electro-tech systems

High Impedance Voltmeter

ETS Model 220B Operating Manual

D01654

Table of Contents

Revision History:

Revision A: Legacy version 2018

Revision B: Released 2020-11-05. Reformat, add new address.

Products described in this manual are designed and assembled in the U.S.A. by

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I. IMPORTANT SAFETY INFORMATION

SAFETY INSTRUCTIONS

The equipment described in this Manual is designed and manufactured to operate within defined design limits. Any misuse may result in injury, electric shock, or discomfort to a person, incorrect readings, or damage to the equipment. The following rules should be observed for installation, use and maintenance. **Read the following safety instructions before operating the instrument.**

POWER

The unit may be operated as a battery powered device using two standard 9V rectangular batteries, or as a plug-in AC device using the supplied 18V wall adaptor. The highly efficient circuit design provides an operating life of about one (1) year under normal use for two 9 Volt alkaline batteries

OPERATION

DO NOT OPERATE WITH COVERS OR PANELS REMOVED. The unit handles input voltages as high as 10,000 volts and all circuitry should be kept enclosed.

The metal enclosure of the unit must be connected to house ground or zero volts with respect to the circuit being measured. If this is not done, the case of the meter may be at a dangerous potential capable of causing injury or discomfort if touched.

The unit includes a high voltage probe and cable. The probe can become charged. Accidentally touching this probe after measuring a high voltage can result in a mild shock. Probe tip is sharp – avoid a puncture wound.

The unit uses standard 9V batteries. Ensure that the batteries are inserted in the proper polarity. Keep any spare batteries separated and the terminals covered, since shorting the 2 terminals to metal or to another battery will result in damage or fire hazard.

DO NOT OPERATE WITH SUSPECTED EQUIPMENT FAILURES. If any odor or smoke becomes apparent turn off the equipment and unplug it immediately. Failure to do so may result in electrical shock, fire or permanent damage to the equipment. Contact the factory for further instructions.

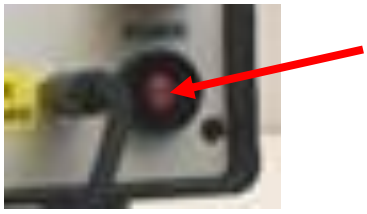
DO NOT USE IN ANY MANNER NOT SPECIFIED OR APPROVED BY THE MANUFACTURER: Unapproved use may result in damage to the equipment or present an electrical shock or fire hazard.

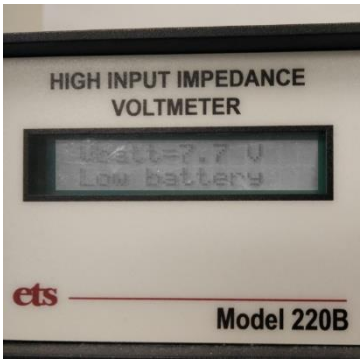
II. Description of Contents

Included:

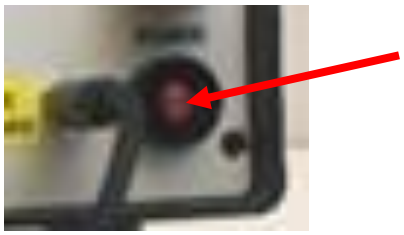
Item	Qty.	Description
Model 220B	1	Circuitry in a metal enclosure with attached 42-inch probe cable with red clip probe.
Ground Cable 1	1	A 42-inch black rubber cable featuring a black banana plug and an alligator clip
Ground Cable 2	1	A 5’ black rubber cable featuring a green banana plug and a alligator clip
Communication Cable	1	A 6-foot cable with DB9 female connectors on each end
Power Adapter	1	Wall-plug-in 18V power module., 100-260VAC input, 8.1W output with attached cable and molded plug. ETS part # 0111-00001A

III. Set-Up Guide

	**Step 1 – Unpack the unit** Verify all parts are present and have survived shipping.
	**Step 2 Initial Setup** Connect the BLACK grounding cable to the banana jack (GND) on the front panel. If desired, the bail on the bottom of the Voltmeter case may be flipped down to tilt the Voltmeter upward toward the user, making it easier to read.
	**Step 3 Power On** Insert two new 9V batteries in the battery compartment, or connect the 18V wall adapter. Push the POWER ON/OFF switch to ON position (display on). The display readout should be active. If the adapter is in use, the display will be illuminated..
BATTERY USE CAUTION!	**The POWER ON/OFF switch** is the only control on the unit. If using battery power, always switch to the OFF position (display off) 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.

	**Step 4 - Initial Status Check** A. If the BATT LO condition is on, replace the batteries (2x9V) before making any measurements. See the instructions in Section VI of this manual.
	B. Apply zero voltage input to the Voltmeter by clipping ground cable to HV probe as shown. Display should read 0 volts.
	C. With 0 volts applied, if the voltage meter does not read 0V, or if the OVER SCALE condition is on, the Voltmeter is not functioning properly and should be tested and repaired before using it to make any HV measurements.

IV. Quick Start Guide

	**Step 1 – Turn on Power** Turn on Power, verify display is active.
 	**Step 2 – Probe the Voltage** First connect the ALLIGATOR CLIP on the grounding cable to a suitable ground (zero voltage) point. Then hold the RED HIGH VOLTAGE PROBE by its red plastic body and place the pointed metal tip in contact with the circuit to be measured.
	**Step 3 – Display** The digital readout will then display the measured voltage directly in volts. A polarity sign will appear to the left of the voltage readout to indicate the polarity of the voltage. Because of the extremely high input impedance of the meter, allow a minimum of 5 seconds for the readout to stabilize after the probe is in contact with the voltage point being measured.

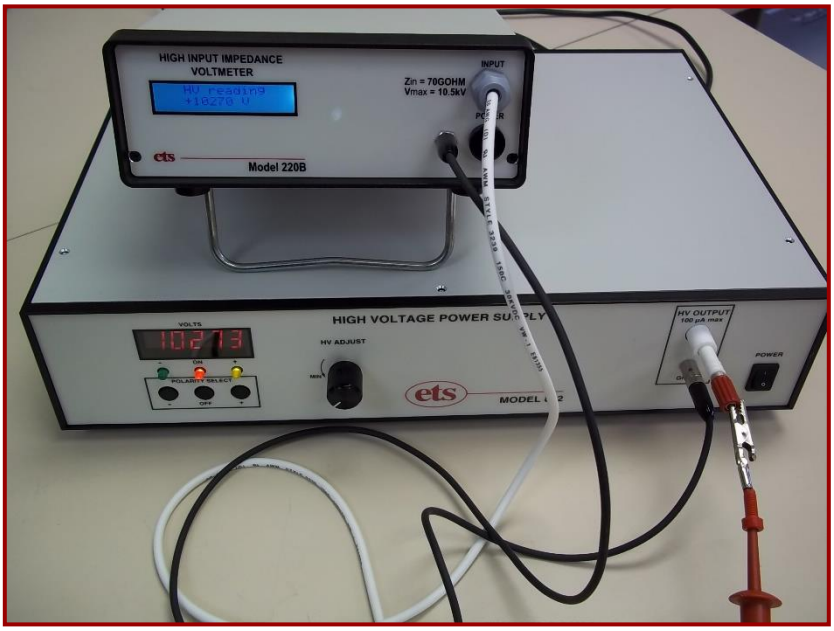
V. Functionality

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.

Description

The Model 220B High Input Impedance Voltmeter, shown in Figure 1-1, 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 70 Gigohms (70,000 Megohms) and is capable of measuring D.C. voltages up to ±10,000 volts. Accuracy is better than ±1% full scale and the direct reading, digital readout provides a resolution of 1 Volt.



Model 220B High Input Impedance Voltmeter
Measuring output from Model 812 High Voltage Power Supply

As a result of the unit's very high input impedance and high accuracy, voltage sources as high as ±10,000 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 or an AC wall adaptor can be used to provide power. It is 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 about one (1) year under normal use.

The digital meter displays the measure voltage directly in ±volts. The digital meter also provides a low battery indication to warn the user that the batteries should be changed. An over-scale indication warns the user that the input range of the unit has been exceeded. The circuits within the Model 220B are protected against over-scale inputs and external transients.

The unit is supplied with a high voltage probe assembly consisting of a 6" (152mm) long (red) H.V. probe on a 42" (1m) H.V. cable with a 42" (1m) grounding cable. The H.V. cable is connected directly to the unit via a pass-through on the front panel of the Voltmeter. The grounding cable plugs into the banana jack on the front panel.

SPECIFICATIONS

Electrical

Voltage Range:	0 to ±10,000 volts D.C.
Absolute Maximum input:	±11,000 V
Input Resistance:	70 GigOhms ± 10%
Input Capacitance	150 pF ± 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 Threshold:	±10,500 V ±5%
Power source:	Two 9Volt alkaline batteries, or AC Wall adapter (included) providing 18VDC,

Mechanical

Size:	7½" wide, 10" deep, 3" high
Weight:	2 lbs. (nominal)
Probe Cable Length:	42"

Environmental

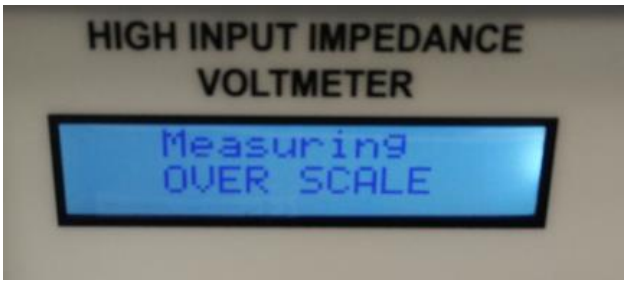
Operating Temperature Range:	0 to 50 degrees C
Temperature coefficient:	±200 ppm/deg C (max)
Humidity:	0 to 70% RH (non-condensing)

VI. Operation of the Model 220B

Display Details

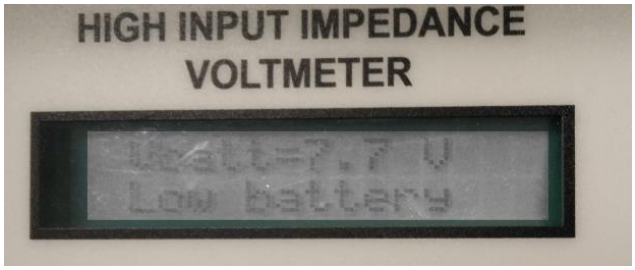
The meter contains a dot-matrix display readout that functions when power is on. When the high voltage input to the Voltmeter is within the nominal range of ±10,000VDC, the display will indicate the value of the voltage being measured directly in volts. The sign to the left of the number is the polarity of the input voltage. When the input to the Voltmeter is zero, the DVM should read 0 ± 1V. The system is auto-zeroing hence, no external zero adjustment is provided nor is one required.

Backlit illumination of the display is provided when the unit is operating on AC power.



Over-Voltage Indication

When the input to the meter exceeds ±10,500VDC (±5%) the DVM will indicate this over-scale condition by displaying a warning message. When the input to the Voltmeter is reduced to within the normal measurement range (i.e., below ±10,500VDC), the readout will automatically return to normal.



Battery Low Indication

The meter will warn the end user when either of the Voltmeter's two batteries reaches the end of its normal life. When a Battery Low condition is indicated, **BOTH 9-VOLT 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.

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 panel 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 BOTH BATTERIES AS A SET with new 9-Volt cells. Alkaline or non-alkaline batteries may be used. Normal use may now be resumed.

Measurement technique

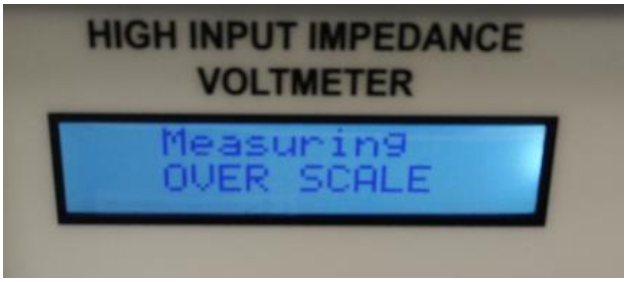
When making high voltage measurements of sources with very high output impedances, the user should hold only the RED PLASTIC BODY of the voltage probe. Depending on the nature of the voltage source being measured, if the user touches a ground point, the meter case, or other parts of the probe assembly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

GROUNDING

The black ground clip on the grounding cable 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 house ground or 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.**

Alternate Grounding Method

If it is not possible (or not desirable) to use the ALLIGATOR CLIP on the grounding cable, 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 or the included GREEN CABLE.



Over-Voltage Condition

If the high voltage input to the Voltmeter exceeds approximately ±10,500V, the meter will automatically switch to the OVER SCALE mode and warn the user that the input range has been exceeded. The input circuits to the meter are over-voltage protected, however, inputs in excess of ±10,500V must be avoided.

Input Protection

The Voltmeter circuits have been designed to be resistant to both external high voltage events and over-voltages. The High Voltage Probe assembly is designed to allow measurements to be safely made up to ±10,500VDC. The components and materials in the probe are designed to operate up to ±10,500VDC, hence, **±10,500VDC IS THE ABSOLUTE MAXIMUM RATING FOR THE SYSTEM**. Voltages in excess of this maximum limit may permanently damage the unit. This damage is **not covered** by the manufacturer's warranty.

VII. Maintenance and Calibration

Calibration

For consistency of performance Annual manufacturer conducted calibration is required.

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.

Calibration addresses the following parameters:

1. Input Offset. With the grounding clip attached to the probe tip, the unit should read 0.0V.
2. Scale. Accuracy is checked at ±500V, ±1,000, ±2,000, ±4,000, ±6,000, ±8,000 and ±10,000 V
3. Over-Voltage detection threshold ±10,500 V

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.

To return equipment to ETS for calibration or repair it is first necessary to obtain a RMA number, please call 215-887-2196 or email service@ets2.com

VIII. 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. Perkasie, Pennsylvania, 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 that 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.

Appendix A. Computer Interface

The Model 220B has a 9-Pin sub min-D RS232A COMM PORT (Note 1) that provides real time data through serial communication. A PC will receive data by simply sending character R (for result) to the device. A simple program must be written by the user in order to collect data. The data can then be transferred to a spreadsheet or other program to obtain the desired data logging and/or analysis. To utilize this function connect a standard 9 Pin sub min-D null modem cable to the serial port of the PC. The cable is the standard 3-wire null modem connection (2 to 3, 3 to 2 and 5 to 5).

To collect data without writing a program, standard Hyper Terminal from any windows operating system can be used. In most computers, to bring up the Hyper Terminal program click on “Start” (lower left hand corner), select Accessories then Communications then Hyper Terminal. Under “Connect using” (on some older Terminals it is the “Phone number”) select the correct COMM port, which the supplied cable is connected to. Set the following properties:

Baud rate:	9600
Data bit:	8
Stop bit:	1
Parity:	None
Flow Control:	None

For the computer to receive the data, depress “R” to send the command signal to the ETS220B. The ETS 220B sends what is on the liquid crystal display. If the LCD displays OVERSCALE or Low Battery, the unit will send the same message. The actual result will be sent as on the LCD displays to the host computer.

Note 1: Use ETS provided Null Modem cable to be sure of proper connections.