MacLean™
POWER SYSTEMS

MSO MOTORIZED SWITCH OPERATOR

Troubleshooting Guide, Version A, Rev. 00

Reciprocating Control Modules

This Guide Applies to the Following CMR#s:

MSO-CMR-86
(S.E.L. 3505 R-TAC)

MSO-CMR-69
(G.E. i-BOX)

MacLean Power Systems

Formerly
(Inertia Engineering & Machine Works, Inc.)

6665 Hardaway Road
Stockton, CA 95215

Tel: (209) 931-1670
Fax: (209) 931-8186

Table of Contents:

Introduction

This manual provides a troubleshooting guide for diagnosing and correcting issues with the MPS Motorized Switch Operator (MSO). If there are any items within the manual that are unclear to the user, it is advised that the user contact the **Engineering Department** at (209) 931-1670 for assistance in troubleshooting the MSO and/or overhead switch.

Where to Begin

This manual covers the most common MSO issues; however, not all sections may be required to diagnose a specific problem. Before beginning any troubleshooting, review the General Safety Information located on the lower half of this page and continuing onto page 3.

In all cases, the first diagnostic step is to perform the **"Preliminary Lamp Test Check"** to verify that the MSO is powered ON and that all status indicator lamps are functioning properly. Refer to page 3, Chart 1 for this procedure.

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To ensure personnel safety and preventing damage to the MSO and or switch, the "Preliminary Lamp Test Check" MUST be performed prior to moving forward with any troubleshooting procedures.

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After completing the Preliminary Lamp Test Check, refer to the Table of Contents and select the troubleshooting chart that matches the observed symptom. Each chart provides step-by-step diagnostic procedures and identifies recommended replacement components, where applicable. If any step is unclear or cannot be performed as written, contact the Engineering Department for technical support before proceeding. Use the Notes pages to document symptoms, test results, and diagnostic actions prior to contacting the factory.

Tools Required/Recommended

A true RMS digital multimeter (DMM) is **required**. The meter shall measure 24 VDC or greater with a minimum resolution of two decimal places for accurate verification of voltage sensors and battery or power supply readings. An audible continuity function is also recommended for required continuity checks.

A clamp meter capable of measuring DC current is **highly recommended**. Measuring current at the battery source terminals provides immediate confirmation of MSO operating status, including system energization, power supply operation, battery charging, or a stalled Battery Test condition. Use of a DC clamp meter significantly improves troubleshooting speed and fault isolation.

Other items that may be needed:

1. Flat head screwdriver, 1/8" width blade (for main terminal block, TB1-1)
2. Flat head screwdriver, 3/16" width blade (for AC terminal block, TB-2)
3. Phillips screwdriver for #8-32 machine screws
4. A PC or Laptop with the appropriate RTU software (SEL / GE-iBOX) for sending remote control commands to an RTU when communication devices are not available.
5. Appropriate communication cable for connecting to a RTU.

General Safety Information

This manual is not a substitute for proper training or adequate experience in the safe operation and maintenance of the equipment described herein. The MSO shall be serviced and maintained only by qualified technicians or electricians who are trained and experienced with this type of equipment. The following are suggested minimum qualifications:

- Knowledge and familiarity of these instructions.
- Trained in Electric Utility accepted high and low-voltage safe operating practices and procedures.
- Trained and authorized to energize, de-energize, clear, and ground electrical distribution equipment.
- Trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hardhat, rubber gloves, hot stick, etc.

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⚠ **DANGER: Hazardous Voltage. Contact with hazardous voltage may cause severe personal injury and/or death. Follow all locally approved procedures and safety practices when working on or around high and low voltage lines and equpment.**

⚠ **WARNING: Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of the operation manual. Improper operation or maintenance may result in severe personal injury and or death.**

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Troubleshooting Chart Safety Notes

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WARNING NOTE 1: Decoupling the MSO Motor

For the MSO, the "Motor Decoupler Handle" disengages the linkage from the motor. If the MSO is not in the fully closed (over-toggled) position, the switch may "fall" open due to the weight of the control rod, and switch blades.

The user must verify the following before proceeding to decouple the motor for energized switches.

- **If MSO is ON... Either open status or closed status LED lamps are on, and the overhead switch is fully open, or fully closed.**
- **If MSO is OFF... The MSO is in the fully "over-toggled" linkage position and the overhead switch is fully open, or fully closed.**

The user must verify the following before proceeding to decouple the motor for un-energized switches.

- **Line crew is not in close proximity of moving switch components (switch blade, interrupters, reciprocating control rod, etc.) if MSO is decoupled and switch "falls" open.**

Failure to comply to the above procedures may result in damage or fire to equipment, and/or injury or death to personnel.

WARNING NOTE 2: Verify Proper System Grounding.

Refer to the "Grounding" section under "Installation wiring diagrams for 115 VAC, 15A maximum primary MSO power supply" on page 15 of the MSO Technical Manual

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Chart 1: Preliminary Lamp Test & Battery Load Check (Sheet 1 of 2)

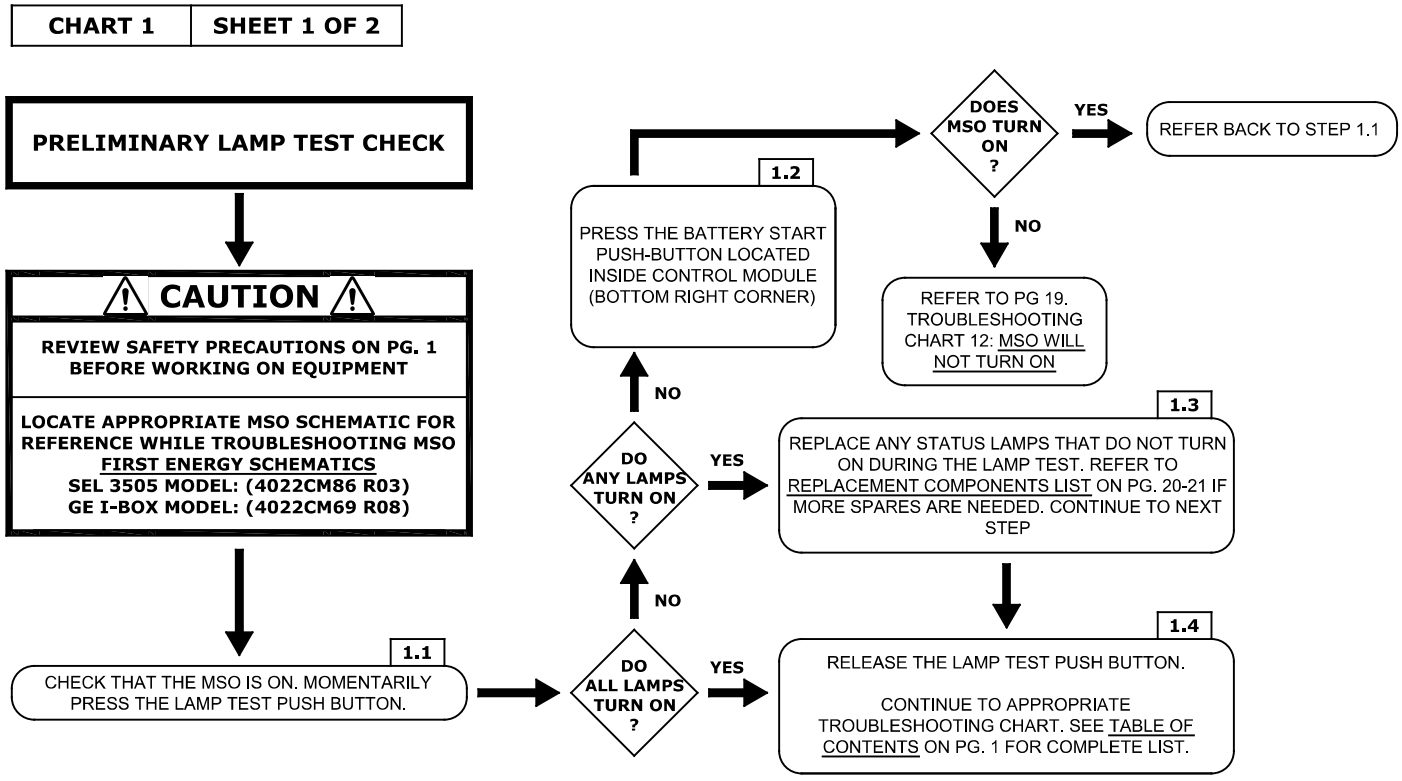


Chart 1: Preliminary Lamp Test & Battery Load Check (Sheet 2 of 2)

CHART 1 | **SHEET 2 OF 2**

BATTERY LOAD CHECK

1.5

USING A DC CLAMP METER, SET THE DIAL TO READ DC CURRENT, THEN APPLY THE CLAMP METER FORKS AROUND THE POSITIVE (+) BATTERY CABLE.

CLAMP METERS USUALLY HAVE AN ARROW PRINTED NEAR THE FORKS TO INDICATE CURRENT POLARITY, WHICH THE DIRECTION THE ARROW IS POINTING THE METER WILL READ AS POSITIVE CURRENT FLOW.

IT IS RECOMMENDED TO ORIENT THE ARROW IN THE DIRECTION POINTING AWAY FROM THE BATTERY, THIS WAY A POSITIVE READING WILL INDICATE THE BATTERY IS SUPPLYING CURRENT HENCE POWERING THE MSO AND A NEGATIVE READING INDICATES THE BATTERY IS BEING SUPPLIED CURRENT HENCE CHARGING.

CLAMP METER VALUE

NEGATIVE VALUE → BATTERY IS CONNECTED TO THE MSO.

CURRENT IS BEING SUPPLIED TO THE BATTERY.

INDICATES POWER SUPPLY IS CONNECTED, OPERATIONAL, AND CHARGING THE BATTERY.

BETWEEN 0A & 0.2A → NO LOAD PRESENT ON BATTERY.

BATTERY IS EITHER DISCONNECTED OR MSO IS OFF.

BETWEEN 2.5A & 22A → **ABNORMAL CURRENT LOAD.**

CONSULT MPS ENGINEERING DEPT. FOR TECHNICAL SUPPORT.

BETWEEN 0.3A & 2.2A → **BATTERY IS CONNECTED, MSO IS ON AND IN IDLE STATE.**

POWER SUPPLY EITHER NOT OPERATIONAL, 120 VAC NOT CONNECTED, OR 120 VAC INPUT FUSE (F1) BLOWN.

BETWEEN 24A & 27A → **MSO IN BATTERY TEST MODE. SHOULD NOT LAST LONGER THAN 5 SEC. BEYOND 5 SEC. INDICATES BATTERY TEST "STUCK" OR 1TR RELAY "LATCHED ON". REFER TO PG. 16 TROUBLESHOOTING CHART 10: BATTERY TEST "STUCK" / "LATCHED" ON.**

FIG. 1

FIG. 2

FIG. 3

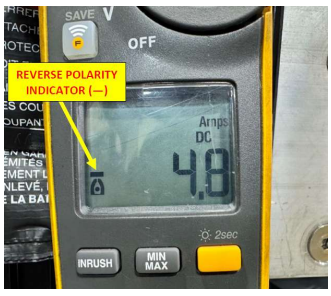


FIG. 4

FIG.1 DEMOSTRATES THE BEST WAY TO POSITION A CLAMP METER ON THE 12VDC BATTERY IN ORDER TO OBTAIN DC CURRENT MEASUREMENTS. THE BLUE ARROW ON THE CLAMP METER INDICATES THE DIRECTION THE METER WILL READ POSITIVE CURRENT FLOW.
FIG.2 DEMONSTRATES DC CURRENT VALUE FROM BATTERY INTO THE MSO WHILE THE MSO IS AT IDLE STATE AND 120 VAC DISCONNECTED BY OPENING FUSE **(F1).**
FIG.3 DEMONSTRATES THE DC CURRENT VALUE WHILE THE MSO IS IN "BATTERY TEST MODE".
FIG.4 DEMONSTRATES THE CURRENT FLOW WHEN (F1) FUSE IS CONNECTED, ALLOWING THE POWER SUPPLY TO CHARGE THE BATTERY. THE YELLOW ARROW POINTS TO THE REVERSE POLARITY SYMBOL WHICH INDICATES CURRENT IS FLOWING IN THE OPPOSITE DIRECTION IN REFERENCE TO THE BLUE ARROW IN **FIG.1.**

Chart 2: MSO Will Not Operate Using Open / Close Push Buttons (Sheet 1 of 2)

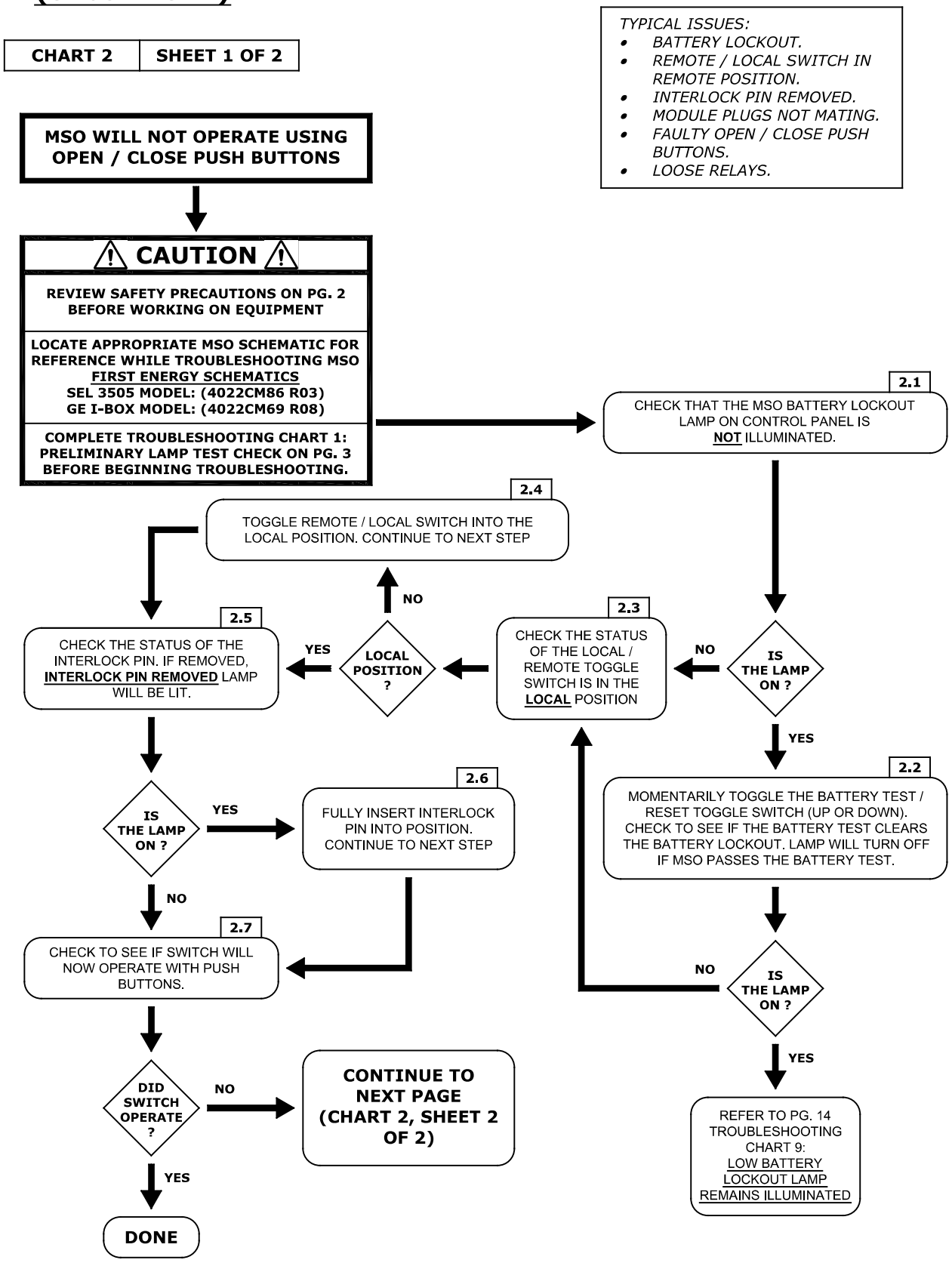


Chart 2: MSO Will Not Operate Using Open / Close Push Buttons (Sheet 2 of 2)

CHART 2	SHEET 2 OF 2

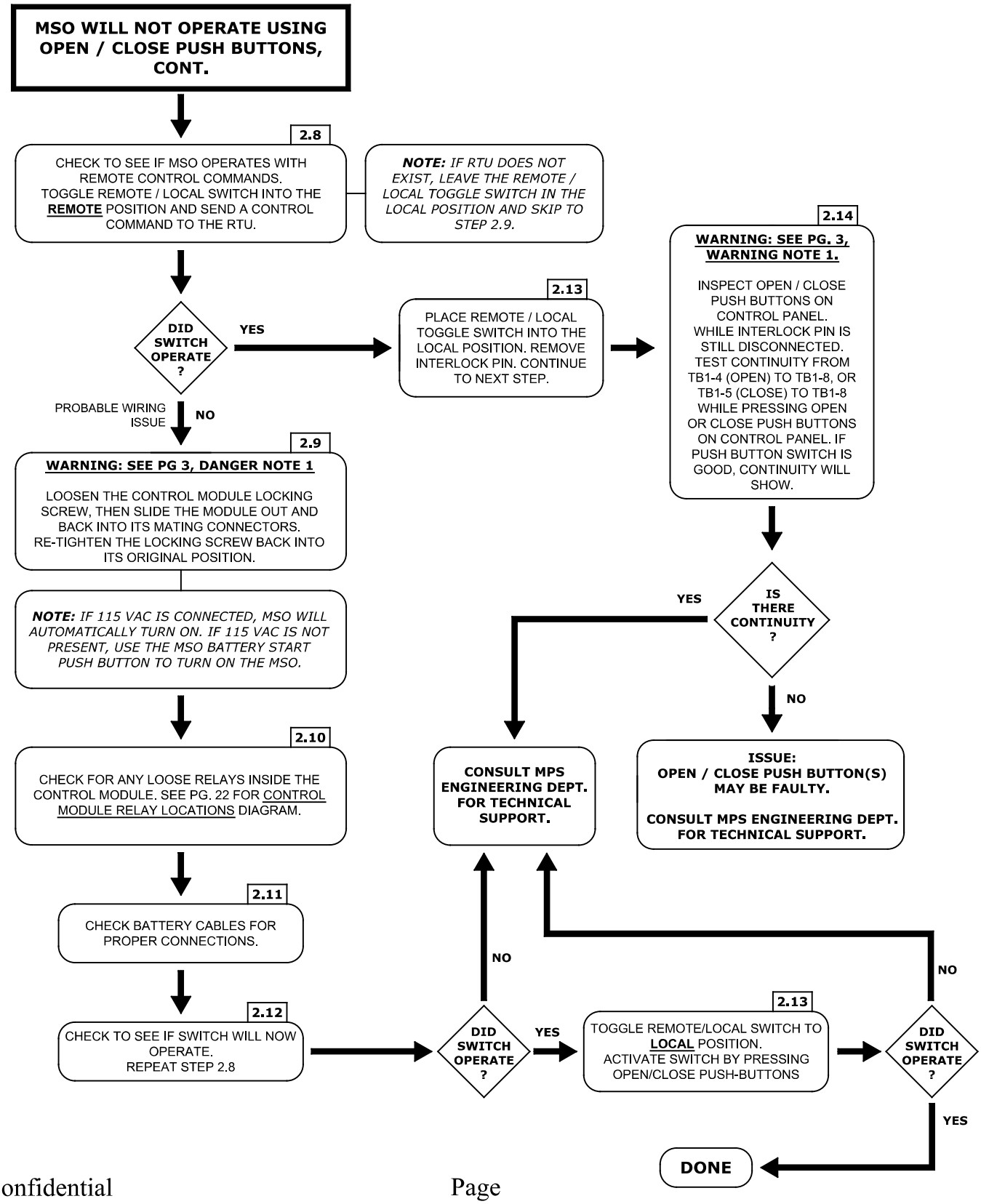


Chart 3: MSO Will Not Operate Using Remote Commands (Sheet 1 of 2)

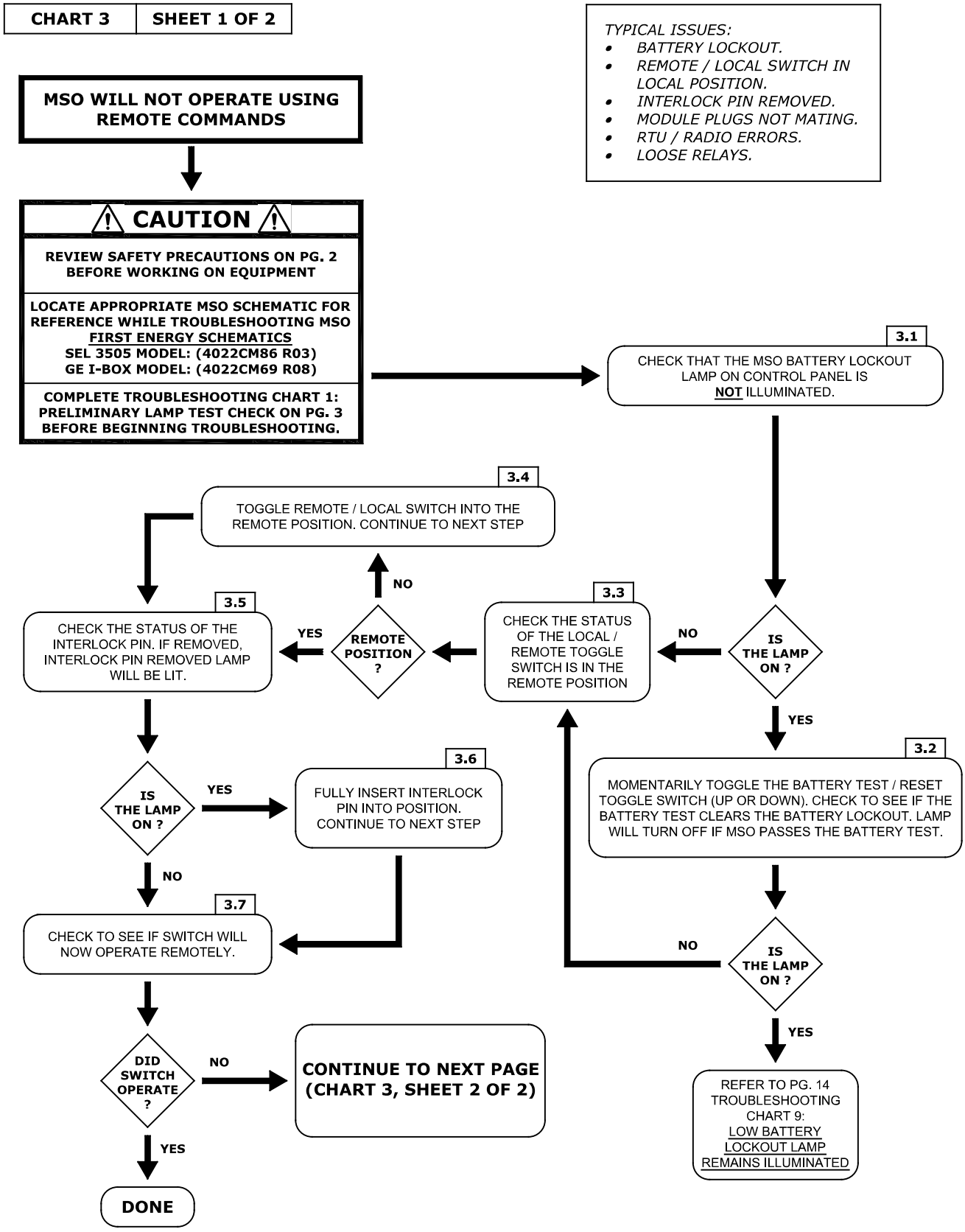


Chart 3: MSO Will Not Operate Using Remote Commands (Sheet 2 of 2)

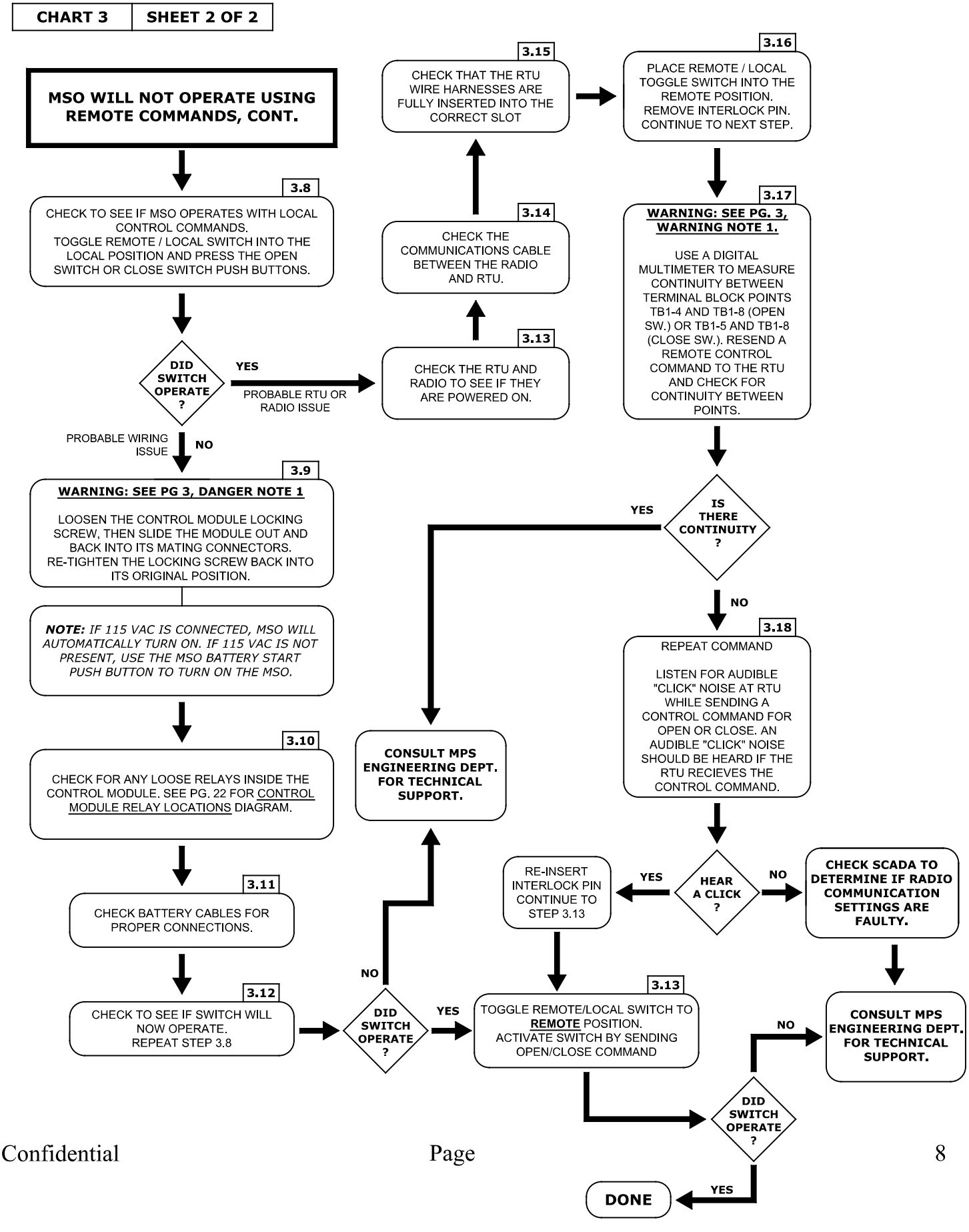


Chart 4: MSO has Stalled While Performing a Switch Operation (Sheet 1 of 1)

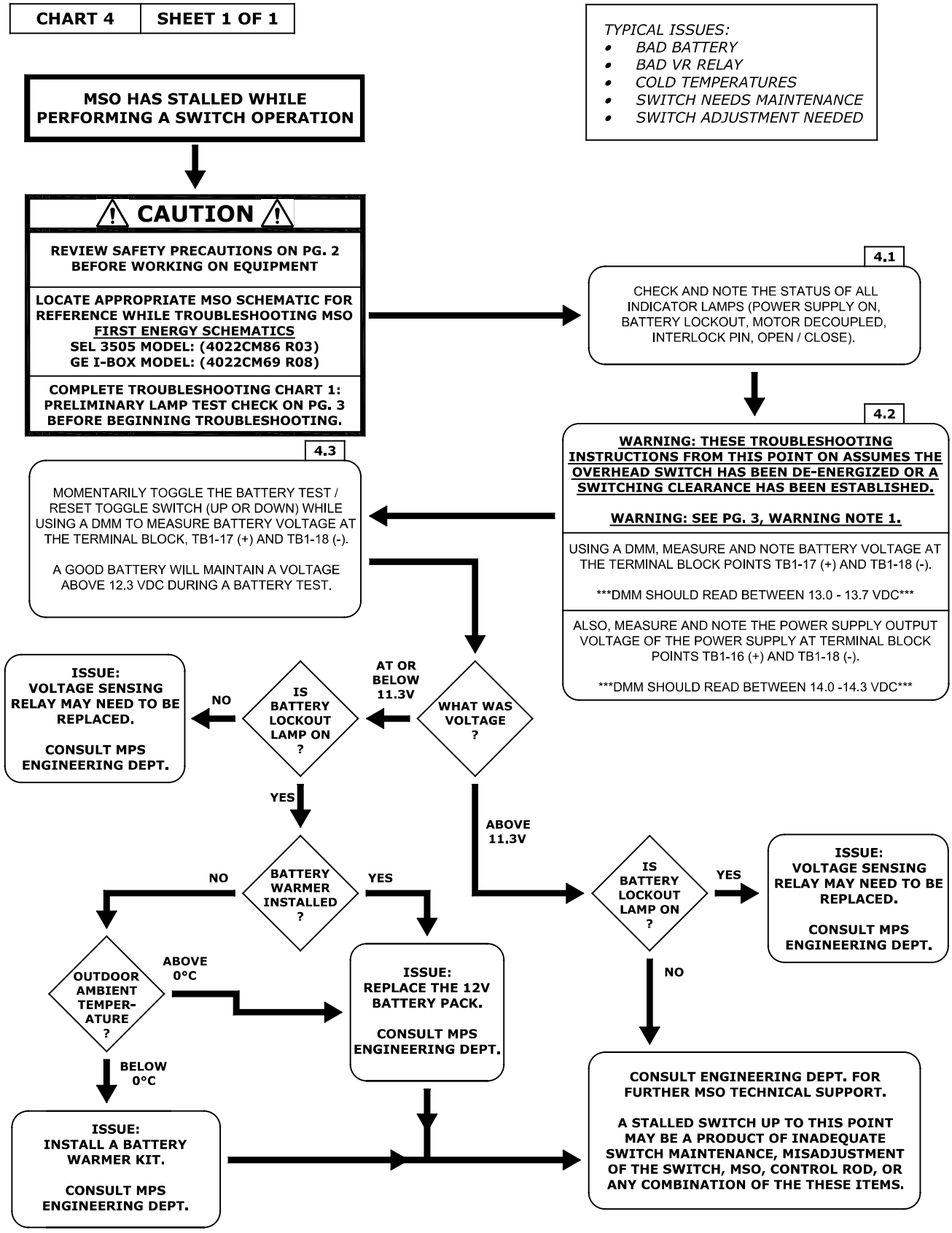


Chart 5: Power Supply Lamp Does Not Illuminate (Sheet 1 of 1)

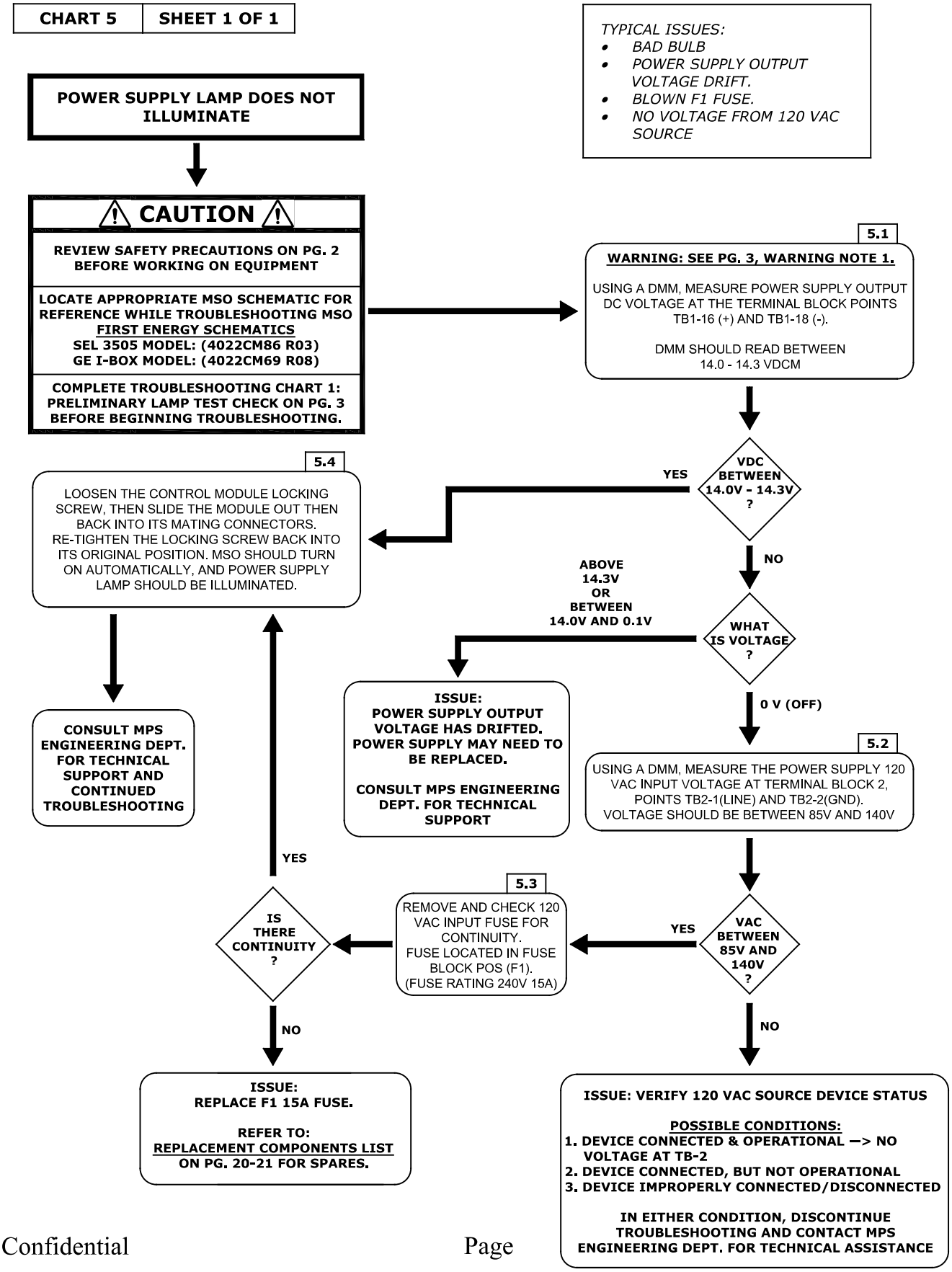


Chart 6: Interlock Pin Removed Lamp Remains Illuminated (Sheet 1 of 1)

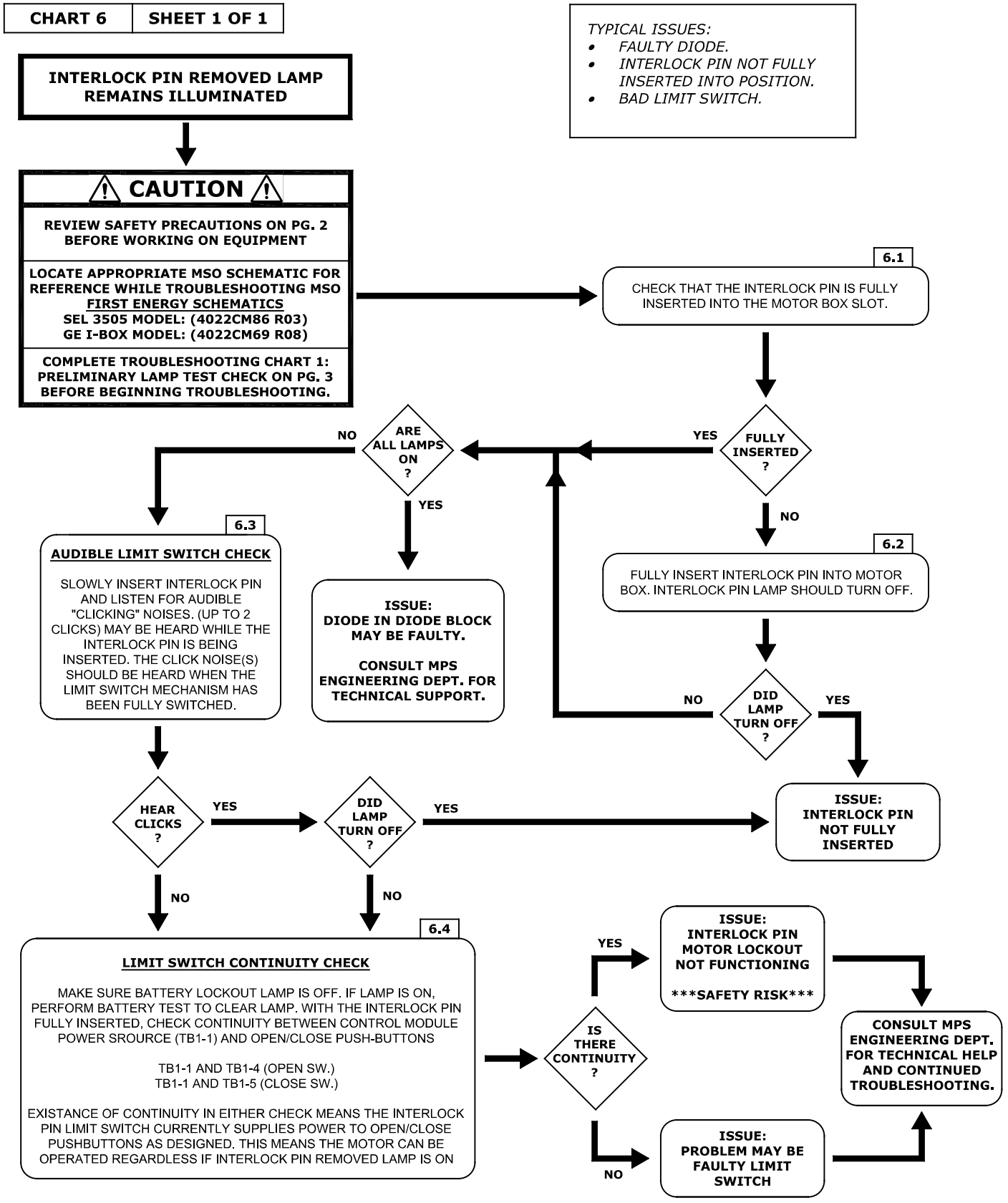


Chart 7: Motor Decoupled Lamp Remains Illuminated (Sheet 1 of 1)

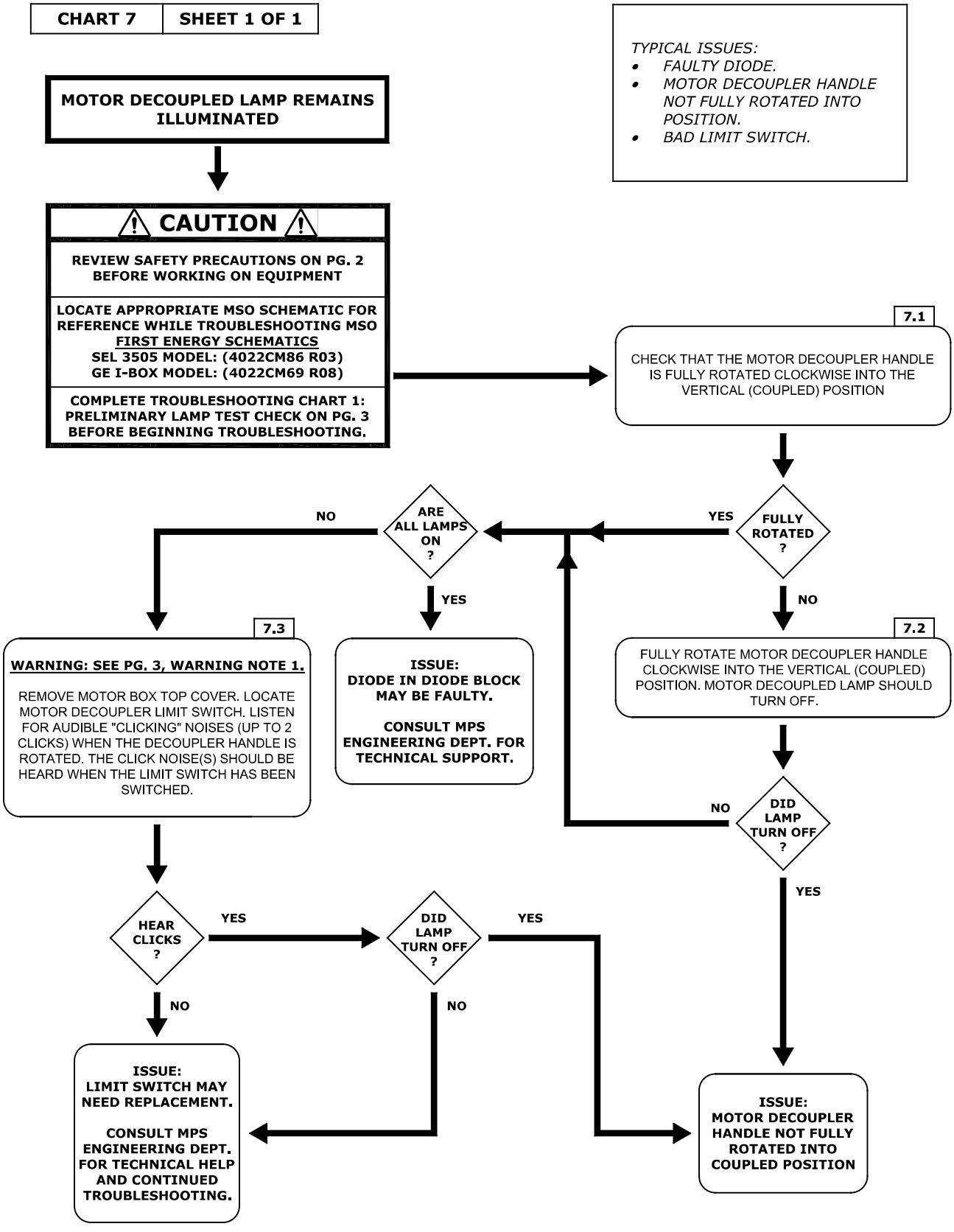


Chart 8: Open Switch and Closed Switch Lamps are BOTH Not Illuminated (Sheet 1 of 1)

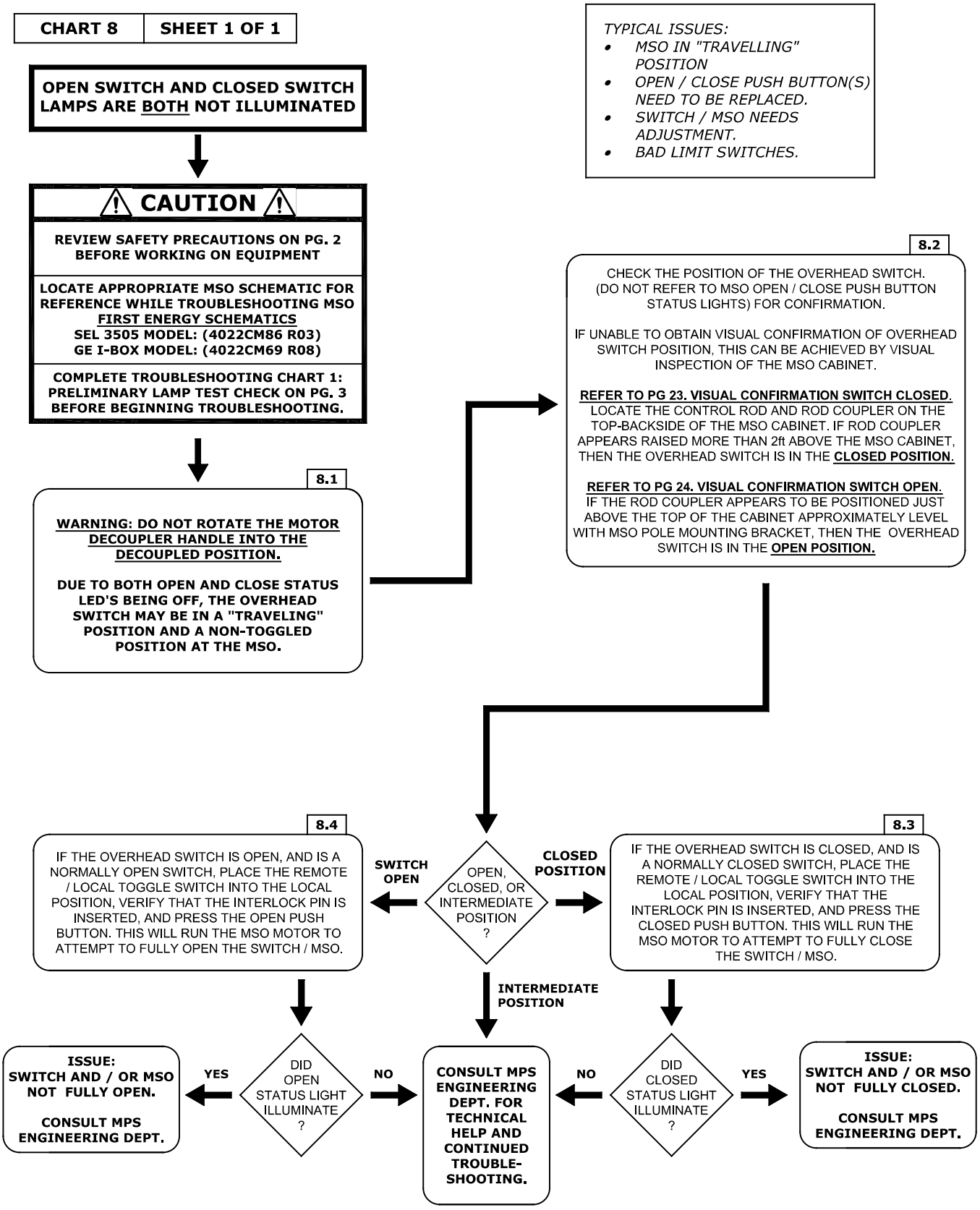


Chart 9: Low Battery Lockout Lamp Remains Illuminated (Sheet 1 of 2)

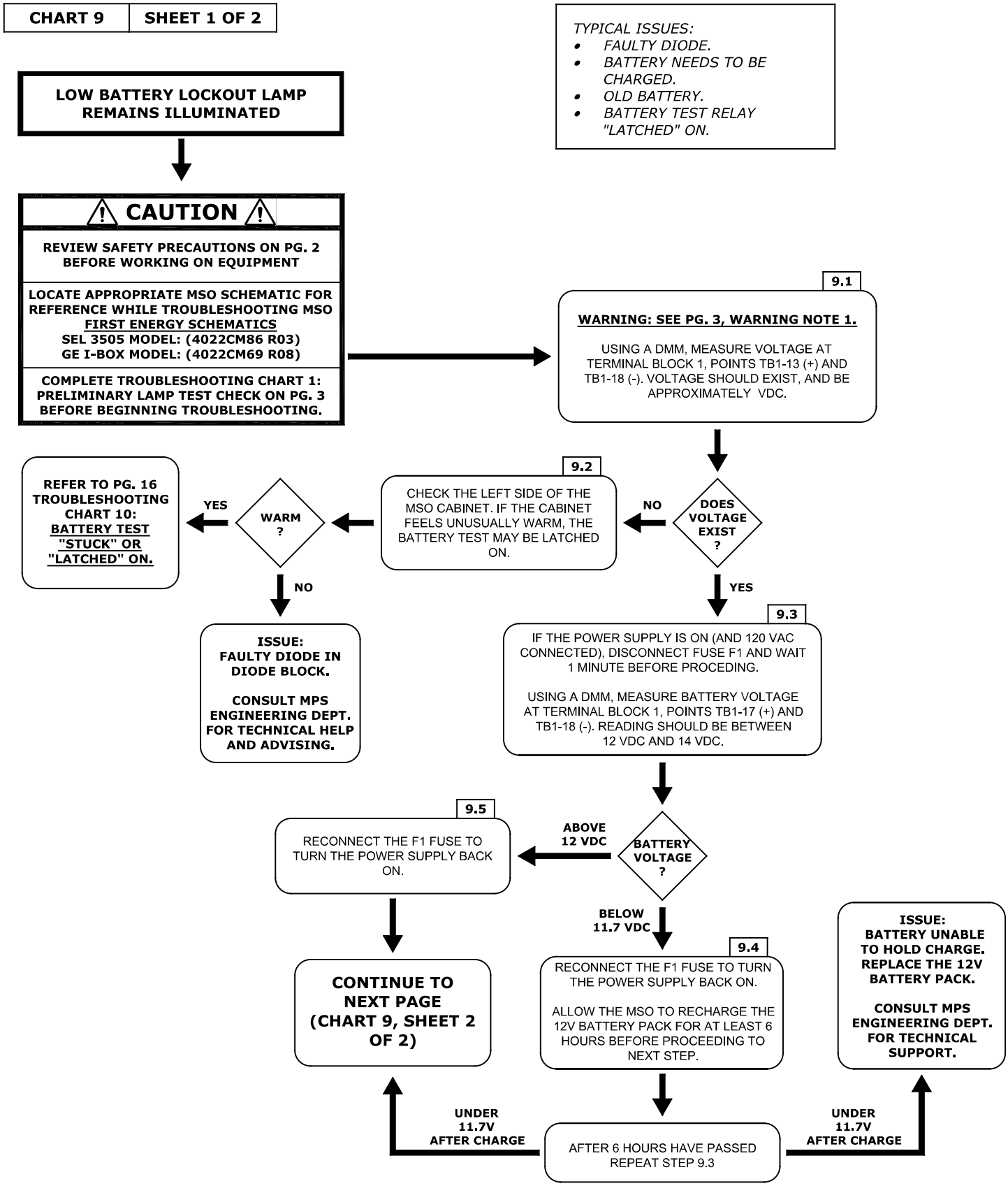


Chart 9: Low Battery Lockout Lamp Remains Illuminated (Sheet 2 of 2)

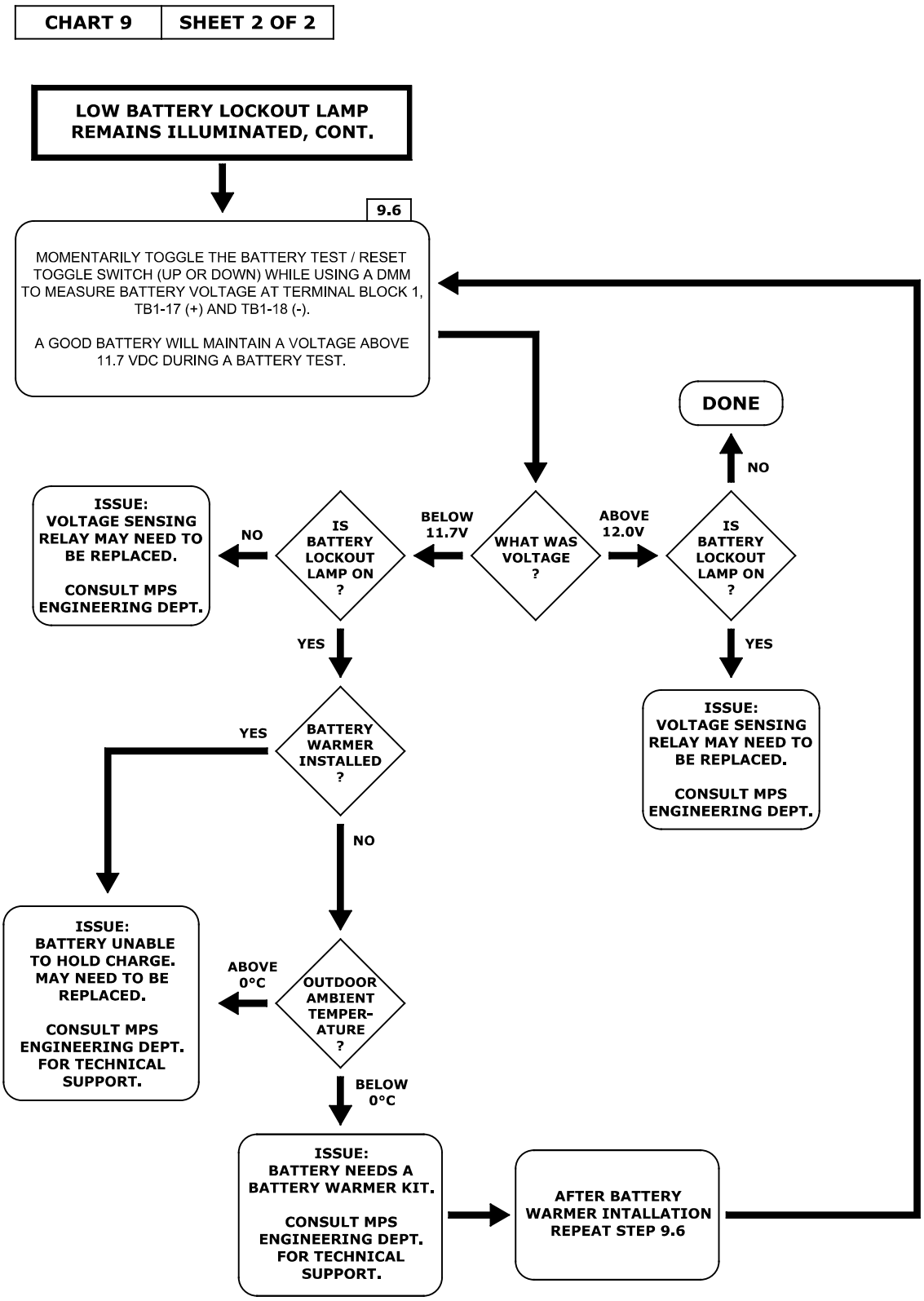


Chart 10: Battery Test "Stuck" or "Latched" On (Sheet 1 of 1)

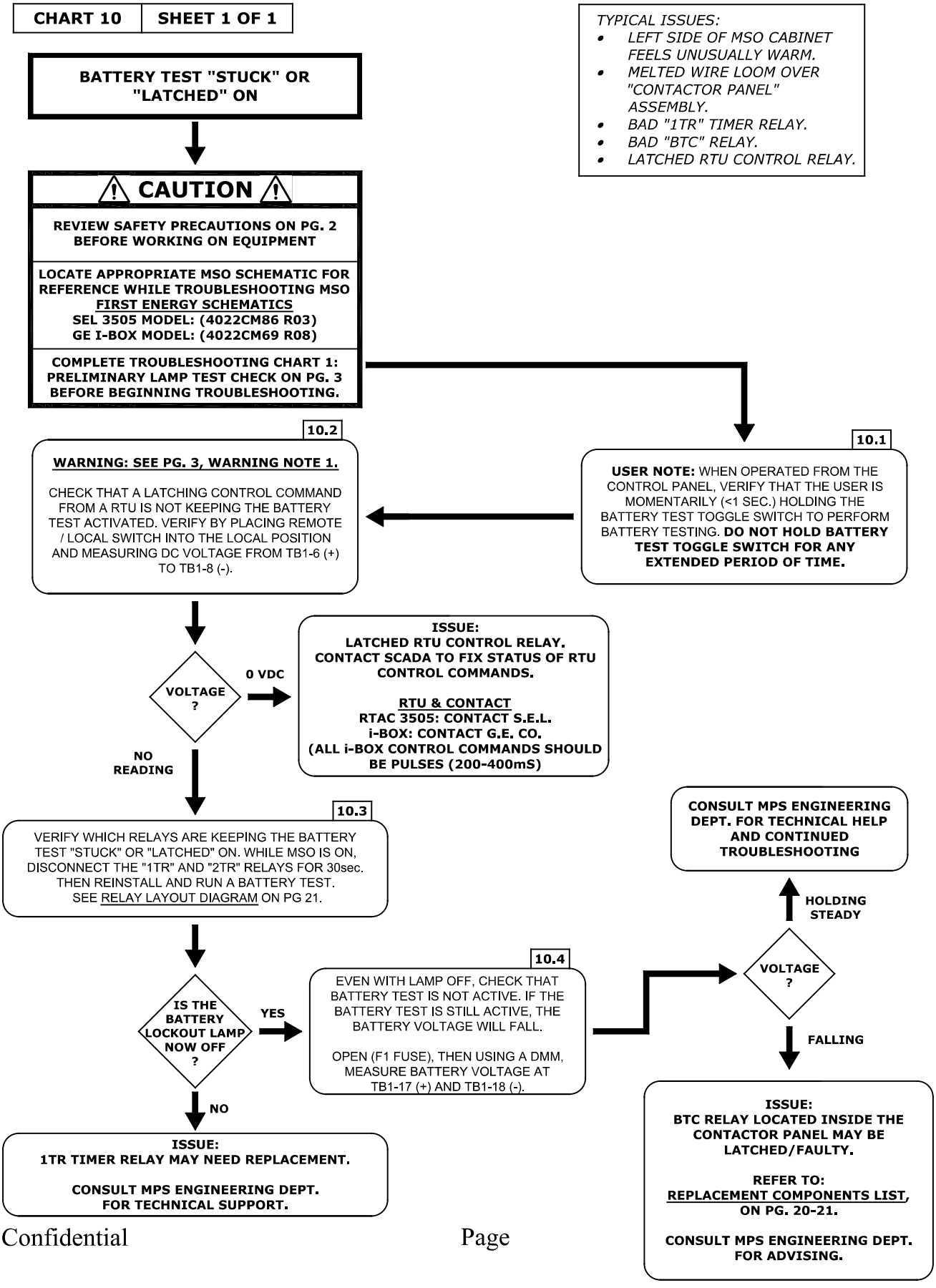


Chart 11: MSO Battery Not Charging (Sheet 1 of 2)

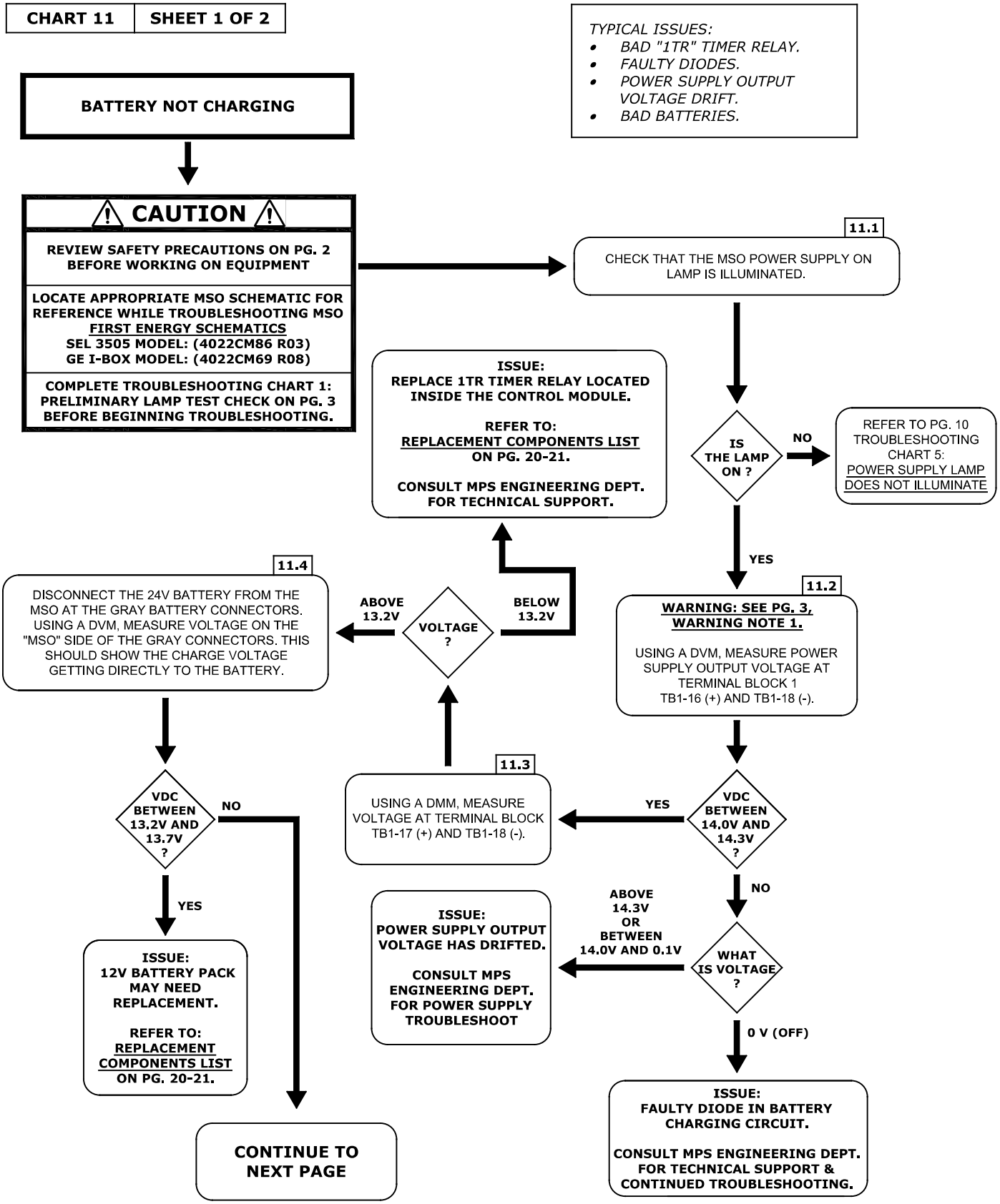


Chart 11: MSO Battery Not Charging (Sheet 2 of 2)

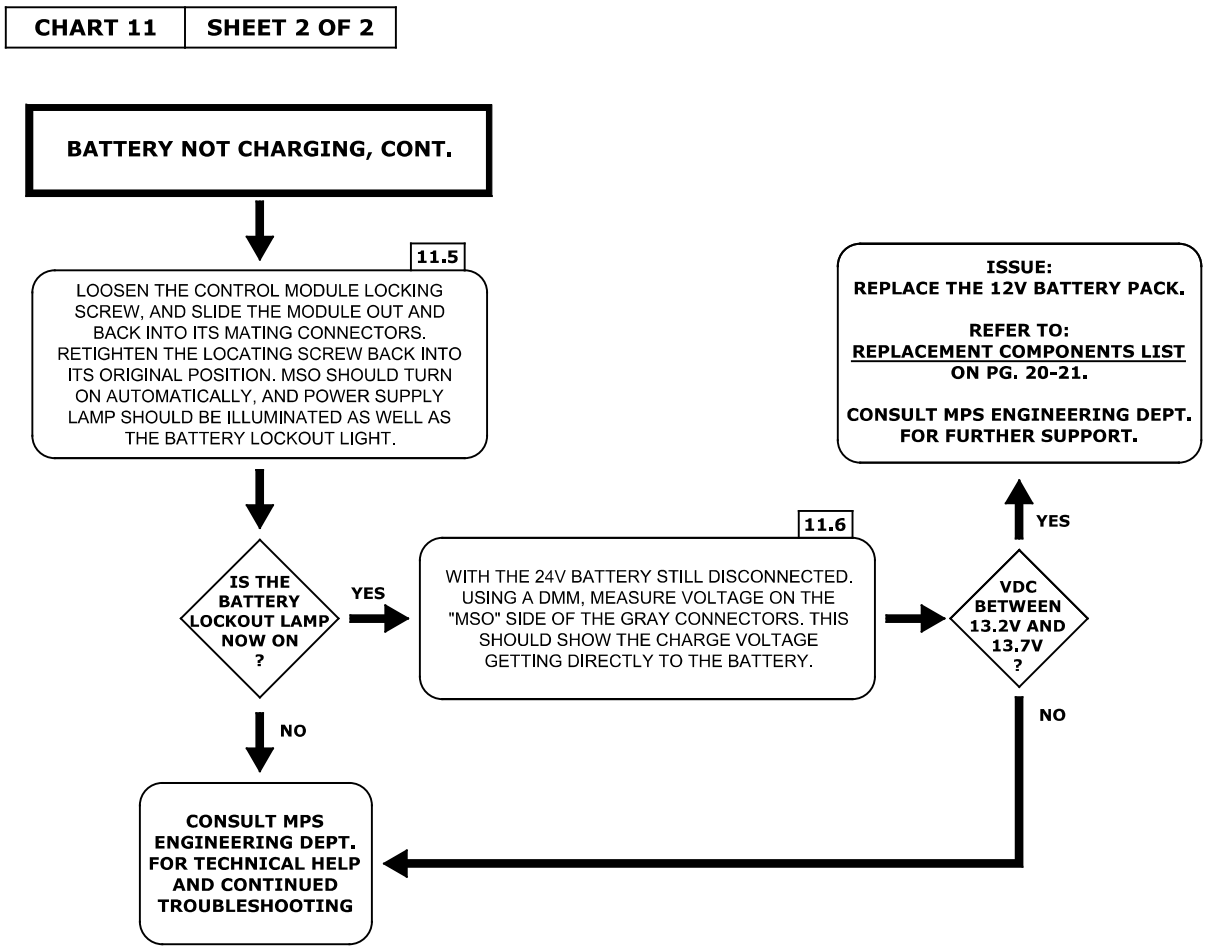
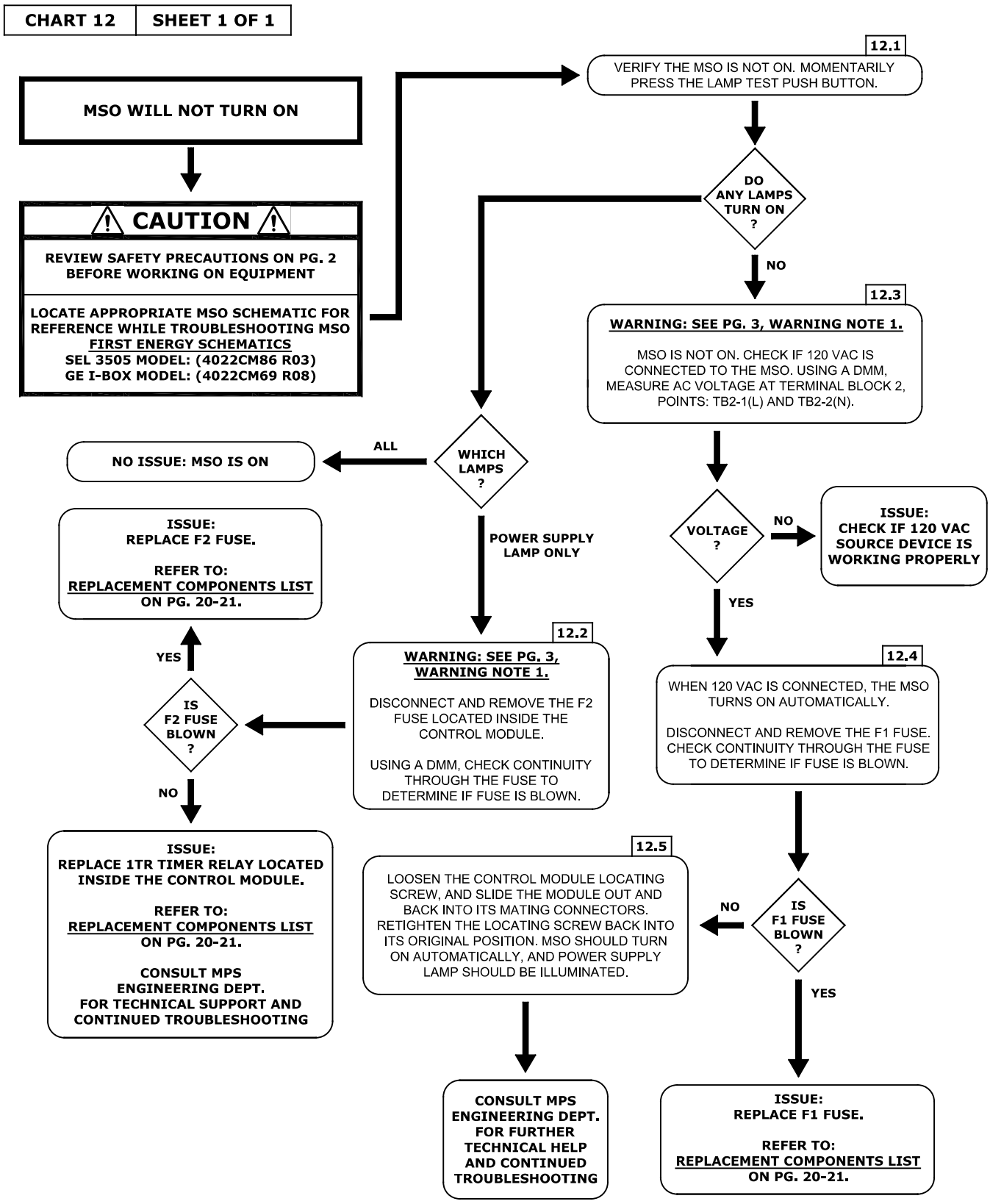


Chart 12: MSO Will Not Turn On (Sheet 1 of 1)



Replacement Components List (Sheet 1 of 2)

CONTROL MODULE

Catalog Number	Schematic Symbol	Description
4-102A	VR	VOLTAGE SENSING RELAY W/ TIME DELAY (12-30)VDC
412-30-0-028-00	1TR	TIME DELAY RELAY, OFF DELAY, 5 SEC. (**12V, OPTOCOUPLER**)
412-20-0-010-00	2TR	TIME DELAY RELAY, ON DELAY, 0.5 — 100 HR (12-125)VDC
4-223-12B	1CR, 2CR	TIME DELAY RELAY, INTERVAL ON, **MOTOR RUN** (12-125)VDC
4-95	3CR	RELAY, 4PDT (24V)
3-017	4CR	RELAY, SPDT (12V)
404-20-0-023-00	5CR/6CR	RELAY, DPDT (12V)
404-20-0-025-00	8CR	RELAY, SPDT (24V)
404-20-0-017-00	F1	FUSE, 15A 250V
404-20-0-019-00	F2/F3	FUSE, 10A 250V
404-20-0-018-00	F4	FUSE, 5A 250V
404-20-0-021-00	-	4CR / 8CR HOLDING CLIP
404-20-0-022-00	-	3CR / 5CR / 6CR HOLDING CLIP
404-20-0-115-00	-	POWER SUPPLY, 15V, 15A, 225W (**MEANWELL HEP-240-15A**)
4-459-12B	-	DC/DC BOOST CONVERTER, 12V TO 24V
4-392-8-1	-	RTU, SEL-3505 RTAC
4-98-15V225W-K	-	POWER SUPPLY RETROFIT ASSEMBLY KIT, (**MEANWELL HEP-240-15A**)

CONTROL PANEL

Catalog Number	Schematic Symbol	Description
406-20-0-010-00	IL1, IL2, IL3, IL4, IL6, IL7	28V LAMP (757)
4-448-12	IL5	12V LAMP (756)
4-293	PB1/PB2	(OPEN/CLOSE) PUSHBUTTON SWITCH, DPDT, RED LED
406-20-0-013-01	PB3	LAMP TEST PUSHBUTTON SWITCH, DPDT, NO LED
4-139	TM1/TM2	BATT. TEST/RESET TOGGLE SWITCH, MOMENTARY, SPDT
406-20-0-015-00	L/R	LOCAL/REMOTE TOGGLE SWITCH, DPDT
408-50-0-001-00	DS	DOOR SWITCH BRACKET/SPDT
4-292-1B	CO	OPEN/CLOSE CYCLE COUNTER
406-20-0-016-00	VAC	120VAC, SINGLE OUTLET, 3-PRONG RECEPTACLE
406-20-0-046-00	-	LAMP SOCKET COVER, RED
406-20-0-012-00	-	LAMP SOCKET COVER, AMBER
4-294	-	PUSHBUTTON CAP RED
4-295	-	PUSHBUTTON CAP GREEN
406-20-0-014-00	-	PUSHBUTTON CAP WHITE
4-53	-	(OPEN/CLOSE) PUSHBUTTON GUARD, CLEAR

*****Note: Consult factory for items not listed in the above table*****

Replacement Components List (Sheet 2 of 2)

CONTACTOR PANEL

Catalog Number	Schematic Symbol	Description
405-20-0-010-00	7CR/BTC	RELAY, SPDT, 30A (12V)
405-20-0-001-01	CAP BANK	SUPER CAPACITOR MODULE, 16V, 58F
405-20-0-008-00	CCR	CAPACITOR CHARGING RESISTOR, 100W, 2Ω
4-93-1	BTR1/BTR2	BATTERY TEST RESISTORS #1 & #2, 200W, 1Ω (EACH)
405-20-0-011-00	MC	MOTOR CONTACTOR RELAY, SPDT, 12V
405-30-0-004-00	CB1/CB2	CIRCUIT BREAKER ASSEMBLY, 12V, 40A
407-30-0-008-00	BW	BATTERY WARMER ASSEMBLY
MSO-BAT-OD12100	BATTERY	BATTERY PACK W/ CABLE ASSEMBLY, 12V, 100AH

MOTOR-BOX

Catalog Number	Schematic Symbol	Description
401-20-0-018-00	LSDI, LSIP, LSOP, LSCL	LIMIT SWITCH, DPDT
401-20-0-001-00	CH	STRIP HEATER 120VAC, 150W
401-20-0-016-00	TS1	STRIP HEATER THERMOSTAT
401-30-0-025-00	TB2	3 POS TERMINAL BLOCK ASSEMBLY, 120VAC INPUT
401-20-0-002-00	SP	SURGE PILLS
401-30-0-006-00	-	DECOUPLER HANDLE
M9-382F	-	INTERLOCK PIN W/ TAG ASSEMBLY

SUB-PLATE

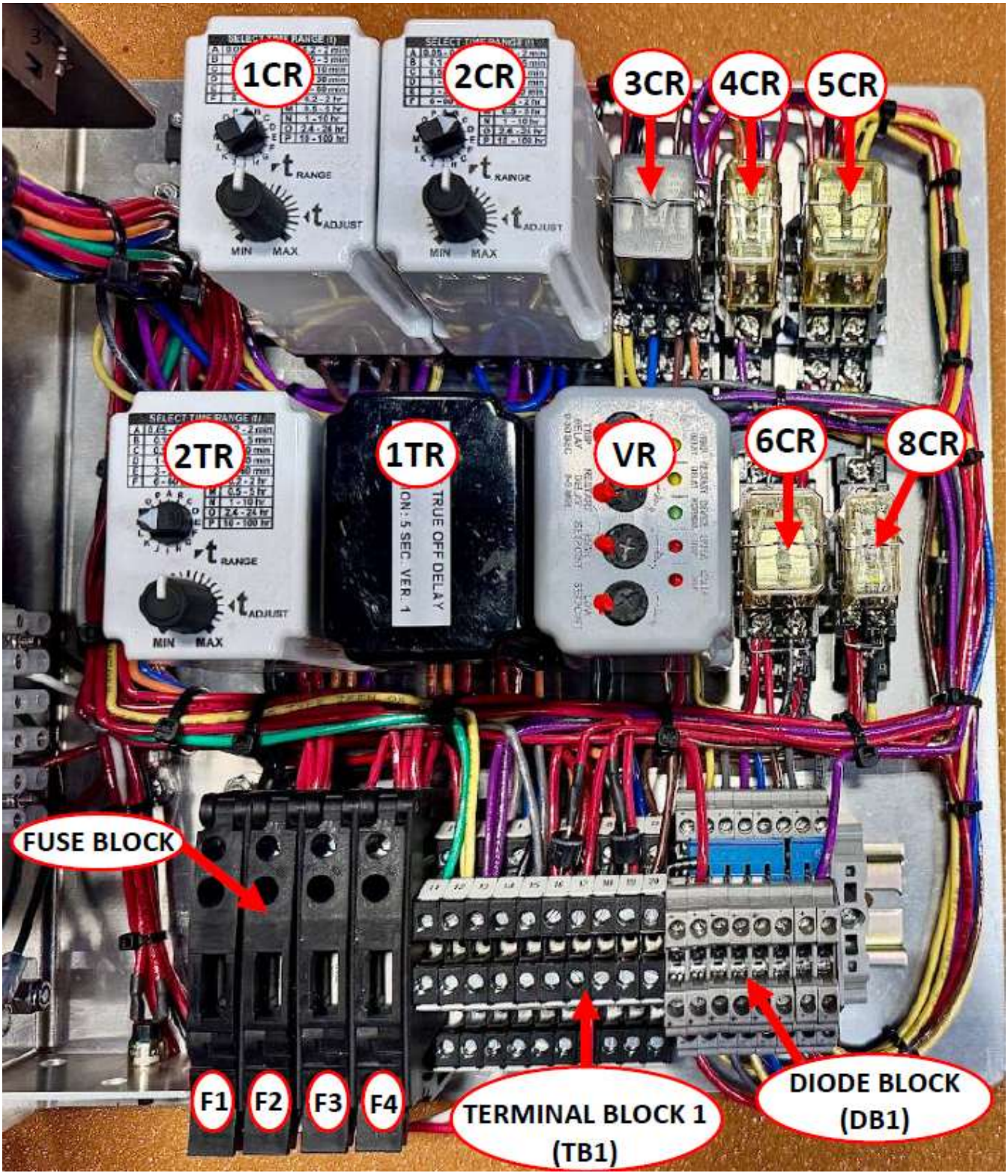
Catalog Number	Schematic Symbol	Description
4-648	F5/F6/F7/F8	FUSE, 250V, 2A, TIME DELAY

EXTERIOR

Catalog Number	Schematic Symbol	Description
50-4024BP	-	MSO MANUAL HANDLE, TRANSMISSION, 24" D-RING
MSO9-333SQ	-	CONTROL ROD ADJUSTER SCREW ASSY, 1.75" SQUARE F.G. 1" IPS COUPLER
408-20-0-001-00	-	MSO CABINET DOOR HANDLE, SS

*****Note: Consult factory for items not listed in the above table*****

Relay Layout Diagram



Notes:

1. If your control module relays do not look like what is shown in this picture, contact the factory.
2. Refer to the MSO Schematic supplied with your MSO for full relay names.

VISUAL CONFIRMATION SWITCH (CLOSED)

VISUAL CONFIRMATION SWITCH (OPEN)

Notes

Notes