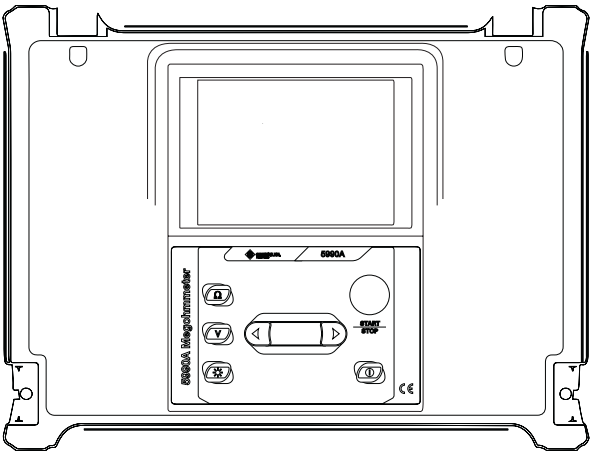
INSTRUCTION MANUAL

GREENLEE®



5990A
Megohmmeter

GREENLEE®

Table of Contents

Description

The Greenlee 5990A Megohmmeter is intended to test insulation and detect voltage. The unit features an easy-to-read and accurate analog scale.

Safety

Safety is essential in the use and maintenance of Greenlee tools and equipment. This instruction manual and any markings on the tool provide information for avoiding hazards and unsafe practices related to the use of this tool. Observe all of the safety information provided.

Purpose

This instruction manual is intended to familiarize all personnel with the safe operation and maintenance procedures for Greenlee 5990A Megohmmeter.

Keep this manual available to all personnel.

Replacement manuals are available upon request at no charge.

Do not discard this product or throw away!
For recycling information, go to www.greenlee.com.

KEEP THIS MANUAL

Important Safety Information

SAFETY ALERT SYMBOL

This symbol is used to call your attention to hazards or unsafe practices which could result in an injury or property damage. The signal word, defined below, indicates the severity of the hazard. The message after the signal word provides information for preventing or avoiding the hazard.

⚠DANGER

Immediate hazards which, if not avoided, WILL result in severe injury or death.

⚠WARNING

Hazards which, if not avoided, COULD result in severe injury or death.

⚠CAUTION

Hazards or unsafe practices which, if not avoided, MAY result in injury or property damage.

⚠WARNING

Read and **understand** this material before operating or servicing this equipment. Failure to understand how to safely operate this tool can result in an accident causing serious injury or death.

⚠WARNING

Electric shock hazard:

Contact with live circuits can result in severe injury or death.

Important Safety Information

⚠WARNING

Electric shock and fire hazard:

- Do not expose this unit to rain or moisture.
- Do not use the unit if it is wet or damaged.
- Use test leads or accessories that are appropriate for the application. See the category and voltage rating of the test lead or accessory.
- Inspect the test leads before use. They must be clean and dry, and the insulation must be in good condition.
- Use this unit for the manufacturer's intended purpose only, as described in this manual. Any other use can impair the protection provided by the unit.

Failure to observe these warnings could result in severe injury or death.

⚠WARNING

Electric shock hazard:

- Do not apply more than the rated voltage between any two input terminals, or between any input terminal and earth ground.
- Do not contact the test lead tips or any uninsulated portion of the accessory.
- Do not contact the test lead tips while performing the insulation resistance test.

Failure to observe these warnings could result in severe injury or death.

⚠WARNING

Electric shock hazard:

- Do not operate with the case open.
- Before opening the case, remove the test leads from the circuit and shut off the unit.

Failure to observe these warnings could result in severe injury or death.

⚠WARNING

Electric shock hazard:

- Unless measuring voltage, shut off and lock out power. Make sure that all capacitors are discharged. Voltage must not be present.
- Using this unit near equipment that generates electromagnetic interference can result in unstable or inaccurate readings.

Failure to observe these warnings could result in severe injury or death.

Important Safety Information

⚠CAUTION

Electric shock hazard:

- Do not attempt to repair this unit. It contains no user-serviceable parts.
- Do not expose the unit to extremes in temperature or high humidity. See Specifications.

Failure to observe these precautions may result in injury and can damage the unit.

⚠WARNING

Working with the instrument:

- Equipment under test must be switched off (i.e. de-energized) before test leads are connected to the equipment.
- Do not touch any conductive parts of equipment under test during the test.
- Make sure that the tested object is disconnected (mains voltage disconnected) before starting the Insulation Resistance measurement!
- Do not touch the tested object whilst testing it, risk of electric shock!
- In case of a capacitive test object (long tested cable etc.), automatic discharge of the object may not be done immediately after finishing the measurement – "Please wait, discharging" message will be displayed.

⚠WARNING

Handling with capacitive loads:

- Note that 40 nF charged to 1 kV or 9 nF charged to 5 kV are hazardous live!
- Never touch the measured object during the testing until it is totally discharged.
- Maximum external voltage between any two leads is 600 V (CAT IV environment).

⚠WARNING

Electric shock hazard:

Contact with live circuits can result in severe injury or death.

Instrument Description

Instrument Casing

The instrument is housed in a plastic box that maintains the protection class defined in the general specifications.

LCD

The LCD has a backlight and offers easy-to-read results. See Fig.1 below.

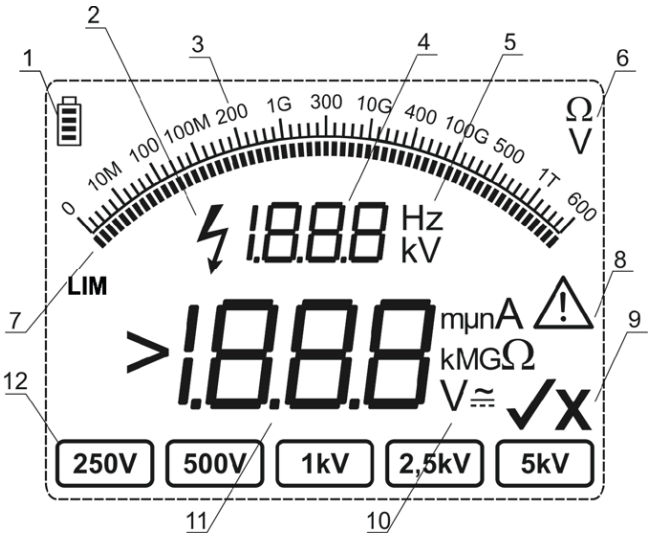


Fig. 1 *LCD Display*

Legend:

1..... **Battery indicator:** This indicates condition of the battery. In battery charging mode it flashes.

2..... **Hazardous Voltage Warning icon:** This indicates that voltage higher than 70 V may be present at the test terminals!

3..... **Analog display**

4..... **Auxiliary digital display**

5..... **Auxiliary units**

6..... **Analog units**

7..... **Bar graph**

8..... **Warning icon:** Carefully read and understand the User Manual.

9..... **Pass or Fail icon**

10..... **Main units**

11..... **Main digital display**

12..... **Test voltage:** Menu for selecting the test voltage.

Instrument Description (cont'd)

Operator's Panel

The operator's panel is shown in Fig. 2 below.

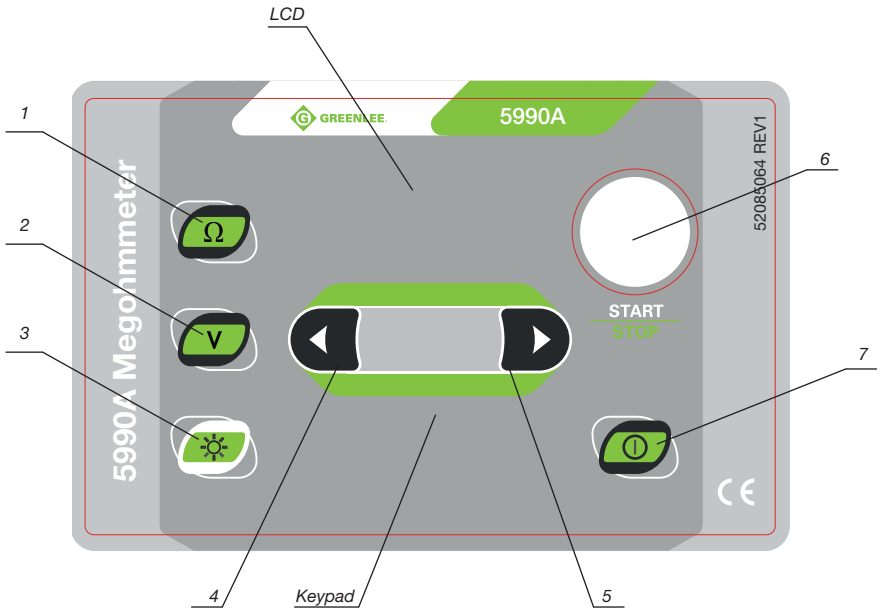


Fig. 2. *Front Panel*

Legend:

1.....Ω: Press to switch to Insulation Measurement Mode. Press again to set a resistance limit value.

2..... **V:** Press to switch to Voltage measurement mode.

3..... ☼ : Press to to turn the display backlight **ON** or **OFF**.

4..... ◀ **cursor:** Press to decrease the test voltage parameter or resistance limit value.

5..... ▶ **cursor:** Press to increase the test voltage parameter or resistance limit value.

6..... **START/STOP:** Press to start or stop insulation measurement.

7..... **ON/OFF:** Press to switch the instrument **ON** or **OFF.**

Instrument Description (cont'd)

Connectors

The 5990A Tester contains the following connections:

- Four banana safety sockets for test leads **(Fig. 3)**.
- Socket for mains supply cable **(Fig. 4)**.

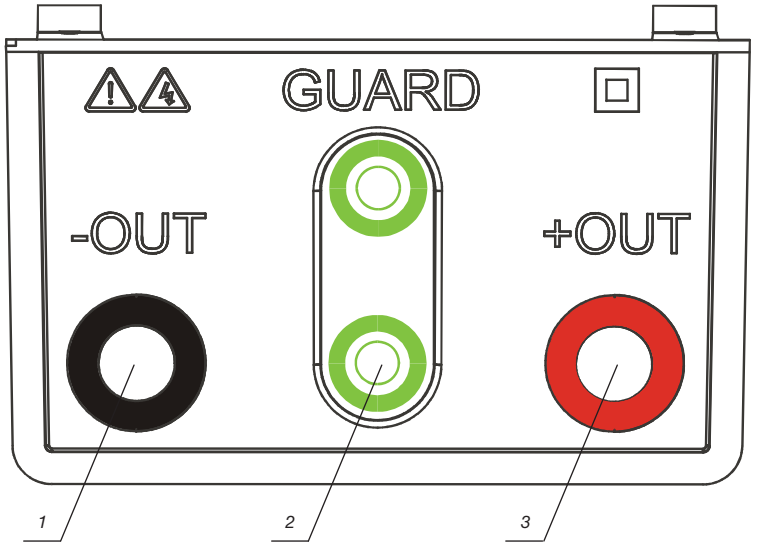


Fig. 3 *Test Leads Connector Diagram*

1..... **(-OUT):** Negative Insulation Resistance test terminal

2..... **GUARD:** Guard terminals are intended to lead away potential leakage current while measuring the Insulation. Both green sockets are connected together inside of the instrument.

3..... **(+OUT):** Positive Insulation Resistance test terminal

Use original test accessories only!

Max allowed external voltage between test terminals and ground is 600V!
Max allowed external voltage between test terminals is 600V!

Instrument Description (cont'd)

Connectors (cont'd)

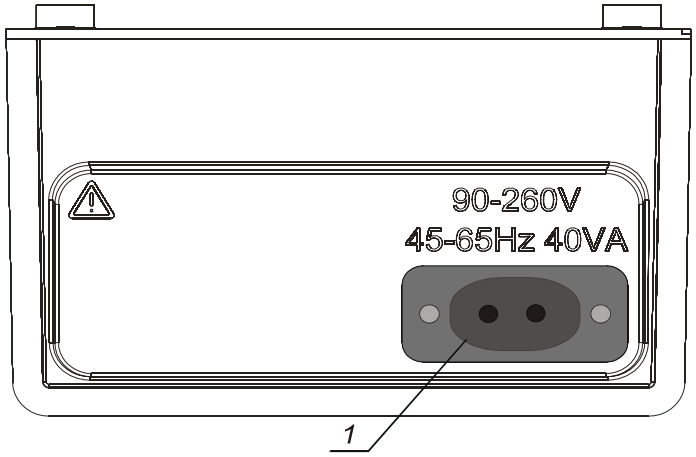


Fig. 4 *Mains Connector*

1.....**Mains connector:** This is to connect the instrument to the mains supply.

Use original mains supply cable only!

Instrument Description (cont'd)

High Voltage Shielded Test Tips with High Voltage Alligators Clips

Fig.5

Fig.6

Application notes:

These test leads are designed for diagnostic testing of insulation and hand held testing of insulation.

Insulation ratings:

- High voltage banana connector (red, black): 5kV d.c (double insulation). See **Fig.5**.
- High voltage tip (red, black): 5kV d.c (double insulation).
- Alligator (red, black): 5kV d.c (double insulation). See **Fig.6**.
- Guard banana connector (green): 600V CAT IV (double insulation).
- Cable (yellow): 12kV (shielded). See **Fig.5**.

Guard Test Lead with Alligator

Insulation ratings:

- Guard test lead with banana connectors (green): 600V CAT IV (double insulation);
- Alligator (green): 600V CAT IV (double insulation).

Performing Measurements

Switching On the Instrument

Auto-Calibration

The instrument is switched **ON** by pressing the **ON/OFF** key. After turning on **(Fig. 7)**, the instrument executes the auto-calibration **(Fig. 8)**.

Note: If batteries are defective or missing and the instrument is powered from mains supply, the instrument cannot be turned **ON**.

The test leads have to be disconnected during auto-calibration. If not, the auto-calibration procedure could fail. After finishing the auto-calibration, the pass icon will appear; the instrument will go into **Insulation Mode (Fig.9)** and be ready for normal operation.

Auto-calibration ensures accuracy when measuring very low currents. It compensates for the effects caused by aging, temperature and humidity changes. Performing a new auto-calibration is recommended when the temperature changes by more than 10° F (5°C).

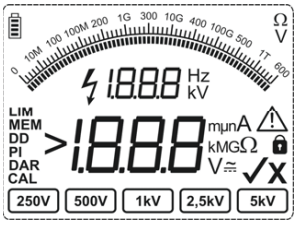


Fig. 7 *Initial State*

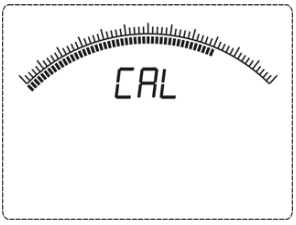


Fig. 8 *Auto-Calibration State*

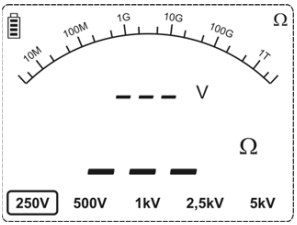


Fig. 9 *Insulation Measuring Mode*

Performing Measurements (cont'd)

Note: If the instrument detects a faulty state during the auto-calibration, the fail icon (**X**) will be displayed:

A common reason for failure is improper environmental conditions. This includes excessive humidity or excessive temperature. In this case it is possible to perform measurements by pressing the **START/STOP** button again but results could be outside of the technical specification.

Mains powered instrument operation

Connecting the instrument to the mains supply while the instrument is OFF will charge the batteries. The instrument will remain OFF during this period. If the batteries are charging, a flashing battery indicator will appear in the upper left corner of the LCD.

Note: If batteries are defective or missing, the charger will not work.

Connecting the instrument to the mains supply while the instrument is ON will cause the instrument to be powered by the mains supply. If the instrument is not in Insulation Measuring Mode*, the internal charger will charge the batteries. If the batteries are charging, a flashing battery indicator will appear in the upper left corner of the LCD.

Note: It is not recommended to connect or disconnect the instrument to mains supply while the instrument is in Insulation Measuring Mode*.

**Insulation Measuring Mode: When the instrument performing insulation measurements.*

Backlight operation (battery powered instrument)

After turning the instrument **ON**, the LCD backlight is automatically turned **ON**. It can be turned **OFF** and **ON** by pushing the ☀ button.

Backlight operation (mains powered instrument)

After turning the instrument **ON**, the LCD backlight is automatically turned **OFF**. It can be turned **OFF** and **ON** by pushing the ☀ button.

Off function

The instrument can be switched **OFF** by pressing the **ON/OFF** button.

Measurements

General Information about DC High voltage testing

The purpose of insulation tests

Insulating materials are important parts of almost every electrical product. The material's properties depend not only on its compound characteristics but also on temperature, pollution, moisture, aging, electrical and mechanical stress, etc. Safety and operational reliability require the regular maintenance and testing of the insulation material to ensure it is kept in good operational condition. High voltage tests are used to test insulating materials.

DC vs. AC testing voltage

Testing with a DC voltage is widely accepted as being as useful as testing with AC and / or pulsed voltages. DC voltages can be used for breakdown tests especially where high capacitive leakage currents interfere with measurements using AC or pulsed voltages. DC is mostly used for insulation resistance measurement tests. In this type of test, the voltage is defined by the appropriate product application group. This test voltage is lower than the voltage used in the withstanding voltage test so the tests can be applied more frequently without stressing the test material.

Electrical representation of insulating material

The following figure **(Fig.10)** represents the equivalent electrical circuit of insulating material

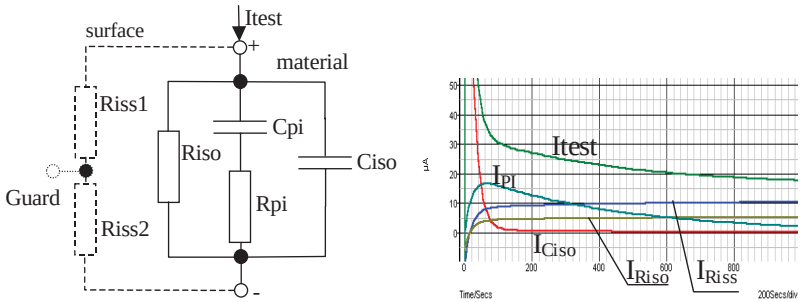


Fig. 10

R_{iss1} and R_{iss2} - the surface resistivity (position of optional guard connection)

R_{iso} – the actual insulation resistance of material

C_{iso} – capacitance of material

C_{pi}, R_{pi} - represents polarization effects.

The right figure shows typical currents for that circuit.

I_{test} = overall test current (I_{test}= I_{PI}+ I_{RISO}+ I_{RISS})

I_{PI} = polarization absorption current

I_{RISO} = actual insulation current

I_{RISS} = surface leakage current

Measurements (cont'd)

Guard terminal

The purpose of the **GUARD** terminal is to lead away potential leakage currents (e.g. surface currents), which are not a result of the measured insulation material itself but are a result of surface contamination and moisture. This current interferes with the Insulation Resistance Measurement. The **GUARD** terminal is internally connected the negative test terminal (black). The **GUARD**s test clip should be connected to the test object so that most of the unwanted leakage current is collected. See **Fig. 11** below.

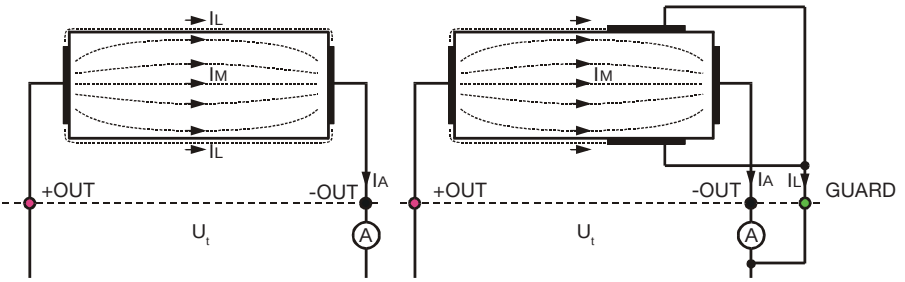


Fig. 11 *Connection of GUARD Terminal to Measured Object*

Where:

U_t.....Test voltage

I_L.....Leakage current (resulted by surface dirt and moisture)

I_M.....Material current (resulted by material conditions)

I_A.....A-meter current

Result without using **GUARD** terminal: $RINS = U_t / I_A = U_t / (I_M + I_L)$ …incorrect result.

Result using **GUARD** terminal: $RINS = Ut / I_A = Ut / I_M$ ……correct result.

It is recommended to use the **GUARD** connection when high insulation resistance (>10G Ω) is measured.

Note:

- The guard terminal is protected by an internal impedance (200 KΩ).

The instrument has two guard terminals to allow easy connection of shielded measuring leads.

Measurements (cont'd)

Insulation Resistance measurement

Select this function by pressing the Ω button. It will display the following states (Initial Display and Display with results). See **Fig. 12** below.

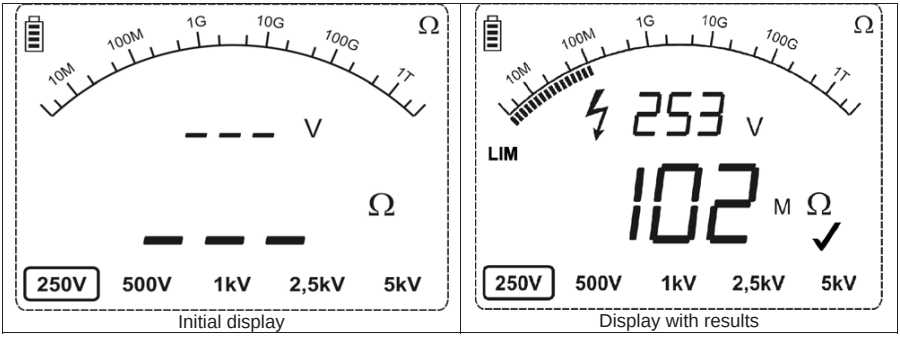


Fig. 12 *Insulation Resistance Function Display States*

Legend of displayed symbols in Fig 12:

Insulation Resistance	Name of selected function
250V	Selected test voltage
253 V	Actual test voltage (measured value)
102 MΩ	Insulation Resistance – **result**
Bar	Analog presentation of result

Measurement procedure:

- Connect the test leads to the instrument and to the test object.
- Select **INSULATION RESISTANCE** mode by pressing the Ω button.
- Press the **START/STOP** button and release it. This will begin continuous measurement.
- Wait until the test result has stabilized then press the **START/STOP** button again to stop the measurement.
- Wait to remove the object under test until it is discharged.

Notes:

- A high-voltage warning symbol appears on the display during the measurement to warn the operator of a potentially dangerous test voltage.

Measurements (cont'd)

Set-up test voltage for Insulation Resistance **(Fig.13)**:
Adjust test voltage using the ◀ and ▶ buttons.

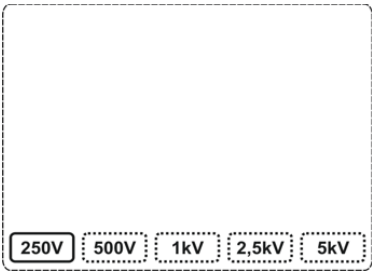


Fig. 13 *Set-Up Test Voltage in Insulation Resistance Measurement*

Legend of displayed symbols:

Name of selected function	Insulation Resistance	
Selected test voltage	Nominal	250V

Set-Up Insulation Resistance Limit Value for Insulation Resistance **(Fig.13):**

- Press the Ω button
- Adjust the limit value using the ◀ and ▶ buttons
- Press the Ω button again or the **START** button to return to the insulation resistance measurement menu.

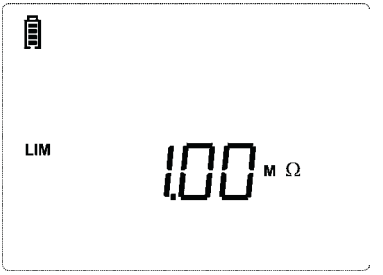


Fig. 13a *Set-Up Insulation Resistance Limit Value*

Legend of displayed symbols:

Name of selected function	Insulation Resistance	
Selected Insulation Resistance Limit Value	Resistance Value	1 MΩ

Insulation resistance limit selection range: [10 kΩ .. 2--MΩ]
No limit selected indication: – – –

Warning!

Refer to Warnings chapter for safety precautions!

Measurements (cont'd)

Voltage Measurement

Select this function by pressing the **V** button. Voltage measurement is active immediately after entering the function. See **Fig. 14** below.

Fig. 14 *Voltage Function Display*

Measurement Procedure:

- Connect the test leads to the instrument and to the measured source.
- Press the **V** button to select voltage mode and continuous measurement will automatically start to run.

Warning!

Refer to Warnings chapter for safety precautions!

Maintenance

⚠CAUTION

Electric shock hazard:

- Do not attempt to repair this unit. It contains no user-serviceable parts.
- Do not expose the unit to extremes in temperature or high humidity. See Specifications.

Failure to observe these precautions may result in injury and can damage the unit.

⚠WARNING

Electric shock hazard:

Before opening the case, remove the test leads from the circuit and shut off the unit.

Inspection

To maintain the operator's safety and to ensure the reliability of the instrument it is advisable to inspect the instrument on a regular basis. Check that the instrument and its accessories are not damaged. If any defect is found please consult the Greenlee Service Center at 800-435-0786.

Insertion and Charging Batteries for the First Time

Battery cells are stored in the bottom section of the instrument casing under the battery cover **(see Fig. 15)**. When inserting batteries for the first time please note the following:

- Disconnect any measurement accessories or mains supply cable connected to the instrument before opening the battery cover to avoid electric shock.
- Remove the battery cover.
- Insert batteries correctly **(see Fig. 15)**, otherwise the test instrument will not operate!
- Replace the battery cover and fixed the cover back in place.

Connect the instrument to the mains power supply for 14 hours to fully charge batteries. (Typical charging current is 300 mA).
When you charge the batteries for the first time, it normally takes about 3 charge and discharge cycles for the batteries to regain their full capacity.

Replacement and Charging of Batteries

The instrument is designed to be powered by rechargeable batteries supported by mains supply. The LCD contains an indication of battery condition (upper left section of LCD). When the low-battery indication appears **(Err),** the batteries have to be recharged. Connect the instrument to the mains power supply for 14 hours to recharge cells. Typical charging current is 300 mA.

Note:

- Operator does not need to disconnect the instrument from mains supply after the full recharging period. The instrument can be connected permanently.

  Fully charged rechargeable batteries can supply the instrument for approx. 4 hours. (Continues testing at 5kV)

Maintenance (cont'd)

If the batteries have been stored for a long time, it normally takes about 3 charge and discharge cycles for the batteries to regain full capacity.
Battery cells are stored in the bottom section of the instrument under the battery cover **(see Fig. 15)**. In case of defective batteries please note the following:

- Turn the power off and disconnect any measurement accessories and the mains supply cable before opening the battery cover to avoid electric shock.
- Remove the battery cover.
- All six cells have to be replaced.
- Insert the batteries correctly **(see Fig. 15)**, otherwise the test instrument will not operate and the batteries may be discharged.
- Replace the battery cover.
- The Instrument will only work when rechargeable batteries are inside the instrument.

Nominal power supply voltage is 7.2 V DC. Use six NiMH cells of C size (dimensions: diameter = 26 mm, height = 46 mm). See the next figure **Fig.15** for correct polarity of batteries.

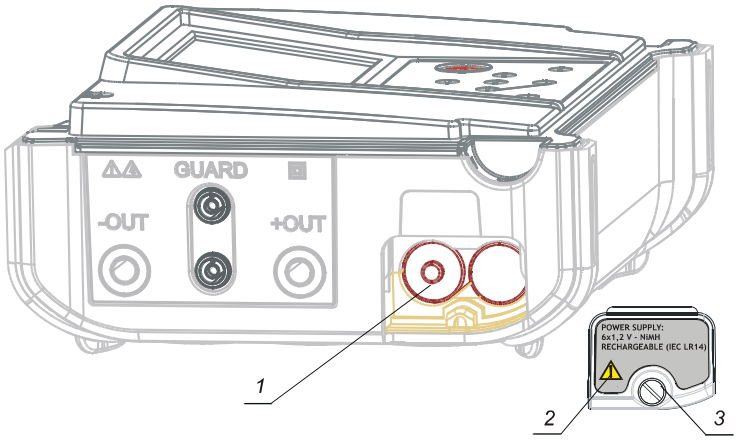


Fig. 15 *Correct Inserted Batteries*

1.....Correctly inserted batteries.
2.....Battery cover.
3.....Screw (unscrew to replace the batteries).

Ensure batteries are used and disposed of in accordance with Manufacturers guidelines and in accordance with Local and National Governmental guidelines.

Disconnect all test leads and switch off instrument before removing the battery cover!

Hazardous Voltage!

Maintenance (cont'd)

Cleaning
Use a soft cloth, slightly moistened with soapy water to clean the surface of the instrument and leave the instrument to dry completely before using it.

Notes:
- Do not use petrol or hydrocarbon based liquids.
- Do not spill cleaning liquid on the instrument.

Calibration
Greenlee recommends that the 5990A Megohmmeter be routinely calibrated to ensure accuracy.

Service
For repairing under or out of warranty period contact your distributor for further information.

Replacement Parts

Cat. No./ UPC	Description	Qty
08728	Test Lead Unit with Case	1
08738	Carrying Case	1
08729	Main Power Cord	1

Specifications

Accuracy

Accuracy is specified from -20°C to 40°C

Measurements

Note: All data regarding accuracy is given for nominal (reference) environment condition.

Insulation Resistance

Nominal test voltage: 250 V, 500 V, 1 kV, 2.5 kV, 5 kV
Current capability of test generator: >1 mA
Short-circuit test current: 5 mA.
Automatic discharge of tested object: Yes

Measuring Range Riso: 0.12 MΩ up to 999 GΩ*

Display Range	Resolution	Accuracy
5 - 999 kΩ	1 kΩ	± (5 % of reading + 3 digits)
1.00 - 9.99 MΩ	10 kΩ	
10.0 - 99.9 MΩ	100 kΩ	
100 - 999 MΩ	1 MΩ	
1.00 - 9.99 GΩ	10 MΩ	
10.0 - 99.9 GΩ	100 MΩ	
100 - 999 GΩ	1 GΩ	±(10 % of reading + 3 digits)

*Full-scale value of insulation resistance is defined according the following equation:
$R_{FS} = 1G\Omega * U_{test}[V]$ (if $U_{test} > 1kV$ then $R_{FS} = 1T\Omega$)

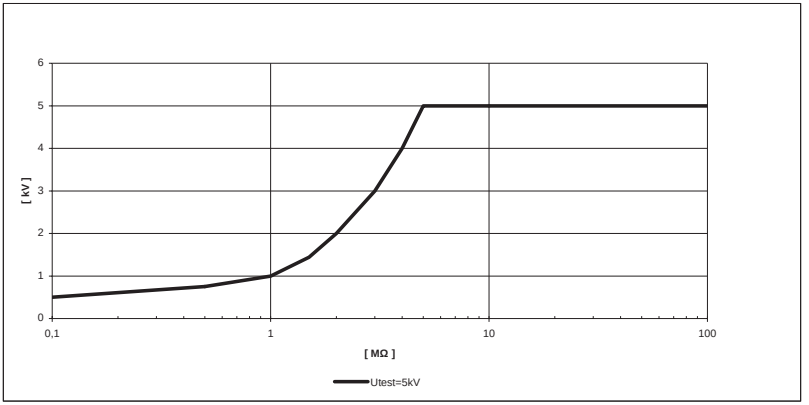
For insulation resistance value under 5 kΩ the instrument will display the value 0 Ω.

DC test voltage:
Voltage value: 250V, 500V, 1kV, 2,5kV, 5kV.
Accuracy: -0 / +10 % + 20 V.
Output power: 5 W max.

Display range test voltage (V)	Resolution	Accuracy
0 - 1999 kΩ 2.00k - 5.50k	1 V 10V	± (3 % of reading + 3 digits)

Specifications (cont'd)

Generator Capability vs Resistance



Voltage

Voltage AC or DC

Display range test voltage (V)	Resolution	Accuracy
0 - 600	1 V	± (3 % of reading + 4 V)

Frequency of External Voltage

Display range test voltage (V)	Resolution	Accuracy
0 and 45 - 65	0.1 Hz	± 0.2 Hz

Note:

- For a frequency between 0 and 45 Hz frequency, result is shown as – – –
- For a frequency over 65 Hz frequency, result is shown as – – –
- For a voltages under 10V frequency, result is shown as – – –

Input resistance: 3 MΩ±10 %

General Specifications

Battery Power Supply.....7.2 V DC (6 × 1.2 V NiMHC size)

Mains Power Supply.....90-260 V AC, 45-65 Hz, 40 VA
Over-Voltage Category.....300 V CAT III

Protection Classification.....Double Insulation ⧈
Measurement Category.....600 V CAT IV
Pollution Degree.....2
Degree of Protection.....IP 40 with case closed
Dimensions (w × h × d).....31 cm x 13 cm x 25 cm
Weight (without accessories, with batteries).....3 kg
Visual and Sound Warnings.....Yes
Display.....LCD segments and analog scale with backlight

Environment Conditions

Working Temperature Range.....-10 - 50 °C
Nominal (reference) Temperature Range.....10 - 30 °C
Storage Temperature Range.....-20 - +70 °C.
Maximum Humidity .....90% RH (0 - 40 °C) non-condensing
Nominal (reference) Humidity Range.....40 - 60 % RH
Nominal Altitude.....Up to 2000m

Auto-Calibration

Auto-Calibration of Measuring System.....Every time after turning power on

Connecting System

Two Safety Banana Sockets.....+OUT, -OUT (5kV CAT I, Double)
Two GUARD Banana Sockets.....GUARD (600V CAT IV, Double)
Guard Resistance.....200 kΩ ± 10 %

Discharging

Every time after measurement completion.
Discharging Resistance:.....300 kΩ ± 10 %

Measurement Categories

These definitions were derived from the international safety standard for insulation coordination as it applies to measurement, control, and laboratory equipment. These measurement categories are explained in more detail by the International Electrotechnical Commission; refer to either of their publications: IEC 61010-1 or IEC 60664.

Measurement Category I
Signal level. Electronic and telecommunication equipment, or parts thereof. Some examples include transient-protected electronic circuits inside photocopiers and modems.

Measurement Category II
Local level. Appliances, portable equipment, and the circuits they are plugged into. Some examples include light fixtures, televisions, and long branch circuits.

Measurement Category III
Distribution level. Permanently installed machines and the circuits they are hard-wired to. Some examples include conveyor systems and the main circuit breaker panels of a building's electrical system.

Measurement Category IV
Primary supply level. Overhead lines and other cable systems. Some examples include cables, meters, transformers, and other exterior equipment owned by the power utility.

Statement of Conformity
Greenlee Tools, Inc. is certified in accordance with ISO 9000 (2000) for our Quality Management Systems.