# INSTRUCTION MANUAL

for

# MEGOHMMETER
# MODEL 2471F

## P/N 101-00220

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OPERATION

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# INSTRUCTION MANUAL

## 1. DESCRIPTION

### A. GENERAL

(1) The 2471-F is a self-contained, battery operated, high potential megohmmeter. Test potentials of 100, 200, and 500 volts are selectable by a panel switch. Current limiting circuitry provides safe, **ABSOLUTELY SHOCK-PROOF** operation.

(2) A single four inch meter scale, increasing from zero at the left to infinity at the right, is incremented from .5 to 1,000 megohms. A pushbutton on the high potential test probe provides for conveniently activating the instrument. Flashlight type batteries are used, and a self-contained battery test is incorporated. Solid state circuitry provides the means for size reduction, high sensitivity, and dependability. The meter is a ruggedized taut-band suspension type which eliminates the need for pivots and jewels. The high potential probe is shield-guarded so that stray leakage through lead insulation will not affect the measurement accuracy.

(3) The output current of the 2471F is limited to a maximum of 30 microamperes even at the 500 volt test potential. This current is well below human sensibility, so that there is no sensation of current if the bare probes are touched with the tester activated. This current limiting prevents damage to any circuitry or components which can withstand the applied voltage, and prevents additional damage to a circuit which exhibits any insulation deterioration.

(4) The 2471-F is also protected from damage due to inadvertently connecting the probes across an energized circuit. **AC** or **DC** voltages up to 300 volts can be safely applied.

### B. THEORY

(1) A transistor converter increases the battery supply to the 100, 200, and 500 volt test potentials selected by the panel switch. A high performance operational amplifier increases the impedance and sensitivity of the panel meter to measure the voltage drop across the test probes in terms of resistance. A panel control adjusts the calibration for infinity with the probes removed from the circuit under test. The batteries are connected to the megohmmeter circuit through transistor switches activated by a subminiature pushbutton on the high potential probe. A single receptacle provides connection to all the test lead cable circuits, and a shieldguard isolates the high potential lead from stray leakage resistance. A panel switch connects the meter for testing of either of the battery circuits or for megohmmeter indication.

## 2. ELECTRICAL SPECIFICATIONS

| TEST POTENTIAL VOLTS | MAX. CURRENT MICROAMPERES |
|---|---|
| 100 ±10% | 6 |
| 200 ±10% | 12 |
| 500 ±10% | 30 |

| RESISTANCE RANGE | MEGOHM INCREMENTS LOW | MIDSCALE | HIGH | ACCURACY % OF READING |
|---|---|---|---|---|
| 0 - INFINITY | .5 | 17 | 1000 | ±10% |

### A. WEIGHT AND DIMENSIONS

Weight: 3.8 lbs.. approx. (with carrying case)

Size: 8" x 6" x 4.75" approx. (with carrying case)

### B. ACCESSORIES

(1) Portable vinyl type Eveready overall carrying case with test cable compartment.

(2) Plug-in test cable leads.

(3) Separable probe clip.

### C. BATTERIES

(1) 3 each 1.5 volt C cells (Eveready E93, or equivalent)

(2) 3 each 1.5 volt AA cells (Eveready E91, or equivalent)

## 3. OPERATING INSTRUCTIONS

**CAUTION:** DO NOT APPLY HIGH VOLTAGE TESTS TO CIRCUITRY NOT DESIGNED FOR HIGH VOLTAGE APPLICATION. MOST SOLID CIRCUITRY IS SUBJECT TO DAMAGE FROM EVEN MOMENTARY APPLICATION OF HIGH VOLTAGE.

MAKE CERTAIN DEVICE UNDER TEST IS CLEAN. DIRT, MOISTURE, AND MOST DEPOSITS EXHIBIT RATHER LOW LEAKAGE RESISTANCE.

## A. GENERAL

(1) Consult component manufacturer's testing specifications for test voltage to be applied. Isolate the device under test from external power or circuitry.

(2) Insert test cable plug fully into receptacle at the top of the test set.

(3) Make certain meter pointer is resting at zero. (Adjust meter pointer zero adjust screw on meter cover bezel, if necessary).

(4) Select **FUNCTION** switch to **B1** and then to **B2** to read battery condition.

(a) A reading above **BATT. OK** radial directly below 100 on the meter dial is satisfactory.

**NOTE: Always return the FUNCTION switch to the MEGOHMS position after a battery test to avoid small amount of battery drain.**

(5) Place **FUNCTION** switch on **MEGOHMS** for megohmmeter operation.

(6) With **RED** test probe free from contact with external circuits or black probe, press probe pushbutton, and then turn **FULL SCALE ADJUST** as required to produce full scale deflection of meter pointer.

**CAUTION: THIS ADJUSTMENT MUST BE RECHECKED WHENEVER A DIFFERENT VOLTAGE SELECTION IS MADE.**

(7) Connect **BLACK** probe to low, common, or ground side of circuit to be tested. (If both sides of circuit to be tested are high, either point may be contacted with black probe). Insert accessory clip on black probe, if more convenient.

(8) Connect **RED** probe to other test point, and with pushbutton depressed, read insulation resistance in megohms on meter scale.

(a) Consult component manufacturer's specifications for acceptable insulation resistance.

**CAUTION: WAIT FOR METER TO COME TO FULL TEST BEFORE READING. THERE MAY BE A MOMENTARY DELAY AFTER BUTTON IS PRESSED FOR HIGH VOLTAGE CONVERTER TO COME UP TO FULL POTENTIAL, AND CAPACITANCE IN THE CIRCUIT UNDER TEST MAY REQUIRE CHARGING TIME.**

(9) Consult **APPLICATION NOTES** for further details on specific application of the 2471-F to insulation testing.

## 4. APPLICATION NOTES

(1) Insulation sometimes will exhibit different leakage resistance with different test potentials applied. A reduced resistance reading with an increased setting of the **VOLTS** switch is a normal condition in such cases.

(2) If the probes are connected across an appreciable value of capacitance, the meter will respond very slowly as a reaction to the charging time of the condenser. (Approximately 5 seconds is required for .1 Mfd and 1 minute for 1 Mfd). If higher capacitance values are to be tested, the condenser should first be charged to the test voltage before applying the megohmmeter. Be certain to connect the **RED** probe to the positively charged capacitance terminal, and wait for the voltage across the capacitance to equalize to the megohmmeter test potential as indicated by an on-scale steady reading on the meter.

(3) Even the slightest amount of electrical continuity to the bare red probe from a circuit not part of that being measured will introduce erroneous readings. Exercise care not to touch the bare end of the red probe or any circuitry not connected to the black probe while testing. Make certain that no part of the device under test is inadvertently grounded other than that which is normal ground.

(4) When testing devices which have been exposed to moisture or dirt, low insulation resistance will often be indicated. Complete cleaning and dry baking at a temperature about 50°F above ambient will generally remove this source of leakage. In hot wet climates, even superior insulations may have conductive paths through fungus growths. Cleaning and drying may remove most of such growths, but if the spores are not killed, the growth may return in a few days. A fungus killing and growth inhibitor is recommended in such cases.

(5) A **DC** megohmmeter is not a substitute for an **AC** high-voltage break down tester. Alternating voltage strains an insulation in first one direction and then another. The behavior of the insulation under such strain is quite different from the application of a low current **DC** test. In may applications, both types of test are required. If the device to be tested is not subject to high voltages or high temperatures under normal operation, high-voltage **DC** megohmmeter tests should suffice.

(6) If a very low insulation resistance is indicated, a conventional ohmmeter should be used for fault isolation. The lower operating voltage and low resistance readability of a conventional ohmmeter is more satisfactory for finding direct or low resistance short circuits.

(7) The normal deterioration of insulation results in a lowering of resistance with time. Therefore, an insulation reading just slightly above a specified minimum, generally indicates an impending failure.

Corrective measures should be taken to prevent further deterioration. By recording periodic insulation measurements, deterioration trends will be indicated so that preventative maintenance can be established.

(8) Insulation minimums are generally specified (or implied) for dry atmospheric conditions. If the unit under test can not be brought into a dry environment, or **baked**, reduced insulation resistance can be anticipated and allowances made accordingly.

(9) Sometimes insulation tests are required in polarized circuits which will exhibit low resistance when subjected to an opposite polarity. Consult the test specifications for polarity. The **RED** probe is always positive polarity from the megohmmeter. If in doubt, make a test with probes connected in one manner and then reversed for a second test. A substantial difference in reading will indicate a polarized circuit.

(10) If the megohmmeter indicates either an upward or downward scale reading with the probes connected, but with the pushbutton released, the circuit under test is energized. (Small potentials may not produce a reading without button pressed but will introduce erroneous readings). Make certain that all power to the device has been removed and that all capacitances have been discharged. Some devices will retain residual voltages long after the power has been removed.

(11) Some tests require that jumpers be placed between two or more points on the device under test while making insulation tests. This is generally done to prevent possible damage to portions of the circuit which are not designed for high voltage application, or to make an overall insulation test for a number of circuits simultaneously. Be certain to follow the test specification procedures when jumpers are indicated.

## 5. CARE AND MAINTENANCE

The 2471-F megohmmeter is designed to give lasting accurate performance provided reasonable care is exercised in operating and handling.

(1) Keep test set in its carrying case at all times to reduce the danger of damage from vibration, shock, and moisture. Exercise reasonable care to avoid dropping or excessive shock. Protect from rain and exposure.

(2) Store in cool, clean, dry place to reduce contamination and battery deterioration. **REMOVE BATTERIES IF TEST SET IS TO BE STORED FOR PROLONGED PERIODS.**

(3) Do not subject megohmmeter to electrically energized circuit. The 2471-F is safe from damage from externally applied **AC** or **DC** voltages up to 300 volts, but high voltages may be dangerous to the operator and will produce erroneous readings.

(4) Two sets of batteries are used. The three smaller AA cells (Eveready E91, or equivalent) provide the positive 4.5 volts for the operational amplifier and triggering of the battery transistor switches. The three larger C cells (Eveready E93, or equivalent) provide the negative 4.5 volts for the operational amplifier and high voltage converter. The 2471-F is designed for operation with alkaline type cells, but conventional zinc carbon cells may be used as temporary replacements.

(5) The **B1** position of the **FUNCTION** switch connects the meter for testing the condition of the C cells, and the **B2** position for the AA cells. A reading below the **BATT. OK** radial on the meter scale is an indication of unsatisfactory battery condition. A more significant test may be made by observing the meter on the **B1** and **B2** positions with the probe pushbutton depressed. The pointer will drop slightly on the **B1** position, but should remain above the **BATT. OK** radial. There should be no more than a barely perceptible drop on **B2** with the button depressed.

(6) To gain access to the batteries, release the strap across the top of the meter and remove tester from its carrying case. Place the test set in a clean area. (A clean cloth or paper pad placed to the right of the test set to receive the inverted panel it desirable). Remove the four corner panel screws. Withdraw the panel and rest it inverted to the right of its case.

(7) Push one of the battery holding clips aside while withdrawing the batteries. When replacing cells, make certain they are all inserted in the retainer tube in the same direction. The small terminal + (plus) end should connect to the **RED** terminal end of the respective battery holder.

(8) A zero adjustment is provided on the printed circuit board. To determine the need for adjustment, proceed as follows:

(a) After good battery condition has been assured, make certain the meter pointer is resting at zero with the pushbutton released. (Adjust meter zero adjust screw on meter cover bezel, if necessary).

(b) Set **FUNCTION** switch to **MEGOHMS** and **VOLTS** switch to **500.** With **RED** probe free from contact, adjust panel **FULL SCALE ADJUST** for full scale meter pointer reading.

(c) Connect test probe ends together and press pushbutton. If meter does not read zero, adjust printed circuit board R17 **ZERO ADJUST** for meter zero.

**CAUTION: DO NOT FORCE ADJUSTMENT BEYOND END STOPS.**

(9) A high voltage adjustment is provided on the printed circuit board. This is adjusted at the factory and field adjustment should not be required unless high voltage converter components are replaced.

Proper adjustment requires the use of a differential type voltmeter.

Other voltmeters will load the circuit and will give improper indications. [See Step (10) for alternate method.] To adjust R1, proceed as follows:

(a) Make certain batteries are fresh, particularly the C cells.

(b) Proceed as described in Step (8).

(c) Reset **VOLTS** switch to **200.**

(d) Set differential voltmeter to measure 215 volts and connect to megohmmeter probes, observing polarity.

(e) Turn R1, **HV ADJ**, carefully to full clockwise stop. Press probe pushbutton and slowly turn R1 counterclockwise until differential voltmeter indicates 215 ±5 volts.

(f) Differential voltmeter should indicates 107.5 ±5 with the **VOLTS** switch at **100**, and 537.5 ±12.5 with the **VOLTS** switch at **500.**

**NOTE: These settings are 7.5% above nominal with fresh batteries so that test voltages of ±10% are assured with any usable battery condition.**

(10) To check or adjust R1 approximately without the use of a differential voltmeter, proceed as follows:

(a) Proceed as in Step (9) (a) and (b).

(b) Reset **VOLTS** switch to **500** and turn **FULL SCALE ADJUST** full counterclockwise.

(c) Press probe pushbutton and meter should indicate 50 + 5 megohms approximately.

(d) To adjust, turn R1, **HV ADJ**, carefully to full clockwise stop. Press probe pushbutton and slowly turn R1 counterclockwise until meter indicates 50 megohms.

(e) Pressing pushbutton with **VOLTS** switch at **100** or **200** should produce a **50 + 5°** megohm indication.

(11) Calibration of the megohmmeter should be checked periodically. (A one year interval should suffice, provided that the batteries are properly maintained and the tester is not abused). Calibration recertification should include the adjustments described in Steps (8) and (9), and the scale accuracy checked at a minimum of two points. At least one test between 5 and 20 megohms, and another 10 to 20 times greater should be made. The test resistors should have an accuracy of + 10%, or better.