

# MS2301

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## Security Statements

**"Warning"** signs indicate danger, which requires to pay attention when implementing the operating steps; electric shocks or personal injuries may be caused by inaccurate operations or doing not follow the operating steps. If the appointed conditions are not completely understood or those conditions are not met, please don't continuously follow any improper operation indicated in the warning signs.

### **Warning**

**In order to avoid electric shocks, personal injuries or equipment damages, please carefully read this manual before using the tester**

- Please use the tester according to the manual, or the protection functions provided by the tester may invalid or be weaken.
- If the product is damaged, such that the shell is broken, please don't use it.
- Don't use the product which is not provided with a rear battery cover or of which the rear cover is not accurately installed.
- 30V AC or 60V DC voltage may cause electric shocks.
- Use proper protection equipment, such as safety glasses, masks, insulating gloves, insulating boots, etc.
- Metal objects or conductors connected on the electrical equipment before test shall be considered fatal consequences, the grounding system is no exception, please pay special attention to safety.
- Don't test in current specified by the tester.
- Must pull the trigger for some times before starting so that the jaws can be completely closed.

- Don't open the jaws or vise any conductor.

## **Maintenance and Servicing**

- Jaw joints shall be clean, stains may cause the measurement error, even cause the functional disturbance.
- Please use soft wet cloth to scrub the jaw joint surface, don't use solvent and tough objects.
- Avoid any impact with the tester, especial the joint surfaces of the jaws.
- Prevent the tester from being too close to magnetic objects.
- After test, press key HOLD to lock, which can reduce the battery consumption.
- When the tester is not used for a long time, please get the battery outside.

## **Overview**

The pincerlike grounding resistance tester is a big breakthrough of traditional grounding resistance measurement technology, and is used for measuring the grounding resistance of the system with circuits, for example, the grounding resistance of power transmission lines or the grounding resistance of communication lines. Auxiliary grounding rods are not needed to use when measuring, several parallel connected grounding systems can be applied, and the equipment to be tested are not interrupted. The grounding resistance can be safely and quickly measured by clamping the grounding wires or the grounding rods only with the jaws.

The pincerlike grounding resistance tester further can be used for measuring the current, the highly sensitive jaws of the tester can measure the leakage current which is low to 1mA and the current of the neutral line which is up to 40A RMS. This function is very important when measuring the grounding network which has large noise and harmonic wave influencing the power quality.

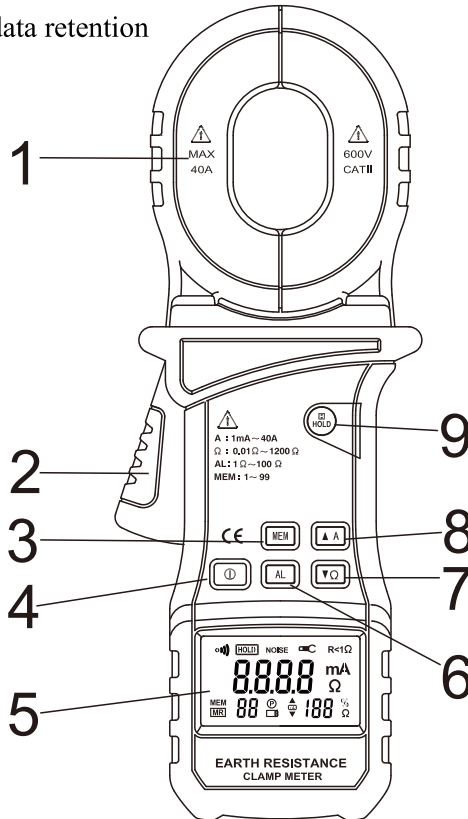
Except to be used in industrial electrical equipment, the tester is widely applied to power distribution, configuration of telecommunications system, building grounding, etc.

### **Functional Characteristics**

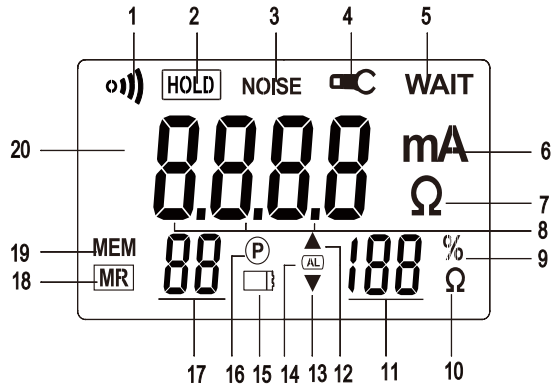
- 0.01Ω low-resistance high-precision measurement
- 0.001Ω high resolution
- 99 groups of resistance measurement data can be stored
- Limit alarm function, which can set the alarm values within the range of 1Ω-100Ω
- Leakage current and the current 1mA-40A of the neutral line
- Large-caliber 45mm×32mm precise measuring probe
- Digital measurement, automatic shift, simple to operate
- The jaws have double-layer insulation protection, which strengthens the anti-interference performance
- Non-contact measurement improves the measurement safety
- Single measuring time is 1s, which embodies the rapidity of the measurement
- Current overload display, >40A RMS, which displays symbol "OL".

# Panel Description

- 1 . Jaw: signal sensor
- 2 . Trigger: press the opened jaw
- 3 . Key MEM: data storage
- 4 . Key  $\text{\textcircled{I}}$  : switch of power supply
- 5 . Displayer: display the test results
- 6 . Key AL: select the alarm mode
- 7 . Key  $\nabla\Omega$ : resistance measurement or reduction key
- 8 . Key  $\blacktriangle A$ : current measurement or multiply key
- 9 . Key HOLD: data retention



# Displayer



- 1 . Symbol of buzzer
- 2 . Data retention symbol: lock the measurement value
- 3 . Noise symbol: circuit current is disturbed, and the resistance measurement value is not certain
- 4 . Jaw symbol: the jaw is not completely closed, and measurement cannot be carried out
- 5 . Wait symbol: waiting when automatic calibrating after started.
- 6 . Current unit
- 7 . Resistance unit
- 8 . Decimal point
- 9 . Battery capacity percentage
10. Resistance unit of warning value
- 11.Warning value or battery capacity display
- 12 . High alarm symbol
13. Low alarm symbol
14. Alarm function mode symbol
- 15.Battery under-voltage symbol
- 16.Auto power-off symbol
- 17.Numbering digit of memory

- 18.Storage reading symbol
- 19.Storage mode symbol
- 20.4-digit LCD digital display

**Function List**

Functions	Keys
Settings of startup/Shutdown/quit	⓪
Select the current measurement/ multiply of warning value/storage number	▲A
Select the $\Omega$ measurement/reduction of warning value/storage number	▼ $\Omega$
Data retention	HOLD
Select the alarm mode	AL
Entry/storage mode	MEM
Turn on or off the buzzer	⓪ + $\Omega$
Set the alarm value	⓪ +AL
Set the automatic shutdown	⓪ +HOLD
Read the storage data	⓪ +MEM
Delete all the storage values	HOLD+MEM



# Operation of Tester

## I. Startup & Shutdown


Pull the trigger for one or two times before starting to ensure that the jaw is perfectly closed.

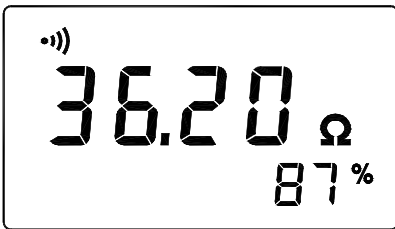
Key ① is used for starting or shut down the tester. Press the key ① to enter the startup state, and if pressing the key ① for more than 2s in the startup state, the tester enters the shutdown state.

After startup, the tester will automatically calibrate. When the tester automatically calibrates, the displayer will display CAL 9 , CAL 8 , CAL 7...CAL 0. Users shall wait the tester to finish the calibration; **during the calibration process, the jaws cannot be opened or conductors or tested objects cannot be jawed.** After the tester is calibrated, it will enter the resistance test mode. In such case, the product is in the state of data locking (the display data is the random numerical number with no meaning) in order to reduce the power consumption for the complete unit. Therefore, it is required to manually press the key of HOLD for it to enter the normal test state.

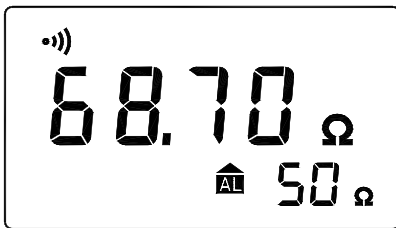
## II. Measurement of Grounding Resistance

- 1 . After the tester is normally started, it will automatically be in the mode of resistance ( $\Omega$ ) test and switched to the current test mode by pressing the key of A.

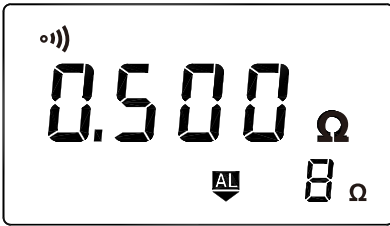
- 2 . Use the jaw to clamp the electrode or the grounding rod to be tested.
- 3 . If the displayer displays “----” and jaw symbol  , it means that the jaw is opened and not completely closed. Pull the trigger of the tester for some times to reclose the jaw, and then enter the normal measurement state after the jaw symbol disappears.
- 4 . Read the current measurement value from the displayer.
- 5 . When the displayer displays noise symbol "NOISE", it means that the circuit has interference current, at this moment, the resistance measurement value is not accurate.
- 6 . Measurement schematic diagram:



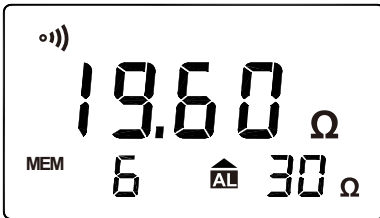
- The buzzer is opened
- Grounding resistance value of circuit 36.2Ω
- Battery residual capacity 87%



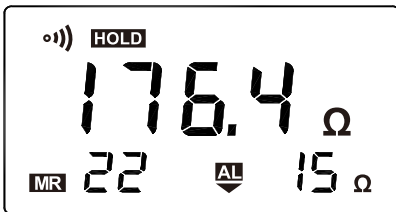
- The buzzer is opened
- Grounding resistance value of circuit 68.7Ω
- Grounding resistance value is -larger than the alarm value for 50Ω
- The buzzer sounds



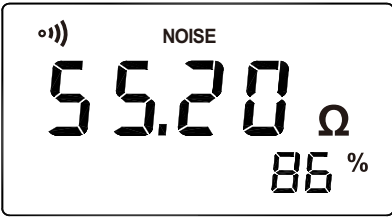
- The buzzer is opened
- Grounding resistance value of circuit 0.5Ω
- Grounding resistance value is larger than the alarm value for 8Ω
- The buzzer sounds



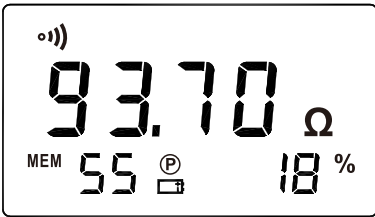
- The buzzer is opened
- Grounding resistance value of circuit 19.6Ω
- Grounding resistance value is larger than the alarm value for 30Ω
- The buzzer does not sound
- Store 6 measurement records



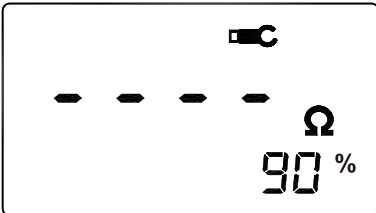
- The buzzer is opened
- Read the stored 22th measurement record
- Resistance value is 176.4Ω
- Low resistance alarm value is set as 15Ω



- The buzzer is opened
- Resistance of circuit is influenced by current
- Resistance measurement value 55.2Ω, uncertain
- Battery residual capacity 86%




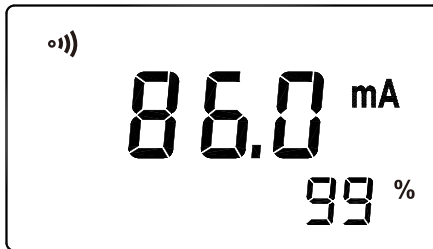
- The buzzer is opened
- Grounding resistance value of circuit 93.7Ω
- Battery capacity 18% , when <20%, display under-voltage symbol
- Automatic shutdown function is opened
- Store 55 measurement value records



- Jaw is not completely closed, display "----" symbol
- Battery capacity 90%

### III. Current Measurement

- 1 . Turn on the power supply of the tester; if the tester is in the resistance state, press key "A" to switch into the current measurement function.
- 2 . The displayer displays the current unit "A" or "mA", at this moment, the tester is in the current measurement state, namely the current can be measured.
- 3 . Use the jaw to clamp the electrode or the grounding rod or the conductor .
- 4 . If the displayer displays “----” and jaw symbol  , it means that the jaw is opened and not completely closed. Pull the trigger of the tester for some times to reclose the jaw, and then enter the normal measurement state after the jaw symbol disappears.
- 5 . Read the current value on the displayer
- 6 . If the displayer displays symbol "OL", it means that the measurement value exceeds the range.





### IV. Data Retention

Press the key "HOLD" when measuring to lock the current state and all the measurement values on the displayer; press the key again to return to the normal measurement state.

## V. Setting of Warning Mode





- 1 . In the resistance measurement state, press the key "AL" to display the symbol "AL" and alarm value.
- 2 . Repeatedly press the key "AL" to circularly display the following three alarm modes:

----Low alarm: Alarm when the resistance measurement value is lower than the preset alarm value. The displayer displays the symbol  .

----High alarm: Alarm when the resistance measurement value is higher than the preset alarm value. The displayer displays the symbol .

----Alarm free: The resistance measurement value is not limited by the alarm value.

- 3 . Setting of alarm value

The high alarm default value of the tester is 20Ω. When testing the resistance, press the keys  + AL to modify the alarm value, at this moment, the displayer displays the symbol "AL" and the alarm value, press key A or Ω to increase or decrease the alarm value, and the preset value can be set within 1-100Ω; the new alarm value will be automatically saved after shutdown, and the alarm value will be kept after startup next time; after the alarm value is set, press the key AL to select the one mode of the high alarm mode, the low alarm mode and the alarm free mode, and then press the key  to exit the alarm value setting state.

## VI. Data Storage Function

### 1. Delete the storage value

Press the keys HOLD+MEM at the same time for 3s until that the displayer displays the symbol "CLR"; after hearing "toot", delete the storage data; after deleting, the tester will automatically return to the primary measurement mode.

### 2. Store the measurement value

When the key MEM is pressed, the displayer displays the symbol "MEM", when the key MEM is pressed longer for 2s, the current measurement value is stored in the tester. The storage number is displayed after automatically added 1; when the storage number is up to 99, the key MEM is pressed, the tester sounds "toot", and forbids to store the measurement value. When the voltage of the battery is lower than 20%, the tester sounds "toot", and forbids to store the measurement value.

### 3. Read the storage data

The keys  $\text{Ⓢ} + \text{MEM}$  are pressed at the same time for longer than 1s to enter the mode of reading the storage data, the displayer displays the symbols "MR" and "HOLD", and simultaneously displays the storage numbers and data. If needing to view the records, press the key  $\blacktriangle A$  or the key  $\blacktriangledown \Omega$  to page up or down.

Press the key  $\text{Ⓢ}$  to exit the storage data record mode, and return to the normal measurement mode.

## VII. Other Functions

### 1 . Open/conceal the voice prompt

Press the keys  $\text{Ⓢ} + \Omega$  to conceal the buzzer symbol  $\bullet \text{•})$ ) and the functions of the buzzer key and the alarm buzzer, and press the keys  $\text{Ⓢ} + \Omega$  to restore the buzzer.

### 2 . Open/conceal the automatic shutdown function

After pressing the keys  $\text{Ⓢ} + \text{HOLD}$ , the displayer displays the symbol "P", the automatic shutdown function is started, if no any operation is executed, the tester will be automatically shutdown, if the keys  $\text{Ⓢ} + \text{HOLD}$  are pressed again, the symbol "P" disappears, and the automatic shutdown function is concealed.

### 3 . Battery under-voltage

If the battery capacity is lower than 20%, the displayer displays symbol  $\text{□} \text{•}$  , and the storage function cannot be realized. When the battery capacity is lower than 15%, the tester will sound prompt tone toot, and the tester will be automatically shut down after sending 10 prompt tones.

### 4 . Symbol NOISE

It means that the interface current is large when the grounding resistance is tested, the tester will display the symbol "NOISE", at this moment, the measured resistance value is not accurate

### 5 . Symbol $\text{□} \text{•} \text{C}$

It means that the jaw is not completely closed, and the measurement



cannot be continued.

#### 6 . Symbol WAIT

When the tester begins to self- calibrate, this symbol is displayed, and calibration and counting from CAL 9、 CAL 8 and so on to CAL0 will be executed

#### 7 . Symbol OL

When the measured resistance exceeds 1200Ω and the measured current exceeds 40A, this symbol is displayed.

### Performance Indexes

	Shift	Accuracy	Resolution
Resistance Measurement	0.01Ω ~ 0.999Ω	$\pm(1.5\%+0.01\Omega)$	0.001Ω
	1Ω ~ 9.99Ω	$\pm(1.5\%+0.1\Omega)$	0.01Ω
	10Ω ~ 99.9Ω	$\pm(2.0\%+0.3\Omega)$	0.1Ω
	100Ω ~ 199.9Ω	$\pm(3.0\%+1\Omega)$	1Ω
	200Ω ~ 400Ω	$\pm(6.0\%+5\Omega)$	5Ω
	400Ω ~ 500Ω	$\pm(10\%+10\Omega)$	10Ω
	500Ω ~ 1200Ω	about 20%	20Ω
Current Measurement	100mA	$\pm(2.5\%+1mA)$	0.1mA
	300mA	$\pm(2.5\%+2mA)$	0.3mA
	1A	$\pm(2.5\%+0.003A)$	0.001A
	3A	$\pm(2.5\%+0.01A)$	0.003A
	10A	$\pm(2.5\%+0.03A)$	0.01A
	20A	$\pm(2.5\%+0.05A)$	0.03A
	30A	$\pm(2.5\%+0.5A)$	0.03A
	40A	$\pm(10\%+0.5A)$	0.03A

<b>Test conditions:</b> Temperature	23°C±3°C
Humidity	50%RH±10%
Power supply of battery	>7V
External magnetic field	<40A/m, external electricfield<1V/m
Current test frequency	45Hz ~ 65Hz

## Technical Specification

Test voltage: 3700V

Electric clearance: 6.5mm (meet IEC1010 double insulation )

CAT II 600V)


Electric shock resistance: EC1010-1

Overload limit: normal current 40A RMS

Mean consumption: 50mA

Range: automatic

Display type: 4 digits, 9999 counting, liquid crystal display

Power shortage: display symbol 

Power supply: 9V 6F22

Single measurement time: 1s

Working temperature: -10°C to 50°C (14°F to 122°F)

Storage temperature: -20°C to 60°C (-4°F to 140°F)

Diameter of jaw:  $\phi$ 32mm or 45mm×32mm


Outline size: 54mm×104mm×276mm

Total weight: about 1050g (include battery)

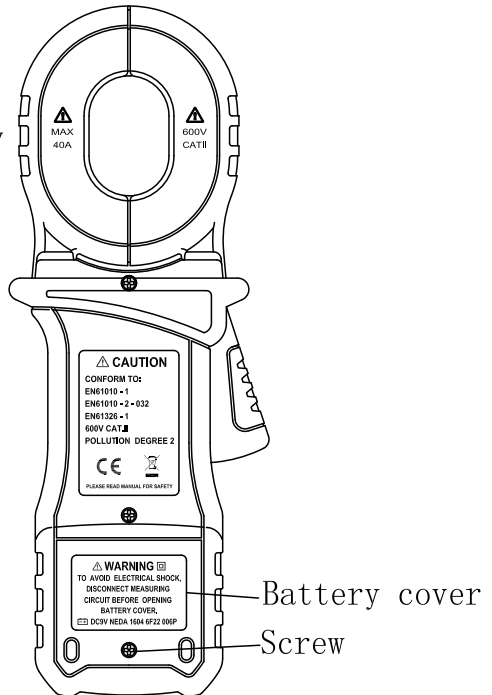
## Accessories

Resistance detector ring (1Ω)	One
Resistance detector ring (5Ω)	One
Resistance detector ring (10Ω)	One
9V battery	One
Operating manual	One
Meter box	One

## Battery Replacement

When the displayer displays symbol , it means power shortage, and new battery shall be installed.

- 1 . Shutdown
- 2 . Loosen the bolts of the battery cover
- 3 . Remove the battery cover
- 4 . Remove the old battery
- 5 . Install the new battery
- 6 . Install the battery cover
- 7 . Fasten the bolts



## Measuring Principle

The pincerlike grounding resistance tester can be used for measuring the grounding resistance of any system with circuits, for example, the grounding resistance of the power transmission lines and the grounding resistance of the communication lines; it also can be used for measuring the grounding resistance of the power equipment and the lightning protection facilities. When the grounding circuit has current interference, the accuracy of the resistance measurement will be influenced, at this moment, the tester can be used for measuring the interference current.

Measuring principle:

$R_x$  : grounding resistance to be tested

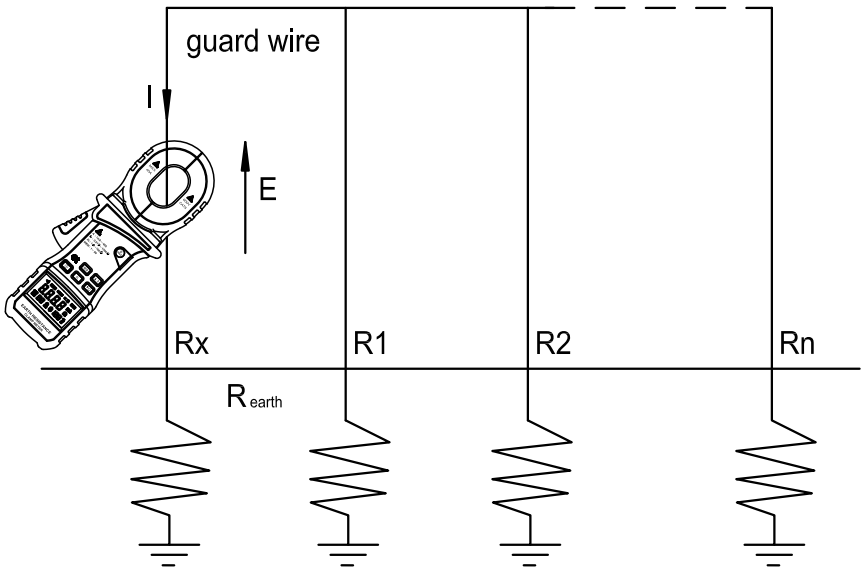
$R_1 R_2 \dots R_n$ : parallel connected grounding resistance

$R_{\text{earth}}$ : often regarded as  $0\Omega$

$R_{\text{guard wire}}$  : often regarded as  $0\Omega$

$R_{\text{Loop}} = R_x + R_{\text{earth}} + (R_1 // R_2 // \dots R_n) + R_{\text{guard wire}}$

When  $R_1 // R_2 // \dots R_n \ll R_x$ ,  $R_{\text{Loop}} = R_x$



## Field Application

### 1. Grounding resistance test of power system

(1) . Grounding resistance test of distribution line A lot of grounding electrodes on the neutral lines of the normal three-phase four-wire distribution system are connected in parallel, so its resistance is very low. The distribution lines can be tested by clamping the grounding wires to be tested via the pincerlike grounding resistance tester. The grounding electrodes of other telegraph poles are adopted as the auxiliary electrode. The test schematic diagram is shown in the figure above.

(2). Measurement of grounding resistance of neutral points of transformer

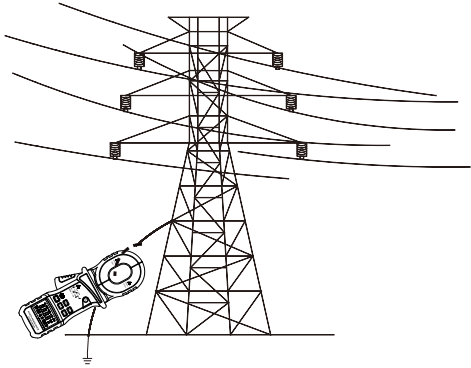
There are two grounding modes of the neutral points of the transformer: repeatedly grounding forms a multi-point grounding system; if there is no repeatedly grounding, single-point grounding measurement forms; if a same rod tower or the transformer has two or more grounding down-lead wires, connection is executed underground, at this moment, other grounding down-lead wires shall be unfastened, and one grounding down-lead wire is left.

(3) . Application of substations of power stations

The tester can test the contact and connection situations of the circuits. The connection situations of the devices in the stations and the grounding grid can be tested. The grounding resistance can be tested according to the single-point grounding.

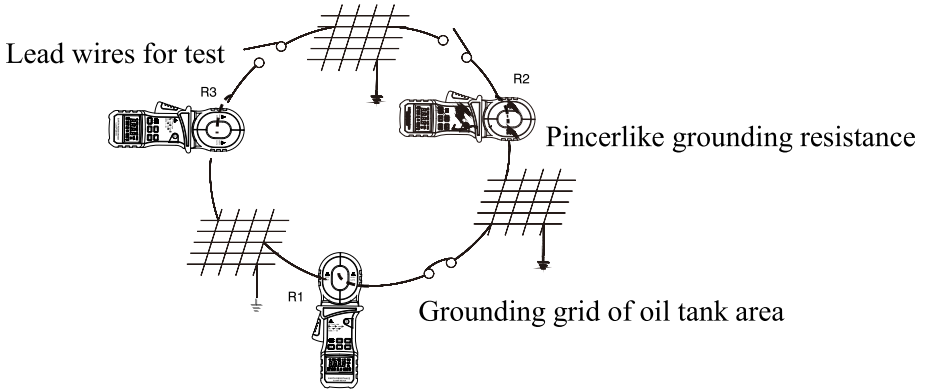
(4) . Test of power transmission line (iron tower)

The normal power transmission lines are finished through the iron towers. The grounding systems of the iron towers are connected through the conductors of the lightning rods on the iron towers, so that the iron towers are auxiliary electrodes which can be perfectly grounded. The test schematic diagram is shown in the figure below:



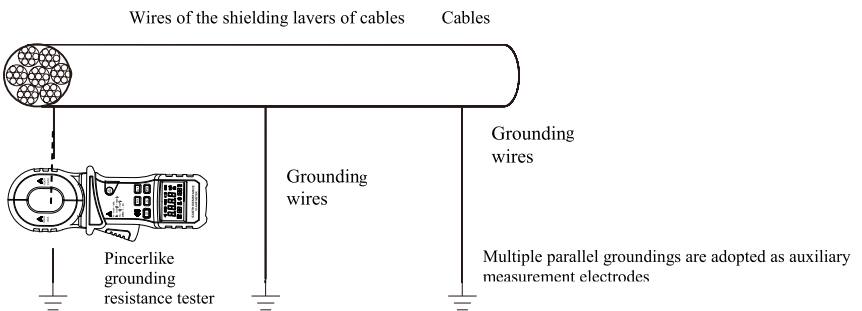
## 2. Power protection of factories

Normal factories divide different grounding grid areas, so that their grounding resistance tests can be followed the method shown in the figure below:



## 3. Application of telecommunication system

(1) . Test of grounding resistance of shielding layers of telecommunication cables. When the grounding shielding layers which are used for preventing the external interference are tested, the pincerlike grounding resistance tester can be directly used for testing the grounding resistance of each grounding point, and the test schematic diagram is shown below:



(2) . Measurement of grounding resistance of machine rooms on floors

The machine room of the telecommunication system is arranged on the upper layer of the building, so it is difficult to measure through megger. The tester is convenient to use, which connects the fire hydrant and the tested grounding electrode through a test wire (the fire hydrants are arranged inside the machine rooms), and then measure the test wires through a clamp meter.

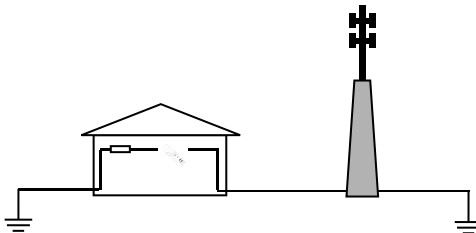
Resistance value of the clamp meter = grounding resistance of the machine room + resistance value of the test wire + grounding resistance of the fire hydrants

If the grounding resistance of the fire hydrant is small:

Grounding resistance of the machine room  $\approx$  resistance value of the clamp meter – resistance value of the test wire

(3) . Measurement of grounding resistance of machine room and transmission towers

The groundings of the machine room and the transmission tower form a two-point grounding system shown in the figure below.

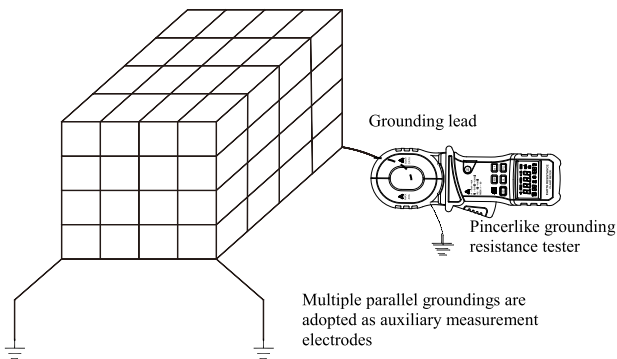




If the measurement value of the tester is smaller than the allowable value of the grounding resistance, the grounding resistance of the machine room and the transmission tower are qualified. If the measurement value of the tester is larger than the allowable value, please measure according to the single-point grounding.

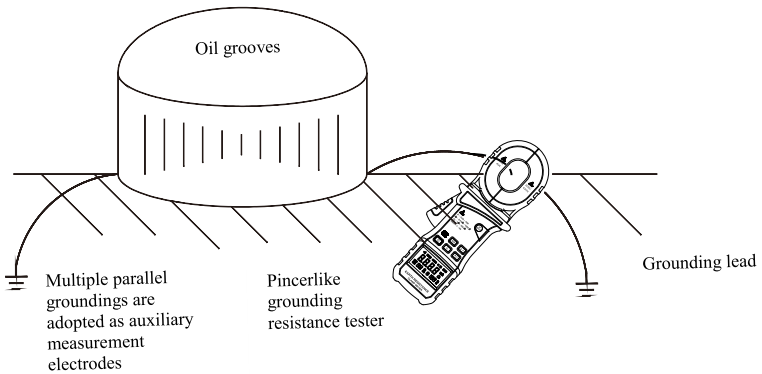
#### 4. Application of Faraday cage protection system

The Faraday cage is adopted to realize the electrostatic shielding so as to prevent the instrument and equipment from disturbing by static electricity, so it is very important to control the grounding resistance. If users only need to test the single grounding resistance of each electrode, the auxiliary electrodes are not needed to set, and the test can be carried out according to the figure below.



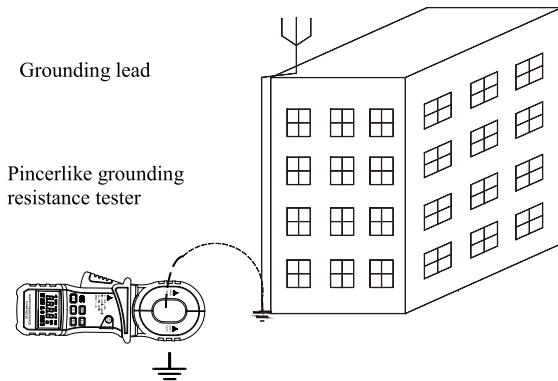
## 5. Test of grounding resistance of oil grooves

The oil grooves have more than two grounding electrodes. When the oil groove has grounding, short circuit is easy to form, and the other oil groove can be adopted as the auxiliary electrode to test. The schematic diagram is shown below:

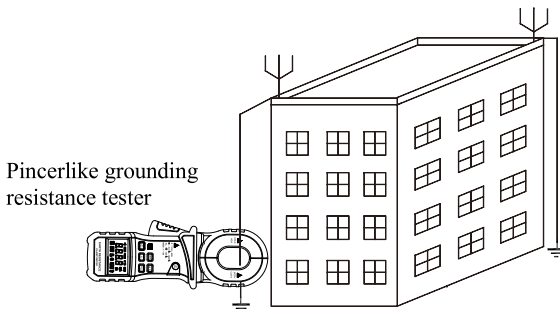


## 6. Test of grounding resistance of lightning rods

When the lightning rod has one grounding lead and one grounding electrode and there is only single electrode to be tested, other grounding objects can be adopted as the auxiliary electrodes to form a circuit, and measurement can be carried out according to the figure below.



When the lightning rod has two or more grounding leads, measurement is carried out according to the method in the figure below. At this moment, the resistance value tested by the pincerlike grounding resistance tester is the partial grounding resistance and the serial resistance values of the grounding leads. (when the resistance of the grounding lead is small, it can be ignored)



## 7. Application of gas stations

For the gas stations, the grounding resistance shall be frequently tested to achieve the purpose of preventing the static electricity. When the pincerlike grounding resistance tester is used, the grounding electrodes of the oil grooves shall be adopted as the auxiliary electrodes to test the grounding resistance of the gas stations. It is noteworthy that the test result maybe the serial value of the grounding resistance value of the refueling stand and the grounding resistance of the oil grooves.

