MODEL 220A

HI INPUT IMPEDANCE VOTLMETER

INSTRUCTION MANUAL

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1.0 Introduction

In many instances, the accurate measurement of D.C. voltages in excess of 1,000 Volts, which are produced by power supplies or voltage dividers with output (source) impedances in excess of 10 megohms, is required. In these situations, most readily available laboratory D.C. voltmeters will be useless since they will have insufficient range and will "load" the source to such a great extent that an accurate measurement is not possible.

1.1 Description

The Model 220A High Input Impedance Voltmeter, shown in Figure 1, is designed for accurate and precise measurement of high voltage D.C. sources where minimal loading of the source is required. The unit has a nominal input resistance of 75 Gigohms (75,000 megohms) and is capable of measuring D.C. voltages up to ±5.00 kilovolts. Accuracy is better than ±1% full scale and the direct reading, 4 ½digit LCD digital readout provides a resolution of 1 Volt.

Figure 1: Model 220A High Input Impedance Voltmeter

As a result of the unit's very high input impedance and high accuracy, voltage sources as high as ±5,000 Volts with source impedances on the order of 100 megohms can be measured with errors of less than ±1% of full scale.

The unit is battery powered, small and lightweight making it ideally suited for both laboratory and portable field use. The highly efficient circuit design utilizes two standard (user replaceable) 9 Volt alkaline batteries, which provide an operating life of more than one (1) year under normal use.

The 4 ½digit LCD (Liquid Crystal Display) digital readout displays the measure voltage directly in kilovolts and includes a polarity indicator. In addition to the digital readout, the unit contains two LEDs (light emitting diodes) which provide for automatic overscale and battery low indication. The battery low indicator illuminates automatically to warn the user that an end of battery life condition exists. The overscale indicator warns the user that the input range of the unit has been exceeded. The circuits within the Model 220A are protected against overscale inputs and external transients.

The unit is supplied with a high voltage probe assembly consisting of a 6" long (red) H.V. probe with a 12" grounding cable and a 42" coaxial cable which is terminated in a high voltage BNC type connector. The cable plugs directly into a mating BNC connector, which is located on the front panel of the Voltmeter.

1.2 SPECIFICATIONS

1.2.1 Electrical

Voltage Range:	0 to ±5.00 Kilovolts D.C.
Absolute Maximum input:	±6.5kV
Input Resistance:	75 Gigohms ±10%
Accuracy:	±1.0% of full scale (max) at 25º C.
Resolution:	1 Volt
Settling Time:	5 seconds (max) to within ±0.5% of final reading.
Overscale Indication Threshold:	±5.55 kV ±5%
Power source:	Two 9Volt alkaline batteries,

1.2.2 Mechanical

Size:	7½" wide, 8 ¾" deep, 2" high
Weight:	2 lbs. (nominal)
Probe Cable Length:	4'

1.2.3 Environmental

Operating Temperature Range:	0 to 50 degrees C
Temperature coefficient:	±200 ppm/deg C (max)
Humidity:	0 to 70% RH (non-condensing)

2.0 OPERATION

2.1 Initial Setup

Connect the High Voltage Probe to the Voltmeter by gently pushing the BNC type connector at the end of the probe cable onto the mating **INPUT** connector located on the front of the Voltmeter. After the two connectors are mated, gently twist the outer ring of the cable connector **CLOCKWISE** about ¼ turn to lock it into place. (When removing the probe assembly, reverse this procedure.) **NOTE: NEVER FORCE THE BNC CONNECTOR WHEN CONNECTING IT TO THE VOLTMETER - DAMAGE MAY RESULT.**

If desired, the two front feet on the bottom of the Voltmeter case may be flipped down to tilt the Voltmeter upward toward the user, making it easier to read.

2.2 Power On

To activate the meter, place the POWER ON/OFF switch in the ON position (switch up). Observe the H.V. readout. It should read 0.000 kilovolts when the power is on and the High Voltage Probe is not connected to any voltage source. The POWER ON/OFF switch is the only control on the unit. It must always be placed in the OFF (switch down) position when the Voltmeter is not in use to ensure maximum battery life. Failure to turn the unit OFF when not in use will result in frequent battery replacement.

2.2.1 Initial Status Check

With the POWER ON and zero voltage input to the Voltmeter, check the OVERVOLTAGE and BAT LO indicators. They should both be OFF (not illuminated). If the BAT LO indicator is on, replace the batteries before making any measurements. If the OVERVOLTAGE indicator is on, or the voltage readout does not read 0.00 with a zero voltage input, the Voltmeter is not functioning properly and should be tested and repaired before using it to make any HV measurements.

2.3 Voltage Measurements

After the unit has been turned on and checked as indicated in Section 2.2, the High Voltage Probe may be connected and voltage

measurements made. To measure the D.C. voltage level of any high voltage source, first connect the BLACK GROUND CLIP on the probe to a suitable ground (zero voltage) point. The pointed metal tip of the RED HIGH VOLTAGE PROBE is then placed in contact with the high voltage point whose voltage potential is to be measured. The digital readout on the Voltmeter will then display the desired voltage directly in kilovolts. A polarity sign will appear to the left of the voltage readout to indicate the polarity of the measured voltage. Because of the extremely high input impedance of the meter, a minimum of 5 seconds should be allowed for the readout to stabilize after the probe contacts the voltage point being measured.

When making high voltage measurements of sources with very high output impedances, the user should hold only the RED PLASTIC BODY of the voltage probe. Depending on the nature of the voltage source being measured, if the user touches a ground point, the meter case, or other parts of the probe assembly (cable, BNC connector, etc.) while a measurement is being made, the accuracy of the measurement may be affected.

2.3.1 Alternate Grounding Method

If it is not possible (or not desirable) to use the BLACK GROUND CLIP on the high voltage probe, the GND connection on the rear panel of the Voltmeter housing may be used to connect the Voltmeter to system ground (zero potential). Any suitable grounding wire may be used.

*****IMPORTANT NOTICE*****

THE BLACK GROUND CLIP ON THE HIGH VOLTAGE PROBE IS CONNECTED DIRECTLY TO THE METAL CASE OF THE VOLTMETER. THIS GROUND CLIP, OR THE GROUND LUG ON THE REAR OF THE METER CASE, SHOULD ALWAYS BE CONNECTED TO GROUND (ZERO VOLTS) RELATIVE TO THE VOLTAGE BEING MEASURED. IF THIS IS NOT DONE, THE CASE OF THE METER MAY BE AT A HIGH (POTENTIALLY DANGEROUS) VOLTAGE LEVEL, AND INJURY TO PERSONNEL MAY RESULT IF THE CASE IS TOUCHED.

2.3.2 Overvoltage Condition

If the high voltage input to the Voltmeter exceeds approximately ±5.5kV, the meter will automatically switch to the OVERVOLTAGE mode and warn the user that the input range has been exceeded. The first indication will be the

illumination of the YELLOW OVERVOLTAGE indicator, which is located directly below the INPUT connector. The second indication will be the display of a “1” preceded by a polarity sign on the digital readout. The input circuits to the meter are overvoltage protected, however, inputs in excess of ±6.5kV may cause corona and/or arcing in the probe, probe cable, or connector. This in turn may cause damage to these parts; thus, inputs of over ±6.5kV must be avoided.

2.4 Controls

2.4.1 Power On/Off

This toggle switch controls the on/off status of the unit. When in the ON (switch up) position, the power is on and the unit is fully functional. When the switch is in the off (switch down) position, the power is off and the battery drain is zero. Place the POWER ON/OFF switch in the OFF position when the unit is not in use for maximum battery life. To conserve power, the only POWER ON indication will be activation of the LCD voltage readout.

2.5 Readout and Indicators

The meter contains one digital readout and two indicators, which function when the power is on.

2.5.1 Digital Voltmeter (DVM)

The DVM is used when making normal high voltage measurements with the instrument. It is also used to display an overvoltage condition.

2.5.1.1 Normal Range Display

When the high voltage input to the Voltmeter is within the nominal range of ±5.00 kVDC of the system, the DVM will indicate the value of the voltage being measured directly in kilovolts. The sign to the left of the number is the polarity of the input voltage. When the input to the Voltmeter is zero, the DVM must read 0.000 ± .001kV. The system is autozeroing hence, no external zero adjustment is provided nor is one required.

2.5.1.2 Overvoltage Display

When the input to the meter exceeds ±5.50 KVDC (±5%), the DVM will indicate this overscale condition by displaying a "1" preceded by a sign which represents the polarity of the overvoltage. When the input to the Voltmeter is reduced to within the normal measurement range (i.e., below ±5.00kV), the readout will automatically return to normal.

2.5.2 Overvoltage Indicator

This YELLOW LED (Light Emitting Diode) will illuminate when an overvoltage condition exists, that is, when the input to the Voltmeter exceeds ±5.5kV. It will automatically go off when the input returns to its normal range.

2.5.3 Battery Low Indicator

The RED "BAT LO" LED indicator will illuminate when either of the Voltmeter's two batteries reach the end of its normal life. Since the system is designed to drain both batteries equally, when a Battery Low condition is indicated, BOTH BATTERIES SHOULD BE REPLACED AS A SET. The efficient design of the system should provide a battery life of at least one (1) year under normal use. This assumes that the Voltmeter is turned on only when measurements are being made, and not left on for long periods when not in use.

2.6 Input Protection

The circuits within the Voltmeter have been designed to be resistant to both external high voltage events and overvoltages, which may be directly impressed on the input to the Voltmeter, however, there are certain limits, which must be observed. The High Voltage Probe assembly is designed to allow measurements to be safely made up to ±5.0kV. The components and materials in the probe assembly and BNC connectors are designed to operate up to ±6.5 kVDC, hence, **±6.5 kVDC IS THE ABSOLUTE MAXIMUM RATING FOR THE SYSTEM**. Should voltages in excess of this maximum limit be impressed on the system via the probe or directly at the BNC INPUT connector, corona and/or arcing may occur and may permanently damage these components. This damage is **not covered** by the manufacturer's warranty.

3.0 MAINTENANCE AND CALIBRATION

The Model 220A High Input Impedance Voltmeter is designed and constructed to operate with a minimum of maintenance. Other than the replacement of the system's two 9-Volt batteries when indicated by the system's battery self test circuit, no other maintenance is required.

3.1 Battery Replacement

To replace the unit's 9-Volt batteries, disconnect the high voltage probe from any voltage source being measured and turn off the power switch on the meter's front panel. On the rear parel is a 2-drawer battery compartment. Lift up each drawer and pull out. Remove the old batteries and insert the new ones. Be careful to observe the polarity. REPLACE THE BATTERIES AS A SET with 9-Volt alkaline cells. NOTE: 9 Volt NON-ALKALINE batteries may be used, but with reduced battery life. Normal use may now be resumed.

3.2 Calibration

As with any test instrument, normal component aging and drift will require that the system be tested and calibrated by a qualified test and calibration facility on a periodic basis to insure that the unit is performing within its specification limits. It is recommended that the system be fully tested and calibrated on an annual basis (once each year). If it is used in a harsh environment where the instrument is exposed to wide temperature or humidity extremes or is subjected to shock and vibration, a more frequent test and calibration schedule may be indicated.

Because of the unit's extremely high input impedance, tight performance specifications, and the specialized nature of the test equipment required for proper test and calibration, only a qualified facility should be used for this purpose. The following information is provided to aid in testing and calibrating the unit, but must be performed with the proper equipment and by qualified personnel.

3.2.1 Input Offset Calibration

With the input to the unit set to exactly 0.000 Volts adjust R14 so that the voltage at the DVM pin 7 (measured with respect to DVM pin 6) is 0.000 Volts ±0.0005 Volts.

3.2.2 Attenuator Calibration

Using a precision high voltage power supply capable of producing a regulated DC output over the range from -6.00 kV to +6.00 kV. Connect the supply to the meter's input and set the supply for an output of =5.000 kV ±.020 kV. Adjust R8 so that the displayed voltage on the unit's digital readout agrees with the simulated high voltage input to within ±0.5%. Check the meter indication at –5.000 kV and at levels of ±1.000, ±2.000, ±3.000 and ±4.000 kV for accuracy.

NOTE:

The P.C. board and the entire high impedance, high voltage input divider has been conformably coated with a special coating. To insure that this unit performs properly at all voltage levels and in all specified environments, the integrity of this coating must be maintained. Should repair of the unit be necessary, the conformal coating must be restored in any areas affected by such repairs.

3.2.3 Overvoltage Circuit Test

Using the same power supply as in 3.2.2, increase the input voltage above ±5.00kV and measure the overvoltage turn on threshold. It should be ±5.55 kV ±5%. NOTE: There is no adjustment for these thresholds since they are determined by fixed precision resistors in the overvoltage threshold circuits.

3.2.4 Top Cover Removal

To gain access to the printed circuit board for test and/or calibration purposes, the top cover of the unit must be removed. To do this, remove the two (2) screws, which secure the front plastic bezel to the unit. Remove the bezel by sliding it forward. The top cover may now be removed by prying the front edge upward and sliding it forward until it is free. Reverse this procedure to replace the cover and bezel.

3.3 ESD Sensitivity

This unit contains active (semiconductor) devices that are static sensitive. When testing, repairing or calibrating this unit, proper precautions must be taken to insure that these sensitive circuits are not damaged by improperly grounded personnel, soldering irons, or test equipment.

4.0 WARRANTY

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice and will, at the discretion of Seller, either replace or repair without charge, F.O.B. Glenside, similar equipment or similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment which are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

The warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer or if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties and the Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products which it may produce and the buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA(Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. If the original packaging is not available, the equipment must be packed in a sufficiently large box (or boxes if applicable) of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner's responsibility.

WARNING

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