OPERATING INSTRUCTION

MODEL 4102
ANALOG EARTH RESISTANCE TESTER

A.W. SPERRY INSTRUMENTS INC.
The Professional’s Choice®
1. Safety Precautions

○ The instrument is designed, manufactured, tested and shipped in prime condition in accordance with the following standards.
  ● IEC 61010-1  Measurement CAT III 300V Pollution Degree 2
  ● IEC 61010-2-31
  ● IEC 61557-1,5
  ● IEC 60529  (IP54)
  ● JIS C 1304-95

This instruction manual contains warnings and safety rules which must be observed by the user to ensure safety operation of the instrument and to retain it in safe condition. Therefore, read through these instructions before using the instrument.

⚠️ WARNING

● Read through and understand instructions contained in this manual before using the instrument.
● Save and keep the manual handy to enable quick reference whenever necessary.
● Be sure to use the instrument only in its intended applications and to follow measurement procedures described in the manual.
● Be sure to understand and follow all safety instructions contained in the manual.

Be sure to observe the above rules strictly. Not following the instructions may cause injury or instrument damage.

○ The symbol ⚠️ on the instrument means that the user must refer to the manual for safe operation of the instrument. There are three kinds of the symbol ⚠️. Read the instructions following each symbol carefully.

⚠️ DANGER is reserved for conditions and actions that are likely to cause serious or fatal injury.
⚠️ WARNING is reserved for conditions and actions that can cause serious or fatal injury.
⚠️ CAUTION is reserved for conditions and actions that can cause minor injury or instrument damage.
2. Features

MODEL 4102 is an earth resistance tester for testing power distribution lines, in-house wiring system, electrical appliances etc. It also has an earth voltage range for earth voltage measurement.

○ Designed to safety standard IEC 61557.

○ Dust and drip proof construction in conformity with IEC 60529 (IP54). Measurement can be made even under adverse weather conditions.

○ Simplified measurement probe has a structure that both the alligator clip and the test bar are available.

○ OK lamp to check proper auxiliary earth resistance within tolerance and to recognize disconnection of test leads at a glance. Normal measuring conditions can be confirmed anytime.

○ Convenient carrying soft bag for accessories etc.

3. Specifications

○ Measuring Range and Accuracy (at 23±5°C and RH 75% or less)

<table>
<thead>
<tr>
<th>Range</th>
<th>Measuring Range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Voltage</td>
<td>0 - 30V</td>
<td>±3.0% of full scale</td>
</tr>
<tr>
<td>Earth Resistance x1Ω</td>
<td>0 - 12Ω</td>
<td>±3.0% of full scale (Auxiliary earth resistance 100Ω±5%)</td>
</tr>
<tr>
<td></td>
<td>0 - 120Ω</td>
<td>(Earth voltage 10V or less)</td>
</tr>
<tr>
<td>x10Ω</td>
<td>0 - 1200Ω</td>
<td></td>
</tr>
<tr>
<td>x100Ω</td>
<td>0 - 1200Ω</td>
<td></td>
</tr>
</tbody>
</table>

○ Applicable Standards
  ● IEC 61010-1 Measurement CAT III 300V Pollution Degree 2
  ● IEC 61010-2-31
  ● IEC 61557-1,5
  ● IEC 60529 (IP54)
  ● JIS C 1304-95
Analog Meter
- Self-shielding core magnet taut-band type

Measuring Method
- Earth voltage measurement
  Average sensing
- Earth resistance measurement
  Constant current inverter
  Frequency: Approx. 820Hz
  Measuring current:
  x1Ω range: Approx. AC 3mA
  x10Ω range: Approx. AC 2mA
  x100Ω range: Approx. AC 1mA

Maximum Operating Error
Operating error (B) is an error obtained within the rated operating conditions, and calculated with the intrinsic error (A), which is an error of the instrument used, and the error (Ei) due to variations.

\[ B = \pm |A| + 1.15 x \sqrt{E_1^2 + E_2^2 + E_3^2 + E_4^2 + E_5^2 + E_6^2 + E_7^2 + E_8^2} \]

- A: Intrinsic error
- E1: Variation due to changing the position
- E2: Variation due to changing the supply voltage
- E3: Variation due to changing the temperature
- E4: Variation due to interference voltages
- E5: Variation due to earth electrode resistance
- E6: Variation due to changing the system frequency
- E7: Variation due to changing the system voltage

Range to keep the maximum operating error
Measurement range within which the maximum operating error (±30%) applies.

- x1Ω range: 6-12Ω
- x10Ω range: 10-120Ω
- x100Ω range: 100-1200Ω

Number of Measurement
- 10000 times or more
  (Measure 6Ω for 5s on x1Ω range and take a pause for 25s)

Operating Temperature and Humidity
- 0-40°C, relative humidity 85% or less (no condensation)

Storage Temperature and Humidity
- -20-60°C, relative humidity 85% or less (no condensation)

Power Source
- 9V DC: R6P (SUM-3) x6

Overload Protection
- Earth voltage and earth resistance ranges: 276V AC/DC (10 seconds)

Insulation Resistance
- 10MΩ or more at 1000V between the electrical circuit and the housing case

Withstand Voltage
- 3700V AC for one minute between the electrical circuit and the housing case

Dimensions
- 105(L) x 158(W) x 70(D) mm

Weight
- Approx. 600g

Accessories
- M-7095 Test Leads x 1 set
- M-8032 Auxiliary Earth Spikes x 2
- M-7127 Simplified Measurement Probe (with safety alligator clip and flat test bar) x 1 set
- M-9084 Carrying Case x 1
- Strap Belt x 1
- Instruction Manual x 1
- Battery R6P (SUM-3) x 6
- Inspection Certificate (STD English only) x 1
4. Layout Diagram

5. Scale Reading

<table>
<thead>
<tr>
<th>Range</th>
<th>Measuring Range</th>
<th>Scale</th>
<th>Scale Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Voltage</td>
<td>0-30V</td>
<td>A</td>
<td>x 1</td>
</tr>
<tr>
<td>Earth Resistance</td>
<td>0-12Ω</td>
<td>B</td>
<td>x 10</td>
</tr>
<tr>
<td></td>
<td>0-120Ω</td>
<td>B</td>
<td>x 100</td>
</tr>
</tbody>
</table>

6. Preparation for Measurement

6-1 Mechanical Zero Adjustment
To obtain a measurement value with high accuracy, rotate the meter zero adjuster by a driver etc. with the range selector switch OFF, and surely match the indicator to “0” graduation value at the left of the scale board.

6-2 Connecting Test Probe
Insert the plug of the probe securely into the terminals of the instrument. Loose connection may result in inaccurate measurements.

6-3 Battery Voltage Check
Set the range selector switch to BATT.CHECK position and press the test button. Then the indicator swings. Make sure that the indicator is at the right of BATT.GOOD graduation borderline on the scale board. Otherwise, the batteries are exhausted. Replace them according to section 8 for Battery Replacement.
7. Operating Instructions

⚠ DANGER
- The instrument will produce a maximum voltage of about 50V between terminals E-C or E-P in earth resistance function. Take enough caution to avoid electric shock hazard.
- When measuring earth voltage, do not apply voltage greater than 30V between measuring terminals.
- When measuring earth resistance, do not apply voltage between measuring terminals.

7-1 Principle of Measurement
This instrument makes earth resistance measurement with fall-of-potential method, which is a method to obtain earth resistance value Rx by applying AC constant current I between the measurement object E (earth electrode) and C (current electrode), and finding out the potential difference V between E and P (potential electrode).

\[ Rx = \frac{V}{I} \]

7-2 Precise Measurement (with Test Probe M-7095)

① Connection of Test Leads
Stick the auxiliary earth spikes P and C into the ground deeply. They should be aligned at an interval of 5-10m from the earthed equipment under test. Connect the yellow lead wire to the earthed equipment under test, the yellow wire to the auxiliary earth spike P and the red wire to the auxiliary earth spike C from terminals E, P and C of the instrument in order.

Note: ◇ Make sure to stick the auxiliary earth spikes in the moist part of the soil. Give enough water where the spikes have to be stuck into the dry, stony or sandy part of the earth so that it may become moist.
◇ In case of concrete, lay the auxiliary earth spike down and water it, or put a wet dustcloth etc. on the spike when making measurement.

② Earth Voltage Measurement
Set the range switch to EARTH VOLTAGE position to check earth voltage in the condition of ① If the indicator swings, earth voltage exists. Make sure that the voltage is 10V or less.
When the display reads more than 10V, it may result in excessive errors in earth resistance measurement. To avoid this, make measurement after reducing the voltage by turning off the power supply of the equipment under test etc.

③ Precise Measurement
Set the range switch to x100Ω position and press the test button. LED remains illuminated during testing. Turn the range switch to x10Ω and x1Ω when the earth resistance is low. This indicated value is the earth resistance of the earthed equipment under test.

Note: ◇ If the auxiliary earth resistance of auxiliary earth spike C is too high to make measurement, the indicator swings without LED lighting. Recheck the connection of test leads and the earth resistance of auxiliary earth spike.
7-3 Simplified Measurement (with Test Probe M-7127)

Use this method when the auxiliary earth spike cannot be stuck. In this method, an existing earth electrode with a low earth resistance, such as a metal water pipe, a common earth of a commercial power supply and an earth terminal of a building, can be used with two-terminal method (E,P).

Use the simplified measurement probe attached which has a convenient structure that both the safety alligator clip and the test bar are available.

① Wiring

Make connection as shown in the figure.

Note: ◇ When the simplified measurement probes are not used, short P and C terminals.

② Earth Voltage Measurement

Set the range switch to EARTH VOLTAGE position to check earth voltage in the condition of ①. If the indicator swings, earth voltage exists. Make sure that the voltage is 10V or less. When the display reads more than 10V, it may result in excessive errors in earth resistance measurement. To avoid this, make measurement after reducing the voltage by turning off the power supply of the equipment under test etc.

③ Simplified Measurement

Set the range switch to x100Ω position and press the test button to make measurement. LED remains illuminated during testing. Turn the range switch to x10Ω and x1Ω when the earth resistance is low. This indicated value is the earth resistance of the earthed equipment under test.
8. Battery Replacement

⚠️ DANGER
- Do not open the battery compartment cover, if the outer surface of the instrument is wet.
- Do not replace batteries while making measurement. To avoid shock hazard, turn the instrument off and disconnect the test leads and the probes from the instrument before opening the battery compartment cover.

⚠️ CAUTION
- Do not mix new and old batteries.
- Install batteries in the orientation as shown inside the battery compartment, observing correct polarity.

① Turn off the instrument and disconnect the test leads and the probes from the terminals.
② Loosen two screws on the bottom of the instrument and remove the battery cover.
③ Always replace all six batteries in correct polarity.
   Battery: R6P (AA dry battery) x6
④ Put the cover back in place and tighten the two screws.

Note: ◇ If the auxiliary earth resistance of auxiliary earth spike C is too high to make measurement, the indicator swings without LED lighting. Recheck the connection of test leads and the earth resistance of auxiliary earth spike.

① Simplified Measurement Value
Two-terminal method is used for simplified measurement. In this method, earth resistance value re of earth electrode connected to terminal P is added to true earth resistance value Rx and shown as an indicated value Re.

\[ Re = Rx + re \]

If the re is known beforehand, true earth resistance value Rx is calculated as follows.

\[ Rx = Re - re \]
9. Notes on Housing Case & Accessories

9-1 Case Lid
Case lid can be fit under the housing case while making measurement.

9-2 How to Fit Strap Belt
The instrument is equipped with a strap to suspend from the neck to allow both hands to be used freely for easy and safe operation.

10. Cleaning of Meter Cover

Antistatic additive has been applied to the meter cover of the instrument for electrification prevention, therefore, do not rub it strongly with a dry cloth etc. even if it is dirty. Should it become old and charged with electricity, wipe the cover with a cloth soaked in the commercial detergent with antistatic additive.
Lifetime Limited Warranty

The attention to detail of this fine snap-around instrument is further enhanced by the application of A.W. Sperry's unmatched service and concern for detail and reliability. These A.W. Sperry snap-arounds are internationally accepted by craftsmen and servicemen for their unmatched performance. All A.W. Sperry’s snap-around instruments are unconditionally warranted against defects in material and workmanship under normal conditions of use and service; our obligation under this warranty being limited to repairing or replacing free of charge, at A.W. Sperry snap-around instrument that malfunctions under normal operating conditions at rated use.¹

Replacement procedure

Securely wrap the instrument and its accessories in a box or mailing bag and ship prepaid to the address below. Be sure to include your name and address, as well the name of the distributor, with a copy of your invoice from whom the unit was purchased, clearly identifying the model number and date of purchase.

A.W.SPERRY INSTRUMENTS INC.
ATT: Customer service dept.
2150 Joshua’s Path, Suite 302,
Hauppauge, NY 11788

¹ The warranty is not applicable if the instrument has been: misused, abused, subjected to loads in excess of specifications, has had unauthorized repair or has been improperly assembled or used.

* Note: Recommended calibration interval should not exceed one year. Calibration service charges are not covered terms and conditions of warranty.