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INSTRUCTION GUIDE

Clamp-on Ground Resistance Tester

MODEL P81001

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Clamp-On Ground Resistance Tester

MODEL P81001

The Clamp-On Ground Resistance Tester Model P81001 allows for the safe, fast and simple measurement of a grounding system with loop. There is no need for auxiliary electrodes or breaking down grounding wires. The meter can be used without disconnecting the ground under test.

The meter is equipped with a long jaw ideal for grounding with flat steel and is suitable for measuring when noise signals and harmonic waves are present in the grounding network.

SAFETY

Carefully read the enclosed operating instructions before use and comply with precautions for the best results from the meter and for your safety. This meter must be only used by qualified and trained users.

APPLICATIONS

The meter is designed for use in the following applications:

POWER | TELECOMMUNICATIONS | OIL FIELDS | CONSTRUCTION | INDUSTRIAL AND ELECTRICAL EQUIPMENT

STANDARD ACCESSORIES

The meter comes with the following standard accessories:

- 1 Verification resistor
- 4 AA 1.5 V dry cell batteries
- 1 Carrying case

PRECAUTIONS

- Only operate within the parameters of the given measuring range and environment.
- Keep the meter away from any impact, especially jaw contact planes.
- Remove batteries if the meter will be stored for long periods.
- Only authorized engineers should disassemble, calibrate and perform maintenance on the meter.
- If hazards result from continuous use, stop using immediately and send for repair.

METER FEATURES

1. Liquid crystal display (LCD)
2. Trigger: Open and close jaw
3. Jaw: 65 mm (L) x 32 mm (W)
4. POWER button: Boot up/shut down/quit
5. HOLD button: Lock/release display
6. O/A: Switch of resistance and current measurement condition

DISPLAY

1. Alarm: Indicates the measured value exceeds the alarm value established in settings
2. Low battery voltage
3. Store data record
4. Review data record
5. Number in sequence of data records
6. Current unit
7. Resistance unit
8. Noise signal
9. Data hold
10. Open jaw indicator
11. Resistance measured lower than 0.01 Ω
12. Metric decimal point
13. 4-digit display

SPECIAL SYMBOL DESCRIPTIONS

1. Open jaw: The jaw is open and unavailable for measurement. The trigger may be pressed or the jaws may be unavailable due to pollution. (see Figure 3)
2. Low battery voltage: Battery voltage is lower than 5.3 V and must be replaced to ensure accuracy.
3. OLQ: The measured resistance exceeds the upper limit of the meter.
4. L0.01 Ω: The measured resistance exceeds the lower limit of the meter.
5. MEM: Storing data records.
6. MR: Data records and number of records.
7. NOISE: Noise current is present in the earth resistance to measure. The accuracy of measurement cannot be guaranteed.

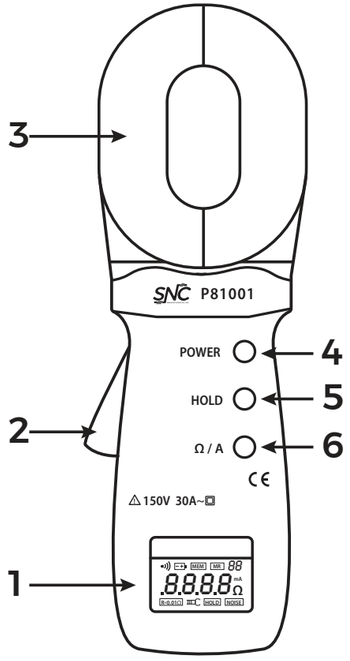

Figure 1

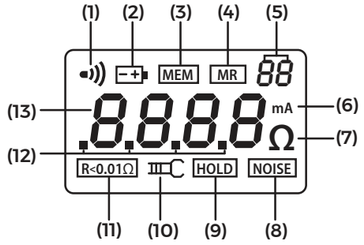

Figure 2

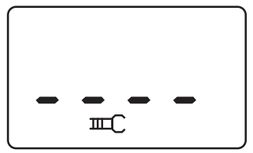

Figure 3

TECHNICAL SPECIFICATIONS

- Power source: 6VDC (4 alkaline batteries)
- Working temperature: -10 to 55 °C
- Relative humidity: 10-90%
- LCD: 4-digital LCD, 47 X 28.5 mm in length
- Jaw span: 28 mm
- Jaw size: 65 x 32 mm
- Meter quality (including batteries): 1320 g
- Meter size: 293 mm (L) x 90 mm (W) x 66 mm (H)
- Protection level: Double insulation
- Featured: By clamp
- Range shift: Automatic
- External magnetic field: <40 A/m
- External electric field: <1 V/m
- Single measuring time: 1 second
- Maximum resolution of resistance measurement resolution .001 Ω
- Range of resistance measurement range: 0.01-1000Q
- Range of current measurement: 00.0-30.00 A
- Frequency of current: 40-65 Hz
- Number of record sets stored: 99 sets
- Range for alarm of resistance: 1-199Q
- Range for alarm of current: 1-499mA

GROUND RESISTANCE TESTER

A/C Leakage Current

Range	Resolution	Accuracy
0-80mA	0.05mA	(±2.5%+1mA)
80mA-650mA	0.5mA	(±2.5%+2mA)
650mA-4A	5mA	(±2.5%+10mA)
30A	10mA	(±2.5%+20mA)

RANGES AND ACCURACY OF EARTH RESISTANCE MEASUREMENTS

Range	Resolution	Accuracy
0.010 - 0.099 Ω	0.001 Ω	(± 1% + 0.01 Ω)
0.10 - 0.99 Ω	0.01 Ω	(± 1% + 0.01 Ω)
1.0 - 49.9 Ω	0.1 Ω	(± 1.5% + 0.1 Ω)
50.0 - 99.5 Ω	0.5 Ω	(± 2% + .5 Ω)
100 - 199 Ω	1 Ω	(± 3% + 1 Ω)
200 - 395 Ω	5 Ω	(± 6% + 5 Ω)
400 - 590 Ω	10 Ω	(± 10% + 10 Ω)
600 - 1000 Ω	20 Ω	(± 20% + 20 Ω)

REFERENCE CONDITIONS

Conditions	Reference
Ambient	(20±3 °C)
Relative Humidity	50% RH ± 10%
Battery Voltage	6 V ± 0.51/
External Magnetic Field	<40 A/m
External Electric Field	<1 V/m
Operating Position	Clamp horizontal
Position of Conductor in the Clamp	Centered
Proximity to Metallic in the Clamp	>10 cm
Loop Resistance	Non-choke resistance
Rate of Distortion	<0.5%
Interference Current On measurement of loop resistance	Nil

OPERATIONS

START-UP CALIBRATION

Before start-up calibration, press the trigger several times to ensure the jaws are closed. Press the POWER button to start the meter. Do not operate the trigger or clamp wires during start-up calibration.

The meter is ready for resistance measurement when OL appears on screen after inspection (see Figure 4).

Figure 4

INSPECTION

During inspection of the meter, DO NOT do any the following which may make measurements inaccurate.

- Press the trigger
- Open the jaw
- Clamp a wire
- Overturn the meter
- Impose any external force on the jaw

If jaws clamp around a conductor loop during inspection, all following measurements will be inaccurate. Remove the conductor loop and restart.

SHUTDOWN

- Press the POWER button to turn the meter off.
- Five minutes after startup, the LCD screen will begin flashing. The meter will automatically shut down after 30 seconds of flashing to preserve battery life. To resume working status, press the POWER button when flashing.
- During the HOLD state, press the HOLD button to quit the HOLD state. Then press the POWER button to shut down.

RESISTANCE MEASUREMENT

- After start-up inspection is completed, OL is displayed indicating the meter is ready to proceed with resistance measurement.
- Press the trigger to open the jaw and clamp the loop to measure read out resistance value.
- A buzzing sound during measurement is normal.
- If necessary, self-calibration can be done with verification resistor in standard accessory as shown in the following figure. The reading should be consistent with the normal value on verification resistor (5.1 W). The calibrated value of verification resistor is in condition of temperature of 20 °C. It is normal to find a difference of numerical 1 word between the shown value and nominal value.

If nominal value of verification resistor is (5.1 W), showing 5.0 W or 5.2 W is normal and accepted, showing OL indicates that the measured resistance value exceeded the upper limit of this meter. Showing 1.0.01 W indicates that the measured resistance value exceeded the lower limit of this meter.

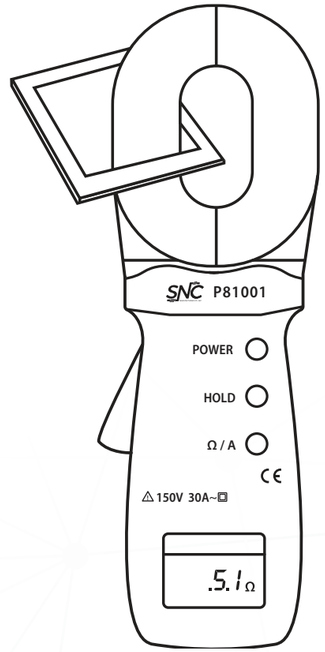

Figure 5

CURRENT MEASUREMENT

When the meter shows OL in mode of resistance measurement after booting self-inspection, press the W/A button to enter current measurement mode. If the meter shows 0.00 mA, press the trigger to open the jaw and clamp the loop to measure read out current value.

Showing OL as in Figure 6 indicates that the measured resistance value exceeded the upper limit of this meter.

Figure 6

DATA LOCK/RELEASE/STORE

- In resistance or current measurement mode, press the HOLD button to lock the current value displayed, with the HOLD symbol showing. Press the HOLD button again to unlock until the HOLD symbol disappears. Then the meter reverts to a state of measuring.
- Press the POWER button for more than 3 seconds in the measuring state. When the symbol MEM displays, the meter numbers and stores the measured values as a group of data in sequence, and the number displays in the top right corner of the LCD panel.
- Press the POWER button for less than 3 seconds to exit the save state.

Figure 7

Figure 7
The meter saved the measured resistance 0.016 W as No. 1 data record.

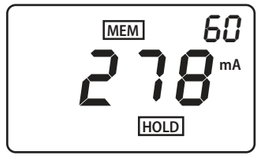

Figure 8

Figure 8
The meter saved the measured current 278 mA as No. 60 data record. The meter memory is full as shown MEM. Stored data remains when shut down.

DATA REVIEW

- Press the HOLD button for more than 3 seconds. The MR symbol displays as Figure 8. The meter is in review stored data mode and displays the data of Group 01 stored by default.
- Press the HOLD button for less than 3 seconds to review all stored data downward. It will automatically return to No. 01 after last record is shown.
- To delete all stored data, press the POWER button.
- Press the HOLD button for more than 3 seconds to quit data reviewing mode.

SETTING CRITICAL VALUE FOR ALARM

In measuring mode of resistance (see Figures 9 and 10), press the HOLD button to switch digits from highest to lowest. Press the Ohm/A button to set the critical value of alarm to revert to measuring mode.

Figure 9

Figure 9
Setting critical alarm of resistance

Figure 10

Figure 10
Setting critical value of alarm by current

REVIEW ALARM SETTING

- In measuring mode of resistance or current, press the W/A button for 3 seconds to examine the critical value of alarm.
- If the top digit flickers, the value examined refers to the amount set last time.
- Within another 3 seconds of pressing the W/A button, the meter will go back to measurement.

In Figure 11, the critical value for alarm by resistance set the last time is 20 Ω.

Figure 11

Figure 11
Flickering digit

Figure 12

Figure 12
The measured resistance is under 0.01 Ω.

Figure 13

Figure 13
Loop resistance measured is 5.1 Ω.

Figure 14

Figure 14
Loop resistance measured is 2.1 Ω. Current reading was locked: 2.1 Ω.

Figure 15
No. 26 data record is stored. Loop resistance measured is 0.028 Ω.

Figure 15

Figure 16
Alarm indicates the measured resistance exceeds alarm value settings. No. 8 data record is stored. Resistance measured is 820 Ω.

MAINTENANCE

- Turn the switch to the OFF position for cleaning. Open the clamp jaws and check all surfaces are free of dust, dirt or foreign substances.
- Clean if necessary to ensure measurement accuracy. Do not use harsh detergents, solvents or cleaners. Only clean with a damp cloth.

Figure 16

MEASUREMENTS

MEASUREMENT POINT SELECTION

Select a proper point for measurement for accurate results. Refer to Figure 17.

POINT A: When the spur track measured is out of circuit, the meter displays OL. Select a different measurement point.

POINT B: When the spur track measured is a circuit formed by a metal conductor, the meter displays OL or the resistance value of a metal circuit. Select a different measurement point.

POINT C: Earth resistance of the spur track is measured.

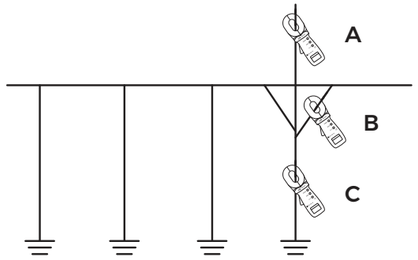

Figure 17

Measuring earth resistance of an oil tank and loading point

Figure 18 represents a grounding system in a gas station oil tank, where earth pole A connects to the oiling machine and loading point earth pole C is an independent earth pole. Another independent earth pole is found as assistant earth pole B (such as the underground water pipe, etc.), and respectively measures out values of RI, R2 and R3 by the meter according to a three-point method.

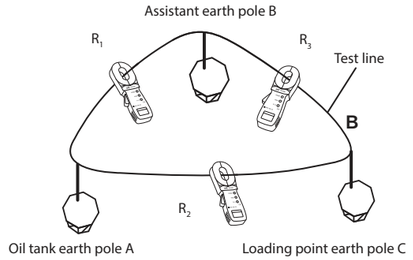

Figure 18

Results:

Earth resistance of oil tank	R	A = (R1 + R2 = R3)
Earth resistance of assistant earth pole	R	B = R1 – RA
Earth resistance of loading point	R	C = R2 – RA

Note: When measuring R1, make sure there is no conductor link between BC and ACV which is requested for measuring R2 and R3.

Measuring earth resistance of an oiling machine

As shown in Figure 19, find an earth pole which is apart from the earth pole of the oiling machine, such as the earth pole of the loading point. Connect the two points with the test line and measure the value RT with the meter.

Results:

Earth resistance of oiling machine R = RT - RC

RT is the resistance measured by the meter.
RC is the earth resistance of loading point.

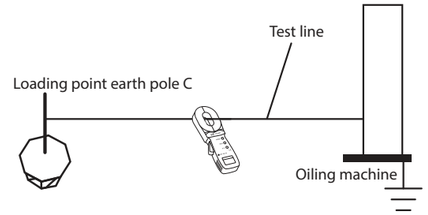

Figure 19

Measuring link resistance of an oil hose on an oiling machine

Connect the oiling machine and refueling gun with a test line. Measure the value RT with the meter.

Results:

Link resistance of the oil hose of the oiling machine
R = RT – RL

RT is the resistance measured by the meter.
RL is the resistance of the test line.

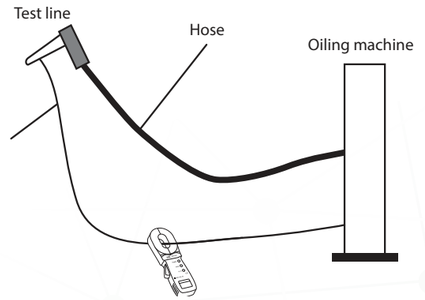

Figure 20

Important notes for measuring earth resistance

There can be a considerable difference when comparing testing values measured by a meter versus a traditional voltage and current method.

Whether unclasped (grounding body to measure is separated from grounding system) has been done when measuring resistance by traditional voltage and current method. If not, the earth resistance that is measured refers to the parallel connection value of earth resistance of all grounding bodies.

It is not beneficial to measure parallel connection value of earth resistance of all grounding bodies. Measuring earth resistance is making a comparison between the earth resistance and a permitted value regulated by relevant standards to decide whether earth resistance is qualified.

For example, earth resistance per radix tower refers to the resistance measured when a grounding body cuts off electric connection with a ground wire. If the grounding body doesn't cut off electric connection with a ground wire, earth resistance measured refers to the parallel connection value of earth resistance of multi-radix towers.

ON-SITE APPLICATION

Application in power systems

(1) Measurement for earth resistance of power transmission line tower

The grounding of power transmission line tower forms a multi-point grounding system. To measure of earth resistance, clamp grounding rods with the meter.

(2) Measurement for earth resistance of neutral point of transformer

There are two cases in neutral point grounding of transformers. If multiple grounding is applied, it is a multi-point grounding system. All other cases are single-point grounding.

For measurement, if the meter shows L0,01 Q it may mean that the same pole and tower or transformer has more than two grounding rods linked together underground. Unveil other grounding rods and keep one rod remaining.

(3) Application in substation of power plant

The meter can check the status of touch and link in circuits. With assistance from a line, it can measure link status between equipment's in-station and earth grid. Earth resistance is measured according to single-point grounding.

Application in telecommunication systems

(1) Measurement of earth resistance of machinery room in telecom building

The machinery rooms for telecommunication systems are often placed on a high floor of the building, which can make it difficult to measure. It can be measured with the meter by linking a fire hydrant and grounding electrode to measure with a test line (fire hydrant is equipped in the machinery room). Measure the test line with the meter.

Reading of resistance = earth resistance of machinery room + resistance of testing line + earth resistance of fire hydrant

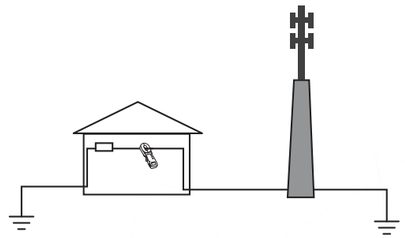

Figure 21

(2) Measurement of earth resistance of machinery room and transmitter tower

Grounding of machinery room and transmitter tower usually forms a two-point grounding system as shown in Figure 21.

- If the measured value of the meter is lower than the permitted value of earth resistance, earth resistance of the machinery room and transmitter tower is qualified.
- If the measured value of the meter is higher than the permitted value of earth resistance, apply measurement of single-point grounding.

Application in lightning-prevention grounding system of buildings

If grounding electrodes of the building are separated from each other, earth resistance of various electrodes can be measured according to the following image.

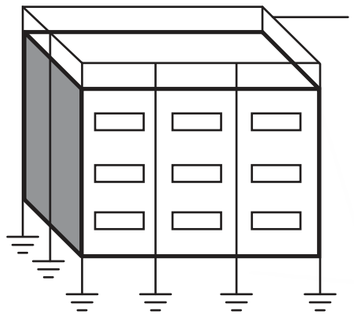

Figure 22
Lightning-prevention overhead conductor

Application in grounding system in gas stations

In an environment full of explosive gas, such as a gas station, oil field and oil groove, it is necessary to adopt explosion-proof products. Generally, gas stations are requested to ensure earth resistance and link resistance as follows:

Number	Item to Measure	Technical Requirement
1	Earth resistance of oil tank	≤ 10 Ω
2	Earth resistance of loading point	≤ 10 Ω
3	Earth resistance of oiling machine	≤ 4 Ω
4	Link resistance of oil hose of oiling machine	≤ 5 Ω

Variations in the nominal working range

Distortion quantity	Limit of operating range	Distortion
Temperature	-10 °C to 55 °C	1.5 class of accuracy per 10
Relative humidity	IO% RH to 90% RH	1.5 class
Battery voltage	5.5 V to 6.5 V	0.25 class
Conductor position	From edge to center	0.1 class
Clamp position	± 180°	0.5 class
Proximity of magnetic mass	1 mm steel plate against jaw face	0.25 class
Magnetic field 50-60 Hz	400 A/m	0.25 class
Electric field 50-60 Hz	0-10 KV 1 m	0.25 class

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