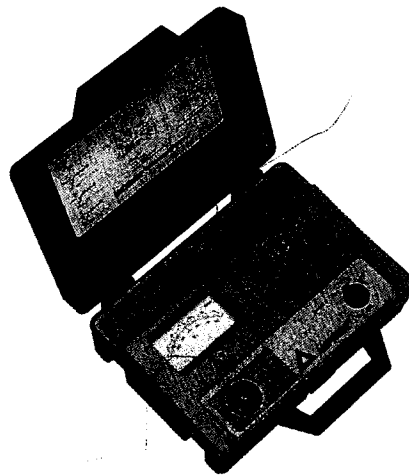


Part No. 947770  
6/95

OPERATING INSTRUCTIONS

# **INSULATION RESISTANCE TESTER**



**Model AMB-5KV**

** **AMPROBE®****

## LIMITED WARRANTY

Congratulations! You are now the owner of an AMPROBE® Instrument. It has been quality crafted according to quality standards and contains quality components and workmanship. This instrument has been inspected for proper operation of all of its functions. It has been tested by qualified factory technicians according to the long-established standards of AMPROBE INSTRUMENT.

Your AMPROBE instrument has a limited warranty against defective materials and/or workmanship for one year from the date of purchase provided that, in the opinion of the factory, the instrument has not been tampered with or taken apart.

***Should your instrument fail due to defective materials, and/or workmanship during the one-year warranty period, return it along with a copy of your dated bill of sale which must identify instrument by model number and serial number.***

For your protection, please use the instrument as soon as possible. If damaged, or should the need arise to return your instrument, it must be securely wrapped (to prevent damage in transit) and sent prepaid via Air Parcel Post insured or UPS where available to:

Service Division  
AMPROBE INSTRUMENT  
630 Merrick Road (For U.P.S.)  
P.O. Box 329 (For P.P.)  
Lynbrook, NY 11563-0329

Outside the U.S.A. the local Amprobe representative will assist you. Above limited warranty covers repair and replacement of instrument only and no other obligation is stated or implied.

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## INTRODUCTION

The AMB-5KV is a battery operated, high voltage insulation tester measuring up to 500 G ohms of resistance. The unit will provide four test voltages, 500V, 1KV, 2.5KV, & 5KV. The AMB-5KV also acts as a Voltmeter, with a 0 to 600V (AC & DC) range, when the "Insulation Test" push button is NOT depressed. This is important to insure that zero (0) voltage is present prior to conducting an "Insulation Resistance" test and will safely act as a capacitive discharge indicator.

The unit works on four (4) "D" size Alkaline batteries. When these batteries get weak, a Low Battery Led will glow. The AMB-5KV is supplied with a set of Heavy Duty test leads and is housed in a sturdy carrying case. The Logarithmic meter scale provides an easy reading of the measured Insulation Resistance.

The AMB-5KV Insulation Resistance Tester is ideal for checking Motor windings, Insulators, Generator windings, etc....and since it is portable, it is perfect for field use.

Please observe all warnings and precautions.

**PRECAUTIONS FOR  
PERSONAL AND  
INSTRUMENT PROTECTION**

- (1) Read and understand these instructions BEFORE using the AMB-5KV.
- (2) Avoid physical contact with crocodile clips while taking a measurement.
- (3) DO NOT USE IN AN EXPLOSIVE ATMOSPHERE
- (4) After making an Insulation Resistance measurement, capacitive circuits MUST be allowed to discharge BEFORE disconnecting instrument test leads.
- (5) Be sure the Device Under Test is DE-ENERGIZED and ISOLATED BEFORE connections are made for an Insulation Resistance test.
- (6) Always check condition of instrument and accessories BEFORE using. Replace any damaged parts.
- (7) Never lock the "Insulation Test" push button in the HOLD position unless it is required.
- (8) This Instrument should be used ONLY by trained and qualified personnel!

## TECHNICAL SPECIFICATIONS

### INSULATION RESISTANCE

Measuring range: 500k through 500G  
Test voltages: 500, 1000, 2500, 5000 VDC  
Max. short circuit measuring current: approx. 1.3mA  
Scale: Logarithmic, L=90mm  
Accuracy: +/- 2 mm  
**TEST HOLD** system: included  
Discharging of line: Automatic, when "INSULATION TEST" push button is NOT pushed.

### VOLTAGE

Measuring range: 0 - 600 Vac/dc  
Input resistance (DC voltage): 3 M ohm  
Input resistance (AC voltage): 1.35 M ohm  
Scale: linear, L=90mm  
Accuracy: +/- 2% of full scale

### GENERAL

Power supply: 4 "D" size alkaline (IEC R20's) batteries  
LOW BAT indicator: Red LED  
Dimensions (WxHxL): 345mm(13.6")x 130mm(5.1")x 250mm (9.8")  
Case: Robust, plastic with carrying handle  
Working temperature range: 0-40°C (32°F to 104°F)  
Weight: 4.5Kg (9.9lb)

### OVERLOAD PROTECTION:

#### VOLTAGE INPUT:

1000 VOLTS AC or DC (Remove Test Leads from Voltage source as soon as possible).

#### INSULATION RESISTANCE INPUT:

600 VOLTS AC. ("Insulation Test" push button depressed, Instrument connected to a Voltage source).



## INSTRUCTIONS FOR USE VOLTAGE MEASUREMENTS

### **WARNINGS:**

- (1) **Maxium** input rating is 1000VDC or 1000VAC PEAK. Disconnect the AMB-5KV immediately if voltage reading exceeds 600v mark on meter.
- (2) Make sure that the AMB-5KV's "TEST" push button is ***NOT*** depressed.

*OPERATION: (Refer to figure A For voltage measurement hook-up)*

- (1) Connect the RED banana plug to the +Rx input jack of the AMB-5KV. Likewise connect the BLACK banana plug to the -Rx input jack.
- (2) Connect the BLACK crocodile clip to the minus(-) or low side of potential being measured.
- (3) Connect the RED crocodile clip to the positive(+) or high side of potential being measured.
- (4) Observe measured potential on AMB-5KV's meter. **DO NOT PRESS "INSULATION TEST" PUSH BUTTON-INSTRUMENT WILL BE DAMAGED!**

HOOK-UP:

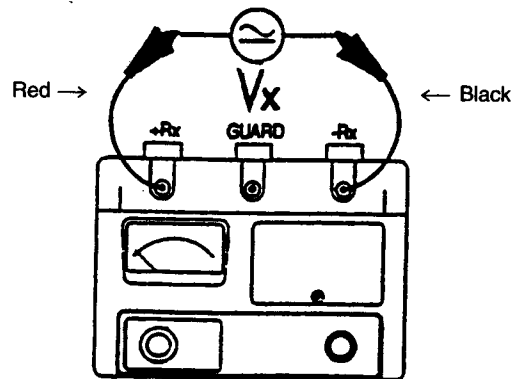


Figure A



## **WHY INSULATION RESISTANCE TESTING?**

The primary purpose of insulation is to keep electricity flowing in the desired path. The "perfect" insulation would have infinite resistance which would prevent the flow of any current through the insulation to ground. However, the perfect insulator has not been developed thus there is always some current flow. Good insulation is one that has and keeps a high resistance value in order to minimize the current flow.

Unless there is accidental damage of some sort, insulation failure is generally gradual rather than sudden. This is because failure is generally a wearing down process due to repeated heating and cooling, the related expansion and contraction, dirt, physical abrasion, vibration, moisture and chemicals, literally aging.

When insulation starts to fail, its resistance decreases allowing more current to flow through the insulation. If the resistance continues to decrease, the condition of the insulation may reach a point where it may permit a large current enough current flow through the insulation to cause: (1) A simple blowing of a fuse, (2) Equipment damage, or (3) Fatal shock. That's why, if you are responsible for the servicing, maintenance or installation of electrical equipment, you must be concerned about insulation resistance.

## **MEASURING INSULATION RESISTANCE**

Insulation resistance measurements are affected by a number of factors. Temperature and the duration of the measurement are two primary ones. Humidity may also affect readings. Insulation resistance readings may be lower on humid days and higher on dry days. Wet or flooded equipment should be dried and cleaned as much as possible before measurements are taken. Lastly, dirt or other contaminants (corrosion, chemicals, etc.) can also affect readings, either raising or lowering them. Therefore, the contact area at which measurements are to be taken should be reasonably clean

## **TEMPERATURE**

Insulation resistance can vary significantly with temperature, decreasing as the temperature increases and increasing as the temperature decreases. If your periodic insulation resistance measurements can not be taken at the same temperature, it is important that these measurements be adjusted to a base temperature.

From IEEE Std. 43-1974 for Rotating Machinery:

$$R_{40c} = K_{t40c} \times R_t$$

where  $R_{40c}$  = Insulation resistance (in Megohms) corrected to 40°

$R_t$  = measured insulation resistance (in Megohms) at t°C

$K_{t40c}$  = Temperature coefficient of insulation resistance as observed for t°C

Example: An insulation has a resistance of 100 Megohms at 30°C. From std.,  $K_{t40c}$  is 0.5.

$$\text{Thus } R_{40c} = 0.5 \times 100 = 50 \text{ Megohms}$$

For temperature correction factors for cable insulation, refer to specifications published by the Insulated Power Cable Engineers Assn. and the Assn. of Edison Illuminating Companies.

## **TIME**

The duration of the resistance measurement also affects the reading. If the insulation is good, the reading will continually increase as long as the megohmmeter is connected to the insulation. The most common megohmmeter measurement is taken at the end of a 60 second interval, as this time period generally gives a satisfactory measurement of the insulation resistance.

A second type of test involves taking a reading after 30 seconds and 60 seconds. The 60 second reading divided by the 30 second reading is known as the "**DIELECTRIC ABSORPTION RATIO**".

Comparing periodic Dielectric Absorption Ratios (DAR) may prove more useful than comparing one minute readings. Generally speaking a ratio of 1.25 is the bottom limit for borderline insulation. An extension of this test is one that involves readings after 60 seconds and 10 minutes. The ratio of the 10 minute reading to the 60 second reading is referred to as the "Polarization Index". The resistance measurement taken at the end of 10 minutes should be considerably higher than the reading taken at 60 seconds. The measured insulation resistance of a dry winding in good condition should reach a relatively steady value in 10 minutes. If the winding is wet or dirty then the steady value will usually be reached in one or two minutes. The Polarization Index is helpful in evaluating the winding dryness and fitness for over-potential testing.

As a guide, the recommended minimum value of the Polarization Index for Alternating and Direct Current rotating machines is 1.5 for 105°C (class A) insulation systems and 2.0 for 130°C (class B) insulation systems.

A complete explanation of these ratios and safe values may be obtained from the following IEEE std. publications:

IEEE std. 43-1974 IEEE std. guide for Testing Insulation Resistance of Rotating Machinery.

IEEE std. 62-1978 IEEE std. Guide for Field Testing Power Apparatus Insulation.

These Publications may be ordered from:

IEEE  
445 Hoes Lane, PO Box 1331  
Piscataway, NJ 08855-1331  
Order line: 1-800-678-IEEE (Credit cards accepted)

### WHAT THE READINGS MEAN

As we have already pointed out, insulation resistance measurements are affected by temperature, humidity, and the time duration of the measurement. They are also affected by such things as the type of insulation, its thickness, cleanliness and the design of the equipment. Therefore, to try and give specific values for each and every situation would be impossible. However, there are some basic guide lines that are useable.

From IEEE std. 43-1974:  
 $R_m = K_v + 1$

Where  $R_m$  = Recommended minimum insulation resistance in Megohms at 40°C of the entire machine winding.

$K_v$  = Rated machine operating potential, in Kilovolts.

Note: If winding of item is not at 40°C, temperature correction should be made.

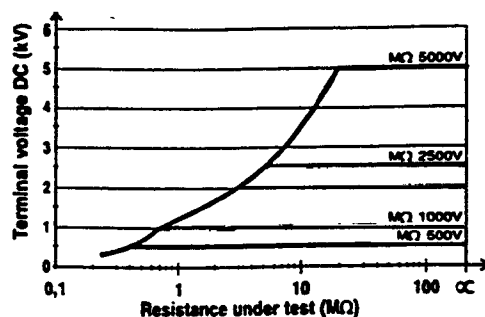
**THIS ESSENTIALLY FOLLOWS AN OLD RULE OF THUMB WHICH SET A MINIMUM INSULATION RESISTANCE VALUE OF 1 MEGOHM FOR EVERY THOUSAND VOLTS OF EQUIPMENT RATING.**

For specific information about individual products, contact the manufacturer. The manufacturer should be able to supply insulation resistance values and test procedures. The important thing to remember is that periodic testing is the primary method of picking up sudden decreases in insulation resistance and this is the key to detecting insulation that is failing. Because it is possible for insulation to fail between tests, testing should be scheduled based on the type of equipment. Generally speaking, equipment that involves movement (e.g. motors) should be checked more frequently than stationary equipment (e.g. cables). In addition, the more critical the equipment is to a company's operation, the more frequently it should be checked.

## INSTRUCTIONS FOR USE INSULATION RESISTANCE MEASUREMENTS

### WARNINGS:

- (1) Don't connect the Device Under Test(DUT) to a power source. The DUT must be disconnected and isolated from any power source.
- (2) Before connecting the AMB-5KV to the DUT, make sure the "TEST" push button is NOT pushed down or in the locked position..
- (3) Should a "capacitive" DUT become disconnected during its test, it remains charged, and has to be discharged before touching it.
- (4) When performing a long duration test (TEST push button locked on), check the AMB-5KV every 5 minutes for a breakdown indication. If a breakdown is detected, turn AMB-5KV off to conserve battery life.
- (5) During the Insulation Resistance Measurement, check the "Lo-Batt" indicator. It should NOT be on.
- (6) After an Insulation Resistance Test is completed (i.e. TEST push button is released), make sure AMB-5KV meter indicates less than 50 volts before disconnecting or otherwise handling the test leads.



## INSTRUCTIONS FOR USE INSULATION RESISTANCE MEASUREMENTS

**OPERATION:**                      **NOTE: DUT refers to Device Under Test**

- (1) Connect the RED banana plug to the +Rx input jack of the AMB-5KV. Likewise connect the BLACK banana plug to the -Rx input jack. Make sure "Insulation Test" push button is not depressed or locked on.
- (2) Connect the RED crocodile clip to the winding of the DUT.
- (3) Connect the BLACK crocodile clip to the metal frame of the DUT.  
NOTE: Observe AMB-5KV meter voltage scale. If it is indicating a voltage reading, DO NOT push "TEST" push button. This voltage must be removed from DUT before proceeding!
- (4) Select the TEST Voltage by rotating the selector switch to the desired value.
- (5) Push the "TEST" push button and observe the Insulation Resistance value on the meter scale. (NOTE: For extended test, while pushing down TEST push button, turn it clockwise. This "locks" the instrument in the ON mode).
- (6) At conclusion of test, release the "TEST" push button. Observe AMB-5KV meter voltage scale. Be sure reading is below 50 volts before touching or removing test leads.

**NOTE:** During the measurement of Insulation Resistance, observe the "LO-BATT" indicator. If this indicator comes on, Instruments batteries must be replaced as reading accuracy will be affected.

- (7) Record observed reading(s)

## WHAT TO RECORD

So that your periodic insulation resistance measurement can be compared meaning-fully, they must have certain information recorded. Each piece of equipment should have its own record card on file. Typical information that should be recorded is:

- (1) Equipment description including rating and serial number.
- (2) Equipment location (building, department, floor, etc.)
- (3) Date of installation
- (4) Dates of repairs and description
- (5) Specific test points
- (6) Equipment temperature at time of reading
- \* (7) Room temperature (ambient) at time of test
- \* (8) Relative humidity
- (9) Corrective factor used to adjust reading to base temperature.
- (10) The adjusted insulation resistance.

With this information, you can make meaningful comparisons between readings. Typical record cards follow.

*\* Amprobe offers an economically priced Temperature/Hygrometer as an accessory to measure Temperature and Humidity. Amprobe P/N TH-2.*



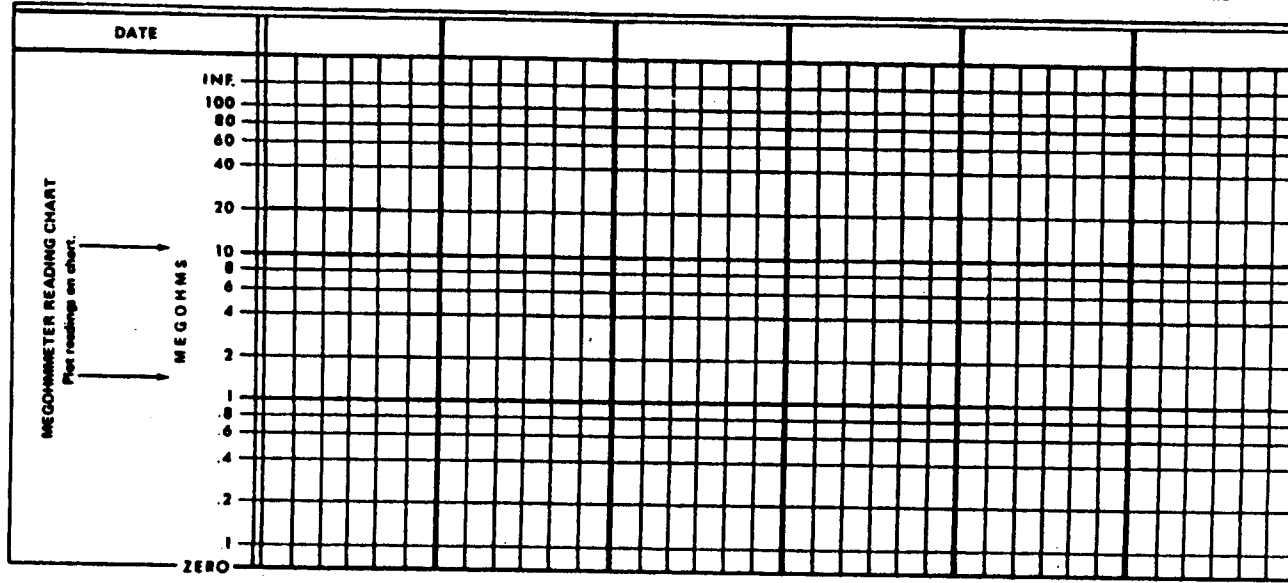
**TEST RECORD - INSULATION RESISTANCE**

EQUIPMENT DESCRIPTION \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

MFGR \_\_\_\_\_ TYPE & MODEL \_\_\_\_\_ VOLTAGE \_\_\_\_\_ HP \_\_\_\_\_

LOCATION \_\_\_\_\_ DATE INSTALLED \_\_\_\_\_

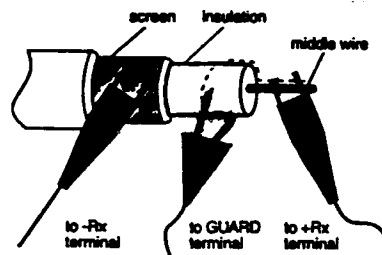
REMARKS \_\_\_\_\_





## USING THE GUARD TERMINAL

For most measurements of Insulation Resistance, the Guard Terminal is NOT used. The Guard Terminal is used only when surface leakage might influence the accuracy of the Insulation Resistance measurement. If a coaxial cable is being tested, the Insulation Resistance measured can be the result of both the insulators conductivity and the insulators surface conductivity (which is usually due to humidity or surface contamination). To eliminate the surface conductivity as an error source, connect the BLACK banana plug of the remaining AMB-5KV test lead to the GUARD input terminal. Connect its crocodile clip to the "insulation" as shown below:



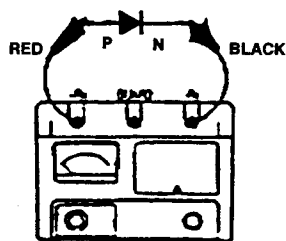
## HIGH VOLTAGE DIODE TESTING (i.e. Microwave oven diodes, etc)

Diodes (sometimes called rectifiers) are electronic valves, allowing current to flow in only one direction. They are made up of "P" & "N" type semi-conductor material. If the positive lead of a source is connected to the "P" and the negative of the same source is connected to the "N" of the diode, current will flow. If the positive and negative leads are reversed, current will not flow.

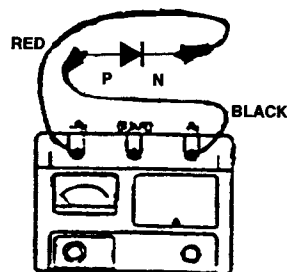
Since the Insulation Resistance Tester is a source, it can be used to test diodes. One must be careful, however, not to exceed the "reverse" or blocking voltage rating of the diode.

- (1) Determine the "reverse" voltage rating of diode and select the test voltage on the AMB-5KV as close to this rating as possible. Do not test diodes with less than a 500 volt rating with the AMB-5KV.
- (2) Connect the +Rx clip to the "P" and the -Rx clip to the "N" of the diode.
- (3) Push the "TEST" push button and observe the meter reading. It should be indicating "0". Release the "TEST" push button.
- (4) Connect the +Rx clip to the "N" and the -Rx clip to the "P" of the diode.
- (5) Push the "TEST" push button and observe the meter reading. It should be indicating a very high megohm reading. Release the "TEST" push button.

**NOTE:** If the desired results were NOT obtained in either step 3 or step 5 the diode is suspect..



(Step 3, "zero" reading)



(Step 5, "Hi" megohm reading)

## MAINTENANCE AND CARE OF INSTRUMENT

### BATTERIES:

If the red light next to the "Insulation Test" push button comes on (during an Insulation Resistance measurement), the batteries must be replaced. Weak batteries will affect measurement accuracy. When replacing batteries, use four "D" size alkalines (IEC-R20). Always replace all four batteries at the same time.

If the AMB-5KV is not going to be used for an extended period of time, remove the batteries to prevent possible damage from battery leakage.  
Battery removal and replacement:

- (1) Disconnect the AMB-5KV test leads from any DUT.
- (2) Remove battery cover by turning cover screw counter-clockwise.
- (3) Remove batteries
- (4) Install new batteries. (Observe polarity symbols on battery holder). NOTE: Do to tightness of battery holder, be sure batteries make contact with tabs on holder.
- (5) Replace battery cover and secure with its screw.

### METER:

Always check if the meter needle rests directly over the "0V" of the voltage scale. If it does not, using a small screwdriver, adjust needle screw until needle rests exactly over (splits) "0V".

Keep meter (and rest of front panel) clean by occasional wiping with a cloth dampened with a very mild detergent. dry immediately .

### TEST LEADS:

The AMB-5KV IS CAPABLE OF PRODUCING 5000 volts DC. It is essential that the test leads be checked BEFORE each use for worn or cracked insulation. Banana plugs and crocodile clips should be inspected for proper mechanical and electrical integrity. IF A PROBLEM IS FOUND, THE TEST LEAD SHOULD BE REPLACED!

**REPLACEMENT PARTS:**

TEST LEAD KIT.....ORDER MTL-5KVTL  
(Consists of ONE RED and TWO BLACK Lead assemblies)  
INSTRUCTION BOOK.....ORDER P/N 947770  
BATTERIES (Pkg. of 4).....ORDER MN-1300

**TECHNICAL HELP:**

**IF YOU HAVE ANY QUESTIONS REGARDING THE OPERATION OF THIS  
INSTRUMENT OR THE INTERPRETATION OF THESE INSTRUCTIONS,  
PLEASE CALL:**

**1-800-477-8658**

**SERVICE:**

(Serial Number is located on the backside of the Battery Cover Door).  
For factory service, package instrument (with packing slip) with sufficient cushioning  
material in a shipping container. Make certain your name and address appears on the  
shipping container as well as the packing slip. Ship prepaid via UPS (Where available)  
or Air Parcel Post insured to:

**Service Division  
AMPROBE INSTRUMENT  
630 Merrick Rd. (UPS use)  
Lynbrook, NY 11563-0329**

Outside the USA, your local AMPROBE representative will assist you.