

PAT DS50/0002
Troubleshooting Manual



PSR Professional Service & Repair Inc.

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1. GENERAL INFORMATION

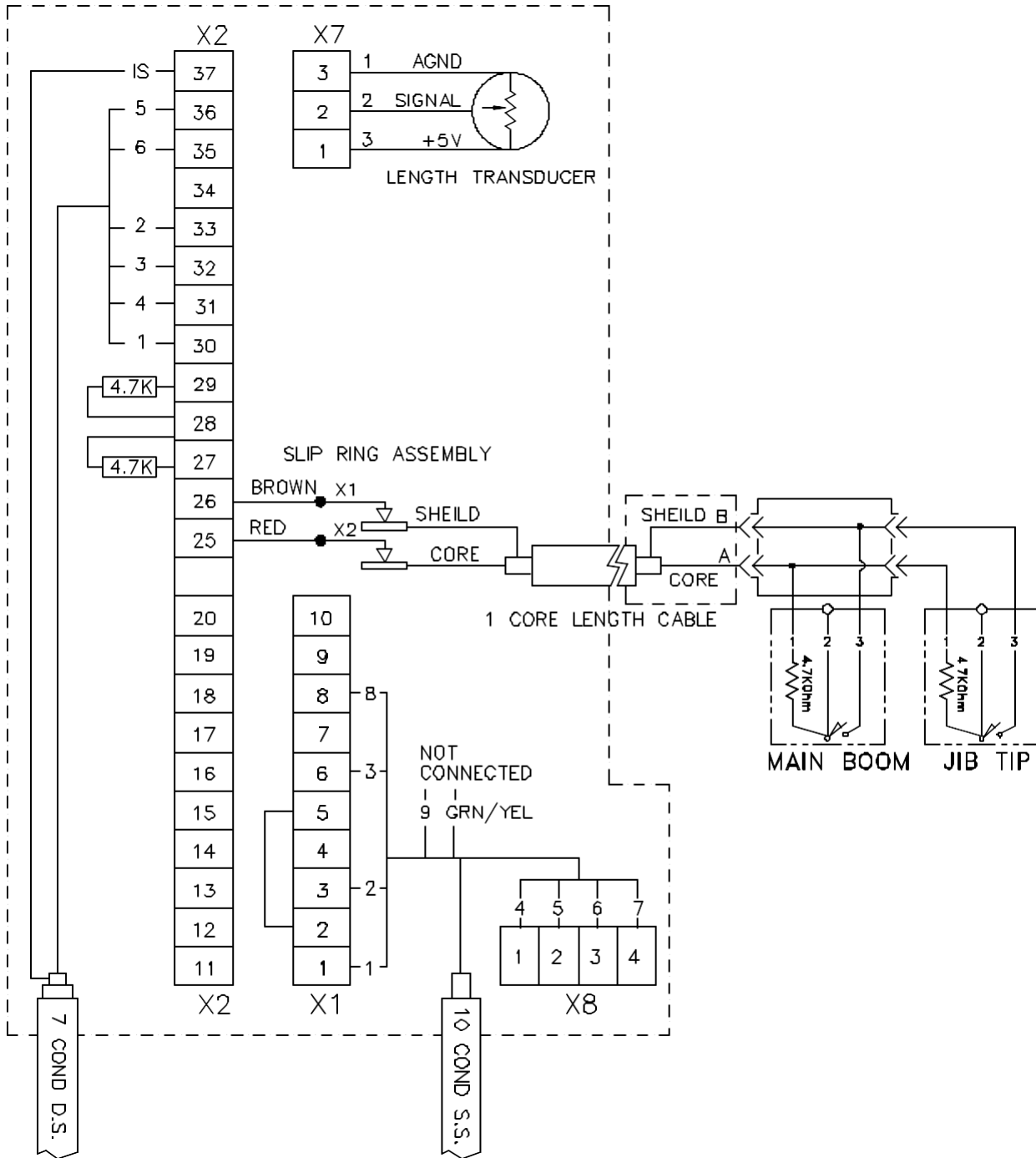
This troubleshooting handbook is designed to assist a service or maintenance person in identifying the system problem area or malfunction. A voltmeter and regular maintenance and service tools will be required to troubleshoot the system.

Refer to the operator's handbook 031-300-190-014 for system and console description, operation, pre-operational inspection, and service and maintenance.

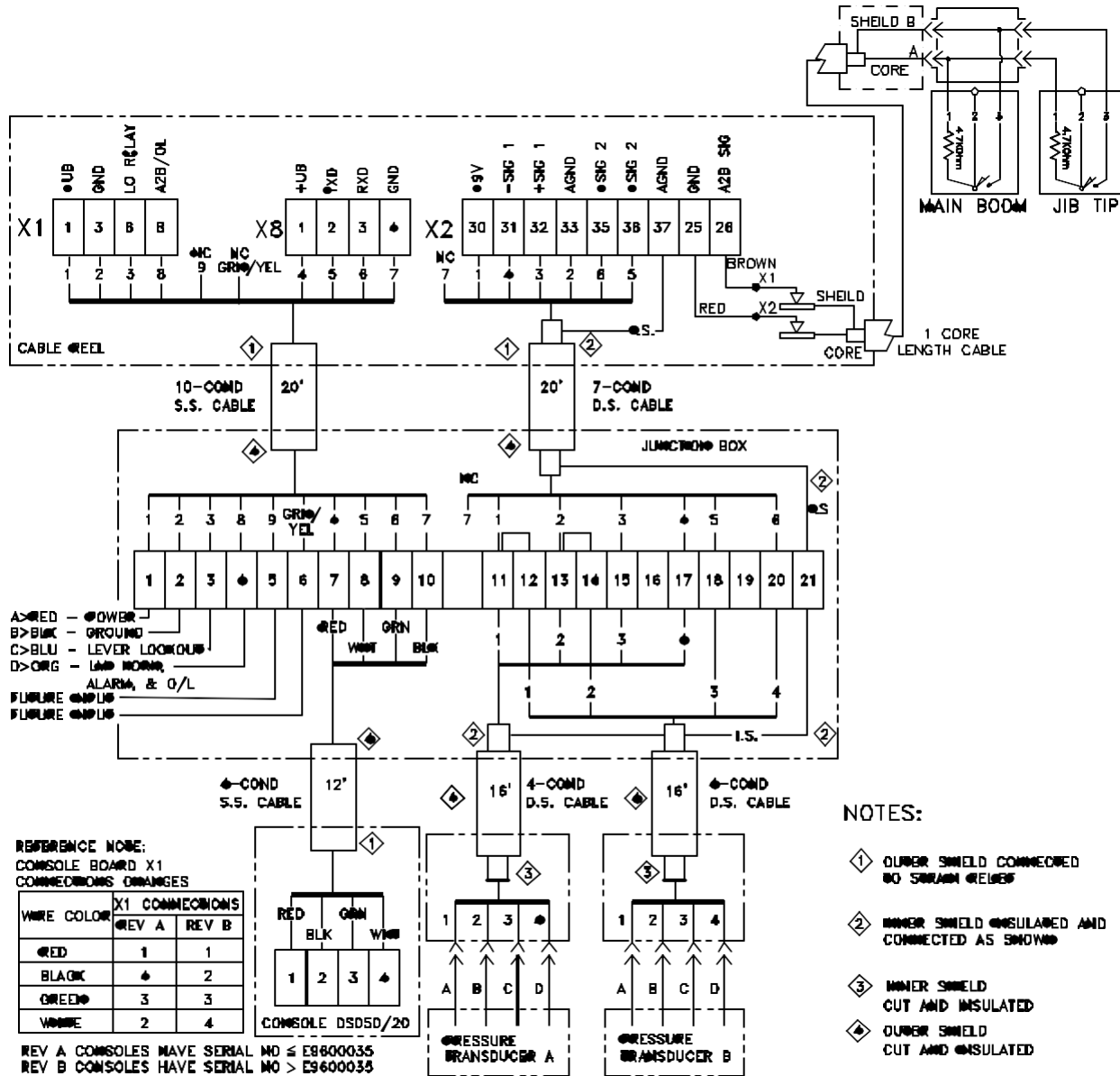
Read and understand the following information:

- Knowledge of how to use a voltmeter is assumed.
- Keep in mind that in troubleshooting high quality electronic components to use caution and necessary care while testing and measuring DS 50 components and circuits of the crane electric's.
- Tools and test equipment must be in good order and shall be inspected on a regular basis.
- Follow all safety instructions according to crane manufacturers handbooks and safety instructions.
 - Obey recommended practice and safety standards applying to the job site.
 - Secure the working area prior to testing and servicing the system.
- Never remove the pressure transducers without first relieving all hydraulic pressure to the lift cylinders.
- The cable reel drum is under high tension. Never allow the length cable to spool back without properly leading it back on the drum.

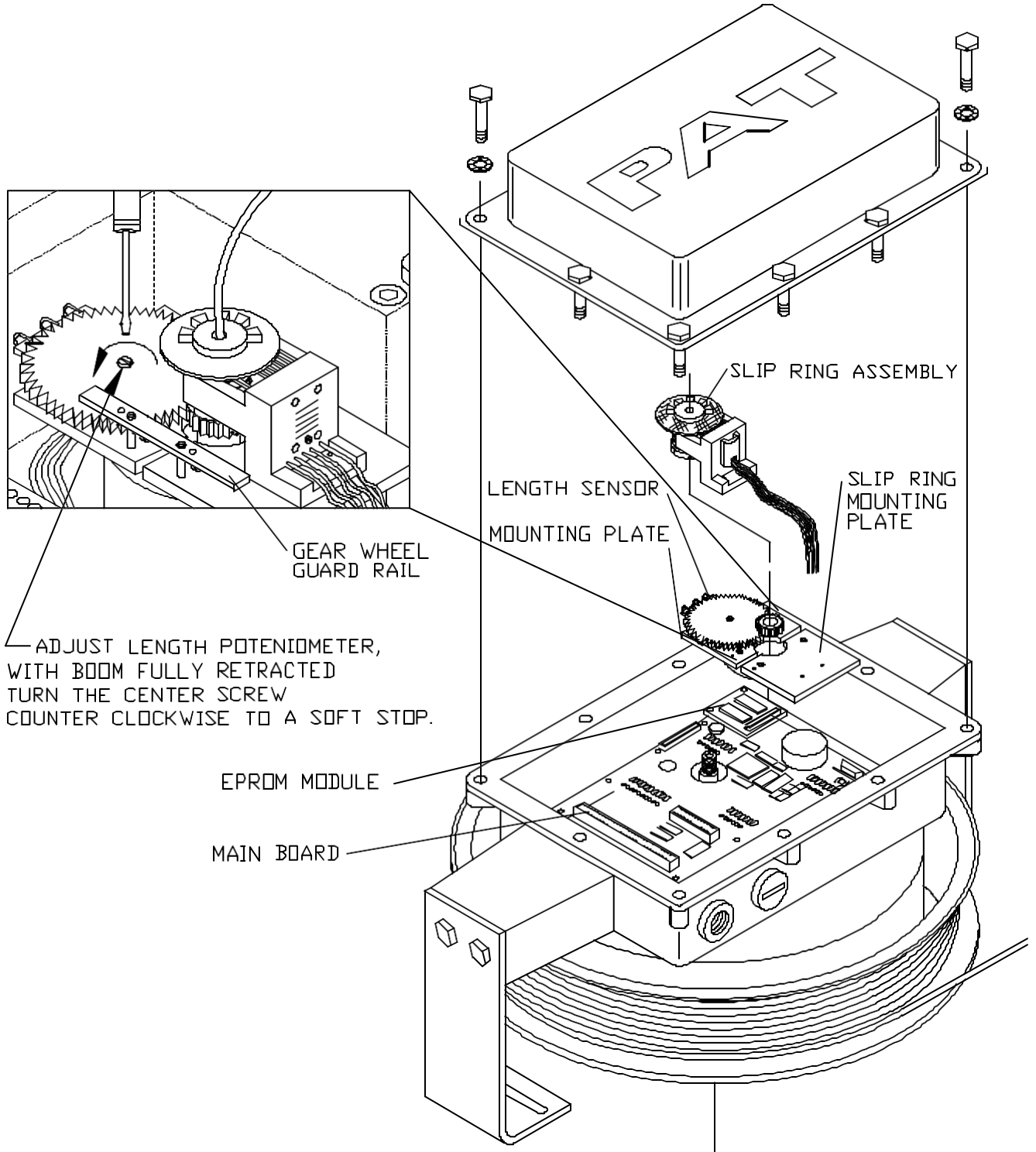
2. DRAWING 1, CABLE REEL ELECTRICAL DIAGRAM



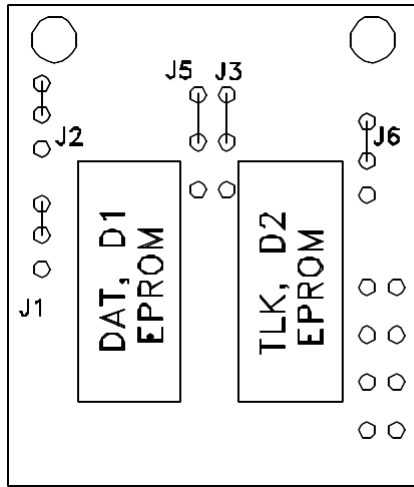
2. DRAWING 2, SYSTEM ELECTRICAL DIAGRAM



2. DRAWING 3, EXPLODED VIEW OF CABLE REEL AND MECHANICAL ADJUSTMENT OF LENGTH SENSOR

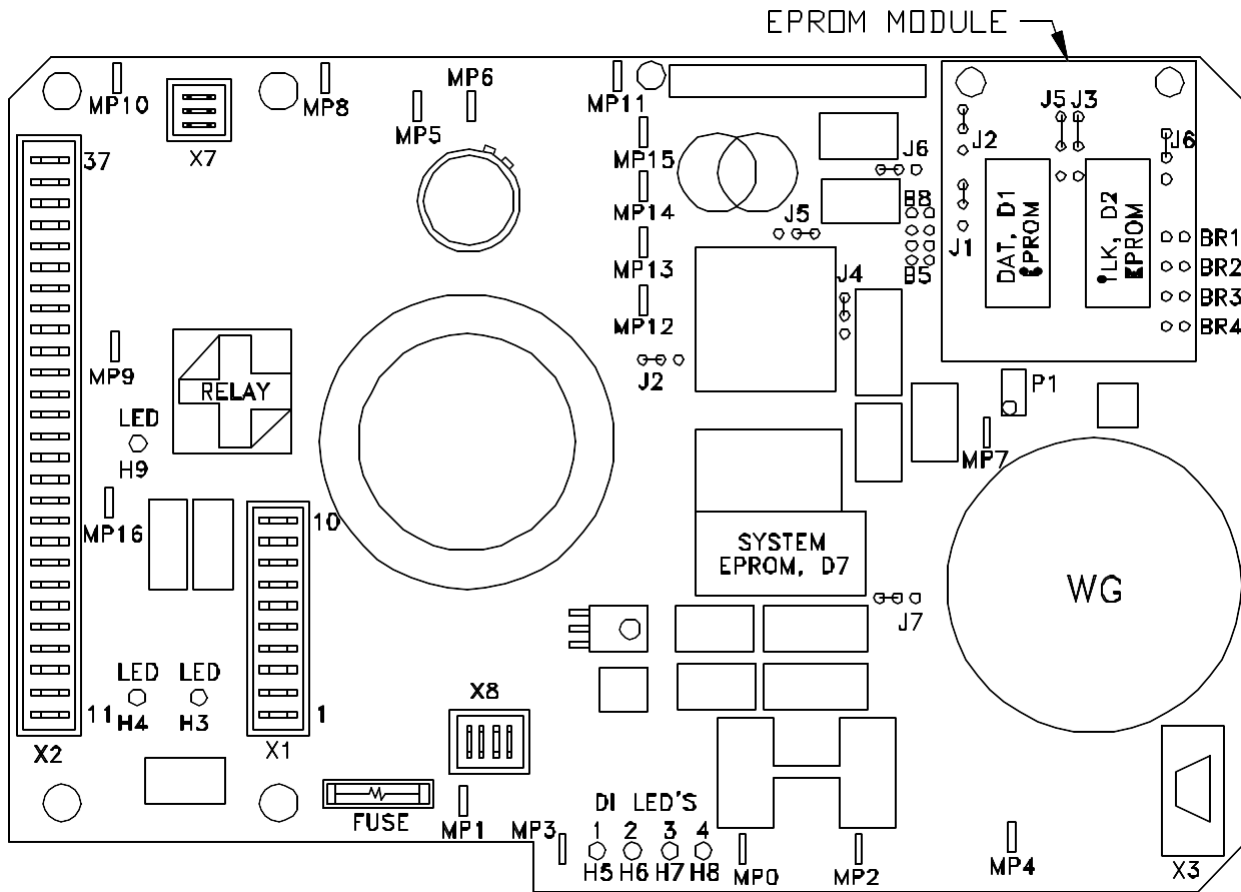


2. DRAWING 4, MAIN BOARD DS50



INSERT BRIDGE IN APPROPRIATE POSITION

- ○ BR1 - NORMAL LMI OPERATION
- ○ BR2 - BUZZER SOUNDS AT PREWARNING
- ○ BR3 - ZERO PRESSURE TRANSDUCER
- ○ BR4 - ADDITIONAL DISPLAYS FOR TROUBLESHOOTING



2. DS 50 MAIN BOARD CONNECTION AND TERMINAL DEFINITIONS

X1/X2 (fast-on plug)

- 1 system supply (10 - 28V)
- 2 system supply (10 - 28V)
- 3 system ground
- 4 system ground
- 5 vehicle relay middle contact
- 6 vehicle relay work contact
- 7 vehicle relay off position contact
- 8 jumper UEL / HES
- 9 jumper over load relay
- 10 jumper hoist limit switch relay
- 11 periphery supply (10 - 28V)
- 12 digital input_1
- 13 digital input_1
- 14 digital input_2
- 15 digital input_2
- 16 digital input_3
- 17 digital input_3
- 18 digital input_4
- 19 digital input_4
- 20 periphery ground
- 21 lamp driver_1
- 22 lamp driver_1
- 23 lamp driver_2
- 24 lamp driver_2
- 25 hoist limit switch signal
- 26 hoist limit switch ground
- 27 supply voltage potentiometric sensor
- 28 2ND angle sensor signal channel
- 29 analog ground
- 30 supply voltage passive DMS
- 31 - return signal DMS
- 32 + return signal DMS
- 33 analog ground
- 34 supply voltage passive DMS
- 35 - return signal DMS
- 36 + return signal DMS
- 37 analog ground

2. DS 50 MAIN BOARD CONNECTION AND TERMINAL DEFINITIONS - continued

X3 (DBM 9pin) RS232 interface for (hand-) terminal

X4 digital angle sensor

X7 (screw snap-on terminal) length sensor

- 1 supply voltage potentiometric sensor
- 2 length sensor signal
- 3 analog ground

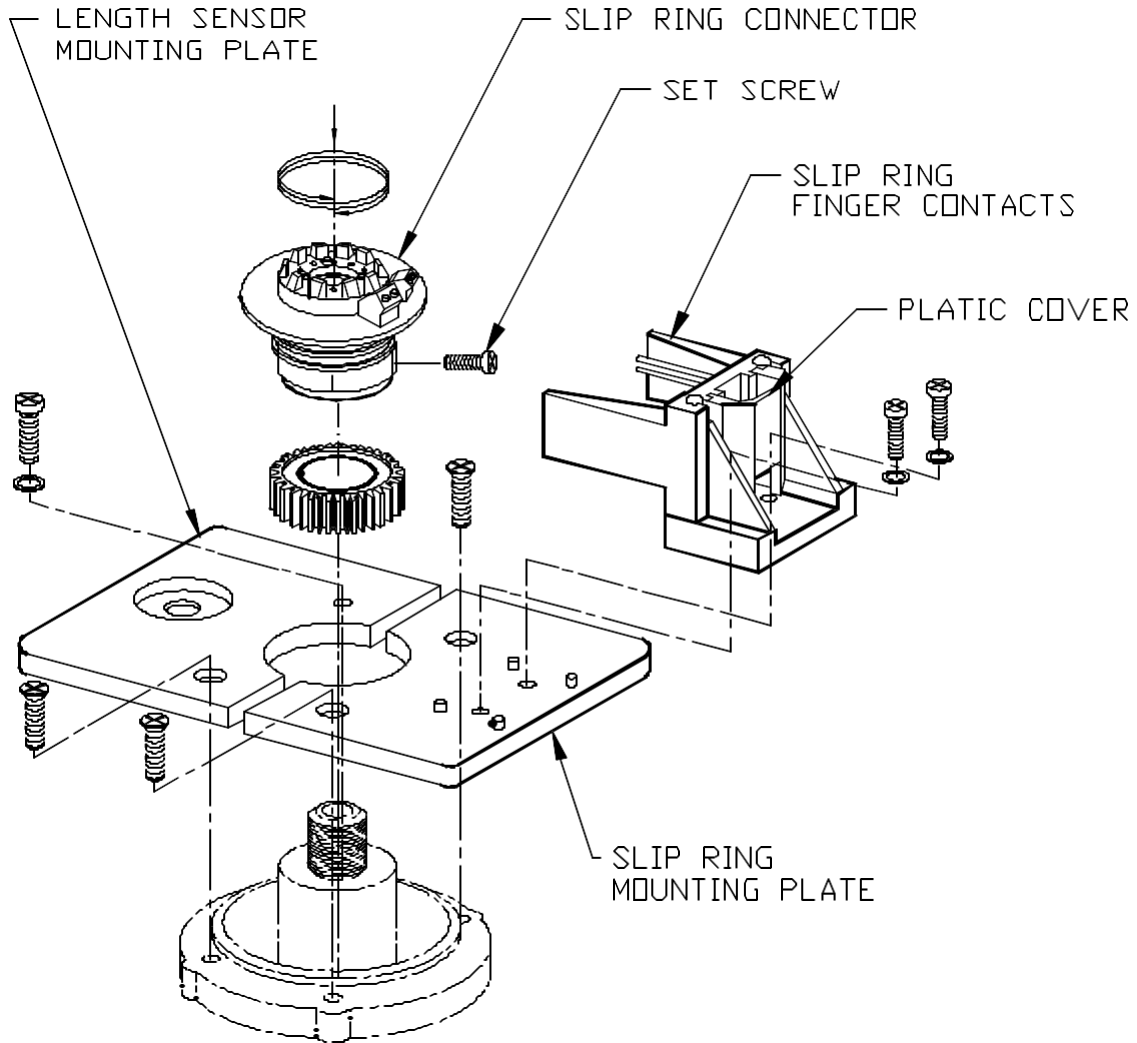
X8 (screw snap-on terminal) DS50 console interface

- 1 periphery supply (10 - 28V)
- 2 transmit data
- 3 receive data
- 4 periphery ground

Main Board Measuring Points

MPO	0V	module ground
MP1	+10 ... 28V	module supply
MP2	+9V ±0.45V	sensor supply
MP3	+5V ±0.25V	sensor supply
MP4	U_{TTL}	supply for hand terminal
MP5	$U_{GEB}/2$	AN3 / angle sensor
MP6	$U_{GEB}/2$	AN2 / length sensor
MP7	0 ... U_{TTL}	voltage controlled current output ($U_{TIL}=1mA$)
MP8	$U_{TTL}/2$	AN11
MP9	U_{TTL}	sensor supply
MP10	$U_{DMS}/2$	symmetric voltage for de-coupling
MP11	U_{ANAL}	DMS - supply voltage
MP12	0V...5V	AN0
MP13	0V...5V	AN1
MP14	$U_{DMS}/3$	AN9
MP15	$2.74V+U_D$	AN8 / temperature voltage
MP16		A2B signal

2. DRAWING 5, SLIP RING ASSEMBLY



3. TROUBLESHOOTING USING THE CONSOLE

The console will help you to find and correct system errors and problems. Troubleshooting begins with the console display. The following table lists the screens available for troubleshooting. These screens are available to check or verify operation but not needed for normal operation. To display the troubleshooting screens, move the jumper from BR1 (Normal LMI Operation) to BR4 (Additional Displays for Troubleshooting) on the eprom module. Refer to Section 2 - Drawing 4. Main Board.

Table 1. Console displayed information

Display Position	Displayed Value XXXX
*0:	error code
1:	main boom length
2:	main boom angle
3:	radius
4:	utilization
5:	tip height
6:	rated load
7:	actual load
8:	actual moment
•9:	pressure piston side [Bar]
•0:	pressure rod side [Bar]
•L:	voltage boom length [mv]
•P:	voltage pressure piston side [mv]
•r:	voltage pressure rod side [mv]
•o:	voltage angle sensor [mv]
•U:	reference voltage + 5V [mv]

- - only displayed if jumper BR4 is installed on eprom module attached to main board.
- * - only displayed if error is present.

If an error code is present, use the following error code table to determine the type, cause, and remedy for the error. This will lead you to a specific section in this manual.

If no error code is displayed, troubleshoot the system by using the basic flowchart provided in Section 4.

TABLE 2. ERROR CODE LIST

Error Code	Error	Cause	Remedy
	Overload	<ul style="list-style-type: none"> cutoff due to overload 	<ul style="list-style-type: none"> reduce load moment
		prewarning	
	A2B switch is activated	<ul style="list-style-type: none"> A2B switch activated, broken length cable, short in wiring 	<ul style="list-style-type: none"> lower the hook block Refer to Section 6
E01	Fallen below minimum radius range or angle range exceeded	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> boom down to a radius or angle specified in the load chart
E02	Radius range exceeded or fallen below angle range	<ul style="list-style-type: none"> gone past the maximum radius or fallen below the minimum angle specified in the respective load chart due to luffing up the boom too far 	<ul style="list-style-type: none"> boom up to a radius or angle specified in the load chart
E04	Operating mode not available	<ul style="list-style-type: none"> A non existing operating mode has been selected 	<ul style="list-style-type: none"> Set the correct operating mode for the operating state in question

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E05	Forbidden length range of the main boom	<ul style="list-style-type: none"> • Boom has been extended too far or not enough, e.g. if operation is only admitted up to a certain boom length or for load charts of jibs with the boom having to be extended to a certain length. • The length sensor adjustment was modified, e.g. rope slid off the length sensor reel. • Clutch between length sensor pot and drive is defective • Failure of the +5V-supply for the analog part of the LMI-analog board. • Length potentiometer defective. 	<ul style="list-style-type: none"> • Retract or extend boom to the correct length. • Retract the boom. Check the pre-stress of the cable reel (the rope has to be under traction). Open the length sensor and carefully turn the length pot shaft slowly counterclockwise with a screwdriver. • Completely replace the clutch with the drive wheel and adjust length sensor pot • Check +5V-voltage. If there is no voltage or break down at a charge of 50 ohm approximately, exchange LMI board. • Replace length potentiometer.

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E07	<p>Faulty acknowledgment by the overload relay of the LMI board.</p> <p>Relay should be energized but 2nd contact is indicated off, or the 2nd contact is indicated on while the relay should be deenergized.</p>	<ul style="list-style-type: none"> • Overload relay defective • LMI board defective 	<ul style="list-style-type: none"> • Replace LMI board
E08	<p>No acknowledgement of the anti-two-block switch relay.</p>	<ul style="list-style-type: none"> • Overload relay defective • LMI board defective 	<ul style="list-style-type: none"> • Replace LMI board
E11	<p>Fallen below limit for the measuring channel "Length telescopic boom".</p>	<ul style="list-style-type: none"> • Length sensor pot defective. • Electronic board in the measuring channel defective. 	<ul style="list-style-type: none"> • Replace length sensor potentiometer. • Replace LMI board.
E12	<p>Fallen below the lower limit value in the measuring channel "pressure piston side"</p>	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Check cable as well as plugs, replace, if need be. • Replace pressure transducer • Replace LMI main board or processor board.
E13	<p>Fallen below lower limit value in the measuring channel "pressure rod side"</p>	<ul style="list-style-type: none"> • refer to E12 	<ul style="list-style-type: none"> • refer to E12

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E15	Fallen below lower limit value for the measuring channel "angle main boom".	<ul style="list-style-type: none"> • Angle sensor defective. • Electronic part in the measuring channel defective. 	<ul style="list-style-type: none"> • Replace angle sensor. • Replace LMI board.
E19	Reference and/or supply voltage defective	<ul style="list-style-type: none"> • The supply voltage is incorrect for one of the sensors (DAV, LWG) • Electronic component is defective 	<ul style="list-style-type: none"> • Check the voltages on the LMI main board MP0(AGND) to MP1, MP2, & MP3(supply voltages). Refer to Section 2. Check sensors, plugs and cables, replace, if need be. • Replace LMI main board
E21	Upper limit value for measuring channel "length telescopic boom" exceeded.	<ul style="list-style-type: none"> • Length sensor pot defective. • Electronic part in the measuring channel defective. 	<ul style="list-style-type: none"> • Replace length sensor potentiometer. • Replace LMI board.
E22	Upper limit value in measuring channel "pressure piston side" has been exceeded	<ul style="list-style-type: none"> • refer to E12 	<ul style="list-style-type: none"> • refer to E12
E23	Upper limit value in measuring channel "pressure rod side" has been exceeded.	<ul style="list-style-type: none"> • refer to E12 	<ul style="list-style-type: none"> • refer to E12
E25	Upper limit value in measuring channel "angle main boom" exceeded	<ul style="list-style-type: none"> • Angle sensor defective. • Electronic part in the measuring channel defective. 	<ul style="list-style-type: none"> • Replace angle sensor. • Replace LMI board.
E31	Error in the system program	<ul style="list-style-type: none"> • The system program PROM is defective. 	<ul style="list-style-type: none"> • Replace system program EPROM (EPROM D7) Refer to Section 16.

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E38	System program and data EPROM do not match.	<ul style="list-style-type: none"> The system program in the LMI does not match to the programming in the data EPROM 	<ul style="list-style-type: none"> Replace the system program EPROM (D7) or the data EPROM (D1) Refer to Section 16.
E39	System program and TLK EPROM do not match	<ul style="list-style-type: none"> The system program in the LMI and the programming in the TLK EPROM do not match. 	<ul style="list-style-type: none"> Replace system program EPROM (D7) or TLK EPROM (D2). Refer to Section 16.
E41	Error in the internal write/read memory (RAM) of the computer component 80C537	<ul style="list-style-type: none"> Computer component 80C537 defective CPU module defective Processor board defective. 	<ul style="list-style-type: none"> Replace computer component 80C537. Replace CPU module. Replace processor board with CPU module.
E42	Error in the external write/read memory, 1st part (RAM)	<ul style="list-style-type: none"> Write/read memory (CMOS RAM) or processor board defective. 	<ul style="list-style-type: none"> Replace processor board with CPU module.
E43	Error in the external write/read memory, 2nd part (RAM)	<ul style="list-style-type: none"> refer to E42 	<ul style="list-style-type: none"> refer to E42
E45	Redundancy error in the A/D conversion	<ul style="list-style-type: none"> The A/D converter on the processing board and the redundant A/D converter in the CPU 80C537 provide different results. 	<ul style="list-style-type: none"> Replace processor board.
E46	Error in the A/D converter uPD 7004 of the processor board.	<ul style="list-style-type: none"> No acknowledgment of the A/D converter uPD 7004 	<ul style="list-style-type: none"> Replace processor board.

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E47	<p>Error in the monitored write/read memory.</p> <p>The CRC verification of the monitored write/read memory provides an incoherent result</p>	<ul style="list-style-type: none"> • The CRC sign of the monitored write/read memory is wrong • The buffer battery is discharged (< 2V at 1kOhm). • Processor board defective. 	<ul style="list-style-type: none"> • Restart the LMI • Replace buffer battery on the LMI main board • Replace processor board.
E48	<p>Cyclic RAM test: error in the internal write/read memory (RAM) of the computer component 80C537</p>	<ul style="list-style-type: none"> • Computer component 80C537 defective • CPU module defective • Processor board defective. 	<ul style="list-style-type: none"> • Replace computer component 80C537. • Replace CPU module • Replace processor board with CPU module.
E51	<p>Error in the crane data EPROM or EEPROM.</p>	<ul style="list-style-type: none"> • No valid data in the crane data EEPROM. • Memory module wrongly bridged. • Crane data EPROM defective 	<ul style="list-style-type: none"> • Load crane data EEPROM containing valid data. • Bridge memory module acc. to memory type • Replace crane data EPROM (D1) Refer to Section 16.
E52	<p>Error in load chart PROM.</p>	<ul style="list-style-type: none"> • Memory module wrongly bridged. • Load chart EPROM defective. 	<ul style="list-style-type: none"> • Bridge memory module acc. to memory type. • Replace load chart EPROM (D2) Refer to Section 16.
E56	<p>Error in crane data EEPROM.</p>	<ul style="list-style-type: none"> • Memory module wrongly bridged. • Crane data EEPROM defective 	<ul style="list-style-type: none"> • Bridge memory module acc. to memory type • Replace crane data EEPROM (D1) Refer to Section 16.

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E57	Error in serial crane data EEPROM.	<ul style="list-style-type: none"> Serial crane data EEPROM does not contain valid data. Memory module defective 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> No valid data in the serial analog data EEPROM. LMI main board defective. 	<ul style="list-style-type: none"> Write data on the serial analog data EEPROM by means of the test program, then, restart the LMI Replace LMI main board.
E80	Error in piston-side pressure transducer	<ul style="list-style-type: none"> Pressure offset value out of specification 	<ul style="list-style-type: none"> Check zero point of pressure transducer (Ensure no residual pressure at transducer during zeroing procedure). Pressure transducer defective, replace and zero transducer.
E81	Error in rod-side pressure transducer	<ul style="list-style-type: none"> refer to E80 	<ul style="list-style-type: none"> refer to E80
E84	Wrong rigging condition.	<ul style="list-style-type: none"> The selected rigging condition is not contained in the data EPROM. 	<ul style="list-style-type: none"> Select another rigging condition Check the programming in the data EPROM.
E85	Error in the radius determination	<ul style="list-style-type: none"> The computed radius is too small (negative deflection) 	<ul style="list-style-type: none"> Check the programming in the data EPROM.

ERROR CODE LIST - continued

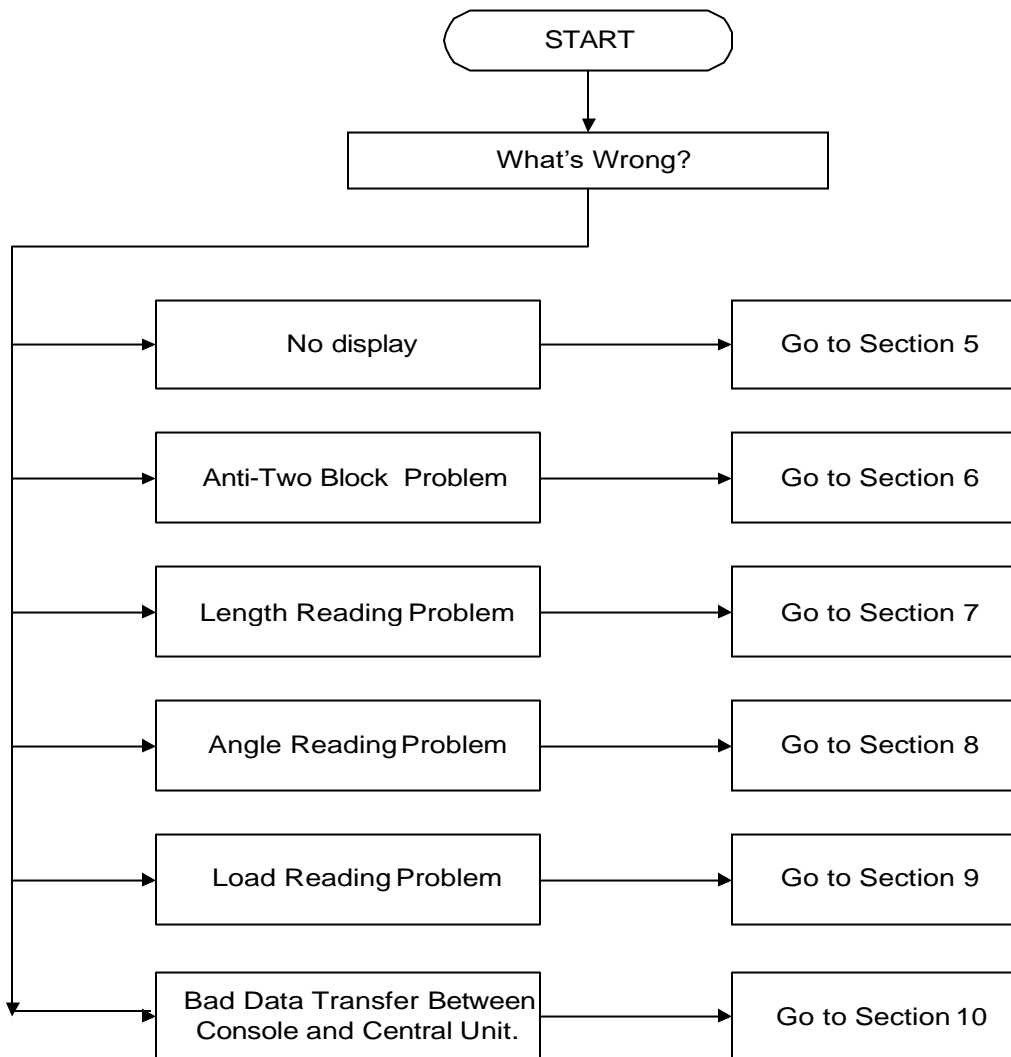
Error Code	Error	Cause	Elimination
E91	No data transmission from the console to the central unit	<ul style="list-style-type: none"> • 24 V supply of the console is interrupted • Interruption or accidental ground in the line between console electronics and central unit • Transmitter/receiver module is defective 	<ul style="list-style-type: none"> • Check 24 V at terminal X1 of the console electronics • 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. • Exchange console electronics or LMI main board resp.
E92	Error in the data transmission from console to central unit	<ul style="list-style-type: none"> • Loose connection in the line between console electronics and central unit • Transmitter/receiver module is defective 	<ul style="list-style-type: none"> • Check the connection between console electronics and central unit <ul style="list-style-type: none"> • Exchange console electronics or LMI main board resp.
E93	Error in the data transmission from the central unit to the console	<ul style="list-style-type: none"> • refer to E92 	<ul style="list-style-type: none"> • refer to E92

ERROR CODE LIST - continued

Error Code	Error	Cause	Elimination
E94	No data transmission from the central unit to the console	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Electro-magnetic interferences (e.g. when switching contacts or valves) 	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Replace console electronics or LMI main board • Replace processor board. • Eliminate the source of interferences by inverse diodes or varistors.
E95	Error in the console EPROM	<ul style="list-style-type: none"> • The console EPROM is defective. 	<ul style="list-style-type: none"> • Replace the console EPROM
E96	Error in the internal RAM of the console.	<ul style="list-style-type: none"> • The CPU of the console is defective. • The console main board is defective. 	<ul style="list-style-type: none"> • Replace the CPU of the console • Replace the console main board.

4. TROUBLESHOOTING FLOW CHART

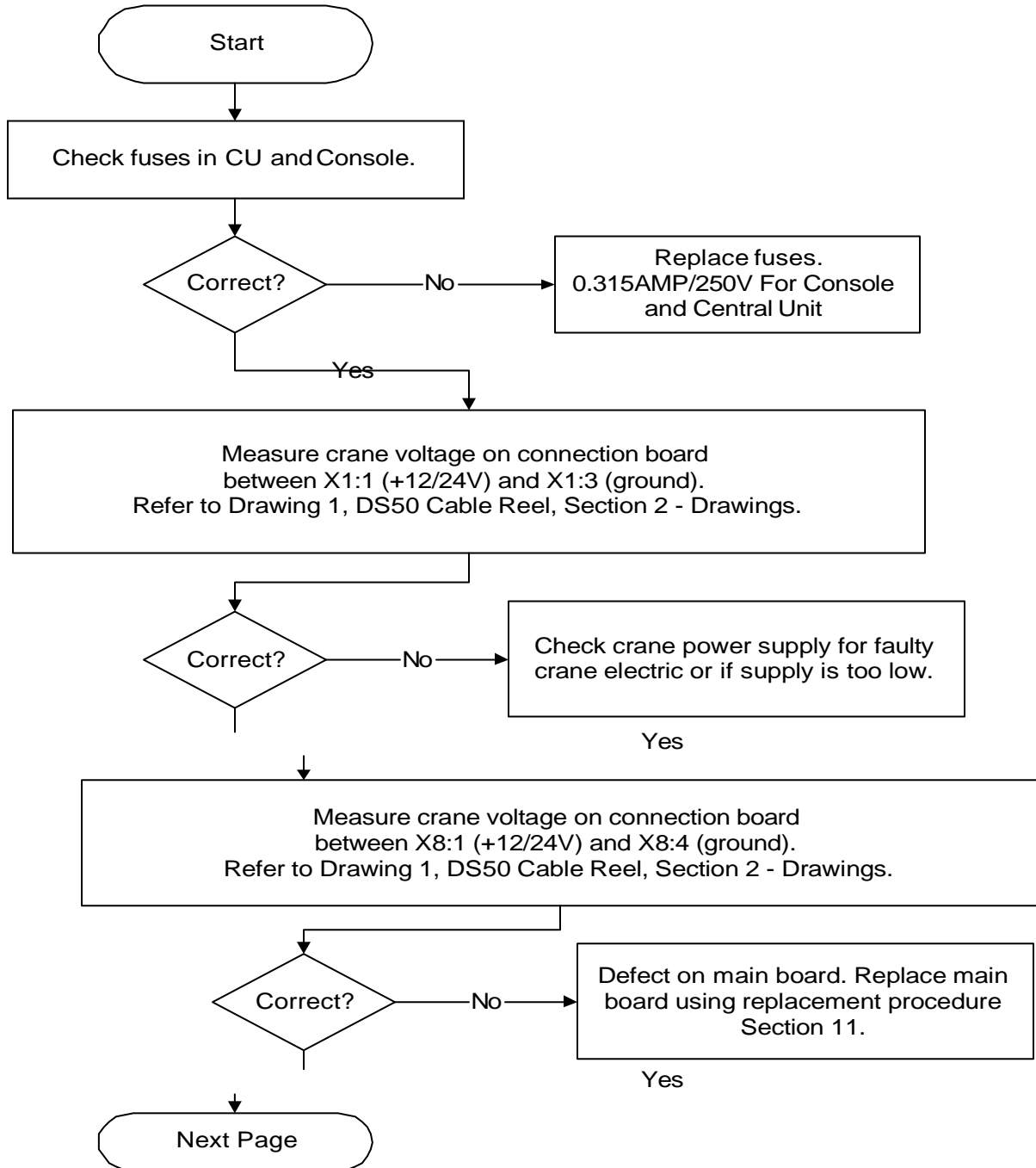
This section explains how to handle a problem that may arise with the DS50, PAT Load Moment Indicator System. The procedures are easy to follow and are given in flowcharts on the following pages. Start with the general flowchart below which will guide you to one of the detailed flowcharts shown in Sections 4 through 10. This section also contains the necessary drawings needed for troubleshooting.



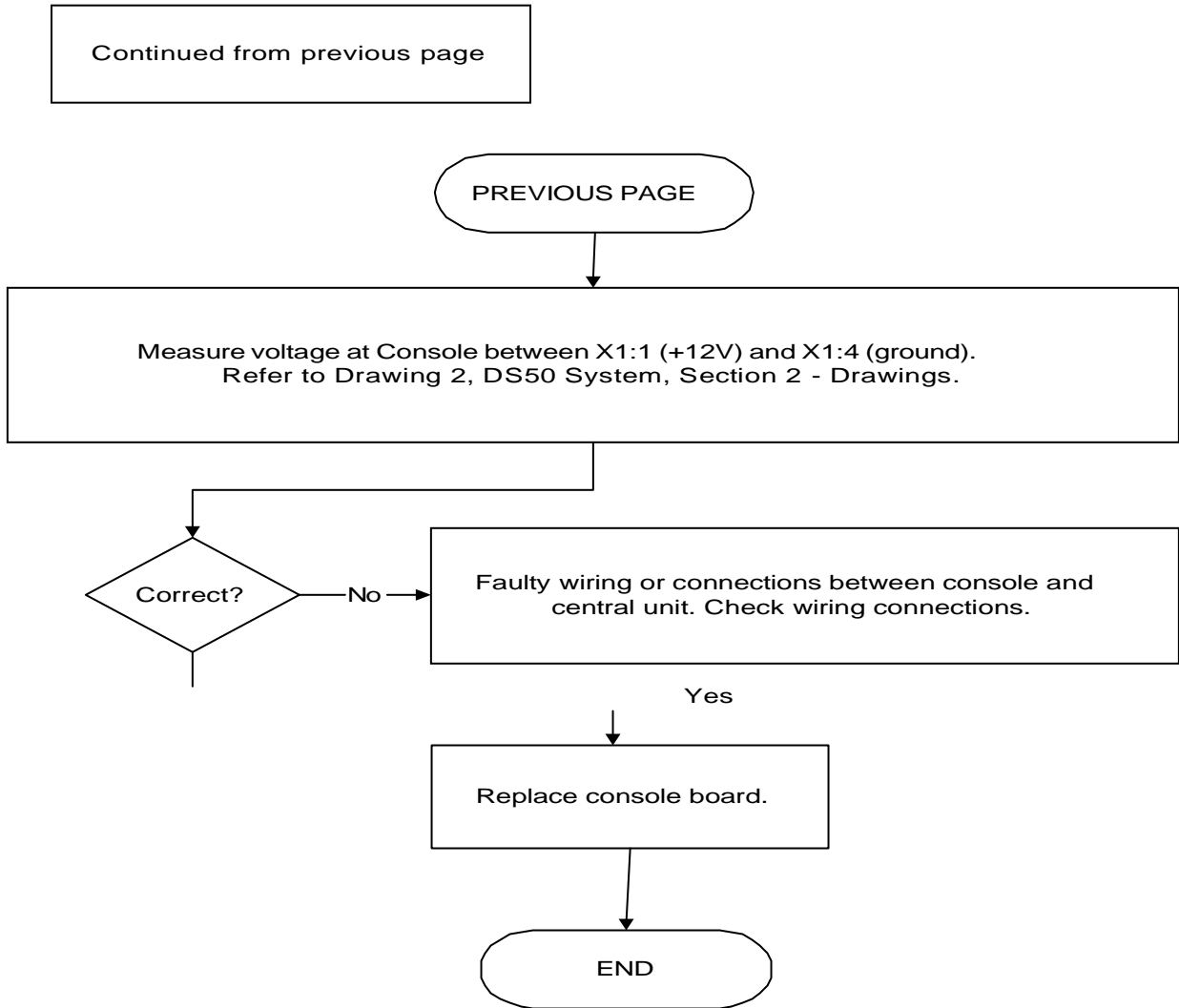
The drawings in Section 2 are provided as reference material that will be used in the troubleshooting flow charts. Use the drawings in conjunction with the flow charts to help understand the operation of the DS50 system.

5. NO DISPLAY

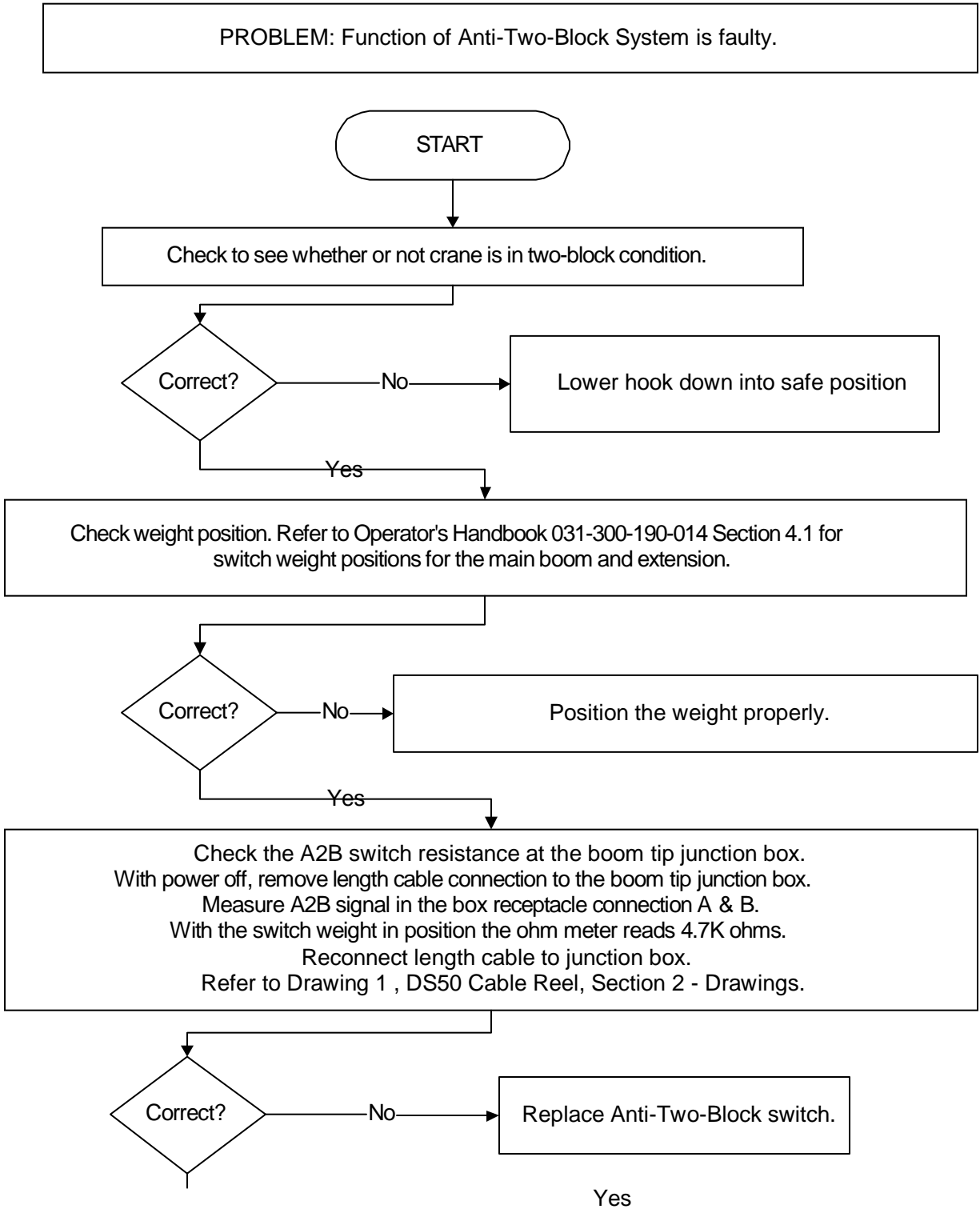
PROBLEM: Blank console display with no warning light shown.
All crane movements have been stopped.



5. NO DISPLAY -continued

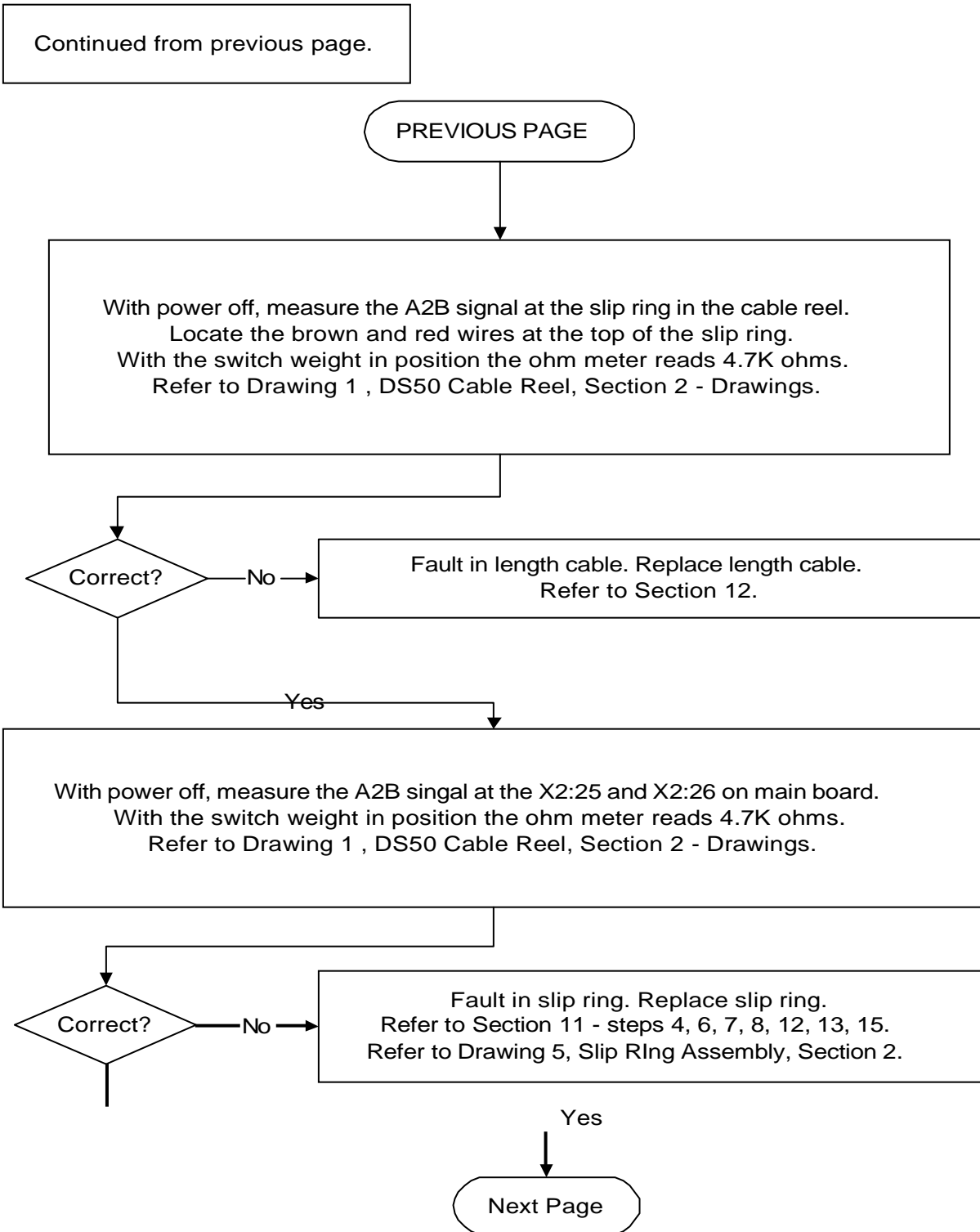


6. ANTI TWO BLOCK PROBLEM



Next Page

6. ANTI TWO BLOCK PROBLEM - continued

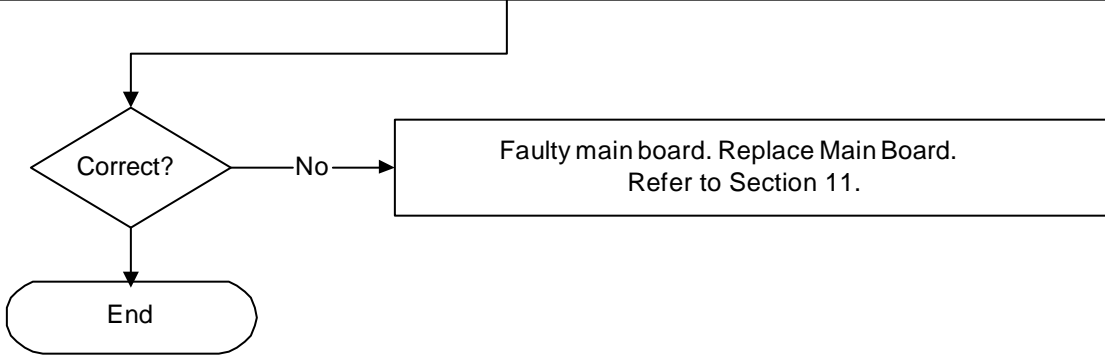


6. ANTI TWO BLOCK PROBLEM - continued

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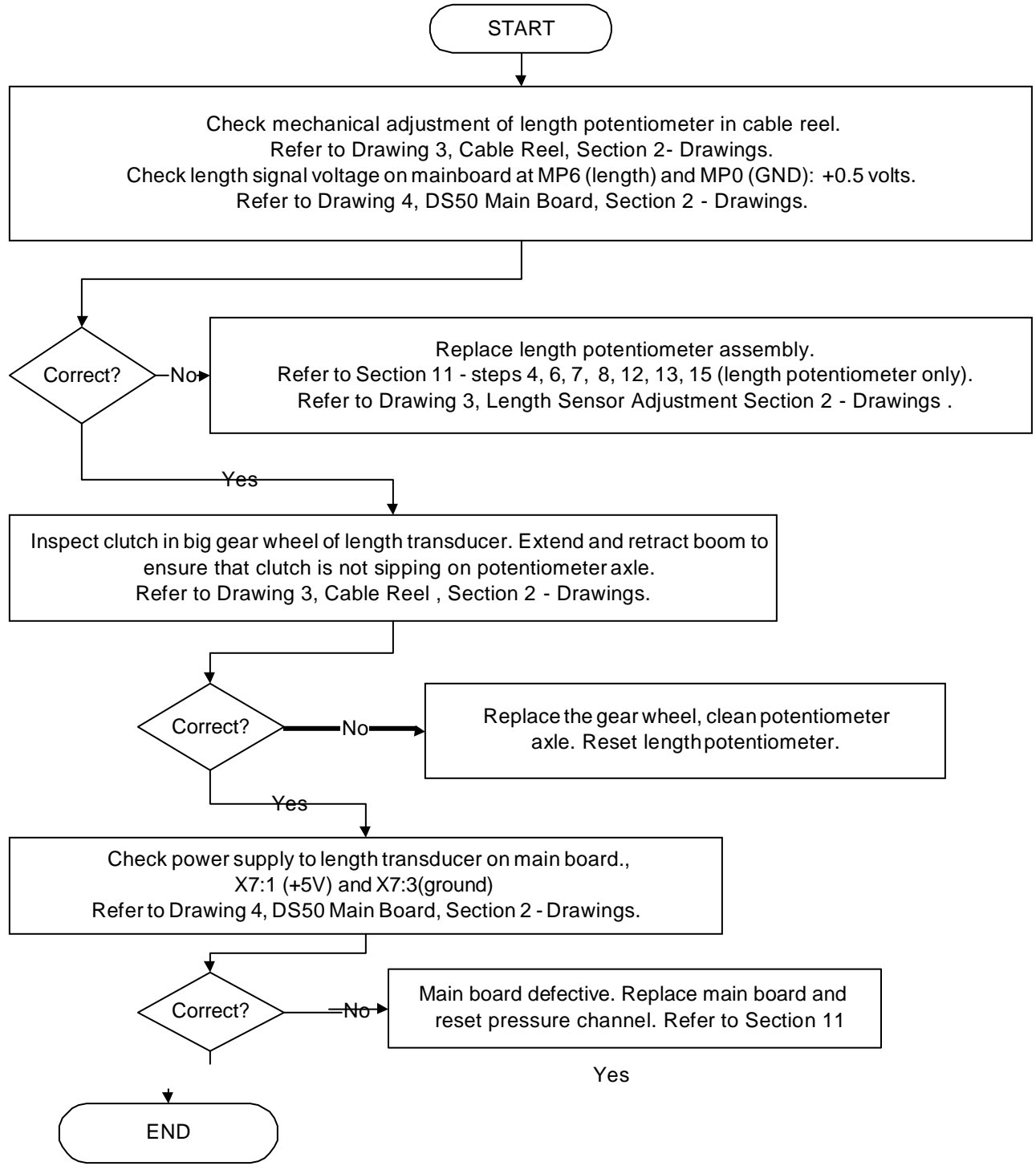
PREVIOUS PAGE

With power on and the switch weight in position,
check LED H4 and H9 are off.
Refer to Drawing 4 , DS50 Cable Reel, Section 2 - Drawings..



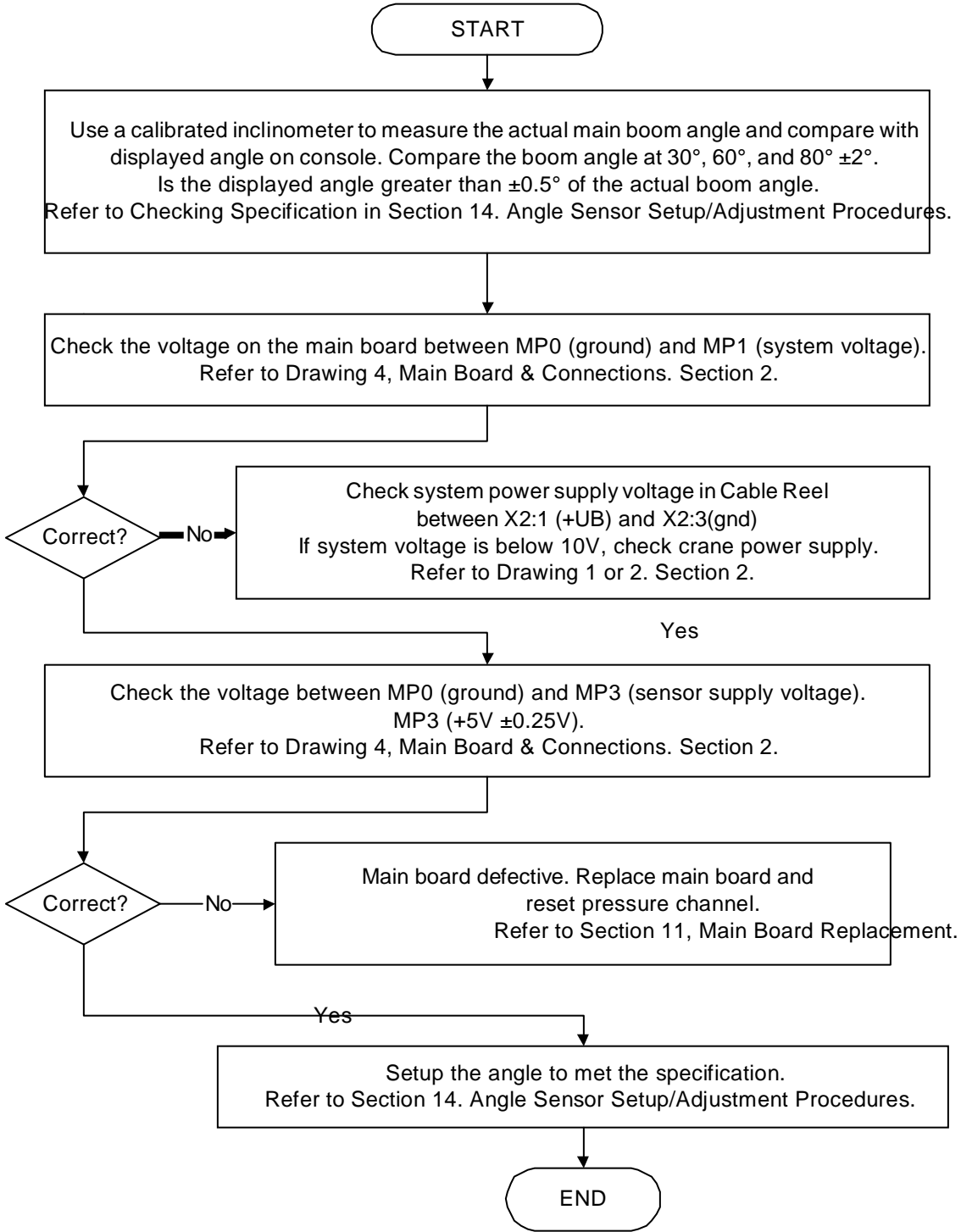
7. LENGTH READING PROBLEM

PROBLEM: Displayed Length Incorrect. Actual measured length is different from displayed length.

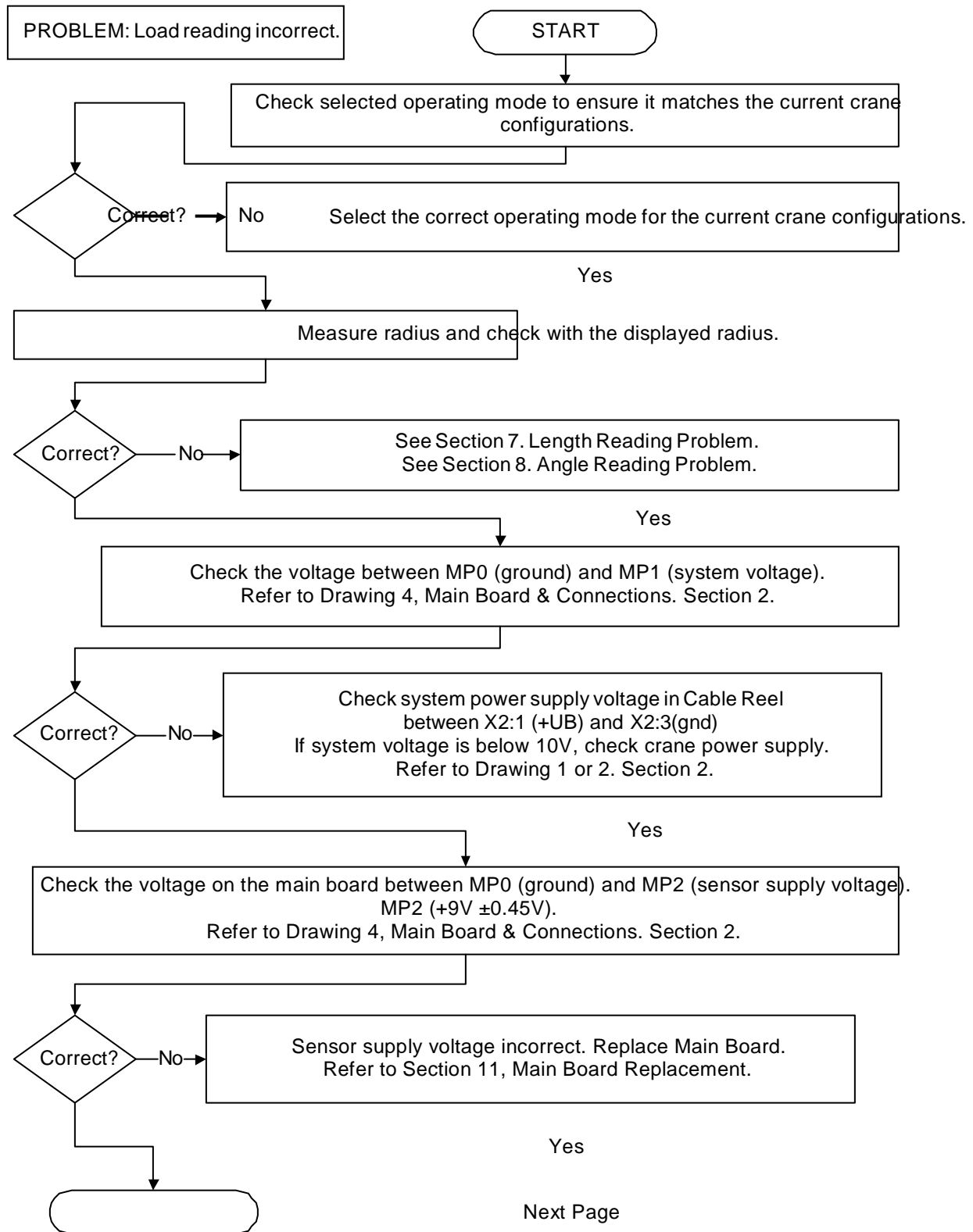


8. ANGLE READING PROBLEM

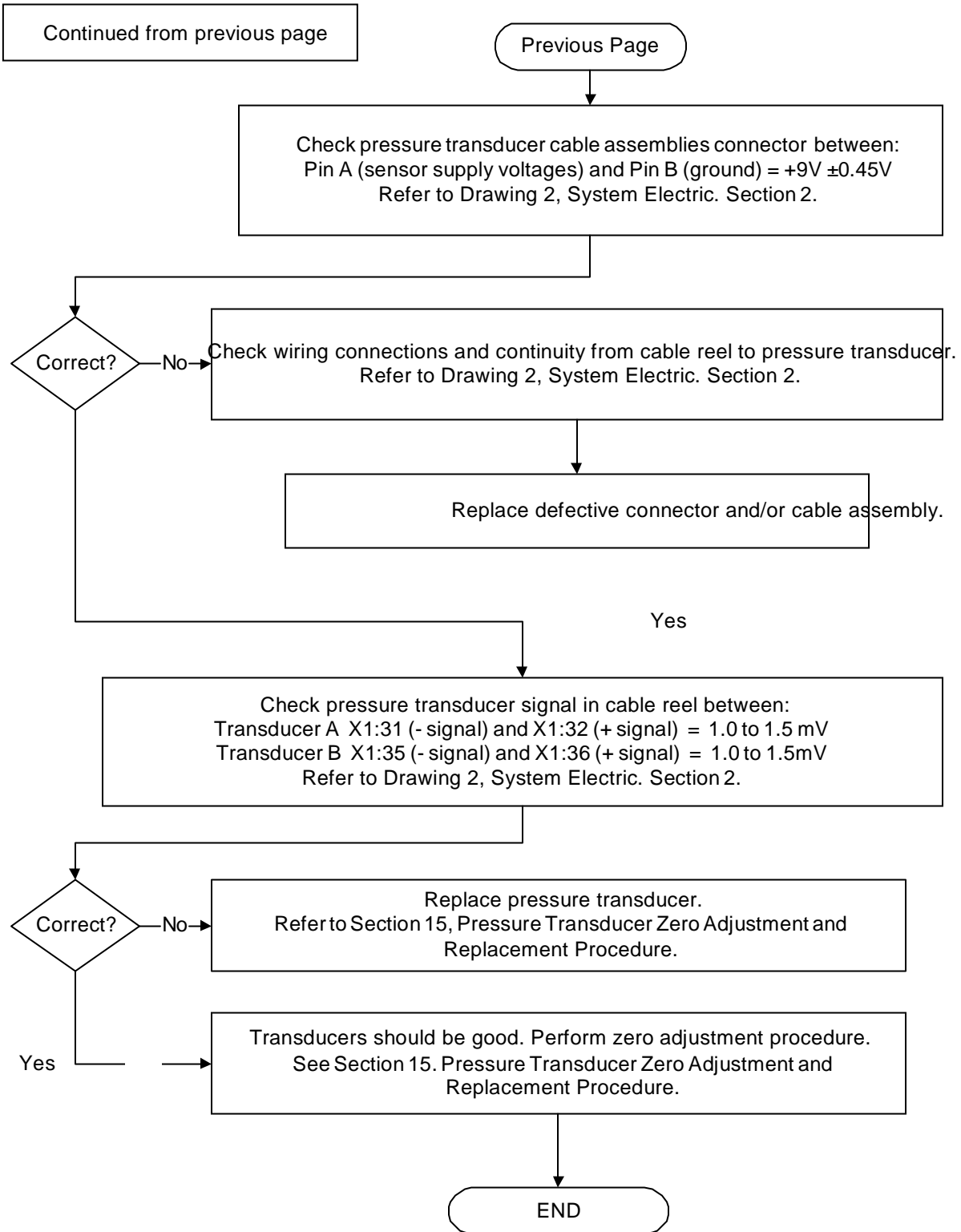
PROBLEM: Displayed Angle Incorrect. Actual measured angle is different from displayed angle.



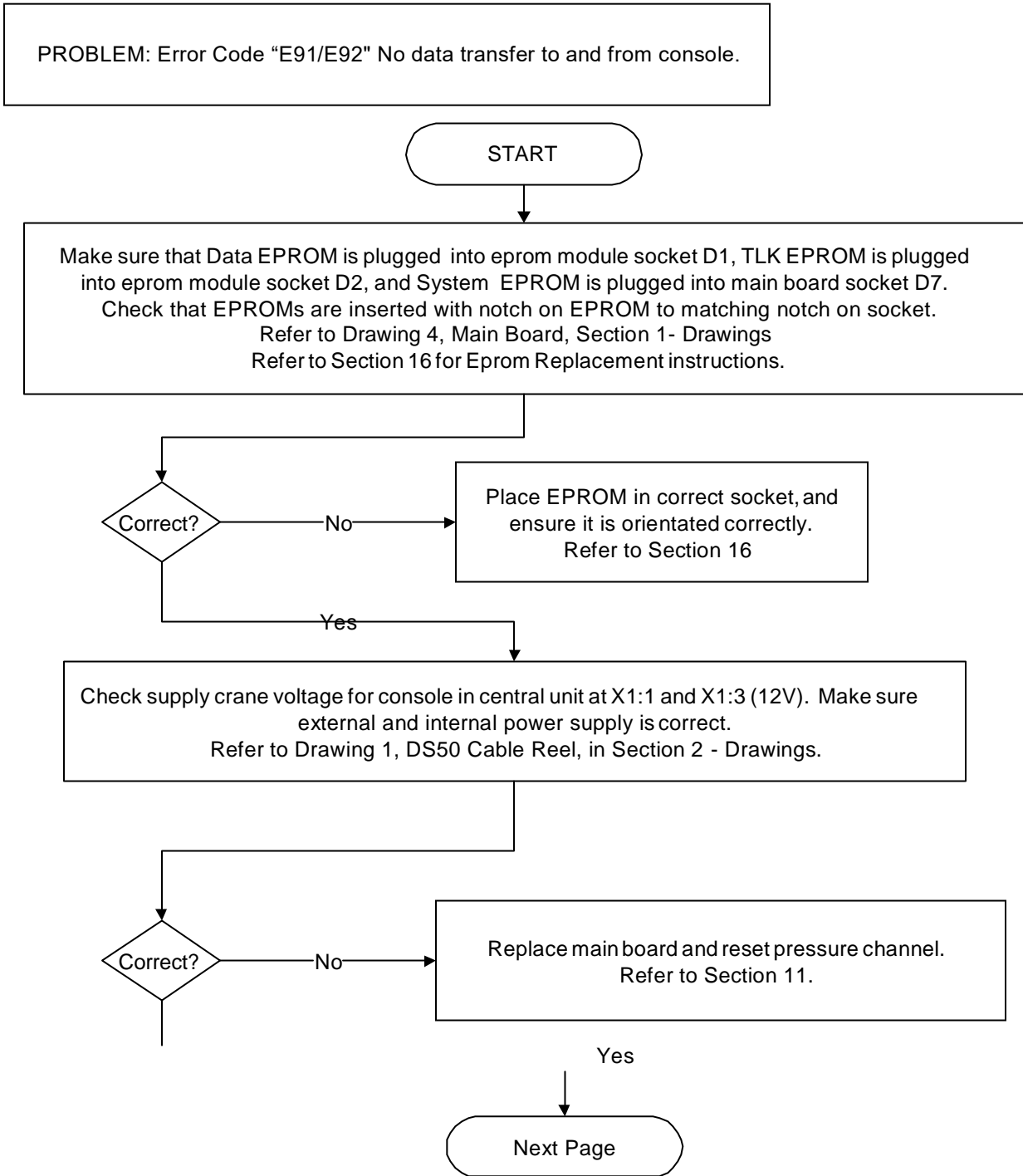
9. LOAD READING PROBLEM



9. LOAD READING PROBLEM - continued

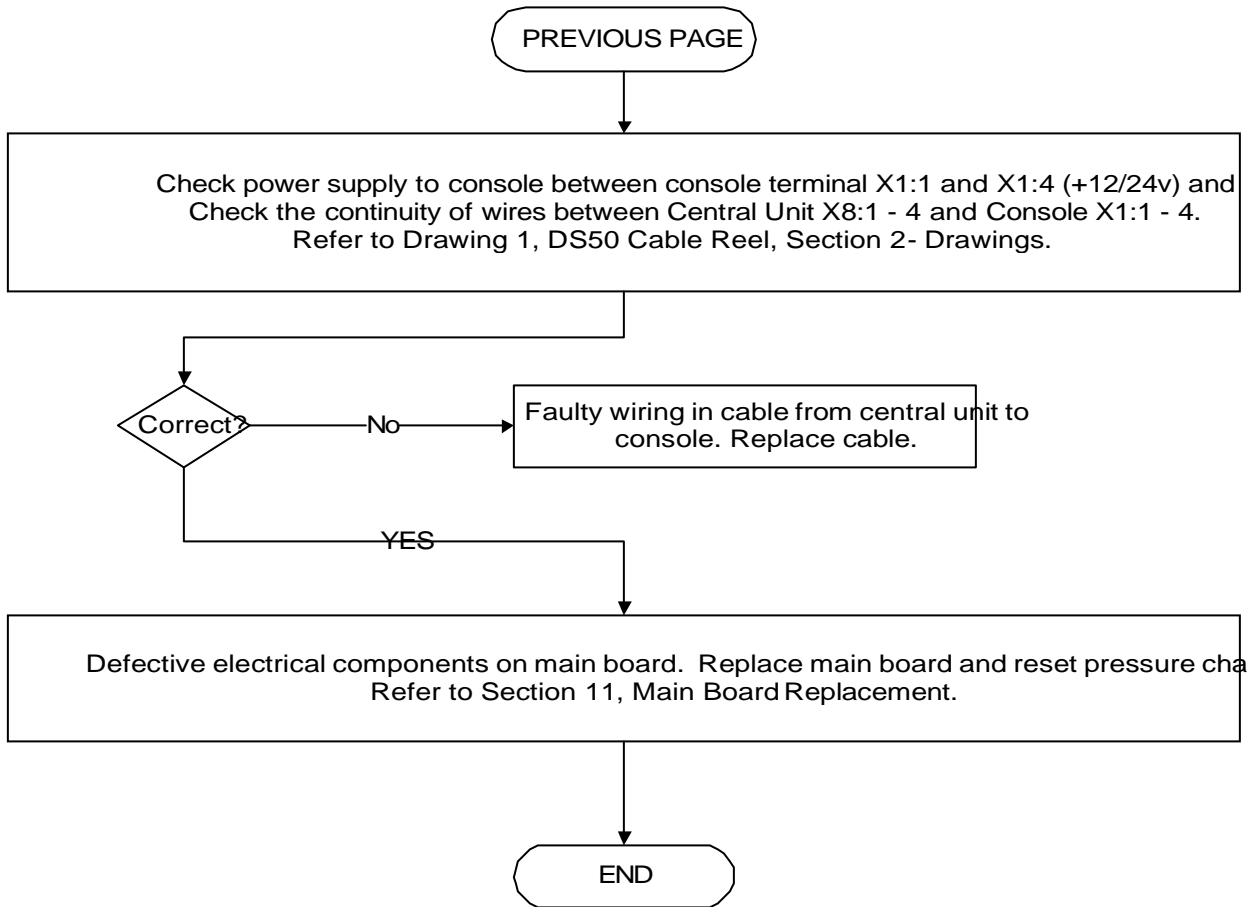


10. BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT



10. BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT - continued

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11. MAIN BOARD REPLACEMENT PROCEDURE

This section explains the replacement of the main board in the event of defect. Only when the adjustment and tests have indicated failed components, should you proceed with this section. Refer to Drawing 3, Section 2, to help locate parts.

1. Retract the boom fully. Refer to the manufactures operators manual and familiarize yourself with its operation and the LMI bypass. Lower the boom to gain access to the DS 50 system.

2. Switch crane power off.

- 1 Remove the cable reel cover face by loosening all 10 screws. The screws should remain secured to the lid.

CAUTION: Use care and minimal force when removing the wire ends and terminals from the connections.

1. Remove all connections located at X-1, X-2, X-7 and X-8. Check the wires to ensure they are numbered, this will allow a easier installation.

2. Remove the two screws that secure the EPROM module and remove it.

3. Remove the two screws that secure the gear wheel guard rail.

4. Remove the 4 screws holding the slip ring/length sensor mounting plates.

5. Remove slip ring and length sensor assemblies.

CAUTION: Use care while removing the screws as a slip of your screw driver can cause serious damage to the surface of the board and may even cut critical electronic traces.

6. Locate the 8 Philip screws that secure the main board to the cable reel housing and carefully remove them.

7. Install new main board and replace the 8 Philip screws

8. Reconnect wires as labeled in Step 4.

Setup angle by using procedure in Section 15. Refer to Section 8 if angle is incorrect.

9. Replace the length sensor and slip ring assemblies.

10. Zero the length sensor and check actual length equals displayed length, refer to Drawing 3 - Section 2. Refer to Section 7 if length is incorrect.

11. Zero the pressure transducers, refer to Section 15.

12. Replace the cable reel cover face and tighten the 10 screws.

12. LENGTH CABLE REPLACEMENT PROCEDURE

WARNING

The cable drum is under high tension. Do not let the length cable spool back without supporting the cable and leading it back on the drum. Pay attention and watch that the wraps do not pile up on one side. De-spooling of the length cable can cause damage to the length sensor. Spooling the length cable without additional support may result in injury or damage. Use caution and protection when working with the length cable under high tension.

Replace length cable using the following procedure:

1. Retract the boom fully. Refer to the manufactures operators manual and familiarize yourself with its operation and the LMI bypass. Lower the boom to gain access to the DS 50 system.
 2. Switch crane power off.
 3. Disconnect damaged length cable from junction box at the boomnose.
4. Remove the cable reel cover face by loosening all 10 screws. The screws should remain secured to the lid.

CAUTION: Use care and minimal force when removing the wire ends and terminals from the connections.

5. Remove all connections located at X1, X2, X7, and X8. Check the wires to ensure they are numbered, this will allow a easier installation.
6. Open the strain relief for the 10 and 7 conductor cables and pull the of cables out of the cable reel.
 7. Remove cable reel from mounting brackets.
8. Remove all conductors from X1 and X2 of the slip ring terminal. Refer to Drawing 2 and 3 in Section 2.
 9. Cut old cable at the back side of the cable drum and remove cable.
10. 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.
11. 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.
12. Reconnect the length cable to the slip ring terminal. Refer to Drawing 1 in Section 2.
 13. Remount cable reel to the boom.
 14. Turn reeling drum clockwise to spool the new cable neatly onto the drum.
 15. Set preload on cable reel by turning the drum counter-clockwise 5 to 8 turns.

16. Anchor cable at boom point.

12. LENGTH CABLE REPLACEMENT PROCEDURE - continued

17. Connect the length cable into the boom tip junction box. Refer to Drawing 2 in Section 1.
18. Fully retracted boom and reset length potentiometer by turning potentiometer carefully counter-clockwise until it stops. Refer to Drawing 3 in Section 2. Check displayed length. Refer to Section 7 if length is incorrect.
19. Check the angle. Use a calibrated inclinometer to measure the main boom angle and compare with displayed angle on console. Adjust the cable reel housing if necessary. Loosen the mounting bolts holding the cable reel to the boom. One of the mounting brackets is slotted which will allow the cable reel to be adjusted on the boom until the displayed angle is equal to or 2 degrees less than the actual (measured) boom angle. Refer to Section 8 if angle is incorrect.
20. Verify A2B operation. Refer to Operator's Handbook 031-300-190-014 Section 5.

13. LENGTH SENSOR REPLACEMENT PROCEDURE

This section explains the replacement of the length potentiometer in the event of defect.
Refer to Drawing 3 in Section 2.

CAUTION: The length potentiometer is an electronic component and not designed to withstand large forces or moments. Carefully adjust the potentiometer only when instructed in this manual. Take special care when you approach the stops on either end. The clutch o-rings are lubricated by PAT to prevent the o-ring from seizing on the potentiometer shaft.

1. Retract the boom fully. Refer to the manufactures operators manual and familiarize yourself with its operation and the LMI bypass. Lower the boom to gain access to the DS 50 system. Switch crane power off.
2. Remove the cable reel cover face by loosening all 10 screws. The screws should remain secured to the lid.
 3. Remove wires # 1, 2, and 3 from the main board X7 terminal connections.
 4. Remove length sensor assembly. Refer to Drawing 3 in Section 2.
 5. Remove the two screws that secure the gear wheel guard rail.
6. Remove the gear wheel from the potentiometer axle by pulling it straight out with your fingers.
 7. Remove the 2 screws holding the mounting plate of the length sensor assembly.
 8. Now remove the retainer nut at the center of the length potentiometer shaft.
9. Mount the new length potentiometer in the same location and position as the one you removed. Pay attention to the locking washer. The pin of the washer must recess in the hole provided in the mounting bracket to avoid movement of the potentiometer body during operation. Use caution when tightening the potentiometer nut. Do not over-torque the nut.
 10. Carefully slide the large white nylon gear wheel onto the potentiometershaft.
11. Install the new length potentiometer assembly by securing the mounting plate with the 2 Phillips screws.
 - Check to ensure the gears mesh and are aligned.
 - Ensure that the grounding wire is also reconnected at the lower right mounting screw.
12. Reconnect wires # 1, 2 and 3 to the corresponding X7 of main board. (Be sure that wires are secured in a way that they cannot become caught in the gear wheel).

14. ANGLE SENSOR SETUP/ADJUSTMENT PROCEDURE

The following procedure should be used to set the angle for the DS50 system.

Purpose:

The purpose for the DS50 angle setup procedure is to mechanically align the angle sensor with the boom.

Procedure Summary:

To achieve the best accuracy in the machine's typical working area, the displayed angle needs to match the actual angle at or near 45° rather than at 0°. To match the displayed and actual angle at 45°, the cable reel would need to be mechanically adjusted at 45°; however, the physical location of the cable reel prevents this direct action. Therefore, the procedure first matches the displayed to the actual angle at 0°. Then booms up to 45° to determine the difference between the displayed and actual angle. The angle difference found is used to adjust the cable reel angle at 0° where it is physically possible, so the displayed and actual angles match at 45°. After completing the setup procedure, check to ensure the displayed angle meets the specification.

Equipment:

Calibrated inclinometer to determine actual boom angle.

Specification:

The angle is in tolerance when the displayed angle is within $\pm 0.5^\circ$ of the actual boom angle throughout the working range of the boom.



The responsibility for the safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

NOTE: During the angle setup procedure, the boom should be fully retracted and have no load on the hook block.

Setup Procedure:

1. Move the boom angle between -2 to 2 degrees using the inclinometer as reference to actual angle.
2. Adjust the cable reel so the displayed boom angle matches the actual angle. Adjust the cable reel by loosening the mounting bolts holding the cable reel to the boom. The mounting brackets are slotted to allow for adjustment.

3. Move the boom angle between 43° to 47° using the inclinometer as reference to actual angle. The cable reel is mechanically set if the displayed angle is neither greater than nor 0.3 degrees less than the actual boom angle. Go to the end of this procedure and check the specification of the angle sensor.

4. Determine the angle offset value by subtracting the displayed angle from the actual angle.

offset value = actual angle - displayed angle

Example: actual angle 45.6°

displayed angle 46.0°

offset value = 45.6 - 46.0 = -0.4

5. Move the boom angle to -2 to 2 degrees using the inclinometer as reference to actual angle.

6. Determine the adjusted angle by adding the offset value found in Step 4 to the actual angle.

adjusted angle = actual + offset value

Example: actual angle 0.3°

offset value -0.4

adjusted angle = 0.3 + -0.4 = -0.1

7. Adjust the cable reel so the displayed boom angle matches the adjusted angle. Adjust the cable reel by loosening the mounting bolts holding the cable reel to the boom. The mounting brackets are slotted to allow for adjustment.

8. Move the boom angle between 43° to 47° using the inclinometer as reference to actual angle. The cable reel is mechanically set if the displayed angle is neither greater than nor 0.3 degrees less than the actual boom angle. Check the specification of the angle sensor using the table below.

9. If the setup is not complete repeat steps 4 through 8.

Checking Specification:

Move the boom to the angles shown in the following table. Check the displayed angle to the inclinometer as reference to actual angle. If the displayed angle is greater than ±0.5° of the actual boom angle, the main board needs to be replaced.

Boon Position	Actual Angle	Displayed Angle
30° ±2		
60° ±2		
80° ±2		

Refer to Section 11 of this handbook for main board replacement.

15. PRESSURE TRANSDUCER ZERO ADJUSTMENT AND REPLACEMENT PROCEDURE

Follow this procedure to zero adjust and/or replace the pressure transducers on the DS50 with software L52SV1.0I or older (i.e. V1.0J...K).

1. Retract the boom fully. Refer to the manufactures operators manual and familiarize yourself with its operation and the LMI bypass. Lower the boom to ensures zero pressure on the lift cylinder and to gain access to the DS 50 system.
 2. Switch crane power off.

CAUTION: Be aware that trapped pressure can still be present and care should be taken when loosening any hydraulic fitting!

3. Disconnect the hydraulic lines connected to the pressure transducers, these are located in the lower turn table.
4. Remove the cable reel cover face by loosening all 10 screws. The screws should remain secured to the lid.
5. Move the Bridge to position BR4 of the Eprom module attached to the main board. See Section 2 Drawing 4 of EpromModule.

CAUTION: Do not start the crane while hydraulic lines are disconnected!

6. Turn power on to the *SYSTEM*, **ONLY**, see Operating Handbook for start up procedure.
7. Check the '9' (piston pressure) or '0' (rod pressure) values on the display. See Section 3. Troubleshooting using the Console
Tolerances for the pressure transducer:
 - Replace transducer, if the '9' or '0' value is outside ± 7.5 bar (2.5% of operating range)
 - Zero transducer, if the '9' or '0' value is within ± 7.5 bar range.
 - Transducer OK, if the '9' or '0' value is within ± 0.5 bar range.
8. Turn system power off. If transducer replacement is necessary, replace at this time.
9. Move the Bridge to position BR3 of the Eprom module attached to the main board. See Section 2 Drawing 4 of EpromModule.
10. Turn power on to the *SYSTEM*, **ONLY**, see Operating Handbook for start up procedure.

**15. PRESSURE TRANSDUCER ZERO ADJUSTMENT AND REPLACEMENT
PROCEDURE - continued**

11. Switch to the programming/sensor signal adjustment procedure:

Display:

12.4:XX.X

The display will show the utilization screen. This utilization allows the operator to know system ready and working correctly.

Key



13. Zero piston side Pressure

This adjustment requires no pressure on the transducer.

Display:

14.9:XXXX



XXXXX = pressure piston side

To skip the pressure piston side adjustment: **Key**



Adjust pressure piston side:

This adjustment requires no pressure on the transducer.

Use **Keys**  and  to set the display of pressure piston side to zero.

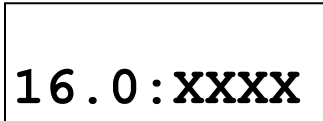
If the '9' value is outside ± 7.5 bar, the system will display an E80 error code. Ensure no residual pressure at transducer. If not turn power off, replace transducer and go to step 10 of this procedure.

Press **Key**  to confirm and proceed

**15. PRESSURE TRANSDUCER ZERO ADJUSTMENT AND REPLACEMENT
PROCEDURE - continued**

15. Zero rod side Pressure

Display:



XXXXX = pressure rod side



To skip the pressure rod side adjustment:

Key



Adjust pressure rod side:

This adjustment requires no pressure on the transducer.

Use **Keys**  and  to set the display of pressure rod side to zero.

If the '0' value is outside ± 7.5 bar, the system will display an E81 error code. Ensure no residual pressure at transducer. If not turn power off, replace transducer and go to step 10 of this procedure.

Press **Key**  to confirm

17. Turn off power to the system.

18. Move the Bridge to BR4 for additional displays for troubleshooting. See Section 3. Troubleshooting using the Console and Section 2 Drawing 4 of Eprom Module.

19. Test the system by turning power on to the *SYSTEM*, **ONLY**.

20. Scroll through the displays and verify the following:

9: 0.0

0: 0.0

NOTE: If the displayed readings are incorrect repeat zeroing procedure.

21. Turn off power to the system.

22. Move the Bridge to BR1 for normal LMI operation. See Section 2 Drawing 4 of Eprom Module.

23. Reconnect the hydraulic lines to the pressure transducers.

24. Slowly bleed any air from the hydraulic hoses.

25. Recheck load indication with certified tests weights. Refer to Operator's Handbook

16. SOFTWARE/EPROM REPLACEMENT PROCEDURE

Instructions for replacement of System, Data (DAT) or Loadcurve (TLK) EPROM's. When replacing Eproms, ensure the correct software and version are used. Contact supplier and/or SkyAzúl if there is a question or concern. The Data and Loadcurve Eproms are different for each crane serial number. Therefore, may require calibration and/or calibration verification after replacing these eproms.

1. Retract the boom fully. Refer to the manufactures operators manual and familiarize yourself with its operation and the LMI bypass. Lower the boom to gain access to the DS 50 system. Switch crane power off.
 2. Switch crane power off.
3. Remove the cable reel cover face by loosening all 10 screws. The screws should remain secured to the lid.
4. Remove the desired EPROM from the module (See Drawing 4, Main Board in Section 2). Using a locally available semiconductor extraction tool to remove the EPROM by pulling it straight out from socket.
 5. Inspect the new EPROM:
 - Inspect the EPROM legs to ensure they are not bent or broken off.
 - The notch on the EPROM always goes towards the top.
 - The EPROM will not fill each hole in the socket. Therefore the EPROM should be placed as to fill the bottom most sockets first. Any empty sockets should be at the top.
 6. Insert the new EPROM into the now empty socket.
7. Inspect the EPROM legs to insure that all are properly in place and that none have been bent during insertion.
 8. Switch system power on and check for operation.
9. Replace cable reel cover.

Additional note:

The EPROM is a sensitive device and can be damaged if not handled properly. To prevent damage discharge any static electricity from body before handling the EPROM's. This can be accomplished by touching a grounded surface.

