

MULTI

Clamp Earth Tester

MET-1

Instruction Manual

Thank you very much for selecting our clamp earth tester. This model is complex instrument and employs a very reliable mechanical/electronic design. Before you use your new instrument, read this instruction manual completely and familiarize yourself thoroughly with all functions. With proper use and care, your tester will give you years of satisfactory service.

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1. General

The periodic measurement of earth electrode resistance is indispensable to ensure the safety for electrical installation.

The ordinary earth electrode test method requires the use of auxiliary test spikes or rods for the measurements.

New clamp earth tester provides simple and quick measurements for earth electrode resistance without lazy spiking work. The new spike-less method is the loop measurements by the operation of two clamps (CTs).

One CT injects a superimposing voltage into the circuit and the other CT measures the injected current of the loop circuit. In our clamp earth tester, the auto sweep signal (4kHz to 400kHz, 160mV p-p) is used and injected into the loop circuit. When the resonance phenomenon is caused at the certain frequency by the inductance and capacitance in the circuit, the current flow becomes maximum. The injected current into the circuit is proportional to the loop resistance. And this current is measured by CT and converted to the earth resistance value.

Please refer to “chapter 3. Measuring principle of clamp earth tester” about details.

Before you use MET-2, read this instruction manual completely and understand yourself thoroughly with all functions.

2. Safety summary

This instrument has been manufactured and tested in accordance with safety regulations IEC 61010-1/EN 61010-1 and IEC 61010-2-032/EN 61010-2-032. If used for its intended purpose, safety of the user and of the instrument is assured. The device may only be operated by properly trained personnel who are capable of recognizing the dangers associated with the measurement of electrical current and voltage.

Read the operating instructions completely and carefully before using the instrument, and follow all instructions included therein.

Meaning of symbols on the instrument:



Warning concerning a source of danger
(Refer to the manual before use.)



The instrument is protected by double or reinforced insulation



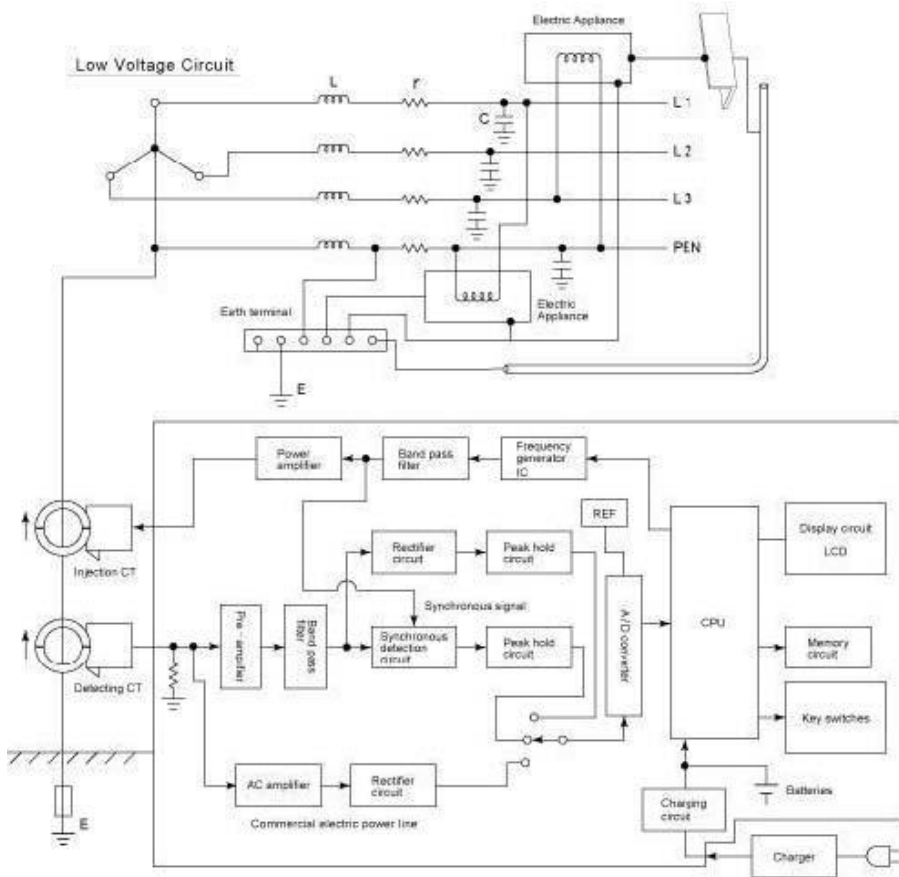
WARNING

- The instrument is designed to measure for the low voltage circuit. Do not make measurements of power lines carrying more than AC 500V.
- POSSIBLE ELECTRICAL SHOCK. Do not make measurements if the case or CT is damaged.
- POSSIBLE ELECTRICAL SHOCK or FIRE HAZARD. Do not expose this instrument to rain or moisture. Do not operate the tester in the presence of flammable gasses or fumes.
- Never fail to keep the maximum tolerable input. Make measurements within the rated current.
- Never make measurements with the case opened.
- Never operate this instrument if it becomes wet, damp or has any liquid condensation build-up on any part of the instrument.
- Never make measurements for un-insulated conductors or bus bars.

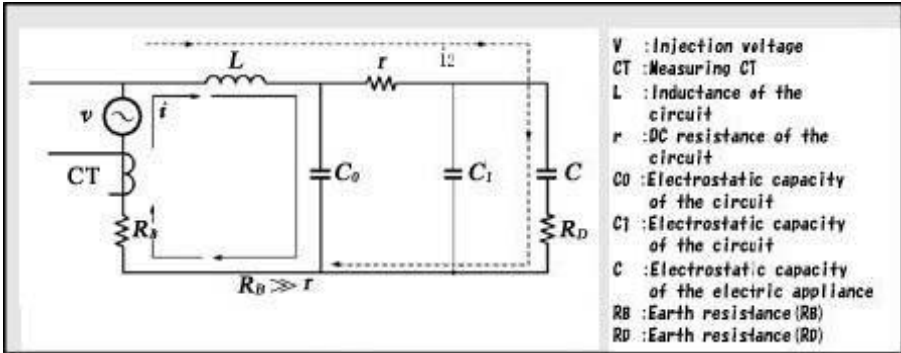
 **CAUTION**

- Do not use or storage the instrument under the direct sunshine, high humidity and temperature, as it may cause the insulation defect of the instrument.
- Do not use the instrument nearby the appliance or machine which generate the strong magnetic field, as it may cause the measuring error of instrument.
- Do not apply the mechanical vibration or shock to the instrument.
- Before operating this instrument, familiarize yourself with all instructions outlined in this manual.
- Always check to make sure that the function switch is set to the proper position.
- When making measurements, use CAUTION as dangerous voltages may be present in normally safe areas.
- To avoid electrical shock, use CAUTION when working above 60V DC or 25V AC rms. Such voltages pose a shock hazard.
- Do not apply the voltage more than AC 10V to the input and output terminals.
- Do not pull the CT cable, as it may cause damages.
- Do not disassemble the instrument.
- If excessive current is applied to the CT, the instrument will be heated and damaged. Use the CT within the rated current.
- The rechargeable batteries are used in the instrument. Do not mix with normal batteries, as it is very dangerous.
- The power supply voltage of battery charger is AC 200~240V. Do not apply higher voltage to the charger, as it may cause the damage to the instrument and or the electrical accident.
- The charging batteries lose some of their capacity when repeatedly charged/discharged. The actual decrease of capacity versus number of charging cycles depend on battery type.

3. Measuring principle of clamp earth tester



Block diagram



Equivalent circuit

The block diagram and equivalent circuit show the measuring principle of CLAMP EARTH TESTER.

When the auto sweep signal (4kHz to 200kHz, 160mV p-p) is injected into the circuit, the resonance phenomenon is caused at the certain frequency by inductance (L) and electrostatic capacity (C_0) or DC resistance (r) and electrostatic capacity (C_1) in the circuit, and the current flow (i) is caused. When the resonance phenomenon is caused, the current flow (i) become maximum. The injected current (i) into the circuit is proportional to the earth resistance (R_B) and this current (i) is measured by the measuring CT and used for the computation of the earth resistance value (R_B) with other calculation factors. The resonance phenomenon is caused almost at 4kHz to 200kHz frequency in our field test.

Note: If the resonance phenomenon is not caused in the circuit, the current flow (i_2) is caused and the measured resistance value become $R_B + R_D + Z_c$. This resistance value will be higher than the actual value abnormally, or over range indication "OVER" will be displayed.

AC current

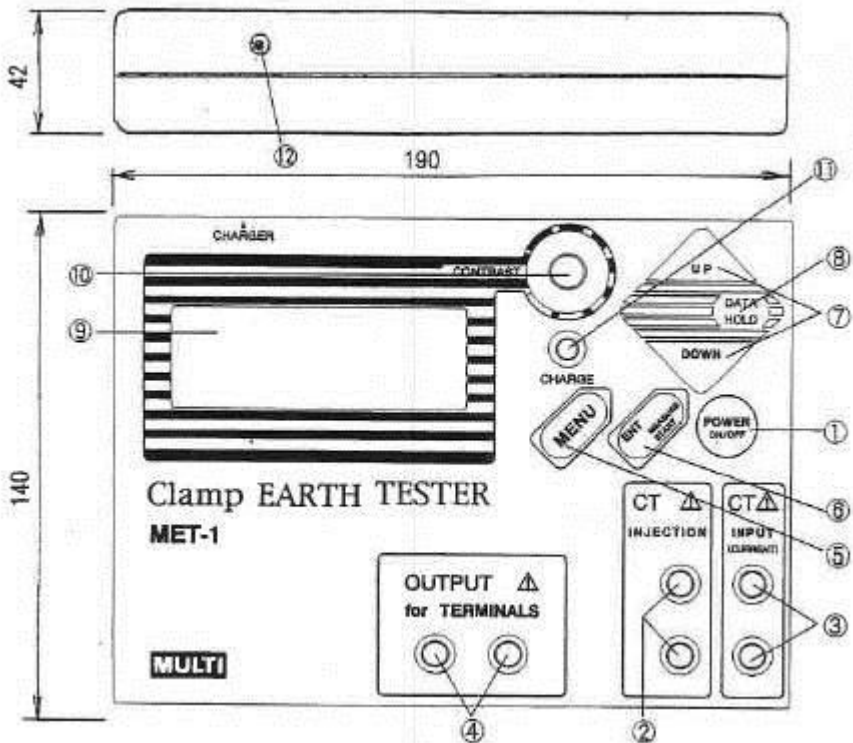
Range	Resolution	Accuracy	Maximum input
200mA	0.1mA	2% rdg ± 8dgt	20A rms
2000mA	1mA	2% rdg ± 8dgt	
20A	0.01A	2% rdg ± 8dgt	

- Measuring CT : φ34mm with 2.5m lead
- Injection CT : φ34mm with 2.5m lead,
- Auto sweep signal : 4kHz~400kHz
- Signal injection level : Approx. 160mV p-p
- Operating temperature : 0°C~40°C, <85%RH without condensation
- Storage temperature : -10°C~60°C, <80%RH without condensation
- Limitation of circuit voltage : Less than AC 500V rms
- Withstanding voltage : AC 3700V 1 minute (between CT core and CT handle)
- Insulation resistance : More than 100MΩ (between CT core and CT handle)
- Power supply : NiMH battery pack (1.2V x 5),
- Battery charger : AC200V-240V(50/60Hz)
- Auto power off function : Approx. 5 minutes later after power on
- Power consumption : Approx. 350mA(Earth resistance measurement)
- Battery life : Approx.450 times measurements under full charged condition
(Subject to the times of charging & discharging)

(Size & weight)

- Measuring CT : 90.5(W) x 165(H) x 38(D)mm, approx.460g
- Injection CT : 90.5(W) x 165(H) x 38(D)mm, approx.440g
- Main unit : 190 (W) x 140(H) x 42(D)mm, approx.800g
- Accessories : Measuring CT.....1
Injection CT.....1
Battery charger.....1
Carrying case.....1
Subsidiary lead wire.....1
Instruction manual.....1
- Option : Lead wires for output terminal injection (MET-LE).....1
Outlet checker.....1

5. Panel description



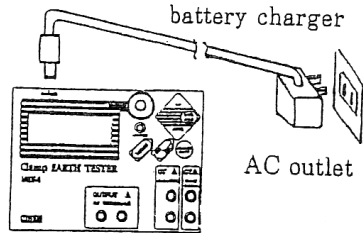
- ① Power switch (POWER) : Power ON/OFF switch. After the final key operation, the power will be turned off automatically 5 minutes later.
- ② Terminal for Injection CT (INJECTION) : The insertion terminal for the injection CT. Connect red plug to the red terminal and black plug to the black terminal.
- ③ Terminal for measuring CT (INPUT) : The insertion terminal for the measuring CT. Connect red plug to the red terminal and black plug to the black terminal.

- ④ Injection Terminal (OUT PUT) : for the signal injection not from the CT but from the instrument body to disconnected terminals of grounding line.
- ⑤ Menu switch (MENU) : Press this switch to return to the default display.
- ⑥ Enter switch (ENT) : Enter switch for the measuring function (earth resistance or current) selected by “UP” and “DOWN” key. Also, used to start the earth resistance measurement.
- ⑦ Up, down key switch (UP, DOWN) : Up and down key switch for the cursor of the display.
- ⑧ Data hold switch (DATA HOLD) : In AC current measurement, press this switch, “DH” mark is displayed and the displayed value is held in the display. To release, press this switch again.
- ⑨ Display : LCD, 16 letters × 2 lines
- ⑩ Knob for display contrast (CONTRAST) : Contrast adjustment of the display.
- ⑪ Charger lamp : During battery charging, this lamp is always lighted.
- ⑫ Jack for charger (CHARGER) : Input jack for charger plug.

6. Preparation before use

6-1. Battery charging

- ① Connect the charger plug to the jack (CHARGER) of the instrument.
- ② Connect the charger to AC outlet making sure that main voltage is compatible (AC 200V~240V).
The charger lamp is turned ON and the battery charging will start immediately.



- ③ Charging of the battery takes 8 hours. Take care for over charging as the charger lamp is not turned off even after full charging.

CAUTION

- Use only charger delivered from manufacture or distributor of the test instrument to avoid possible fire or electric shock.
- Do not charge alkaline battery.

6-2. Rechargeable battery

NiMH battery is affected by various condition, and instrument operation time may be affected by the charging/ discharging cycles and condition.

Precaution on charging of battery unused for a long period of time:

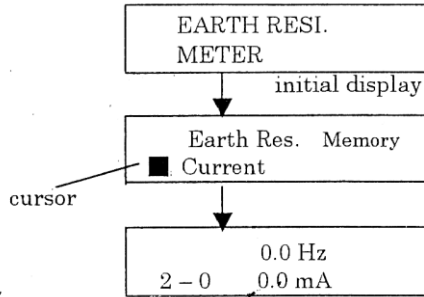
- Charge the battery at least once per 6 months, otherwise the battery power will be exhausted.
- When the battery unused for a long period of time, the battery may not be charged sufficiently.
- Keep the instrument at dry place.

- When the instrument is unused for a long period of time, the battery power will be consumed by the self discharging.
- Avoid over charging, it may damage the battery life.
- Before using the instrument, charge the battery sufficiently.
- When instrument operation time is significantly reduced even after full charging, replace the battery to new one, as the battery power is exhausted.

7. Operation

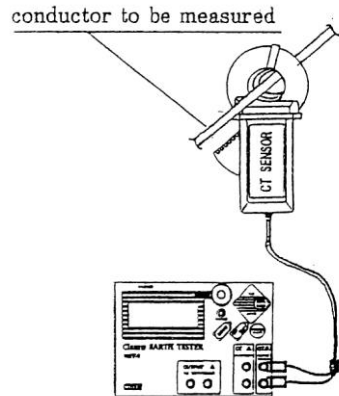
7-1. AC current measurements

- ① Press "POWER" switch, the power is turned ON.
- ② Press "DOWN" key switch and move the cursor to "Current" position and press "ENT" key. The tester is set to AC current measurement mode as the drawing.



- ③ Connect the plug of measuring CT to the "INPUT" terminal.
- ④ **Measurement of load current** (Max. AC 20A rms)

Clamp the conductor of the circuit under test. Read the displayed value. If the measured current is over range, "OVER" is displayed. If you made measurements in a dark place or in a place where it is difficult to see the readings, use "DATA HOLD" switch.



Note: Clamp only one conductor of the circuit to be measured.

- ⑤ **Measurement of leakage current**

a. Measurement of grounding line

Clamp the grounding line and read the displayed value.

b. Measurement of single-phase or three phase electric circuit

To measure a leakage current in a single-phase or three phase circuit, clamp the all active conductors (e.g. L1, N or L1, L2, L3, N). Read the displayed value.

If you make measurements in a dark place or in a place where it is difficult to see the readings, use "DATA HOLD" switch.

Note: Press “MENU” switch to the return to the initial display.

⚠ CAUTION

- The input frequency is limited to 100Hz for AC current measurements.
- The frequency value is not displayed for less than 3mA input.

⚠ WARNING

POSSIBLE ELECTRICAL SHOCK OR FIRE HAZARD:

- The applicable circuit voltage is limited to AC 500V rms. Before measurements, check the circuit voltage to be measured.
- Never make measurements for uninsulated conductors.
- Never fail to keep the maximum tolerable input. Do not apply more than AC 20A rms to the CT.

7-2. Earth resistance measurements

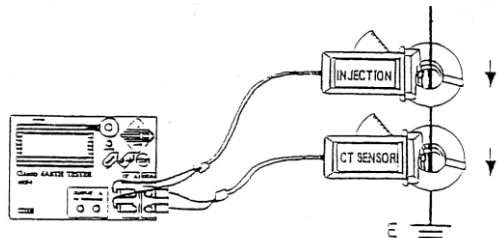
- ① Press “POWER” switch, the power is turned ON.
- ② Connect the plug of injection CT to the “INJECTION” terminal.
Connect the plug of measuring CT to the “INPUT” terminal.
- ③ Clamp the grounding circuit under test by two CTs making sure that the arrow marks of the CTs are same direction.

EARTH RESI.
METER VER 1.03

↓ (initial display)

■ Earth Res. Memory
| Current

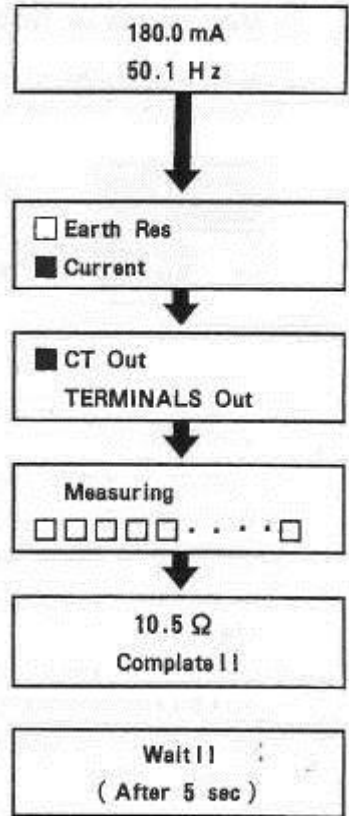
cursor



- ④ Set the cursor to “Current” position and press “ENT” switch. The tester is set to AC current measurement mode.
Check the current value of grounding circuit. If the measured current value is more than 2A, the earth resistance is not measurable.
- ⑤ Press “MENU” switch to return to initial display.
- ⑥ Set the cursor to “Earth Res.” Position and press “ENT” switch .
- ⑦ Set the cursor to “CT Out” position and press “ENT” switch.
- ⑧ “Measuring” indication begins to blink and the measurement will start.
- ⑨ After approx. 30 seconds, the measured value will be displayed.

Note:

- Press “MENU” switch to return to the initial display.
- When making the successive measurement, the waiting time is provided for the stabilization of the circuit, but this is not abnormal.

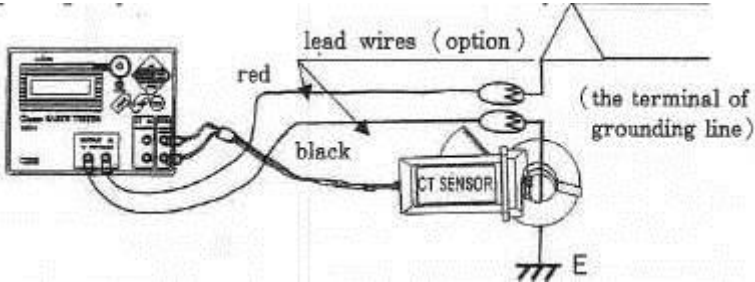


⚠ CAUTION for earth resistance measurement

- Be sure to clamp the grounding line by both Injection CT and Measuring CT with the same direction of the arrow mark. If incorrect direction is used, the measuring error will be caused or abnormal value will be displayed.
- The grounding circuit with more than 1A current flow is not measurable.
- This instrument measures the earth resistance using the resonance phenomenon caused by L (Inductance) and C (Capacitance) in the circuit. When the measured resistance value is abnormal higher than the estimated value, there is a possibility that the resonance phenomenon is not caused. In such case, use a subsidiary jumper wire to create a good loop circuit.

7-3. Measurement by TERMINALS Out mode

This TERMINAL Out mode means the measurement for earth resistance by using output from the terminal of instrument body.



- ① Make power off of the circuit and disconnect the terminal of grounding line.
- ② Connect the lead wires as above drawing.
- ③ Press “POWER” switch once.
- ④ Set cursor at “Earth Res.” on the display.
- ⑤ Press “ENT” switch and set the cursor at “TERMINALS Out” on the display.
- ⑥ Press “ENT” switch once. “Measuring” sign appears on the display and measurement starts.
- ⑦ After approx. 30 seconds, the measurement value is shown on the display.

* To get back the initial display from the measuring condition, press “MENU” switch once.

CAUTION

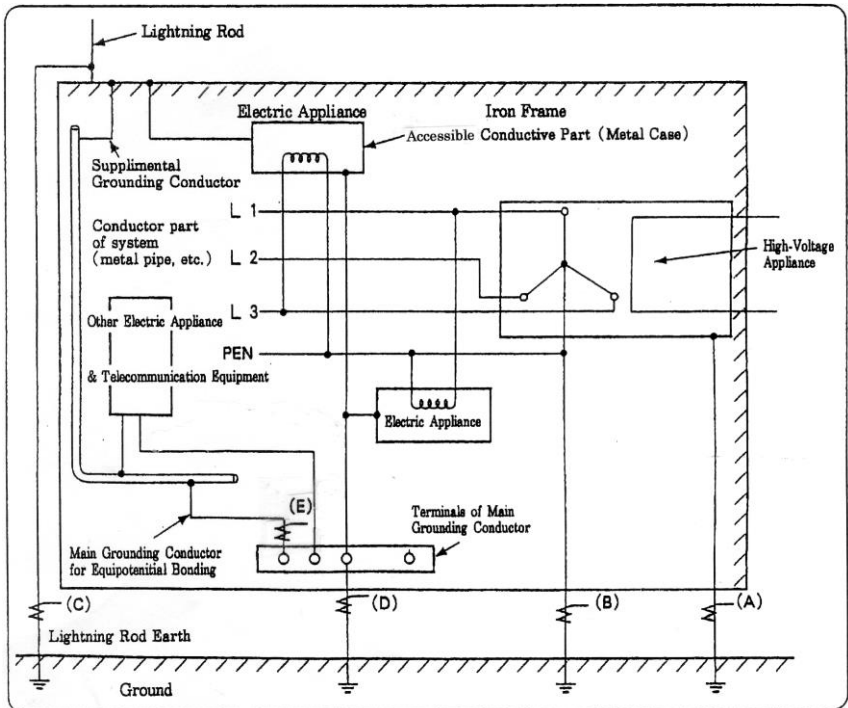
- Locate the direction of red & black lead wires from the output terminals and the Detection CT (CT SENSOR) as above drawing. In case of different direction between lead wires and CT, the display will show “OVER” or wrong value.
- At the time of disconnecting the terminals of grounding line, make power off the circuit.
- Lead wires are optional accessories. If you make them yourself, use wires with ϕ 2mm and make the length less than 1m.

8. Measuring example

The various measuring examples are showed in this chapter, however, these are potential sources of error or incorrect test results due to the difference of the earthing system and configuration in the field. It is important to remember the key rules for the correct measurements.

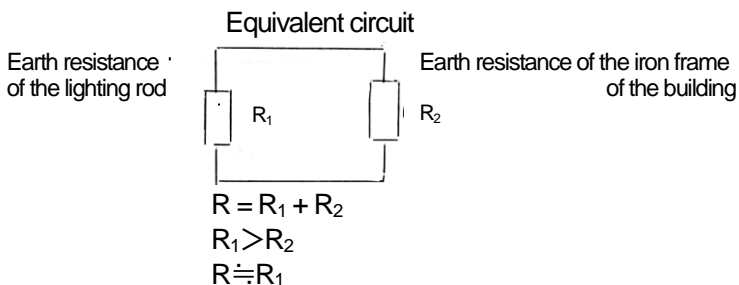
- There must be a loop resistance to measure.
- The earth path must be in loop circuit.
- There must be L (inductance) and C (capacitance) in a loop circuit.

8-1. Electric installation



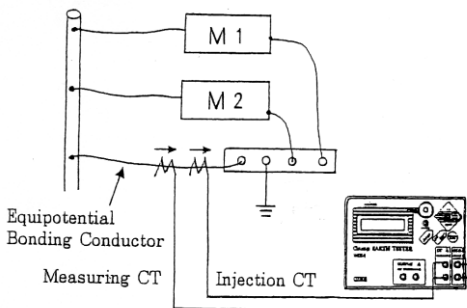
“(E)” is shows the clamping point of the injection CT and the measuring CT.

- The clamping point (A) is used for the earth resistance measurement of the metal case of high voltage appliance.
Connect the earth (A) to the known good earth by the subsidiary lead wire to create the loop circuit.
- The clamping point (B) is used for the PEN earth resistance measurement.
In this case, simply clamp the measuring point by the injection CT and the measuring CT.
- The clamping point (C) is used for the earth resistance measurement of the lighting rod.
Connect a temporary link to the iron/steel frame of the building by the subsidiary lead wire to create a loop circuit as the drawing.



The instrument measures the whole loop resistance. If the earth resistance (R_2) is much lower than (R_1), then the correct measurement is enabled.

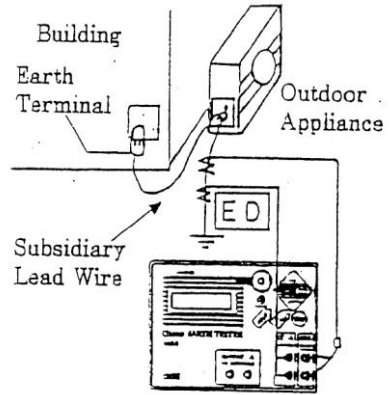
- The clamping point (D) is used for the earth resistance measurement of the accessible parts of low voltage appliance. In this case, simply clamp the measuring point by the injection CT and the measuring CT.
- The clamping point (E) is used to check the poor connection of bonding conductor for the equipotential bonding system. For poor connection, the higher resistance value will be displayed.



8-2. Earth resistance measurements for the outdoor appliance

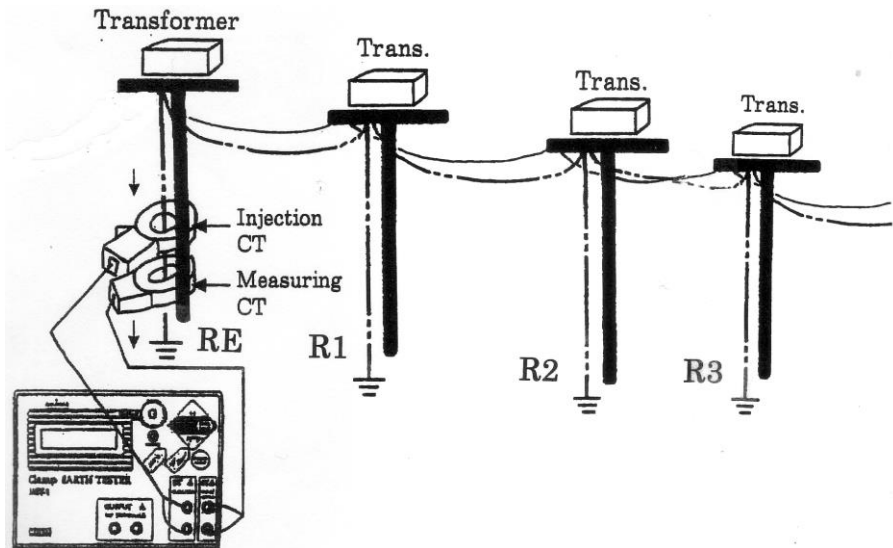
(Air conditioner, etc.)

Measure the earth resistance at the measuring point (ED) without the connection of the subsidiary lead wire at first. If the measured value is extremely high or "OVER" is displayed, use the subsidiary lead wire to create the loop circuit. Connect the earth conductor to the earth terminal of the building by the subsidiary lead wire, then measure again.

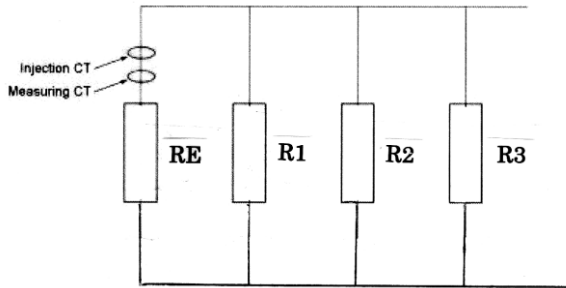


Note: If needed, turn on the power of appliance. The electrostatic capacity of the appliance will be increased.

8-3. Earth resistance measurements for multiple earth system



Equivalent circuit



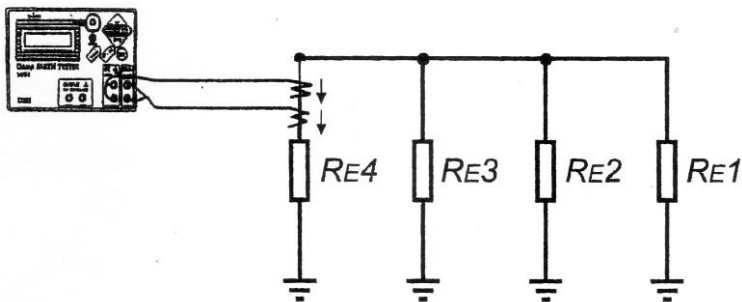
$$\text{Test result} = RE + (R_1 // R_2 // R_3 // \dots)$$

$$\text{Resistance of parallel connection } (R_1 // R_2 // R_3 // \dots) < RE$$

$$\text{Test result} \doteq RE$$

The greater the number of parallel paths, the closer the measured value will be to the actual earth resistance.

8-4. Earth resistance measurements for the earthing electrode



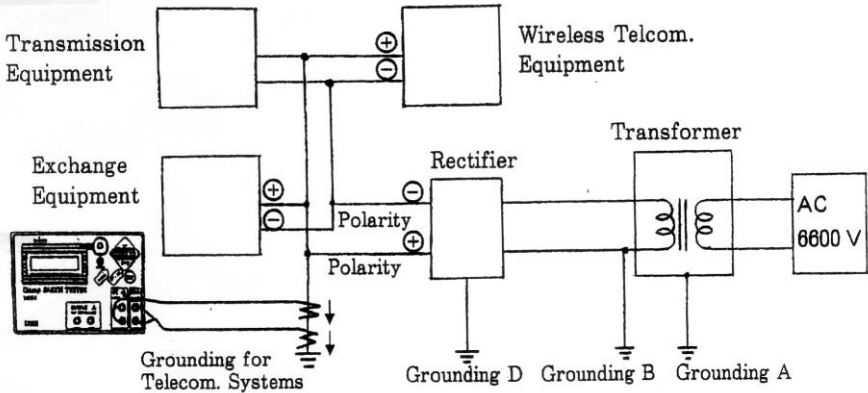
RE1 to RE4.....Individual earth resistances of tested earthing system

$$\text{Test result} = RE4 + (RE3 // RE2 // RE1)$$

$$\text{Resistance of parallel connection } (RE3 // RE2 // RE1) < RE4$$

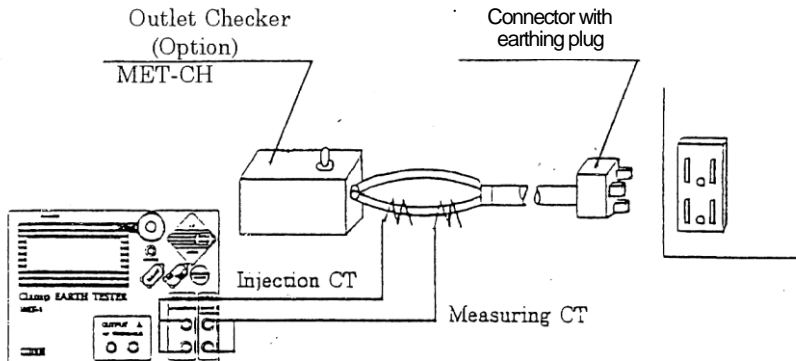
$$\text{Test result} \doteq RE4$$

8-5. Earth resistance measurements for telecommunication system



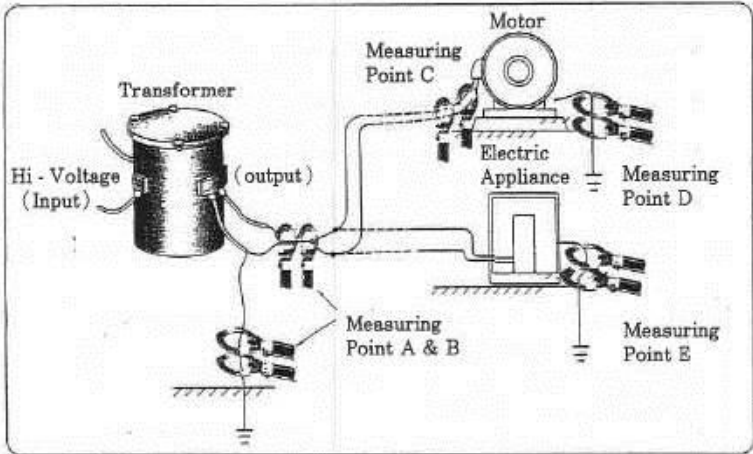
8-6. Measurements for the earthing connection of the outlet

MET-CH outlet checker (optional accessory) is used to check for mis-wiring of the earthing connection of the outlet.



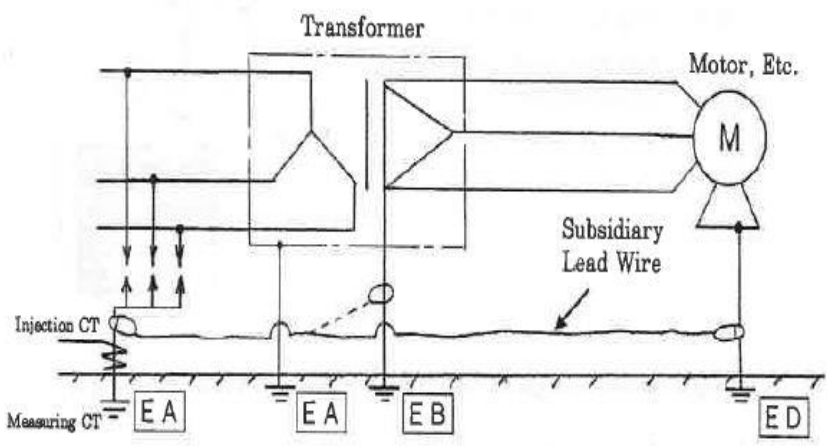
8-7. Measurements for the active line

The earth resistance can be measured by clamping 2 CTs near at transformer (point A or B) and near at the electrical loading part (motor, electric appliance, etc. (point C. D. or E.).



8-8. Measurements where L (inductance) & C (capacitance) are low

Where L & C resonance has not been gotten, this instrument may show "OVER" at the display. In this case, connect the objective grounding line (EA) to other grounding lines (EB or ED) by the subsidiary lead wire and clamp 2 CTs at the measuring point (EA). Even in the case of no resonance between L & C, the multiple earth resistance can be measured.



9. Maintenance

When making requests for repair service, please bring the instrument directly to the dealer. If this is impossible, however, send the instrument directly to our sales office.

When mailing this instrument, always pack it in its original or equivalent packing material and pack together with name, address, telephone number and the warranty documentation.

- To ensure speedy and reliable repair, always include information of the type of failure and cause.
- If required, always return accessories with the instrument.
- When contacting us, provide the model number and serial number of your instrument.

10. Warranty

The instruments are subject to strict quality control. However, should the instrument function improperly during daily use, you are protected by our 12 months warranty (valid only with invoice). We will repair free of charge any defects in workmanship for our original defect. Any damage due to dropping, incorrect operations and use, or repair/modification made by unauthorized person are not covered by the warranty.