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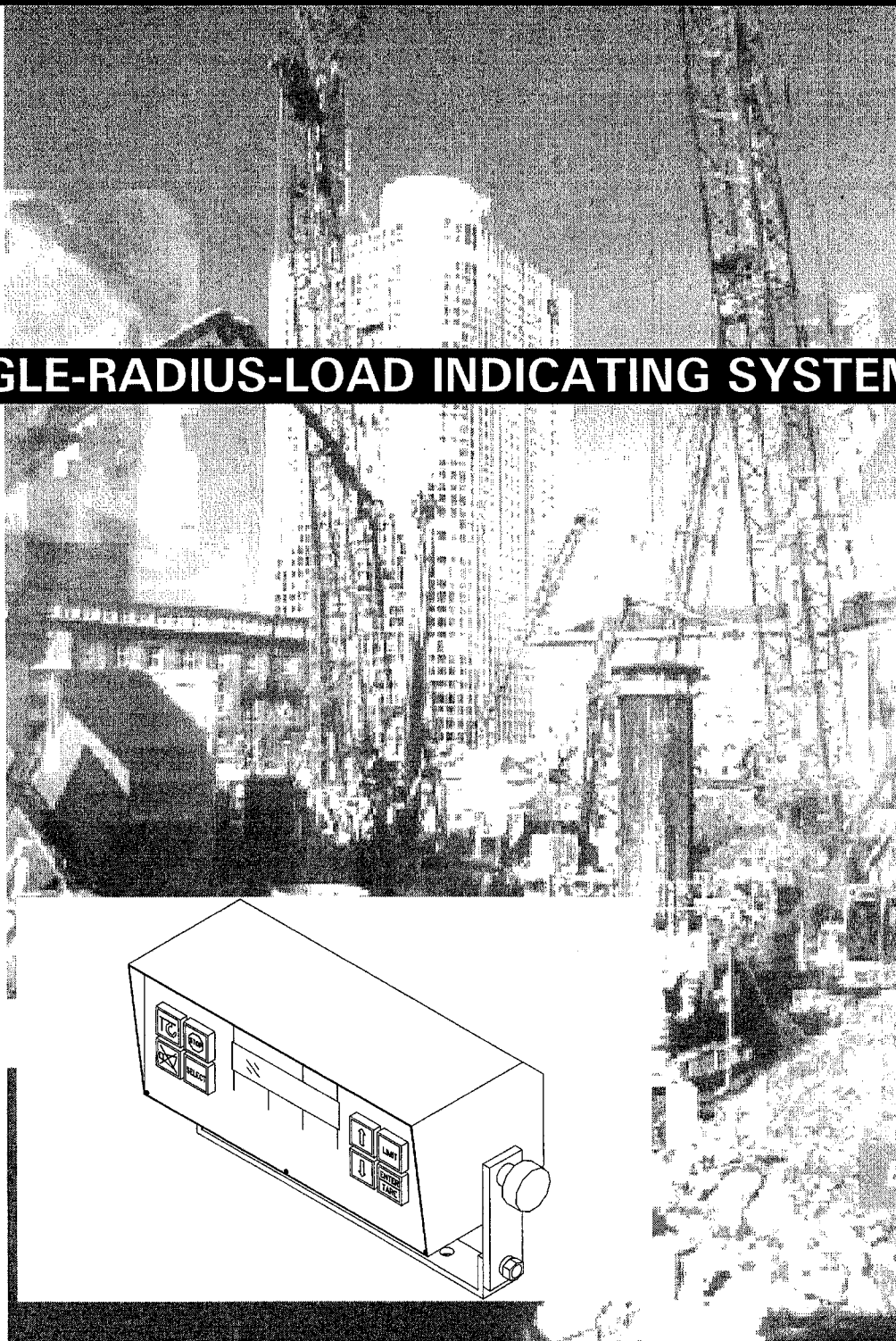
PAT America, Inc.

PAT

PAT

LENGTH-ANGLE-RADIUS-LOAD INDICATING SYSTEM

EI65/0001



SERVICE MANUAL

P/N 031-300-101-047, Rev. A, 10/19/00

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1 GENERAL INFORMATION

The purpose of this service manual is to provide additional information to assist a service or maintenance person in identifying malfunctions or system problems with the PAT System. A digital voltmeter and regular maintenance and service tools will be required to troubleshoot the system. Note: Knowledge of how to use a digital voltmeter is assumed.

REFERENCE:

Operator's/Calibration Manual 056-065-190-001

SYSTEM MALFUNCTION:

MB 115.0	J1 85.0	■
J2 50.0	OJ 15.0	E71

In case of a malfunction of the system, an error code which identifies the system malfunction will be displayed in the reeving portion of the display. The error codes are listed in Section 4, Error Codes. The table identifies various faults that can occur with the EI65, explain each fault, and describe the action, which shall be taken to correct the fault.

Faults within the electronic microprocessor shall be repaired by factory trained service personnel. When these faults occur, contact your authorized dealer or service organization.

If the operator identifies a possible problem in the system, perform the pre-operation inspection Section 5 in the Operator's Manual 056-065-190-001 to define the problem.

SYSTEM DESCRIPTION:

The PAT Length-Angle-Radius-Load Indicator System EI65 has been designed to provide the crane operator with the essential information required to enable the machine to be used within its design parameters. The EI65 System indicates the length and angle of the boom, tip height, working radius and the total weight being lifted by the crane. Using the various sensors and the limits set by the operator, the EI65 System warns the crane operator of certain approaching hazardous conditions which could occur during the operation of his crane.

WARNING

Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

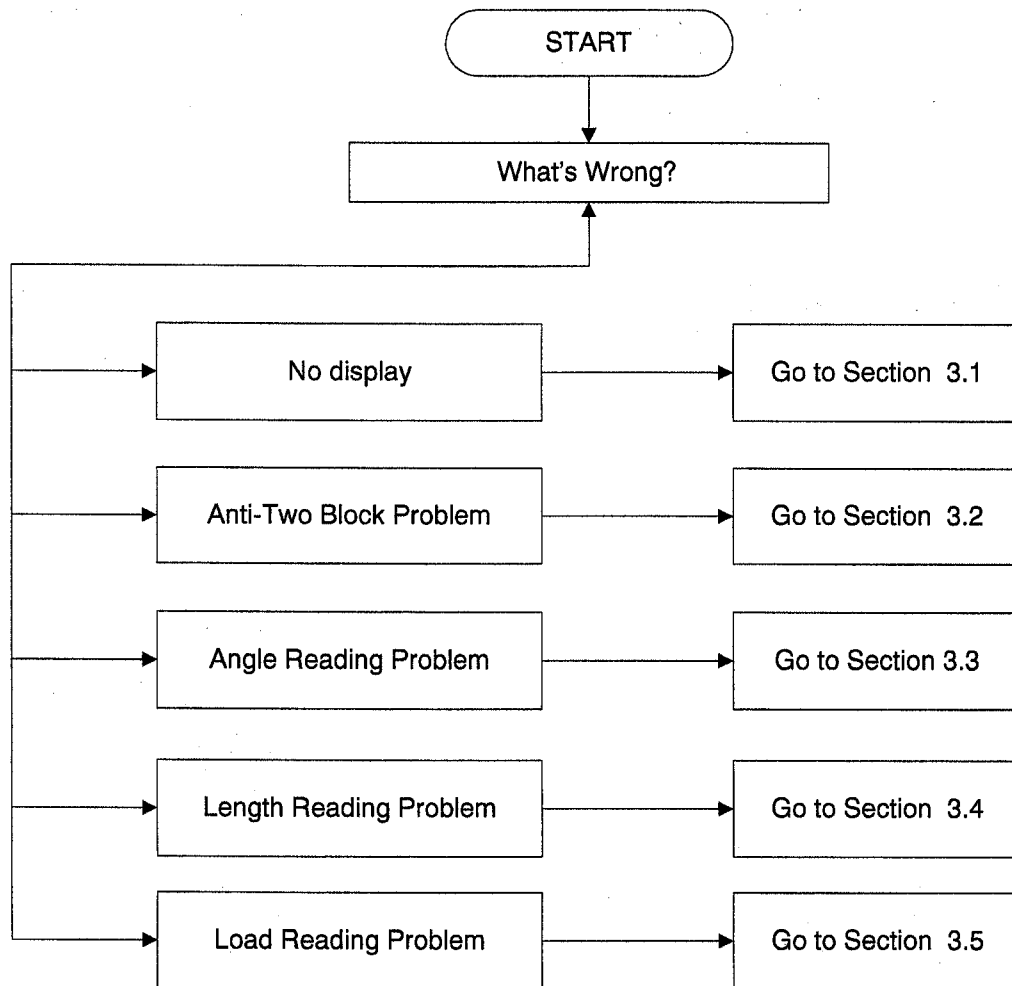
2 WARNINGS

- The EI65 is an operational aid, which warns a crane operator of certain approaching hazardous conditions, which could cause damage to equipment and personnel.
- The device is not, and shall not be, a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.
- The responsibility for the safe operation of the crane shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.
- Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in the operator's manual to ensure that he/she knows the operation and limitations of the indicating system and crane.

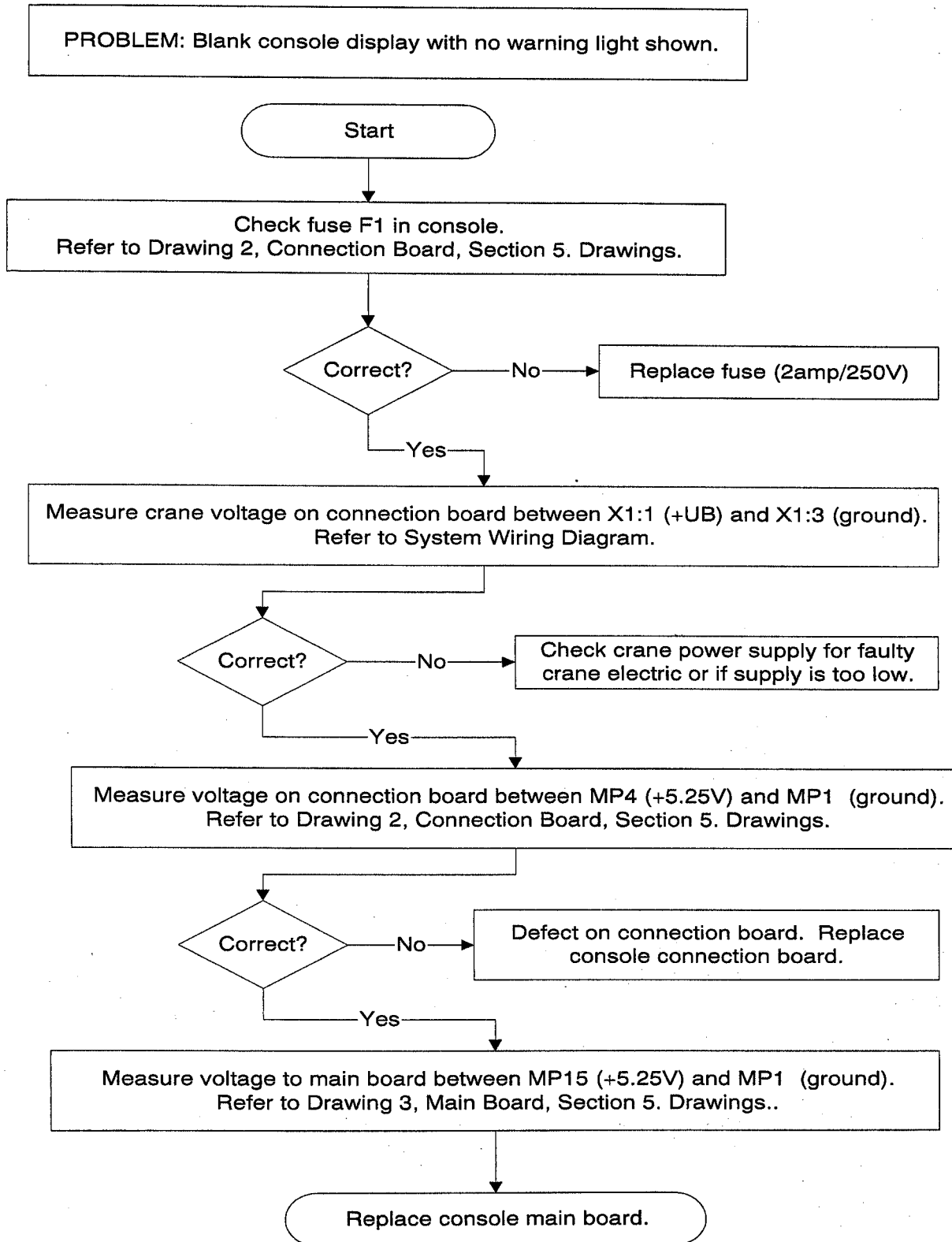
3 TROUBLESHOOTING FLOW CHARTS

This section explains how to handle a problem that may arise with the EI65, PAT Load Indicator System. The procedures are easy to follow and are given in flowcharts on the following pages. Start with the general flowchart below that will guide you to one of the detailed flowcharts shown in this section. Section 5 contains the necessary drawings needed for troubleshooting.

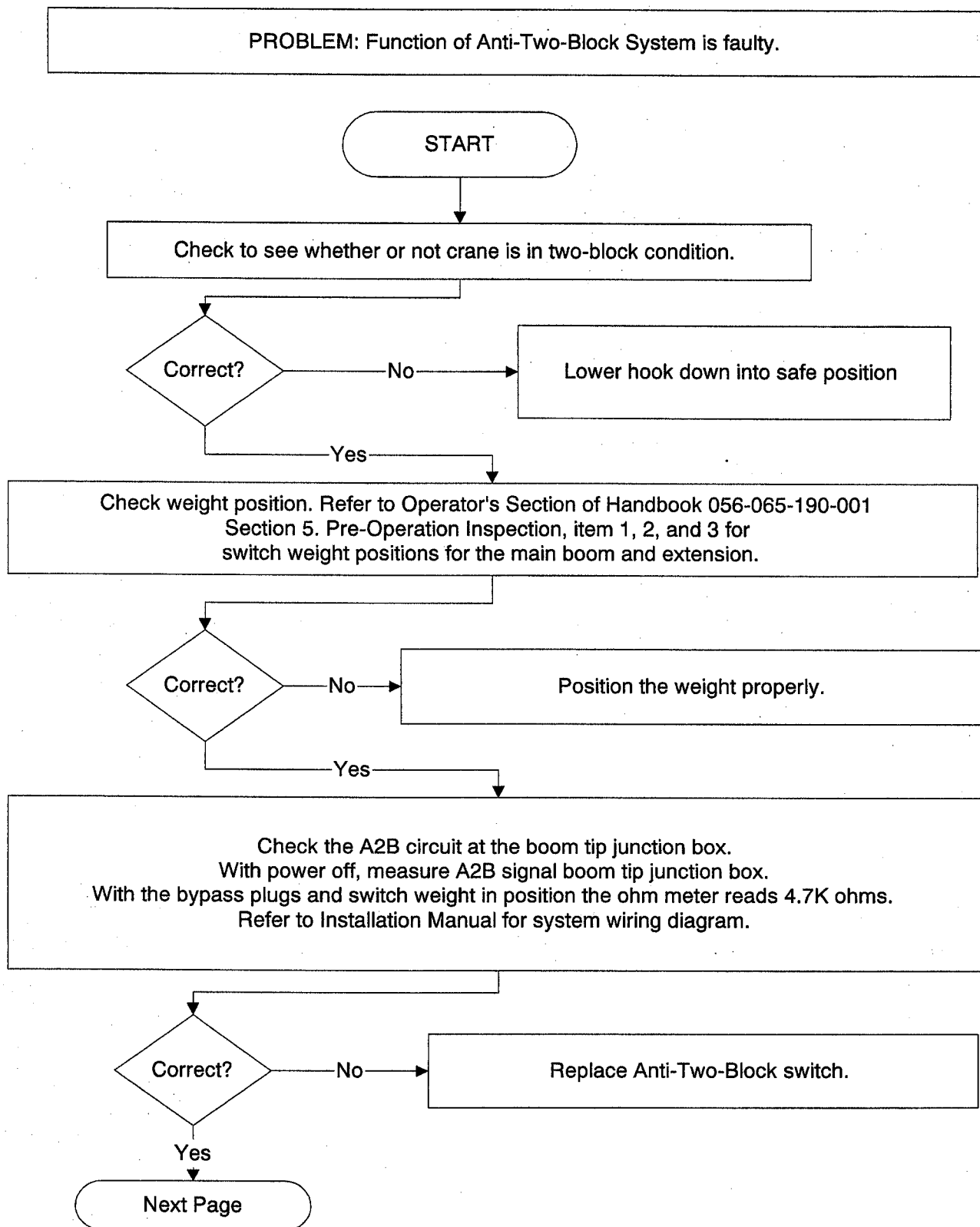
3.1 GENERAL FLOW CHART

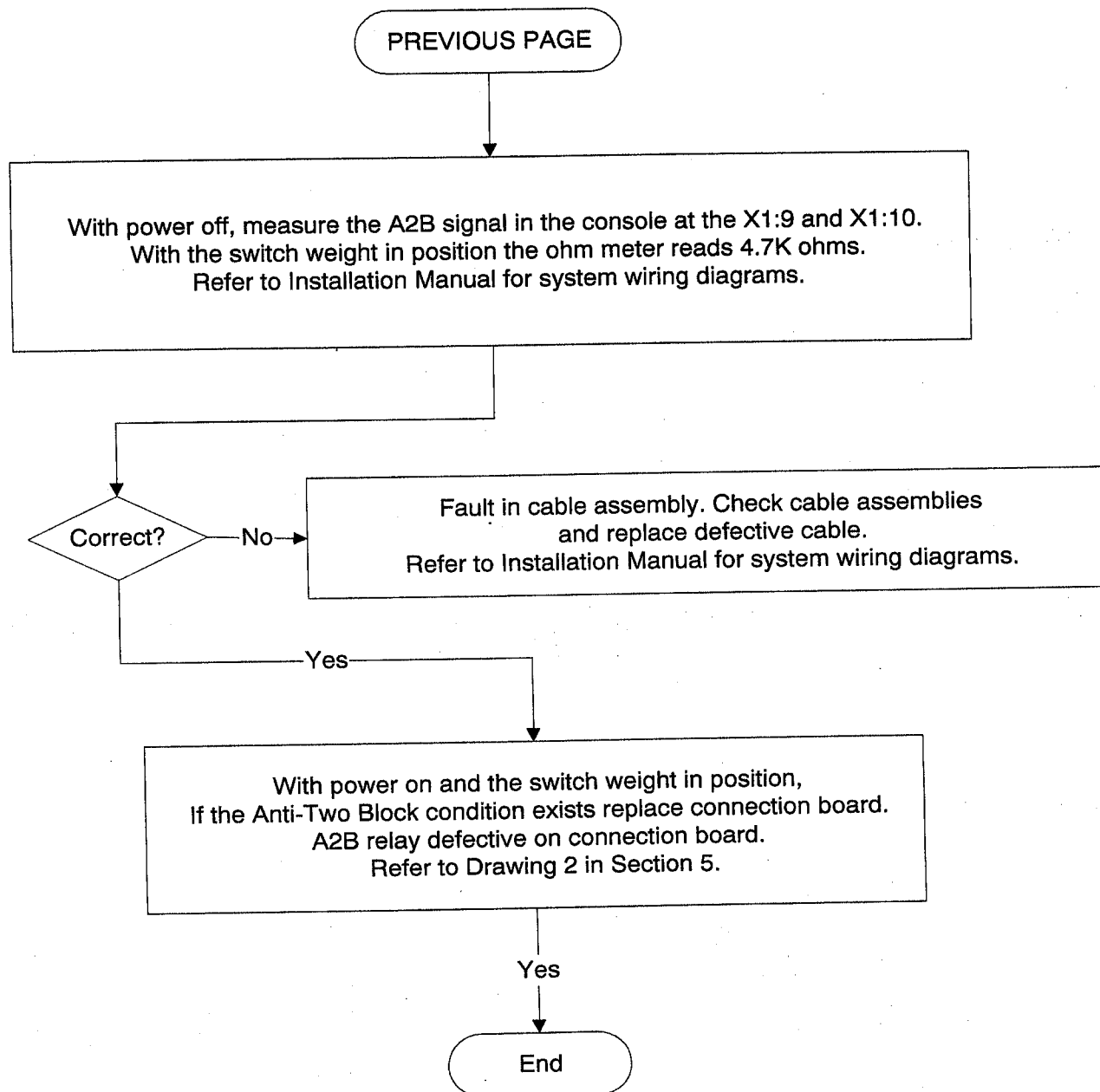


3.2 NO DISPLAY



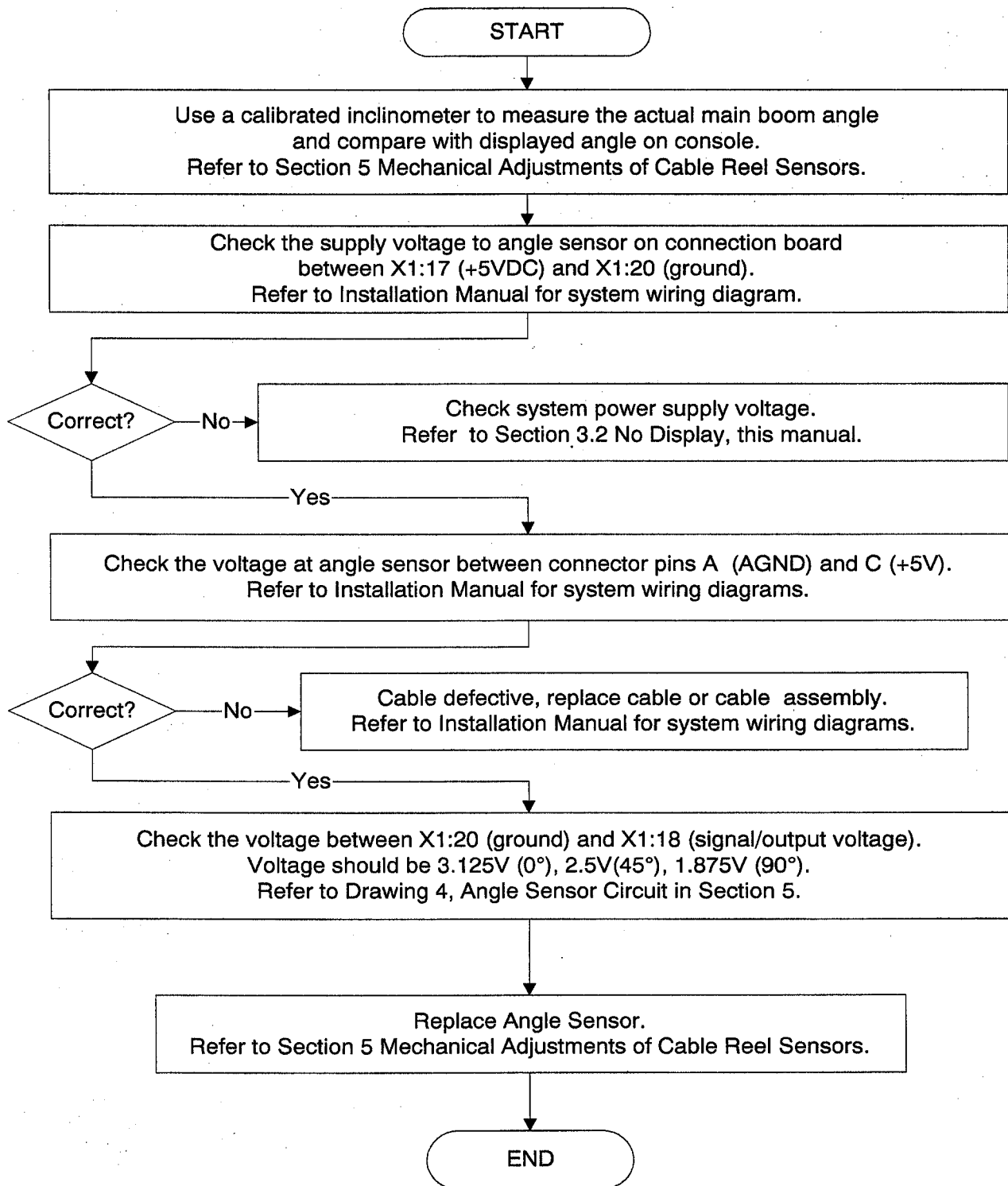
3.3 ANTI TWO BLOCK PROBLEM





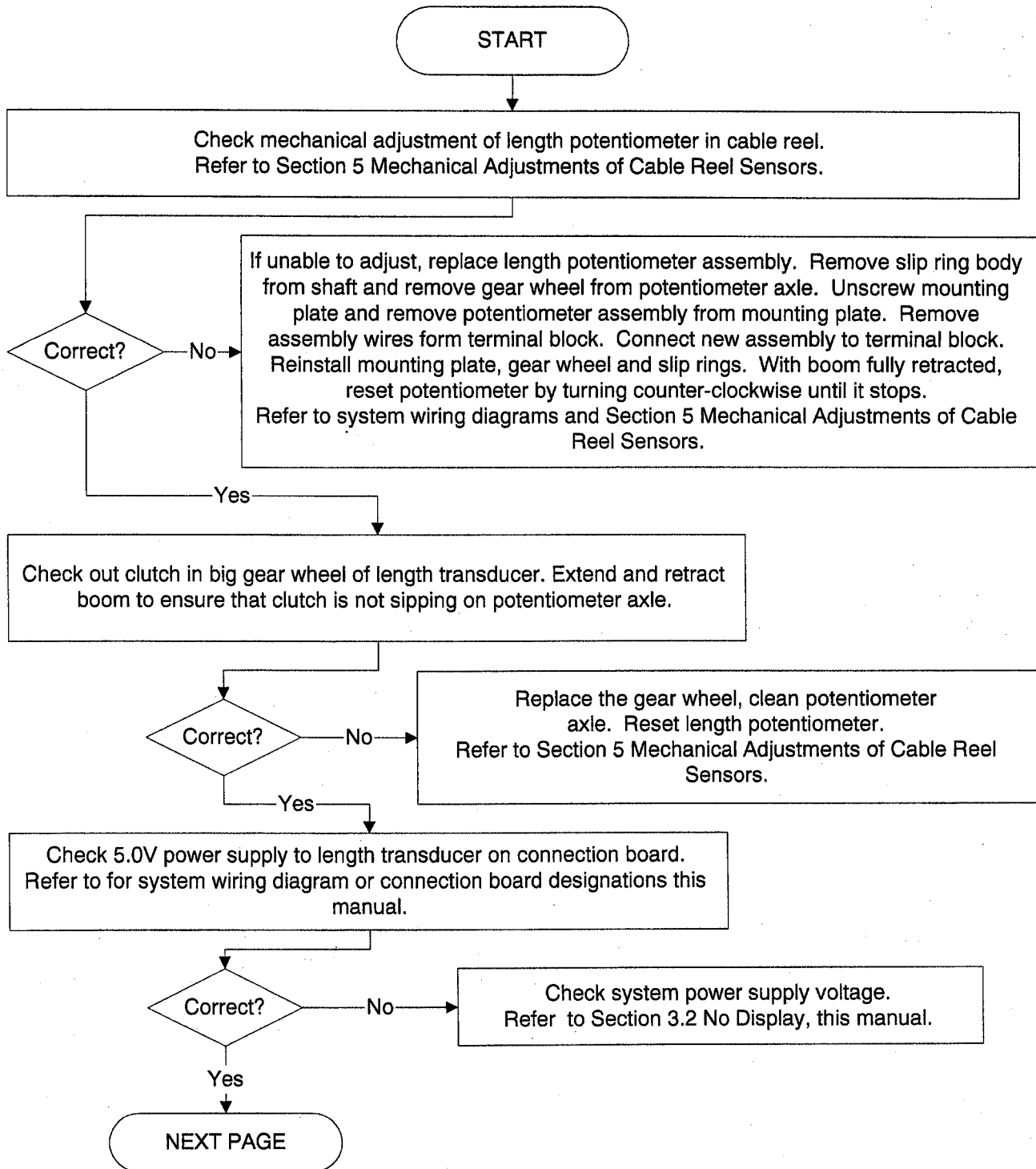
3.4 ANGLE READING PROBLEM

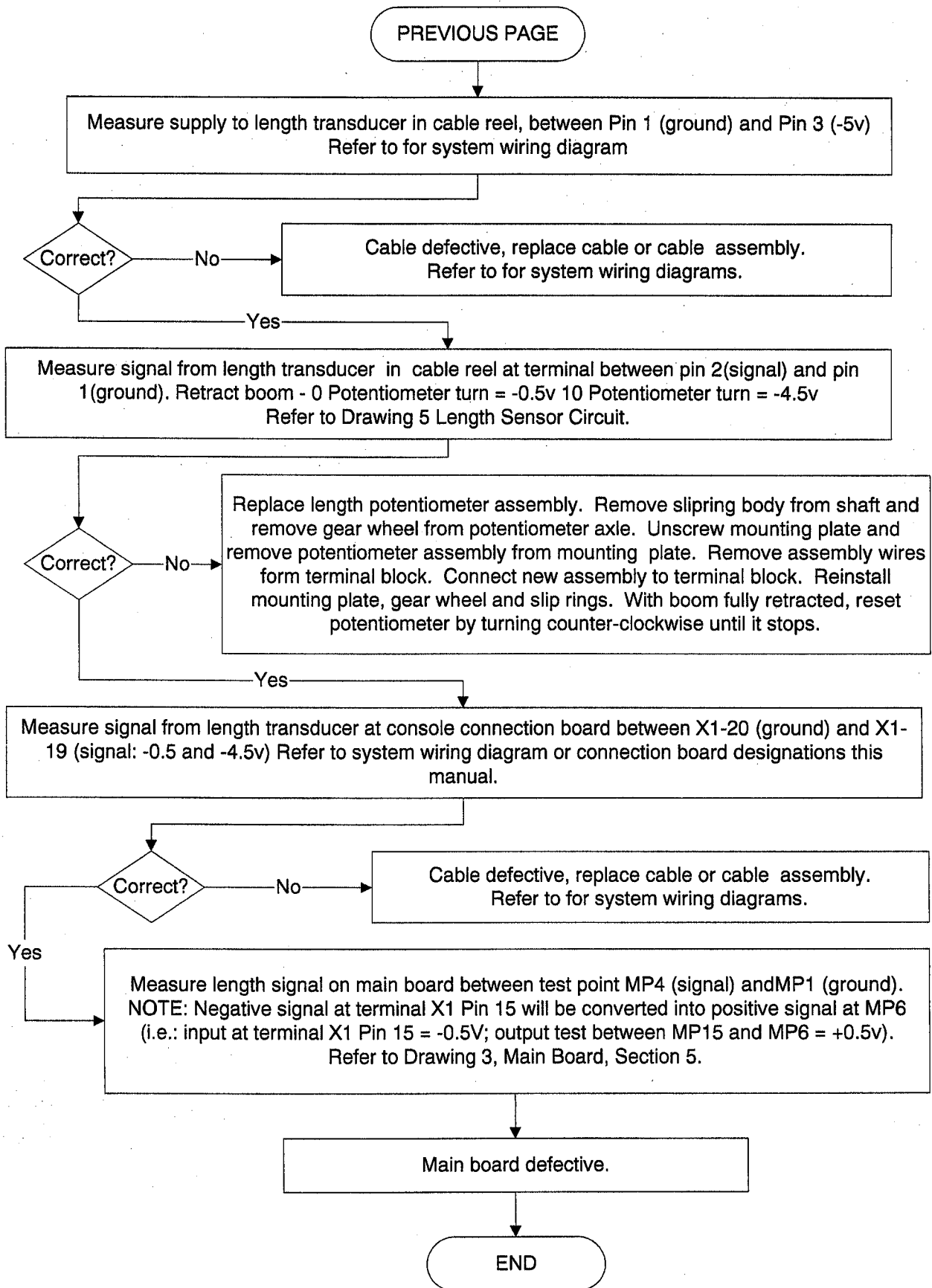
PROBLEM: Displayed Angle Incorrect. Actual measured angle is different from displayed angle.



3.5 LENGTH READING PROBLEM

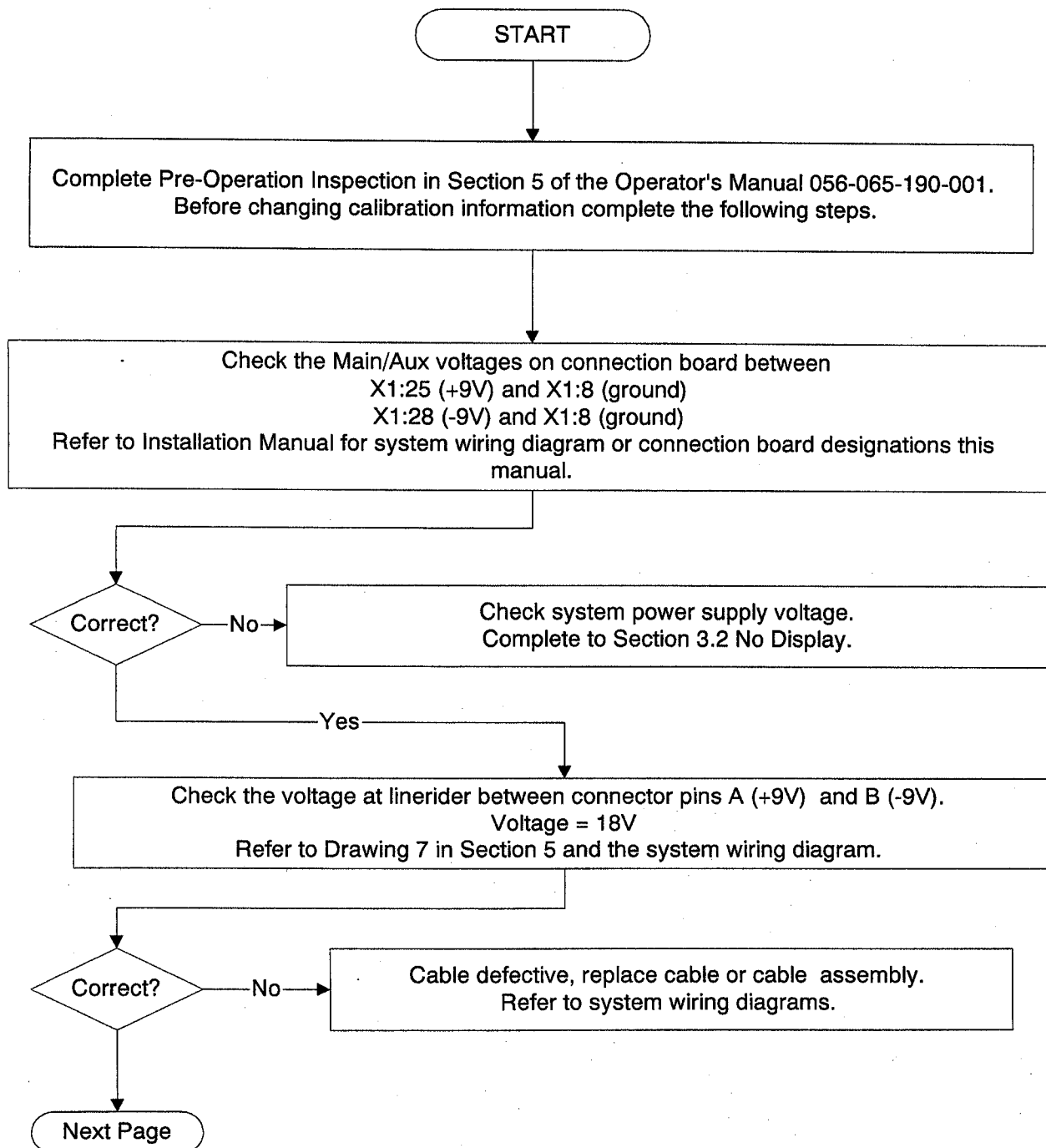
PROBLEM: Length reading incorrect. Crane is not in "out of load chart" condition.

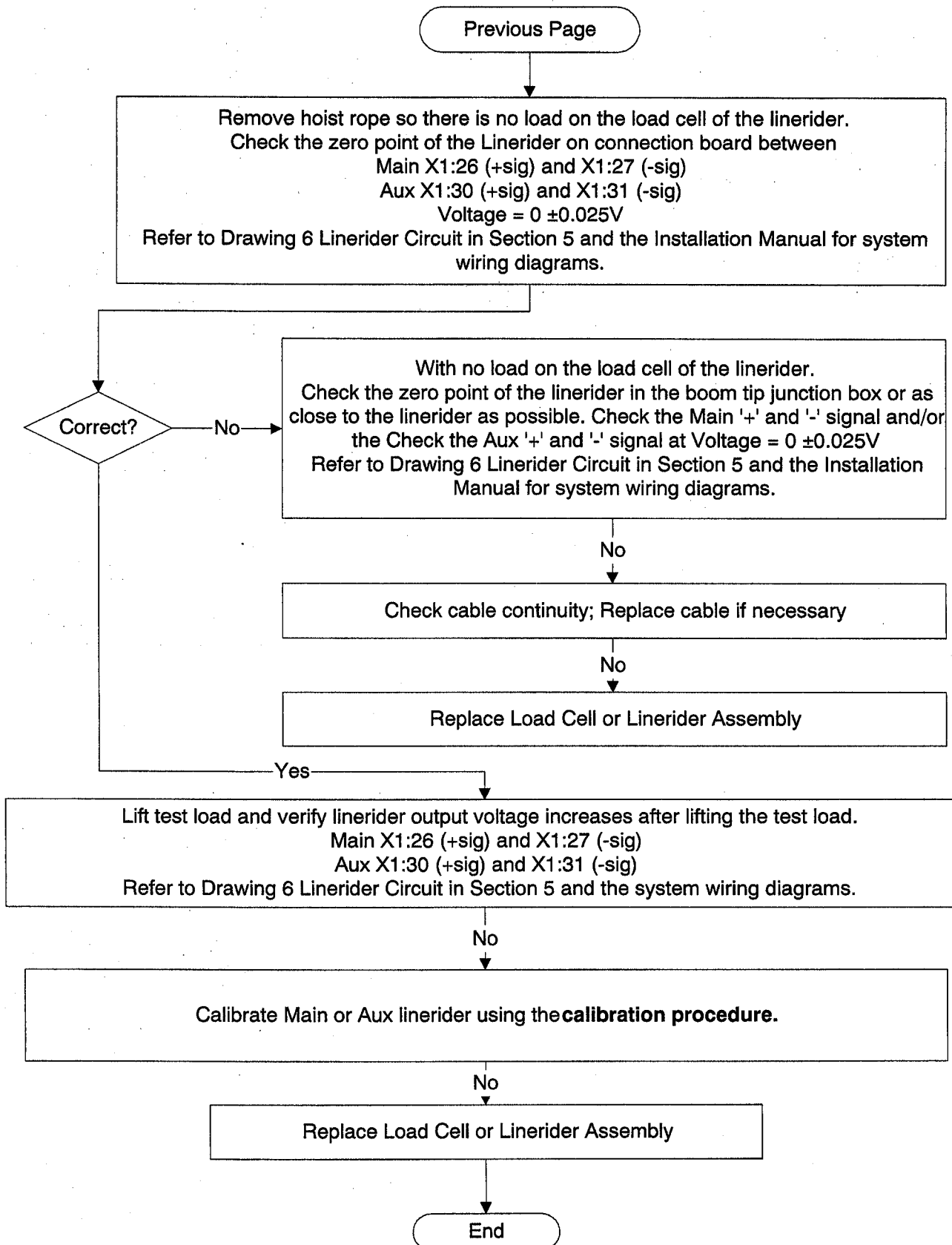




3.6 LOAD READING PROBLEM

PROBLEM: Displayed Load is out of tolerance. The displayed load should be equal to or 10% greater than the actual load.





4 ERROR CODE TABLE

Error code	Reason	Action
11	Operating data in the buffered RAM	Turn on the system again and adjust operating data
21	Crane parameters in the serial EPROM incorrect	Re-calibrate the system
31	Wrong EPROM programming or EPROM defective	Exchange EPROM
51	Short circuit min layer device term 11&12	Check minimum layer device
52	Cable break min layer device term 11&12	Check minimum layer device
53	Short circuit A2B -switch - 2 term 13&14	Check anti-two block system
54	Cable break A2B -switch - 2 term 13&14	Check anti-two block system
55	Short circuit A2B -switch - 1 term 9&10	Check anti-two block system
56	Cable break A2B -switch - 1 term 9&10	Check anti-two block system
•61	Load on the main hoist hook too big	Reduce load on main hoist
•63	Load on the auxiliary hoist hook too big	Reduce load on aux. hoist
•71	Limit Length - Main - Boom - Max.	Decrease length limit
•72	Limit Length - Main - Boom - Min.	Increase length limit
•73	Limit WG - Main - Boom - Max.	Decrease main boom angle
•74	Limit WG - Main - Boom - Min.	Increase main boom angle
•75	Limit Boom height - Max.	Decrease main boom angle
•76	Limit Boom height - Min.	Increase main boom angle
•77	Limit Working radius - Max.	Increase main boom angle
•78	Limit Working radius - Min.	Decrease main boom angle
81	ADC-Measuring value KMD1 too big	Check zero point in linerider
82	ADC-Measuring value KMD1 too low	Check zero point in linerider
83	ADC-Measuring value KMD2 too big	Check zero point in linerider
84	ADC-Measuring value KMD2 too low	Check zero point in linerider
91	ADC-Measuring value LG1 too big	Check main length sensor circuit
92	ADC-Measuring value LG1 too low	Check main length sensor circuit
93	ADC-Measuring value WG1 too big	Check main angle sensor circuit
94	ADC-Measuring value WG1 too low	Check main angle sensor circuit
95	ADC-Measuring value WG2 too big	Check luffing angle sensor circuit
96	ADC-Measuring value WG2 too low	Check luffing angle sensor circuit

- Limit set by the operator refer to Operator's Manual, Section 4.3. Activating and Setting Preset Limits

5 SYSTEM DRAWINGS

The PAT EI65 System drawings in this section are provided as reference material for the troubleshooting flow charts. Use the drawings in conjunction with the flow charts to help understand the operation of the EI65 system.

Drawing List:

1. System Diagram
2. Connection Board Layout
3. Main Board Layout
4. Anti-Two Block Circuit
5. Angle Sensor Adjustment
6. Angle Sensor Circuit
7. Linerider Circuit

Refer to the Operator's Manual for basic component layout on the crane and console drawing. The EI65 console connection board has the following terminal designations.

Connection Board 056-065-300-002 Designations:

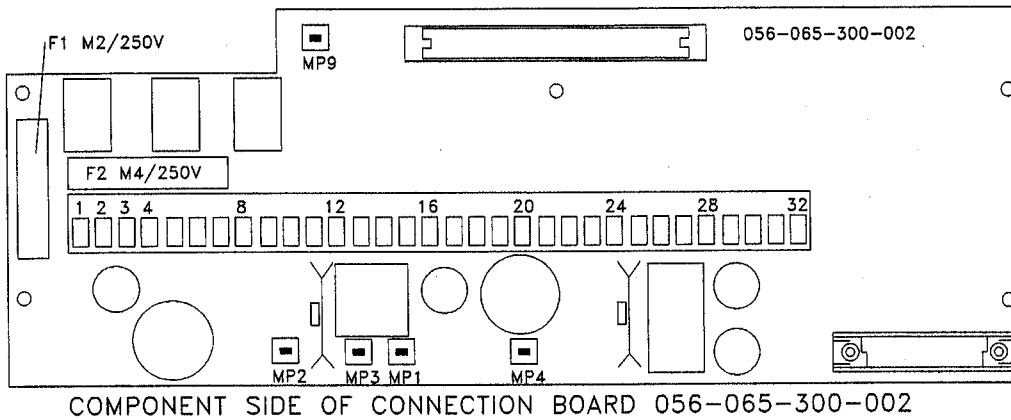
1	+ Battery
2	+ Battery
3	- Battery
4	- Battery
5	Load Limit output
6	A2B Relay output 2
7	A2B Relay output 1
8	Peripheral ground
9	A2B 1 input
10	A2B Ground
11	A2B 2 input
12	A2B Ground
13	3rd Wrap Switch input
14	3rd Wrap Switch ground
15	Digital input 1
16	Digital input 2

17	+5VDC
18	Main Boom angle input
19	Main Boom Length input
20	Analog Ground
21	+5VDC
22	Jib Angle input
23	Analog Ground
24	Analog Ground
25	+9VDC
26	KMD1 +Signal input
27	KMD1 -Signal input
28	-9VDC
29	+9VDC
30	KMD2 +Signal input
31	KMD2 -Signal input
32	-9VDC

5.1 SYSTEM WIRING DIAGRAM (REFER TO INSTALLATION MANUAL)

5.2 CONNECTION BOARD LAYOUT

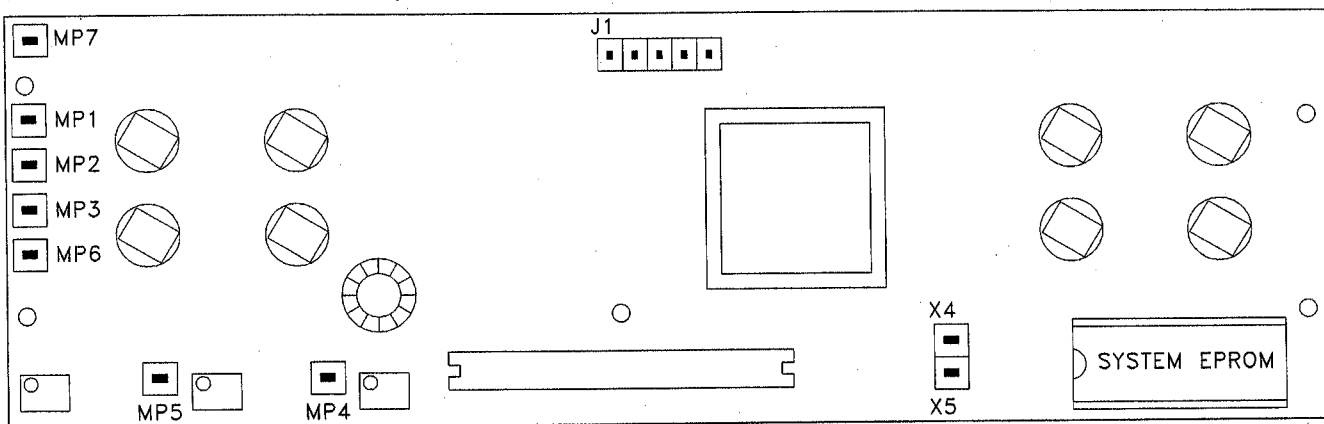
056-065-300-002 BOARD, TERMINAL EI65



COMPONENT SIDE OF CONNECTION BOARD 056-065-300-002

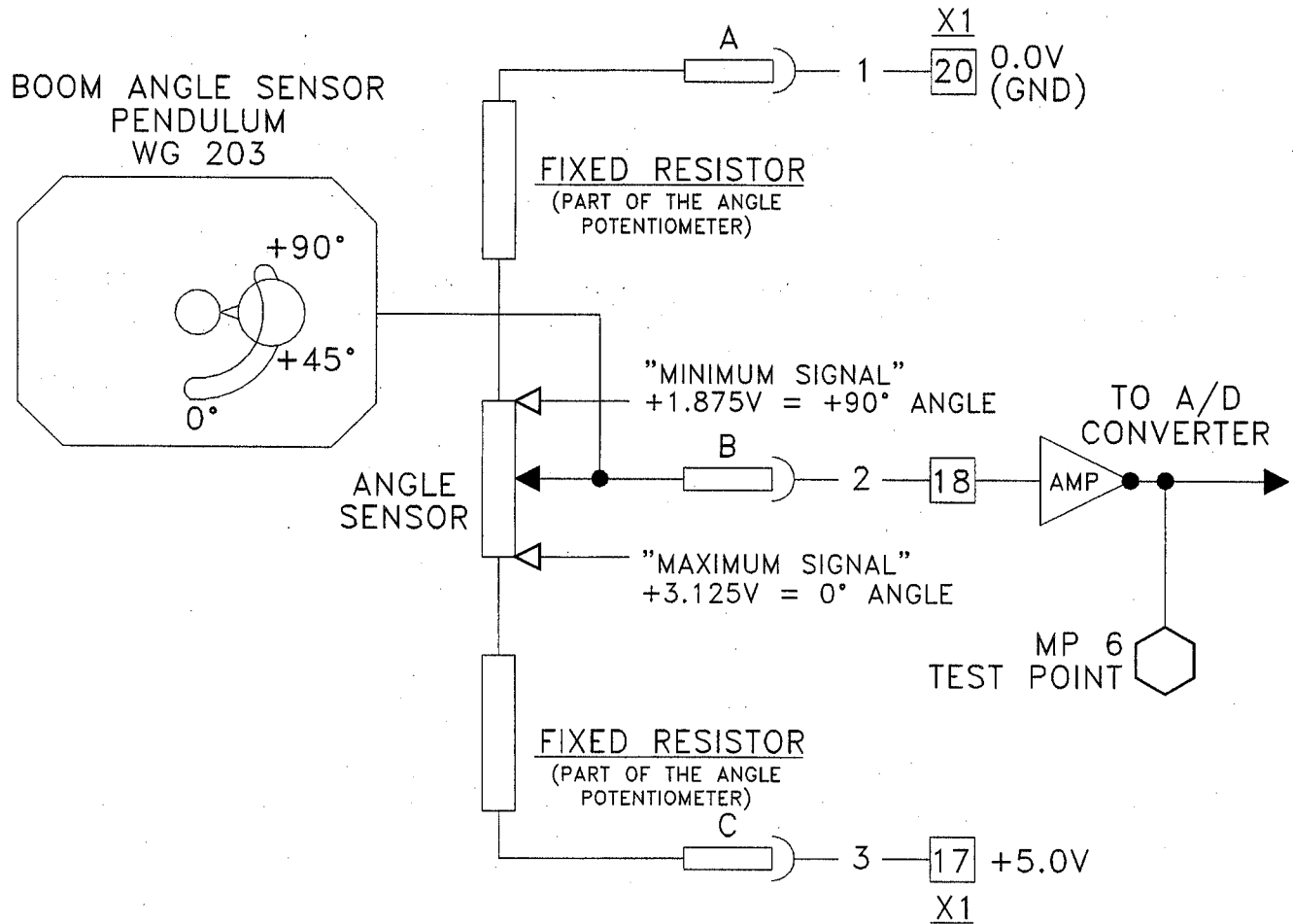
5.3 MAIN BOARD LAYOUT

056-065-300-001 BOARD, MAIN EI65 W/RIBBON CABLE



COMPONENT SIDE OF MAIN BOARD 056-065-300-001

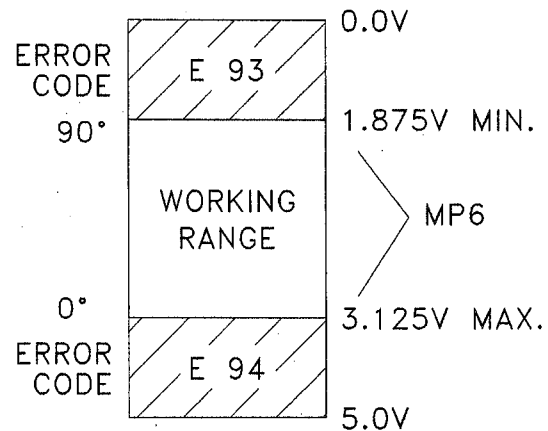
5.4 ANGLE SENSOR CIRCUIT



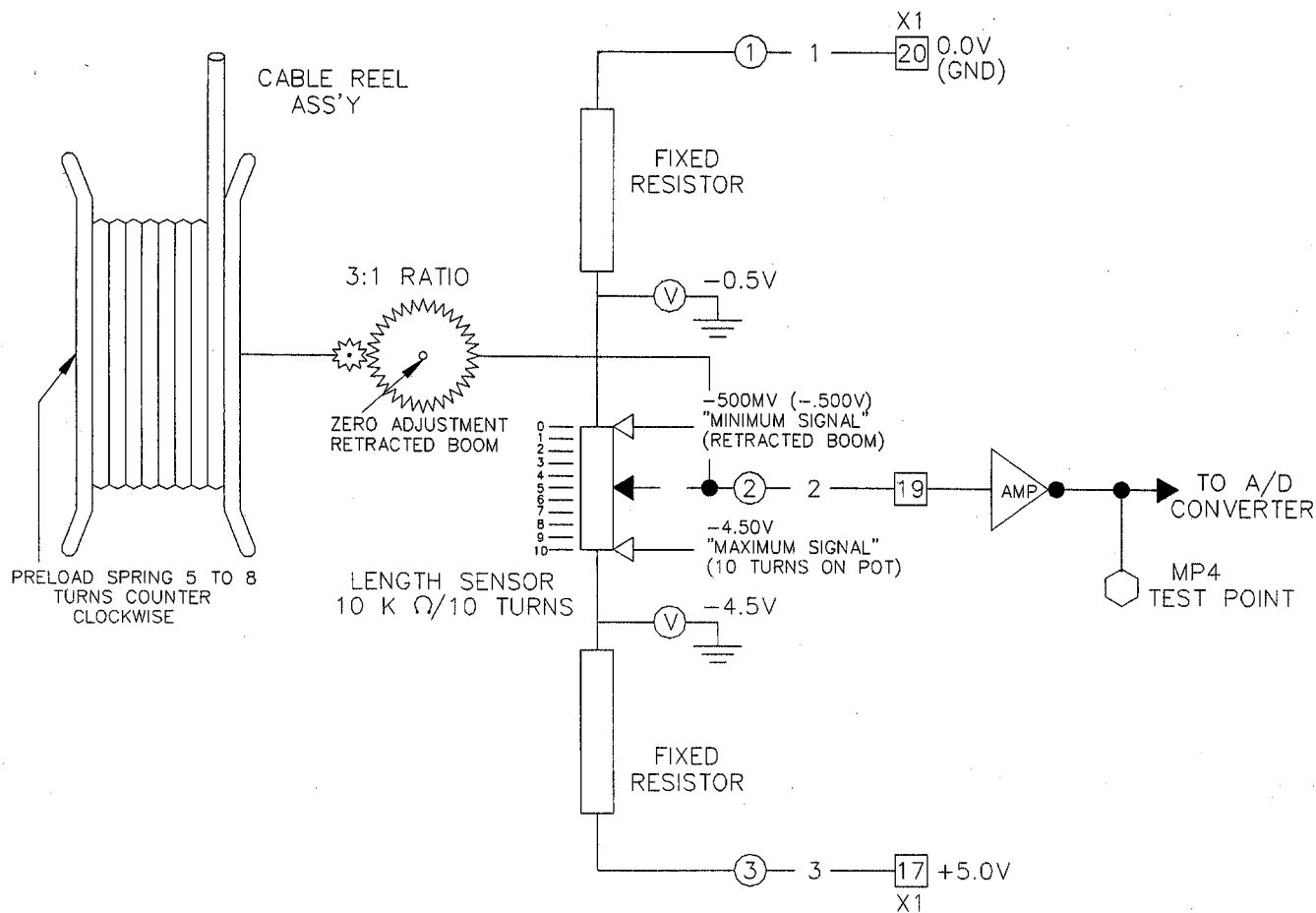
NOTE: MINIMUM AND MAXIMUM VOLTAGES
ARE MEASURED ON THE TERMINAL
BOARD X1-18 TO 20.

"MINIMUM SIGNAL"
+1.875V = +90° ANGLE

"MAXIMUM SIGNAL"
+3.125V = 0° ANGLE



5.5 LENGTH SENSOR CIRCUIT

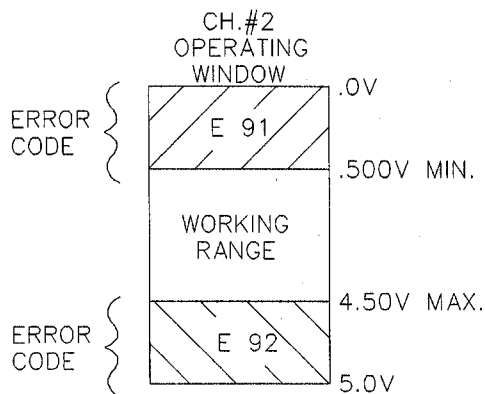


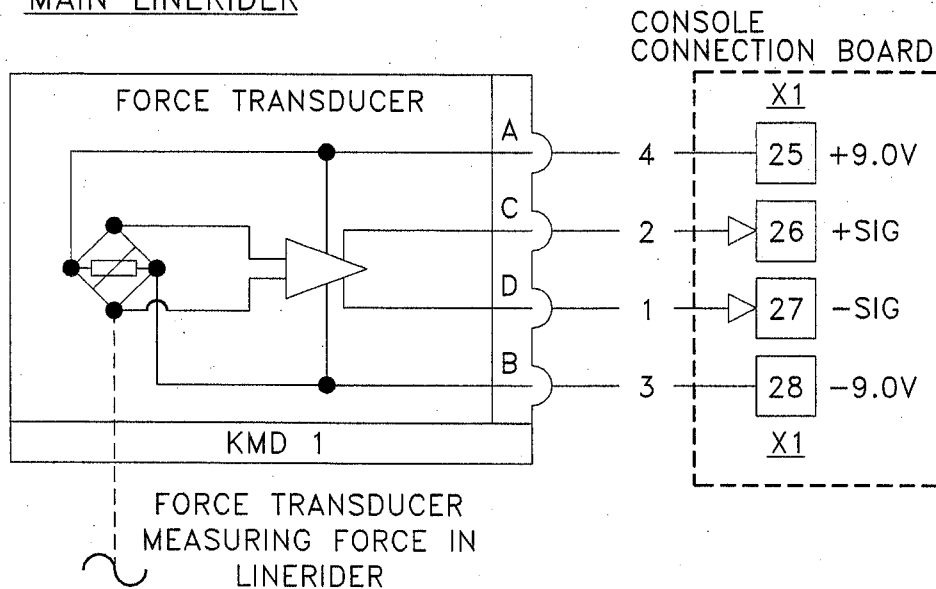
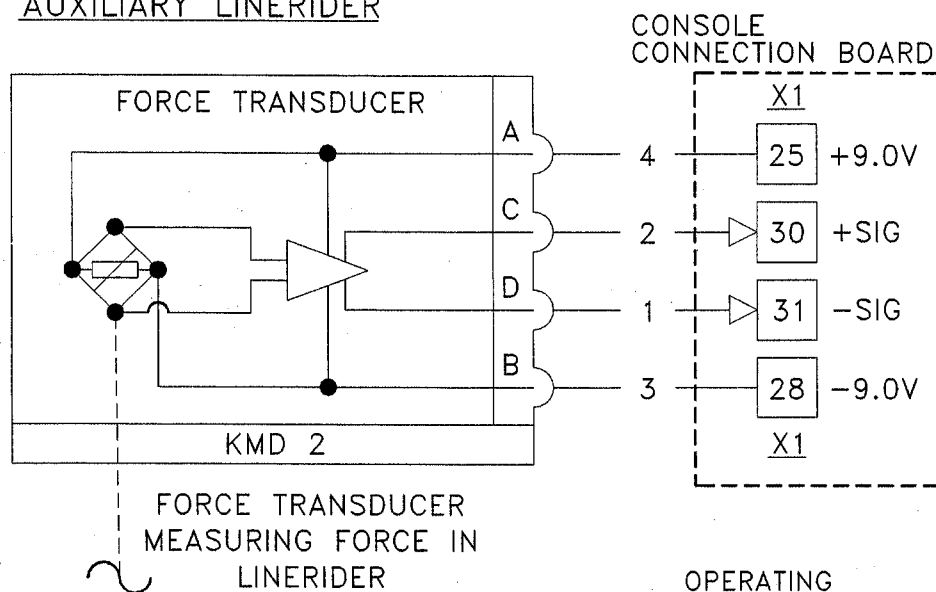
MP4 VOLTAGES

+500MV (.500V) = MIN. SIGNAL
(RETRACTED BOOM)

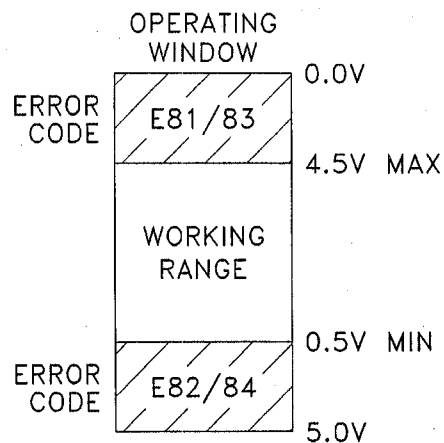
+4.50V = MAX. SIGNAL
(10 TURNS ON POT)

ALL VOLTAGES ARE MEASURED WITH
REFERENCE TO GND (TERMINAL X1:20 OR MP0)
ON MAIN BOARD



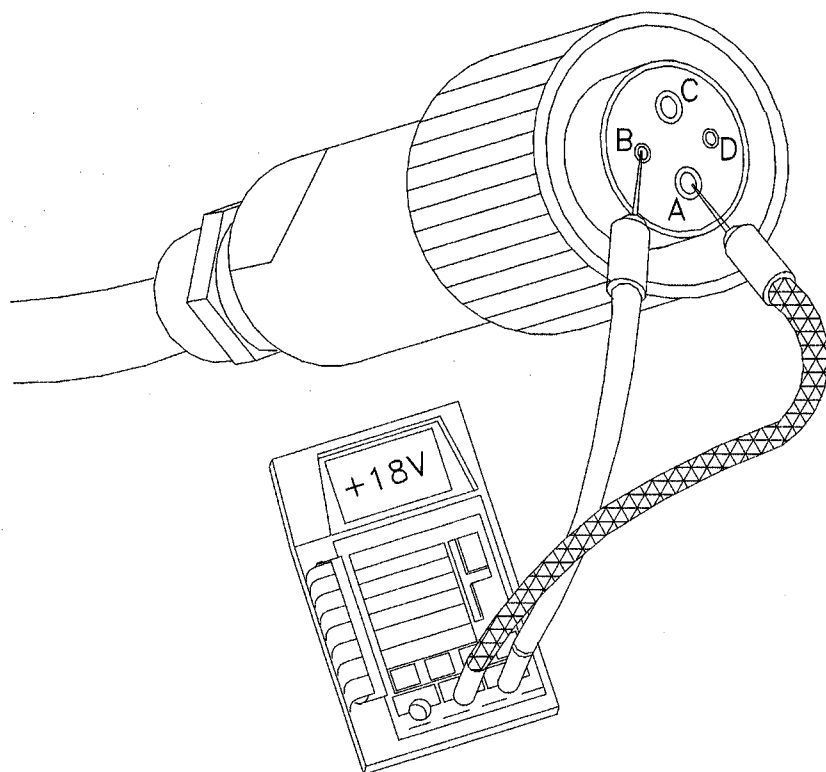
5.6 LINERIDER CIRCUITMAIN LINERIDERAUXILIARY LINERIDER

DIFFERENTIAL OUTPUT SIGNAL
 MAIN LINERIDER X1-26 & 27
 AUX LINERIDER X1-30 & 31
 ZERO FORCE = 0.0V $\pm 25\text{mV}$
 MAX. RATED FORCE = 2.5V

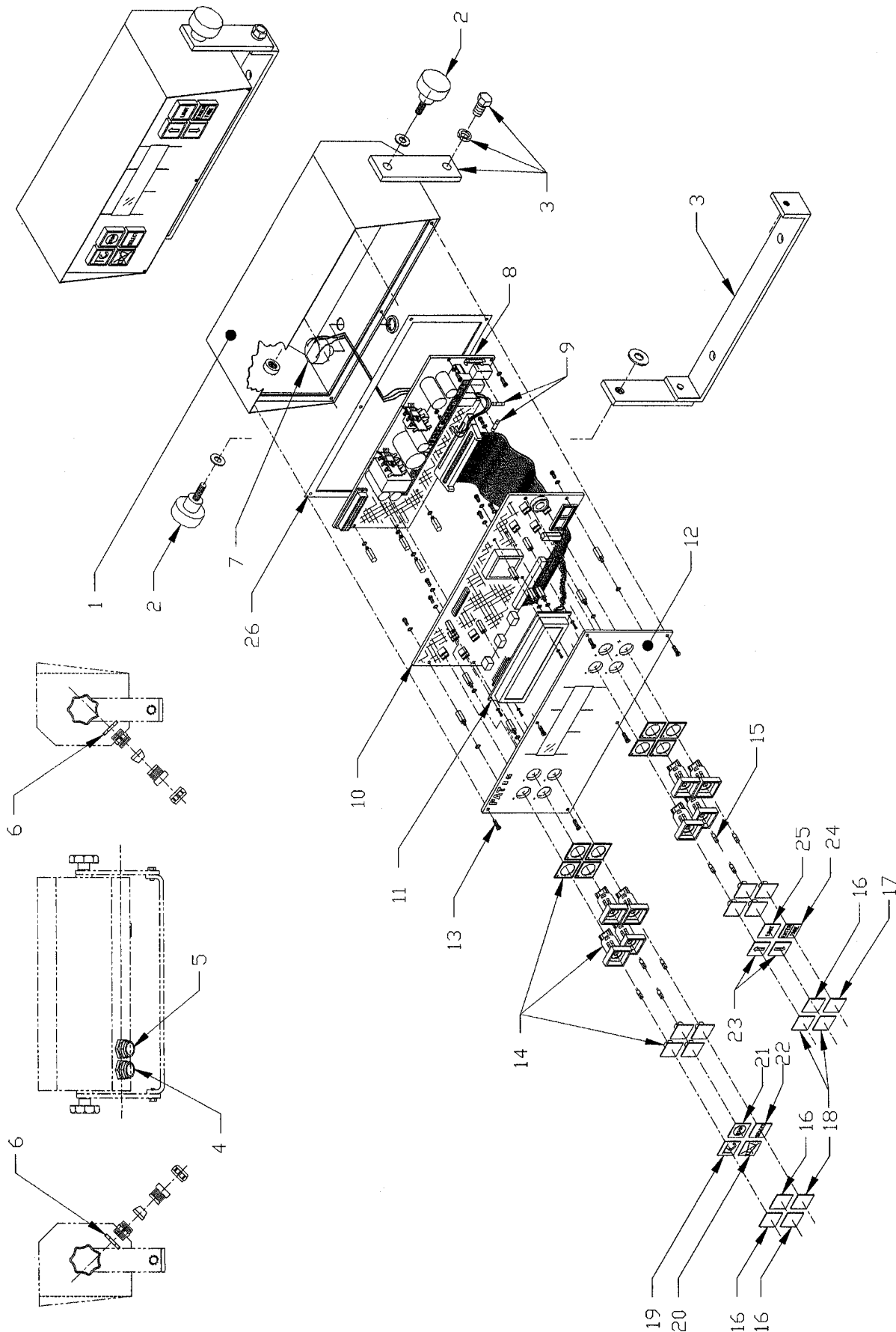


5.7 LINERIDER SUPPLY VOLTAGES

The supply voltage can be checked directly at the cannon connection. Using a digital voltmeter measure between pins A and B, ($A = +9v$) + ($B = -9v$) = 18volts. If this voltage is not correct refer to the system wiring diagram and verify all cable connections. You may need to start at the console and check the supply voltages at their proper measuring points.

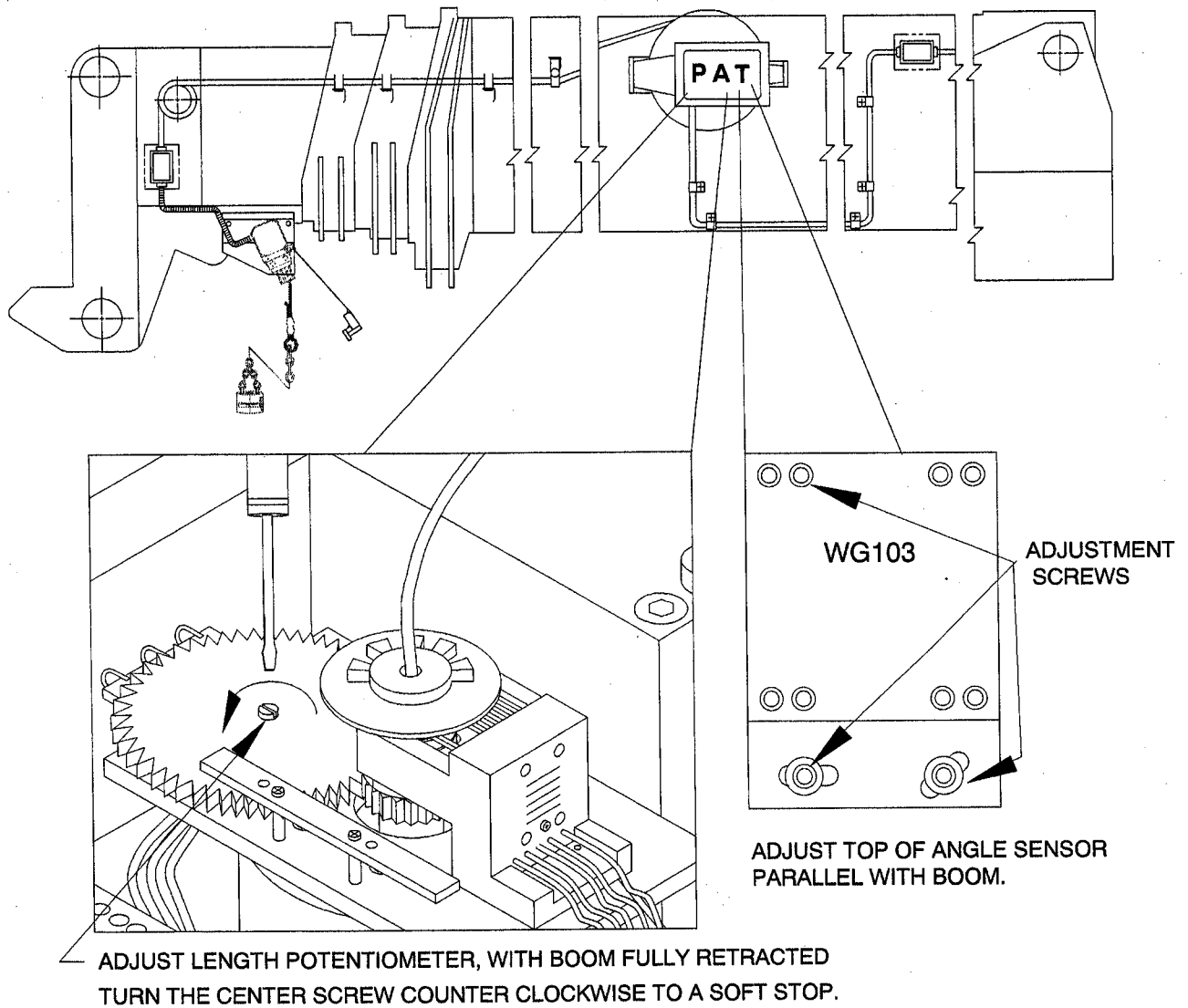


5.8 CONSOLE PARTS LIST



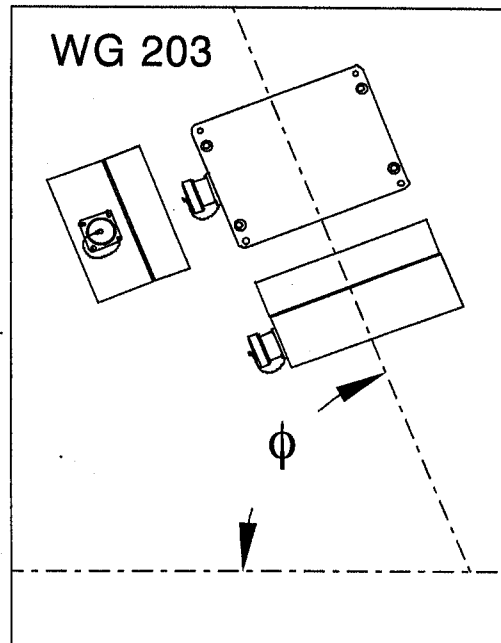
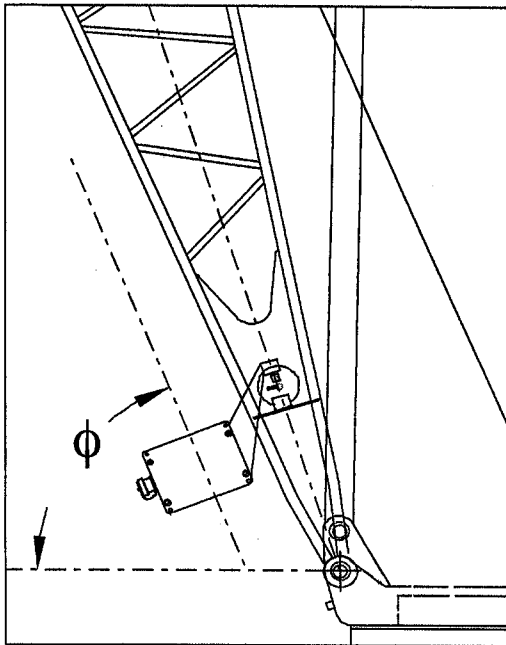
NO.	PART NO.	QTY	DESCRIPTION
01	050-000-100-075	1	HOUSING, CONSOLE, EI65 (001)
02	050-350-110-183	2	KNOB, MOUNTING KNOB
03	031-300-100-293	1	BRACKET, MTG. EI65 CONSOLE
04	021-441-161-213	1	STRAIN RELIEF, PG13.5, 12-15mm GRAY+WHITE INSERT
05	021-441-131-013	1	STRAIN RELIEF, PG 13.5, 8-12mm RED+WHITE INSERT
06	000-214-210-013	2	NUT, PG13.5
07	000-323-010-525	1	ALARM, A2B, EI10, EI20
08	056-065-300-002	1	BOARD, TERMINAL EI65, 12V
09	031-300-100-294	2	FUSE, 4 AMP FOR EI-65 CONSOLE
10	056-065-300-001	1	BOARD, MAIN EI65 W/RIBBON CABLE
11	050-000-100-078	1	DISPLAY
12	056-065-110-019	1	FACEPLATE, EI65 CONSOLE
13	002-053-703-101	6	SCREW, 3x10mm, PANHEAD, PHILLIPS
14	003-051-460-002	8	SWITCH, PUSHBUTTON, EI 65 CONSOLE, (NO LENS)
15	056-065-110-001	8	LAMP, 12V, EI65 CONSOLE
15	056-065-110-002	8	LAMP, 24V, EI65 CONSOLE
16	003-051-461-306	3	SWITCH ACCY, LENS, RED, EI65 CONSOLE
17	003-051-461-505	2	SWITCH ACCY, LENS, GREEN, EI65 CONSOLE
18	003-051-461-403	3	SWITCH ACCY, LENS, YELLOW, EI65 CONSOLE
19	050-901-120-119	1	SWITCH ACCY, SYMBOL INSERT, (A2B) EI65 CONSOLE
20	050-902-120-119	1	SWITCH ACCY, SYMBOL INSERT (ALARM OFF) EI65
21	050-903-120-119	1	SWITCH ACCY, SYMBOL INSERT, (STOP) EI 65 CONSOLE
22	050-904-120-119	1	SWITCH ACCY, SYMBOL INSERT, (SELECT) EI65
23	050-905-120-119	2	SWITCH ACCY, SYMBOL INSERT, (SCROLL) EI65
24	050-906-120-119	1	SWITCH ACCY, SYMBOL INSERT, (ENTER/TARE) EI65
25	050-907-120-119	1	SWITCH ACCY, SYMBOL INSERT, (LIMIT) EI65 CONSOLE
26	050-000-050-309	1	GASKET

5.9 MECHANICAL ADJUSTMENTS OF CABLE REEL SENSORS HYDRAULIC CRANE



LATTICE CRANE

The angle ϕ shown in Figure 1 needs to be within $+0$, -0.4 of the actual angle of the boom. Check boom angle at base/heel section only. After adjustment, compare the actual boom angle with the displayed angle at about 0° , 30° and 60° . To comply with the SAE J375 standards the displayed angle must be $+0.0^\circ$ to -2.0° of the actual angle.



MANUAL REVISIONS

REV	DATE	NAME	DESCRIPTION
-	06/27/00	CSH	EI65 SERVICE Manual created.
A	10/19/00	CSH	Added console parts list