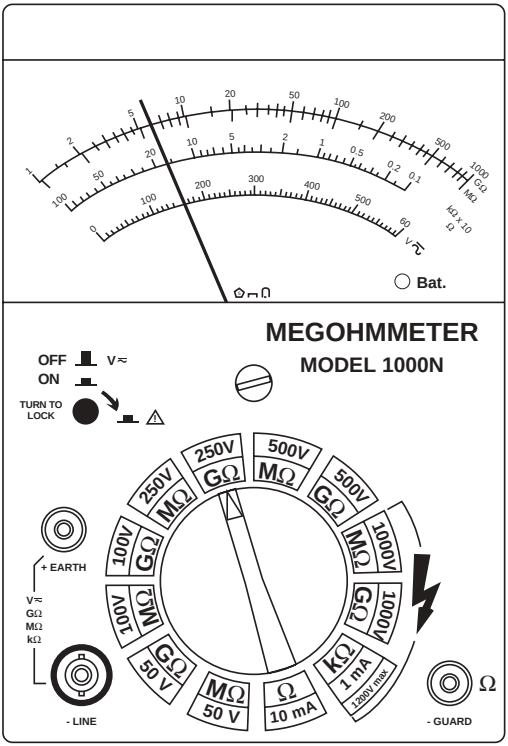
# 1000V Megohmmeter
# Model 1000N

# ESD Conductivity Test Kit
# Model 1100N

## USER MANUAL




AEMC® INSTRUMENTS

# Limited Warranty

The Megohmmeter Models 1000N and 1100N are warranted to the owner for a period of 2 years from the date of original purchase against defects in manufacture. This limited warranty is given by AEMC® Instruments, not by the distributor from whom it was purchased. This warranty is void if the unit has been tampered with, abused or if the defect is related to service not performed by AEMC® Instruments.

**What AEMC® Instruments Will Do:** If a malfunction occurs within the 2 year period, you may return the instrument to us for repair or replacement free of charge, provided we have your REGISTRATION CARD on file. AEMC® Instruments will, at its option, repair or replace the faulty material.

**Note: If a registration card is not on file, we will require a dated proof of purchase as well as your REGISTRATION CARD accompanied by the defective material.**

**REGISTER ON LINE AT:**
**www.aemc.com**

**What You Must Do:** First request a return authorization form by phone or by fax from AEMC® Instruments, then return the instrument along with the signed authorization repair form. Return material, postage pre-paid to:

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
Service Department
15 Faraday Drive
Dover, NH 03820 USA
Tel: (800) 945-2362 (X360)
(603) 749-6434 (X360)
Fax: (603) 742-2346

**Caution:** To protect against in-transit loss, we recommend you insure your returned material.

**For full warranty coverage, please read the Warranty Card which is affixed to the Warranty Registration Card. Please keep the Warranty Card with your records.**

# Table of Contents

## Warning

These safety warnings are provided to ensure the safety of personnel and proper operation of the instrument.

**WARNING: HIGH VOLTAGE PRESENT**

- Do not attempt to perform any tests with these instruments until you have read the instruction manual.
- Safety is the responsibility of the operator!
- Tests are to be carried out only on non-energized circuits! Check for live circuits before making resistance measurements (safety check).
- The Megohmmeters Models 1000N and 1100N are sources of high voltage, as is the sample connected to them. All persons performing or assisting in the tests must employ all safety precautions to prevent electrical shock to themselves and to others.
- AEMC® considers the use of rubber gloves to be an excellent safety practice even if the equipment is properly operated and correctly grounded.
- When testing capacitance samples, make sure that they have been properly discharged and that they are safe to touch. Dielectric insulation samples should be short-circuited for at least five times the amount of time they were energized.
- Megohmmeters should never be used in an explosive environment.
- Use the leads supplied with the megohmmeters. If they are defective or worn, replace before testing.

## International Electrical Symbols

This symbol signifies that the instrument is protected by double or reinforced insulation. Use only specified replacement parts when servicing the instrument.

This symbol signifies CAUTION! and requests that the user refer to the user manual before using the instrument.

Risk of electric shock. The voltage at the parts marked with this symbol may be dangerous.

# MEGOHMMETER MODEL 1000N

## Receiving Your Shipment

Upon receiving your shipment, make sure that the contents are consistent with the packing list. Notify your distributor of any missing items. If the equipment appears to be damaged, file a claim immediately with the carrier and notify your distributor at once, giving a detailed description of any damage.

## Packaging

The Megohmmeter Model 1000N (Cat. #185.100) is shipped with eight 1.5V "AA" batteries, two color-coded safety leads with insulated alligator clips, a separate shielded lead, a separate insulated alligator clip, test probe, one spare fuse, carrying case and instruction manual.

## Accessories and Replacement Parts

AC power supply module with line cord and plug for switch-selectable 110/220VAC at 47 to 400Hz ..... **Cat. #100.142**

Protective rubber case with handle ..... **Cat. #2980.02**

Rugged plastic carrying case, 19 x 14 x 7" ..... **Cat. #2118.07**

Fuse, set of five, 0.1A slow-blow for AC supply module ..... **Cat. #100.438**

Fuse, set of one, 0.3A, for Model 1000 ..... **Cat. #100.429**

One test probe and one insulated alligator clip ..... **Cat. #100.404**

Replacement leads for Models 1000N/1100N/5000N ..... **Cat. #1017.23**

7-pin shielded lead, 10 ft, for Models 1000N/5000N/5100 ... **Cat. #2950.10**

**Replacement Leads for Model 1000**

Coaxial shielded lead ..... **Cat. #100.439**

Set of leads: one coaxial shielded lead, pair of safety leads, alligator clip, and test probe ..... **Cat. #100.482**

# Description

The AEMC® Model 1000N (Cat. #185.100) is a portable, multi-range, high-sensitivity megohmmeter capable of measuring a wide range of insulation resistances from 1 kilohm to 1000 gigohms. The Model 1000N has five test voltages of 50, 100, 250, 500 and 1000V. Each test voltage setting has two resistance ranges: 1 to 1000MΩ and 1 to 1000GΩ.

In addition, the Model 1000N has a unique low insulation test range of 1 to 1000kΩ with a constant current of 1mA (maximum voltage of 1200VDC), which is useful for testing old or flooded installations. A voltmeter (safety check) with a range of 0 to 600V is standard.

The Model 1000N may be powered by either AC or DC. DC power is supplied by eight 1.5V alkaline "AA" batteries. As an option, an AC line supply module and cord for 110/220VAC at 47 to 400Hz can be inserted in the battery compartment.

An audible signal consisting of approximately ten beeps per minute is present when the megohmmeter is ON, and serves as a time base for tests of long duration. A green LED, when ON, indicates that the batteries are good when the PUSH-TO-TEST button is depressed. It also serves as a warning light when the instrument is in use, indicating that the selected test voltage is present at the terminals.

# Specifications

## INSULATION TESTS

**DC Test Voltages:**
50, 100, 250, 500, 1000V

**Megohm Ranges:**
For each test voltage two direct reading ranges:
1 to 1000MΩ
1 to 1000GΩ

**Short Circuit Current:** 5mA (max)

**Accuracy:** 5% of reading typical
15% of reading between 100 and 1000GΩ on the 50V range

**Charging Time:**
1000 MΩ range: 0.3 seconds/µF
1000 GΩ range: 4 seconds/µF

**Discharging Time:**
Automatic discharge when test button is released; 0.1 seconds/µF

**Scale:**
Two large overlapping scales: 4.7" (119 mm) for each range

**Test Voltage Generation:**
Solid state circuitry generating rated test voltage across the full range

## RESISTANCE TESTS

**Test Current:** Constant 1mA DC

**Kilohm Range:** 1 to 1000kΩ (1MΩ)

**Maximum Test Voltage:** 1200VDC

**Accuracy:** 5% of reading typical

## CONTINUITY TESTS

**Resistance Range:**
0.1 to 100Ω; 3Ω mid-scale

**Accuracy:** 6% of reading

**Audible Tone:** Continuous for continuity resistances under 200Ω

**Fuse:** High interrupting capacity (0.315A)

## VOLTAGE TESTS (SAFETY CHECK)

**Voltage Range:** 0 to 600VAC/DC

**Accuracy:** 3% of full scale

## GENERAL SPECIFICATIONS

**Audible Test Signal:**
Ten beeps per minute (constant tone for continuity resistance under 200Ω)

**Power Supply:**
Eight 1.5V "AA" alkaline batteries (NEDA 15A). Typical battery life: 350 one-minute tests; power consumed only when test button is depressed; built-in battery check by green LED.

*Option:*
110/220V selectable, 47 to 400Hz AC supply module

**Dielectric Test:** 4000VAC, 50/60Hz, 1 minute

**Fuse Protection:**
0.3A high interrupting capacity fuse between line and guard terminals

**Meter Movement:** Rugged taut band suspension

**Dimensions:** 7.7 x 5.2 x 3.75" (196 x 132 x 95mm)

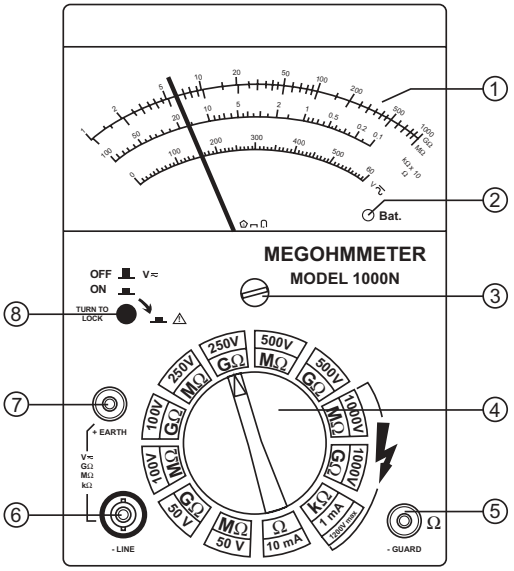
**Weight:** 2.2 lbs (1 kg)

**Temperature Range:** 23° to 122°F (-5° to +50°C)

**Case:** High impact gray polycarbonate

**Terminals:**
Color-coded safety terminals; guard terminal eliminates surface leakage errors

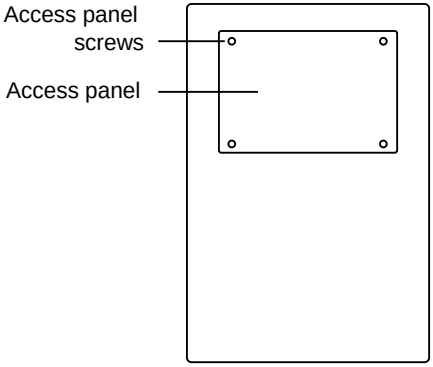
# Control & Connector Identification




1. Analog Measurement Scale
2. Battery Power Indicator:
   Green lamp ON indicates batteries are good when PUSH-TO-TEST button is depressed. Audible “beep” is also emitted approximately every 6 seconds.
3. Mechanical Zero Adjust
4. Selection Switch
5. GUARD terminal (blue):
   Used to minimize the effect of leakage current.
   Also used for the 10Ω range.
6. LINE terminal (black):
   Connects to the equipment to be tested.
7. EARTH terminal (green):
   Connects to ground for insulation testing.
8. PUSH-TO-TEST button
   Lock “ON” by turning button a quarter turn to the right.
   OFF Position: Voltmeter position
   ON Position: Test position with voltage present at outputs

## Battery Replacement

The Model 1000N is powered by eight 1.5V “AA” batteries. To replace the batteries, disconnect the instrument from any circuits, verify the PUSH-TO-TEST button is in the OFF position and proceed as follows.




- Unscrew the four standard screws on the four corners of the battery pack and remove the battery pack.
- Replace the batteries, observing the proper polarities.
- Replace the battery case, taking care not to pinch the connecting wire, and tighten the four screws.

## AC Supply Module

The optional AC supply module (Cat. #100.142) provides power to the Model 1000N at 110 or 220VAC. The AC power supply module is designed to plug into the back portion of the instrument, directly replacing the batteries. The module is protected by a 0.1A slow-blow fuse.

**Note:** Cat. #100.142 is supplied with 110V US plug.

- Unscrew the four screws on the corners of the back panel battery pack.
- Disconnect and remove the battery pack.
- Connect the AC supply module to the power supply connector.
- Place the AC supply module into the back of the instrument and tighten the four corner screws, making sure not to pinch the wires of the power supply connector.
- With the tip of a screwdriver, select the proper voltage with the 110/220 supply switch on the back panel of the AC supply module
- Plug AC supply cord into the appropriate voltage receptacle.

# OPERATION

## The Analog Scale

**Before taking any measurements, verify that the pointer is zeroed correctly (AC scale "0"). If it is not, adjust with the mechanical zero adjust screw.**

The analog scale serves two functions. First, it indicates the actual resistance of the insulating material under test (black scales). The top scale is used for measurement on the MΩ and GΩ ranges. The bottom half (MΩ) covers the range of 1MΩ to 1000MΩ, reading from left to right The upper portion of the scale (GΩ) covers the range of 1GΩ to 1000GΩ and reads left to right.

The center scale is used for the low insulation test range of 1kΩ to 1000kΩ, reading from right to left.

The bottom arc is an AC/DC voltmeter which is divided into 10-volt increments. The voltmeter function is operable any time the PUSH-TO-TEST button is out. The voltmeter detects the presence of voltage on the equipment to be tested. **(If voltage is detected, do not proceed with the insulation test.)**

The voltmeter function also indicates if, after completing insulation testing, the sample under test has stored a dangerous capacitive charge. The instrument discharges this capacitance internally and the needle will drop accordingly. Disconnect the meter when the sample is discharged.

 **Warning:**

Electrical equipment and cables may have sufficient capacitance to store a dangerous charge from the instrument test current. For proper discharge to occur the PUSH-TO-TEST button must be in the OFF position with the sample connected between the EARTH and LINE terminals.

On prolonged tests, the PUSH-TO-TEST button may be locked in the ON position; care should be taken in this mode that no damage is done if the instrument is left unattended.

## Preliminary Check

When the PUSH-TO-TEST button is in the OFF position, the pointer should be on zero of the voltmeter scale, and on three of the GΩ scale. If it is not, use the mechanical zero adjust on the front of the instrument.

- Detach the leads from the instrument.
- Press the PUSH-TO-TEST button into the ON position. The pointer should deflect completely to the far right of the scale. The green neon "Bat." lamp should light up.

**Note:** Ensure that the "Bat." light (green) does not go out at any point during the testing. If the light does not illuminate, stop the test and change the batteries before continuing.

Verify that NO VOLTAGE is present on the circuit to be tested.

## How to Use the PUSH-TO-TEST Button

**OFF:** PUSH-TO-TEST button is in the raised position. This is for measurement of AC or DC voltages (safety check).

**Note:** Do not depress the PUSH-TO-TEST button if voltage is present.

**ON:** PUSH-TO-TEST button is depressed and held down for the duration of the test. This is for insulation resistance tests.

**LOCK-IN:** PUSH-TO-TEST button is depressed and turned clockwise 90° to lock into position. This is for insulation resistance tests of long duration such as the Time Resistance or Absorption Test.

## Utilizing the Guard Terminal

Guard terminals are useful when measuring high resistance values and for stabilizing readings.

When testing the insulation at the end of a cable, it is necessary to eliminate the error from surface leakage which occurs, particularly at high resistance values. The guard terminal provides a third terminal within the path of the surface leakage “E”. Connect the instrument as shown in Figure 3.

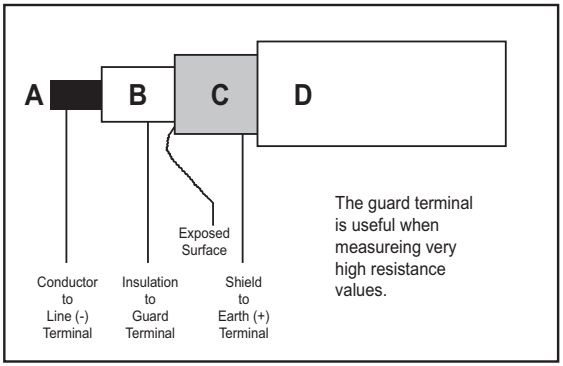



*Figure 3*

If there is no shield at “B”, use a copper wire wound several times around the exposed surface “B”. (Note: If a shield is not available and you do not make up a shield around “B” and connect to the guard terminal (-), the measurement will be erroneous and lead to confusion as to the cable’s condition.)

If the guard terminal is not connected at “B”, the instrument measures the current “I” flowing through the insulation and a surface leakage current “$i^1$”. See Figure 4.

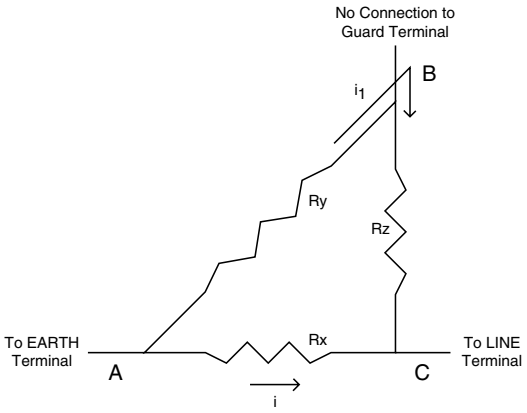



*Figure 4*

When the guard terminal is connected at “B”, the instrument measures the current “I” and not the surface leakage current “$i^1$”, which is not included in the measurement. See Figure 5. This type of measurement will give the true value of the resistance “Rx”, providing the “Ry” and “Rz” are not too low.

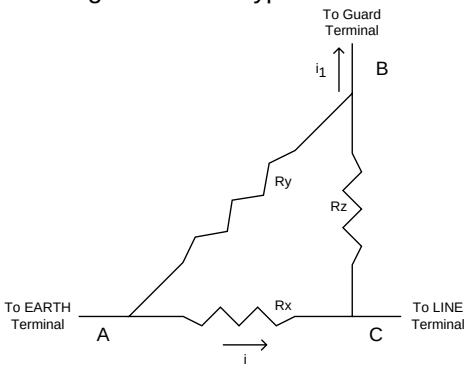



*Figure 5*

## Voltage Measurements (Safety Check)

Insulation resistance tests are to be carried out on non-energized circuits only. Voltage measurements are made as a safety precaution. If any voltage is present do not proceed with insulation resistance testing. This instrument can measure both AC or DC voltages. For voltage measurements, proceed as follows:

- The PUSH-TO-TEST button should be in the OFF position.
- Connect the instrument with the voltage leads connected between the Line (-) and Earth (+) terminals on the unit.
- Read the voltage directly on the voltage scale.

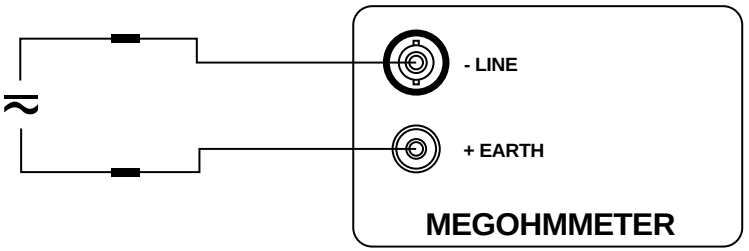



*Figure 6*

## Audible Signal

When the PUSH-TO-TEST button is in the ON or LOCK-IN position, an audible signal will result. This signal consists of approximately one beep every six seconds (ten beeps per minute). The signal can be used as a time base for monitoring the duration of the test. On the MΩ and GΩ ranges, the signal indicates that the instrument is in operation and that the selected DC test voltage may be present on the terminals of the instrument.

## Precautions when Making DC Insulation Tests

- The equipment should be taken off the line sufficiently in advance to permit it to cool to ambient temperature.
- When you are testing windings, they should be clean and dry; let solvents and cleaners evaporate. Should foreign matter or wet surfaces be present, erroneous readings may result. (A clean, dry sample's resistance may rise for 5 to 15 minutes, whereas a wet, dirty one will stabilize quickly).
- Make sure that the equipment tested is properly discharged and grounded before testing.
- When testing individual windings, connect all other windings (not under test) together and ground to motor frame.
- When testing phases, be sure they are open to test each individually.
- After applying a test voltage, allow sufficient discharge time. As a rule, discharge twice as long as tested.

**Note:** The instrument voltmeter will indicate the discharge voltage at the terminals.

# Insulation Measurement - Connections

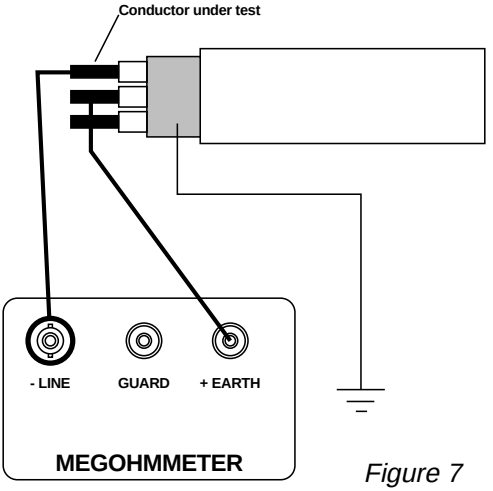



*Figure 7*

Figure 7 shows the connections to measure the insulation of one conductor to the other conductors. The cable should be disconnected at both ends to avoid leakage through switchboards and panels.

Figures 8 and 9 show the connection for testing insulation from a supply conductor to a ground (motor frame). The connection to the guard terminal is used to eliminate the effects of surface leakage across exposed insulation at one end of the cable. Refer to the section “Utilizing the Guard Terminal.” The cable should be disconnected at both ends to avoid leakage through switchboards and panels.

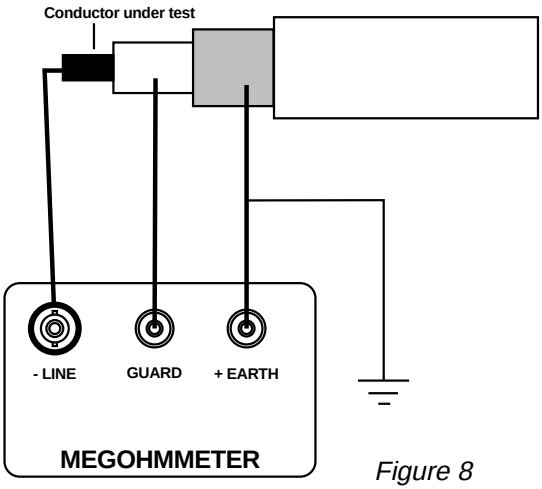



*Figure 8*

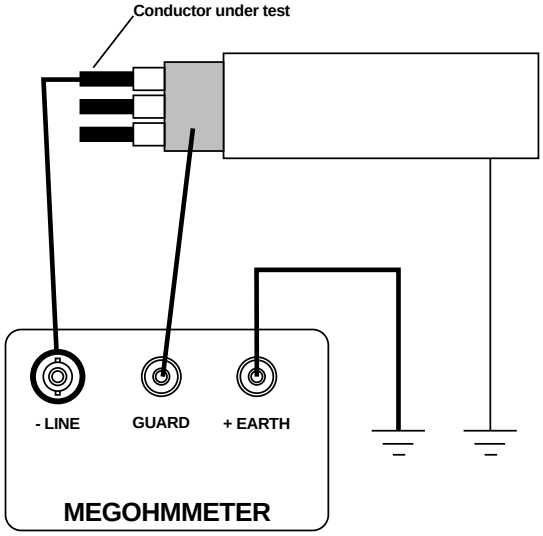



*Figure 9*

Figure 10 shows the connections to a transformer. Make sure that the switches and/or circuit breakers on both sides are open. Check the high voltage winding to ground, low voltage to ground, and the resistance between them with no winding grounded.

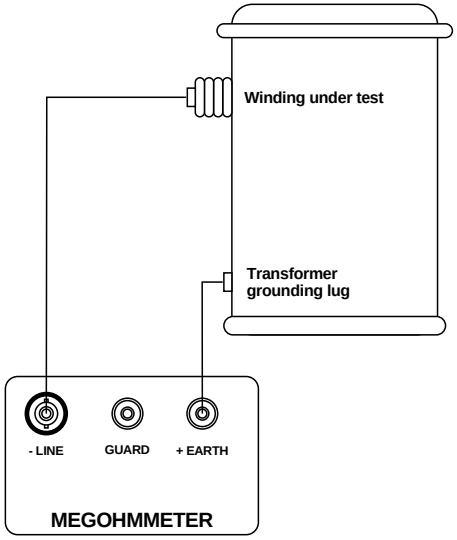



*Figure 10*

Figure 11 shows the connections for measuring the insulation of a three-phase line to ground by connecting the jumpers between phases. This gives a reading of all conductors at once. If a load such as a motor, heater, etc., is attached to the other end of the line, it will read the load resistance to ground at the same time. By removing the jumpers, readings can be made between the individual conductors and ground.

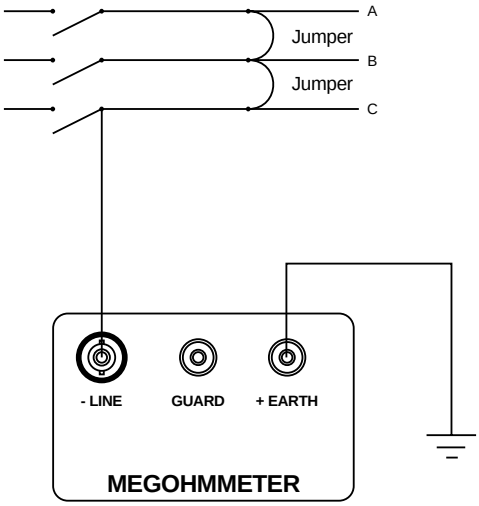



*Figure 11*

# Insulation Resistance Measurements on Motors

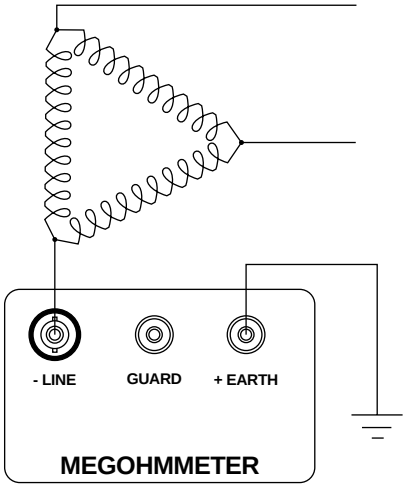



Figure 12 shows reading the resistance to ground of a three-phase motor winding. Since the three-phase motors are internally connected, it is only necessary to connect one lead to the motor lead and the other lead to the motor frame as shown.

*Figure 12*

Figure 13 shows the windings of a three-phase motor separated. Sometimes this can be done at the lead terminals while other times the end bells must be removed to get at the lead wires of the coils. By connecting the megohmmeter as shown, the phase insulation resistance value can now be determined. Read between phases “A” and “B”, then “B” and “C”, then “C” and “A”.

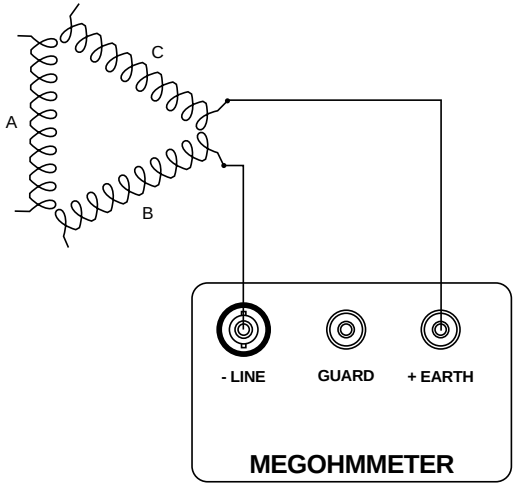



*Figure 13*

Figure 14 shows connections for testing insulation from a supply conductor in a switchbox to ground (motor frame). An identical test may be carried out from the motor starter.

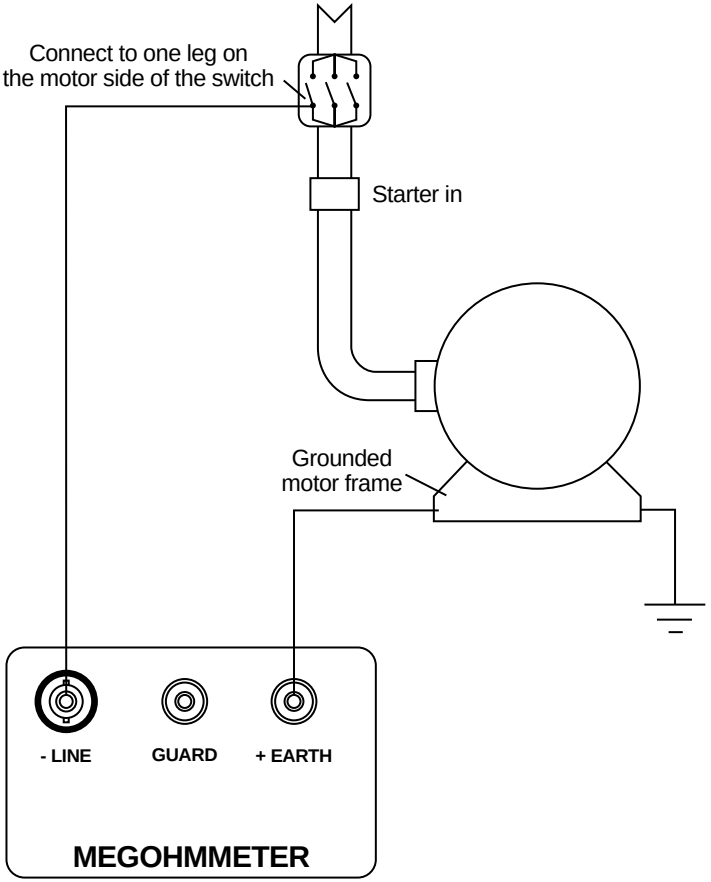



*Figure 14*

# Understanding Insulation Testing

Insulation is the material between two points of different potential which, through high resistivity, prevents the flow of current between those points. Insulation failure is one of the most common problems associated with electrical equipment breakdown.

A megohmmeter is an insulation resistance tester which is essentially a high resistance ohmmeter (MΩ or greater) providing a high DC potential (up to 5000V). This high potential causes low amounts of current to flow through and over the insulation which is under test.

Many factors can cause insulation to fail: mechanical damage, moisture, heat, foreign debris, corrosion, etc. As time passes, these factors combine to permit excessive current to flow through insulation at points where it would normally be blocked by the insulation resistance. Usually, the resistance on degrading insulation will drop gradually, providing plenty of warning. Other times it will drop suddenly, as when it is immersed. With periodic resistance tests and good record keeping, it is possible to get an accurate picture of the insulation condition. Insulation resistance testing is intended to indicate not only if equipment is bad, but also whether it is becoming bad.

Resistance of many types of insulation can vary greatly with temperature. The resistance data obtained should be corrected to the standard temperature for the class of equipment under test.

Please note that although we present information on test procedures, values and recommended frequency of testing, the manufacturer of your particular piece of equipment is the definitive source for testing parameters and procedures. While we refer to commonly applied rules and practices, every test will not be practical to each piece of electrical equipment in your facility.

# Types of Tests

## SPOT READING TEST

### Method

For this test, the megohmmeter is connected across the insulation of the windings of the machine being tested. A test voltage is applied for a fixed period of time, usually 60 seconds, and a reading is taken. The spot reading test should only be carried out when the winding temperature is above the dewpoint[1]. The operator should note the winding temperature so that the reading may be corrected to a base temperature of 20°C (68°F).

### Test Duration

To obtain comparable results, tests must be of the same duration. Usually the reading is taken after 60 seconds.

### Interpreting the Results

Proper interpretation of spot reading tests requires access to records of results from previous spot reading tests. For conclusive results, only use results from tests performed at the same test voltage for the same amount of time under similar temperature and humidity conditions. These readings are used to plot a curve of the history of insulation resistance. A curve showing a downward trend usually indicates a loss of insulation resistance due to unfavorable conditions such as humidity, dust accumulation, etc. A very sharp drop indicates an insulation failure.

## RATIO TESTING

In time resistance reading (dielectric absorption ratio), readings are taken at 30 seconds and 60 seconds to obtain the dielectric absorption ratio.

$$\frac{\text{Insulation resistance @ 60s}}{\text{Insulation resistance @ 30s}} = \text{Dielectric Absorption Ratio (DAR)}$$

This test is useful for increasing the accuracy of spot testing. In general, a ratio of 1.25 to 2 or better should be required. (Below 1.1 is dangerous; 1.1 to 1.25 is questionable; 1.25 to 1.4 is fair; and 1.4 to 2 and above is good.) A ratio below this indicates that repair is probably needed.

[1] Dewpoint temperature is the temperature at which the moisture vapor in the air condenses as a liquid.

Remember that a DC insulation test may be used for acceptance testing, but is more commonly used to check the gradual deterioration of equipment over its lifetime. Consult your equipment manufacturer for specific test or test voltage if not known.

Insulation resistance decreases with moisture, temperature and age, and should be recorded over time at a given temperature and corrected.

## DIELECTRIC ABSORPTION TEST

### Method

This test is based on the comparison of absorption characteristics of good insulation vs. the absorption characteristics of humid or otherwise contaminated insulation. During the test, a test voltage is applied for an extended period, usually 10 minutes. The operator takes a reading every 10 seconds for the first minute, and then every minute up to 10 minutes. A curve is drawn showing the insulation resistance value versus time.

### Test Duration

10 minutes

### Interpreting the Results

If the results were plotted on a graph, the slope of the curve would indicate the condition of the insulation under test. A good insulation will show a continual increase in resistance for typically 10 to 15 minutes. Contaminated, moist, or cracked insulation will produce a relatively flat curve.

A ratio known as the **polarization index** can be obtained by dividing the value from the 10-minute reading by the value from the one-minute reading. This polarization index is indicative of the slope of the curve.

A low polarization index usually indicates excessive moisture and contamination. On large motors or generators, values as high as 10 are commonly expected.

$$\text{Polarization index} = \frac{\text{10-minute reading}}{\text{1-minute reading}}$$

The IEEE Std 43-1974[2] lists the following minimum values for the polarization index for AC and DC rotating machines:

Class A: 1.5 Class B: 2.0 Class C: 2.0

[2] IEEE Std. 43-1974, - *Recommended Practice for Testing Insulation Resistance of Rotating Machinery*

## STEP VOLTAGE TEST

**Method**
In this test, the operator applies two or more test voltages in steps. The recommended ratio for the test voltage steps is 1 to 5. At each step, test voltage should be applied for the same length of time, usually 60 seconds. The application of increased voltage creates electrical stresses on internal insulation cracks. This can reveal aging and physical damage even in relatively dry and clean insulation which would not have been apparent at lower voltages.

**Test Duration**
A series of “steps,” each step lasting 60 seconds.

**Interpreting the Results**
Compare the readings taken at different voltage levels, looking for any excessive reduction in insulation resistance values at the higher voltage levels. Insulation that is thoroughly dry, clean, and without physical damage should provide roughly the same resistance values despite changes in test voltage levels. If resistance values decrease substantially when tested at higher voltage levels, this should serve as a warning that insulation quality may be deteriorating due to dirt, moisture, cracking, aging, etc.

# The Effects of Temperature

Insulation resistance measurements are changed by variations in temperature of the insulation material. Typically, when the temperature goes up, the insulation resistance will go down. Inversely, when the temperature drops the insulation resistance will increase in value.

The best way to obtain consistent measurement results is to test the insulation at a standard temperature, typically 68°F (20°C). If the temperature of the material you are testing is either higher or lower than 68°F (20°C), refer to the temperature correction chart (see table). As a general rule the insulation resistance value may be corrected by:

- Halving the resistance measurement value for every 10°C above the base temperature of 68°F (20°C), or
- Doubling the resistance value for every 10°C below 68°F (20°C)

| °C | °F | Multiplication Factor |
|---|---|---|
| 0 | 32 | 0.25 |
| 5 | 41 | 0.36 |
| 10 | 50 | 0.50 |
| 15 | 59 | 0.75 |
| 20 | 68 | 1.00 |
| 25 | 77 | 1.40 |
| 30 | 86 | 1.98 |
| 35 | 95 | 2.80 |
| 40 | 104 | 3.95 |
| 45 | 113 | 5.60 |
| 50 | 122 | 7.85 |
| 55 | 131 | 11.20 |
| 60 | 140 | 15.85 |
| 65 | 149 | 22.40 |
| 70 | 158 | 31.75 |
| 75 | 167 | 44.70 |
| 80 | 176 | 63.50 |

# Interpreting the Results

Insulation resistance values are a function of the type of insulating material. The actual value you read may vary greatly and is not as important as the trends of the values over time. This is why the resistance measurement must be taken in a greater context. Some other factors to consider are:

**Previous Testing Results**
These are very important, since they will indicate the decline in the insulation resistance over time. All new equipment should be tested and documented to serve as a benchmark for future testing.

**Careful Visual Inspection**
By taking a very close look at the equipment you are testing it may be possible to see cracks, excessive moisture, burn marks, etc., which may, over time, cause catastrophic equipment failure.

**Manufacturers' Recommendations for Specific Equipment**
The definitive source for information on a specific piece of equipment is its manufacturer. Most manufacturers will provide basic information about the insulation resistance which may be encountered during testing.

**Comparisons with Similar Equipment**
Similar equipment should provide similar insulation resistance values. This would also remain true when testing cables. For three-phase systems, it would be very useful to compare resistive values between the phases.

By performing insulation resistance tests regularly and recording the test results, it may be possible to predict failure by detecting a downward trend in the resistance. Careful notations should be made as to time/date, temperature, applications, etc.

The information contained in this manual is intended only as a guide to acceptable procedure; it is not intended to be used as a test specification for specific electrical equipment.

# ESD CONDUCTIVITY TEST KIT MEGOHMMETER Model 1100N

## Receiving Your Shipment

Upon receiving your shipment, check that the contents agree with the packing slip. Notify your distributor at once of any shortages. If the equipment appears to be damaged, file a claim immediately with your carrier, and notify your distributor at once, giving a detailed description of the damages. Save the damaged packing container to substantiate your claims.

## Packaging

ESD Conductivity Test Kit Megohmmeter Model 1100N (Cat. #2110.03) is shipped with the AEMC® Model 1000N megohmmeter, two floor weights, 25-foot shielded lead, two safety leads, an alligator clip, test probe, batteries, carrying case and instruction manual.

## Accessories & Replacements for Model 1100N

1000V Megohmmeter ..... **Cat. #2110.02**

Fuse, set of one, 0.3A ..... **Cat. #100.429**

Floor weights, set of two ..... **Cat. #2118.05**

Carrying case ..... **Cat. #2118.07**

Set of 3 leads for 1100N ..... **Cat. #2118.42**

7-Pin shielded lead, 25-ft, for 1100N/5100 ..... **Cat. #2118.26**

AC power supply module with line cord and plug for switch-selectable 110/220VAC at 47 to 400Hz ..... **Cat. #100.142**

Fuse, set of five, 0.1A slow-blow for AC supply module ..... **Cat. #100.438**

**Replacement Leads for Model 1100**

Set of leads: 25-ft shielded lead, two safety leads, alligator clip and test probe ..... **Cat. #2118.06**

# Description

ESD Conductivity Test Kit Megohmmeter Model 1100N Kit (Cat. #2110.03) is designed specifically for floor resistance testing in areas where electrostatic discharge is a problem, such as computer rooms, electronic assembly rooms, hospitals, etc. The kit includes a 1000V megohmmeter which features excellent resolution in the critical $10^7$ to $10^9\Omega$ ranges, and fine resolution up to $10^{12}\Omega$; 25-foot shielded lead; and two floor weights - NFPA probes for consistent and repeatable contact with the surface under test. The Model 1100N is useful for testing effectiveness of conductive carpets, mats, tables, chairs, etc.

The Model 1000N is especially suited for this type of measurement, due to high accuracy and resolution in the megohm and gigohm ranges.

Conductivity testers are important in any operation where the presence of electrostatic discharge charges poses a danger to personnel or the operation of electronic equipment.

There are several standards in the industry which may be referenced when performing ESD testing of conductive flooring or tiles.

Standard 99
*Reduction in Electrostatic Hazard*
National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

Standard F 150-72
*Electrical Resistance of Conductive Resilient Flooring*
American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

Standard #4 EOS/ESD
*Standard for Protection of Electrostatic Discharge Susceptible Items*
EOS/ESD Association inc.
201 Mill St.
Rome, NY 13440

Additional standards and specific recommendations for your application may be obtained from equipment and flooring manufacturers.

# Specifications

## INSULATION TESTS

**DC Test Voltages:**
50, 100, 250, 500, 1000V

**Megohm Ranges:**
For each test voltage two direct reading ranges:
1 to 1000MΩ ($10^6$ to $10^9$Ω)
1 to 1000GΩ ($10^9$ to $10^{12}$Ω)

**Short Circuit Current:** 5mA (max)

**Accuracy:** 5% of reading typical

**Charging Time:**
MΩ range: 0.3 seconds/µF
GΩ range: 4 seconds/µF

**Discharging Time:**
Automatic discharge when test button is released; 0.1 seconds/µF

**Scale:**
Two large overlapping scales: 4.7" (119mm) for each range

**Test Voltage Generation:**
Solid state circuitry generating rated test voltage across the full range

## RESISTANCE TESTS

**Test Current:** Constant 1mA DC

**Kilohm Range:** 1 to 1000kΩ (1MΩ)

**Maximum Test Voltage:** 1200VDC

**Accuracy:** 5% of reading typical

## CONTINUITY TESTS

**Resistance Range:** 0.1 to 100Ω; 3Ω mid-scale

**Accuracy:** 6% of reading

**Audible Tone:**
Continuous for continuity resistances under 200Ω

**Fuse:** High interrupting capacity (0.315A)

## VOLTAGE TESTS (SAFETY CHECK)

**Voltage Range:** 0 to 600VAC/DC

**Accuracy:** 3% of full scale

## GENERAL SPECIFICATIONS

**Audible Test Signal:**
Ten beeps per minute
(constant tone for continuity resistance under 200Ω)

**Power Supply:**
Eight 1.5V "AA" alkaline batteries (NEDA 15A). Typical battery life: 350 one-minute tests; power consumed only when test button is depressed; built-in battery check by green LED

*Option:*
110/220V selectable, 47 to 400Hz AC supply module

**Dielectric Test:** 4000VAC, 50/60 Hz, 1 minute

**Fuse Protection:**
0.3A high interrupting capacity fuse between line and guard terminals

**Meter Movement:** Rugged taut band suspension

**Dimensions:** 7.7 x 5.2 x 3.75" (196 x 132 x 95mm)

**Weight:** 2.2 lbs (1 kg)

**Temperature Range:** 23° to 122°F (-5° to +50°C)

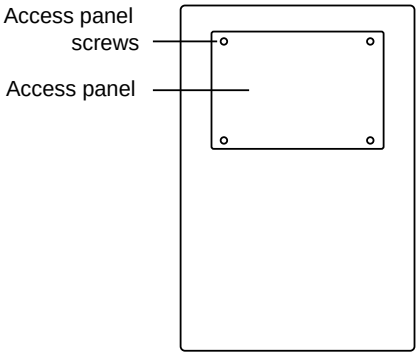
**Case:** High impact gray polycarbonate

**Terminals:**
Color-coded safety terminals; guard terminal eliminates surface leakage errors

## Battery Replacement

The Model 1100N is powered by eight 1.5V “AA” batteries. To replace the batteries, disconnect the instrument from any circuits, verify the PUSH-TO-TEST button is in the OFF position and proceed as follows:

- Unscrew the four standard screws on the four corners of the battery pack and remove the battery pack.
- Replace the batteries, observing the proper polarities.
- Replace the battery case, taking care not to pinch the connecting wire, and tighten the four screws.




## AC Supply Module

The optional AC supply module (Cat. #100.142) provides power to the Model 1100N at 110 or 220VAC. The AC power supply module is designed to plug into the back portion of the instrument, directly replacing the batteries. The module is protected by a 0.1A slow blow fuse. **Note:** Cat. #100.142 is supplied with 110V US plug.

- Unscrew the four screws on the corners of the back panel battery pack.
- Disconnect and remove the battery pack.
- Connect the AC supply module to the power supply connector.
- Place the AC supply module into the back of the instrument and tighten the four corner screws, making sure not to pinch the wires of the power supply connector.
- With the tip of a screwdriver, select the proper voltage with the 110/220 supply switch on the back panel of the AC supply module
- Plug AC supply cord into the appropriate voltage receptacle.

# Resistance Testing of Conductive Flooring

## Background

There are numerous standards currently being developed for measuring conductive flooring resistance under 100V and 500V. Actual resistance values vary from specification to specification, but $10^4$ to $10^{10}\Omega$ are typical values. The following simplified procedure is an extrapolation from the ASTM standard F 150-72. You may also refer to other sources, such as the NFPA or EOS/ESD for alternate procedures.

## General Notes

The floor sample should consist of a section covering 48 x 48 inches (1.22 x 1.22 meters) in area.

When the sample is to be tested after installation, the test area dimensions should not exceed a section of floor 20 x 20 feet (6 x 6 meters).

## Conditioning

Whenever possible, condition the test area at least twenty-four hours at 73.4°F ±1.8°F (23°C ±1°C) and 50% ±5% RH and test under the same conditions.

## Test Procedure

1. **For uninstalled panels:** Place the dry specimen as described in General Notes #1 on a nonconductive surface and lightly wipe with a lint-free cloth to remove any foreign material prior to the placing of the weights. Place the weights 2" (50.8 mm) in from an edge of the sample and 36" (914.4 mm) apart. Apply 500 volts and take a reading five seconds after application of the voltage.
2. **For installed panels:** Place the weights 36" (914.4 mm) apart and at least 36" (914.4 mm) from any ground connections or grounded object resting on the floor sample described in General Notes #2. Apply 500 volts and take a reading five seconds after application of the voltage.
3. Unless otherwise specified, make five measurements on each floor section with the weights at different locations for each measurement and record the value of two significant figures (see Figure 16).

4. Repeat the above procedure with the megohmmeter connected between one weight and a known electrical ground (see Figure 17). In the case of an uninstalled floor sample as in step #1, the ground should be part of the sample panel. In the case of an installed floor sample as in step #2, the ground should be a water pipe or known electrical ground. Interchange the leads at the megohmmeter for each measurement and report the average value obtained as the value for that measurement.
5. When finished, turn off the megohmmeter and return it to the case.

**Note:** If the resistance changes with time during a measurement, the value observed after about 5 seconds shall be considered to be the measured value.

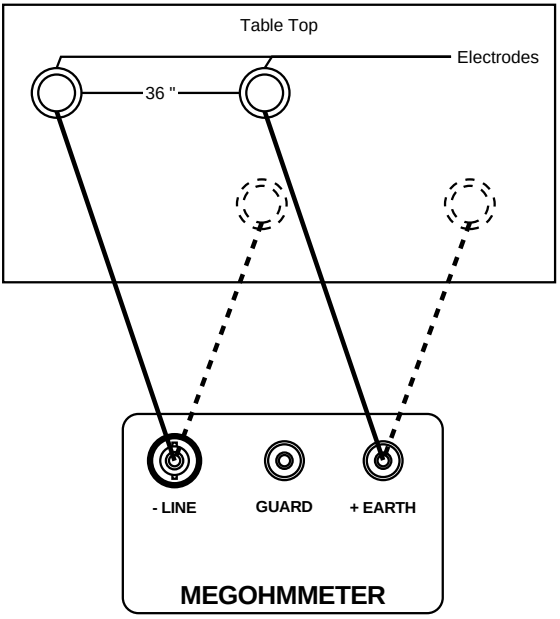



*Figure 16*

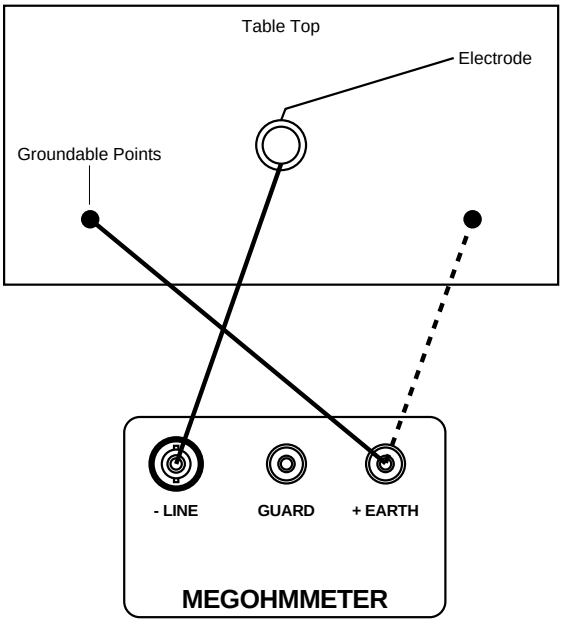



*Figure 17*

## Measurement Results

Specific measurement results for each individual application of the Model 1100N are difficult to determine. The definitive information on which voltage level to apply, as well as which measurement values will indicate a proper resistivity, should be determined by the manufacturer of the conductive flooring or tiles.

The following values (based on EOS/ESD, S4.1-1990) may serve as a minimum resistivity level which has been proven to provide an appropriate level of protection in the manufacturing environment.

**Resistance from test electrode to a groundable point (Figure 17):**

Measured value: ≤ 10,000 megohms (10 gigohms)

**Resistance from electrode to electrode (Figure 16):**

Measured value: ≥ 1 megohm

# Maintenance

**Warning:**

- For maintenance use only original factory replacement parts.
- To avoid electrical shock, do not attempt to perform any servicing unless you are qualified to do so.
- Do not perform any service while the Megohmmeter Model 1000N/1100N is on any circuit.
- To avoid electrical shock and/or damage to the instrument, do not let water or other foreign agents into the electronic module.

### Cleaning:

The megohmmeter may be gently cleaned with a soft cloth, soap and water. Dry immediately after cleaning. Avoid water penetration into the electronic module.

Make sure the megohmmeter and all leads are dry before further use.

## Repair and Calibration

To guarantee that your instrument complies with the factory specifications, we recommend that the megohmmeter be submitted to our factory service center at one-year intervals for recalibration, or as required by other standards.

For instrument repair and calibration:
Call (800) 945-2362 (X360) • (603) 749-6434 • Fax: (603) 742-2346

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
15 Faraday Drive
Dover, NH 03820 USA

(Or contact your authorized distributor.)

Costs for repair, standard calibration, and calibration traceable to N.I.S.T. are available.

**Note: All customers must call for a CSA# before returning any instrument.**

## Technical and Sales Assistance

If you are experiencing any technical problems, or require any assistance with the proper use or application of this instrument, please call our technical hotline:

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
Phone: (800) 343-1391
(508) 698-2115
Fax: (508) 698-2118
www.aemc.com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