

DC

OPERATION

AND

SERVICE MANUAL

ROD-L

ELECTRONICS, INC.

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CERTIFICATION

Rod-L Electronics, Inc. certifies that this instrument was thoroughly inspected and tested and found to meet its published specifications when it was shipped from the factory.

WARRANTY AND ASSISTANCE

This **Rod-L Electronics, Inc.** instrument is warranted against defects in materials and workmanship for 5 years following date of delivery. **Rod-L Electronics, Inc.** will repair or replace this instrument (at our discretion) if proven to be defective during the warranty period provided it is returned to **Rod-L Electronics, Inc.**

Rod-L Electronics, Inc. recommends that this instrument be calibrated on a 6-month cycle. Under no circumstance should a 12-month cycle be exceeded. This warranty remains valid providing calibration is performed at least once every 12 months by **Rod-L Electronics, Inc.** This warranty is nontransferable and is offered solely to the purchaser.

This warranty is void if the instrument has been changed, modified, or otherwise altered without the expressed permission of **Rod-L Electronics, Inc.** **Rod-L Electronics, Inc.** is not liable for consequential damages. No other warranty is expressed or implied.

Returned Material Authorization must be obtained from **Rod-L Electronics, Inc.** before returning this instrument for warranty repair. Transportation costs for return of defective instrument for warranty repair must be prepaid, and borne by the customer. **Rod-L Electronics, Inc.** will assume the cost of transportation when returning Warranty Repaired Equipment to the customer. Such method of transportation shall be at the discretion of **Rod-L Electronics, Inc.**

Bills of Materials, Schematics, Diagrams

BOMs for Assy's	44
Wiring Diagrams, Assembly Prints, and Schematics for all PCBs (in same order as BOMs)	78

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Section 1

INTRODUCTION

1-1. Scope of This Manual

This publication provides operating and servicing instructions for the **Rod-L Electronics, Inc.** Models M100DC, M120DC, and M130DC Hipot Test Instruments. It is divided into six sections.

Section 1 — Introduction (capabilities and specifications)

Section 2 — Installation and Operation

Section 3 — Theory of Operation

Section 4 — Maintenance and Service

Section 5 — Options

Section 6 — Parts Lists, Schematics and Diagrams

1-2. DC Hipot Tester General Description and Test Features

The **Rod-L** DC Hipot Test Instruments are essentially the same. The M100DC is the base model, and all the controls for the M120DC are on the front panel. All are rugged, self-contained testers designed for production and/or laboratory use. The DC Hipot Tester's purpose is to provide a means for evaluating the dielectric withstand capabilities of electric and/or electronic devices when subjected to abnormally high input voltages. This is accomplished by monitoring for "breakdown" in the form of arcing/corona or exceeding of the maximum allowable current, determined by the positioning of "Current Trip Potentiometers."

The DC Hipot Testers perform a DC High Voltage leakage and breakdown dielectric withstand test. They test and display DC current and voltage. Specifications are given in Table 1-1.

These models also conduct a low current Ground Continuity Test concurrent with the Hipot Test to ensure that the Device Under Test (DUT) is capable of effectively shunting the "leakage" current produced by the high voltage to earth ground. For operator safety, this CHASSIS GROUND SENSE connection must be made with a low resistance return on the DUT. Without this connection, the tester cannot enter the READY state. Both the Chassis Ground and the power cord Safety Ground of the DUT are monitored and stressed electronically. If either ground fails during the test, the Hipot Tester automatically goes into failure mode; i.e., high voltage is shut down and there is a visual and audible alarm.

NOTE: *The CHASSIS GROUND SENSE circuit is intended to act as a safety ground and ground continuity test for devices employing a chassis ground plane. For testing of two-wire devices or*

three-wire devices that are exempted by the pertinent regulatory agency from performing a chassis ground continuity test, the CHASSIS GROUND SENSE connection can be made to either Pin 2 of the rear panel high voltage connector or to any appropriate hipot chassis point (e.g., handle, screw, etc.)

Connection of the DUT to the Hipot Tester is made via the front panel High Voltage Receptacle (DUT's that terminate in a three prong cord) or the rear panel High Voltage Connector (all others.)

All models incorporate a rapid, automatic electronic shutdown circuit to turn off the high voltage within 2ms (two milliseconds) after a fault. To prevent turn-on surges, the high voltage has an electronically controlled rate-of-rise (adjustable from 50V/sec to 5000V/sec.)

1-3. Product Specifications (Table 1-1)

Table 1-1: DC Hipot Tester Specifications

Test Current	40 microamperes (μ A) to 10 milliamperes (mA) full scale (F.S.)
Test Voltage	User specified up to 5000 VDC
Voltage Rate of Rise	50 V/second to 5000 V/second (adjustable)
High Voltage Test Time	1 second to 90 seconds (adjustable)
High Voltage Shutdown	Within 2 milliseconds after a fault or end of test is detected (electronic shut down circuits)
Initial Turn-On Period	Requires 2 seconds normally for safety ground test before starting Hipot test
Safety Ground Continuity	Reject level: 0.1 to 0.5 Ω , (adjustable) \pm 0.01 Ω
Accuracy (Current and Voltage Monitoring)	Better than 1%
Resolution (Output Voltage Control)	2.5V
Resolution (Output Current)	4 Microamperes (μ A)
Input Power	115/230 VAC, 44-66 Hz., 360 watts, max
Ripple	1% at full load, 0.05% at zero current
Regulation	0.05% at full load
Environmental Operating Temperature	0° to 50° C, 32° to 122° F
Exterior Color	Mint grey and Olive Grey or Black
Weight	24 lbs (10.9 kg) net, 29 lbs (13.15 kg) shipping
Dimensions	16.75 x 13.25 x 5.5 inches (43 x 34 x 14 cm)

1-4. Safety Features

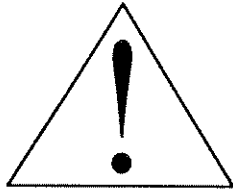
- A) "Chassis Ground Sense" - Safety ground required to begin a test
- B) Loss of safety ground terminates test cycle
- C) Front panel receptacle accepts 3-pronged power cord from DUT providing maximum safety and significantly reduces time required to perform the test
- D) Recessed START button
- E) Visual alarm at failure
- F) Audible alarm at failure (continuous tone)
- G) Fast electronic shut down of DC High Voltage
- H) Hard RESET after failure required to perform next test
- I) Visually displayed Programming of DC Current Trip Point and High Voltage
- J) Adjustable, linear Ramp Up of High Voltage
- K) Complete discharge of Device Under Test (DUT)
- L) High Voltage Output closed to Ground when not in test

1-5. Supplied Equipment

- A) DC Hipot Test Instrument
- B) Power Cord, three pronged, 6 ft
- C) Chassis Ground Sense cable, 3 ft
- D) Kit for HV connector mate
- E) Operation/Service Manual
- F) Extra fuse set for the alternate AC supply voltage

Section 2

INSTALLATION AND OPERATION



The exclamation point within a triangle is intended to tell the user that important operating and servicing instructions are in the papers that are provided with the equipment.

WARNING

Verify that the voltage selector switch is positioned and the correct power supply cord is selected to match the voltage source.

WARNING

This product is shipped with a high voltage mating plug and hole cover installed on the rear panel HV OUT/INTERFACE connector. To reduce the risk of shock, this plug and cover must be used whenever the high voltage interface cable is not installed.

In addition, the high voltage interface cable must only be used when both ends are terminated at their respective equipment connectors. To reduce the risk of electric shock, the equipment must not be operated with one end not terminated.

2-1. General Information

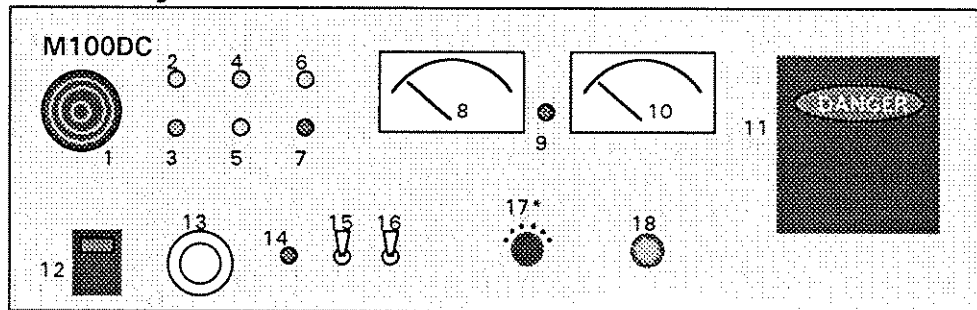
This section contains the recommended procedures for unpacking, inspection, installation, and operation.

2-2. Unpacking and Inspection

Retain the shipping carton and the padding material. **Rod-L Electronics** may assess a charge for a new shipping container if an instrument is not received in the original container.

A shipping carton that appears damaged should be inspected and unpacked with the carrier's agent present. Inspect the instrument for damage (scratches, dents, broken knobs or meters, etc.)

Figure 2-1: M100DC Front Panel Controls



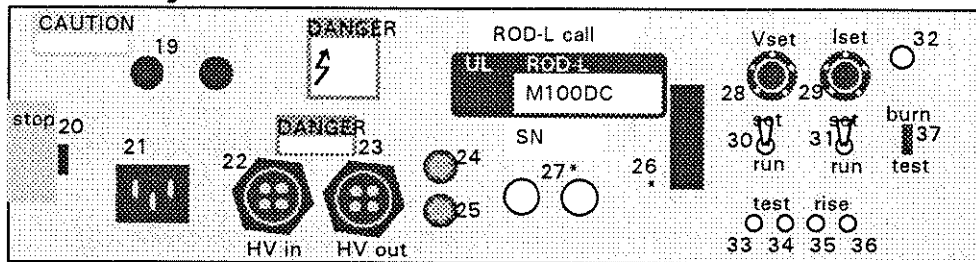
- | | |
|--------------------------------|--|
| 1. Alarm | emits audible signal on failure |
| 2. V-SET lamp | on when V-SET switch is in set position
off when V-SET switch is in run position |
| 3. READY lamp | on when ready to begin Hipot Test |
| 4. I-SET lamp | on when I-SET switch is in set position
off when I-SET switch is in run position |
| 5. TESTING lamp | on during DC Hipot Test |
| 6. AC lamp | on when AC/DC switch is in AC position |
| 7. FAIL lamp | on if DC Hipot Test fails |
| 8. Current meter | indicates current in DC mA (μ A with Option 09);
inactive during AC Hipot Test;
indicates fail point when in I-SET mode |
| 9. HV ON lamp | flashes when 40VDC or more is present;
inactive during AC Hipot Test |
| 10. Voltage meter | indicates volts in DC kV; inactive for AC test;
indicates max DC kilovolts when in V-SET mode |
| 11. HV Output Block receptacle | for input to DUT where DC or AC HV is applied |
| 12. LinePower switch | turns on and indicates line power input |
| 13. START switch | initiates DC (or AC) Hipot Test if READY |
| 14. RESET button | resets Hipot |
| 15. DC/AC switch | chooses DC Hipot or the input from AC Hipot |
| 16. A/B switch | chooses A or B Ramp Rate and Test Time |
| 17.* Select switch | (*Optional) chooses different parameter sets |
| 18. Chassis Ground Sense jack | for DUT chassis ground connection |

If the instrument is found to be damaged upon receipt, notify the carrier and **Rod-L Electronics** immediately.

2-3. Installation

The **Rod-L** DC Hipot Test Instruments are suitable for either bench or rack mounting. To rack mount the instrument, use Option 15A. The instructions for rack mounting are on page 39.

Figure 2-2: M100DC Rear Panel Controls



19. AC Fuses F1/F2 3A @ 115VAC, 1.5A @ 230VAC
 20. Voltage Selector Switch chooses 115VAC or 230VAC input; be sure to install correct fuses
 21. AC line power in receptacle
 22. HV In connector for AC Hipot Interface
 23. HV Out connector for Ground Tester Interface
 24. AC Hipot Chassis connects Gnd of DC Hipot to Gnd of AC Hipot Gnd Sense jack to enable AC Hipot Test to start
 25. Chassis Ground for DUT chassis ground connection Sense jack
 - 26.* Remote connector (*Optional) for Remote Interface
 - 27.* Hands-Off con.s (*Optional) for Hands-off palm switches
 28. V-SET pot for voltage programming
 29. I-SET pot for current trip programming
 30. V-SET switch in "set" position allows voltage programming pot to be adjusted and viewed on the voltage meter
 31. I-SET switch in "set" position allows current "trip" fail point programming pot to be adjusted and viewed on the current meter
 32. Ground jack for connecting tester's chassis' together
 33. "A" Test Time Adjustment potentiometer
 34. "B" Test Time Adjustment potentiometer
 35. "A" Voltage Rise (Ramp Rate) Adjustment potentiometer
 36. "B" Voltage Rise (Ramp Rate) Adjustment potentiometer
 37. Burn Switch enables DC Hipot to perform destructive test
- Note that on the M120DC, all controls are on the Front Panel.

2-4. Power Requirements

The Rod-L DC Hipot Testers require a power source of either 115 or 230 volts AC, 44 to 66 Hz, single-phase. Prior to applying power to the instrument, ensure the AC line voltage selector switch on the Rear Panel is in the appropriate position. When using the Rod-L Hipot with other Rod-L Testers, the Ground Sense Circuit often works better when the Rod-L Testers are connected to a line input with the same ground circuit.

2-5. Operating Controls

The front panel and rear panel controls and indicators for the M100DC are shown and briefly described in Figures 2-1 and 2-2. They would all be on the Front Panel of the Model M120DC.

2-6. Storage

It is strongly recommended that the DC Hipot be packed as if for reshipment. Environmental conditions during storage and reshipment should be as follows:

- A) Maximum temperature: 167°F (75°C)
- B) Minimum temperature: -40°F (-40°C)

2-7. Repackaging for Shipment

If possible, use the original shipping container and packing materials. Otherwise:

- A) Wrap the DC Hipot in heavy paper or plastic before placing it in the shipping container.
- B) Use plenty of packing material around the instrument, and protect the front panel with cardboard or plastic bubble packing. Protect the instrument with two inch rubberized foam pads placed along all surfaces of the instrument, or with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.
- C) Use a strong, well-sealed shipping container (350 lb/in² bursting test.)
- D) Mark the container "FRAGILE — DELICATE INSTRUMENT."

WARNING

This instrument to be used **ONLY** in **THREE WIRE GROUNDED OUTLETS**. It is recommended that periodic checks of the outlet and the ground wire be made to ensure operator safety.

2-8. Initial Installation and Power-Up

The Rod-L DC Hipot Tester is shipped configured for 115 VAC operation. Appropriate fuses (1.5 ampere) are also provided for 230 VAC operation. Before applying 230 VAC power to the instrument, ensure that the correct fuses are installed (see Fig. 2-2.,) then ensure that the Voltage Selector Switch on the Rear Panel is in the correct position.

CAUTION

Changing Fuses: Turn off the Hipot Tester and **DISCONNECT THE POWER CORD**. Then install the proper fuses. Otherwise, damage to the instrument and/or operator could result.

2-9. Factory Settings

The Rod-L DC Hipot Tester is shipped with the following factory-selected settings (unless otherwise requested in writing by the customer):

Table 2-1: Factory Settings

TEST MODE SWITCH	"A"	"B"
Voltage	1500 VDC	1500 VDC
Maximum Current	5 mA	5 mA
Test (Dwell) Time	15 sec	2 sec
Ramp Rate	200 V/sec	1000 V/sec
Input Line Voltage Select	115 VAC	

2-10. Operational Check

This is an operator oriented procedure which allows operational check of the Rod-L DC Hipot Test Instrument without test equipment. Refer to Section 4 of this manual for a complete calibration procedure.

Place the instrument in a sturdy position, preferably on an insulated surface, with all surrounding metal/conductors grounded. Position the power cord so as to avoid being walked on or pinched by other equipment.

- A) Set LINE POWER switch to OFF.
- B) Validate that fuses F1 and F2 are the proper values.
- C) Verify Input Line Voltage Select Switch position.
- D) Connect AC Power Cord to AC receptacle on the rear panel.
- E) Connect the AC Power Cord to a 115 VAC $\pm 10\%$ power source.
- F) Ensure that the V-SET and I-SET switches are in the "RUN" position. Place the AC/DC switch in the DC position.
- G) Verify Remote/Local Switch is in Local position.
- H) Connect low current Ground Sense Cable to the CHASSIS GROUND SENSE terminal on the front panel. Then clip the other end of the cable to the Hipot Tester chassis (the handle is a convenient point.) When Option 09 Low Current is present, the alligator clip end has to be connected to HV Return instead.
- I) Set LINE POWER switch to ON. The power ON lamp should illuminate.
- J) The green READY lamp should illuminate.

NOTE: *If the lamp in the power switch remains off, check for proper AC line voltage. If the lamp in the power switch is ON and the green READY lamp remains off, check the CHASSIS GROUND SENSE connections.*

- K) With the READY lamp lit, push the START switch. The HV ON lamp will begin flashing. While the HV ON lamp is flashing, quickly disconnect the CHASSIS GROUND SENSE cable. The FAIL lamp should light and the alarm sound, indicating a Safety Ground failure.

WARNING

DC high voltage is present at the front panel HV receptacle block and the rear panel cylindrical connector when the HV ON lamp flashes.

- L) Push the RESET switch to extinguish the FAIL lamp and the alarm.
- M) Reconnect the CHASSIS GROUND SENSE cable per step "H." The READY lamp should re-illuminate.
- N) Push START. The HV ON lamp will begin flashing and the OUTPUT VOLTAGE meter will indicate the controlled rise to the preset voltage. The HV ON light will remain flashing until the test time has expired or a test failure is detected.

2-11. Fail Indications

Over Current failures are represented with the FAIL lamp and audible alarm coming on continuously until the RESET button is pressed.

Ground Continuity faults are also depicted with the FAIL lamp and audible alarm coming on continuously, and additionally, the READY lamp turns off. The Hipot Tester must be manually RESET.

An Under Current FAIL is indicated with a tone that is about one second long, then the Hipot Tester resets itself.

Option 05 Hands-Off FAIL signal is about two seconds long, and then the Hipot Tester resets itself automatically.

Option 20 Ohm Sense FAIL emits beeps at about 1 to 2 per second until the reset button is pushed. Also, there are no TESTING nor FAIL lights. This does not denote failure.

When Option 10 Audible Test Tone is installed in a Hipot Tester, the alarm will sound pulses at 3 to 6 beeps per second whenever a TEST is in progress.

2-12. Set Current Fail Point

When the I-SET switch is in the "set" position, adjust the I dial on the rear panel until the desired setting is indicated on the current meter [CW (clockwise) to increase.]

2-13. Preset Test Voltage

With the V-SET switch in the "set" position, adjust the V dial to the desired setting (CW to increase.)

Be sure to return the SET switches to the RUN position.

2-14. Preset Test Time/Rise Time

With the A/B switch in the A position, the A Test Time Pot can be adjusted (CW to increase.) A TEST must be in progress to adjust for desired Ramp Rate (rate of rise to full voltage.) Remember, increasing the time will decrease the Ramp Rate.

The "A" test time pot is used to adjust for desired dwell time at full voltage. These adjustments may require starting the TEST several times.

The "B" times are adjusted with the A/B switch in the B position.

2-15. Automatic Test Procedure

Connect the Device Under Test (DUT) to the Hipot Tester output voltage receptacle. Then connect the Chassis Ground Cable between the DC Hipot Tester and an electrical ground of the DUT. If the READY light goes on a solid ground connection is sensed and the testing may proceed; if the READY light does not go on, the ground needs checking.

When the READY light comes on, the DUT is ready to be hipot tested with the START signal coming from the REMOTE or the START Switch.

NOTE: *If the DC Hipot Tester is operated at maximum voltage and maximum current simultaneously, then the operation duty cycle must not exceed 25%—where duty cycle shall be defined as:*

$$\frac{\text{operation time}}{\text{operation time} + \text{rest time}} \times 100\%$$

2-16. Using the DC Hipot Tester with a Rod-L AC Hipot

See the drawings at the rear of this manual, #s 01076-01, 01077-01, and 01076-01. One of these drawings should enable setting up of the DC Hipot Tester with a Ground Continuity Tester and/or AC Hipot Tester.

Ensure the Testers are connected to the same AC Line Power source.

The Ground Tester/Hipot Tester Interface Cable is connected from the AC Hipot Tester to the connector on the Rear Panel of the DC Hipot Tester labeled "AC Hipot," which is the input HV connector. This ties the high voltage, Start, and Reset signals from the AC Hipot Tester, so that the DUT need be connected only into the Front Panel Receptacle of the DC Hipot Tester. Then, when the AC/DC switch is switched to AC, and the Start button on the DC Hipot Tester is pressed, the AC Hipot begins a test, and the high voltage is connected to the Front Panel Receptacle of the DC Hipot Tester.