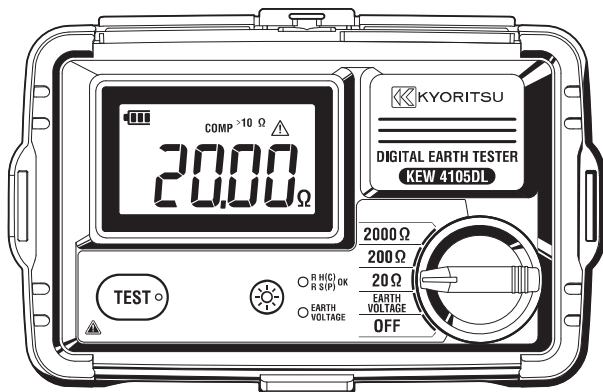


Instruction Manual



Digital Earth Resistance Tester

KEW4105DL



**KYORITSU ELECTRICAL
INSTRUMENTS WORKS, LTD.**

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1. Safety warnings




This instrument has been designed, manufactured and tested according to IEC 61010: Safety requirements for Electronic measuring apparatus, and delivered in the best condition after passing quality control tests. This instruction manual contains warnings and safety rules which have to be observed by the user to ensure safe operation of the instrument and to maintain it in safe condition. Therefore, read through these operating instructions before starting to use the instrument.

DANGER

- Read through and understand the instructions contained in this manual before starting to use the instrument.
- Keep the manual at hand to enable quick reference whenever necessary.
- The instrument is to be used only in its intended applications.
- Understand and follow all the safety instructions contained in the manual.

It is essential that the above instructions are adhered to. Failure to follow the above instructions may cause injury, instrument damage and/or damage to equipment under test. Kyoritsu is by no means liable for any damage resulting from the instrument in contradiction to these cautionary notes.

The symbol  indicated on the instrument, means that the user must refer to the related parts in the manual for safe operation of the instrument. It is essential to read the instructions wherever the symbol appears in the manual.

-  **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 injury or instrument damage.

⚠ DANGER

- Never make measurements on circuits in which earth potentials higher than the following values exist.
* 300 V or higher in CAT II, 150 V or higher in CAT III and 100 V or higher in CAT IV environment.
- Keep your hand and fingers behind the protective finger guard during a measurement.
- Do not attempt to make measurements in the presence of flammable gasses. Otherwise the use of the instrument may cause sparking, which can lead to an explosion.
- Never attempt to use the instrument if its surface or your hand is wet.
- Be careful not to short-circuit the power line with the metal part of the test lead during a measurement. It may cause personal injury.
- Do not exceed the maximum allowable input of any measuring range.
- Ensure that the test leads are firmly connected to the instrument, and then press the TEST button.
- Never open the battery compartment cover during a measurement.
- The instrument should be used only in its intended applications or conditions. Otherwise, safety functions equipped with the instrument do not work, and instrument damage or serious personal injury may be caused.
- Keep your fingers and hands behind the protective fingerguard during measurement.





⚠ WARNING

- Never attempt to make any measurements if any abnormal conditions, such as a broken cover or exposed metal parts are present on the instrument and clamp sensor.
- Do not install substitute parts or make any modifications to the instrument. Return the instrument to your local KYORITSU distributor for repair or re-calibration in case of suspected faulty operation.
- Do not try to replace batteries if the surface of the instrument is wet.
- Connect the test leads firmly into each terminal.
- Set the range selector switch to OFF position when opening the battery compartment cover for battery replacement.
- Stop using the test lead if the outer jacket is damaged and the inner metal or color jacket is exposed.

CAUTION

- Always make sure to set the range selector switch to the appropriate position before making a measurement.
- Power off the instrument after use. Remove batteries if the instrument is to be stored and will not be in use for a long period.
- Do not expose the instrument to direct sunlight, high temperature, humidity or dew.
- Use a damp cloth with neutral detergent or water for cleaning the instrument. Do not use abrasives or solvents.
- If the instrument is wet, make sure to let it dry before putting it into storage.

Symbols

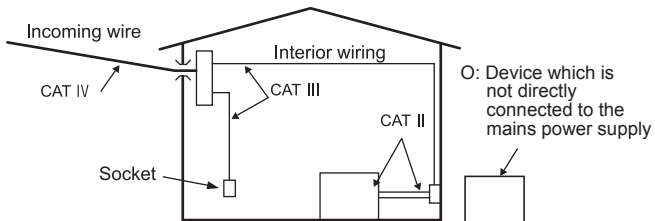
| | |
|---|--|
| CAT II | Electrical circuits of equipment connected to an AC electrical outlet by a power cord. |
| CAT III | Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets. |
| CAT IV | The circuit from the service drop to the service entrance, and to the power meter and primary over-current protection device (distribution panel). |
|  | Double or reinforced insulation |
|  | User must refer to the explanations in the instruction manual. |
|  | Earth |
|  | This instrument satisfies the marking requirement defined in the WEEE Directive (2002/96/EC). This symbol indicates separate collection for electrical and electronic equipment. |

Measurement Category

To ensure safe operation of measuring instruments, IEC 61010 establishes safety standards for various electrical environments, categorized as 0 to CAT IV, and called measurement categories.

Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measuring instrument designed for CAT III environments can endure greater momentary energy than one designed for CAT II.

- 0 : Circuits which are not directly connected to the mains power supply.
- CAT II : Electrical circuits of equipment connected to an AC electrical outlet by a power cord.
- CAT III : Primary electrical circuits of the equipment connected directly to the distribution panel, and feeders from the distribution panel to outlets.
- CAT IV : The circuit from the service drop to the service entrance, and to the power meter and primary over-current protection device (distribution panel).



2. Features

KEW4105DL is an earth resistance tester for testing power distribution lines, in-house wiring system, electrical appliances etc. It also has an earth voltage range to measure earth voltage.

- Designed to meet the following safety standards.
IEC 61010-1, IEC 61010-2-030 CAT II 300 V, CAT III 150 V,
CAT IV 100 V, Pollution degree 3
IEC 61010-031,
IEC 61557-1, -5
- Dust and water-proof construction in conformity with IEC 60529 (IP67)
This instrument is water-proof, so it is washable.
- Backlight to facilitate working at dimly illuminated location or at nighttime work. The backlight automatically turns off if the range selector switch is not moved or a button is not pressed for two minutes.
- The instrument automatically powers off if the range selector switch is not moved or a button is not pressed for ten minutes. This auto-power-off function doesn't work during a continuous measurement.
- Shoulder strap for both-hands operation
- Earth voltage measurement
 - AC/ DC auto detection
 - Warning LED for hazardous high earth voltage
- Earth resistance measurement
 - If the auxiliary earth resistance of auxiliary earth spikes is too high to make a precision measurement, the display shows warning and indicates which terminal, H(C) or S(P), has higher values with a warning LED.
 - Simplified measurement probe has a structure that both the alligator clip and the test bar are available.
 - Comparator function to give warning when a measured value exceeds the pre-set reference value. For further detail, see **8-1. Comparator function** in this manual. This function can be disabled.

3. Specifications

- Measuring range and accuracy (23°C±5°C, RH 75% or less)

Earth voltage measurement

| Measuring range | Display range | Accuracy |
|------------------------------|-----------------|-------------|
| 0 to 300 V AC (45 - 65Hz) | 0.0 to 314.9 V | ±1%rdg±4dgt |
| ±0 to ±300 V DC | 0.0 to ±314.9 V | |

Measuring method: Average sensing, True RMS value display

* AC/ DC auto-detection for an input of 2 V or higher. The LCD shows AC or DC mark according to the input polarity.

Earth resistance measurement

| Range | Measuring range | Display range | Accuracy* ¹ |
|-------------|-----------------|----------------|-----------------------------|
| 20Ω Range | 0.00 to 2000Ω | 0.00 to 20.99Ω | ±1.5%rdg±0.08Ω ² |
| 200Ω Range | | 0.0 to 209.9Ω | ±1.5%rdg±4dgt |
| 2000Ω Range | | 0 to 2099Ω | |

Measuring method: Constant current inverter/ 825 Hz

Approx. 3 mA (20Ω Range)

Approx. 1.7 mA (200Ω Range)³

Approx. 0.7 mA (2000Ω Range)³

¹ For precision measurement, auxiliary earth resistance should be 100Ω±5% or less.


² At precision measurement or when using optional test leads M-7241A, add ±0.10 Ω to the specified accuracy.

³ Current is reduced as follows if auxiliary earth resistance is high.
Approx. 0.7 mA: 200Ω Range, if aux. earth resistance is 25kΩ or higher.
Approx. 0.3 mA: 2000Ω Range, if aux. earth resistance is 50 kΩ or higher.

- Applicable standards
 - IEC 61010-1
CAT II 300 V CAT III 150 V CAT IV 100 V
Pollution degree 3
 - IEC 61010-2-030
 - IEC 61010-031
 - IEC 61557-1, -5
 - IEC 60529 IP67
 - IEC 61326-1, -2-2
 - EN 50581
MODEL7127B...CAT III 300 V CAT IV 150V
- * When test leads are connected to and used with the instrument, the lower category either of them belongs to is applied.
- Location for use Altitude 2000m or less, in-door/ out-door use
- Display Liquid crystal display with backlight
- Operating temp. & humidity -10°C to 50°C, 80% or less (no condensation)
- Storage temp. & humidity -20°C to 60°C, 75% or less (no condensation)
- Withstand voltage 2210 V AC (50/60Hz) / 5 sec
Between electrical circuit and enclosure
- Insulation resistance 50 MΩ or more/ 1000 V DC
Between electrical circuit and enclosure
- Auto power off function Turns off the instrument automatically if there is no function change, range change or button press for about 10 min.
- Backlight Automatically turns off if there is no activity for about 2 min.
*Auto-off is disabled during a measurement.
- Dimensions 121(L)×188(W)×59(H) mm * including case lid
- Weight Approx. 690g * including batteries and case lid
- Power source Six size AA alkaline batteries (LR6)
- Operating uncertainty
Operating uncertainty (B) is an uncertainty obtained under the rated operating conditions, and calculated with the intrinsic uncertainty (A), which is an error of the instrument used, and the error (En) due to variations.
According to IEC61557, the maximum operating uncertainty should be within $\pm 30\%$.

● Operating uncertainty in earth resistance measurements (IEC61557-5)

* Formula: $B = \pm(|A| + 1.15 \times \sqrt{E_2^2 + E_3^2 + E_4^2 + E_5^2})$

| | |
|----------------|--|
| A | Intrinsic uncertainty |
| E ₂ | Variation due to changing the Battery voltage (till the battery indicator becomes empty”  ”) |
| E ₃ | Variation due to changing the temperature (-10°C to 50°C) |
| E ₄ | Variation due to series interference voltage 16·2/3 Hz, 50 Hz, 60 Hz: 25 V DC: 10 V 400 Hz: 5 V |
| E ₅ | Variation due to resistance of the auxiliary earth electrode 20Ω range: 0 – 10 kΩ 200Ω range: 0 – 50 kΩ 2000Ω range: 0 – 100 kΩ |

* The measuring range to keep operating uncertainty of ± 30%:

20Ω range : 5.00 Ω – 20.00 Ω

200Ω range : 20.0 Ω – 200.0 Ω

2000Ω range : 200 Ω – 2000 Ω

● Possible number of measurements where battery voltage is within the effective range (measurement of 5 sec., pause of 25 sec.)

| Function | Test resistor | Possible number of measurements |
|-------------------|---------------|---------------------------------|
| Earth measurement | 10 Ω | Approx. 10000 times |

4. Name of parts

(1) Front panel

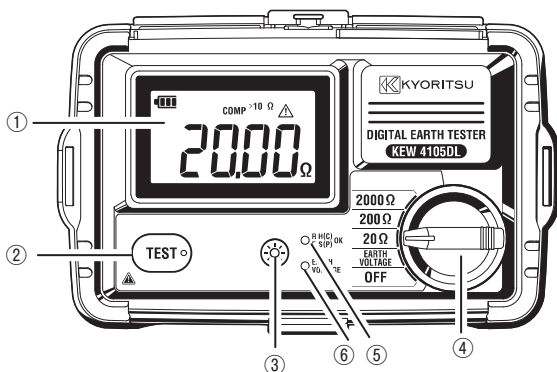


Fig. 4-1

| | Name | Description |
|---|-------------------------------|---|
| ① | LCD | LCD with backlight |
| ② | Test button | Starts/ stops a measurement. |
| ③ | Backlight button | Turns on/ off the backlight. |
| ④ | Range selector switch | Selects a range for earth resistance or earth voltage measurement. |
| ⑤ | LED for aux. earth resistance | Green LED lights up in earth measurements while the auxiliary earth resistance is within the allowable range. |
| ⑥ | Earth voltage warning LED | Red LED lights up in earth voltage measurements if the earth voltage is over the allowable range. |

(2) Terminal part

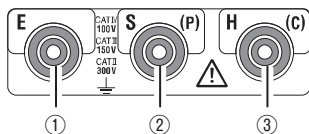


Fig. 4-2

| | Terminal | Designated function |
|---|----------|---|
| ① | E | For an earth electrode |
| ② | S(P) | For an aux. earth (potential) electrode |
| ③ | H(C) | For an aux. earth (current) electrode |

(3) LCD

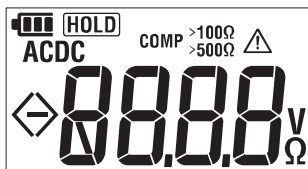



Fig. 4-3

● Symbols common to all functions

| | |
|--|---|
| | Battery level indicator |
| | Segments for numerical display |
| | Indicates “Over-range” status – the measured value is exceeding the display range. Resistance: >20.99 (20Ω range) >209.9 (200Ω range) >2099 (2000Ω range) Voltage : >314.9V(“<-314.9V” is displayed for negative DC input) |

● Symbols for earth measurement

| | |
|---|--|
| Ω | Measurement unit |
| <i>RH_H · RS_H</i> | Warning - Aux. earth resistance is too high. (See P. 18.) |
| HOLD | Data hold is active. |
| COMP | Comparator function is active. |
| $>10 \Omega$ $>100\Omega$ $>500\Omega$ | While the comparator function is active, these signs indicate that the present input is more than the pre-set threshold values. $>10 \Omega$ (20 Ω range) $>100\Omega$ (200 Ω range) $>500\Omega$ (2000 Ω range) |
|  | While the comparator function is active, this sign indicates that the present input is more than the pre-set threshold value. |

● Symbols for voltage/ earth voltage measurement

| | |
|----------------|--|
| AC · DC | Alternating current, direct current |
| V | Unit for voltage measurement |
| — | Indicates that the negative voltage is measured. |

5. Accessories

- (1) Test leads for precision measurement MODEL7266
(Red: 20m, Yellow: 10m, Green: 5m)

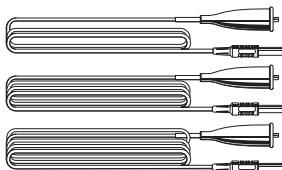


Fig. 5-1

- (2) Test leads for simplified measurement MODEL7127B

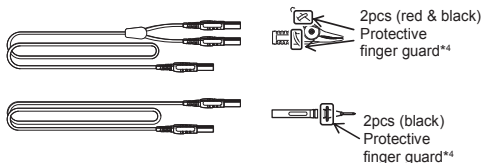


Fig. 5-2

** Protective finger guard is a part providing protection against electrical shock and ensuring the minimum required air and creepage distances.

- (3) Auxiliary earth spike MODEL8041



Fig. 5-3

- (4) Cable reel (supplied depending on the purchased model)

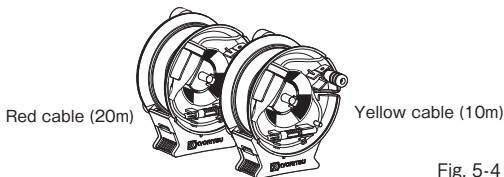


Fig. 5-4

Cable reel + Red cable (20m) MODEL7267
Cable reel + Yellow cable (10m) MODEL7268

- (5) Shoulder strap MODEL9121
- (6) Six AA alkaline batteries (LR6)
- (7) Instruction manual
- (8) Hard case MODEL9191 (supplied depending on the purchased model)

Each item can be stored as shown below.

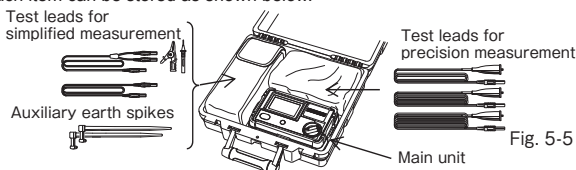


Fig. 5-5

- (9) Soft case MODEL9190 (supplied depending on the purchased model)

Each item can be stored as shown below.

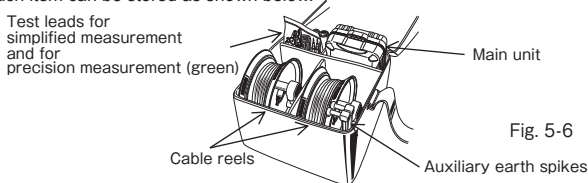
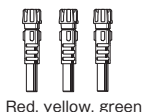


Fig. 5-6

● Optional accessories

- (1) Adapter for measurement terminal MODEL8259



Red, yellow, green

Fig. 5-7

Offering easy connection of a cable with spade connector

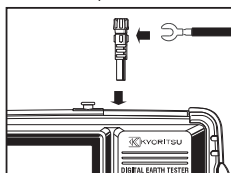


Fig. 5-8

⚠ DANGER

Do not connect the adapter of precision test leads to mains power or a circuit in which electrical potentials exceeding 33 V rms, 46 V (peak value) or 70 V DC exist; otherwise, electrical shock may be caused by the exposed electrode.

⚠ CAUTION

Resistance of test leads to be connected to E terminal affects measured results. The specified accuracy may not be guaranteed if test leads other than the ones supplied with this instrument are used.

- (2) Test leads for precision measurement MODEL7241A
(Red, Yellow, Green: 1.5m)

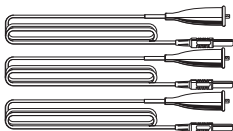




Fig. 5-9

6. Getting started

Battery voltage check

- (1) Please refer to **11. Battery replacement** in this manual and insert batteries in KEW4105DL.
- (2) Turn and set the range selector switch to any position other than OFF to power on the instrument.
- (3) Battery level indicator appears at the upper left on the LCD. Battery voltage is extremely low if "  " mark is displayed. Replace batteries with reference to **11. Battery replacement** to carry out further measurements.
If empty "  " mark is displayed, battery voltage is below the lower limit of the operating voltage. In such a condition, accuracy of the measured result isn't guaranteed. Replace the batteries as soon as this mark appears.

Use of AA alkaline battery is recommended. Use of other batteries may cause improper indication of battery level.

7. Earth resistance measurement

With the earth resistance measurement function of this instrument, earth resistance of power distribution lines, in-house wiring system and electrical appliances can be measured.

⚠ DANGER

- Be extremely careful when measuring earth resistance; high voltage, 50 V max is generated across H(C) – E terminals.
- When measuring earth voltage, do not apply 300 V or higher voltage between S(P) – E and between H(C) – E terminals.
- When measuring earth resistance, do not apply voltage, more than 25 V, between measuring terminals.

7-1. Measurement principle

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

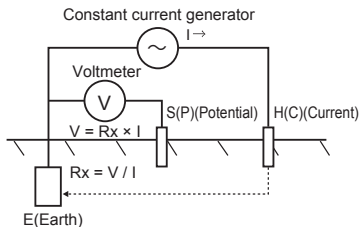


Fig. 7-1

7-2. Precision measurement (with test leads for precision measurement)

(1) Connection

Stick the auxiliary earth spikes $S(P)$ and $H(C)$ into the ground deeply. They should be aligned at an interval of 5 - 10 m from the earthed equipment under test. Connect the green wire to the earthed equipment under test, the yellow wire to the auxiliary earth spike $S(P)$ and the red wire to auxiliary earth spike $H(C)$ from terminals E , $S(P)$ and $H(C)$ of the instrument in order. See Fig. 7-2 and 7-3.

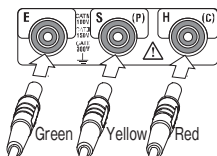


Fig. 7-2

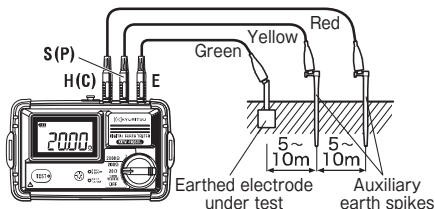


Fig. 7-3

Insert the plug of test leads firmly into each terminal. If they are not inserted firmly, the loose connection may cause inaccurate readings.

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 cloth etc. on the spike when making measurement.

Confirm that the LED for aux. earth resistance lights up before pressing the TEST button. For further detail, please refer to **Clause 7.2, (4) Auxiliary earth resistance**. Aux. earth electrodes cannot be used on the ground such as asphalt where water will not permeate.

(2) Earth voltage check

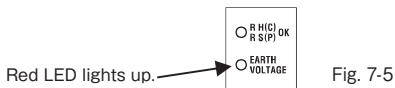
- Select the Earth voltage function and check the voltage value displayed on the LCD. The displayed earth voltage is the voltage between S(P) and E terminals.

Display example



Fig.7-4

Confirm that the displayed voltage value is 25V or less. When the display reads more than 25V, the warning LED as shown below lights up. (The warning LED lights up at; more than 10V for DC earth voltage and more than 5 V for earth voltage of 400 Hz.)



Excessive errors in earth resistance measurement may be caused in the condition that warning LED for high earth voltage is lighting up. To avoid this, make measurement after reducing the voltage by turning off the power supply of the equipment which is connected to the earthed electrode under test etc. Earth voltage warning LED works on earth resistance function.

⚠ DANGER

- Do not connect the precision measurement test leads to a circuit in which electrical potentials exceeding 33 V rms, 46 V peak or 70 V DC exist, in addition, not use them for voltage measurement.

(3) Measurement

Select a desired range and press the TEST button to start measurement.

TEST button LED blinks to indicate the instrument is performing measurement. The displayed value is the earth resistance of the earthed electrode under test. Press the TEST button again to stop measurement. If the measured result exceeds the display range, set the rotary selector switch to a higher range.

Display example



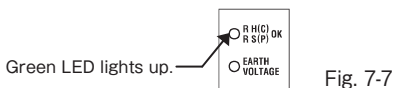
Fig. 7-6

When the measured result exceeds the display range (over-range), the LCD shows:

- >20.99Ω (20Ω range)
- >209.9Ω(200Ω range)
- >2099Ω (2000Ω range).

(4) Auxiliary earth resistance

If the auxiliary earth resistance is within the allowable range and doesn't affect measurement, the green LED shown below lights up. The table below shows the upper limit of auxiliary earth resistance.



Upper limit of auxiliary earth resistance

| Measurement range | Aux. earth resistance |
|-------------------|-----------------------|
| 20Ω | 10 kΩ |
| 200Ω | 50 kΩ |
| 2000Ω | 100 kΩ |

If the auxiliary resistance of auxiliary spike H(C) or S(P) is too high to make measurement, the display reads "RH_H" or "RS_H". Recheck the connection of test leads and the earth resistance of auxiliary earth spike.

When earth resistance at H(C)
(aux. earth (current) electrode)
is too high:

When earth resistance at S(P)
(aux. earth (potential) electrode)
is too high:



Indications of aux. earth resistance warning are switchable: RH_H -> RC_H, RS_H -> PR_H. For further detail, please refer to **9. Switching indications of aux. earth resistance warning.**

⚠ CAUTION

- If measurement is made with the test leads twisted or in touch with each other, the reading of the instrument may be affected by induction. For accurate measurement, test leads should be arranged so as not to be contacted with each other.
- If earth resistance of auxiliary earth spikes is too large, it may result in inaccurate measurement. Make sure to stick the auxiliary earth spikes H(C) and S(P) into the moist part of the earth carefully, and ensure sufficient connections between the respective connections.

7-3. Simplified measurement (with test leads for simplified measurement)

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-pole method.

(1) Connect the test leads as Fig. 7-10 shows.

MODEL7127B (red) to H(C) and S(P) terminals, and MODEL7127B (green) to EARTH (E) terminal.

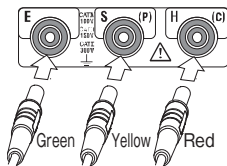


Fig. 7-10

Tip adapters for the test leads for simplified measurement can be changed depending on the applications.

[How to attach]

Firmly insert and connect the adapter you want to use to the end of the cord (with banana plugs at both ends).

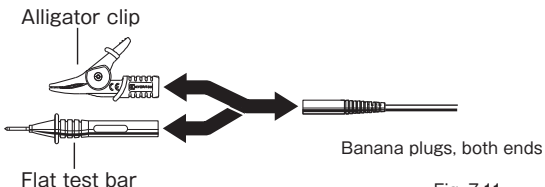


Fig. 7-11

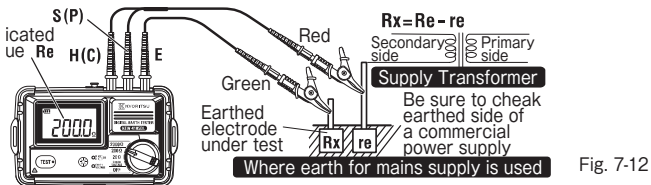
Insert the plug of test leads firmly into each terminal. If they are not inserted firmly, the loose connection may cause inaccurate readings.

⚠ DANGER

- To avoid getting electrical shocks, ensure that test leads are disconnected from the instrument when replacing the metal tip or adapter for test leads.

(2) Wiring

Make connection as shown in the following figure.



⚠ DANGER

- Use a voltage detector to check a common earth of commercial power supply.
- Do not use this instrument to check a common earth of commercial power supply. A danger will be caused because the voltage may not be displayed even in case of a live conductor, when the connection of the earth electrode to be measured has come off, or when the connection of the test leads of the instrument is not correct etc.

(3) Earth voltage check

- Select the Earth voltage function and check the voltage value displayed on the LCD. The displayed earth voltage is the voltage between S(P) and E terminals.

Confirm that the displayed voltage value is 25 V or less. When the display reads more than 25 V, the warning LED as shown below lights up. (The warning LED lights up at; more than 10 V for DC earth voltage and more than 5 V for earth voltage of 400 Hz.)

Display example



Fig.7-13

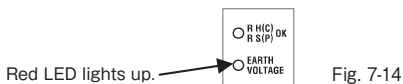


Fig. 7-14

Excessive errors in earth resistance measurement may be caused in the condition that warning LED for high earth voltage is lighting up. To avoid this, make measurement after reducing the voltage by turning off the power supply of the equipment which is connected to the earth electrode under test etc. Earth voltage warning LED works on earth resistance function.

(4) Measurement

Select a desired range, and press the TEST button to start measurement. LED lights up to indicate the instrument is performing a measurement. The displayed value is the earth resistance of the earthed electrode under test. Press the TEST button again to stop measurement. If the measured result exceeds the display range, set the rotary selector switch to a higher range.

Display example



Fig. 7-15

When the measured result exceeds the display range (over-range), the LCD shows:

>20.99Ω (20Ω range)

>209.9Ω (200Ω range)

>2099Ω (2000Ω range).

(5) Simplified measurement value

Two-pole method is used for simplified measurement. In this method, earth resistance value r_e of earth electrode connected to terminal H(C) - see Fig. 7-12 - is added to true earth resistance value R_x and shown as an indicated value R_e .

$$R_e \text{ (indicated value)} = R_x + r_e$$

If the r_e is known beforehand, true earth resistance value R_x is calculated as follows.

$$R_x \text{ (true resistance)} = R_e - r_e$$

8. Comparator function

8-1. Comparator function

When the measured value in earth measurement exceeds a certain reference value, the LCD shows \triangle mark and corresponding warning indication with blinking backlight. (See Fig. 8-1.)

Reference values for each range

| Range | Reference value |
|-------|-----------------|
| 20Ω | 10.00 Ω |
| 200Ω | 100.0 Ω |
| 2000Ω | 500 Ω |

● Hysteresis of reference value

The warning will not stop or go off until the measured value drops 99% or less of each reference value.

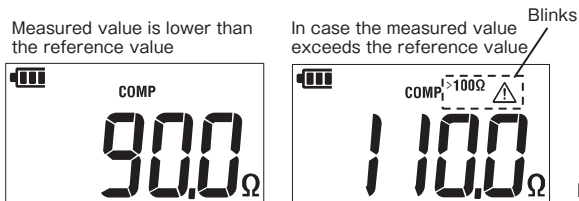
Measured values that cancel the warning;

20Ω range : 9.90 Ω or less

200Ω range : 99.0 Ω or less

2000Ω range : 495 Ω or less

Display example (200Ω range)



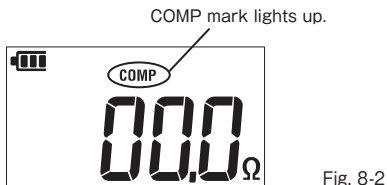
8-2. How to enable/ disable comparator function

* The comparator function has been disabled by default.

1. Set the range selector switch to OFF position.
2. Power on the instrument while holding down the backlight button.
3. All segments in the LCD light up, and then “COMP” mark blinks twice to indicate the comparator function is enabled.



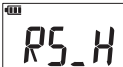

To disable the function, perform above steps 1. and 2. while the function is enabled. The “COMP” mark blinks twice and the function is disabled.

The COMP mark is always displayed on resistance ranges while the comparator function is enabled. (See Fig. 8-2.)



9. Switching indications of aux. earth resistance warning

Warning indications for aux. earth resistance can be switched between (1) and (2) as shown in the table below; default setting is (1).

| Conditions | (1) | (2) |
|--------------------------------------|---|---|
| Resistance at H(C) terminal is high. |  |  |
| Resistance at S(P) terminal is high. |  |  |

● How to switch the indications:

- (1) Turn the range selector switch from OFF to EARTH VOLTAGE while pressing down the TEST and backlight button. Then the currently selected indication will be displayed for one sec. When the indication switches from (1) to (2), the LCD shows “RC_H” and “RP_H” one second each.
- (2) Repeating above operation switches the indications in turn, (1) -> (2) ->(1)...

10. Backlight

Press the backlight button to turn on the backlight. Press the button again to turn off the backlight. The backlight automatically turns off if there is no activity for about 2 min. (*Auto-off is disabled during a measurement.)

11. Battery replacement

Replace the batteries as soon as the  mark appears.

DANGER

- Do not open the battery compartment cover if the instrument is wet.
- Never attempt to replace batteries during a measurement. In order to avoid getting electrical shock, ensure that the instrument is powered off and test leads are disconnected from the instrument before replacing batteries.
- The battery compartment cover must be closed and screwed before starting a measurement. Otherwise, electrical shock hazard may be caused.

CAUTION

- Do not mix new and old batteries or mix different types of batteries.
- Install batteries in correct polarity as marked inside. Do not open the battery compartment cover if the instrument is wet.
- In order to preserve water-proof feature, do not remove the packing from the battery compartment cover and keep the packing clean. Wipe off any tiny dust particles from the packing surface.

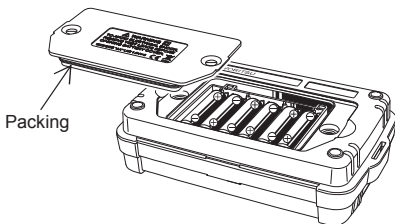


Fig. 11-1

- (1) Power off the instrument, and then disconnect the test leads.
- (2) Loosen two screws which are fixing the battery compartment cover, and remove the cover.
- (3) Replace all six batteries with new ones at the same time. Be sure that the battery polarity is correct.
Use of six size AA alkaline batteries (LR6) is recommended.
- (4) Install the battery compartment cover, and tighten two screws for the cover.

⚠ CAUTION

Remove all batteries if the instrument is to be stored and will not be in use for a long period.

In this case, when attaching the battery compartment cover, keep the right screw of the cover slightly loose.

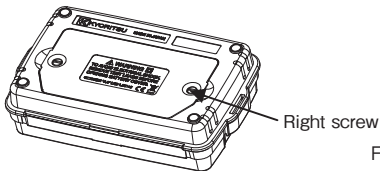


Fig. 11-2

This instrument has water-proof feature and has high sealing property, therefore, air pressure adjustment is necessary.

Air pressure between inside and outside of the instrument can be balanced by loosening the right screw of the battery compartment cover. Always tighten the screw completely before using the instrument.

12. Cleaning

This instrument is designed to meet IP67 (IEC 60529) dust and water-proof construction.

IP67

This indicates the degree of protection provided by the enclosure of the device against entry of solid foreign objects, and the ingress of water.

IP6x: Dust-proof type (Dust shall not penetrate the enclosure.)

IPx7: Watertight (Quantities of water that may harm the enclosure when it is temporarily immersed in water shall not penetrate the enclosure.)

Use a damp cloth with neutral detergent or water for cleaning the instrument. Do not use abrasives or solvents. Read and observe the following cautions when washing the instrument.

⚠ CAUTION

- The watertight feature may be degraded after prolonged use. This feature works on fresh water and tap water only and is guaranteed as long as the following conditions are met.
 - Temperature of fresh water or tap water is 15 – 35°C.
 - Ambient temperature is 15 – 35°C.
 - Difference in temperatures of water and instrument enclosure is within 5°C
- Replace the waterproof packing if it is degraded.
- Check the packing for deformation, cracks when washing the instrument and firmly secure the battery compartment cover when washing the instrument.

13. Notes on housing case

Case lid can be fit under the housing case while making measurement.

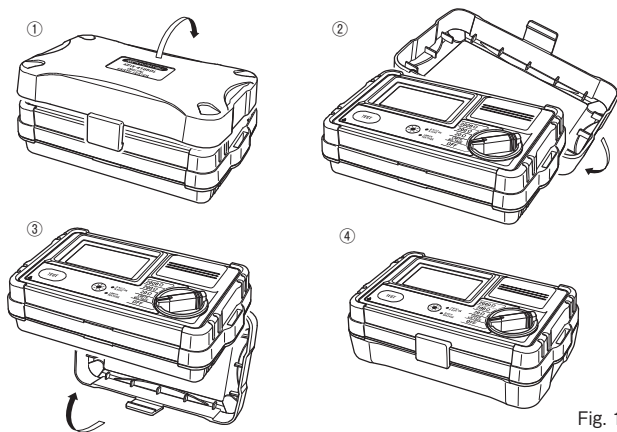


Fig. 13-1

14. How to fit strap belt

The instrument is equipped with a strap belt to suspend from the neck to allow both hands to be used freely for easy and safe operation.

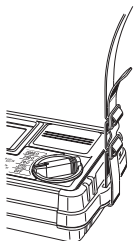


Fig. 14-1

15. Cable reels

15-1. Operating instruction

Connection

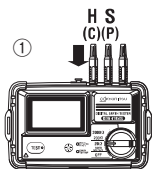


Fig. 15-1

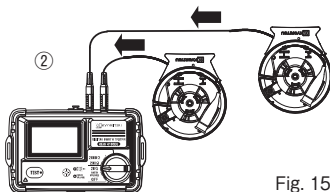


Fig. 15-2

Connect the cable to the instrument.

Pull out the cable from the cable reel.

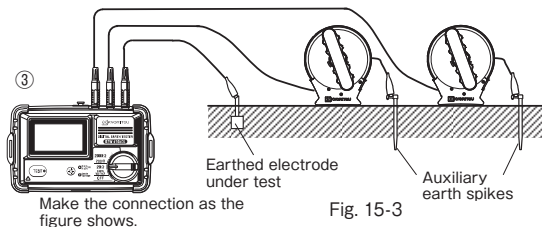


Fig. 15-3

Make the connection as the figure shows.

Storage

First, house the alligator clip onto the cable reel as follows. Then hold the grip of the cable reel with your left hand and slack the cable downward.

Rotate the handle with your right hand for rewinding.

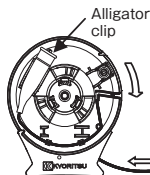


Fig. 15-4

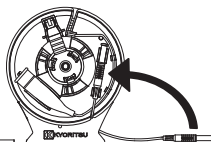


Fig. 15-5

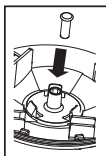
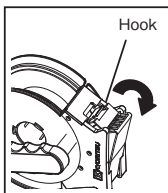


Fig. 15-6

Plug cap can be housed in the center of the cable reel.

15-2. Cable replacement

How to remove the cable

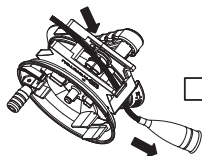


To replace the cable with a new one, first, pull out the cable fully. Then take the bottom cover away, and remove the cable from the cable reel. No need to remove the alligator clip.

Fig. 15-7

How to attach a new cable

For attaching a new cable, reverse the procedure above.



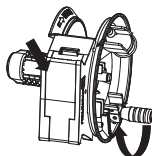
Insert a cable through the bottom.

Fig. 15-8



House the alligator clip and cable.

Fig. 15-9



Attach the bottom cover and wind the cable.

Fig. 15-10

This cable reel is washable. You can remove dirt and mud easily.

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