Amblyonix

5004 Model

Four-Pole Ground Resistance Tester

USER MANUAL

Amblyonix
Industrial Instrument Company

20 Republic Road, North Billerica, MA 01862
800-447-4020 WWW.AMBLYONIX.COM

MODEL 5004

Dear Customer,

Thank you for purchasing one of our Ground Resistance Testers. 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.

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

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

Amblyonix Industrial Instrument Company

20 Republic Road
North Billerica, MA 01862

Phone: 1-800-447-4020
Fax: 1-978-667-8901
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This product is designed to produce and deliver a low-frequency, constant current test signal to the circuit under test. 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 the device under test. 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, DO NOT connect this instrument to a faulted circuit.
- Keep unqualified and/or unauthorized personnel away from the testing area.
- Always use the proper power cord. Only use the power cord supplied with this unit or an acceptable equivalent that meets the specifications of this product.
- Never touch the energized output of the ground tester or the equipment under test during a test.
- Always use this product by connecting and disconnecting it properly to the device under test. Never connect or disconnect the output or any of the test connections during a test.
- After testing, always turn the ground tester off before coming into contact with the test connections.
- Unless otherwise specified, this product has been designed for 110VAC/60Hz operation and for battery operation.
- Do not operate this ground tester outside of its case. Do not operate this product when its covers or panels have been removed.
- Only use the properly rated fuse specified for this product.
- Avoid coming in contact with the output connections or electrified surfaces during or after a test, and until the ground tester or the device under test has been fully de-energized.
- Do not operate this ground tester 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 ground tester is clean and dry during use.
- Fully document your use of this product. We anticipate that with proper care, this ground tester will provide you with years of service. As time goes by, you may wish that you had recorded your testing scenarios and results to compare against future challenges. Nothing beats experience. Help your future self out today!!

Introduction

From the earliest days in the beginning of the electrical industry, proper grounding of electrical equipment has been known to be a vital component of electrical design and construction. The safe operation of any electrical product relies upon the presence of a good electrical ground as well as good electrical grounding and bonding. We have all heard the term “a good earth ground”. Establishing a good earth ground is the first step in creating a safe electrical environment.

As the term itself implies, the earth plays a vital role in the effectiveness of a grounding circuit. The resistivity of the soil in any given area is the most important factor to consider when attempting to establish a good earth ground. It is important to understand that soil resistivity varies significantly over a broad range of geological environments. Measuring the resistivity of the soil provides useful information when creating an effective local ground. If the resistivity of the soil is found to be low, creating a good ground connection to the earth can be as simple as driving a single 8ft ground rod into the soil. However, if the resistivity of the soil is high in value, multiple ground-rod systems or a grounding grid may need to be constructed to create a safe and effective ground.

Although low-resistivity soil conditions are desirable for establishing a good earth ground, the down side of low resistivity soil is that corrosive galvanic currents flow through it freely. These currents, coupled with moisture and environmental conditions, increase the effects of corrosion on buried utility infrastructure. By establishing a periodic ground testing program, the integrity of an electrical grounding system can be monitored and maintained.

The Model 5004 is designed to measure the resistance of grounding electrodes or grids, utilizing the fall-of-potential test method. The Model 5004 is perfectly suited to perform soil-resistivity measurements, touch/step potential measurements, and display earth-voltage readings. Phase-locked loop and switched-filter design allows for smooth operation even in electrically noisy environments. Standard features include a rugged aluminum-alloy case, three resistance ranges, an earth voltage measurement function, four-pole terminal connections, line or battery power capability, and a direct-reading digital display. The unit is supplied with a power cord for line-powered operation, eight AA batteries for battery operation, auxiliary electrodes, test cables and connectors for performing various types of tests, a manual and an NIST traceable certificate of calibration.

Features

Rugged, compact design

3 or 4 pole testing capability

Line or battery operation

Active electrical-noise-suppression circuitry

Large LCD indications

Specifications

Operating Conditions: 14 to 113 degrees F @ 85% RH

Measurement Range and Constant Current Test Signal:

Resistance: 0-20Ω (10mA), 0-200Ω (1mA), 2000Ω (0.1mA)

Voltage: 0-19.99VAC

Measurement Range and Accuracy:

0-20Ω ≤ ±3%rdg +1D

0-200Ω ± 1.5%rdg +1D

0-2000Ω ± 1.5%rdg +1D

Measurement errors may be caused by excessive auxiliary-ground-electrode resistance and the presence of ground voltages.

Maximum values for auxiliary electrode resistance are as follows:

Auxiliary electrode resistance RC (between C1 and C2)

0-20Ω ≤ 1KΩ

20-2000Ω ≤ 2KΩ

Auxiliary electrode resistance RP: (between P1 and P2)

<40KΩ error ≤±5%

Power Supply and Power Dissipation:

Maximum Power Dissipation: ≤2W

Power Requirements:

AC Power: 110VAC 60Hz

Battery Power: 8 AA Batteries

Dimensions: 8.7 x 7.9 x 4.25 inches

Weight: 3.1IbsTheory of Operation

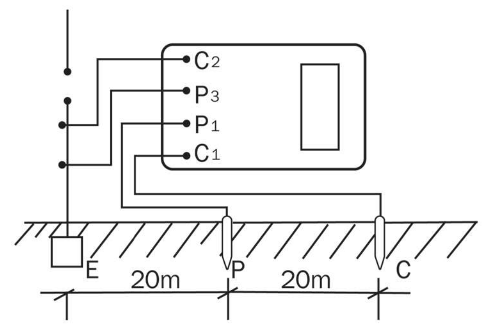
The Model 5004 employs a built-in DC/AC converter to transform internal power supply voltages into a low-frequency constant-current test signal. This test signal it then injected into the earth via auxiliary electrodes

Operating Instructions:

Ground Resistance Measurements

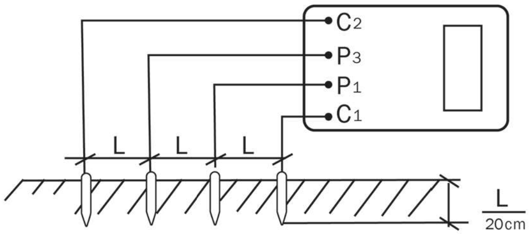
Prior to performing this test, it is important to disconnect the grounding electrode from service. Failure to do so will result in erroneous readings. The Model 5004 employs the Fall-of-Potential method for measuring ground resistance of grounding electrodes. When measuring ground electrode resistance, connect the Model 5004 as shown in Figure one.

Figure 1



Most grounding electrodes are a minimum of 8ft. long. If this consideration is used as a starting assumption for the depth of the electrode being tested, position the C1 auxiliary electrode into the earth approximately 80ft from the subject ground rod. Position the P1 auxiliary electrode into the earth at approximately 62% of the distance from the rod under test and the C1 electrode. Connect the C2 and P2 cables to the disconnected ground under test.

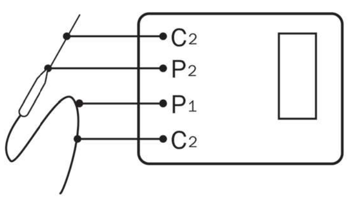
Figure 2



Turn the Model 5004 ON and select the proper resistance range to achieve a reading of maximum resolution. Perform this test three different times.

On test #2, move the P1 electrode 10% closer to the C1 electrode and observe the displayed reading. On test #3 mover the P1 electrode 10% closer to the electrode under test from its original position and observe this reading. If the measured values are all very similar, the average of these readings will be the resistance value of the electrode under test. If the readings vary significantly, the electrode under test may be much deeper than originally anticipated, and the scale of the test must be increased by spacing the auxiliary electrodes further from the ground being tested. If the display does not indicate a resistance measurement and instead displays “1” the resistance of the auxiliary electrodes may be too high, or excessive ground currents may be present. If the auxiliary electrode resistance is too high, water can be poured of the auxiliary connections to lower their resistance(s). If the measurement error is found to be caused by excessive ground currents, one solution may be to position the auxiliary electrode in a different straight-line tangent from the electrode under test.

Figure 3



Soil Resistivity Measurements

When measuring Soil Resistivity, the simplest test to perform is called the Wenner Method. Using this test method auxiliary electrodes are inserted into the earth in a straight line as depicted in Figure 2. The spacing of the electrodes relates directly to the size or depth of the sample being measured. When testing a location for soil resistivity, if the electrodes are spaced 10ft apart a ten-foot sample will be measured. If the desired test sample is for a twenty-foot depth, the electrodes must be also spaced 20ft apart, and so on. Keep in mind that soil resistivity is most commonly expressed in Ohm-centimeters. It is derived by using the following formula:

(Resistivity) $\rho = 2\pi AR$

Where Resistivity = 2x π x A(the area of the test) x R(the reading on the display). In the example where a 10ft sample is being measured, position the auxiliary electrodes into the earth in a straight line as mentioned above and proceed as follows:

Convert the length into centimeters. 10ft spacing equals approximately 305 centimeters. If for this case we arbitrarily select a measured value of 100.0, the formula then becomes:

Resistivity = 6.28 x 305 x 100.0 = 2543.4Ωcm. By applying this value into a grounding nomograph, the depth of a driven ground rod can be determined for a desired ground resistance for that ground rod.

Using the EV Function

A unique feature of the Model 5004 is the EV function. This feature allows the operator to assess the relative safety of a ground circuit under ground-fault conditions. When considering the safety of electrical circuits, terms such as STEP POTENTIAL, TOUCH POTENTIAL, and EARTH VOLTAGE are commonly used. They all refer to electrical potentials, measured between two or more points, that are the result of currents flowing through the earth towards a circuit ground.

Picture the following scenarios:

Scenario 1

A customer complaint to the local utility identifies a situation where residents are getting shocked when getting out of the hot tub that was installed on a concrete slab in their back yard. About one hundred yards away is a high-tension power line. An electrical inspection reveals that an induced voltage gradient is present when measured from the direction of the powerline toward the hot tub. When one test connection of a meter is inserted into the soil at the edge of the concrete slab, and the other is lowered into the water of the hot tub, a surprisingly large voltage is measured. When the customer enters the hot tub with dry feet they don't experience any discomfort, but when they get out of the tub and make contact with wet feet on the concrete slab while still partially in the tub, they experience an electrical shock.

Scenario 2

A substation has a grounding grid installed beneath the soil, and all of the equipment in the station are connected to it, including the surrounding chain-link fence. The grounding grid establishes an area of equi-potential throughout the installation, thereby creating a safe working environment. However, if a large ground fault outside the station should occur, it may be very dangerous to be in contact with the fence when excessive ground-fault currents complete a path back to the station ground.

To measure the relative safety of equipment in an electrical circuit, connect the Model 5004 as shown in Figure X. To measure the EARTH VOLTAGE (or touch-potential) of an area surrounding the piece of equipment, position the P1 electrode one arm-length (or one meter) away from the equipment under test. Turn the Model 5004 on and select the EV FUNCTION. To determine the EARTH VOLTAGE that may be locally present under fault conditions, multiply the displayed reading by the maximum ampacity of the faulted circuit.

Measuring the resistance of bonded connections.

Connect the Model 5004 across the connection to be measured as shown in Figure X. Select the lowest resistance range to supply maximum current available for the test, and for maximum resolution of measurement.

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