



TEGAM is a manufacturer of electronic test and measurement equipment for metrology, calibration, and production test. We also provide repair, calibration, and other support services for a wide variety of test and measurement equipment including RF power sensor calibration systems, RF attenuation measurement systems, resistance standards, ratio transformers, arbitrary waveform generators, micro-ohmmeters, LCR meters, handheld temperature calibrators, thermometers, humidity and temperature control devices, and more.

TEGAM also repairs and calibrates test and measurement equipment formerly manufactured by Electro-Scientific Industries (ESI), Gertsch, Keithley Instruments, Lucas Weinschel, and Pragmatic Instruments. A complete list can be viewed on our Product Service Directory at www.tegam.com.

For more information about TEGAM and our products, please visit our website at www.tegam.com; or contact one of our customer service representatives at sales@tegam.com or 800-666-1010.

Model 120

Instruction Manual

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This owner's manual was as current as possible when this product was manufactured. However, products are constantly being updated and improved. Because of this, some differences may occur between the description in this manual and the product you receive.

WARRANTY

Tegam, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from date of shipment. During the warranty period, we will at our option, either repair or replace 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 we will recalibrate any product that does not conform to the published accuracy specification.

To exercise this warranty, contact Tegam, Inc., Ten Tegam Way, Geneva, Ohio 44041 / PHONE (440) 466-6100 / FAX (440) 466-6110, M-F, 8 a.m.-5 p.m. ET. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty, or at least 90 days, whichever is longer.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Tegam, Inc. shall not be liable for any indirect, special or consequential damages.

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.

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SPECIFICATIONS

FUNCTIONS: VAC/VDC, with automatic selection. When both AC and DC input voltages are present, VAC function is selected if peak AC voltage is greater than magnitude of DC voltage. Otherwise, VDC function is selected.

RANGES: 750 volts AC.
± 750 volts DC.

RESOLUTION: 1 volt

ACCURACY: VAC: $\pm(0.2\%rdg + 1 \text{ volt})$, 50-60 Hz
 $\pm(0.5\%rdg + 1 \text{ volt})$, 45-1000 Hz
VDC; $\pm(0.2\%rdg + 1 \text{ volt})$

MAXIMUM INPUT: 750 volts continuous.

OVERVOLTAGE TEST: 1100 volts peak for <5 seconds.

INPUT RESISTANCE: 5K ohm typical.

NORMAL MODE REJECTION: 40 dB typical.

REJECTION OF CAPACITANCE-COUPLED INPUTS:
Suppresses 1500pF of capacitive effect to less than 1 count at 120v/60Hz. Reads <(50,000) (LineFreq) (LineVoltage) (Capacitance)

READING RATE: 2.5 readings/second

DISPLAY: 0.5" LCD (3.5 digits), polarity and annunciators for VAC, VDC, OL, Low Battery.

INPUT LEADS: PVC insulated, 36" long, with color-coded, fuse-protected probes, retracting tip-sheaths. Strain-relieved leads soldered into eyelets to permit replacement by meter-repair personnel.

ENVIRONMENTAL LIMITS FOR OPERATION: -10°F 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°F 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.

POWER: 9 volt battery (NEDA 1604).

TABLE 1. VERIFICATION SUMMARY

Input	Allowable Reading
Shorted	0 ± 1
+750 VDC	750 ± 3 VDC
-750 VDC	-750 ± 3 VDC
750 VDC	750 ± 3 VDC

Turn off Model 120. Verify resistance between probe tips is 5000 ohms, ±10%.

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.

1. Place the unit face 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 the display) and carefully lifting it away from the display.
3. Remove the old battery.
4. Place the new battery in the battery compartment. Be sure to observe the proper polarity (refer to Figure 2).
5. Reinstall the bottom cover before resuming use of the instrument.

OPTIONAL ACCESSORIES

- Model 1104 Utility belt carrying case (leather).
 - Model 1204 Linesman case (Cordura).
 - Model 8668 Soft carrying case, antique vinyl (brown)
 - Model 12501 Alligator Clip Kit
 - Model 12502 Universal Probe Tip Kit
 - Model 120-404 Replacement Probe/Lead Set
- Calibration and Troubleshooting Guide.

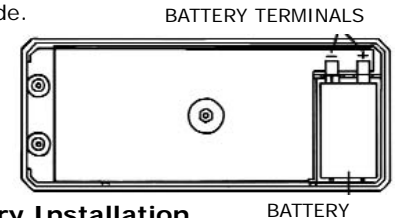


Figure 2. Battery Installation

Install a 1/4 watt, carbon-composition, 4.7 Mohm resistor (TEGAM P/N R-76-4.7M) in location R10 on the circuit board. Reassemble Model 120 and confirm that a 2 minute (approx.) timeout is in effect.

Timing can later be returned to 10 minutes by reversing this procedure.

DISABLING AUTOMATIC TURN-OFF FEATURE

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.

Users also have the option of disabling the automatic turnoff feature. This is done by removing resistors R9 (22M ohm composition) and R10 (if previously installed). This can be quickly performed by cutting the resistor leads.

FUNCTIONALITY CHECKS

1. ZERO

Switch on Model 120, 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 Model 120 probes to the hot and neutral terminals 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 (10K Ω \pm 10% accuracy or better).

Turn on Model 120. Use the voltage sources and the following table to verify that readings are within specifications.

BATTERY LIFE: 200 hours typical, alkaline battery.

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

AUTOMATIC TURN-OFF: Voltmeter turns off after 10 minutes (typical) of operation to conserve battery life. Turns off below 6.5v (typical) battery voltage.

SIZE, WEIGHT: 6.3" x 2.7" x 1.2", 12 oz.

CONSTRUCTION: Heavy-duty ABS plastic housing.

ACCESSORIES SUPPLIED: Manual, Battery.

DESCRIPTION

TEGAM's Model 120 is a hand-held digital voltmeter designed specifically to increase productivity of electric-utilities' meter installers and linemen. It differs from conventional DMMs in many important respects.

- Model 120 is insensitive to the effects of distributed capacitance in residential wiring. In meter installation applications it functions like an analog meter yet provides a digital display. Capacitance induced readings are typically 1 volt or less instead of the 50-90 volt readings displayed by other digital meters.
- Model 120's integral probe-holder permits true two hand operation, while the permanently secured test leads prevent loose-end shocks. Sheathed probe tips also enhance safety.
- Model 120 turns off after 10 minutes of operation. This feature helps conserve battery power when a user forgets to turn off the meter.
- Model 120 provides more than a low-battery warning. When battery power is too weak to ensure accurate readings, the meter turns off automatically.
- Model 120 has automatic selection of AC or DC measurement. This precludes the potential hazard of a live circuit measuring zero due to incorrect meter-function selection by a user.

APPLICATIONS

Typical applications of Model 120 include verification of electrical-service voltage, and checking the integrity of residential wiring. Wiring integrity is usually checked by measuring the voltage between the line and load connections of a meter-base with the customer's switch in the open position. Model 120 is well suited to these applications because of its low sensitivity to distributed capacitance.

Most digital voltmeters as well as a few analog voltmeters cannot be used where significant capacitive effect is present. The reason for this is that a "parasitic" current flows through the meter, and returns to ground via the distributed free-space and inter-conductor capacitance of the load wiring. Sensitive voltmeters are able to measure this current, but in doing so, give ambiguous readings as to the condition of the load wiring.

In Model 120, a shunting impedance across the input terminals of the meter diverts most of the parasitic current around the metering circuit. In typical applications where conventional DMMs read 50-90 volts due to distributed capacitance, Model 120 indicates 1 volt or less.

When Model 120 is used to verify service voltage, the shunt impedance still bypasses current around the meter. However, no loading error is introduced in the measurement due to the low impedance of an electrical service.

MANUAL ADDENDA

Improvements or changes to this manual will be explained on an addendum included with the instrument. All change information should be incorporated immediately into the appropriate places in the manual.

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.

The following items are included with every shipment.

1. Model 120 Electrical Service Voltmeter.
2. Instruction Manual.
3. 9 volt Battery (NEDA 1604).
4. Optional Accessories as requested.

PROBE REPLACEMENT PROCEDURE

WARNING

Probe replacement to be done by Qualified personnel only.

CAUTION

Replacing Model 120 probes with anything other than a TEGAM P/N 120-404 probe set will reduce meter overload protection.

WARNING

Disconnect probes from external circuits and turn the instrument off before performing probe replacement. Reinstall the cover before resuming use of the instrument.

Open the Model 120 case (see Battery Installation/Replacement section), and cut the strain relief tie-wrap securing the test-leads to the circuit board.

Next, remove the circuit board from the top case by unscrewing the hex spacer in the center of the board.

Use a small soldering iron (< 45 watts) to remove the test-leads from the circuit board eyelets. Pull the old probes free of the Model 120 case.

Feed the test-leads of the replacement probes through the holes in the topcase, and solder into appropriate eyelets (red probe to (+) eyelet, black probe to (-) eyelet). Install new tie-wraps (TEGAM P/N CC-38-4), and reassemble Model 120.

Check Model 120 operation per Performance Verification section.

REDUCING TURN-OFF DELAY

WARNING

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

Model 120 has a timer which automatically turns off the meter approximately 10 minutes after the ON/OFF switch is moved to the ON position. This feature prevents premature battery discharge when a user forgets to turn a unit off. This delay can be reduced to 2 minutes as follows:

Turn off Model 120, and remove its bottom cover and battery. Detach the circuit board from the top case.

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 30V rms or 42.4V peak 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 with P/N 120-404 probe/ test-lead set before using the instrument. 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 safety 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.
8. Fundamental safe work practices recommend testing any voltmeter on a known low-energy source before and after each use.

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.

MAINTENANCE INFORMATION

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

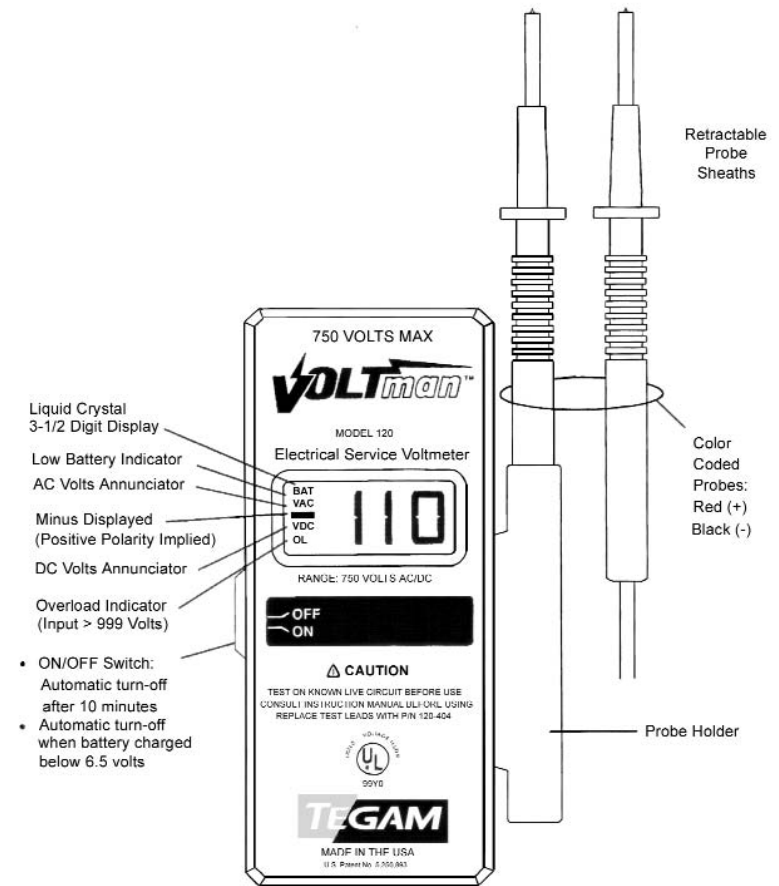


Figure 1. Model 120 Electrical Service Voltmeter

NOTE: In the operating position, install probe with "TEGAM" marking facing to right. To store probe, remove from probe-holder, rotate "TEGAM" marking toward rear and reinsert in holder.

PREPARATION FOR USE

Each instrument is supplied with a 9 volt battery. See Battery Installation section of this manual for battery installation instructions.

OPERATION

The automatic features of Model 120 make it easy to use. Just slide the power switch to the "ON" position (See Figure 1).

WARNING

Observe safety precautions listed in Safety Precautions section of this manual.

After turn-on, the instrument automatically selects either VDC or VAC function. VAC is selected if the peak value of an AC input voltage is greater than the magnitude of any DC voltage present. Otherwise the VDC function is enabled. VAC and VDC annunciators in the liquid crystal display indicate the selected function. Observe the maximum allowable input (750 volts continuous).

After approximately 10 minutes, Model 120 turns off automatically to conserve battery life. (This interval can be reduced to 2 minutes with an internal modification to the voltmeter. Refer to the Maintenance Information section for details.) To turn Model 120 on again, return the ON/OFF switch to the OFF position, then back to the ON position.

When battery voltage drops below 6.5 volts, the Model 120 turns off until a new battery is installed (refer to Battery Installation section).

"Phantom" readings (due to capacitance-coupled inputs) are suppressed by the low input resistance of Model 120. When normal line voltages are measured, Model 120 automatically switches to a high resistance input to prevent overheating. This unique arrangement creates a meter that measures voltage like a DMM, blocks "ghost" voltages (capacitive effect) like a solenoid-type voltage indicator, yet is safer and more accurate than both in field use.

WARNING


Model 120 is capable of indicating voltages that exceed the maximum rated value. These voltages pose a safety hazard to the user, and can damage the meter.

Excessive input voltages will damage components within the meter. Fusible resistors are built into the test-probes to enhance user safety under abusive overvoltage conditions. However, these resistors cannot guarantee meter protection. An instrument incurring over-voltage damage must be returned to the factory for repair.

ENVIRONMENTAL CONDITIONS

Operation of the instrument should take place at an ambient temperature of -10°F to 150°F , less than 80% relative humidity up to 95°F . Reduce relative humidity limit by 1.7% per $^{\circ}\text{F}$ from 95°F to 150°F .

SAFETY SYMBOLS AND TERMS

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

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

The **Caution** term used in this manual and on the instruments explains hazards that could damage the instrument.

SAFETY PRECAUTIONS

CAUTION

1. Test instrument on a known live-circuit before use.

WARNING

The following safety precautions should be observed before operating a Model 120.

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