Amblyonix
3000 Series
Industrial Megohmmeters

USER MANUAL

MODEL 3005

MODEL 3010

MODEL 3015

Amblyonix
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Dear Customer,

Thank you for purchasing one of our AC/DC Kilovoltmeters. Please read this manual in detail prior to first use, as it will acquaint you with the product and help you to use it skillfully.

Our goal is to continuously improve our products, so there may be slight differences between the product you purchased and its original instruction manual. If changes in this manual occur, you will find them in the appendix. If you have questions or would like to discuss a unique testing application, please contact us.

This product is covered by a one-year limited warranty from the date of shipment. If it is found to be defective due to parts or workmanship during the warranty period, we will repair it free of charge.

Should this product require repair either in or out of warranty please return it to us at:

Please visit our website for technical updates and news concerning this and other products available in our continuously expanding product offering.

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Diagrams

Insulation resistance Measurement wiring diagrams for substation transformer end and cable.

Figure 1
500KV PowerTransfomer LV winding insulation test wiring diagram

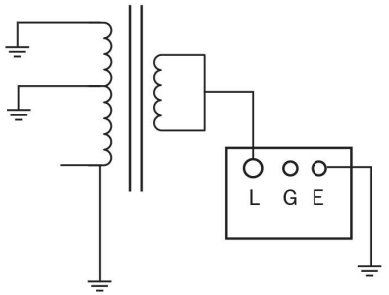


Figure 2
500KV PowerTransfomer HV winding insulation test wiring diagram

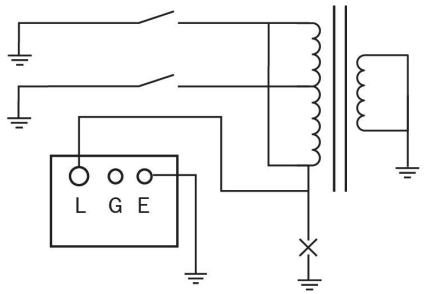


Figure 3
Shielded cable Insulation test wiring diagram

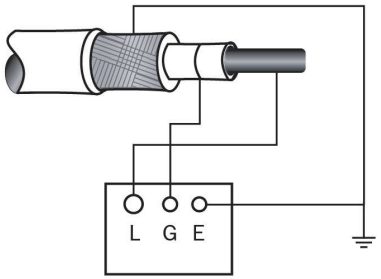
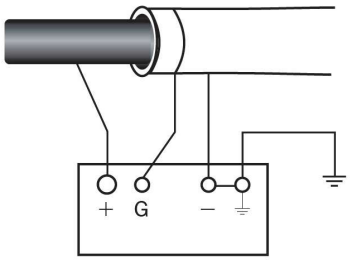


Figure 4
Non-Shielded cable connection diagram



Using the Guard Terminal

Often, equipment being tested for insulation resistance integrity can be dirty, oily, or otherwise subjected to some form of contamination on its outside surfaces. An example of this would be a wet, oily cable. When testing such equipment, it is importance to be sure that leakage currents do not obscure the insulation resistance test results. By establishing a guard connection as shown in the Testing Diagrams section of this manual, these leakage currents are removed from the measurement circuit and will no longer influence the test results.

Table 2

Problem	Cause	Solution
Power LED doesn't turn on	The battery voltage is less than 10V	Fully charge the batteries
Batteries have been charging for more than 8 hours, but the Charge Indicator LED does not turn green	Damaged battery pack	Replace the battery pack
No HV Output	Unit may have been overloaded	Check internal components BU406 and C2482
Output Voltage is high and can't be adjusted	Internal amplifier damage	Replace CA3140 on high-voltage circuit board
Resistance displays a -1 or other fixed value	Damaged amplifier	Replace meter's A/D converter
Resistance readings drift or are out of tolerance	Sometimes caused by extreme electrical interference or insulation failure	Use the reference resistor to test the unit for proper operation

This instrument is equipped with rechargeable batteries. Fully recharging a completely discharged battery pack typically takes approximately 6 to 8 hours. The rechargeable batteries can provide enough power to operate the megohmmeter for 6 to 8 hours of continuous work. To ensure long battery life, if the megohmmeter is not used for an extended period, please recharge the batteries every three months.

Table of Contents

This product is designed to measure very high AC and DC voltages. Only properly trained personnel should operate this instrument. Prior to first use please read this manual entirely. Familiarize yourself with all aspects of this products' features and functions. Always use best testing practices when using this instrument.

Safety Requirements

Please read the following safety precautions carefully to avoid the risk of personal injury, and to prevent damage from occurring to this instrument and/or other devices that are connected to it. To avoid possible danger to equipment or personnel, never use this product outside of the scope of its intended use.

If this product should appear to malfunction, never attempt to perform repairs yourself. Only qualified technicians that are completely familiar with every aspect of its operation should perform repairs.

To Avoid Fire Hazards or Personal Injury

- In case of emergency or if a suspected issue occurs, always turn off the high voltage first.
- Keep unqualified and/or unauthorized personnel away from the testing area.
- Always use the proper interconnecting and ground cables.
- Never touch the energized surfaces and/or output of this device during a test.
- Always use this product by connecting and disconnecting it properly to the source being measured. Never connect or disconnect the high voltage connections, or any of the other test connections during a test.
- After testing, always turn off the applied voltage first.

Grounding

- The 3000 series of AC/DC Kilovoltmeters are grounded through the dedicated ground terminal located at the base of the High Voltage stack. To prevent electric shock, good testing practices dictate that the case ground connection must be connected to a good earth ground. Before making any other connections from this device to the voltage source being measured, please ensure that your Kilovoltmeter is properly grounded.
- Do not operate this product when its covers or panels have been removed.
- Avoid coming in contact with the high-voltage connections or electrified surfaces during or after a test until the Kilovoltmeter and the voltage source has been fully de-energized.Do not operate this Kilovoltmeter if you suspect faulty operation. If you suspect faulty operation, stop immediately. Contact our repair department for technical assistance.
- Do not operate in wet/damp conditions. Do not operate in explosive atmospheres. Ensure that this Kilovoltmeter is clean and dry during use.

Next

- Connect the Megohmmeter's front panel ground terminal to a good earth ground.
- Connect the High Voltage Cable (+) and Return Cable (-) to the Megohmmeter's designated front panel connections.
- Connect the High Voltage Cable (+) and Return Cable (-) to the device under test. See the Testing Diagrams section of this manual.
- Turn the Voltage Range Switch to the desired voltage for the test you are about to perform.
- Turn the Megohmmeter ON by moving the Power Switch to the UP position.
- Press the Push to Test Button and adjust the Voltage Adjust knob to the desired output voltage as displayed on the kV Meter.
- Starting with the Resistance Range Switch set to the highest range, select the best range for the best reading resolution for the measured insulation resistance value obtained.
- If you are doing a time dependent measurement, use the Time Meter to begin the test when the maximum test voltage is achieved.
- At the end of your test, return the Voltage Adjust knob to its minimum (fully counterclockwise) position.
- Press the Push to Test Button. The Red indicator lamp will extinguish, and the test signal to the device under test will be de-energized. At this moment the kV Meter display will slowly return to zero and the Time Meter will turn off.
- When the kV Meter returns to zero, the Power Switch can be turned to the OFF (down) position. The output connections can now be physically grounded before disconnecting the megohmmeter from the device under test.

Testing

After reading this entire manual, and after familiarizing yourself with the above self-test procedure, you may begin testing. If this is your first time using a megohmmeter, proceed under supervision by qualified individuals.

Start by making sure that before connecting the instrument to the device under test, that the Power Switch is in the OFF position (down), and the Voltage Adjust Knob is set to its minimum (fully counterclockwise) position.

Make certain that the device to be tested is de-energized and out of service. In some instances, strong interference may be present due to induced electrical currents in places such as electrical substations. Under these conditions it is advisable to physically electrically ground the connections of the device to be tested to a known good earth ground before making connections to the instrument. After connecting the instrument to these previously grounded connections, remove the ground connections before performing an insulation test.

Before You Test

Before performing any test, always make sure that your Kilovoltmeter is well grounded. Ensuring that this device is properly grounded is the first step in creating a safe testing environment.

Once testing has been initiated do not attempt to terminate the test by shorting the output directly to ground. After testing, it is important to allow the device under test to fully discharge correctly through the megohmmeter before applying a direct short to the output. Shorting the output during a test can damage not only the device under test, it can also damage the internal circuitry of your megohmmeter.

Overview

In ancient times electrical phenomena such as lightning, static electricity, and magnetism were observed but very little understood. Philosophers and physicists of the seventeenth, eighteenth, and nineteenth centuries labored to understand the complex subject of what electricity is. Some were rewarded for their research by having electrical parameters such as the Volt, Amp, and Ohm named after them. Gradually, through experimentation and observation, electricity became something that was not only understandable, but also containable and predictable. Because of this, electrical devices became available to society in the nineteenth century. Almost immediately, it became obvious that the forces of entropy were just as active in this new realm as it always had been in the rest of the physical world. Heat, corrosion, oxidation, and time all contribute to the gradual breakdown of insulating materials that electrical circuits depend upon to function properly.

In those early days of electrical innovation, it was observed that periodic testing was an important factor in determining the viability of insulating materials used in the construction of motors, generators, transformers and other electrical devices. Periodic preventative maintenance testing identified which devices should be repaired or replaced before catastrophic failures occurred.

As we began to harness the power of electrical energy, products like paper, rubber, and varnish played a key role as insulating materials in electrical circuits. In those days, a common rule-of-thumb for determining the viability of electrical insulation was called the One-Megohm Rule. This meant that if the insulating material was measured to be greater than one megohm it was considered to be acceptable.

Today, synthetic materials like Teflon, mylar, and plastics are available with far greater insulating properties. Although this is true quite a bit of the world's electrical infrastructure is decades old and is still performing up to manufacturers specifications. Modern insulation testing instruments must be able to accurately measure a far broader range of resistances that older instruments did, as in many cases the One-Megohm Rule is still good enough. However, in the modern era it is very common to measure insulation resistance many thousands of times greater than one megohm.

As insulating materials have evolved so too has our ability to produce and work with higher voltages. With technology trending in this direction, electrical instruments must be able to operate in a much more active electrical environment. An example of this occurs domestically in some areas of the Hoover Dam complex. Visitors to this facility that have implanted medical devices are instructed not to enter certain areas where strong magnetic fields are present and may affect the operation of these devices.

Only the highest quality components are used in the construction of these products. Equipped with the ability to operate while subjected to strong electrical interference, these megohmmeters perform accurately in the largest substations. They can deliver 10mA of short-circuit current and are suitable for testing high-capacity and highly inductive devices. Six ranges of high-resolution readings give these megohmmeters the ability to measure the insulation integrity of older electrical equipment just as well as in products built to the current state of the art. Small, light-weight, and visually appealing, they will endure for years of rugged service.

Specifications

Measurement Voltage Ranges:

Model 3005: 100V, 250V, 500V, 1kV, 2.5kV, and 5kV

Model 3010: 250V, 500V, 1kV, 2.5kV, 5kV, 10kV

Model 3015: 500V, 1kV, 2.5kV, 5kV, 10kV, 15kV

Measurement Range and Accuracy:

Table 1

Measurement Range	Resistance Measurement Range	Accuracy
20MΩ	0.01 to 19.99MΩ	±(5%+3d)
200MΩ	5.0 to 199.9MΩ	±(5%+3d)
2GΩ	0.05 to 1.999GΩ	±(5%+3d)
20GΩ	0.5 to 19.99GΩ	±(5%+3d)
200GΩ	5.0 to 199.9GΩ	±(10%+3d)
2000GΩ	50 to 1999GΩ	±(20%+10d)

Preparation

The instruments' internal batteries should be fully charged before operation. Connect the instrument to line power and fully charge the batteries until the charge indicator changes from red to green. A fully discharged battery pack will typically recharge in eight hours. Failure to do so may result in power being lost during a test.

Self Test

Before connecting the instrument to the device under test, make sure that the Power Switch is in the OFF position (down), and the Voltage Adjust Knob is set to its minimum (fully counter-clockwise) position. Connect the test cables to the megohmmeter and connect the ground connection to a suitable earth ground. Prior to performing an insulation resistance test, you may perform a self-test by connecting the test resistor supplied with your megohmmeter to the "+" and "-" cables. Next select the 2.5kV Voltage Range, and the 2GΩ Resistance range. Turn the power switch to the ON (up) position. Press the Push to Test button and see that its red indicator illuminates. Also observe that the Time Meter is advancing. Keeping your hands clear of the output cables, slowly adjust the Voltage Adjust knob for a kV Meter indication of 2.50kV. Observe that the MΩ/GΩ Meter is displaying the approximate value of the test resistor, within its range tolerance. Notice that the Reading Hold indicator illuminates once, fifteen seconds into the test, and then every sixty seconds thereafter. Each time the Reading Hold indicator illuminates, you will hear an audible beep and notice that the MΩ/GΩ Meter display freezes for three seconds. This is useful for when time-dependent measurements are recorded for calculating dielectric absorption ratios or for establishing polarization indexes. Next, slowly turn the Voltage Adjust Knob to zero by returning it to its fully counter-clockwise position. When the kV meter indicates zero volts, press the Push to Test button to de-energize the output. Before disconnecting the High Voltage Cables, discharge any residual voltage by shorting the output to ground. It is now safe to disconnect the test resistor from the megohmmeters' output cables.

Operating Instructions

There are many ways to analyze the integrity of electrical insulation when using a megohmmeter. The most common test is the “Spot-Reading” test. In this instance, the operator performs a single measurement and compares the results to previous measurements that were recorded during the last round of periodic maintenance testing. As test results are compared and graphed, trends can be seen that may “deviate-from-the-norm” and indicate a present or future insulation failure. When performing spot readings, it is important to record the temperature of the device under test, as insulation resistance values will deviate considerably when performed at different temperatures. As with any kind of analysis, it is important to make observations under similar environmental conditions, thereby removing the potential variability of measured results.

In many instances the device under test may be a highly capacitive piece of equipment as is the case with large motors, generators, and transformers. When the test signal from a megohmmeter is applied to these devices the operator may observe that the insulation resistance reading will slowly increase (or decrease) until a stable value is displayed. However, in very large test subjects this stabilization time may be significant and continue for a protracted period. In these cases a time-dependent measurement may be called for.

Step Voltage, Dielectric Absorption Ratio, and Polarization Index testing are all tests that are performed over measured intervals of time.

- Step voltage testing is performed by applying different test voltage levels to the device under test, typically at one-or-five-minute intervals, depending on the size of the test subject.
- Dielectric Absorption Ratio test readings are typically performed at fifteen seconds and sixty seconds: DAR= R60S/R15S
- Polarization Index tests are made at one minute and at ten minutes: PI= R10min/R1min

Theory of Operation

The 3000 series of megohmmeters derive their test signals from a solid-state DC/DC voltage converter. The output is controlled by an adjustable feedback circuit that adds stability to the test signal even when it encounters strong external interference. The front panel displays utilize dual-slope integration processors that enhance the very-high interference capability. This allows resistance measurements to remain unchanged should test voltage fluctuations occur during low-frequency interference.

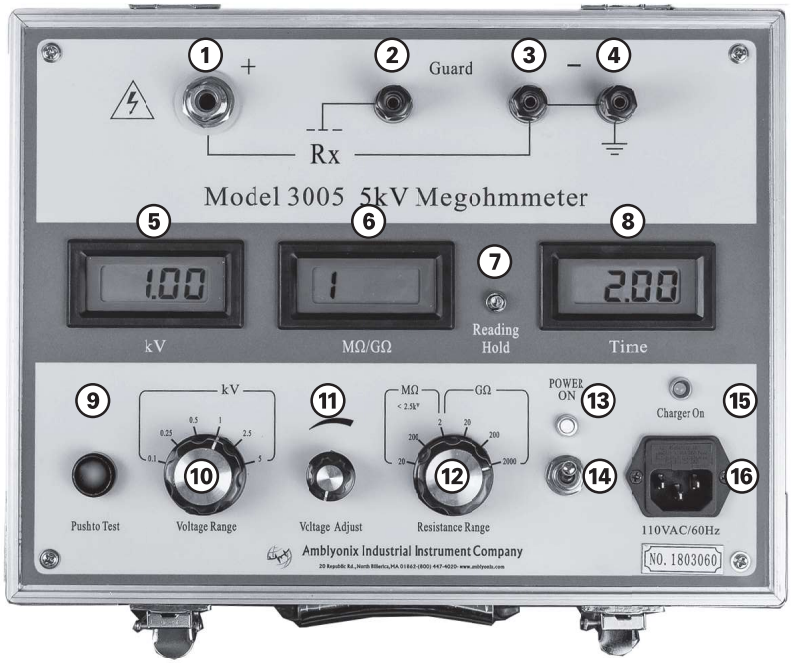
Note

- Calibration Voltage of MΩ ranges is 500V, 2.5kV for GΩ ranges
- Resistance accuracy is guaranteed when tests are performed at greater than 20% of the nominal value of the applied voltage range.
- When testing at voltages that exceed 8kV, measurement accuracy can be enhanced on readings exceeding 20GΩ by enclosing the HV output connections in a plastic bag. This disrupts the influence of air ionization during the test.
- Measurements using the 2000GΩ are best performed when relative humidity is below 70%.
- Anti-electric field interference capacity: 2mA (60Hz)
- Timing and alarm functions: The maximum value of the timer display is 19 minutes, 59 seconds. As the timing display progresses an audible “beep” will occur at 15 seconds, 60 seconds, and every sixty seconds thereafter. At each audible beep, the resistance meter display is frozen for 3 seconds. If the measured resistance is below the lower limit of a given range, the reading is deemed invalid and the megohmmeter will produce a continuous audible alarm.
- Display: Three, 3½ digit LCD meters respectively show test voltage, test resistance, and test time.
- Power Supply: 12VDC (3000mAh NiMH rechargeable battery) Re-Charging voltage 110VAC 60Hz.
- Environmental Operating Conditions: Temperature -4°F to 104°F Humidity 20% to 90% non-condensing.
- Dimensions: 12.4 x 9.45 x 7.1 Inches
- Weight: 12lbs.

Front Panel Layout

Front Panel Description

1. High Voltage Output [+]
2. Guard Terminal
3. Signal Output Return [−]
4. Case Ground
5. Kilovolt Meter
6. MΩ/GΩ Meter
7. Reading Hold Indicator
8. Time Meter



9. Test Enable Switch
10. Test Voltage Selector Switch
11. Voltage Adjust Control
12. Resistance Range Selector Switch
13. Power ON Indicator
14. Power Switch
15. Charger On Indicator
16. Charging Power Input

1 **High Voltage Output Termina:l [+]** Often called the LINE Terminal. Connects the device under test to the megohmmeter via the High Voltage Output Cable.

2 **Guard Terminal:** Allows the operator to establish a guard connection to eliminate the effects of surface leakage caused by dirty/ contaminated cable connections.

3 **Signal Output Return: [−]** Connects to the return path of the High Voltage Output.

4 **Case Ground:** This terminal connects the return path of the High Voltage Output to a known good earth ground, such as a ground rod or water pipe.

5 **kV Meter:** Displays the test voltage of the High Voltage Output terminals "+" and "−".

6 **MΩ/GΩ Meter:** Displays the resistance value of the device under test for the selected resistance range.

7 **Reading Hold Indicator:** Used in time-dependent insulation resistance testing such as dielectric absorption ratio testing, or polarization index testing. This indicator illuminates 15 seconds after the PUSH TO TEST button is depressed at the start of a test, and every sixty seconds thereafter. The resistance readings are briefly frozen for three seconds when this indicator is illuminated.

8 **Time Meter:** Displays test time in minutes and seconds. It is initiated when the PUSH TO TEST button is depressed. Maximum displayed time is 19 minutes and 59 seconds, after which the display resets to zero.

9 **Push to Test" Button:** When depressed, this button actuates the test, starts the time of the test, and energizes the High Voltage Output of the instrument.

10 **Voltage Range Knob:** Used to select the test voltage for the device under test.

11 **Voltage Adjust Control:** Allows the operator to smoothly adjust the output voltage from zero to the maximum value of the selected range.

12 **Resistance Range Switch:** Indicates the maximum value of the selected resistance range.

13 **Power On LED:** Illuminates when the unit is turned on.

14 **"Power Switch:** When moved to the UP position this switch turns the power on.

15 **Charger On Indicator:** This dual-colored LED will illuminate red when batteries are charging through the charging receptacle. When batteries are fully charged the LED will display a green indication.

16 **Power Receptacle:** Used to connect to 110VAC, 60Hz power to charge the internal batteries.