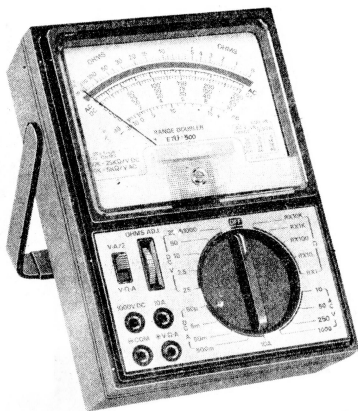


# instruction manual

**VOM-MULTITESTER**  
**50,000 ohms/volts dc**  
**MODEL ETU-500**

**43 RANGES**



## DESCRIPTION

Ideal for use where measurements must not appreciably disturb the circuit being tested, the Model ETU- 500 features high 50,000 ohms/volt dc and 10,000 ohms/volt ac sensitivities, on one set of voltage ranges. A second group of voltage ranges with sensitivities of 25,000 ohms/volt dc and 5,000 ohms/volt ac, has been designed into this instrument. Because of the availability of 12 dc voltage ranges and 8 ac voltage ranges, more accurate readings are possible with this instrument than with an ordinary VOM. Also included are ten dc current ranges and five resistance ranges to assure precise current and resistance indications. In conjunction with a power supply, the Model ETU- 500 can be used to measure capacitance and inductance. Special circuitry has been included to protect the meter movement against accidental overload. A mirror arc has been provided to help eliminate parallax errors from readings. A convenient carrying handle built onto the case can also be used to position the meter for easy reading. The ETU- 500 is a quality product in both performance and appearance.

## SPECIFICATIONS

- DC Voltage :            0—0.25, 2.5, 10, 50, 250, 1000 volts  $\pm 3\%$  of full scale reading except 0.25, 2.5, 1000 volts  $\pm 4\%$ ; 25,000 ohms/volt.  
                              0—0.125, 1.25, 5, 25, 125, 500 volts  $\pm 3\%$  of full scale reading except 0.125, 1.25, 500 volts  $\pm 4\%$ ; 50,000 ohms/volt.
- AC Voltage :            0—10, 50, 250, 1000 volts  $\pm 4\%$  of full scale reading; 5,000 ohms/volt.  
                              0—5, 25, 125, 500 volts  $\pm 4\%$  of full scale

|                |                                                                                                                              |
|----------------|------------------------------------------------------------------------------------------------------------------------------|
|                | reading; 10,000 ohms/volt.                                                                                                   |
| Decibels :     | -20 to +62 dB, 8 ranges.                                                                                                     |
| DC Current     | 0-25, 50 $\mu$ A; 9-2.5, 5, 25, 50, 250, 500 mA; 0-5, 10 A $\pm$ 3% of full scale reading.                                   |
| Ohmmeter :     | 0-20 Megohms in 5 ranges $\pm$ 3% of full scale arc.                                                                         |
| Power Supply : | One 9-volt battery (Novel 006P, Eveready 261, etc.) for R x 10K range; one 1.5-volt "AA" cell for all other ohmmeter ranges. |
| Size :         | 6-3/4" x 5" x 2"                                                                                                             |
| Weight :       | 1 lb., 5 oz. (including batteries)                                                                                           |

## CONTROLS AND JACKS

**RANGE switch :** Use to select factor to be measured and range.

**V- $\Omega$ -A slide switch :** Meter pointer indicates dc or ac voltage or dc current on range selected by RANGE switch, when slide switch is set to the V- $\Omega$ -A position. Meter pointer indicates one half the voltage or current on range selected by RANGE switch, when slide switch is set to the V-A/2 position.

**OHMS ADJ. control :** Use to set pointer to 0 (extreme right on meter scales) on uppermost ohmmeter scale in an OHMS setting of the RANGE switch, when test leads are connected to each other.

**Mechanical adjust :** Screw on meter movement to set pointer to zero when leads are connected to each other in a DCV setting of the RANGE switch.

⊖COM jack : Plug-in connection for black, negative, test lead.

⊕V- $\Omega$ -A jack : Plug-in connection for red, positive test lead.

**1000V DC jack :** Plug-in connection for red test lead when measuring dc to 1,000 volts. RANGE switch must be set to the 250 & 1000 DCV position and V- $\Omega$ -A slide switch must

be set to the V- $\Omega$ -A position. Voltage will be 1/2 that noted on meter (to 500 volts) if the V- $\Omega$ -A slide switch is set in the V-A/2 position.

10A jack : Plug-in connection for red, positive, test lead when measuring dc to 10 Amperes. RANGE switch must be set to 10A and V- $\Omega$ -A slide switch must be set to the V- $\Omega$ -A position. Current will be 1/2 that noted on meter (to 5 Amperes) if V- $\Omega$ -A switch is set to the V-A/2 position.

## **OPERATING PROCEDURE**

### **PRELIMINARY ADJUSTMENTS**

1. Check the mechanical adjust screw setting as follows:
  - a. Place the ETU- 500 tester flat on a bench.
  - b. Set the RANGE switch to 2.5 DCV. The V- $\Omega$ -A slide switch can be set in either position.
  - c. Connect one test lead to the other.
  - d. Note if the meter pointer indicates exactly 0 at the extreme left end of the black scales.
  - e. If it does not read 0, turn the screw on the meter movement slowly until the proper 0 reading is realized.
2. Check the batteries as follows.
  - a. Connect one test lead to the other.
  - b. Set the RANGE switch to R x 1.
  - c. Turn the OHMS ADJ. control until you find the position where the meter pointer indicates the full scale 0 on the OHMS scale. If this adjustment cannot be made, replace the 1.5 volt size "AA" cell.
  - d. Now set the RANGE switch to R x 10K.
  - e. Turn the OHMS ADJ. control until you find the position where the meter pointer indicates full scale 0 on the

OHMS scale. If this adjustment cannot be made, replace the 9-volt battery with a Novel 006P, Eveready 216, or equivalent. (See MAINTENANCE).

## OPERATING SUGGESTIONS

1. Meter ranges are noted on the front panel, around the RANGE switch. Dc and ac voltage as well as dc current ranges selected through use of the knob on the RANGE switch, are those shown at this switch only when the V- $\Omega$ -A slide switch is in the V- $\Omega$ -A position. In this case, the sensitivity of the voltmeter is 25,000 ohms/volt dc and 5,000 ohms/volt ac. Voltage and current ranges are one-half those shown by the knob on the RANGE switch, when the V- $\Omega$ -A slide switch is in the V-A/2 position. Now the sensitivity of the voltmeter is 50,000 ohms/volt dc and 10,000 ohms/volt ac. Sensitivity of 25,000 ohms/volt dc and 5,000 ohms/volt ac is excellent and acceptable in most measuring situations. If you must have a sensitivity of 50,000 ohms/volt dc or 10,000 ohms/volt ac at any time, set the V- $\Omega$ -A switch in the V-A/2 position and divide all readings by two.
2. Set the RANGE switch to the proper voltage or current range before making measurements. If the lowest usable range is one of those listed on the panel at the RANGE switch, set the V- $\Omega$ -A slide switch to the V- $\Omega$ -A position. If it is one-half of a range listed on the panel at the RANGE switch, set the V- $\Omega$ -A slide switch to the V-A/2 position. When the V- $\Omega$ -A slide switch is in the V- $\Omega$ -A position, never apply more voltage or current than the amount noted on the front panel in each RANGE switch position. When the V- $\Omega$ -A slide switch is in the V-A/2 position, never apply more voltage or current than one-half the amount noted on the front panel in each RANGE switch position. When in doubt as to the voltage or current present in a circuit, start with the highest

range and set the V- $\Omega$ -A slide switch to the V- $\Omega$ -A position. If the voltage or current is of such magnitude as to be measurable on a lower range, select the lowest RANGE switch position which will provide you with a reading without causing the meter pointer to deflect off-scale. If the maximum pointer deflection is below one-half scale on the meter, set the V- $\Omega$ -A slide switch to the V-A/2 position and divide all readings by 2.

3. Do not check resistance when voltage or current is present in the circuit.
4. Discharge a capacitor before measuring it.
5. Avoid placing the tester in a place where severe vibration is encountered. Do not store it in an extremely hot or humid location.
6. Remove the batteries before storing the tester for a long period of time. Also rotate the RANGE switch from time to time to clean the contacts.
7. To extend the life of the batteries, never leave the RANGE switch in an OHMS setting when you are not in the process of measuring resistance. It is best that you keep the RANGE switch in the OFF position when the ETU-500 is not being used.
8. For all measurements, plug the black test lead into the  $\ominus$ COM jack. Plug the red test lead into the  $\oplus$ V- $\Omega$ -A jack except when measuring from 250 to 1,000 volts or from 500 mA to 10A.
9. You can see a reflection of the meter pointer in the mirror arc. To avoid parallax errors in your readings, look straight down onto the meter scale. You are doing this perfectly if the mirror image of the pointer is covered by the actual meter pointer, so that you do not see its reflection in the mirror arc.

## DC VOLTAGE MEASUREMENTS

Select the required dc voltage range or use the procedure in "2" above under OPERATING SUGGESTIONS. Connect the test leads across the circuit whose voltage is to be measured. Observe polarity. Read dc voltage on the appropriate scale. Be sure to take the setting of the V- $\Omega$ -A slide switch into account. The range is as indicated by the pointer knob on the RANGE switch, when the V- $\Omega$ -A slide switch is in the V- $\Omega$ -A position. The range is one-half that indicated by the pointer knob on the RANGE switch, when the V- $\Omega$ -A slide switch is in the V-A/2 position.

## DC CURRENT MEASUREMENTS

Select the required dc current range or use the procedure in "2" above under OPERATING SUGGESTIONS. Connect the test leads in series with the circuit to be measured. Observe polarity. Read dc current on the appropriate scale. Be sure to take the setting of the V- $\Omega$ -A slide switch into account, as described in the DC VOLTAGE MEASUREMENTS section. Should the ranges provided not be sufficient to measure current in your circuit, the DC voltage ranges of your ETU- 500 may be utilized for this purpose. Measure the voltage across a resistor in the circuit through which the current flows. If this is not possible, add a small resistor in series with the circuit. The added resistor, if used, must be small enough so as not to upset the circuit. Measure the voltage across this resistor. Calculate the current flowing through this resistor, using Ohm's Law. See the example in Figure 1. Here, it is assumed that 2 volts is across a 1-ohm resistor. The current flowing through the resistor is:

$$I = \frac{E}{R} = \frac{2}{1} = 2 \text{ Amps}$$

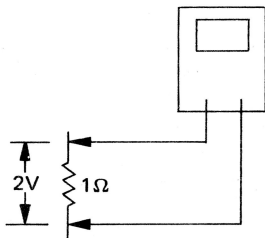


FIGURE 1

## AC VOLTAGE MEASUREMENTS

Select the required red AC voltage range or use the procedure in "2" above under OPERATING SUGGESTIONS. Connect the test leads across the voltage to be measured. Leads may be connected in either direction. Read ac voltage on the appropriate scale. Be sure to take the setting of the V- $\Omega$ -A slide switch into account, as described in the DC VOLTAGE MEASUREMENTS section.

## AC CURRENT MEASUREMENTS

Ac current cannot be measured directly on this instrument. However, if you need an ac current measurement, measure the voltage across a resistor in the circuit or across a small resistor wired in series with the circuit. Calculate the current flowing through this resistor, using Ohm's Law. See the procedure and example under DC CURRENT MEASUREMENTS.

## RESISTANCE (OHMS) MEASUREMENTS

Set the RANGE switch to an OHMS range and the V- $\Omega$ -A slide switch to V- $\Omega$ -A. (you cannot measure resistance when the V- $\Omega$ -A slide switch is in the V-A/2 position). Connect one test lead to the other and set the OHMS ADJ. control for a full scale deflection of the meter pointer. Separate the test leads and connect them across the resistor to be measured. Read the resistance on the OHMS scale. Use the appropriate multiplier as required for the different resistance ranges.

## DB RATIO MEASUREMENTS

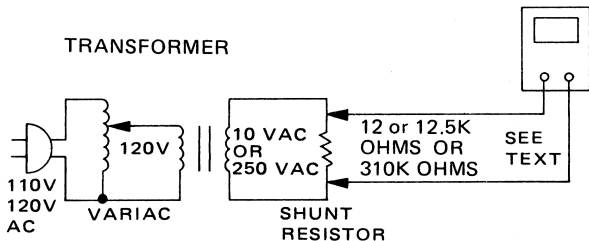
The ratio of two ac voltages can be expressed in terms of dB. A standard has been adopted which establishes one reference voltage as the 0 dB level. It is 0.774 volt rms. This assumes that 1 milliwatt is developed across an impedance of 600 ohms.

When using the 10 ACV range, read the dB scale if the V- $\Omega$ -A slide switch is set to V-A/2. For dB measurements on the other ac ranges when the V- $\Omega$ -A slide switch is in the V-A/2 position, read the same dB scale but now add 14 dB when set to the 50V range, 28 dB when set to the 250V range, and 40 dB when set to the 1000V range. When the V- $\Omega$ -A slide switch is in the V- $\Omega$ -A position, read the same dB scale on the meter but now add 6 dB in the 10V range, 20 dB in the 50V range, 34 dB in the 250V range, and 46 dB in the 1000V range.

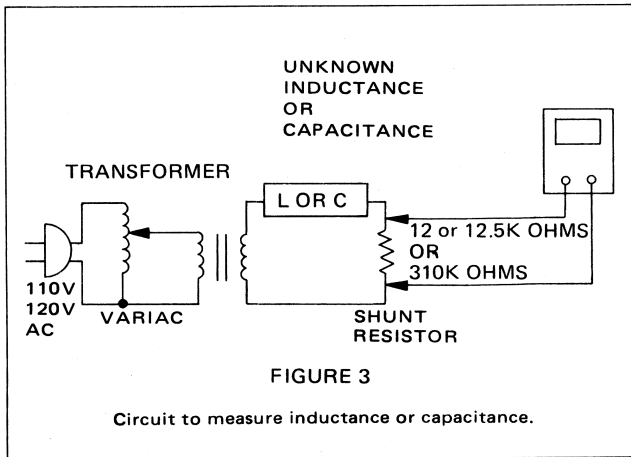
## INDUCTANCE MEASUREMENTS

1. Wire the circuit shown in Fig. 2 using a power transformer and variable AC supply voltage. Connect a 12- or 12.5-K ohm resistor across the test leads. (Note: The 12- or 12.5-K ohm resistor is used across the test leads when measuring inductance and high capacitance. A 310-Kohms resistor is used across the test leads when measuring low capacitance.) Any inductance between 4 and 2000 Henrys can be measured.

NOTE: Adjust voltage with variac before measuring capacitance or inductance. Transformer voltage and shunt resistor requirements are discussed in the text. Do not change variac voltage after setting has been made.



2. Set the RANGE switch to 10 ACV and the V- $\Omega$ -A slide switch to V- $\Omega$ -A. Connect the test leads across the secondary of the transformer, as shown in Figure 2. Starting at zero volts, slowly increase the AC voltage until you read 10 volts. Do not change this voltage setting until you have completed the measurements in step 3.



3. Connect the unknown inductor (drawn as a rectangular box marked L OR C) as shown in Figure 3. Note the voltage on the 10 volt scale. Use TABLE 1 to determine the inductance in the circuit from the voltage read on the meter. You can interpolate between values if the actual voltage read on the meter is not indicated on the table.

**TABLE 1. VOLTAGE TO INDUCTANCE CONVERSION  
(4 HENRYS TO 2000 HENRYS)**

| <b>RMS VOLTS</b> | <b>INDUCT-<br/>ANCE (H)</b> | <b>RMS VOLTS</b> | <b>INDUCT-<br/>ANCE (H)</b> |
|------------------|-----------------------------|------------------|-----------------------------|
| 9.88             | 4                           | 3.14             | 80                          |
| 9.83             | 5                           | 2.81             | 90                          |
| 9.75             | 6                           | 2.56             | 100                         |
| 9.67             | 7                           | 2.16             | 120                         |
| 9.57             | 8                           | 1.86             | 140                         |
| 9.47             | 9                           | 1.63             | 160                         |
| 9.35             | 10                          | 1.45             | 180                         |
| 7.99             | 20                          | 1.31             | 200                         |
| 6.63             | 30                          | 0.88             | 300                         |
| 5.52             | 40                          | 0.64             | 400                         |
| 4.67             | 50                          | 0.53             | 500                         |
| 4.04             | 60                          | 0.27             | 1000                        |
| 3.52             | 70                          | 0.13             | 2000                        |

## **HIGH CAPACITANCE MEASUREMENTS (.005 TO 1 MFD)**

1. Connect the circuit shown in Figure 2, using a 12- or 12.5-Kohms resistor.
2. Set the RANGE switch to 10 ACV, and the V- $\Omega$ -A slide switch to V- $\Omega$ -A. Connect the test leads across the secondary of the transformer. Starting at zero volts, slowly increase the AC voltage until you read 10 volts. Do not change this voltage setting until you have completed the measurements in step 3.
3. Connect the capacitor (drawn as a rectangular box marked L OR C) as shown in Figure 3. Note the voltage on the 10 volt scale. Use TABLE 2 to determine the capacitance in the circuit from the voltage read on the meter. You can interpolate between values if the actual voltage read from the meter is not indicated on the table.

**TABLE 2. VOLTAGE TO CAPACITANCE CONVERSION  
(.005 MFD TO 1 MFD)**

| <b>RMS VOLTS</b> | <b>CAPACITANCE (mfd)</b> | <b>RMS VOLTS</b> | <b>CAPACITANCE (mfd)</b> |
|------------------|--------------------------|------------------|--------------------------|
| .19              | .005                     | 4.67             | .14                      |
| .32              | .009                     | 5.15             | .16                      |
| .38              | .01                      | 5.61             | .18                      |
| .73              | .02                      | 6.01             | .2                       |
| 1.11             | .03                      | 6.86             | .25                      |
| 1.49             | .04                      | 7.49             | .3                       |
| 1.85             | .05                      | 8.34             | .4                       |
| 2.21             | .06                      | 8.83             | .5                       |
| 2.55             | .07                      | 9.14             | .6                       |
| 2.87             | .08                      | 9.35             | .7                       |
| 3.20             | .09                      | 9.50             | .8                       |
| 3.52             | .1                       | 9.58             | .9                       |
| 4.12             | .12                      | 9.67             | 1                        |

## **LOW CAPACITANCE MEASUREMENTS (100 TO 50,000 PF)**

1. Connect the circuit shown in Figure 2, using a 310,000-ohm resistor.
2. Set the RANGE switch to 250 ACV and the V- $\Omega$ -A slide switch to V- $\Omega$ -A. Connect the test leads across the secondary of the transformer. Starting at zero volts, slowly increase the AC voltage until you read 250 volts. Do not change the voltage setting until you have completed the measurements in step 3.
3. Connect the capacitor (drawn as a rectangular box marked L OR C) as shown in Figure 3. To avoid an electric shock, disconnect the variable supply from the power source while working in the circuit, but do not change the voltage setting. Note the voltage on the 250 volt scale. Use TABLE 3 to determine the capacitance in the circuit from the voltage read on the meter. You can interpolate between values if the

actual voltage read from the meter is not indicated on the table.

**TABLE 3. VOLTAGE TO CAPACITANCE CONVERSION  
(.0001 MFD TO .05 MFD)(100 PF – 50,000 PF)**

| <b>RMS VOLTS</b> | <b>CAPACITANCE (pF)</b> | <b>RMS VOLTS</b> | <b>CAPACITANCE (pF)</b> |
|------------------|-------------------------|------------------|-------------------------|
| 2.25             | 100                     | 59               | 2600                    |
| 4.5              | 200                     | 64               | 2800                    |
| 6.75             | 300                     | 68               | 3000                    |
| 9.25             | 400                     | 78               | 3500                    |
| 11.8             | 500                     | 88               | 4000                    |
| 14               | 600                     | 97.5             | 4500                    |
| 16               | 700                     | 106              | 5000                    |
| 18.1             | 800                     | 112              | 5500                    |
| 21               | 900                     | 124              | 6000                    |
| 23.3             | 1000                    | 130              | 6500                    |
| 27.7             | 1200                    | 137              | 7000                    |
| 32.7             | 1400                    | 151              | 8000                    |
| 37               | 1600                    | 161              | 9000                    |
| 42               | 1800                    | 172              | 10K                     |
| 46.2             | 2000                    | 221              | 20K                     |
| 51               | 2200                    | 236              | 30K                     |
| 55               | 2400                    | 245              | 50K                     |

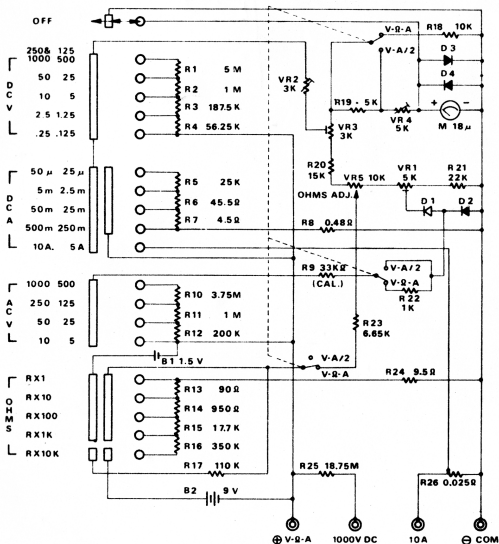
## **MAINTENANCE**

Test the batteries as described above under PRELIMINARY ADJUSTMENTS. If a battery must be replaced, remove the screws in the rear cover of the case. Lift the back of the case off the front section. Note the orientation of the batteries in their compartments. When replacing the "AA" cell, the positive (+) end of the cell should be at the end so indicated on the case closest to the top. Be sure that the contact at each end of the compartment makes a good connection with the metallic battery terminal at its positive end and with the metallic portion of the battery case at its negative end.

The 9 volt battery must be so oriented that its plus terminal is at the connector marked "+" in the case (closest to the side) and its minus terminal is at the connector marked "-". Slide the battery straight down into its compartment, being sure that it is held firmly.

Carefully replace the back onto the front of the case. Tighten the screws. Do not tighten them excessively, or you will strip the threads in the case.

## SCHEMATIC DIAGRAM



Printed in KOREA