HIPOTRONICS

HD100 Series AC/DC Hipot Tester

USER MANUAL

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.

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Rev. A

About the User's Guide

This user's guide describes the Hipotronics HD100 Series of AC/DC Hipot Testers. 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.

Information in this user's guide applies to all models in the HD100 series. Specific information for the model purchased includes a diagram of the front panel, a PCB assembly diagram, a parts list, and a schematic diagram.

Before You Begin

It is assumed that the user has a basic understanding of electrical equipment and the functions to be performed by this unit. ***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 HD100 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 overload adjustment, recalibrating the unit, diagnosing problems, and performing maintenance.

Related Publications

The functions, features, and specifications of the HD100 Series are discussed in Section 1 of the Hipotronics product catalog.

General Information

This section acquaints the user with the major features and specifications of the Hipotronics HD100 Series and the functions performed by each of the controls and indicators on the front panel.

Features and Specifications

The HD100 Series of AC/DC Hipot Testers performs ac and dc Hipot testing, the process of testing the dielectric strength of insulation at a chosen voltage by measuring the leakage current through the insulation.

All models operate from an input voltage of 115 or 220V ac, 50/60 Hz, 3 amps, (See Fig. 1) with a rated output current of 5 mA. Each model is equipped with a three-range kilovoltmeter and a four-range current meter. The following table lists *specific* ranges for each model in the HD100 series:

Model	**Output Voltage (kV)**		**Output Current Meter**		**KV Meter Ranges**
	AC	**DC**	**DC**	**AC**	
HD103	2.5	3.0	↑		0-0.6/1.2/3 kV
HD106	5.0	6.0	0-50μA	↑	0-1.2/3/6 kV
HD115	12.0	15.0	0-500μA	0-5 mA	0-3.75/7.5/15 kV
HD125	10.0	25.0	0-5mA	↓	0-5/10/25 kV
HD140	15.0	40.0	↓		0-8/20/40 kV
Dimensional Data:	21" W x 19" D x 11"H (533mm W x 483mm D x 279mm H				
Input:	115V ac, 60 Hz, 3 amp (max.). ("- A" models) 220V ac, 50 Hz, 3 amp (max.). ("- B" models)				
Meters	4½" Meter, 2 percent full scale accuracy				
Options	HV test probe / Spare Parts Kit				

Figure 1 *Hipotronics AC/DC Hipot Testers Specifications*

Standard features of the HD100 Series of AC/DC Hipot Testers include:

- Adjustable output voltage control
- Visual and audible overload indicators with **RESET** pushbutton
- "Zero start" and external interlock provisions
- Analog voltmeter
- Analog current meter
- Meter recalibration potentiometers
- HV ON and OFF pushbuttons
- Input power switch and current limiting fuse
- Indicator pilot lights

- Ground lead and shielded test lead.

Control and Indicators

A diagram of the front panel for the HD100 Series of AC/DC Hipot Testers is displayed in Figure 2. Refer to this diagram, as well as to the front panel itself, 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.***

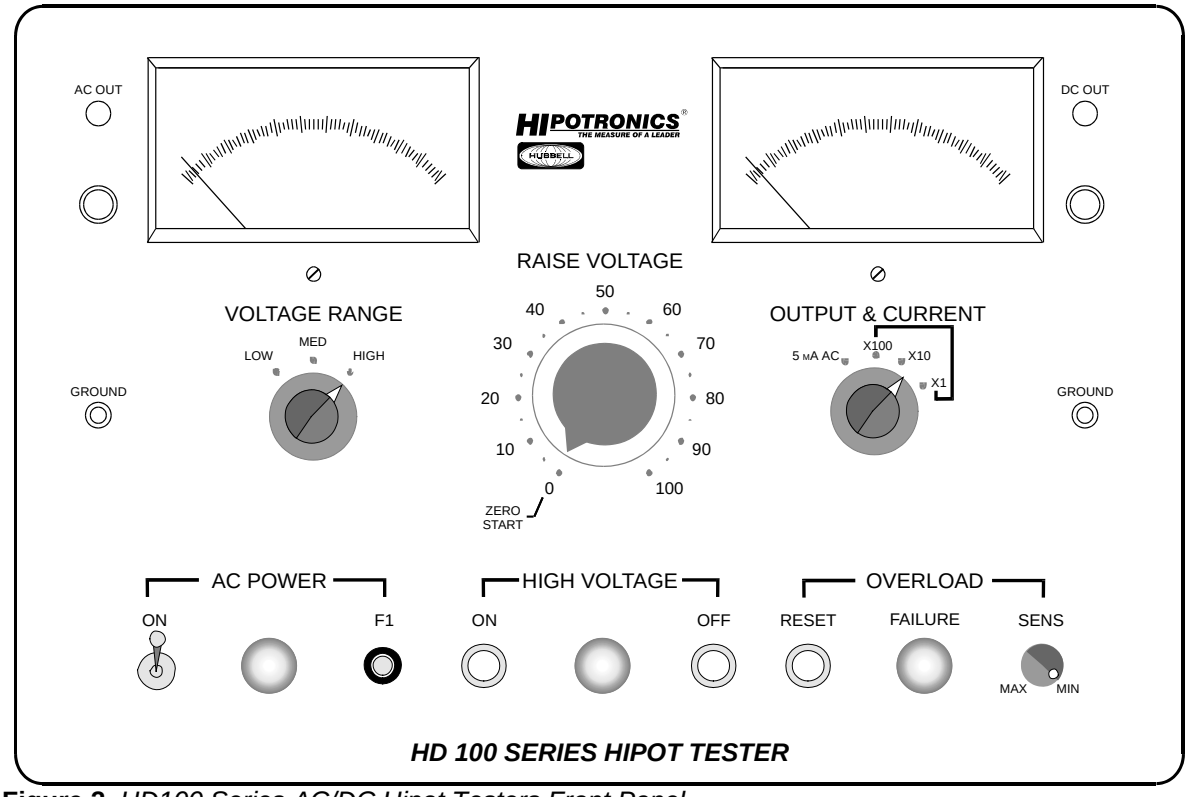

Figure 2 *HD100 Series AC/DC Hipot Testers Front Panel*

Voltmeter and Range Selector

The kilovoltmeter is located on the left side of the front panel and is labeled AC/DC KILOVOLTS on the scale. Directly below the kilovoltmeter is a triple-range selector, 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.

Current Meter and Output & Current Range Selector

The current meter is located on the right side of the front panel and is labeled AC MILLIAMPERES/DC MICROAMPERES on the scale. Directly below the current meter is a four-range selector with one ac range and three dc ranges. When the range selector is in the ac position, readings are obtained from the numbers in red on the scale. When the range selector is in any one of the three dc positions, readings are obtained from the numbers in black and by the appropriate range selector factor. For example, if performing a dc Hipot test with the current meter reading 40 on the dc μA scale and the **OUTPUT & CURRENT** range selector set to X100, the reading would be 40x100, or 4000 μA.

AC/DC Mode of Operation

Mode selection establishes the appropriate metering circuitry (ac or dc). Either ac or dc mode of operation may be selected via the **OUTPUT & CURRENT** range selector. Above the output jack is a corresponding indicator that will light to indicate the mode of operation.

Warning: Both ac and dc output jacks are energized when high voltage is activated.

AC Power Controls

The AC power section of the front panel 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.

Overload

There are two **OVERLOAD** controls, **RESET** and **SENS** (sensitivity), used during Hipot testing. The **RESET** pushbutton must be pressed following a failure to permit further testing and to turn off the indicators. The **SENS** control is used to adjust the overload from 500 μA (**MAX** sensitivity) to 5.5 mA (**MIN** sensitivity). In ac mode, maximum usable sensitivity is approximately 300 μA, due to unavoidable capacitive current flow in the output cable. A red **FAILURE** indicator lights when leakage current from the test sample exceeds the overload (**SENS**) setting.

External Interlock Provision

This system is supplied with terminals at the rear of the control cabinet that enable the user to install safety interlocks in the test area and coordinate them with the set. When these interlocks are open, it is impossible to activate the high

voltage section. The **INTLK OPEN** indicator lights when the interlock system is not secure.

High Voltage Controls

The **HIGH VOLTAGE ON** pushbutton, when pressed, activates the high voltage section. All units are supplied with a zero start feature that prohibits the user from activating the high voltage section unless the **RAISE VOLTAGE** control is at zero. The red indicator lights when the high voltage section is activated. The **HIGH VOLTAGE OFF** pushbutton, when pressed, de-energizes the high voltage section.

Output Jacks

The output jacks are located on each side of the front panel. It is through these output jacks that high voltage is generated. The **AC OUT** jack is used when performing ac Hipot testing, while the **DC OUT** jack is used when performing dc Hipot testing or resistance measurement.

Warning: When the unit is operating, both jacks are energized, regardless of the test being performed. Avoid contact with the unused jack when the unit is on.

Ground Posts

Ground posts are the brass posts used to complete the circuit when testing and are connected to the return side of the HV section through the current meter circuit.

Setting Up the Equipment

This section provides instructions for installing and setting up the HD100 Series Hipot Testers.

1. Select a location for the unit so the meters are at eye level and can be read accurately.
2. Check and secure all external interlocks and ensure that the **AC POWER** switch is OFF.

> ***Warning!!***
> ***To ensure operator safety, external interlocks must be used at all times.***

3. ***Ensure that the case is grounded before connecting input power.*** A ground post on the front panel may be used for this purpose.
4. Plug the cord into a 115 volt, 50/60 Hz outlet. ***If a two-prong adapter is used, be sure to ground the pigtail.***
5. Turn the **AC POWER** switch ON.

Operating the Equipment

This section provides step-by-step instructions for performing ac and dc Hipot testing. Prior to performing these tests, the procedures described in the section of this user's guide titled *Setting Up the Equipment* must be performed.

DC Hipot Testing

To ensure that *only* leakage current from the test sample is recorded on the current meter, remove any other potential sources of leakage in or near the test sample before beginning the test.

1. Set the **OUTPUT & CURRENT** range selector to the appropriate dc current range.
2. ***Ensure that the unit is properly grounded and that the*** **RAISE VOLTAGE** ***control is at zero.***
3. Connect the low end of the test sample to a ground post. The ground lead supplied with the unit may be used for this purpose.
4. Connect the alligator clip of the shielded HV test lead to the high end of the test sample.
5. Set **OVERLOAD** to the desired sensitivity. (See *Overload Adjustment* in the section of this user's guide titled *Performing Special Operations*).
6. Press the **HV ON** pushbutton.
7. Increase output voltage to the desired level by turning the **RAISE VOLTAGE** control.
8. Maintain output voltage at the desired level for the required amount of test time. Note the reading on the current meter.
9. When the test is complete, turn the **RAISE VOLTAGE** control to zero.
10. Wait for the voltmeter reading to return to zero and press the **HIGH VOLTAGE OFF** pushbutton.

Notes:

- If the test sample breaks down, the overload trips and causes the **FAILURE** indicator to light. Press the **RESET** button to reset the system.
- After the **RAISE VOLTAGE** control reaches zero, connect a ground to the high voltage lead to prevent shock.
- To resume testing, ensure that the voltmeter is at zero, disconnect the leads from the test sample, and go to Step 3.

AC Hipot Testing

1. Set the **OUTPUT & CURRENT** range selector to the ac position.
2. ***Ensure that the unit is properly grounded and that the* RAISE VOLTAGE *control is at zero.***
3. Connect the low end of the test sample to a ground post. The ground lead supplied with the unit may be used for this purpose.
4. Connect the alligator clip of the shielded HV test lead to the high end of the test sample.
5. Set **OVERLOAD** to the desired sensitivity. (See *Overload Adjustment* in the section of this user's guide titled *Performing Special Operations*).
6. Press the **HIGH VOLTAGE ON** pushbutton.
7. Increase the output voltage to the desired level by turning the **RAISE VOLTAGE** control.
8. Maintain output voltage at the desired level for the required amount of test time. Note the reading on the current meter.
9. When the test is complete, turn the **RAISE VOLTAGE** control to zero.
10. Wait for the voltmeter reading to return to zero and press the **HIGH VOLTAGE OFF** pushbutton.

Notes:

- If the test sample breaks down, the overload trips and causes the **FAILURE** indicator to light. Press the **RESET** button to reset the system.
- After the **RAISE VOLTAGE** control reaches zero, connect a ground to the high voltage lead to prevent shock.
- To resume testing, ensure that the voltmeter is at zero, disconnect the leads from the test sample, and go to Step 3.

Performing Special Operations

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

Overload Adjustment

Adjusting the overload point (the amount of leakage current that causes the failure signal to be activated) is important for accurate Hipot testing. The HD100 Series Hipot Testers will test for leakage current at any desired point between 500 μA (maximum sensitivity) and 5.5 mA (minimum sensitivity), depending on the **SENS** control setting. If ac testing is being performed, do not set the **SENS** control to the **MAX** setting, as leakage current in most test samples will exceed 50 μA and repeatedly activate the failure signal.

Adjusting the Overload

1. ***Ensure that the unit is properly grounded and that the*** **RAISE VOLTAGE** ***control is at zero.***
2. Set the **OUTPUT & CURRENT** range selector to the appropriate range setting.
3. Connect the low end of the test sample to a ground post. The ground lead supplied with the unit may be used for this purpose.
4. Connect the alligator clip of the shielded HV test lead to the high end of the test sample.
5. Press the **HIGH VOLTAGE ON** pushbutton.
6. Increase the output voltage by turning the **RAISE VOLTAGE** control until the desired level of trip current is indicated on the current meter.
7. Turn the **SENS** control slowly toward **MAX** until the overload trips and shuts off the high voltage. The **FAILURE** indicator lights.
8. Turn the **RAISE VOLTAGE** control to zero. Press the **RESET** button.
9. Verify the accuracy of the **OVERLOAD** setting by repeating Step 7. Note the reading on the current meter when the **FAILURE** indicator lights.
10. If the current meter reading matches the value of the desired trip current leakage, turn the **RAISE VOLTAGE** control to zero and press the **RESET** pushbutton. If the current meter reading *does not* match the value of the desired trip current leakage, turn the **RAISE VOLTAGE** control to zero, press the **RESET** pushbutton, and begin again at Step 6.
11. Ground the high voltage output lead and disconnect the resistive load.

12. Resume ac or dc Hipot testing at Step 5 of the relevant section of this user's manual titled *Operating 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 usage and 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.

Meter recalibration consists of four separate operations to be performed in the following sequence:

- Set-up procedures
- Voltmeter Calibration - AC
- Voltmeter Calibration - DC
- Current Meter Calibration

Setting Up the Unit for Calibration

1. If the unit is enclosed in a cabinet, loosen the four screws on the front panel. Remove the unit from the cabinet.
2. Select a location for the unit so the meters are at eye level and can be read accurately.
3. Ensure that the **AC POWER** switch is **OFF**.
4. Ground the case before connecting the input power. A ground post on the front panel or at the back of the unit may be used for this purpose.
5. Remove the protective dust cover by removing the machine screws from the top and rear of the unit.
6. Plug the cord into a 115 volt, 50/60 Hz outlet. ***If a two-prong adapter is used, be sure to ground the pigtail.***
7. Turn the **AC POWER** switch **ON**. Allow the unit to warm up for at least one minute before calibrating.

Calibrating the Voltmeter – AC

1. ***Ensure that the unit is properly grounded and that the* RAISE VOLTAGE control *is at zero***.
2. Set the **OUTPUT & CURRENT** range selector to **AC** and set the **VOLTAGE RANGE** selector to **LOW**.
3. Connect the low side (ground) of a calibrated external kilovoltmeter to the **GROUND** post of the unit.
4. Connect the alligator clip of the shielded test lead to the high side of the external kilovoltmeter.
5. Increase the output voltage with the **RAISE VOLTAGE** control until the external voltmeter reading is equivalent to two-thirds of the **LOW** kilovolt scale of the unit's meter.
6. With a long, insulated screwdriver, adjust the calibration potentiometer (labeled *AC CAL* on the printed circuit board) until the reading on the unit's meter equals the reading on the external meter. Avoid contact with the high voltage leads connected to the large transformer in the rear of the unit.
7. Turn the **VOLTAGE RANGE** control to **MED** and **HIGH** and check the unit's meter to ensure that these scale readings are accurate. If the unit meter reading at the **HIGH** setting is not accurate, replace resistor R4. If the unit meter reading at the **MED** setting is inaccurate, replace resistor R3.
8. Turn the **RAISE VOLTAGE** control to zero.

Calibrating the Voltmeter – DC

1. ***Ensure that the unit is properly grounded and that the*** **RAISE VOLTAGE** ***control is at zero***.
2. Set the **OUTPUT & CURRENT** range selector to **DC X1** and set the **VOLTAGE RANGE** selector to **LOW**.
3. Connect the low side (ground) of a calibrated external kilovoltmeter to the **GROUND** post of the unit.
4. Connect the alligator clip of the shielded test lead to the high side of the external kilovoltmeter.
5. Increase the output voltage with the **RAISE VOLTAGE** control until the external voltmeter reading is equivalent to two-thirds of the **LOW** kilovolt scale of the unit's meter.
6. With a long, insulated screwdriver, adjust the calibration potentiometer (labeled *DC CAL* on the printed circuit board) until the reading on the unit's meter equals the reading on the external meter. Avoid contact with the high voltage leads connected to the large transformer in the rear of the unit.
7. Turn the **VOLTAGE RANGE** control to **MED** and **HIGH** and check the unit's meter to ensure that these scale readings are accurate. If the unit meter reading at the **HIGH** setting is not accurate, replace resistor R4. If the unit meter reading at the **MED** setting is inaccurate, replace resistor R3.
8. Turn the **RAISE VOLTAGE** control to zero.

Calibrating the AC Current Meter

Note: Current meters in the HD100 Series can only be calibrated in the 5 mA ac range.

1. ***Ensure that the unit is properly grounded and that the* RAISE VOLTAGE *control is set to zero***.
2. Set the **OUTPUT & CURRENT** range selector to **AC.**
3. Select a 250 kΩ, 25 W resistive load and an external current meter with a 0-5 mA ac range.
4. Connect the low side of the external current meter to the unit's ground post, and the high side to one end of the resistive load.
5. Connect the other side of the resistive load to the ac output voltage.
6. Turn the **RAISE VOLTAGE** control until the external current meter reading is 4 mA.
7. Using the calibration potentiometer labeled **CUR CAL**, adjust the unit's meter as necessary to indicate 4 mA.
8. Turn the **RAISE VOLTAGE** control to zero.
9. Disconnect the shielded test lead from the **AC OUT** bushing. Disconnect the leads from the resistive load, the current meter, and the unit's ground post.

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. 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 the Hipotronics Service Department for further information.

Figure 3 lists the most frequently encountered problems, with possible causes and corrective actions. The enclosed schematics provide additional information if a more complex problem arises. See the enclosed *Parts List* to obtain part numbers for all components.

PROBLEM	POSSIBLE CAUSE / CORRECTIVE ACTION
No high voltage output	• Overload not reset. Press RESET pushbutton. • Overload relay contacts connecting. Clean or replace RY1A contacts. • Damage to T2 Transformer or T1 Variac (RAISE VOLTAGE CONTROL). Check output of component with external voltmeter and replace if necessary.
Low voltmeter readings	• Voltmeter out of adjustment. Recalibrate voltmeter. • Low line voltage. Obtain reading at power source and inform responsible authority.
Erratic high voltage output	• Variac (RAISE VOLTAGE CONTROL) brushes dirty or worn. Clean or replace Variac brushes. • Overload relay contacts not connecting properly. Clean or replace RY1A contacts. • Fluctuating line voltage. Obtain reading at power source and inform responsible authority.
AC output OK; no DC output	• Faulty HV output diode and resistor assembly. Replace HV output diode and resistor.
Erratic output current	• Arcing from resistor. Replace resistor. • Internal arcing in T2 transformer. Check output current from T2 transformer and replace if not constant. • Internal arcing in HV tank. Replace HV tank.
Overload does not trip	• Bad 2D21 tube. Replace 2D21 tube. • Failure in power supply. Check voltage at transformer (T1). • SENS resistor value to low. Replace SENS resistor (R4).
Overload trips too soon	• SENS control set improperly. Perform OVERLOAD adjustment. • HV load more than 5 mA. Limit HV load to maximum of 5 mA. • SENS resistor value too high. Replace SENS resistor (R4).
Raising voltage blows fuse (NO LOAD)	• Damage to T1 Variac. Check Variac and brushes for burn marks. Replace if damaged. • Faulty component in HV section. Disconnect input to C1 capacitor and raise voltage. If fuse does not blow, check and replace faulty capacitor C1 or diode CR1 on HV PCB.
CONTACT HIPOTRONICS' SERVICE DEPARTMENT IF OTHER PROBLEMS OCCUR.	

Figure 3 *Diagnosing Problems*

Performing Maintenance

> ***Warning!!***
> ***To ensure operator safety, interconnecting ground and output cables must be inspected regularly for degraded insulation and frayed conductors.***

Cleaning the Equipment Surfaces

Clean the painted surfaces and front panel with a damp cloth and a mild detergent, ensuring that the solution does not come in contact with the electrical circuitry. Clean meter faces and acrylic parts with a residue-free, commercial grade glass cleaner. Periodically, the interior of the unit should be blown out with water-free, filtered compressed air. This prevents dust build-up and extends the operating life of the equipment.

Cleaning the Meter Faces

When a meter acts erratically, clean the face with an anti-static solution such as Crown™ or Statnul ™.

Calibration Pot Wiring For HD125 and HD140

	HD125	HD140
AC CAL	1K	5K
DC CAL	50K	10K
CUR CAL	50K	50K