGURATION AND FUNCTIONS

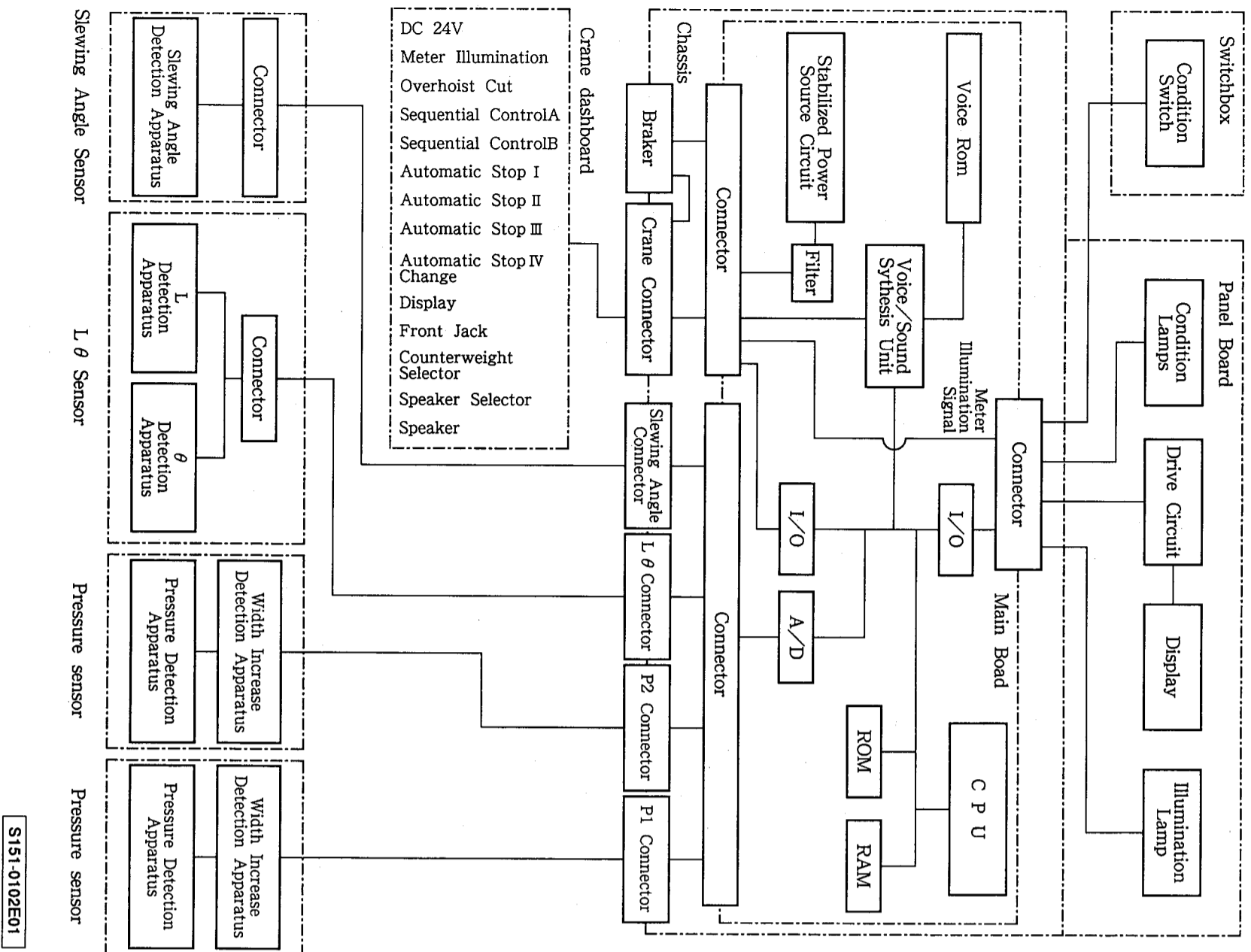
1-1 System Configuration (S151-010100E)



M151-0302E01-1

CONFIGURATION AND FUNCTIONS

1-2 Hardware Block Diagram (S151-010200E)

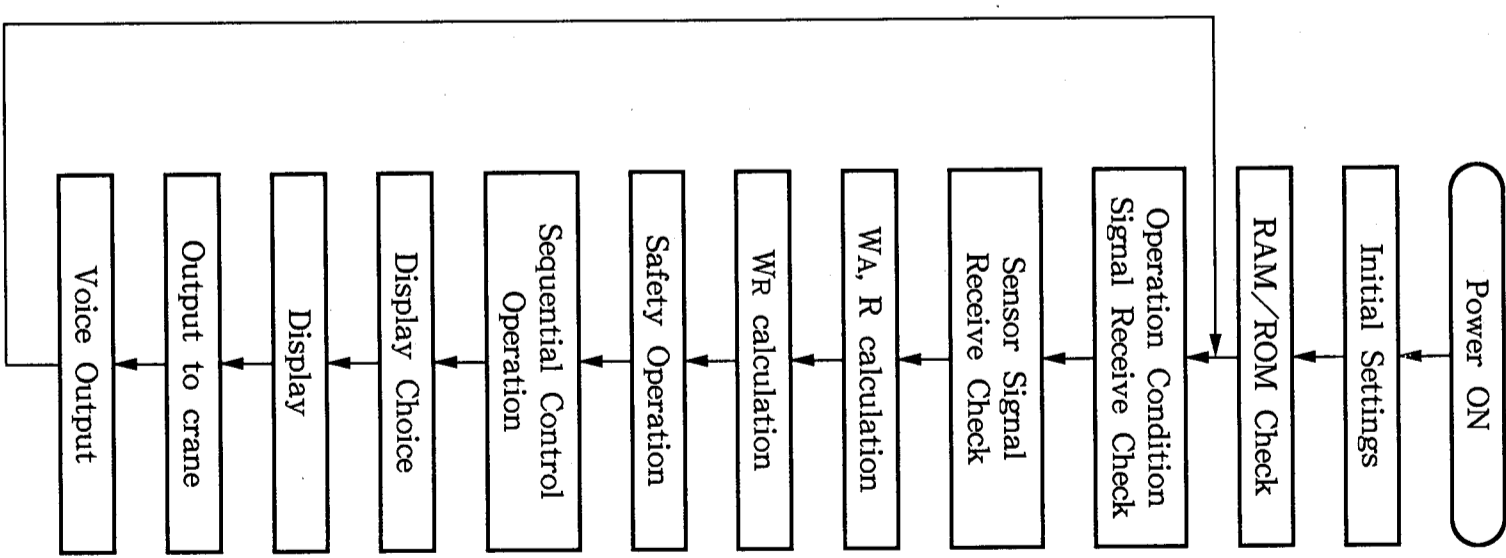


S151-0102E01

CONFIGURATION AND FUNCTIONS

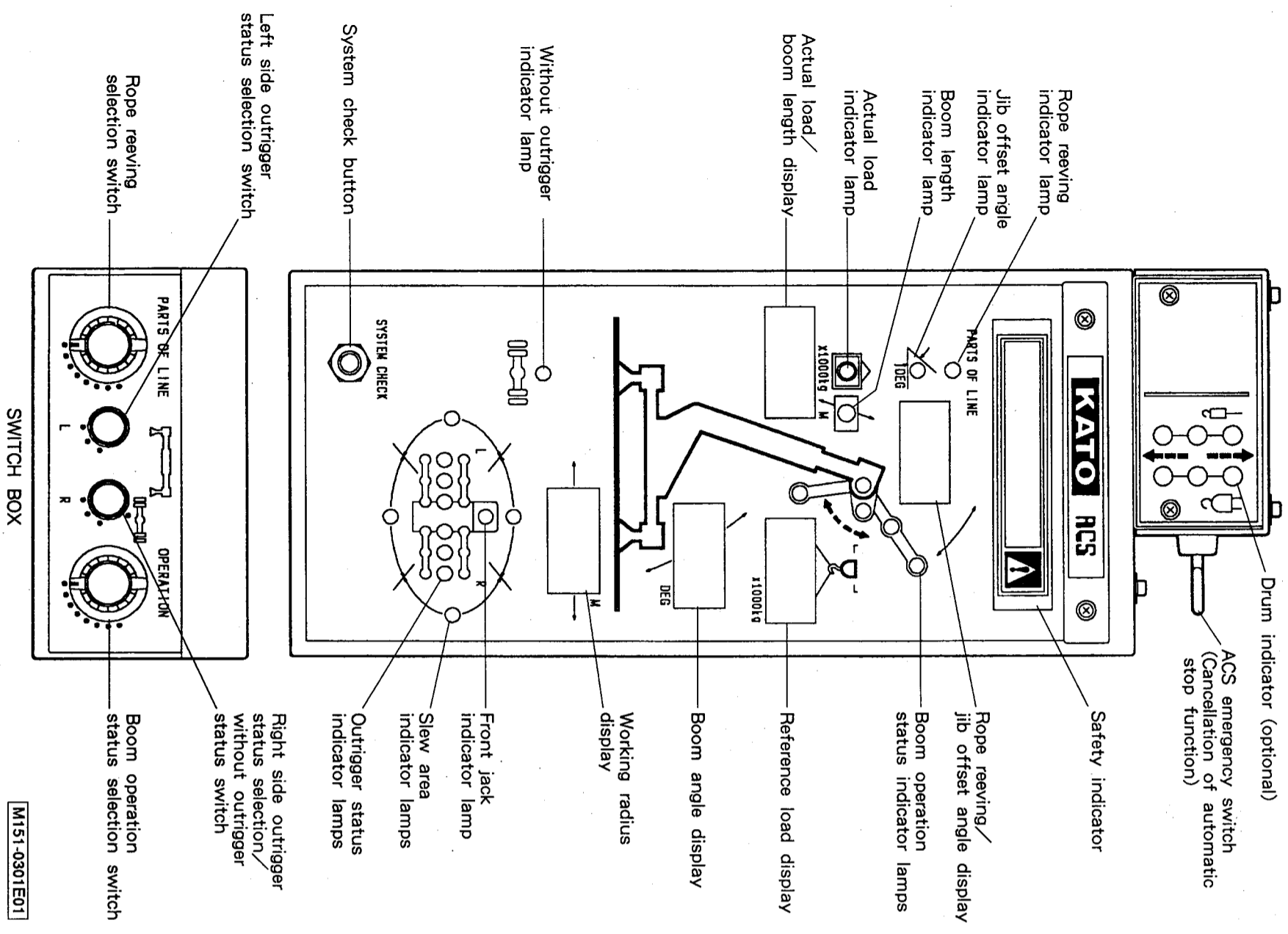
1-3 Software Operation Flowchart (S151-010300E)

The CPU follows the commands stored in ROM, performs the following operations, and so controls the crane.



CONFIGURATION AND FUNCTIONS

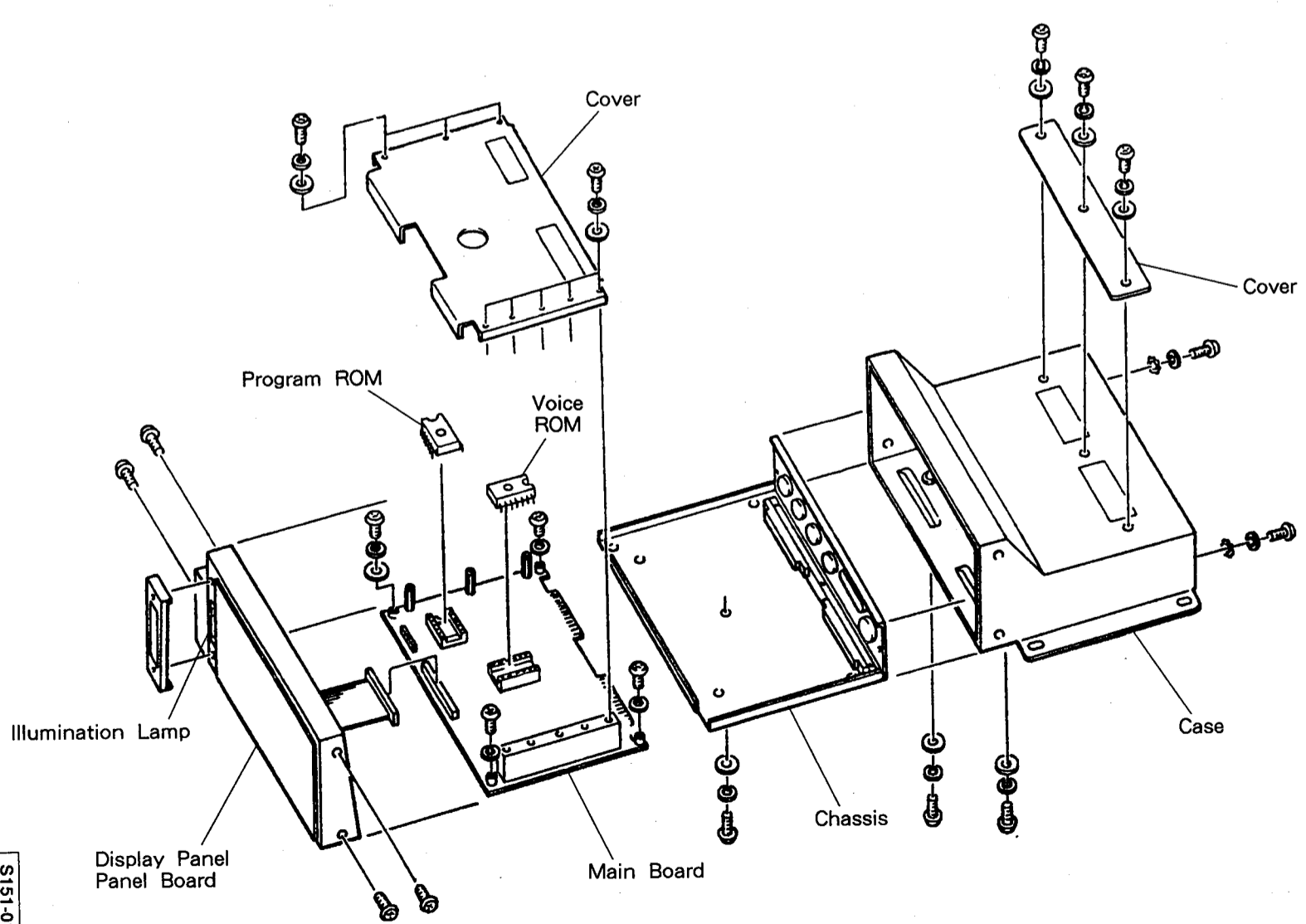
1-4 Display (S151-010400E)



M151-0301E01

CONFIGURATION AND FUNCTIONS

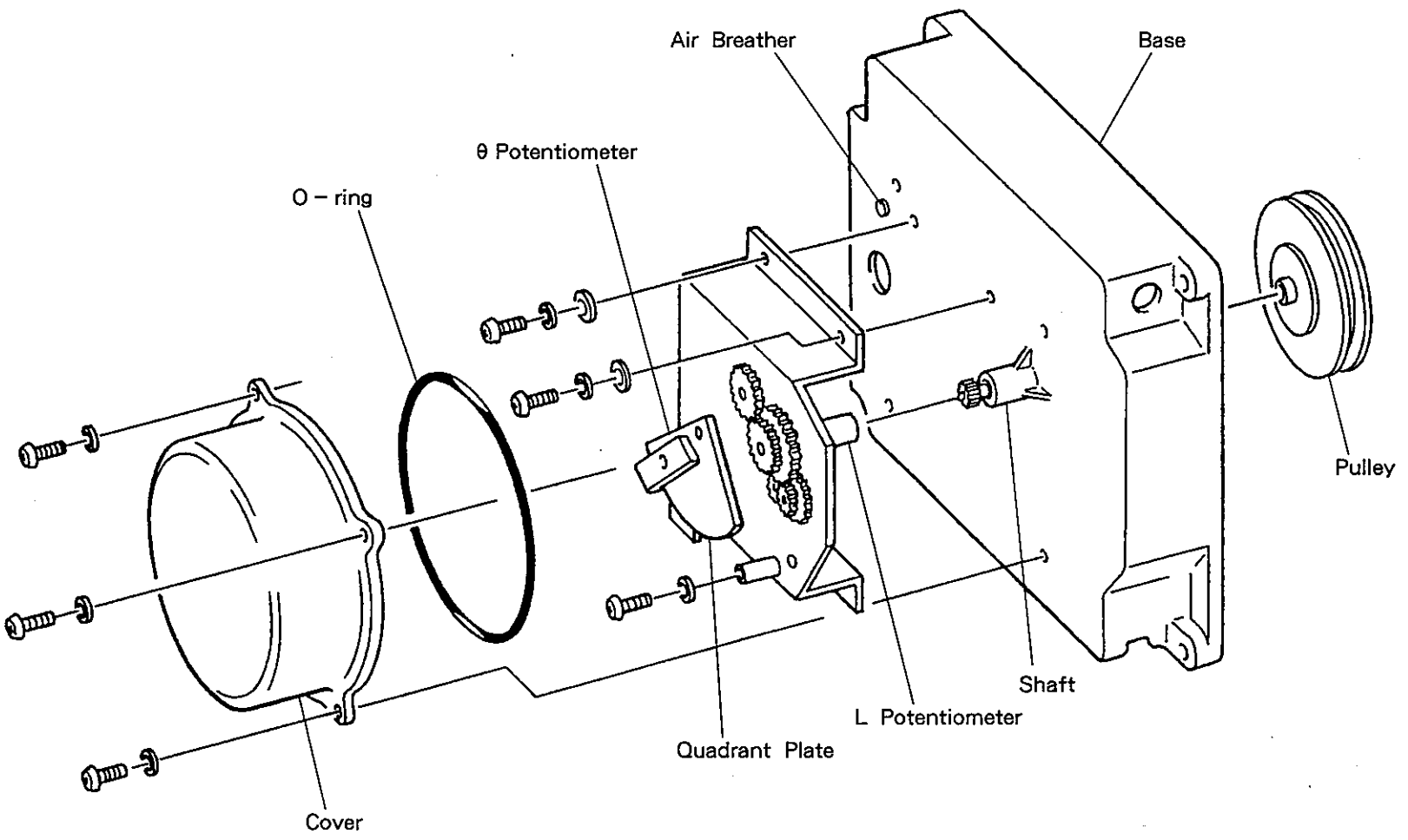
1-5 Main Body (exploded view) (S151-010500E)



S151-0105E01

CONFIGURATION AND FUNCTIONS

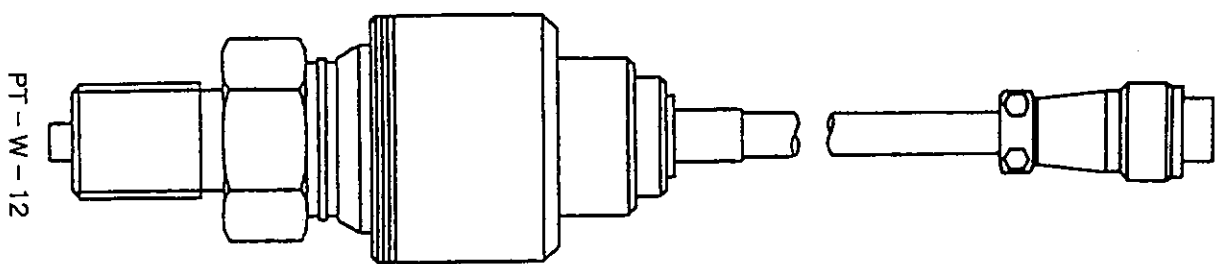
1-6 L θ Sensor (exploded view) (S151-010800E)



S151-0108E01

CONFIGURATION AND FUNCTIONS

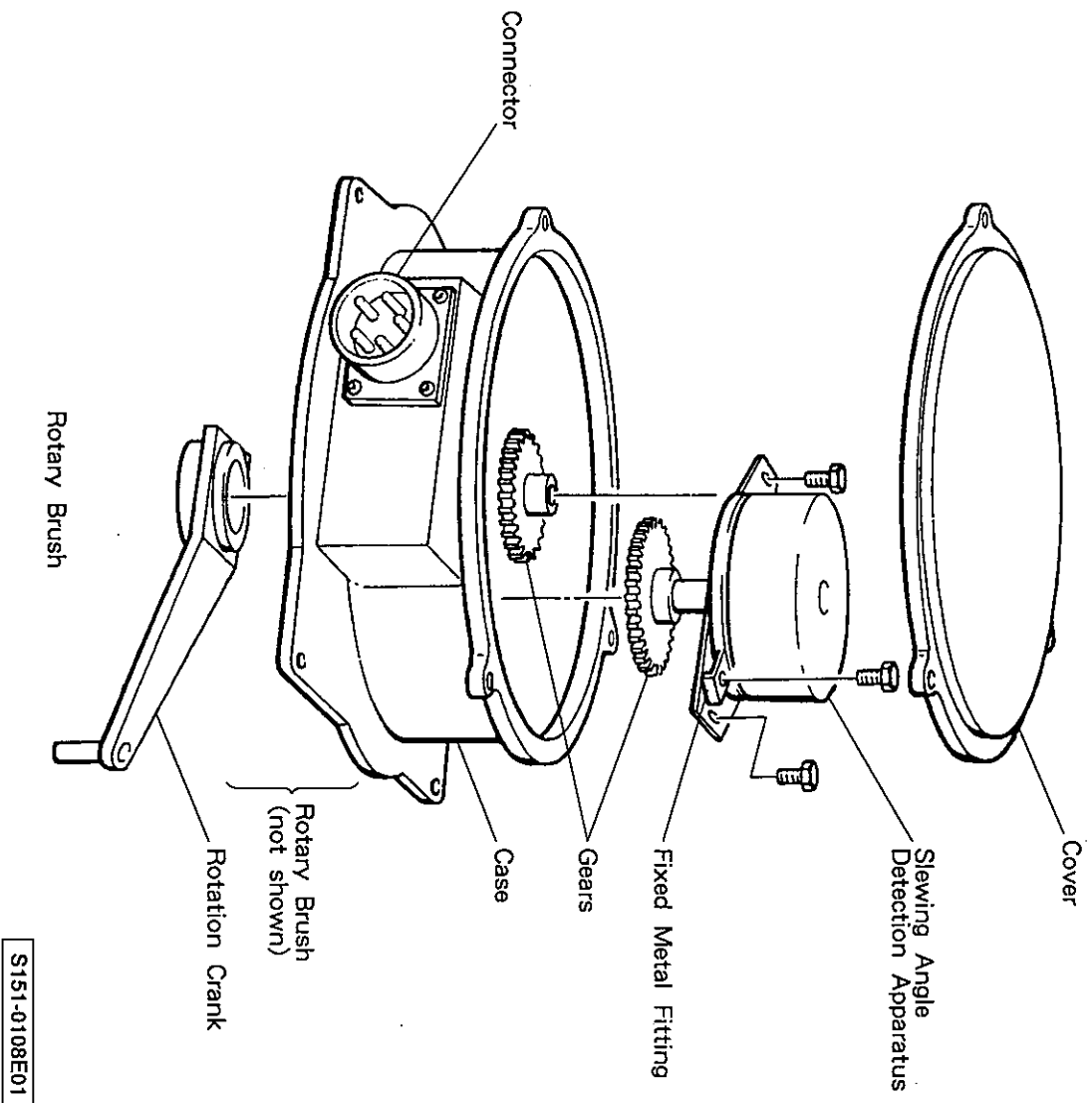
1-7 Pressure Sensor (S151-010700E)



S151-0107E01

CONFIGURATION AND FUNCTIONS

1-8 Slewing Angle Sensor (exploded view) (S151-010800E)



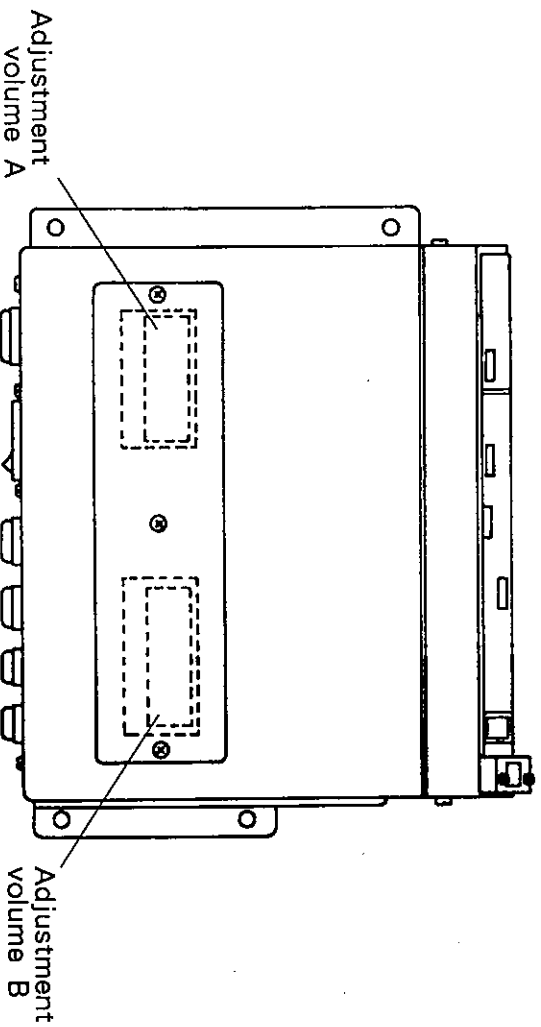
2. CHECKS AND ADJUSTMENTS

(S151-020000E)

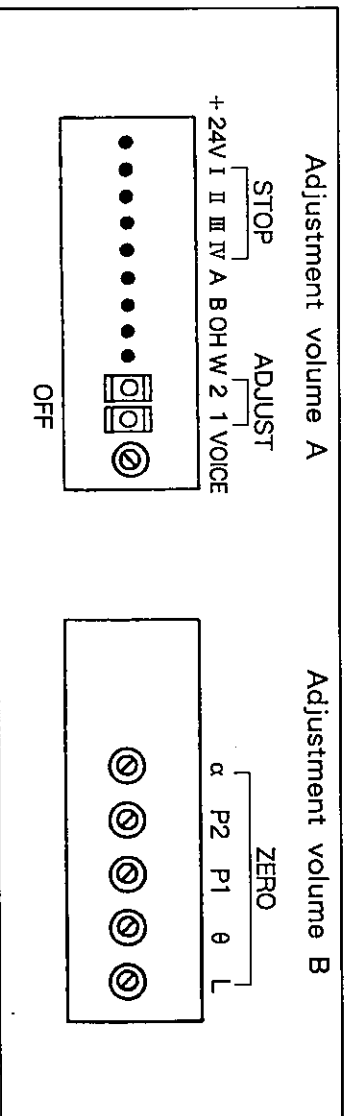
CHECKS AND ADJUSTMENTS

2-1 Input/Output for each Component (S151-020100E)

(1) Main body adjustment volume layout diagram



S151-0201E01



-monitor LED adjustment volume ADJUST switch

Monitor LED Activation Conditions

- 1) + 24Vwhen ACS power source switch ON ; breaker ON
- 2) STOPwhen auto-stop signal not output
- 3) Wwhen load display change button ON
- 4) Awhen A signal for sequential control output
- 5) Bwhen B signal for sequential control output
- 6) OHwhen overhoist cut signal output

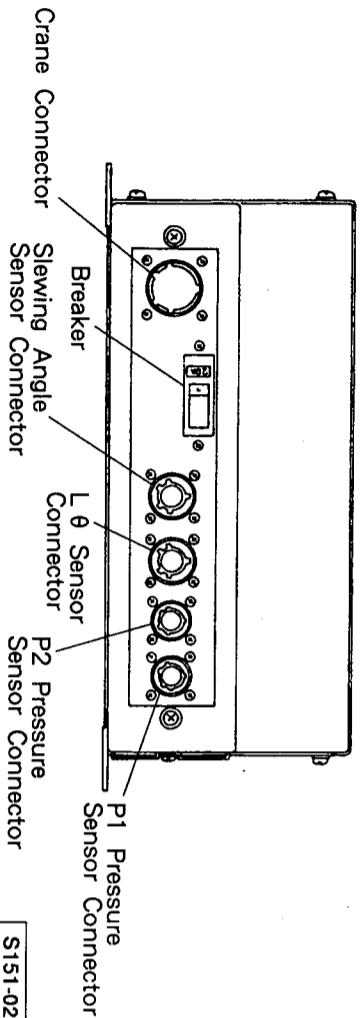
Adjustment Volumes

- 1) VOICEvolume of sound adjustment (Adjusted upon shipment ; do not adjust)
- 2) αslewing angle zero adjustment
- 3) P1P1 pressure sensor zero adjustment
- 4) P2P2 pressure sensor zero adjustment
- 5) θboom angle zero adjustment
- 6) Lboom length zero adjustment

S151-0201E02

CHECKS AND ADJUSTMENTS

(2) Main body connector location/pin number layout diagram



| NAME | Crane Connector | Slewing Angle Sensor Connector | L θ Sensor Connector | Pressure Sensor Connector |
|--------------|---|---|---|--|
| PIN POSITION | | | | |
| | SRC02A-25-24P | SRC02A16-7S | SRC02A16-10S | SRC02A13-5S |
| | 1 +24V 2 meter illumination 3 overhoist cut 4 (spare 1 input signal) 5 (spare 2 input signal) 6 (counterweight selector) 7 display selector 8 front jack 9 auto-stop I 10 sequential control A 11 sequential control B 12 GND 13 auto-stop II 14 auto-stop III 15 auto-stop IV 16 voice selector 17 speaker (+) 18 speaker (-) 19 GND 20 21 22 23 24 | +5.12V slewing angle 1 slewing angle 2 GND shield | +5.12V GND boom length input signal shield +5.12V GND boom angle input signal | +24V pressure input signal GND shield |

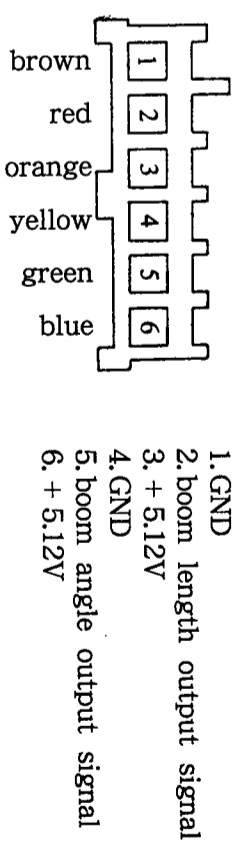
S151-0201E04

CHECKS AND ADJUSTMENTS

(3) Sensor connector pin diagram

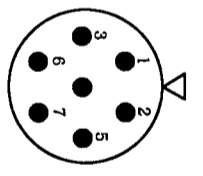
L θ Sensor (internal)

< cabtire - side connector >



S151-0201E05

Slewing Angle Sensor

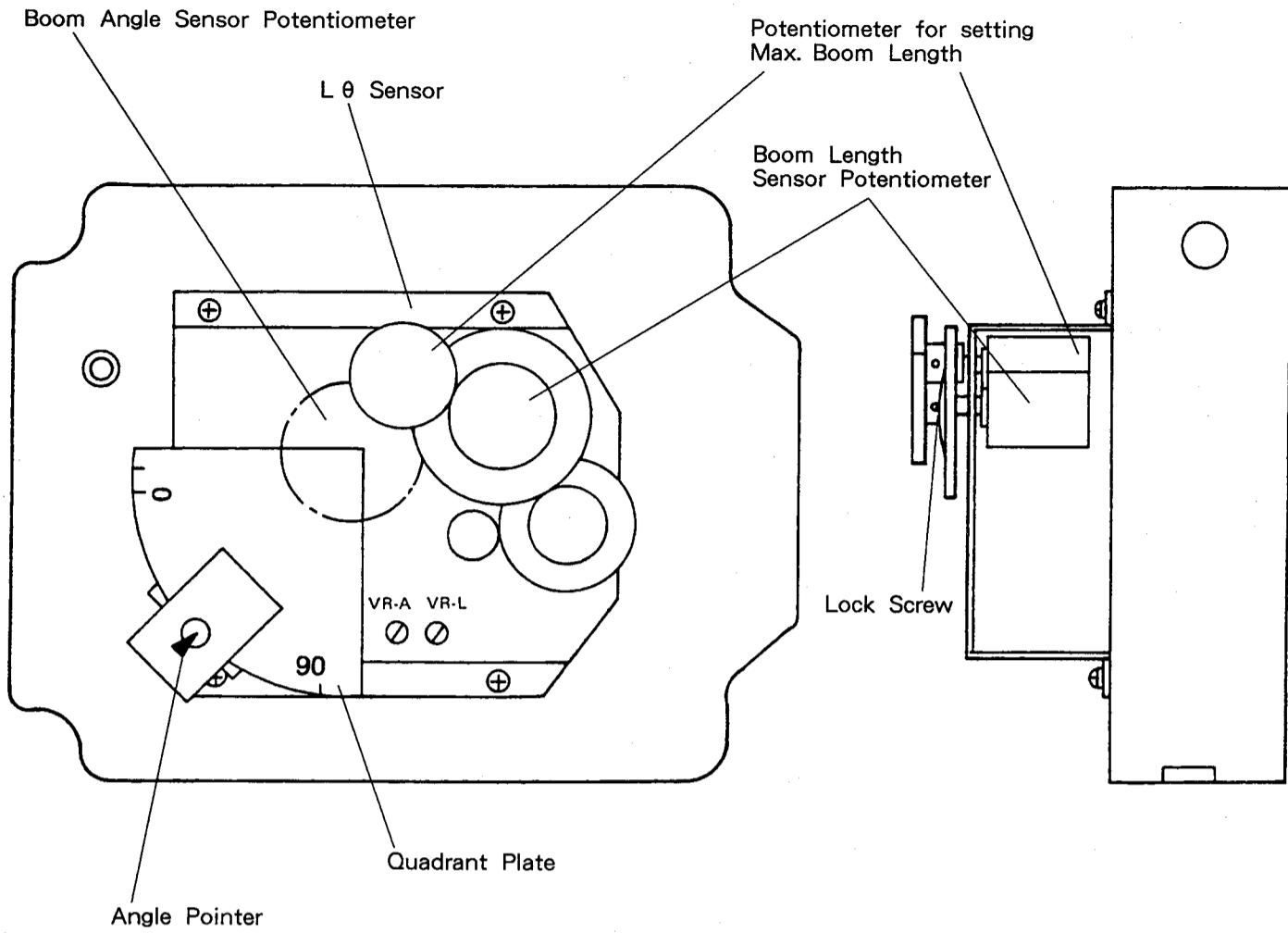


1. +5.12V
2. GND
3. -
4. -
5. shield
6. a 2
7. a 1

S151-0201E06

CHECKS AND ADJUSTMENTS

(4) L θ sensor adjustment volume layout diagram

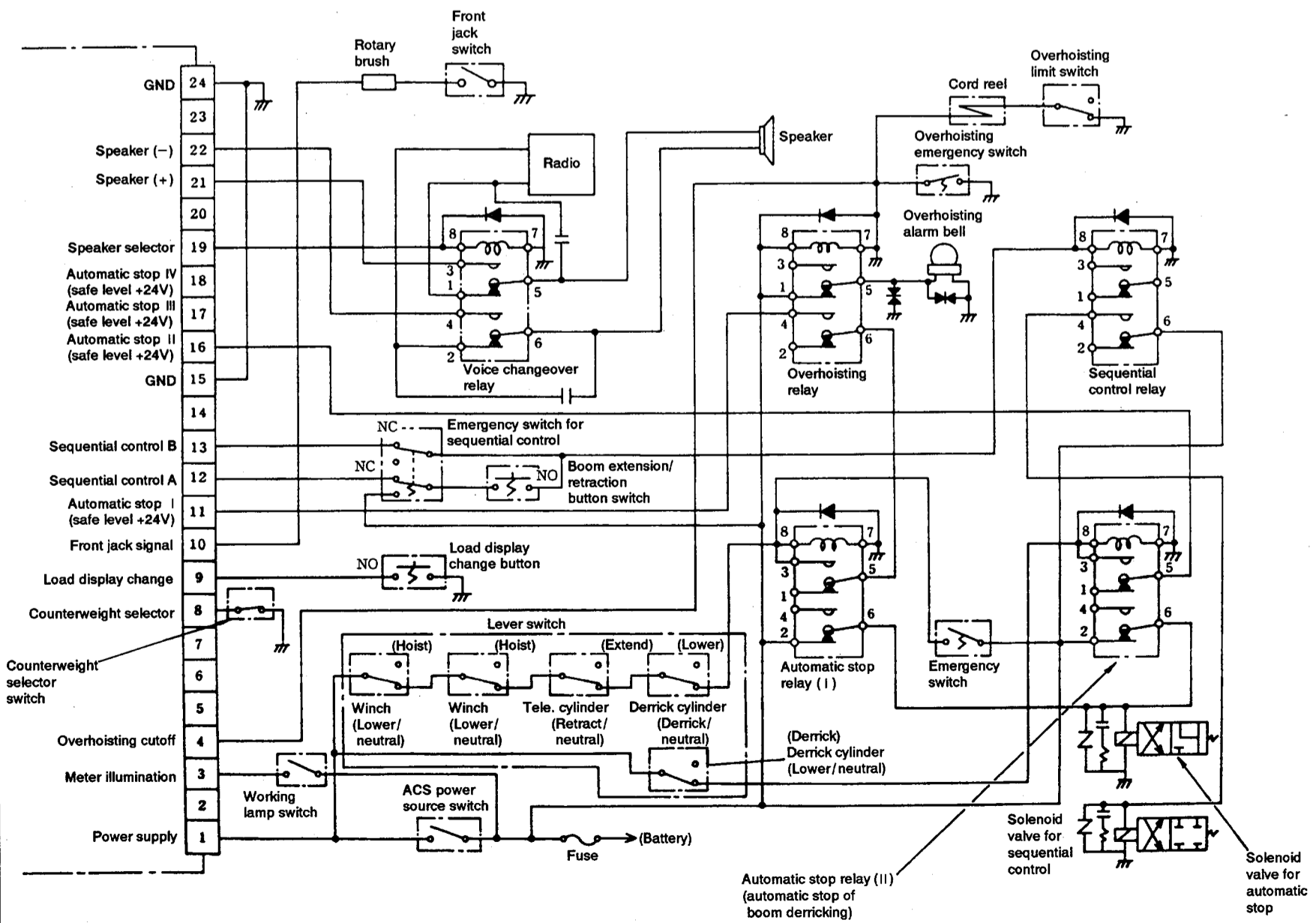


VR - A : boom angle span adjustment volume
 VR - L : boom length span adjustment volume

S151-0201E07

CHECKS AND ADJUSTMENTS

(5) Crane ACS - related circuit diagram
 NOTE : Differs with crane model



S151-0201E08

CHECKS AND ADJUSTMENTS

2-2 Troubleshooting (S151-020200E)

(1) Error codes

When an error occurs during crane operation, the safety indicator lights, an error number is displayed, and the crane stops automatically.

| Error No. | Error | Countermeasures |
|-------------------|---|---|
| E01 | RAM error | Change main board |
| E02 | ROM error | ① Change program ROM ② Change main board |
| E03 | Stabilized power source error | SEE E03 in "Troubleshooting" |
| E04 | Analog input defect | ① Unplug external connectors one by one to confirm ② Check main board |
| E05 | Internal operation defect | ① Check sensor input ② Change program ROM |
| C10 | Outrigger status selection SW incorrectly set to "intermediate" | ① Check setting of outrigger status selection SW/indicator LEDs ② Change switchbox ③ Change main board |
| C11 | Outrigger status selection SW set for fully-retracted outriggers with an extended front jack (front jack indicator LED lit) | ① Confirm status selection SW setting ② Change switchbox ③ Change main board |
| E12 E13 E14 | Outrigger status selection SW defect | ① Check outrigger status indicator LEDs ② Change switchbox ③ Change main board |
| C20 | Boom operation status selection SW set to "intermediate" | ① Check setting of boom operation status selection SW/indicator LEDs ② Change switchbox ③ Change main board |
| E21 | Boom operation status selection SW input-program ROM mismatch | ① Check ROM and panel ② Change switchbox ③ Change main board |
| E22 E23 E24 | Boom operation status selection SW defect | ① Check boom operation status indicator LEDs ② Change switchbox ③ Change main board |

CHECKS AND ADJUSTMENTS

| Error No. | Error | Countermeasures |
|-----------|---|--|
| C25 | Rope reeving selection SW set to "intermediate" | ① Check rope reeving selection SW ② Change switchbox ③ Change main board |
| E40 | Boom length signal disconnection or short | SEE "Troubleshooting" |
| E41 | Boom length signal too strong/weak | SEE "Troubleshooting" |
| E50 | Boom angle signal disconnection or short | SEE "Troubleshooting" |
| E51 | Boom angle zero adjustment circuit defect | Change main board |
| E60 | P1 signal disconnection or short | Change P1 pressure sensor |
| E61 | P1 signal too strong/weak | SEE "Troubleshooting" |
| E62 | P2 signal excessive compared to P1 signal | SEE "Troubleshooting" |
| E70 | P2 signal disconnection or short | Change P2 pressure sensor |
| E71 | P2 signal too strong/weak | SEE "Troubleshooting" |
| E72 | P2 calculation impossible | Change main board, program ROM, or P2 pressure sensor |
| E80 | Slewing angle signal disconnection or short | Change rotary brush or cable |
| E81 | Slewing angle signal defect | SEE "Troubleshooting" |

CHECKS AND ADJUSTMENTS

(2) Display

(ADJ 1 SW = OFF)

| Operation Condition | Check | Main | Rooster | Jibset | Jib |
|------------------------|----------------------------|----------------|------------------|-------------|------------------|
| Rope reeving display | 8.8.8. display off | parts of line | parts of line(1) | display off | jib offset angle |
| Actual load display | 8.8.8. crane code | actual load | actual load | boom length | actual load |
| Reference load display | 8.8.8. performance code | boom length | boom length | boom length | boom length |
| Boom angle display | 8.8.8. ACS type | reference load | reference load | display off | reference load |
| Working radius | 8.8.8. software code | boom angle | boom angle | display off | boom angle |
| | | working radius | working radius | boom angle | boom angle |
| | | working radius | working radius | display off | working radius |
| | | working radius | working radius | display off | working radius |

(ADJ 1 SW = ON)

| Operation Condition | Check | Main | Rooster | Jibset | Jib |
|------------------------|---|----------------|-------------------|----------------|------------------|
| Rope reeving display | display off display off | parts of line | parts of line (1) | parts of line | jib offset angle |
| Actual load display | + 3V error number | actual load * | actual load * | boom length | actual load * |
| Reference load display | slewing angle derrick holding pressure | boom length | boom length | boom length | boom length |
| Boom angle display | slewing angle signal 1 head pressure | reference load | reference load | reference load | reference load |
| Working radius | slewing angle signal 2 rod pressure | boom angle * | boom angle * | boom angle * | boom angle * |
| | | working radius | working radius | boom angle * | boom angle * |
| | | working radius | working radius | boom angle * | boom angle * |
| | | working radius | working radius | boom angle * | boom angle * |

NOTE: 1. [] indicates that the Display change button is ON

2. " * " negative values also displayed (A denotes negatives)

3. When error occurs

IF ADJ 1 SW = OFF, error number displayed

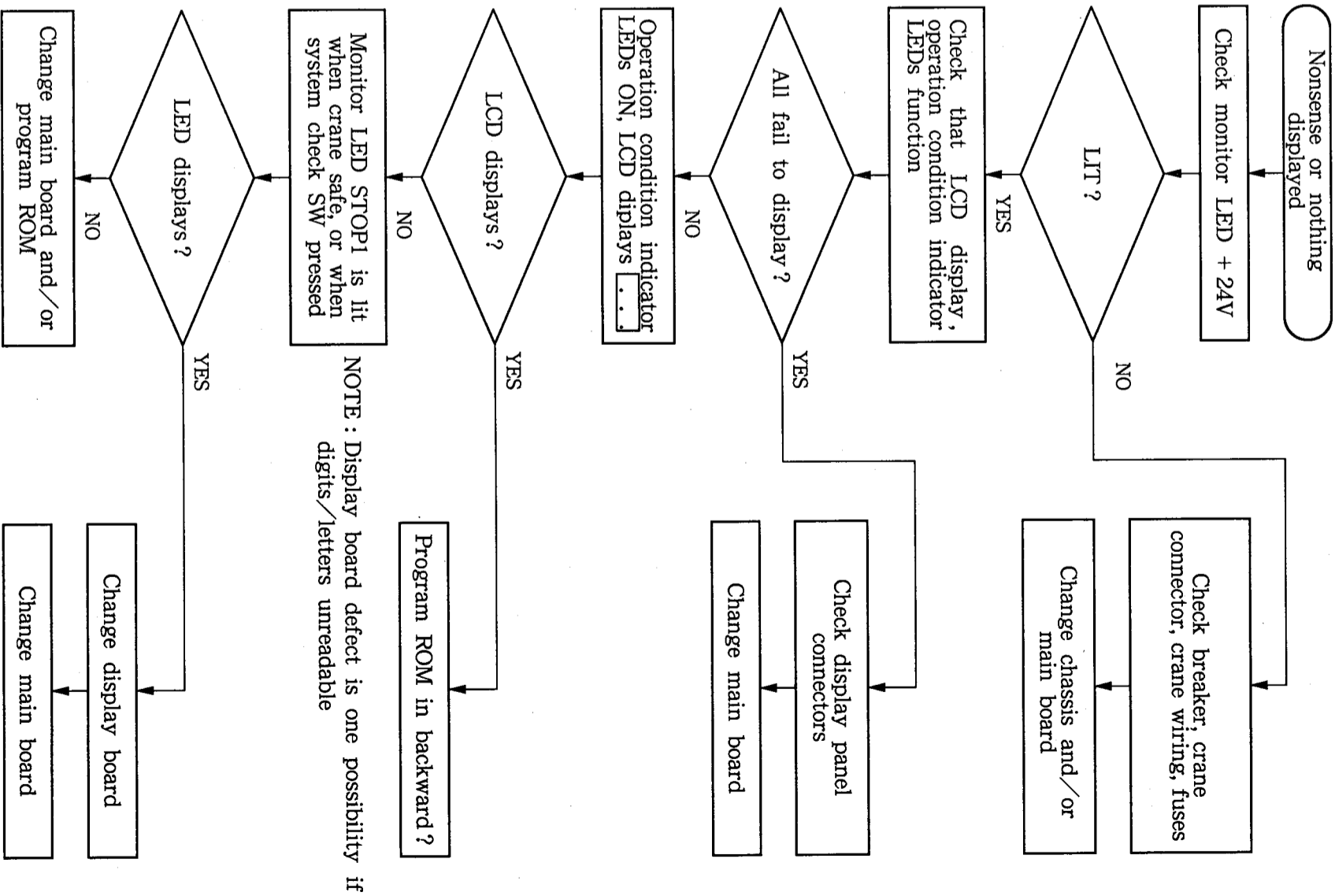
IF ADJ 2 SW = ON, display that of normal condition

4. ADJ 2 SW takes off an order of magnitude from displayed number

CHECKS AND ADJUSTMENTS

(3) Troubleshooting

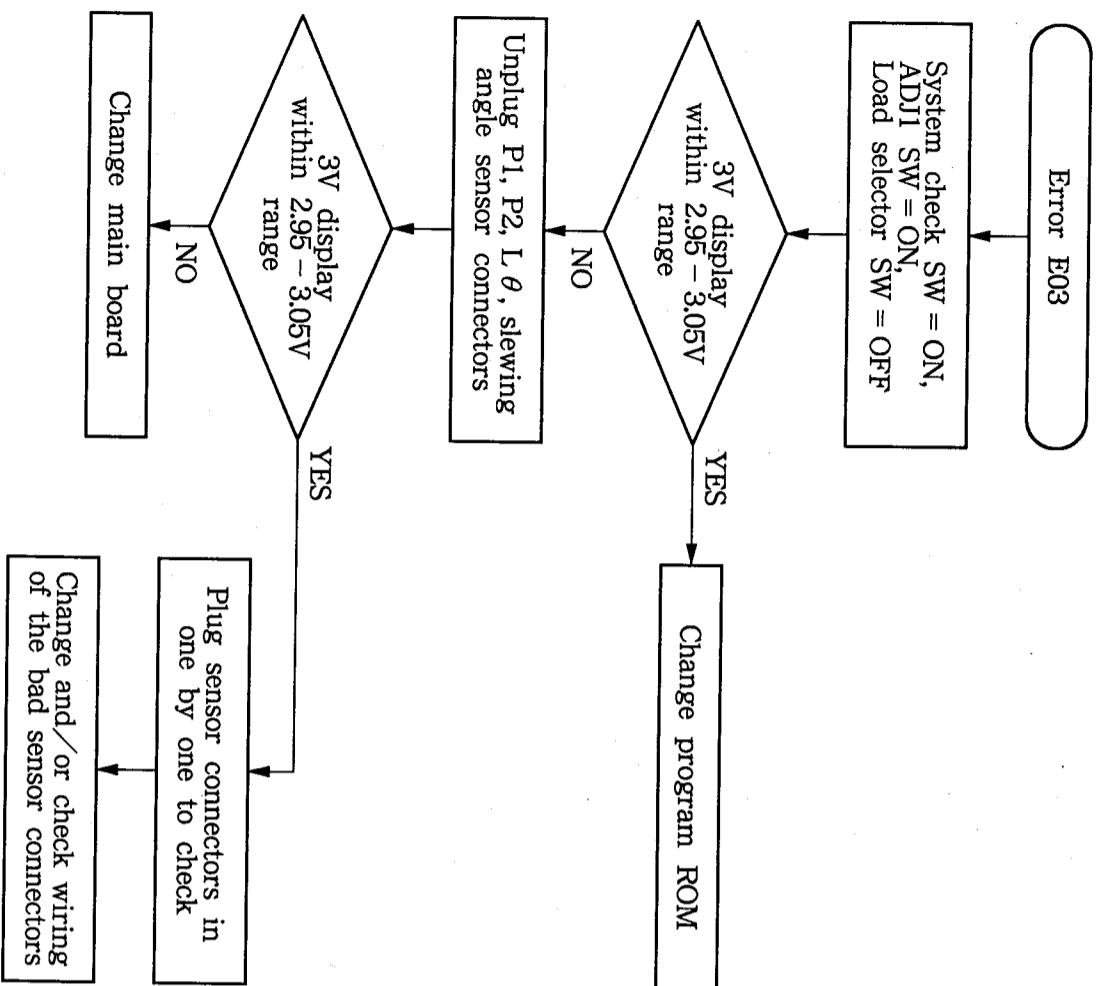
Nonsense or nothing displayed



NOTE: Display board defect is one possibility if digits/letters unreadable

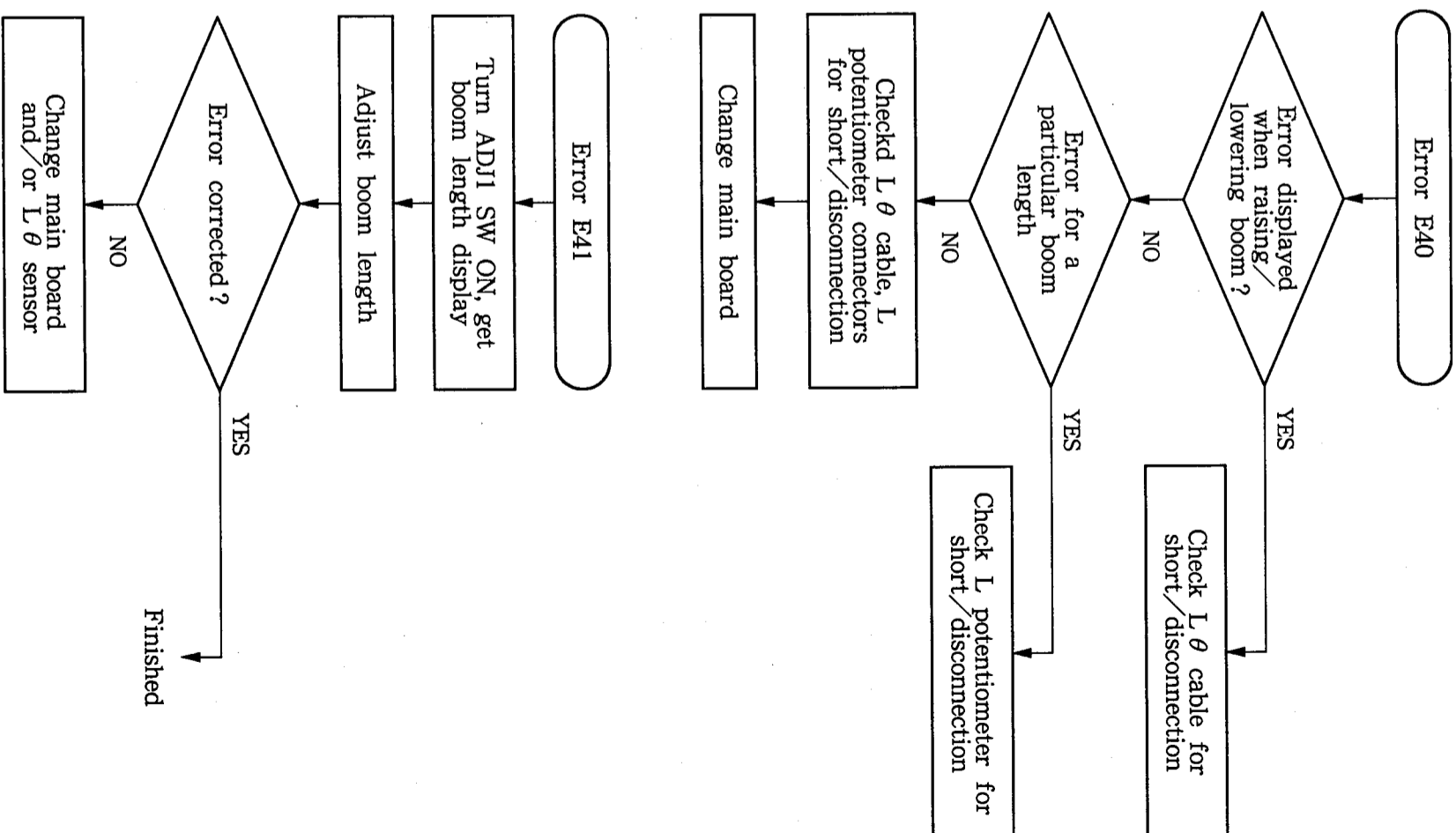
CHECKS AND ADJUSTMENTS

Troubleshooting
Stabilized power source error



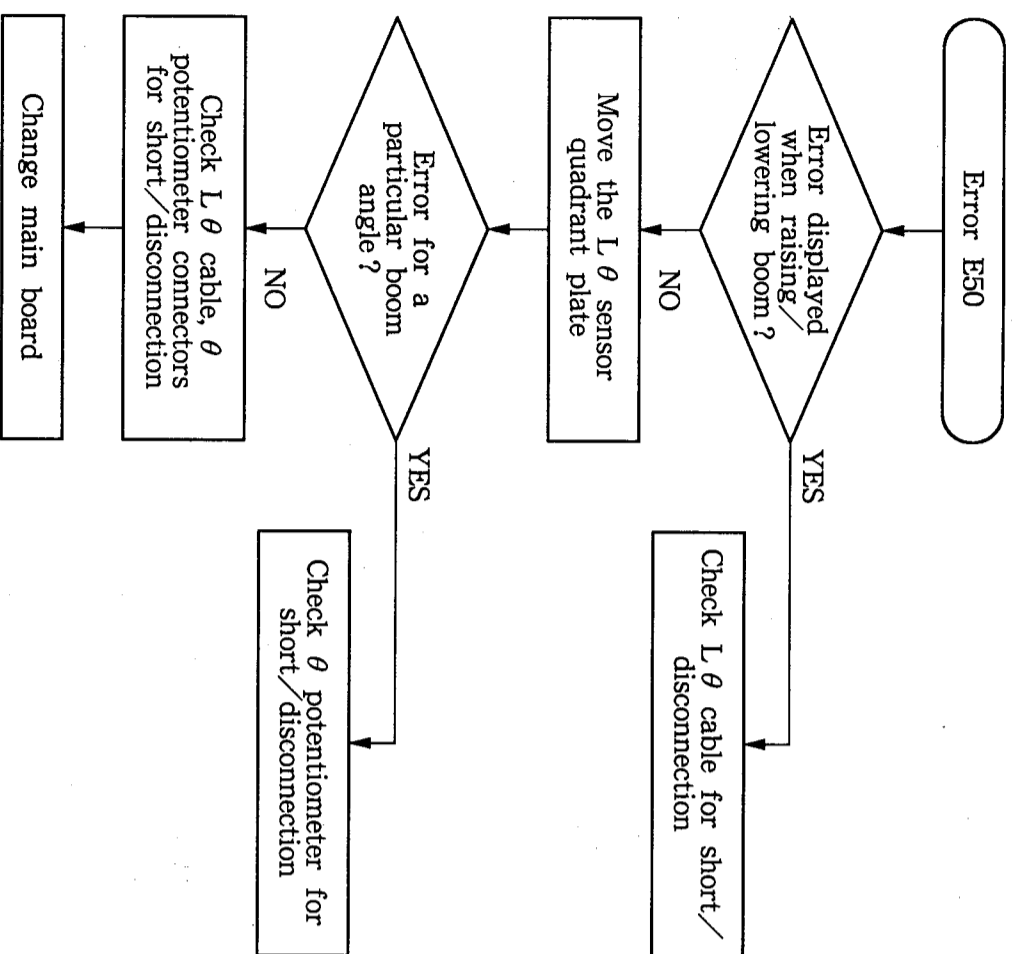
CHECKS AND ADJUSTMENTS

Troubleshooting



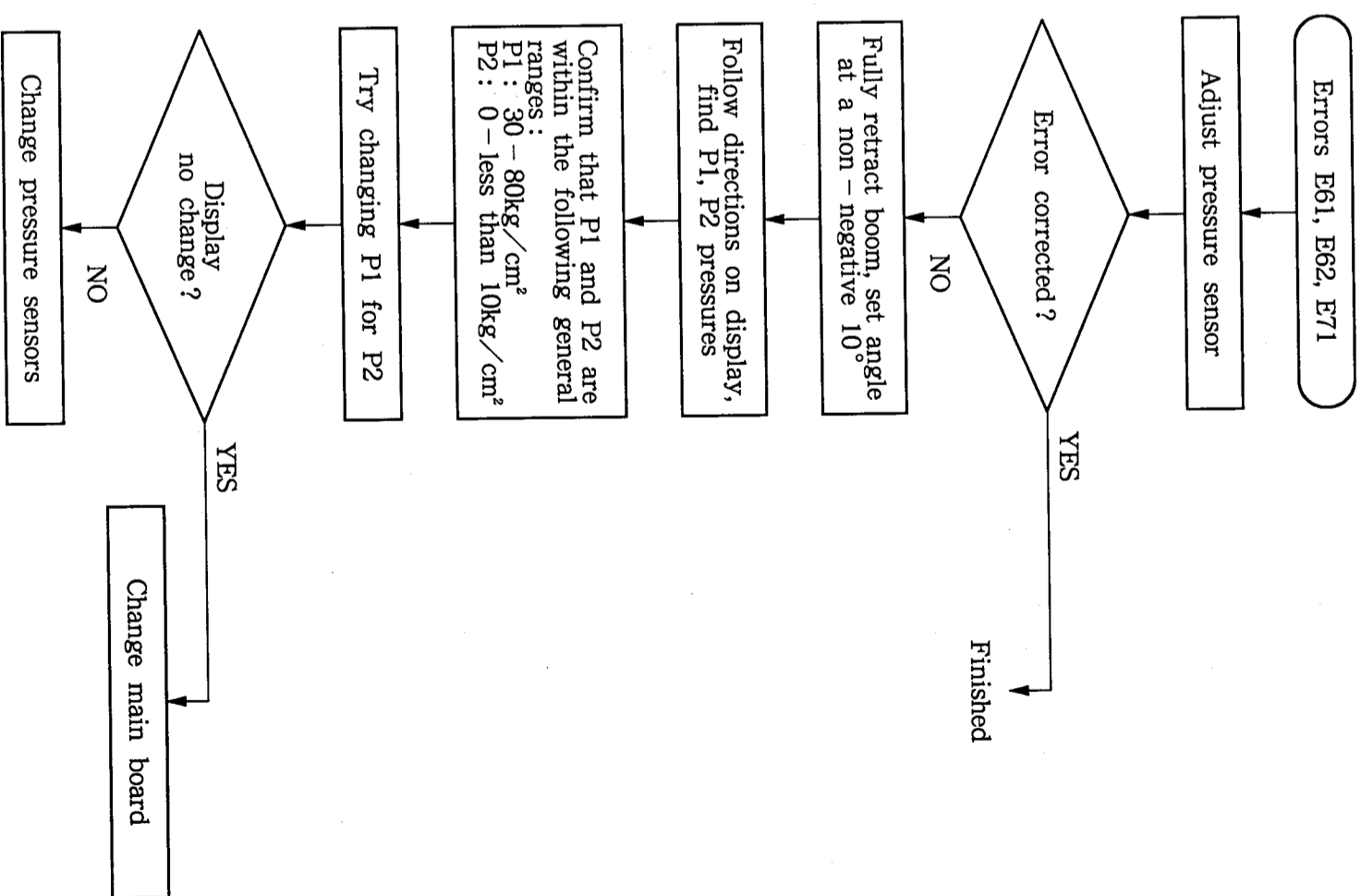
CHECKS AND ADJUSTMENTS

Troubleshooting



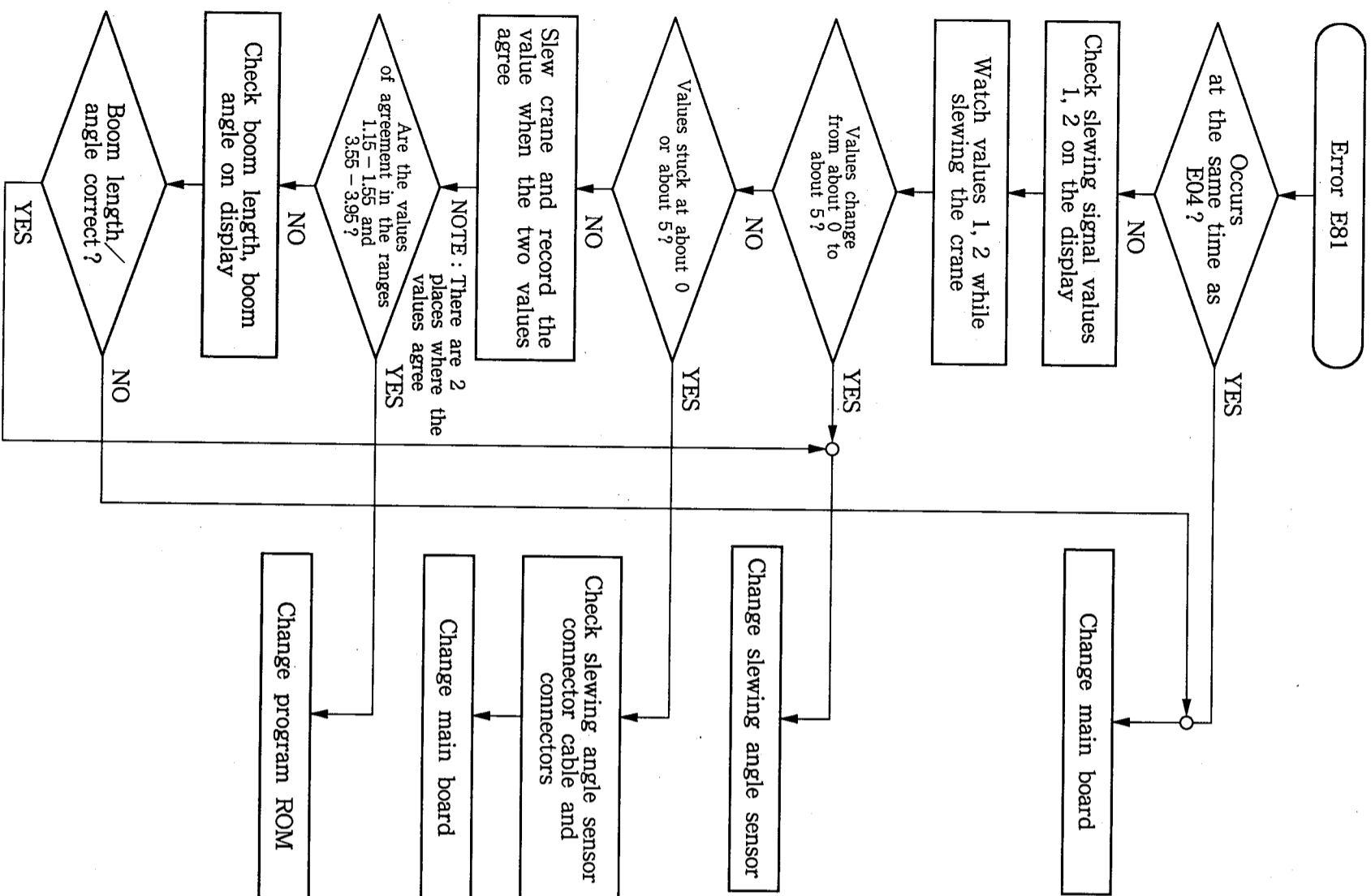
CHECKS AND ADJUSTMENTS

Troubleshooting



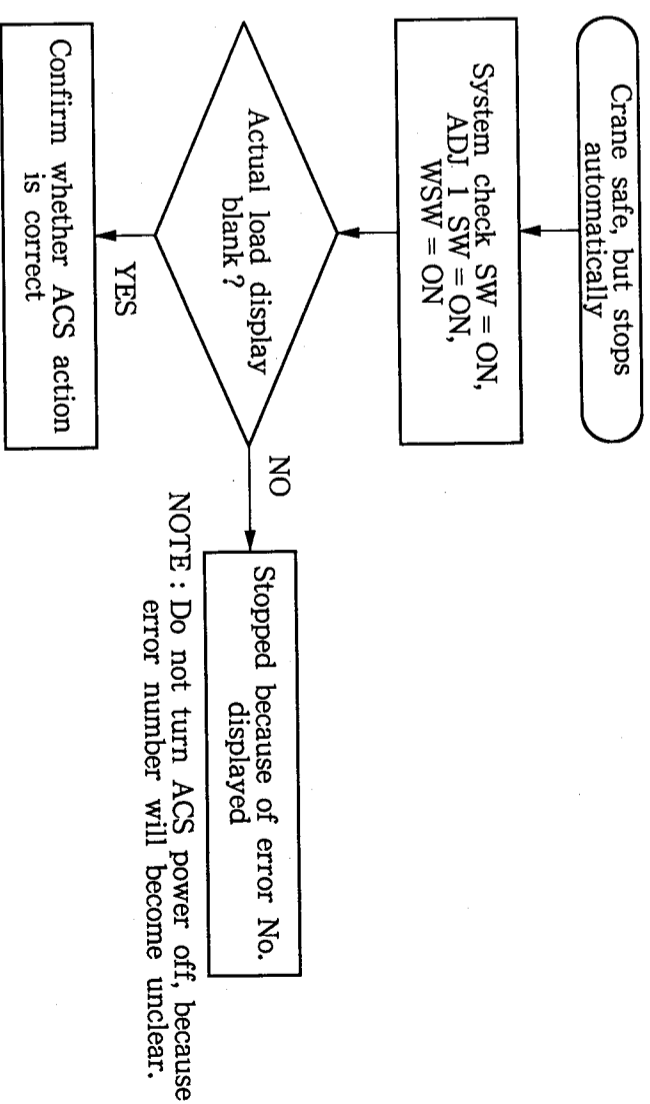
CHECKS AND ADJUSTMENTS

Troubleshooting Errors E81 - E04, E81



CHECKS AND ADJUSTMENTS

Troubleshooting



CHECKS AND ADJUSTMENTS

Troubleshooting

Actual load incorrect

1. Confirm whether the hook or parts of line are those established for the boom length.
2. When the actual load is incorrect for the main boom, check whether the auxiliary hook is not attached to the rooster, and whether the jib is in its housing.
3. Confirm whether the proper hook is attached to the main boom, when the jib or rooster are in place.
4. Is the crane on firm, level ground?
5. Checking the actual load after setting load on ground, and slowly winching it up?

Recheck pressure, boom length/angle

Check reference load to see whether operating conditions OK

CHECKS AND ADJUSTMENTS

2-3 Adjustments (S151-020300E)

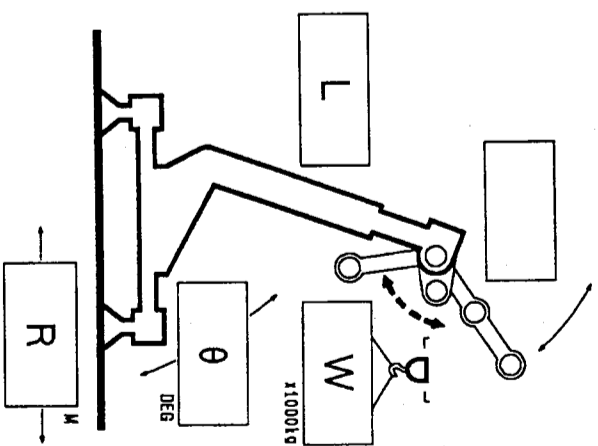
(1) About this section

How to read the following sheets

| No. Checks and Adjustments | Explanation | Adjusting Method | | | Indicator | Adjusting Volume | Data |
|----------------------------|-------------|---------------------|------------------|----------------------------|-----------|------------------|------|
| | | System Check Switch | Setting ADI 1 SW | Load display change button | | | |
| | [IF NOT] | | | | | | |

(Procedure)

- 1) Follow the "explanation" for each "adjustment" or "check".
- 2) Set switches as in "setting", and check that the values displayed as below are within the permissible range listed in "data".
- 3) If not within the permissible range, adjust with the "adjustment volume" listed.
- 4) If still unadjustable, follow suggestions in IF NOT.



S151-0203E01

CHECKS AND ADJUSTMENTS

(2) Power source adjustment (Turn ADJ 2 SW ON when decreasing displayed data by some order of magnitude, OFF under normal conditions.)

| No. | Checks and Adjustments | Explanation | Adjusting Method | | | | | Data |
|-----|---|--|---------------------|------------------|----------------------------|-----------------------|------------------|-----------------------|
| | | | System Check Switch | Setting ADJ 1 SW | Load display change button | Indicator | Adjusting Volume | |
| 1 | Preparation | Turn ACS power source OFF, check that connectors are properly plugged in, turn ACS power source | | | | Monitor LED + 24V lit | | |
| | [IF NOT] | Check fuse or ACS breaker | | | | | | |
| 2 | Confirm stabilized power source voltage | NOTE : Turn ADJ2 SW On to reduce order of agnitude, and then check. | ON | ON | OFF | L | | + 2.95 } + 3.05 |
| | [IF NOT] | Unplug the L θ sensor connector, pressure sensor, and slewing angle sensor in that order, and REDO No.2 | | | | | | |

CHECKS AND ADJUSTMENTS

(3) Boom angle adjustment (Turn ADJ 2 SW ON when decreasing displayed data by some order of magnitude, OFF under normal conditions.)

| No. | Checks and Adjustments | Explanation | Setting | | | Indicator | Adjusting Volume | Data |
|-----|---------------------------------------|---|---------------------|----------|----------------------------|-----------|------------------|---------------------|
| | | | System Check Switch | ADJ 1 SW | Load display change button | | | |
| 1 | Quadrant plate zero-degree adjustment | Check that boom is horizontal with a level, align the pointer of the L θ sensor with the zero on the quadrant plate, lock with the lock-screw, and apply locktite. | | | | | | |
| 2 | Zero check | Fix the quadrant plate at 10° with a piece of thick paper | | OFF | OFF | θ | θ ZERO | 9.9° } 10.1° |
| 3 | Span check | Fix the quadrant plate at 80° with a piece of thick paper | | OFF | OFF | θ | VR-A | 79.7° } 80.3° |
| 4 | Reconfirm zero | If adjusting as in No.3, reconfirm as in No.2 | | | | | | |
| | [IF NOT] | 1. Check wiring, connectors 2. Change main board or L θ sensor | | | | | | |

CHECKS AND ADJUSTMENTS

(4) Boom length adjustment (Turn ADJ 2 SW ON when decreasing displayed data by some order of magnitude, OFF under normal conditions.)

| No. | Checks and Adjustments | Explanation | Adjusting Method | | | | | Data |
|-----|-------------------------------|--|---------------------|------------------|----------------------------|--------------------|------------------|--|
| | | | System Check Switch | Setting ADJ 1 SW | Load display change button | Indicator | Adjusting Volume | |
| 1 | Preparation | Fully extend and retract the boom once. Use the sequential control emergency SW, if crane so equipped. | | | | | | |
| 2 | Maximum retraction adjustment | Fully retract boom, turn the boom length sensor potentiometer counterclockwise as far as the stopper. NOTE : Adjustment volumes should be set by turning ADJ2 SW ON. | | OFF | ON | L | L ZERO | Minimum } min. + 0.05m |
| 3 | Maximum extension adjustment | Loosen the lock screw on the gear of the max boom length set potentiometer, and fully extend boom. Turn the potentiometer counterclockwise as far as the stopper, tighten the lock screw and apply locktite. | | OFF | ON | L | VR-L | Maximum length ± 0.15m |
| | [IF NOT] | Check wiring, connectors. Change main board and / or L θ sensor. | | | | | | |
| 4 | Reconfirm | If adjusting as in No.3, reconfirm No.2 | | | | | | |
| 5 | Sequential control check | Fully extend and retract the boom. Confirm boom length when monitor LED A lights and monitor LED B goes out. | | OFF | ON | LEDs A and B light | | LED A : Sequential control boom length - 0.5m LED B : Sequential control boom length + 0.5m |
| | [IF NOT] | Check wiring, connectors. Change main board. | | | | | | |

CHECKS AND ADJUSTMENTS

(5) Pressure sensor adjustment (Turn ADJ 2 SW ON when decreasing displayed data by some order of magnitude, OFF under normal conditions.)

| No. | Checks and Adjustments | Explanation | Setting | | | Indicator | Adjusting Volume | Data |
|-----|------------------------|---|---------------------|----------|----------------------------|--|--|--|
| | | | System Check Switch | ADJ 1 SW | Load display change button | | | |
| 1 | ZERO check | Fully retract and lower boom, stop engine, reduce derrick cylinder pressure | ON | ON | ON | θ (P ₁) R (P ₂) Note : Unit : kgf/cm ² | P ₁ ZERO P ₂ ZERO | 0~1 kg/cm ² 0~1 kg/cm ² |
| | [IF NOT] | Check wiring, connectors. Change pressure sensor, main board. | | | | | | |

CHECKS AND ADJUSTMENTS

(6) Slewing angle adjustment (Turn ADJ 2 SW ON when decreasing displayed data by some order of magnitude, OFF under normal conditions.)

| No. | Checks and Adjustments | Explanation | Adjusting Method | | | | | Data |
|-----|--------------------------|---|---------------------|------------------|----------------------------|-----------|------------------|----------------|
| | | | System Check Switch | Setting ADJ 1 SW | Load display change button | Indicator | Adjusting Volume | |
| 1 | Slewing angle adjustment | Set boom exactly front. NOTE : Turn ADJ 2 SW ON to check. | ON | ON | OFF | W | α ZERO | 1.0° 359.0° |
| | (IF NOT) | 1. After slewing about 180°, remove rotary brush, turn rotation crank 180° and refit rotary brush. | | | | | | |
| 2 | Slewing angle 180° check | Slew crane slowly and check that slewing angle changes continuously, and that the display reads 180° when boom is exactly behind. | ON | ON | OFF | W | | |

3. REPLACEMENTS

(S151-030000E)

REPLACEMENTS

Points to note when changing ROM

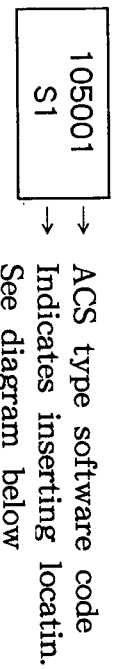
- (1) BE PARTICULARLY CAREFUL OF STATIC ELECTRICITY. If the glass window on the ROM is touched with a charged body, or rubbed with plastic or dry fabric, static will accumulate on the window causing erratic operation.
- (2) Use the designated tools for fitting and removing ROM. Use of other tools may damage the pins.
- (3) Take care to mount the ROM in the proper direction, as it may be damaged if mounted backward, and electricity is applied.
- (4) Be sure the anti-UV label on the glass window is affixed properly. Affixed at the factory, these labels shade the ROM from UV light, and if not properly affixed, the UV that leaks through will cause erratic operation.
- (5) When changing program ROM, confirm with the following :
 - a) Check that ADJ 1/ADJ 2 SW are OFF.
 - b) Turn display selector SW ON.
 - c) Turn system check SW ON.

After setting as in a, b and c, the actual load display indicates the crane code, the reference load display the model code, the boom angle display the ACS model number, and the working radius display the software code, all as follows :

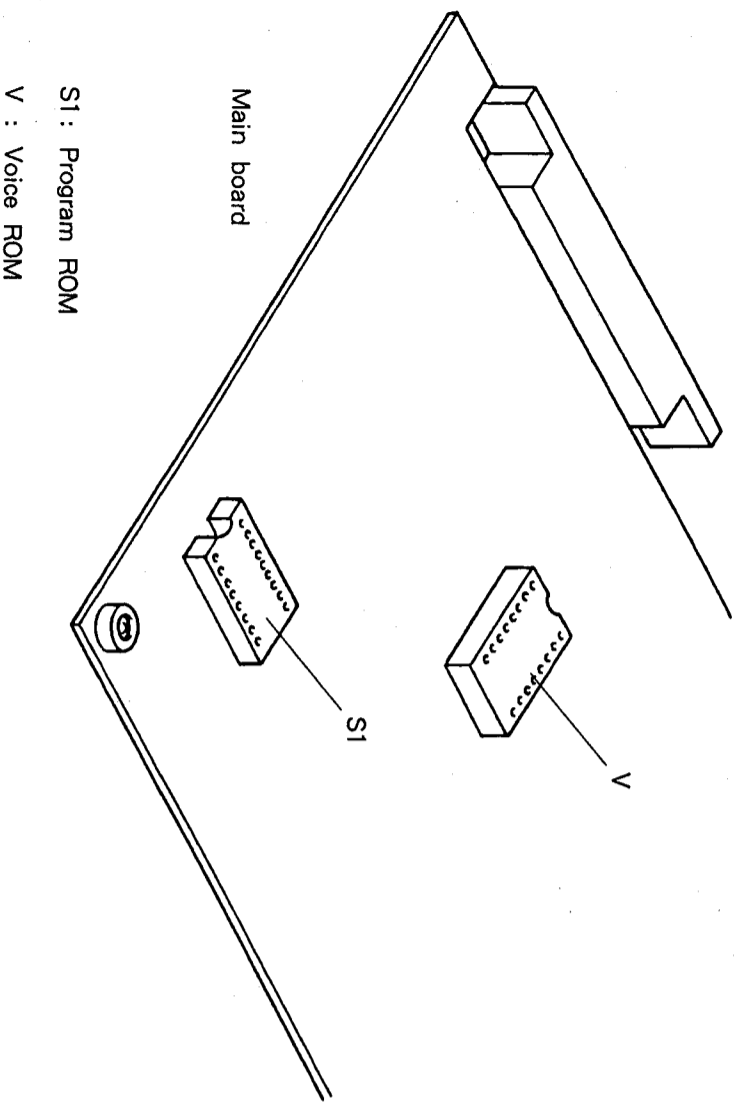
| | | |
|--------------|-----|---|
| (L) | 772 | Crane code |
| (W) | 10 | Model code |
| (θ) | 105 | ACS model "10" indicates MS-10, and "5" indicates E. |
| (R) | 01 | Software code |

Confirm the crane code and model code when changing ROM.

ROM seal :



REPLACEMENTS



S151-0300E01

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