CM 20

DS350 LMI

TROUBLESHOOTING MANUAL

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GENERAL INFORMATION

The PAT Load Moment Indicator (LMI) DS 350 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters.

Using different sensing devices, the Load Moment Indicator monitors various crane functions and provides the operator with a continuous reading of the crane's capacity. The readings continuously change as the crane moves through the motions needed to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the total calculated weight being lifted by the crane.

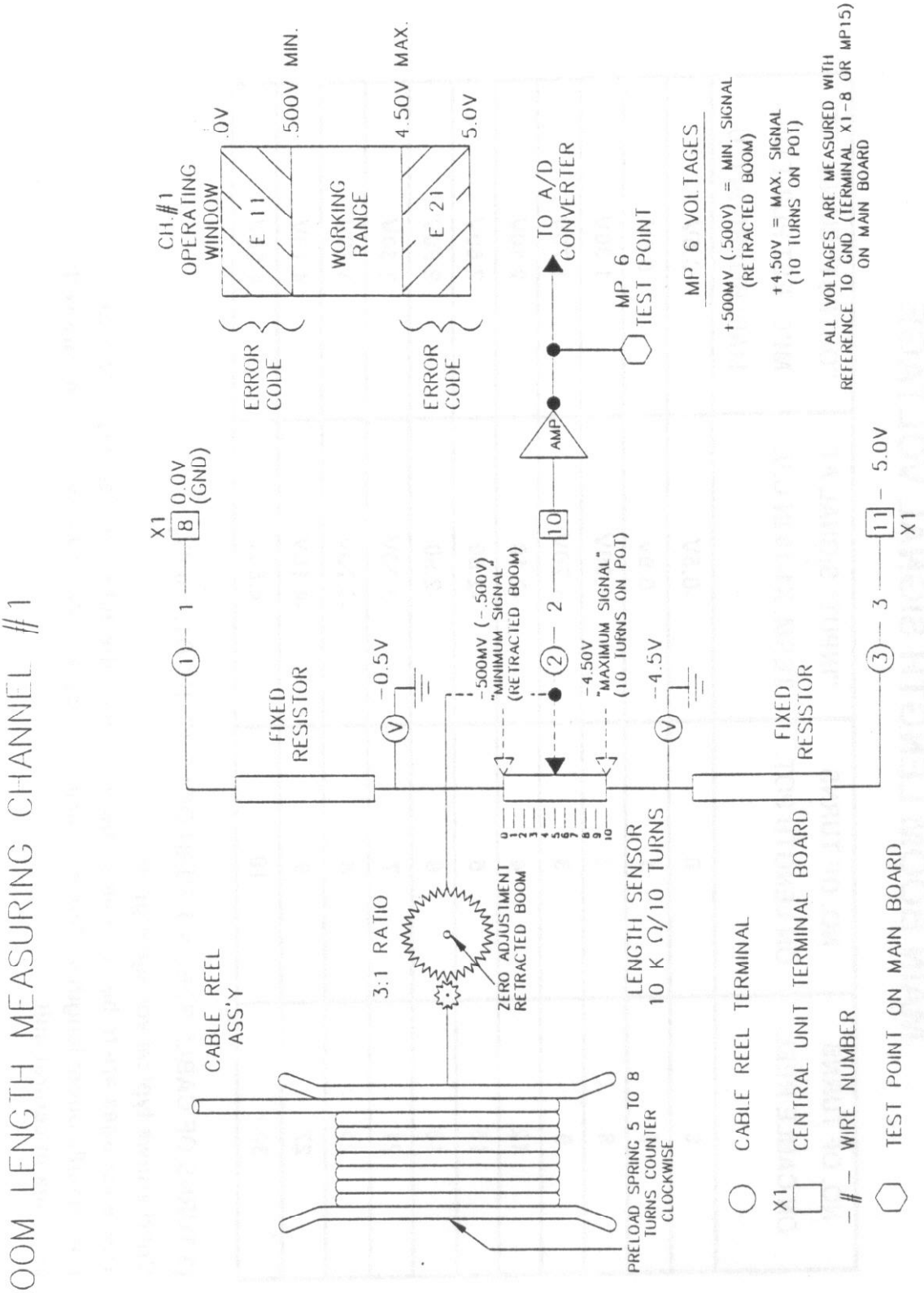
If non permitted conditions are approached, the DS 350 Load moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light and locking out those functions that may aggravate the crane's condition.

This troubleshooting handbook is designed to assist a service or maintenance person in identifying the system problem area or malfunction. 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.

For system operation refer to the operator's handbook for the console.

The drawings in Section 1 are provided as reference material that will be used in the troubleshooting flow charts. Use the drawings in conjunction with the flow charts to help understand the operation of the LMI.

The following drawings provide a theory of operations for length, angle, and load in the LMI.


BOOM LENGTH MEASURING CHANNEL #1
CH.#1 OPERATING WINDOW
.0V
500V MIN.
WORKING RANGE
4.50V MAX.
5.0V
E 11
E 21
ERROR CODE
ERROR CODE
TO A/D CONVERTER
AMP
MP 6 TEST POINT
MP 6 VOLTAGES
+500MV (.500V) = MIN. SIGNAL (RETRACTED BOOM)
+4.50V = MAX. SIGNAL (10 TURNS ON POT)
ALL VOLTAGES ARE MEASURED WITH REFERENCE TO GND (TERMINAL X1-8 OR MP15) ON MAIN BOARD
X1
8
0.0V (GND)
1
FIXED RESISTOR
-0.5V
-500MV (-.500V) "MINIMUM SIGNAL" (RETRACTED BOOM)
2
10
-4.50V "MAXIMUM SIGNAL" (10 TURNS ON POT)
-4.5V
FIXED RESISTOR
3
11
5.0V
X1
CABLE REEL ASS'Y
3:1 RATIO
ZERO ADJUSTMENT RETRACTED BOOM
LENGTH SENSOR 10 K Ω/10 TURNS
PRELOAD SPRING 5 TO 8 TURNS COUNTER CLOCKWISE
CABLE REEL TERMINAL
X1 CENTRAL UNIT TERMINAL BOARD
-# - WIRE NUMBER
TEST POINT ON MAIN BOARD

PAT DS350G/GW
MAIN BOOM LENGTH SIGNAL VOLTAGE

NO. OF TURNS ON CABLE REEL	NO. OF TURNS ON LENGTH POT.	"INPUT" SIGNAL AT TERM. X1-10 IN C.U.	"OUTPUT" SIGNAL AT MP6 TEST POINT ON MAIN BOARD IN C.U.
0	0	-0.5V	0.5V
3	1	-0.9V	0.9V
6	2	-1.30V	1.30V
9	3	-1.70V	1.70V
12	4	-2.10	2.10V
15	5	-2.50	2.50V
18	6	-2.90	2.90V
21	7	-3.30V	3.30V
24	8	-3.70V	3.70V
27	9	-4.10V	4.10V
30	10	-4.50V	4.50V

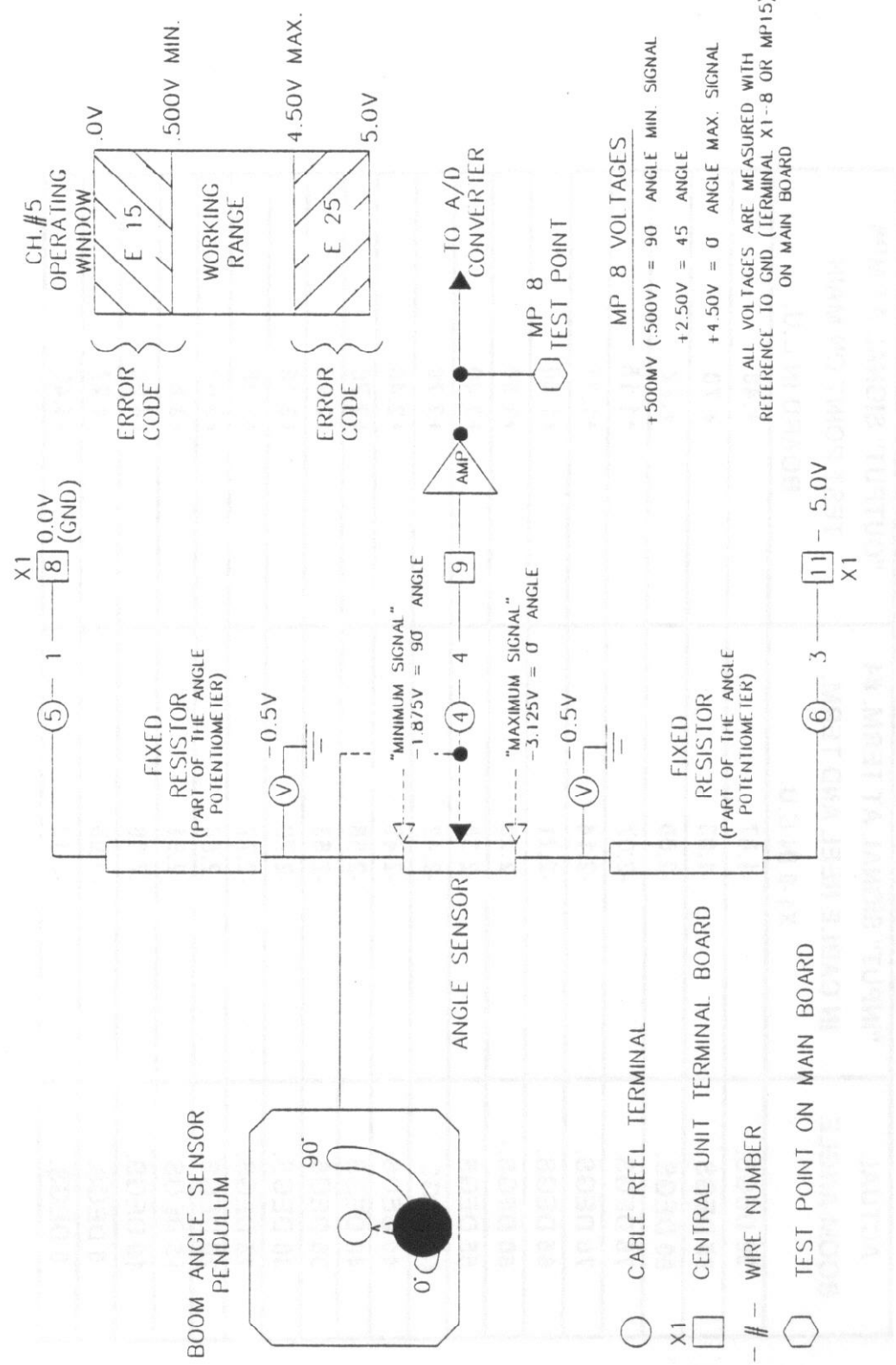
(3 TURNS OF CABLE REEL = 1 TURN OF LENGTH POT. = 0.4V)

Chart shows typical voltage signals.

These voltages are to be used as a reference only, the actual signal may vary slightly.

For specific boom length voltages, check voltages at MP6 or X1-10 and compare with test data in central unit.

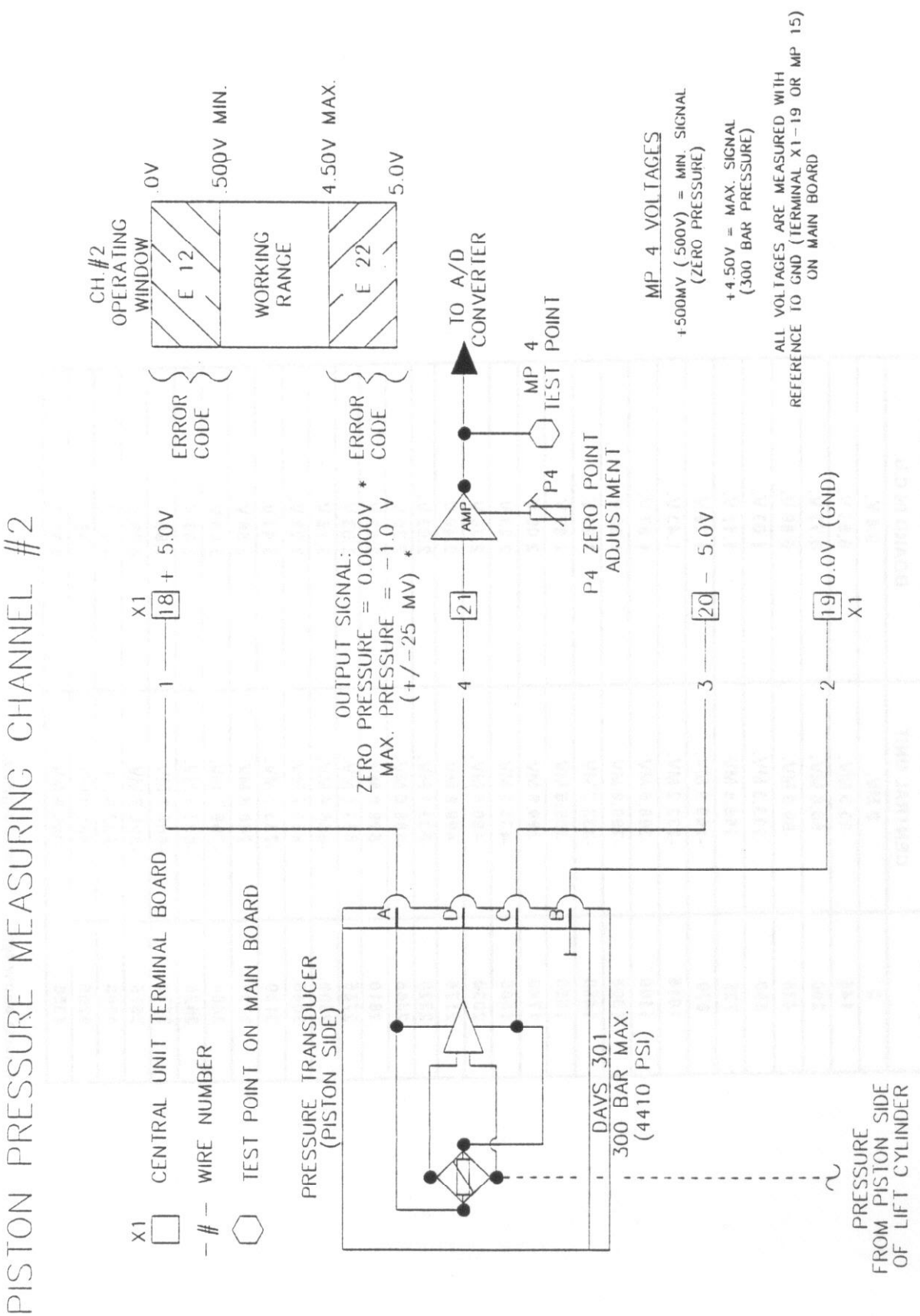
BOOM ANGLE MEASURING CHANNEL



PAT DS350G/GW
BOOM ANGLE SIGNAL VOLTAGE

ACTUAL BOOM ANGLE	"INPUT" SIGNAL AT TERM. #4 IN CABLE REEL AND TERM. X1-9 IN C.U.	"OUTPUT" SIGNAL AT MP8 TEST POINT ON MAIN BOARD IN C.U.
90 DEGS.	-1.87	+.48
85 DEGS.	-1.93	+.70
80 DEGS.	-2.00	+.92
75 DEGS.	-2.07	+1.15
70 DEGS.	-2.14	+1.37
65 DEGS.	-2.21	+1.60
60 DEGS.	-2.28	+1.80
55 DEGS.	-2.35	+2.40
50 DEGS.	-2.42	+2.26
45 DEGS.	-2.49	+2.48
40 DEGS.	-2.56	+2.70
35 DEGS.	-2.63	+2.92
30 DEGS.	-2.70	+3.15
25 DEGS.	-2.77	+3.38
20 DEGS.	-2.84	+3.60
15 DEGS.	-2.91	+3.82
10 DEGS.	-2.98	+4.04
5 DEGS.	-3.05	+4.27
0 DEGS.	-3.12	+4.49

Charts show typical voltage signals.
These voltages are to be used as a reference only, actual signal may vary slightly.



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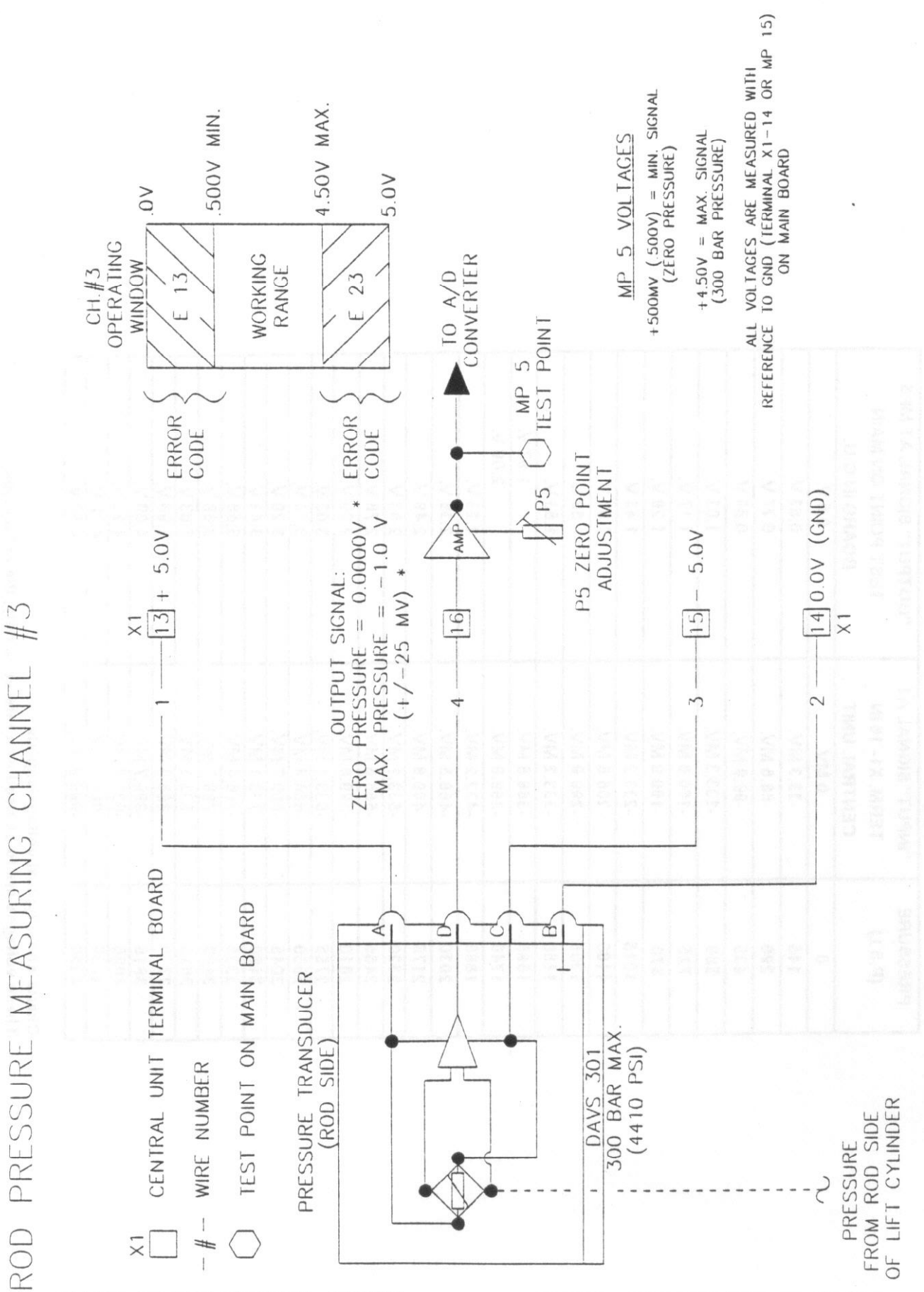
PAT DS350G/GW
PISTON PRESSURE TRANSDUCER VOLTAGE SIGNALS

PRESSURE (P.S.I.)	"INPUT" SIGNAL AT TERM. X1-21 IN CENTRAL UNIT	"OUTPUT" SIGNAL AT MP4 TEST POINT ON MAIN BOARD IN C.U.
0	0 MV.	0.5 V.
145	-33.3 MV.	0.63 V.
290	-66.6 MV.	0.77 V.
435	-99.9 MV.	0.89 V.
580	-133.3 MV.	1.03 V.
725	-166.6 MV.	1.17 V.
870	-199.9 MV.	1.29 V.
1015	-233.2 MV.	1.43 V.
1160	-266.6 MV.	1.57 V.
1305	-299.9 MV.	1.69 V.
1450	-333.2 MV.	1.83 V.
1595	-366.5 MV.	1.97 V.
1740	-399.9 MV.	2.09 V.
1885	-433.2 MV.	2.23 V.
2030	-466.5 MV.	2.36 V.
2175	-499.8 MV.	2.49 V.
2320	-533.1 MV.	2.63 V.
2465	-566.5 MV.	2.76 V.
2610	-599.8 MV.	2.89 V.
2755	-633.1 MV.	3.03 V.
2900	-666.4 MV.	3.16 V.
3045	-699.7 MV.	3.29 V.
3190	-733.1 MV.	3.43 V.
3335	-766.4 MV.	3.56 V.
3480	-799.7 MV.	3.69 V.
3625	-833.1 MV.	3.83 V.
3770	-866.3 MV.	3.96 V.
3915	-899.7 MV.	4.09 V.
4060	-932.9 MV.	4.23 V.
4205	-966.3 MV.	4.36 V.
4350	-999.9 MV.	4.50 V.

Charts show typical voltage signals.
These are to be used as a reference only, the actual signal may vary slightly.



031-300-190-0252 REVISION - 02/18/97

PAT DS350G/GW
ROD PRESSURE TRANSDUCER VOLTAGE SIGNALS

PRESSURE (P.S.I.)	"INPUT" SIGNAL AT TERM. X1- 16 IN CENTRAL UNIT	"OUTPUT" SIGNAL AT MP5 TEST POINT ON MAIN BOARD IN C.U.
0	0 MV.	0.5 V.
145	-33.3 MV.	0.63 V.
290	-66.6 MV.	0.77 V.
435	-99.9 MV.	0.89 V.
580	-133.3 MV.	1.03 V.
725	-166.6 MV.	1.17 V.
870	-199.9 MV.	1.29 V.
1015	-233.2 MV.	1.43 V.
1160	-266.6 MV.	1.57 V.
1305	-299.9 MV.	1.69 V.
1450	-333.2 MV.	1.83 V.
1595	-366.5 MV.	1.97 V.
1740	-399.9 MV.	2.09 V.
1885	-433.2 MV.	2.23 V.
2030	-466.5 MV.	2.36 V.
2175	-499.8 MV.	2.49 V.
2320	-533.1 MV.	2.63 V.
2465	-566.5 MV.	2.76 V.
2610	-599.8 MV.	2.89 V.
2755	-633.1 MV.	3.03 V.
2900	-666.4 MV.	3.16 V.
3045	-699.7 MV.	3.29 V.
3190	-733.1 MV.	3.43 V.
3335	-766.4 MV.	3.56 V.
3480	-799.7 MV.	3.69 V.
3625	-833.1 MV.	3.83 V.
3770	-866.3 MV.	3.96 V.
3915	-899.7 MV.	4.09 V.
4060	-932.9 MV.	4.23 V.
4205	-966.3 MV.	4.36 V.
4350	-999.9 MV.	4.50 V.

Charts show typical voltage signals.
These voltages are to be used as a reference only, the actual signal may vary slightly.

Anther important factor in troubleshooting the CM 20 is understanding the use of proximity switches and the corresponding digital input. The following chart shows the operating modes and the digital inputs used in the LMI.

14 41 01 03: GROVE CM20 (72% TIPPING LOAD)
(DS 350G - Passive LMI)

	OM IND.	OM	SLOPE	WORKING AREA	EXTENSION LENGTH	OFFS.
			>>>> Main Boom on crawlers <<<<			
	0101	1	0°-2°	360°	----	----
	1101		2°-5°			
*	2101		>5°			
	9901			Rigging Mode		
			>>>> Main Boom with 25’ Extension on crawlers <<<<			
	0180	2	0°-2°	360°	25’	0°
	1180		2°-5°			
*	2180		>5°			
			>>>> Main Boom with 25’/43’ Tele-O-Extension on crawlers <<<<			
	0131	3	0°-2°	360°	25’	0°
	1131		2°-5°			
*	2131		>5°			
	0132	4	0°-2°	360°	25’	30°
	1132		2°-5°			
*	2132		>5°			
	0133	5	0°-2°	360°	43’	0°
	1133		2°-5°			
*	2133		>5°			
	0134	6	0°-2°	360°	43’	30°
	1134		2°-5°			
*	2134		>5°			
			>>>> Main Boom with Aux. Boom Nose on crawlers <<<<			
	0198	7	0°-2°	360°	----	----
	1198		2°-5°			
*	2198		>5°			

Remarks:

OM-Ind.	= Operating Mode Indication (Online, PC)
OM	= Operating Mode Position in Eprom
Nmb. LS	= Number of Length Steps (Main Boom)
*	= Operating Mode Locked

The information identifies the digital inputs to the controlling proximity switch
Digital Input, Central Unit Board:

DI 1:	Unused
DI 2:	Unused
DI 3:	Unused
DI 4:	Unused
DI 5:	Unused
DI 6:	Unused
DI 7:	Slope switch, software simulation
DI 8:	Slope switch, software simulation

Digital Input, Extension Board:

DI 01:	Detection of fixed jib	
DI 02:	Detection of no jib	
DI 03:	Detection of tele-o-jib at 0°	
DI 04:	Detection of tele-o-jib retracted	
DI 05:	Detection of aux. boom nose unused	
DI 06:	Detection of extended tracks	
DI 07:	Detection of main hoist, not used in Data-Prom	Code 1 ⇑
DI 08:	Detection of aux. hoist not used in Data-Prom	⇓
DI 09:	Unused	
DI 10:	Unused	Code 2
DI 11:	Unused	
DI 12:	Unused	
DI 13:	Unused	
DI 14:	Unused	
DI 15:	Unused	
DI 16:	Unused	

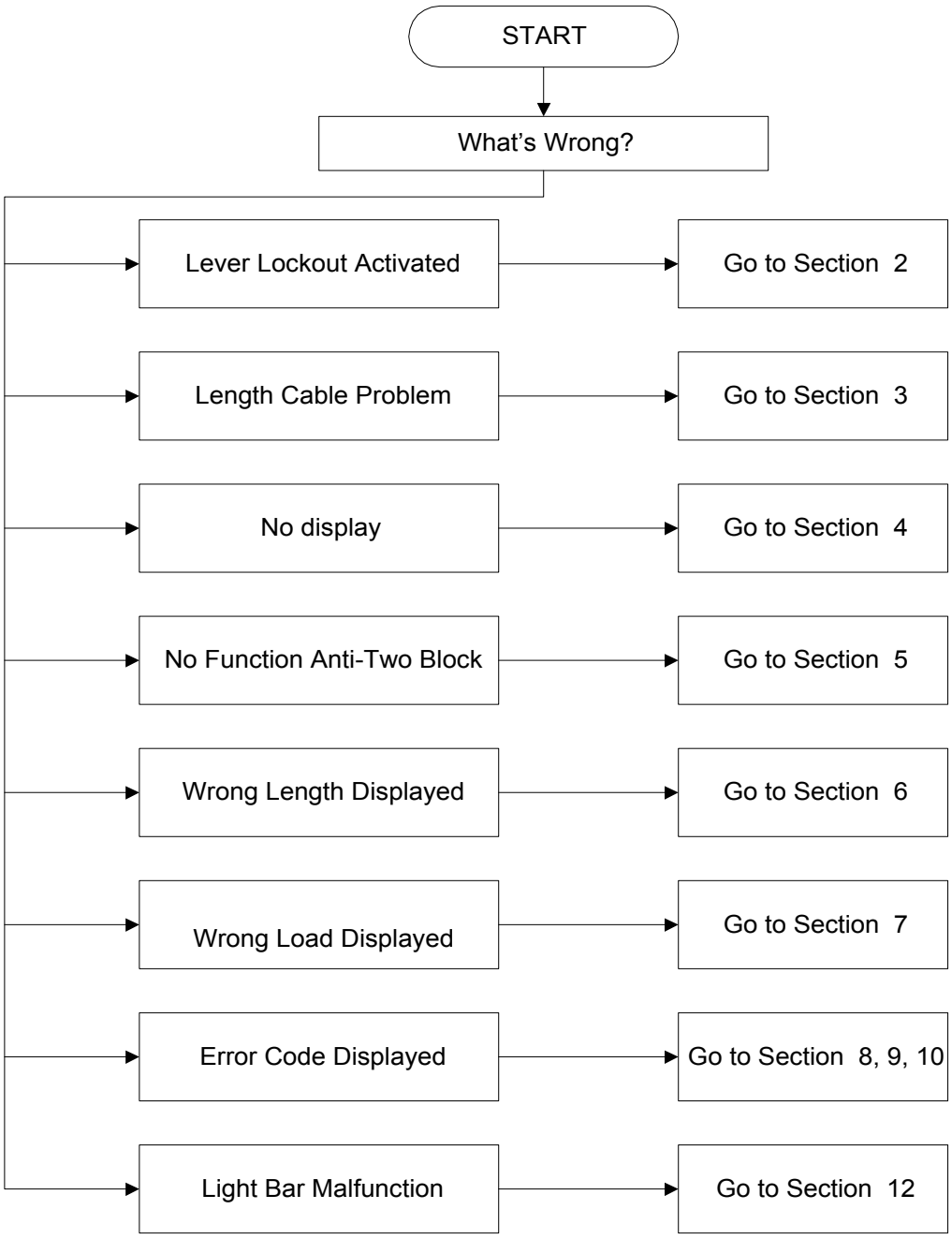
Digital inputs for the operating modes.

Operating Mode	Digital Inputs							
	1	2	3	4	5	6	7	8
0101	0	1	0	0	1	1	X	X
1101	0	1	0	0	1	1	X	X
2101	0	1	0	0	1	1	X	X
9901	0	1	0	0	1	1	X	X
0180	1	0	0	0	X	1	X	X
1180	1	0	0	0	X	1	X	X
2180	1	0	0	0	X	1	X	X
0131	0	0	1	1	X	1	X	X
1131	0	0	1	1	X	1	X	X
2131	0	0	1	1	X	1	X	X
0132	0	0	0	1	X	1	X	X
1132	0	0	0	1	X	1	X	X
2132	0	0	0	1	X	1	X	X
0133	0	0	1	0	X	1	X	X
1133	0	0	1	0	X	1	X	X
2133	0	0	1	0	X	1	X	X
0134	0	0	0	0	X	1	X	X
1134	0	0	0	0	X	1	X	X
2134	0	0	0	0	X	1	X	X
0198	0	1	0	0	0	1	X	X
1198	0	1	0	0	0	1	X	X
2198	0	1	0	0	0	1	X	X

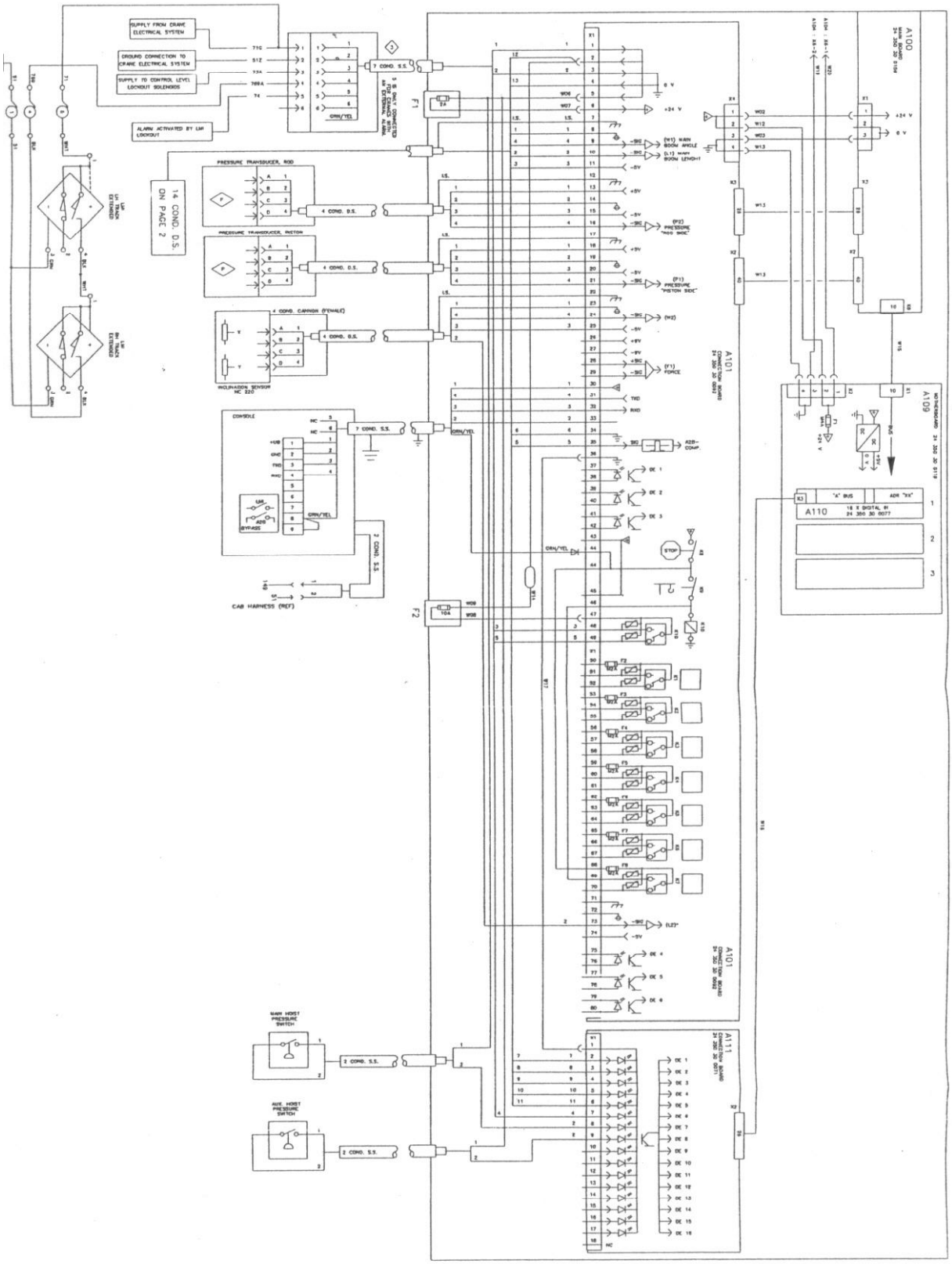
0 - Digital Input OFF
1 - Digital Input ON
X - A Lockout but Not Required for Operating Mode

1. GENERAL FLOWCHART AND DRAWINGS

This section explains how to handle a problem that may arise with the PAT Load Moment Indicator System-PAT DS350. The procedures are easy to follow and are given in flowcharts on the following pages. Start with the general flowchart below which will guide you to one of the more detailed flowcharts shown in Sections 2 through 10. This section also contains the necessary drawings needed for troubleshooting.

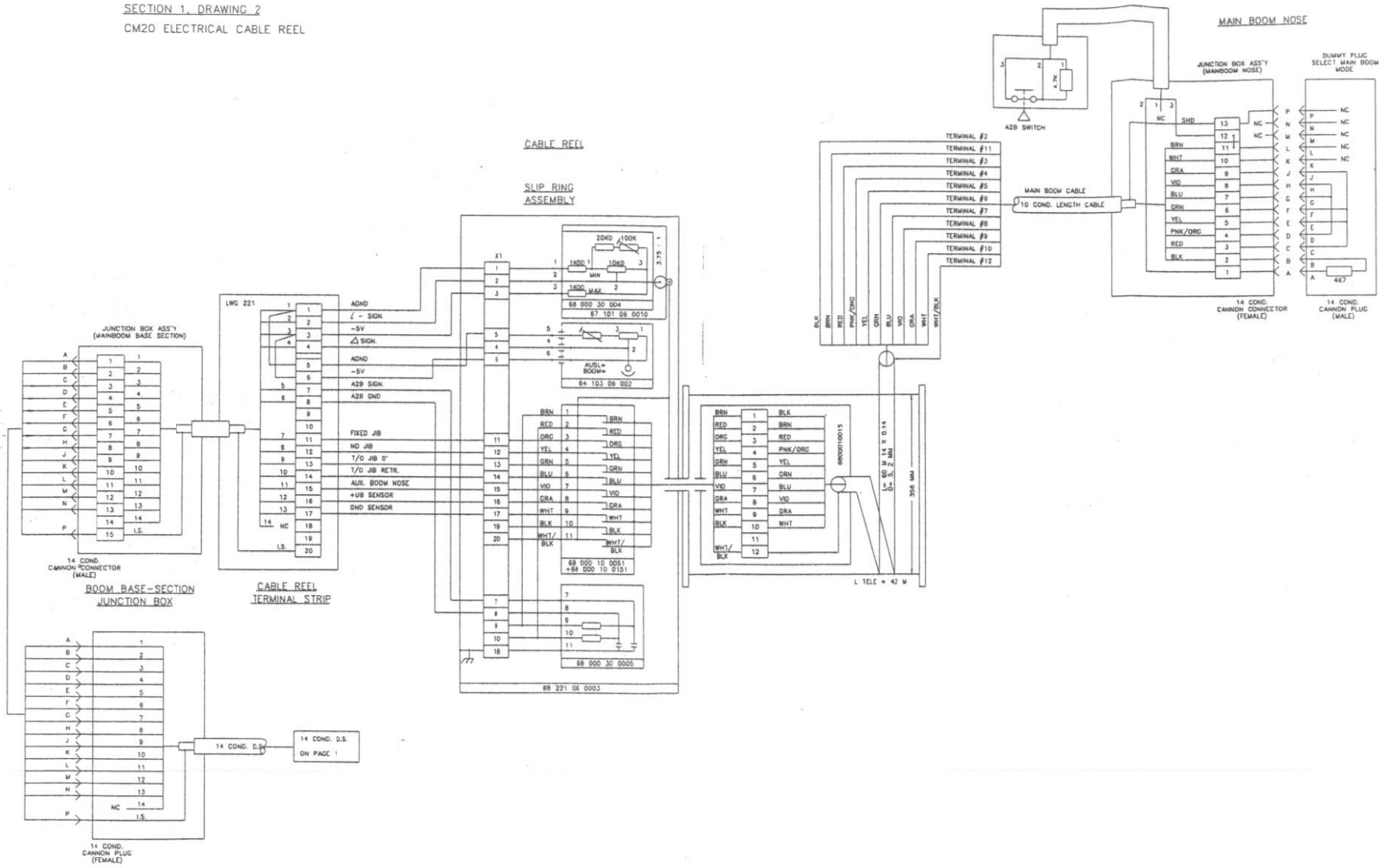


SECTION 1, DRAWING 1
CM20 ELECTRICAL CENTRAL UNIT



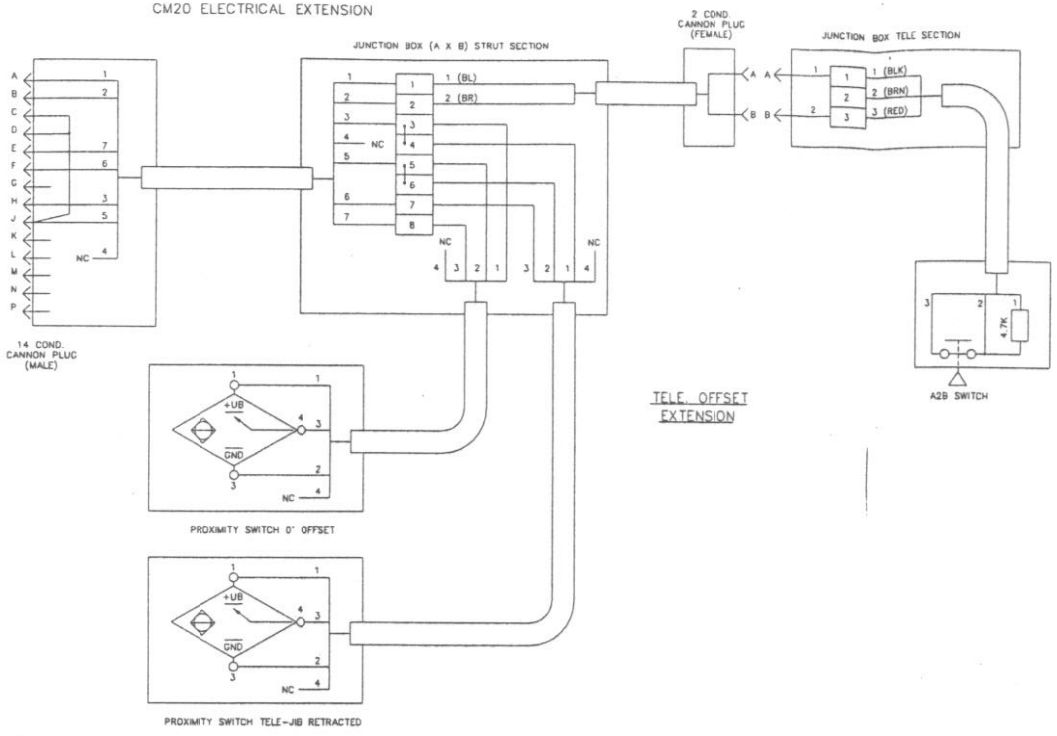
SECTION 1, DRAWING 2

CM20 ELECTRICAL CABLE REEL

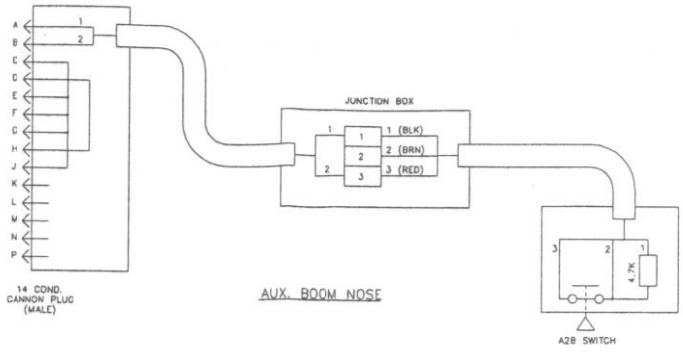


SECTION 1. DRAWING 3

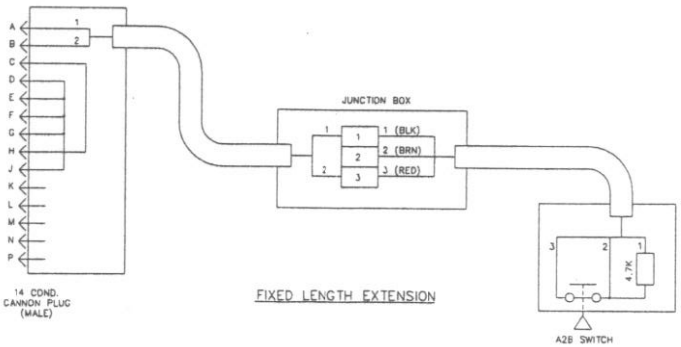
CM20 ELECTRICAL EXTENSION



TELE. OFFSET EXTENSION



AUX. BOOM NOSE



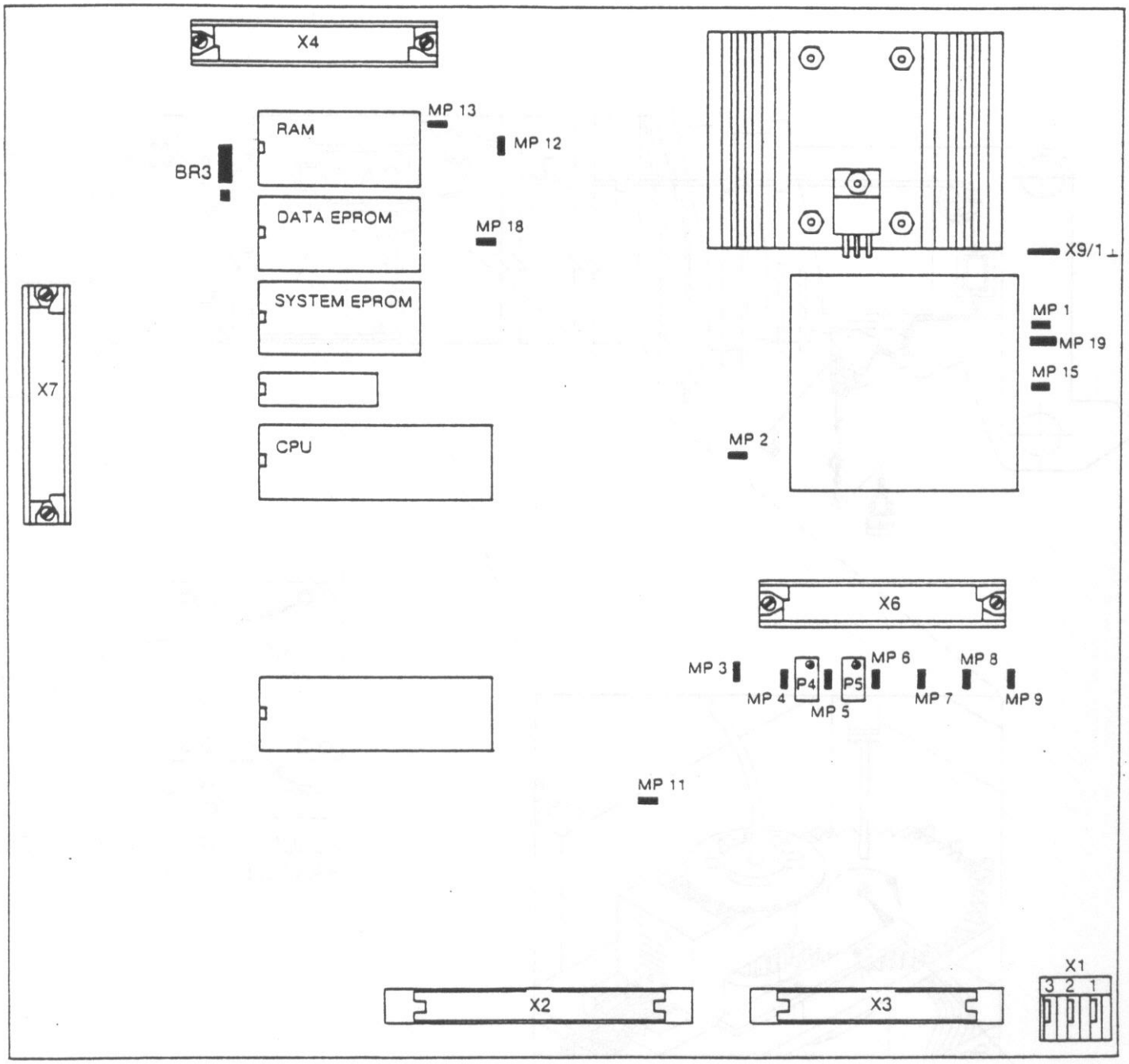
FIXED LENGTH EXTENSION

LEGEND	
BRN	BROWN
BLK	BLACK
WHT	WHITE
GRY	GRAY
GRN	GREEN
BLU	BLUE
RED	RED
PNK	PINK
ORG	ORANGE
YEL	YELLOW
VIO	VIOLET
GRN/YEL	GREEN/YELLOW
SHD	SHIELD
I.S.	INNER SHIELD
NC	NOT CONNECTED
S.S.	SINGLE SHIELDED
D.S.	DOUBLE SHIELDED

A111	FIXED JIB		AUX NOSE	MAIN BOOM	TELE OFF 0° RET.	TELE 30° RET.	TELE 0° EXT.	TELE 30° EXT.
X1 GND								
2 DI1 FIXED JIB	1		0	0	0	0	0	0
3 DI2 NO JIB	0		1	1	0	0	0	0
4 DI3 TELE OFF JIB 0°	0		0	0	1	0	1	0
5 DI4 TELE OFF JIB RET.	0		0	0	1	1	0	0
6 DI5 AUX NOSE	0		0	1	0	0	0	0
7 DI6 TRACKS EXT.	1		1	1	1	1	1	1
8 DI7 MAIN HOIST								
9 DI8 AUX HOIST								

SECTION 1, DRAWING – 4

MAIN BOARD



Power Supply Test Points

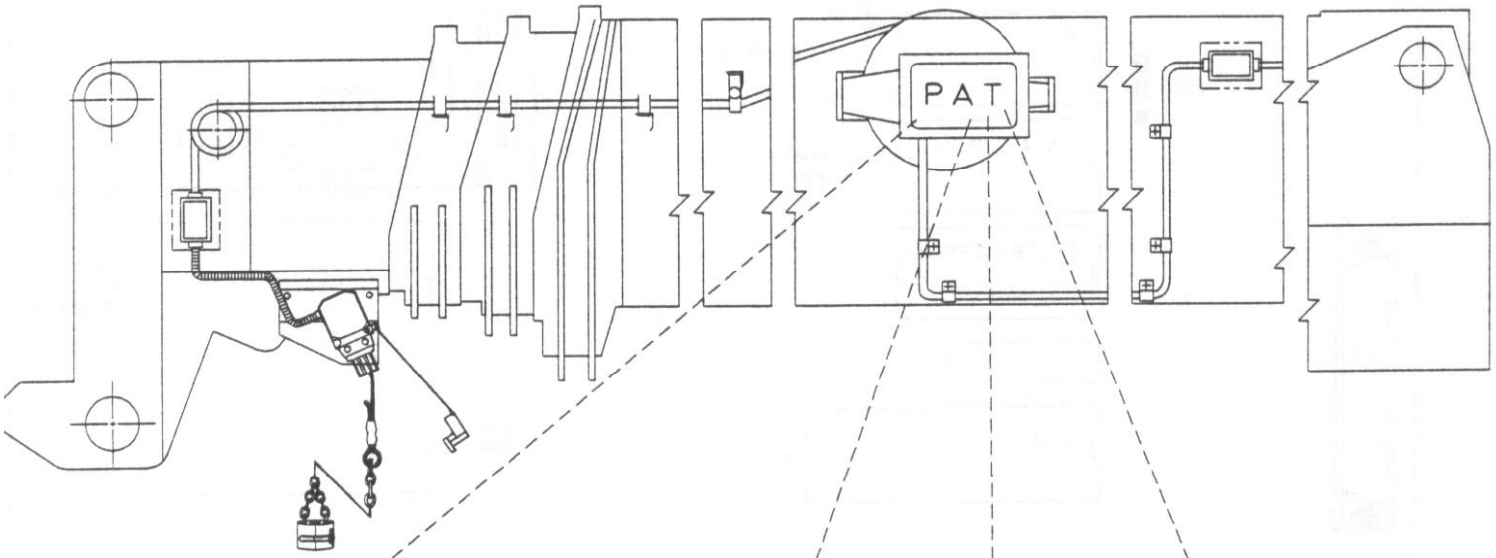
MP 1 = + 5V
MP 2 = - 5V
MP 11 = Ground
MP 12 = + 5V
MP 13 = Digital Ground
MP 15 = Analog Ground
MP 19 = - 5V

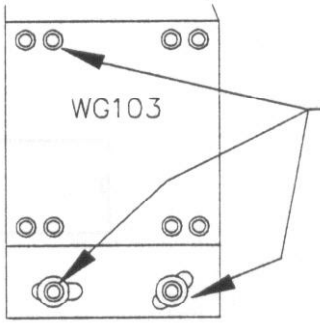
Analog Measuring Channels/Test Points

Ch. 1 Boom Length — MP 6/P6 - Do Not Adjust
Ch. 2 Piston Pressure — MP 4/P4
Ch. 3 Rod Pressure — MP 5/P5
Ch. 4 Force Transducer — MP 3/P3 - Do Not Adjust
Ch. 5 Boom Angle — MP 8/P8 - Do Not Adjust
Ch. 6 Jib Angle — MP 9/P9 - Do Not Adjust

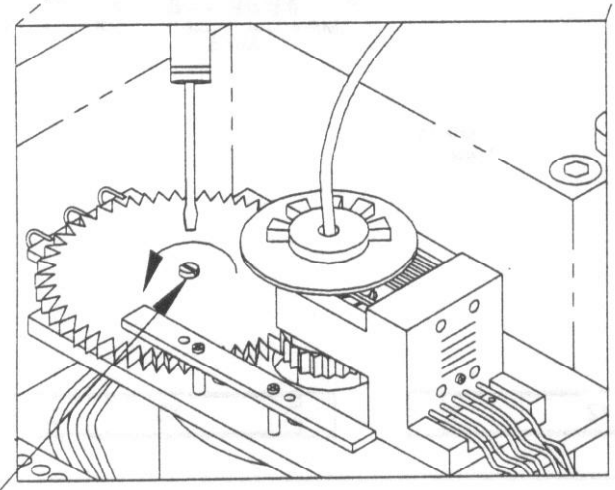
SECTION 1, DRAWING – 5

MECHANICAL ADJUSTMENT FOR CABLE REEL SENSORS





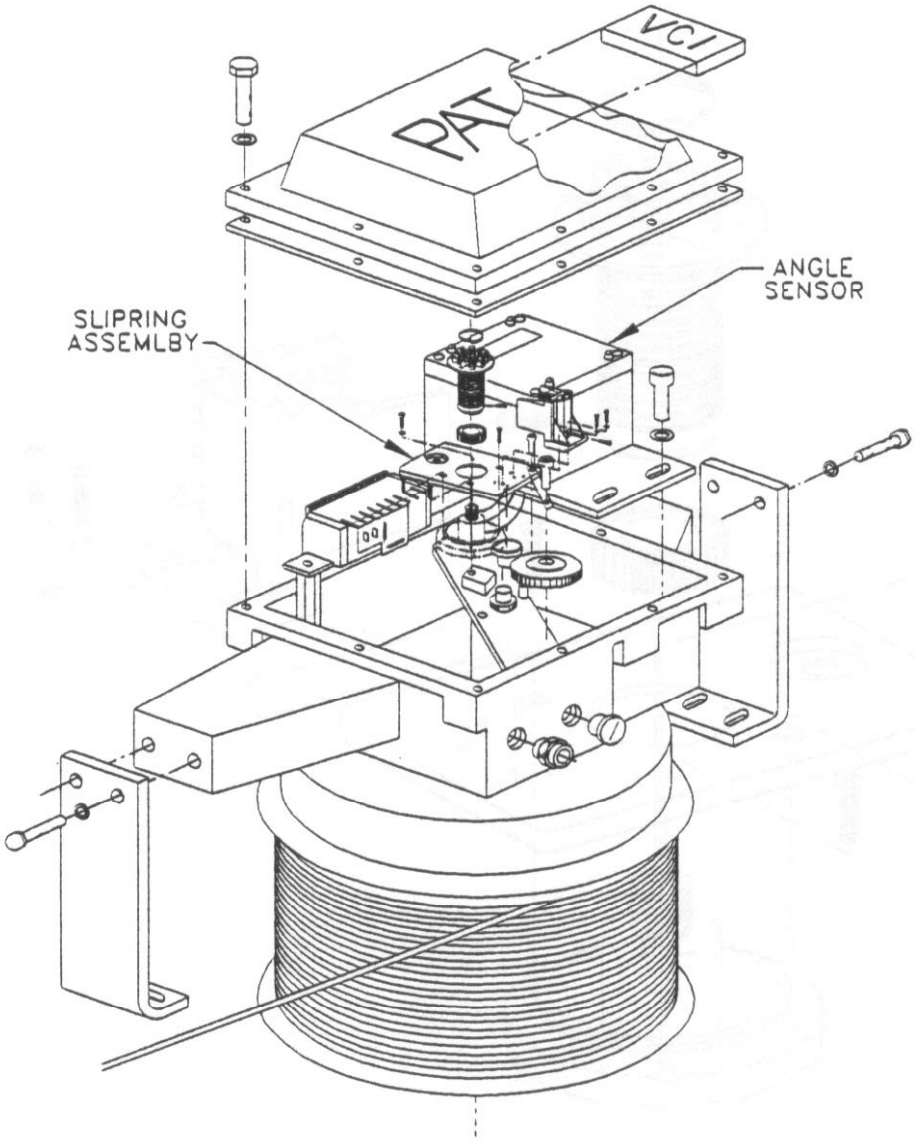
ADJUST TOP OF ANGLE SENSOR PARALLEL WITH BOOM.



ADJUST LENGTH POTENEIOMETER, WITH BOOM FULLY RETRACTED TURN THE CENTER SCREW COUNTER CLOCKWISE TO A SOFT STOP.

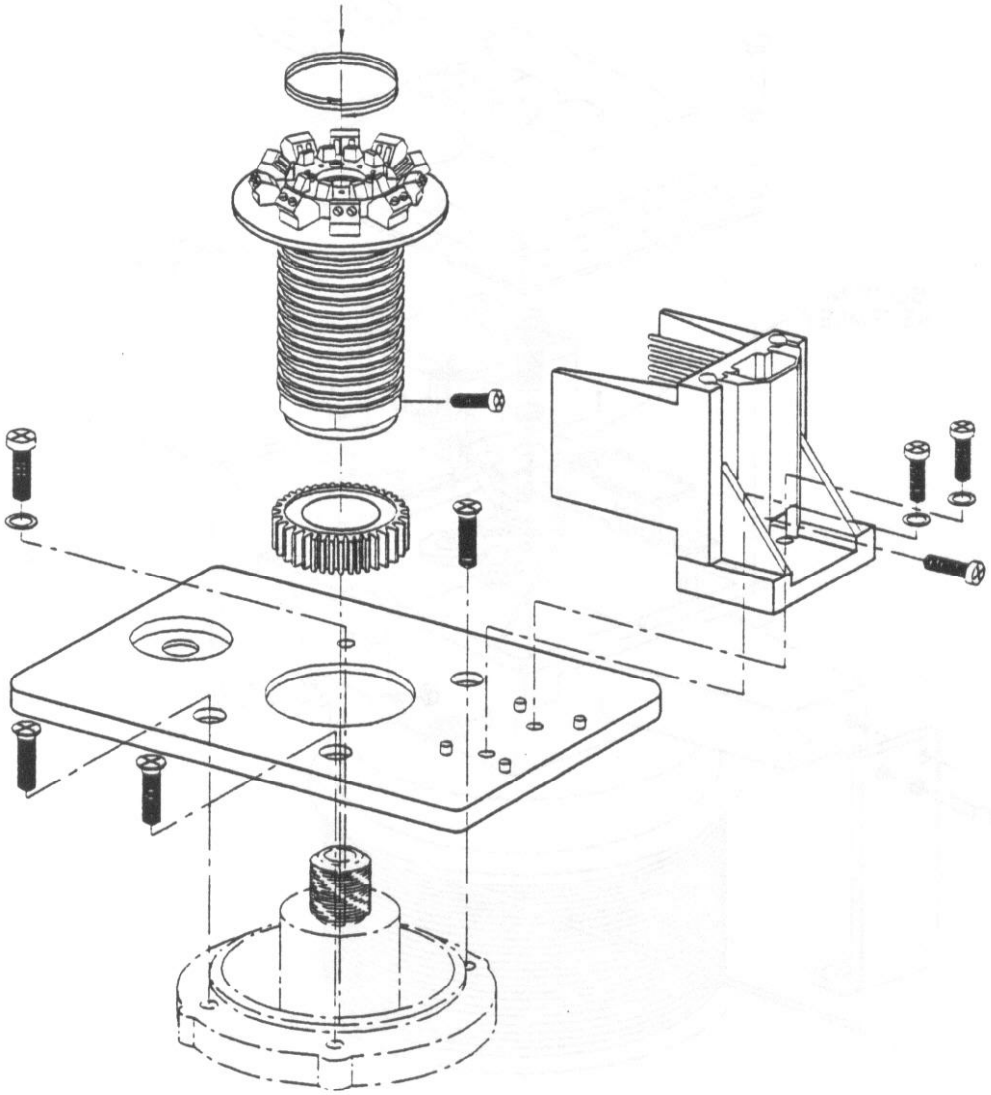
SECTION 1, DRAWING – 6

CABLE REEL

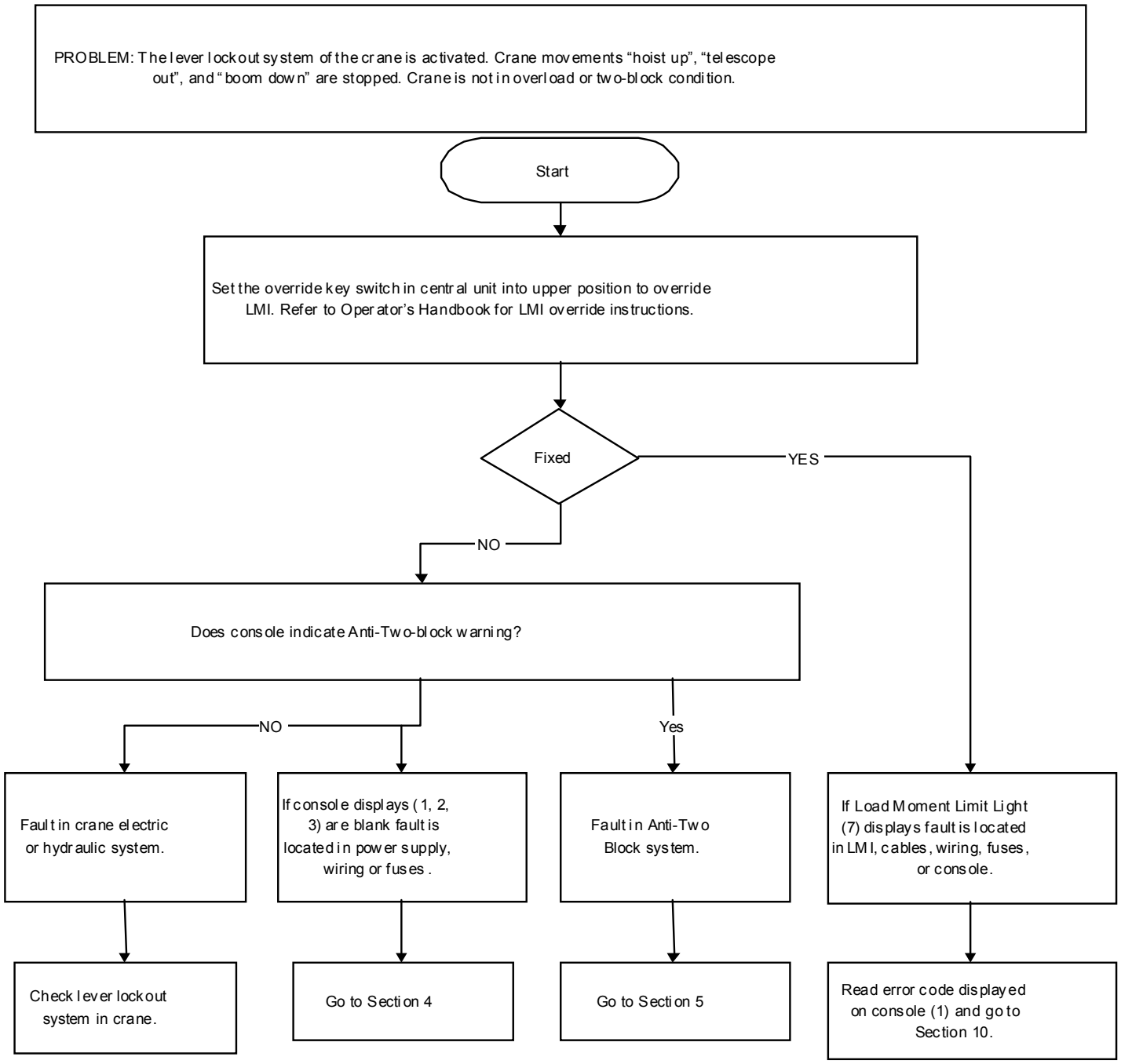


SECTION 1, DRAWING – 7

SLIPRING ASSEMBLY



2. LEVER LOCKOUT ACIVATED



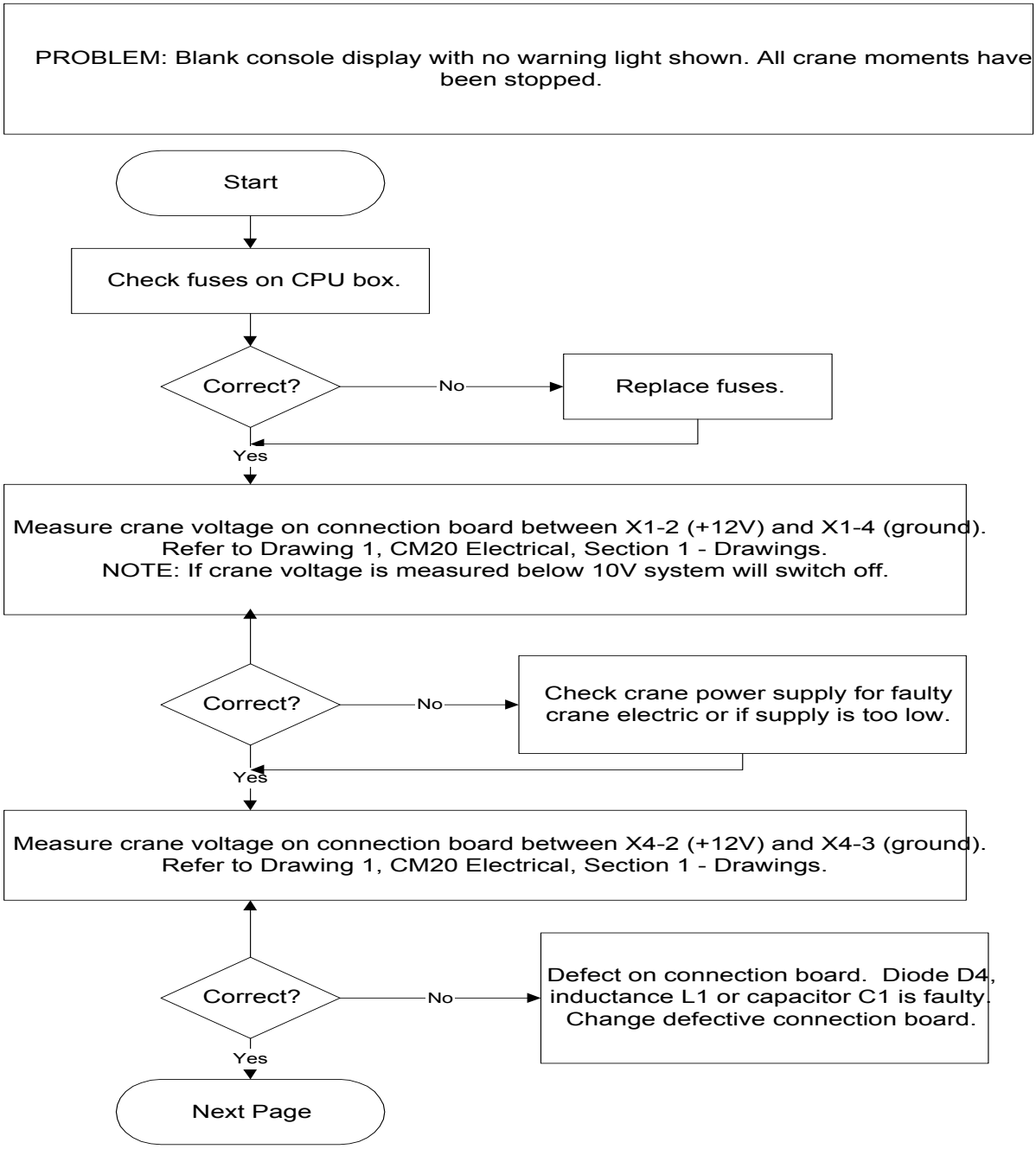
3. BROKEN LENGTH CABLE

PROBLEM: Damaged or broken length cable.

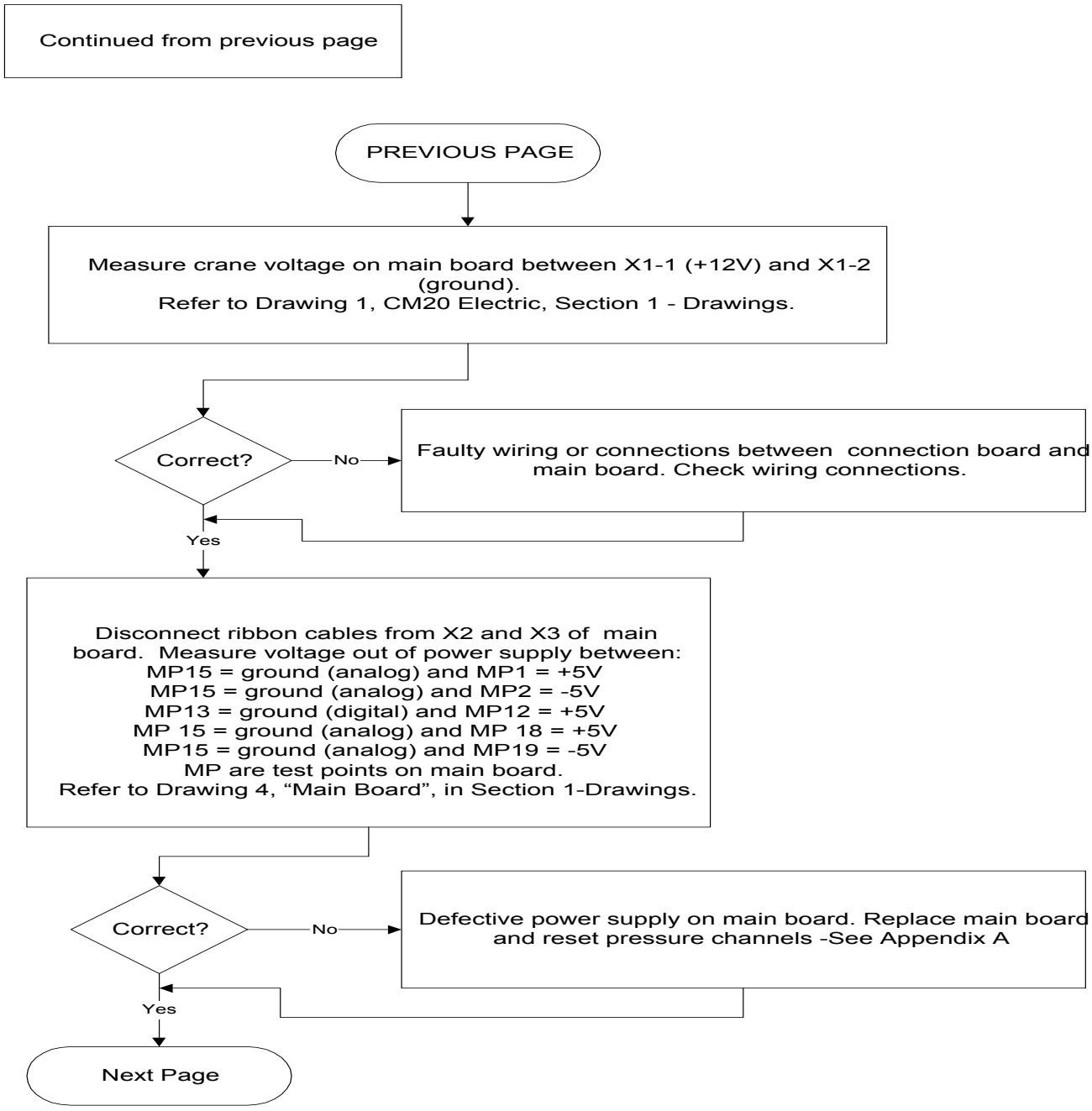
Replace length cable using the following procedure:

1 Cut old cable at cable drum
2 Disconnect damaged length cable from junction box at the boom nose.
3 Open cable reel cover and disconnect wiring from terminal block. Pull 14 conductor cable out of strain relief.
4 Remove cable reel from mounting brackets.
5 Remove damaged length cable, which is mounted to the slip rings in the cable reel, from slipring terminal. Refer to Drawing 2 in Section 1 - Drawings
6 On the back side of the cable reel, open the strain relief attached to the axle in the center of the drum. Pull existing length cable out of the cable reel.
7 Pull new length cable through the hole, pipe and strain relief and push it through the axle of the reeling drum. Tighten strain relief to ensure sealing.
8 Reconnect the length cable to the slipring. Refer to Drawing 2 in Section 1 - Drawings.
9 Remount cable reel to the boom.
10 Turn reeling drum clockwise to spool the new cable neatly onto the drum.
11 Set preload on cable reel by turning the drum counter-clockwise 5 to 8 turns.
12 Wrap the new length cable around the boom tip ancor pin (4 or 5 wraps) and secure with tie wraps. Leave enough length cable to connect into the boom tip junction box.
13 Connect the length cable into the boom tip junction box. Refer to Drawing 2 in Section 1 - Drawings.
14 Reset length potentiometer in length angle transducer (screw is located in center of white gear); with boom fully retracted, turn potentiometer carefully counter-clockwise until it stops. Recheck length and angle display. Refer to Drawing 5 in Section 1 - Drawings.

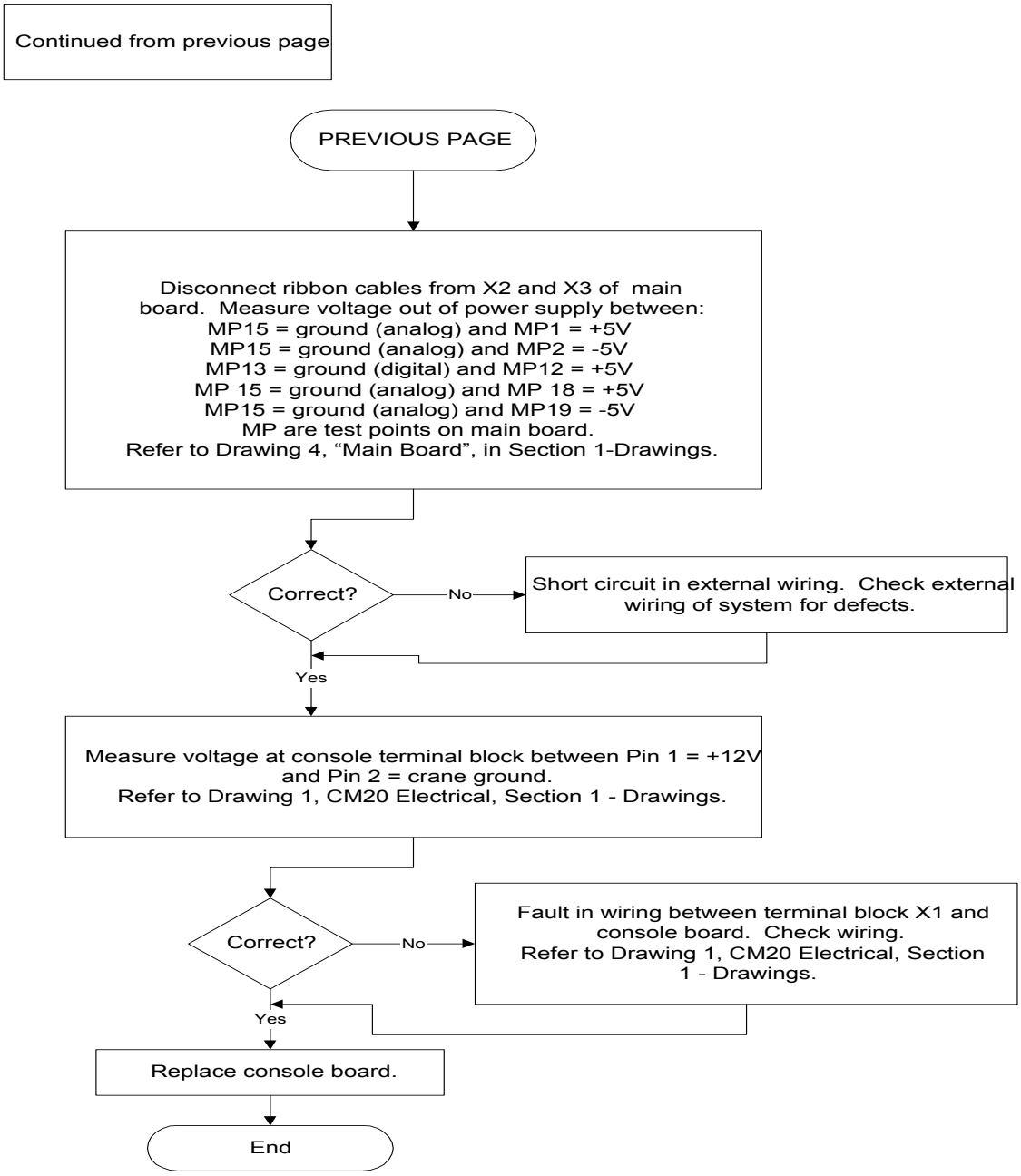
4. NO DISPLAY


PROBLEM: Blank console display with no warning light shown. All crane moments have been stopped.
Start
Check fuses on CPU box.
Correct?
No
Replace fuses.
Yes
Measure crane voltage on connection board between X1-2 (+12V) and X1-4 (ground).
Refer to Drawing 1, CM20 Electrical, Section 1 - Drawings.
NOTE: If crane voltage is measured below 10V system will switch off.
Correct?
No
Check crane power supply for faulty crane electric or if supply is too low.
Yes
Measure crane voltage on connection board between X4-2 (+12V) and X4-3 (ground).
Refer to Drawing 1, CM20 Electrical, Section 1 - Drawings.
Correct?
No
Defect on connection board. Diode D4, inductance L1 or capacitor C1 is faulty.
Change defective connection board.
Yes
Next Page

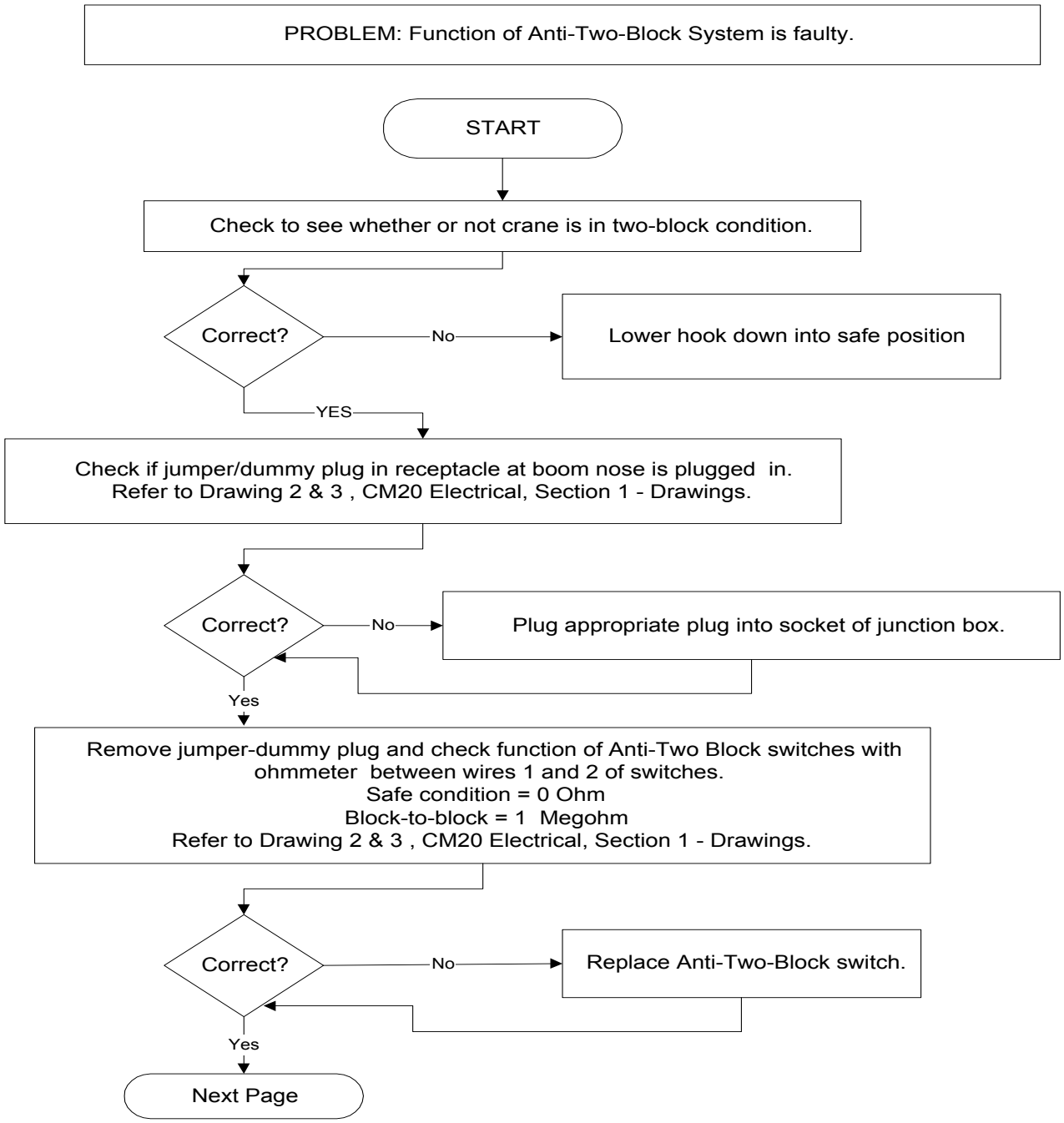
4. NO DISPLAY -continued



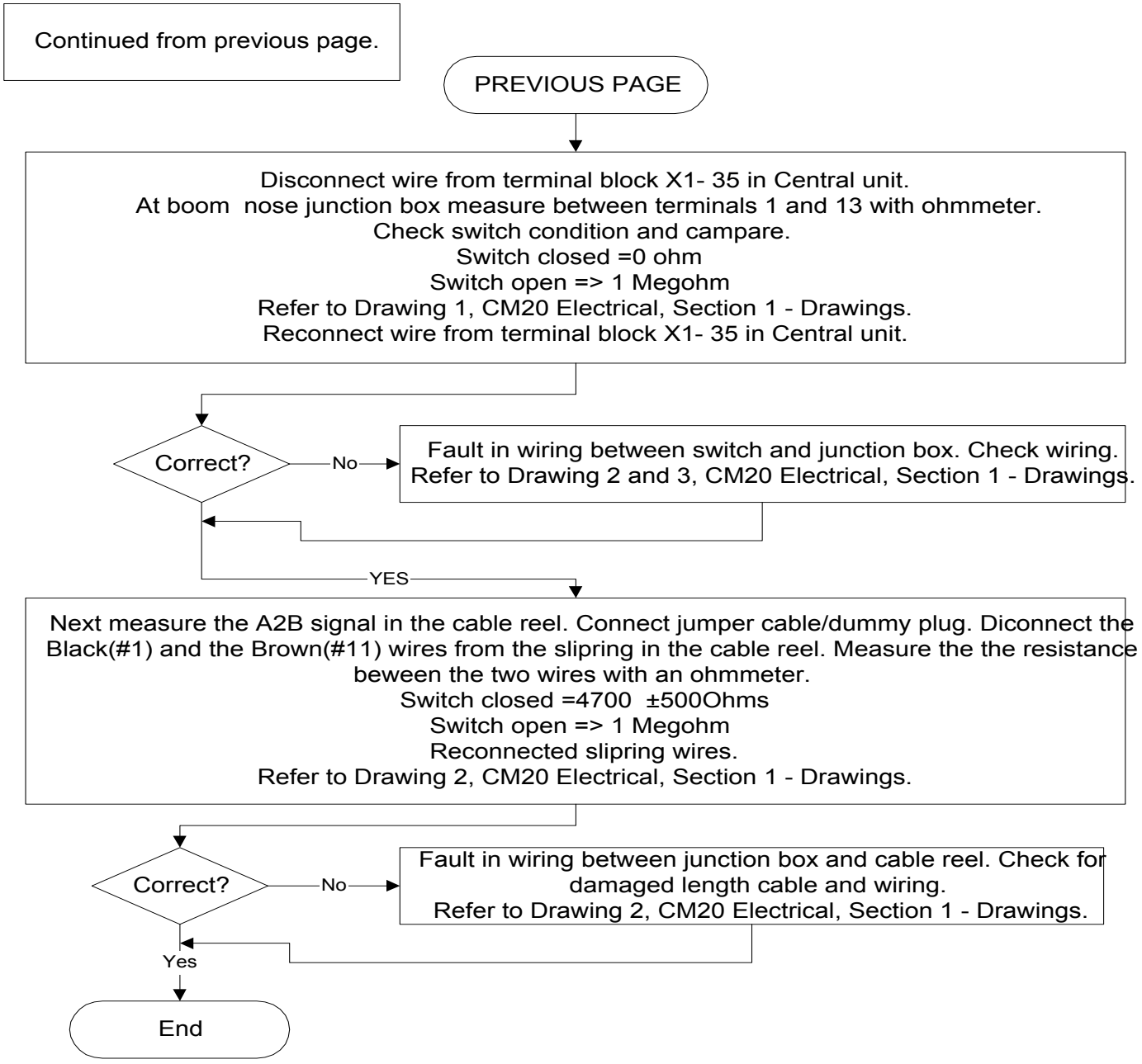
4. NO DISPLAY -continued



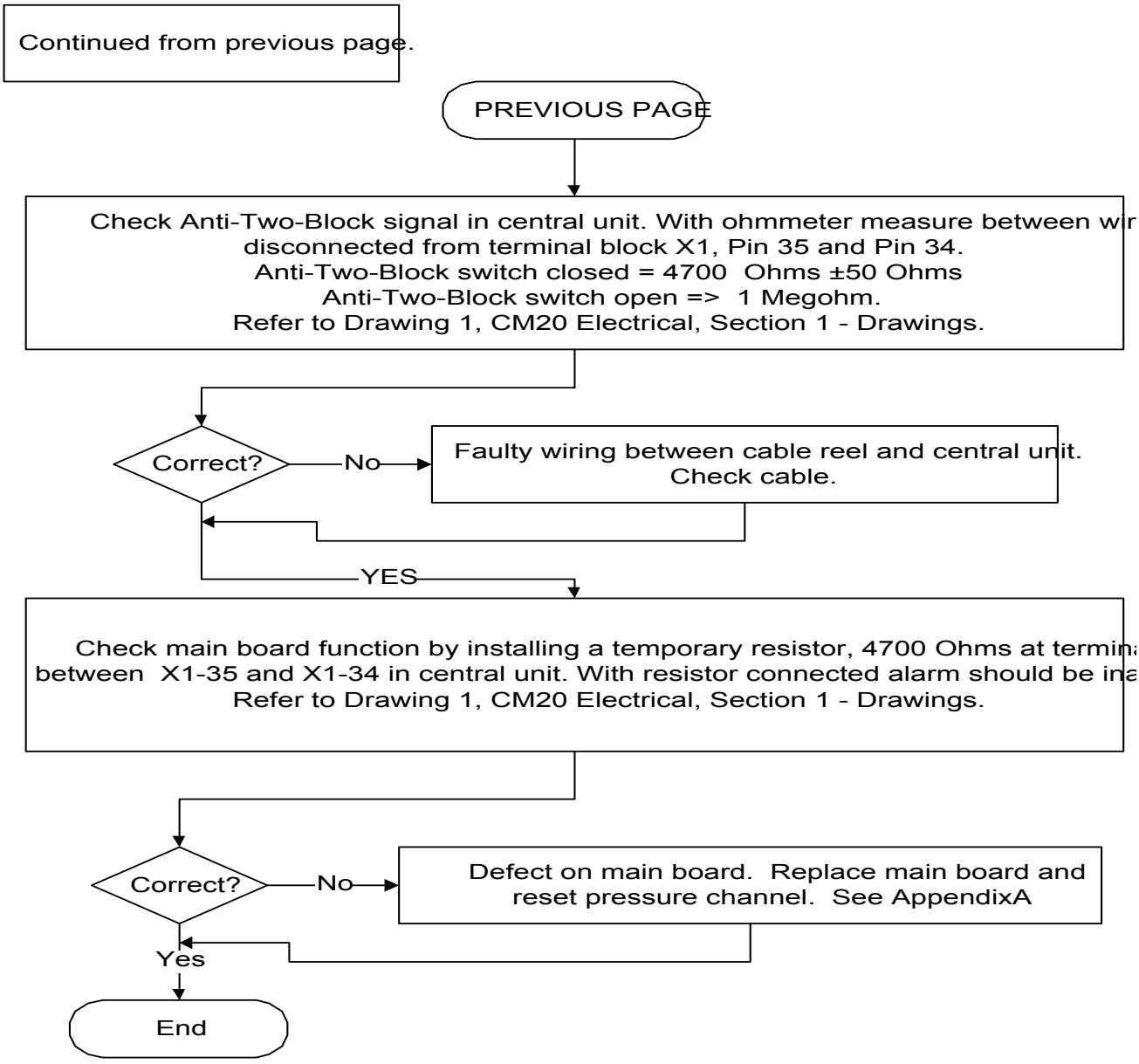
5. ANTI TWO BLOCK PROBLEM



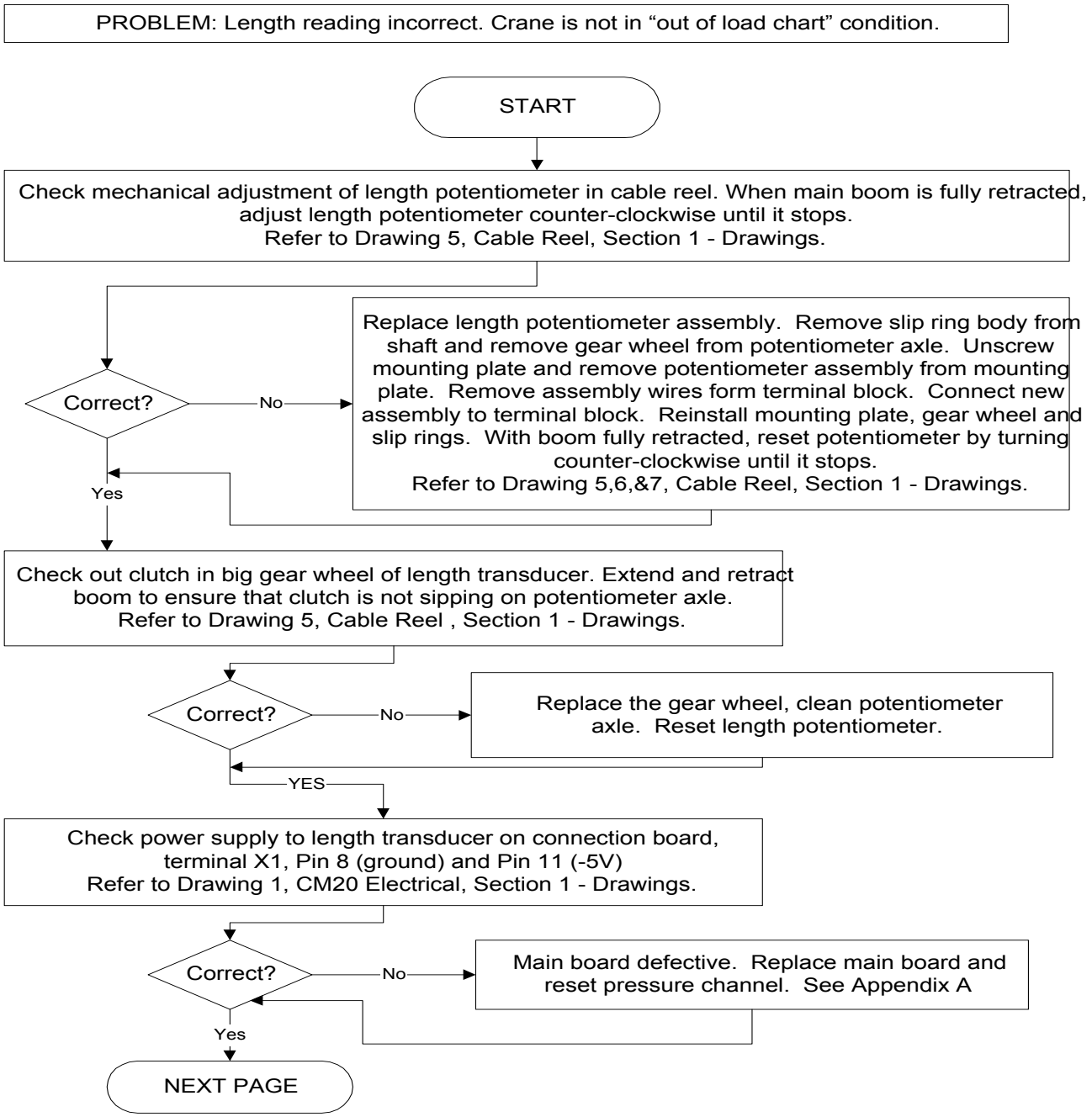
5. ANTI TWO BLOCK PROBLEM - continued



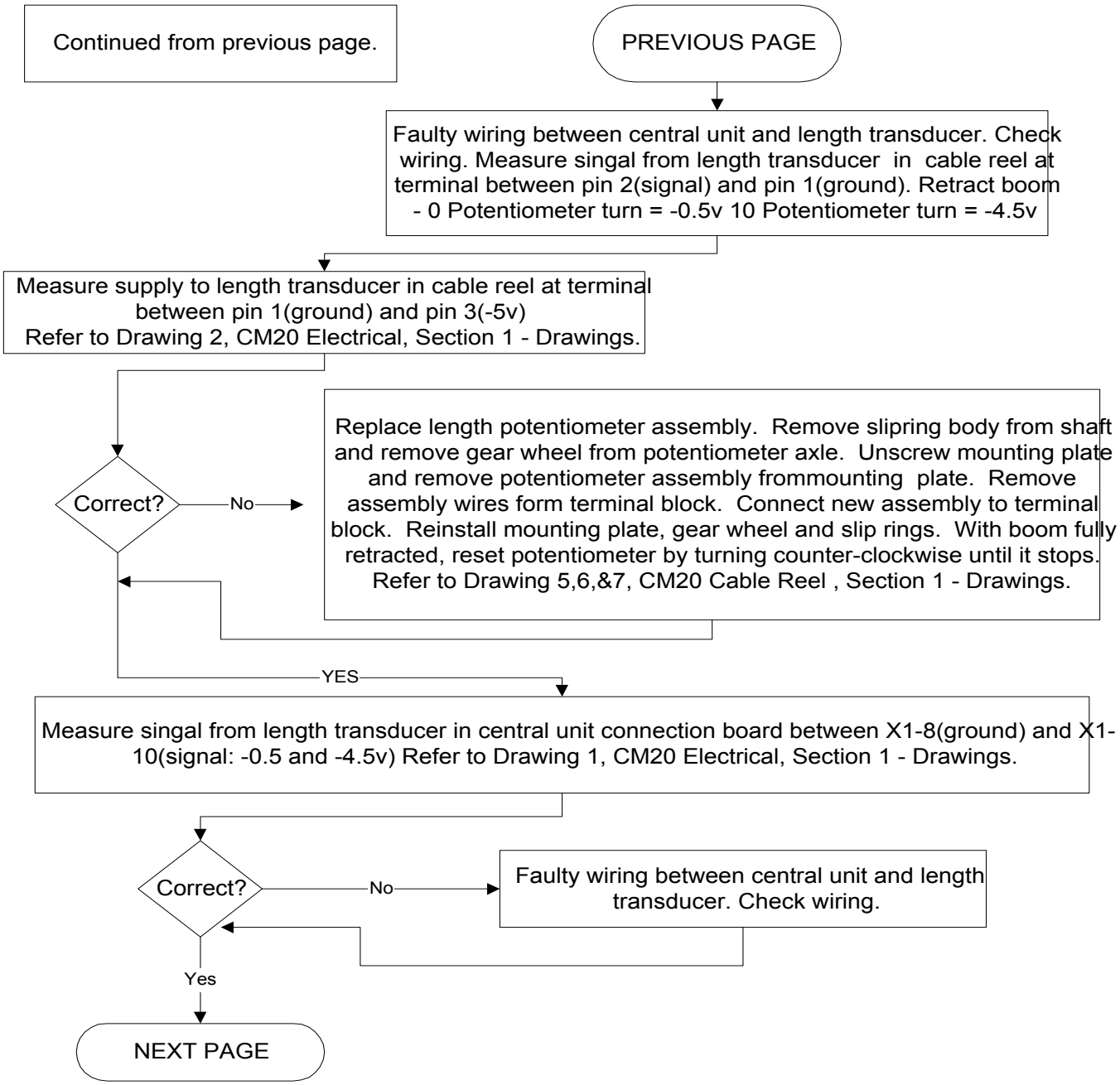
5. ANTI TWO BLOCK PROBLEM - continued



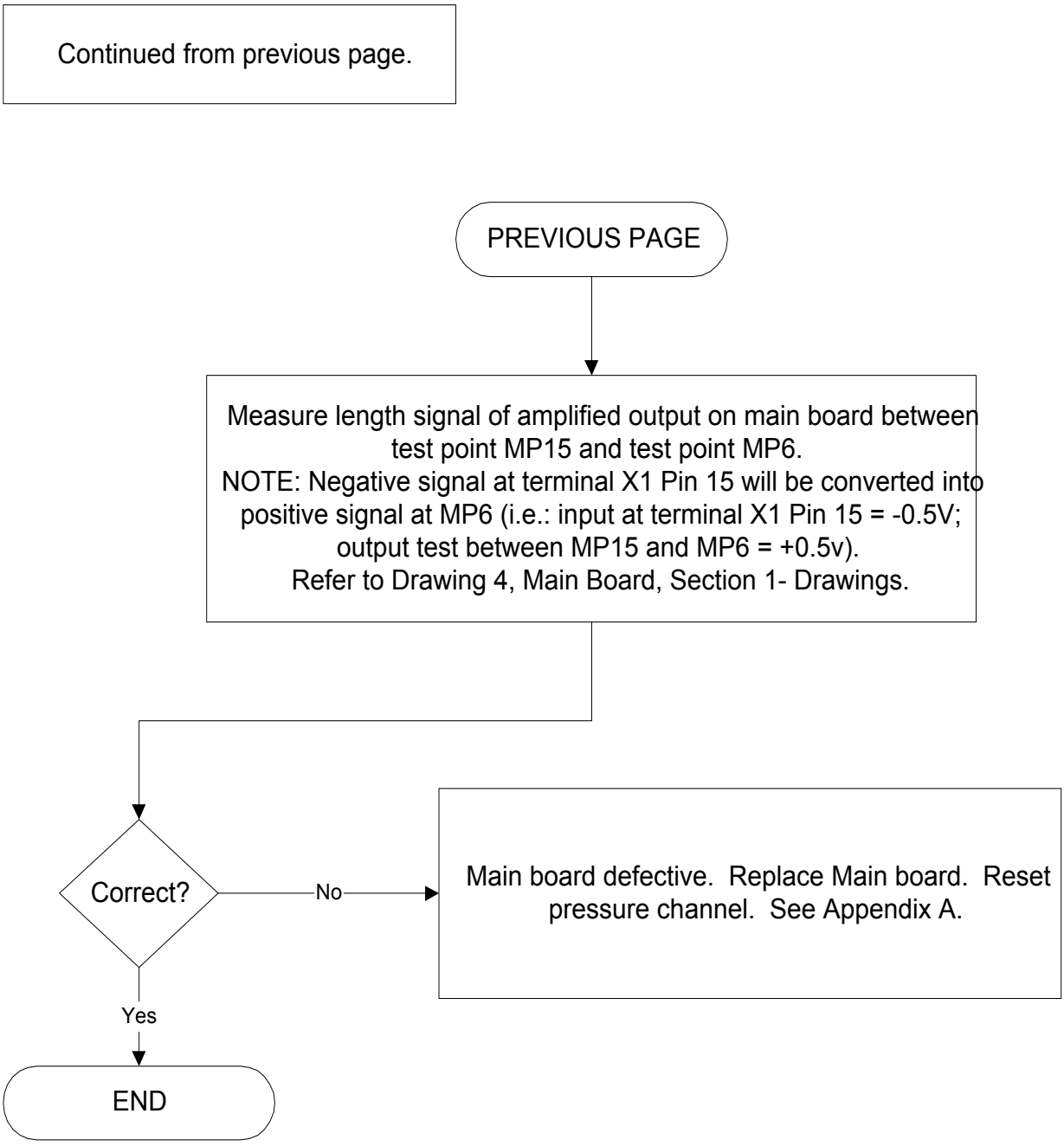
6. LENGTH READING PROBLEM



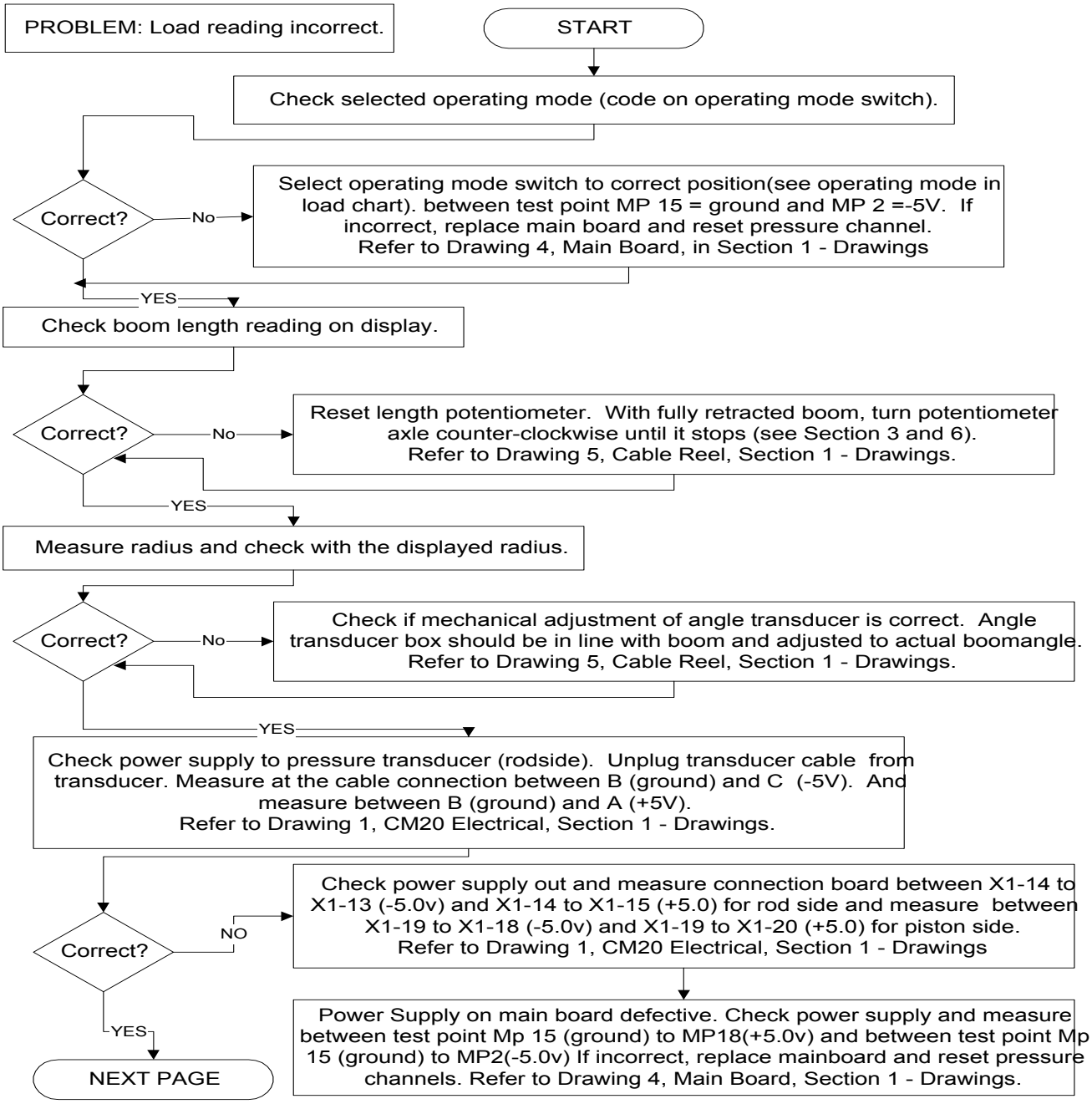
6. LENGTH READING PROBLEM - continued



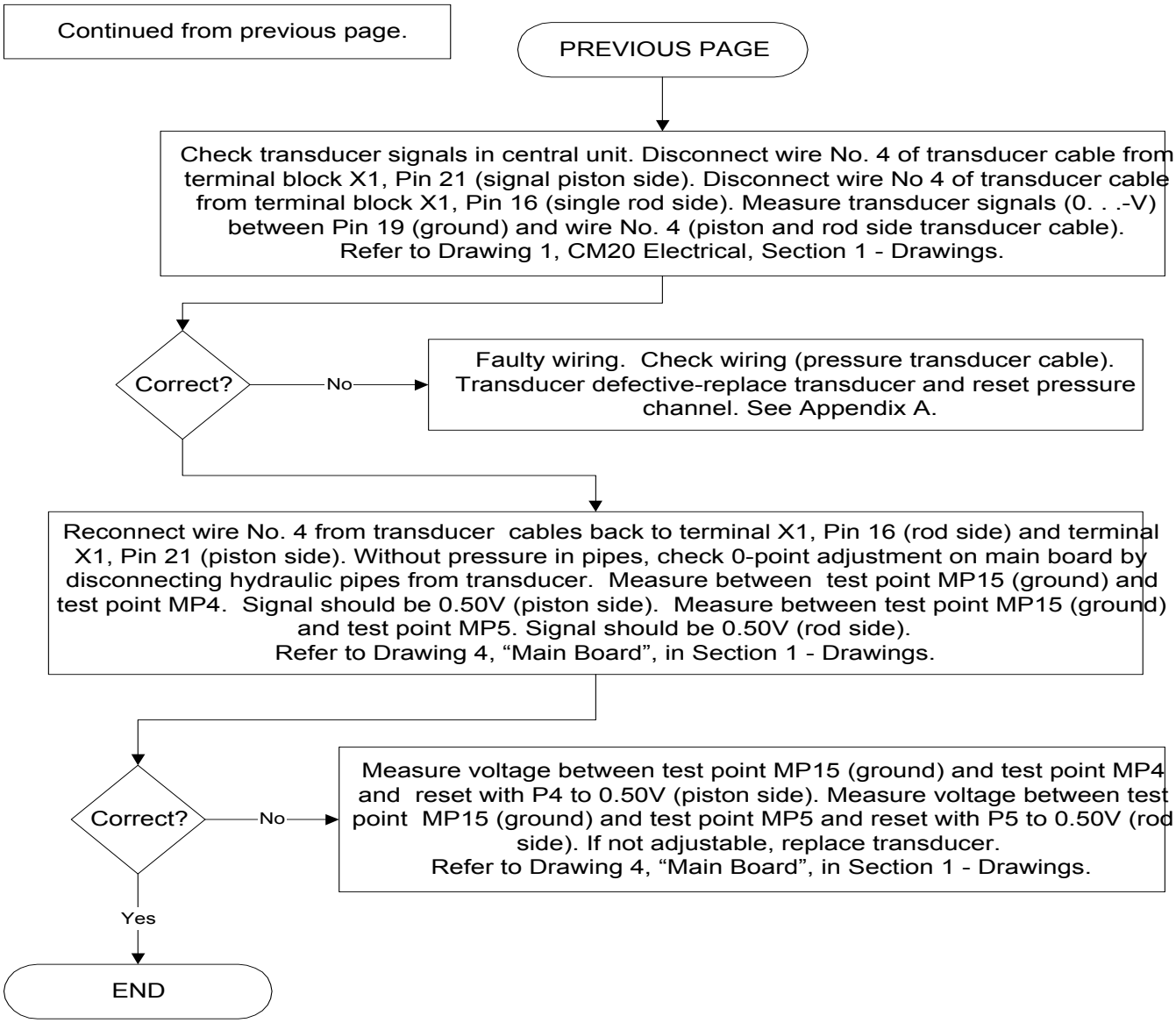
6. LENGTH READING PROBLEM - continued



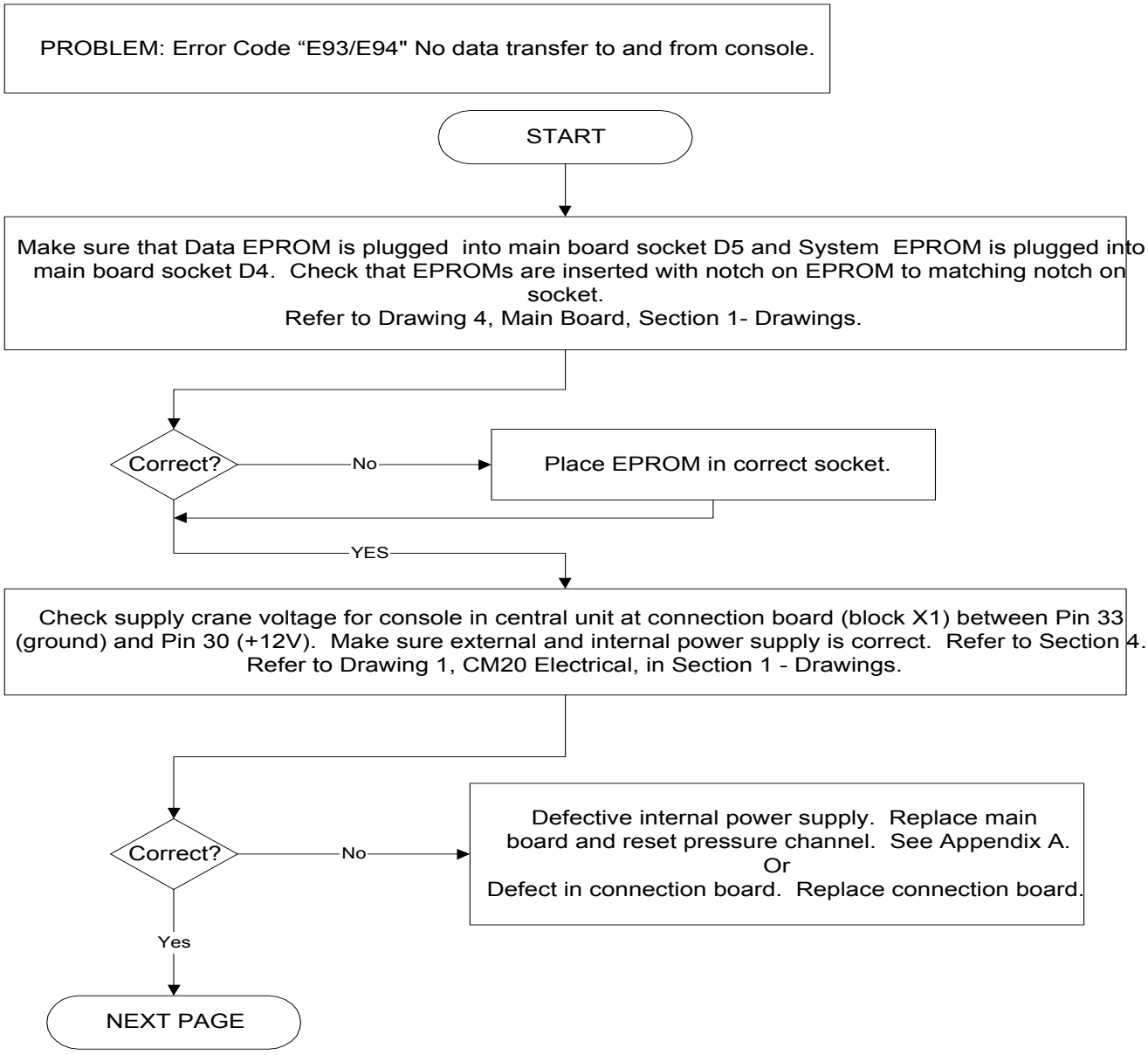
7. LOAD READING PROBLEM



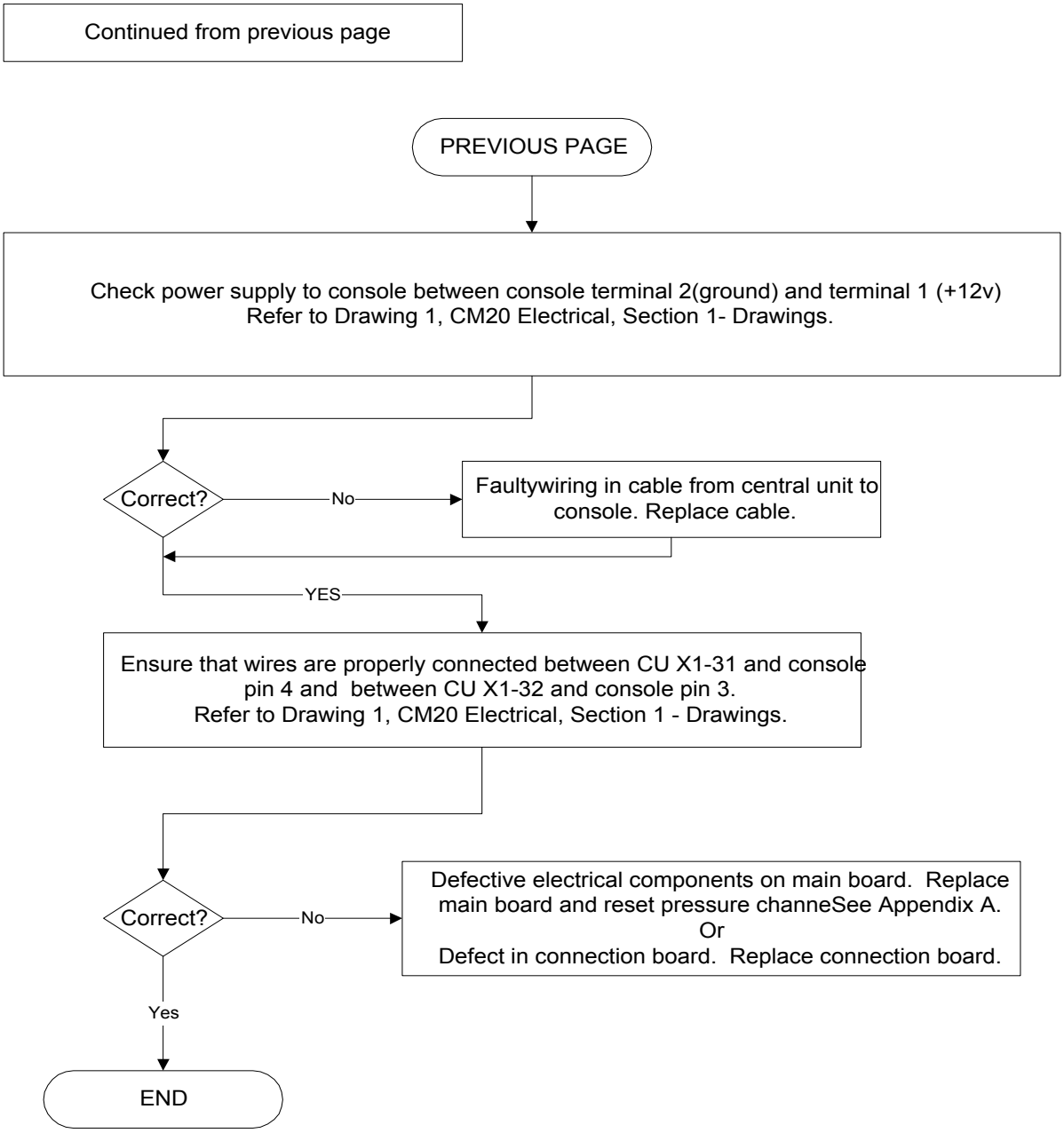
7. LOAD READING PROBLEM - continued



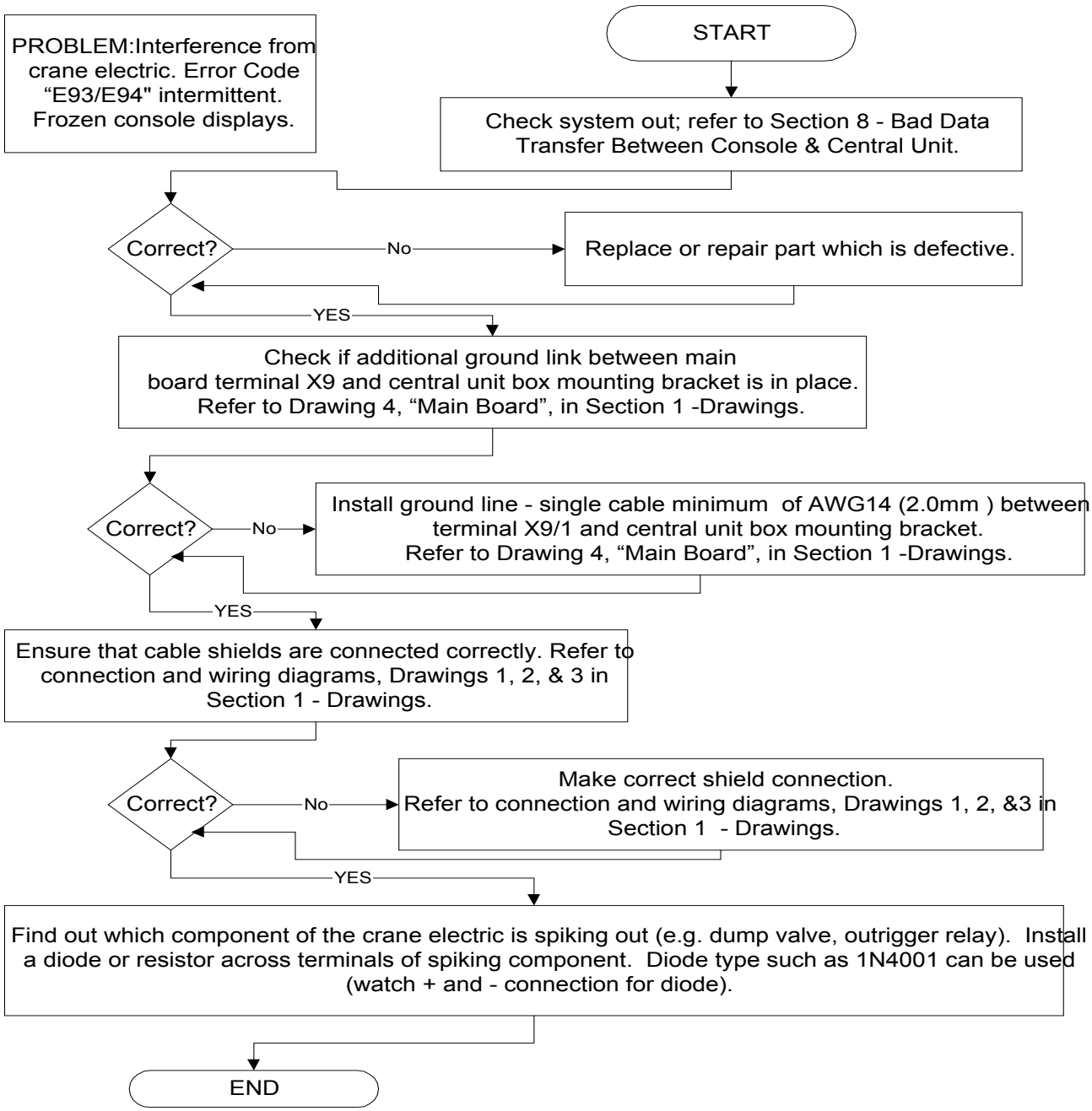
8 BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT



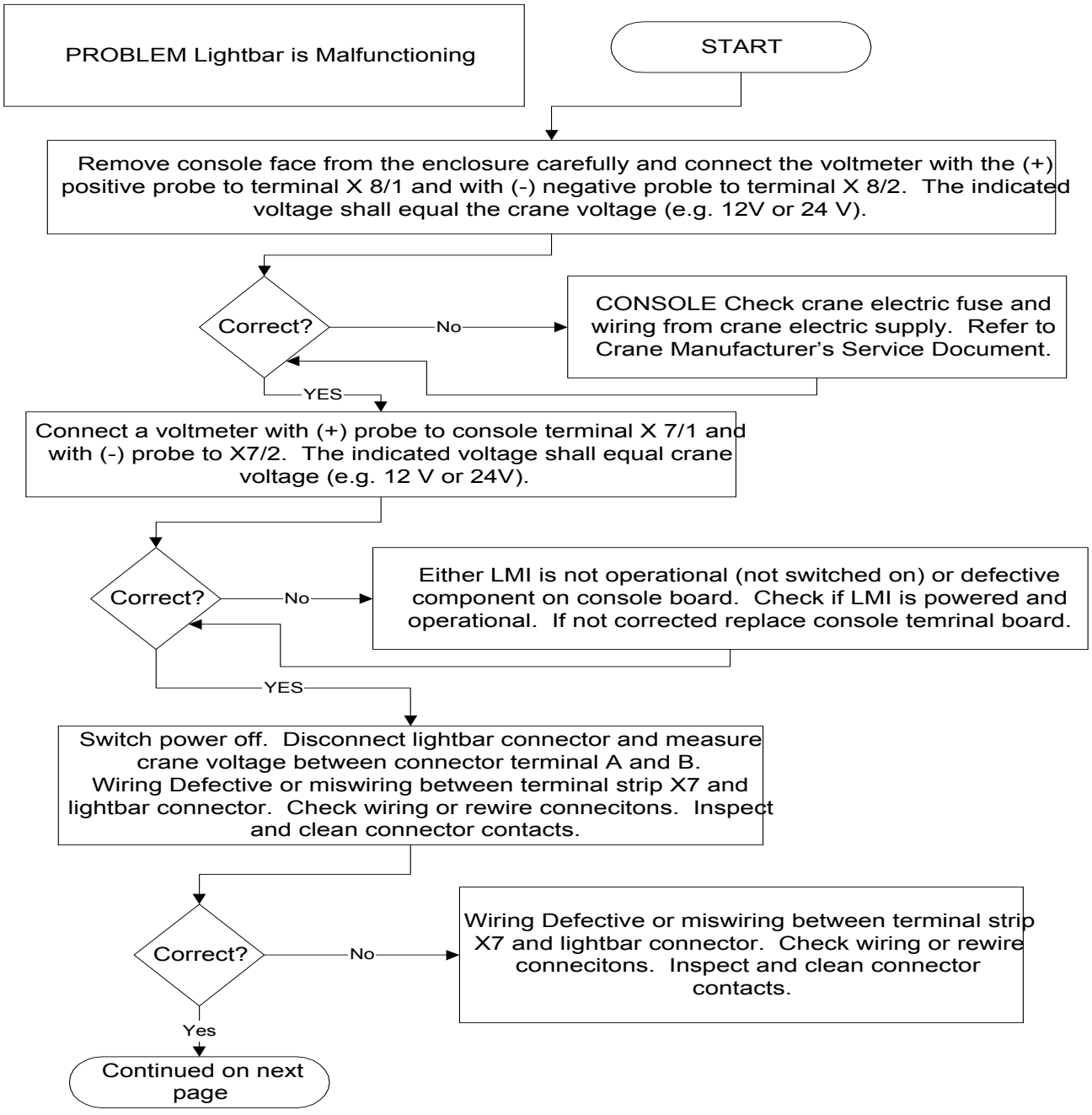
8 BAD DATA TRANSFER BETWEEN CONSOLE & CU - continued



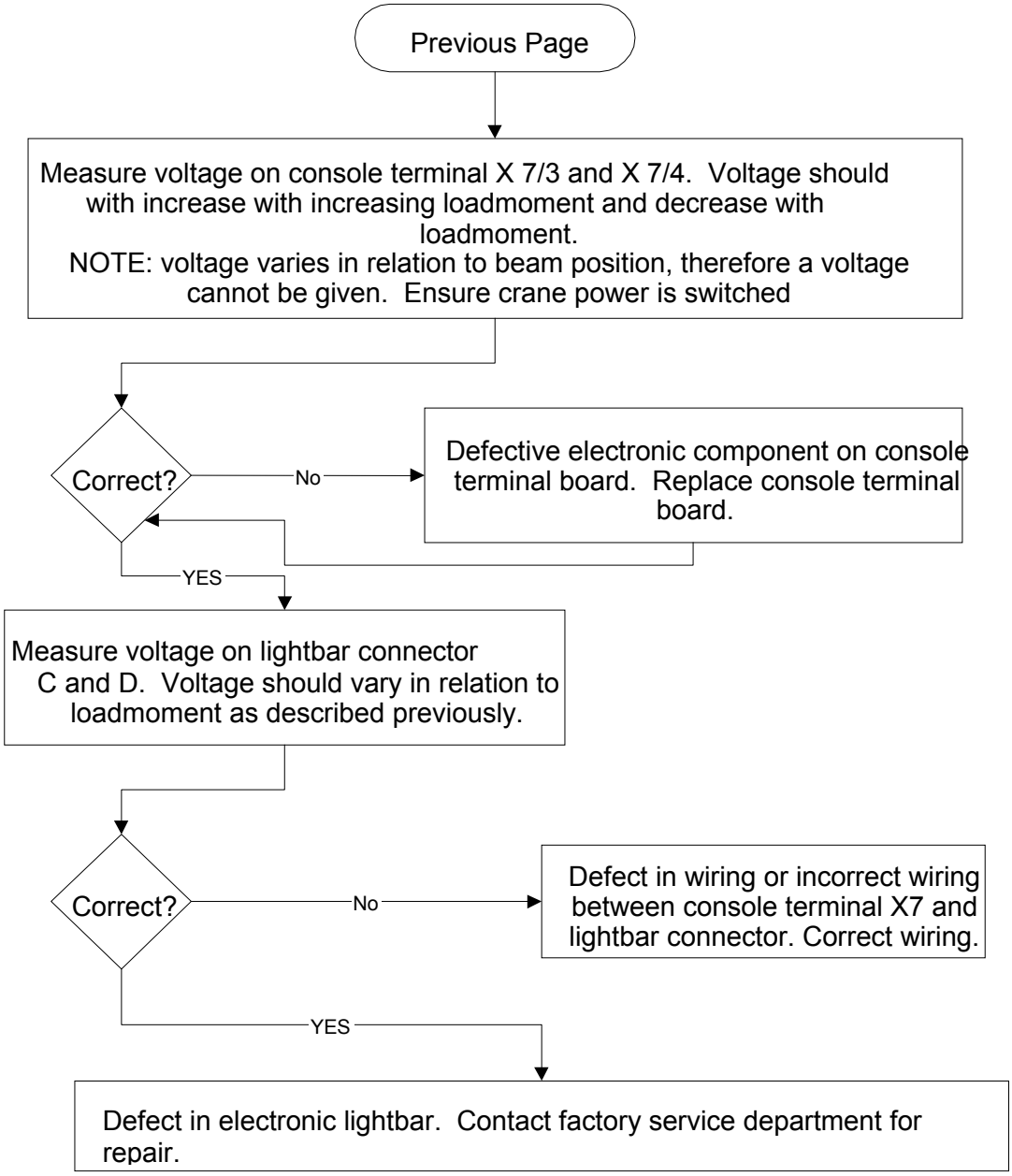
9. INTERFERENCE PROBLEM



10. LIGHTBAR MALFUNCTION



10. LIGHTBAR MALFUNCTION - continued



11. ERROR CODE DISPLAY

PROBLEM: Error code displayed. Lever lockout activated. Warning lights on.

ERROR CODE	ERROR	CAUSE	ACTION
E01	Minimum radius or maximum angle range exceeded	Fallen below the minimum radius or above the angle given in the load chart due to raising the boom to far.	Lower boom back to a radius or angle given in the load chart.
E02	Maximum radius or minimum angle range exceeded	The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.
E03	Prohibited slewing range (no load area)	Slewing range prohibited with load.	Slew back into admissible range.
E04	Operating mode not available	Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.	Set operating mode switch correctly to the code assigned to the operating mode of the crane. See General Information for digital input positions.
E05	Length range not permitted	Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.	Retract or extend boom to correct length given in the load chart. See Section 6 and Drawing 5.
E06	Fallen below angle range with luffing jib operation.	Fallen below the minimum jib angle specified n the respective load chart due to luffing out the jib too far.	Luff in the jib to a radius or angle specified in the load chart.
E07	No acknowledgment signal from overload relay (K1).	Overload relay is stuck, defective or not being selected.	Replace relay.
E08	No acknowledgment signal from Anti-Two-Block switch relay (K2).	Anti-Two-Block switch relay is defective or not being selected.	Replace relay.
E11	Fallen below limit for the measuring channel “length”.	a.) Cable between length sensor and central unit defective, not connected or water in the connectors. b.)Length sensor Potentiometer defective. c.)Electronic board in the measuring channel defective.	a.)Check cable and connector as well and replace, if necessary. Section 6. b.)Replace and reset length sensor Potentiometer. See section 6 & Drawing 5. c.)Replace main board and reset pressure channels. Section 7 & Appendix A.

ERROR CODE	ERROR	CAUSE	ACTION
E12	Fallen below lower limit value for the measuring channel “pressure transducer piston side”.	a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on piston side defective. c.)Electronic component in the measuring channel defective.	a.)Check cable and connector as well and replace, if necessary. Section 7. b.)Replace pressure transducer and reset pressure channel. See Section 7 & Appendix A. c.)Replace main board and reset pressure channels. Section 7 & Appendix A.
E13	Fallen below lower limit value for the measuring channel “pressure transducer rod side”.	a.)Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on rod side defective. c.)Electronic component in the measuring channel defective.	a.)Check cable and connectors as well and replace, if necessary. Section No. 7. b.)Replace pressure transducer and reset pressure channel. See Section 7 & Appendix A. c.)Replace main board and reset pressure channels. Section 7 & Appendix A.
E14	Fallen below lower limit value for the measuring channel “force”.	a.)Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Force transducer defective. c.)Electronic component in the measuring channel defective.	a.)Check cable and connectors as well and replace, if necessary. Section 7. b.)Replace force transducer. c.)Replace main board and reset pressure channels. Section 7 & Appendix A.
E 15	Fallen below lower limit value for the measuring channel “angle main boom”.	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Angle sensor defective. c.)Electronic component in the measuring channel defective.	a.)Check cable. Replace if necessary. See Section 6 b.)Replace angle sensor and reset adjustment. Drawing 5 c.)Replace main board and reset pressure channels. See section 7 & Appendix A.
E16	Fallen below lower limit value for measuring channel “Luffing Jib Angle”.	a.)Cable from central unit to angle sensor defective or disconnected or water inside the plug. b.)Angle sensor defective. c.)Electronic component in the measuring channel defective.	a).Check cable as well as plug, replace if need be. b.)Replace angle sensor. c.)Replace Main board and reset pressure channels. See Section 7 & Appendix A.

ERROR CODE	ERROR	CAUSE	ACTION
E17	Fallen below lower limit value for the measuring channel 7.	a.)Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. b.)Sensor of channel 7 defective. c.)Electronic component in the measuring channel 7 defective.	a.)Check cable as well as connectors and replace, if necessary. b.)Replace sensor of channel 7 and reset adjustment. c.)Replace main board and reset pressure channels. See Section 7 & Appendix A.
E19	Error in the reference voltage.	Electronic component on the main board defective.	Replace main board and reset pressure channels. See Section 7 & Appendix A.
E20	No analog voltages	a.)The crane supply voltage is too low. b.)The voltage converter is defective or short circuit in the wiring.	a.)Check crane voltage. b.)Check supply voltages.
E21	Upper limiting value for the measuring channel “length” exceeded.	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Length potentiometer defective. c.)Electronic component in the measuring channel defective on main board.	a.)Check cable. Replace if necessary. See section No. 6. b.)Replace and reset length potentiometer. See Drawing 5. c.)Replace main board and reset pressure channels. See Section 7 & Appendix A.
E22	Upper limiting value for the measuring channel “pressure piston side” exceeded.	a.)Cable from central unit to the pressure transducer defective, loose or water in the plug. b.)Pressure transducer on piston side defective. c.)Electronic component in the measuring channel defective on main board.	a.)Check cable as well as plug. Replace if necessary. See Section 7. b.)Replace pressure transducer and reset pressure channels. See Section No. 7. c.)Replace main board and reset pressure channels. See Section 7 & Appendix A.
E23	Upper limit value for the measuring channel “pressure transducer rod side” exceeded.	a.) Cable lead in from the central unit to press trans defective, not connected or water in the connectors. b.) Pressure transducer on road side defective. c.) Electronic component in the measuring channel defective.	a.) Check cable and connectors as well and replace, if necessary. Section 7. b.) Replace pressure transducer c.) Replace main board and reset pressure channels. Section 7 & Appendix A.

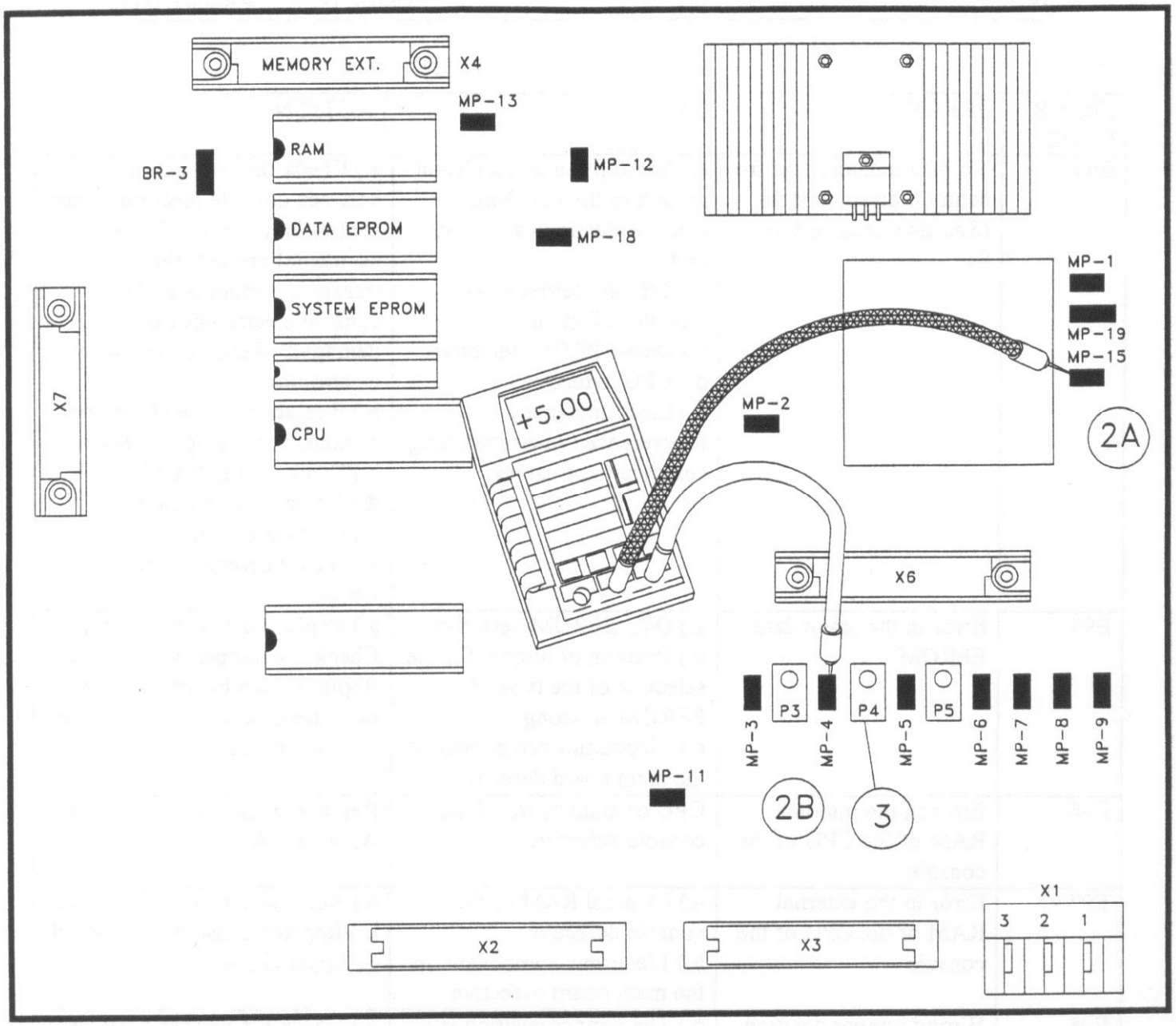
ERROR CODE	ERROR	CAUSE	ACTION
E24	Upper limit value for the measuring channel "force" exceeded.	a.) Cable leading from the central unit to the force transducer defective, not connected or water in the connectors. b.) Force transducer defective. c.) Electric component in the measuring channel defective.	a.) Check cable and connectors as well and replace, if necessary. Section No. 7. b.) Replace force transducer. c.) Replace main board and reset pressure channels. Section 7 & Appendix A.
E25	Upper limit value for the measuring channel "angle main boom" exceeded.	a.) Cable leading from the central unit to the length/angle sensor defective, loose or water I the connectors. b.) Angle sensor defective c.) Electronic component in the measuring channel defective.	a.) Check cable as well as connectors and replace, if necessary. Section No. 6. b.) Replace angle sensor and reset adjustment. See Section No. 6 & Drawing 5. c.) Replace main board and reset pressure channels. Section 7 & Appendix A.
E26	Upper limit value for the measuring channel "Leafing Jib Angle" exceeded.	a.) Cable leading from the central unit to the jib angle sensor defective, loose or water in the connectors. b.) Jib angle sensor defective. c.) Electronic component in the measuring channel defective.	a.) Check cable as well as connectors and replace, if necessary. b.) Replace jib angle sensor and reset adjustment. c.) Replace main board and reset pressure channels. See Section 7 & Appendix A.
E27	Upper limit value for the measuring channel 7 exceeded.	a.) Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. b.) Sensor of channel 7 defective. c.) Electronic component in the measuring channel 7 defective.	a.) Check cable as well as connectors and replace, if necessary. b.) Replace sensor of channel 7 and reset adjustment. c.) Replace main board and reset pressure channels. See Section 7 & Appendix A.
E29	Reference coltage defective.	a.) The total of the supply and the reference voltages on MP10 is more than 3.3V b.) A/D converter defective.	a.) Check supply voltages. b.) Replace main board and reset pressure channels. See Section 7 & Appendix A.

ERROR CODE	ERROR	CAUSE	ACTION
E31	Error in the system program.	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM b.) Replace main board and reset pressure channels. See Section 7 & Appendix A.
E37	Error in the program run	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM. b.) Replace main board and reset pressure channels. See Section 7 & Appendix A.
E38	Wrong system program in the LMI.	The system program in the LMI does not correspond to the programming in the data EPROM	Replace system program EPROM
E 41	Error in the external RAM.		Replace main board and reset pressure channels. See Section No. 7 & Appendix A..
E 42	Error in the external write/read memory (RAM).	Internal defect in digital part of CPU.	Exchange write/read memory (CMOS-RAM). Replace main board and reset pressure channels. See Section No. 7.
E 45	Error in internal communications.	Defective electronic component.	Replace main board and reset pressure channels. See Section 7 & Appendix A.
E 48	Malfunction in the monitored write/read memory.	Internal defect in digital part of CPU	Replace main board and reset pressure channels. See section No. 7 & Appendix A..
E 51	Error in data memory.	Data EPROM on the main board defective.	Replace Data EPROM. Make sure BR3 on the main board is installed. See Drawing 4 in Section 1.
E71	Incorrect acknowledgment of the 1. Relay on the terminal board A101.	a.) Anti Two-block relay is stuck or defective. b.) Anti Two-Block relay is not being selected due to a break on the terminal board A101, main board or ribbon cables.	a.) Replace 1. relay. b.) Check terminal board A101, main board and ribbon cables as well as replace defective part, if necessary.
E72 - E77	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2..7.

ERROR CODE	ERROR	CAUSE	ACTION
E89	Change of the operating code during lifting a load.	The operating mode switch in the console was used during lifting a load.	Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.
E 91	No data transmission from console to central unit. (See Section 8 and 9)	a.)12V supply of console interrupted. b.)Interruption or accidental ground in the line from console electronics to central unit. c.)Transmitter/receiver module defective.	a.)Check 12V at terminal X1 of console electronics. b.)Check the connection between console electronics and central unit. c.)If you find an accidental ground, the transmitter module in the console electronics can be damaged. You should, therefore, replace the console electronics. Replace console electronics or main board respectively.
E92	Error in the data transmission from console to central unit. (See also Section 8 and 9)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	a.) Check the connection between console electronics and central unit.
E93	Error in the data transmission from central unit to console. (See also Section 8 and 9)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively.

ERROR CODE	ERROR	CAUSE	ACTION
E94	No data transmission fro central unit to console. (See also Section 8 and 9)	a.) Interruption or accidental ground in the line from console electronics to central unit. b.) Transmitter/receiver module defective. c.) Data-EPROM defective. d.) CPU defective. e.) Electromagnetic interference (when switching contractors or valves)	a.) Check the connection between console electronics and central unit. If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics. b.) Replace console electronics or main board respectively. c.)Check data EPROM. d.) Replace main board. e.) Eliminate interference source by inverse diodes or varistors.
E95	Error in the crane data EPROM	a.) Data EPROM defective b.) Position of jumper for the selection of the type of EPROM is wrong c.) Electronics component on the main board defective.	a.) Replace data EPROM b.) Check the jumper position c.) Replace main board and reset pressure channels. See Section 7 & Appendix A.
E96	Error in the internal RAM of the CPU of the console	CPU or main board of the console defective	Replace console main board & Appendix A.
E97	Error in the external RAM of the CPU of the console	a.) External RAM of the console defective b.) Electronic component on the main board defective.	a.) Replace console main board b.) Replace console main board & Appendix A.
E98	Wrong jumper position in the console	a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit. b.) Electronic component on the main board defective.	a.) Check the jumper position b.) Replace console main board & Appendix A.

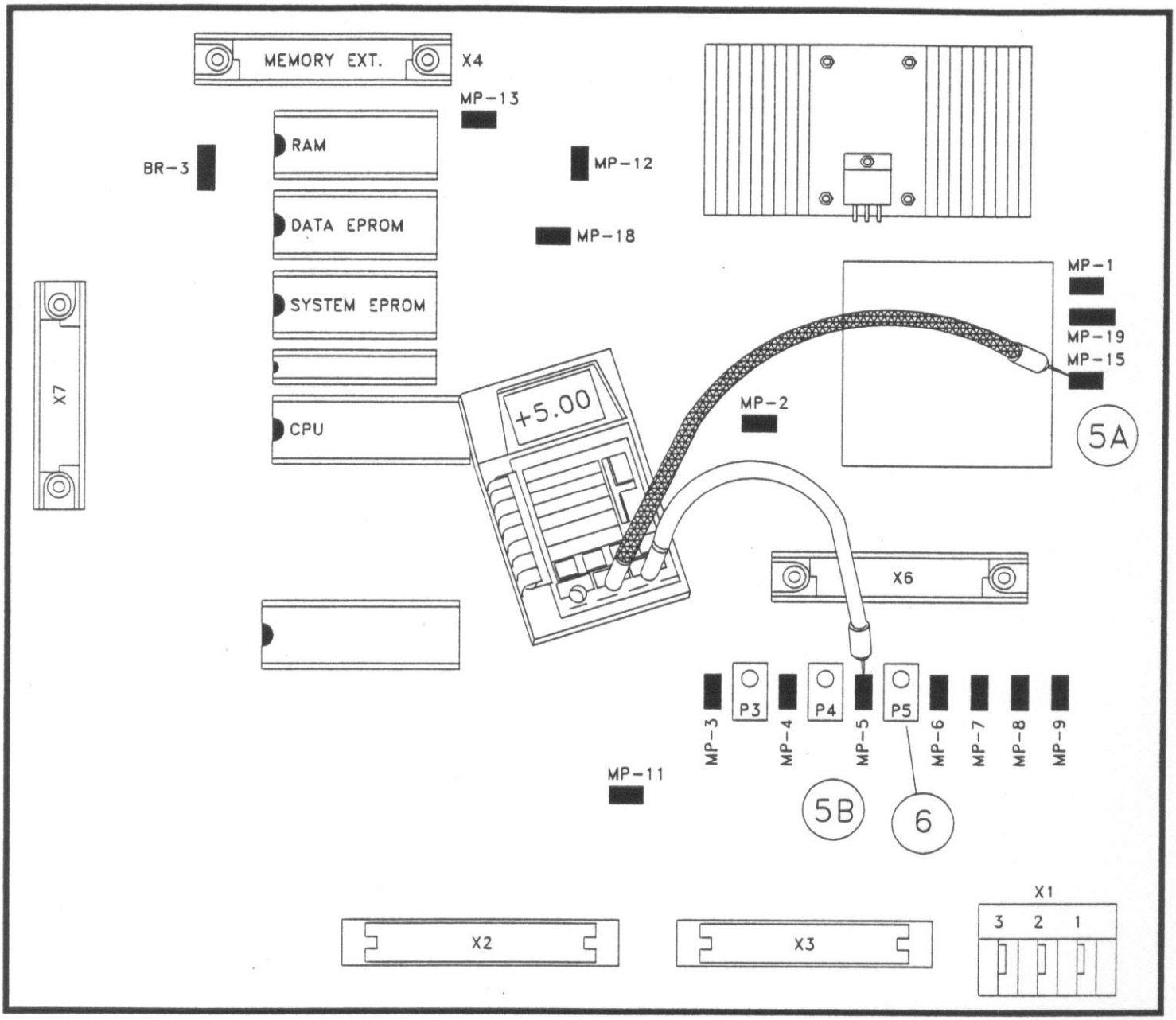
APPENDIX A PRESSURE TRANSDUCER ADJUSTMENT



PISTON PRESSURE CHANNEL ZERO POINT ADJUSTMENT

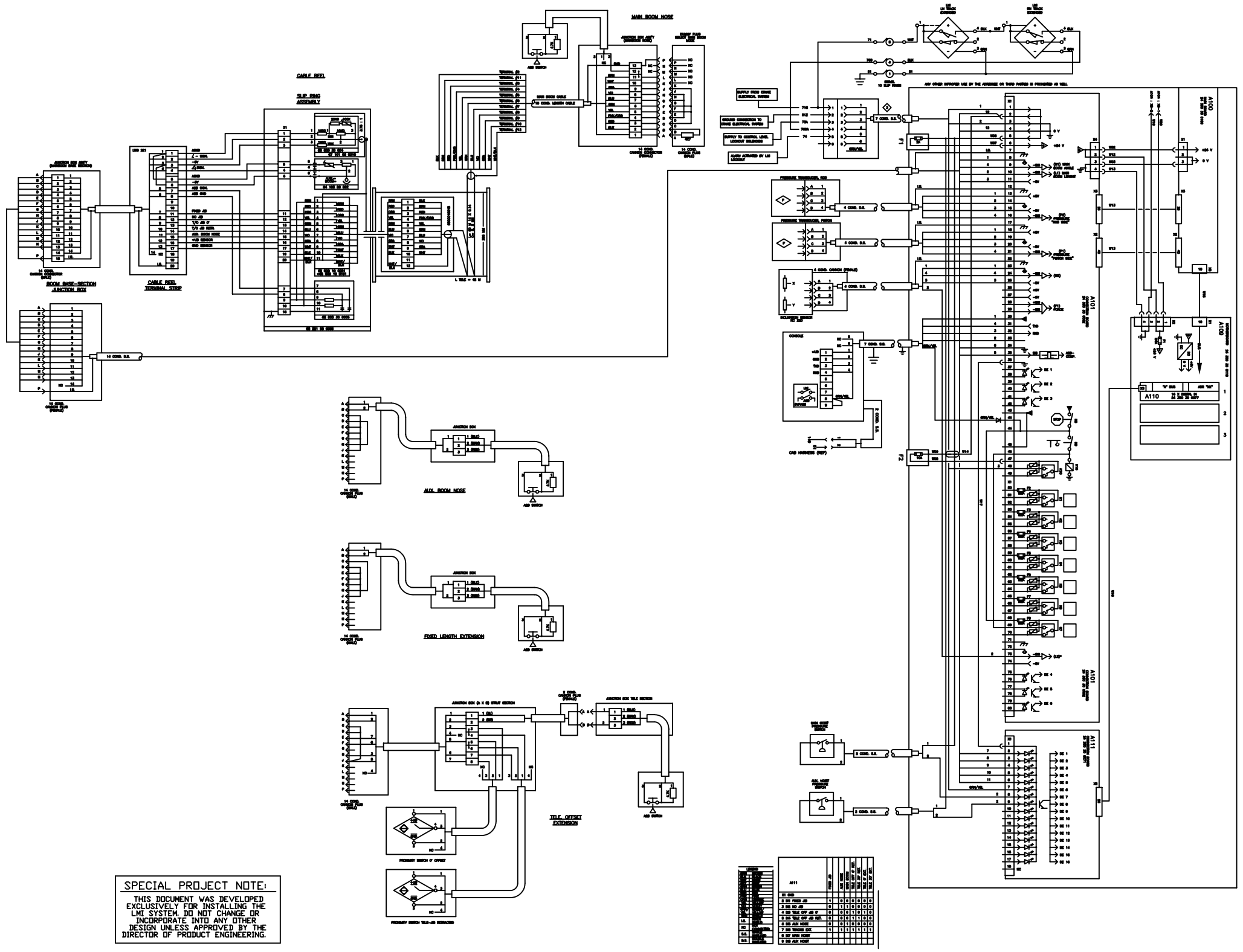
1. LOWER BOOM ALL THE WAY DOWN (NO REST PRESSURE) THEN DISCONNECT HYDRAULIC HOSE FROM THE PISTON SIDE PRESSURE TRANSDUCER.
2. CONNECT A DIGITAL VOLTMETER TO MAIN P.C. BOARD
   A) BLACK (−) LEAD TO MP15
   B) RED (+) LEAD TO MP4
3. ADJUST P4 TO OBTAIN A READING OF 0.500 VOLTS (500MV) ON METER.

APPENDIX A PRESSURE TRANSDUCER ADJUSTMENT



ROD PRESSURE CHANNEL ZERO POINT ADJUSTMENT

4. DISCONNECT HYDRAULIC HOSE FROM THE ROD SIDE PRESSURE TRANSDUCER.
5. CONNECT A DIGITAL VOLTMETER TO MAIN P.C. BOARD
   A) BLACK (−) LEAD TO MP15
   B) RED (+) LEAD TO MP5
6. ADJUST P5 TO OBTAIN A READING OF 0.500 VOLTS (500MV) ON METER.
7. RECONNECT HYDRAULIC HOSES TO PRESSURE TRANSDUCERS, THEN BLEED THE AIR FROM HYDRAULIC LINES.



SPECIAL PROJECT NOTE:

THIS DOCUMENT WAS DEVELOPED EXCLUSIVELY FOR INSTALLING THE LMI SYSTEM. DO NOT CHANGE OR INCORPORATE INTO ANY OTHER DESIGN UNLESS APPROVED BY THE DIRECTOR OF PRODUCT ENGINEERING.

PAT EQUIPMENT CORPORATION
1665 ORCHARD DRIVE
CHAMBERSBURG, PA 17201

GENERAL TOLERANCES
X.XX = 0.01
X.XXX = 0.005

REV	ECN	DESCRIPTION	BY	APV	DATE

C.A.G.E. 79760

CM20 ELECTRICAL DIAGRAM

P/N	031-300-150-638
DRAWN	SHEILA BOWMAN
APPROVED	
SCALE: NONE	SHEET: 1 OF 1
SIZE: A	DWG NO.: 031 300 31 0638
REV	—