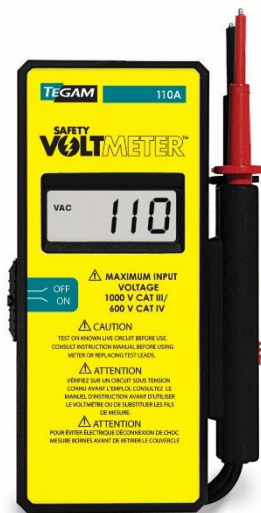


# Safety Voltmeter MODEL 110A



Instruction Manual  
PN# 110A-901-01E  
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REV. F

NOTE: This User's Manual was as current as possible when this product was manufactured. However, products are constantly being updated and improved. To ensure you have the latest documentation, refer to [www.tegam.com](http://www.tegam.com)



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## SECTION 1

### INSTRUMENT DESCRIPTION

#### INTRODUCTION

The Model 110A Safety Voltmeter is the only single switch, single range, digital voltmeter that automatically measures AC & DC volts to 1000 V for voltage troubleshooting, line clearing, lock out/tag out procedures and anywhere hazardous voltages may be present. The 110A has a 1 M $\Omega$  current limiting resistor in each lead to protect the user against arc-flash potential.

Model 110A meets Category IV 600 V and Category III 1000 V Overvoltage protection under IEC-61010-1.

#### SPECIFICATIONS

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**FUNCTIONS:** VDC/VAC, with automatic selection. When both DC and AC input voltages are present, the voltage type with the higher magnitude is selected and displayed.

**RANGES:**  $\pm 1000$  VDC. 1000 VAC (45-500 Hz, average responding, calibrated in RMS of a sine wave).

**RESOLUTION:** 1 V

**ACCURACY:**  $\pm(0.2\% \text{ rdg} + 1 \text{ volt})$ , DC, 50-60 Hz, 64 to 82 °F.

**MAXIMUM ALLOWABLE INPUT:** 1000 volts continuous. Overload annunciator (OL) turns on above 999 volts.

**OVERVOLTAGE TEST:** High Pot tested at 2500 VAC for < 5 sec.

**NORMAL MODE REJECTION:** AC Rejection (VDC Mode): > 40 dB. DC Rejection (VAC Mode): 40 dB typ. (for DC voltage < 10% peak AC voltage).

**READING RATE:** 2.5 readings/second

**INPUT RESISTANCE:** 10 M $\Omega$  (8 M $\Omega$  in voltmeter, 1 M $\Omega$  in each attached input probe)

**DISPLAY:** 0.5" LCD (3 ½ digits), polarity, and annunciators for VAC, VDC, OL, Low Battery.

**INPUT PROBES:** Permanently attached to voltmeter. Sheathed tips with retracting sleeves. PVC insulated leads, 36" long.

**POWER:** 9 V alkaline or carbon-zinc battery (NEDA 1604).

**BATTERY LIFE:** 200 hours typical, alkaline.

**ENVIRONMENTAL LIMITS FOR OPERATING:** -10 to 150 °F, less

than 80% R.H. up to 95 °F. Reduce R.H. limit by 1.7% per °F above 95 °F.

**ENVIRONMENTAL LIMITS FOR STORAGE:** -30 to 150 °F, less than 90% R.H. up to 95 °F. Reduce RH limit by 1.7% per °F above 95 °F.

**ENVIRONMENTAL/TIME LIMITS TO ACCURACY:** 64° to 82 °F, 80% R.H., 1 year.

**TEMPERATURE COEFFICIENT:** From 64 °F to 82 °F; included in accuracy specifications. Below 64 °F and above 82 °F; less than 0.05 times applicable specifications per °F.

**LOW-BATTERY INDICATOR:** Display indicates 'BAT' when less than 10% of life remains.

**AUTOMATIC TURN-OFF:** Voltmeter turns off after 10 minutes of operation. Turns off below 6.5 V battery voltage.

**SIZE:** 6.3" x 2.7" x 1.2"

**WEIGHT:** 12 oz.

**CONSTRUCTION:** Heavy-duty ABS plastic housing.

**INCLUDED ACCESSORIES:** Battery, Operating Instructions.

## ACCESSORIES SHEET



### 1104 - Leather Utility Belt Carrying Case

The 1104 case protects your voltmeter and probes from broken displays and other damages that can occur. This case has a 2 in. belt loop. It is long lasting, super durable, and is made from top-grain cowhide with riveted seams.



### 1204 - Cordura Nylon lineman's Carrying Case

The 1204 case protects your voltmeter and saves you time because the meter can stay in the case during use. It features a window to access the ON/OFF switch, a retainer that holds the meter in place, space for probe storage and a 22 in. shoulder strap. It also comes with a belt clip and can be worn on a utility belt. *Size- 5 ½ x 7 ½ x 1 ½ in. (W x H x D).*



### **12501 - Alligator Clip Adapter**

The 12501 probe adapter kit allows you to convert your test leads to alligator clips. The kit includes two screw-on probe adapters and two heavy duty screw in alligator clips with insulating rubber boots. These alligator clips open to ½ in. and fit most terminals and bus bars.



### **12502 - Universal Adapter Kit**

The 12502 probe adapter kit includes two screw-on probe adapters and interchangeable screw-in accessories including two alligator clips with insulating rubber boots, two banana plugs, two needle tips, two spade lugs and two heavy duty tips. With this kit you can adapt your voltmeter to the many different situations you encounter on the job.

### **PN 110-404**

Replacement probe/test-lead set (1 red, 1 black) for Model 110A.



## SECTION 2

### PREPARATION FOR USE

#### UNPACKING AND INSPECTION

Each instrument is inspected both mechanically and electrically before shipment. Upon receiving your instrument unpack all items from the shipping container and check for any obvious damage that may have occurred during transit. Report any damage to the shipping agent. Retain and use the original packing materials if reshipment is necessary.

#### PREPARATION FOR USE

Each instrument is supplied with a 9 V battery. See page 3-8 of this manual for battery installation instructions.

#### OPERATION

The Model 110A digital voltmeter (DVM) is easy to use. There is only one control (located on the side of the instrument) that turns the instrument ON/OFF (Figure 1).

After turn-on, the instrument automatically selects either VDC or VAC function. VDC is selected if the magnitude of a DC input voltage is greater than the peak value of any AC voltage present. Otherwise the VAC function is enabled. VAC and VDC annunciators in the liquid crystal display indicate the selected function. Observe the maximum allowable input (1000 V continuous).

After approximately 10 minutes, the voltmeter turns off automatically to conserve battery life. To turn the voltmeter on

again, return the ON/OFF switch to the OFF position, and then back to the ON position.

When battery voltage drops below 6.5 V, the voltmeter turns off until a new battery is installed (Refer to Battery Installation Section).

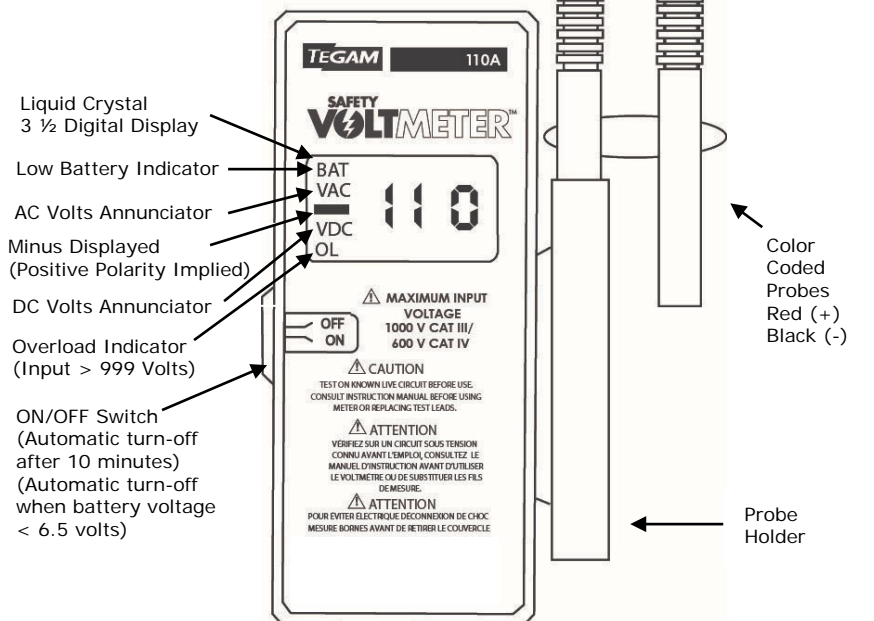
## **OPERATING CONDITIONS**

In accordance with the Standard for Electrical Measuring and Test Equipment IEC-61010-1, the TEGAM Model 110A Safety Voltmeter is designed for safe operation under the following conditions:

- Indoor use, or outdoor use in where the instrument and probes remain dry (i.e. protected from exposure to rain, fluids, or condensing humidity).
- Altitudes up to 2000 m above mean sea-level.
- Temperature:  $-23\text{ }^{\circ}\text{C}$  to  $65\text{ }^{\circ}\text{C}$
- Relative humidity: 80% R.H. up to  $35\text{ }^{\circ}\text{C}$ , decreasing linearly to 0% R.H. at  $60\text{ }^{\circ}\text{C}$ .
- Power source: 9 V transistor battery (NEDA 1604), alkaline or carbon-zinc type. The voltmeter automatically turns off before battery discharge can cause malfunction.
- Pollution: Degree 2 per IEC 664.
- Installation Category IV (up to 600 V) / Category III (up to 1000 V)

**NOTE:**

In operate position, install probe with "TEGAM" marking facing to right. To store probe, remove from probe-holder, rotate "TEGAM" marking toward rear, and reinsert into holder.





**Figure 1: Model 110A Front Panel**

## SECTION 3

### SAFETY AND MAINTENANCE

#### SAFETY SYMBOLS AND TERMS

The symbol  on the instrument denotes that the user should refer to the operating instructions.

The symbol  on the instrument denotes that 750 V or more may be present on the terminal(s).

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

#### SAFETY PRECAUTIONS

Fundamental safe work practices recommend testing any voltmeter on a known low-energy source before and after use.

#### WARNING

**The following safety precautions should be observed before operating the Model 110A DVM.**

**Les précautions de sécurité suivantes doivent être respectées avant d'utiliser le modèle 110A DVM.**

1. This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read over the

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- manual carefully before operating this instrument.
2. Exercise extreme caution when a shock hazard is present at the instrument's input. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 Vrms or 42.4 Vpeak are present. A good safety practice is to expect that a hazardous voltage is present in any unknown circuit before measuring.
  3. Inspect the test leads for possible wear, cracks or breaks before each use. If any defects are found, replace immediately with P/N 110-404 probe/test-lead set. Refer to Maintenance Information section.
  4. For optimum safety do not touch the test leads or the instrument while power is applied to the circuit under test. Turn the power off and discharge all capacitors, before connecting or disconnecting the instrument.
  5. Do not touch any objects which could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface, capable of withstanding the voltage being measured.
  6. Exercise extreme caution when testing high energy power circuits (AC power lines, etc.).
  7. Do not exceed the instrument's maximum allowable input as defined in the specifications and printed on the front panel of the instrument.

## OPTIONAL SAFETY TESTS

TEGAM, Inc. recommends periodic safety inspections for all high voltage equipment. With the Model 110A, users may wish to check probe resistance and instrument over-voltage capability in order to find safety hazards (actual or potential) due to product damage and/or wear.

### WARNING

**The information presented in this section is intended for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing unless you are qualified to do so.**

### AVERTISSEMENT

**L'information présentée dans cette section est destinée à être utilisée par du personnel qualifié. Pour réduire le risque de choc électrique, ne pas effectuer l'entretien, sauf si vous êtes qualifié pour le faire.**

### WARNING

**Disconnect probes from external circuits before performing safety tests.**

### AVERTISSEMENT

**Débrancher les sondes de circuits externes avant d'effectuer les tests de sécurité.**

## Probe Resistance Check

Open the DVM case (see Battery Installation/Replacement section) and measure the resistance between each probe tip and the circuit-board eyelet terminating the respective probe lead-wire. Each probe should measure  $1\text{ M}\Omega \pm 1\%$ . An excessively high or low resistance measurement indicates probe failure due to electrical overload or

mechanical wear. Replace defective probes immediately. (Refer to Maintenance Information section.) Close DVM case.

### **Differential HI -POT Test**

Apply a momentary (< 5 seconds) 2500 VAC hi-pot between the tips of the two test probes. There should be no voltage breakdown across the probes or instrument. Units failing this test should be returned to TEGAM for diagnosis and repair.

### **Common Mode HI -POT Test**

Wrap the test leads and the instrument in a single sheet of aluminum foil. About 1" -2" of the tips of each probe should extend outside the foil wrap. Apply a momentary (< 5 seconds) 2500 VAC hi-pot between one probe tip and the foil wrap. No breakdown should be observed. Repeat this test for the other probe tip. Units failing this test should be returned to TEGAM for diagnosis and repair.

## MAINTENANCE INFORMATION

This section contains information needed to maintain your instrument. The following information is included: probe replacement procedure, functionality checks, performance verification, and battery installation/replacement.

### WARNING

**The information presented in this section is intended for use by qualified personnel only. To reduce risk of electric shock, do not perform any servicing unless you are qualified to do so.**

### AVERTISSEMENT

**L'information présentée dans cette section est destinée à être utilisée par du personnel qualifié. Pour réduire les risques de choc électrique, ne pas effectuer l'entretien, sauf si vous êtes qualifié pour le faire.**

## Test Lead Replacement

### WARNING

**Replacing test leads with anything other than a TEGAM P/N 110-404 probe/test-lead set will degrade accuracy, reduce meter overload protection, and pose a serious safety hazard to the user.**

### AVERTISSEMENT

**Remplacement essai conduit avec d'autres d'une TEGAM P / N 110-404 sonde / test-tête ensemble tout va dégrader la précision, réduire mètre protection contre les surcharges, et poser un risque grave pour la sécurité de l'utilisateur.**



**WARNING**

**Disconnect probes from external circuits and turn the instrument off before removing the bottom cover. Reinstall the cover before resuming use of the instrument.**

**AVERTISSEMENT**

**Débrancher les sondes de circuits externes et éteindre l'appareil avant de retirer le couvercle inférieur. Remettre le couvercle avant de reprendre l'utilisation de l'instrument.**

Open the voltmeter case (see Battery Installation/Replacement section), and cut the (2) strain relief cable ties that secure the test-leads to the circuit board. Next, remove the circuit board from the top case by unscrewing the hexagonal spacer in the center of the board. Use a small soldering iron (< 75 W) to remove the test-leads from the circuit board eyelets. Pull the old probe/test-lead set free of the voltmeter case.

To install the new lead set, push the leads through the top case holes, and solder into the appropriate eyelets (red-probe connects to +eyelet, black-probe connects to -eyelet). To secure the test leads, use the cable ties supplied with the replacement lead set. Allow a lead length of 23-28 mm (0.9-1.1 inches) between the circuit-board eyelets and the respective cable ties. Use a cable-tie tool with a tension setting of 35-55 N (8-12 lb.) to install the cables ties.

Reinstall the circuit board into the top case. Check that the fish paper barrier at the switch opening is securely attached to the top case. Before the bottom case is reattached, be sure that the switch actuator cover is in place.

Confirm meter operation (refer to Performance Verification, page 3-7).

## FUNCTIONALITY CHECKS

### 1. ZERO

Switch on the DVM, and touch the probe tips together. Meter should read 0 VDC or 0 VAC. An occasional reading flicker to 1 V is normal.

### 2. DC VOLTS

Touch the black probe to the negative terminal of a fresh 9 volt transistor battery (alkaline or carbon-zinc), and touch the red probe to the positive terminal. A reading of 9-10 VDC should be displayed. Reverse the probes. The same reading except for a minus polarity should be displayed.

### 3. AC VOLTS

Connect the DVM probes to the hot and neutral outlets of a standard 120 VAC power receptacle. Under normal line conditions, a reading of  $120 \pm 10$  VAC should be displayed.

## PERFORMANCE VERIFICATION

Equipment needed:

- 750 VDC voltage source with 0.05% accuracy or better
- 750 VAC, 60 Hz voltage source with 0.05% accuracy or better
- Ohmmeter with 0.1% accuracy or better at 10 M $\Omega$ .

Turn on the DVM, and use the voltage sources and the following table to verify that readings are within specifications.

Input	Allowable Reading
Shorted	$0 \pm 1$
+ 750 VDC	$750 \pm 3$ VDC
-750 VDC	$-750 \pm 3$ VDC
750 VAC	$750 \pm 3$ VAC

**TABLE 1: Verification Summary**

Keep the DVM turned on, and measure the resistance between the probe tips. A measurement of 9.89-10.11 M $\Omega$  confirms integrity of the high voltage resistors inside the probes and meter.

If DVM readings and input resistance are out of specification, check the probes further for possible failure. Refer to Probe Resistance Check section.

## BATTERY INSTALLATION/REPLACEMENT

### WARNING

Disconnect probes from external circuits and turn the instrument off before removing the bottom cover. Reinstall the cover before resuming use of the instrument.

### AVERTISSEMENT

Débrancher les sondes de circuits externes et éteindre l'appareil avant de retirer le couvercle inférieur. Remettre le couvercle avant de reprendre l'utilisation de l'instrument.

1. Place the unit facing down on a bench or other similar surface and remove the screws from the bottom cover.
2. Separate the bottom cover from the rest of the instrument by grasping the top of the case (just above display) and carefully lifting it away from the display.

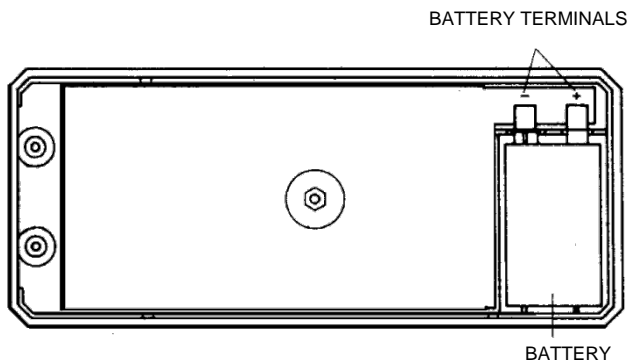


Figure 2: Battery Installation

3. Remove the old battery.
  4. Place the new battery in the battery compartment. Be sure to
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observe the proper polarity (refer to Figure 2).

5. Reinstall the bottom cover before resuming use of the instrument.

## CLEANING INSTRUCTIONS

Before cleaning a Model 110A voltmeter, disconnect the voltmeter probes from electrical sources, and turn off the voltmeter. Use a soft non-abrasive cloth dampened with a water-detergent solution to clean outside surfaces of the voltmeter. Squeeze excess moisture from the cloth so that no liquid residue is left on the voltmeter. Do not allow moisture to accumulate on any surface or penetrate case openings or crevices. **Do not attempt to clean the inside of the voltmeter.** Allow 24 hours for the voltmeter to dry at room-temperature before resuming operation.



## SECTION 4

### SERVICE INFORMATION

#### PREPARATION FOR CALIBRATION OR REPAIR SERVICE

Once you have verified that the cause for 110A malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA, (Returned Material Authorization), number. You can contact TEGAM customer service via the TEGAM website, [www.tegam.com](http://www.tegam.com) or by calling 440.466.6100 (*All Locations*) or 800.666.1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify your instrument and to address the particular service request by you which is assigned to that RMA number.

Of even greater importance, a detailed written description of the problem should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or of a detailed description of the problem.

This description should include information such as measurement range, and other instrument settings, type of components being tested, are the symptoms intermittent?, conditions that may cause the symptoms, has anything changed since the last time the instrument was used?, etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use a copy of the Repair and Calibration Service form provided on the next page.

Once this information is prepared and sent with the instrument to our service department, we will do our part in making sure that you receive the best possible customer service and turnaround time possible.

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## EXPEDITE REPAIR & CALIBRATION FORM

Use this form to provide additional repair information and service instructions. The Completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

### Repair Instructions:

- Evaluation       Calibration Only       Repair Only  
 Repair & Calibration       Z540 (Extra Charge)

### Detailed Symptoms:

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent?, Has anything changed with the application since the last time the instrument was used?, etc.




## WARRANTY

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

TEGAM, Inc. warrants the calibration of this product for a period of one year from date of shipment. During this period, TEGAM, Inc. will recalibrate any product, which does not conform to the published accuracy specifications.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever period is longer.

## Warranty Limitations

*The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.*

The foregoing warranty of TEGAM is in lieu of all other warranties, expressed or implied. TEGAM specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. In no event will TEGAM be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranty of TEGAM shall be to return the item to TEGAM; shipping charges prepaid and at the option of TEGAM obtain a replacement item or a refund of the purchase price.

## Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by TEGAM Inc. The accuracy and calibration of this instrument are traceable to the National Institute of Standards and Technology through equipment, which is calibrated at planned intervals by comparison to certified standards maintained in the laboratories of TEGAM Inc.

### Contact Information

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