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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 overoad-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)

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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)

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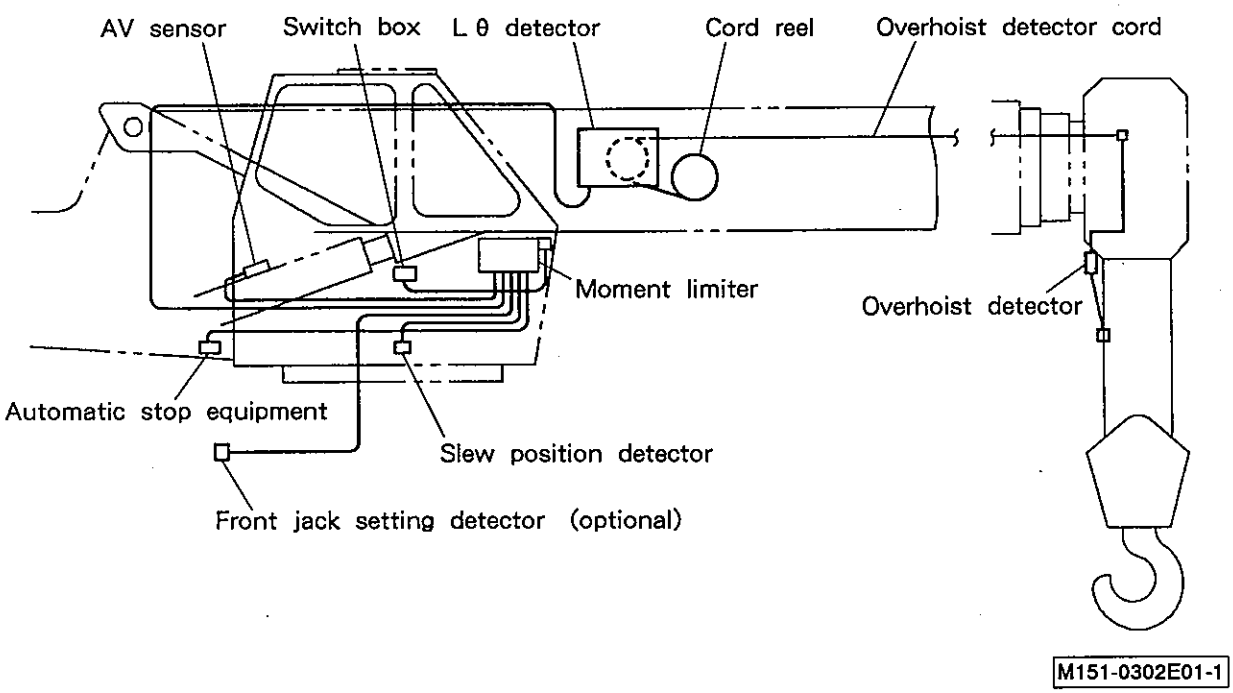
CONFIGURATION AND FUNCTIONS

1-1 System Configuration (S151-010100E)



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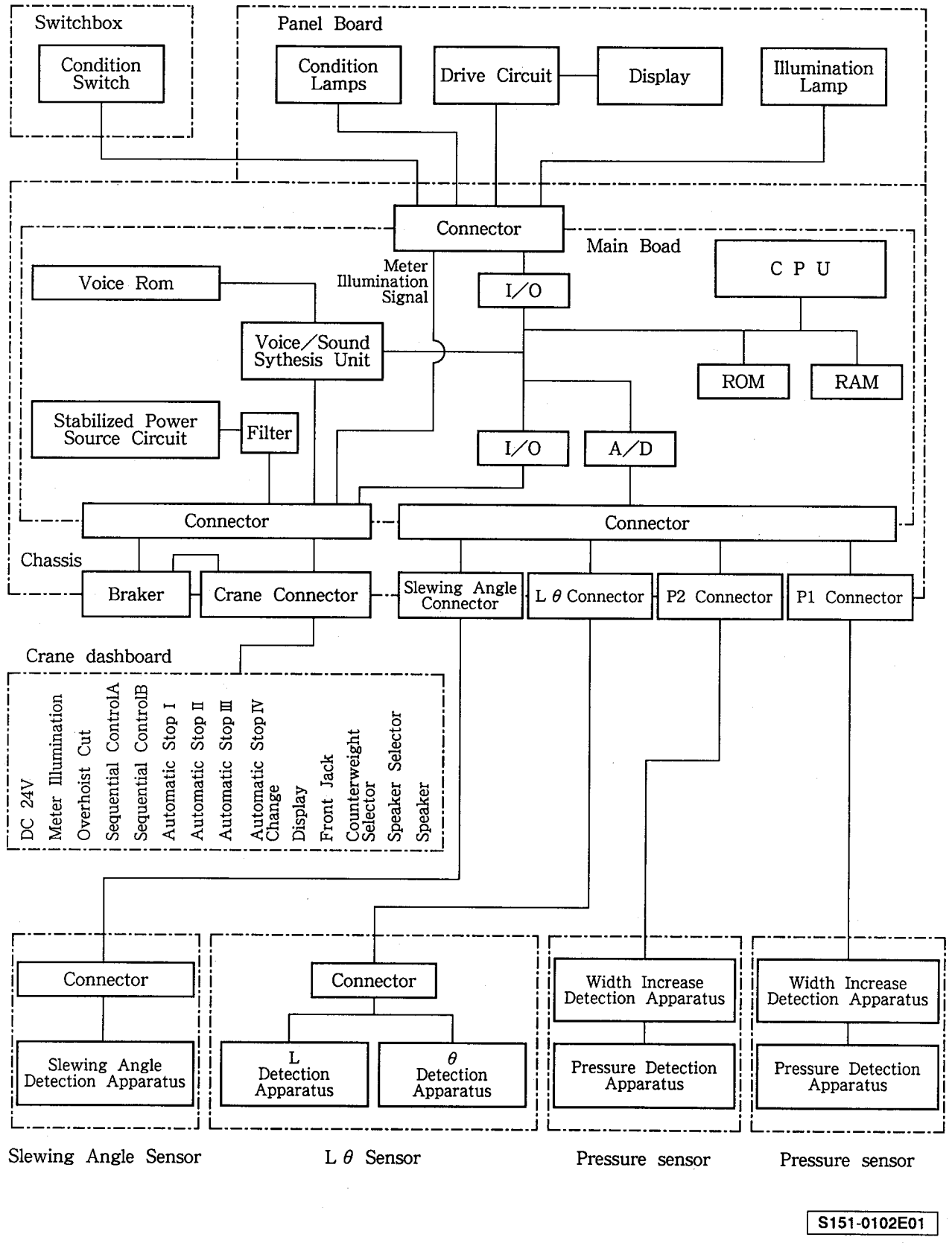
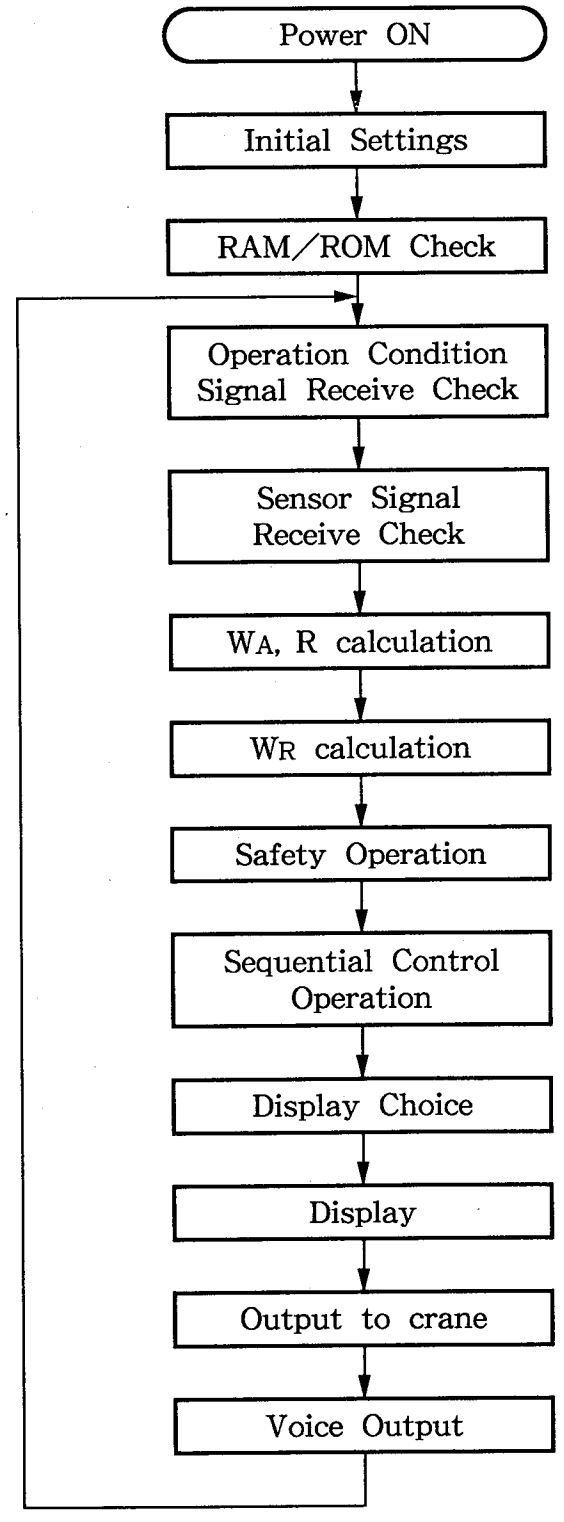
1-2 Hardware Block Diagram (S151-010200E)



S151-0102E01

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

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



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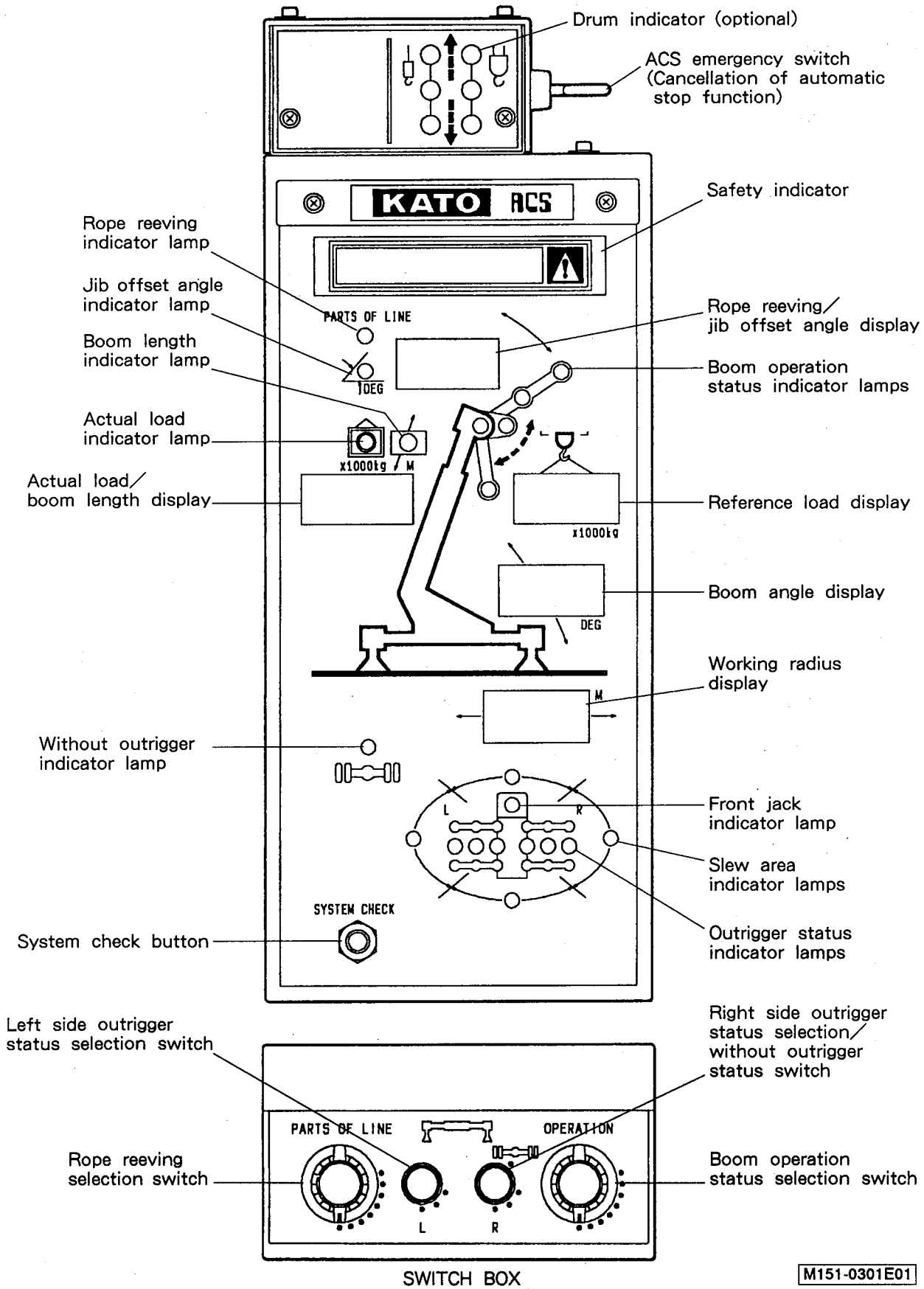
1-4 Display (S151-010400E)



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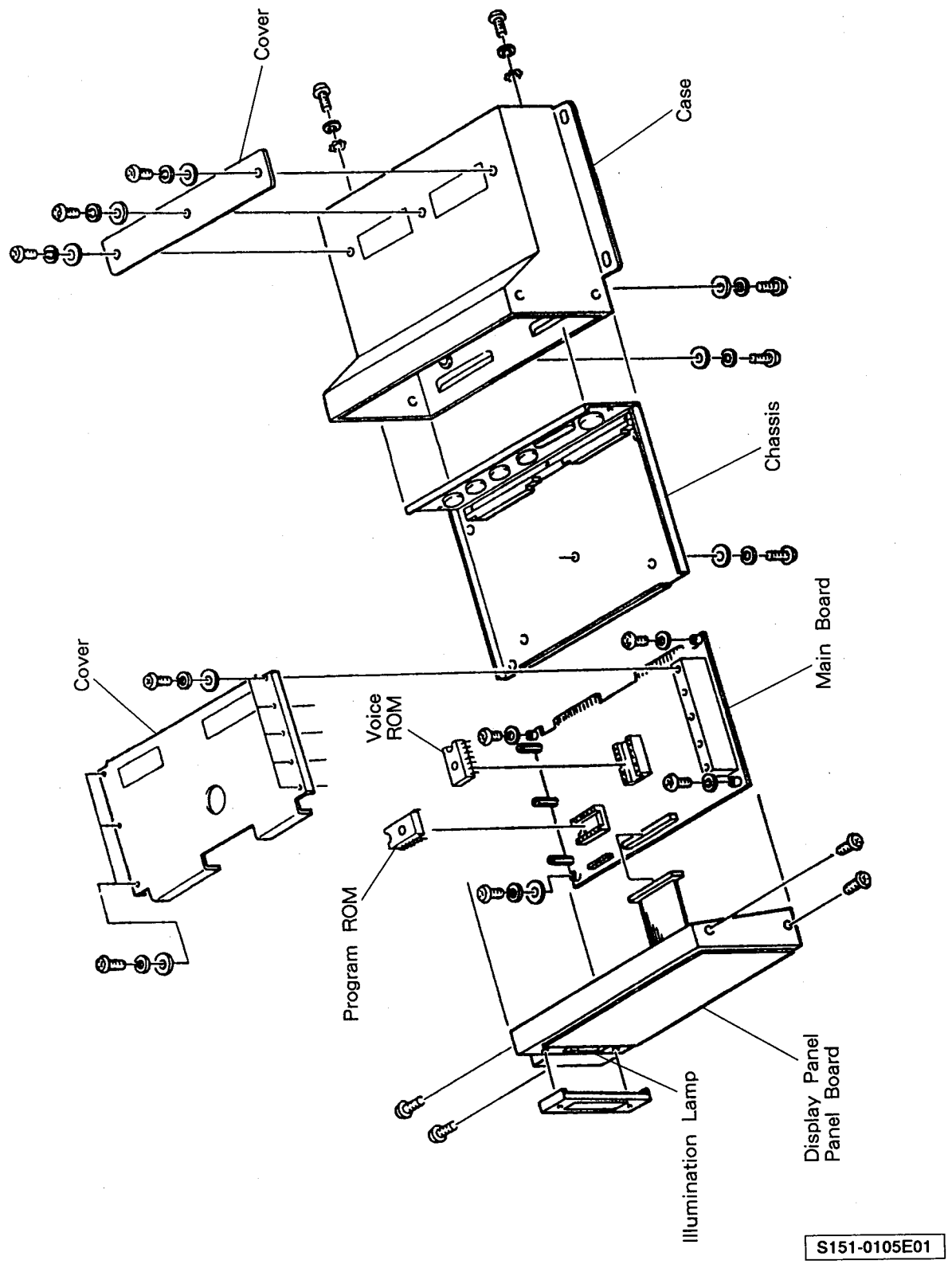
1-5 Main Body (exploded view) (S151-010500E)



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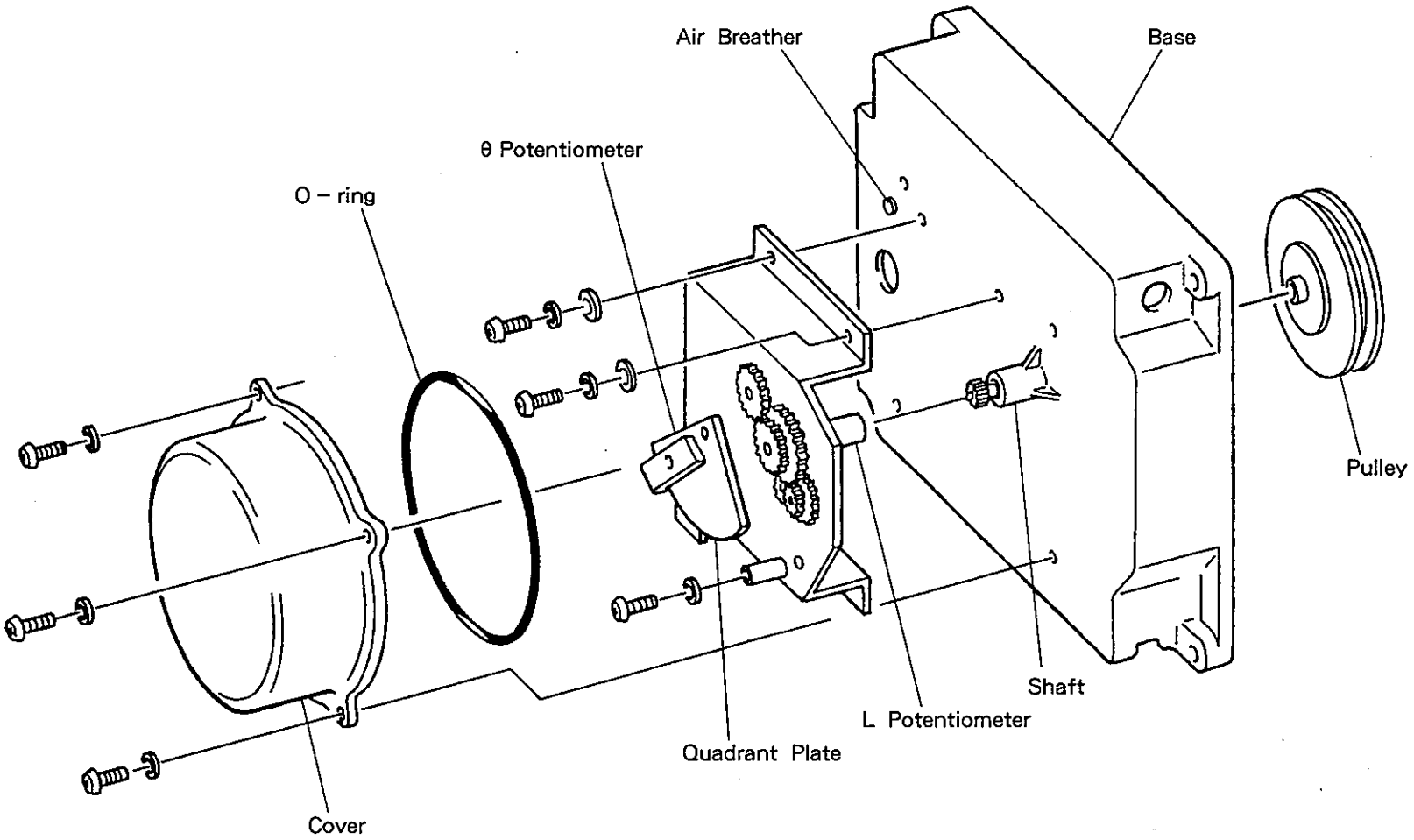
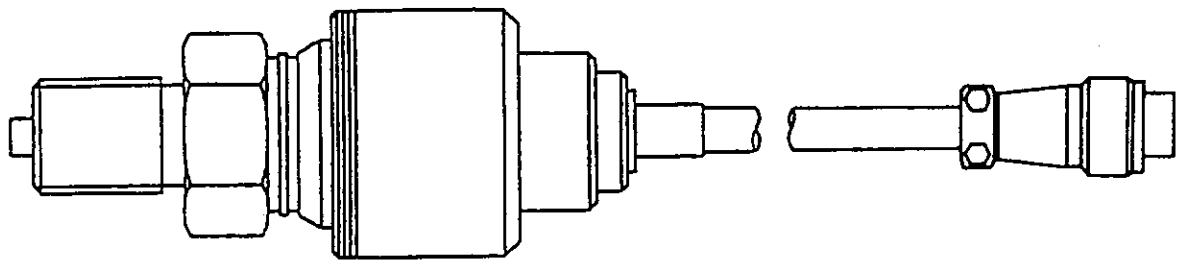
1-6 L θ Sensor (exploded view) (S151-010600E)



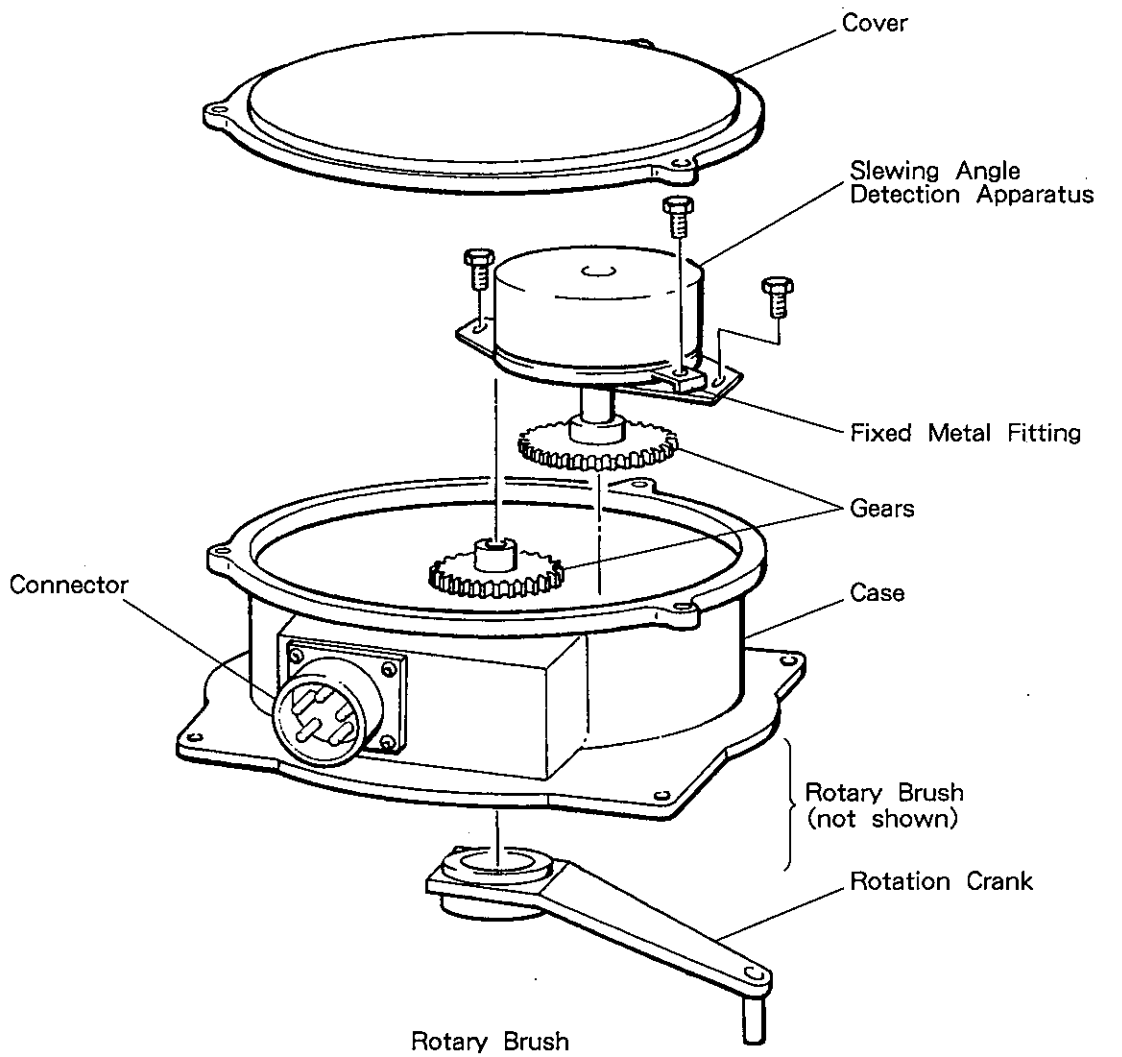
S151-0106E01

1-7 Pressure Sensor (S151-010700E)



S151-0107E01

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



S151-0108E01

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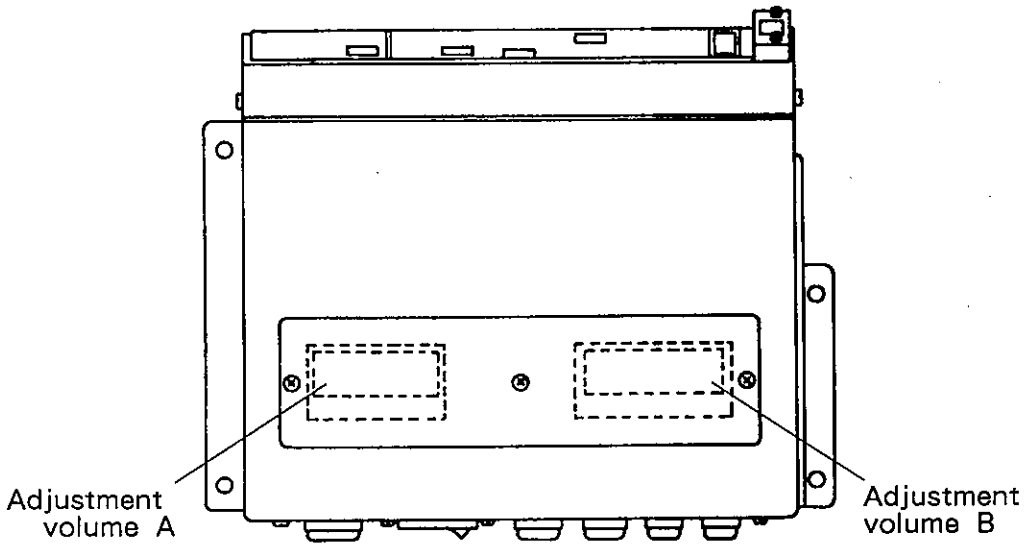
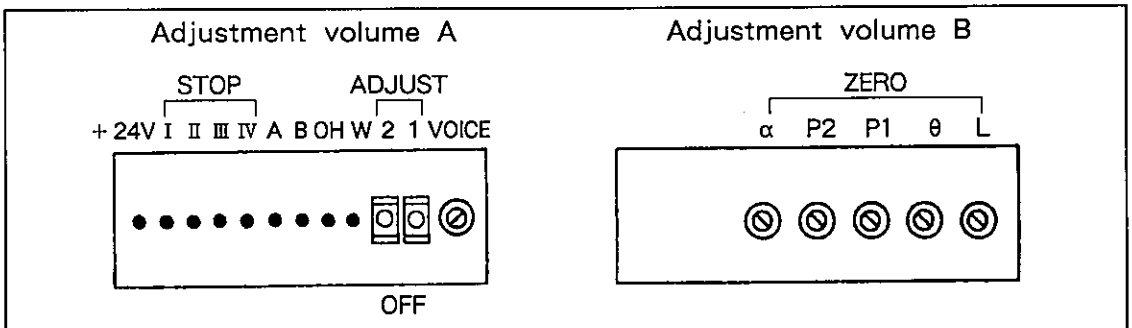
2. CHECKS AND ADJUSTMENTS (S151-020000E)

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) + 24V ……when ACS power source switch ON ; breaker ON
2) STOP ……when auto-stop signal not output
3) W ……when load display change button ON
4) A ……when A signal for sequential control output
5) B ……when B signal for sequential control output
6) OH ……when overhoist cut signal output

Adjustment Volumes

1) VOICE ……volume of sound adjustment (Adjusted upon shipment ; do not adjust)
2) α ……slewing angle zero adjustment
3) P1 ……P1 pressure sensor zero adjustment
4) P2 ……P2 pressure sensor zero adjustment
5) θ ……boom angle zero adjustment
6) L ……boom length zero adjustment

S151-0201E02

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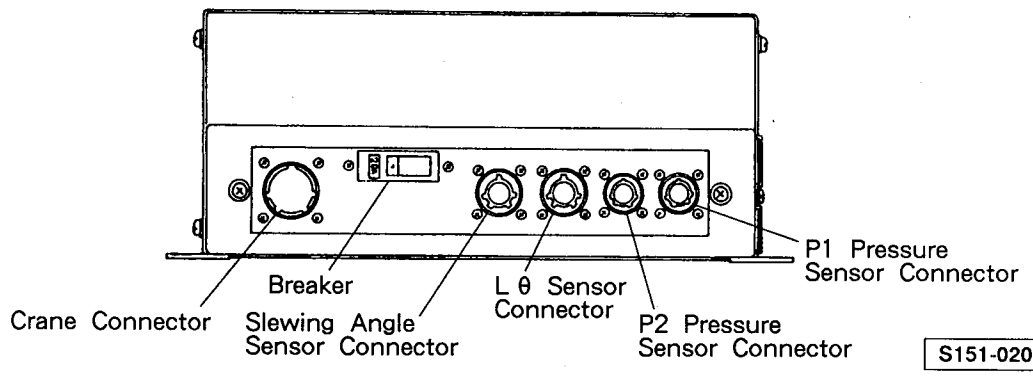
(2) Main body connector location/pin number layout diagram



S151-0201E03

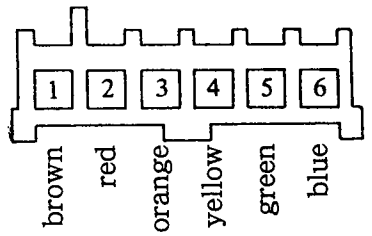
NAME / PIN NO.	Crane Connector	Slewing Angle Sensor Connector	L θ Sensor Connector	Pressure Sensor Connector
PIN POSITION	SRC02A-25-24P	SRC02A16-7S	SRC02A16-10S	SRC02A13-5S
1	+ 24V	+ 5.12V	+ 5.12V	+ 24V
2	————	slewing angle 1	GND	pressure input signal
3	meter illumination	slewing angle 2	boom length input signal	————
4	overhoist cut	————	————	GND
5	————	GND	————	shield
6	(spare 1 input signal)	shield	————	
7	(spare 2 input signal)		shield	
8	(counterweight selector)		+ 5.12V	
9	display selector		GND	
10	front jack		boom angle input signal	
11	auto-stop I			
12	sequential control A			
13	sequential control B			
14	————			
15	GND			
16	auto-stop II			
17	auto-stop III			
18	auto-stop IV			
19	voice selector			
20	————			
21	speaker (+)			
22	speaker (−)			
23	————			
24	GND			

S151-0201E04

(3) Sensor connector pin diagram

L θ Sensor (internal)

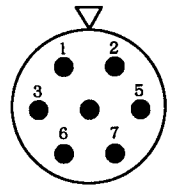
< cabtire – side connector >



1. GND
2. boom length output signal
3. + 5.12V
4. GND
5. boom angle output signal
6. + 5.12V

S151-0201E05

Slewing Angle Sensor



1. + 5.12V
2. GND
3. –
4. –
5. shield
6. α 2
7. α 1

S151-0201E06

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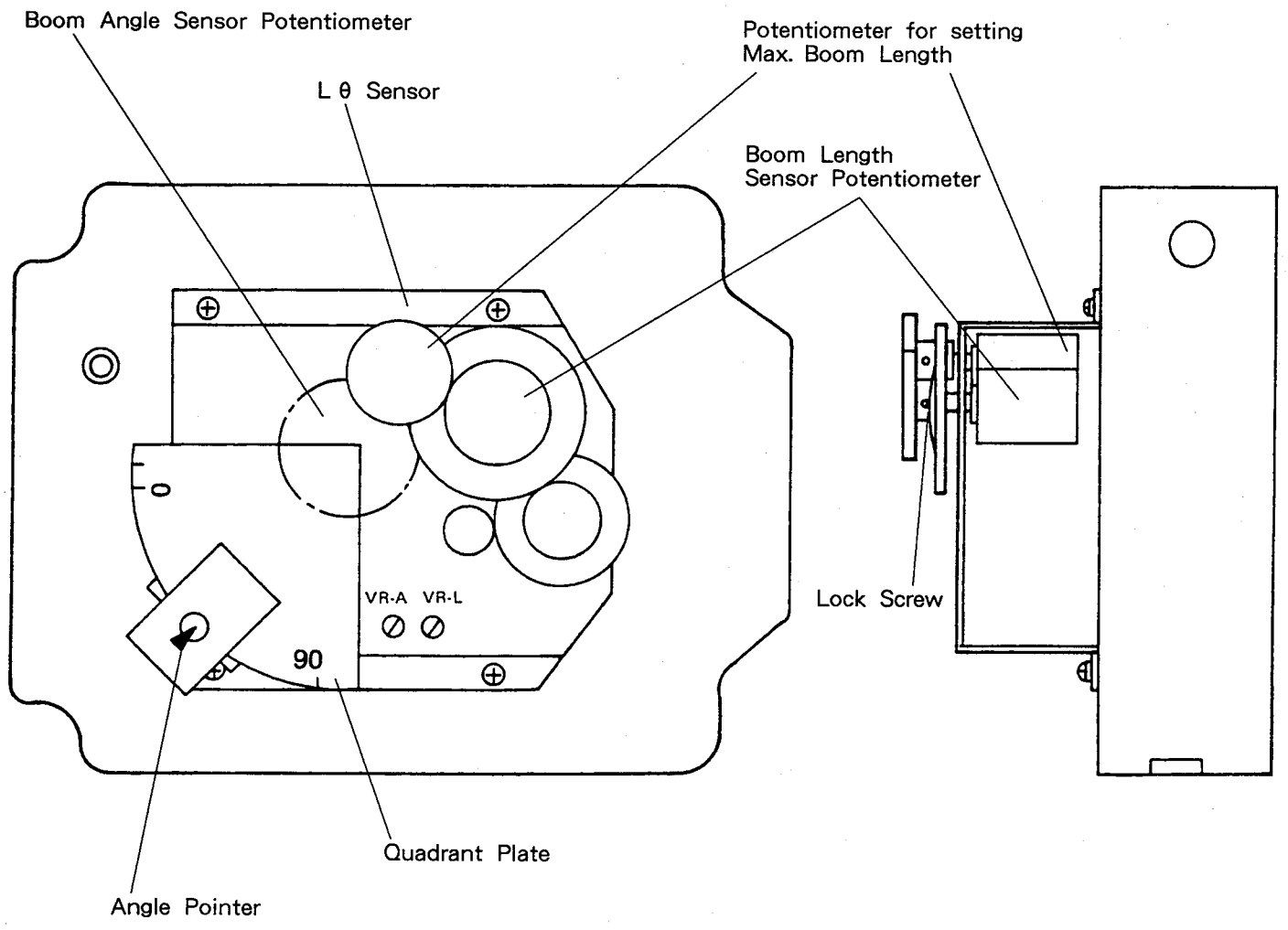
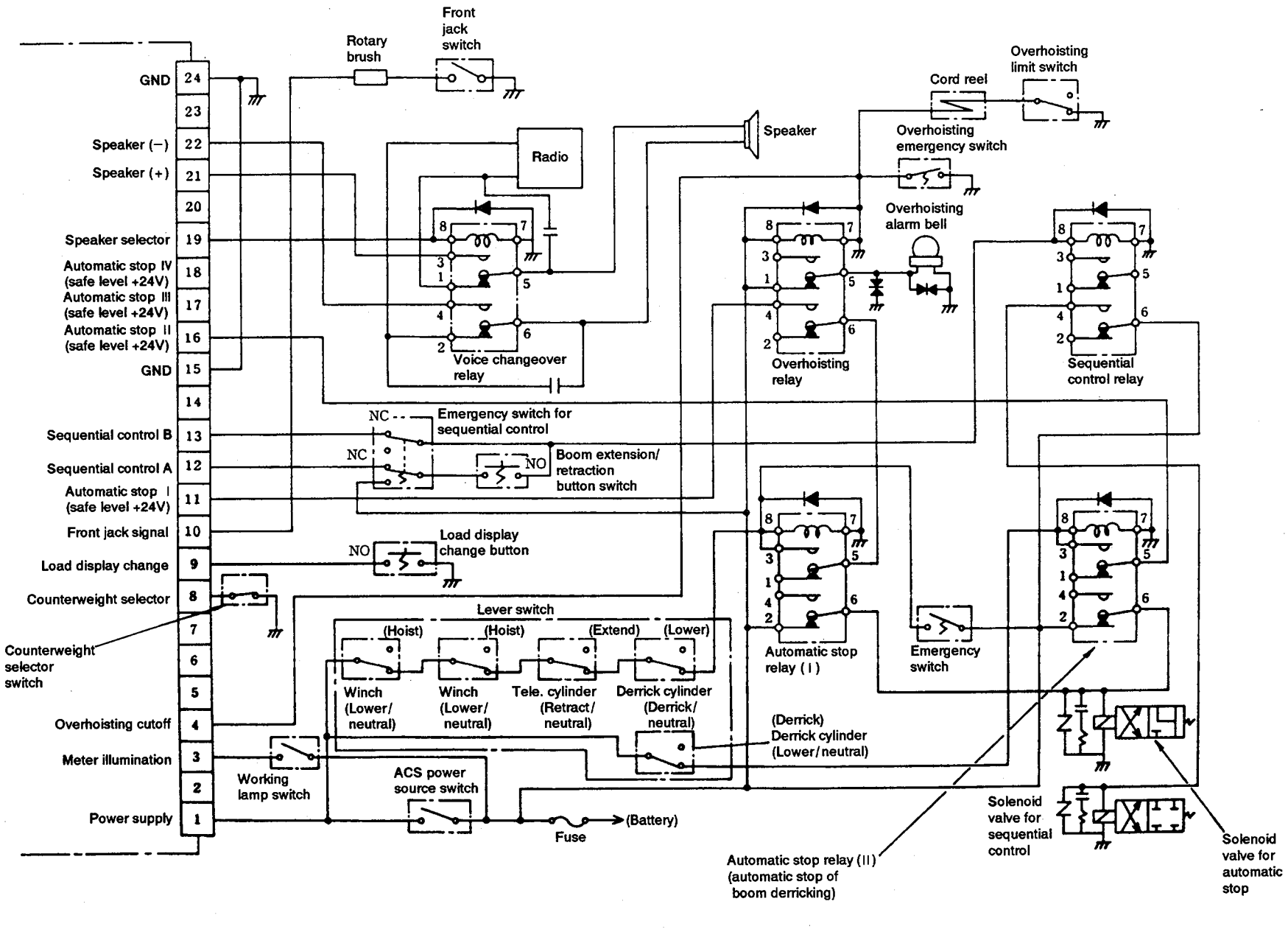
(4) L θ sensor adjustment volume layout diagram



S151-0201E07

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

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



S151-0201E08

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

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"

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(2) Display

〈ADJ 1 SW = OFF〉

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

〈ADJ 1 SW = ON〉

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

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

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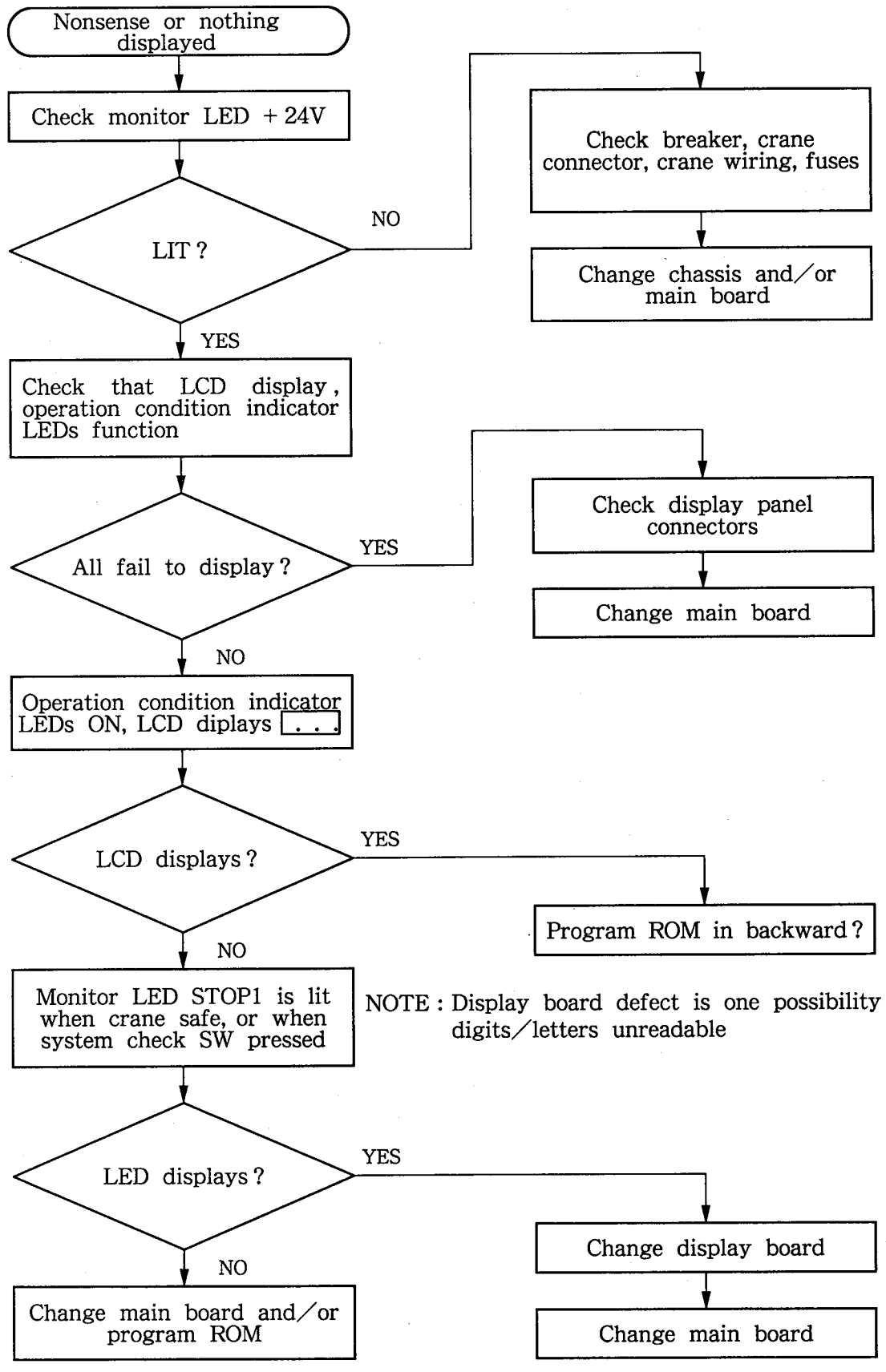
(3) Troubleshooting

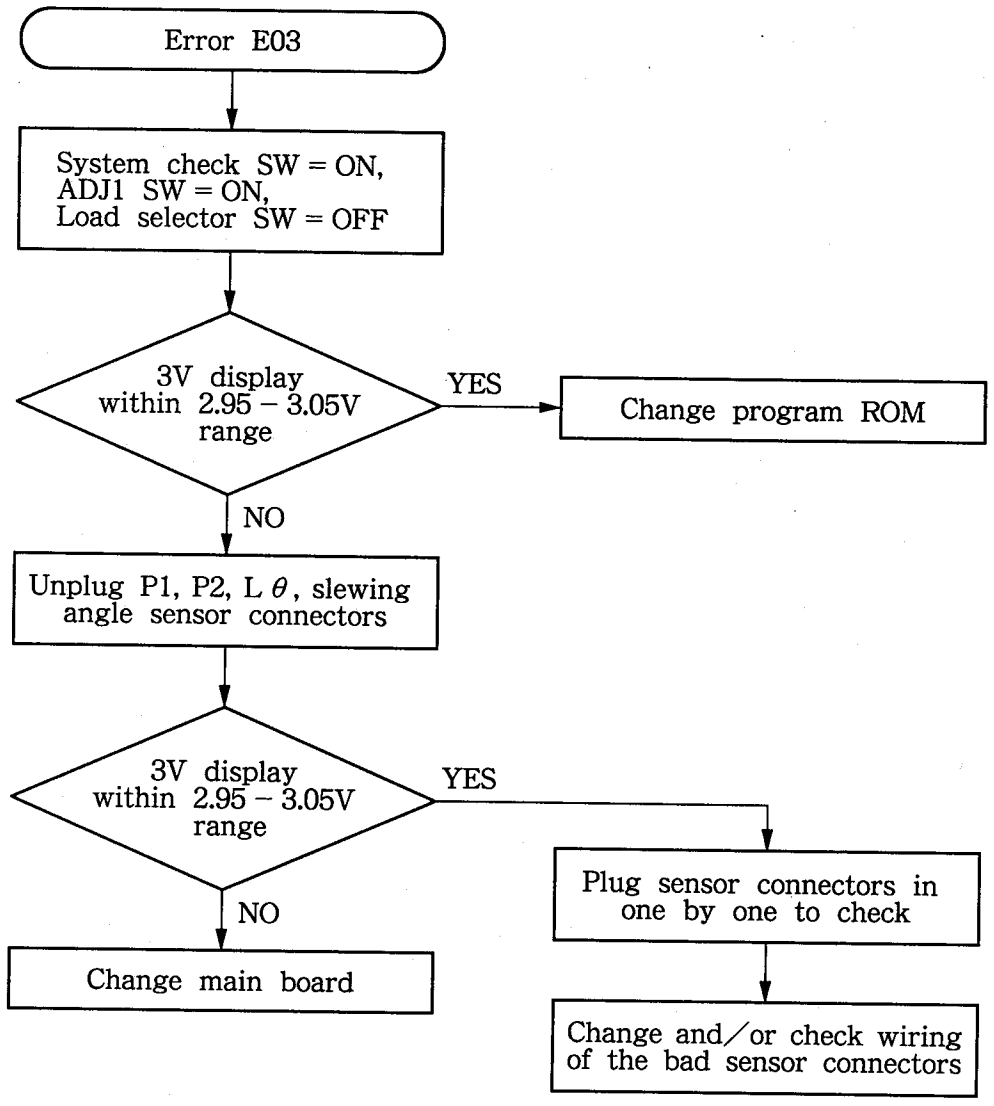
Nonsense or nothing displayed



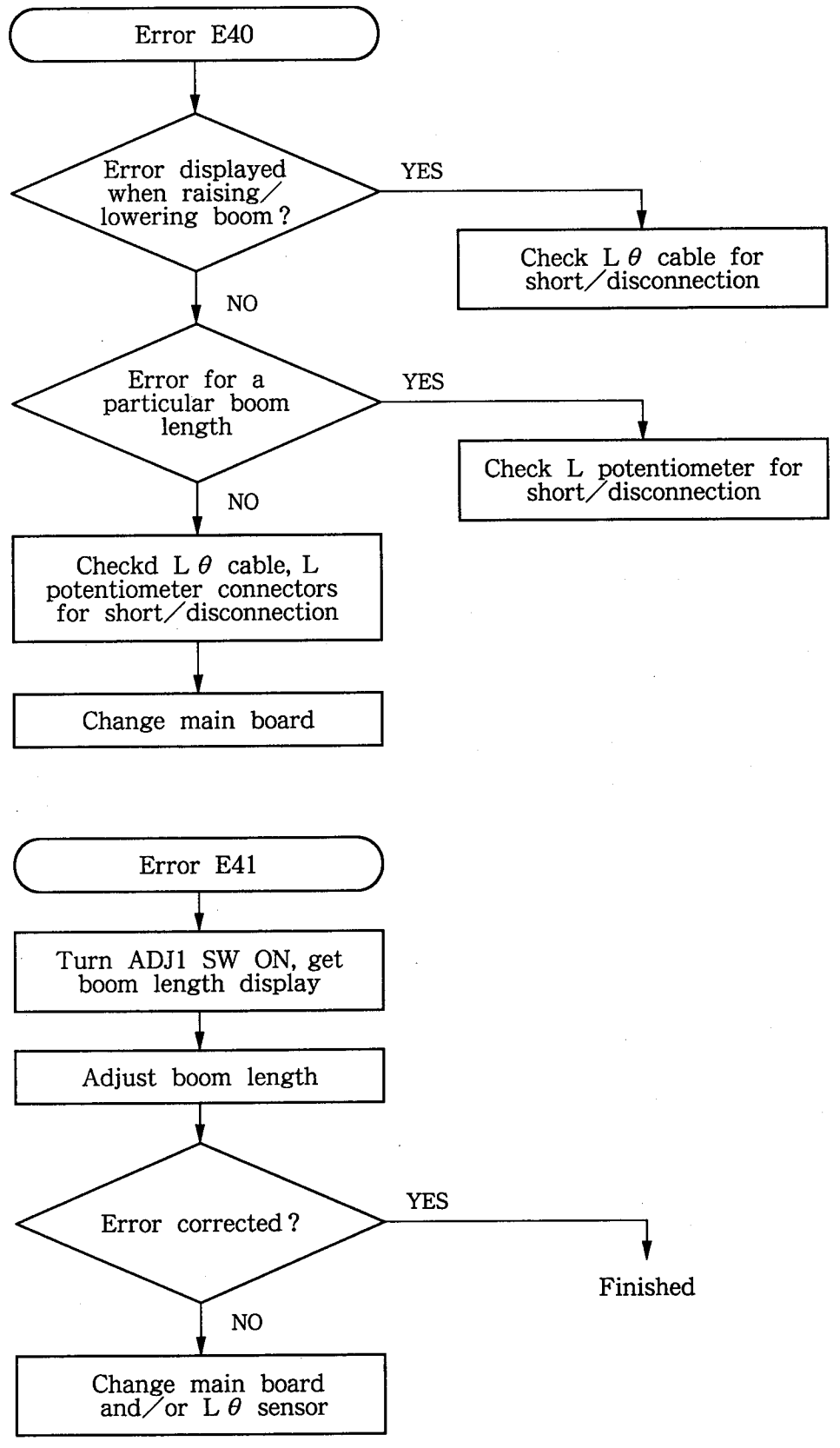
NOTE : Display board defect is one possibility if digits/letters unreadable

Troubleshooting

Stabilized power source error



Troubleshooting



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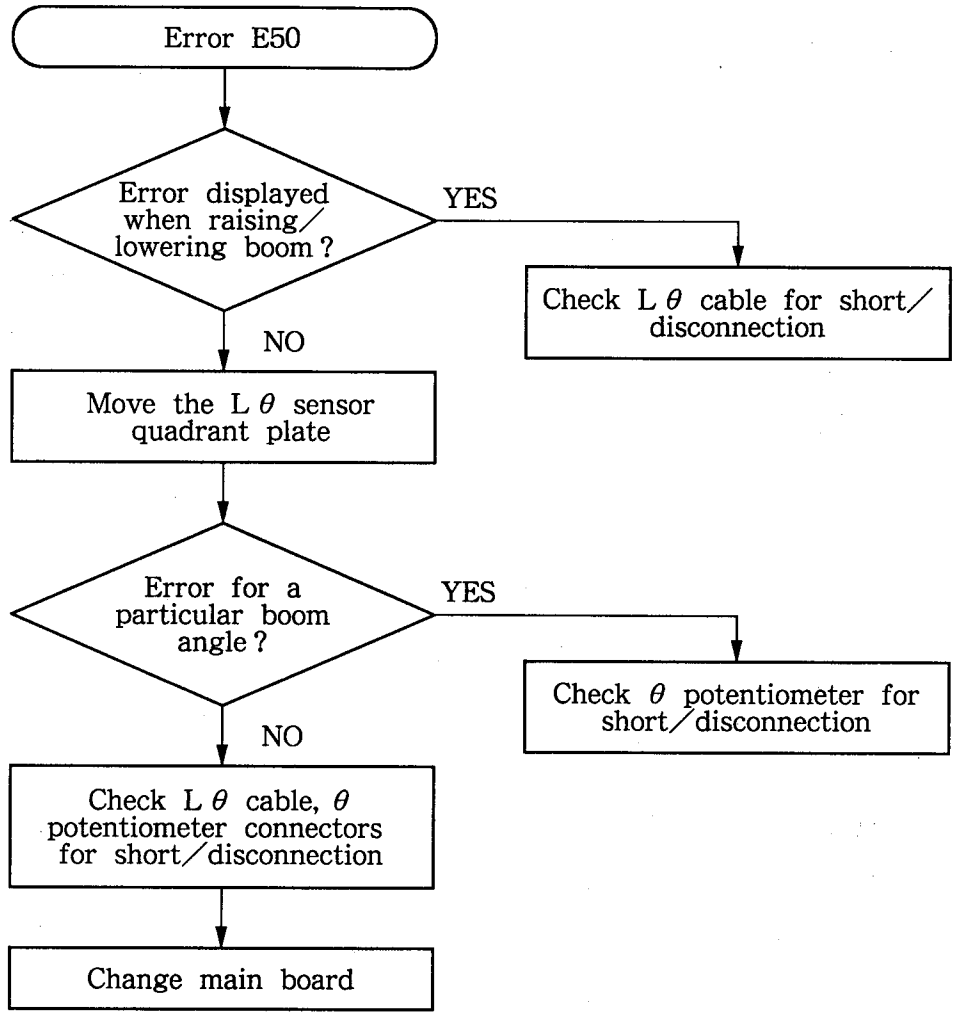
Troubleshooting



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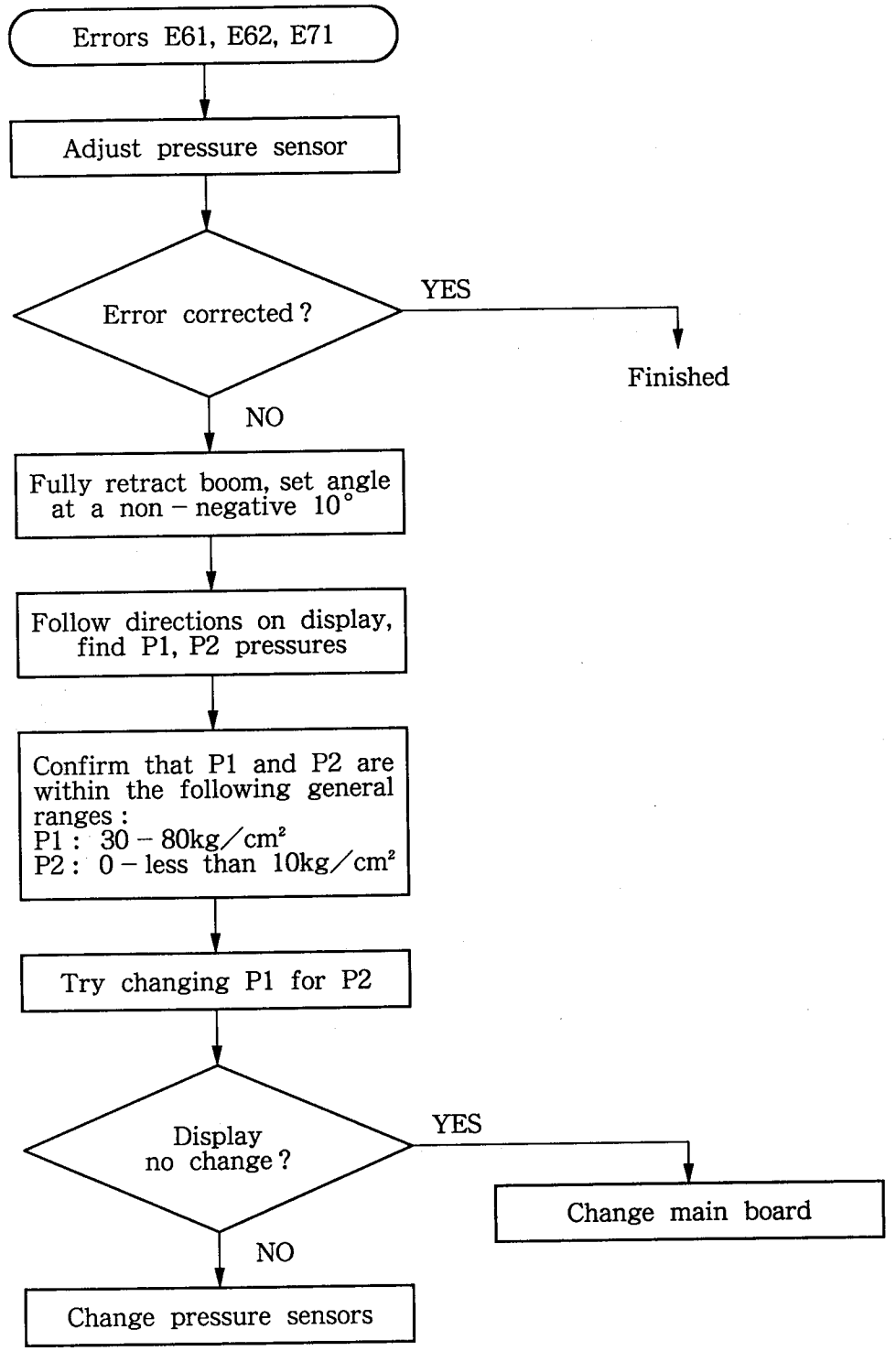
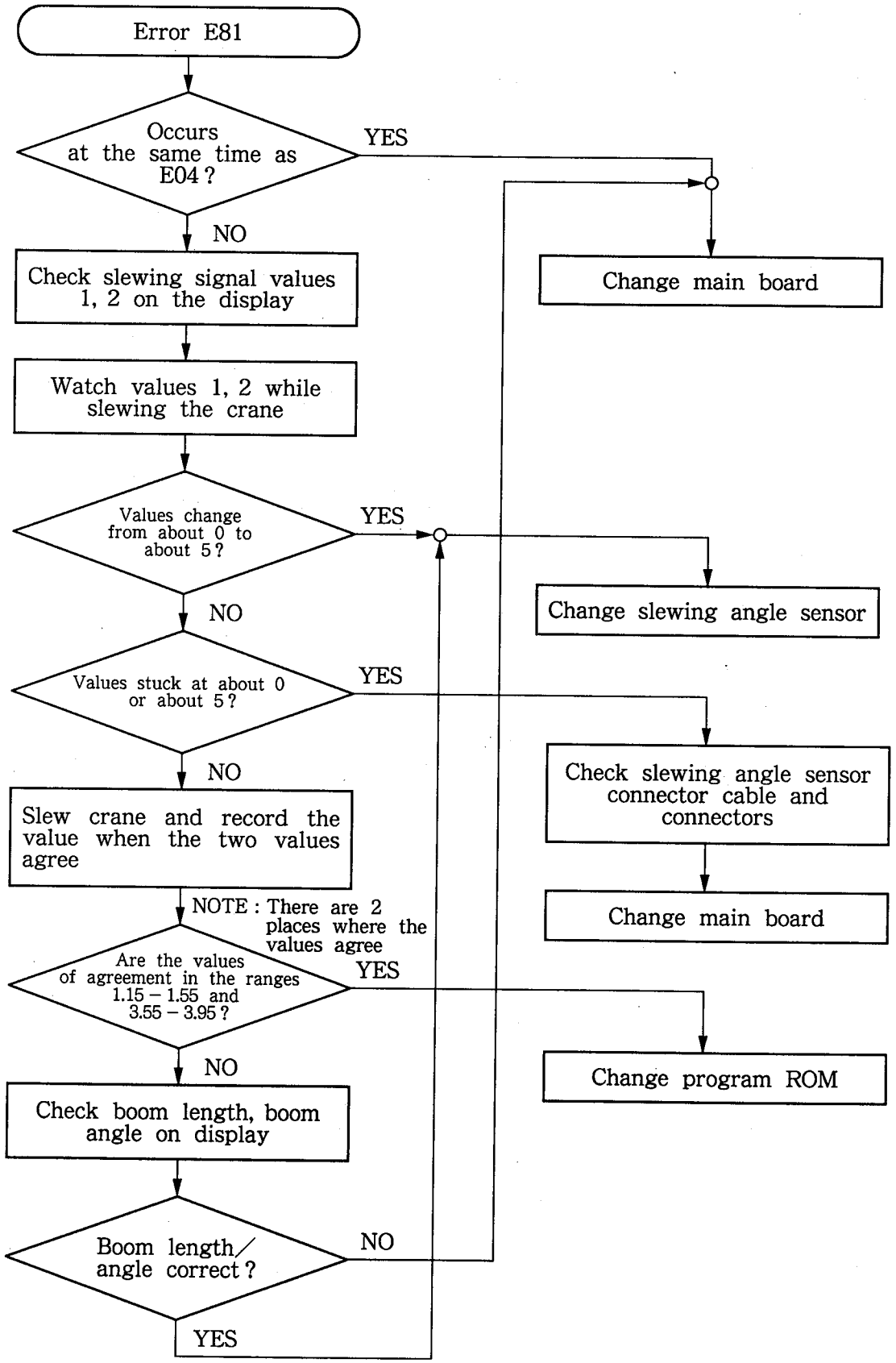
Troubleshooting



Troubleshooting Errors E81 – E04, E81



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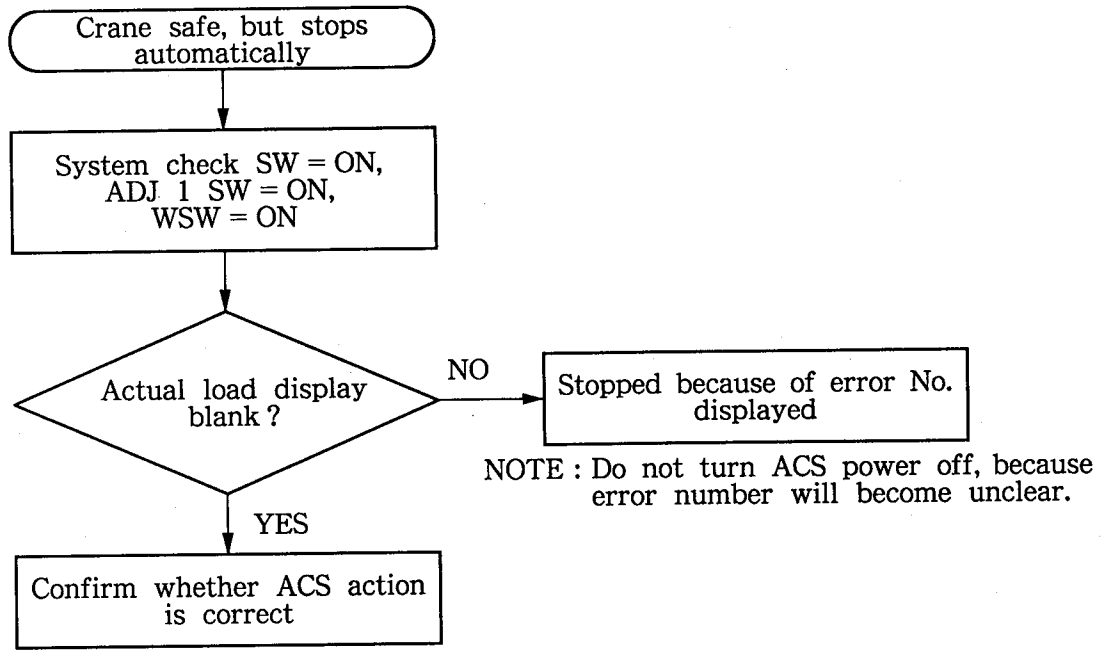
Troubleshooting



NOTE : Do not turn ACS power off, because error number will become unclear.

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

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2-3 Adjustments (S151-020300E)

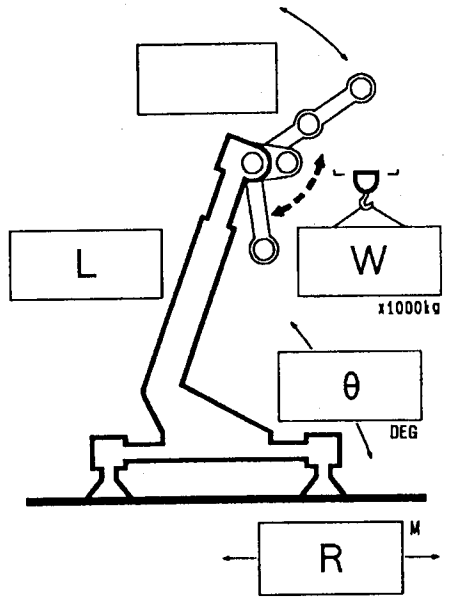
(1) About this section

How to read the following sheets

No.	Checks and Adjustments	Explanation	Adjusting Method					
			Setting			Indicator	Adjusting Volume	Data
			System Check Switch	ADJ 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

(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					
			Setting			Indicator	Adjusting Volume	Data
			System Check Switch	ADJ 1 SW	Load display change button			
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						

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(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	Adjusting Method					
			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 quardant 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°
	[IF NOT]	1. Check wiring, connectors 2. Change main board or L θ sensor						
4	Reconfirm zero	If adjusting as in No.3, recofnfirm as in No.2						

(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					
			Setting			Indicator	Adjusting Volume	Data
			System Check Switch	ADJ 1 SW	Load display change button			
1	Preparation	Fuflly 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 extention 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.						

(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	Adjusting Method					
			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／c m²	P_1 ZERO P_2 ZERO	0～1 kg/cm² 0～1 kg/cm²
	〔IF NOT〕	Check wiring, connectors. Change pressure sensor, main board.						

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(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					
			Setting			Indicator	Adjusting Volume	Data
			System Check Switch	ADJ 1 SW	Load display change button			
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		

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3. REPLACEMENTS (S151-030000E)

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 :

105001	→	ACS type software code
S1	→	Indicates inserting locatin. See diagram below

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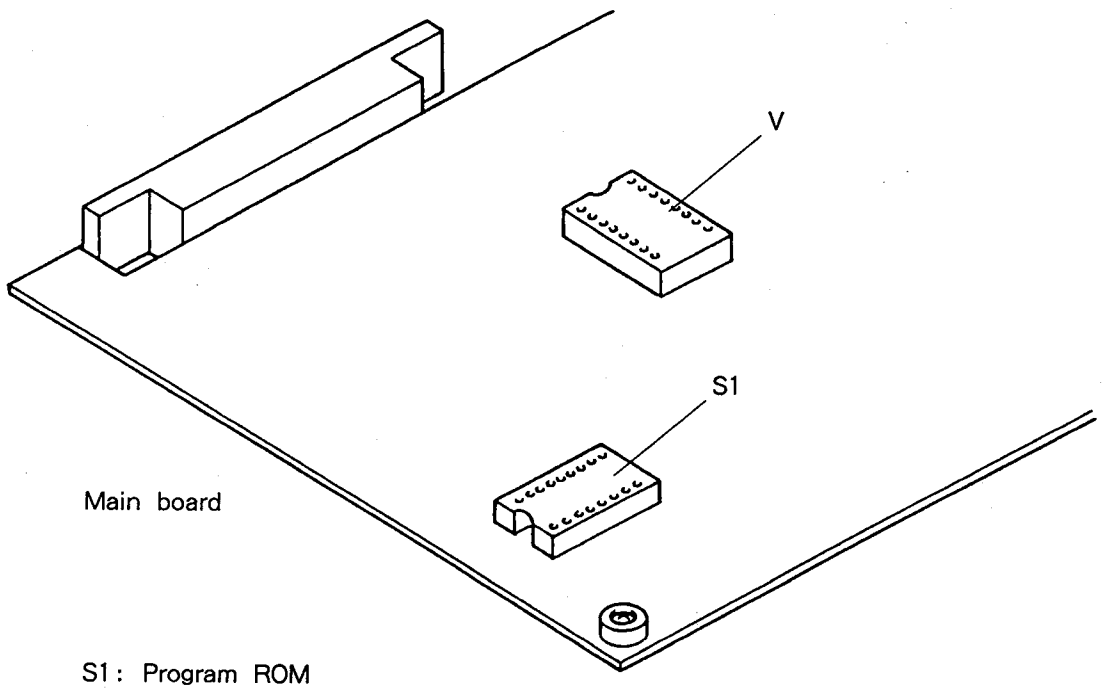
REPLACEMENTS



S1 : Program ROM

V : Voice ROM

S151-0300E01

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