Digital Surface Resistance Meter Kit Installation, Operation and Maintenance

Made in the United States of America

Figure 1. Vermason Digital Surface Resistance Meter Kit

Description

The Vermason 222642 Digital Surface Resistance Meter Kit is an instrument designed to measure resistance point-to-point (Rp-p) or surface to ground (Rg) in accordance with EN 61340-5-1 Electrostatics and its test method IEC 61340-2-3.

Its test functions include:

- Resistance measurement accuracy of ±10% (±20% for resistance values 1 x 10^{11} ohms and greater)
- Resistance range of <1 x 10^{3} ohms to >1 x 10^{12} ohms
- Under load voltages of 10 and 100 volts ±5%
- Electrification period of approximately 15 seconds

The Digital Surface Resistance Meter also measures ambient temperature and relative humidity.

NOTE: Volume Resistance can be measured using one 2 kg Electrode and a flat conductive metal plate (not included).

The Digital Surface Resistance Meter Kit and its accessories are available in the following item numbers:

Item	Description
222642	Digital Surface Resistance Meter Kit
222643	Digital Surface Resistance Meter
222002	Concentric Ring Probe
222003	Concentric Ring Probe Kit
222633	Shielded Test Leads
222634	2 kg Electrodes, 1 Pair

The Surface Resistance Meter Kit (or its Meter) is referenced and designed to be used to make measurements in accordance with the test procedures in:

- Working surfaces, storage racks, trolleys and seating - IEC 61340-2-3
- Flooring - IEC 61340-4-1
- Garments - ANSI/ESD STM2.1 Garments
- Person/footwear / flooring system - IEC 61340-4-5

“A compliance verification plan shall be established to ensure the Organization’s fulfilment of the technical requirements of the plan. Process monitoring (measurements) shall be conducted in accordance with a compliance verification plan that identifies the technical requirements to be verified, the measurement limits and the frequency at which those verifications shall occur. The compliance verification plan must document the test methods and equipment used for process monitoring and measurements. If the organization uses test methods that differ from the standards referenced in this standard, the organization must be able to show that the results achieved correlate with the referenced standards. Compliance verification records shall be established and maintained to provide evidence of conformity to the technical requirements.
The test equipment selected shall be capable of making the measurements defined in the compliance verification plan.” (IEC 61340-5-1 Edition 1 2007-08 clause 5.2.3 Compliance verification plan)

Reference Literature
In addition to those noted above:
EN 61340-5-1 Electrostatics and PD CLC/TR 61340-5-2 User Guide Electrostatics

These documents can be obtained from from British Standards at www.bsigroup.com.

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Packaging

222642 Digital Surface Resistance Meter Kit

1 Digital Surface Resistance Meter
2 Shielded Test Leads, 1.5 m Length
2 2 kg Electrodes
2 AA Alkaline Batteries
1 Gator Clip
1 BNC / Banana Jack Adapter
1 Plastic Carrying Case
1 Certificate of Calibration

Figure 2. Vermason 222642 Digital Surface Resistance Meter Kit

222643 Digital Surface Resistance Meter

1 Digital Surface Resistance Meter
2 AA Alkaline Batteries
1 Certificate of Calibration

Figure 3. Vermason 222643 Digital Surface Resistance Meter

Features and Components

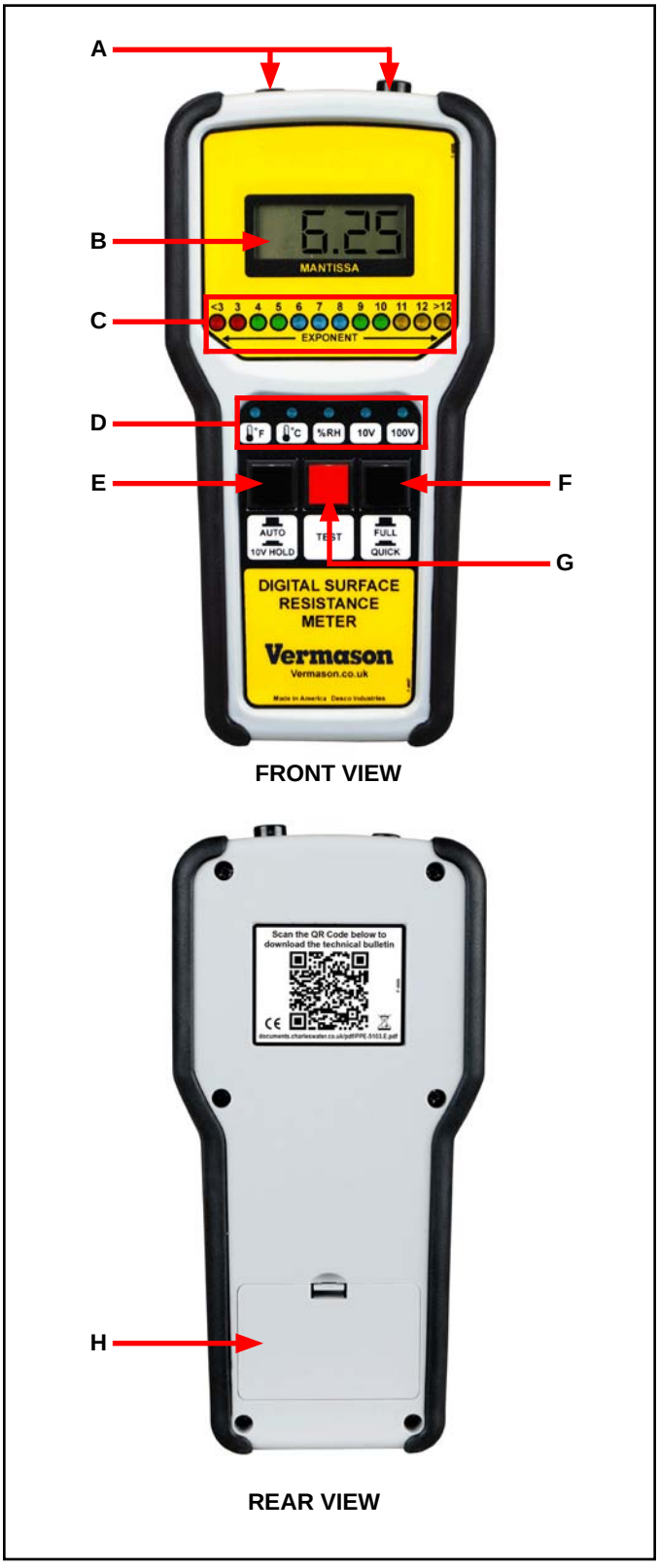

Figure 4. Digital Surface Resistance Meter features and components

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A. Test Jacks: The shielded test leads connect here. The black test lead's 3.5mm plug connects into the stereo jack, and the white test lead's banana plug connects into the banana jack.

B. Liquid Crystal Display: Temperature, Relative Humidity and Resistance Mantissa values appear on this display.

When the test button is depressed and the meter is set to FULL test mode, the following information will display in sequence:

- Temperature in degrees Fahrenheit (±10%)
- Temperature in degrees Celsius (±10%)
- Relative Humidity as a percentage (±10 integers)
- Surface Resistance Mantissa (with exponent displayed via LED, measurement in ohms)

Surface resistance ohm values are expressed with a mantissa and exponent (power) of the number. For example, if the #8 exponent LED illuminates and the meter displays "7.14", the measurement is 7.14 x 10^8 ohms or 714,000,000 ohms.

If the measured surface resistance is over 10^{12} ohms, "1___" will appear on the liquid crystal display.

C. Exponent Light Emitting Diodes (LED): These LEDs indicate the surface resistance exponent value. They are colour coded for quick checks.

Exponent	Colour
<3, 3	Red
4, 5	Green
6, 7, 8	Blue
9, 10	Green
11, 12, >12	Yellow

Quick Checks
The surface resistance exponent number illuminates immediately (i.e. 8 = 1 x 10^8 ohms to less than 1 x 10^9 ohms or 100,000,000 to less than 1,000,000,000 ohms).

D. Function LEDs: These LEDs indicate the measurement type displayed. The surface resistance mantissa is displayed when either the "10V" or "100V" LED is illuminated.

The Function LEDs will flash when the battery voltage drops to approximately 2 volts. Replace the batteries when this occurs.

E. Test Voltage Button: When set to AUTO, the meter will automatically switch to the appropriate test voltage for the measured resistance range. The Function LEDs will indicate the applied test voltage. Material that is 9 x 10^5 ohms or less should be measured at 10 volts. Material that is 1 x 10^6 ohms or greater should be tested at 100 volts. (Ref: IEC 61340-2-3) When the switch is set to 10V HOLD, the test voltage will be fixed at 10 volts regardless of the measured resistance value.

F. Quick Check Button: When set to FULL, the meter will cycle through the approximate 15 second electrification period that displays the temperature and relative humidity before the surface resistance mantissa is displayed. When set to QUICK, the meter will skip the 15 second period and immediately display the measured surface resistance mantissa.

G. Test Button: Push and hold this red button to make a measurement with the meter. Testing in accordance with IEC 61340-2-3 requires 15 seconds of electrification. These 15 seconds are included when the meter is set to FULL test mode. The surface resistance mantissa will display on the meter after temperature and relative humidity measurements are displayed.

The surface resistance exponent number illuminates immediately, and the meter first displays the temperature and relative humidity during a 15 second electrification period. The mantissa is then displayed at the end of the test sequence. For example, if the #8 exponent LED illuminates and the meter displays "7.14", the measurement is 7.14 x 10^8 ohms or 714,000,000 ohms.

H. Battery Compartment: Open this compartment to install the two AA alkaline batteries needed to power the meter. Replace the batteries once the Function LEDs begin flash.

Operation

Per IEC User Guide Testing of Installed ESD Control Items
"Once the ESD ground reference has been verified it is important to ensure that each of the ESD control items used is connected to the ground reference. First ensure that each ESD control item is connected to the ground reference. Next, using the test method or standard and limits for each ESD control item given in Tables 2 and 3 of IEC 61340-5-1,verify that the resistance to ground (or to the common connection point) meets the required limit". (CLC/TR 61340-5-2 User guide Grounding/bonding systems clause 4.4.5 Verification of proper installation of ESD control items)

General Guidelines
- Use both 2 kg electrodes for Rp-p measurements.
- Use one 2 kg electrode and connect the black sensing test lead to ground for Rg measurements.
- Ensure that the item being measured is electrically isolated (placed on an insulative surface). The meter will measure the lowest resistance path.
- Ensure that the test leads are separated and uncrossed as a best practice.
- When using 2 kg electrodes:
  - Place them no closer than 5 cm from the edge of the surface being measured
  - Place them no closer than 8 cm to any groundable point
  - Place them about 25 cm apart from each other for Rp-p measurements of a worksurface
  - Place them about 1 m apart from each other for Rp-p measurement of a floor

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- Preferable electrode placements include:
  - Most commonly used area of a surface
  - Most worn area
  - Center of surface
  - Furthest area from a grounded point
- If the surface to be measured has sections (i.e. floor tiles, garment panels), place the 2 kg electrodes on different sections for Rp-p measurements.
- Clean the material's surface for Test Lab measurements, but do not clean the surface for materials that are already installed. Only clean and re-test the installed material if failure occurs.
- Push and hold the Test Button until the surface resistance mantissa is displayed.

Measure Resistance to Ground (Rg)

Test Procedure in accordance with IEC 61340-2-3 and EN 61340-5-1 Tabe 3 Note 2 "The test methods in the compliance verification column refer to the basic test procedure only. It is not expected that the test method will be followed in its entirety."

- Do not clean the surface.
- Remove from the surface only those items that might interfere with the test.
- ESD sensitive devices shall also be removed.
- Attach the black sensing test lead to protective earth ground.
- Use one 2 kg electrode on the other test lead and place the electrode on the furthest convenient point on the surface.
- Push and hold the Test Button until the surface resistance mantissa is displayed.
- Perform additional measurements by placing the electrode on the most commonly used or worn area. Set the meter to QUICK test mode to skip the 15 second period if preferred.

If the measurement is outside acceptable limits, clean the surface with an ESD cleaner containing no insulative silicone such as Reztore™ Antistatic Surface & Mat Cleaner, and re-test to determine if the cause of failure is an insulative dirt layer or the ESD worksurface material.

Figure 5. Rg test setup

Measure Resistance Point-to-Point (Rp-p) on the Surface

- Do not clean the surface.
- Remove from the surface only those items that might interfere with the test.
- ESD sensitive devices shall also be removed.
- Use two 2 kg electrodes and place them on the most commonly used area of the surface. Ensure that the electrodes are about 25 cm apart from each other and 5 cm away from any edge and 8 cm away from any grounded point.
- Push and hold the Test Button until the surface resistance mantissa is displayed.
- If the most used area is not obvious, use two points near the center of the surface.
- Perform additional measurements by placing the electrode on the most commonly used or worn area. Set the meter to QUICK test mode to skip the 15 second period if preferred.

If the measurement is outside acceptable limits, clean the surface with an ESD cleaner containing no insulative silicone such as Reztore™ Antistatic Surface & Mat Cleaner, and re-test to determine if the cause of failure is an insulative dirt layer or the ESD worksurface material.

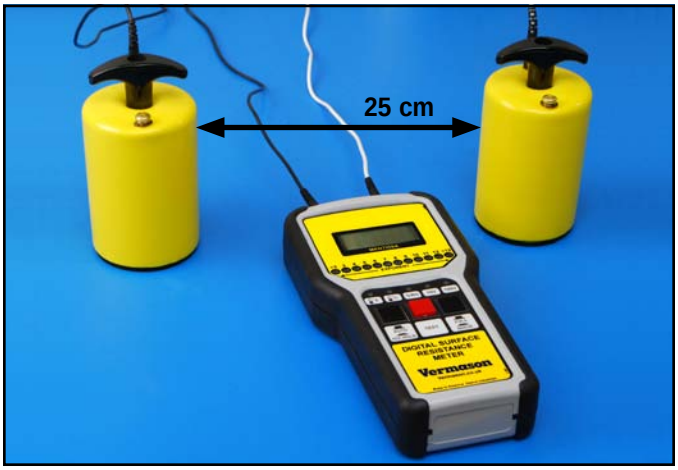

Figure 6. Rp-p test setup - set the electrodes about 25 cm apart for working surfaces and about 1 m apart for flooring

Reporting and Using Test Results

Different standards have different requirements; however, follow the requirements as specified in the user's ESD control plan. Examples are:

Working surfaces, report:

- Rg maximum and minimum values measured for resistance-to-ground in ohms
- Rp-p maximum and minimum values measured for point-to-point resistance in ohms

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Flooring, report:

- Rg all values in ohms for resistance-to-ground
- Rp-p all values in ohms for point-to-point resistance
- Test voltage
- Test date
- Temperature
- Relative humidity
- Test equipment used and latest calibration date

Summarize the test data by reporting the minimum, maximum, median and mean values that were obtained. Include a diagram showing the approximate electrode positions and ground connections used.

Frequency of Compliance Verification Testing

"The frequency for checking the function of ESD control elements is dependent on a number of factors such as how often the item is used, the item's durability and the impact on the ESD control program if the control item were to fail. As an example, wrist straps are often used as the primary ground for personnel. A wrist cord, whilst being worn, is subjected to thousands of stretchlbend cycles each day and the conductive wire(s) in the wrist cord will eventually break. The typical verification frequency, used by industry, for wrist cords is once per shift due to the wrist cord's importance to the success of the program and the likelihood of failure. Some organizations may want to increase the time between verifications of an ESD control item after it has been in use for a period of time. This is typically done by monitoring the failures of the ESD control item. Once the organization has evidence that there is an acceptable period of time where no failures were found, the time between verifications can be increased. The new verification interval is then monitored. If an unacceptable level of failures is identified, then the verification frequency should revert back to the previous level." (PD CLC/TR 61340-5-2 User guide clause 4.3.3 Verification frequency)

The frequency of periodic testing is normally specified in corporate operating procedures. However, a common guide would be to conduct the measurements of EPA ESD control items at least quarterly, and to test personnel grounding devices (while worn) at least each shift.

Possible frequency is listed in EN 61340-5-1 Annex

Surface Resistivity

Theoretically, Resistivity is 10 times greater than Resistance.

For example, a material that measures 10^7 ohms in surface resistance should measure 10^8 ohms/square in surface resistivity.

"When it is appropriate to convert a resistance obtained by this test method to an equivalent resistivity in ohms per square, multiply the resistance measurements obtained by this method by 10. The conversion factor of 10 is derived from the geometry of the electrode assembly." (Ref: ANSI/ ESD STM11.11 section 12.0 Conversion to Resistivity)

Product Qualification Test Lab Test Procedure Guideline

For test lab use of ESD Working Surfaces, Floor Materials, Footwear, Garments or Seating, the best practice advise:

- Cleaning the test specimens and electrodes shall be cleaned twice with a minimum 70% isopropanol-water solution using a clean, low-linting cloth each time. Allow the material to completely dry.
- Environmental chamber control relative humidity to 12 ±3% relative humidity and 50 ±5% relative humidity and temperature to 23 ±1°C.
- Specimen support surface to be greater than 1×10^{12} ohms such as PMMA, PTFE or polycarbonate.
- Specimen Pre-Conditioning at 23 ±1°C; 3 specimens at 12 ±3% relative humidity for up to 72 hours minimum, and 3 specimens at 50 ±5% relative humidity for up to 72 hours minimum.
- Reporting Test Results: report:
  - Minimum, median and maximum readings for both resistance-to-groundable point and point-to-point resistance in ohms at low relative humidity
  - Minimum, median and maximum readings for both resistance-to-groundable point and point-to-point resistance in ohms at moderate relative humidity
  - Temperature
  - Relative humidity
  - Actual duration of conditioning
  - Test equipment used and latest calibration date

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Vermason 222002 Concentric Ring Probe

Figure 7. Vermason 222002 Concentric Ring Probe

The Vermason 222002 Concentric Ring Probe is an instrument to be used in conjunction with a resistance meter, such as the Vermason 222643 Digital Surface Resistance Meter, to measure surface resistance per EN 61340-5-1 Table 4 Packaging of solid planar materials.

The Concentric Ring Probe can measure the volume resistance of planar materials using a flat conductive metal plate (not included).

The Concentric Ring Probe may be used for the resistance measurements of ESD packaging including static shielding and other bags.

See TB-7549 for more information.

Maintenance

The Digital Surface Resistance Meter requires little maintenance. There are no user serviceable parts. If your meter requires service beyond cleaning the electrodes or replacing the batteries, please contact the factory.

This product utilizes a high frequency switching circuit to step up the 3 volts from the batteries to the 100 volt test level. Some users are able to discern a slight hum or buzzing when the meter is powered. This is perfectly normal and is not considered a flaw or defect.

Battery Replacement
The Function LEDs located above the push buttons will flash when the battery voltage drops to approximately 2 volts. This indicates that the meter's batteries should be replaced. Open the compartment located on the back of the meter to replace the batteries. The meter uses two AA alkaline batteries. Ensure that the batteries' polarities are oriented in the correct fashion to avoid any possible circuit damage.

Cleaning the Digital Surface Resistance Meter
The area surrounding the cable jacks at the top end of the meter should be wiped with a clean, isopropanol-alcohol moistened cloth to remove skin oils that will accumulate and affect the meter's accuracy at high resistances. The frequency of cleaning will depend on usage. Vermason recommends cleaning this area once a month. Cable jackets should also be cleaned in this fashion.

Cleaning the 2 kg Electrodes
Clean the electrodes with a minimum 70% isopropanol-water solution. Make sure the 2 kg electrodes' conductive pads are dry prior to use.

See specific product test standards for test lab specimen cleaning instructions. Per ANSI/ESD S4.1 Worksurfaces "The test specimens and electrodes shall be cleaned twice with a minimum 70% isopropanol-water solution using a clean, low-linting cloth each time." (Note: The item should then be conditioned for 72 hours minimum)

Calibration

The Digital Surface Resistance Meter is calibrated to NIST traceable standards. Most users require calibration annually which is our recommendation. Please e-mail Service@Vermason.co.uk for details. In-house calibration can be performed by using 1% resistors in each of the meter ranges. Simply attach the resistors to the test leads using clips and record the meter's display. Keep the test leads uncrossed and separated from one another. Should adjustment be necessary, Vermason recommends to return the unit to the factory. Special equipment is required to adjust the meter.

Required Equipment
- Digital Multimeter: accurate to 1.25% @ 10VDC and 100VDC
- Fixed Decade Box with values from 10^3 - 10^{12}: accurate to ±2%, except at 10^{11} and 10^{12} (±5%)
- Thermometer: accurate to ±1°F
- Relative Humidity Meter: accurate to 2%
- Test Leads
- 99% Isopropyl Alcohol and Cleaning Wipes

Setup
- **Test Area** - needs to be free of any high voltage transformers or power supplies and away from any type of fluorescent lighting or high power lighting.
- **Worksurface** - needs to be covered with a grounded conductive mat at 1.0 x 10^3 or less.
- **Technician** - needs to be connected to equipment ground with a 0 ohm resistor in the ground cord.
- **Decade Box** - needs to be connected to equipment ground.

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Normalization of the Meter
The temperature inside the testing area needs to be 24°C ±1.7°C at 40% to 60% relative humidity. The meter needs to stay at a temperature of 24°C ±1.7°C for approximately 2 hours for proper readings. The meter cannot be normalized inside objects, enclosed boxes, containers or cases. The temperature inside an enclosed case will differ from the outside temperature. These cases will act as insulators to the meter. The meter must remain stationary in the testing area for about 2 hours without any significant changes to the temperature.

NOTE: Accuracy is measured after normalizing the meter for a minimum of 2 hours.

Calibration Test Procedure

- Use only the test leads that were supplied with the meter.
- Clean around the banana jack and stereo jack located at the top of the meter with 99% isopropyl alcohol. Oil from human fingers can affect the accuracy of the meter.
- Set the Test Voltage Button to 10V HOLD. Press and hold the Test Button. The measured voltage between the two test leads should be 10V ±5%.
- Set the Test Voltage Button to AUTO. Press and hold the Test Button. The measured voltage between the two test leads should be 100V ±5%.
- Ensure that the Test Voltage Button is set to AUTO when performing the following measurements. Always measure from 1.0 x 10^{12} ohms and work your way down to 1.0 x 10^{3}. Never start your measurements from 1.0 x 10^{3}.

Temperature:	24°C ±1.7°C (75°F ±3°F)
Relative Humidity:	±10 integers

A. 1.0 x 10^{12}

+20%	LED = 12 Yellow	Mantissa 1.20
0%	LED = 12 Yellow	Mantissa 1.00
-20%	LED = 11 Yellow	Mantissa 8.00

B. 1.0 x 10^{11}

+20%	LED = 11 Yellow	Mantissa 1.20
0%	LED = 11 Yellow	Mantissa 1.00
-20%	LED = 10 Green	Mantissa 8.00

C. 1.0 x 10^{10}

+10%	LED = 10 Green	Mantissa 1.10
0%	LED = 10 Green	Mantissa 1.00
-10%	LED = 9 Green	Mantissa 9.00

D. 1.0 x 10^{9}

+10%	LED = 9 Green	Mantissa 1.10
0%	LED = 9 Green	Mantissa 1.00
-10%	LED = 8 Blue	Mantissa 9.00

E. 1.0 x 10^{8}

+10%	LED = 8 Blue	Mantissa 1.10
0%	LED = 8 Blue	Mantissa 1.00
-10%	LED = 7 Blue	Mantissa 9.00

F. 1.0 x 10^{7}

+10%	LED = 7 Blue	Mantissa 1.10
0%	LED = 7 Blue	Mantissa 1.00
-10%	LED = 6 Blue	Mantissa 9.00

G. 1.0 x 10^{6}

+10%	LED = 6 Blue	Mantissa 1.10
0%	LED = 6 Blue	Mantissa 1.00
-10%	LED = 5 Green	Mantissa 9.00

H. 1.0 x 10^{5}

+10%	LED = 5 Green	Mantissa 1.10
0%	LED = 5 Green	Mantissa 1.00
-10%	LED = 4 Green	Mantissa 9.00

I. 1.0 x 10^{4}

+10%	LED = 4 Green	Mantissa 1.10
0%	LED = 4 Green	Mantissa 1.00
-10%	LED = 3 Red	Mantissa 9.00

J. 1.0 x 10^{3}

+10%	LED = 3 Red	Mantissa 1.10
0%	LED = 3 Red	Mantissa 1.00
-10%	LED = <3 Red	Mantissa <0.90

Specifications

Resistance Ranges	1 x 10^{3} - 1 x 10^{12} ohms @ 10 Volts 1 x 10^{6} - 1 x 10^{12} ohms @ 100 Volts
Accuracy	Resistance measurements within ±10% (±20% for resistance values 1 x 10^{11} and greater). Under load voltages of 10 Volts ± 5% and 100 Volts ± 5% (Ref: EN 61340-2-3).
Power Supply	2 AA alkaline batteries
Battery Life	Approx. 1,500 measurements
Operating Temperature	0 to 40°C (32°F to 104°F)
Meter Dimensions	21 cm x 10 cm x 4 cm
Meter Weight	0.3 kg
Kit Dimensions	34 cm x 27 cm x 10 cm
Kit Weight	5.9 kg
External Electrode	2 kg [5 lbs (±2 oz)], 6 cm in diameter (Ref: EN 61340-2-3)

Limited Warranty, Warranty Exclusions, Limit of Liability and RMA Request Instructions

See the Desco Europe Warranty - DescoEurope.com/Limited-Warranty.aspx

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