PAT

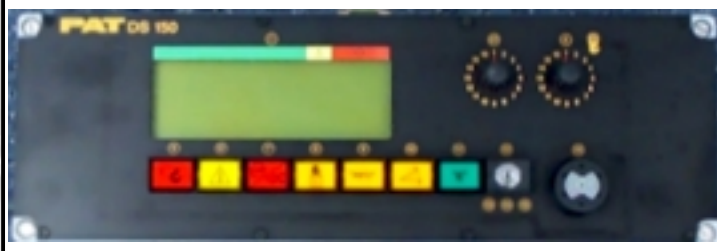
www.patamerica.co

PAT America, Inc.

PAT

LOAD MOMENT INDICATOR

DS150C



SERVICE MANUAL

P/N 031-300-190-052 REV E 8/23/01

NOTICE

PAT America, Inc. makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and/or its fitness for a particular purpose.

PAT America, Inc. will not be liable for errors contained in this manual or for incidental or consequential damages in connection with the furnishing, performance, or use of this manual. This document contains proprietary information, which is protected by copyright, and all rights are reserved.

No part of this document may be photocopied, reproduced, or translated to another language without the prior written consent of PAT America, Inc.

PAT America, Inc. reserves proprietary rights to all drawings, photos and the data contained therein. The drawings, photos and data are confidential and cannot be used or reproduced without the written consent of PAT America, Inc. The drawings and/or photos are subject to technical modification without prior notice.

All information in this document is subject to change without notice.

MANUAL REVISIONS

REV	DATE	NAME	DESCRIPTION
A	1/22/01	JRR	Revised description of CPU module, made correction to K8, K9 relays, made corrections to 5 volt measuring references
B	03/02/01	GJO	Change wiring in Theory 1. And formatted sections.
C	05/01/01	CSH	Chg channels in Section 6 Theory, correction to wiring diagram Section 4 drawing 4
D	07/17/01	SB	Refer to ECN 01-215
E	08/23/01	GJO	Refer to ECN 01-246

TABLE OF CONTENTS

1 MECHANICAL DESCRIPTION OF THE SYSTEM COMPONENTS

Pressure Transducer: The pressure transducer transforms hydraulic pressure into an electric analog voltage signal. Two pressure transducers are connected, one to the rod side and one to the piston side of the lift cylinder. The pressure transducer is connected to the central unit with a four-conductor, double-shielded cable.

The power supply voltage is ± 5V.
The output signal is 0.00V under 0 pressure to -1.00V at max. pressure (4410psi)

The Length-Angle Transducer: The length-angle sensor (LWG) is a combination of two transducers in one box, fitted at the base section of the boom. It measures the length and angle of the boom.

A reeling drum drives a potentiometer, which is the length transducer. Part of the length transducer is the length cable on the drum, which is a two-conductor cable (screen and live). It is connected to the anti-two-block switch at the boom head and to a slip ring body in the reel. The angle transducer is fitted into a small box filled with oil. A pendulum drives the axle of the angle potentiometer.

The power supply voltage for both is -5.00V
The output signal for the length transducer is: -0.500V up to -4.500V
The output signal for the angle transducer is: -1.875V up to -3.125V

Anti-Two-Block Switch: The anti-two-block switch monitors the load block and its relationship with the head of the boom. In working condition, the switch is closed. When the hook block strikes the weight, the circuit opens, disengaging a relay output to the lockout solenoid valves, where applicable. To check the cable for damage, (short circuit to ground) there is a 4.7k resistor between ground and the contact of the switch. The weight at the anti-two-block switch keeps the switch closed until the hook block strikes it.

Console: The console displays the geometrical information such as length and angle of main boom, working radius and head height of the boom. It also displays the actual load and the maximum load permitted by load chart. Furthermore, it has an alarm horn and a warning light for overload, and a pre-warning light. The analog instrument shows a percentage of the total permissible moment. The console has a switch for the operating modes (duty-selection switch for crane configurations) and a switch for the Reeving of the hook block. It also has a warning light for anti-two-block conditions and an override switch for overload or anti-two block condition.

Duty Selection Switches (Digital Inputs): The system has to be programmed for the lifting area configuration. The crane is going to be worked in (e.g. main boom) on outriggers over front, or rear, or over the side for 360 degrees. For obtaining this information from the crane, micro switches are installed in the electrical swivel that tells the system the exact location of the boom. Micro switches are also located on the counterweight which tells the system if the counterweight is installed or not, where applicable.

2 MECHANICAL AND ELECTRICAL DESCRIPTION OF THE CENTRAL UNIT

All the data of the crane is stored inside the central unit in EPROM's. The central unit receives all actual information of the crane. This is computed against the reference data and the crane status is continuously monitored.

Description of the Housing: The central unit DS150C is a rugged, waterproof sheet steel housing. It is mounted on the left side of the turn table weldment or on the counterweight. The cables are led into the central unit via strain reliefs and connected with fast-ons. An override switch is mounted on the housing, which overrides the LMI function. The system is protected by a 2-AMP fuse, which is mounted on the lower right side. The output signal is protected by a 10-AMP fuse, mounted on the lower mid.

Description of the Boards: Inside the central unit (CU) there is a connection, CPU module and EPROM module board. The connection board connects to the CU. The CPU module is plugged into the connection board, and fastened with four (4) screws. The EPROM module slides into a receptacle on the main board. The CPU module is the heart of the system, and it contains the processor and the system EPROM. The EPROM module holds the data (crane and calibration information) and TLK (load chart information) EPROM's. The wires from the various components are connected with fast-ons to the connection board. The connection board holds the electronics necessary to receive, evaluate, and direct the continuous flow of data from the sensors to the processor.
Connection board components:
Power supply: Provides all the necessary voltages for the transducers and the electronics on the main board.
Analog input part: Receives and prepares all the signals from the transducers for further processing.
Analog/digital converter part: Converts all the processed analog signals into digital ones.
Relays, an overload and anti-two-block relay: Controls the Bosch relay for lever lockout.

Incoming Signals: Signals from the transducers are connected to the connection board. The signals vary depending on the sensor:
Angle transducer signal is between -1.875V and -3.125V.
Length transducer signal is between -0.500V and -4.500V.
Pressure transducer signals are between 0.00V and -1.00V. (measured between the negative and positive outputs)
Anti-two-block switch resistance is 4.7Kohms.
Digital inputs for the duty selection switches are on or off.

Outgoing Signal: The outgoing signal of the connection board is the signal for lever lockout of connection #48. In normal working conditions there are 12 volts at this connection. If there is an overload or anti-two-block condition the signal becomes 0 volts. Furthermore, all voltages for the transducers are going out through the connection board.

2.1 Basic Adjustment Of The Hardware

Length: Ensure that the length cable tension is correct with fully retracted boom and no tension on the cable reel. Turn the cable drum 5 to 8 turns counter clockwise. Then remove cover from cable reel and adjust the potentiometer counter clockwise to end stop. See Procedure 3.

Angle: Set the boom between 0 and 5 degrees and set the inclinometer to the boom angle. Adjust the angle sensor to the same angle as the boom. Check the angle at 20 degrees, 45 degrees, and 70 degrees. Angle display should be less than ± .5 degrees of the value of the inclinometer. See Procedure 3.

Pressure Channel: Rest the boom and disconnect hydraulic hoses from the pressure transducers. Measure and record the zero-points of both pressure transducers on the connection board. Adjust P1 and P2 on the main board to 500mV at test points MP11 and MP12. Connect hydraulic hoses back to the pressure transducers. See Procedure 2.

Duty Selection Switches Digital Inputs): Check the duty selection switches for correct operation. Check the voltage on digital input connections.

Check the function of the hoist limit switch (anti-two-block)
Check function of lever lockout.

Measure and record the power supply voltages. See Addendum A.

3 DEFINITIONS

BOOM LENGTH: The straight line through the centerline of boom pivot pin to the centerline of the boom point load hoist sheave pin, measured along the longitudinal axis of the boom. (Indicator ± 2%)

BOOM ANGLE: The angle between the longitudinal centerline of the boom base section and the horizontal plane. (Indicator 65° to 90° boom angle + 0°/2°; less than 65° boom angle + 0°/-3°)

RADIUS OF LOAD The horizontal distance from a vertical projection of the crane's axis of rotation to the supporting surface, before loading, to the center of the vertical hoist line or tackle with rated load applied. (Indicator 100% to 110%)

RATED LOAD The load value shown on the applicable load-rating chart of the crane for the particular crane configuration, boom length, boom angle, or functions or these variables. For radii outside those shown on the load-rating chart, the rated load is to be considered as zero.

ACTUAL LOAD The weight of the load being lifted and all additional equipment such as blocks, slings, sensors, etc. Also referred to as working load. (Indicator 100% to 110%)

CRANE CONFIGURATION The physical arrangement of the crane which is prepared for a particular operation in conformance with the manufacturer's operating instructions and load rating chart.

TWO-BLOCKING Contact of the lower load block or hook with the upper load block, boom point, or boom point machinery.

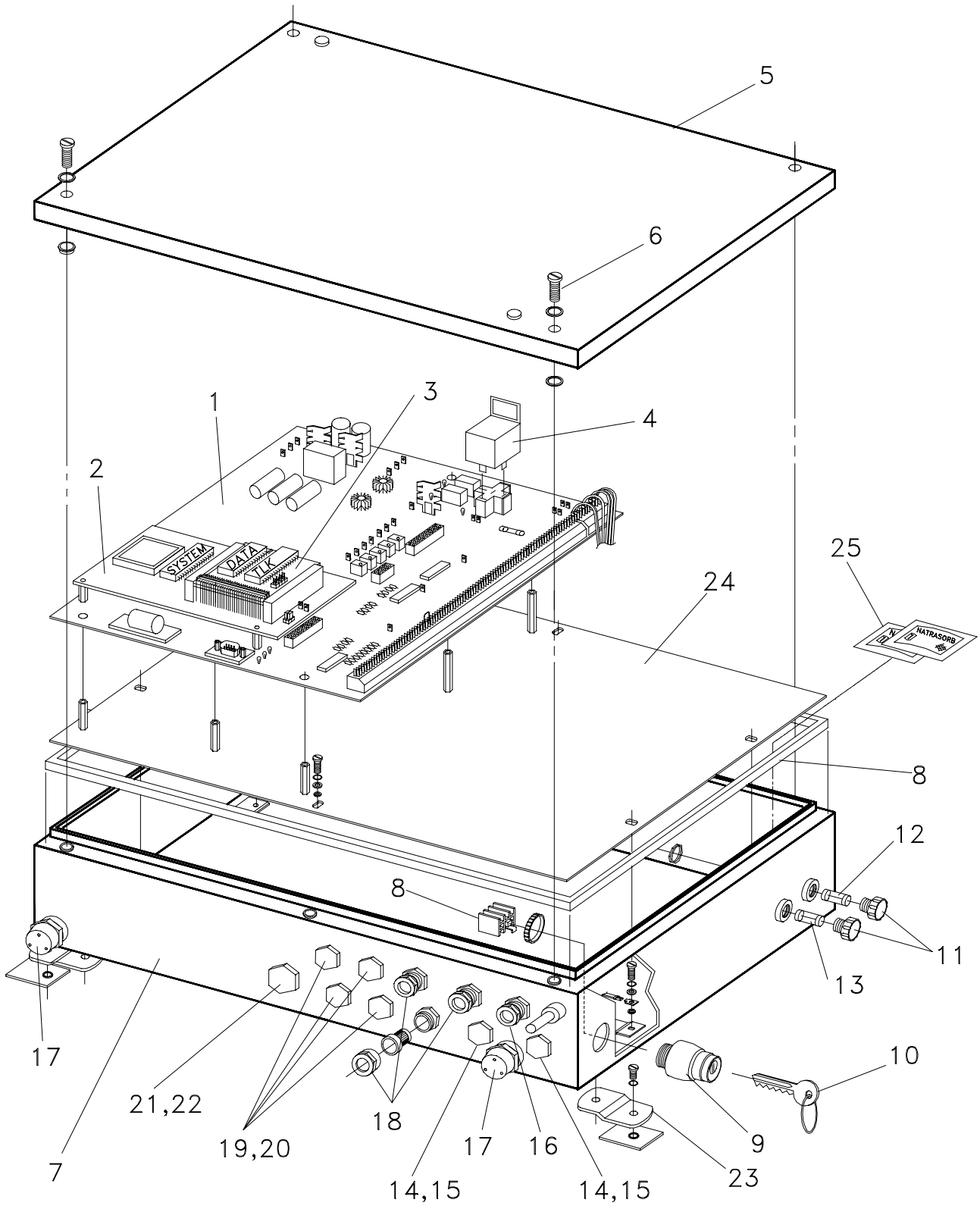
ANALOG: Electrical signals that vary in proportion to the quantities they represent. (Boom length, angle, and pressure transducer)

DIGITAL: Electrical signals of an on-and-off state (two different voltage levels) to represent some quantity of operation. (A2B, area definition switch)

BLANK PAGE

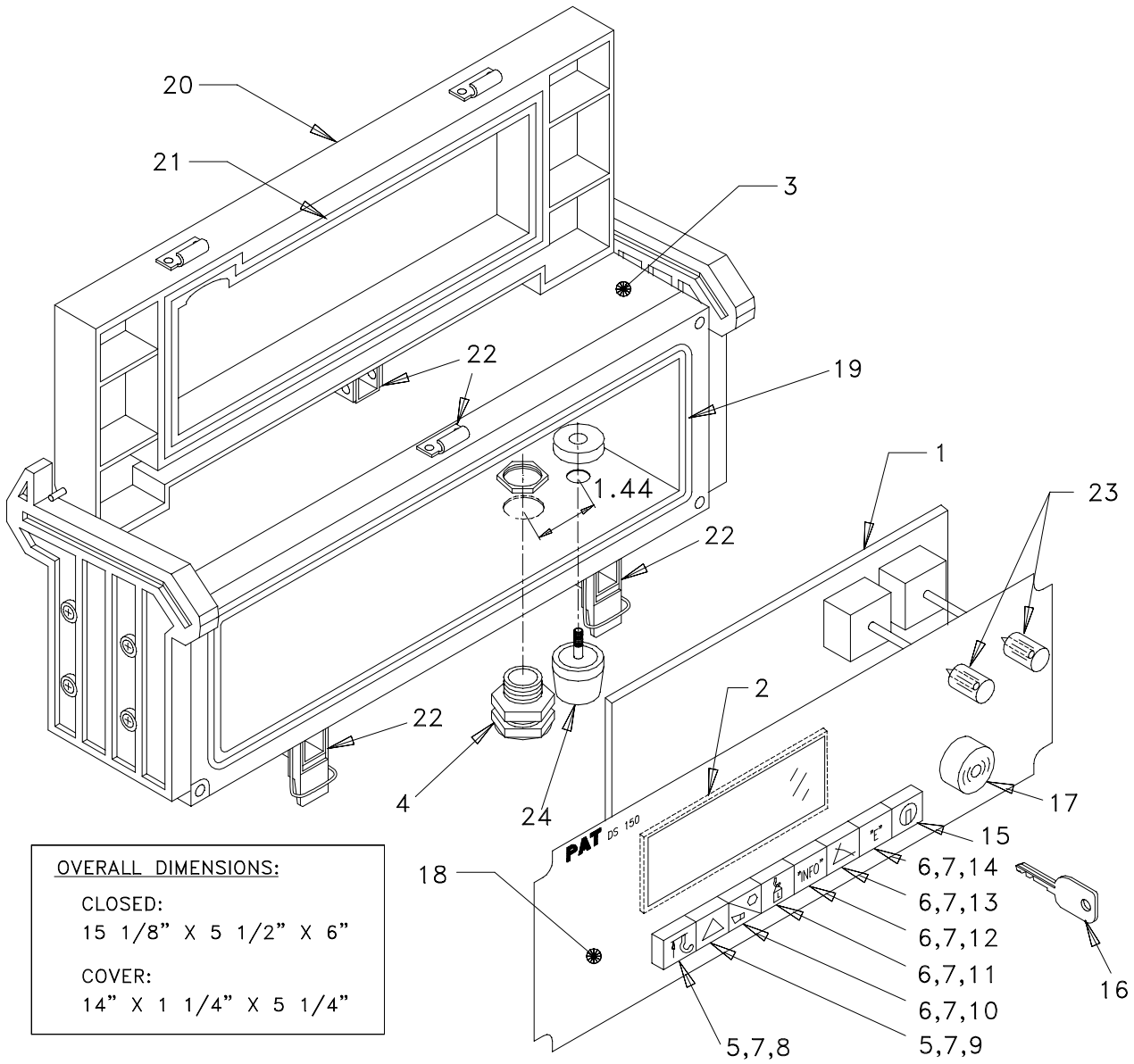
4 DRAWINGS

4.1 DRAWING 1. Central Unit 024-150-061-005 Spare Parts List



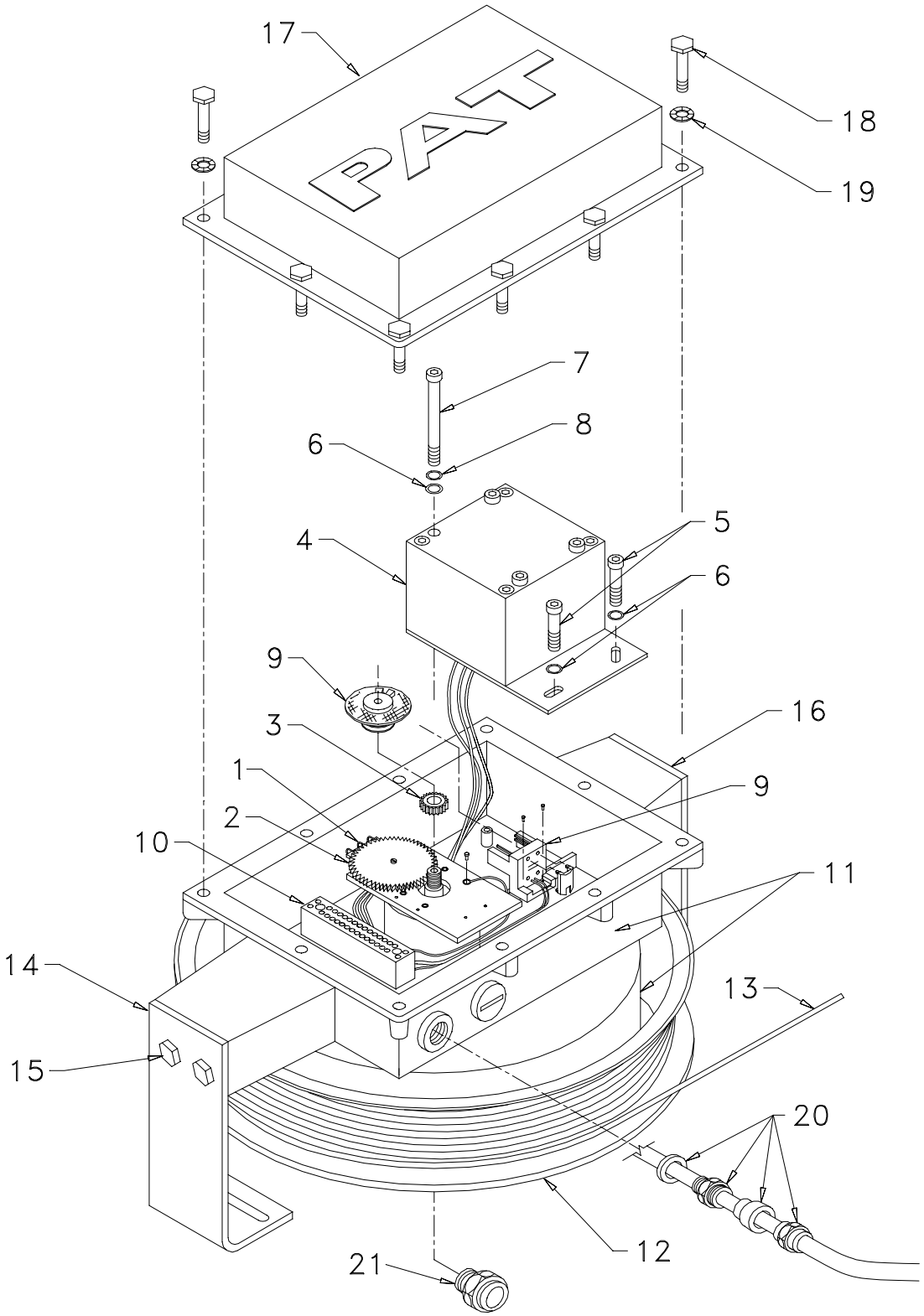
NO.	PART NO.	QTY	DESCRIPTION
01	024-150-300-050	1	Board, Connection, DS150, CU
02	024-351-300-004	1	Board, Processor
03	024-351-300-011	1	Board, EPROM Module
04	000-304-140-122	1	Relay, Shut-Off 12 V
05	024-150-110-002	1	Cover, Central Unit, DS150
06	024-350-100-135	1	Central Unit Accy, Screw Set, DS150
07	024-150-100-001	1	Housing, Central Unit DS150
08	024-350-110-066	1	Central Unit Accy, Gasket, For C.U. Cover
09	024-350-100-661	1	Key Switch, Central Unit
10	031-300-101-131	1	Key, Central Unit Key Switch
11	000-314-022-006	1	Fuse Holder, Central Unit
12	000-313-062-001	1	Fuse, 2 Amp 1/4 X 1 1/4, 250v Fast-Acting
13	000-313-062-002	1	Fuse, 10 Amp 1/4 X 1 1/4, 250v Fast-Acting
14	000-214-340-013	2	Strain Relief Accy, PG13.5 Hole Plug
15	000-214-210-013	2	Nut, PG13.5
16	050-350-110-116	1	Strain Relief Assy, PG 13.5 Red Long W/Nut + Washer
17	024-350-100-312	2	Central Unit Accy, Check Moisture Drainage
18	024-350-110-067	3	Strain Relief Assy, PG 11, Grn Long W/Nut + Washer
19	000-214-340-011	4	Strain Relief Accy, PG11 Hole Plug
20	000-214-210-011	4	Nut, PG11
21	000-214-340-016	1	Strain Relief Accy, PG16 Hole Plug
22	000-214-210-016	1	Nut, PG16
23	024-350-100-139	1	Central Unit Accy, Wall Mount Set, DS150/350
24	024-150-100-002	1	Central Unit Accy, Baseplate, DS150
25	031-300-100-078	1	Chemical, Moisture Pack

4.2 DRAWING 2. Console 050-150-060-006 Spare Parts List



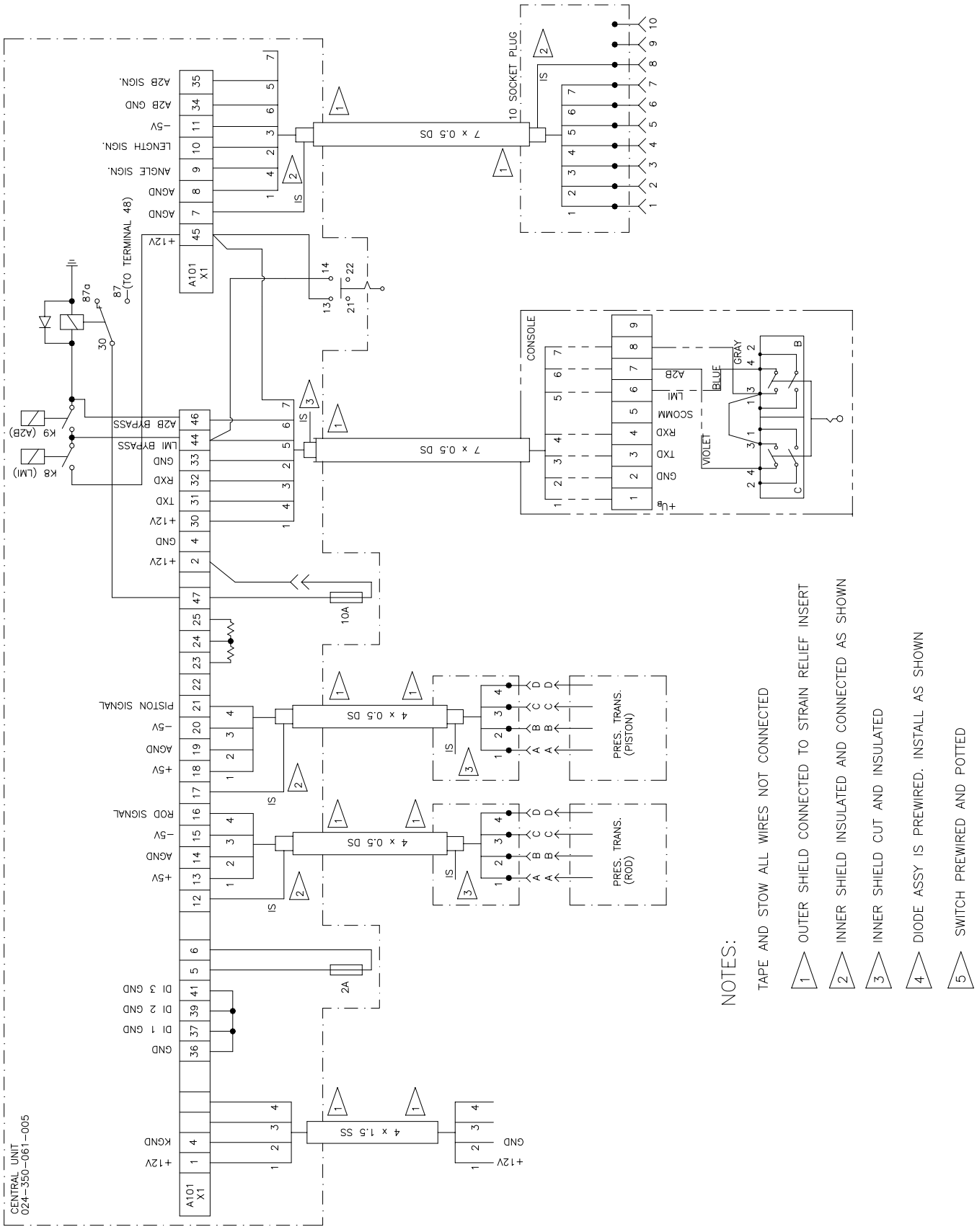
NO.	PART NO.	QTY	DESCRIPTION
01	050-150-300-003	1	CONSOLE BOARD W/ROTARY SWITCH - DS150
02	050-350-110-292	1	LCD DISPLAY DS150
03	050-000-100-060	1	CONSOLE HOUSING W/LID
04	050-350-110-116	1	STRAIN RELIEF/LONG RED
05	000-305-045-141	2	LUMINOUS HOUSING
06	003-051-405-423	5	LUMINOUS PUSH BUTTON HOUSING
07	000-311-023-114	7	LIGHT BULB 12V
08	050-350-110-277	1	CAP A2B (RED)
09	050-350-110-278	1	CAP PREWARNING (YELLOW)
10	050-350-110-279	1	CAP STOP/ALARM OFF (RED)
11	050-350-110-280	1	CAP LOAD (ORANGE)
12	050-350-110-281	1	CAP INFO (ORANGE)
13	050-350-110-282	1	CAP ANGLE (ORANGE)
14	050-350-110-283	1	CAP ENTER (GREEN)
15	003-051-903-364	1	KEY SWITCH
16	050-350-110-139	1	CONSOLE OVERRIDE KEY DS150/350
17	050-000-110-007	1	ALARM BUZZER
18	050-150-100-006	1	FRONT PANEL
19	000-209-022-095	850mm	GASKET FOR FRONT PANEL
20	050-000-100-092	1	CONSOLE LID DS150/0006
21	050-150-110-005	1	GASKET FOR LID
22	050-000-110-014	3	LATCH ASSEMBLY
23	050-000-700-301	2	KNOB FOR ROTARY SWITCH
23	024-350-100-312	1	LABYRINTH MOISTURE ELEMENT

4.3 DRAWING 3. Cable Reel 068-208-060-013 LWG208 Spare Parts List



NO.	PART NO.	QTY	DESCRIPTION
01	006-710-006-002	1	SENSOR, LENGTH TRANS. LGE 100 (KT200/LWG208)
02	068-000-110-038	1	SENSOR ACCY, GEAR WHEEL, KT200 CABLE REEL
03	067-000-050-065	1	SENSOR ACCY, GEAR WHEEL, T = 50 CENTER SHAFT
04	064-103-060-002	1	SENSOR, ANGLE WG103
05	002-050-206-012	2	SCREW, 6M X 12 SOCKET CAP
06	000-207-010-064	3	WASHER, FLAT 6MM
07	002-050-206-100	1	SCREW, 6M x 100M SOCKET CAP
08	000-208-040-083	1	WASHER, LOCK 6MM
09	068-000-100-064	1	SLIPRING, 2 CONDUCTOR
10	068-000-110-029	1	CONNECTION STRIP
11	068-000-100-152	1	CABLE REEL, KT200 HOUSING,BKT,CABLE DRUM & NYLON CABLE COVER
12	068-000-110-011	1	CABLE REEL ACCY, CABLE DRUM,KT 200/ LWG208
13	000-673-020-002	139'	CABLE, LENGTH SENSOR, 1 CORE W/SHEILD (per ft)
14	006-800-005-058	1	BRACKET, MTG. CABLE REEL ARM, ONE SLOT
15	000-205-031-230	4	SCREW, 12mm x 30MM HEX HEAD
16	006-800-005-057	1	BRACKET, MTG. CABLE REEL ARM, TWO SLOTS
17	005-682-000-001	1	COVER, CABLE REEL, KT200
18	068-000-110-031	10	CABLE REEL ACCY, SCREW CABLE REEL COVER
19	000-208-020-006	10	WASHER, LOCK 6mm
20	021-441-131-013	1	STRAIN RELIEF, PG 13.5, 8-12mm RED + WHITE
21	000-214-030-703	1	STRAIN RELIEF, PG7 BLACK

4.4 DRAWING 4. Central Unit Electrical Diagram

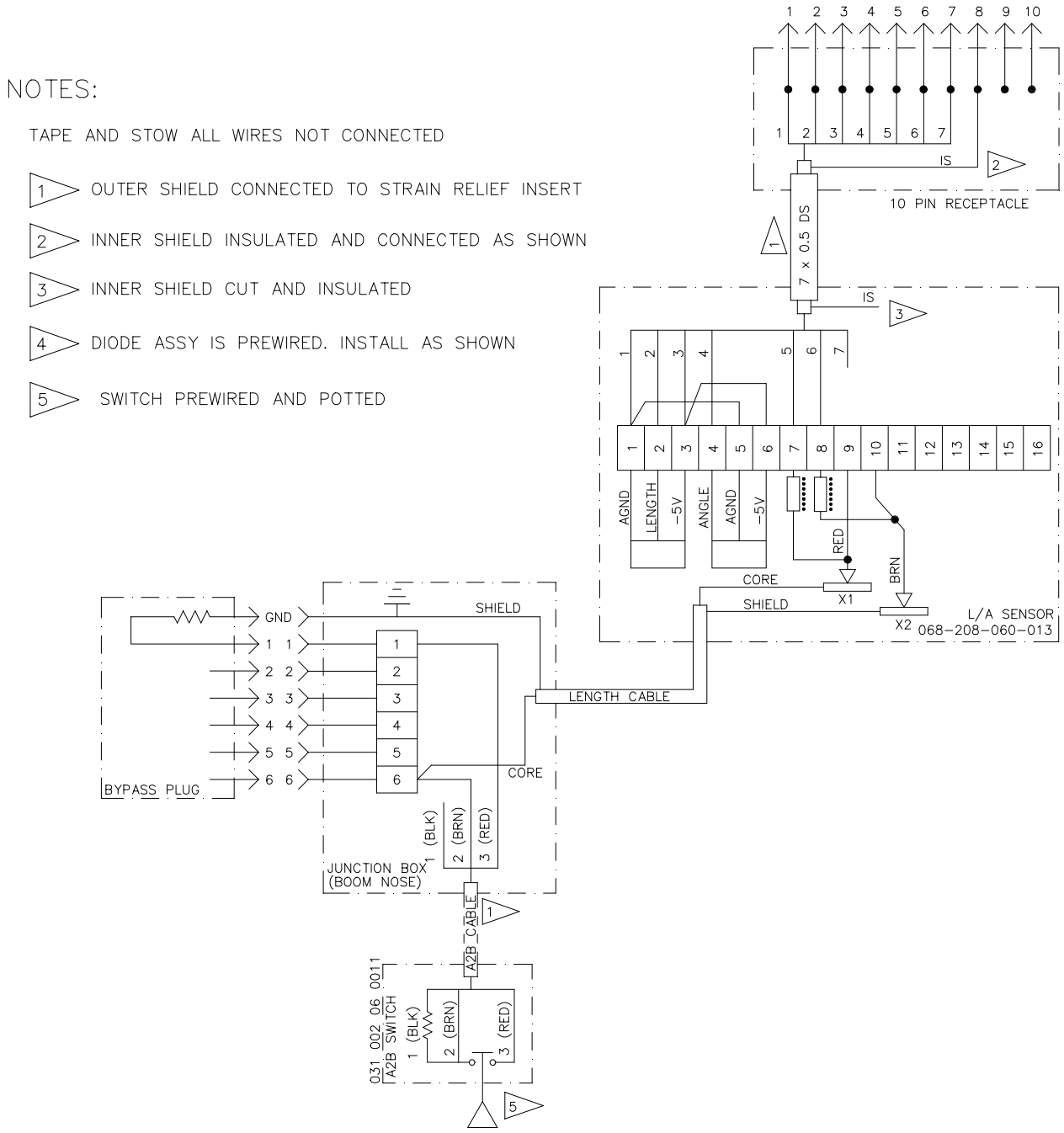


NOTES:

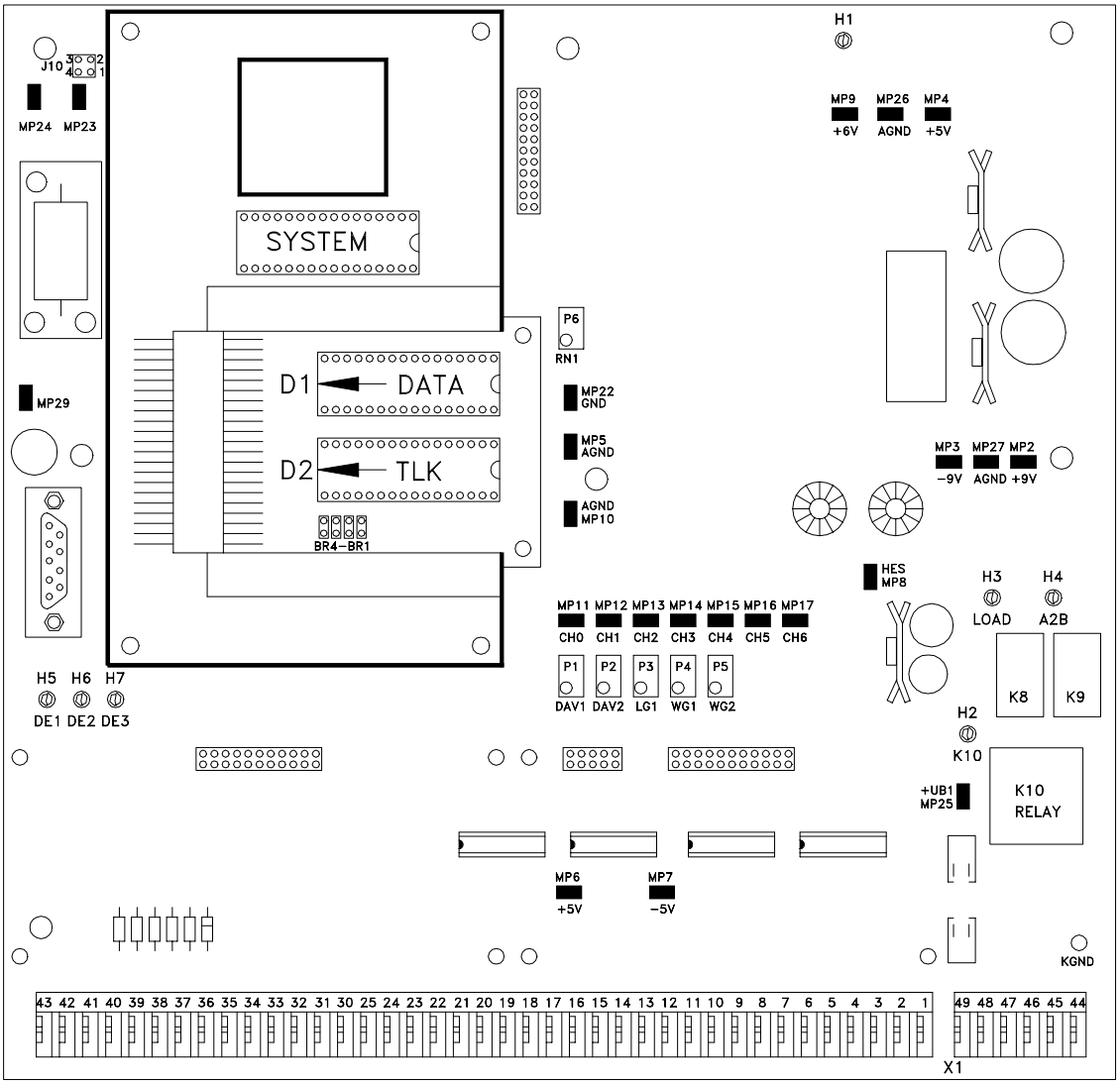
TAPE AND STOW ALL WIRES NOT CONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. INNER SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED. INSTALL AS SHOWN
5. SWITCH PREWIRED AND POTTED

4.5 DRAWING 5. Cable Reel Electrical Diagram



4.6 DRAWING 6. Central Unit Board Layout And Measuring Points



Measuring Points

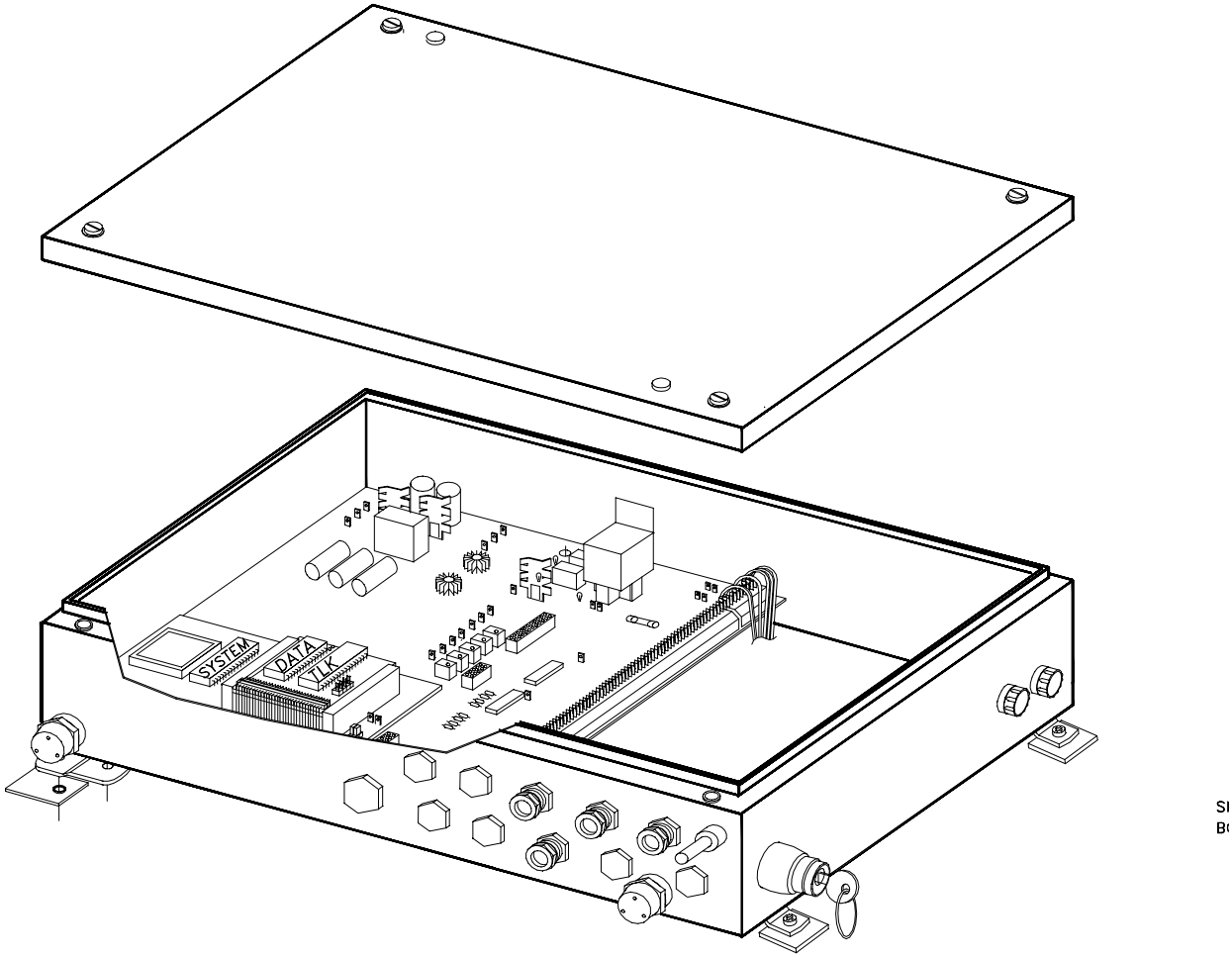
MP0: AGND
MP2: + 9V
MP3: -9V
MP4: + 5V
MP5: AGND
MP6: + 5V sensors supply
MP7: - 5V sensors supply
MP8: HES
MP9: + 6V
MP10: AGND
MP11: PISTON PRESSURE SIGNAL
MP12: ROD PRESSURE SIGNAL
MP13: LENGTH SIGNAL
MP14: ANGLE SIGNAL 1
MP15: ANGLE SIGNAL 2
MP22: GND
MP25: + UB
MP26: GND
MP27:AGND

5 PROCEDURE

5.1 PPRCEDURE 1. EPROM replacement in Central Unit

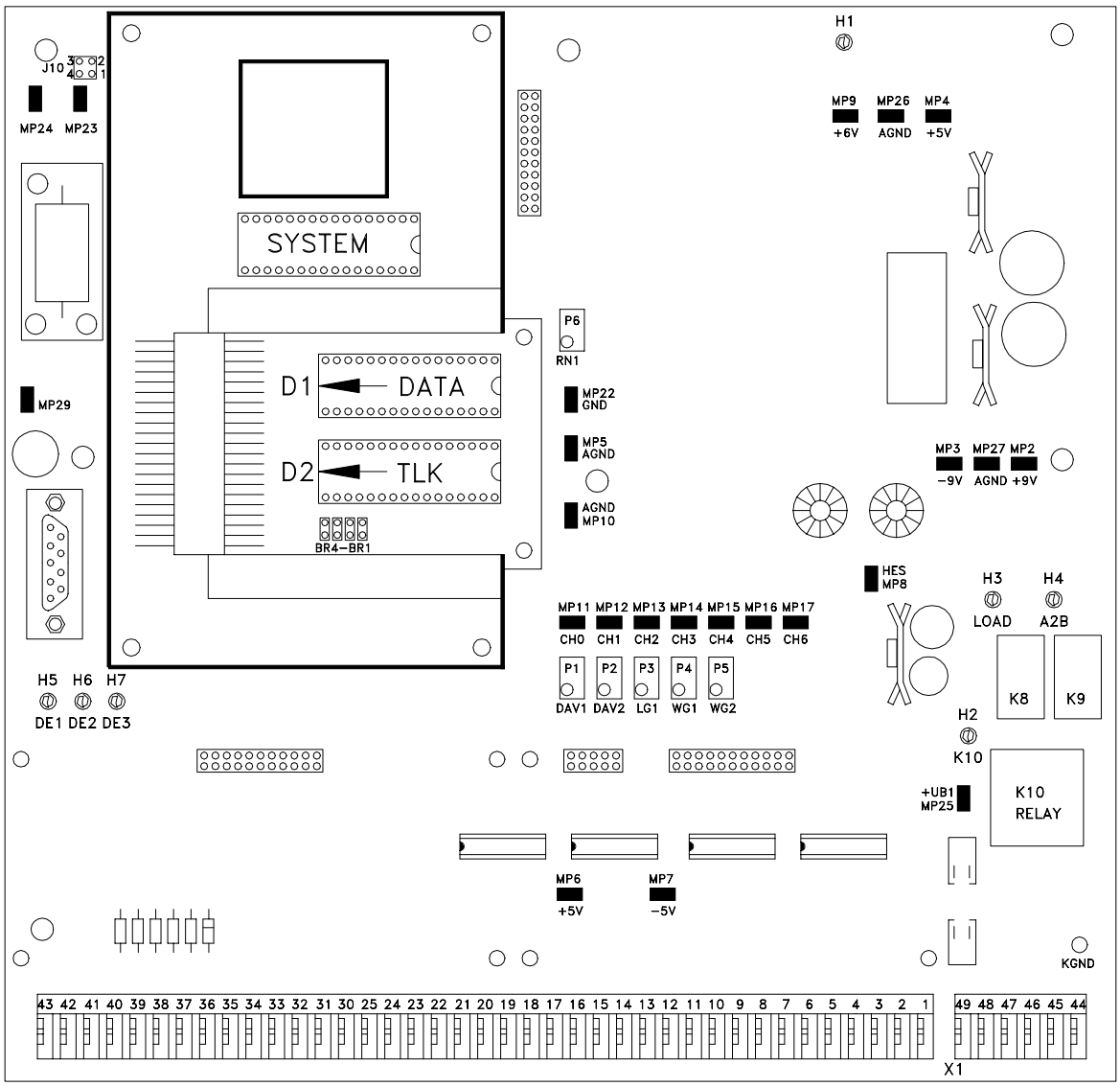
Follow this procedure when changing EPROM's in the DS150C central units.

1. Remove cover, from central unit.



CAUTION: Before handling the EPROM, discharge any static electricity from your body by touching a ground source. The EPROM could be damaged if this procedure is not followed.

2. Remove the old EPROM from the main board using an EPROM puller. Be careful not to bend the legs of the EPROM when removing it.



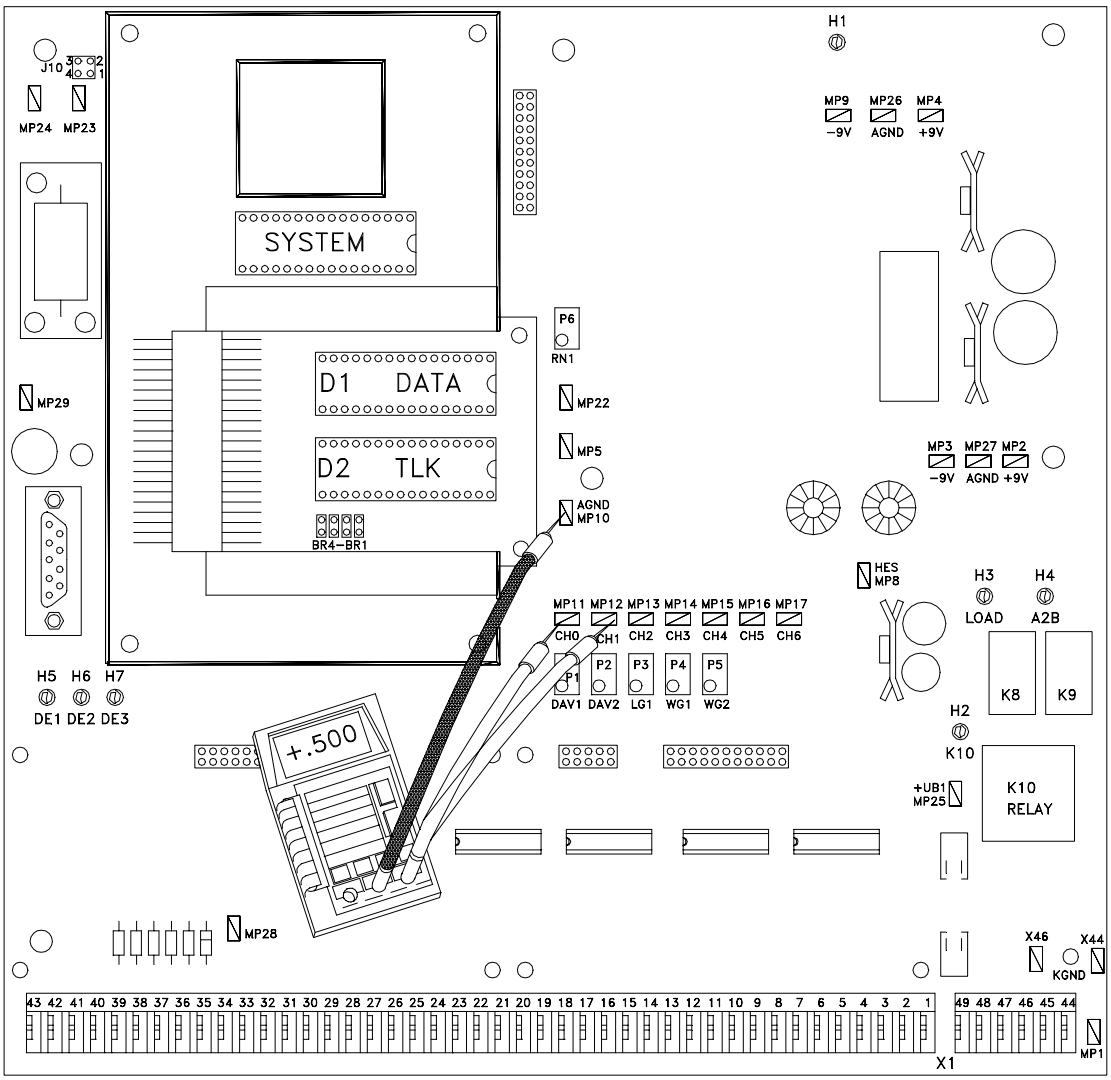
3. Installing the new EPROM:

- Ensure the notch is in the correct direction. The direction of the EPROM is determined by the notch on the end of the EPROM.
- The DATA and TLK EPROM's fill the bottom of the socket as shown by the arrows.
- Place EPROM in the correct EPROM socket as shown.

4. Reinstall cover using the following procedures to prevent any moisture from entering the central unit.

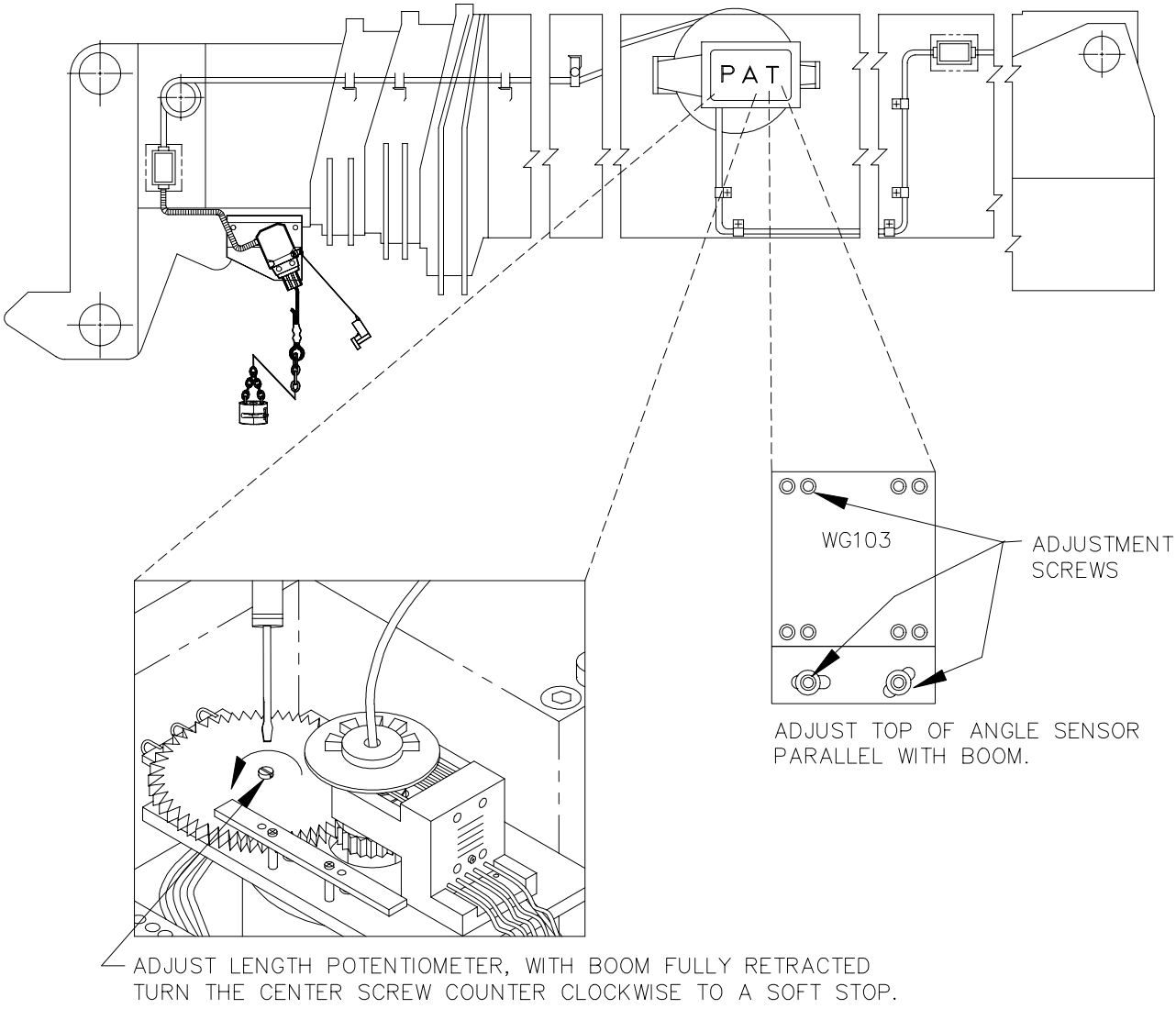
Reference material:
031-300-340-002 Central Unit Cover Installation and Tightening Procedure; Rev A.
031-300-340-003 Central Unit Gasket Recommendations; Rev -.

5.2 PROCEDURE 2. Piston & Rod 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 connection board
   A) black (-) lead to mp10
   B) red (+) lead to mp11
3. Adjust P1 to obtain a reading of 0.500 volts (500mv) on meter.
4. Disconnect hydraulic hose from the rod side pressure transducer.
5. Connect a digital voltmeter to connection board
   A) BLACK (-) lead to MP10
   B) RED (+) lead to MP12
6. Adjust P2 to obtain a reading of 0.500 volts (500mv) on meter.
7. Reconnect hydraulic hoses to pressure transducers, and then bleed the air from hydraulic lines.

5.3 PROCEDURE 3. Length & Angle Adjustments



5.4 PROCEDURE 4. Connection Board Replacement

Refer to Drawing 1, central unit parts list for board location.

1. Turn system power off.
2. Remove the central unit lid.

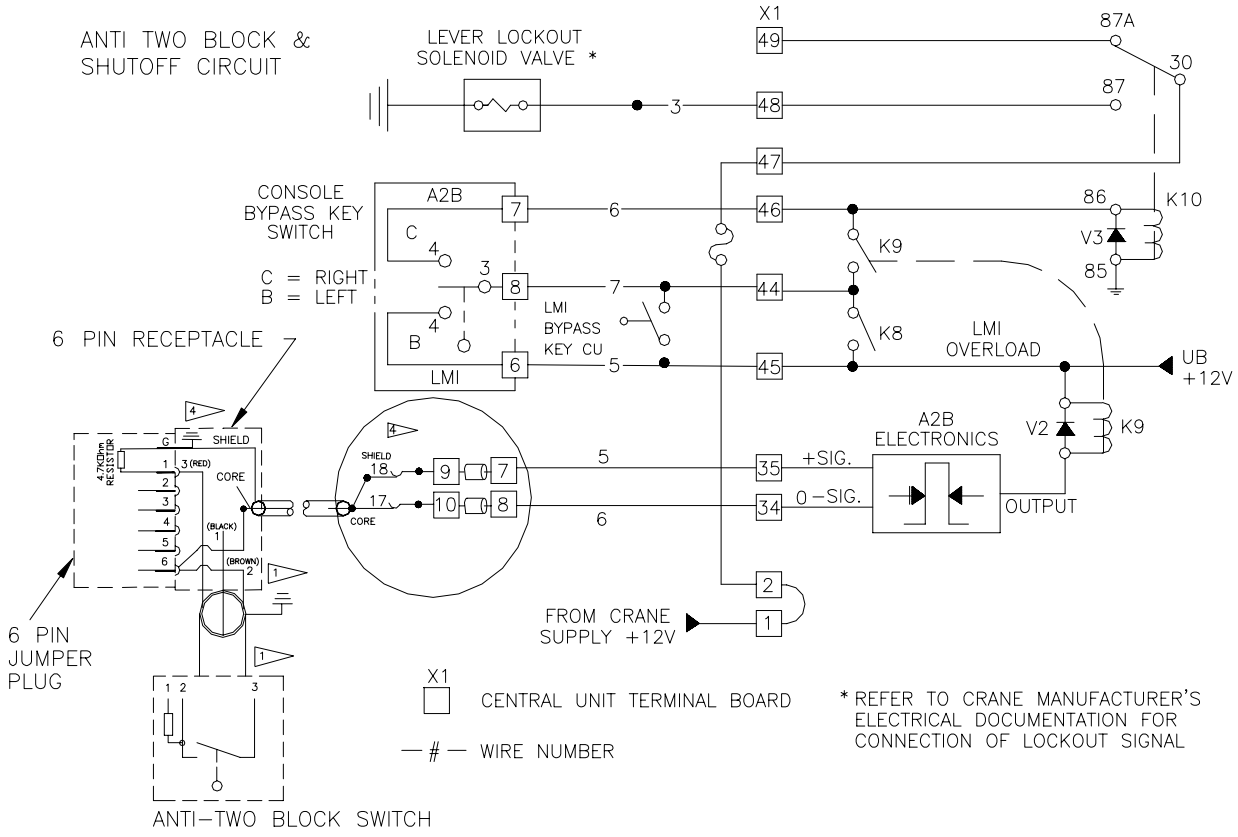
NOTE: Take care not to damage the boards with the screwdriver, when removing and inserting screws.

NOTE: Be careful when lifting the CPU module board from the connection board, because these boards have pins on the bottom side, which insert into the connection board.

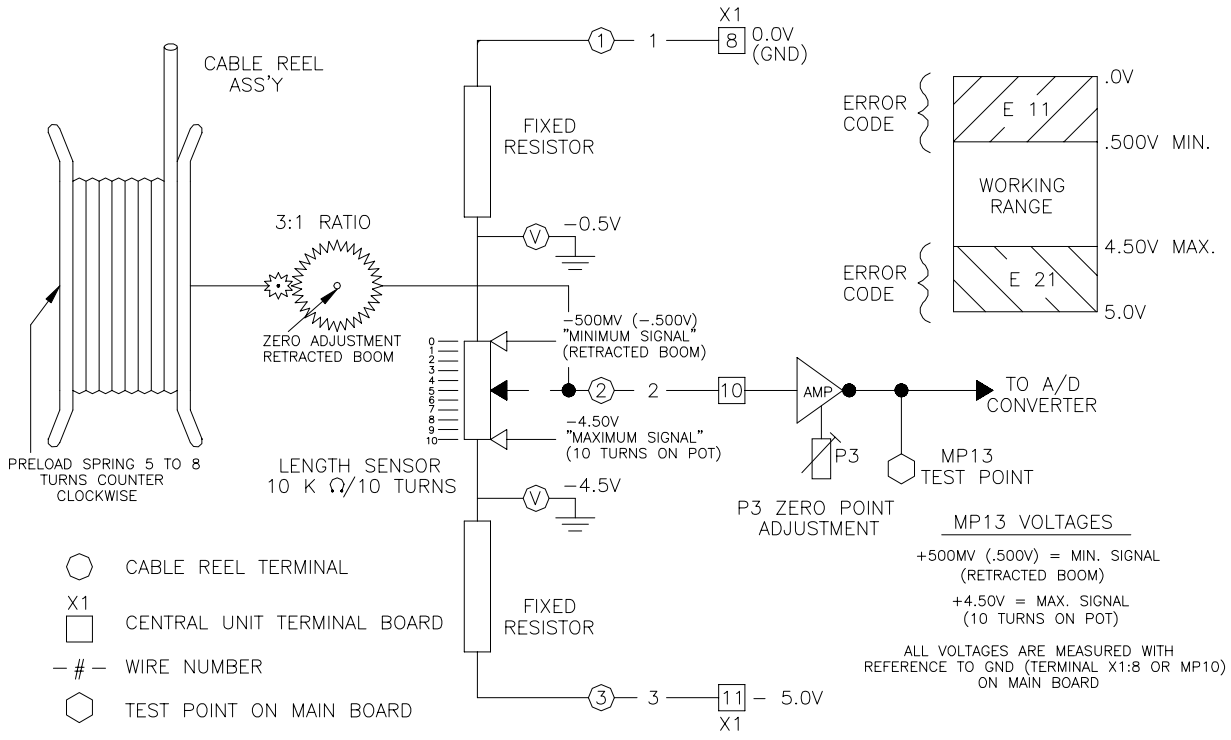
3. Remove CPU module board by taking out the 4 small Philips screws holding it in place.
4. Remove the relay from the connection board. Item 4 on Drawing 1.
5. Mark all connection wires before removing, to identify location for reconnecting. Disconnect all X1 terminal wires from the connection board.
6. Remove the 9 large Philips screws holding the connection board in place.
7. Note the orientation of the connection board in the central unit. Remove connection board and place it in the same packing material that the replacement in which the connection board came.
8. Carefully insert the new connection board in place. Refer to Drawing 1 for location.
9. Insert the 9 Philips mounting screws.
10. Insert CPU module board by lining up the pins into the sockets X11 and X12 and the 4 screw holes.
11. Insert the 4 small Philips screws and washers.
12. Insert the relay into the main board. Item 4 on Drawing 1.
13. Connect the X1 terminal wires to the main board. Refer to Drawing 4.
14. Inspect the gasket for nicks, cuts, or damages. Refer to 031-300-340-003 DS 350 Central Unit Gasket Recommendations, Revision - and 031-300-340-002 Central Unit Cover Installation and Tightening Procedure, Revision A

6 THEORY

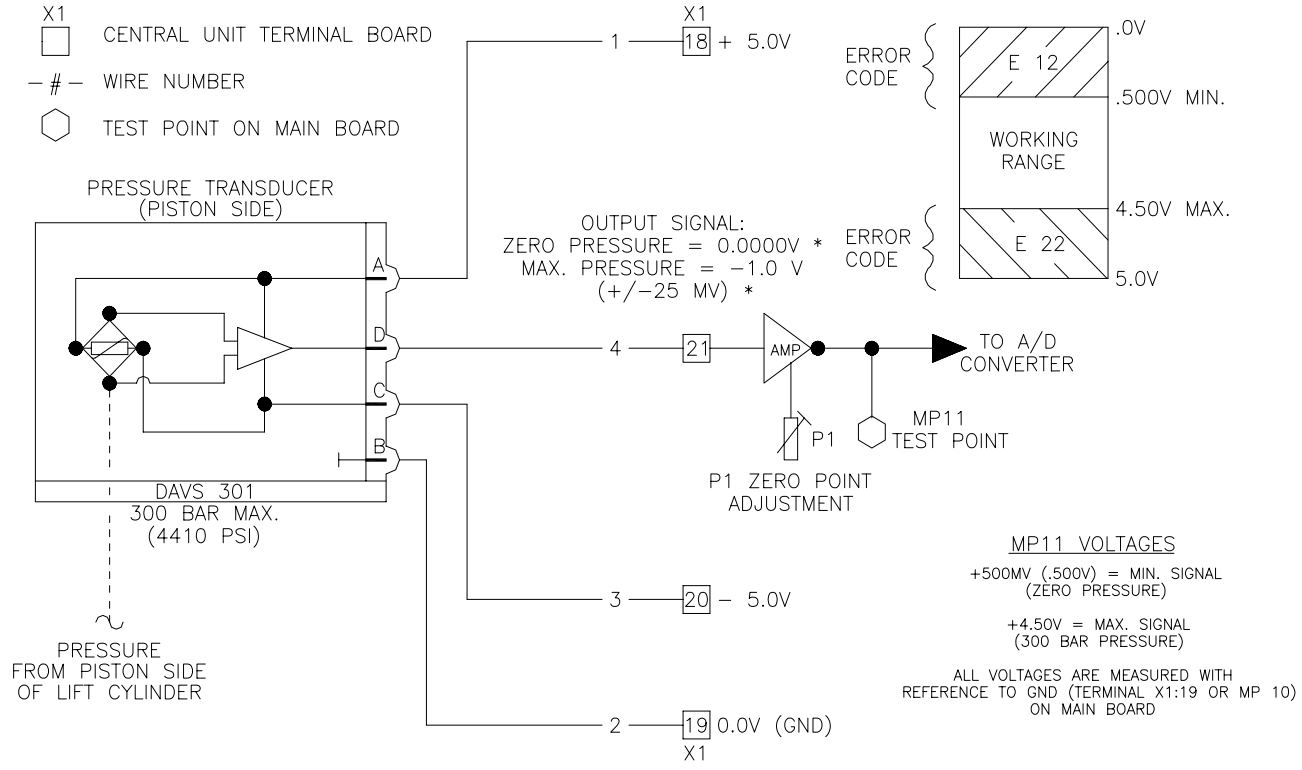
6.1 THEORY 1. Anti-Two Block & Shutoff Circuit



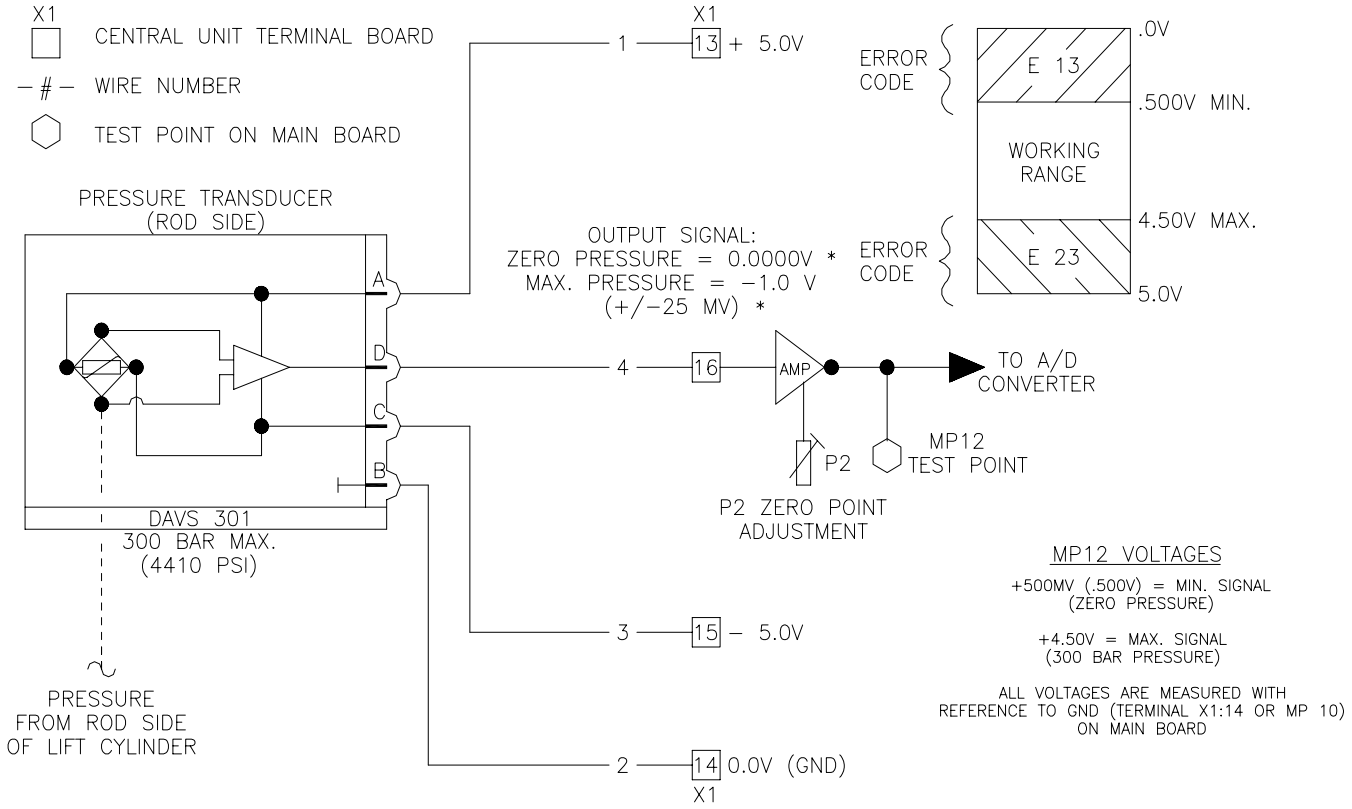
6.2 THEORY 2. Length Measuring Channel



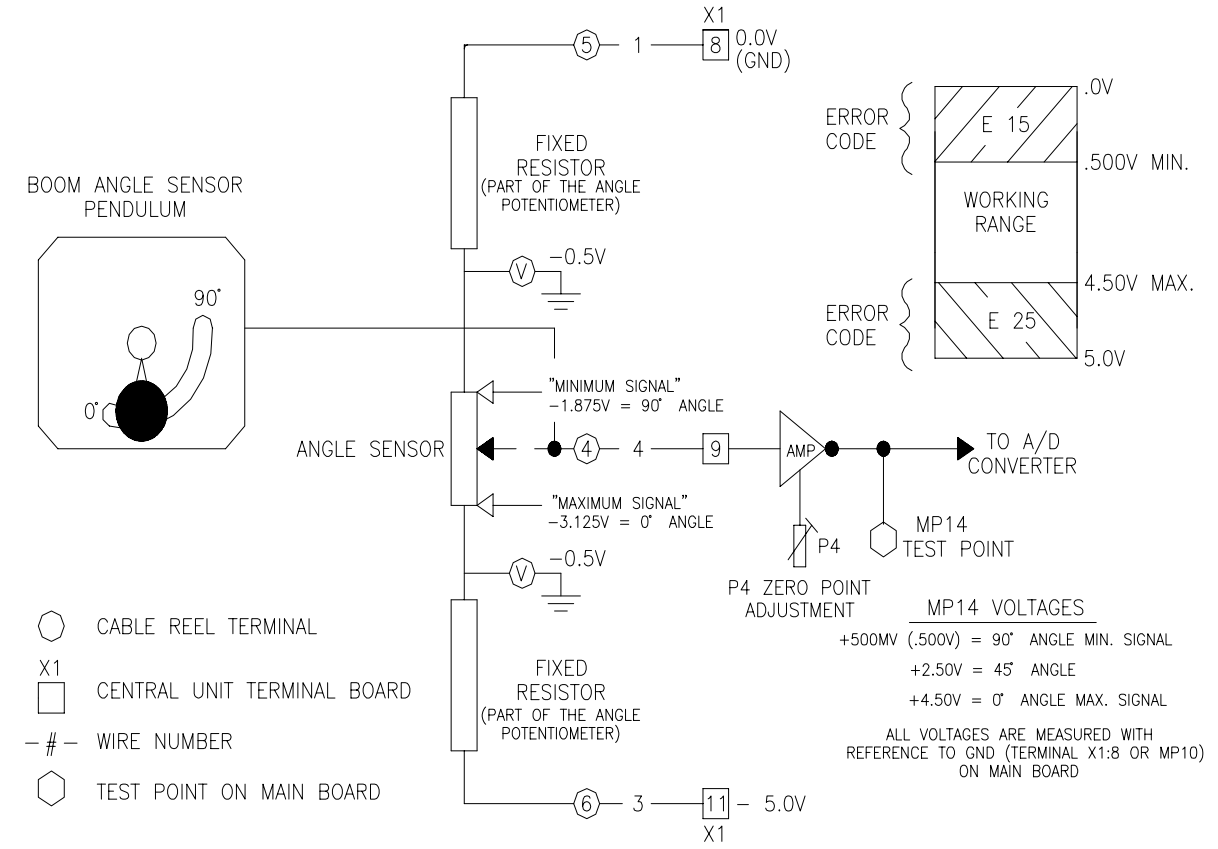
6.3 THEORY 3. Piston Side Pressure Measuring Channel



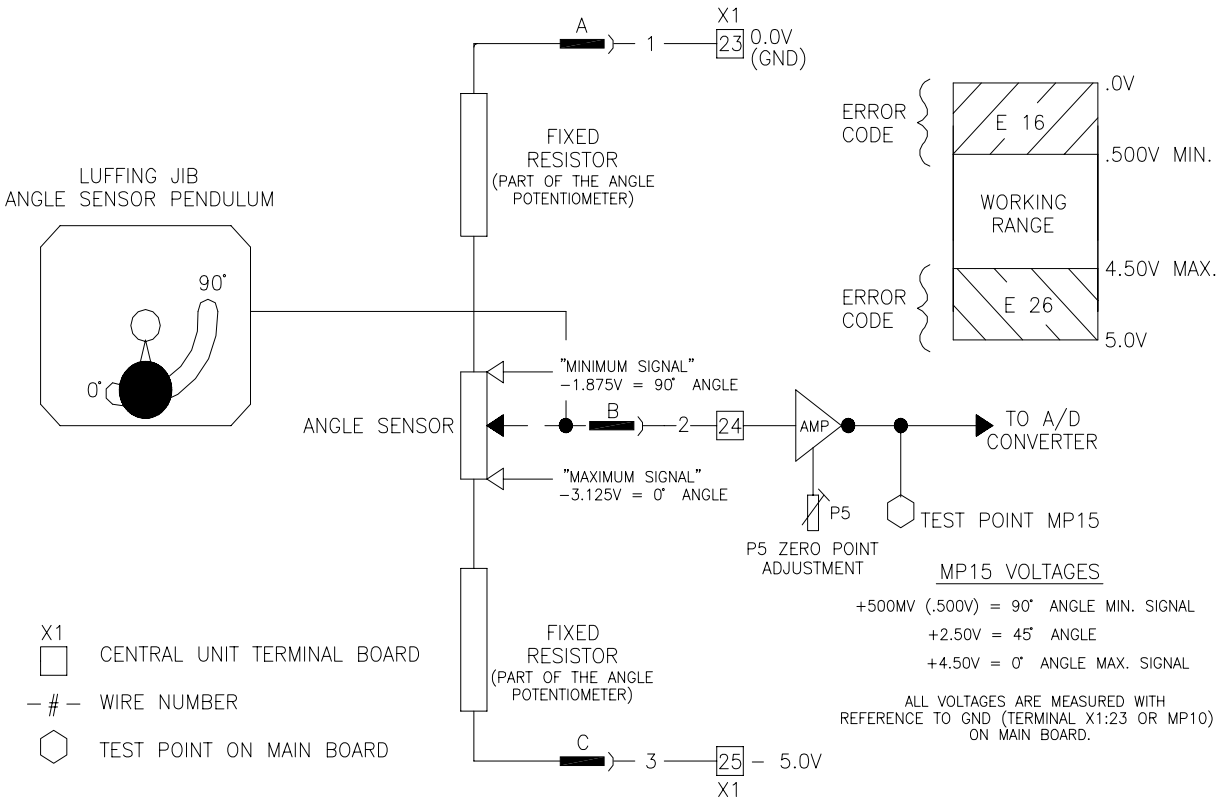
6.4 THEORY 4. Rod Side Pressure Measuring Channel



6.5 THEORY 5. Main Boom Angle Measuring Channel



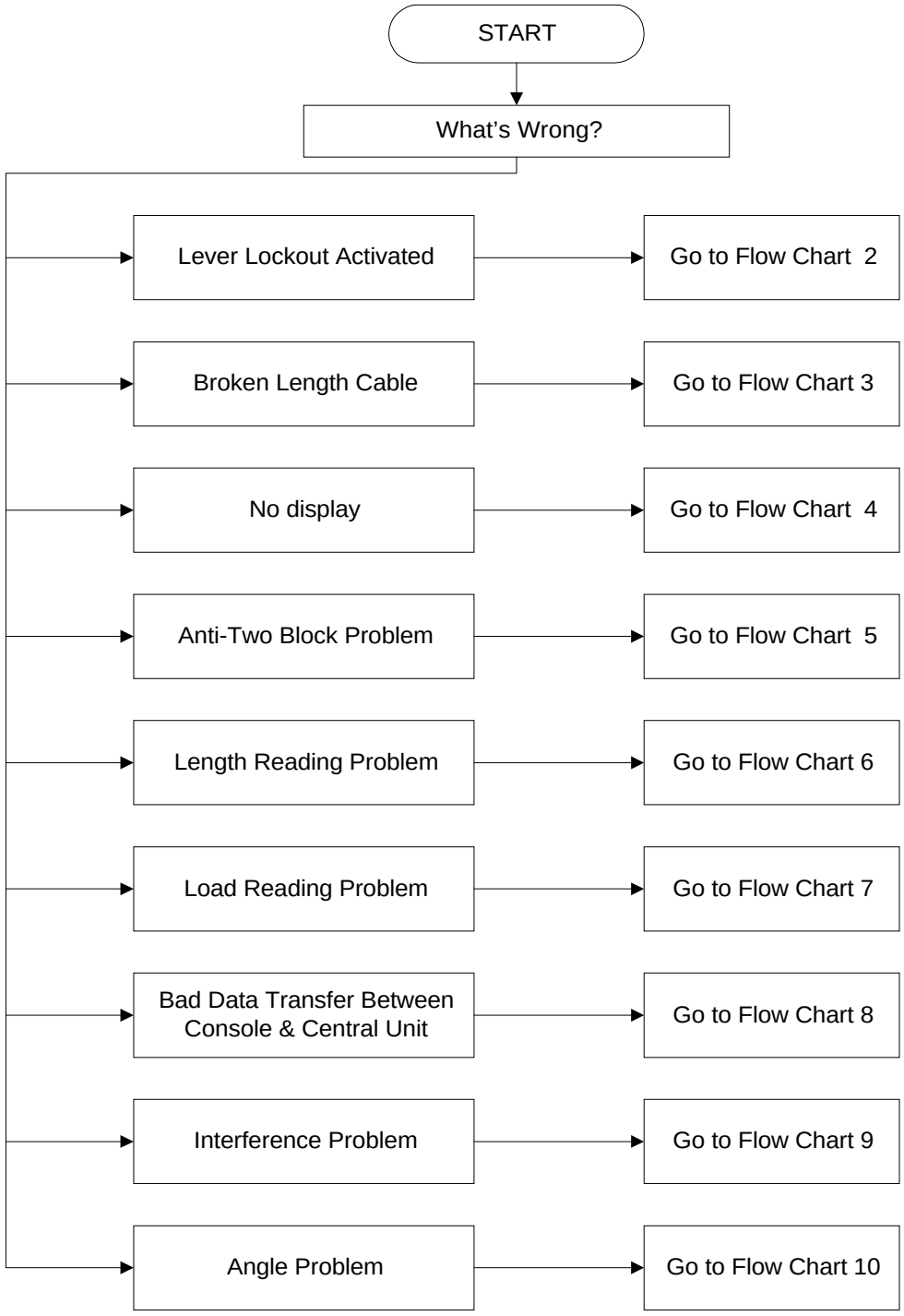
6.6 THEORY 6. Second Angle Measuring Channel



7 TROUBLESHOOTING FLOW CHARTS

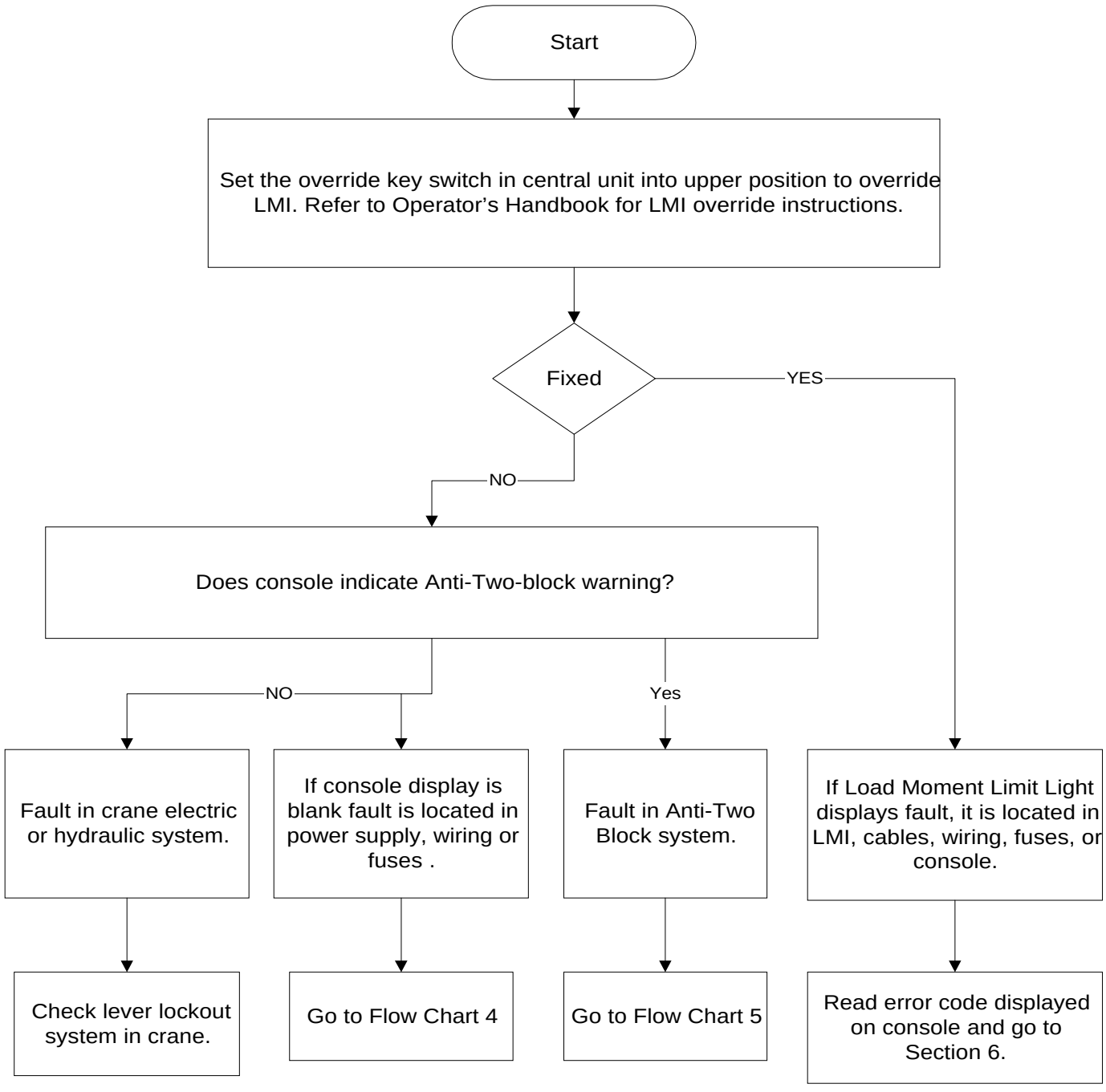
7.1 General Flowchart

This section explains how to handle a problem that may arise with the PAT Load Moment Indicator System-PAT DS150C. 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 detailed flowcharts shown in this section.



7.2 Lever Lockout Activated

PROBLEM: The lever lockout system of the crane is activated. Crane movements “hoist up”, “telescope out”, and “boom down” are stopped. Crane is not in overload or two-block condition.



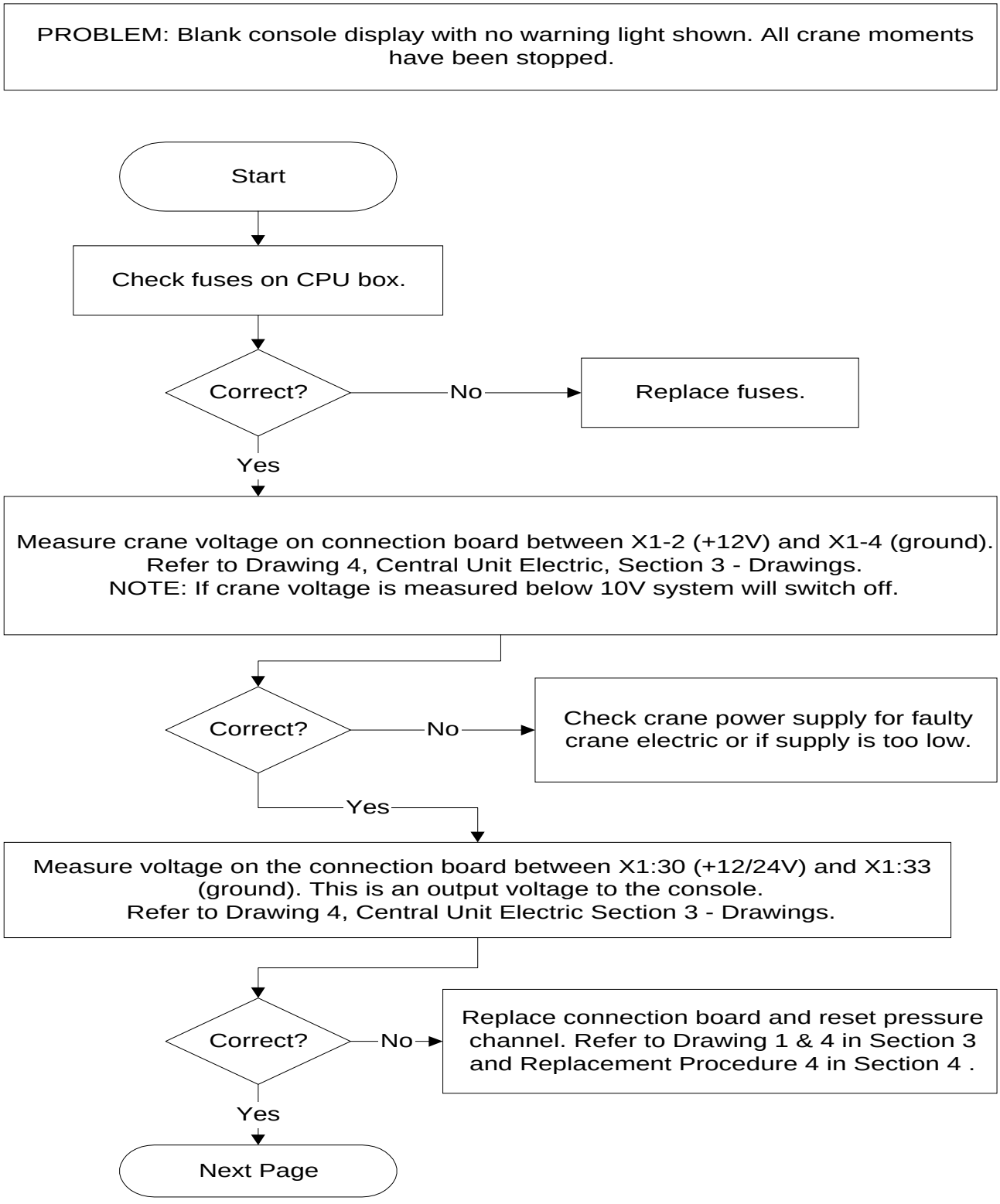
7.3 Broken Length Cable

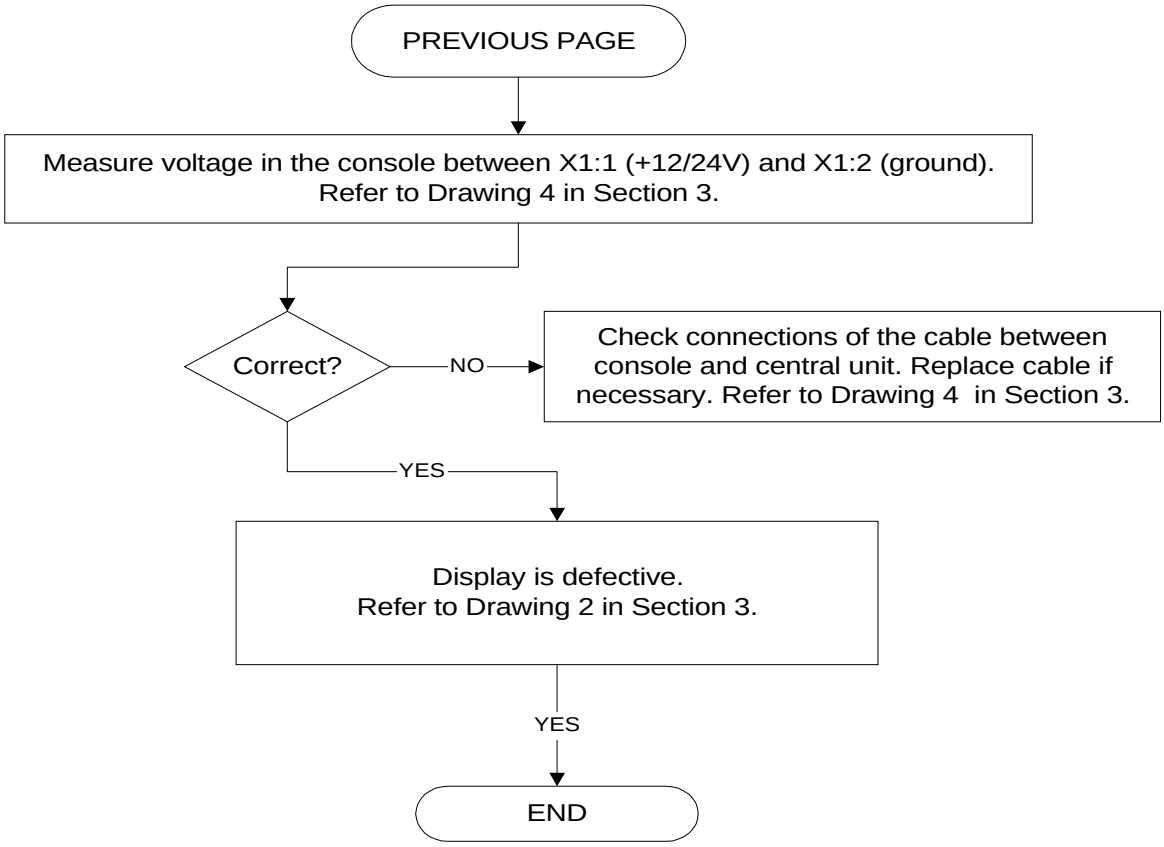
PROBLEM: Damaged or broken length cable.

Replace length cable using the following procedure:

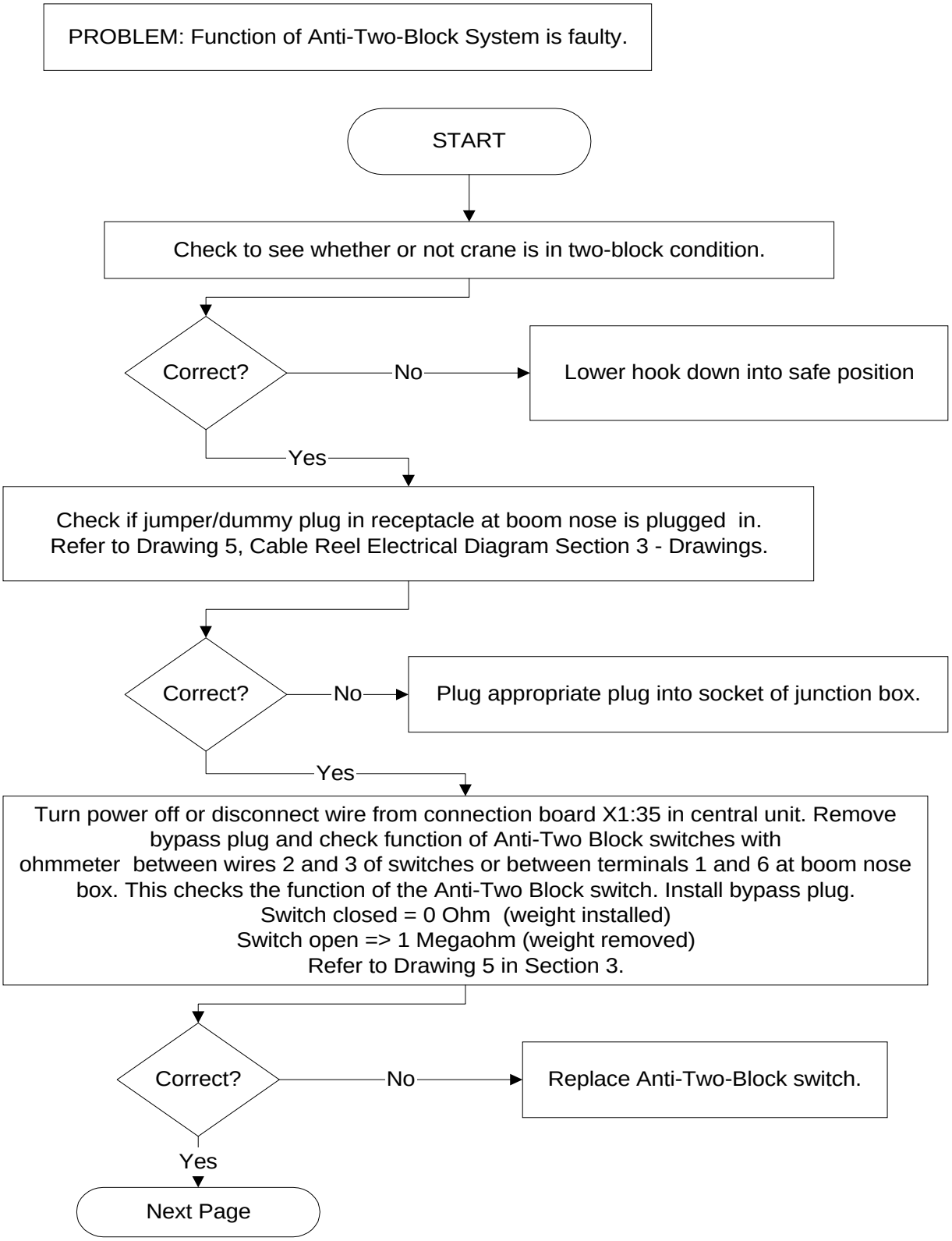
1 Cut old cable at cable drum
2 Disconnect damaged length cable from junction box at the boom nose.
3 Open cable reel cover and disconnect wiring from connection block. Pull 7 conductor cable out of strain relief.
4 Remove cable reel from mounting brackets.
5 Remove damaged length cable, which is mounted to the slip rings in the cable reel, from slip ring connection. Refer to Drawing 3 & 5 in Section 4 - Drawings
6 On the backside 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 slip ring. Refer to Drawing 3 & 5 in Section 4 - 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 anchor 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 5 in Section 4 - 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 Procedure 3 in Section 4 – Procedure.

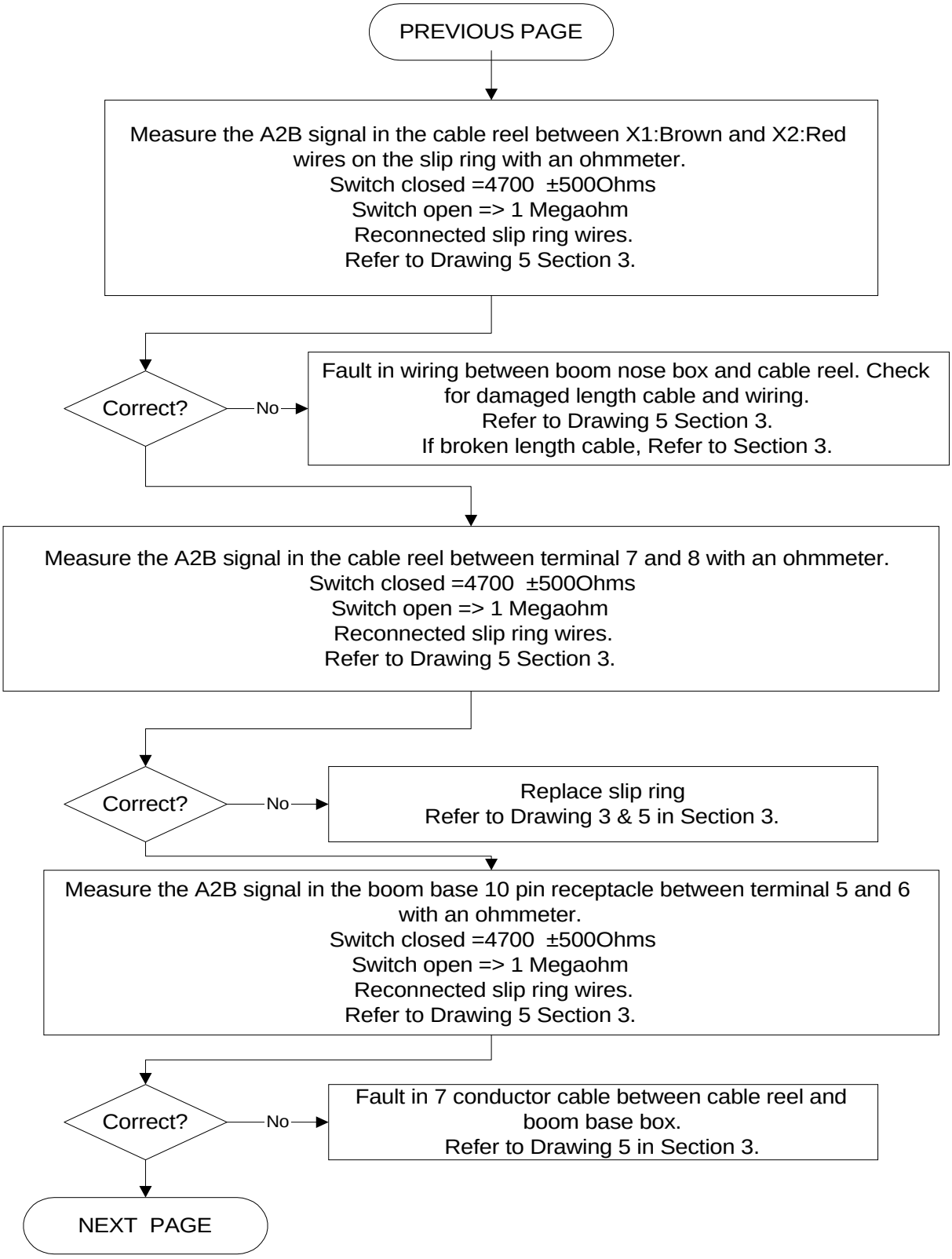
7.4 No Display

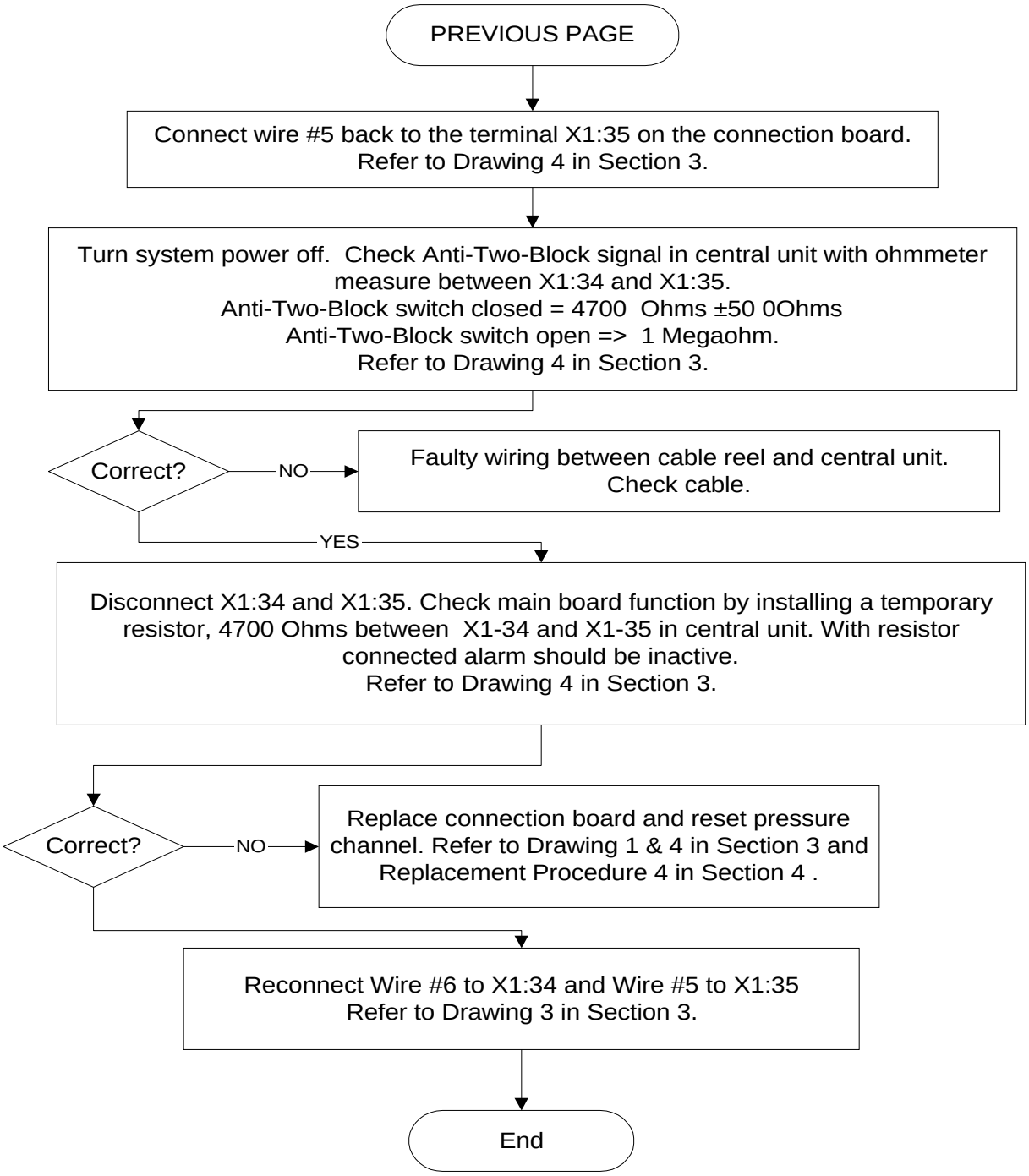



PREVIOUS PAGE
Measure voltage in the console between X1:1 (+12/24V) and X1:2 (ground).
Refer to Drawing 4 in Section 3.
Correct?
NO
Check connections of the cable between console and central unit. Replace cable if necessary. Refer to Drawing 4 in Section 3.
YES
Display is defective.
Refer to Drawing 2 in Section 3.
YES
END

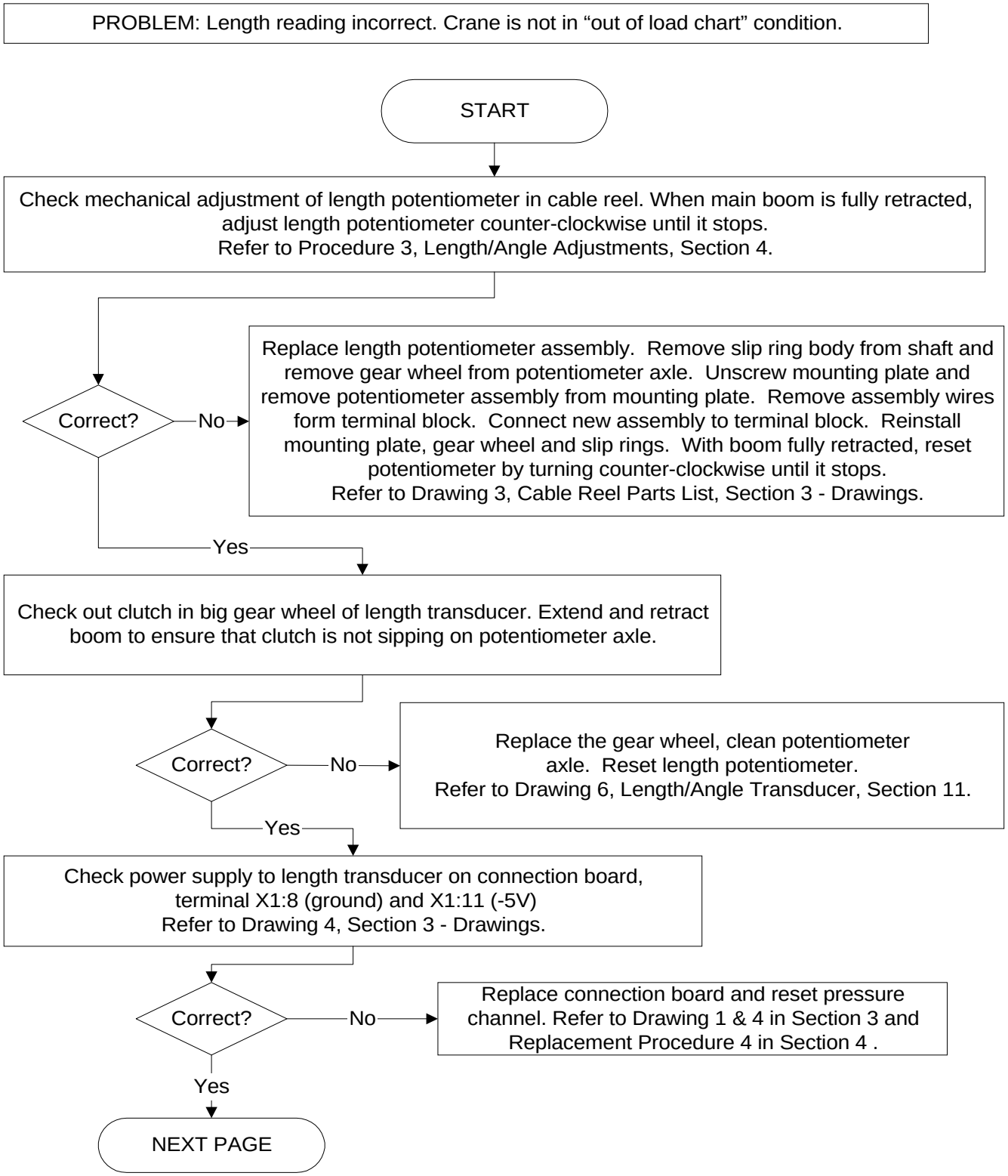
7.5 Anti Two Block Problem

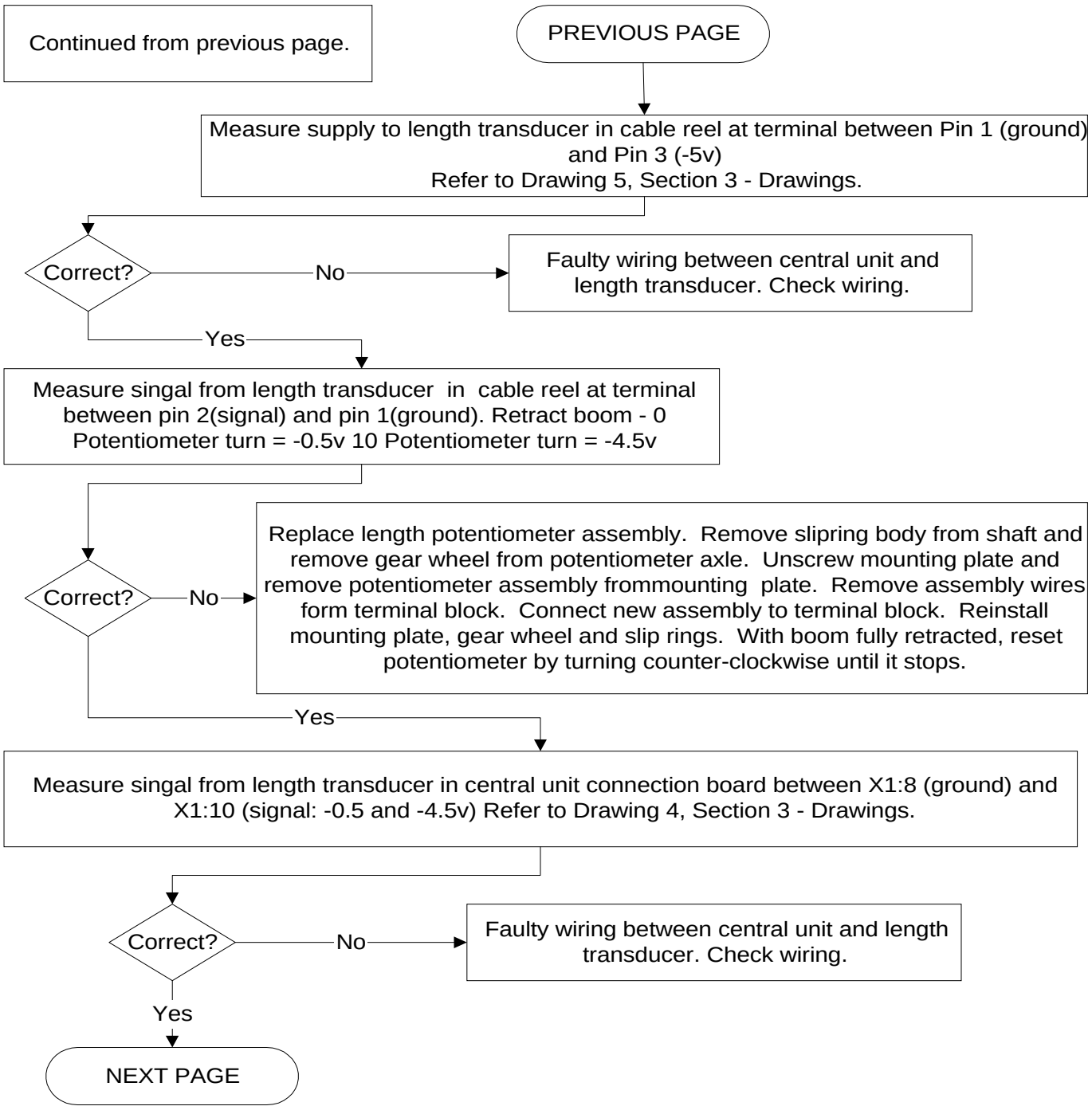



PREVIOUS PAGE
Measure the A2B signal in the cable reel between X1:Brown and X2:Red wires on the slip ring with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 5 Section 3.
Correct?
No
Fault in wiring between boom nose box and cable reel. Check for damaged length cable and wiring.
Refer to Drawing 5 Section 3.
If broken length cable, Refer to Section 3.
Measure the A2B signal in the cable reel between terminal 7 and 8 with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 5 Section 3.
Correct?
No
Replace slip ring
Refer to Drawing 3 & 5 in Section 3.
Measure the A2B signal in the boom base 10 pin receptacle between terminal 5 and 6 with an ohmmeter.
Switch closed =4700 ±500Ohms
Switch open => 1 Megaohm
Reconnected slip ring wires.
Refer to Drawing 5 Section 3.
Correct?
No
Fault in 7 conductor cable between cable reel and boom base box.
Refer to Drawing 5 in Section 3.
NEXT PAGE

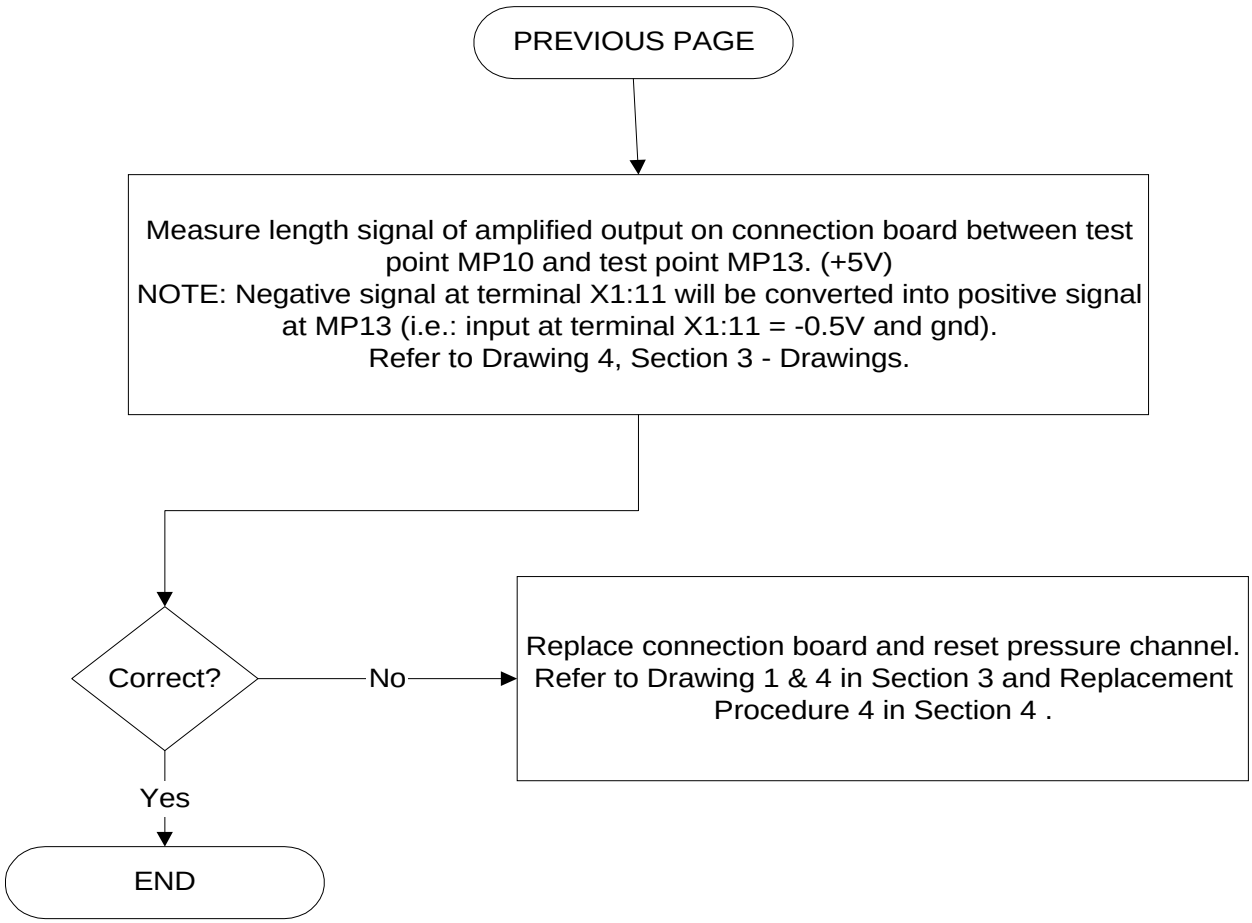

PREVIOUS PAGE
Connect wire #5 back to the terminal X1:35 on the connection board.
Refer to Drawing 4 in Section 3.
Turn system power off. Check Anti-Two-Block signal in central unit with ohmmeter measure between X1:34 and X1:35.
Anti-Two-Block switch closed = 4700 Ohms ±50 0Ohms
Anti-Two-Block switch open => 1 Megaohm.
Refer to Drawing 4 in Section 3.
Correct?
NO
Faulty wiring between cable reel and central unit.
Check cable.
YES
Disconnect X1:34 and X1:35. Check main board function by installing a temporary resistor, 4700 Ohms between X1-34 and X1-35 in central unit. With resistor connected alarm should be inactive.
Refer to Drawing 4 in Section 3.
Correct?
NO
Replace connection board and reset pressure channel. Refer to Drawing 1 & 4 in Section 3 and Replacement Procedure 4 in Section 4 .
Reconnect Wire #6 to X1:34 and Wire #5 to X1:35
Refer to Drawing 3 in Section 3.
End

7.6 Length Reading Problem

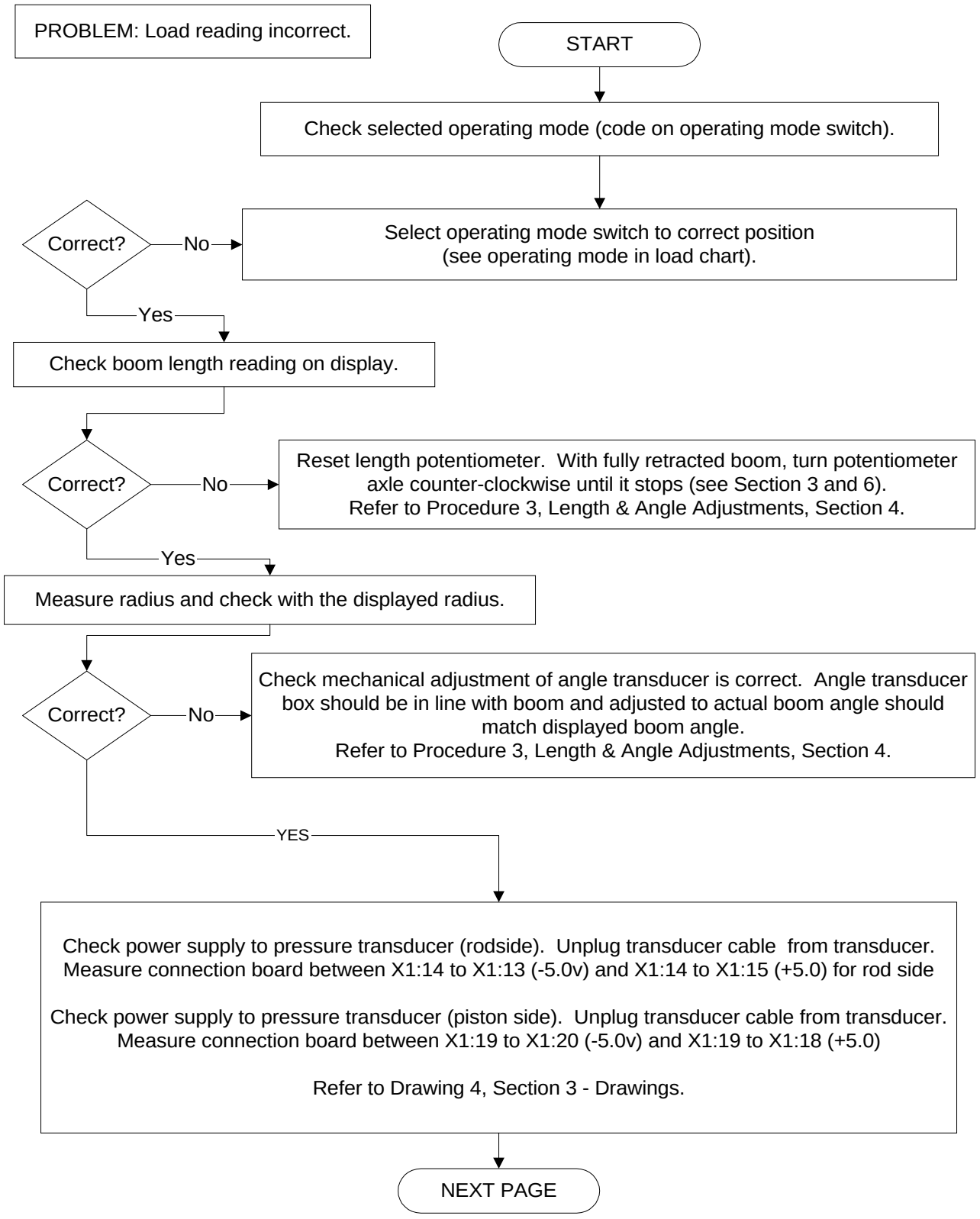


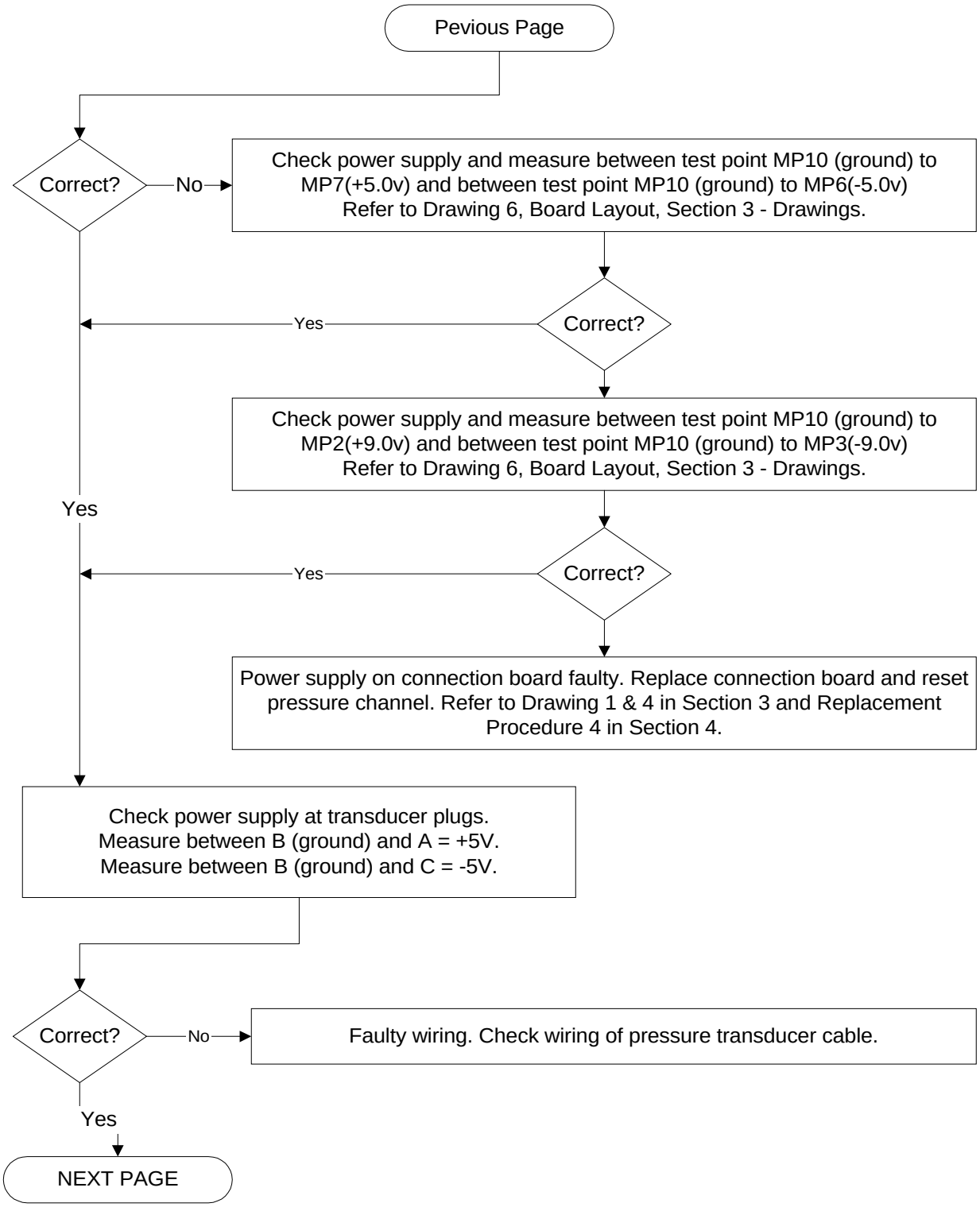

Continued from previous page.
PREVIOUS PAGE
Measure supply to length transducer in cable reel at terminal between Pin 1 (ground) and Pin 3 (-5v)
Refer to Drawing 5, Section 3 - Drawings.
Correct?
No
Faulty wiring between central unit and length transducer. Check wiring.
Yes
Measure singal from length transducer in cable reel at terminal between pin 2(signal) and pin 1(ground). Retract boom - 0 Potentiometer turn = -0.5v 10 Potentiometer turn = -4.5v
Correct?
No
Replace length potentiometer assembly. Remove slipring body from shaft and remove gear wheel from potentiometer axle. Unscrew mounting plate and remove potentiometer assembly frommounting plate. Remove assembly wires form terminal block. Connect new assembly to terminal block. Reinstall mounting plate, gear wheel and slip rings. With boom fully retracted, reset potentiometer by turning counter-clockwise until it stops.
Yes
Measure singal from length transducer in central unit connection board between X1:8 (ground) and X1:10 (signal: -0.5 and -4.5v) Refer to Drawing 4, Section 3 - Drawings.
Correct?
No
Faulty wiring between central unit and length transducer. Check wiring.
Yes
NEXT PAGE

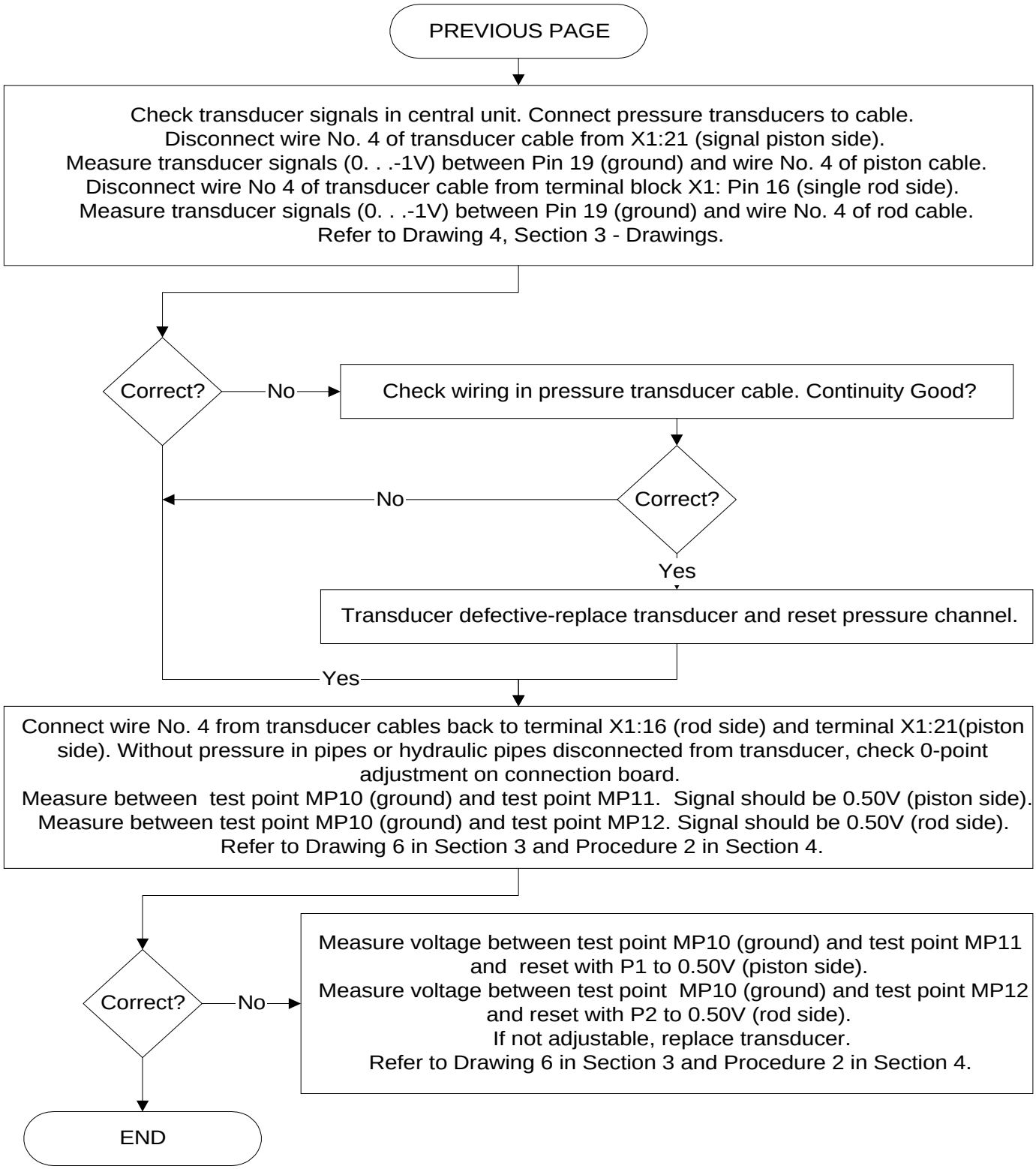
Continued from previous page.



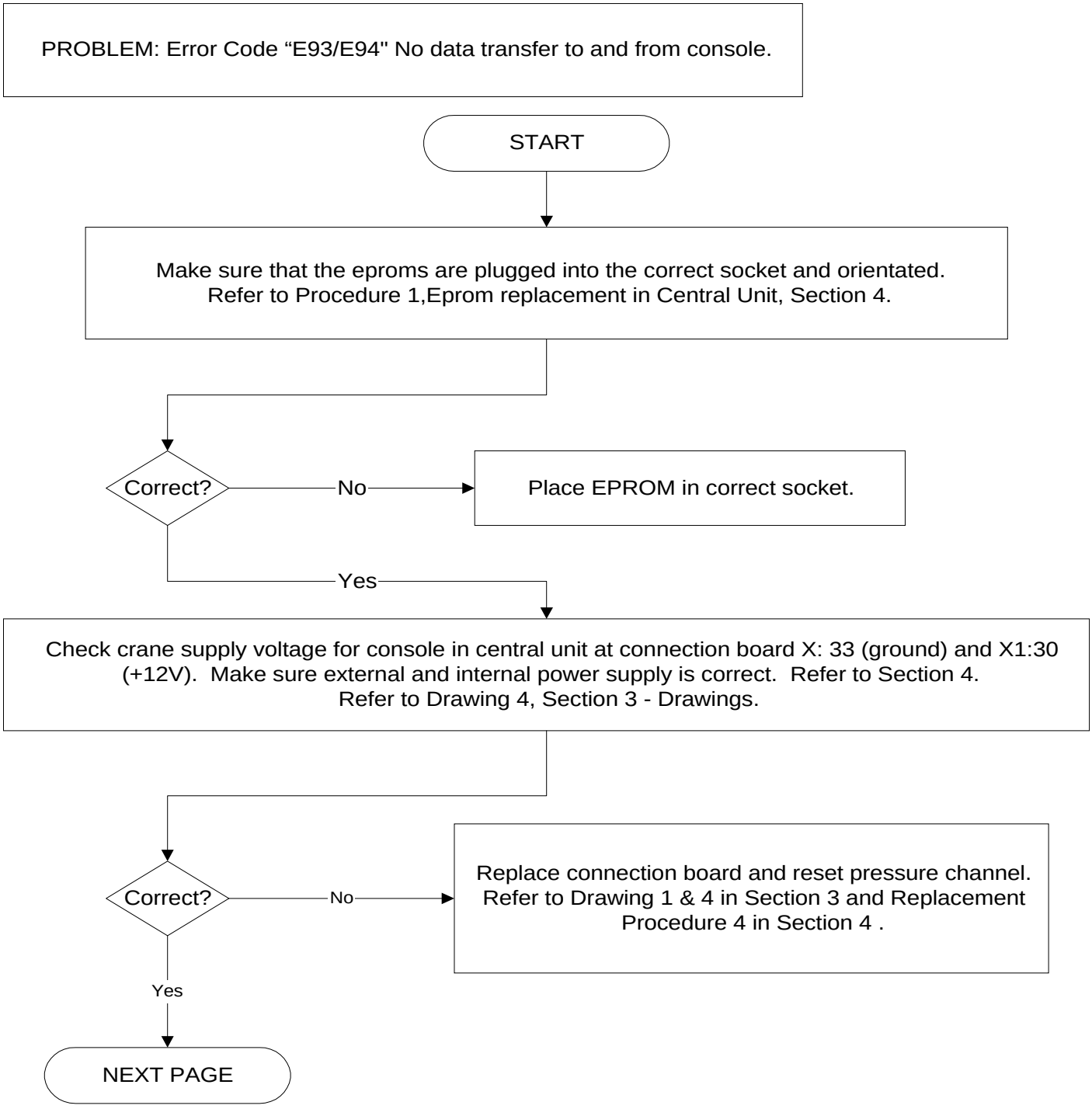
7.7 Load Reading Problem

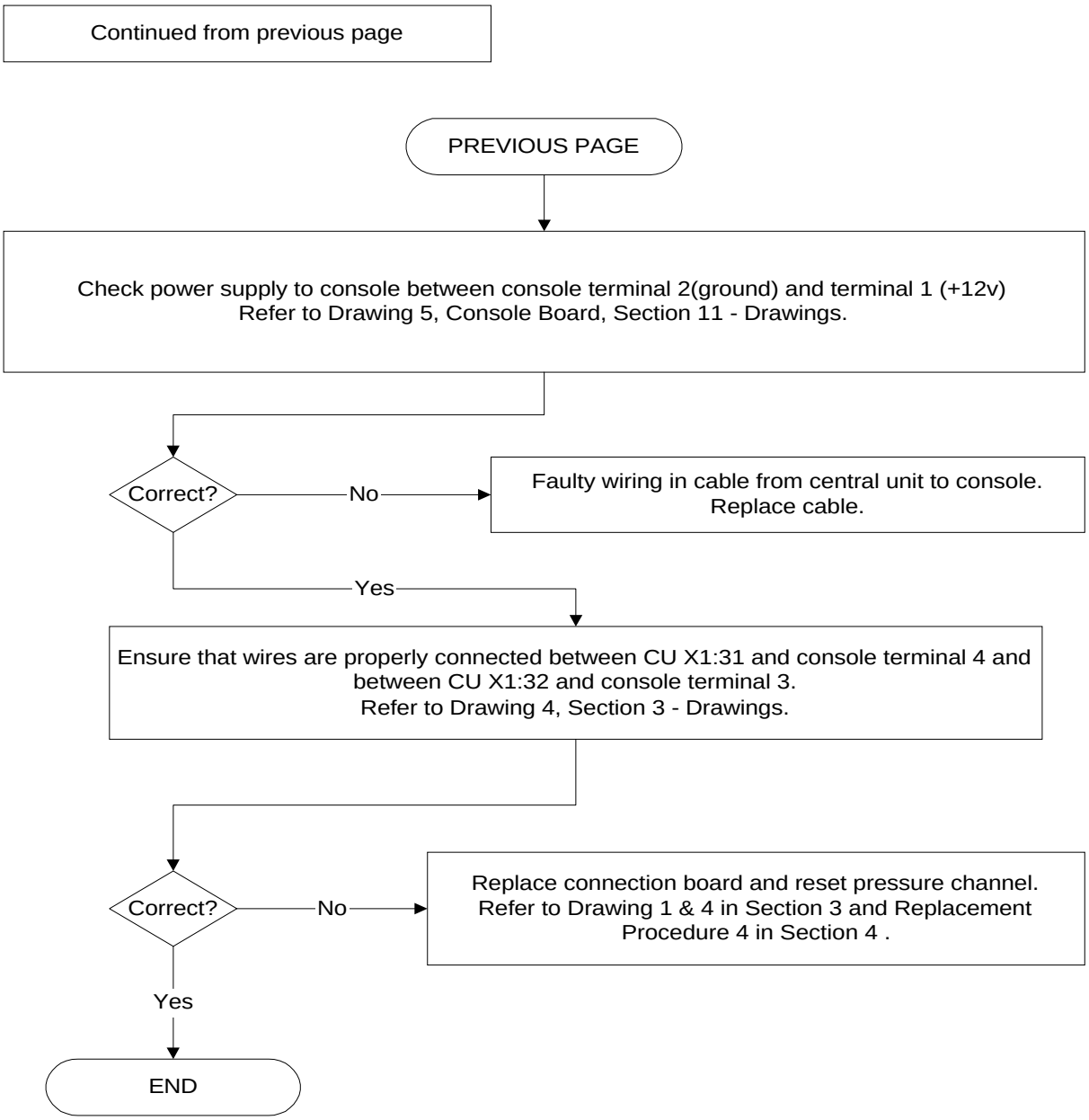



Pevious Page
Correct?
No
Check power supply and measure between test point MP10 (ground) to MP7(+5.0v) and between test point MP10 (ground) to MP6(-5.0v) Refer to Drawing 6, Board Layout, Section 3 - Drawings.
Yes
Correct?
Check power supply and measure between test point MP10 (ground) to MP2(+9.0v) and between test point MP10 (ground) to MP3(-9.0v) Refer to Drawing 6, Board Layout, Section 3 - Drawings.
Yes
Yes
Correct?
Power supply on connection board faulty. Replace connection board and reset pressure channel. Refer to Drawing 1 & 4 in Section 3 and Replacement Procedure 4 in Section 4.
Check power supply at transducer plugs.
Measure between B (ground) and A = +5V.
Measure between B (ground) and C = -5V.
Correct?
No
Faulty wiring. Check wiring of pressure transducer cable.
Yes
NEXT PAGE

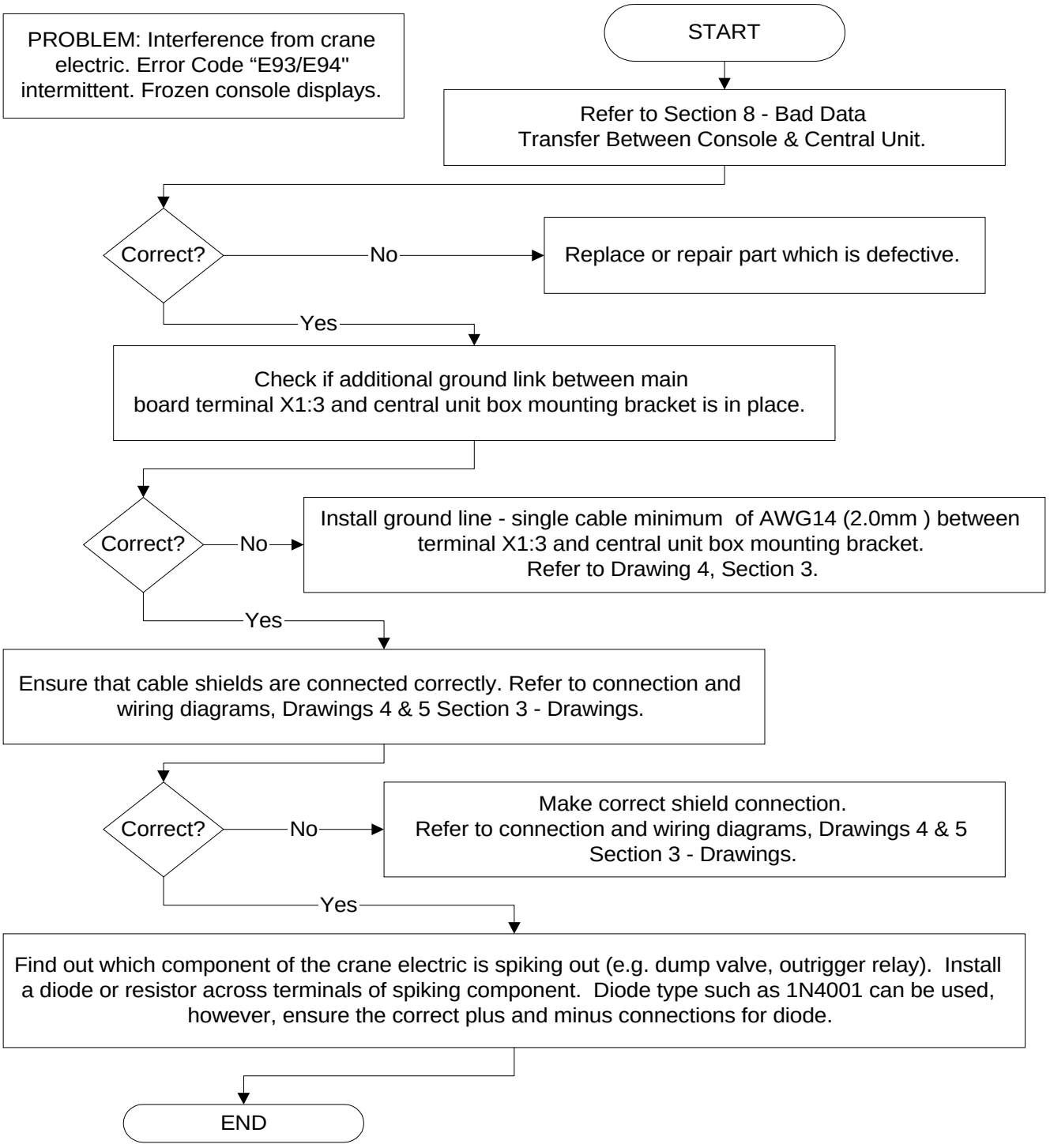

PREVIOUS PAGE
Check transducer signals in central unit. Connect pressure transducers to cable.
Disconnect wire No. 4 of transducer cable from X1:21 (signal piston side).
Measure transducer signals (0. . .-1V) between Pin 19 (ground) and wire No. 4 of piston cable.
Disconnect wire No 4 of transducer cable from terminal block X1: Pin 16 (single rod side).
Measure transducer signals (0. . .-1V) between Pin 19 (ground) and wire No. 4 of rod cable.
Refer to Drawing 4, Section 3 - Drawings.
Correct?
No
Check wiring in pressure transducer cable. Continuity Good?
Correct?
No
Yes
Transducer defective-replace transducer and reset pressure channel.
Yes
Connect wire No. 4 from transducer cables back to terminal X1:16 (rod side) and terminal X1:21(piston side). Without pressure in pipes or hydraulic pipes disconnected from transducer, check 0-point adjustment on connection board.
Measure between test point MP10 (ground) and test point MP11. Signal should be 0.50V (piston side).
Measure between test point MP10 (ground) and test point MP12. Signal should be 0.50V (rod side).
Refer to Drawing 6 in Section 3 and Procedure 2 in Section 4.
Correct?
No
Measure voltage between test point MP10 (ground) and test point MP11 and reset with P1 to 0.50V (piston side).
Measure voltage between test point MP10 (ground) and test point MP12 and reset with P2 to 0.50V (rod side).
If not adjustable, replace transducer.
Refer to Drawing 6 in Section 3 and Procedure 2 in Section 4.
END

7.8 Bad Data Transfer Between Console & Central Unit

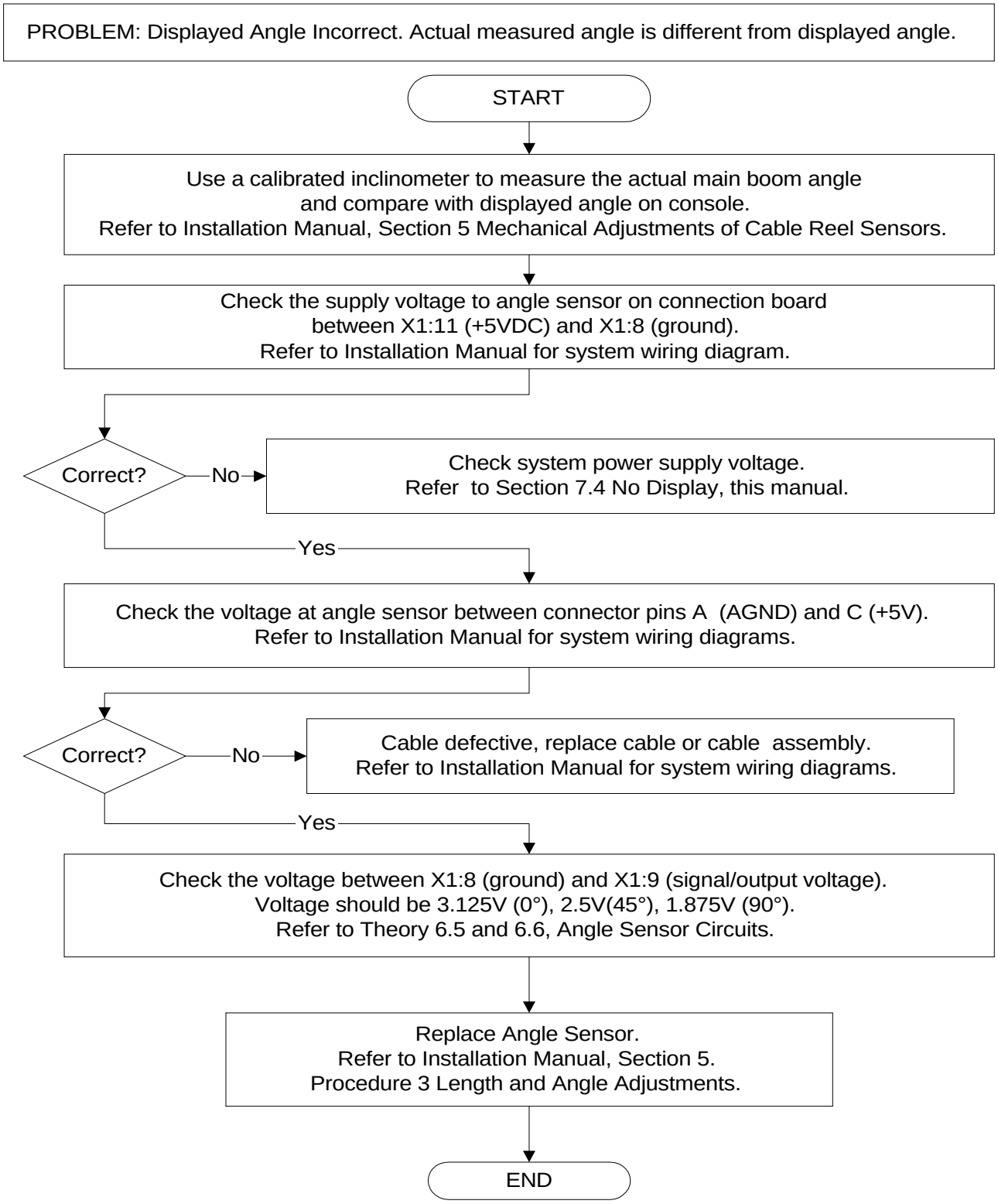



Continued from previous page
PREVIOUS PAGE
Check power supply to console between console terminal 2(ground) and terminal 1 (+12v)
Refer to Drawing 5, Console Board, Section 11 - Drawings.
Correct?
No
Faulty wiring in cable from central unit to console.
Replace cable.
Yes
Ensure that wires are properly connected between CU X1:31 and console terminal 4 and between CU X1:32 and console terminal 3.
Refer to Drawing 4, Section 3 - Drawings.
Correct?
No
Replace connection board and reset pressure channel.
Refer to Drawing 1 & 4 in Section 3 and Replacement Procedure 4 in Section 4 .
Yes
END

7.9 Interference Problem



7.10 Angle Problem



8 ERROR CODE TABLE

Error Code	Error	Cause	Elimination
E01	Fallen below radius range or angle range exceeded	• Fallen below the minimum radius or gone past the maximum angle specified in the respective load chart due to luffing up the boom too far	• Luff down the boom to a radius or angle specified in the load chart.
E02	Radius range exceeded or fallen below angle range	• Gone past the maximum radius or fallen below the minimum angle specified in the respective load chart due to luffing down the boom too far	• Luff up the boom to a radius or angle specified in the load chart.
E03	Non-permitted slewing zone (no load area)	• The slewing zone with load is not permitted	• Slew to permitted area
E04	Operating mode not acknowledged or non permitted slewing zone	• A non existing operating mode has been selected • The boom is in a non-permitted slewing zone	• Set the correct operating mode for the operating state in question • Slew the boom to a permitted area.
E05	Prohibited length range	• Boom has been extended either too far or not far enough, e.g. if it is prohibited to go beyond a certain maximum boom length or with load curves for jibs where the main boom has to be extended to a certain length	• Extend/retract boom to the correct length
		• Length sensor adjustment has changed, e.g. the cable slid off the length sensor reel.	• Retract boom. Check the pre-stress of the cable reel (cable must be taut). Open the length sensor and carefully turn the length sensor pot counter clockwise until loosened by using a screw driver

Error Code	Error	Cause	Elimination
		• Clutch between length sensor pot and drive is defective	• Replace the complete clutch including drive wheel and adjust length sensor pot as described above
		• Failure of +5V supply of analog part of analog board	• Check +5 V supply. Exchange main board in case of voltage failure or breakdown when loaded with 50 ohms approx.
		• Cable between central unit and length sensor is defective or disconnected.	• Check cable and plugs, replace, if need be.
		• Defective length potentiometer	• Replace length potentiometer.
E06	Radius range exceeded or fallen below angle range with luffing jib operation	• Maximum radius as specified in the load chart exceeded or fallen below minimum angle due to luffing down the luffing jib too far	• Luff the jib to a radius or angle specified in the load chart.
E07	Faulty acknowledgment of the overload relay on the connection board. The relay should be energized, the 2nd contact however is indicated to be off, or the 2nd contact is indicated to be on while the relay should be de-energized.	• Overload relay or connection board are defective	• Replace connection board
		• Processor board defective	• Replace processor board.
E08	No acknowledge-ment from the anti-two-block relay	• Refer to E07	• Refer to E07

Error Code	Error	Cause	Elimination
E11	Fallen below lower limit value for measuring channel "length main boom"	• Cable between central unit and length sensor is defective or disconnected. Water inside the plug of the length/angle sensor • Length potentiometer is defective • Electronic component in the measuring channel is defective	• Check cable as well as plugs, replace, if need be. • Replace length potentiometer • Replace LMI main board or processor board.
E12	Fallen below the lower limit value in the measuring channel "pressure piston side"	• Cable between the central unit and pressure transducers defective or water inside the plugs • Pressure transducer is defective. • Electronic component in the measuring channel is defective.	• Check cable as well as plugs, replace, if need be. • Replace pressure transducer • Replace LMI main board or processor board.
E13	Fallen below lower limit value in the measuring channel "pressure rod side"	• Refer to E12	• Refer to E12
E15	Fallen below lower limit value in measuring channel "angle main boom"	• Cable between central unit and the length/angle sensor defective or loose. Water inside the plug of the length/angle sensor. • Angle potentiometer defective • Electronic component in the measuring channel defective.	• Check cable as well as plugs, replace, if need be. • Replace angle sensor • Replace LMI main board or processor board.

Error Code	Error	Cause	Elimination
E16	Fallen below lower limit value in measuring channel "angle 2"	• Cable between the central unit and the angle sensor defective or loose. Water inside the plug of the angle sensor. • Angle potentiometer defective • Electronic component in the measuring channel defective.	• Check cable as well as plugs, replace, if need be. • Replace angle sensor • Replace LMI main board or processor board.
E17	Fallen below lower limit value "length telescope I (+II)"	• Cable between the central unit to the length sensor defective or loose. Water inside the length sensor plug. • Length potentiometer defective • Electronic component in the measuring channel defective	• Check cable as well as plugs, replace, if need be. • Replace length sensor. • Replace LMI main board or processor board.
E19	Reference and/or supply voltage defective	• The supply voltage is falsified by one of the sensors (DAV, LWG) • Electronic component is defective • A/D converter defective.	• Check the voltages on the LMI main board. Check sensors, plugs and cable, replace, if need be. • Replace LMI main board • Replace LMI main board
E21	Upper limit value in measuring channel "main boom length" has been exceeded.	• Refer to E11	• Refer to E11
E22	Upper limit value in measuring channel "pressure piston side" has been exceeded	• Refer to E12	• Refer to E12
E23	Upper limit value in measuring channel "pressure rod side" has been exceeded.	• Refer to E12	• Refer to E12

Error Code	Error	Cause	Elimination
E25	Upper limit value in measuring channel "main boom angle" has been exceeded.	• Refer to E15	• Refer to E15
E26	Upper limit value in measuring channel "angle 2" has been exceeded.	• Refer to E16	• Refer to E16
E27	Upper limit value in measuring channel "length telescope I (+II) has been exceeded.	• Refer to E17	• Refer to E17
E29	Reference and/or supply voltage defective.	• Refer to E19	• Refer to E19
E31	Error in the system program	• The system program PROM is defective.	• Replace system program PROM (PROM No. 0)
E38	System program and data EPROM do not match.	• The system program in the LMI does not match to the programming in the data EPROM	• Replace the system program PROM or the data EPROM (PROM No. 1)
E39	System program and TLK EPROM do not match	• The system program in the LMI and the programming in the TLK EPROM do not match.	• Replace system program PROM or TLK EPROM (PROM No. 2).
E41	Error in the internal write/read memory (RAM) of the computer component 80C537	• Computer component 80C537 defective • CPU module defective • Processor board defective.	• Replace computer component 80C537. • Replace CPU module. • Replace processor board with CPU module.
E42	Error in the external write/read memory, 1st part (RAM)	• Write/read memory (CMOS RAM) or processor board defective.	• Replace processor board with CPU module.
E43	Error in the external write/read memory, 2nd part (RAM)	• Refer to E42	• Refer to E42

Error Code	Error	Cause	Elimination
E45	Redundancy error in the A/D conversion	• The A/D converter on the processing board and the redundant A/D converter in the CPU 80C537 provide different results.	• Replace processor board.
E46	Error in the A/D converter uPD 7004 of the processor board.	• No acknowledgment of the A/D converter uPD 7004	• Replace processor board.
E47	Error in the monitored write/ read memory. The CRC verification of the monitored write/read memory provides an incoherent result	• The CRC sign of the monitored write/read memory is wrong • The buffer battery is decharged (< 2V at 1kOhm). • Processor board defective.	• Restart the LMI • Replace buffer battery on the LMI main board • Replace processor board.
E48	Cyclic RAM test: error in the internal write/read memory (RAM) of the computer component 80C537	• Computer component 80C537 defective • CPU module defective • Processor board defective.	• Replace computer component 80C537. • Replace CPU module • Replace processor board with CPU module.
E51	Error in the crane data EPROM or EEPROM.	• No valid data in the crane data EEPROM. • Memory module wrongly bridged. • Crane data EPROM defective	• Load crane data EEPROM containing valid data. • Bridge memory module acc. to memory type • Replace crane data EPROM
E52	Error in load chart PROM.	• Memory module wrongly bridged. • Load chart EPROM defective.	• Bridge memory module acc. to memory type. • Replace load chart EPROM

Error Code	Error	Cause	Elimination
E56	Error in crane data EEPROM.	• Memory module wrongly bridged. • Crane data EEPROM defective	• Bridge memory module acc. to memory type • Replace crane data EEPROM
E57	Error in serial crane data EEPROM.	• Serial crane data EEPROM does not contain valid data. • Memory module defective	• Write data on the serial crane data EEPROM (by means of test program or on-line function), then restart the LMI • Replace memory module.
E58	Error in the serial analog data EEPROM.	• No valid data in the serial analog data EEPROM. • LMI main board defective.	• Write data on the serial analog data EEPROM by means of the test program, then, restart the LMI • Replace LMI main board.
E59	Error in the serial analog data EEPROM.	• No valid data in the serial analog data EEPROM. • LMI main board defective.	• Write data on the serial analog data EEPROM by means of the test program, then, restart the LMI • Replace LMI main board.
E84	Wrong rigging condition.	• The selected rigging condition is not contained in the data EPROM.	• Select another rigging condition • Check the programming in the data EPROM.
E85	Error in the radius determination	• The computed radius is too small (negative deflection)	• Check the programming in the data EPROM.

Error Code	Error	Cause	Elimination
E91	No data trans-mission form the console to the central unit	• 24 V supply of the console is interrupted	• Check 24 V at terminal X1 of the console electronics
		• Interruption or accidental ground in the line between console electronics and central unit	• Check the connection console electronics - central unit. In case of an accidental ground, the transmitter module of the console electronics might be damaged. Therefore, replaces the console electronics.
		• Transmitter/receiver module is defective	• Exchange console electronics or LMI main board
E92	Error in the data transmission from console to central unit	• Loose connection in the line between console electronics and central unit • Transmitter/receiver module is defective	• Check the connection between console electronics and central unit • Exchange console electronics or LMI main board
E93	Error in the data transmission from the central unit to the console	• Refer to E92	• Refer to E92

Error Code	Error	Cause	Elimination
E94	No data transmission from the central unit to the console	• Interruption or accidental ground in the line central unit - console • 5 V supply of the computer in the central unit is missing • 5 V supply is too low • Transmitter/receiver module is defective • Computer module is defective • Electro-magnetic interferences (e.g. when switching contacts or valves)	• Check line to the console (in case of accidental ground, replace console electronics, too). • Check connection to the power unit • Exchange the LMI main board • Replace console electronics or LMI main board • Replace processor board. • Eliminate the source of interference by inverse diodes or varistors.

Note:
If an error message is displayed which is not contained in above list, please contact PAT America, Inc. service department.

ADDENDUM A BASIC ADJUSTMENT AND VOLTAGE CHECKS

MODEL:_____

S/N:_____

PAT DS150C P/N 024-150-061-005 central unit / 024-150-300-050 connection board

1. Crane Supply Voltage @ X1-1 (+) & X1-4 (GND) = VDC
2. Supply Voltage to Main Board @ X1-1 (=) & X1-3 (GND) = VDC
3. Main Board Power Supply (Reference Voltages +/ -50 MV):

   + 5V @ Mp4 = _____ VDC Mp 10 Ground - Internal to Board

   + 6V @ Mp9 = _____ VDC Mp 10 Ground - Internal to Board

   + 9V @ Mp2 = _____ VDC Mp 10 Ground - Internal to Board

   - 9V @ Mp3 = _____ VDC Mp 10 Ground - Internal to Board

   + 5V @ Mp6 = _____ VDC Mp 10 Ground - Jib-Angle, Length/Angle, Rod, Piston

   - 5V @ Mp7 = _____ VDC Mp 10 Ground - Piston & Rod Pressure

   +12V @ Mp25 = _____ VDC Mp 15 Ground - Internal to Board

4. Boom Length: (MP10 Ground for Meter)

   Fully Retracted _____ Ft. _____VDC @ X1:10 _____DC @ MP13

   Fully Extended _____ Ft. _____VDC @ X1:10 _____DC @ MP13

   -5 Volt Reference Voltage_____ VDC @ X1:11

5. Boom Angle: (MP10 Ground for Meter)

   Minimum Angle _____ ° _____VDC @ X1:9 _____VDC @ Mp14

   Maximum Angle_____ ° _____VDC @ X1:9 _____VDC @ Mp14

   -5 Volt Reference Voltage _____ VDC @ X1:11

6. Pressure Transducers: (MP10 Ground for Meter)

   Piston Zero Point _____ VDC @ X1:21 _____ VDC @ Mp11

   Rod Zero Point _____ VDC @ X1:16 _____ VDC @ Mp12

   +5 Volt Reference Voltage _____ VDC @ X1:13 & 18

   -5 Volt Reference Voltage _____ VDC @ X1:15 & 20

ADDENDUM B Reference Tables for measuring supply and signal voltages for sensor channels

Use the table as a quick reference for measuring supply and signal voltages for the sensor channels that are specific to the error code listed.

Signal Voltage					
			Terminal Board Terminal X1		
Error Code	Channel		Pin 'ground'	Pin 'supply'	Nominal Voltage (VDC)
E11/21	2	Length	8	11	-5
E12/22	1	Pressure Piston side	19	20	-5
			19	18	+5
E13/23	0	Pressure Rod side	14	15	-5
			14	13	+5
E15/25	3	Angle Main boom	8	11	-5
E16/26	4	Angle Jib	23	25	-5

Signal Voltage						
			Terminal Board Terminal X1			Amplified Signal on main board
Error Code	Channel		Pin 'ground'	Pin 'supply'	Voltage (VDC)	use MP10 - GND and MP supply voltage 0.5...4.5V
E11/21	2	Length	8	10	-0.5...-4.5	MP13
E12/22	0	Pressure Piston side	8	21	0...-1	MP11
E13/23	1	Pressure Rod side	8	16	0...-1	MP12
E15/25	3	Angle Main boom	8	9	-1.875...-3.125	MP14
E16/26	4	Angle Jib	8	24	-1.875...-3.125	MP15