SECTION 5
SERVICE

5.1 GENERAL

This section provides calibration, troubleshooting, and removal and replacement instructions for the equipment.

5.2 TEST AND CALIBRATION PROCEDURES

5.2.1 GENERAL

This paragraph provides calibration and test procedures for the equipment. Unless otherwise indicated, all test and calibration procedures are performed under the following conditions:

IMPORTANT:

- Systems with Series 00 Power Modules: The test and calibration procedures must be performed when either the Power Module or Controller is repaired or replaced. The only exception to this rule is when the two units are replaced with a set of units known to have been calibrated as a matched pair.

- Systems with Series 01 Power Modules: The Controllers and Power Modules in these systems may be interchanged without recalibration if the Controller had originally been calibrated to operate with a Series 01 Power Module; otherwise, recalibration is required.

1. THE EQUIPMENT IS CONNECTED TO A PRIMARY POWER SOURCE of the correct voltage and frequency. (Refer to data tags.)

2. AMBIENT TEMPERATURE FOR TEST and calibration is 24.0°C ± 3.0°C (75.0°F ± 5.0°F).

5.2.2 TEST EQUIPMENT REQUIRED

The following test equipment is required for test and/or calibration. Equivalent test equipment may be substituted.

- Variac - General Radio Model W5MT3A (100V and 110/120V models)
- Variac - General Radio Model W20HMT3A (220/240V models)
- Digital Voltmeter - Fluke 8000A
- Extender Board - Air-Shields Part No. 78 319 70
- Oscilloscope - Tektronix 561A
- Extension Ribbon Cable - Air-Shields Part No. 78 319 20
- Probe Simulator - Air-Shields Part No. 68 900 80

NOTE: Probe Simulator Part No. 68 900 80 is also used for test and calibration of the Model C100 Infant Incubator.

5.2.3 POWER MODULE CALIBRATION PROCEDURE

IMPORTANT: This calibration procedure applies only to the Series 01 Power Module. The Series 00 Power Module has no adjustments.

TEST HOOKUP

1. REMOVE THE POWER MODULE from the Warmer Housing (refer to paragraph 5.4.2 and Figure 5.1).

2. REFER TO FIGURE 7.1A and connect jumper wires to the Power Module as follows.

   J2-9 to J2-21
   J2-7 to J2-19
   J2-11 to J2-23
   This replaces the connections normally supplied by the WARMER switch.

3. CONNECT LINE VOLTAGE TO THE POWER MODULE using a Variac, Adjust the input voltage as follows:

   110/120V Power Module; 115 VAC ± 1.0 VAC
   220/240V Power Module; 230 VAC ± 1.0 VAC
   100V Power Module; 100 VAC ± 1.0 VAC

PROCEDURE

1. CONNECT A DIGITAL VOLTMETER between TP1 and TP4 (ground) and adjust R6 for a reading of +12.6V ± 50mV.

2. CONNECT A DIGITAL VOLTMETER between TP2 and TP4 (ground) and adjust R9 for a reading of +5.0V ± 50mV.

3. CONNECT A DIGITAL VOLTMETER between TP3 and TP4 (ground) and adjust R12 for a reading of -12.0V ± 50mV.

4. REINSTALL THE POWER MODULE in the Warmer Housing.

5.2.4 CONTROLLER CALIBRATION PROCEDURE

IMPORTANT:

- When calibrating the Controller, all adjustment procedures must be performed in the order given to obtain correct results.

- If any procedure cannot be completed, refer to the appropriate troubleshooting information given in paragraph 5.3.

TEST HOOKUP

1. REMOVE THE CONTROLLER from the Mounting Post (refer to paragraph 5.4.3).

2. REMOVE PCB3 from the Controller and reinstall using Extender Board, Part No. 78 319 70 to provide access to test points and adjustments.

3. USING EXTENSION RIBBON CABLE, part no 78 319 20, reconnect the Controller to the interconnecting ribbon cable (item 2, Figure 5.2).

4. CONNECT THE PROBE SIMULATOR part no. 68 900 80 to the PATIENT PROBE jack on the Controller.

5. CONNECT LINE VOLTAGE to the Power Module using a Variac. Adjust the line voltage as follows:

   110/120V Power Module; 115 VAC ± 1.0 VAC
   220/240V Power Module; 230 VAC ± 1.0 VAC
   100V Power Module; 100 VAC ± 1.0 VAC

6. SET THE WARMER SWITCH on the Warmer Housing to the ON-1 position.

ANALOG CALIBRATION

1. CONTROL VOLTAGE ADJUSTMENT

   A. Set the CONTROL MODE switch on the Controller to SKIN position, the SKIN indicator should light.

   B. Set the SKIN TEMP.°C thumbwheel switches on the Controller to 36.0°C.

   C. Set the control switch on the Probe Simulator to SKIN and the °C switch to 36.0°C.

   D. Connect a digital voltmeter to J3-12 on PCB3 (Figure 5.2); the ground connection is J-3,4.

   E. Adjust potentiometer R2 on PCB2 (Figure 5.2) until the digital voltmeter reads 0.0 ± 0.05 VDC.

DISPLAY CALIBRATION

1. OFFSET ADJUSTMENT

   A. Set the CONTROL MODE switch on the Controller to MANUAL position, the MANUAL indicator should flash continuously.

   B. Set the °C switch on the Probe Simulator to 25.0°C.

   C. Adjust potentiometer R2 on PCB1 (Figure 5.2) until the digital display indicates 25.0°C.

2. GAIN ADJUSTMENT

   A. Set the °C switch on the Probe Simulator to 36.0°C.

   B. Adjust potentiometer R7 on PCB1 (Figure 5.2) until the digital display indicates 36.0°C.

NOTE: It may be necessary to repeat the Offset and Gain Adjustments to obtain accurate results.

CONTROL CIRCUIT CALIBRATION

1. LINE VOLTAGE ADJUSTMENT

   A. Set the CONTROL MODE switch on the Controller to SKIN position, the SKIN indicator should light.

   B. Set the SKIN TEMP. °C thumbwheel switches on the Controller to 36.4°C.

   C. Set the °C switch on the Probe Simulator to 36.0°C.

   D. Connect a digital voltmeter to J3-14 on PCB3 (Figure 5.2); the ground connection is J3-3,4.

   E. Adjust line voltage until digital voltmeter indicates 23.3 ± 0.02 VDC.

   F. Connect a digital voltmeter to J3-25 on PCB3 (Figure 5.2); the ground connection is J3-3,4.

   G. Adjust potentiometer R6 on PCB3 until the digital voltmeter indicates +1.80 ± 0.05 VDC with full heater power.

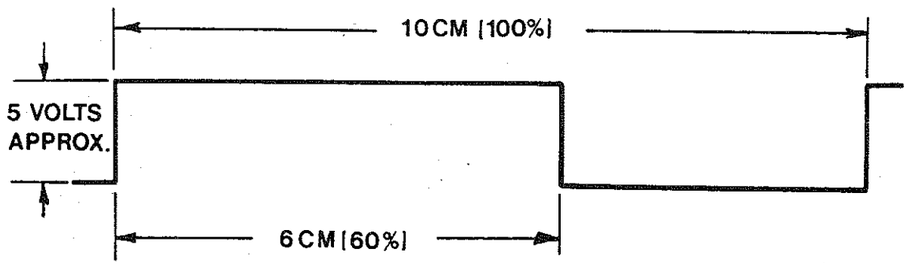
H. Readjust the line voltage as follows:

110/120V Models; 115 ± 1.0 VAC
220/240V Models; 230 ± 1.0 VAC
100V Models; 100 ± 1.0 VAC

2. DUTY CYCLE ADJUSTMENT

A. Set the SKIN TEMP °C thumbwheel switches on the Controller to 36.0°C.

B. Connect an oscilloscope to J3-11 on PCB3 and adjust potentiometer R14 on PCB3 (Figure 5.2) for a duty cycle of 60% as shown below.



5.2.5 PERFORMANCE CHECKS - SKIN CONTROL MODE

TEST CONDITIONS

1. SET THE WARMER SWITCH on the Warmer Housing to the OFF-O position.

2. REMOVE THE EXTENDER BOARD from the Controller and disconnect the extension ribbon cable.

3. REINSTALL PCB3 in the Controller, reconnect the Controller to the Power Module, and reinstall the Controller in the Mounting Post (Figure 5.2).

4. SET THE CONTROL MODE SWITCH on the Controller to SKIN position.

5. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C.

6. CONNECT THE PROBE SIMULATOR, Part No. 68 900 80 to the PATIENT PROBE jack on the Controller; set the control switch to SKIN and the °C switch to 36.0°C.

START-UP SEQUENCE

1. SET THE WARMER SWITCH ON THE WARMER HOUSING to the ON-1 position.

   NOTE: During the automatic test sequence, disregard other extraneous displays or indications which may occur within this sequence.

   A. The SKIN TEMP °C digital display should display all eights (88.8).

   B. All HEATER power indicators should light.

   C. After a short delay, the displays blank, the PROBE FAIL and SET POINT alarm indicators light and the audible alarm sounds and then stops.

   D. After a short delay, the PROBE FAIL and SET POINT indicators light again, the audible alarm sounds, and the HEATER power indicators go out.

   When the PROBE FAIL and SET POINT alarms stop the automatic test sequence is complete.

SKIN TEMPERATURE DISPLAY

1. SET THE PROBE SIMULATOR to 25.0°C, 36.0°C and 40.0°C; the SKIN TEMP °C display should be accurate to within ± 0.1°C for all settings.

2. DEPRESS THE CAL CHECK SWITCH; the SKIN TEMP display should indicate 36.0 ± 0.1°C to indicate that the unit is calibrated.

HEATER LEVEL

1. SET THE °C SWITCH ON THE Probe Simulator to 36.°C.

2. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C; two or three HEATER level indicators should be illuminated.

3. PROBE FAILURE ALARM (SHORTED)

   A. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C and the °C switch on the Probe Simulator to 36°C; the digital display should indicate 36.0°C.

   B. SET THE °C SWITCH on the Probe Simulator to SHORT. The digital display should blank continuously or intermittently.

   C. AFTER A 14 to 20 SECOND DELAY, a continuous alarm should sound, the PROBE FAIL and SET POINT indicators should flash, and HEATER indicators should be off. This alarm condition cannot be reset until the alarm condition is corrected.

   D. TO RESET THE CIRCUIT, set the °C switch on the Probe Simulator to 36°C and depress the SILENCE/RESET switch; the unit should return to normal operating condition.

4. PROBE FAILURE ALARM (OPEN)

   A. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C and the °C switch on the Probe Simulator to 36°C; the digital display should indicate 36.0°C.

   B. SET THE °C SWITCH on the Probe Simulator to OPEN. The digital display should blank continuously or intermittently.

   C. AFTER A 14 TO 20 SECOND DELAY, a continuous alarm should sound, the PROBE FAIL and SET POINT indicators should flash, and HEATER indicators should be off. This alarm condition cannot be reset until the alarm condition is corrected.

   D. TO RESET THE CIRCUIT, set the °C switch on the Probe Simulator to 36°C and depress the SILENCE/RESET switch; the unit should return to normal operating condition.

PROBE FAILURE ALARM (HIGH SKIN TEMPERATURE (39.0°C))

1. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C and the °C switch on the Probe Simulator to 40.0°C.

2. AFTER A 14 TO 20 SECOND DELAY, a continuous alarm should sound, the SET POINT AND PROBE FAIL indicators should flash, and all HEATER indicators should be off. This alarm condition cannot be reset until the alarm condition is corrected.

3. TO RESET THE CIRCUIT, set the °C switch on the Probe Simulator to 36°C and depress the SILENCE/RESET switch; the unit should return to normal operating condition.

HIGH SKIN TEMPERATURE MODEL CM78-1

1. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C, the control switch on the probe simulator to SKIN, and the °C switch on the probe simulator to 36.0°C; the digital display should indicate 36.0°C and the alarms should not be activated. Typically, two heater indicators should be lit.

2. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 35.3°C. All heater indicators should be off.

3. AFTER A 14 TO 20 SECOND DELAY, a continuous alarm should sound, and the SET POINT indicator should flash. This alarm condition cannot be reset until the alarm condition is corrected.

4. TO RESET THE CIRCUIT, set the SKIN TEMP °C thumbwheel switches on the Controller to 36.0°C; and depress the SILENCE/RESET Switch; the unit should return to normal operating condition.

HIGH SKIN TEMPERATURE MODEL CM78-2

1. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C, the control switch on the probe simulator to SKIN, and the °C switch on the probe simulator to 36.0°C; the digital display should indicate 36.0°C and the alarms should not be activated. Typically, two heater indicators should be lit.

2. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 35.3°C. All heater indicators should be off.

3. AFTER A 14 TO 20 SECOND DELAY, a continuous alarm should sound, and the SET POINT indicator should flash.

4. TO RESET THE CIRCUIT, set the SKIN TEMP °C thumbwheel switches on the Controller to 36.0°C; the unit should return to normal operating condition.

LOW SKIN TEMPERATURE

1. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C, the control switch on the probe simulator to SKIN, and the °C switch on the probe simulator to 36°C; the digital display should indicate 36.0°C and the alarms should not be activated. Typically, two heater indicators should be lit.

2. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.7°C. All heater indicators should be lit.

3. AFTER A 14 TO 20 SECOND DELAY, a continuous alarm should sound and the SET POINT indicator should flash.

4. DEPRESS THE SILENCE/RESET SWITCH, the alarm should be silenced but the SET POINT indicator should continue to flash. All heater indicators should be lit.

5. SET THE SKIN TEMP °C THUMBWHEEL SWITCHES on the Controller to 36.0°C. The circuit should reset automatically and the SET POINT indicator should turn off. Typically, two heater indicators should be lit.

5.2.6 PERFORMANCE CHECKS - MANUAL CONTROL MODE

STANDARD ALARMS DISABLED CHECK

1. SET THE CONTROL MODE SWITCH on the Controller to MANUAL; the MANUAL indicator should flash on and off continuously.

2. CONNECT THE PROBE SIMULATOR to the PATIENT PROBE connector on the Controller; set the control switch to SKIN and the °C switch to OPEN. The digital display should show random numbers and blank intermittently or continuously.

3. WAIT AT LEAST 20 SECONDS, no visual or audible alarms should occur.

   NOTE: The standard alarms (except for POWER FAIL) are disabled when operating in manual mode.

15-MINUTE TIMER CHECK

1. SET THE CONTROL MODE SWITCH TO SKIN.

2. SET THE CONTROL MODE SWITCH TO MANUAL, the MANUAL indicator should flash on and off continuously indicating that the timer is running; begin measuring elapsed time.

   IMPORTANT: If the MANUAL indicator does not flash on and off continuously, the 15-minute timer is inoperative.

3. AFTER 9 TO 12 MINUTES TOTAL ELAPSED TIME, a one second duration beep (Manual Alert) should sound every 30 seconds; this indicates that the heater may be reset for an additional 15 minutes without the heater turning off. To check the reset circuitry, proceed as follows:

   A. Depress and hold the SILENCE/RESET switch for at least 2 seconds after the audible signal starts; this will allow time for internal circuitry to reset.

   B. After 9 to 12 minutes total elapsed time, a one second duration beep (Manual Alert) should sound every 30 seconds.

4. AFTER 13 TO 19 MINUTES ELAPSED TIME, a steady alarm should sound, the MANUAL indicator should go off and all HEATER indicators should turn off indicating that the manual heating period has ended.

5. DEPRESS THE SILENCE/RESET SWITCH for at least 2 seconds; this resets the circuitry and the complete cycle should repeat.

POWER FAILURE ALARM CHECK

1. DISCONNECT THE POWER CORD from the wall receptacle or Power Module; the POWER FAIL indicator should light and the alarm should sound continuously.

2. RECONNECT THE POWER CORD or set the WARMER ON-OFF switch to the OFF position to terminate the alarm.

5.3 TROUBLESHOOTING

5.3.1 GENERAL

Troubleshooting guides for the equipment are provided in paragraph 5.3.3 in the form of flowcharts. It is assumed that an attempt has been made to calibrate the equipment and that all cables are in good condition.

5.3.2 TEST EQUIPMENT REQUIRED

The test equipment listed below is required for troubleshooting the equipment. Equivalent test equipment may be substituted.

- Variac - General Radio Model W5MT3A (100V and 110/120V models)
- Variac - General Radio Model W20HMT3A (220/240V models)
- Digital Voltmeter - Fluke 8000A
- Extender Board - Air-Shields Part No. 78 319 70
- Oscilloscope - Tektronix 561A
- Extension Ribbon Cable - Air-Shields Part No. 78 319 20
- 2KΩ, 10W resistor (100V and 110/120V models)
- 4KΩ, 10W resistor (220/240V models)
- Probe Simulator - Air-Shields Part No. 68 900 80

NOTE: Probe Simulator Part No. 68 900 80 is also used for test and calibration of the Model C100 Infant Incubator.

5.3.3 TROUBLESHOOTING PROCEDURES

The following flowcharts are provided as an aid in localizing the cause of equipment malfunctions. The charts are intended for use in conjunction with the equipment theory of operation (Section 3) and the schematic diagrams (Section 7). It is assumed that the Operational Checkout Procedure (paragraph 2.5) has been performed, and that the Test and Calibration Procedures (paragraph 5.2.6) have been attempted.

When using the flowcharts, do not skip steps. The flowcharts have been designed to minimize the number of checks required to localize the problem area and isolate the defective component.

If the problem area is known, proceed directly to the appropriate flowchart; however, if the problem area cannot be immediately defined, first perform the Power Module output voltage test that follows.

POWER MODULE VOLTAGE TEST

TEST HOOKUP

1. REMOVE THE CONTROLLER from the Mounting Post (refer to paragraph 5.4.3).

2. REMOVE PCB3 from the Controller and reinstall using Extender Board, Part No. 78 319 70 to provide access to test points and adjustments.

3. USING EXTENSION RIBBON CABLE, part no. 78 319 20, reconnect the Controller to the Power Module.

4. CONNECT THE PROBE SIMULATOR part no. 68 900 80 to the PATIENT PROBE jack on the Controller and set the °C switch to 36.0°C.

5. SET THE °C THUMBWHEEL SWITCHES on the Controller to 36.0°C.

6. CONNECT LINE VOLTAGE to the Power Module using a Variac. Adjust the line voltage as follows:

   110/120V Power Module; 115 VAC ± 1.0 VAC
   220/240V Power Module; 230 VAC ± 1.0 VAC
   100V Power Module; 100 VAC ± 1.0 VAC

7. SET THE WARMER SWITCH on the Warmer Housing to the ON-1 position.

PROCEDURE

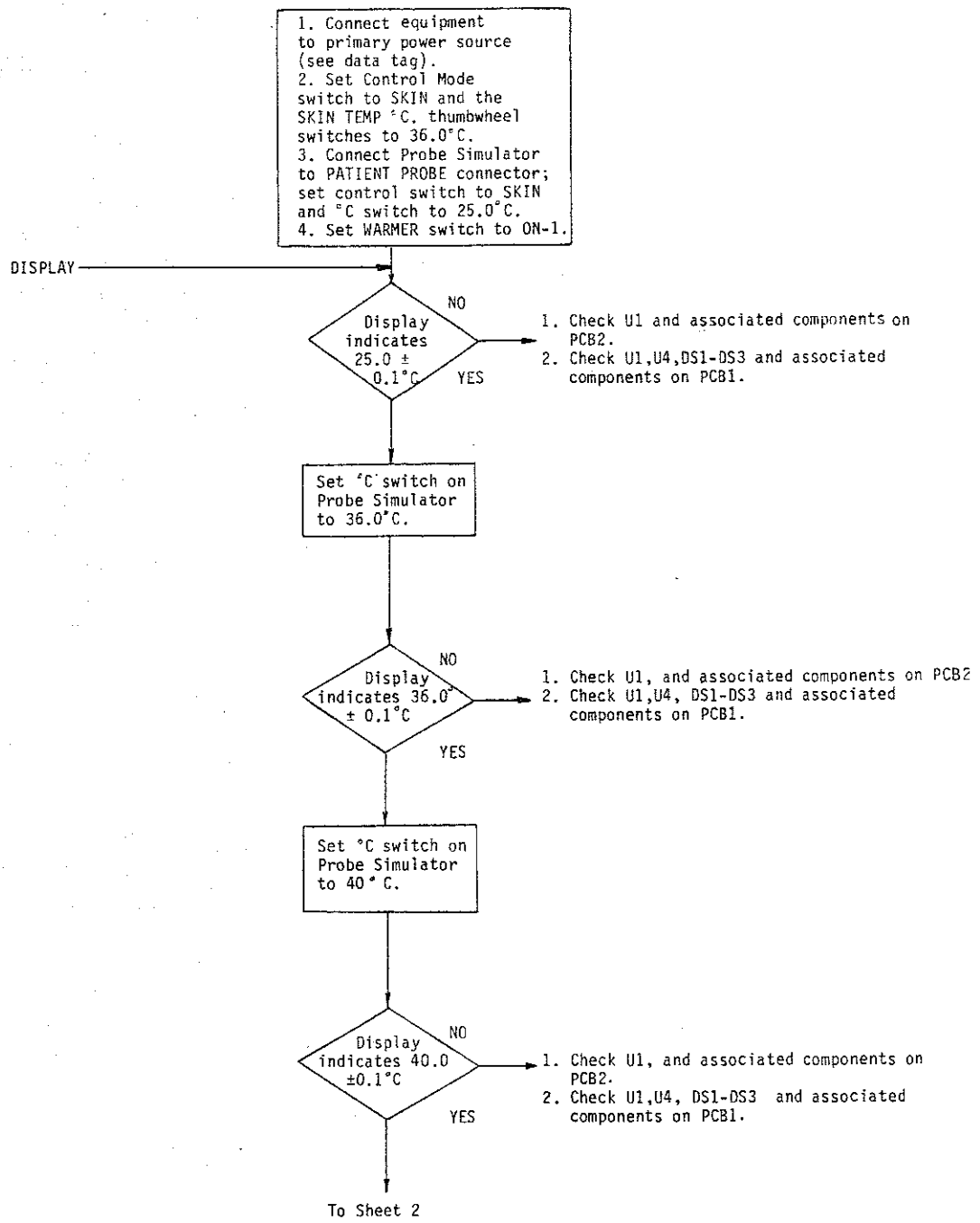
1. USING A DIGITAL VOLTMETER, check that the Power Module output voltages are within the limits indicated below. The test points are located on connector J3 of PCB3 in the Controller.

	FROM	TO(GND)		VOLTAGE	MAXIMUM RIPPLE P-P
	J3-7	J3-3		+5.0 ± 1.0 VDC	1.0V
*	J3-9	J3-3		+12.6 ± 0.5 VDC	10.0 mV
*	J3-9	J3-3	**	+12.6 ± 50 mV	10.0 mV
	J3-14	J3-3		+21.0 ± 1.0 VDC (+18.75 in 220/240V units)	1.5 V
*	J3-19	J3-3		-12.0 ± 0.5 VDC	10.0 mV
*	J3-19	J3-3	**	-12.0 ± 50 mV	20.0 mV
*	J3-23	J3-3		+5.0 ± 0.3 VDC	10.0 mV
*	J3-23	J3-3	**	+5.0 ± 50 mV	10.0 mV

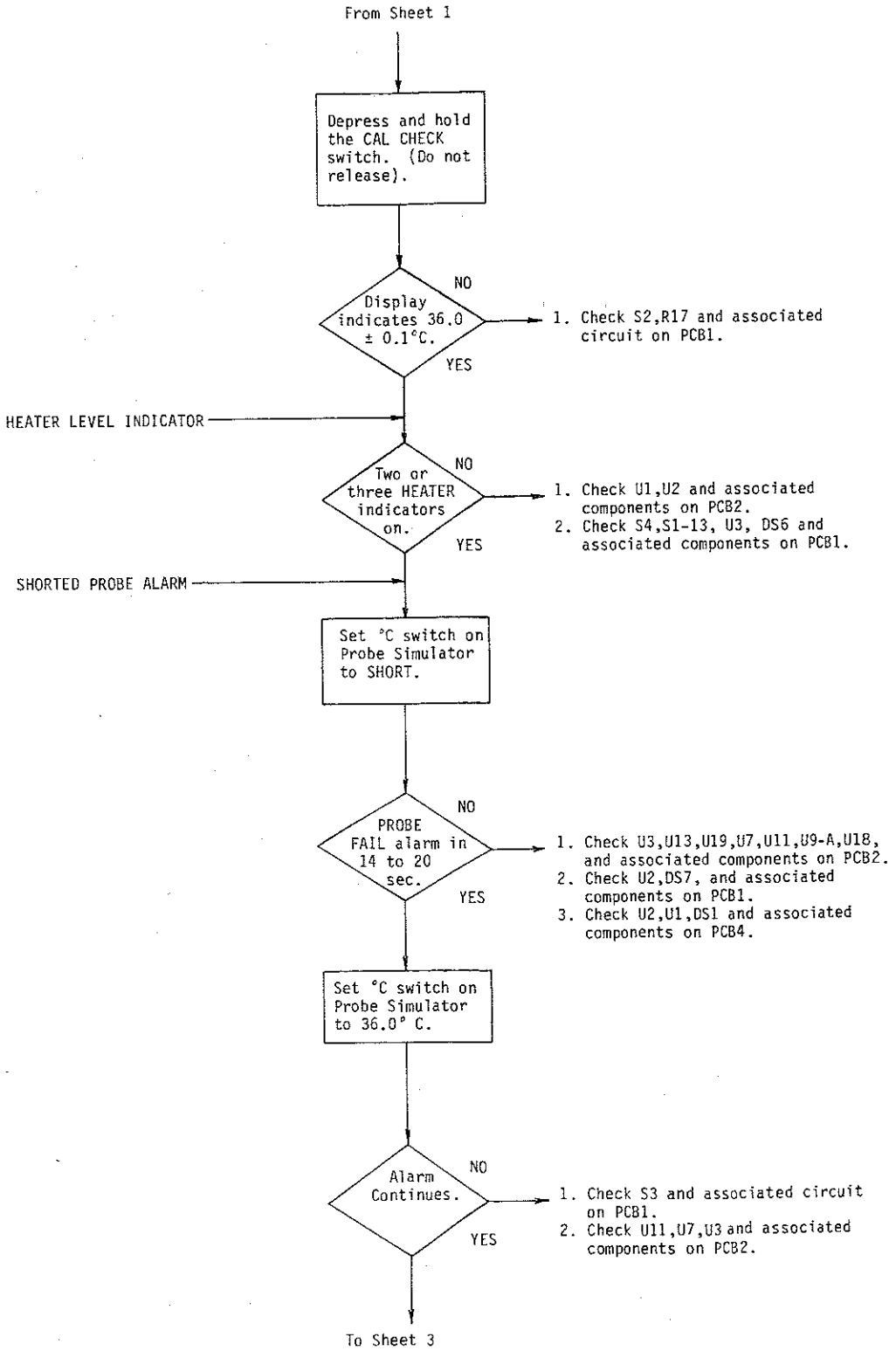
* Reading must not vary more than 0.2V over following range of applied voltage:

110/120V Power Module; 99 to 132 VAC
220/240V Power Module; 198 to 264 VAC
100V Power Module; 90 to 110 VAC

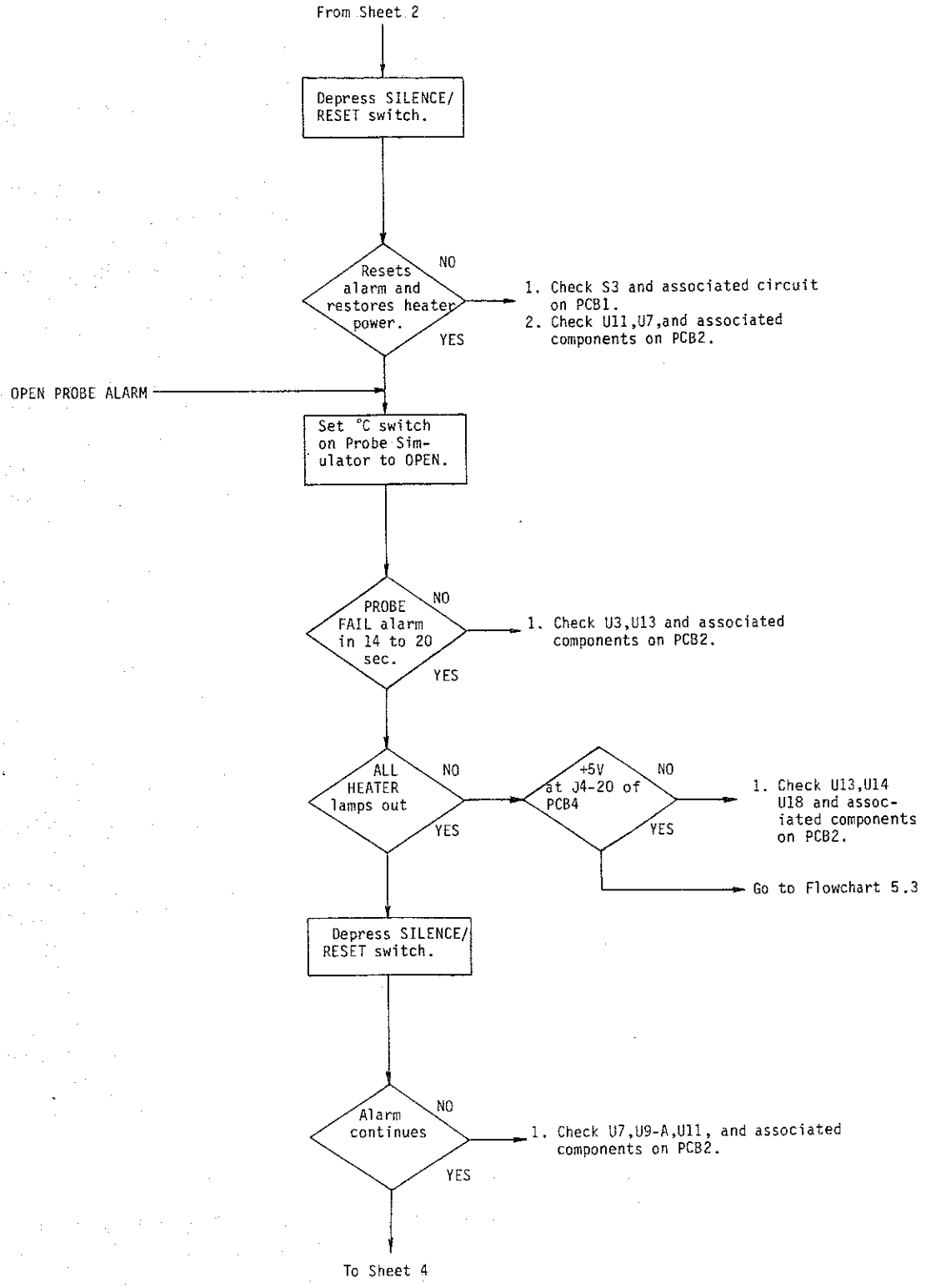
** Readings obtained when using a Series 01 Power Module.



FLOWCHART 5.1 CONTROLLER MODULE TROUBLESHOOTING
(Sheet 1 of 9)



FLOWCHART 5.1 CONTROLLER MODULE TROUBLESHOOTING
(Sheet 2 of 9)



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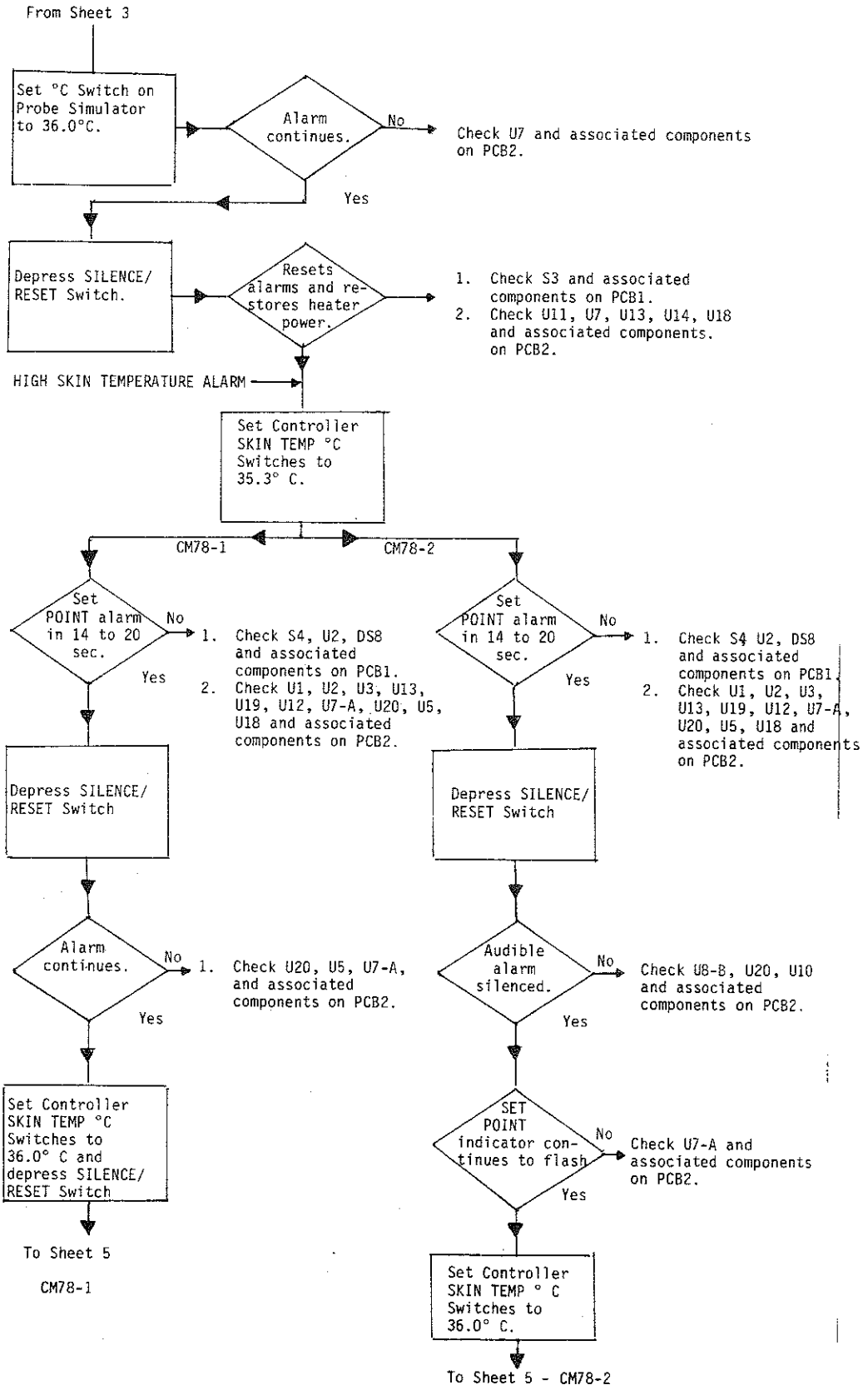
(Sheet 3 of 9)



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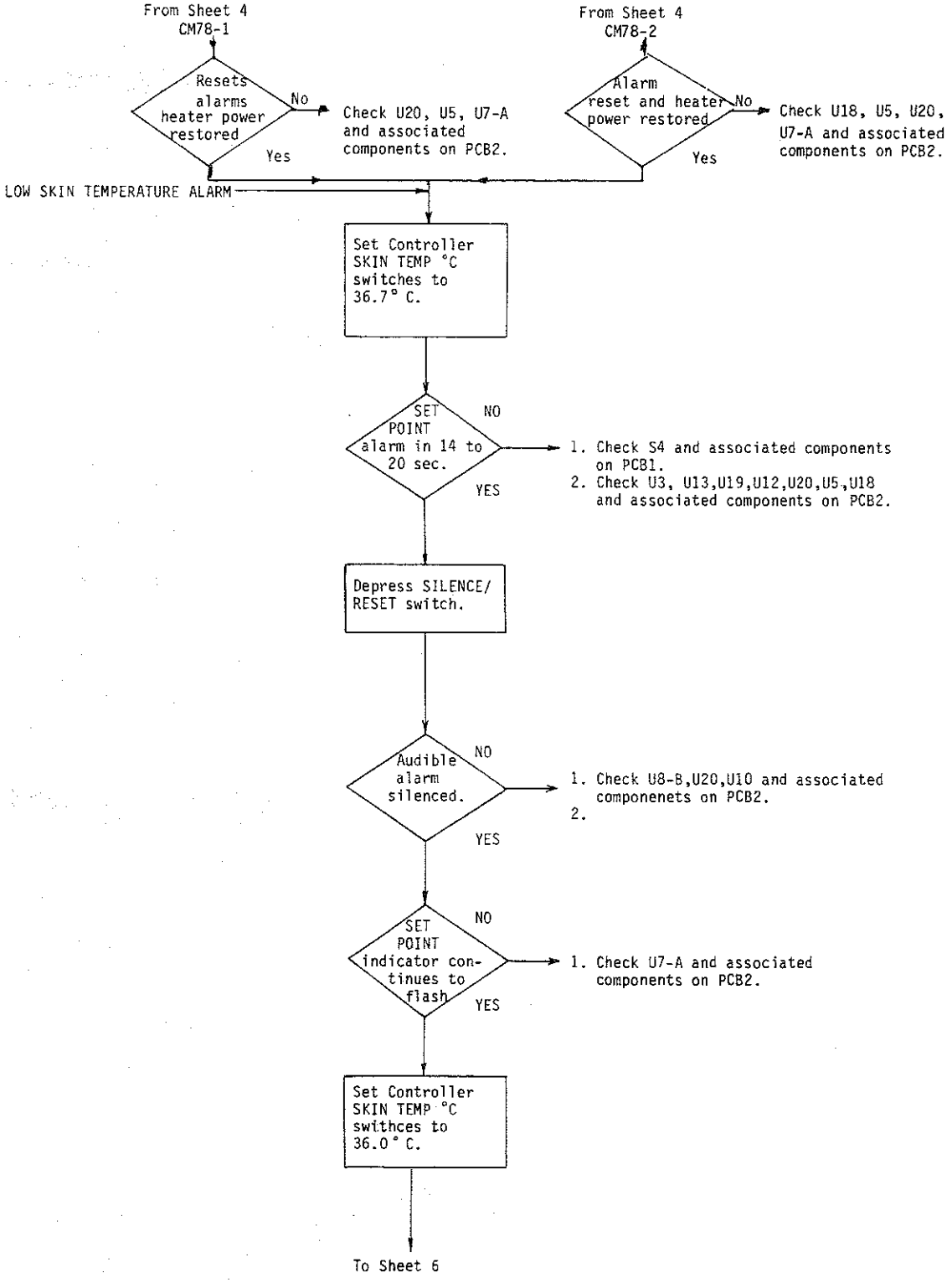
(Sheet 4 of 9)



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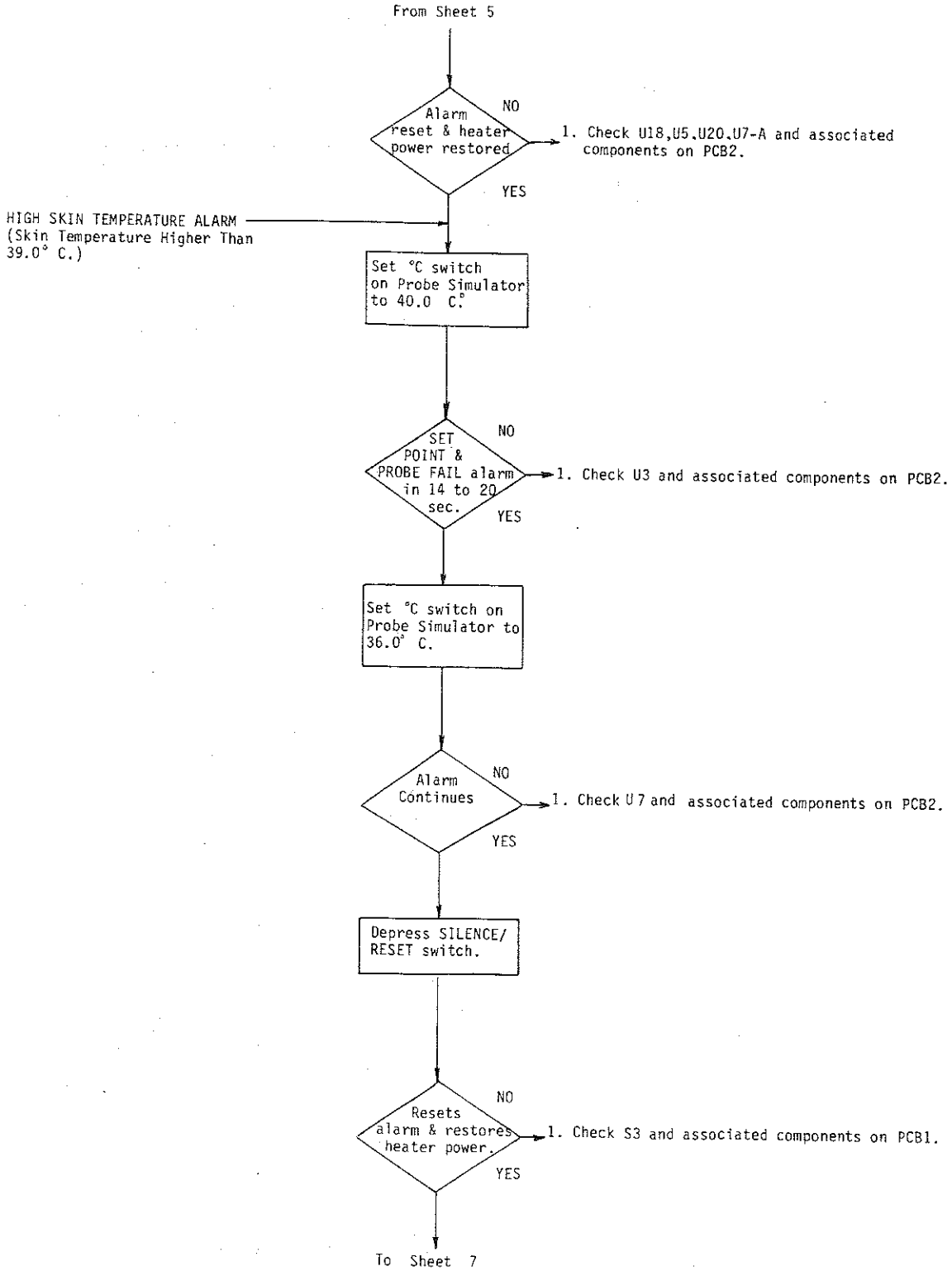
(Sheet 5 of 9)



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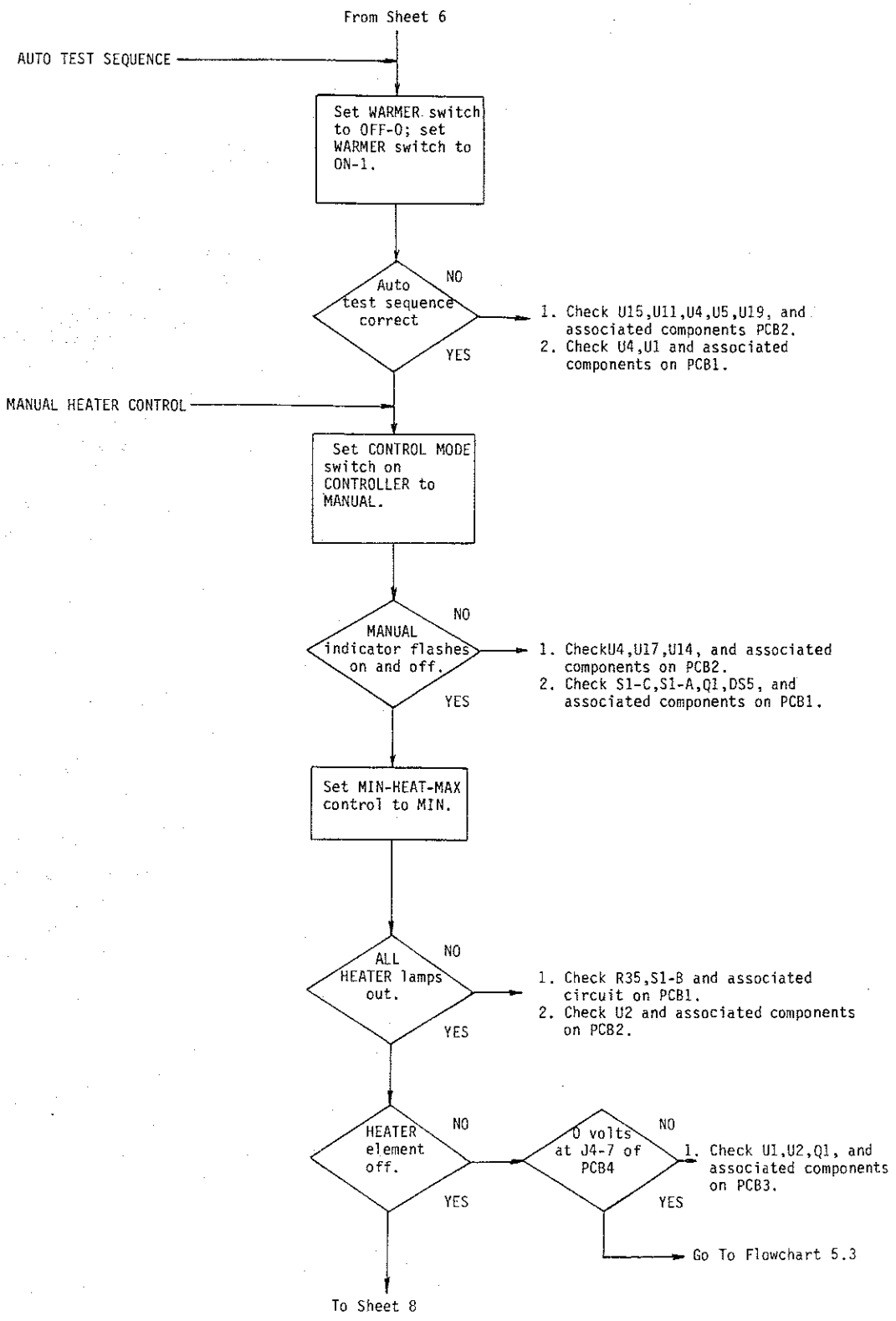
(Sheet 6 of 9)



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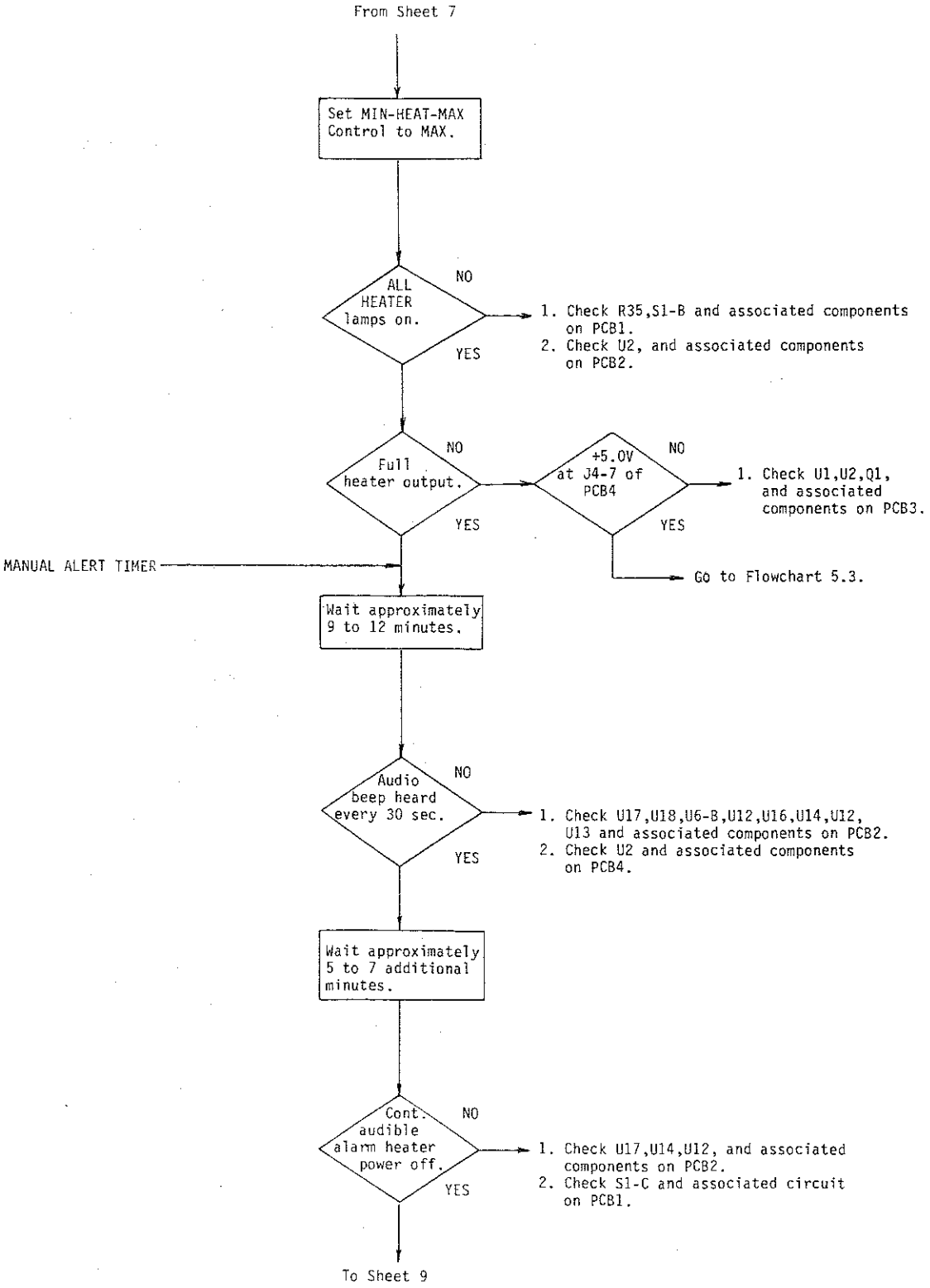
(Sheet 7 of 9)



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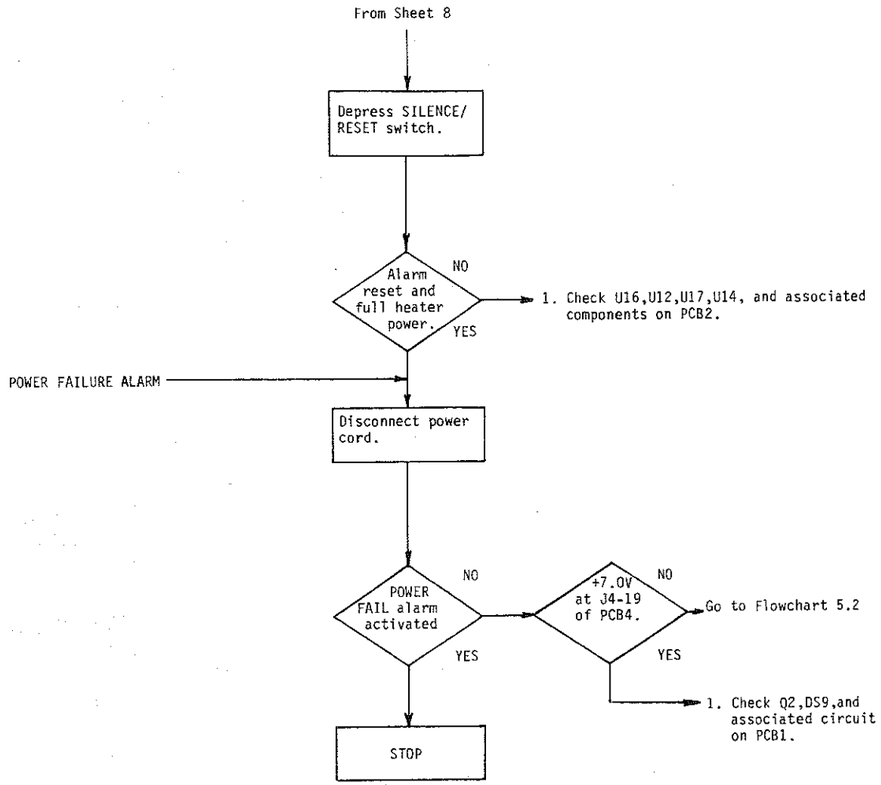
(Sheet 8 of 9)



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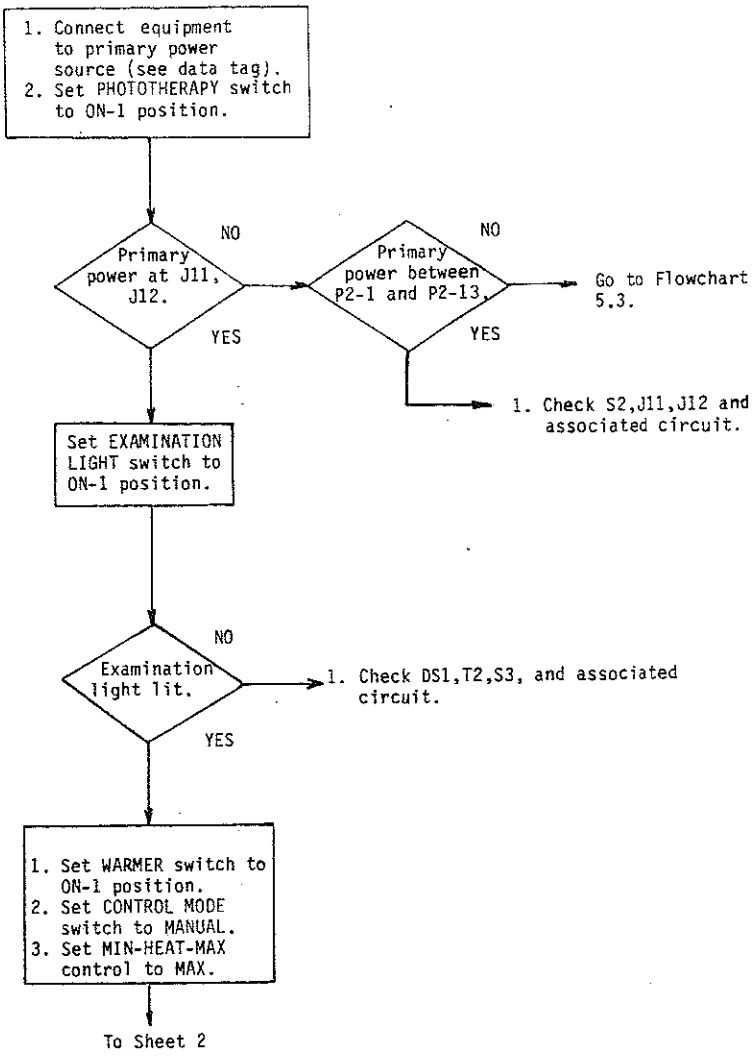
(Sheet 9 of 9)



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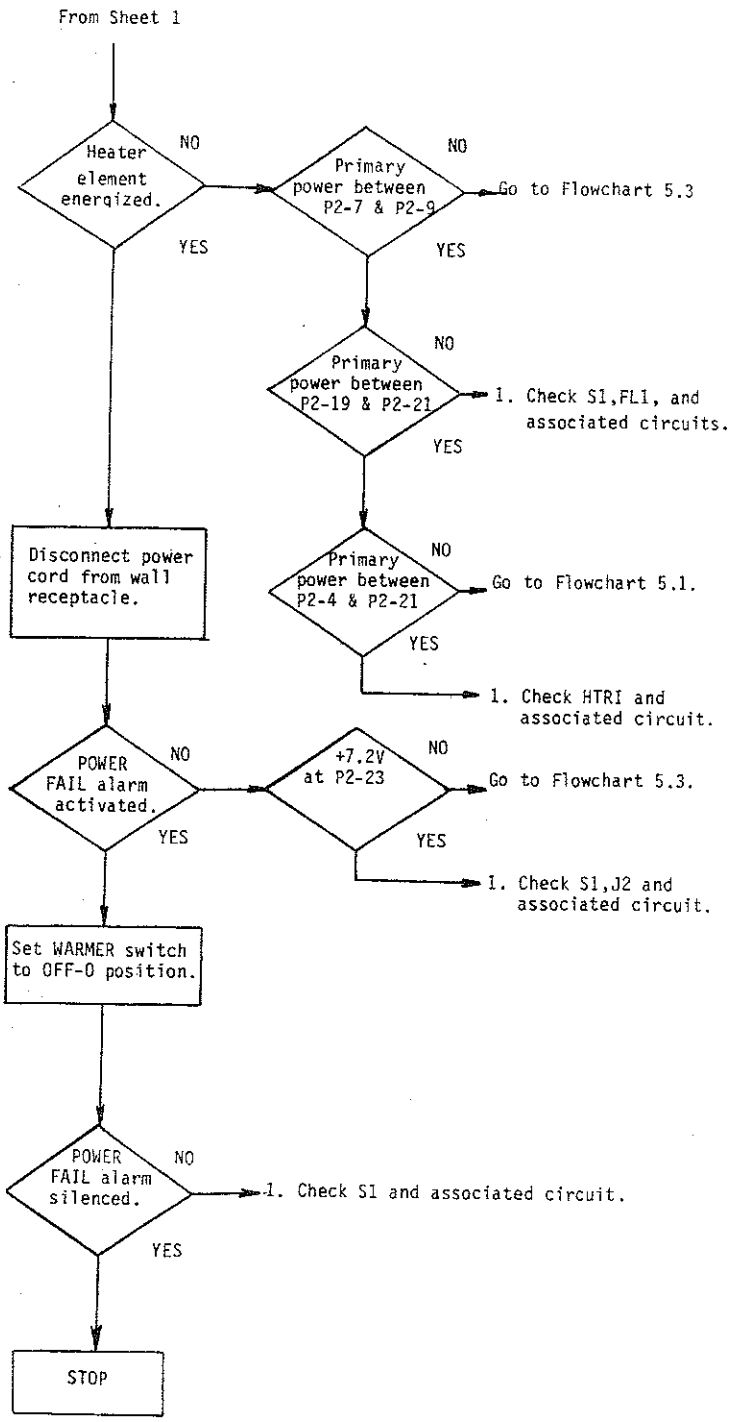
(Sheet 1 of 2)



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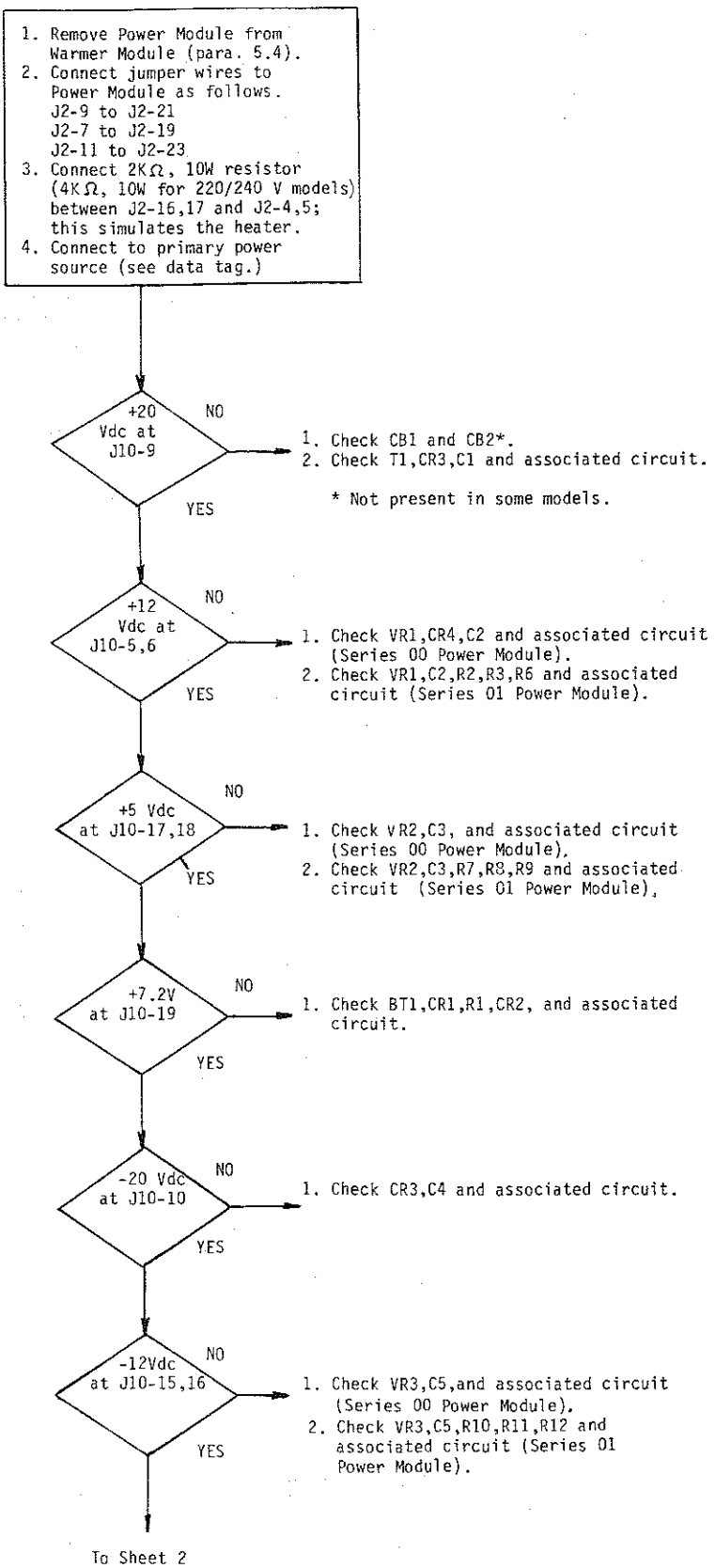
(Sheet 2 of 2)



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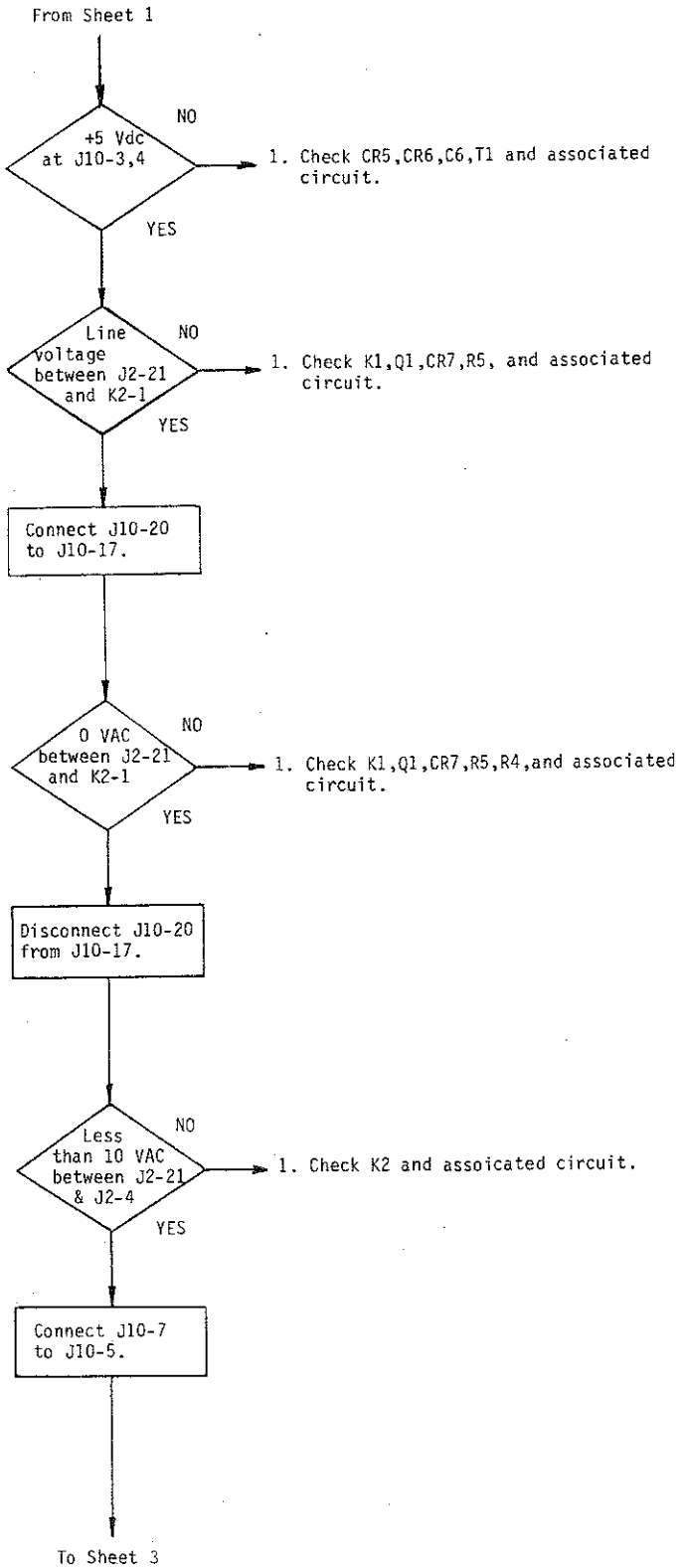
(Sheet 1 of 3)



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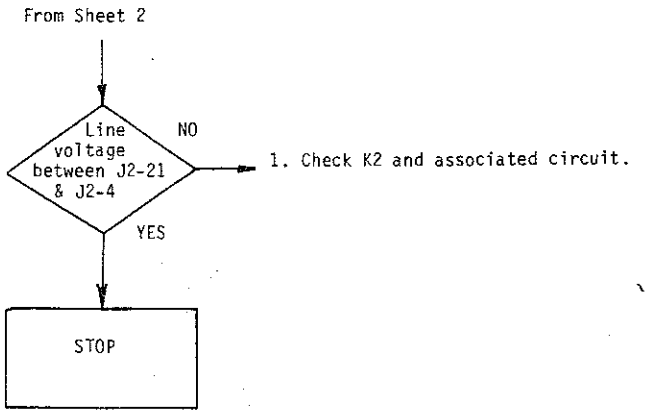
(Sheet 2 of 3)



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(Sheet 3 of 3)