PAT America, Inc.

Rheinmetall Elektronik

DS350 G BOOM CONTROL

for
GROVE CRANE
RT865 BXL, TMS 870, TTS 870
WITH 5 SECTION BOOM

TROUBLESHOOTING MANUAL

031-300-190-039 Rev. B 04/30/99

Notice

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1. General Information

The DS 350 load moment indicator (LMI) with boom control extension is designed to aid the crane operator through the crane operations. The DS 350 with boom control extension is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedure.

2. Reference Material

Parts & Installation Manual:

Crane Model	*PAT- Part number*	*Grove- Part number*
TMS/ TTS 870	031-300-150-662	9-333-103129
RT 865 BXL	031-300-150-659	9-333-103-206

Operator's Handbook:

PAT - Part number
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3. Warnings

The DS 350 load moment indicator (LMI) with boom control extension is an operational aid that warns the crane operator when he approaches an overload condition, a two block condition and an out of boom sequence condition. The boom control extension controls the sequence of the boom during operation. It still remains the operator's responsibility to verify the operation and to select the correct mode during crane operations.

The manual mode is a rigging mode. Lifting loads with manual mode programmed is prohibited.

Should an out of sequence condition occur, the crane operator is responsible to select manual mode to return the sections into sequence before continuing the lift.

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

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information provided by the crane and load moment indicator manufacturer.

Proper functioning depends upon proper daily inspection and observance of the operating instructions provided with the crane and load moment indicator.

4. Service and Maintenance

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
   If electrical wiring is damaged, it shall be replaced immediately.

2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

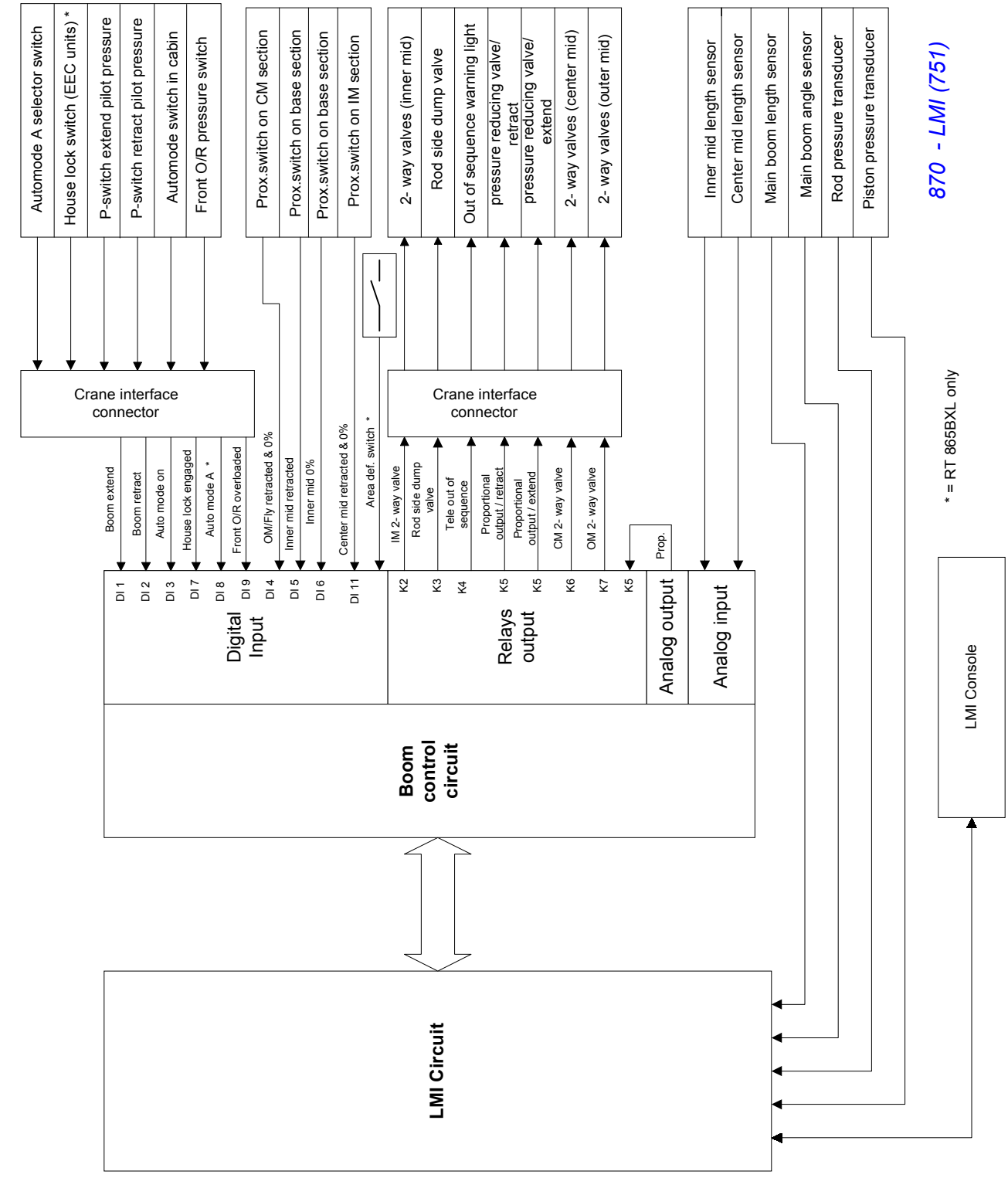
3. Check the anti two-block limit switches for freedom of movement.

4. The cable reel shall be under tension to operate properly.

5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non expert personnel.

5. Boom Control Interface



Drawing 1.

Auto mode / Manual mode:
The operator selects auto mode or manual mode using the rocker switch in the dash board. Auto mode is the working mode and manual mode is used for rigging or sequencing purpose only.

Pilot pressure switch signal / Analog output signal:
Two pressure switches in the pilot pressure circuit are used to distinguish between boom extend or boom retract. The two circuits are wired through the crane interface connector into the DS 350 G central unit.

When the operator extends the boom, the pressure switch signal at central unit terminal A101-X1/38 changes from 0V to +24V. The boom control logic allows electrical current to flow to the extend pressure reducing valve coil. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 800 mA.
To measure the coil current while extending, remove wire #20from central unit terminal A101-X1/63. Connect the Amp-meter in series with wire #20 to terminal X1/63.

When the operator retracts the boom, the pressure switch signal at central unit terminal A101-X1/40 changes from 0V to +24V. The boom control logic allows electrical current to flow to the retract pressure reducing valve coil. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 800 mA.
To measure the coil current while retracting, remove wire #21 from central unit terminal A101-X1/64. Connect the Amp-meter in series with wire #21 to terminal X1/64.

Length sensors:
Three length sensors are mounted to the boom base section to measure the overall length, the inner mid section length and the center mid section length. The software utilizes the signals to calculate the outer mid and fly section length.

Disengage the boom stop to retract the boom completely.

With retracted main boom the overall boom length signal is -500 mV (A101-X1/10). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground. Disengage the boom stop to retract the boom completely.

With retracted main boom the inner mid section length signal is -500 mV (A101-X1/24). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

With retracted main boom the center mid section length signal is -500 mV (A101-X1/73). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

Keep the cable on the length transducer drum spooled properly. A poorly spooled cable may causes the boom to become out of sequence. If the boom becomes out of sequence, select manual mode and correct the length by operating individual sections. Once the sections are sequenced again the operator may return to the automode. Refer to section 9.1 for boom components installation and set up.

Inner mid retract and % reset switch:
The reset- proximity switch on the base section provides a (+24V) signal to central unit terminal A 104 X1/80 when the inner mid section is retracted against the boom stop. The signal resets the inner mid percentage to 1%.

The retract- proximity switch on the base section provides a (+24V) signal to central unit terminal A 104 X1/78 when the inner mid section is fully retracted (disengage the boom stop).

Center mid retract and % reset switch:
The proximity switch on the inner mid section provides a (+24V) signal to central unit terminal A 114 X1/9 when the center mid section is fully retracted. The signal resets the center mid percentage to 0%.

Refer to Parts & Installation Manual and follow the installation instructions for switch and target adjustment.

Outer mid/ fly retract and % reset switch:
The proximity switch on the center mid section provides a (+24V) signal to central unit terminal A 114 X1/76 when the outer mid and fly section is fully retracted. The signal resets the outer mid/ fly percentage to 0%.

Refer to Parts & Installation Manual and follow the installation instructions for switch and target adjustment.

System inputs:

DI #	Description	Central Unit Terminal	Signal (DI=on)
1 MB	Pressure switch - boom extend GND	A104 - X1/38 A104 - X1/37	+24V 0V
2 MB	Pressure switch -boom retract GND	A104 - X1/40 A104 - X1/39	+24V 0V
3 MB	Automode switched on GND	A104 - X1/42 A104 - X1/41	+24V 0V
4 MB	Outer mid/ fly retract and % switch GND	A104 - X1/76 A104 - X1/75	+24V 0V
5 MB	Inner mid retract switch GND	A104 - X1/78 A104 - X1/77	+24V 0V
6 MB	Inner mid % reset switch GND	A104 - X1/80 A104 - X1/79	+24V 0V
1 EX	House lock engaged (RT 865 BXL-- Europe) * GND	A114 - X1/1 A114 - X1/2	+24V 0V
2 EX	Automode A = on; Automode B = off * GND	A114 - X1/3 A114 - X1/4	+24V 0V
3 EX	+ Ub (24V) Front outrigger overload (GND)	A114 - X1/5 A114 - X1/6	+24V 0V
4 EX	Area def. switch (RT 865 BXL) * GND	A114 - X1/7 A114 - X1/8	+24V 0V
5 EX	Center mid retract and % reset switch GND	A114 - X1/9 A114 - X1/10	+24V 0V

Note: MB = main board ** = RT 865 BXL only*
EX = extension board

Output for two- way valves:

A pair of two- way valves controls the oil to each tele- cylinder. The relay output K2, K6, K7 operates the pair of two- way valves in automode. The valve need to be de-energized to operate the particular cylinder. The valves for the sections that are not selected are powered to prevent movement of the other cylinders.

Mode	Relay K2 [V]	IM 2 way valves	Relay K6 [V]	CM 2 way valves	Relay K7 [V]	OM 2 way valves
	A104-X1/54		A104-X1/66		A104-X1/69	
Auto IM	0	0	24	1	24	1
Auto CM	24	1	0	0	24	1
Auto OM	24	1	24	1	0	0
Manual IM	0	0 *	0	1 *	0	1 *
Manual CM	0	1 *	0	0 *	0	1 *
Manual OM	0	1 *	0	1 *	0	0 *
Error (Auto)	24	1	24	1	24	1
Neutral (Auto)	24	1	24	1	24	1

*Note: * = powered directly from the section selector switch in the cabin.*

Relay outputs:

Relay	Fuse	Description	Central Unit Terminal	Signal
K1	F2	not used not used		
K2	F3	Inner mid two way- valves GND	A104 - X1/54 A104 - X1/3	+24V 0V
K3	F4	Rod side dump valve GND	A104 - X1/57 A104 - X1/3	+24V 0V
K4	F5	Tele out of sequence - Warning light in cabin GND	A104 - X1/61 A104 - X1/3	+24V 0V
K5 K5 K5	F6	Signal from analog output board Directs the analog signal to the extend valve Directs the analog signal to the retract valve	A104 - X1/62 A104 - X1/63 A104 - X1/64	0-800mA 0-800mA 0-800mA
K6 K6	F7	Center mid two way- valves GND	A104 - X1/66 A104 - X1/3	+24V 0V
K7	F8	Outer mid two way- valves GND	A104 - X1/69 A104 - X1/3	+ 24V 0V
K8	none	Internal LMI use (overload, error)	A104 - X1/44	+ 24V
K9	none	Internal LMI use (A2B)	A104 - X1/46	+ 24V
K10	external	Motion cut (Bosch relay)	A104 - X1/48	+ 24V

Rod side dump valve:

Relay K3 controls the rod side dump valve. The valve dumps the rod side pressure when the controller is in neutral position and during the time the section stops while changing over to another section.

Controller	**Relay K3 A101 x1/ 57**
Extend on	0V
Retract on	0V
Neutral	+24V
Retracted/ retract on	+24V

6. Boom Sequence

Main Boom:

Mode	IM %	CM %	OM %	FLY %
Auto B	0	0	0	0
Auto B	50	0	0	0
Auto B	50	50	0	0
Auto B	75	50	0	0
Auto B	75	75	0	0
Auto B	100	75	0	0
Auto B	100	100	0	0
Auto B	100	100	100	100

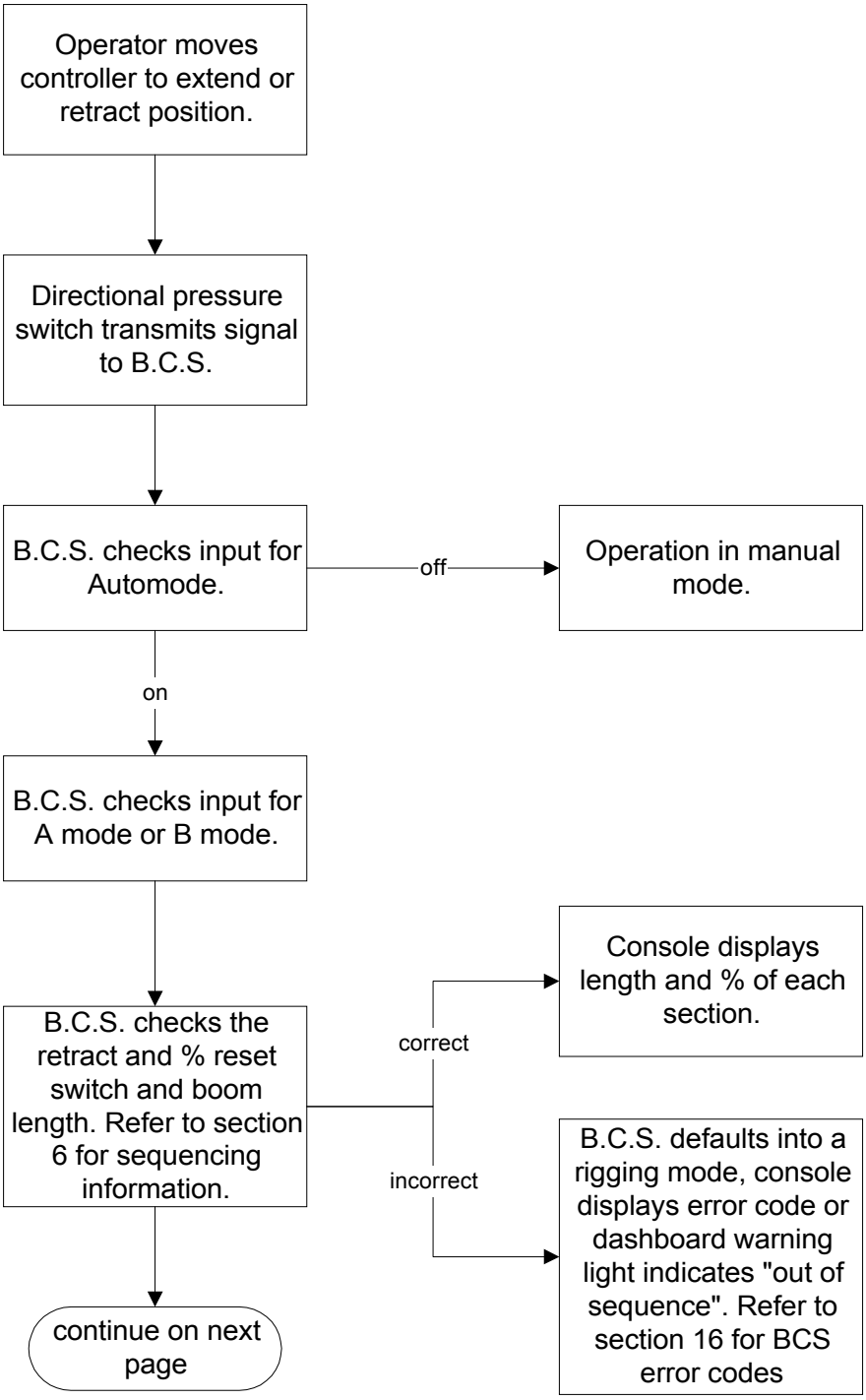
Mode	IM %	CM %	OM %	FLY %
Auto A *	0	0	0	0
Auto A *	0	100	0	0
Auto A *	0	100	100	100
Auto A *	100	100	100	100

*= Mode A not available on RT 865 BXL

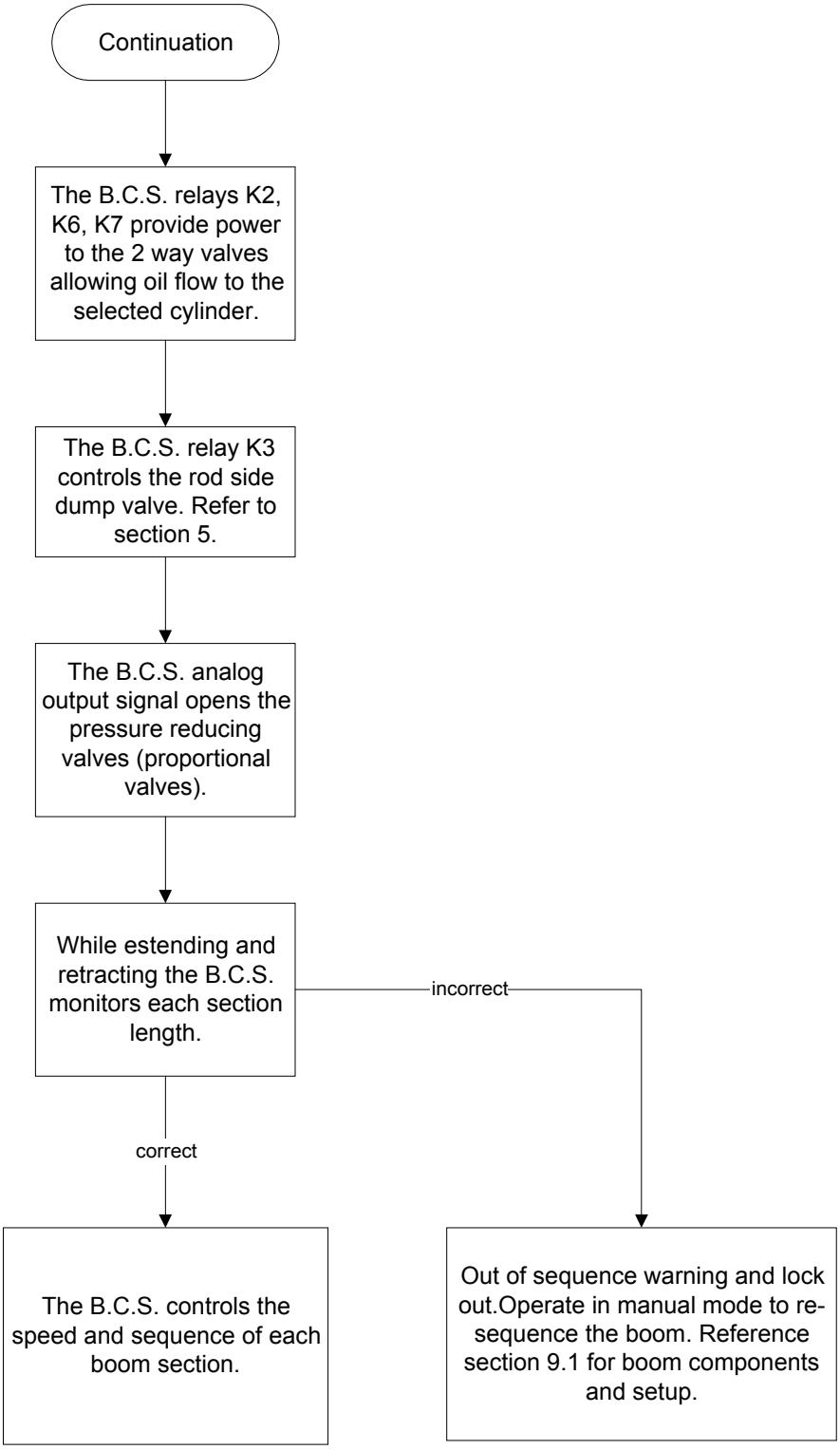
Extensions:

Mode	IM %	CM %	OM %	FLY %
Auto	0	0	0	0
Auto	100	0	0	0
Auto	100	100	0	0
Auto	100	100	100	100

7. Boom Control Flow

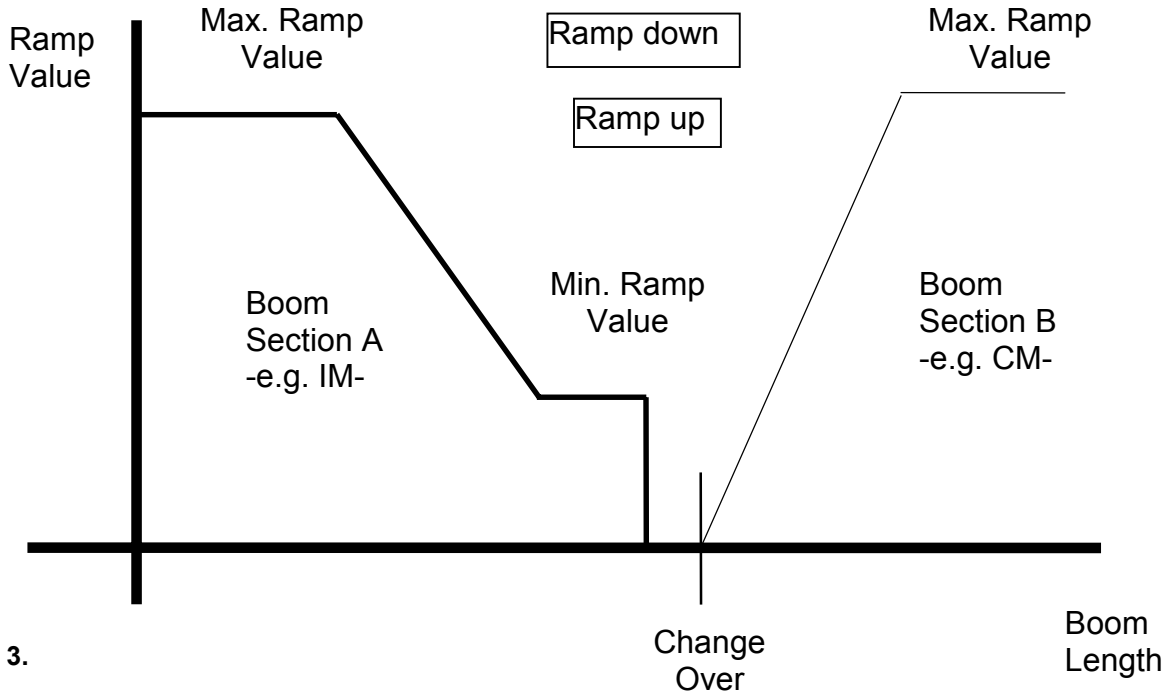


Drawing 2a.


Continuation
The B.C.S. relays K2, K6, K7 provide power to the 2 way valves allowing oil flow to the selected cylinder.
The B.C.S. relay K3 controls the rod side dump valve. Refer to section 5.
The B.C.S. analog output signal opens the pressure reducing valves (proportional valves).
While estending and retracting the B.C.S. monitors each section length.
incorrect
correct
The B.C.S. controls the speed and sequence of each boom section.
Out of sequence warning and lock out.Operate in manual mode to re-sequence the boom. Reference section 9.1 for boom components and setup.

Drawing 2b.

8. Ramping

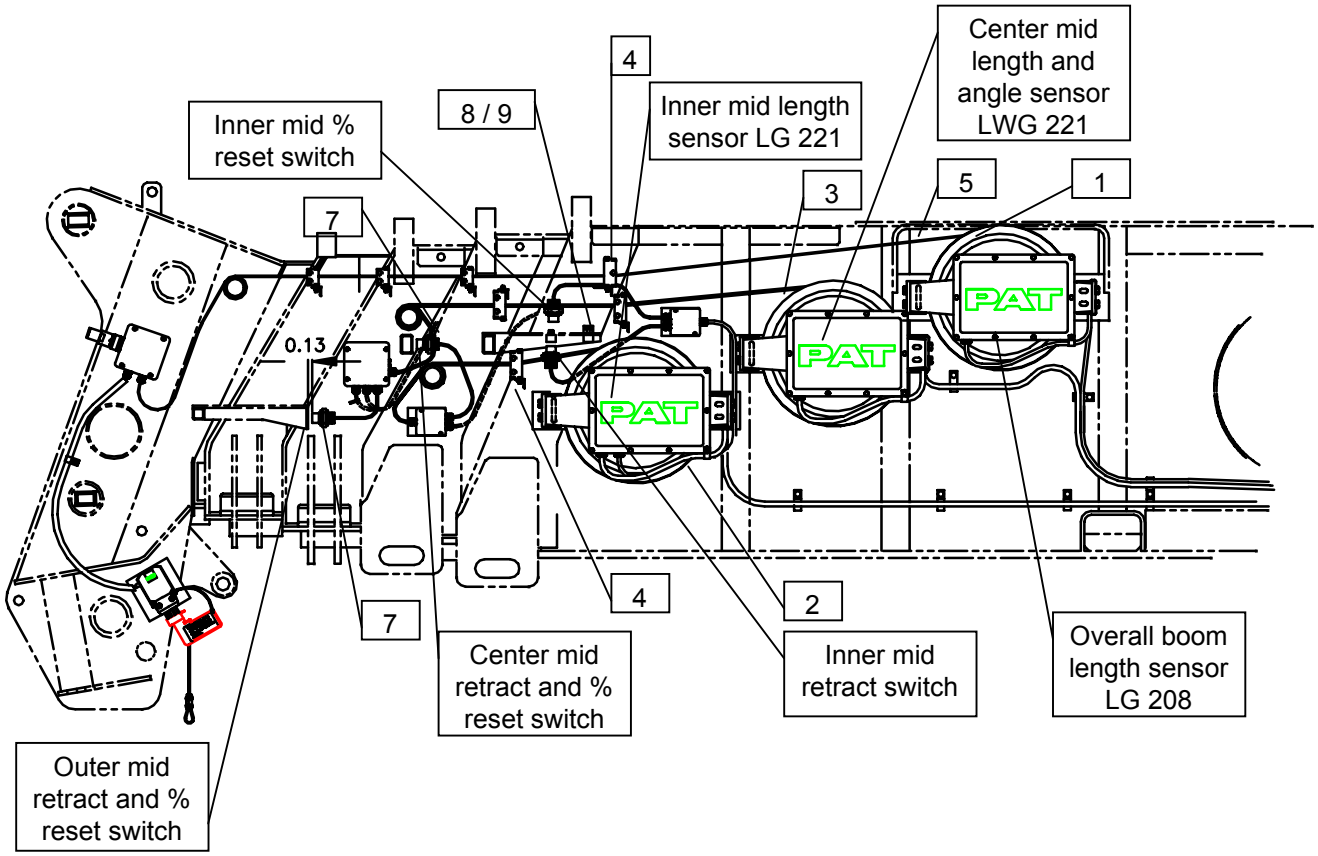


Drawing 3.

Ramp value:	A hex value in the software which determines the output current to the proportional valve.
Max. ramp value:	The maximum hex value (hex 255) equals to 800 mA valve (pressure reducing valve). This current is required to open the valve for maximum tele speed.
Min. ramp value:	The minimum hex value that is required to move a section in the ramping area. These values may differ for each ramping area.
Change over:	The previous section comes to a complete stop and the next section ramps up (accelerates speed).

IM:	Inner Mid Section
CM:	Center Mid Section
OM/Fly:	Outer Mid Section & Fly

9.1 DS 350 G - Boom Components and Setup



Drawing 4.

1. Pre-tension the cable reel spring by rotating drum (16) revolution counterclockwise. If replacing the LG 208 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

2. Pre-tension the cable reel spring by rotating drum (35) revolution counterclockwise. If replacing the LG 221 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

3. Pre-tension the cable reel spring by rotating drum (30) revolution counterclockwise. If replacing the LWG 221 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

4. Run cable through the cable guides. Remove 1/4-20 nuts on bottom of cable guide, insert cable guide screws through existing angle bracket and secure in place with 1/4-20 nuts removed previously.

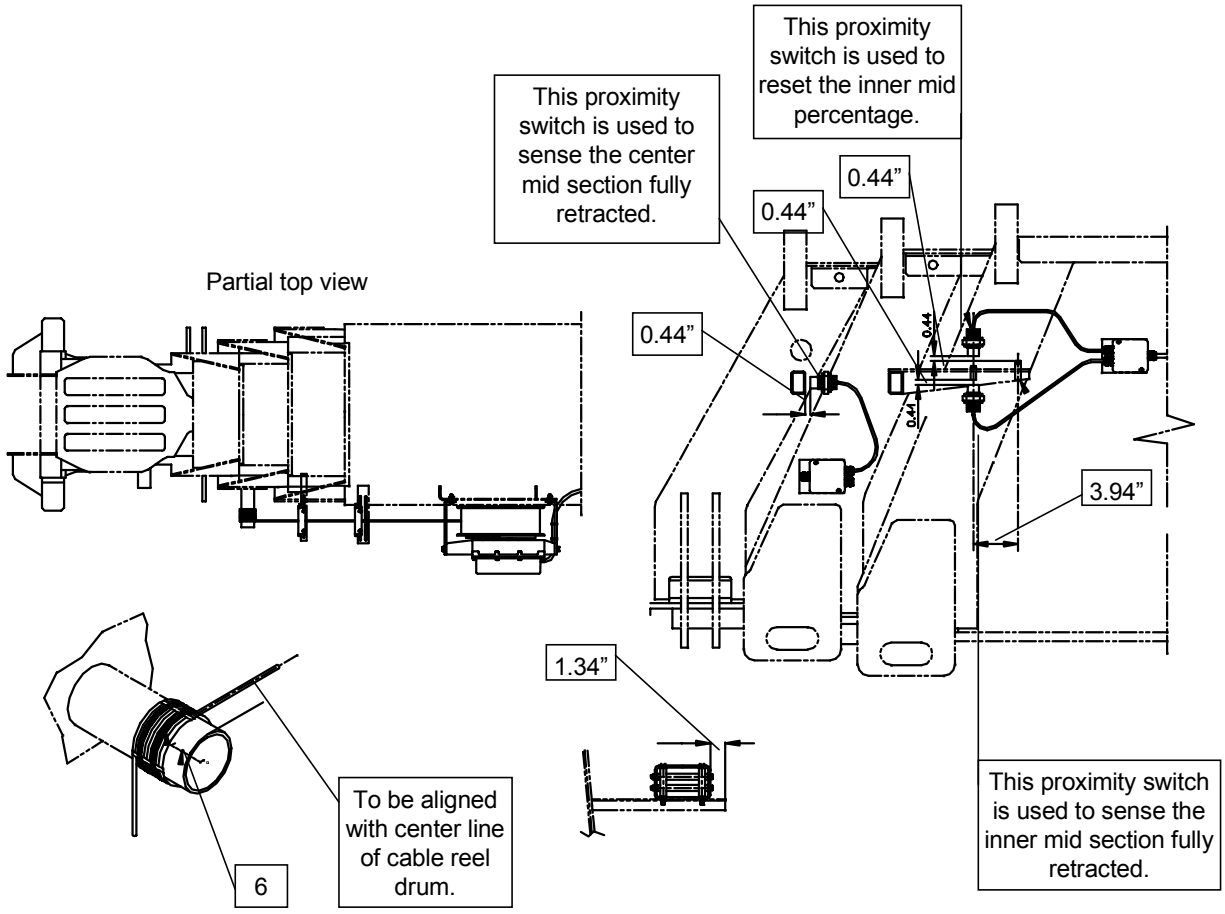
5. Center line of cable must be aligned with center line of cable drum. See partial top view.

1. Place tie wrap, 120 degree apart around the bushing. Wrap cable (8-10) revolutions over the tie wraps starting from the outside and working inward. Allow ample cable to reach the junction box. Secure with (2) additional tie wraps. See page 17.

2. Check proximity switch installation (0.44 inch from target) when boom sections are fully retracted.

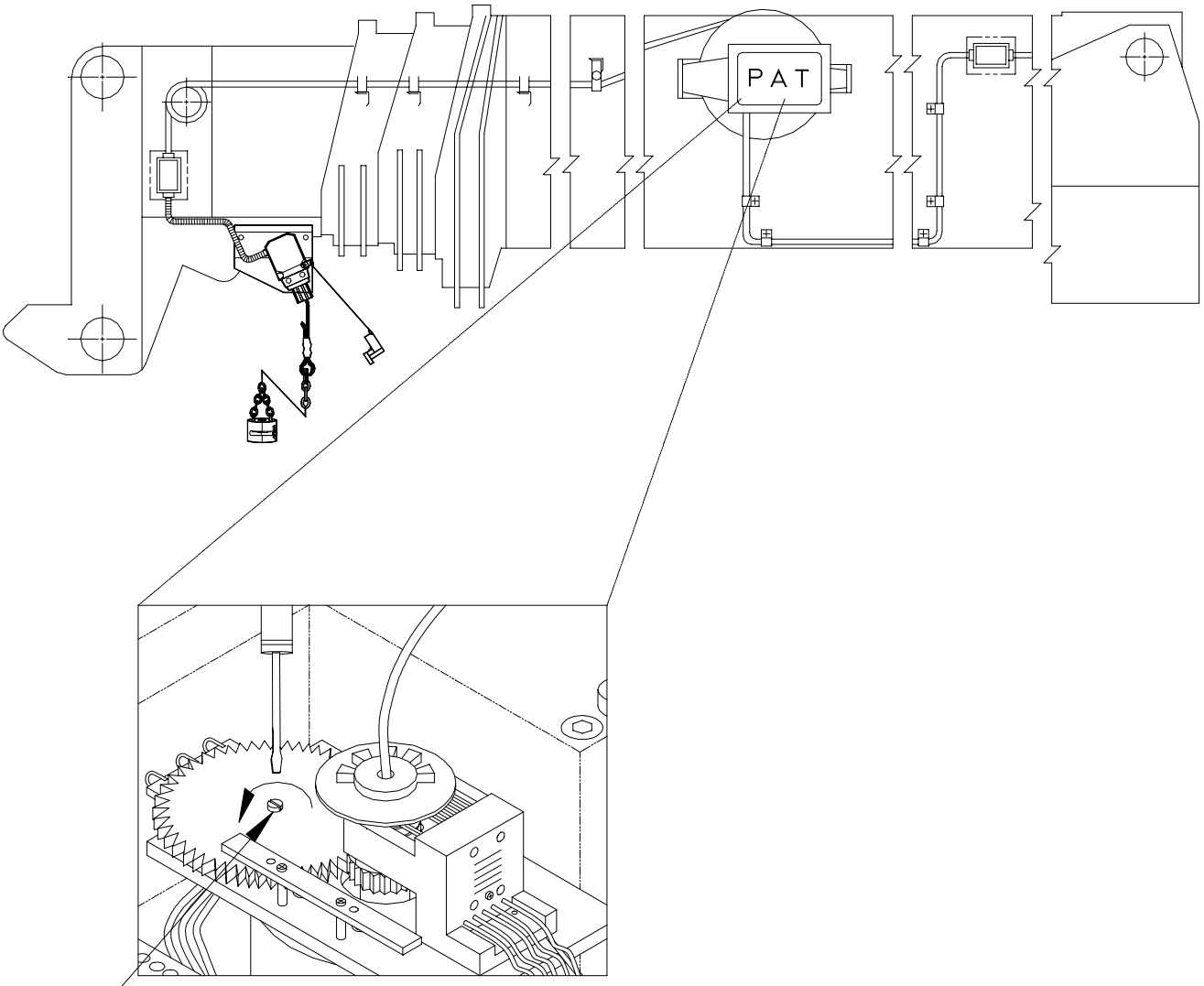
3. This target is only installed if the boom is equipped with a boom extension stop block.

4. Check this proximity switch installation (0.13 inch from target) when boom sections are fully retracted.



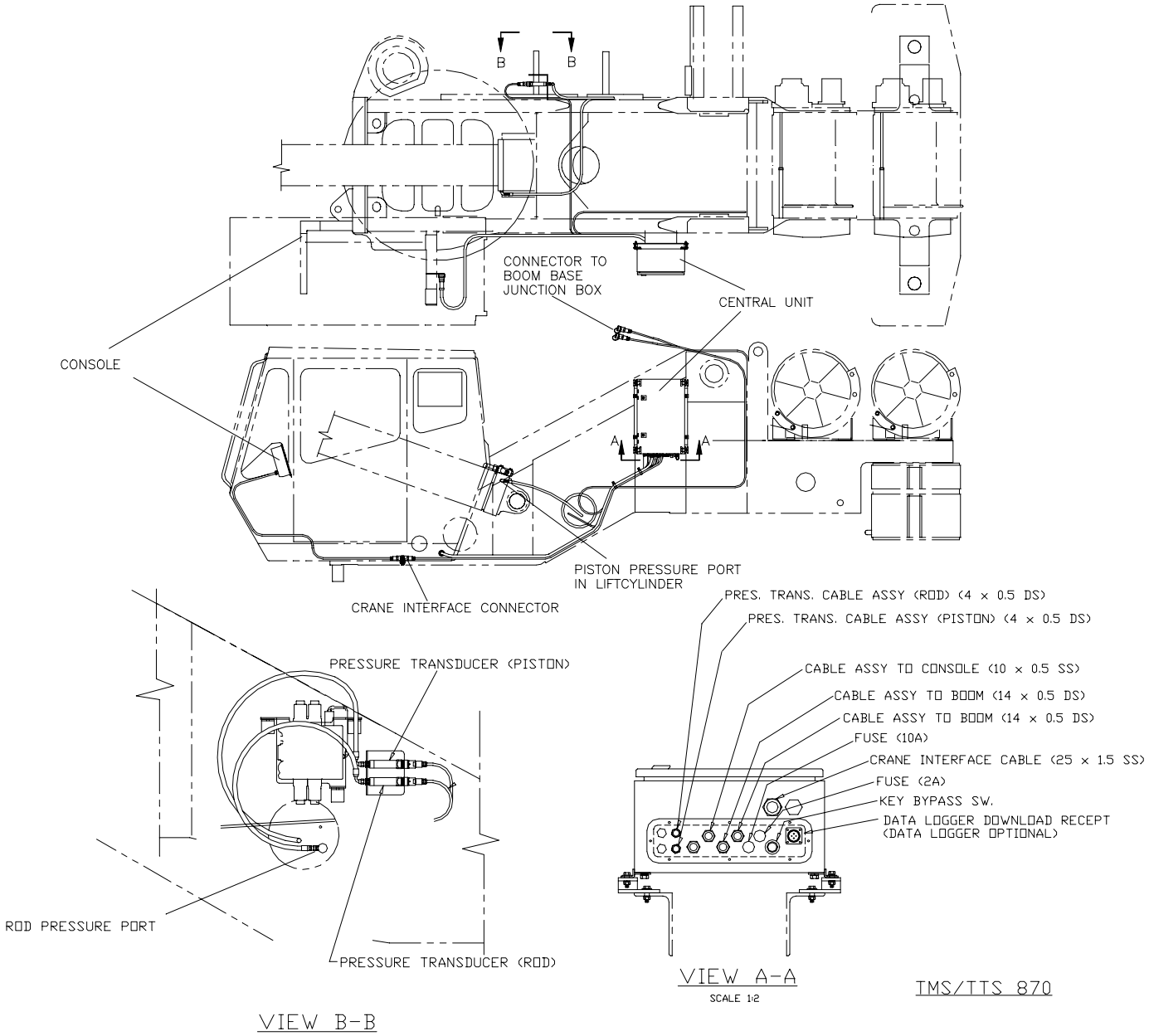
Drawing 5.

9.2 Length Transducer Adjustment



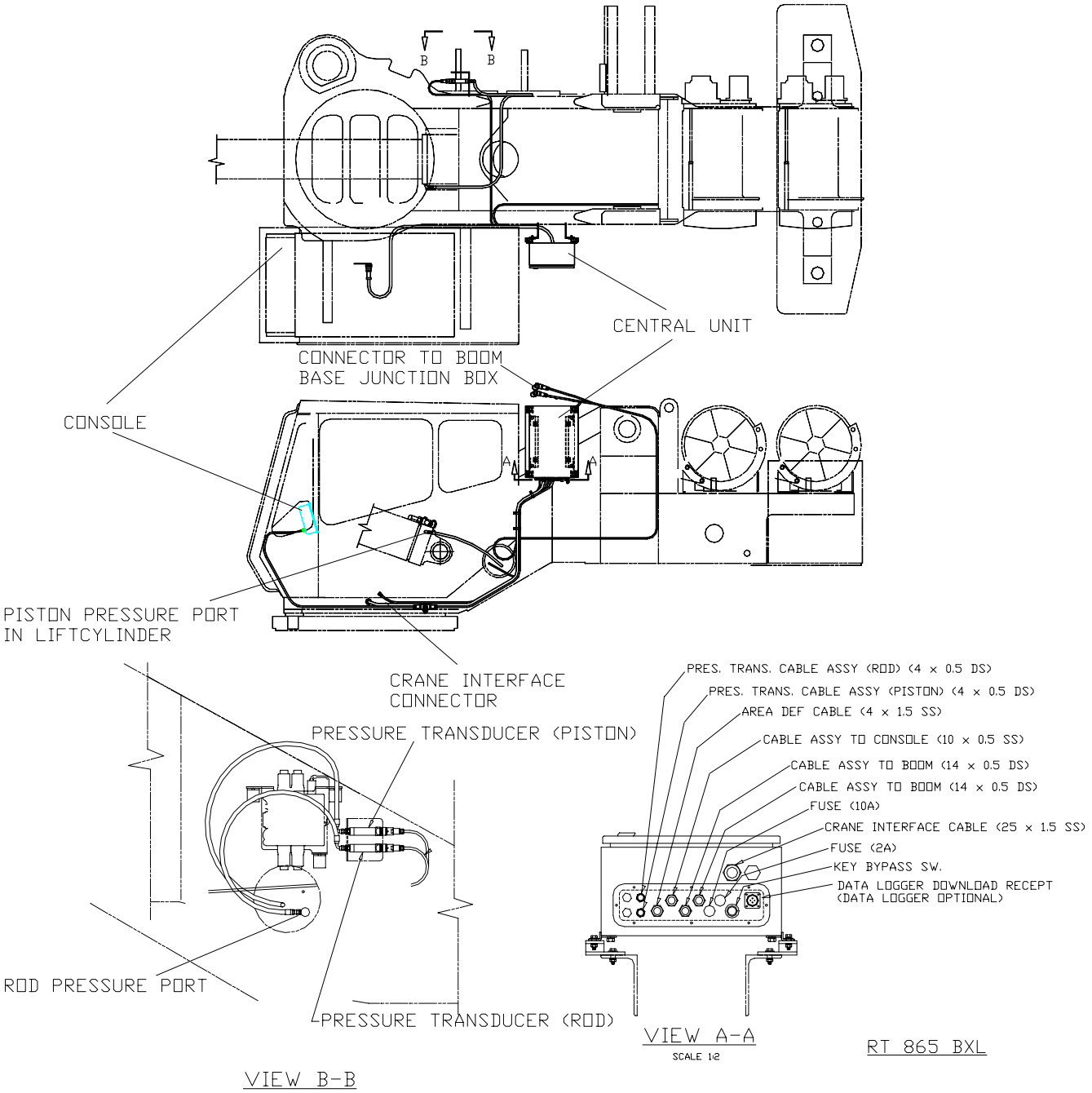
Drawing 6.

9.3 DS 350 G Superstructure Components - TMS/TTS 870



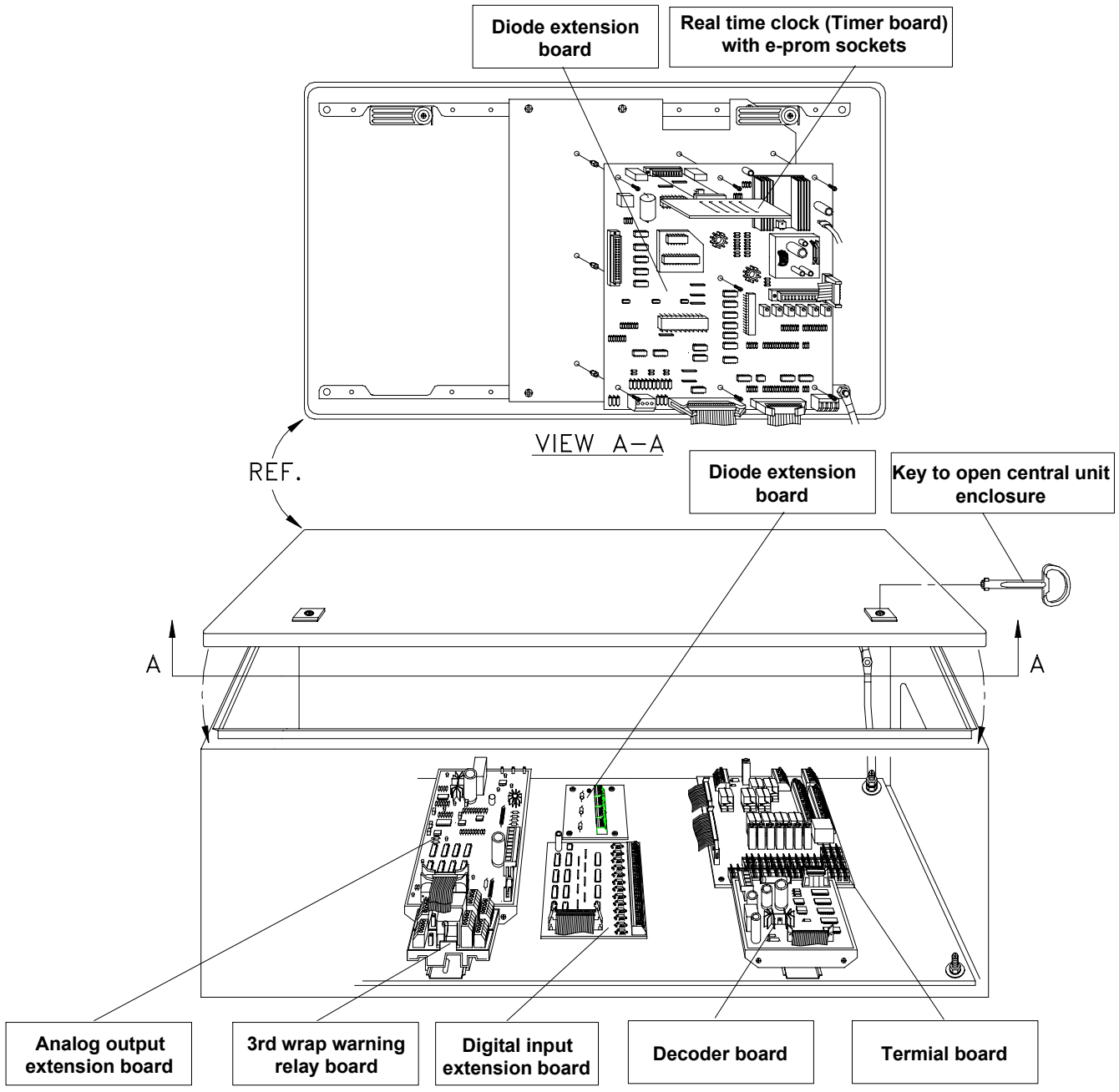
Drawing 7.

9.4 DS 350 G Superstructure Components - RT 865 BXL



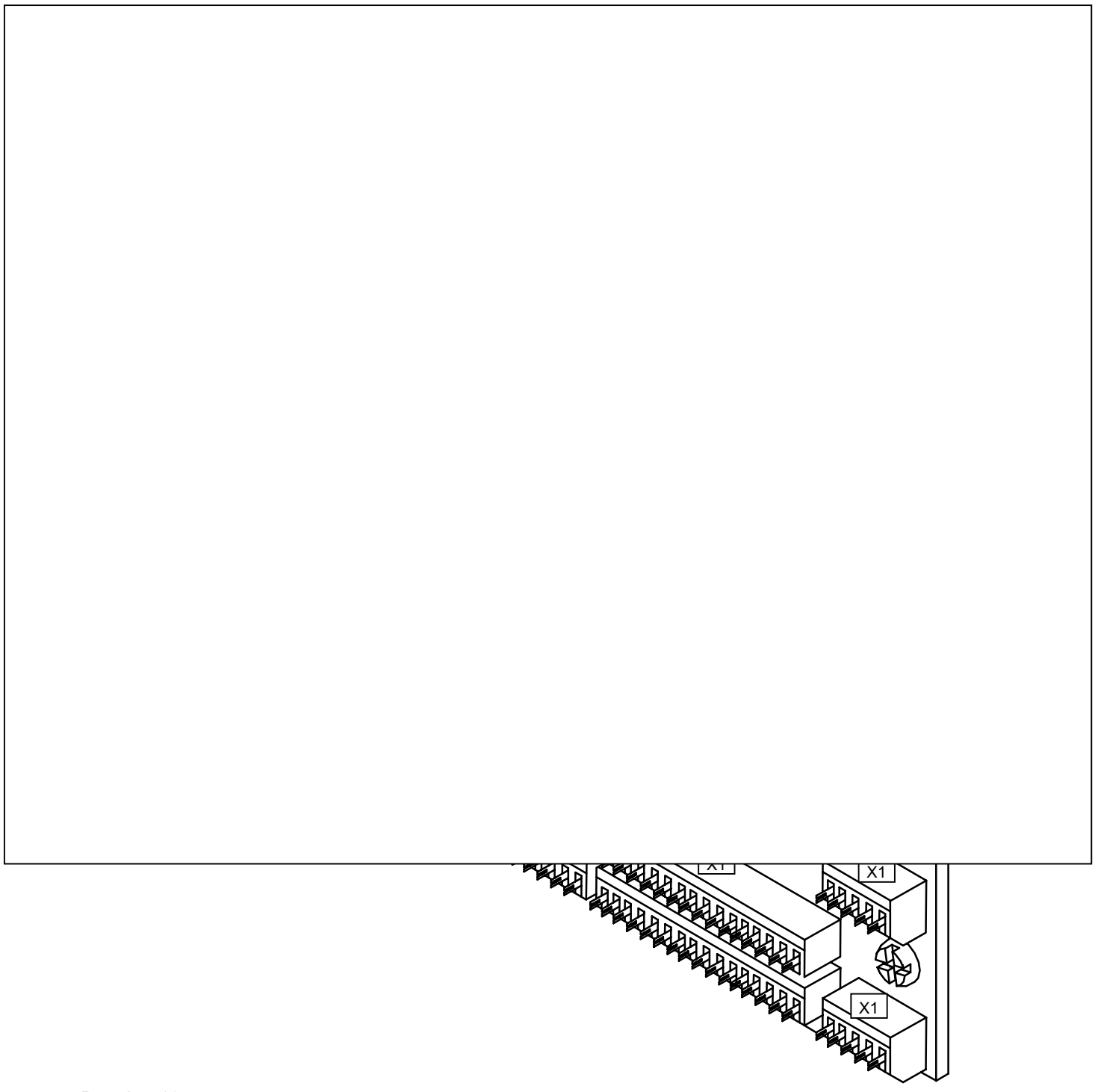
Drawing 8.

10.1 DS 350 G LMI central unit (751) - TMS/TTS 870 & RT 865 BXL



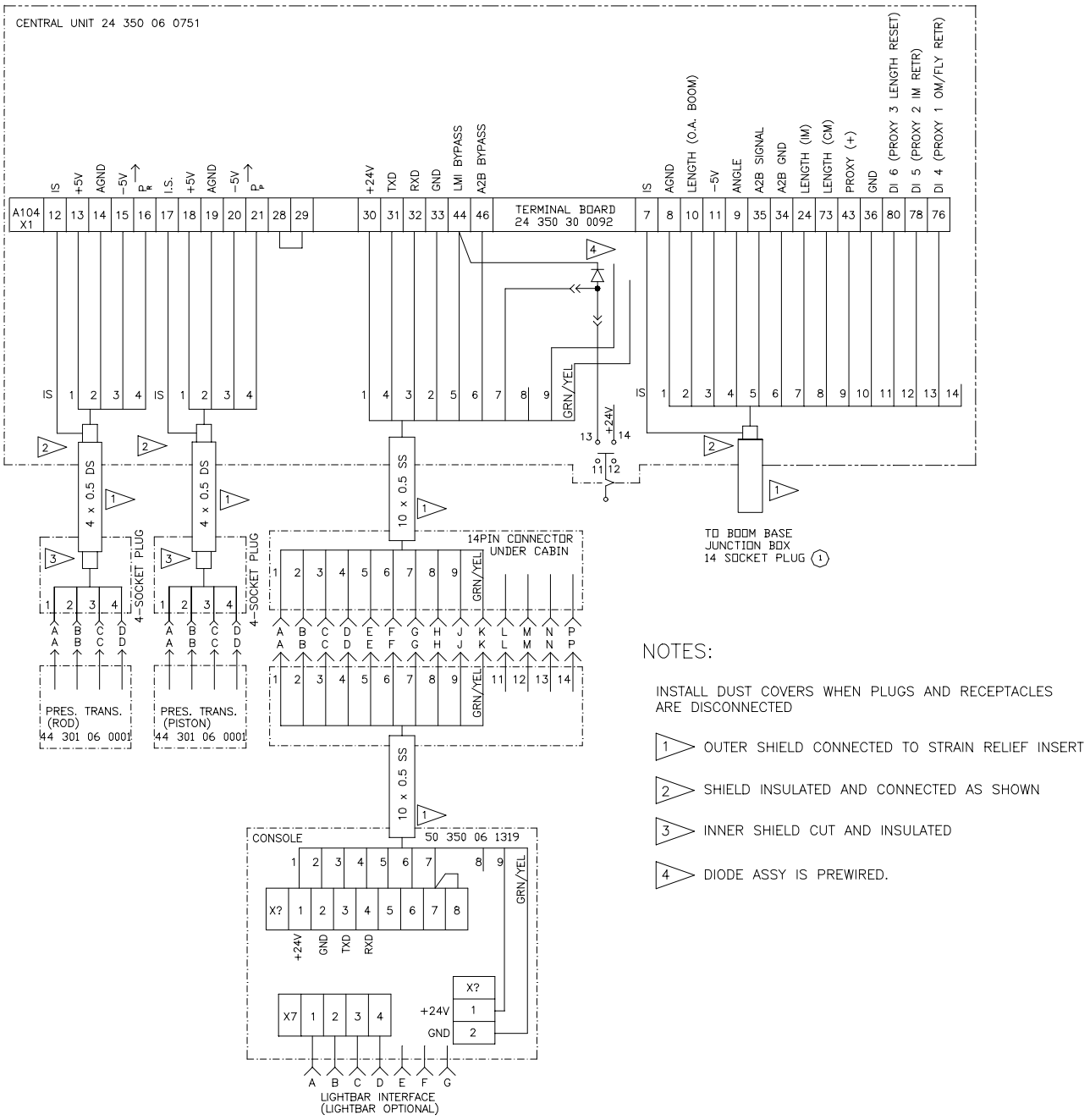
Drawing 9.

10.2 LMI Terminal board - TMS 870, TTS 870 and RT 865 BXL



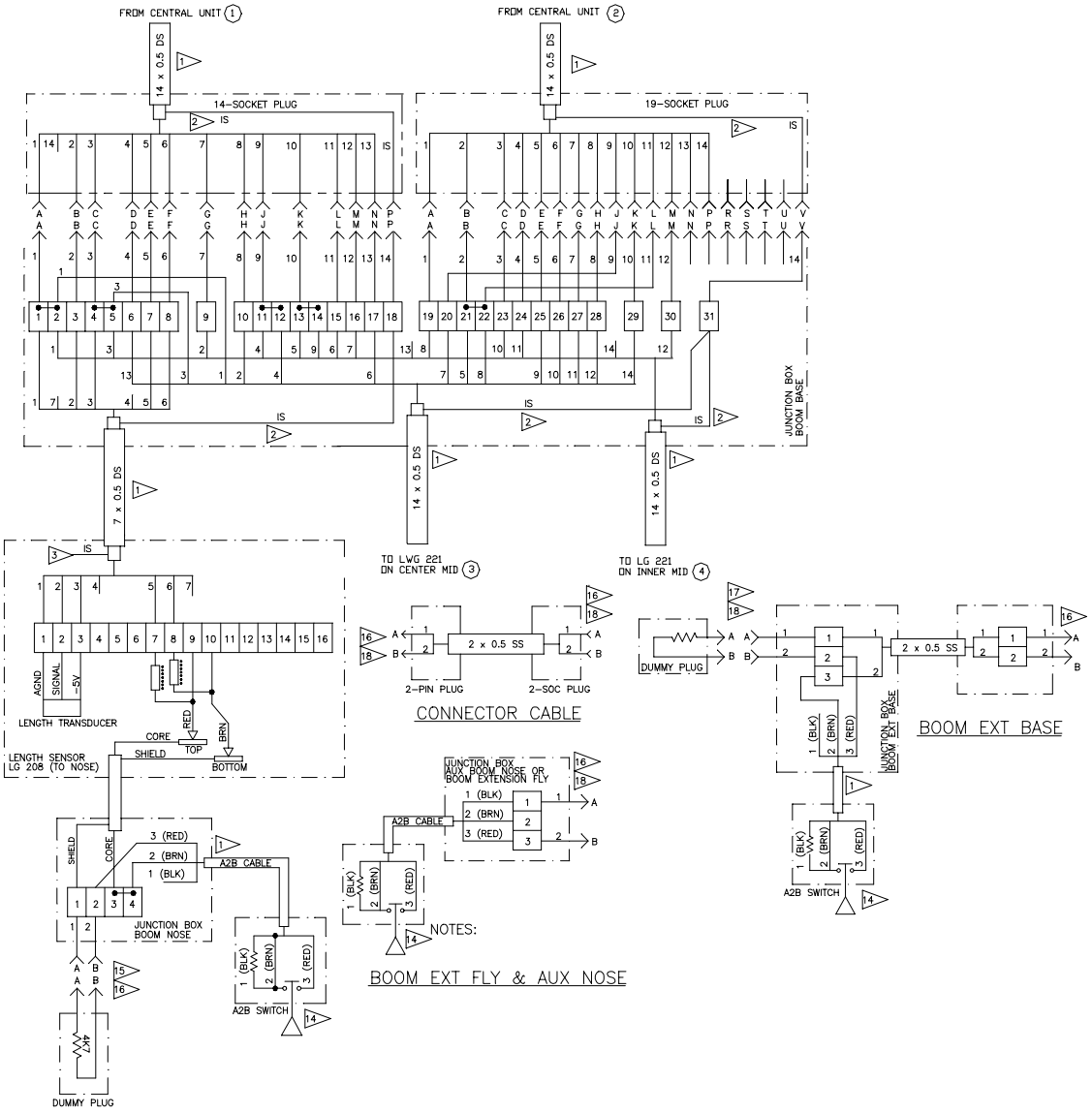
Drawing 10.

11.1 Wiring Schematic - TMS 870/ TTS 870



Drawing 11.1

11.1 Wiring Schematic - TMS 870/ TTS 870



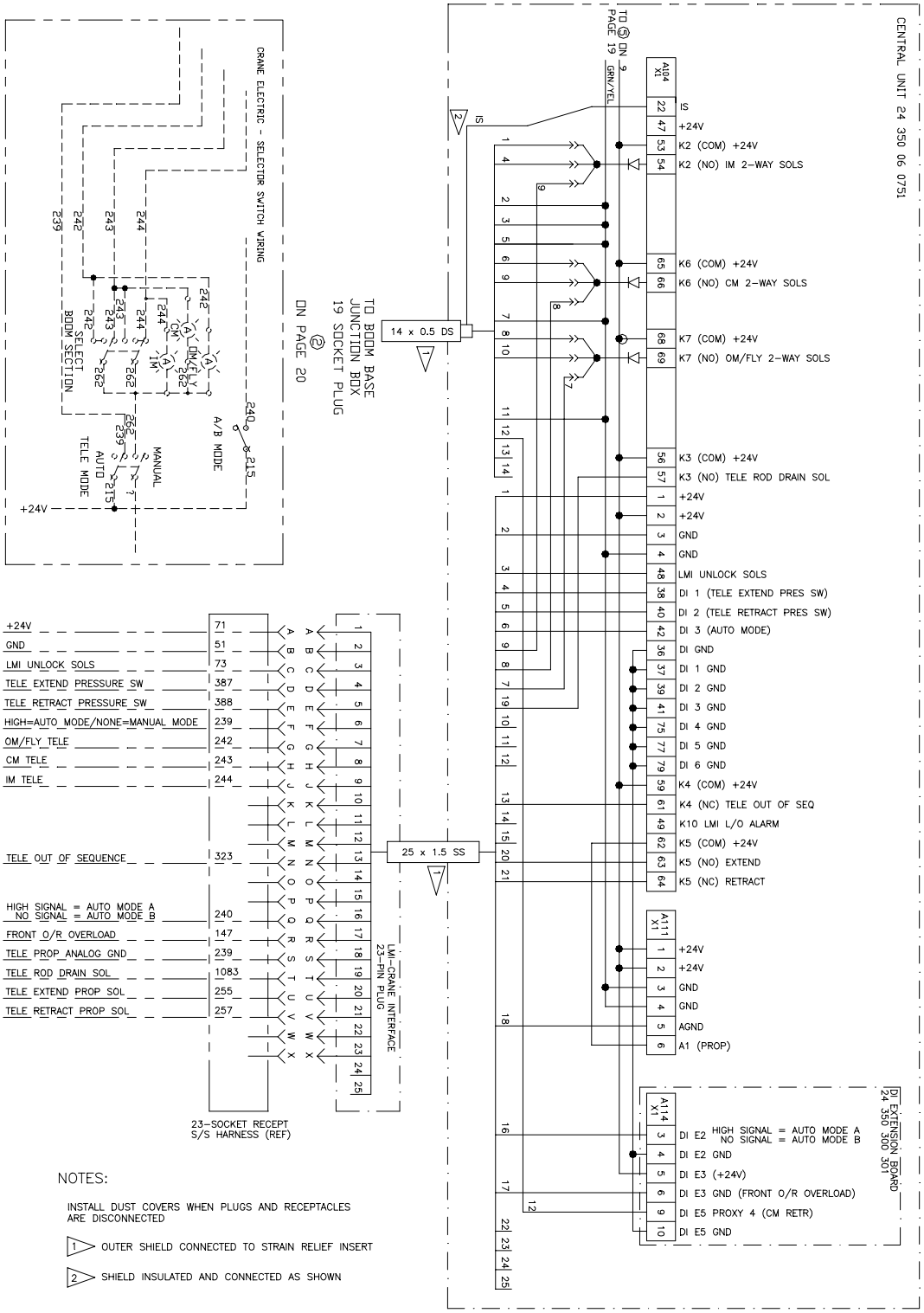
NOTES:

INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES
13. RELAY AND DIODE ASSY ARE PREWIRED
14. A2B SWITCH IS PREWIRED & POTTED
15. WHEN BOOM EXT OR AUX NOSE IS NOT USED, INSTALL DUMMY PLUG INTO RECEPT ON BOOM NOSE JUNCTION BOX
16. WHEN BOOM EXT OR AUX BOOM NOSE IS USED, INSTALL CONNECTOR CABLE FROM RECEPT ON BOOM NOSE JUNCTION BOX TO RECEPT ON BOOM EXT OR AUX NOSE JUNCTION BOX
17. WHEN BOOM EXT BASE IS USED WITHOUT FLY, INSTALL DUMMY PLUG INTO RECEPT ON BOOM EXT BASE JUNCTION BOX
18. WHEN BOOM EXT FLY IS USED, INSTALL 2nd CONNECTOR CABLE FROM RECEPT ON BOOM EXT BASE JUNCTION BOX TO RECEPT ON BOOM EXT FLY JUNCTION BOX

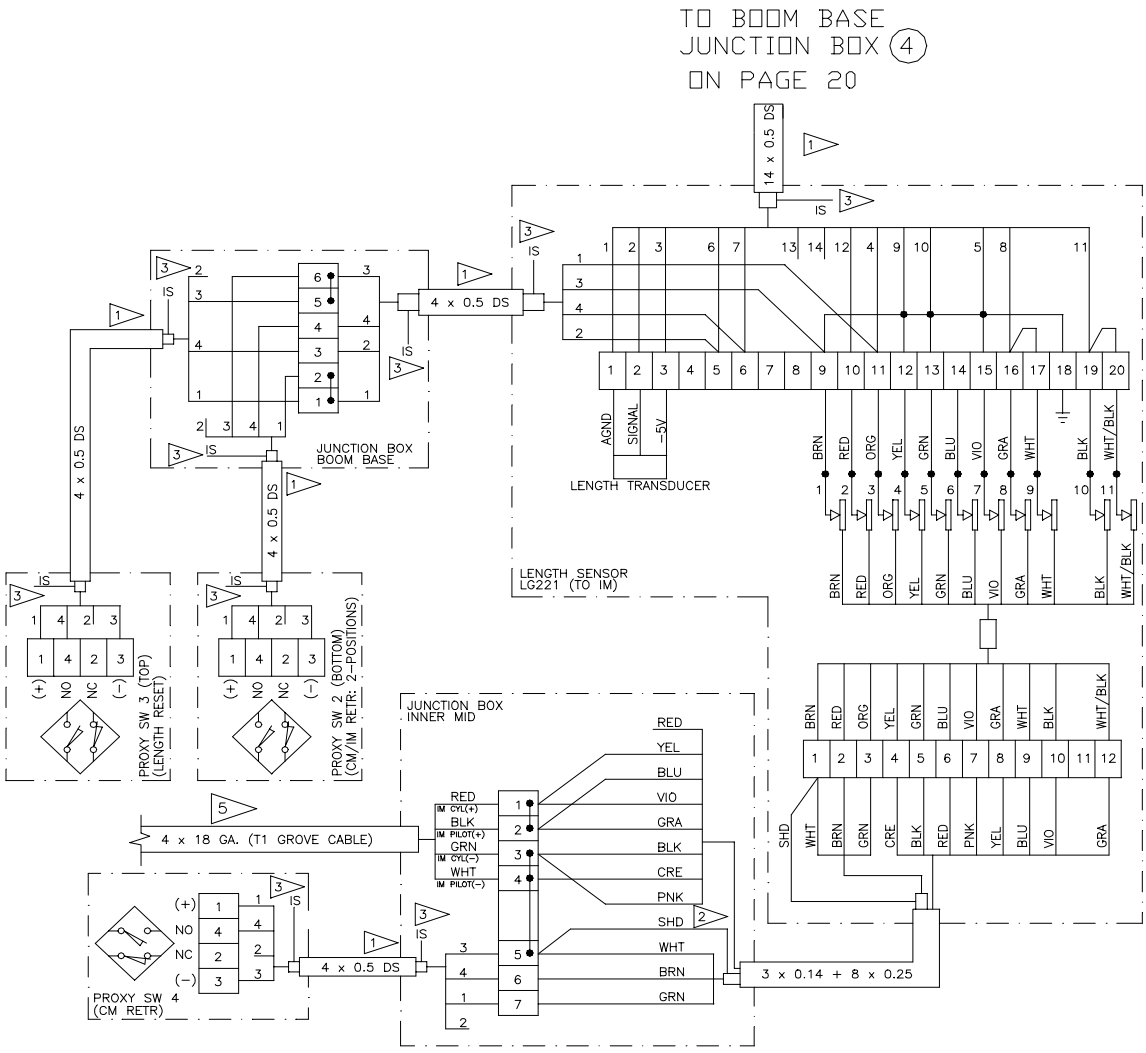
Drawing 11.2

11.1 Wiring Schematic - TMS 870/ TTS 870



Drawing 11.3

11.1 Wiring Schematic - TMS 870/ TTS 870



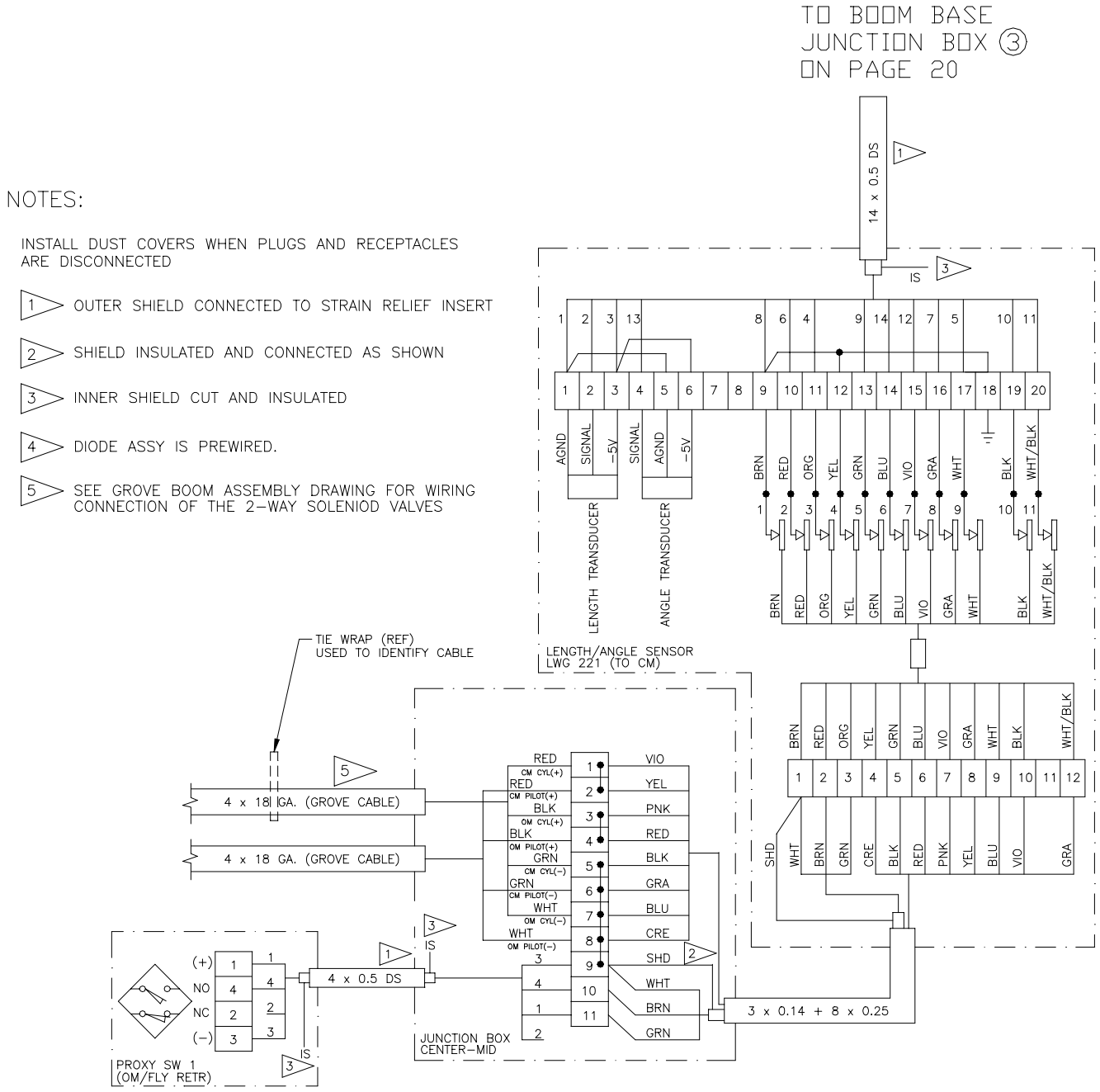
NOTES:

INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES

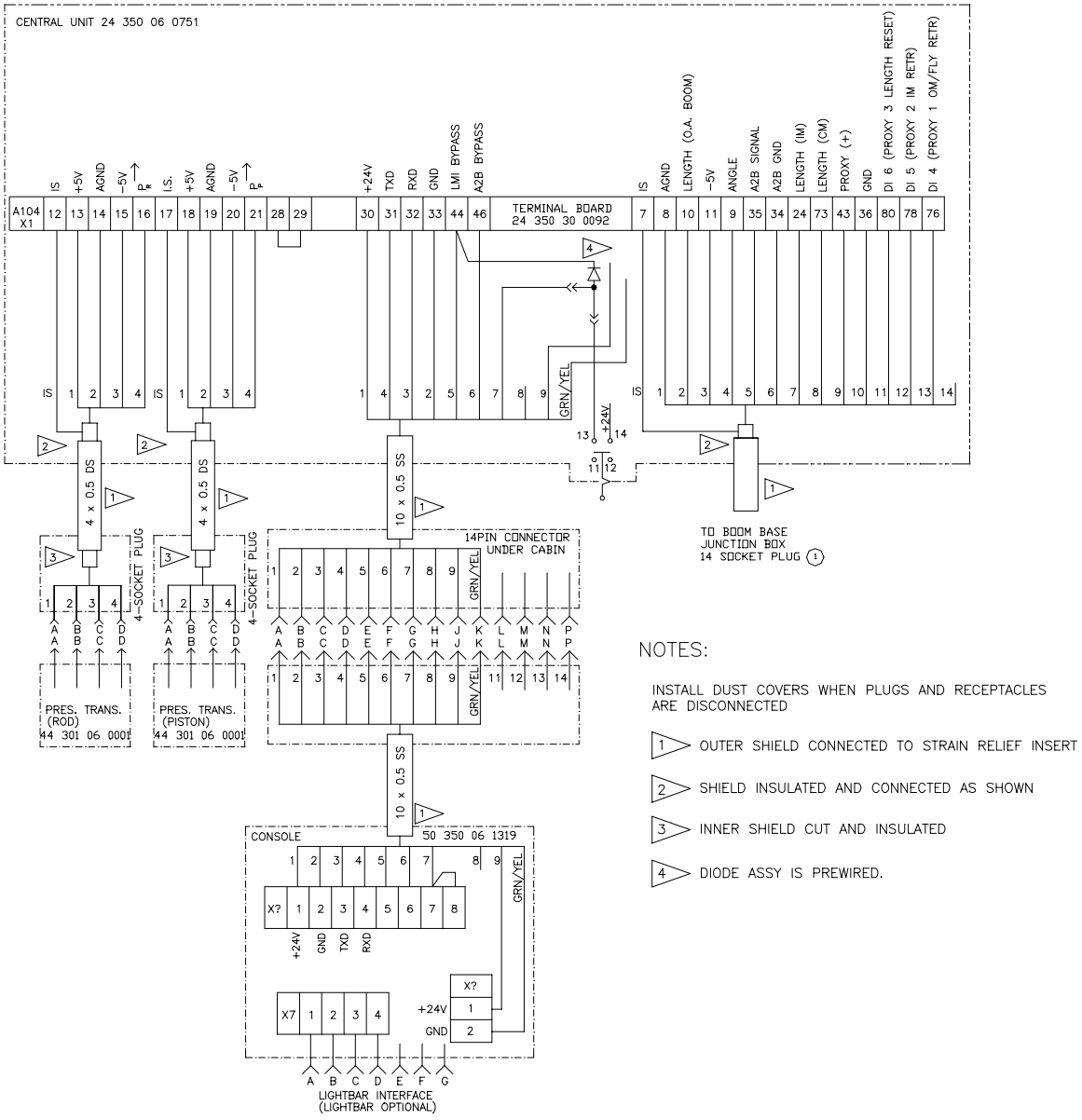
Drawing 11.4

11.1 Wiring Schematic - TMS 870/ TTS 870



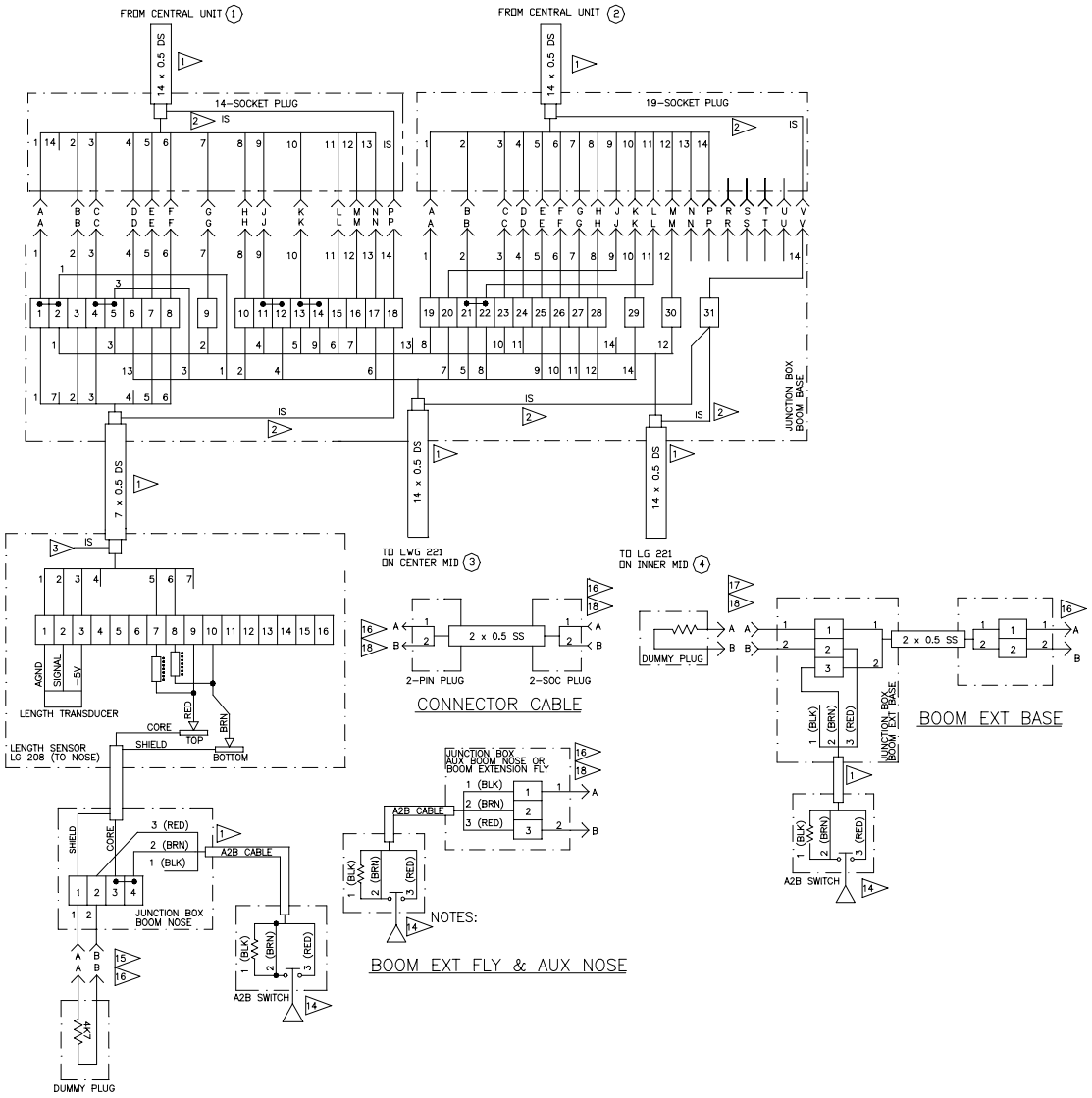
Drawing 11.5

11.2 Wiring Schematic - RT 865 BXL



Drawing 12.1

11.2 Wiring Schematic - RT 865 BXL



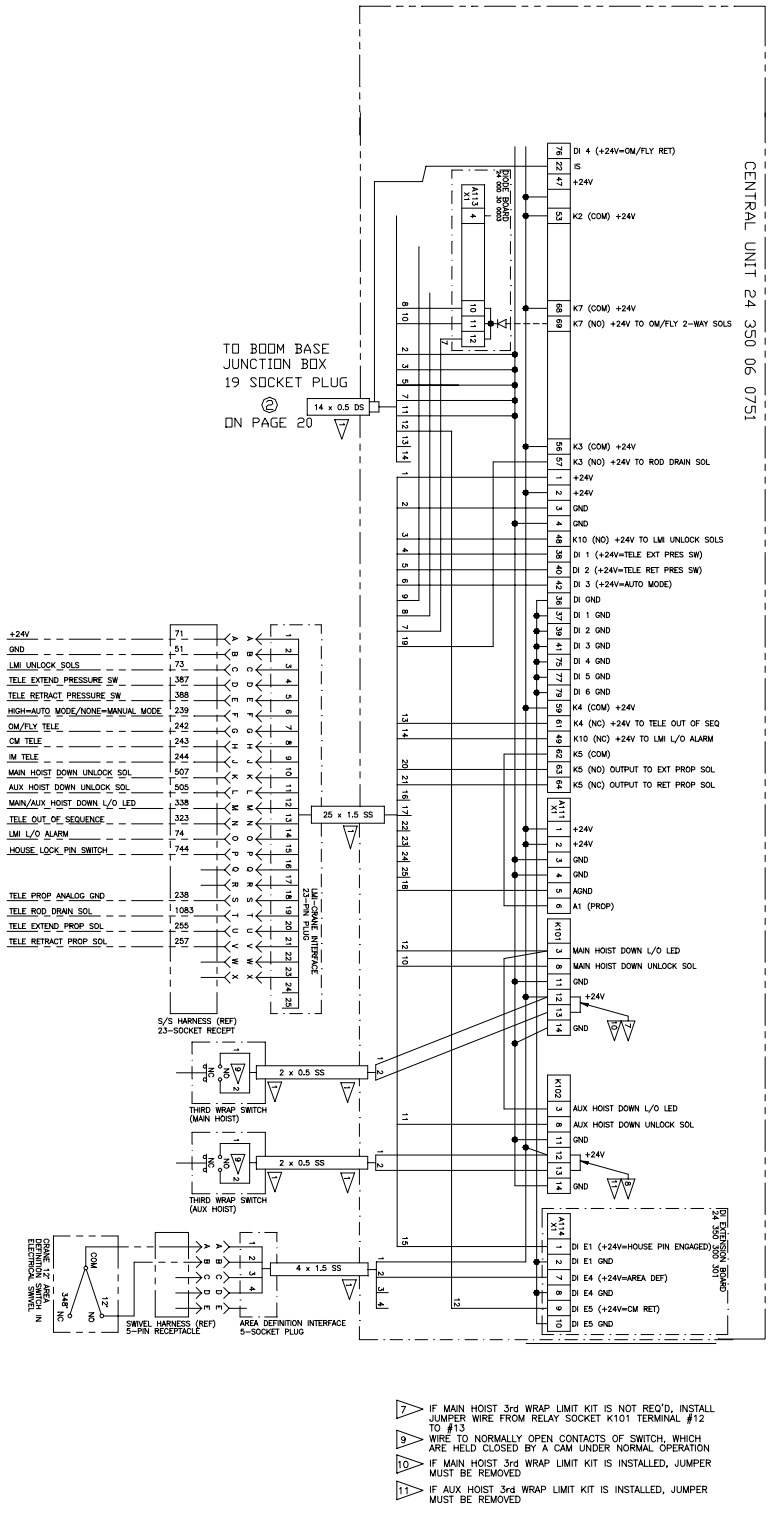
NOTES:

INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES
13. RELAY AND DIODE ASSY ARE PREWIRED
14. A2B SWITCH IS PREWIRED & POTTED
15. WHEN BOOM EXT OR AUX NOSE IS NOT USED, INSTALL DUMMY PLUG INTO RECEPT ON BOOM NOSE JUNCTION BOX
16. WHEN BOOM EXT OR AUX BOOM NOSE IS USED, INSTALL CONNECTOR CABLE FROM RECEPT ON BOOM NOSE JUNCTION BOX TO RECEPT ON BOOM EXT OR AUX NOSE JUNCTION BOX
17. WHEN BOOM EXT BASE IS USED WITHOUT FLY, INSTALL DUMMY PLUG INTO RECEPT ON BOOM EXT BASE JUNCTION BOX
18. WHEN BOOM EXT FLY IS USED, INSTALL 2nd CONNECTOR CABLE FROM RECEPT ON BOOM EXT BASE JUNCTION BOX TO RECEPT ON BOOM EXT FLY JUNCTION BOX

Drawing 12.2

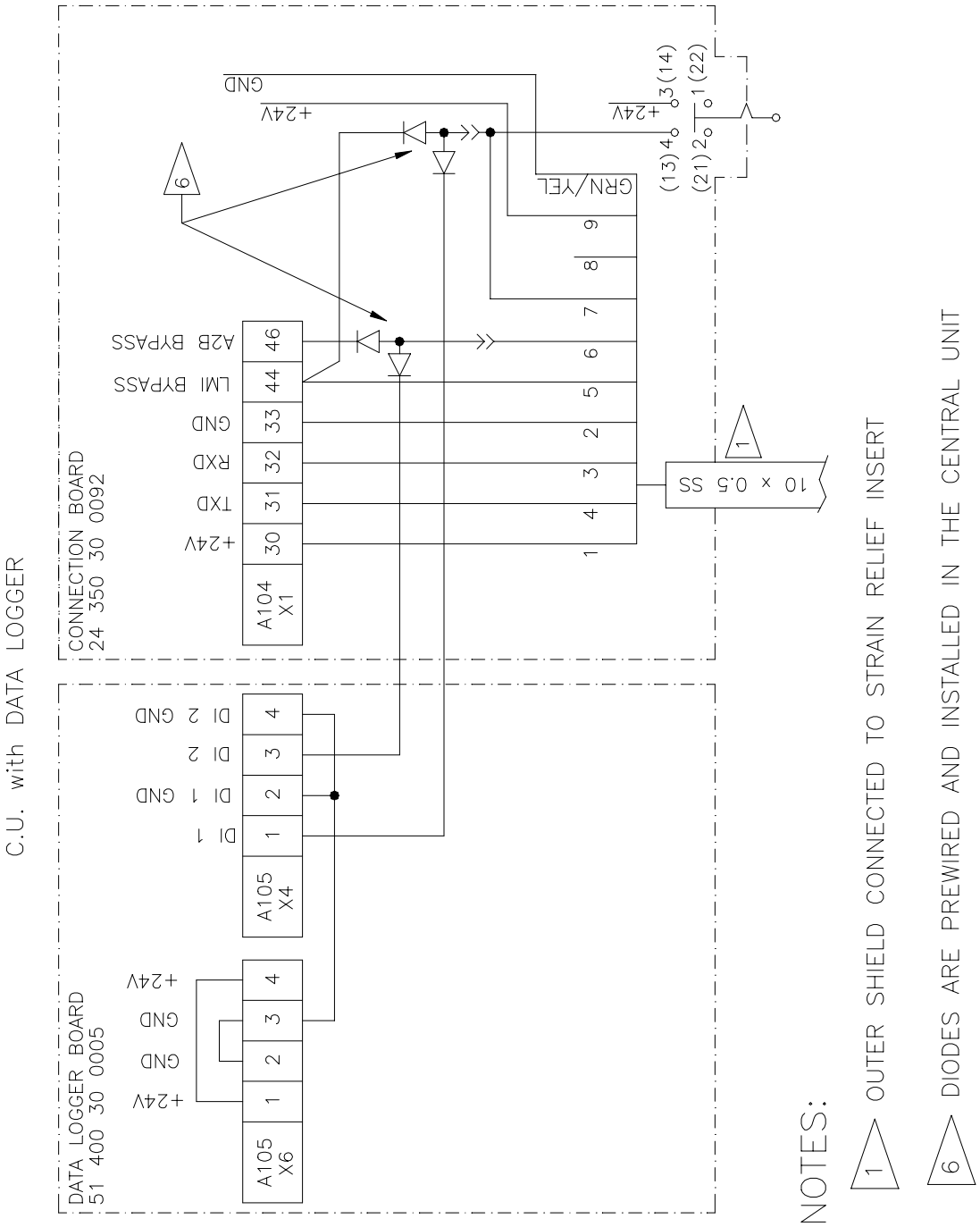
11.2 Wiring Schematic - RT 865 BXL



Drawing 12.3

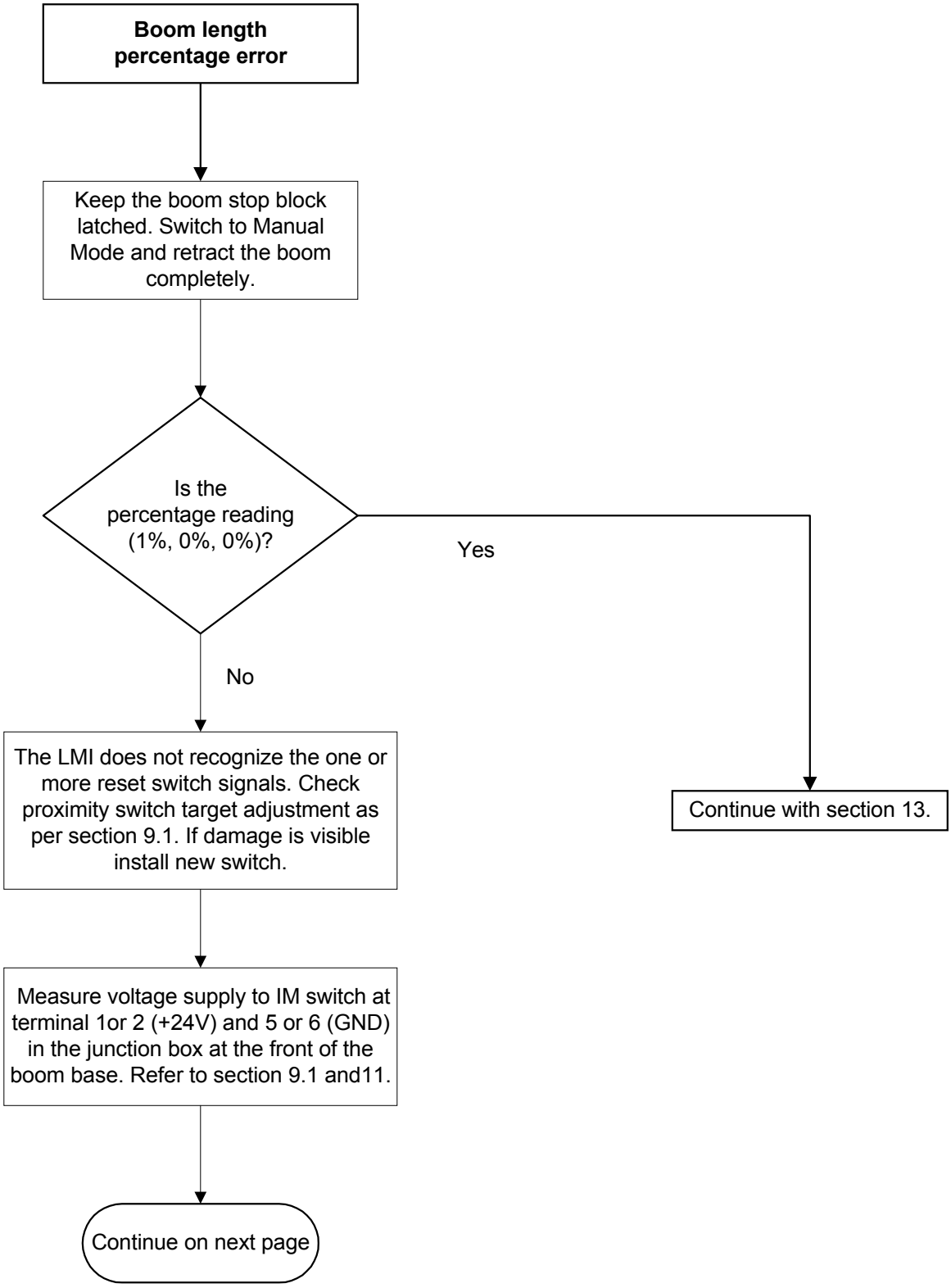
11.2 Wiring Schematic - RT 865 BXL

Optional Data Logger Connection

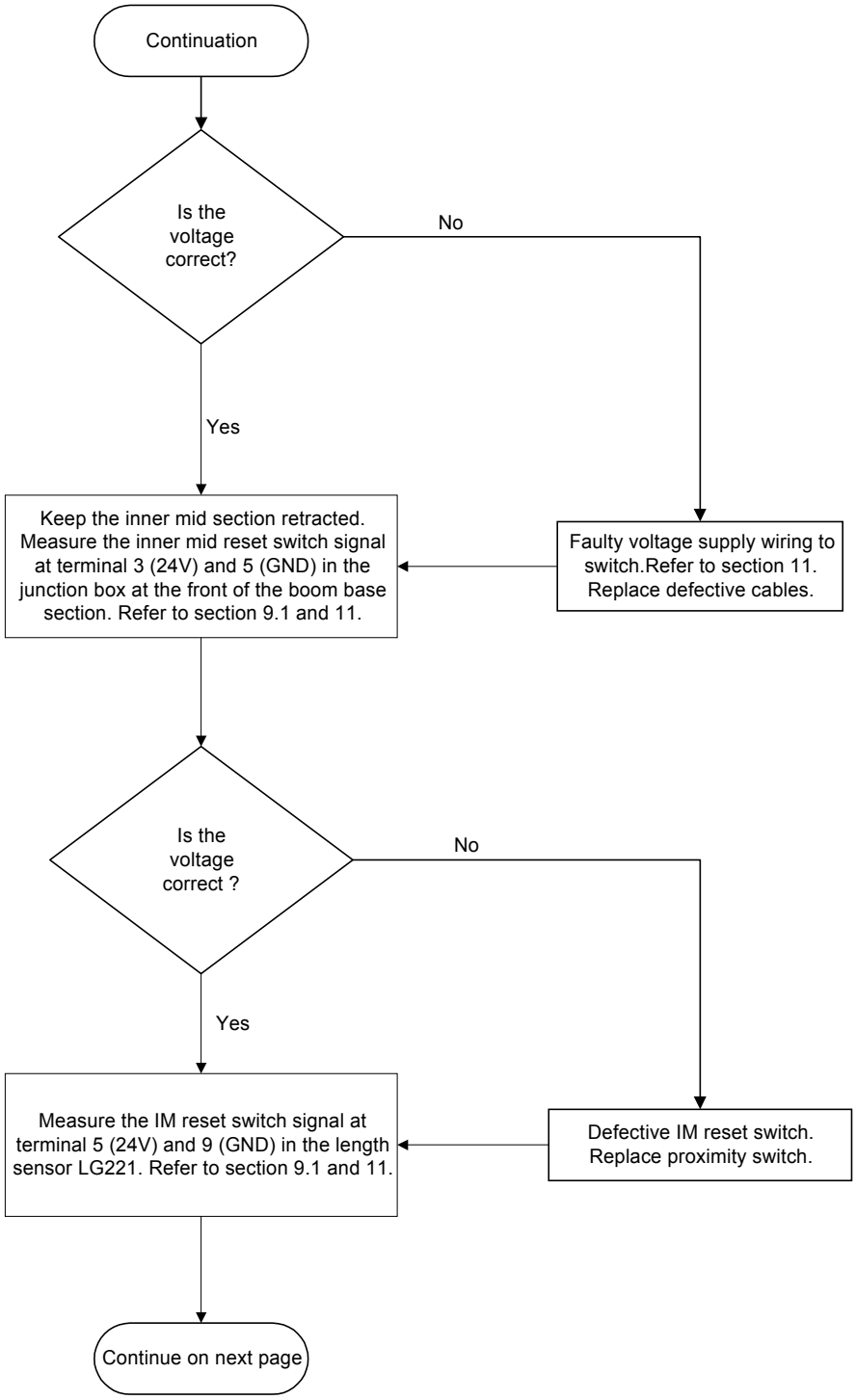


Drawing 12.4

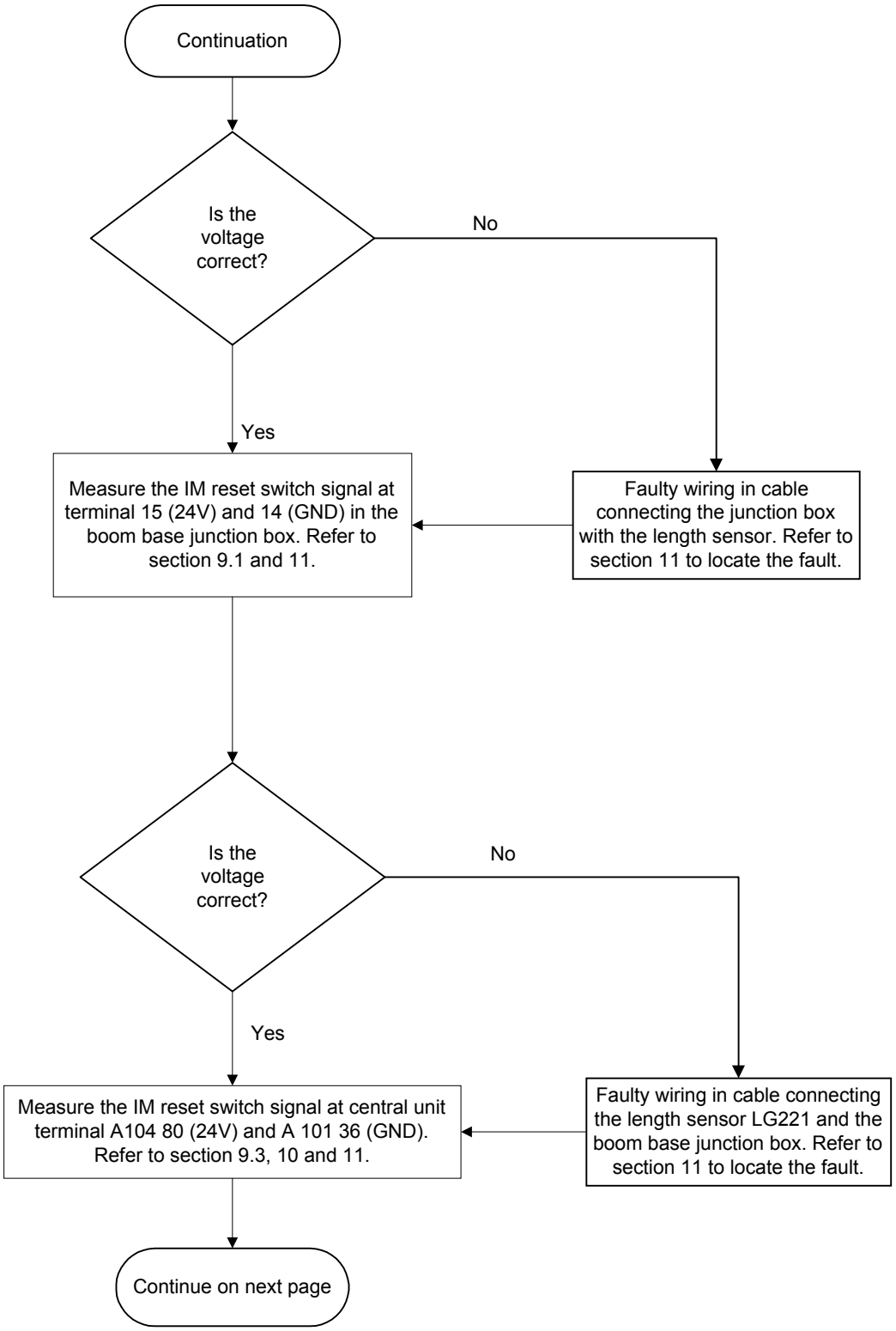
12. Boom Length Percentage Error



12. Continuation



12. Continuation



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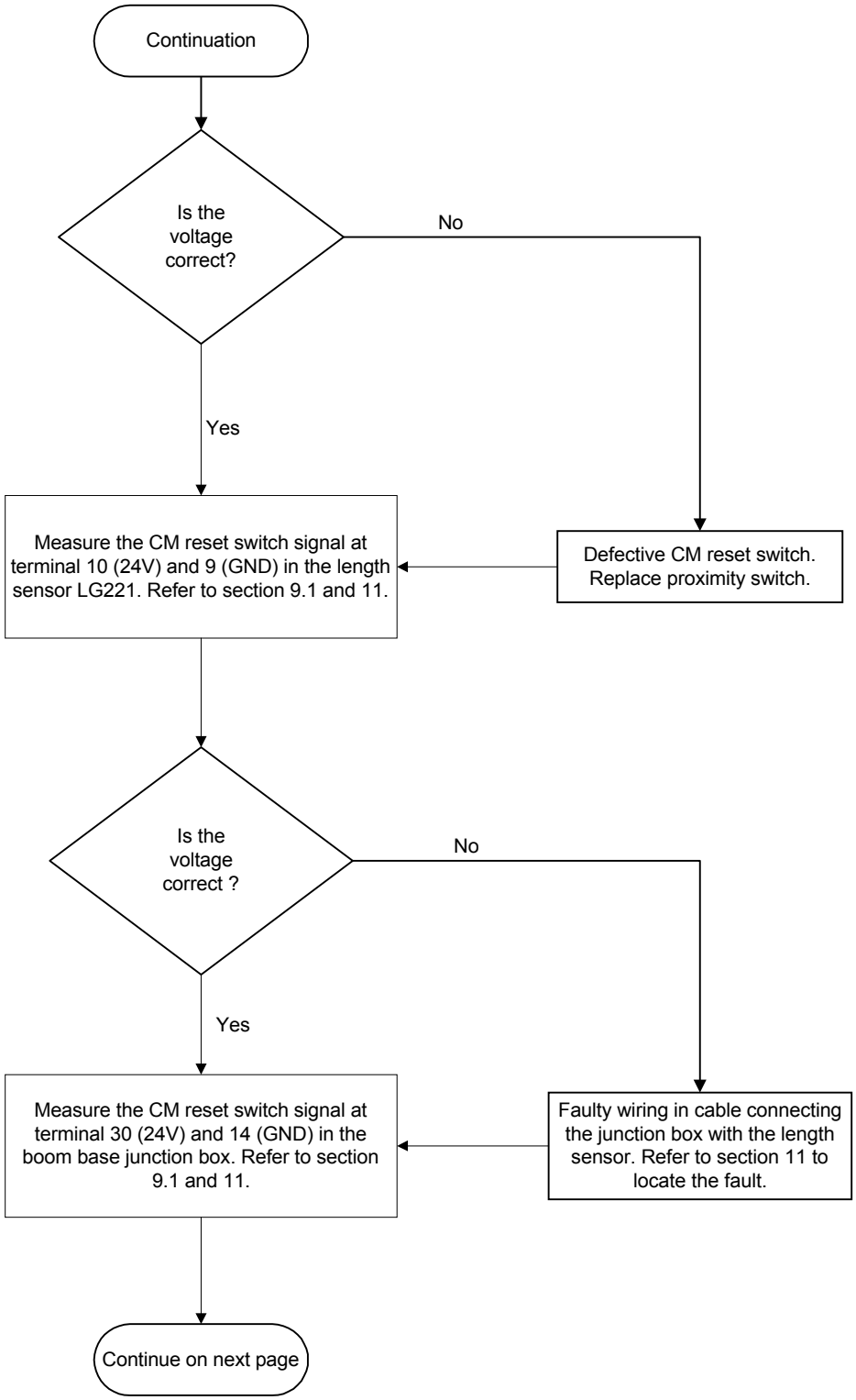

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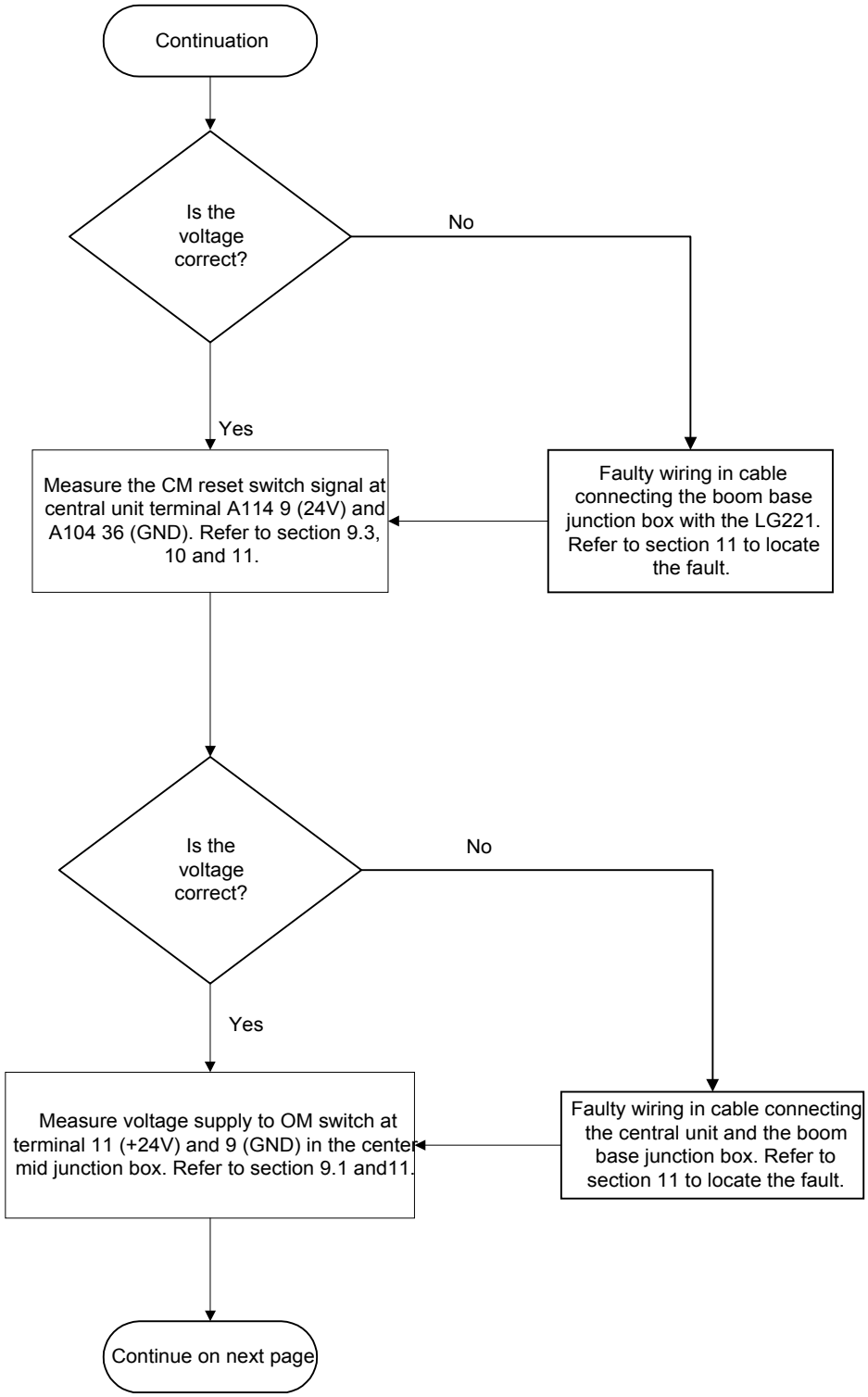

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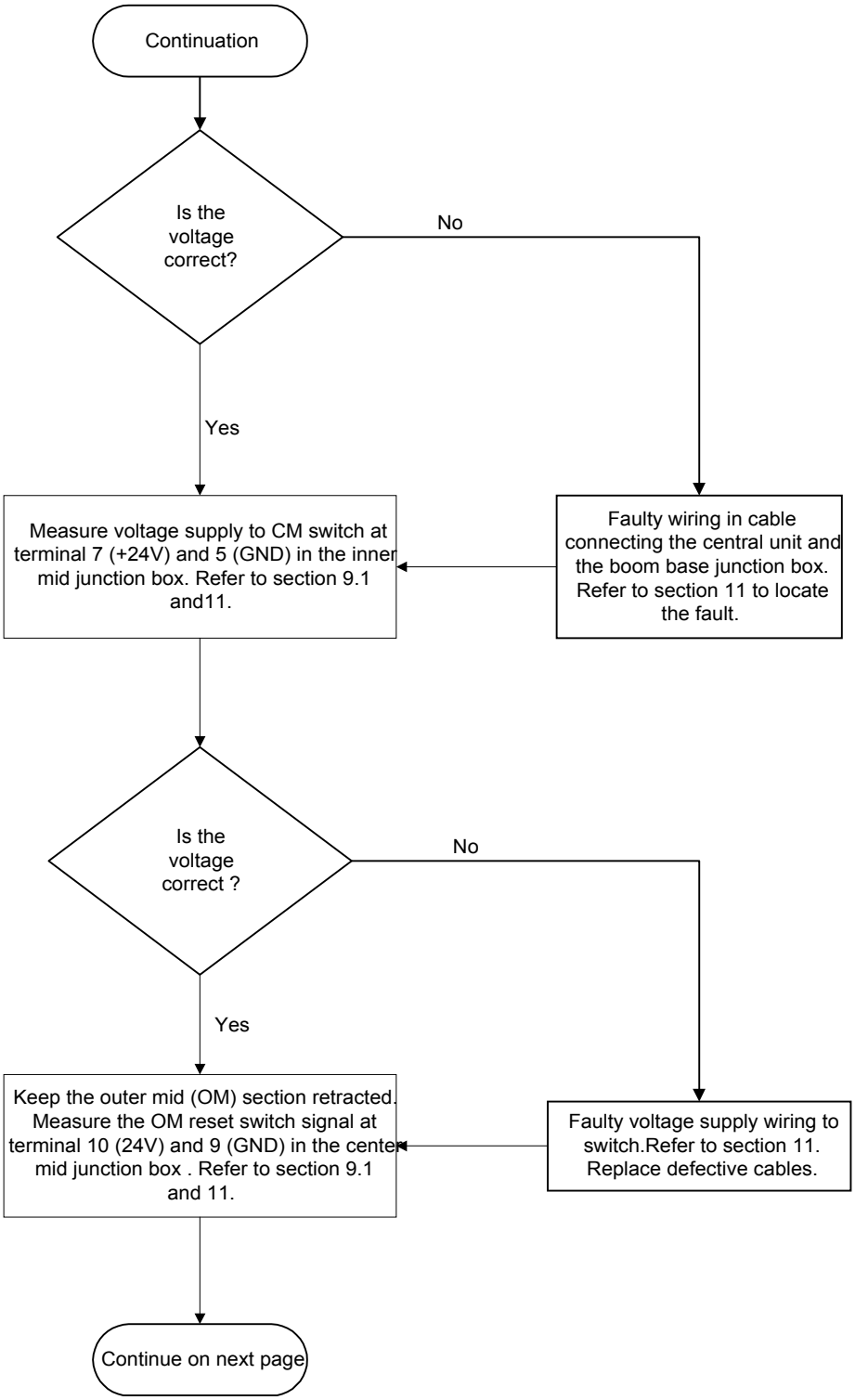

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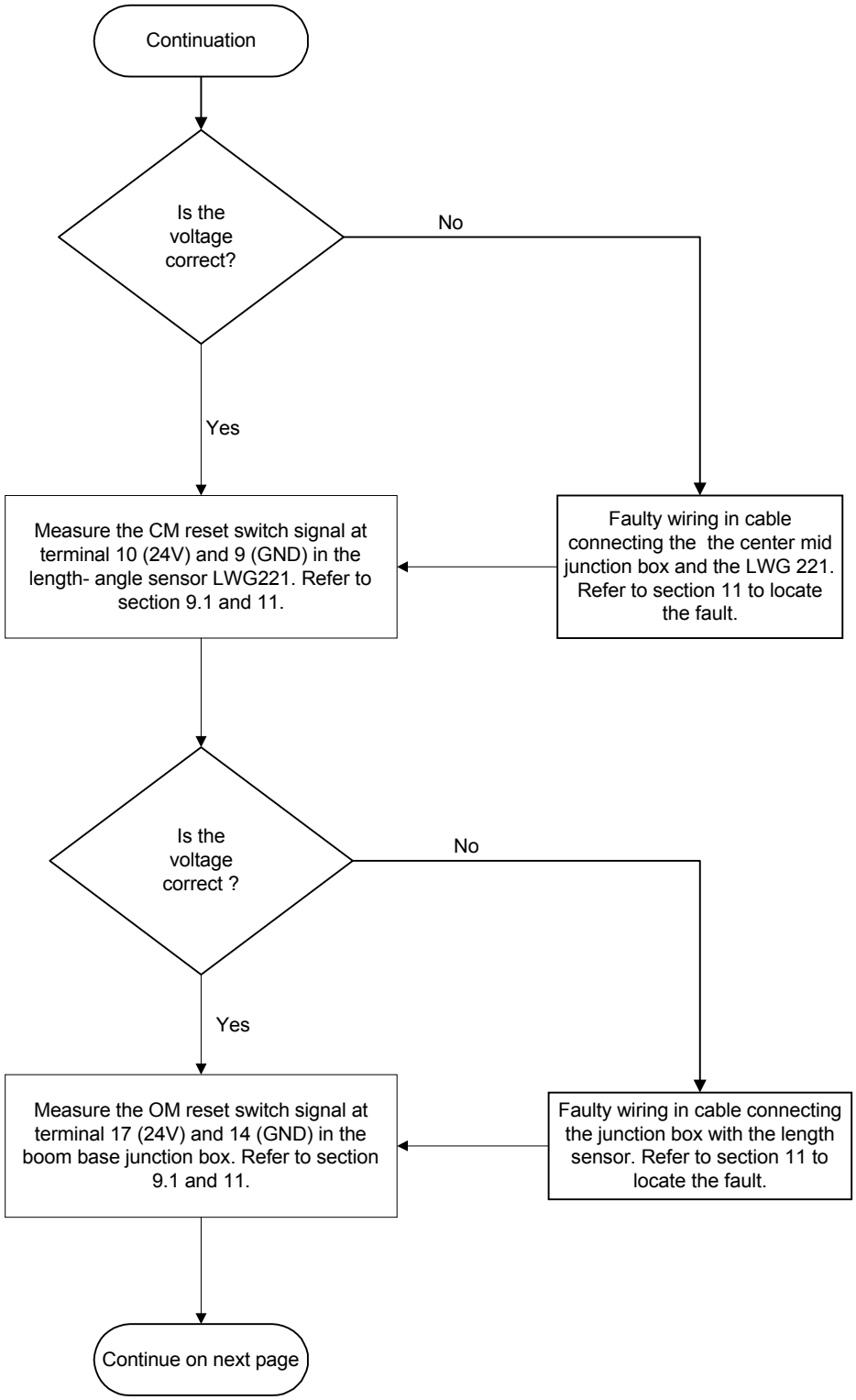

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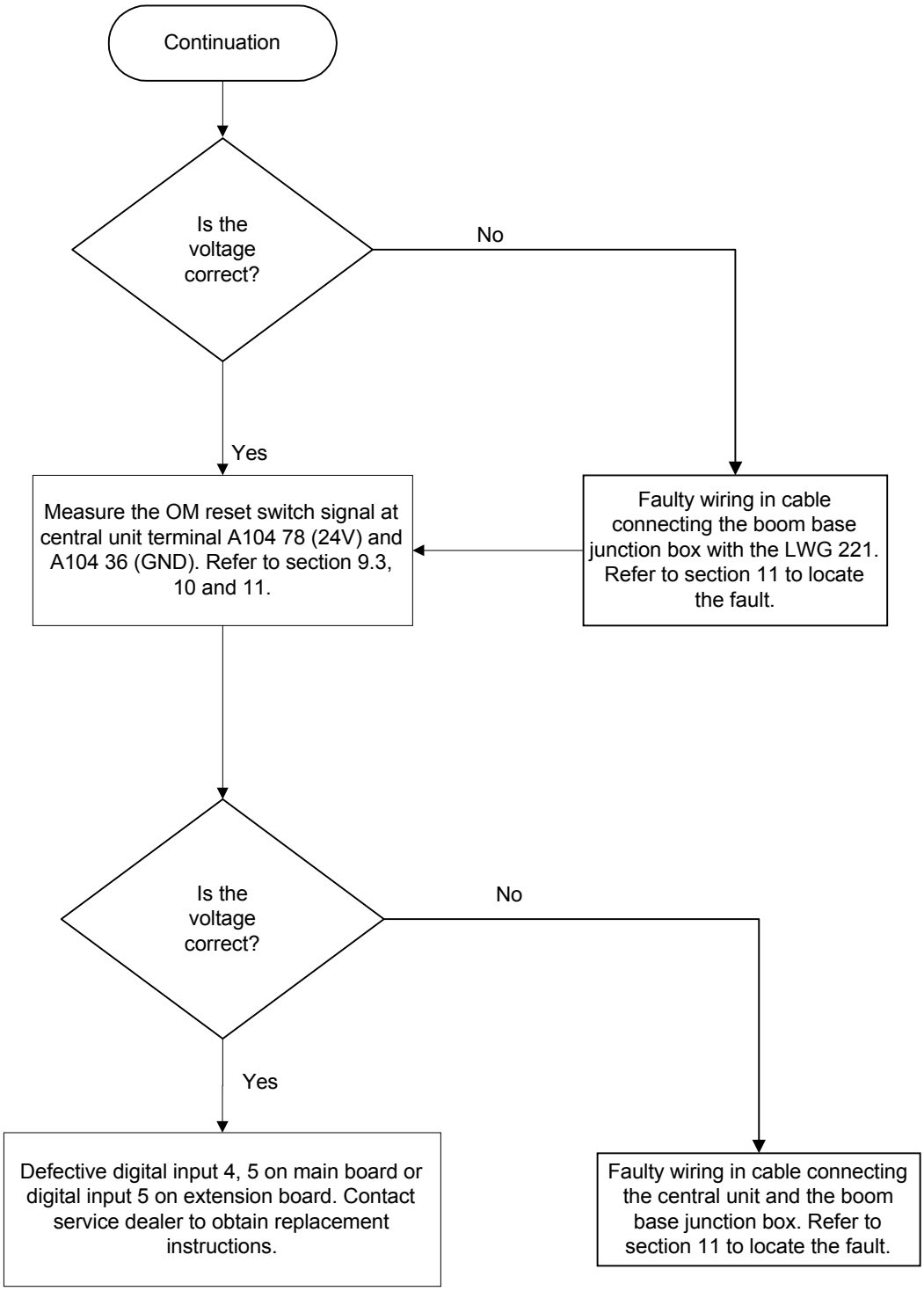
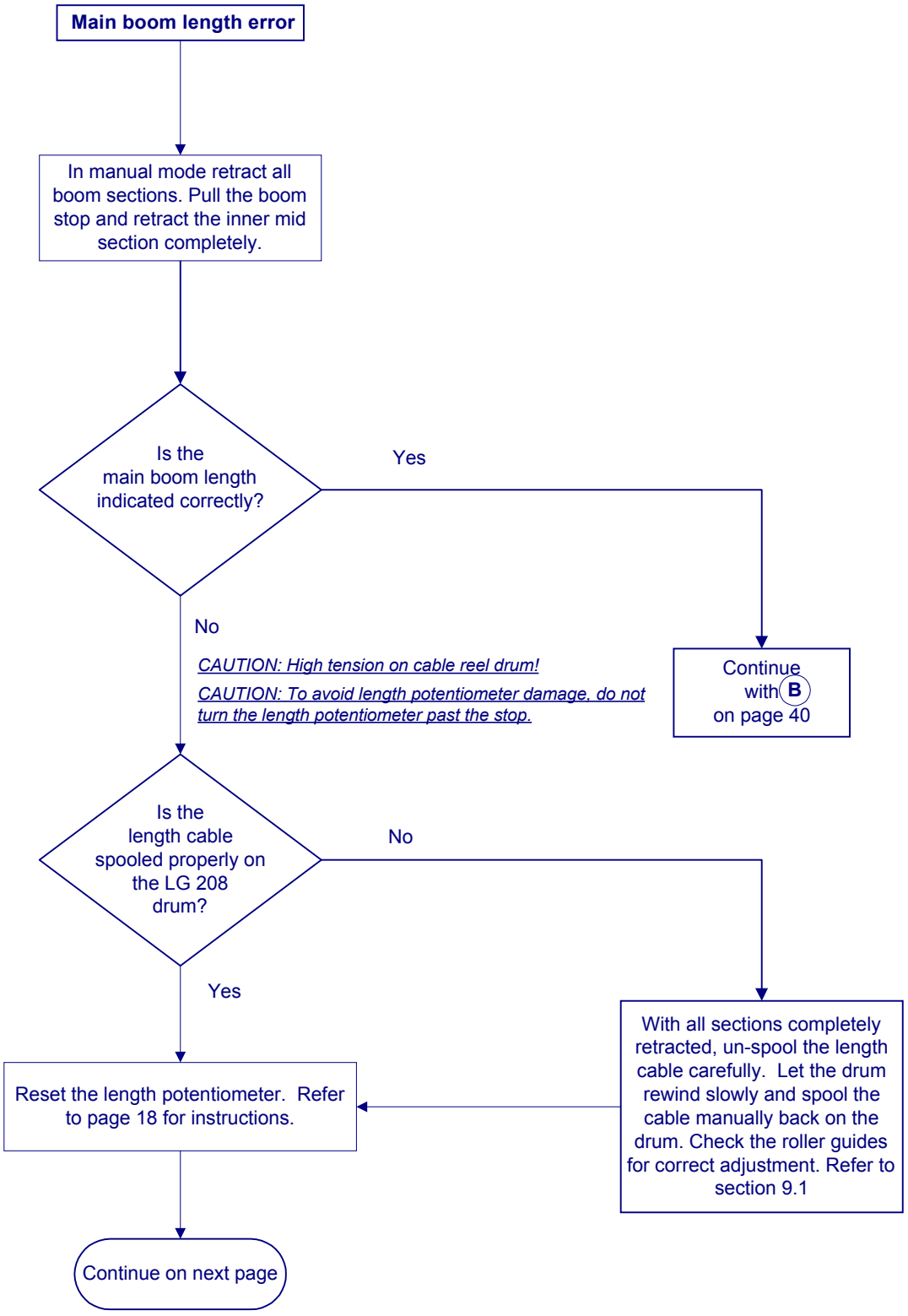


13. Main Boom Length Error



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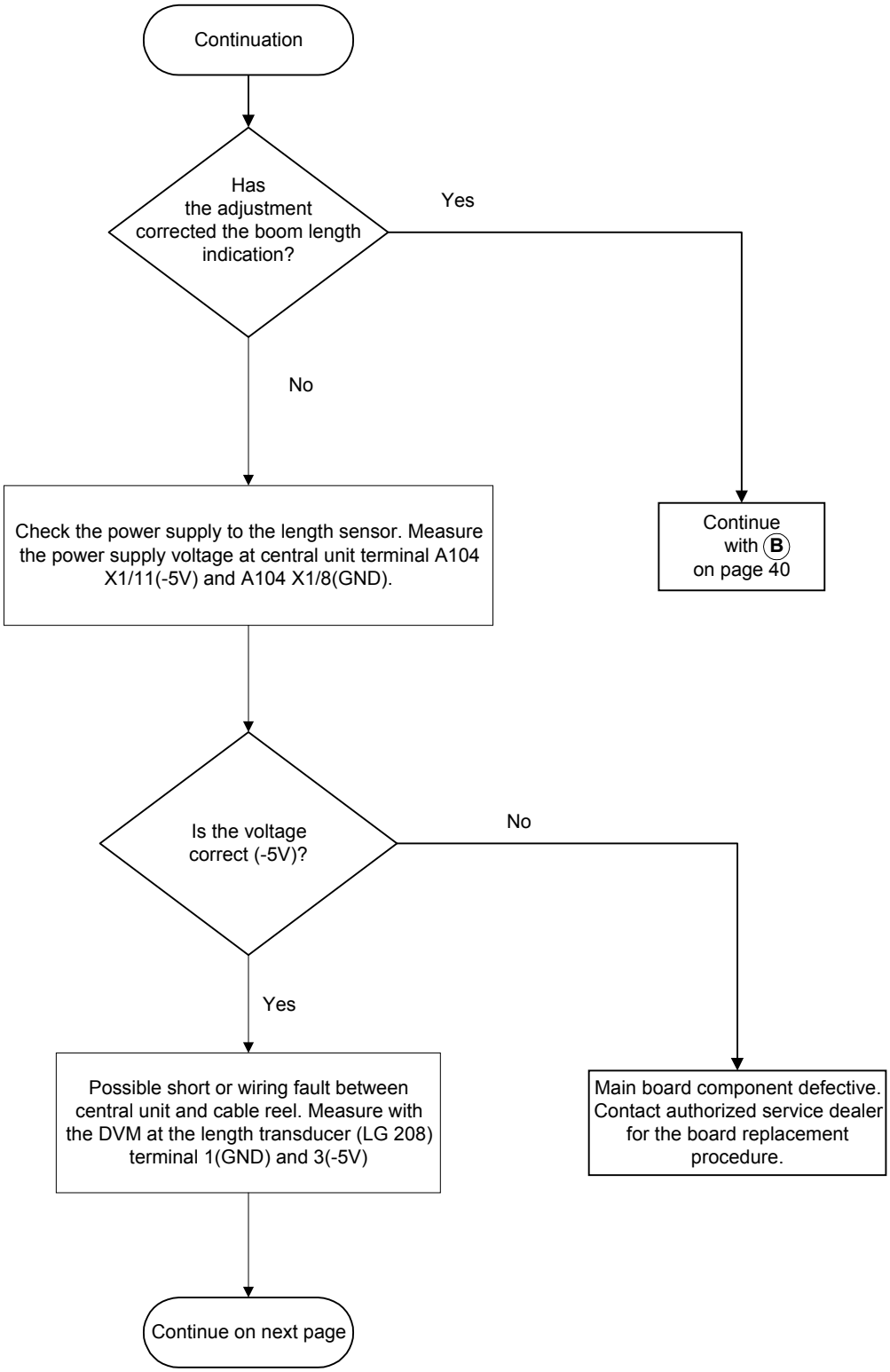
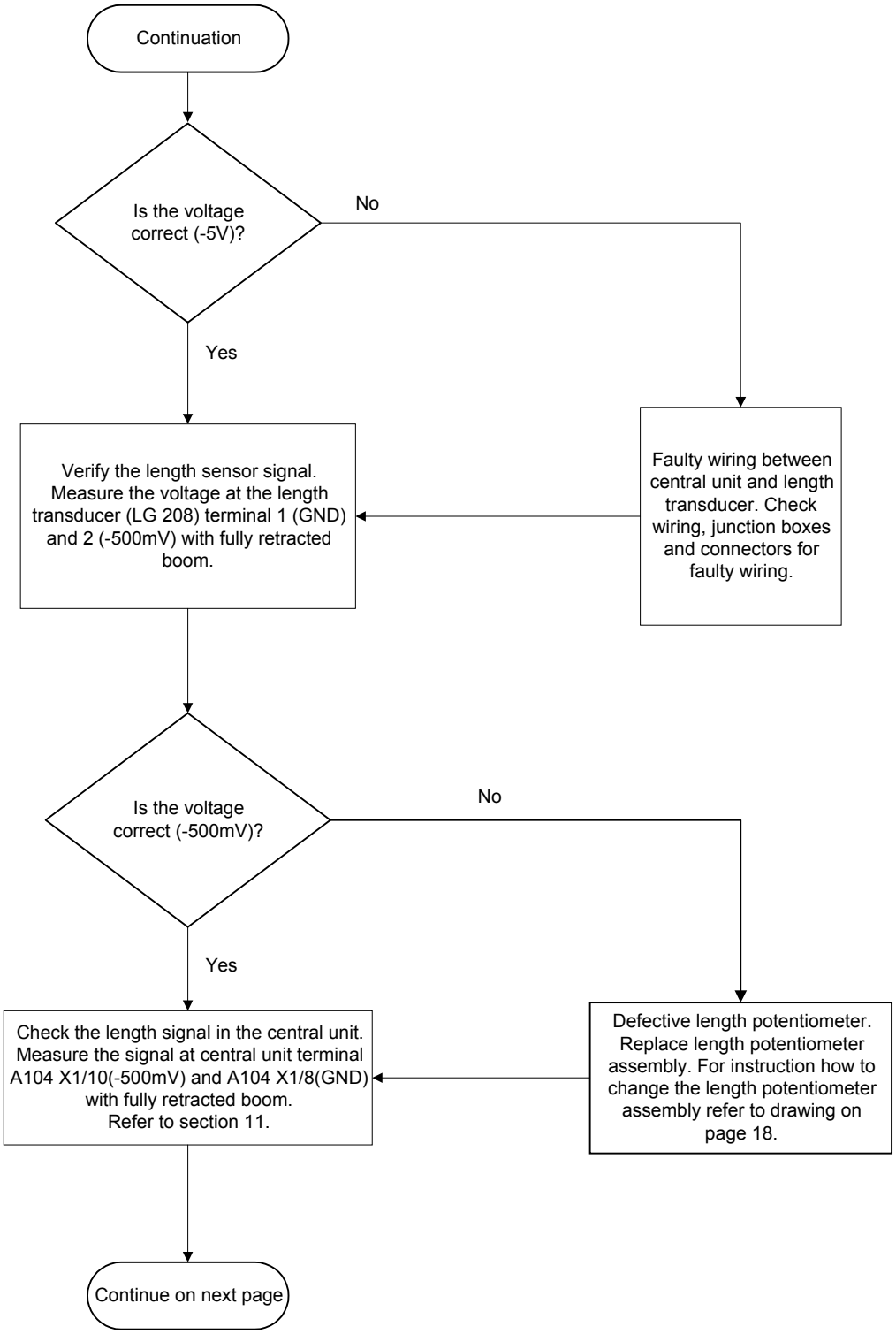


13. Continuation



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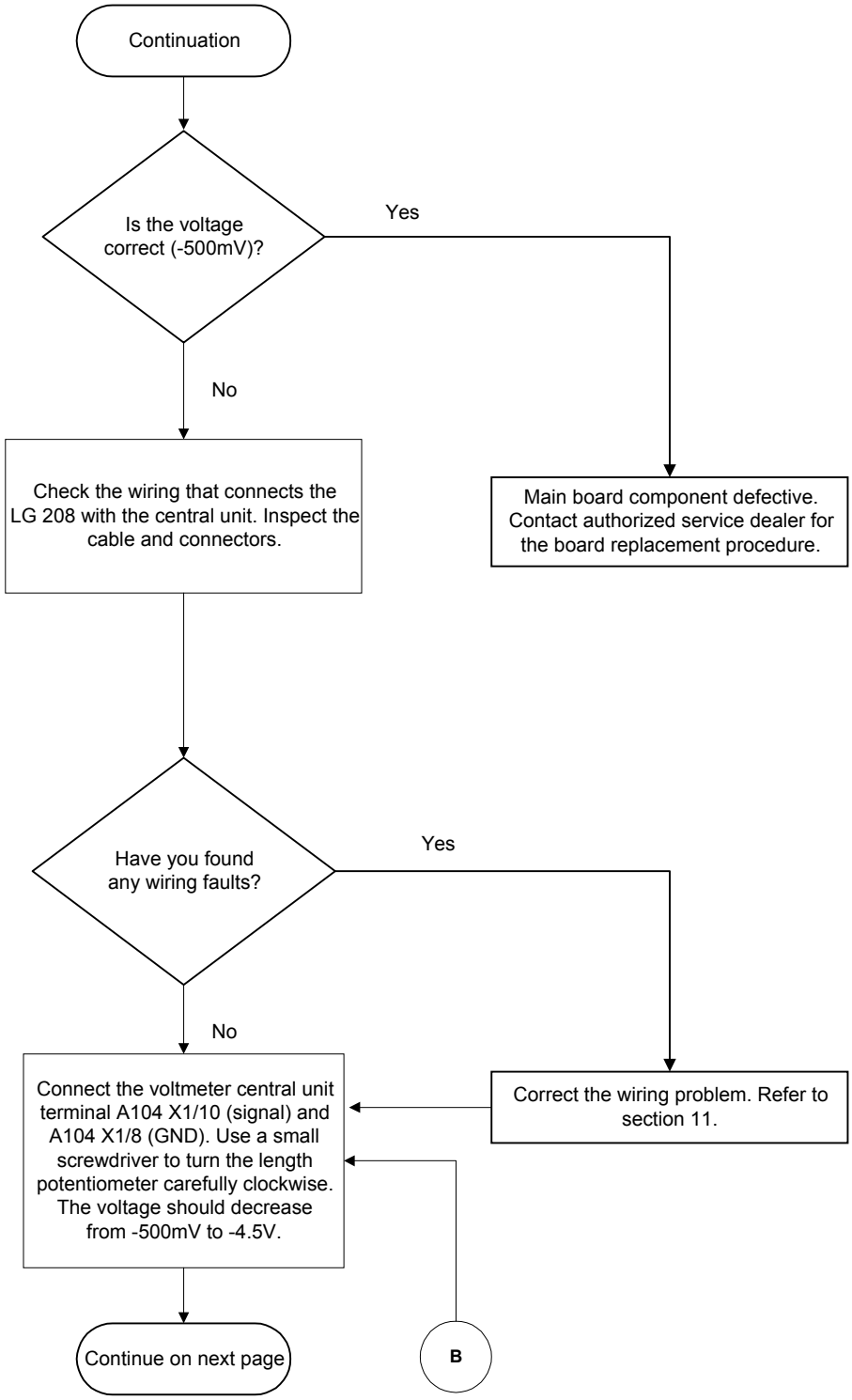

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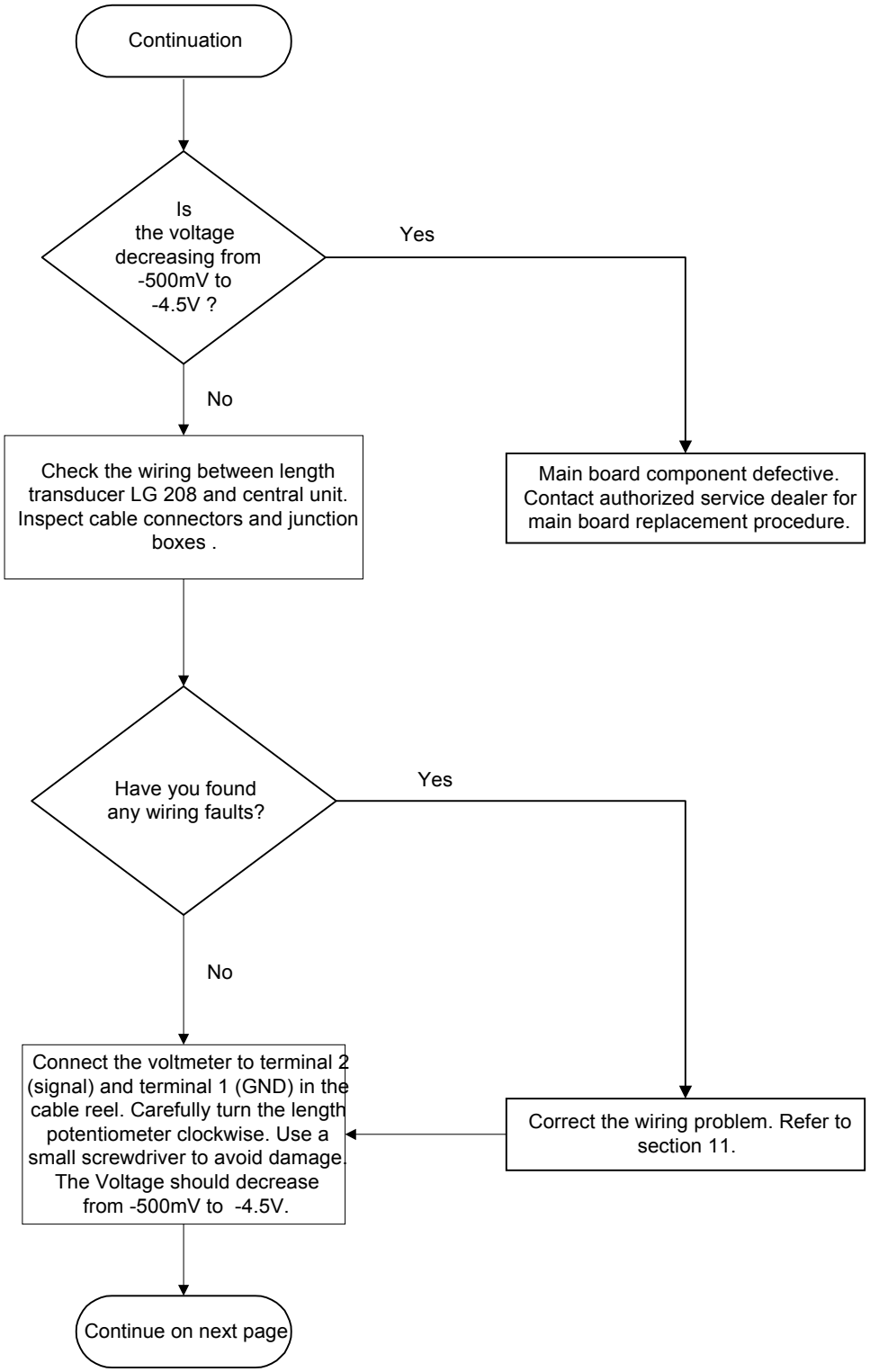
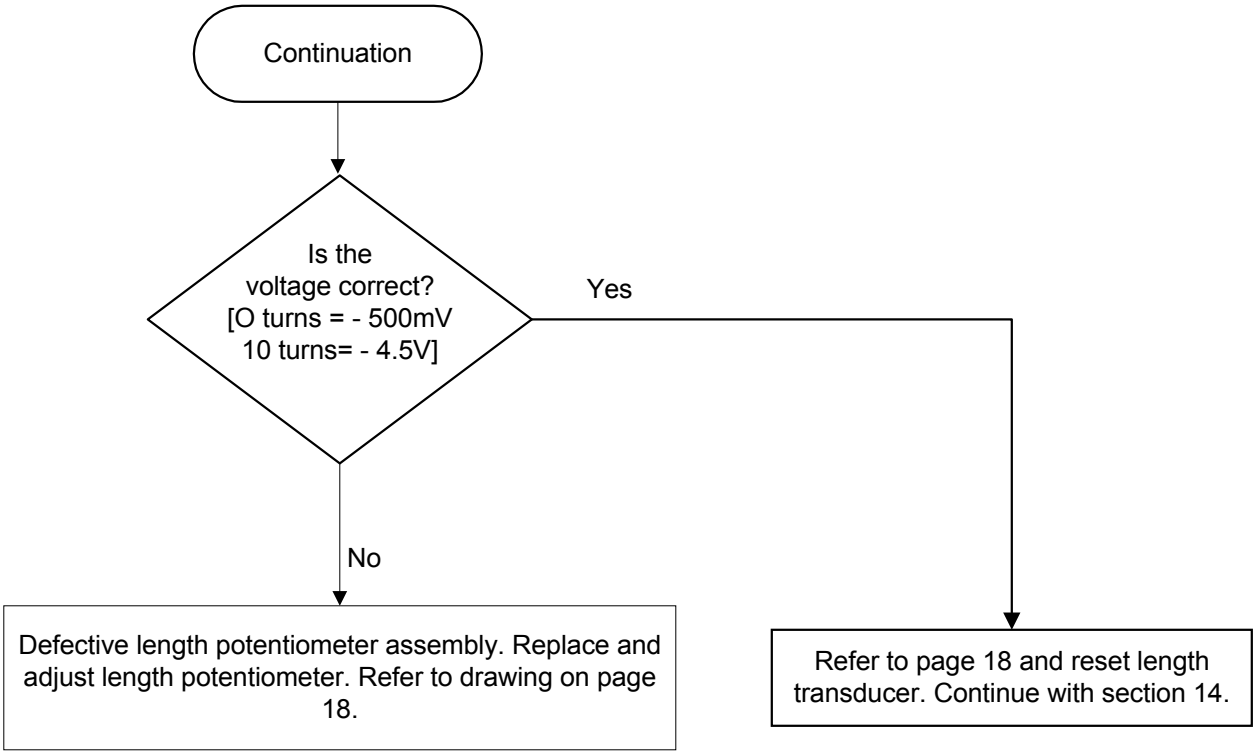
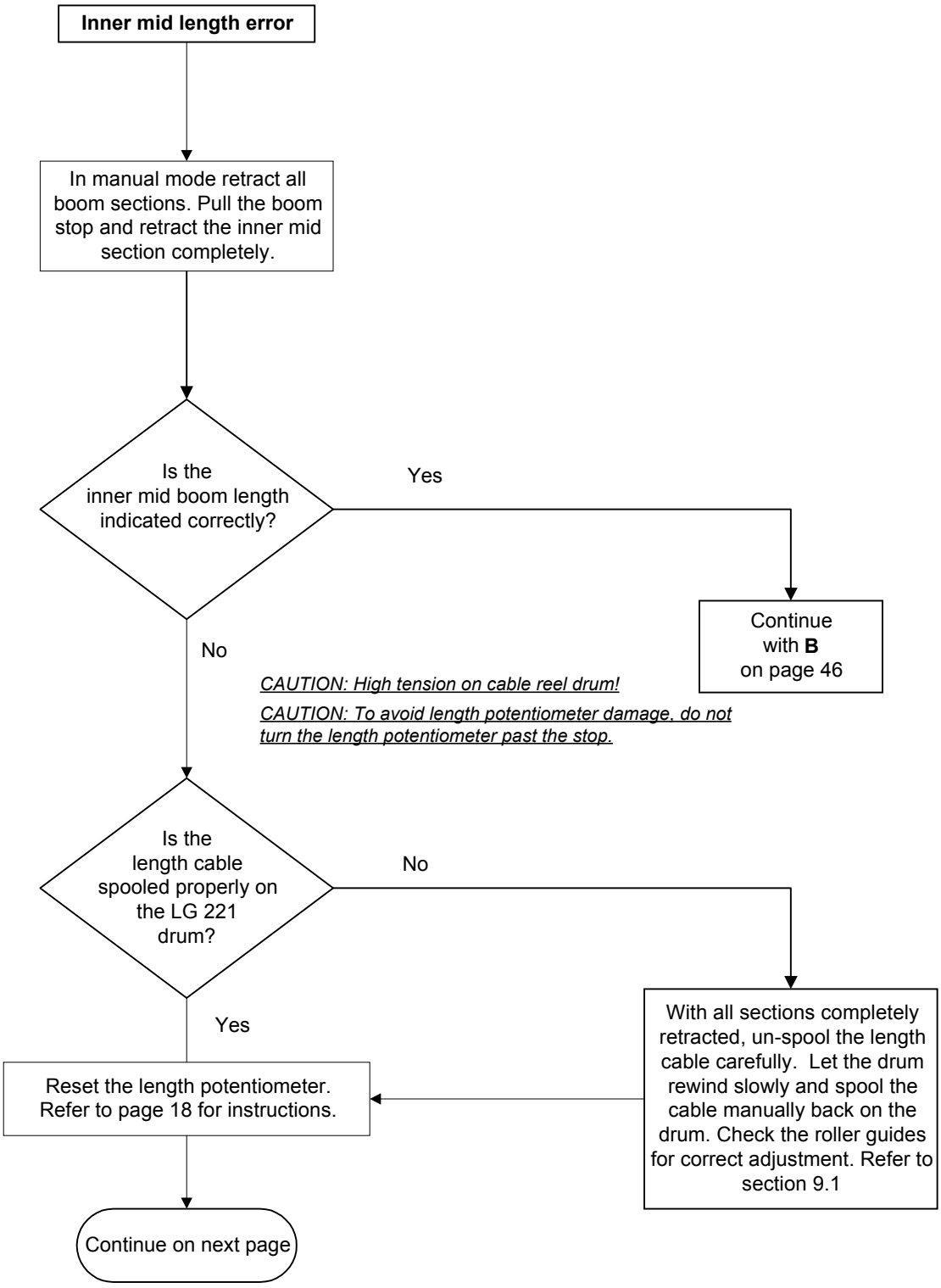


13. Continuation



14. Inner Mid Length Error



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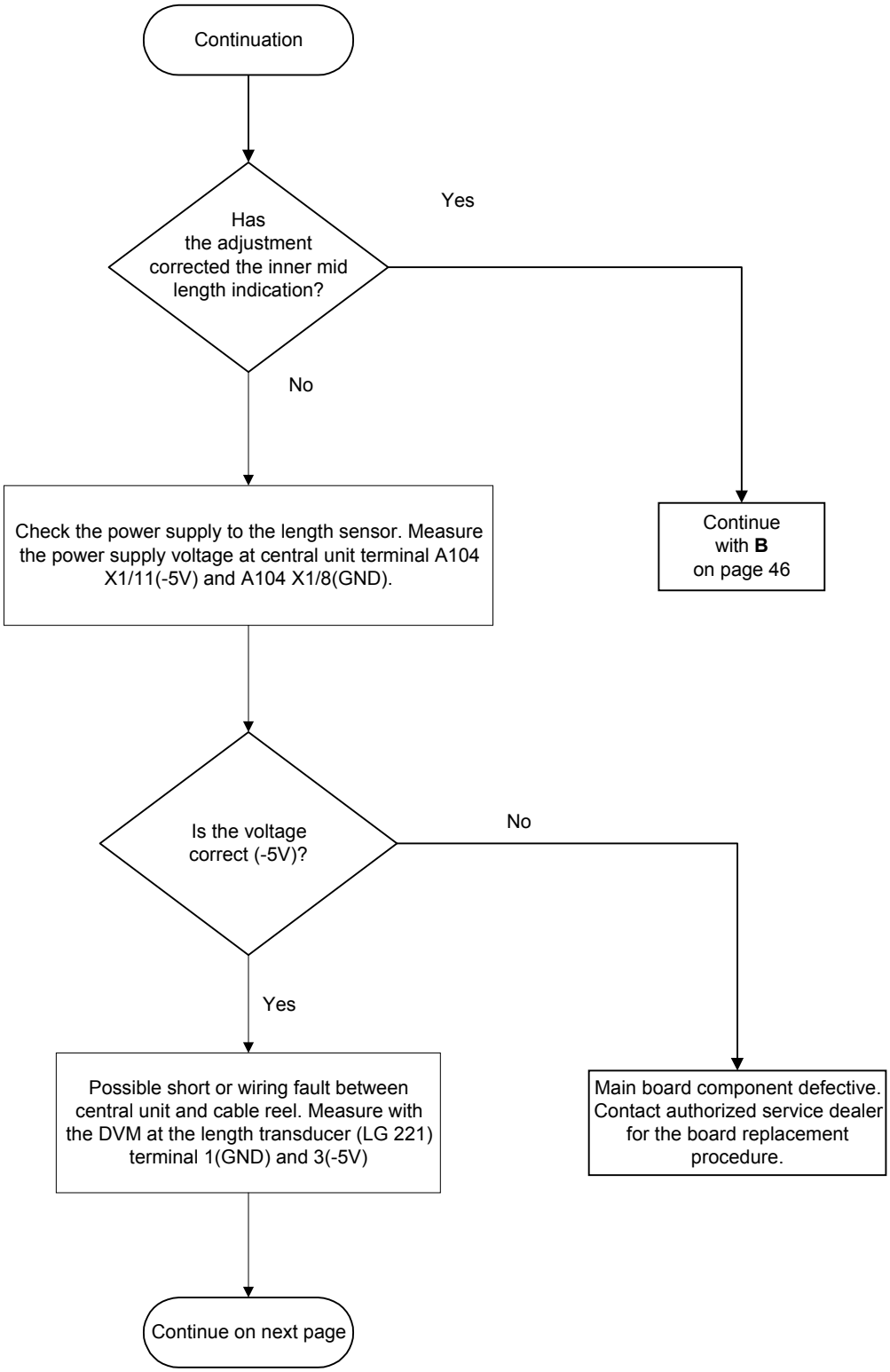

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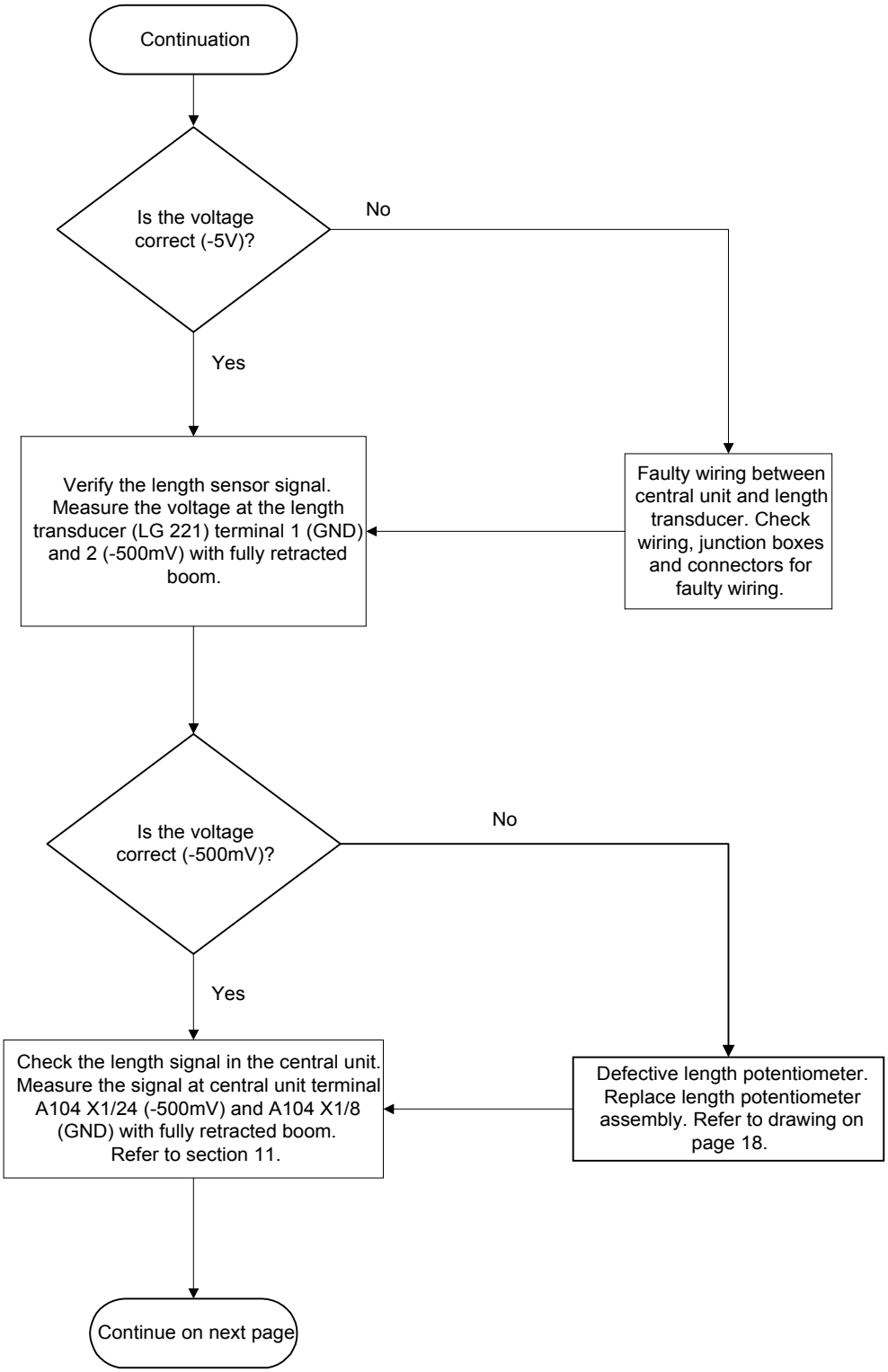

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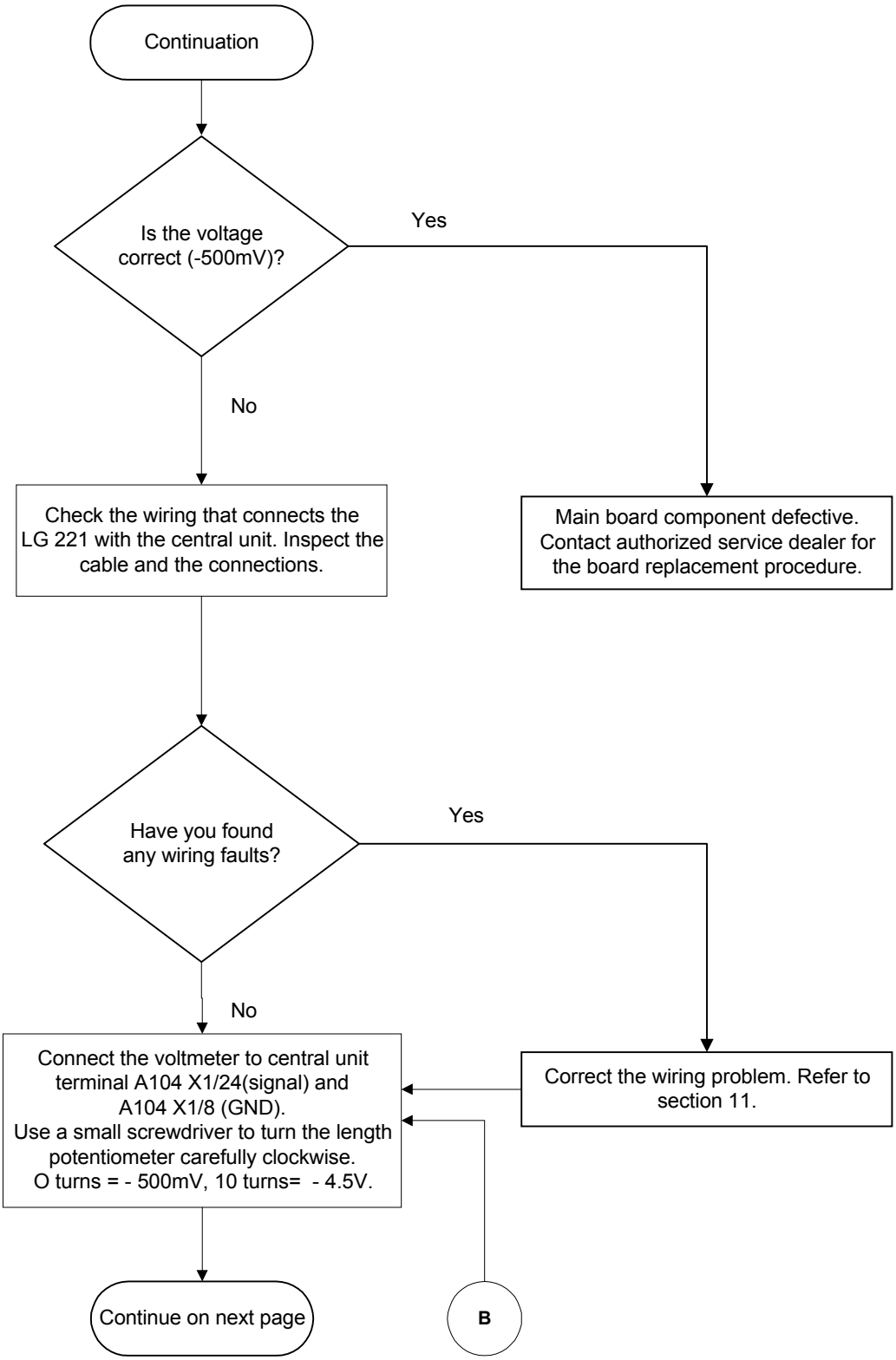

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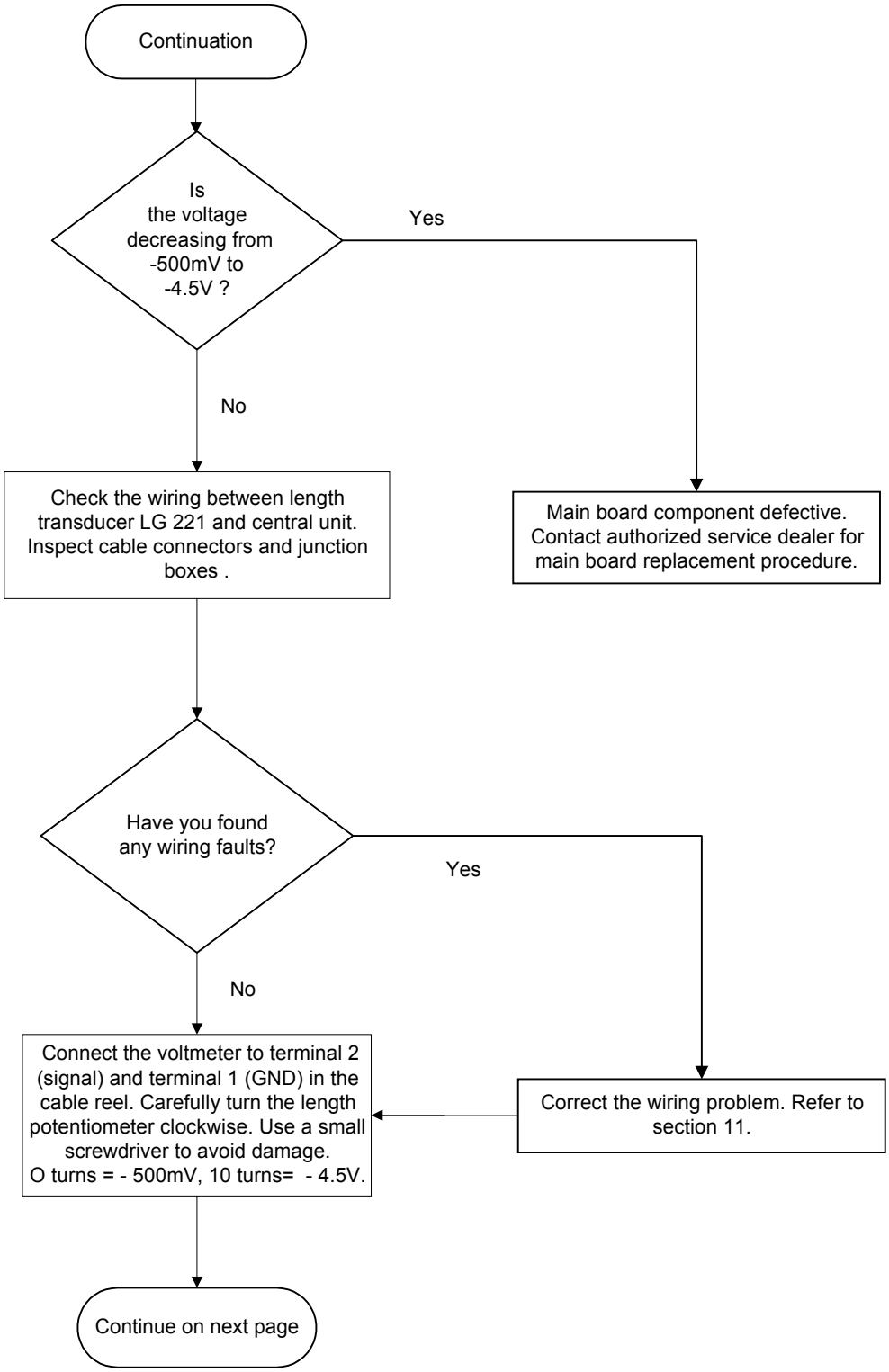

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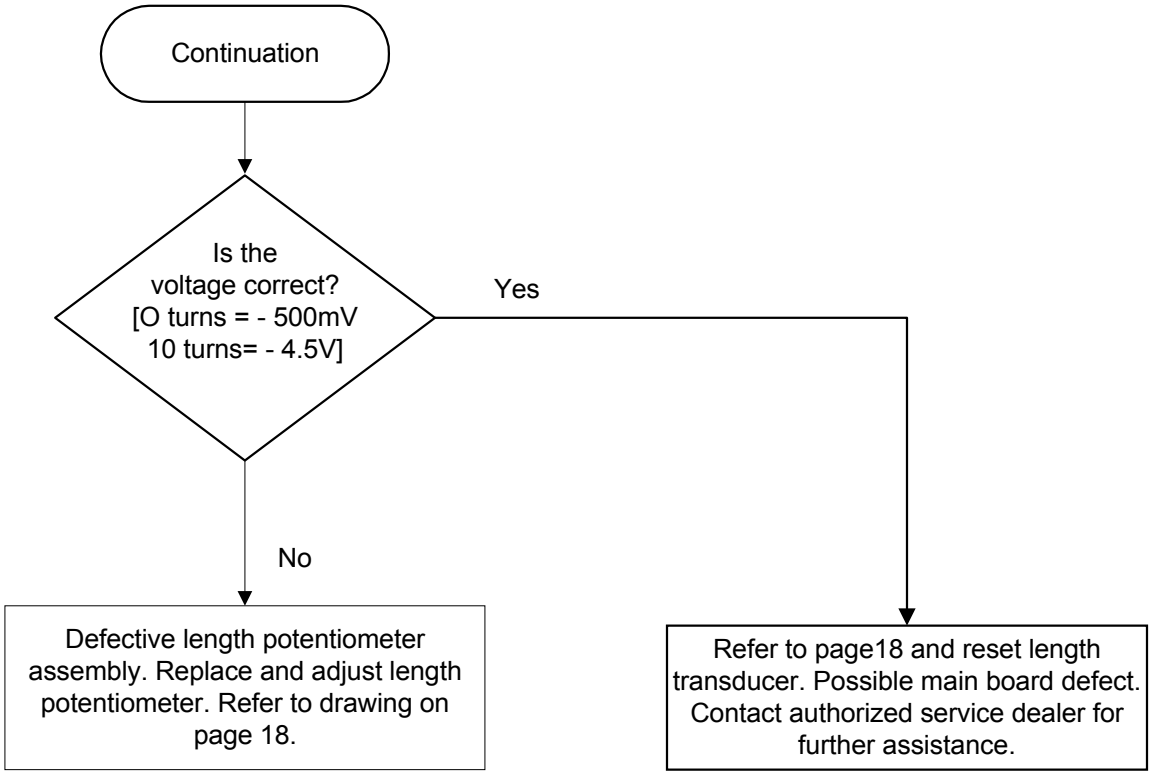
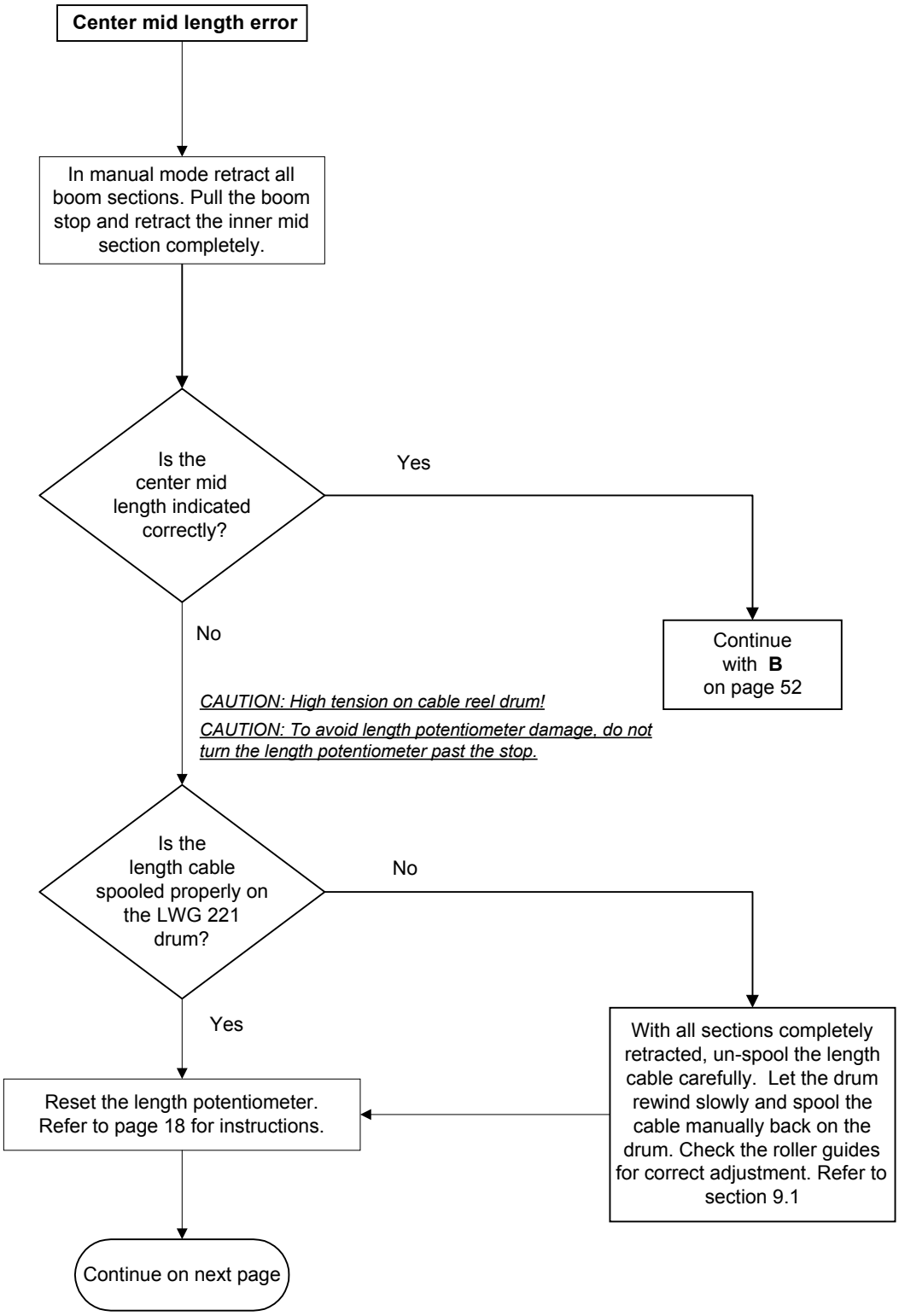
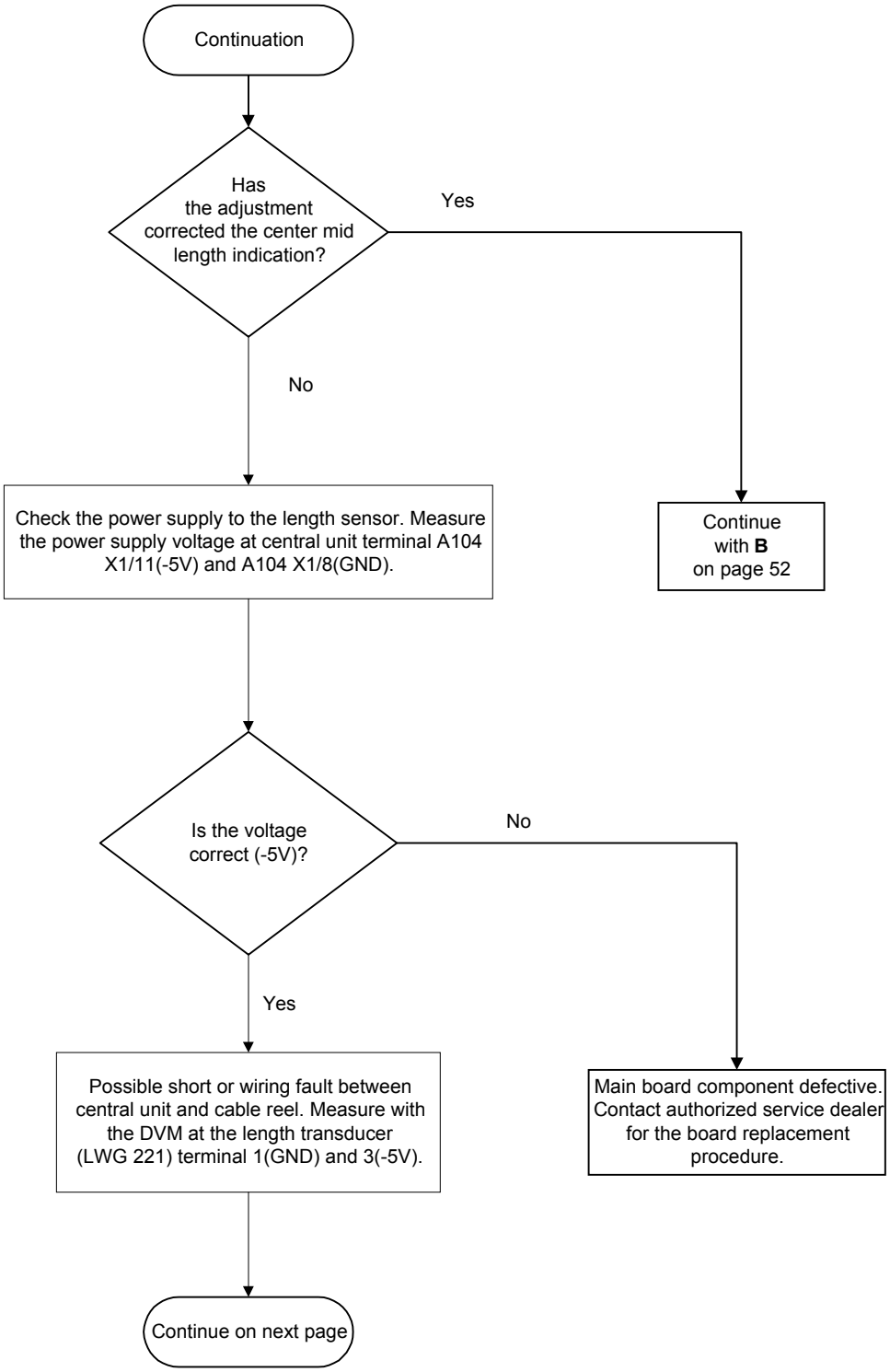


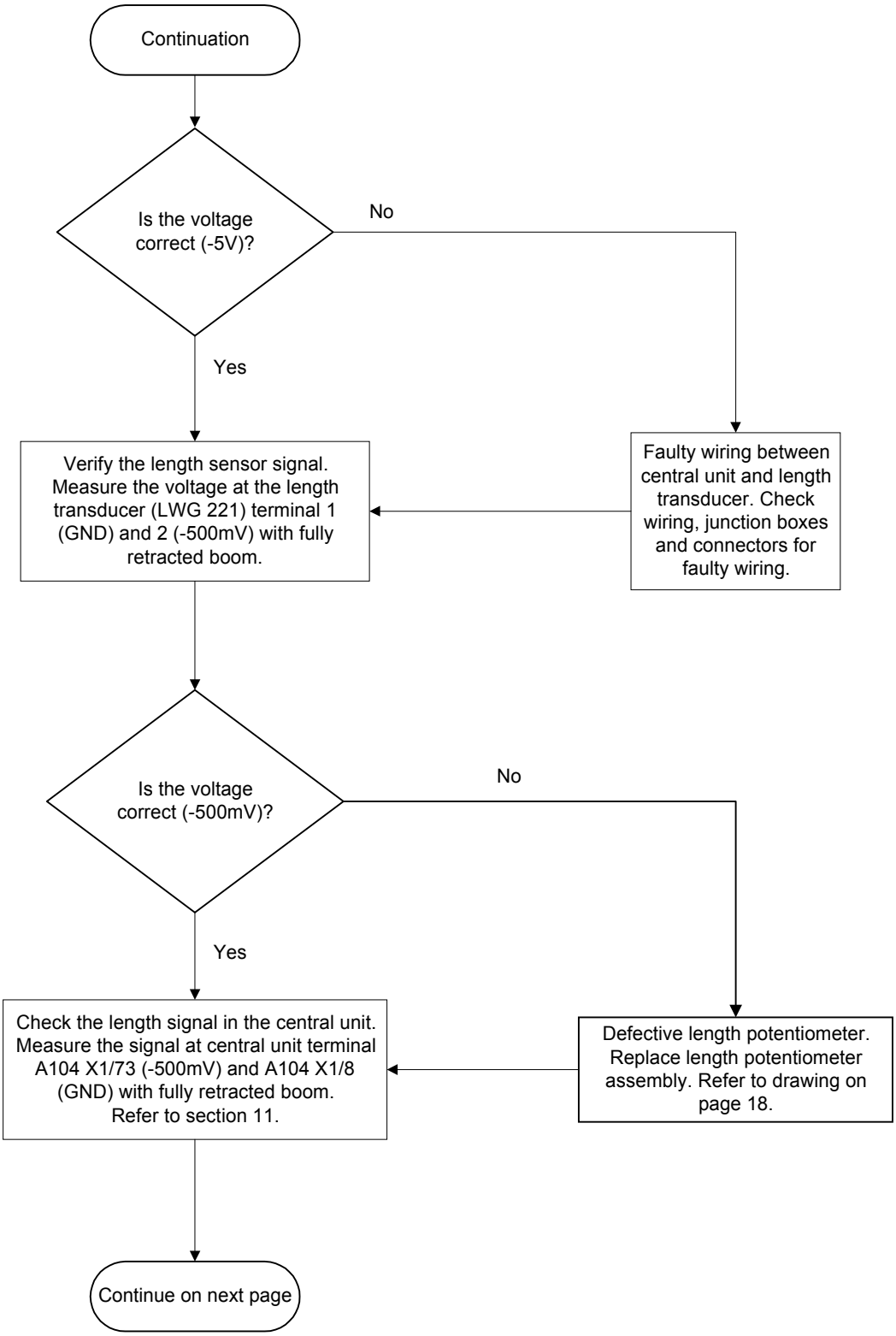
15. Center Mid Length Error



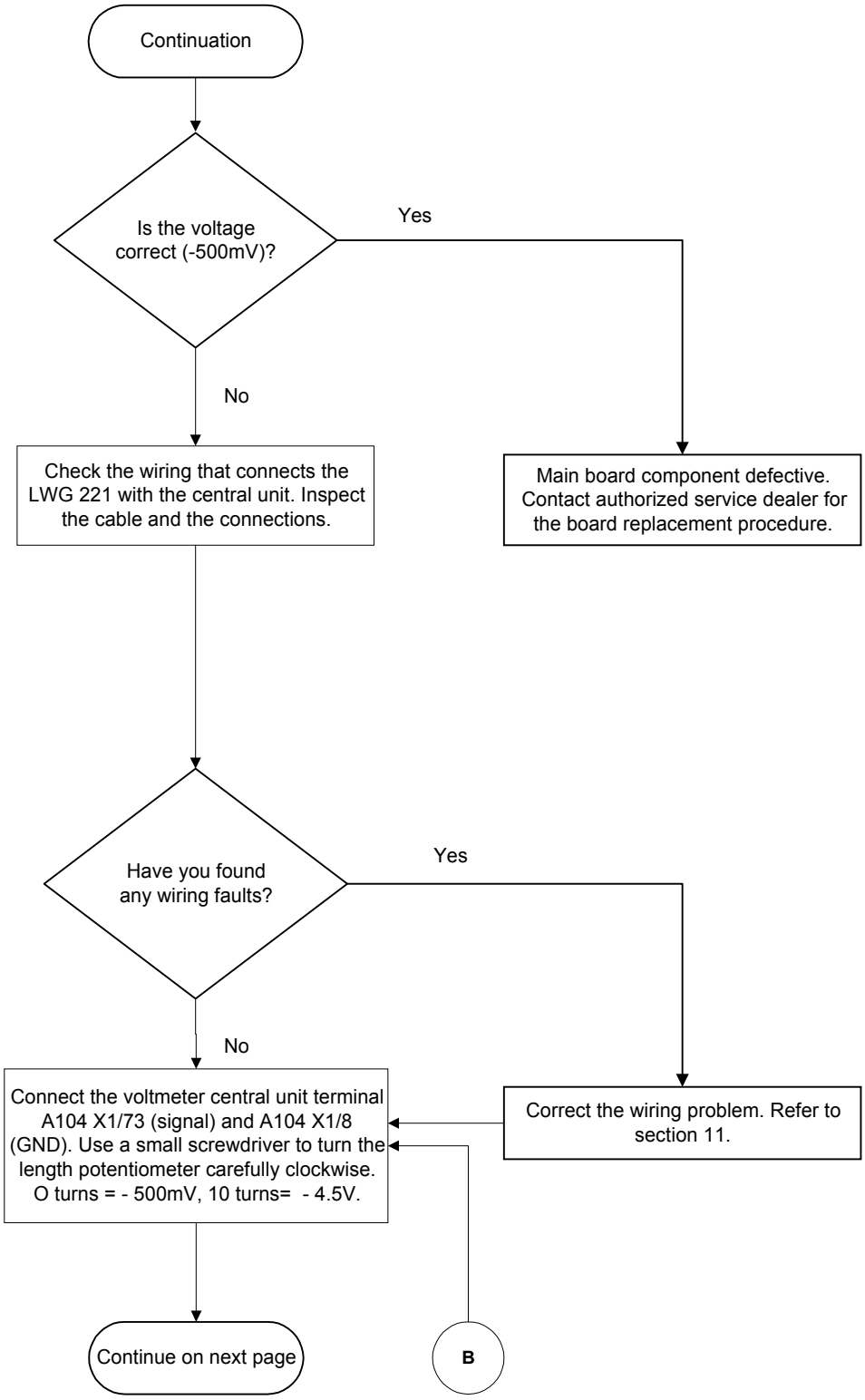
15. Continuation



15. Continuation



15. Continuation



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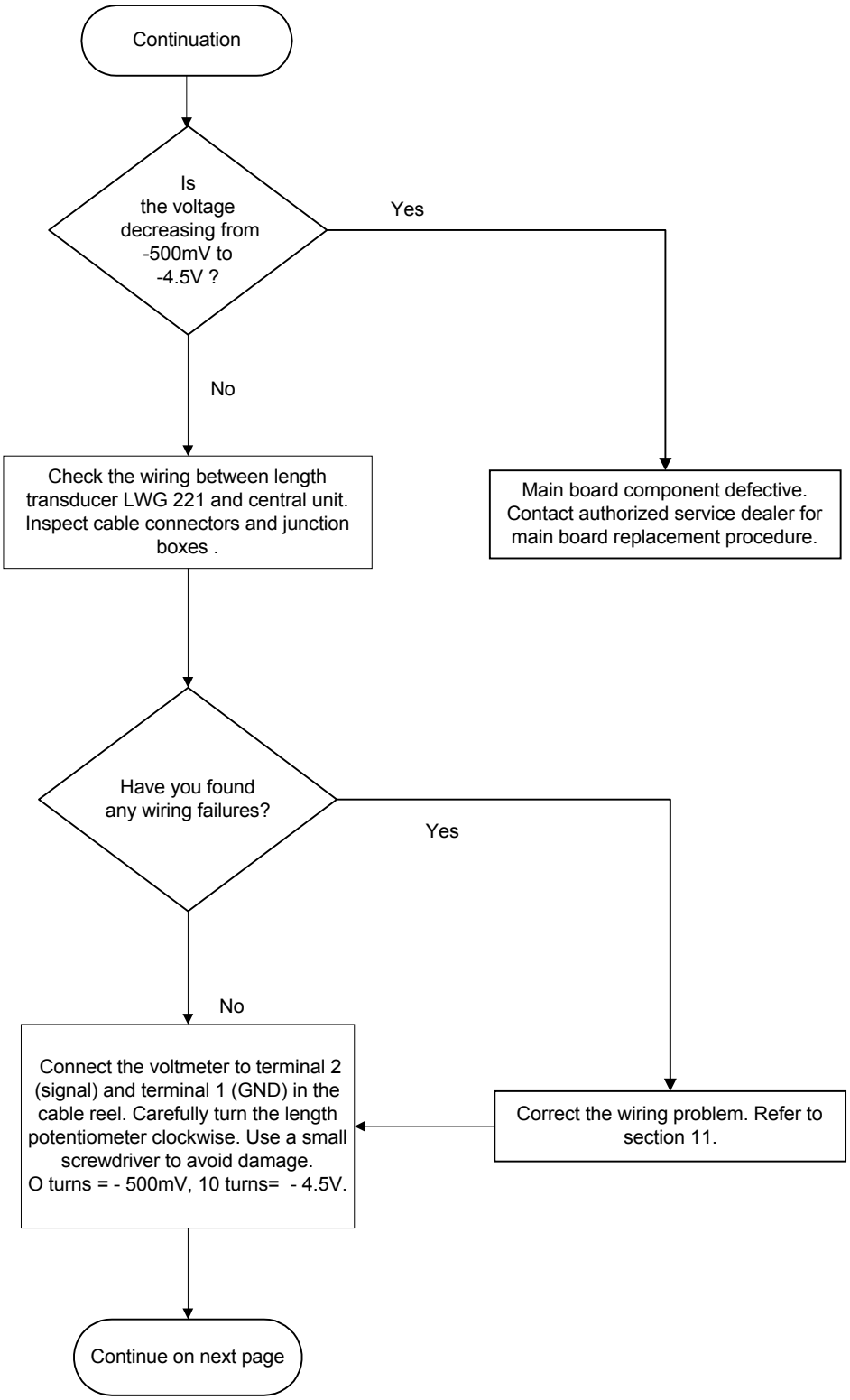
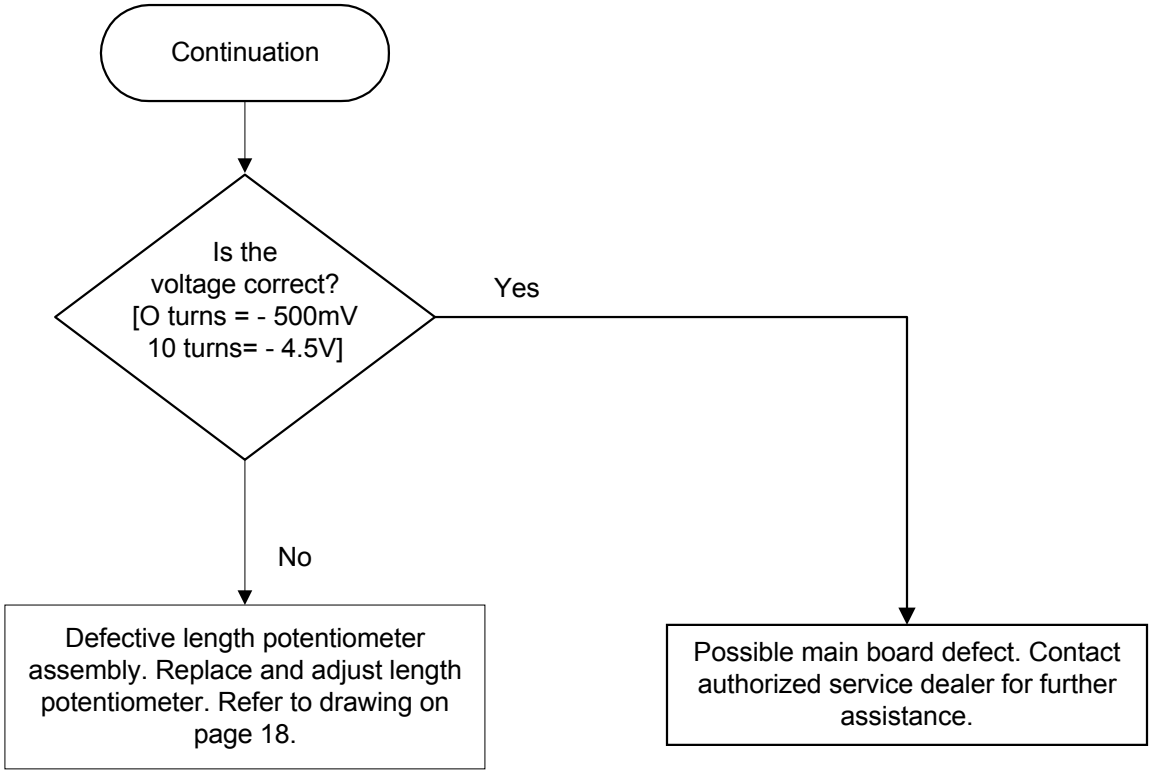
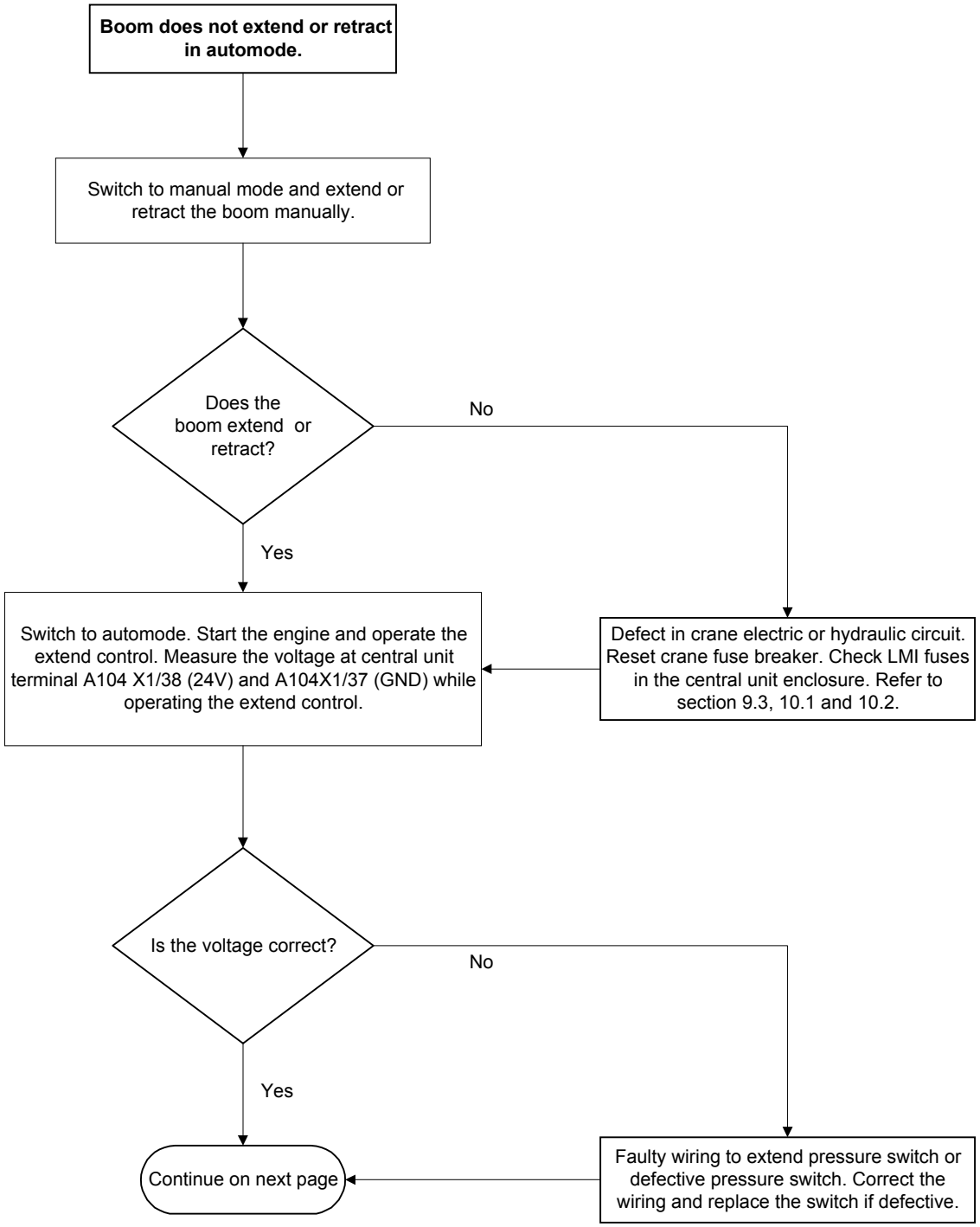


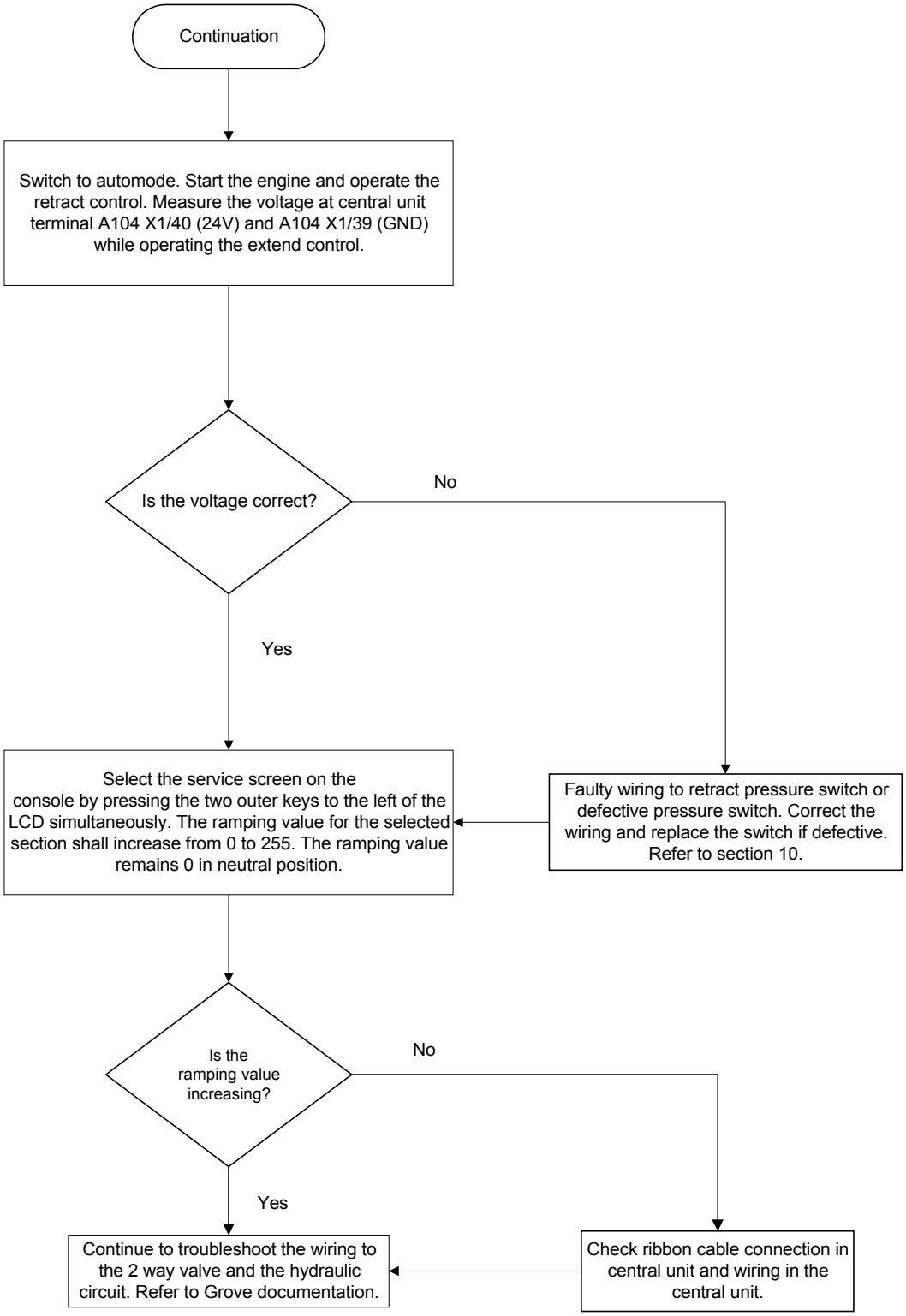
15. Continuation



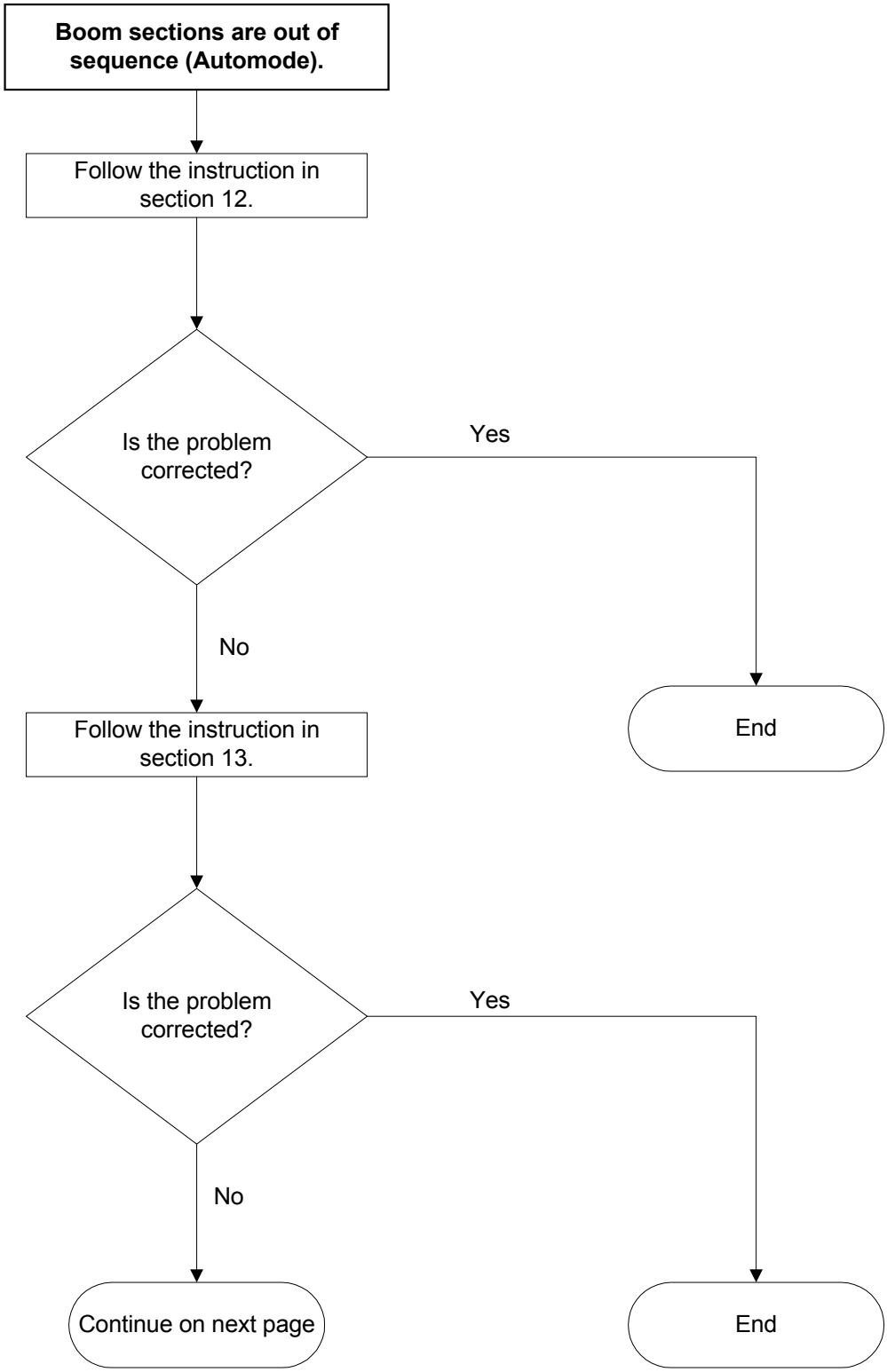
16. No Extend or Retract Function in Automode



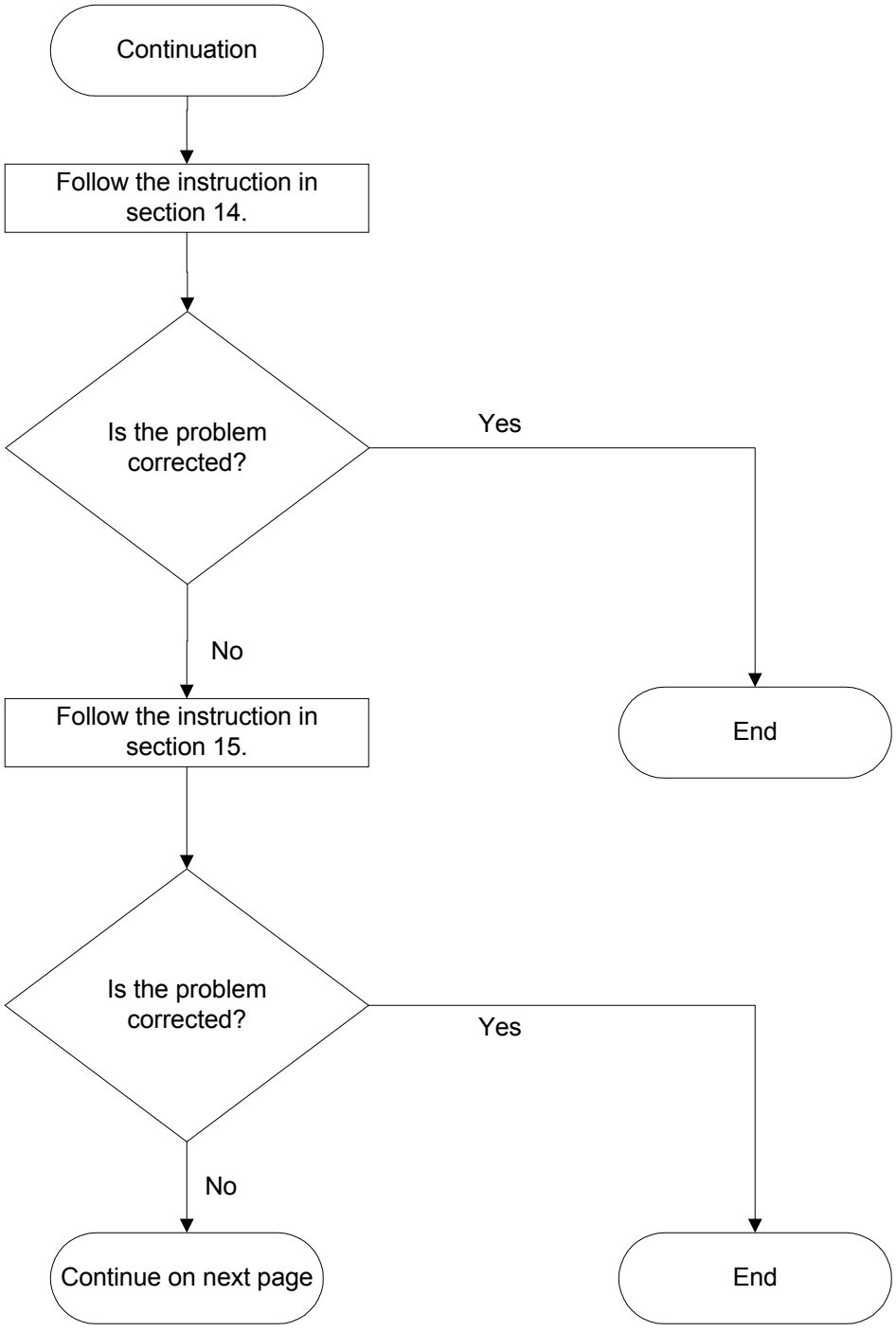
16. Continuation



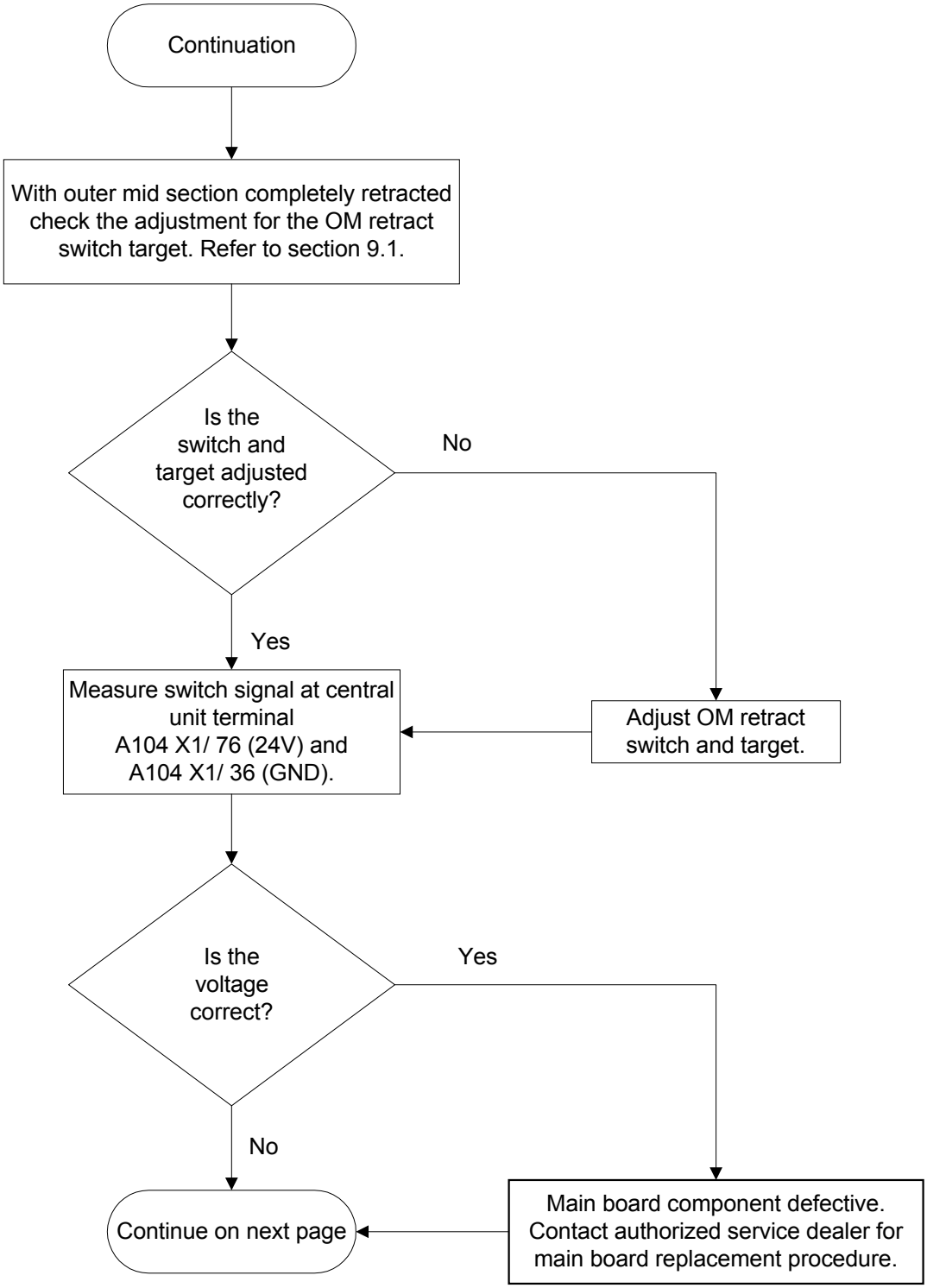
17. Out of Sequence Warning



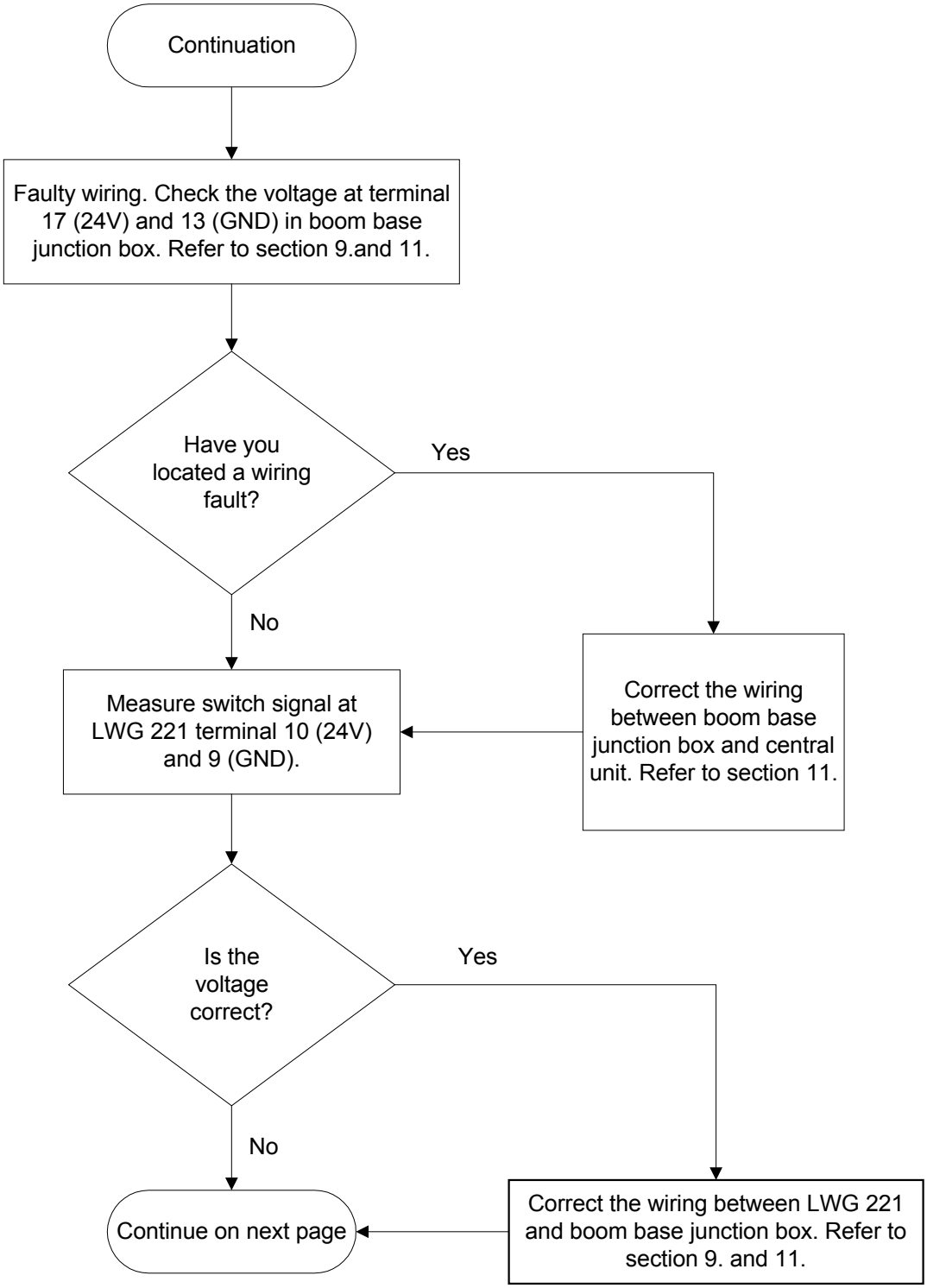
17. Continuation



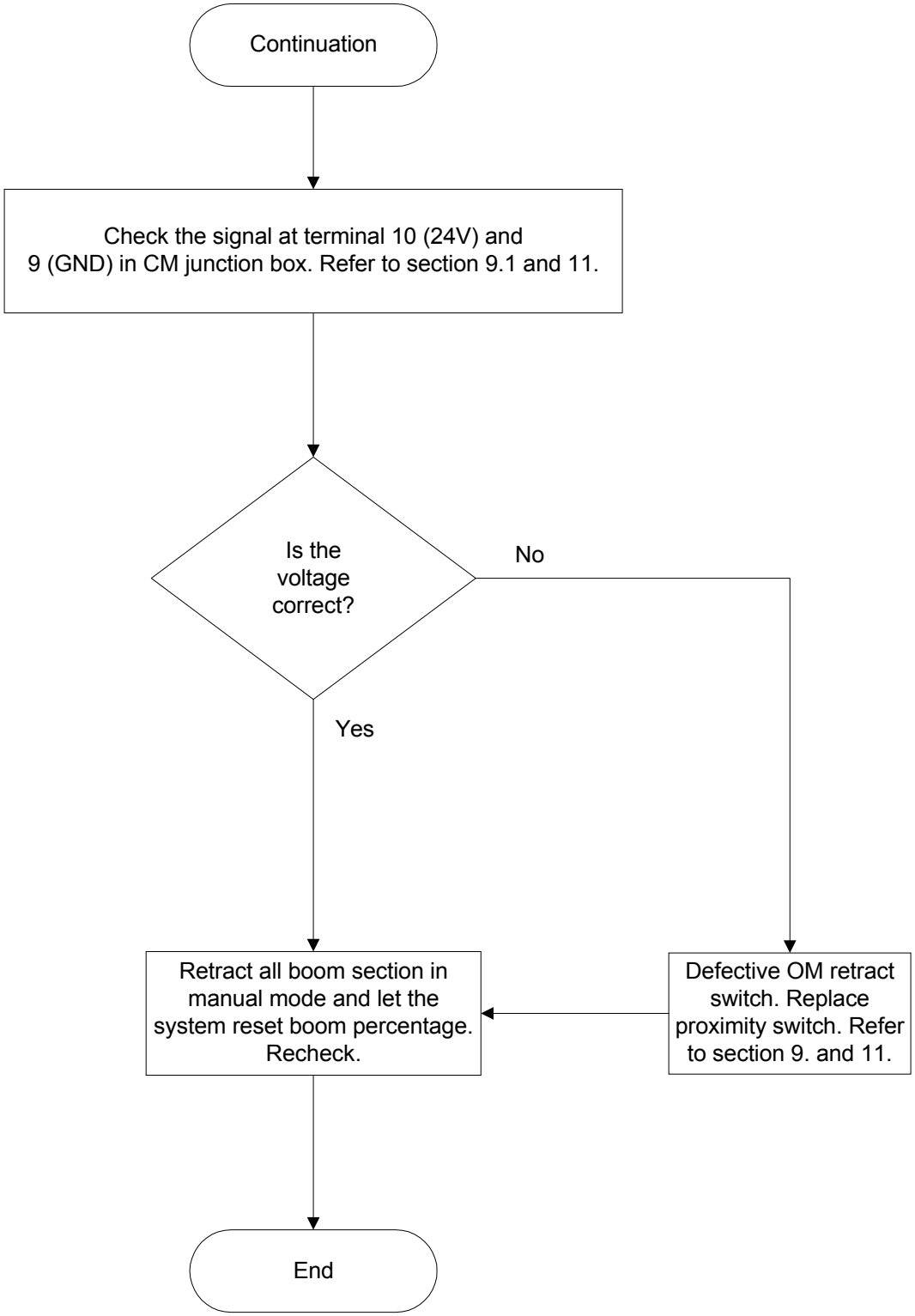
17. Continuation



17. Continuation



17. Continuation



18.1 Additional Error Codes - Operational

Error code	Description	Solution
E18	Front Stabilizer overloaded	Achieve a safe working area immediately.
E83	The outer mid section and fly section are not fully retracted while the center mid section or the inner mid section retracts or extends. No cut off with E83, but *flashing pre-warning light* in console and *reduced capacity chart* (rigging mode).	Select manual mode. Manually retract the outer mid and fly section until fully retracted. Return to auto mode. Check fly section cable adjustment. The fly section shall not be extended when center mid section is fully retracted.
Flashing % indication	Out of telescope sequence (rigging mode selected). The red warning light “Out of sequence” in the console panel lights up.	Select manual mode. Rectify the solution by manually operating each telescope until % indication stops flashing and the red warning light “Out of sequence” in the console panel is dim. Return to auto mode.

18.2 Additional Error Codes - System

Error code	Description	Solution
E 47	Processor can not locate analog output circuit for center mid section	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only).
E 60	*DATA- EPROM* is not plugged into the correct socket or location is not programmed correctly in the *EPROM*.	Refer to the trouble shooting manual and identify the correct location for the data eprom.
E70	No or wrong return signal from digital input extension module to processor.	Digital input circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.
E80 / E98	No or wrong return signal from analog output extension module (for inner mid section) to processor.	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.