I-1267

HUBBELL® HIPOTRONICS®
THE MEASURE OF A LEADER

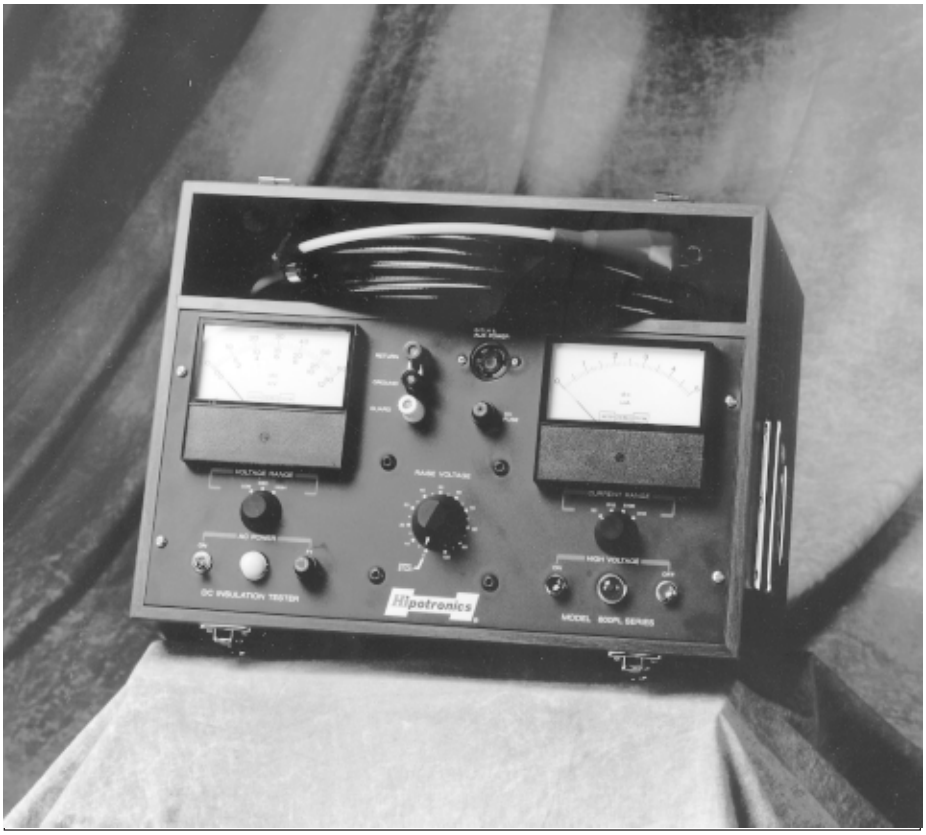
800PL Series
DC Hipot Testers

KEY FEATURES

- Rugged and portable
- One-piece construction
- Shielded output cable
- Guard circuit
- Full-wave voltage doubling rectifier circuit
- Zero start interlock
- Internal discharge on HV OFF
- Meter accuracy ± 2% full scale
- 5 mA current rating for cable charging
- External interlock provisions
- Three range voltmeter
- Four range current meter
- No internal leakage at full load
- Instantaneous overload relay
- Surge-limiting resistors in HV output

BENEFITS

- Ideal for field testing – lightweight, compact, and rugged
- Safe and easy operation
- No exposed high voltage
- Accurate leakage current measurement
- Guard circuit eliminates stray leakage currents



Model 880PL
DC Hipot Tester

APPLICATIONS

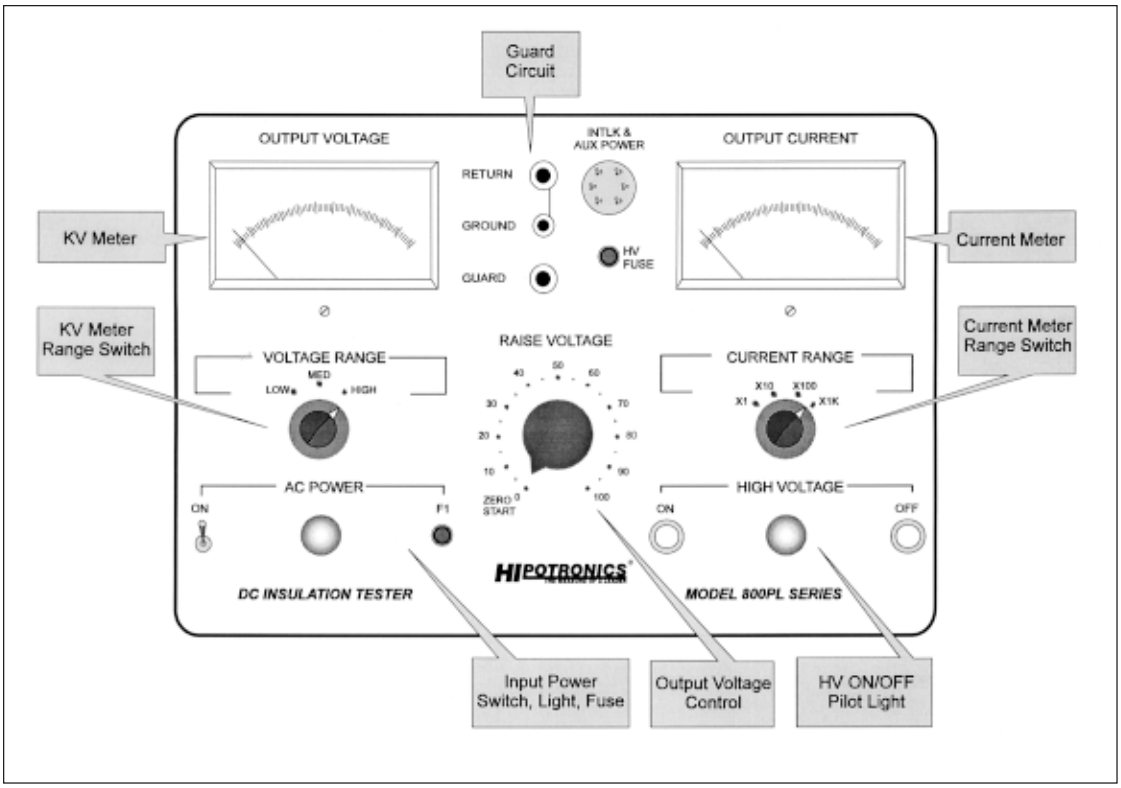
DC Hipot testing of:

- cable
- transformers
- electrical switchgear
- motors
- generators
- other electrical apparatus

DESCRIPTION

The 800PL Series DC hipot testers provide an economical solution to DC field testing of cables, terminations, motors, generators and other electrical apparatus. Models 815PL and 880PL offer 15kV or 80kV respectively. All models are self contained in a single rugged and durable enclosure which is complete from input line cord to high voltage output cable. Cables are conveniently stored inside the case.

The 800 Series testers feature accurate kV meter readings regardless of load current. Accurate voltage and current measurements are assured since voltage readings are taken directly at the output of the high voltage transformer and current measurements are taken in the return leg. Safe discharging of both the test object and the high voltage transformer occur whenever the high voltage is turned off. Output power is provided by means of a full-wave voltage doubling rectifier circuit with silicon rectifiers.



800 PL Panel Detail

SPECIFICATIONS

INPUT VOLTAGE		Model number suffix -A 120 V / 60 Hz Model number suffix -B 220 V / 50 Hz	
MODEL		**815PL**	**880PL**
OUTPUT VOLTAGE		0 - 15 kV	0 - 80 kV
OUTPUT CURRENT		5 mA	5 mA
WEIGHT	**Net.**	47 lb (21 kg)	76 lb (34 kg)
	Ship.	57 lb (26 kg)	86 lb (39 kg)
POLARITY		Negative output, positive ground	
METERING		± 2% full scale accuracy	
RIPPLE		Less than 2.5%	
DIMENSIONS		18" W x 13" D x 13" H (46 x 33 x 33 cm)	
CABLES AND CORDS		Input Line Cord	6 ft (1.8 m) 3 wire & plug, grounded type
		Return Cable	25 ft (7.6 m)
		High Voltage Output Cable	25 ft (7.6 m) shielded RG34/U w/alligator clip & rubber insulated boot

ACCESSORIES

- Spare Parts Kits – Catalog Nos. SPK1-815PL, SPK1-880PL

For further information, contact:

Hipotronics, Inc.
A Subsidiary of Hubbell, Incorporated
Route 22, P. O. Box 414
Brewster, NY 10509, U.S.A.
1-800-727-4476
Tel: 845-279-8091
Fax: 845-279-2467

HUBBELL

HIPOTRONICS®
THE MEASURE OF A LEADER

ROBINSON INSTRUMENTS

USER'S GUIDE

Model Number: 880PL– 10mA-A
880PL– 10mA-B
Part Number: DS11-1244

WARNING

This publication describes a product engineered and designed to measure or operate with **HIGH VOLTAGES**. Accordingly, maximum safeguards have been built into the equipment and the best safety techniques possible are described in the unit's operating instructions. These instructions caution the user to exercise great care when using certain controls at appropriate points in the operating procedures. In addition to following these written warnings, the operator of this equipment is strongly advised to maintain safety consciousness. The following rules are particularly relevant and must be followed at all times.

- Ground the system before connecting input power.
- Disconnect power before un-grounding the system.
- Never approach or touch a potentially live **HIGH VOLTAGE** circuit without solidly connecting an appropriate ground conductor first.

Hipotronics, Inc. - P.O. Box 414 - Route 22 - Brewster, N.Y. - 10509-0414 – (845) 279-3644 – Fax: (845) 279-2467

Table of Contents

About the User's Guide

This user's guide describes the HIPOTRONICS 800PL Series of portable dc insulation test sets. It is intended to provide a simplified reference for users of this equipment, allowing the quick, safe, and efficient use of the unit's features.

Instructions for the following model and its associated part number is included in this user's guide:

Model	880PL 10mA-A	880PL 10mA-B
Part No.	DS11-1244	DS11-1244

Before You Begin

It is assumed that the user has a basic understanding of electrical equipment and the major functions to be performed by the specific unit discussed in this manual. ***Only trained, qualified personnel should operate this equipment.***

Organization of this User's Guide

This user's guide is divided into four major sections, including:

- **General Information**, which discusses the features and specifications of the HIPOTRONICS 800PL series and provides a description of the functions performed by each of the controls and indicators on the front panel.
- **Setting Up the Equipment**, which provides instructions for preparing the unit for test operations.
- **Operating the Equipment**, which provides instructions for performing test operations.
- **Performing Special Operations**, which provides procedures for recalibrating the unit and diagnosing common problems.

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- **Setting Up the Equipment**, which provides instructions for preparing the unit for test operations.
- **Operating the Equipment**, which provides instructions for performing test operations.
- **Performing Special Operations**, which provides procedures for recalibrating the unit and diagnosing common problems.

General Information

This section acquaints the user with the major features and specifications of the HIPOTRONICS 800PL series of portable dc insulation testers and the functions performed by each of the controls and indicators on the front panel.

Features and Specifications

The HIPOTRONICS 800PL series of portable dc insulation testers consists of equipment particularly suited for use in the utility and wire and cable industries. These units are used to test cables, capacitors, and other insulated samples.

Model 880PL-10mA-A operates from an input of 120 volts ac, 50/60 Hz, 10 amps.
Model 880PL-10mA-B operates from an input of 220 / 240 volts ac, 50/60 Hz, 5 amps.

These models are housed in a high impact plastic cabinet containing an oil-filled, hermetically sealed steel container. The storage section at the rear of the cabinet contains two insulated return leads, an auxiliary power plug, a three wire input power cord, and a shielded HV output cable with a connector clamp.

Standard features of the 800PL series of portable dc insulation testers include:

- Triple range kV meter
- Four range current meter
- Adjustable voltage control
- "Zero start" interlock
- Insulated return and guard circuits
- HV shorting solenoid with a discharging resistor
- Provision for an external interlock or "deadman" switch
- Input and backup overload fuses
- Pilot light indicators for ac input and high voltage output.
- Rated output current of 10 mA for 15 minutes (capacitor charging duty)
- Internal circuit protection allowing for repeated short circuits at full output

Figure 1 on Page 3 lists the specifications for these models in the series.

MODEL	OUTPUT VOLTAGE	RIPPLE AT RATED LOAD	REGULATION NL-FL	WEIGHT	SIZE
880PL-10mA	0-80 kV Negative Polarity	2.5 % @ 50 Hz	15 %	76 lb. (34.5 kg)	15¼" H (387 mm) 19¼" W (489 mm) 17" D (432 mm)

Figure 1 *Portable 800PL Series Specifications*

This special 800 PL-10mA has been modified to provide 10mA at 60kV dc. However, all 800 PL Series units are rated for 15 minute duty at 5 milliamperes. The mA rating is not continuous. There is a maximum of 5 minutes 'ON' time with 10 minutes 'OFF' time for component cooling.

Environment

Storage Temperature:	-10° to 45° C
Operating Temperature:	10° to 40° C
Humidity:	Less than 95 percent non-condensing
Altitude:	Less than 1000 meters

Controls and Indicators

A diagram of the front panel for the HIPOTRONICS 800PL Series is displayed in ***Figure 2***. Refer to this diagram, as well as to the actual front panel, when reading the description of the controls and indicators. ***Note that the front panel displayed in Figure 2 may differ slightly from that of the model purchased.***

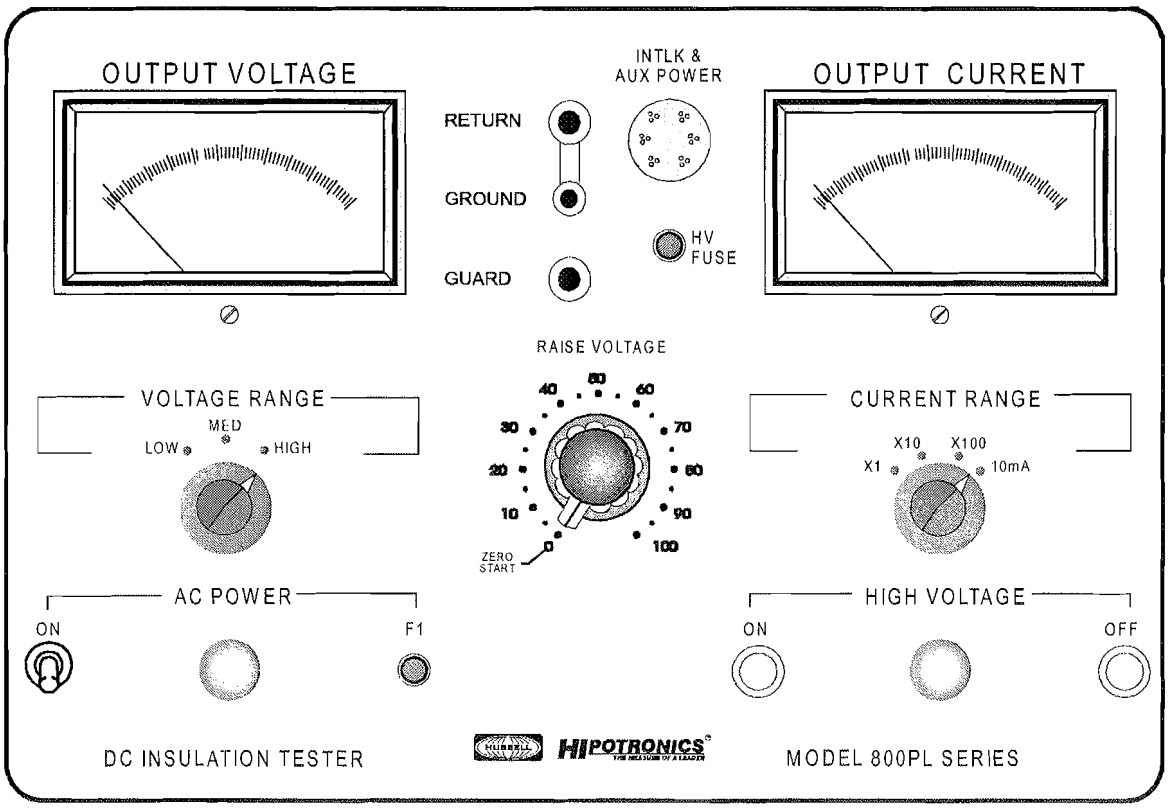


Figure 2 *DC Insulation Tester Front Panel*

Voltmeter and Range Selector

The kilovoltmeter is located at the top left of the front panel and is labeled *DC kV* on the scale. Directly below the meter is a triple-range selector switch, with each range corresponding to a different set of numbers on the scale. The **LOW** range corresponds to the bottom row of numbers, the **MED** range to the middle row, and the **HIGH** range to the top row. The voltmeter indicator should be at 0 when the unit is **OFF**. Minor adjustments may be made via the adjusting screw below the meter window. To make these adjustments, the high voltage must be **OFF**.

Current Meter and Range Selector

The current meter is located at the top right of the front panel and is labeled *DC μA* on the scale. Directly below the meter is a four-range selector switch. To obtain proper dc readings, multiply the scale reading by the factor at which the range selector is positioned. The factors associated with the various range settings are as follows:

Setting	Value	Setting	Value
X1	1	X100	100
X10	10	10mA	10mA

For example, when performing a dc insulation test, the current meter indication is 4 on the dc μA scale and the **CURRENT RANGE** setting is X100. The correct reading is 4 x 100, or 400 μA.

The current meter indicator should be at 0 when the unit is **OFF**. Minor adjustments may be made via the adjusting screw below the meter window. To make these adjustments, the high voltage must be **OFF**.

AC Power Controls

The **AC POWER** section contains an **ON/OFF** toggle switch, a pilot light to indicate that AC power is on, and a current limiting fuse. The current limiting fuse protects the unit and may be removed for replacement by pressing the black cap down while turning it counterclockwise,

High Voltage Controls

The **HIGH VOLTAGE** controls consist of **ON** and **OFF** pushbuttons, a lighted indicator, and a **RAISE VOLTAGE** control. High voltage can be energized by turning the **RAISE VOLTAGE** control to zero (zero start interlock) and pressing the **HV ON** pushbutton. The indicator lights when the high voltage is on. If the **HV OFF** pushbutton is pressed or if the test is terminated by another means, for example, if an overload circuit trips, the indicator light goes out and the high voltage is de-energized.

The **RAISE VOLTAGE** control regulates output voltage. The markings on the control knob indicate the percent of output. ***Keep the RAISE VOLTAGE control set to zero when not in use, and set the control to zero immediately upon completion of a test.***

Interlock and Auxiliary Power Socket

The **INTLK & AUX POWER** socket provides for an external interlock or "deadman" switch, which must be connected to the interlock and the auxiliary power plug provided with the unit. Whether or not this feature is used, the power plug *must* be plugged into the socket in order for the unit to operate.

HV Fuse

The **HV FUSE** is located beneath the **INTLK & AUX POWER** socket and functions as a backup overload fuse. For model 815PL, this is a 5 amp fuse. For Models 880PL – 10mA, 8120-5PL and 8170-5PL this is a 10 amp fuse. This fuse is accessed in the same manner as the **AC POWER** fuse described in this section, and serves both as current surge protection and the overload tripping facility for the unit.

Guard/Ground/Return Connections

There are three connection posts on the front panel labeled **GUARD**, **GROUND**, and **RTN**. **GUARD** or **RTN** must *always* be connected to **GROUND** by a jumper when testing. **Figure 3** and **Figure 4**, illustrate these connections.

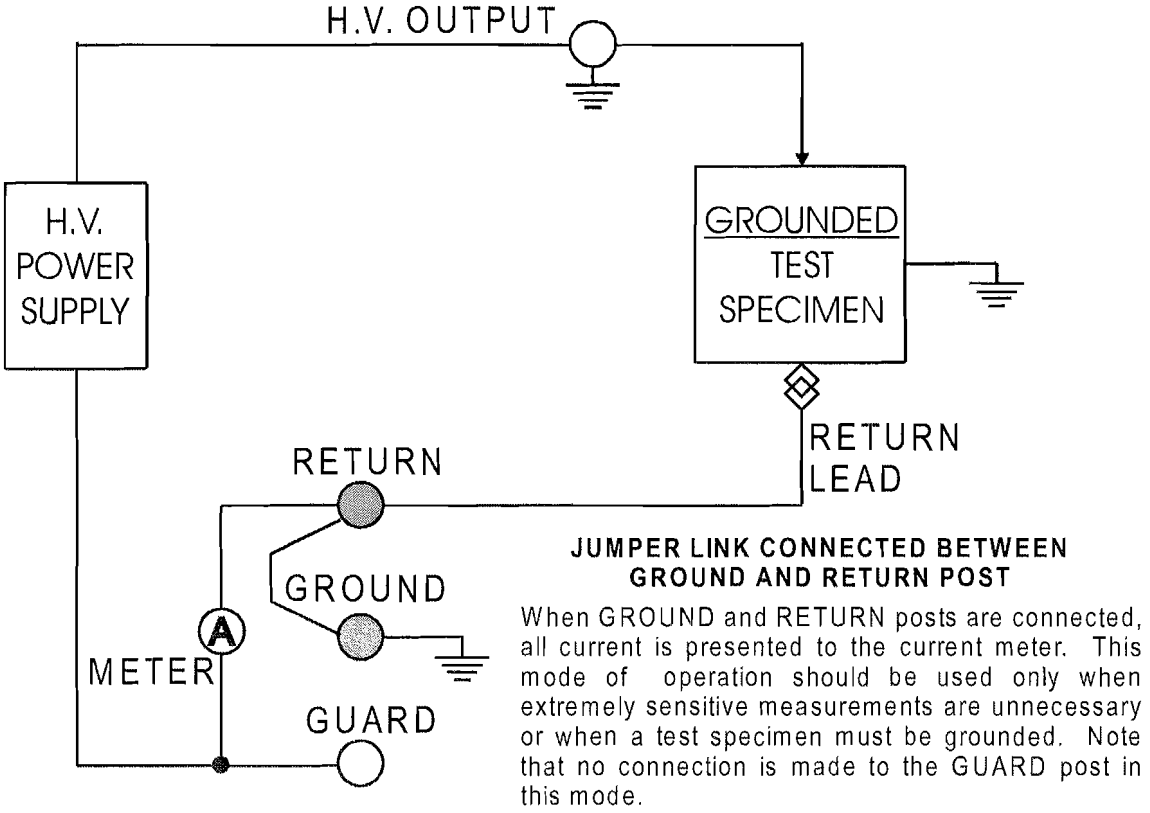


Figure 3 Jumper Link Connected Between Ground and Return PostJumper

Jumper Link Connected Between GROUND and GUARD Posts

The sole function of this mode of operation is to separate the paths of leakage currents. These leakage currents are *leakage to ground* and *leakage across the test specimen*. The leakage currents to **GROUND** are bypassed around the current meter, measuring only the specimen leakage current. The low side (**RETURN**) connection of the specimen must be "floated" (isolated from **GROUND**).

This is typically used for discrete components or when leakage to **GROUND** is to be disregarded. For example, when testing a transformer for leakage (or resistance) between the secondary and the primary, the guarded return mode allows leakage to the core or frame to bypass the meter, thus reading only leakage between the two coils.

It is not possible to test installed cables in this mode of operation, as the cable shields are always grounded, making it impossible to see the leakage current.

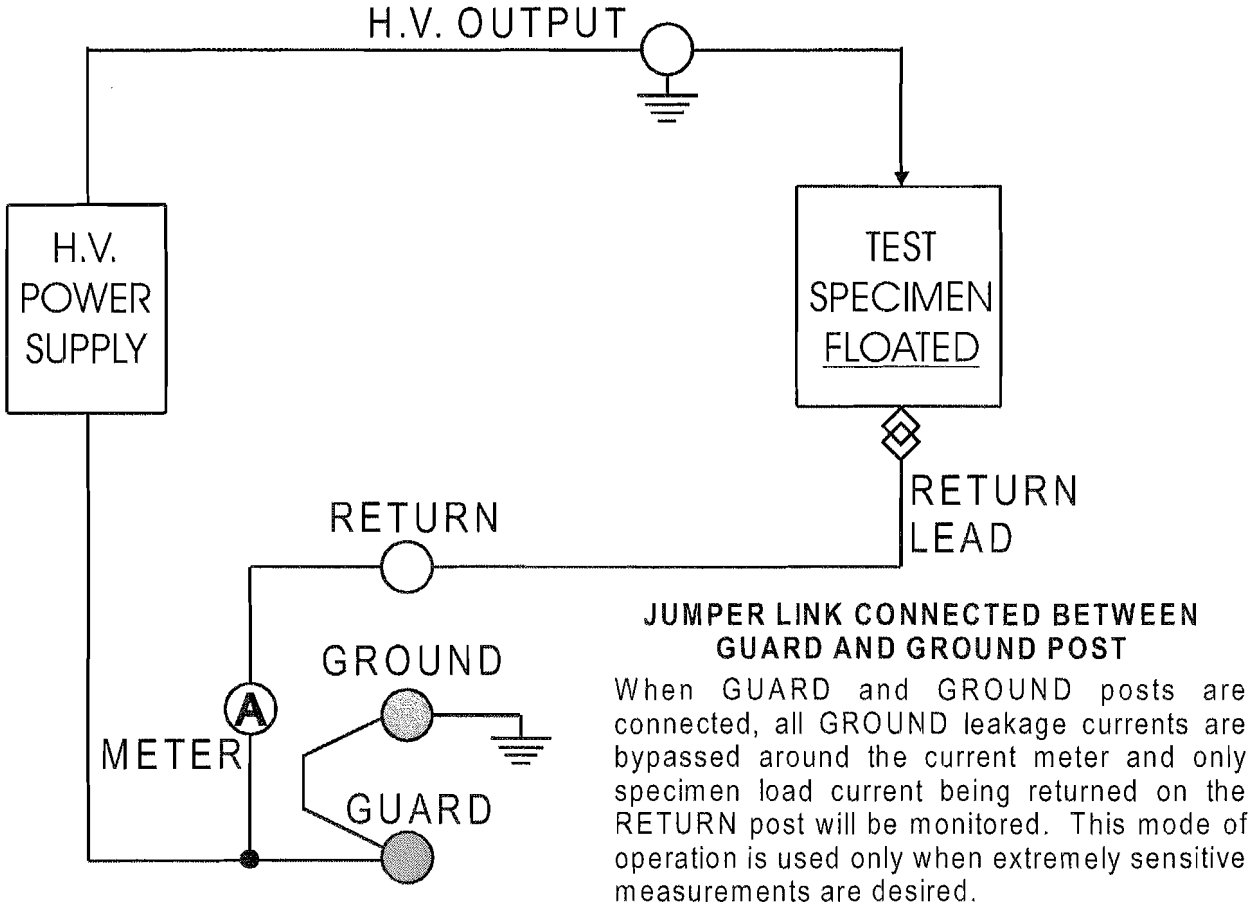


Figure 4 *Jumper Link Connected Between Ground and Guard Post*

Setting Up the Equipment

1. Select a location for the unit that places the meters at a level to allow maximum accuracy when reading.

2. Set the **RAISE VOLTAGE** control to zero and check to ensure that the **AC POWER** switch is **OFF**.

3. ***Ground the unit before connecting input power.*** The **GROUND** post on the front panel may be used for this purpose. Connect the jumper link between the **GROUND** and **RETURN** posts for most cable tests.

4. Insert the 5-pronged shorting plug provided with the unit into the **INTLK & AUX POWER** socket on the front panel. (This plug may also be used as a connector to the external interlock or capacitor discharge unit. See the schematic for pin connections.)

5. Connect the insulated return leads supplied with the unit as illustrated in Figure 3 and Figure 4.

6. For Models 8120-5PL and 8170-5PL, connect a 25-foot interconnect lead between the HV tank and the controls. ***Ensure that the HV tank is grounded to a reliable ground.***

Operating the Equipment

This section provides step-by-step instructions for performing dc insulation testing of one-side grounded and ungrounded samples. In addition, it provides a section with instructions for testing high voltage cable, and a section containing special safety instructions.

Before beginning any test procedures, ensure that the equipment has been properly installed according to the steps in the section of this user's guide titled *Setting Up the Equipment.*

1. Set the **CURRENT RANGE** control to the 10mA range setting.

2. Set the **VOLTAGE RANGE** control to the desired setting for voltmeter reading.

3. Connect the HV output lead to the test sample.

4. Plug the line cord of the unit into a 120 volt, 50/60 Hz outlet. If a 2-prong adapter is used, ***be sure to ground the third wire.***

5. Turn the **AC POWER** toggle switch ON. ***Ensure that the test area is clear of all personnel not directly involved with testing procedures.***

6. Press the **HIGH VOLTAGE ON** pushbutton. The indicator will light.

7. Increase the output voltage to the desired level with the **RAISE VOLTAGE** control. Note that the current meter readings increase along with the voltage.

8. Maintain the output voltage at the desired level for the required amount of test time. Reduce the **CURRENT RANGE** until the needle deflects 10 percent or more for the most accurate leakage reading. Steady voltage must be maintained in order to read leakage rather than charging current.

9. When the test is complete, slowly lower the **RAISE VOLTAGE** control to zero. When the voltmeter reading is zero, press the **HIGH VOLTAGE OFF** pushbutton. Ensure that the **CURRENT RANGE** control is positioned at the highest range (10mA) when reducing voltage to prolong the life of the meter.

10. If the test sample fails, the overload circuit trips **HIGH VOLTAGE OFF** and the internal shorting solenoid will bleed off the remaining charge in the sample.

Testing High Voltage Cables

1. Ensure that all insulators, pot heads, and stress cones are clean and free of dust or moisture.

2. Ensure that the shields of all three cables are grounded and tied together at the near end of the cable.

3. Isolate the far end of the cable conductors under test from each other and from all ground points. They must also be free of all other potential sources of leakage, such as sharp points.

4. When testing each of three conductors separately, two must be grounded to protect against dangerous charge build up, as must other de-energized cables in the test area.

5. Increase voltage slowly, following the test specifications outlined by the cable manufacturer or any other relevant standards. Charging current depends on the rate of rise of the voltage.

6. In an average test of a 3-conductor, 3-phase circuit, the current meter readings should be approximately the same on all three conductors. Higher than expected readings or flashover are indicative of a faulty cable, a poor splice, a dirty pot head or insulator, or cable end leakage.

7. Upon completion of the test, follow the *Turn Off Procedure* on Page 14.

TEST EXAMPLE

One thousand feet of cable rated at 15 kV ac is to be tested for five minutes at a voltage level of approximately 50 kV dc, in accordance with manufacturer's specifications. Using a HIPOTRONICS 880PL unit, (or higher) and by following the installation and operation instructions described previously, it will be noted that current meter readings in the order of magnitude of 100 μA will exist until voltage has been increased to 50 kV dc. Current meter readings then drop off to approximately 10 μA for the duration of the test on a good cable. Current meter readings can vary significantly according to the length and size of the cable under test. Readings can also be affected by damp weather, cable splices, switchgear in the circuit, and voltage change in the input source. For further details, see **Figure 5**.

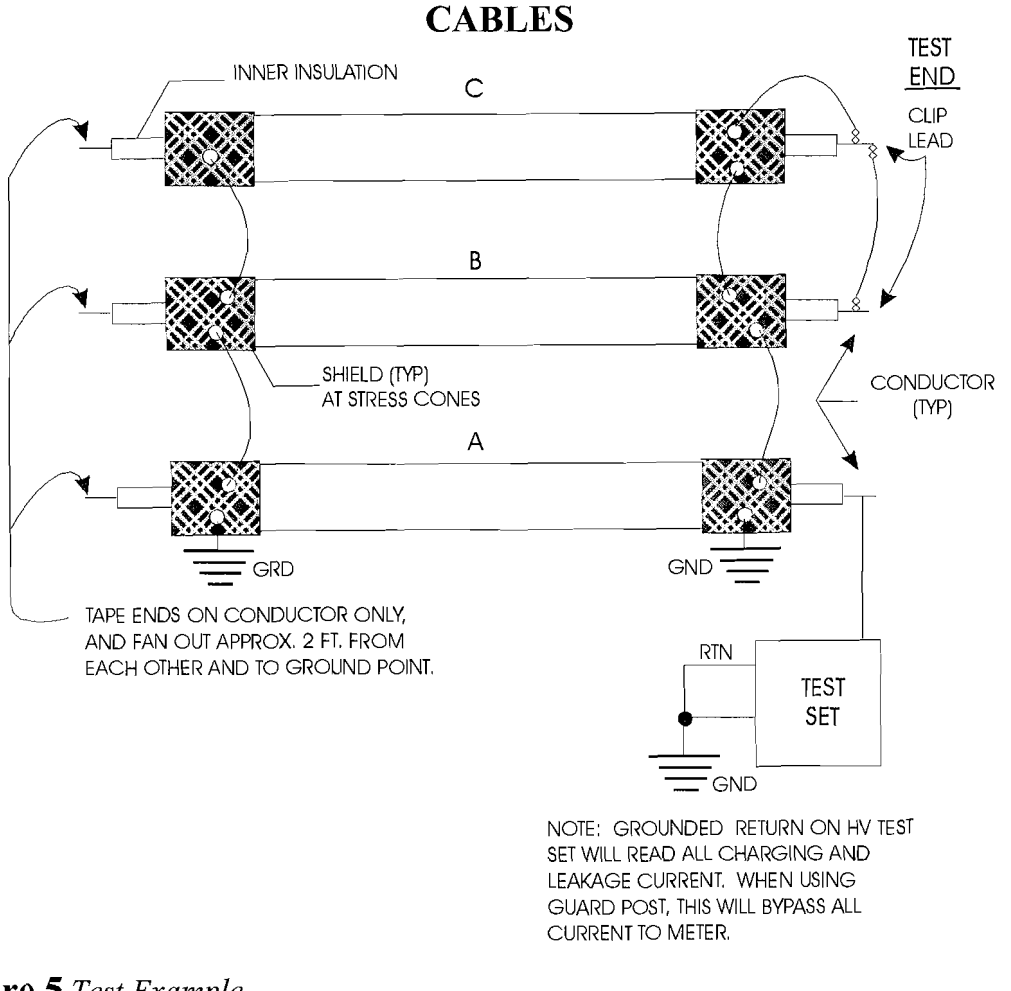
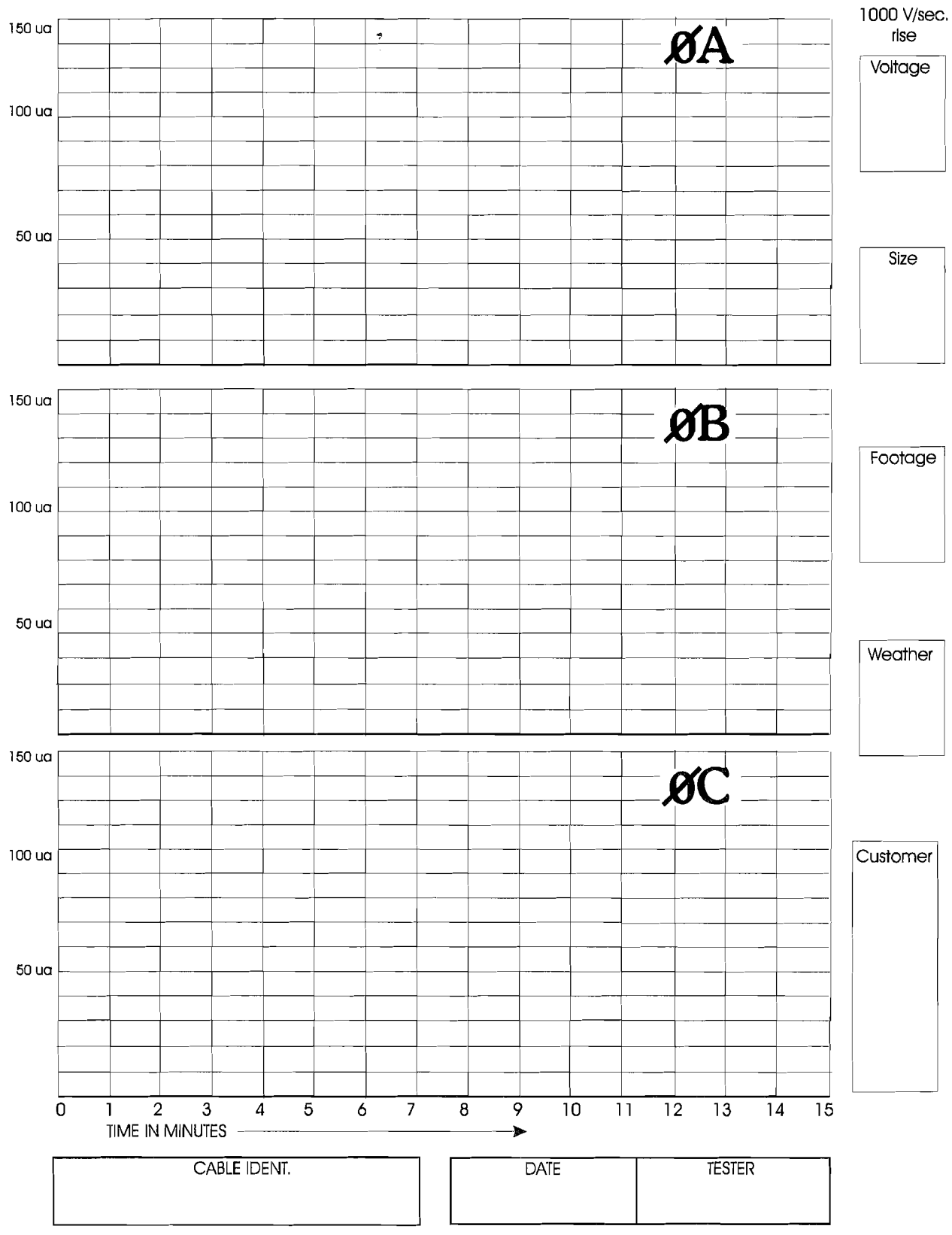


Figure 5 *Test Example*

CABLE TEST RECORD



Special Safety Instructions

Follow these safety procedures upon completion of testing.

Turn Off Procedure

Warning!! ***Never press the* HIGH VOLTAGE OFF *pushbutton or turn off the main power switch immediately upon completion of a high voltage test. When stored energy is greater than 1 kilojoule, allow the energy to bleed down until the voltmeter reading is zero.***

1. Slowly turn the **RAISE VOLTAGE** control to zero. Ensure that **CURRENT RANGE** is set to 10mA.

2. Allow the charged cable to bleed down to approximately 10 kV on the voltmeter or proceed to Step 3.

3. Press HV OFF switch

4. Completely discharge the cable through a resistive grounding (shorting) stick.

5. Attach a solid ground connection before touching the sample.

Completing Tests of Large Capacitive Loads

When completing a dc insulation test of large capacitive loads, the following steps are recommended for the protection of both the user and the equipment.

1. ***Secure a tested, hand-held, resistive grounding (shorting) stick.***

2. Using the hand-held grounding stick, bleed down the charged cable or other capacitive load. This eliminates the unnecessary discharge of a high capacitive cable back into the high voltage section of the 800PL unit when the **HIGH VOLTAGE OFF** pushbutton is pressed.

3. Place a solid earth connection before touching the sample.

Performing Special Operations

The first part of this section describes the step-by-step procedures required to perform meter recalibration. The second part of this section provides suggestions for problem diagnosis and maintenance of the equipment.

Meter Recalibration

HIPOTRONICS meters have been calibrated with standards traceable to national standards maintained by the National Institute of Standards and Technology (NIST) in Washington, DC and are certified accurate to within 2 percent when shipped. Perform meter recalibration as often as necessary to meet the requirements of each particular installation, as dictated by use and by standards for accuracy. Three factors influence the frequency of meter calibration: the amount of physical handling, time lapse, and extent of usage. Intervals between meter recalibration can vary from one month to one year.

The voltmeter potentiometer is accessed through the front panel. The current meter is factory calibrated and need not be adjusted.

Recalibrating the Voltmeter

1. Ensure that the voltmeter is set to zero. Adjust the zero setting screw if necessary.

2. Select a location for the unit that places the voltmeter at a level to allow maximum accuracy for calibration.

3. Set the **RAISE VOLTAGE** control to zero and check to ensure that the **AC POWER** toggle switch is OFF.

4. ***Ground the case before connecting the input power.*** The **GROUND** post on the front panel may be used for this purpose.

5. Ensure that the 5-pronged shorting plug provided with the unit is plugged into the **INTLK & AUX POWER** socket on the front panel.

6. Set **VOLTAGE RANGE** to **LOW**.

7. Connect the **RETURN** post to the **GROUND** post on the front panel with the jumper link.

8. Select a calibrated external voltmeter with a meter range appropriate for the unit to be calibrated (HIPOTRONICS' Model KVM 100 or similar).

9. Connect the low side (ground) of the external voltmeter to the **RETURN** post of the front panel using the insulated return lead supplied with the unit.

Performing Special Operations

The first part of this section describes the step-by-step procedures required to perform meter recalibration. The second part of this section provides suggestions for problem diagnosis and maintenance of the equipment.

Meter Recalibration

HIPOTRONICS meters have been calibrated with standards traceable to national standards maintained by the National Institute of Standards and Technology (NIST) in Washington, DC and are certified accurate to within 2 percent when shipped. Perform meter recalibration as often as necessary to meet the requirements of each particular installation, as dictated by use and by standards for accuracy. Three factors influence the frequency of meter calibration: the amount of physical handling, time lapse, and extent of usage. Intervals between meter recalibration can vary from one month to one year.

The voltmeter potentiometer is accessed through the front panel. The current meter is factory calibrated and need not be adjusted.

Recalibrating the Voltmeter

1. Ensure that the voltmeter is set to zero. Adjust the zero setting screw if necessary.

2. Select a location for the unit that places the voltmeter at a level to allow maximum accuracy for calibration.

3. Set the **RAISE VOLTAGE** control to zero and check to ensure that the **AC POWER** toggle switch is OFF.

4. ***Ground the case before connecting the input power.*** The **GROUND** post on the front panel may be used for this purpose.

5. Ensure that the 5-pronged shorting plug provided with the unit is plugged into the **INTLK & AUX POWER** socket on the front panel.

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8. Select a calibrated external voltmeter with a meter range appropriate for the unit to be calibrated (HIPOTRONICS' Model KVM 100 or similar).

9. Connect the low side (ground) of the external voltmeter to the **RETURN** post of the front panel using the insulated return lead supplied with the unit.

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The voltmeter potentiometer is accessed through the front panel. The current meter is factory calibrated and need not be adjusted.

Recalibrating the Voltmeter

1. Ensure that the voltmeter is set to zero. Adjust the zero setting screw if necessary.

2. Select a location for the unit that places the voltmeter at a level to allow maximum accuracy for calibration.

3. Set the **RAISE VOLTAGE** control to zero and check to ensure that the **AC POWER** toggle switch is OFF.

4. ***Ground the case before connecting the input power.*** The **GROUND** post on the front panel may be used for this purpose.

5. Ensure that the 5-pronged shorting plug provided with the unit is plugged into the **INTLK & AUX POWER** socket on the front panel.

6. Set **VOLTAGE RANGE** to **LOW**.

7. Connect the **RETURN** post to the **GROUND** post on the front panel with the jumper link.

8. Select a calibrated external voltmeter with a meter range appropriate for the unit to be calibrated (HIPOTRONICS' Model KVM 100 or similar).

9. Connect the low side (ground) of the external voltmeter to the **RETURN** post of the front panel using the insulated return lead supplied with the unit.

10. Connect the output of the unit to the high side of the external voltmeter using the shielded high voltage lead supplied with the unit.

11. Unscrew the front panel from the cabinet, tipping the panel vertically and locating the kV calibration potentiometer (pot) in the corner of the circuit board attached to the back of the voltmeter.

12. Secure the front panel in a vertical position, allowing ease of access to the kV calibration potentiometer and accurate meter readings.

13. Turn **VOLTAGE RANGE** to **LOW** and energize the high voltage. Raise the voltage to approximately 70 percent of the full scale on the unit's kilovoltmeter. Note that calibrating the **LOW** range automatically calibrates the **MED** and **HIGH** ranges, but it is recommended that each range be checked individually.

14. Calibrate the unit's meter with the external meter using the calibration potentiometer (2 percent accuracy is recommended).

15. Return the **RAISE VOLTAGE** control to zero and turn the high voltage OFF.

Recalibrating the Current Meter

1. Ensure the unit is properly grounded.

2. Ensure that the current meter is set to zero. Adjust the zero setting screw if necessary.

3. Connect a 4G Ohm, 10W resistor in series with a suitable 1 percent standard current meter between the high voltage output and the ground.

4. Set the **CURRENT RANGE** X1.

5. Turn AC POWER ON and press the **HV ON** pushbutton.

CAUTION
Do not change range or disconnect current meter while HV is energized.

6. Calibrate the Current Meter at 4 μA using calibration potentiometer R1. Check calibration at 1, 2, 3 and 5 μA. Calibration must be within ± .1μA.

7. Return the **RAISE VOLTAGE** control to zero and turn the high voltage OFF.

8. Connect a 400 M Ohm, 10 W resistor in series with a standard Current Meter between the high voltage output and the ground. Set **CURRENT RANGE** to X10. Check calibration at 10, 20, 30, 40, 50 μA. Calibration must be within ± 1μA.

9. Connect a 40 M Ohm, 25 W resistor in series with a standard Current Meter between the high voltage output and the ground. Set **CURRENT RANGE** to X100. Check calibration at 100, 200, 300, 400, 500 μA. Calibration must be within ± 10 μA.

10. Connect a 2 M Ohm, 250 W resistor in series with a standard Current Meter between the high voltage output and the ground. Set **CURRENT RANGE** to 10mA. Check calibration at 2, 4, 6, 8, 10 mA. Calibration must be within ± .2 mA.

Diagnosing Problems

All products shipped by HIPOTRONICS are thoroughly tested against a rigid set of standards by the firm's Quality Control Department. If a unit does not function properly upon delivery, refer to the section titled *Returned Material* at the end of the user's guide.

This section is intended to help the user *locate* the source of a problem when the unit is not functioning or is functioning improperly. The procedures described should be performed by a trained repair technician and are not recommended for individuals trained only to operate the equipment. It is not recommended that repairs be performed while the equipment is under Warranty, as some of the recommended steps may void the Warranty. Contact HIPOTRONICS' Service Department for further information.

Figure 6 lists the most frequently encountered problems, with possible causes and corrective actions. If a more complex problem arises, the enclosed schematics should provide the experienced technician with additional information. See the enclosed *Parts List* to obtain part numbers for all components listed.

PROBLEM	POSSIBLE CAUSE/ CORRECTIVE ACTION
No high voltage output	• Defective F2 fuse. Replace fuse. • INTLK & AUX POWER plug faulty or not plugged in. Plug in the INTLK plug or replace the faulty plug. See J1 in the schematic; prongs 2 and 3 should be connected together. • Zero start faulty. Clean contact between T1 swinger and the arm of the zero start.
Low voltmeter readings	• Voltmeter out of adjustment. Re-calibrate the voltmeter. • Low line voltage. Obtain a reading at the power source and inform the responsible authority.
Erratic high voltage output	• Variac (RAISE VOLTAGE control) brushes dirty or worn. Clean or replace brushes. • Fluctuating line voltage. Obtain reading at power source and inform responsible person.
Overload doesn't trip	• Faulty RYA relay. Replace RYA relay. • C1 capacitor shorted. Replace C1 capacitor. • RYA operation impaired. Check wire harness to ensure it does not impair RYA operation.
Overload trips before hookup	• Short in HV output cable. Replace HV output cable.
Current meter doesn't function	• Jumper clip on front panel not connected properly. Connect jumper clip as illustrated in Figure 3 and Figure 4.
CONTACT HIPOTRONICS' SERVICE DEPARTMENT IF OTHER PROBLEMS OCCUR.	

Figure 6 *Diagnosing Problems*