



**PAT America, Inc.**  
**Rheinmetall Elektronik**

**DS350 MODULAR**

**BOOM CONTROL EXTENSION**  
**FOR**  
**GROVE CRANE TMS/TTS 870**

**TROUBLESHOOTING MANUAL**

P/N 031-300-190-061 Rev. B 02/12/01

# NOTICE

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## GENERAL INFORMATION

This troubleshooting manual is designed to assist a service or maintenance person in identifying LMI (Load Moment Indicator) problem areas or malfunctions. A digital voltmeter with the capability to also measure current will be required. Regular maintenance and service tools will also be required.

NOTE: Knowledge of how to use a voltmeter to measure both voltage and current is assumed.

For system operation refer to the Operator's Manual for the console. This may differ from crane manufacturer and model.

Section 2 provides the drawings and reference material that will be used in the troubleshooting flowcharts of this manual. Use the reference drawings in conjunction with the flowcharts to help understand the operation of the system.

The PAT LMI DS 350 Modular with Boom Control Extension has been designed to provide the crane with the essential information required to operate the machine within the designed parameters.

Using different sensing devices, the DS 350 LMI monitors various crane functions and provides the operator with a continuous display of the crane's capacity. The display continually changes as the crane moves through the motions needed to make a lift.

The DS 350 Modular LMI provides the operator with information regarding the boom length and boom angle of the main boom, working radius rated load and the total calculated weight being lifted by the crane.

If non-permitted conditions are approached, the DS 350 LMI will warn the operator by sounding an audible alarm and lighting a warning light. In addition the LMI system has the capability to provide a signal to the solenoids and thereby locking out those functions that may aggravate the crane's condition.

## WARNINGS

The DS 350 load moment indicator (LMI) with boom control extension is an operational aid that warns the crane operator when approaching an overload condition, a two block condition and an out of boom sequence condition.

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.

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.

It still remains the operator's responsibility to verify the operation and to select the correct mode during crane operations.

The DS 350 Modular 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

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

The manual mode is a rigging mode. Lifting loads in manual mode 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.

## REFERENCE MATERIAL

Document	PAT- Part number	Grove- Part number
Parts & Installation Manual	031-300-150-713	9-333-103628
Operator's Manual	50\350\19_1319e.doc	

## SERVICE AND MAINTENANCE

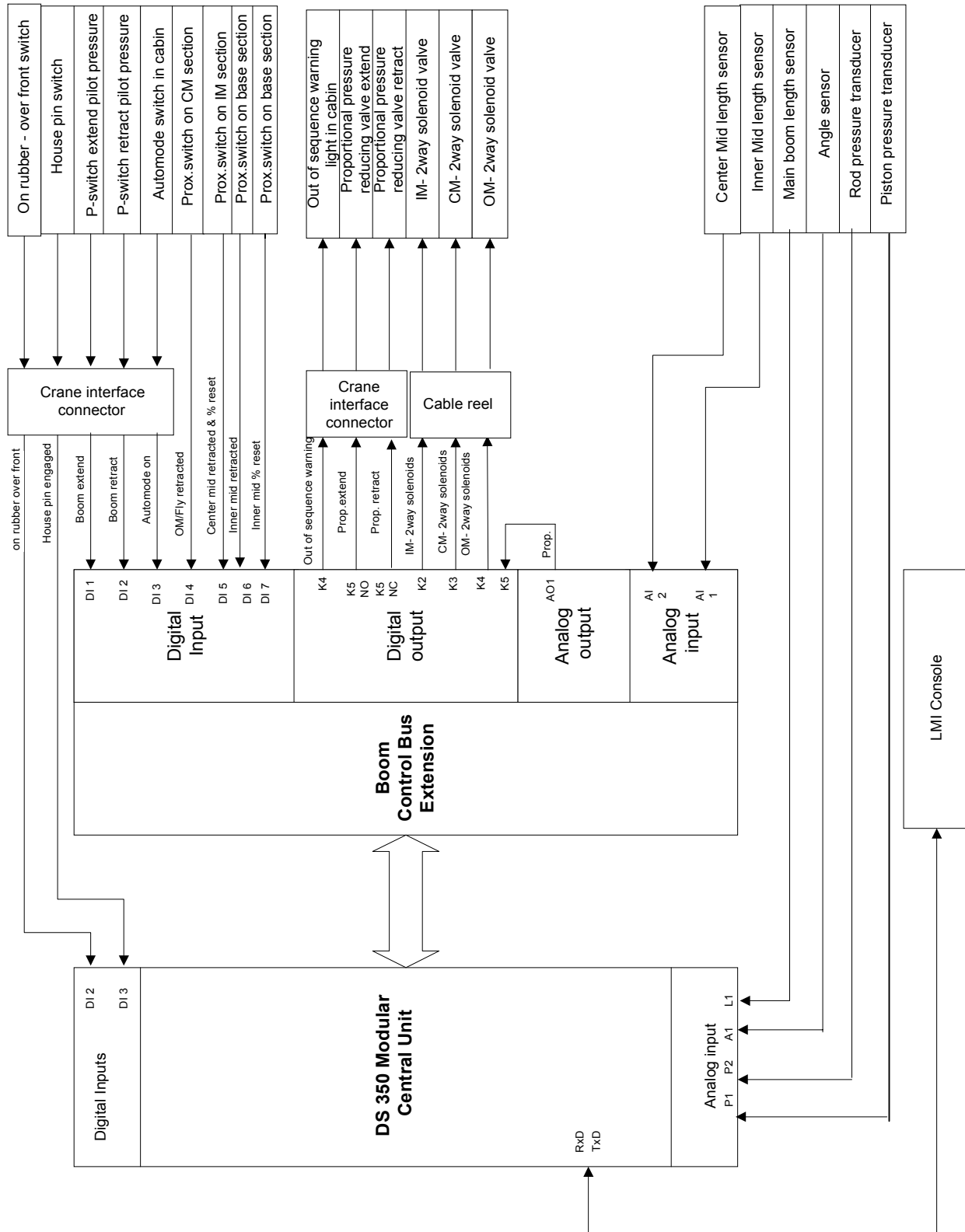
Daily maintenance of the load moment indicator consists of inspecting:

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 must 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.

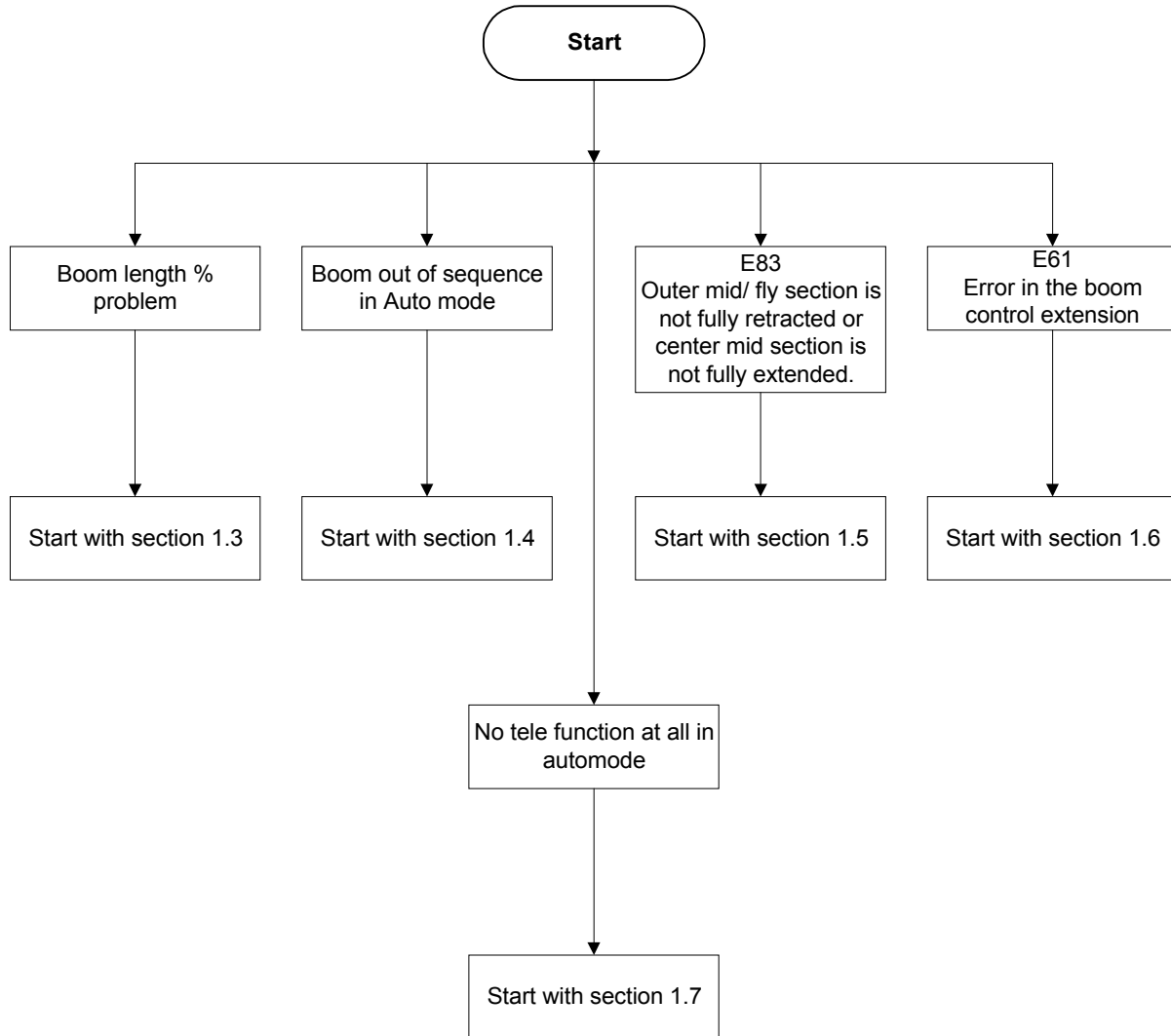


# 1. BOOM CONTROL INTERFACE



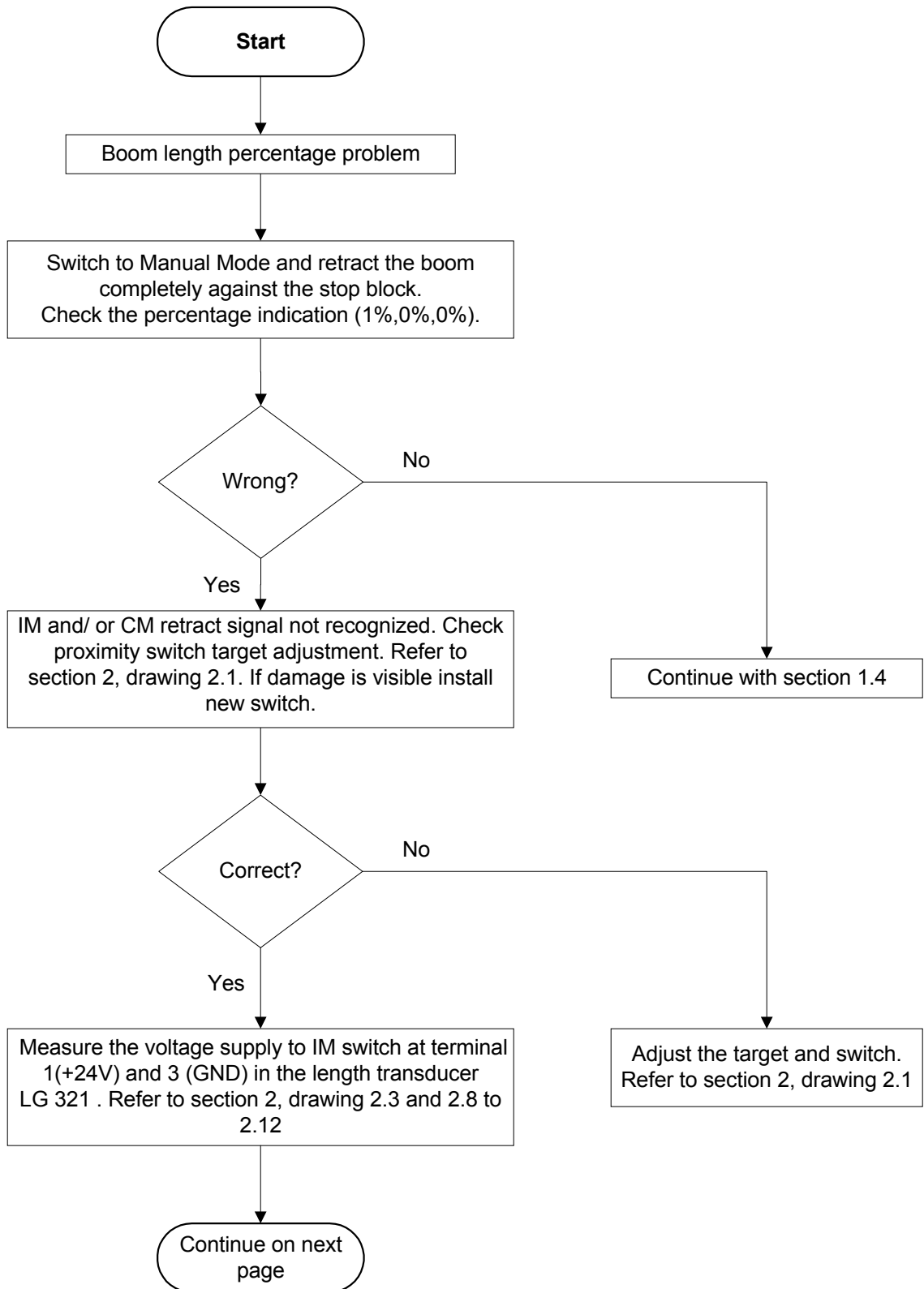
## 2. GETTING STARTED

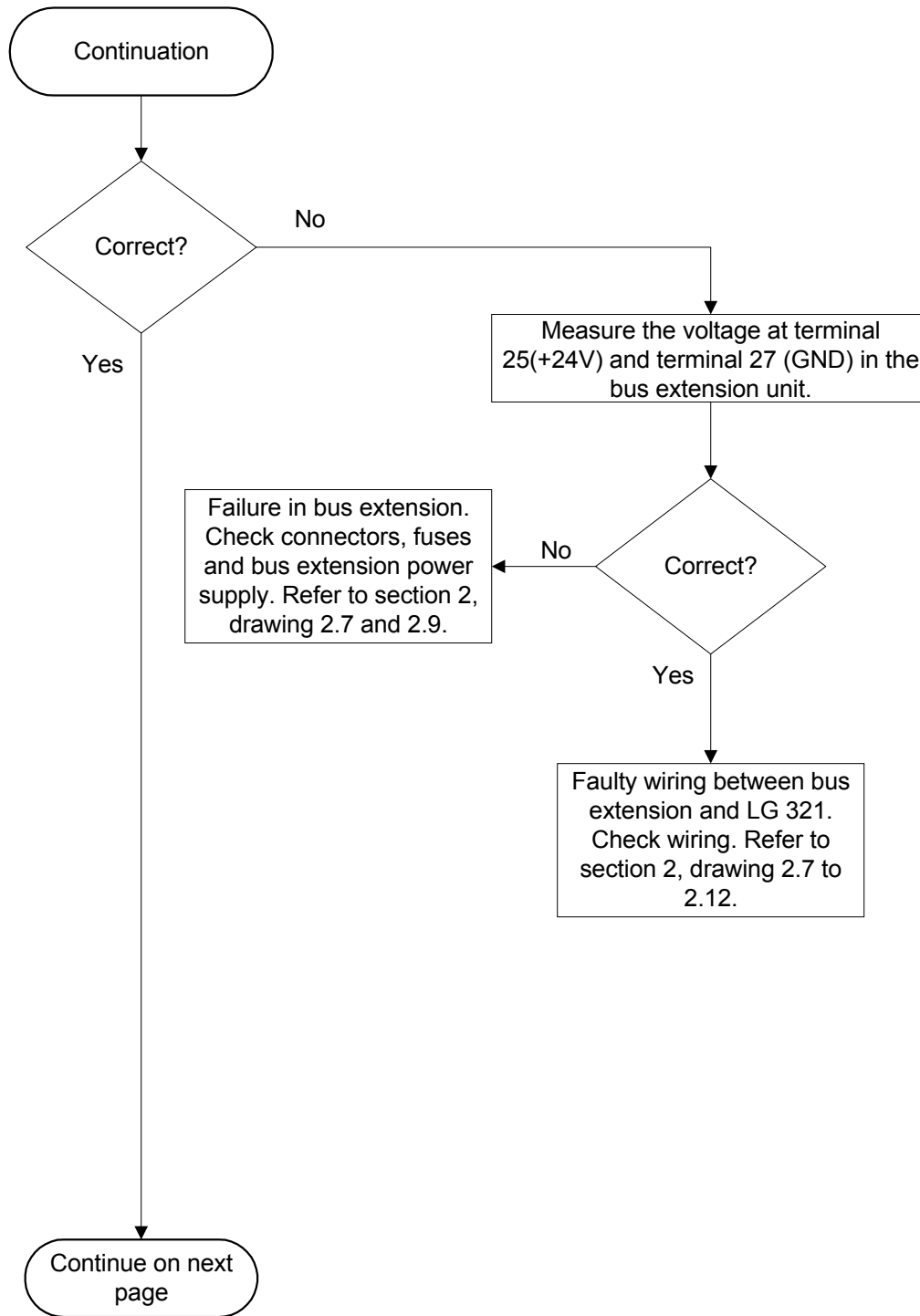
This section explains how to handle a problem that may arise with the PAT DS 350 Modular LMI boom control extension. The procedures are given in flowchart format for the following sections. Start with the general flowchart below that will guide you to one of the detailed flowcharts shown in Sections 1.1 to 1.7. The drawings that are referenced in these sections can be found in Section 2.1 to 2.13.

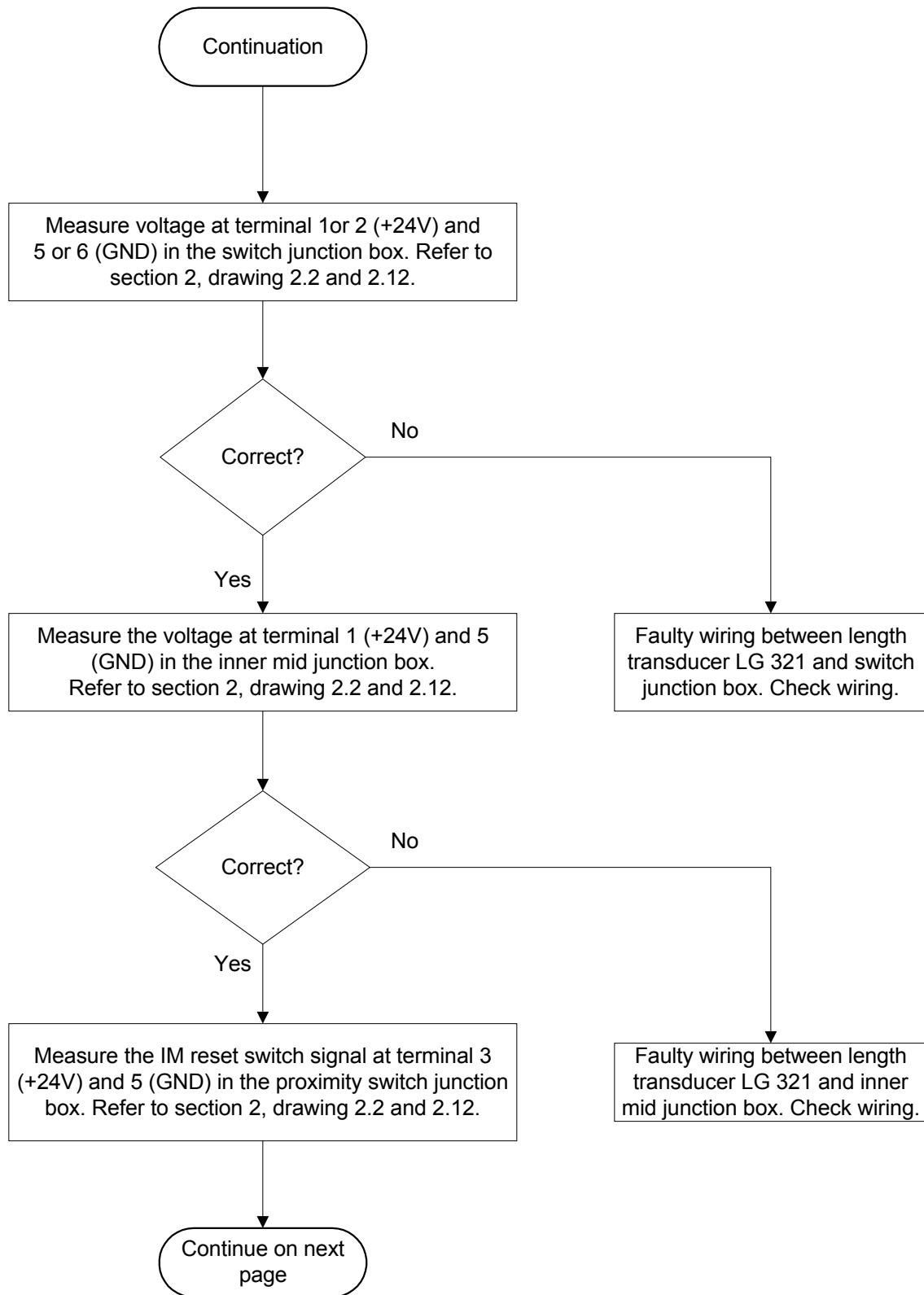


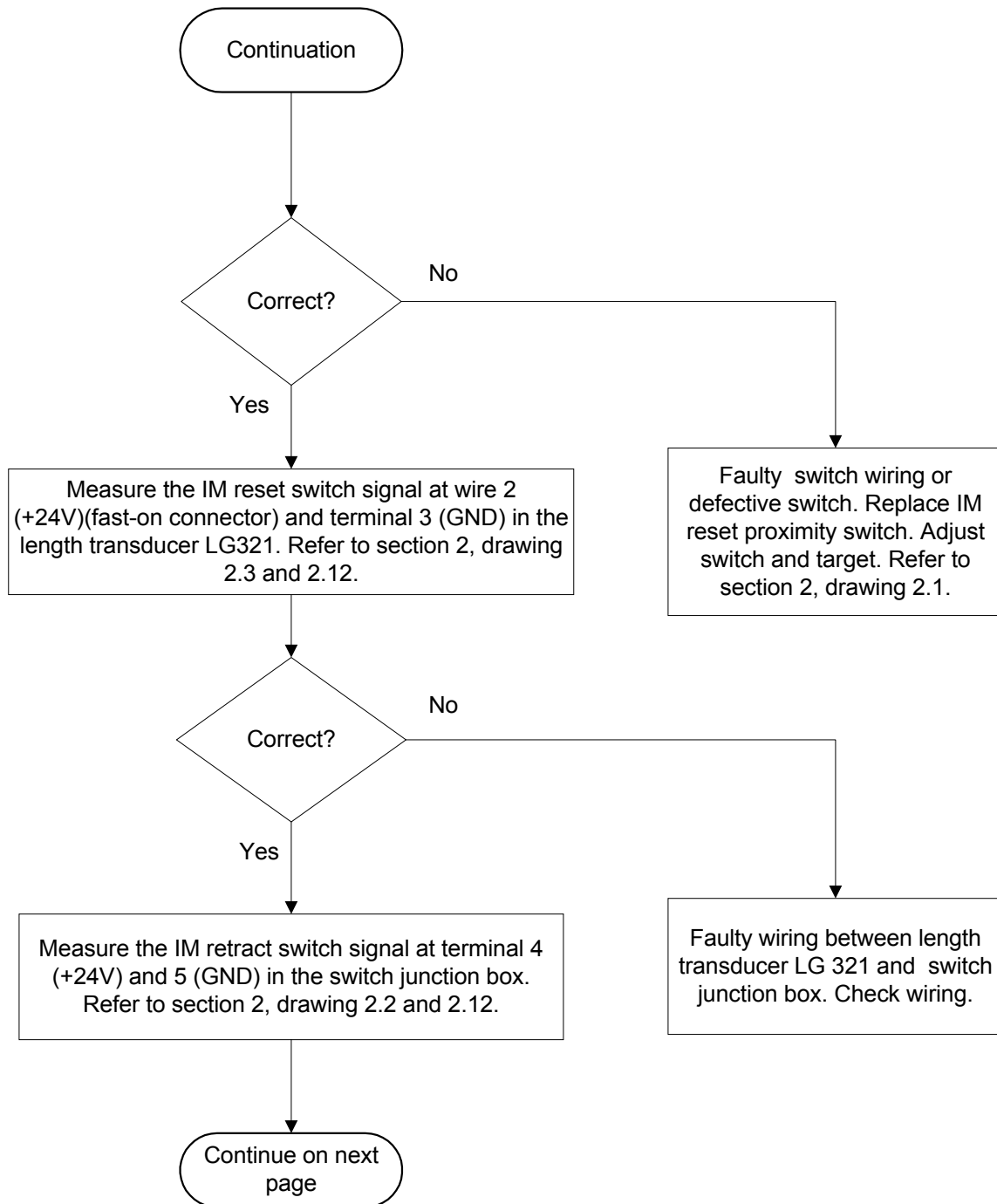


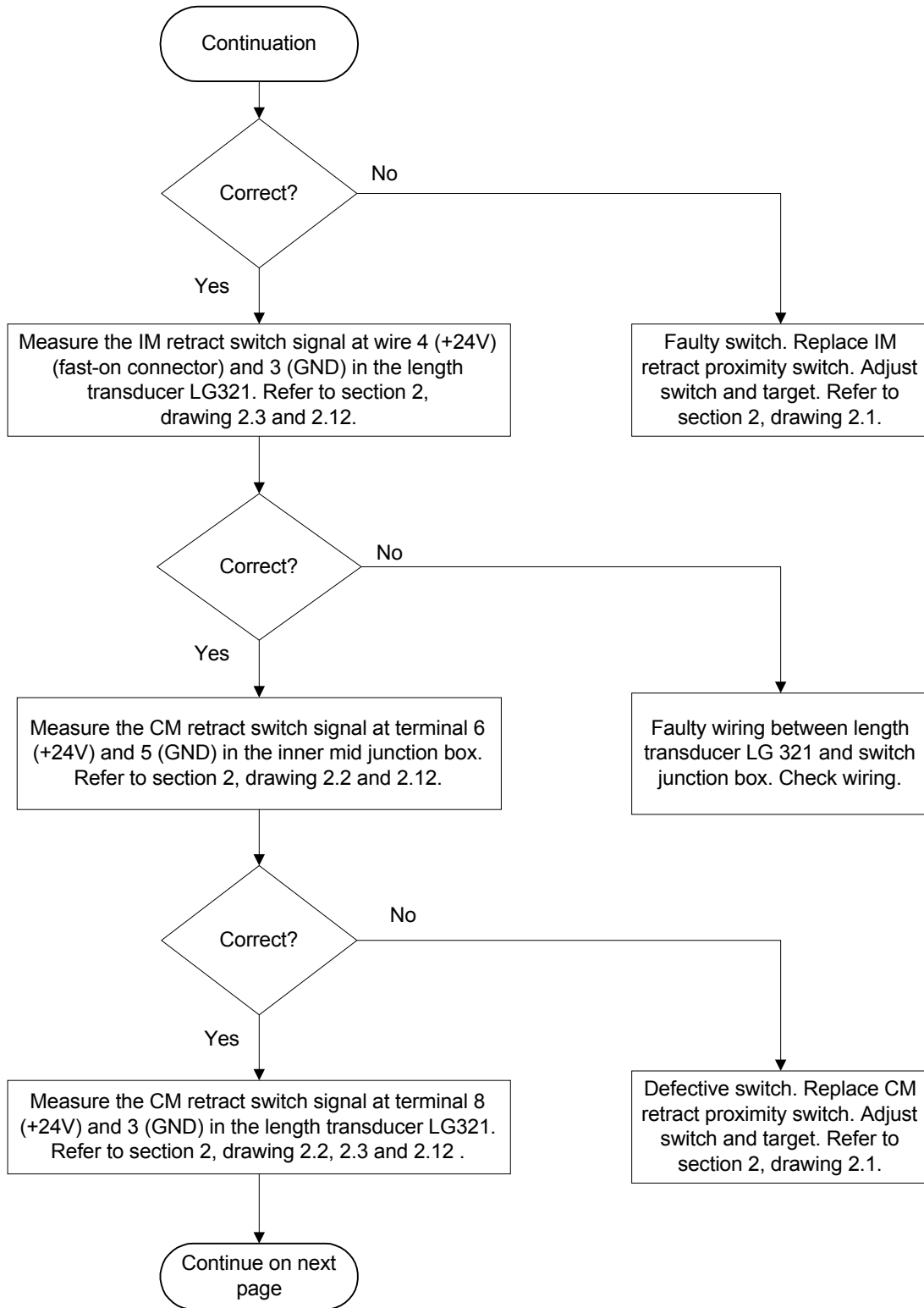
### 3. BOOM LENGTH PERCENTAGE PROBLEM

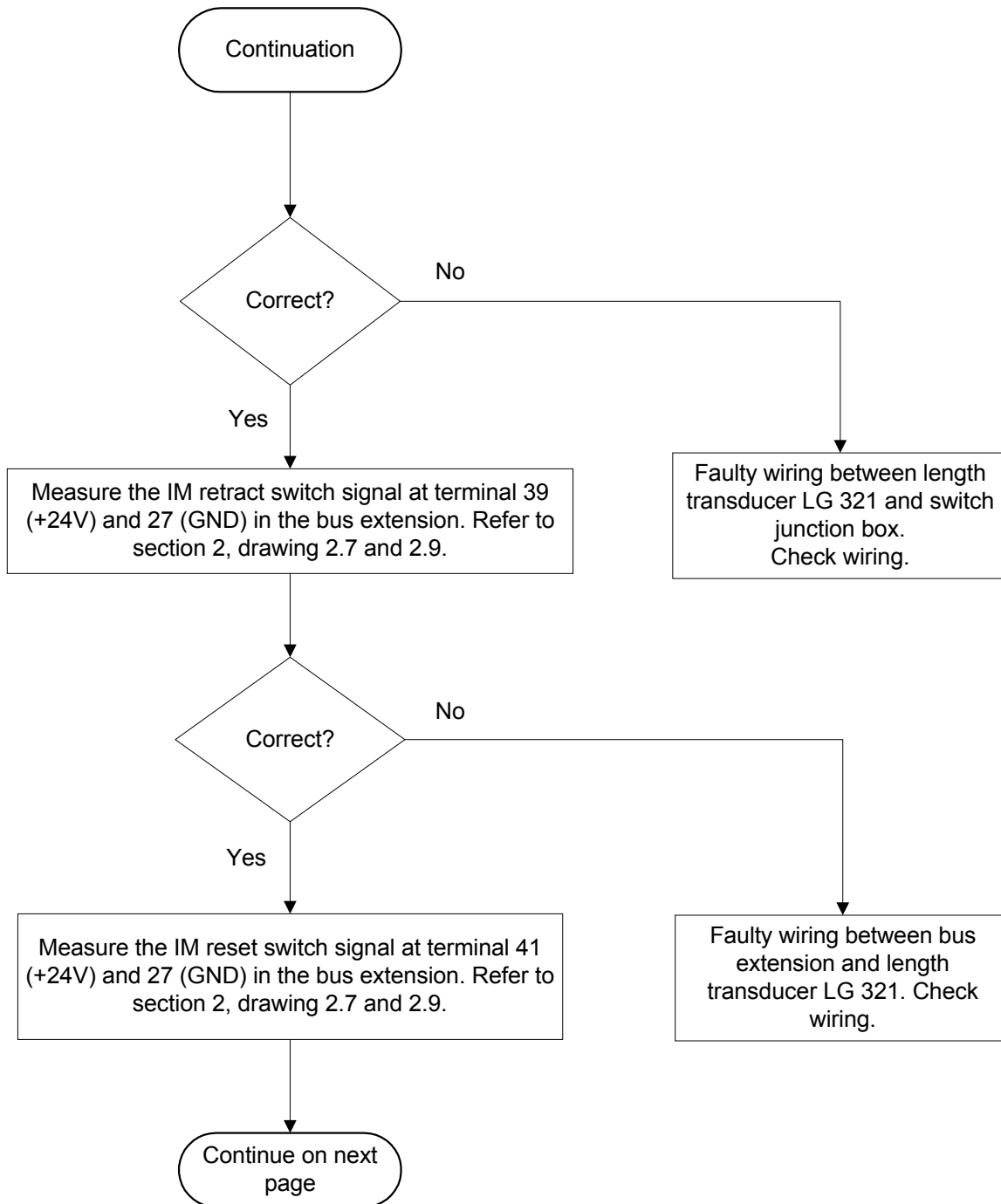


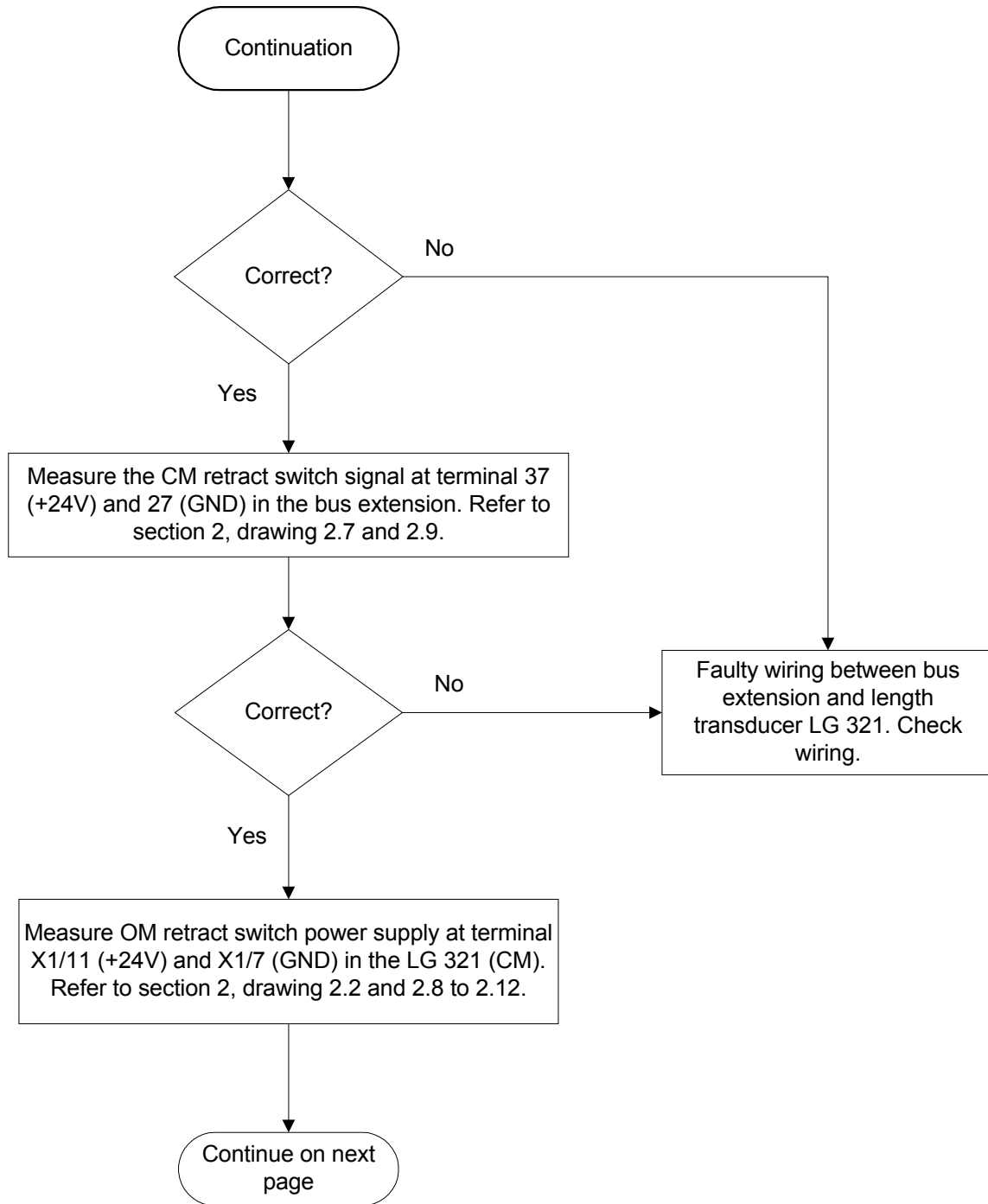


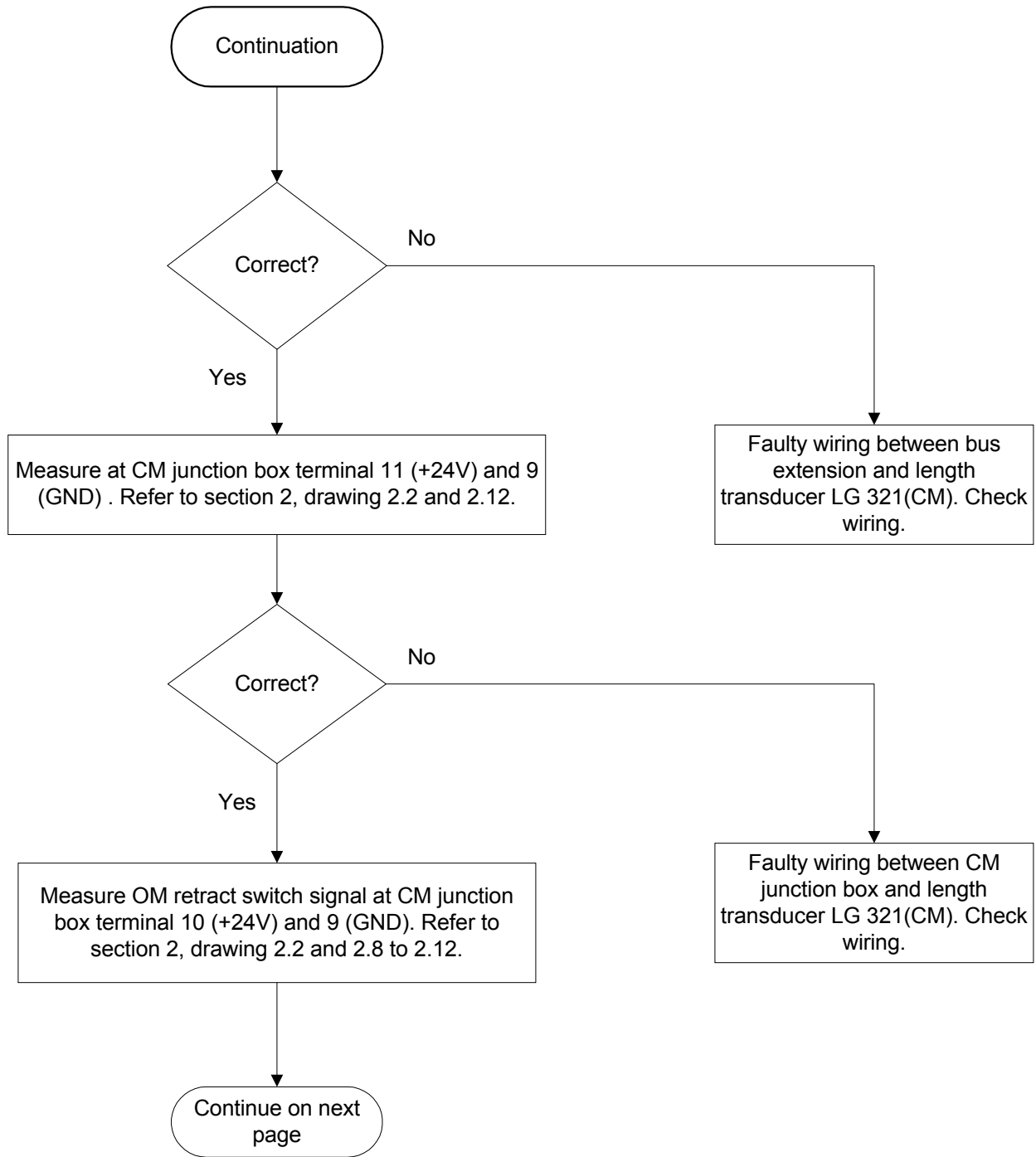




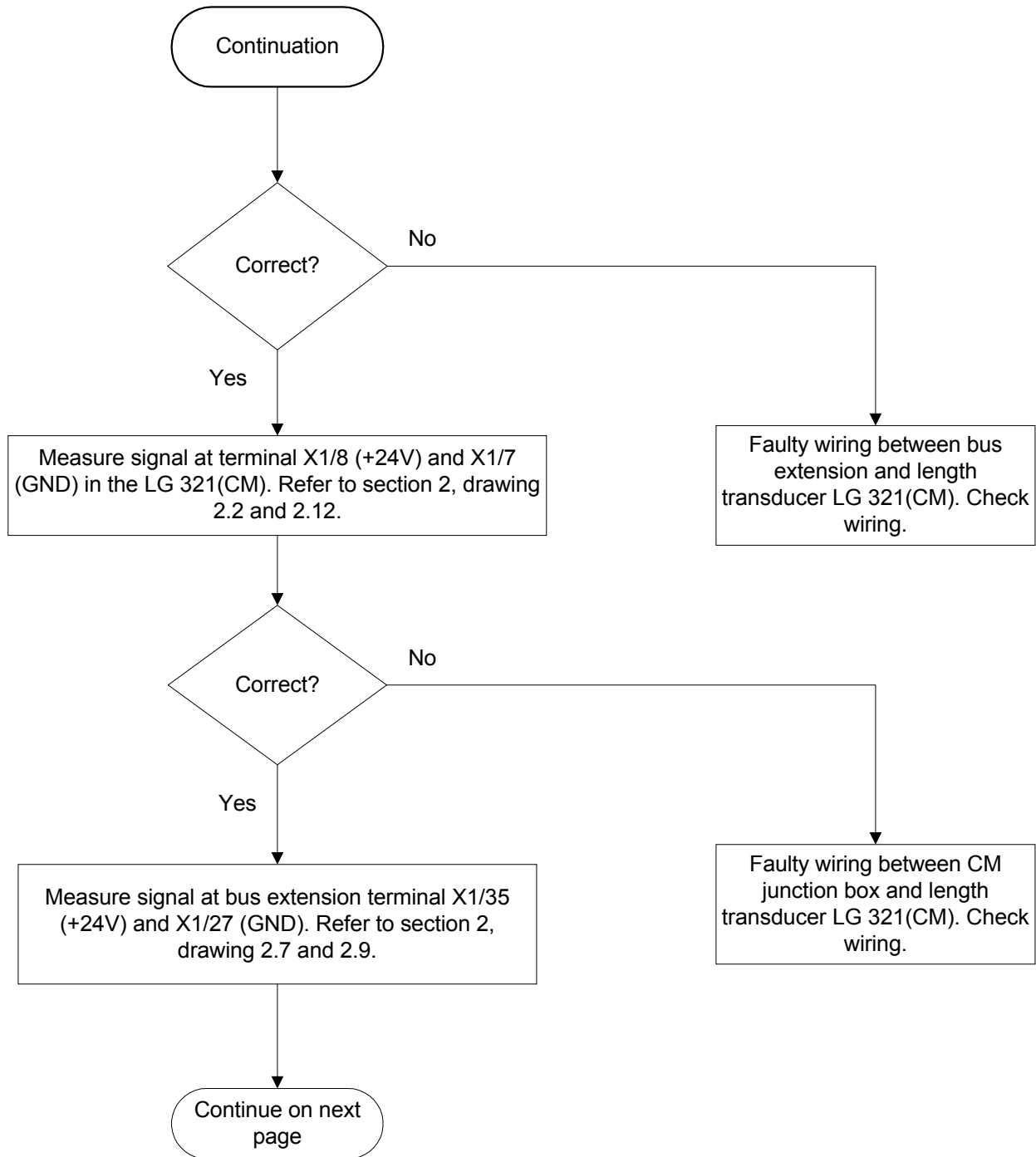


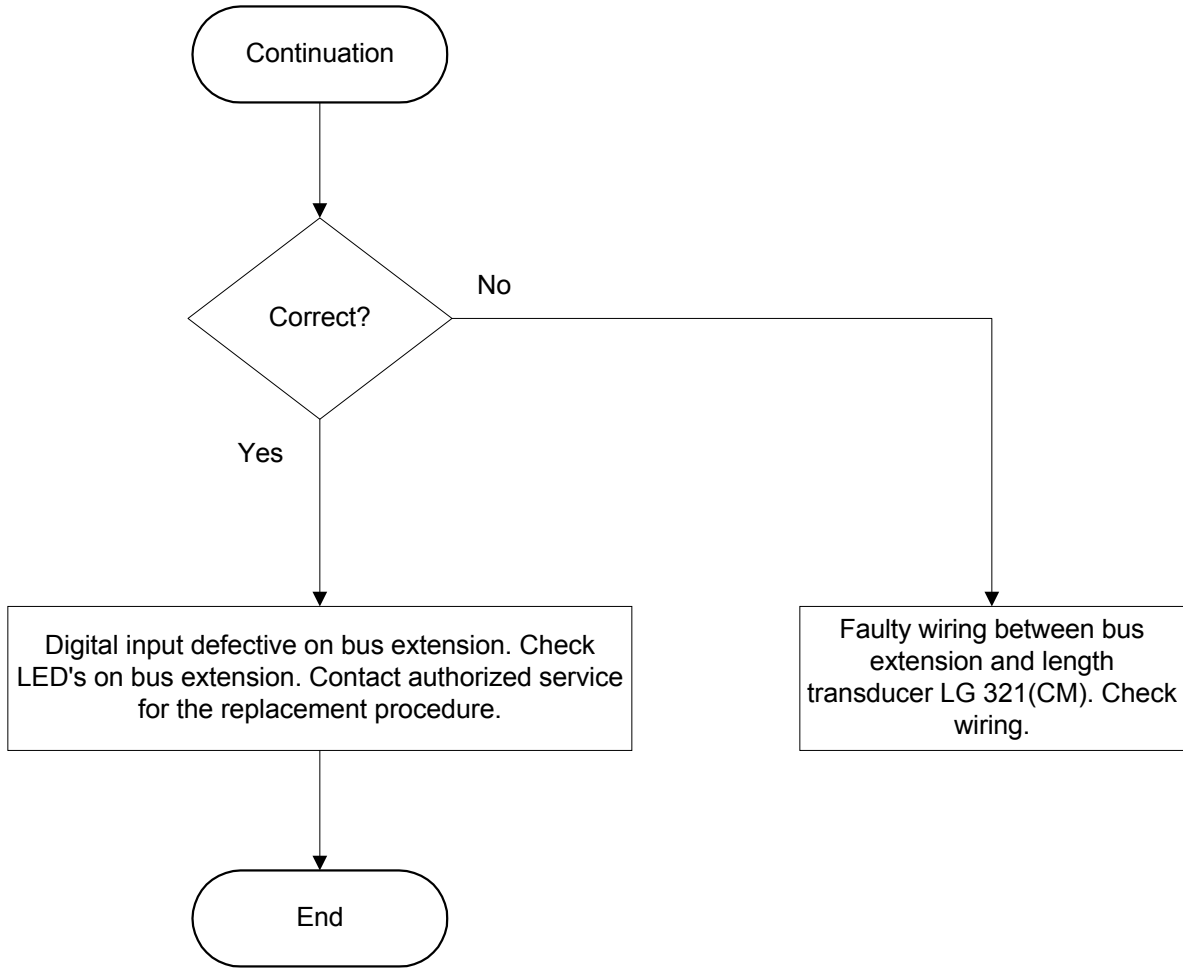




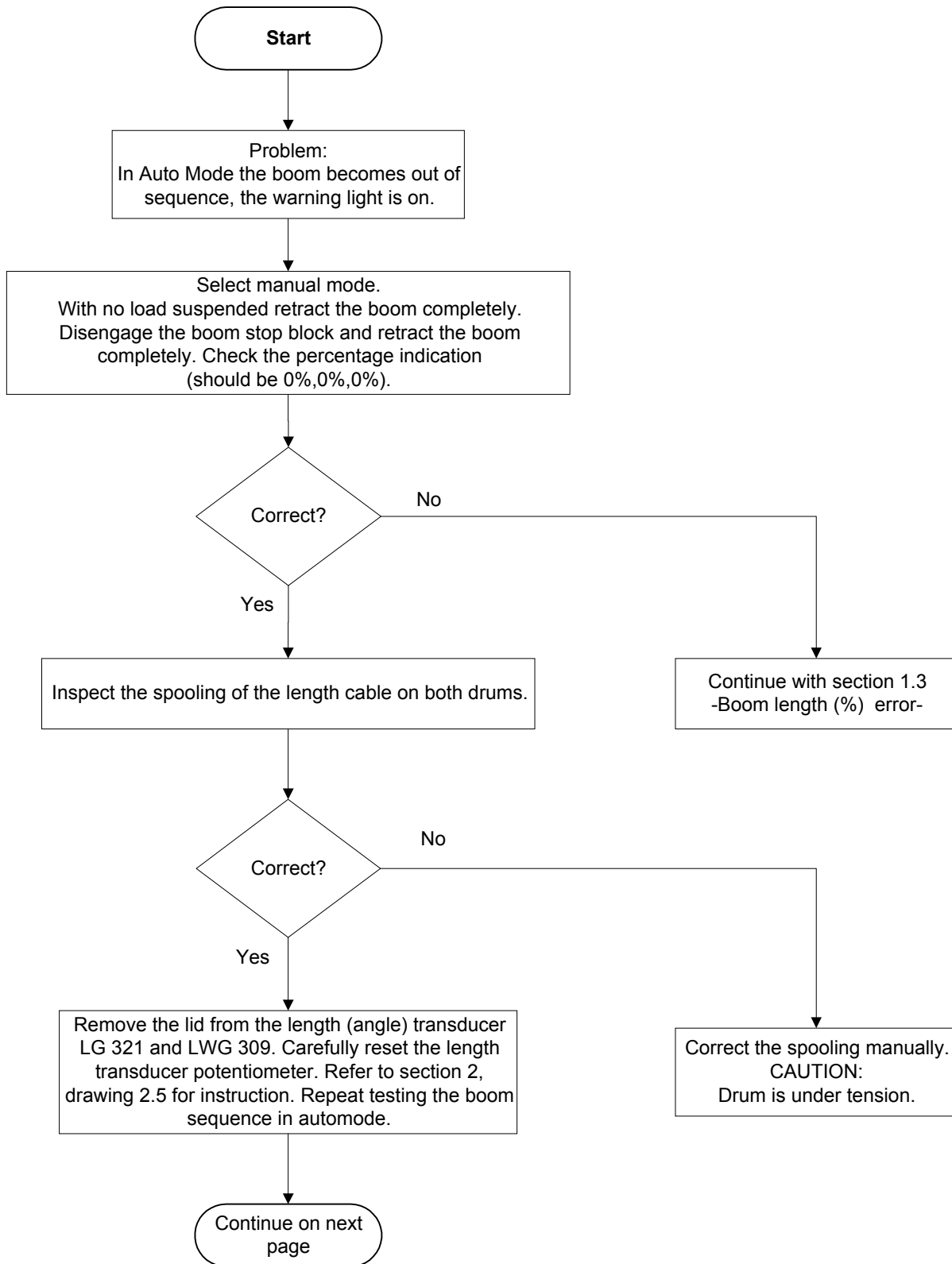


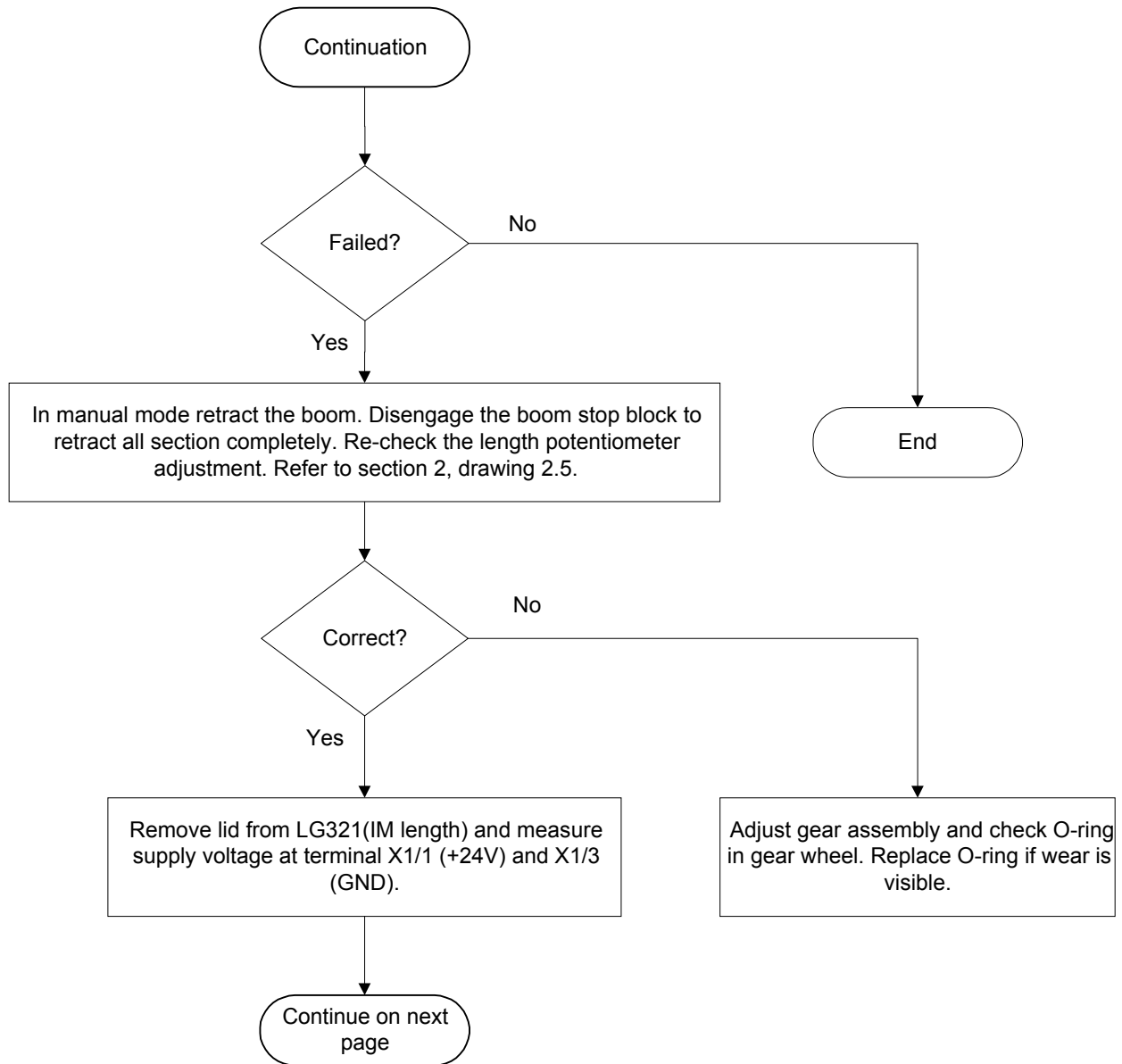


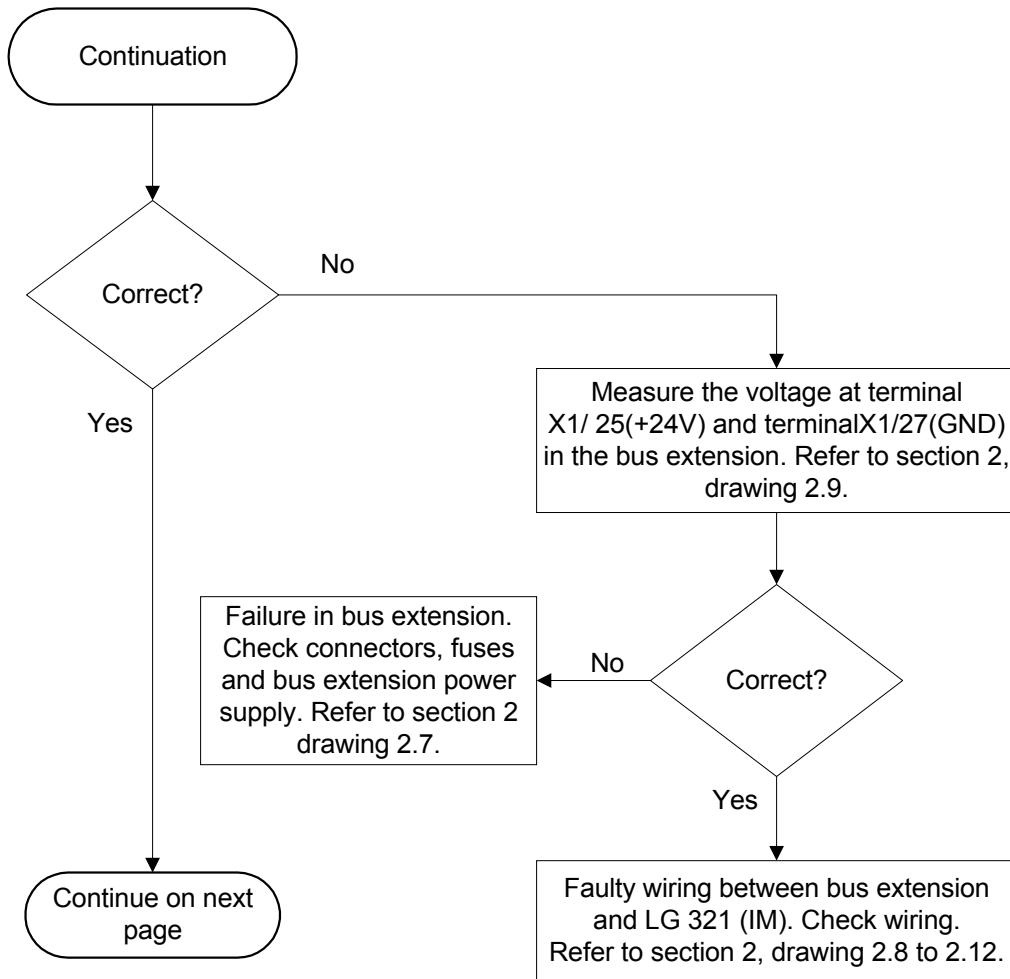


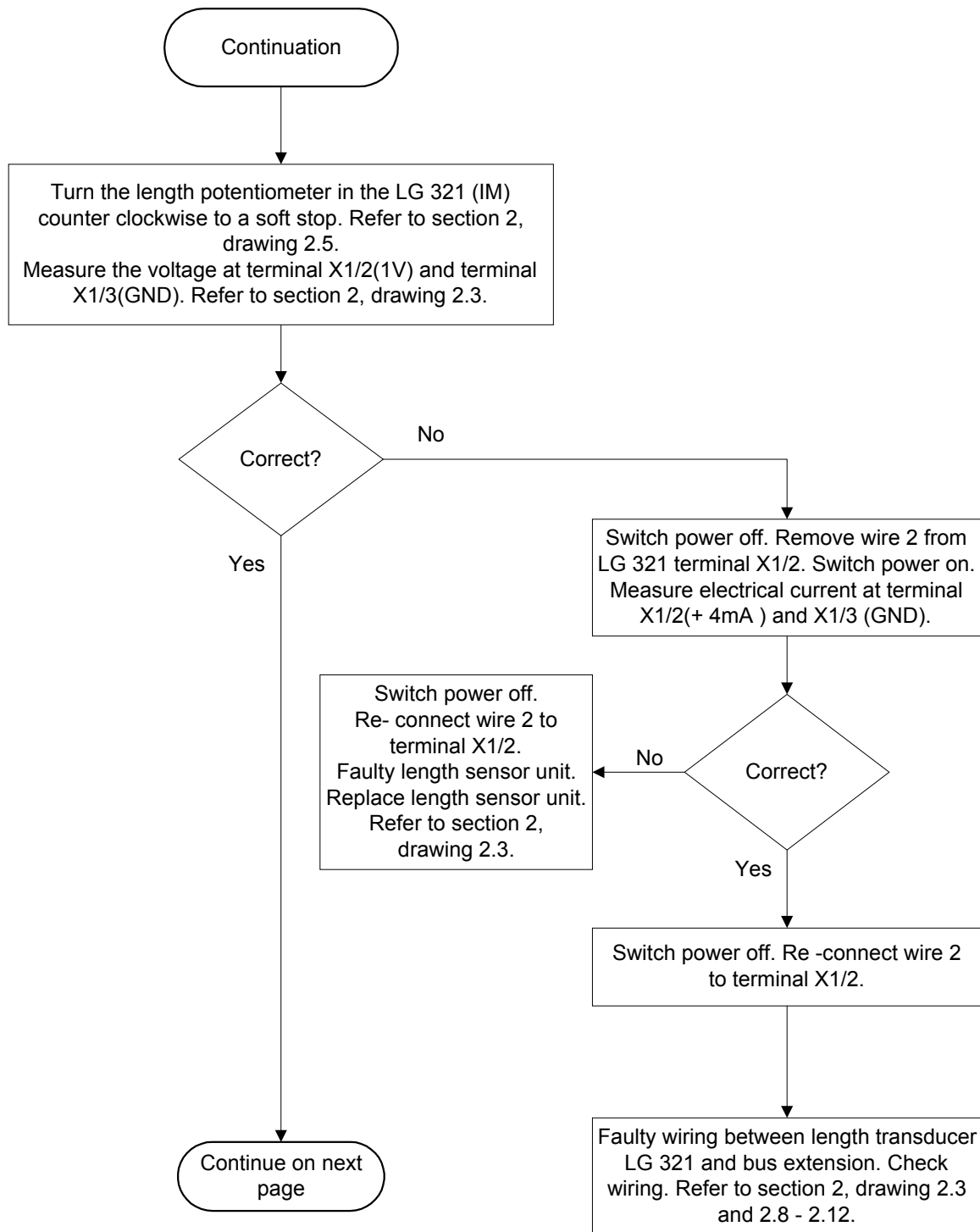


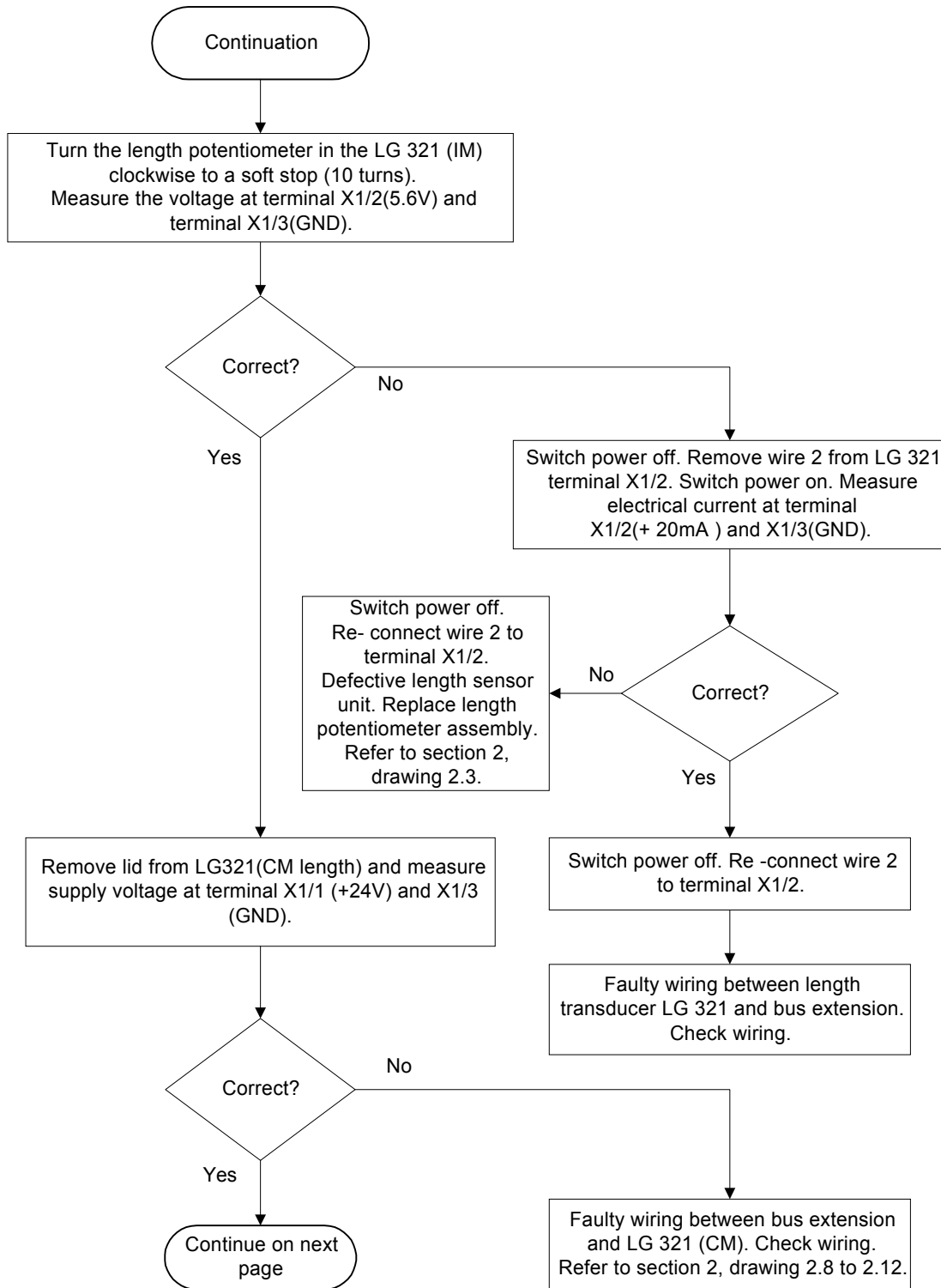
### 4. BOOM OUT OF SEQUENCE IN AUTOMODE

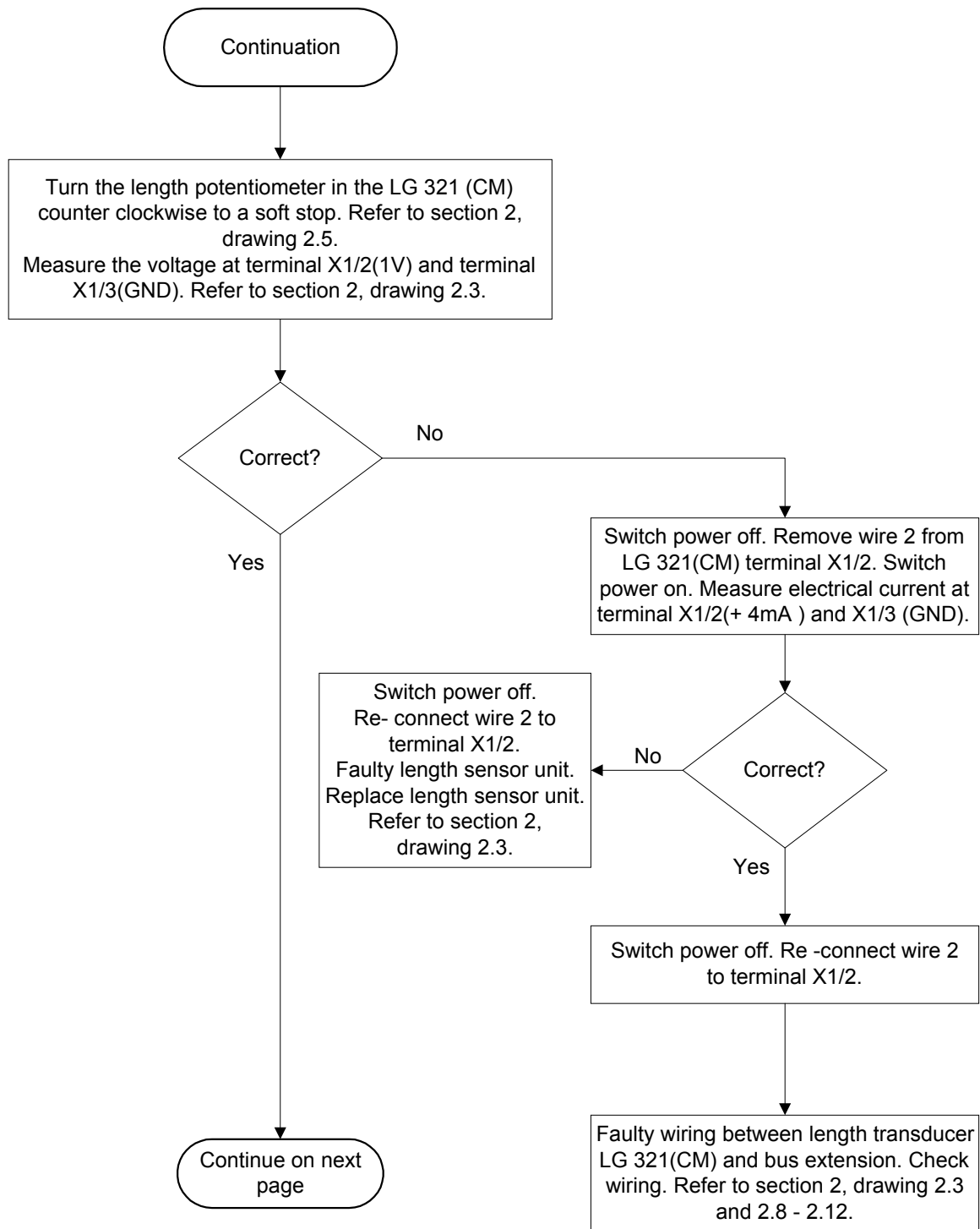




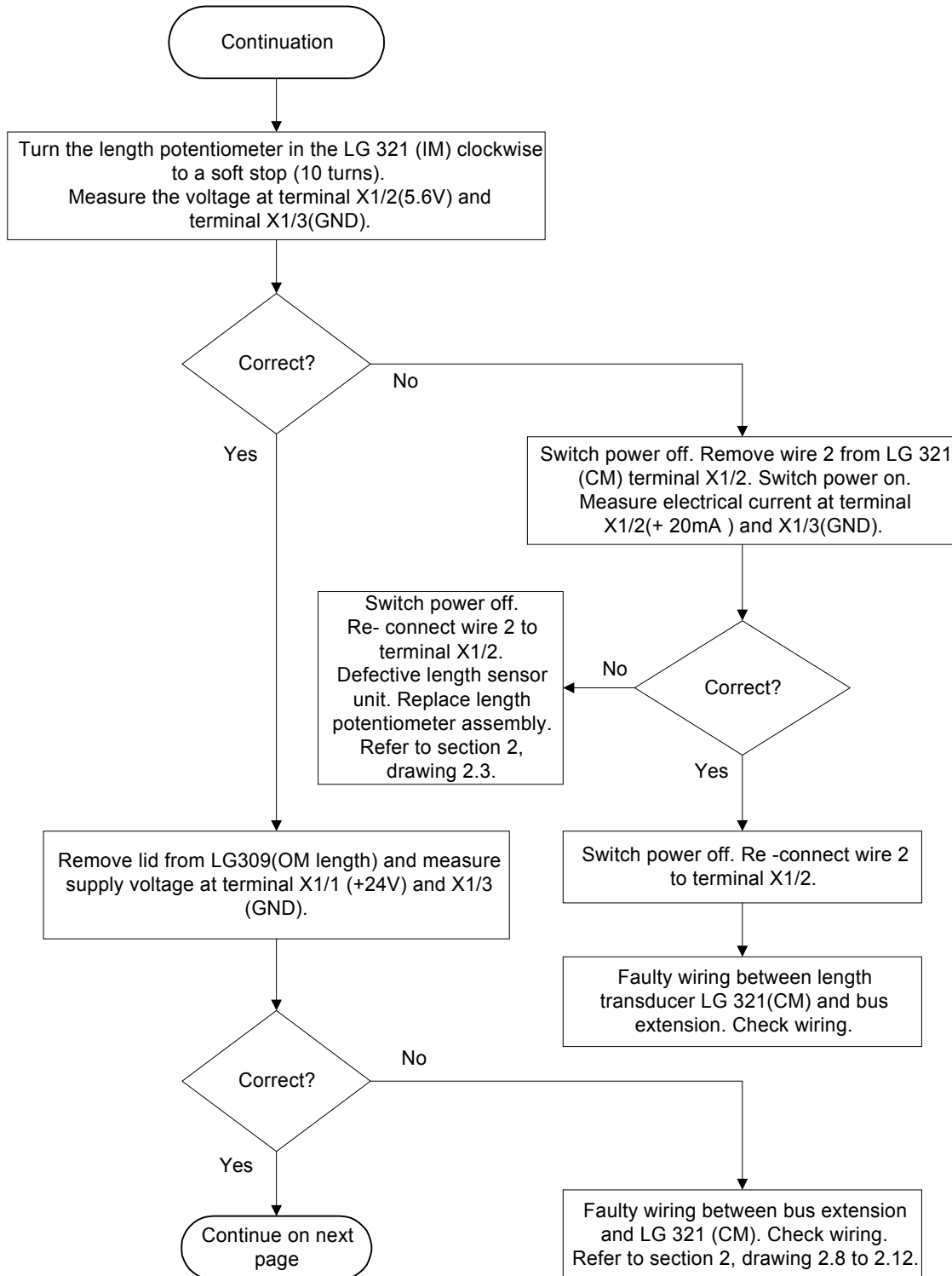


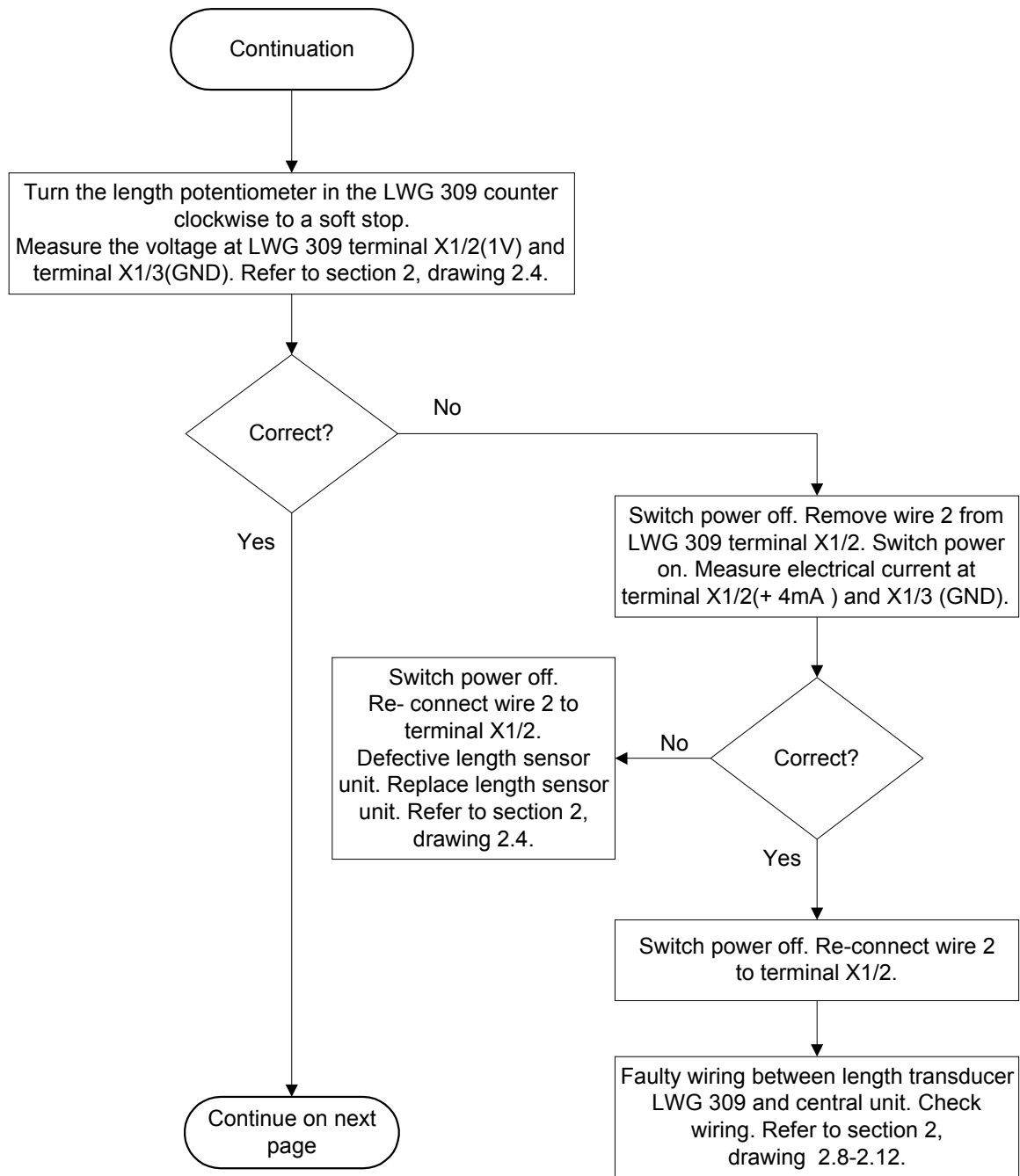


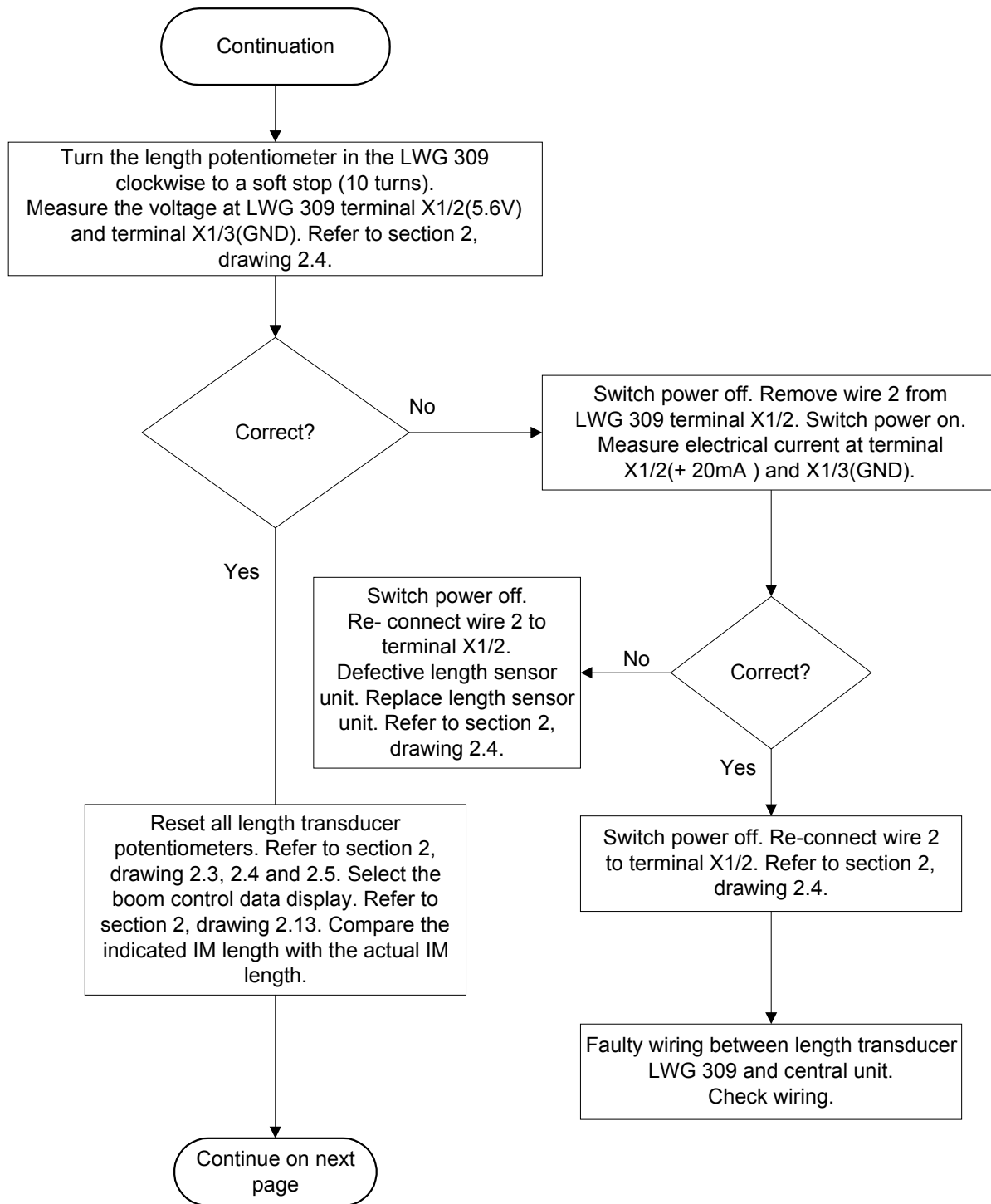


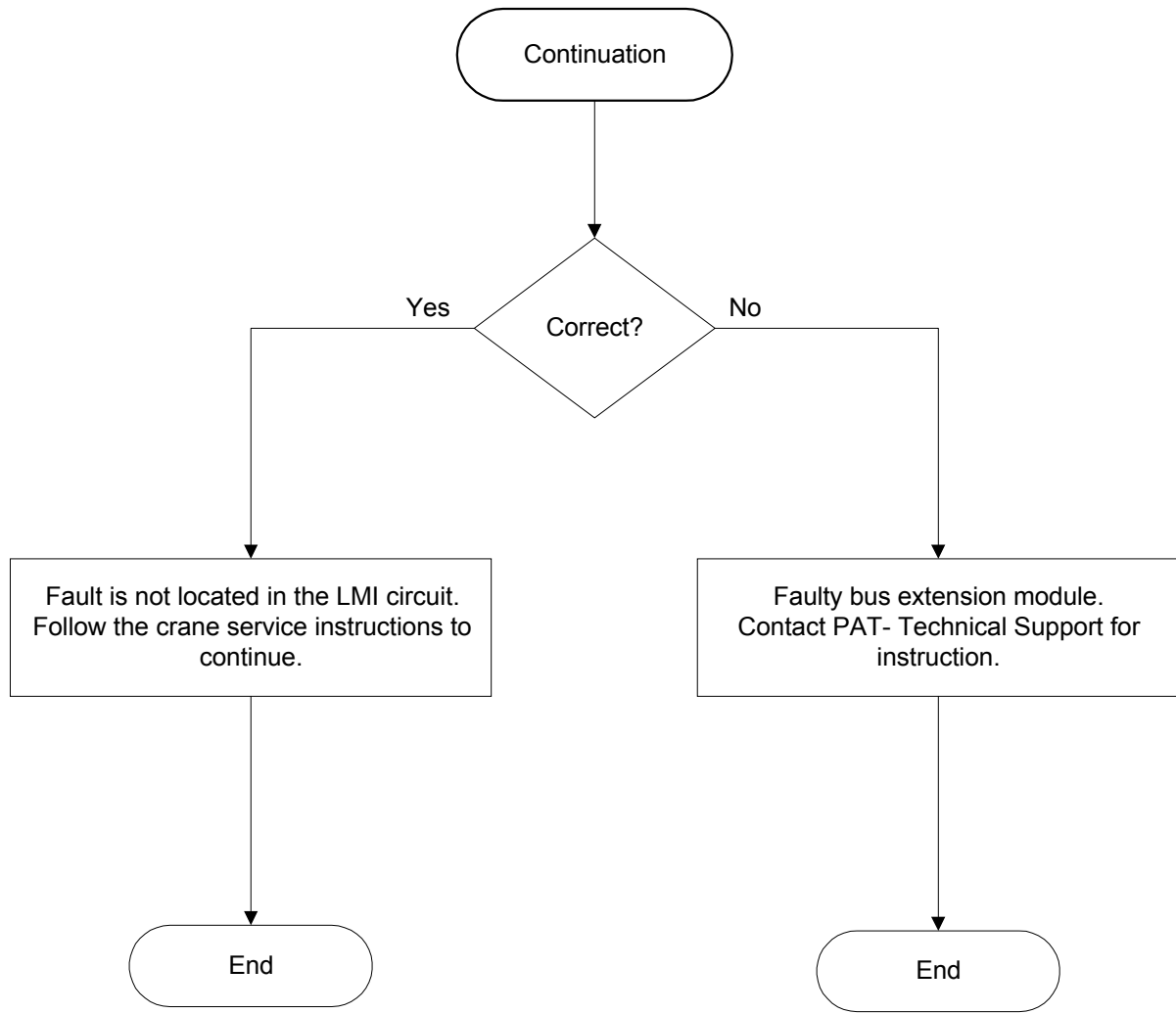




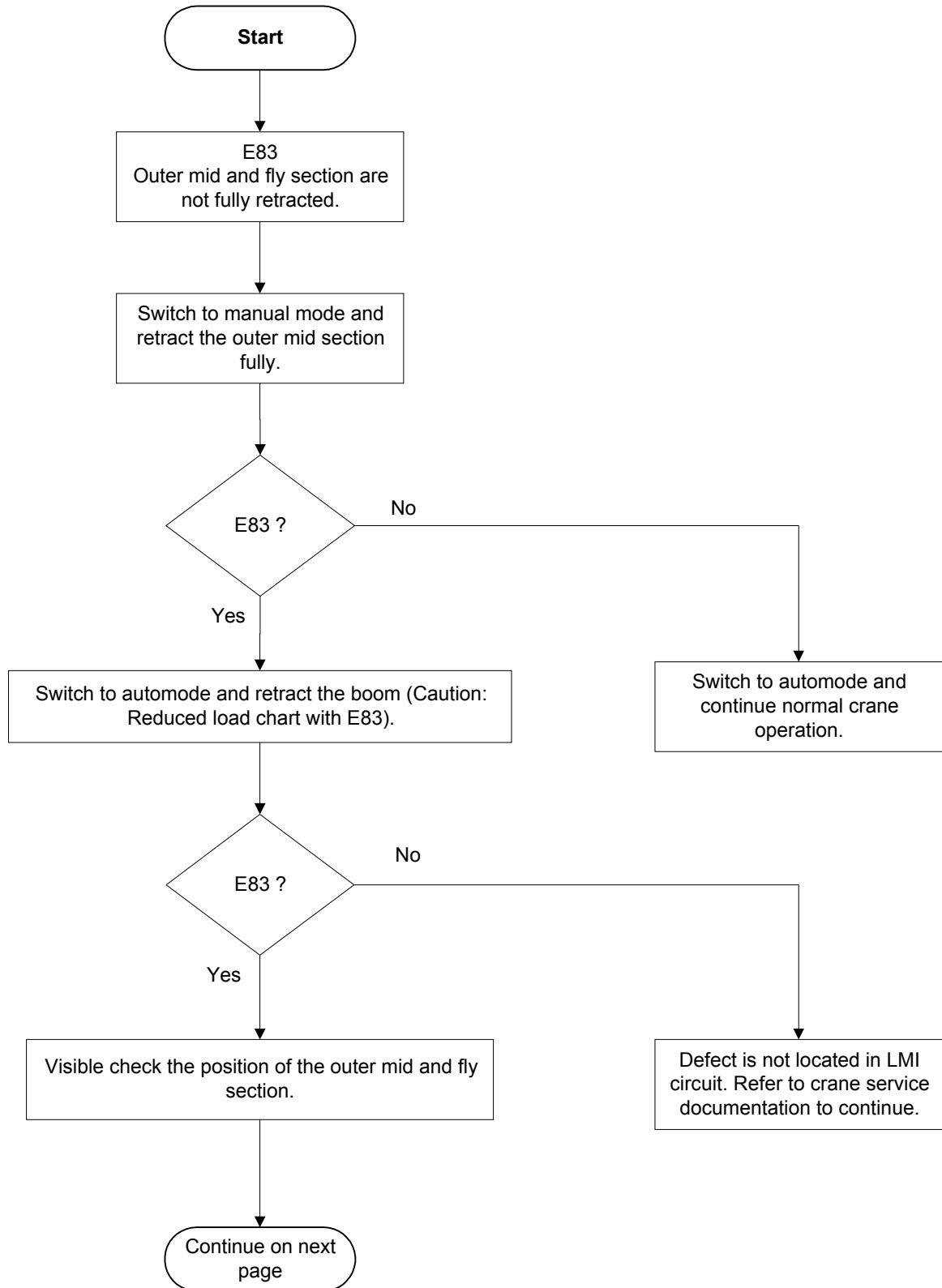


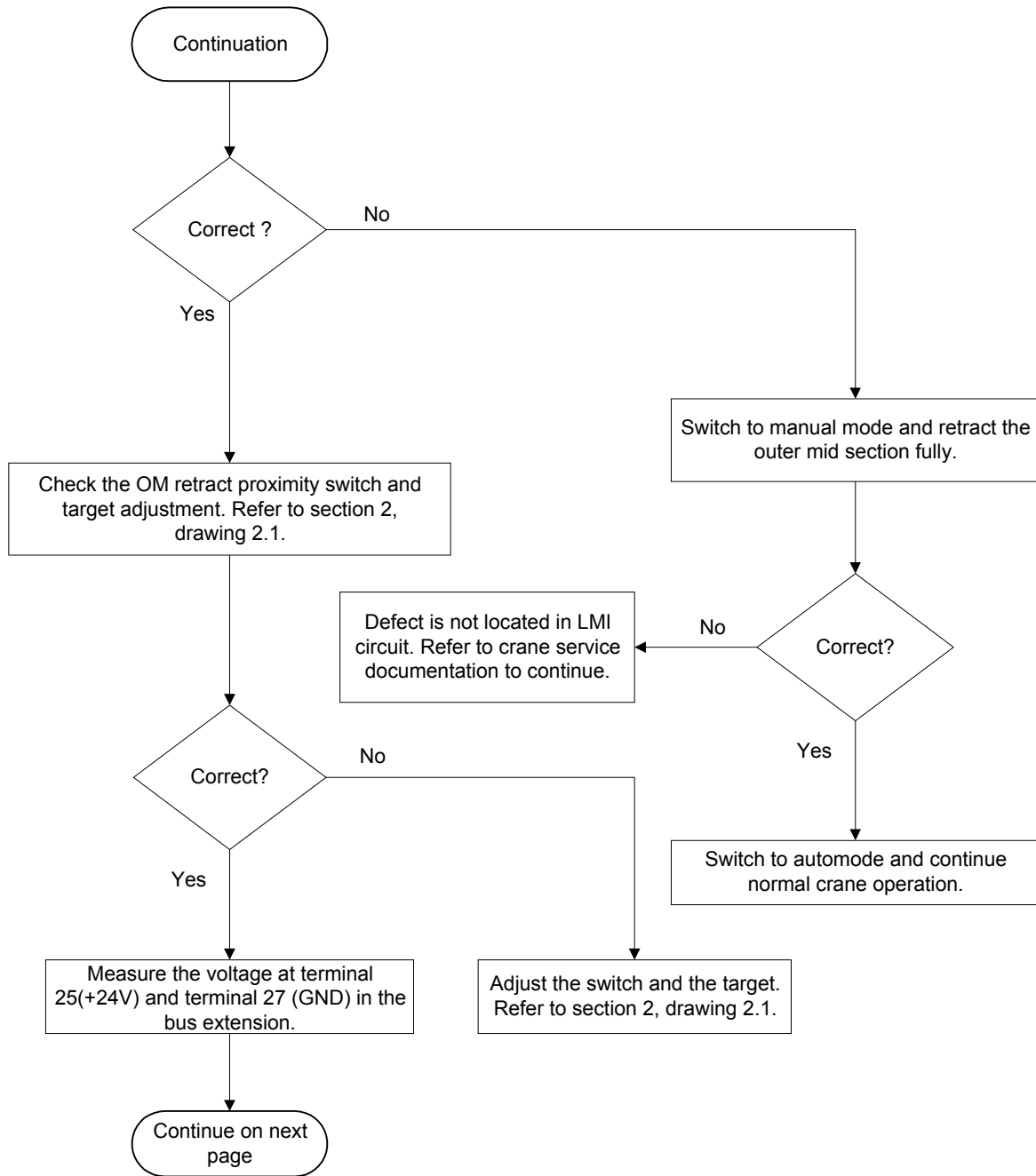


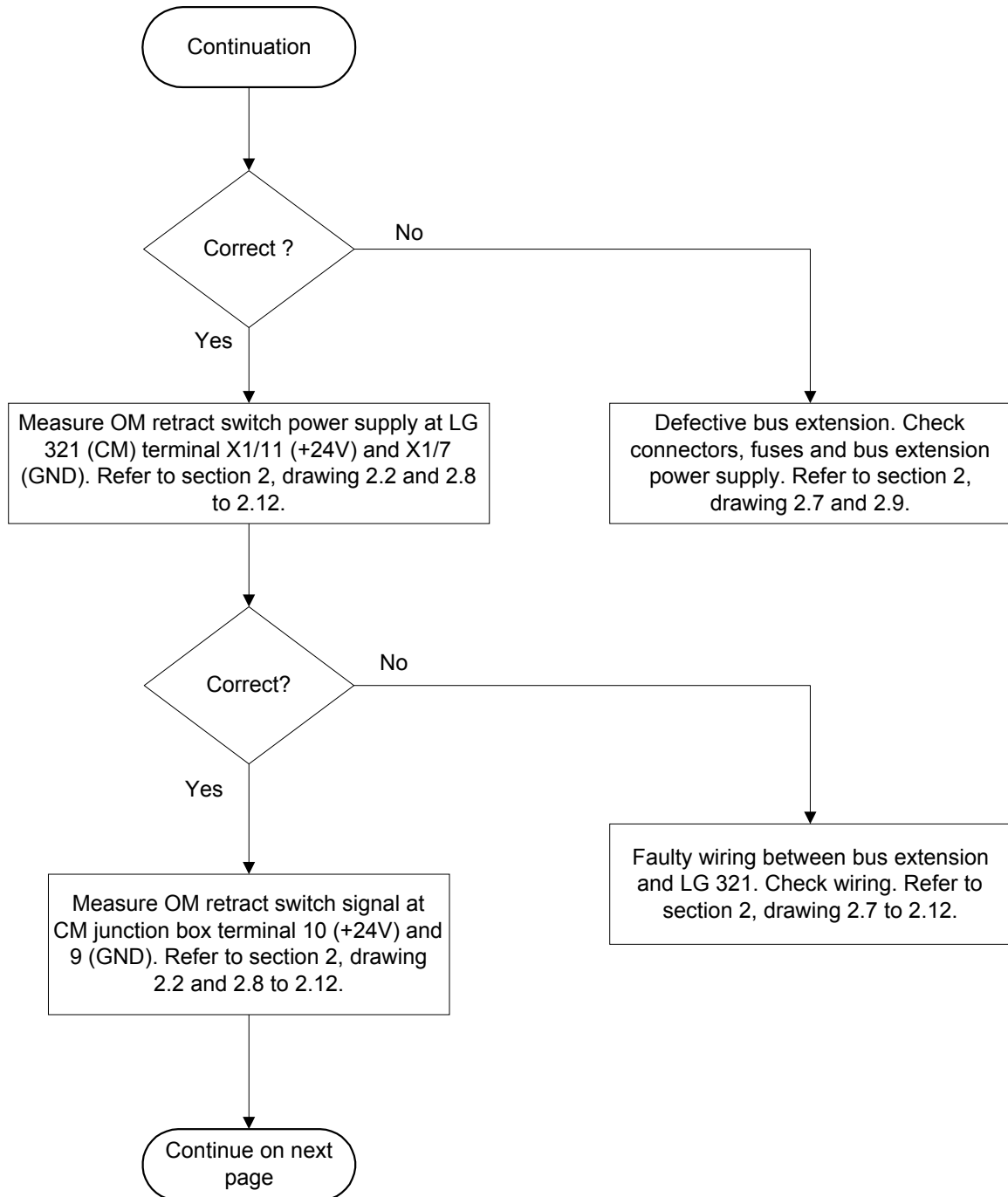


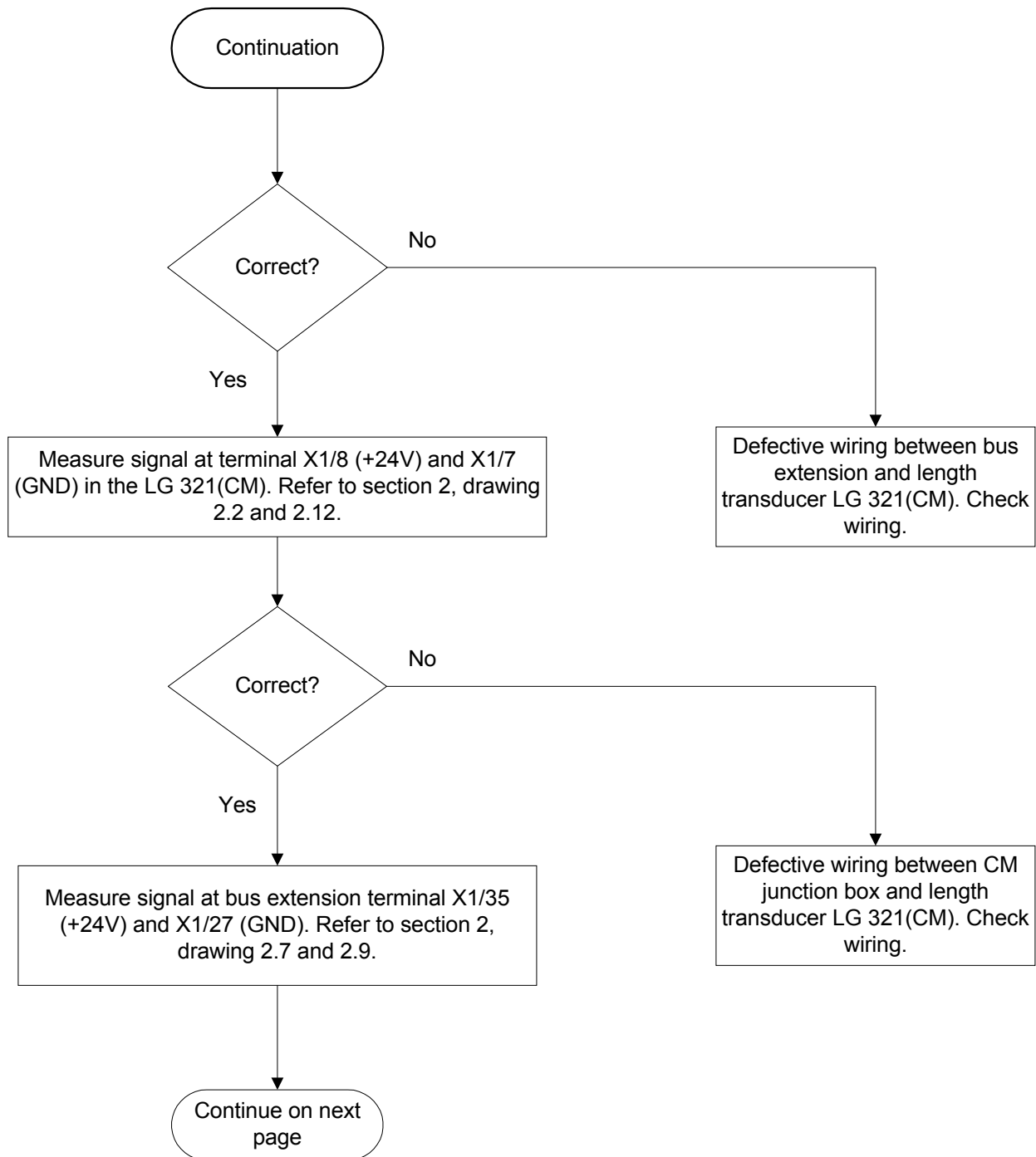


**5. [E83] OUTER MID AND FLY SECTION ARE NOT RETRACTING**

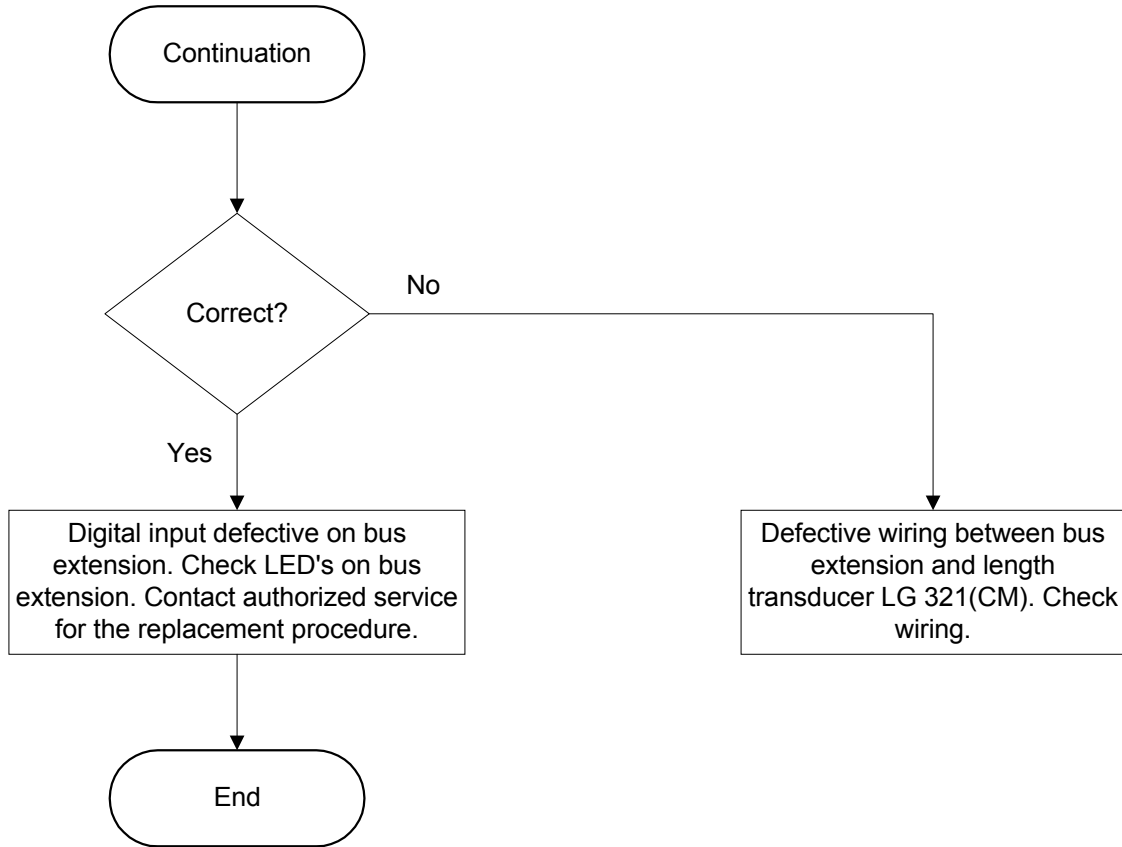




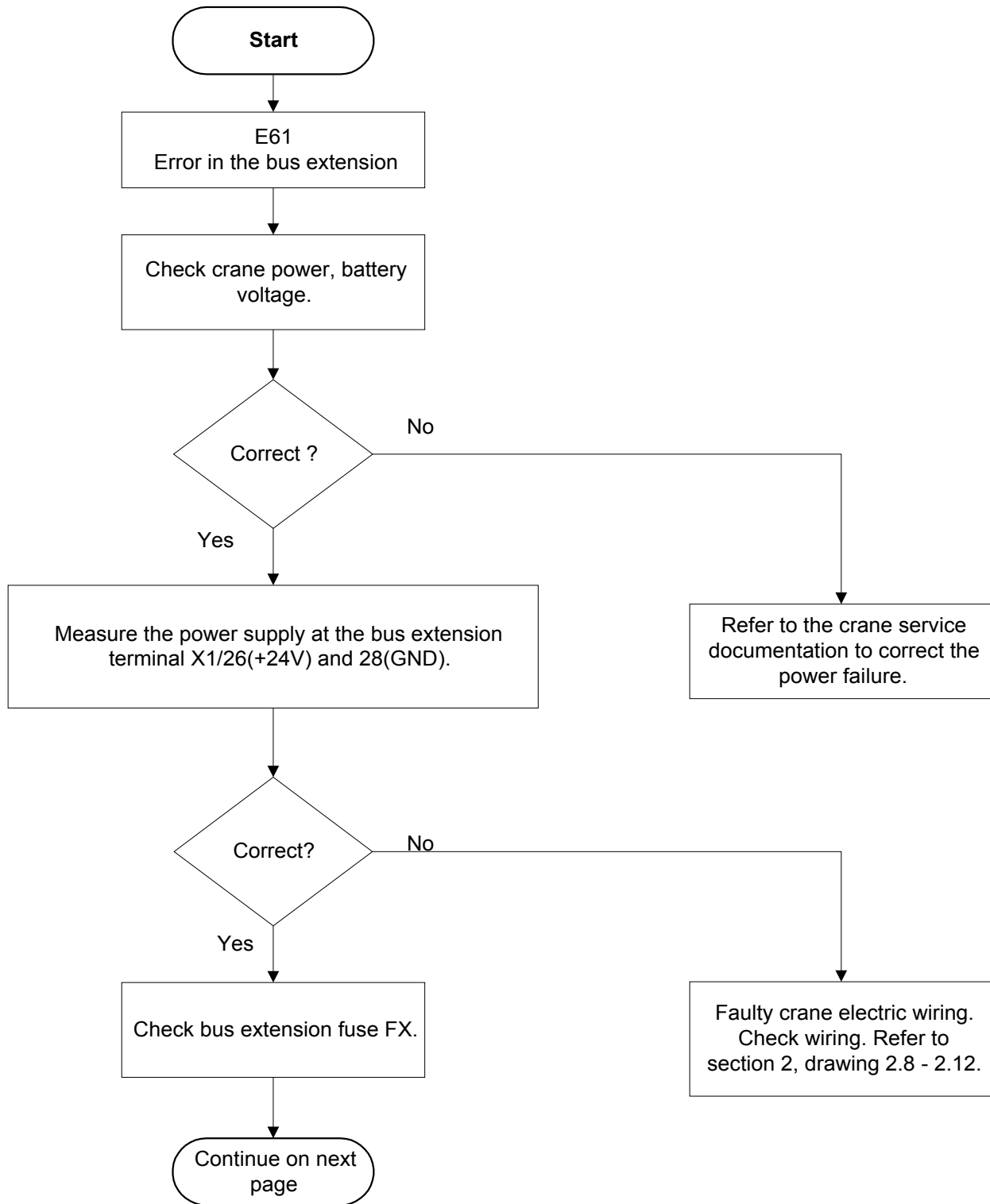


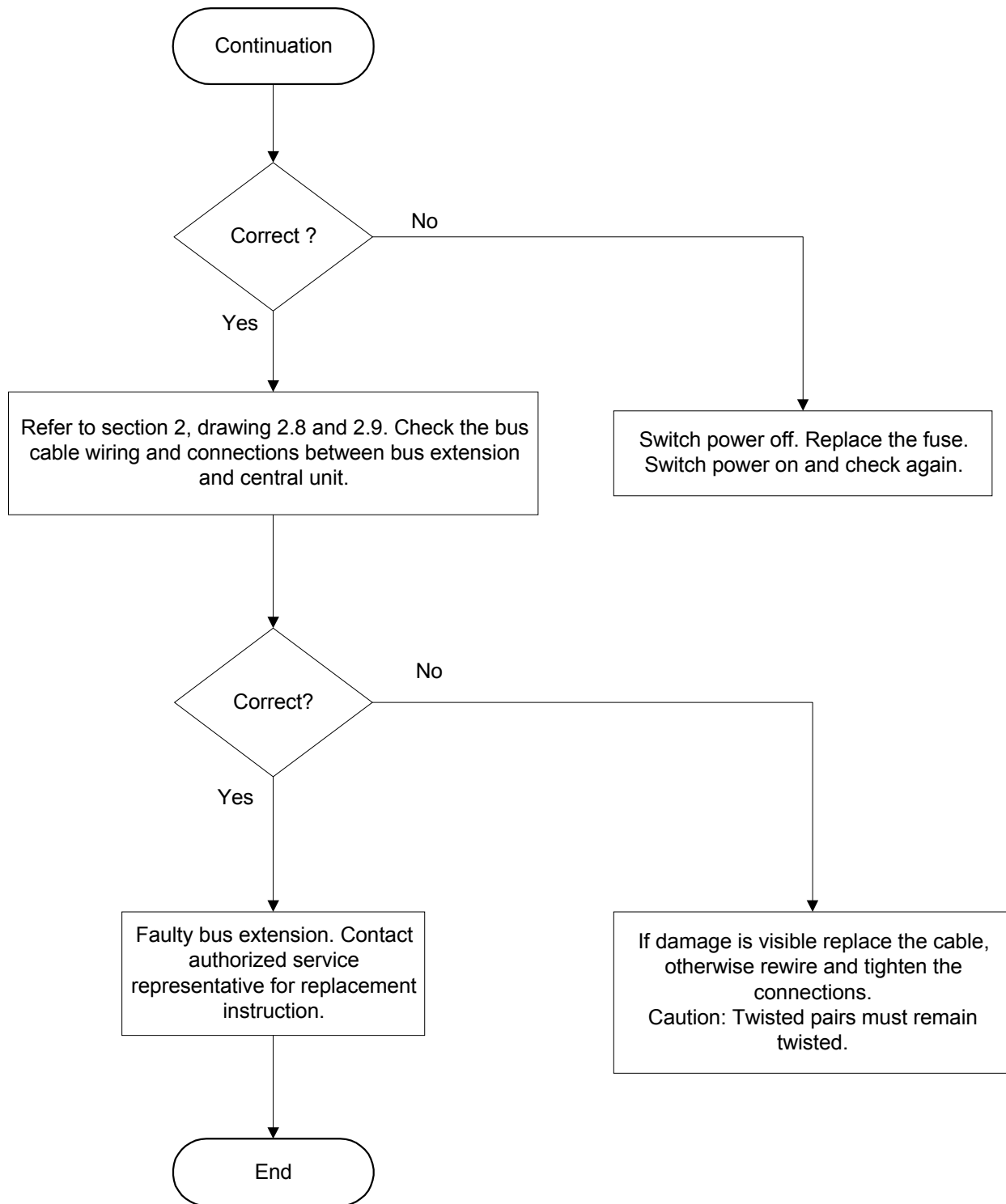




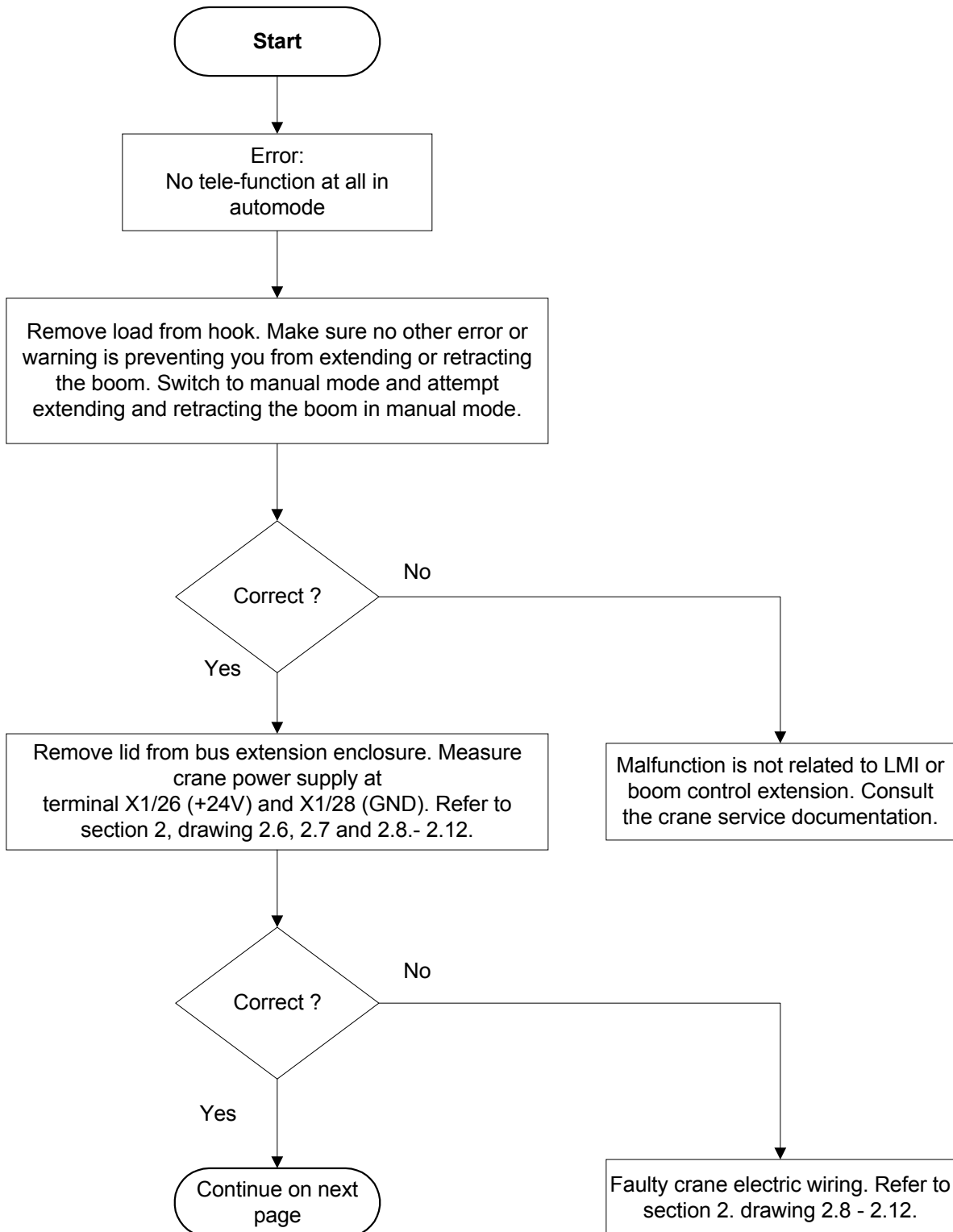


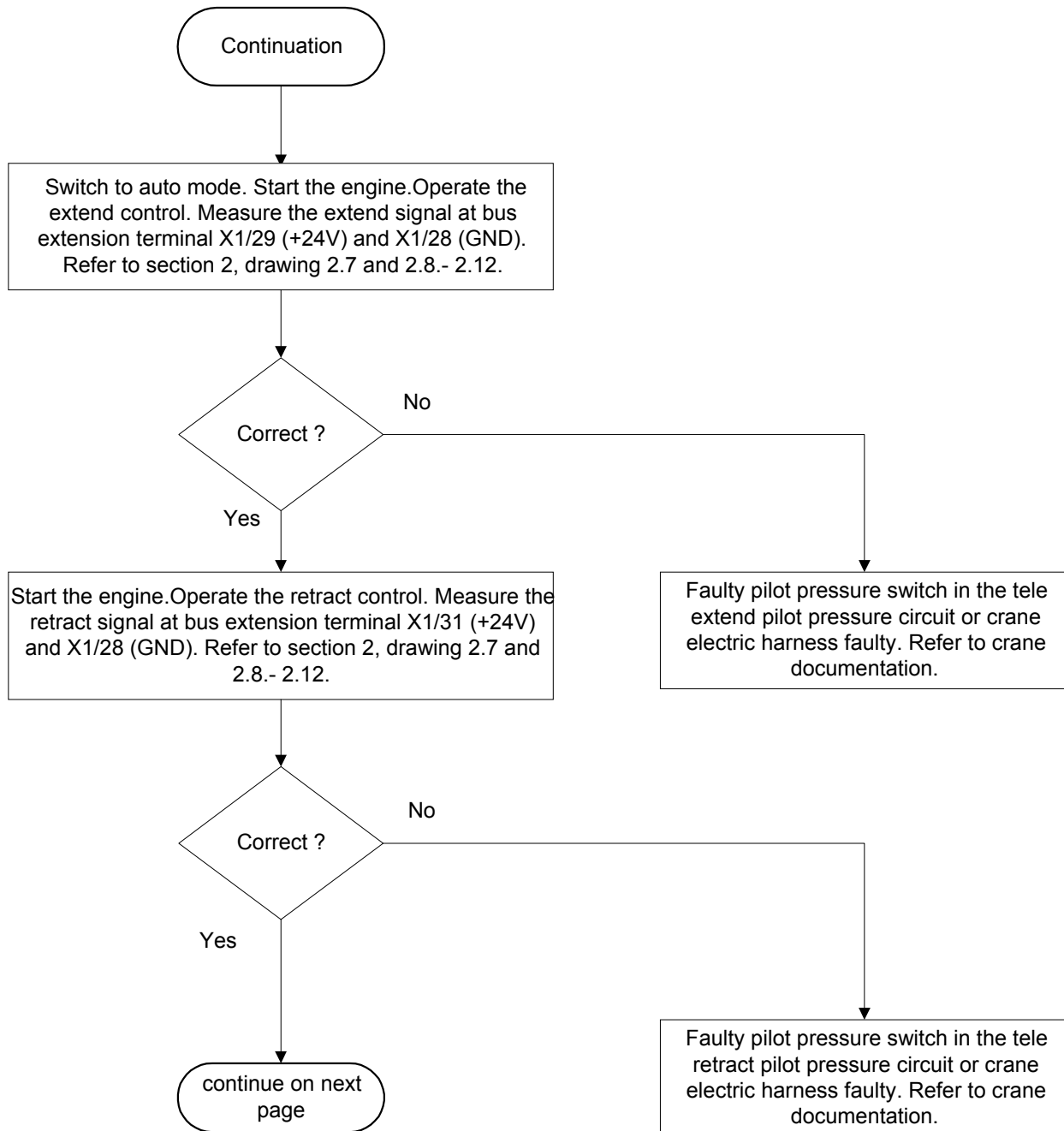
**6. [E61] Error in the bus extension**

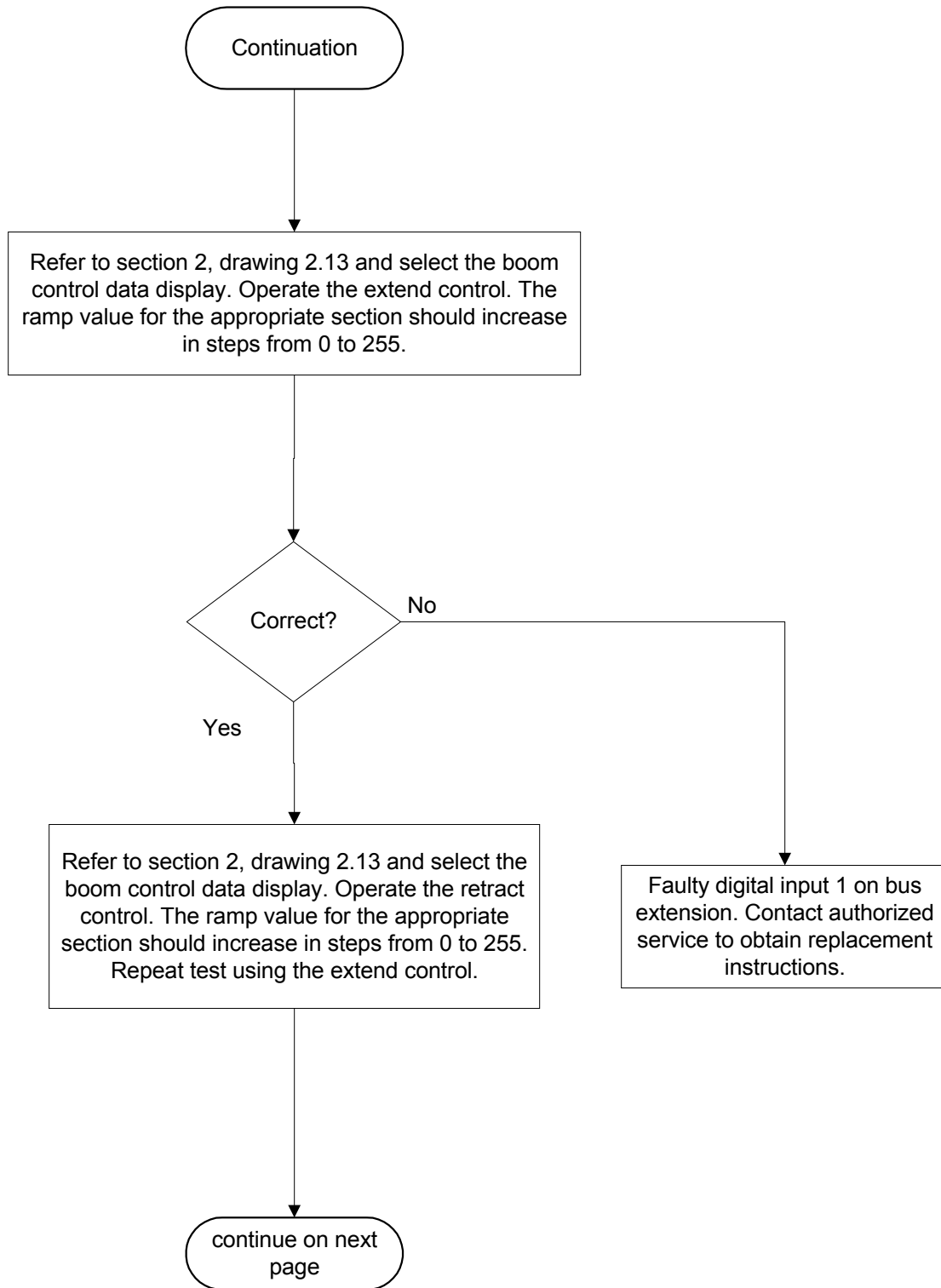


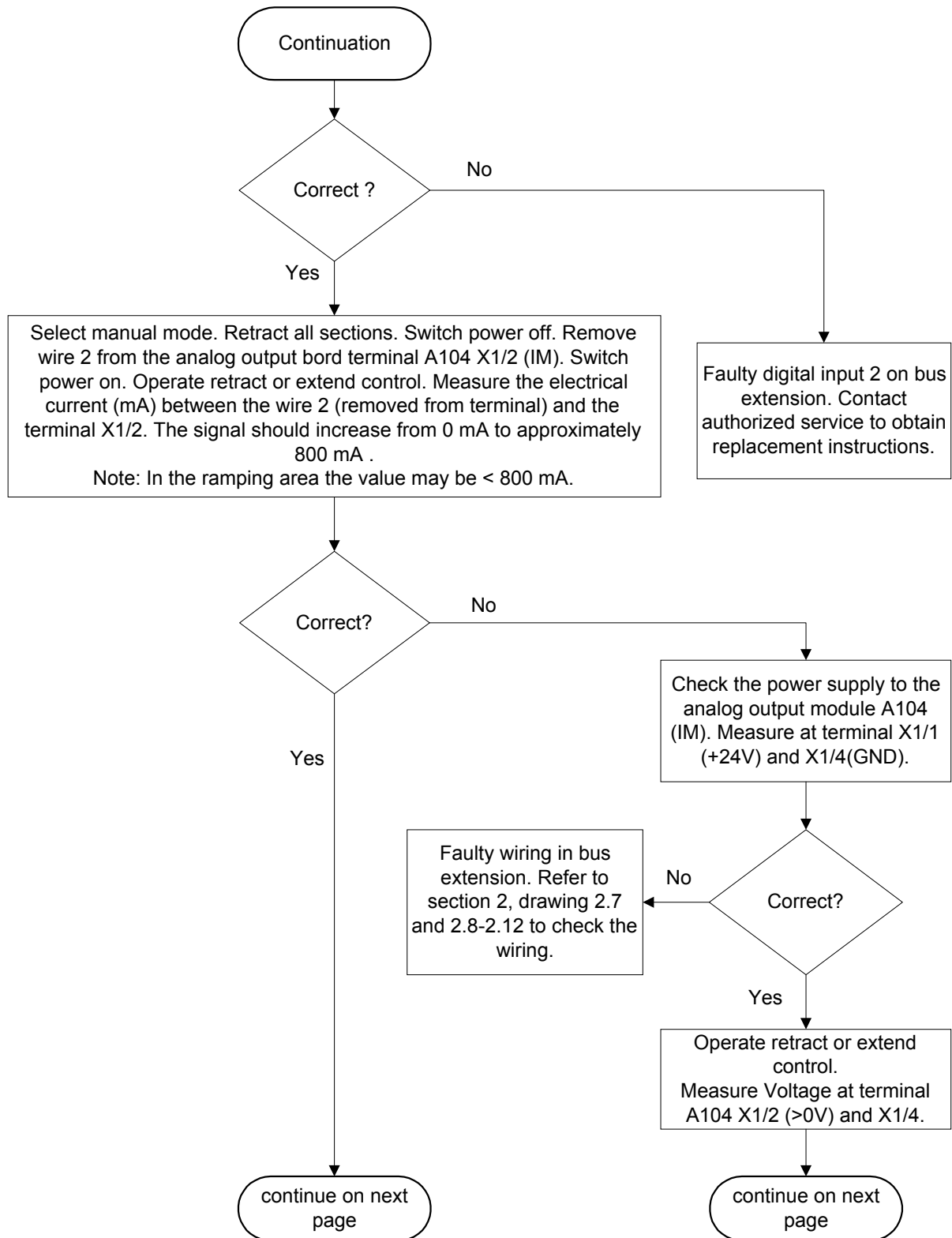


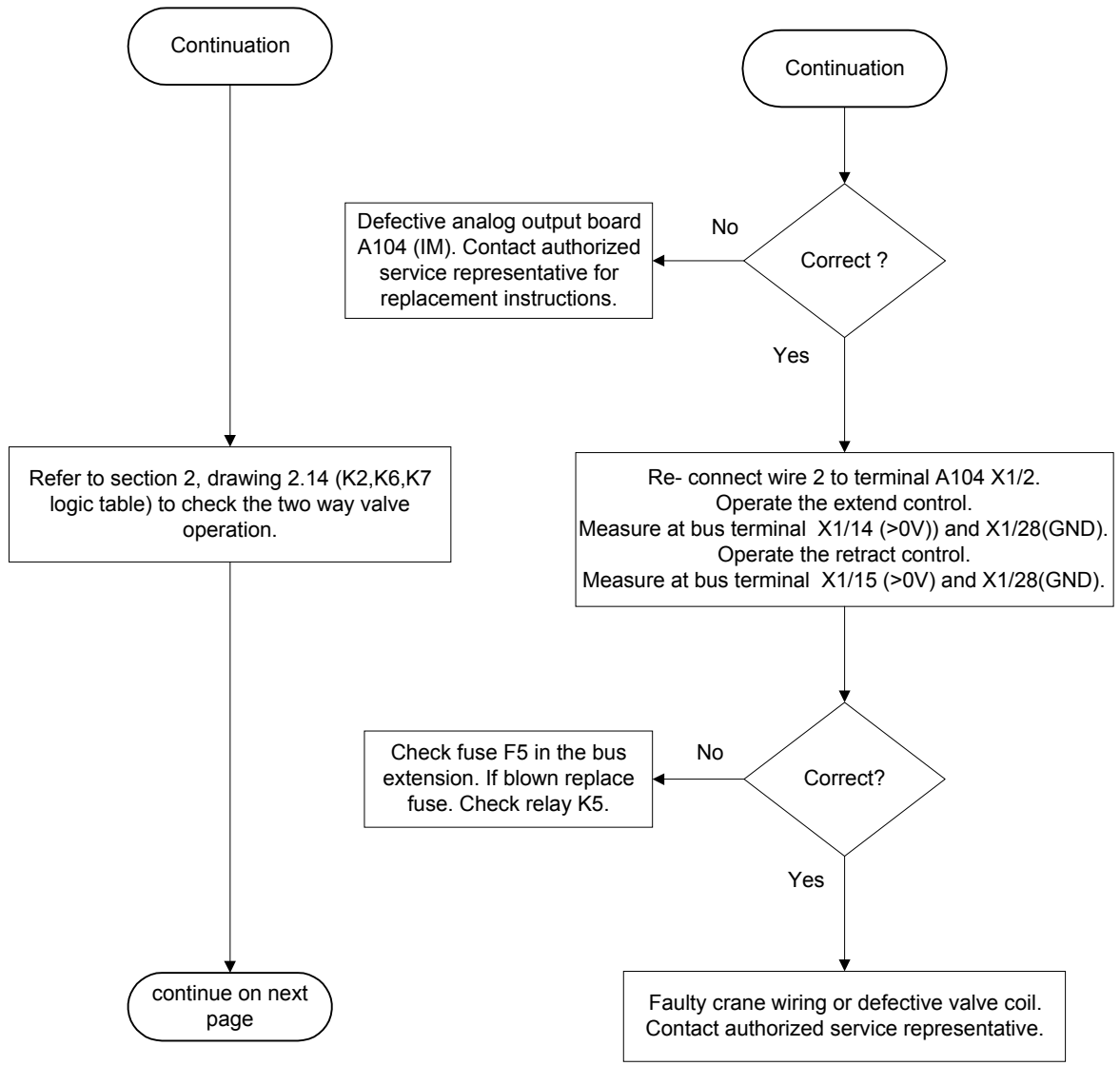
**7. No tele function at all in Auto mode**



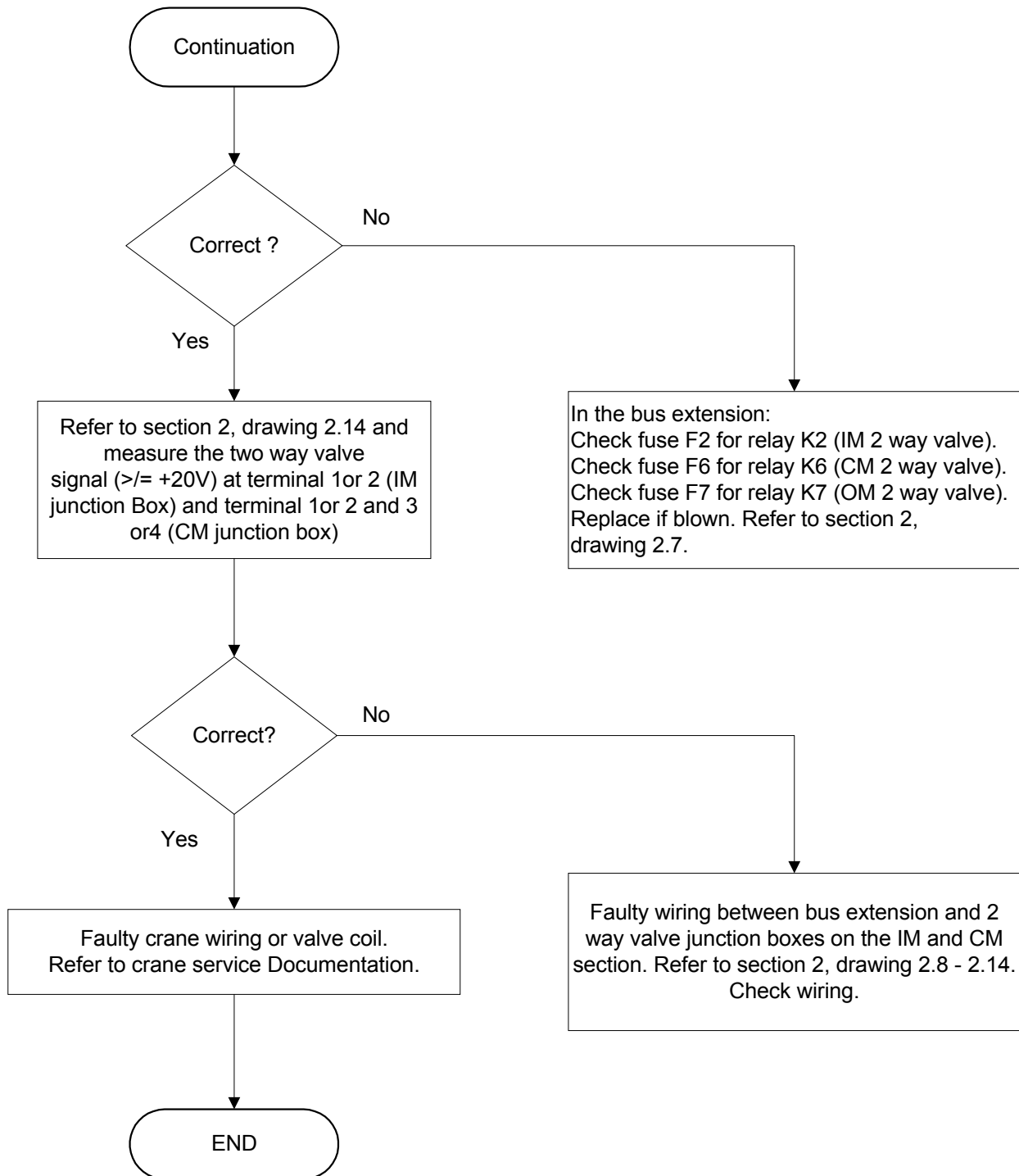




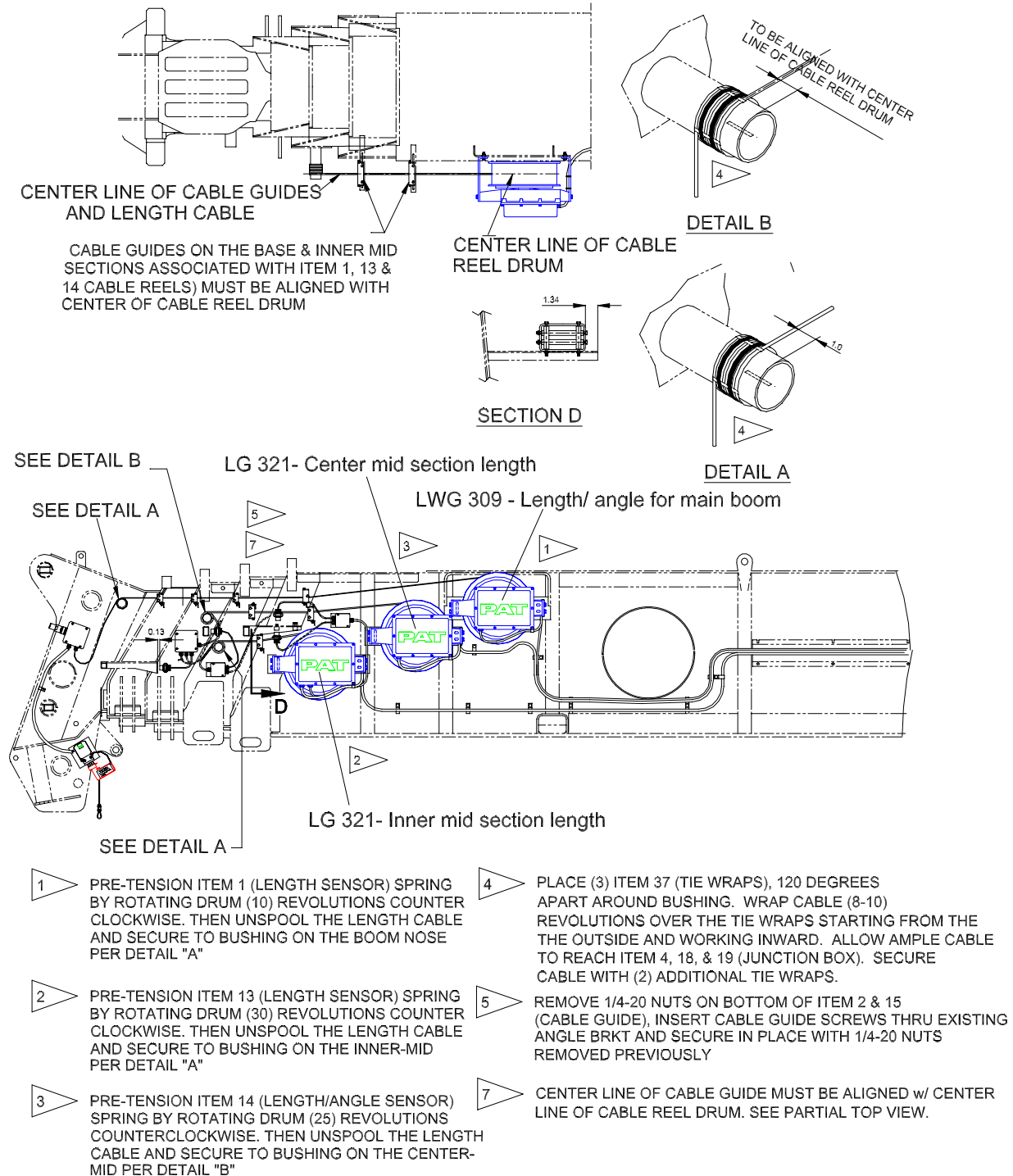




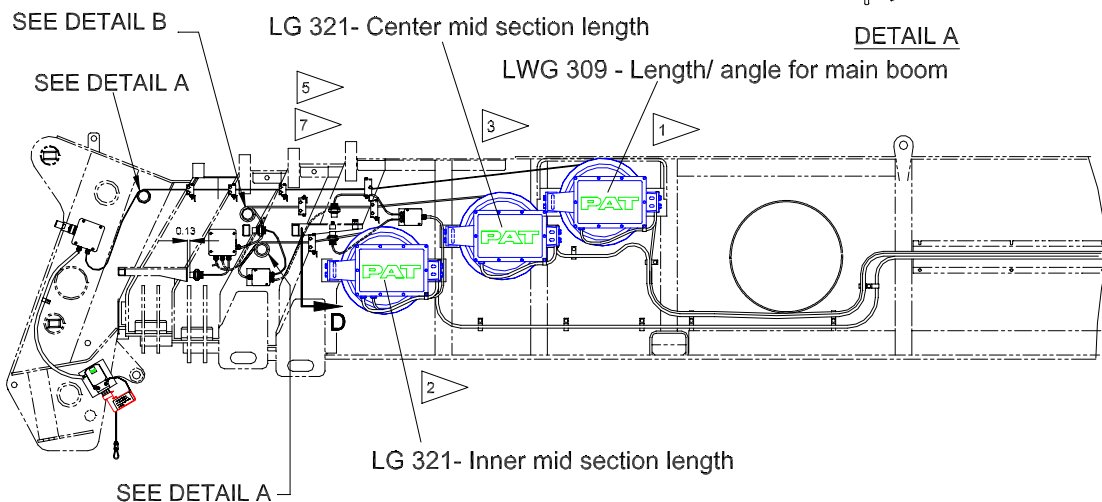
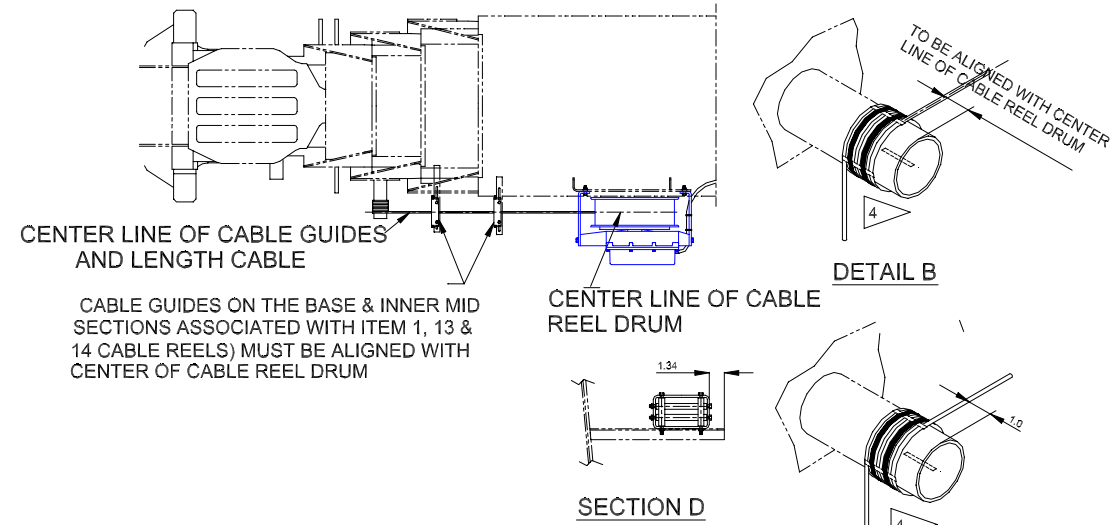




## 8. Proximity switch location and adjustment



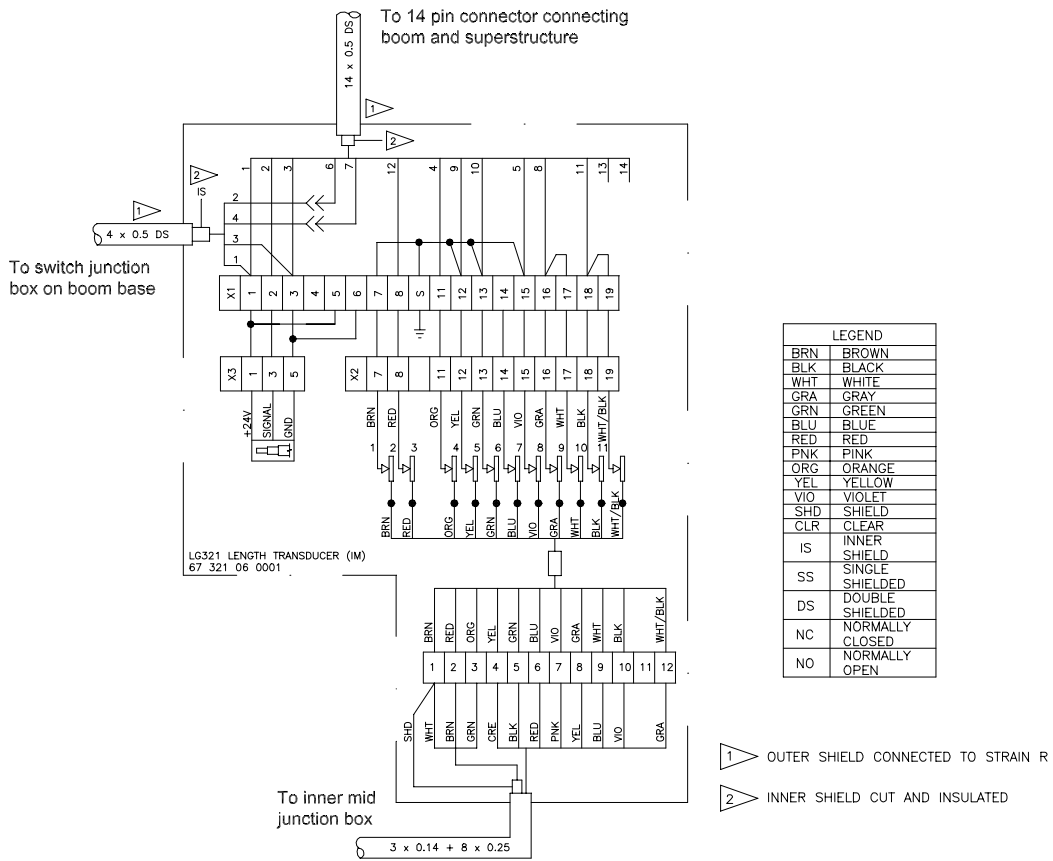
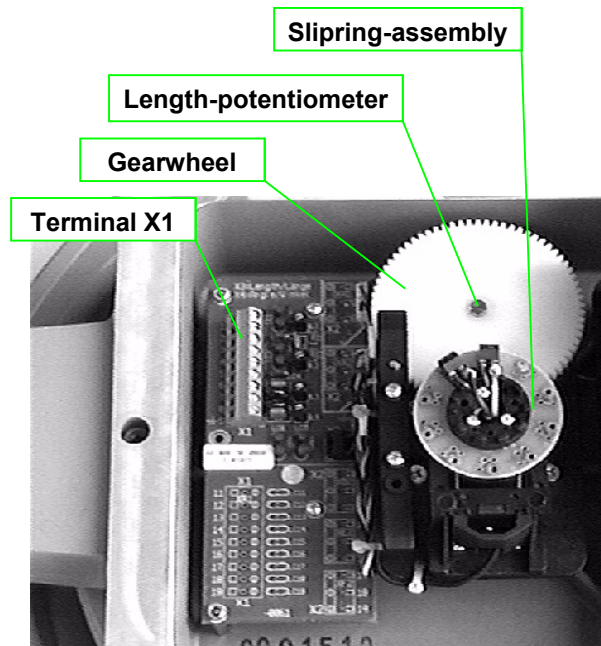
### 9. Boom Hardware -LMI



- 1 PRE-TENSION ITEM 1 (LENGTH SENSOR) SPRING BY ROTATING DRUM (10) REVOLUTIONS COUNTER CLOCKWISE. THEN UNSPOOL THE LENGTH CABLE AND SECURE TO BUSHING ON THE BOOM NOSE PER DETAIL "A"
- 2 PRE-TENSION ITEM 13 (LENGTH SENSOR) SPRING BY ROTATING DRUM (30) REVOLUTIONS COUNTER CLOCKWISE. THEN UNSPOOL THE LENGTH CABLE AND SECURE TO BUSHING ON THE INNER-MID PER DETAIL "A"
- 3 PRE-TENSION ITEM 14 (LENGTH/ANGLE SENSOR) SPRING BY ROTATING DRUM (25) REVOLUTIONS COUNTERCLOCKWISE. THEN UNSPOOL THE LENGTH CABLE AND SECURE TO BUSHING ON THE CENTER-MID PER DETAIL "B"
- 4 PLACE (3) ITEM 37 (TIE WRAPS), 120 DEGREES APART AROUND BUSHING. WRAP CABLE (8-10) REVOLUTIONS OVER THE TIE WRAPS STARTING FROM THE THE OUTSIDE AND WORKING INWARD. ALLOW AMPLE CABLE TO REACH ITEM 4, 18, & 19 (JUNCTION BOX). SECURE CABLE WITH (2) ADDITIONAL TIE WRAPS.
- 5 REMOVE 1/4-20 NUTS ON BOTTOM OF ITEM 2 & 15 (CABLE GUIDE), INSERT CABLE GUIDE SCREWS THRU EXISTING ANGLE BRKT AND SECURE IN PLACE WITH 1/4-20 NUTS REMOVED PREVIOUSLY
- 7 CENTER LINE OF CABLE GUIDE MUST BE ALIGNED w/ CENTER LINE OF CABLE REEL DRUM. SEE PARTIAL TOP VIEW.

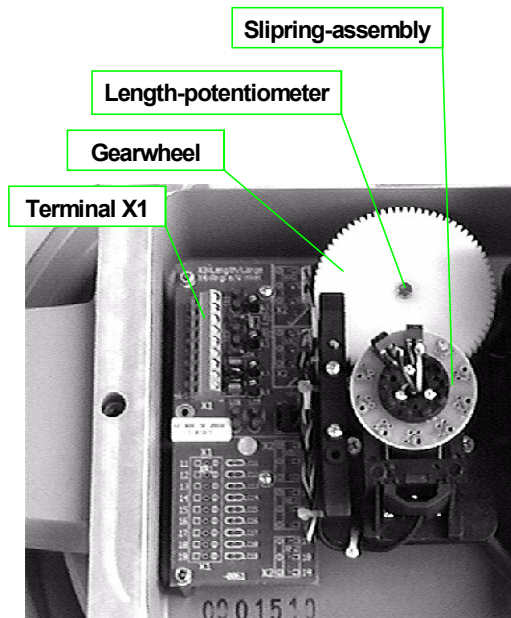


### 10. Length transducer - inner mid section

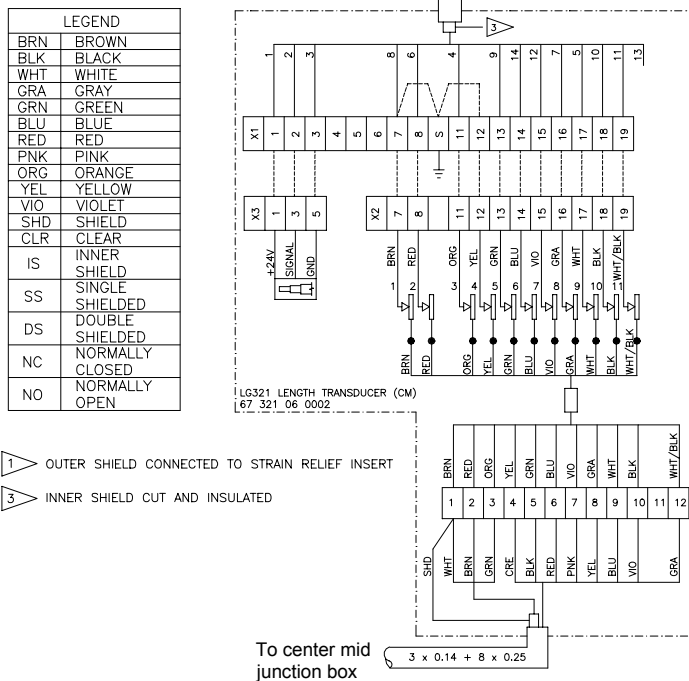


Drawing: 2.3.1: LG 321 Inner Mid Section

### 11. Length transducer - Center Mid section

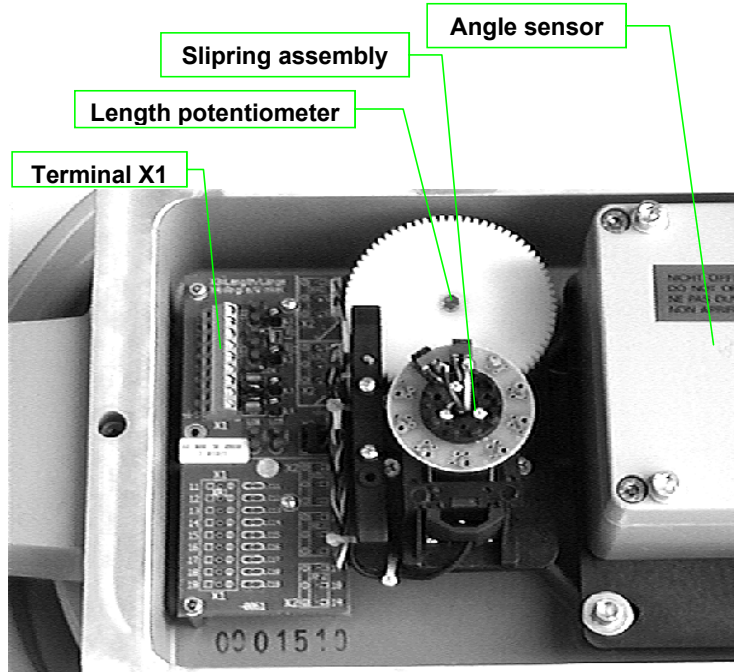


To 19 pin connector- connecting boom and superstructure



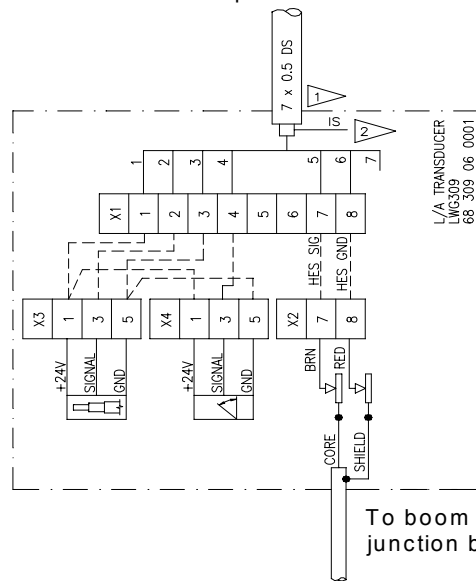
Drawing 2.3.2: LG 321- Center mid section

## 12. LENGTH ANGLE TRANSDUCER- OVERALL LENGTH



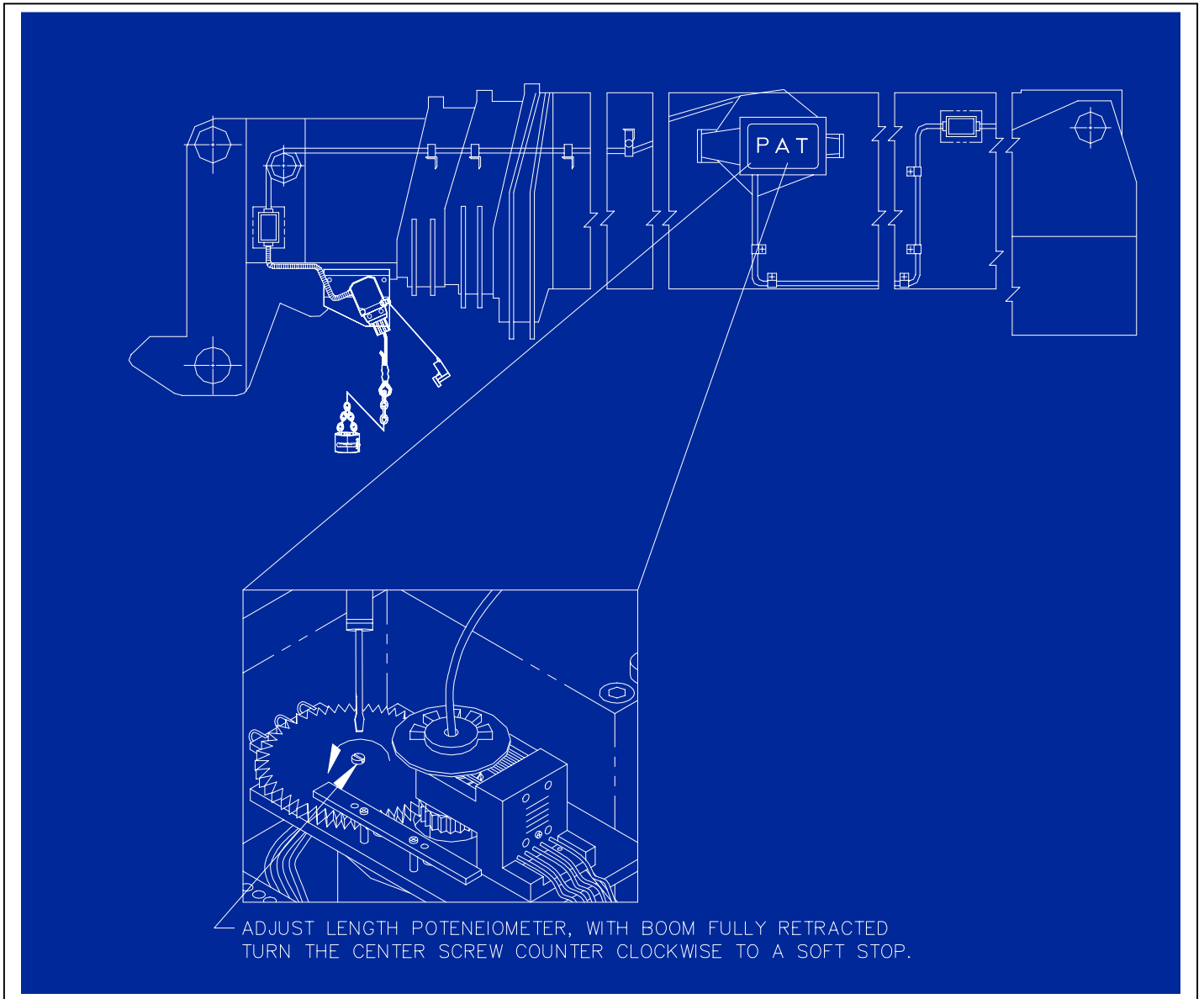
To 7 pin connector - connecting boom with superstructure

LEGEND	
BRN	BROWN
BLK	BLACK
WHT	WHITE
GRA	GRAY
GRN	GREEN
BLU	BLUE
RED	RED
PNK	PINK
ORG	ORANGE
YEL	YELLOW
VIO	VIOLET
SHD	SHIELD
CLR	CLEAR
IS	INNER SHIELD
SS	SINGLE SHIELDED
DS	DOUBLE SHIELDED
NC	NORMALLY CLOSED
NO	NORMALLY OPEN

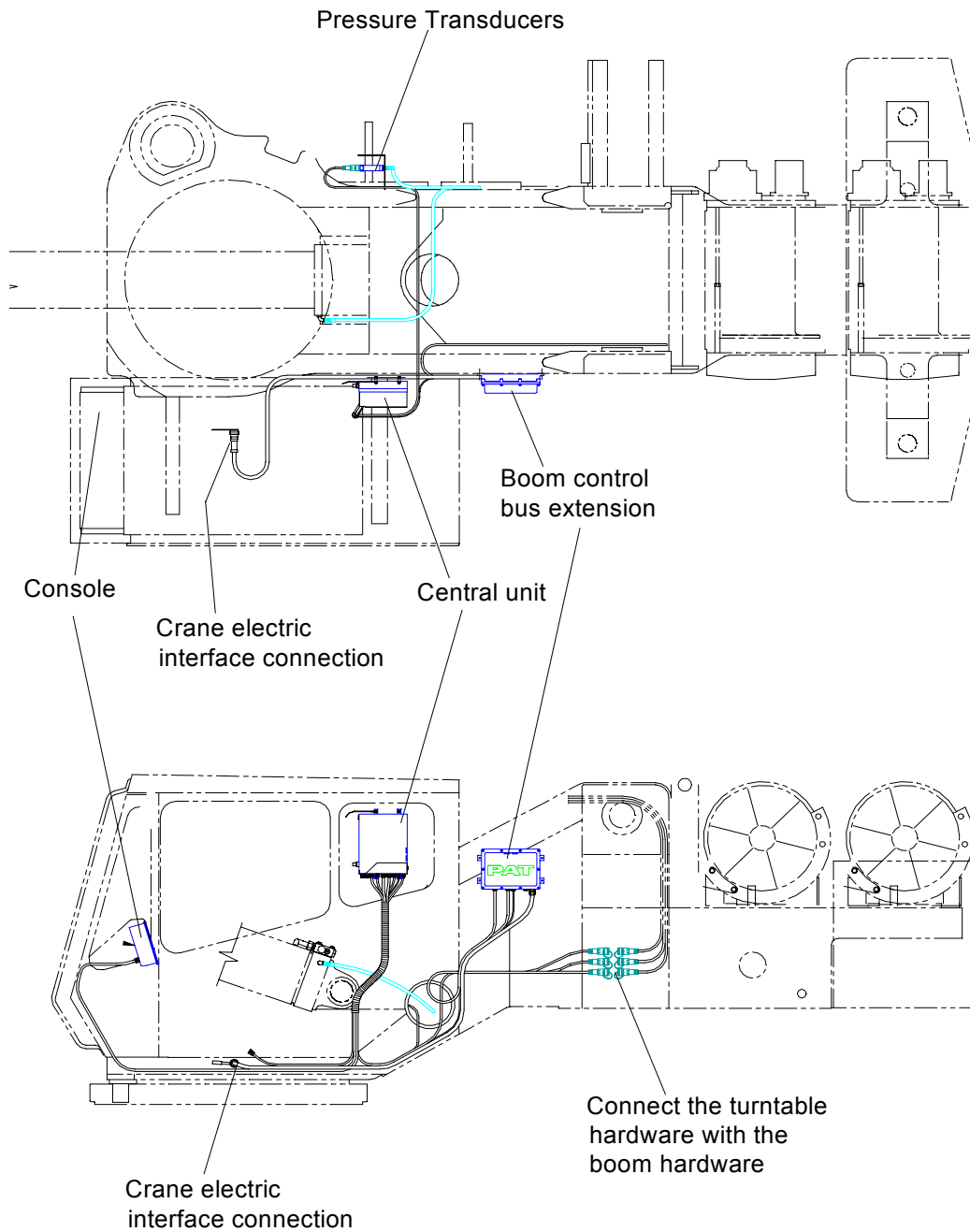


- 1 OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
- 2 INNER SHIELD CUT AND INSULATED

### 13. LENGTH TRANSDUCER ADJUSTMENT

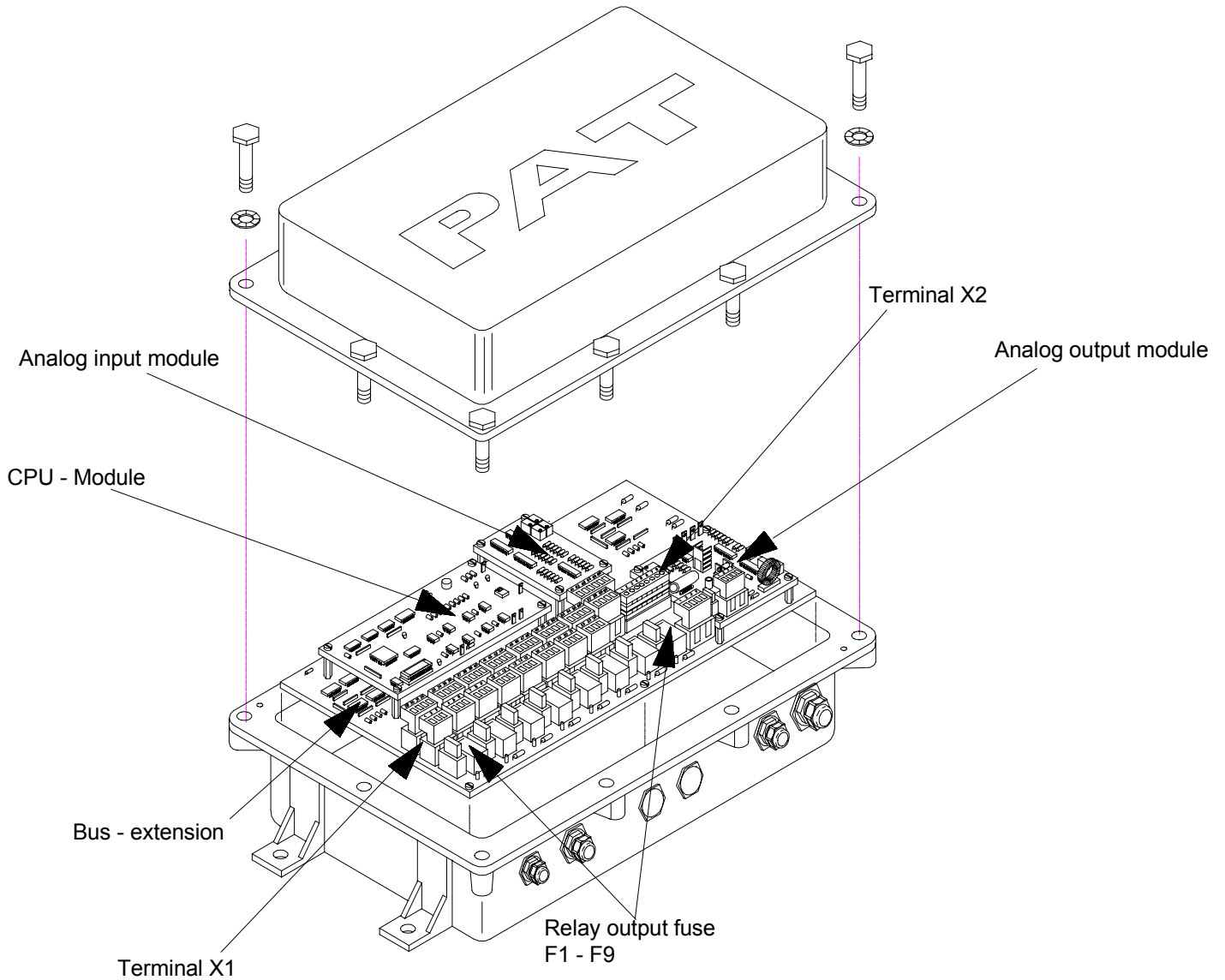


### 14. TMS/TTS 870 Turntable - LMI Hardware



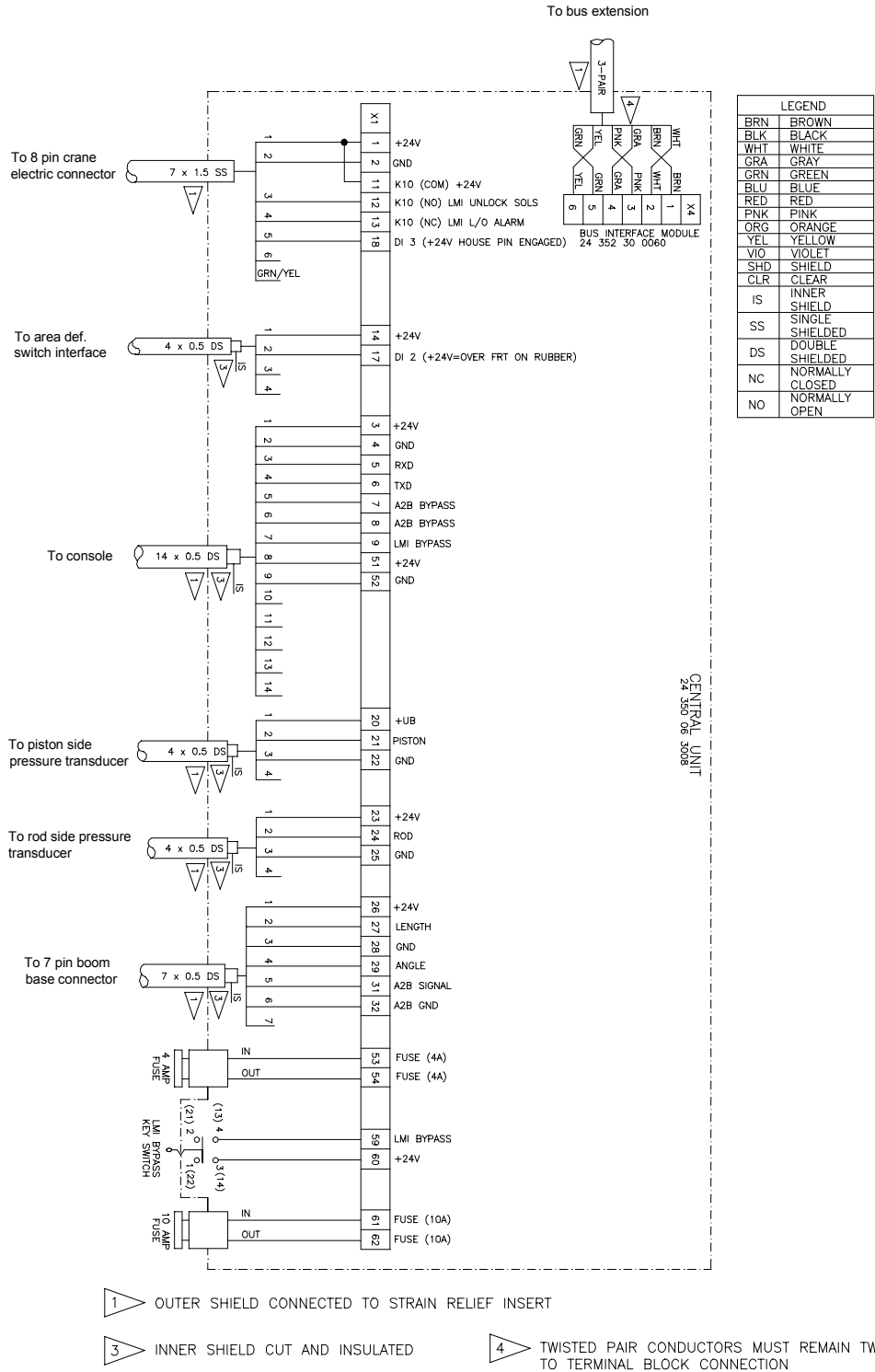


### 15. Boom Control - Bus Extension



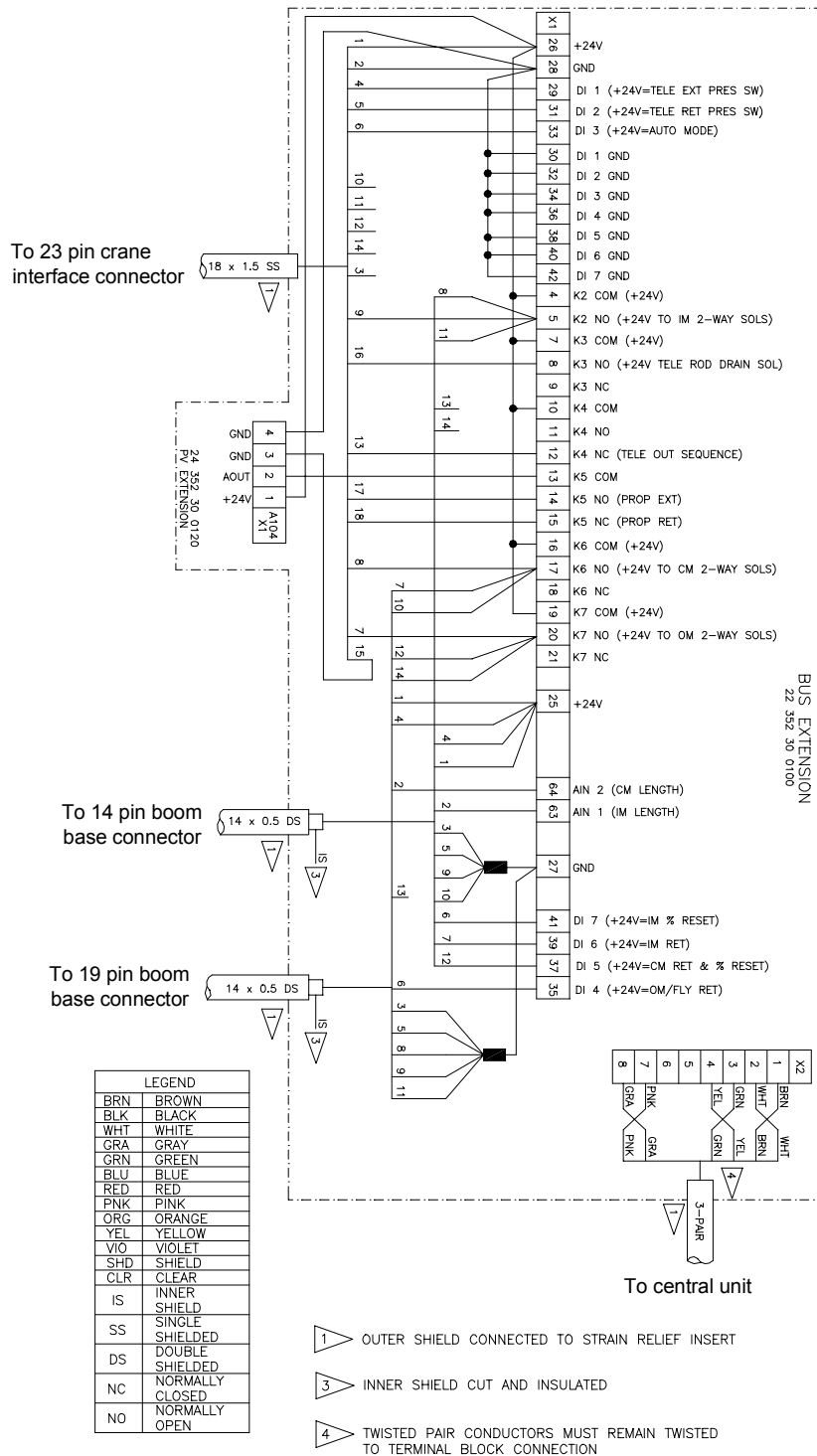
Drawing 2.7: Boom control bus extension

### 16. Electric Wiring - Central Unit



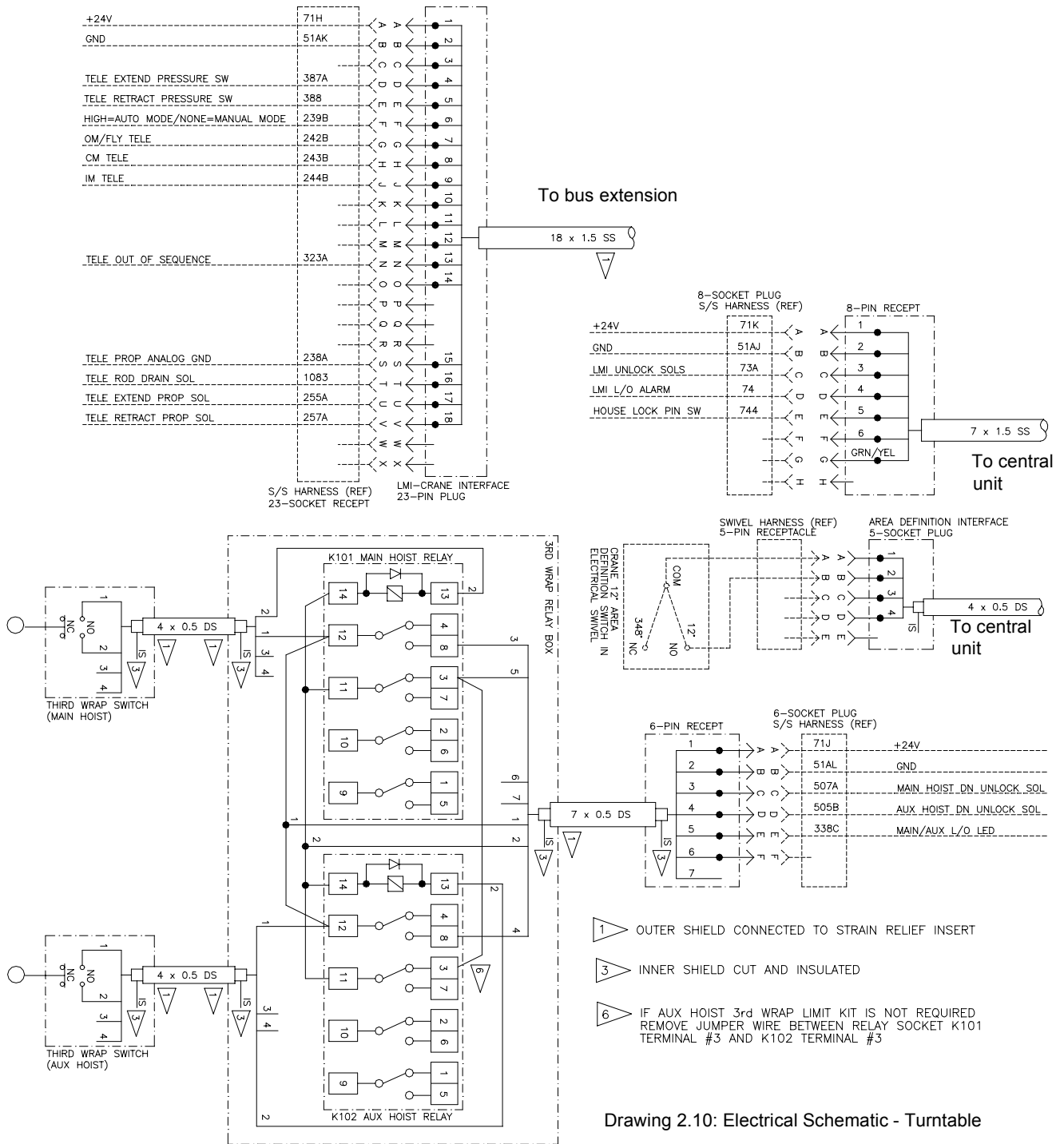
Drawing 2.8: Electrical schematic - Central Unit DS 350 (Modular)

### 17. ELECTRIC WIRING - BUS EXTENSION



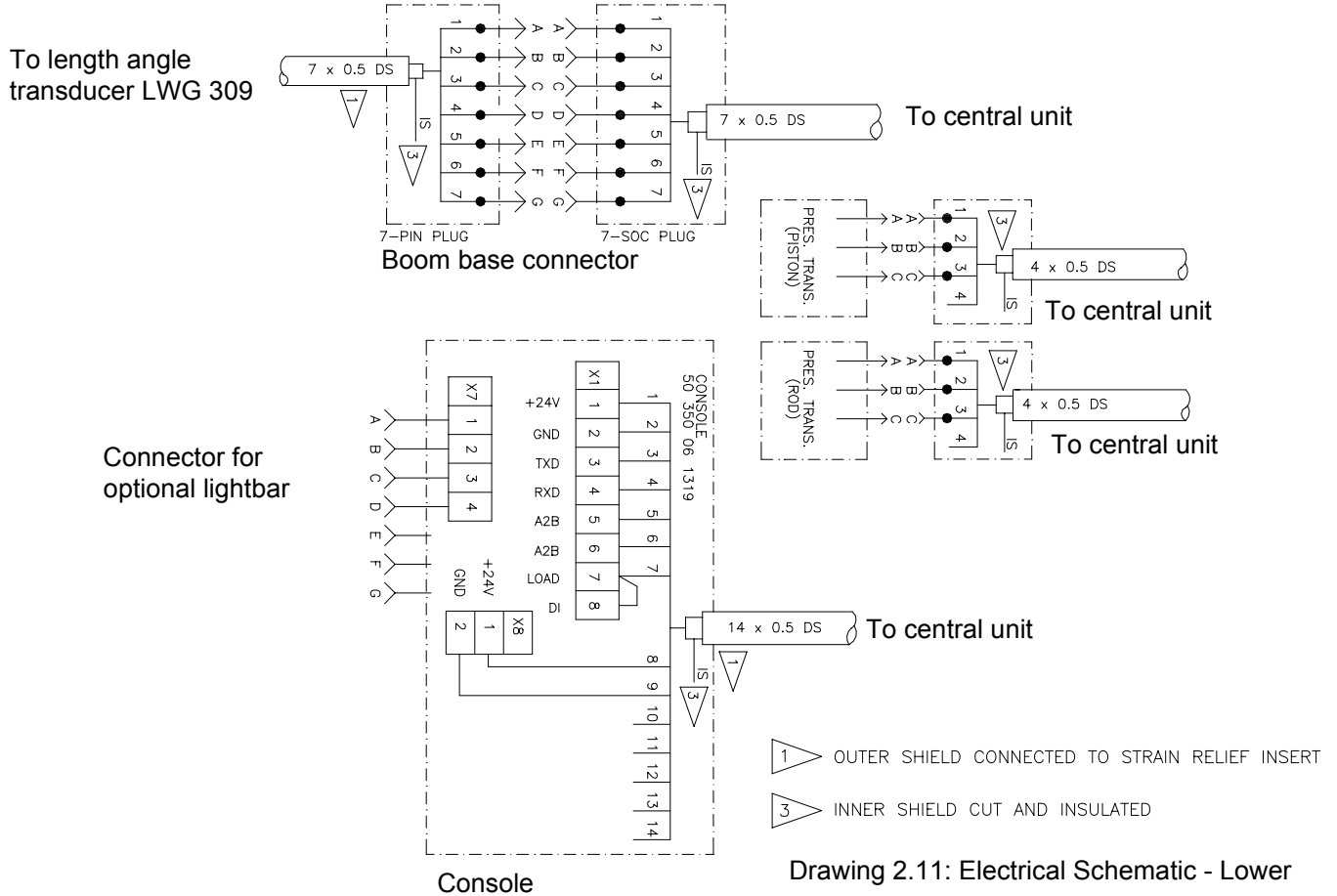
Drawing 2.9: Electrical Schematic - Bus extension

### 18. Electric Wiring - Turntable



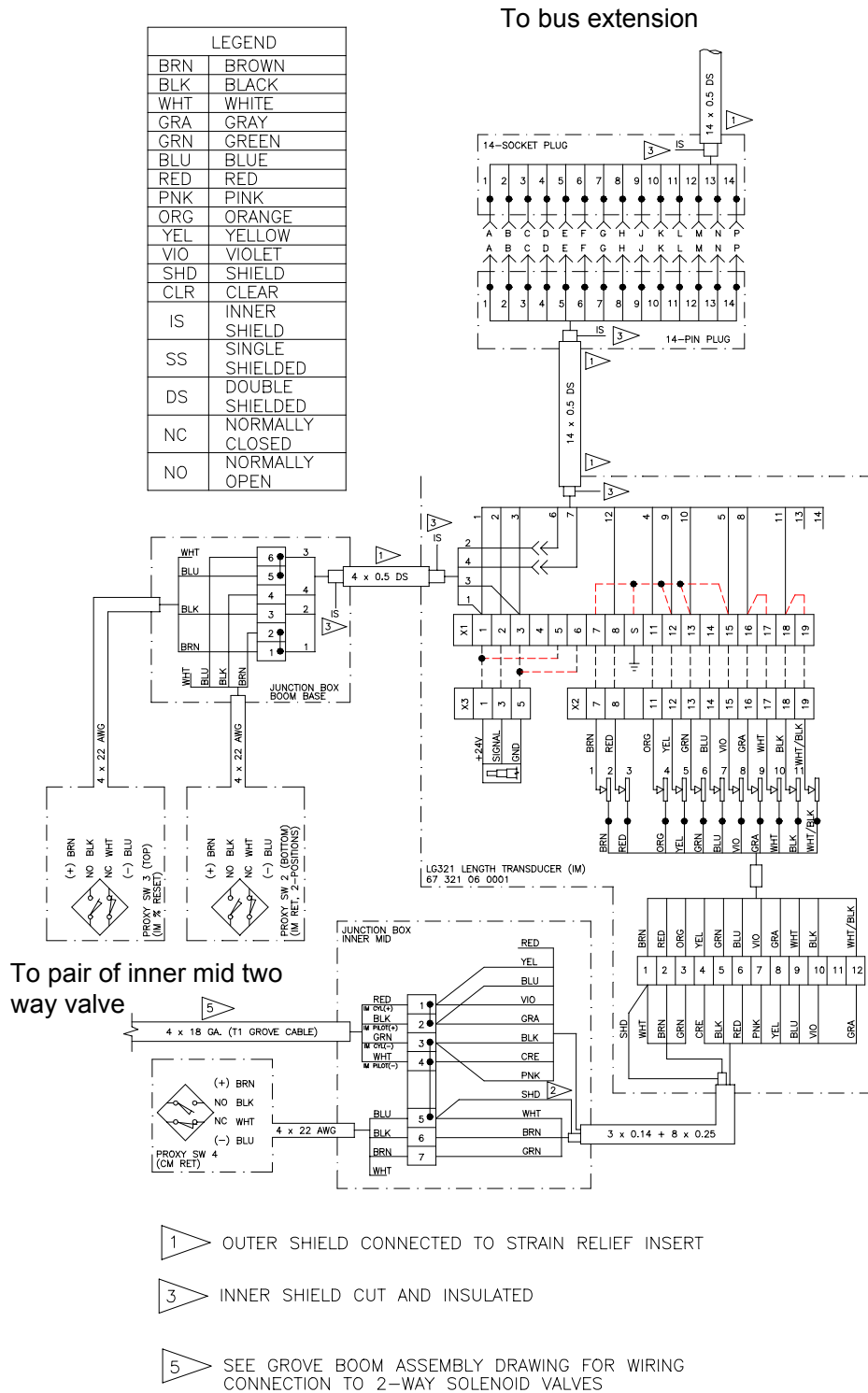
Drawing 2.10: Electrical Schematic - Turntable

**19. Electric Wiring - Lower**

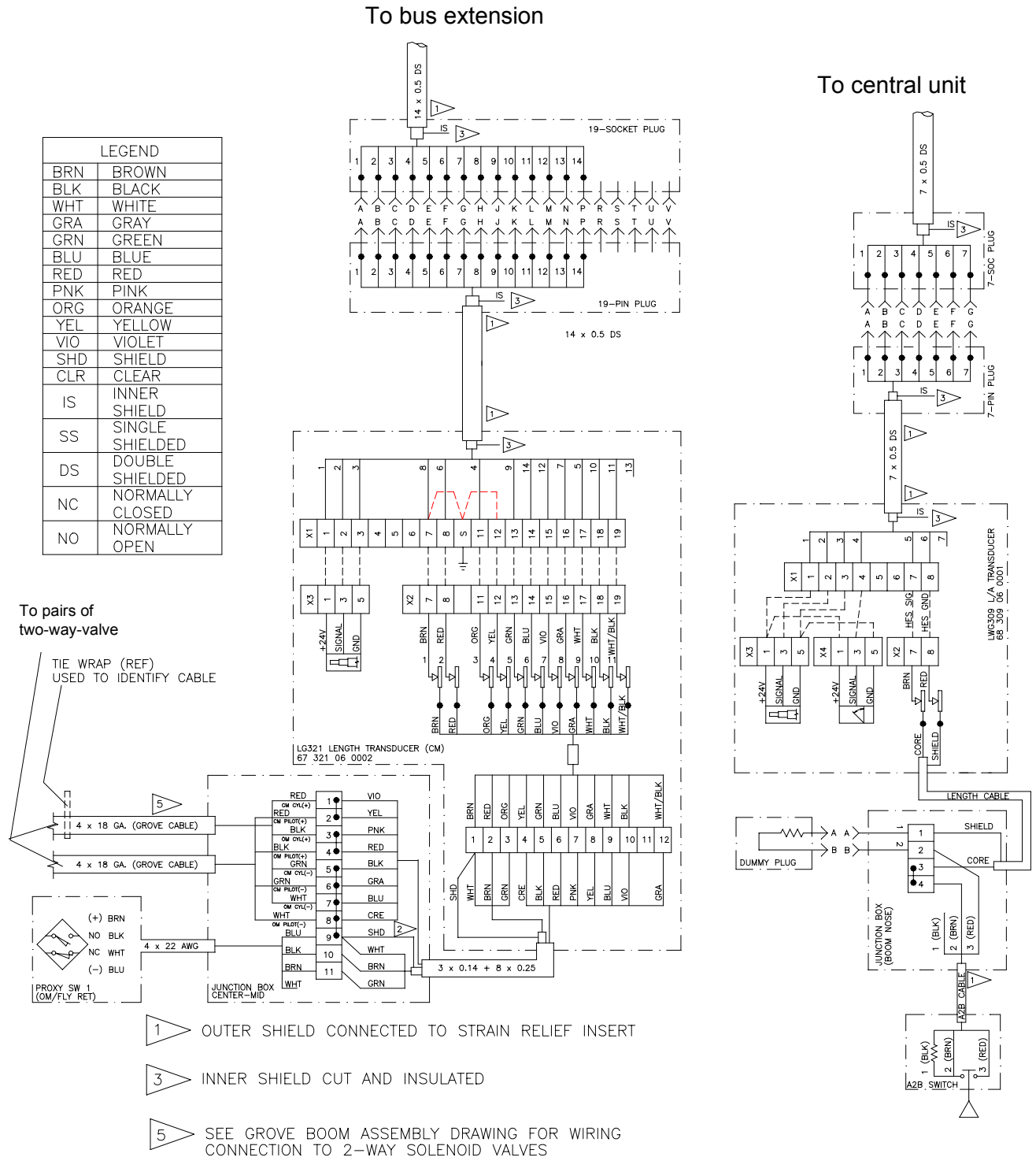


**Drawing 2.11: Electrical Schematic - Lower**

## 20. Electric Wiring - Boom

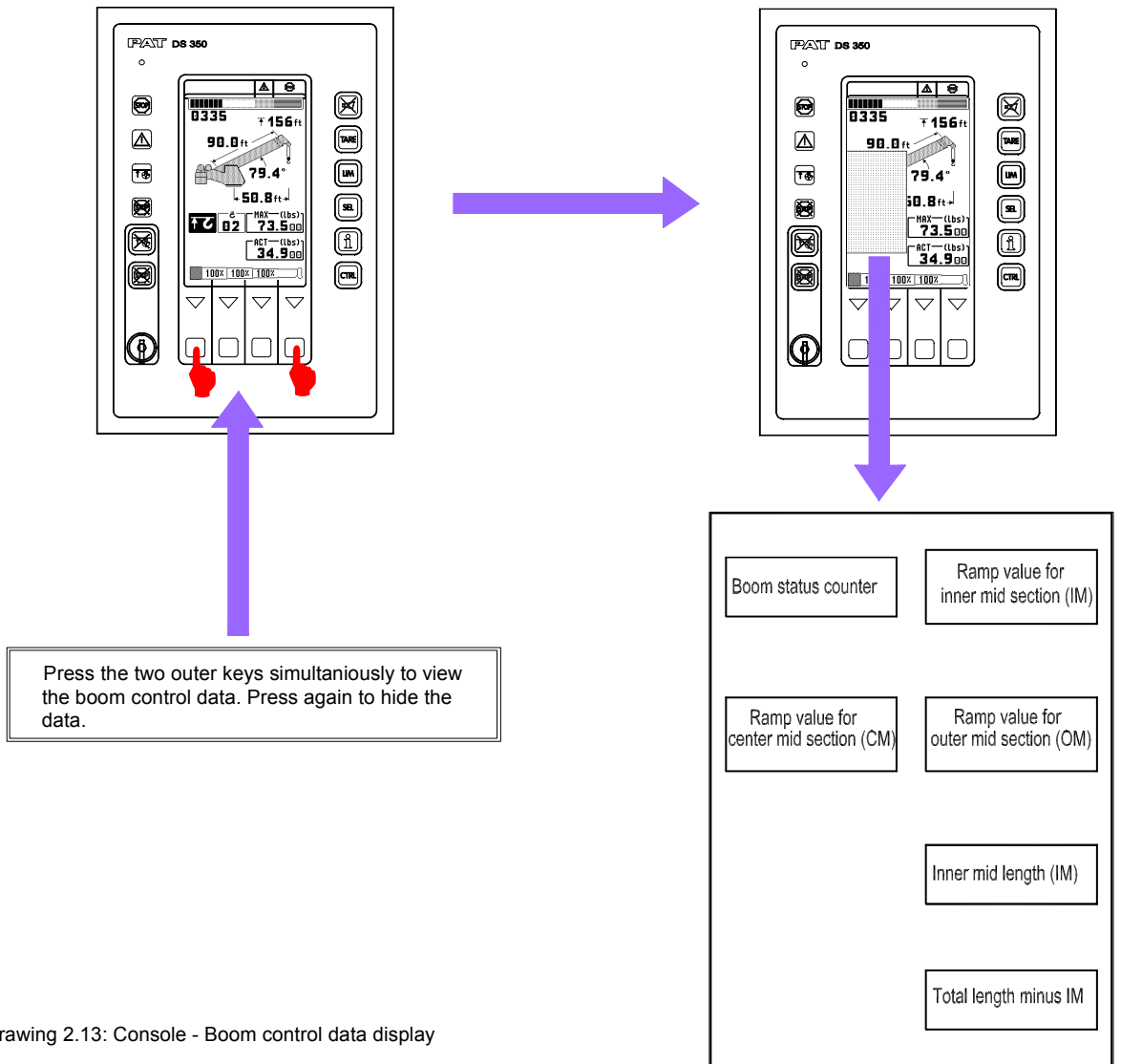


Drawing 2.12.1: Electrical Schematic - Boom



Drawing 2.12.2: Electrical Schematic - Boom

## 21. Console – Service Display



Drawing 2.13: Console - Boom control data display



## 22. RELAY OUTPUT LOGIC FOR TWO-WAY-VALVES

Relay No.	Designation	Tele- Section
2	Relay K2 on bus extension	IM two-way-valves
6	Relay K6 on bus extension	CM two-way-valves
7	Relay K7 on bus extension	OM two-way-valves

Table A	K2	K6	K7
out of sequence	0	0	0
IM ext/ret	0	1	1
CM ext/ret	1	0	1
OM ext/ret	1	1	0

0 = no power output  
 1 = +24V output

Note: The two-way-valve must be powered to stop the section from moving and is power-free when section is allowed to move.