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1. INTRODUCTION AND SYSTEM DESCRIPTION

- The Calibrator is a precision instrument that is part of a system aimed at improving the accuracy and efficiency in the process of battery testing and certification
- The Calibrator is designed to verify the performance and to calibrate Battery Charger-Analyzers used on Nickel-Cadmium, Lead-Acid and other types of batteries.
- It is principally designed for the line of Battery Test Equipment manufactured by JFM Engineering but it can also be applied to other types of chargers and charger-analyzers[1].
- The instrument is basically a digital Ammeter and Voltmeter that is connected between the charger under test and the battery that also provides a low current adjustable voltage source to simulate the various battery voltage cut-off points and a Temp-Plate simulator to test the battery overtemp portion of the line of battery test instruments manufactured by JFM[2].
- Two 3-1/2 digit LED meters provide the simultaneous monitoring of voltage and current on the charger and battery under test. The voltmeter can also be used independently by way of the two external meter lead jacks.
- Current and voltage measurement can be performed through the external cables, fitted with a Battery Cable Plug and a Battery Receptacle, or through the front panel binding posts, for other types of tests at reduced currents.
- *Note: some connections and tests are dictated by the type of Charger-Analyzer. They are identified as Superseder type for the models with analog selectors on the Front Panel and as ICA (Intelligent Charger-Analyzers) with digital Front Panel selectors.*

[1] Check the specifications from the manufacturers to establish the applicability of this Calibrator to other makes of Chargers and Charger-Analyzers.
[2] That have provisions for temperature monitoring for batteries under test

2. SPECIFICATIONS

2.1 CURRENT CAPACITY:

2.1.1. Through the rear cables: 80A max, continuous, 100A max (intermittent).

2.1.2. Through the front panel binding posts: 10A max[3].

2.2 VOLTAGE MEASUREMENT CAPACITY:

2.2.1. 0 to 20V (19.99V) or 0 to 200V (199.9), internal or external.

2.3 VOLTAGE SOURCE:

2.3.1. Externally adjustable: 0 to 100V, 25mA max.

2.4 SHUNT:

2.4.1. 1mV/A (200mV/200A), 0.25% accuracy.

2.5 METERS:
Type: LED, 3-1/2 digit.

2.5.1. Voltage: 0 to 19.99V and 0 to 199.9V.
Accuracy: 0.25% of reading, ∀1 digit.

2.5.2. Current: 0 to 199.9A
Accuracy: 0.5% of reading ∀1 digit.

2.6 STATUS INDICATORS:

2.6.1. Calibrator on-line, connected to the charger under test (front posts/rear cables).

2.7 CONTROLS:

2.7.1. Voltmeter source and scale selector.

2.7.2. Potentiometer for calibrator voltage adjustment.

2.7.3. Calibrator ON LINE/OFF (connected to the output/disconnected) selector switch.

2.7.4. Calibrator polarity (normal and reverse) selector switch.

2.7.5. Thermistor selector switch.

2.7.6. Thermistor temperature simulator selector switch.

2.7.7. Power ON/OFF switch (on the rear power block).

[3] Fuse protected

2.8 CONNECTORS:

2.8.1. Front panel binding posts (fused).

2.8.2. External voltmeter banana jacks.

2.8.3. Rear posts with cables with battery connectors.

2.8.4. Shunt monitor banana jacks.

2.8.5. Temp-Plate simulator cable connector.

2.9 FUSES:

2.9.1. Power: 0.5A slow-blow (0.25A for 230V operation).

2.9.2. Output: 12A, slow-blow (for the front panel binding posts).

2.10 LINE VOLTAGE:
Universal, 100-240VAC, 50-60Hz.

2.11 ENVIRONMENTAL:
5^{o} C to 35^{o} C.

3. CONTROLS AND DISPLAYS

3.1 Front Panel:

M1 Ammeter Display

M2 Voltmeter Display

DS1 Calibrator output on-line

Indicates that the Calibrator is connected to the charger (rear/front posts) to simulate the battery.

J1 Calibrator output (+)

Separate, independent output

J2 Calibrator output (-)

Separate, independent output

NOTE: There is always a voltage present at the Calibrator jacks (as set by the potentiometer). This output can be used to test other units, independent of the Charger/Battery connections to the Calibrator (provided that the Calibrator is not on-line). Maximum current is 20mA.

SW1 Calibrator on-line/off selector switch.

SW2 Calibrator polarity normal/reverse selector switch.

SW3 Voltmeter Source and Scale Selector

R1 Calibrator voltage adjustment potentiometer.

J3 Charger Input (+)

J4 Charger Input (-)

J5 External Voltmeter Input (+)

J6 External Voltmeter Input (-)

J7 Output to the Battery (+)

J8 Output to the Battery (-)

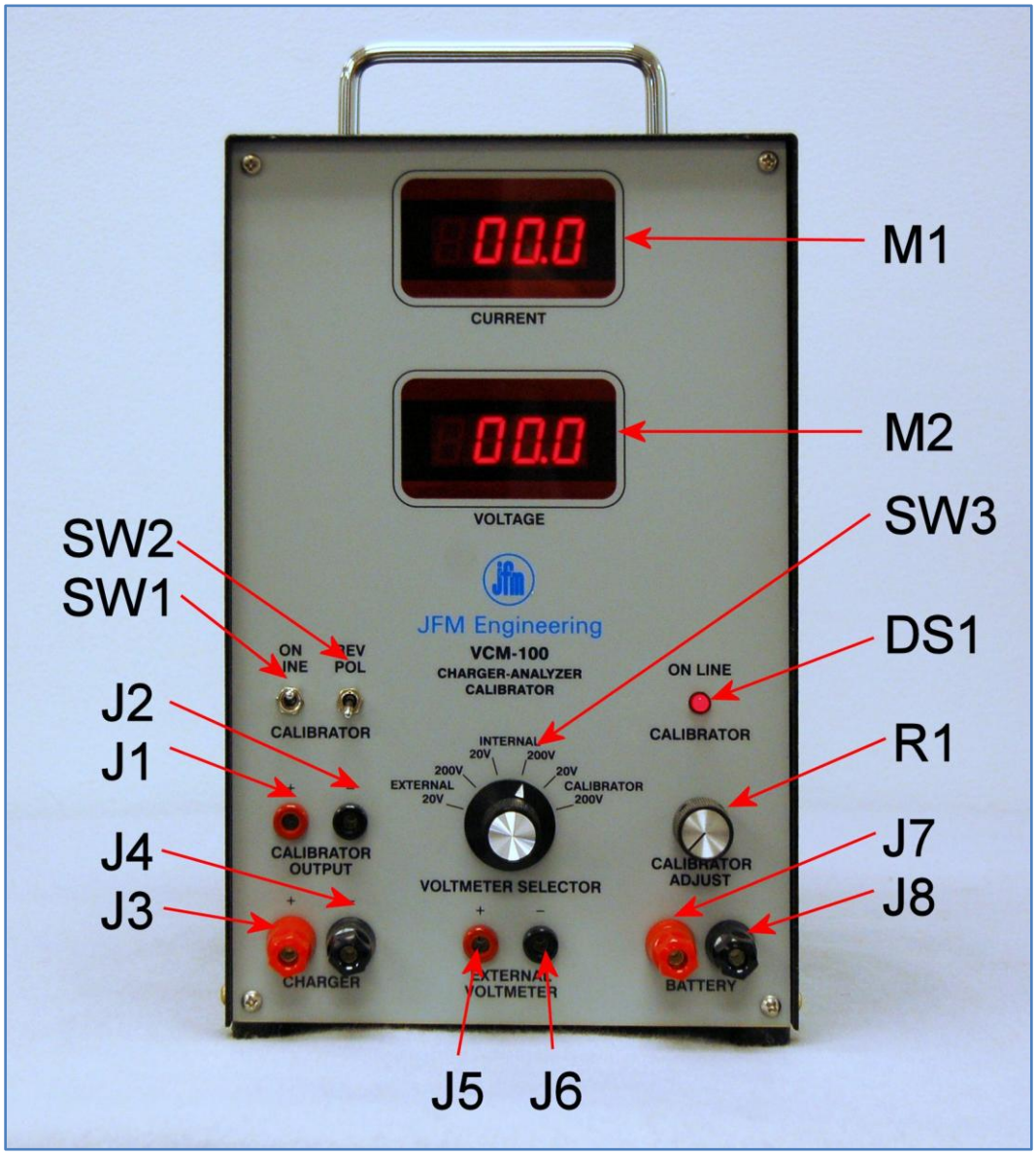

Figure 1 – Front View

3.2 Rear Panel:

F1 Calibrator Output Fuse (62 mA)

Protects the Calibrator output circuit in case of connection to a negative voltage.

SW4 Temp-Plate Temperature Simulator Selector switch.

SW5 Thermistor Selector switch.

J9 Thermistor Monitor (+)

J10 Thermistor Monitor (-)

J11,12 Temp-Plate Simulator

- Round connector for earlier models
- DB9 connector for newer models

Connects to the Temp-plate cable in the Superseder type Charger-Analyzer Battery Cable (round connector, older models) and DB9 connectors on the Rear Panel on newer models .

J13 Shunt Monitor (+)

Reads the Shunt output.

J14 Shunt Monitor (-)

Reads the Shunt output.

J15,SW6 Power Entry Block

Combined line cord receptacle, line fuse(s) and power on-off switch[4].

F2 Shunt Fuse (12A SB).

For protection while using the front panel jacks only.

(+) Input. Connection to the Charger (-).

(-) Input. Connection to the Charger (-) (common).

(+) Output. Connection to the Battery (+).

(-) Output. Connection to the Battery (-) (common).

[4] The line voltage selector feature is not used (not required due to the universal voltage capability)

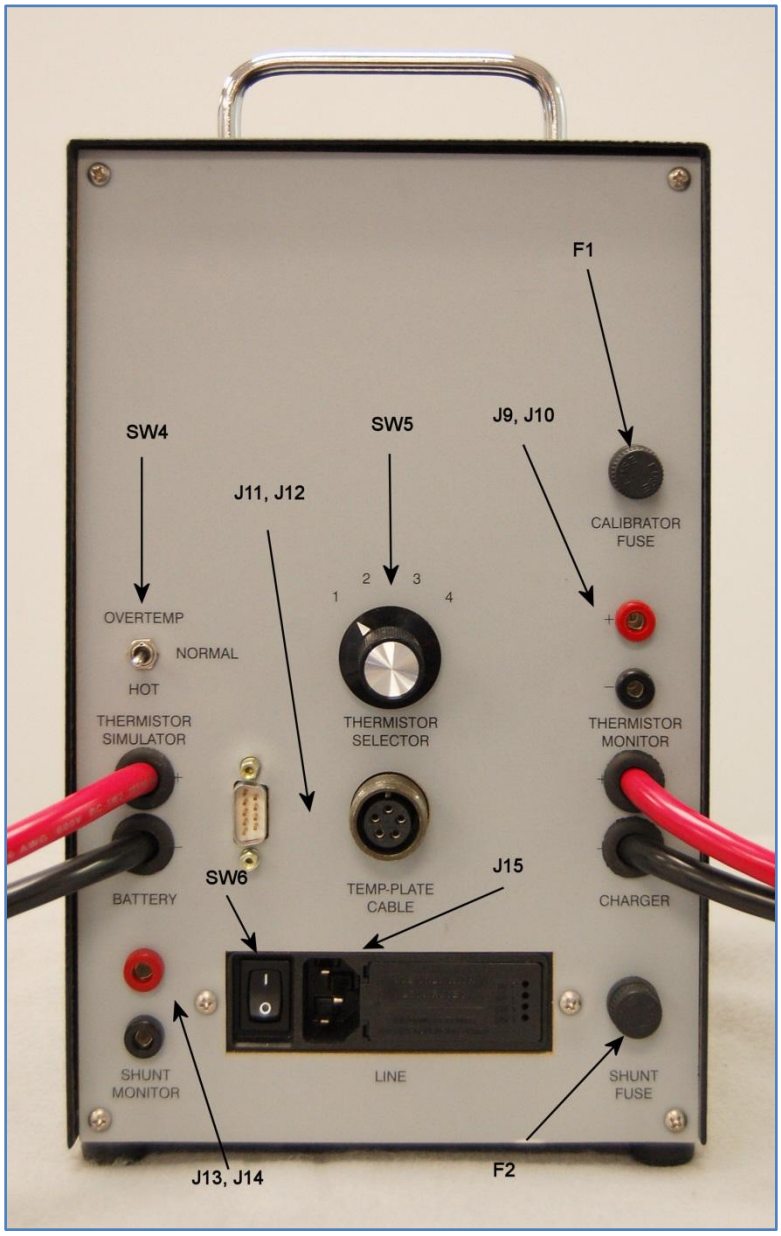

Figure 2 – Rear View

4. OPERATING INSTRUCTIONS

NOTE: Do not use the front panel and rear panel current connections at the same time.
NOTE: Do not connect to a battery if the Calibrator output is set on-line.
NOTE: Connect or disconnect only with the Charger-Analyzer in RESET.

4.1 Charger-Analyzer Voltage and Current monitoring:

4.1.1. Set the Calibrator voltmeter selector to INTERNAL 200V and the calibrator ON LINE and REV POL switches to off (down).

4.1.2. Connect one ELCON connector on the Charge-Analyzer Battery Cable to the receptacle at the charger side of the Calibrator. Short the remaining ELCON on the Battery Cable (on the Temp-Plate).

4.1.3. Connect the ELCON connector on the Calibrator to the battery.

NOTE: Other than voltmeters, make no connections to the binding posts on the front panel of the instrument while the output cables are in use.

4.1.4. The voltmeter will indicate battery voltage. Verify that the reading on the Charger-Analyzer matches the reading on the Calibrator.

NOTE: Most exact Voltmeter readings must be done with no current flow to eliminate the errors due to voltage drops on the Charger-Analyzer Battery Cables Cable and the Shunt and Cables on the Calibrator.

4.1.5. Start the Charger-Analyzer and verify its current readings against those of the Calibrator.

4.2 Charger-Analyzer Voltmeter testing/calibration:

4.2.1. Refer to the calibration instructions in the Charger-analyzer manual.

4.2.2. Adjust the calibrator output to obtain the required voltage.

4.2.3. Calibrate the voltmeter as required.

4.2.4. For Charger-Analyzers with a Voltmeter Selector with external inputs, connect also the calibrator output jacks of the Calibrator to the Charger-Analyzer to verify proper Voltmeter operation.

4.3 Charger-Analyzer Voltage cut-off testing and calibration:

NOTE: No battery connection for this test.

4.3.1. Refer to the calibration instructions in the Charger-Analyzer manual.

4.3.2. Connect the calibrator cable to the Charger-Analyzer Battery Cable (Short the remaining connector on the Battery Cable).

4.3.3. Set the Charger-Analyzer current selectors to zero (For Intelligent Charger-Analyzers program zero current).

4.3.4. Set the Voltmeter Selector on the Calibrator to INTERNAL 200V and the Calibrator ON LINE to on (up). The REV POL switch is used in the normal position (down) except when a reverse polarity test is called for.

4.3.5. Adjust the Calibrator output voltage as required to test/calibrate the Charger-Analyzer Open Circuit, Reverse Polarity, Overvoltage and Discharge Cut-Off functions.

4.4 Charger-Analyzer Ammeter calibration:

4.4.1. Refer to the calibration instructions in the Charger-Analyzer Manual.

4.4.2. Set the calibrator ON LINE to off (down) and the Voltmeter selector to INTERNAL 200V.

4.4.3. Connect the Calibrator to the Charger-Analyzer and to a battery.

4.4.4. Start the Charger-Analyzer and adjust the charging current to the required level. Test/Calibrate the Charger-Analyzer ammeter as required.

4.4.5. Verify readings on discharge.

4.5 Temp-Plate simulation:

Note: The Charger-Analyzer must be running in Charge Mode to test this functionality.

4.5.1. Connect the Temp-plate end of the Charger-Analyzer Battery Cable to the Calibrator.

4.5.1.1. The Superseder red OVERTEMP light must turn-off.

4.5.2. Set the Thermistor simulator to HOT.

4.5.2.1. No alarm indication must occur.

4.5.3. Set the Thermistor simulator to OVERTEMP.

4.5.3.1. The alarm must sound.

4.5.4. The following voltages must be registered at the Calibrator Thermistor monitor jacks:

4.5.4.1. NORMAL: 7.5V ± 0.15V

4.5.4.2. HOT: 6.36V ± 0.127V

4.5.4.3. OVERTEMP: 6.23V ± 0.124V

4.5.5. Repeat for all four thermistors

4.6 Charger-Analyzer Temp-Plate Test:

Note: The Charger-Analyzer must be running in Charge Mode to test this functionality.

4.6.1. Connect the Temp-plate input in the rear of the Charger-Analyzer to the Calibrator.

4.6.2. Set the Thermistor simulator to HOT.

4.6.2.1. No alarm indication must occur.

4.6.3. Set the Thermistor simulator to OVERTEMP.

4.6.3.1. The alarm must sound.

4.6.4. Connect the Temp-plate input in the rear of the Charger-Analyzer to the Calibrator.

4.6.5. Set the Thermistor simulator to HOT.

4.6.5.1. No alarm indication must occur.

4.6.6. Set the Thermistor simulator to OVERTEMP.

4.6.6.1. The alarm must sound.

4.6.6.2. Repeat for all four thermistors

4.6.7. Set the Thermistor simulator to HOT.

4.6.7.1. No alarm indication must occur.

4.6.8. Set the Thermistor simulator to OVERTEMP.

4.6.8.1. The alarm must sound.

4.6.8.2. Repeat for all four thermistors

4.6.9. The following voltages must be registered at the Calibrator Thermistor monitor jacks:

4.6.9.1. NORMAL: 3.75V ± 0.08V

4.6.9.2. HOT: 3.18V ± 0.06V

4.6.9.3. OVERTEMP: 3.11V ± 0.06V

4.6.10. The following temperatures must be registered at the LCD Screen of the SuperMasterCharger/SupersederXG (VIEW 5 – Temp-Plate Temps)

4.6.10.1. NORMAL: 25°C ± 0.5°C

4.6.10.2. HOT: 37.8°C ± 0.8°C

4.6.10.3. OVERTEMP: 39.3°C ± 0.8°C

4.6.10.4. VIEW-5
External Battery Temperatures (Temp-Plate)

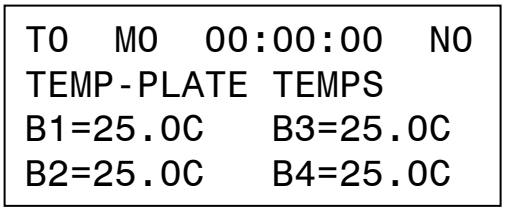

Figure 3 – Battery Temperature (Temp-Plate) Screen

4.6.11. The following temperatures must be registered at the LCD Screen of the Charger-Analyzer (VIEW 5 – Temp-Plate Temps)

4.6.11.1. AMBIENT 25°C ± 0.5°C

4.6.11.2. VIEW-6
Ambient Temperature and Auxiliary Input (TBD)

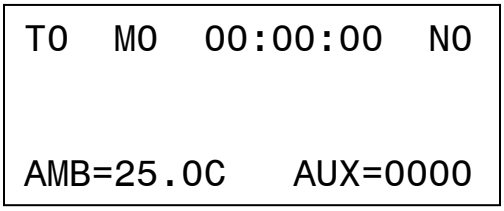

Figure 4 – Ambient Temperature Screen

5. VERIFICATION OF PERFORMANCE AND CALIBRATION

NOTE: Verify performance every 6 months. Calibrate every 12 months.

NOTE: Verify performance first by executing the tests without the adjustments. Proceed with adjustments when the tests indicate a deviation.

5.1 METERS CIRCUIT BOARD:

5.1.1. Voltmeter:

5.1.1.1. Set the voltmeter selector to EXT 20V.

5.1.1.2. Connect a DC voltage source (power supply) to the External Voltmeter Jacks and to an external reference voltmeter.

5.1.1.3. Set the voltage source for a voltage between 19 and 20V and adjust R20 to match the reading on the Calibrator.
Note: The adjustment is in the back of the board

5.1.1.4. Verify tracking by comparing readings at other voltages between 0V and 20V (e.g. every 5V).

5.1.1.5. Set the scale to EXT 200V. Verify readings at various voltages between 0V and 200V (or 100V).

5.1.1.6. *NOTE: The 200V scale is generated by a divider. No adjustment is available.*

5.1.2. Ammeter:

5.1.2.1. Connect a Charger to the input (charger) side of the Calibrator and connect the output (battery) side to a battery through a reference ammeter or shunt. A high current power supply and a suitable load can also be used in place of a charger and a battery.

5.1.2.2. Set the Charger (or Power Supply) for a current of 50A (40A minimum) and adjust R7 to match the reading on the Calibrator.
Note: The adjustment is in the back of the board

5.1.2.3. Verify tracking by comparing readings at other currents.

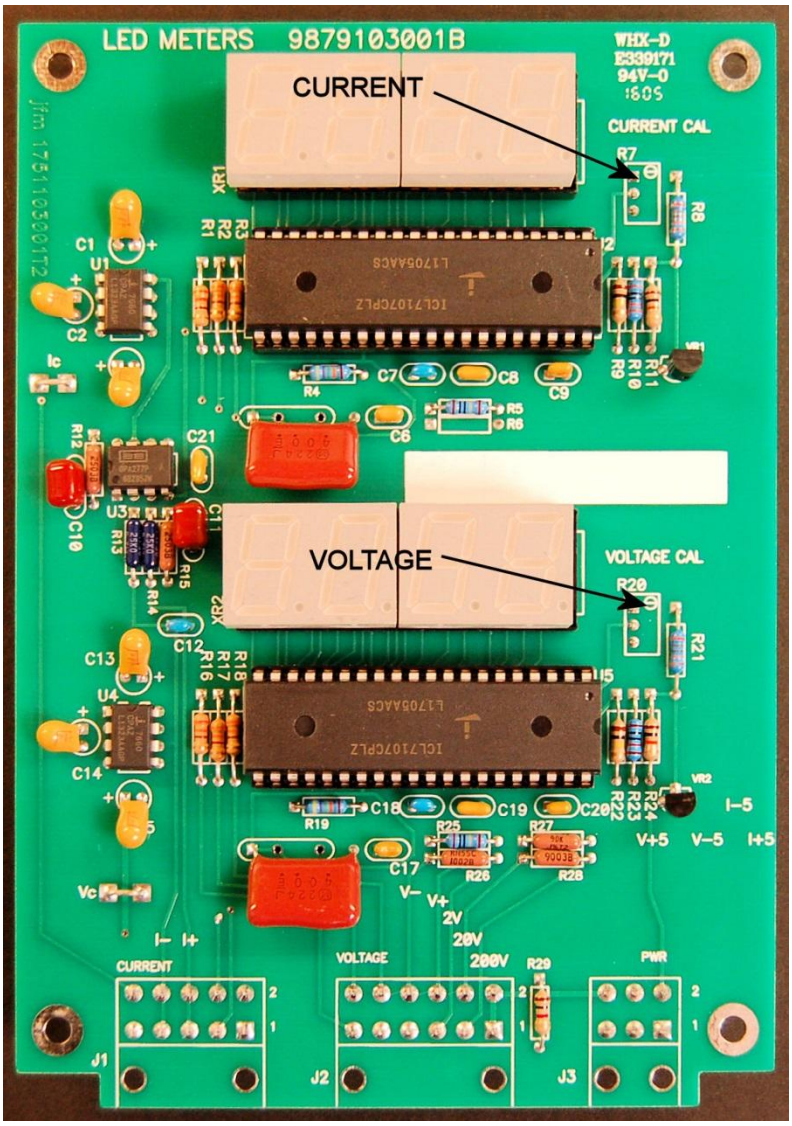

Figure 5 – Meters Board Adjustments

5.2 CALIBRATOR CIRCUIT BOARD:

5.2.1. Maximum Voltage:

Note: This adjustment is only for maximum range setting (exact value not critical).

5.2.1.1. Connect the output of the Calibrator to a reference voltmeter.

5.2.1.2. Turn the “On Line” switch to ON and set the Voltage Adjustment Potentiometer (Calibrator front panel) to maximum (CW)

5.2.1.3. Adjust R8 for an output of 100.0V.

5.2.2. Maximum Current:

Note: This adjustment is only for protection (exact value not critical).

5.2.2.1. Turn the “On Line” switch to ON and set the calibrator output for 50.0V

5.2.2.2. Connect a 2K-ohm, 5W resistor (for 25mA) or a 2.5K-ohm resistor (for 20mA) to the output of the calibrator.

5.2.2.3. Adjust R9 (increase the current) to insure that the output remains at 50.0V when loaded by the resistor.

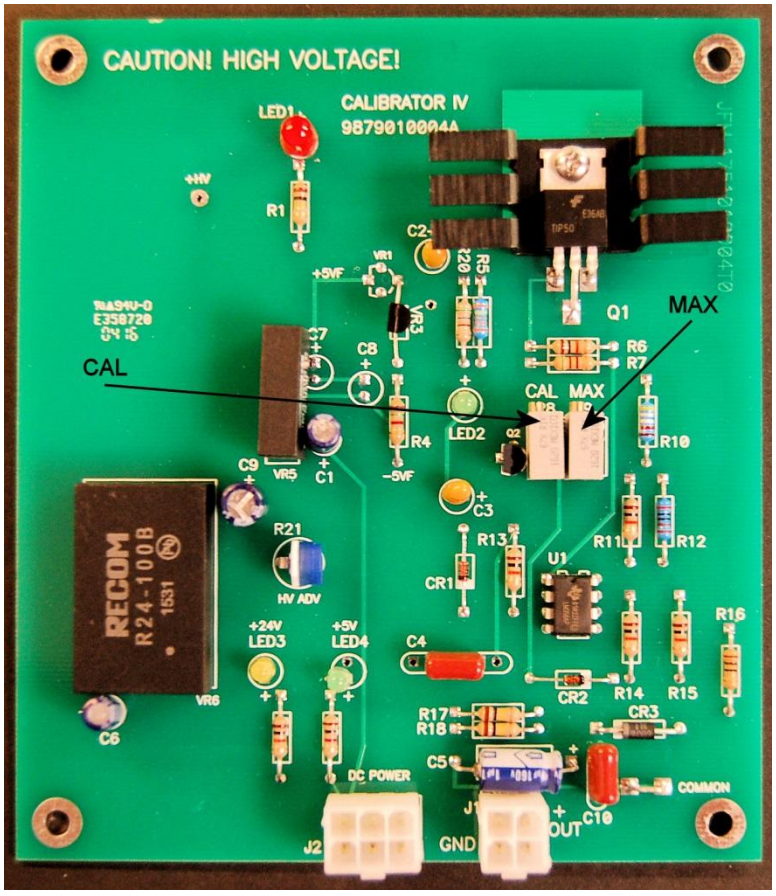

Figure 6 – Calibrator Board Adjustments

5.3 TEMP-PLATE SIMULATOR:

5.3.1. Resistance test:

5.3.1.1. Measure with an Ohm-Meter at the Thermistor monitor (no connection to the Charger-Analyzer).

- Normal: 30.1K-Ohm, ± 1% (± 301 Ohms).
- Hot: 17.2K-Ohm, ± 1% (± 175 Ohms).
- Overtemp: 15.9K-Ohm, ± 1% (± 165 Ohms).

5.3.2. Active test, Superseder and MasterCharger:

Note: for reference only (these results are based on a 10K, 1% resistor pulling-up to +10V at the Charger-Analyzer side).

5.3.2.1. Measure with a Voltmeter at the Thermistor monitor with the Temp-plate cable connected to the Superseder/MasterCharger (with power on).

- Normal: 7.5V, ±0.15V
- Hot: 6.36V, ±0 .127V
- Overtemp: 6.23V, ± 0.124V

5.3.3. Active test, SupersederXG and SuperMasterCharger:

Note: for reference only (these results are based on a 10K, 1% resistor pulling-up to +5V at the Charger-Analyzer side).

5.3.3.1. Measure with a Voltmeter at the Thermistor monitor with the Temp-plate cable connected to the Superseder/MasterCharger (with power on).

- NORMAL: 3.75V ± 0.08V
- HOT: 3.18V ± 0.06V
- OVERTEMP: 3.11V ± 0.06V

6. TROUBLESHOOTING

6.1 DOES NOT TURN ON:

6.1.1. Unit not plugged in.

6.1.2. Open line fuse.

6.1.3. Problems with the Power Supplies.

6.2 AMMETER DISPLAY IS OFF

6.2.1. 5V Power Supply

6.3 VOLTMETER DISPLAY IS OFF

6.3.1. 5V Power Supply

6.4 NO VOLTMETER READING WITH A BATTERY CONNECTED:

6.4.1. Voltmeter not on internal.

6.5 CANNOT READ CURRENT OR VOLTAGE THROUGH THE FRONT PANEL BINDING POSTS:

6.5.1. Open Shunt fuse.

6.6 CANNOT OBTAIN AN OUTPUT FROM THE Calibrator:

6.6.1. Open Calibrator fuse.

6.7 VOLTMETER INDICATES A READING WITHOUT A BATTERY CONNECTED:

6.7.1. Calibrator set to on-line or voltmeter set to calibrator.

6.8 OUTPUT VOLTAGE AT MAXIMUM AT OVER 100V. CANNOT BE ADJUSTED:

6.8.1. Shorted output transistor.

6.8.2. Damaged output voltage selector (potentiometer)

6.8.3. Damaged regulator circuit

7. CHANGING LINE (MAINS) FUSES

7.1 Remove the line cord.

7.2 With a small screwdriver remove the plate that covers the power block (Rear Panel).

7.3 Remove the fuse holder and replace with 0.25A SB fuses.

7.4 Plug back in the fuse holder.

7.5 Re-install the cover and line cord.

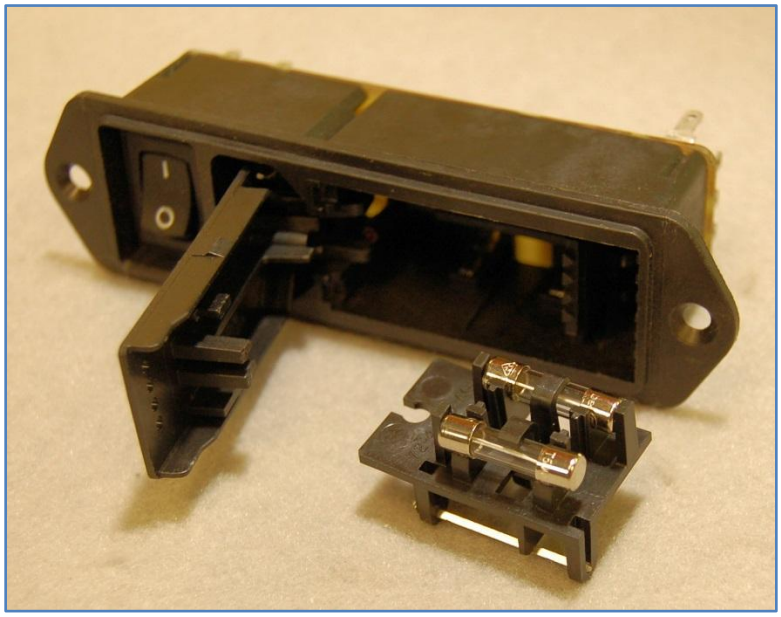

Figure 7 – Fuse Block

WIRING DIAGRAM

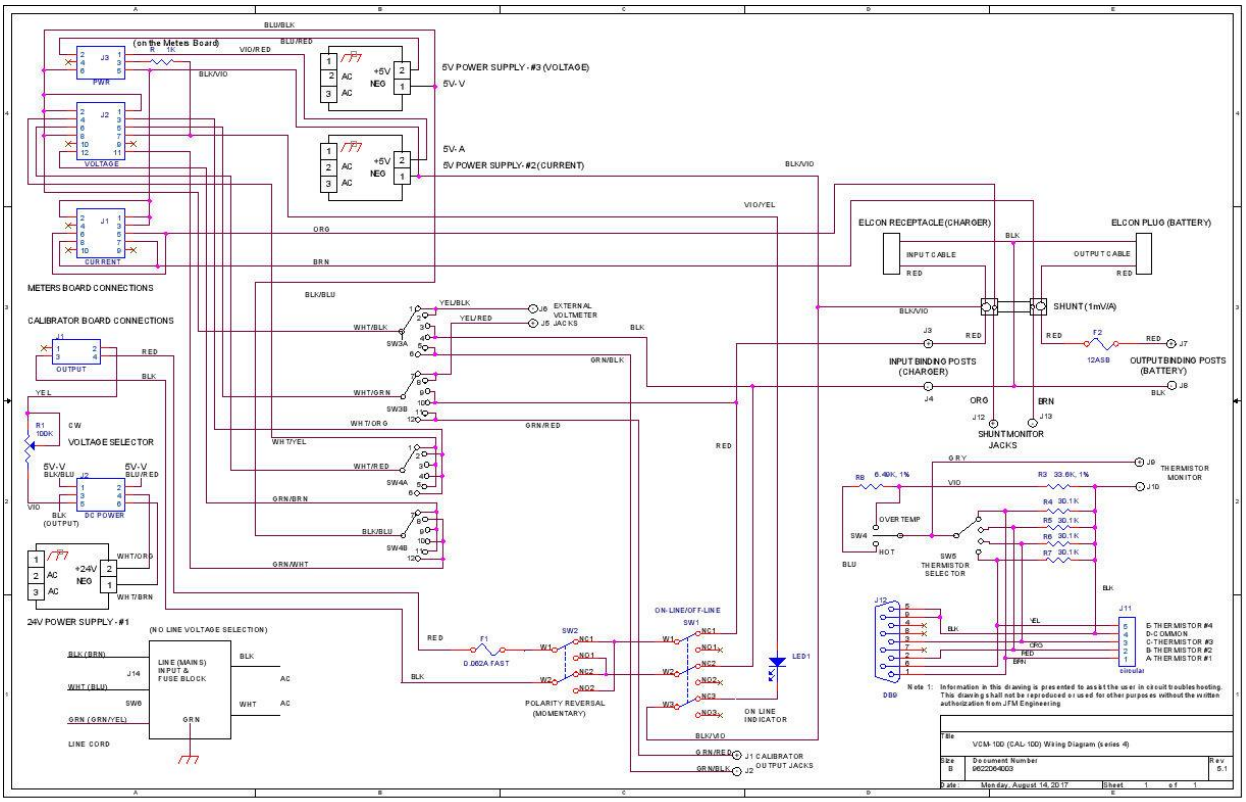

Figure 8 – Wiring Diagram

8. REPLACEABLE MODULES AND PARTS

8.1 Calibrator Circuit Board – P/N 9879010004

8.2 Meters Board – P/N 9879103001

8.3 Voltage Selector (10 turn, 100K potentiometer) – P/N 4753101040

8.4 5V Power Supply – P/N 4022PS0505

8.5 24V Power supply – P/N 4022PS0524

9. DISCLAIMER

9.1 Qualified Personnel

This Calibrator is a precision instrument intended to be operated by personnel qualified in the servicing of aircraft, industrial or medical batteries.

9.2 JFM Engineering's responsibility

Limited to the repair/replacement of any malfunctioning part of the system (not responsible for any losses incurred from the usage of the system).

9.3 User's Responsibility

- It is the user's responsibility to verify suitability in the intended application.
- It is the user's responsibility to verify the performance of the instruments and to operate and maintain it in accordance with the above given instructions.
- It is the user's responsibility to calibrate the Charger-Analyzers in accordance with the instructions and recommendations of the manufacturers of the Charger-Analyzer.
- It is the user's responsibility to operate the Instrument within standard safety procedures applicable to the operation of a Battery Test Facility.
- It is the user's responsibility to install power receptacles and wiring in accordance with local wiring codes.
- It is the user's responsibility to verify the integrity of the performance of this instrument in accordance with the instructions of Section [4].
- It is the user's responsibility to operate this instrument within the limits and guidelines as described throughout the manual.
- It is the user's responsibility to properly package the instrument for shipping whenever factory service is required.

10. REVISION INDEX

Table 1 - Index of Revisions

REVISION	DATE	NOTES
1.0	24 May 1990	Released
1.1	29 August 1994	Re-type, additional figures
1.1.1	26 August 1997	Re-type
1.2	22 December 2000	Re-type
2.0	20 June 2005	Document re-format
3.0	16 January 2010	Document re-format, text updates, figures updates
3.1	25 February 2011	Paragraph 5.1.2.5: R10 was R17 Page 20: added wiring diagram
3.2	4 March 2011	Added section 4.6 Edited section 5.2
4.0	15 August 2017	New series with universal power. Misc. updates and clarifications
4.0a	16 August 2017	
4.0b	26 February 2018	Corrected Nominal resistor values in section

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