

# sanwa®

# MG5000

HIGH VOLTAGE  
DIGITAL INSULATION RESISTANCE TESTER

INSTRUCTION MANUAL

CE





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## [1] SAFETY PRECAUTIONS

### -Before use, read the following safety precautions.-

Thank you for purchasing the Sanwa MG5000 high voltage digital insulation resistance tester. Before use, please read this manual thoroughly to ensure correct and safe use. Keep this instruction manual together with the product.

Be sure to read the information under “WARNING” and “CAUTION” that is intended to prevent personal injury such as burn and electric shock and other serious accidents.

### 1-1 Explanation of Warning Symbols


The meaning of the symbols used in this manual and attached to the product is as follows.

 : Very important instruction for safe use.


- The **WARNING** messages are intended to prevent accidents to operating personnel such as burn and electrical shock.
- The **CAUTION** messages are intended to prevent incorrect handling and measurement which may damage the product.


Symbols attached to the product

 : Symbol soliciting reference to this manual before use

 : Do not touch this part because a dangerous high voltage is applied

 : Double or enhanced insulation

 : Earth (ground)

 : The AC incorrect input protection voltage in the insulation resistance measurement is 1000 V

### 1-2 Warning Instruction for Safe Use

#### **WARNING**

The following instructions are intended to prevent personal injury such as burn and electric shock. Be sure to follow them when using the tester.

1. Although the tester is equipped with the voltage measurement function, never use it to measure voltage of electric circuits that exceed CAT.IV 600 V/CAT.III 1000 V.
2. Pay special attention when measuring the voltage of AC 33 V rms (46.7 V peak) or DC 70 V or more to avoid injury.
3. Never input signals exceeding the maximum rated input value (see **1-3**).
4. Never use the tester for measuring voltage of lines connected to equipment (e.g. motors) that generates induced or surge voltage since it may exceed the maximum allowable overload input.

5. Never use the tester if the tester, test lead or alligator clip is damaged or broken.
6. Never use the tester with the rear case or battery lid removed.
7. When using the test leads, keep your fingers behind the finger guards of the test probe and the barrier of the alligator clip.
8. During measurement, do not change the function or range.
9. Before starting measurement, make sure that the function and range are properly set in accordance with the measurement.
10. Never use the tester when it is wet or with wet hands.
11. Do not use the instrument in a place where corrosive or explosive gas is produced.
12. Never attempt repair or modification, except for battery replacement.
13. To ensure safety and maintain accuracy, check the tester in the start-up inspection as well as in the inspection to be performed at least once a year.
14. The tester is for indoor use only.
15. Wear insulating protective gear when using the meter with equipment containing a hazardous live part. Also be sure to observe your local and national safety rules.
16. Always use the meter in a specified method to prevent the protective function from being imperiled.

### 1-3 Overload Protection Input Values

Function	Input terminals	Max. rated input value	Max. overload protection input
<b>V</b>	LINE(L). = Earth(E)	DC/AC 1000 V	DC/AC 1100 V
<b>MΩ</b>		Voltage input prohibited	DC/AC 1000V
<b>-</b>	GUARD(G)	Voltage input prohibited	DC/AC 30V

## [2] APPLICATIONS AND FEATURES

### 2-1 Applications

This instrument is a high voltage digital insulation resistance tester capable of measuring voltages within the range of 600 V under IEC61010-1 CAT.IV and 1000 V under CAT.III.

## 2-2 Features

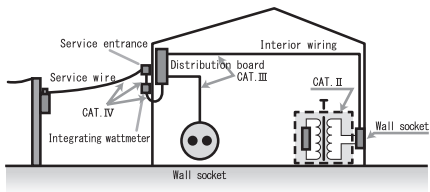
- Safety design in compliance with IEC61010-1.
- Five voltage ranges for insulation resistance measurement.
- Easy auto display of DAR (Dielectric Absorption Ratio) and PI (Polarization Index) with a single button.
- Auto hold function to hold the measured value.
- Auto discharge function to display the discharge situation on the monitor.

## Measurement categories (Overvoltage categories)

CAT. II: Primary circuit of equipment with a power cord to be connected to a mains socket.

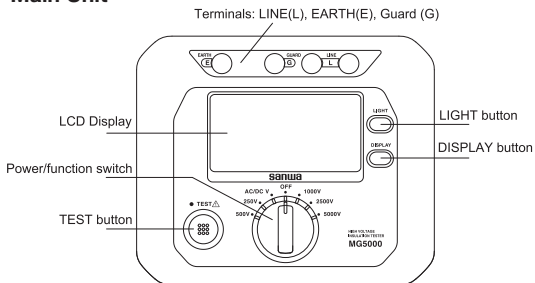
CAT. III: Primary circuit of equipment that inputs power directly from the distributor and the circuit from the distributor to the mains socket.

CAT. IV: Circuit from the leading wire to the distributor

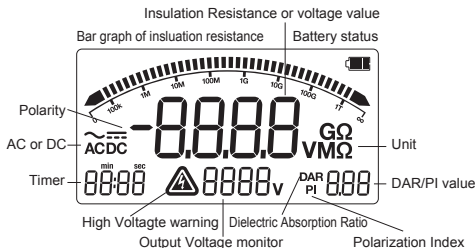


## [3] NAMES OF COMPONENT UNITS

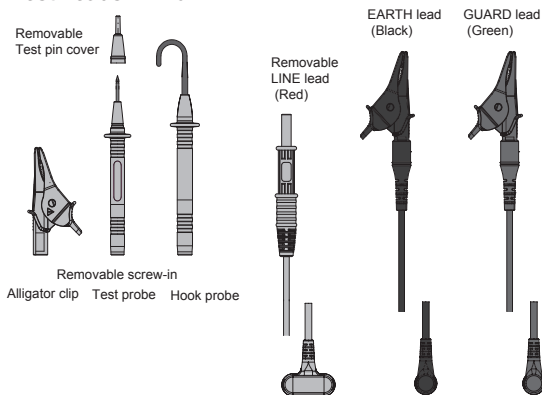
### 3-1 Main Unit



### 3-2 Display



### 3-3 Test Leads : TL-5K



TL-5K-R : Removable LINE lead (Red) : 3 m

TL-5K-B : EARTH (ground) lead (Black) : 3 m

TL-5K-G : GUARD lead (Green) : 3 m

TL-5K-A : Alligator clip

TL-5K-P : Test probe (Removable test pin cover)

Uncovered with the cover : CAT.II 1000 V

Covered with the cover : CAT.IV 600 V/CAT.III 1000 V

TL-5K-H : Hook probe (No Measurement Category)

Take special care against accidents caused by short-circuiting, etc.

### 3-4 Optional Accessories

TL-5K-15 : Removable LINE lead (Red) : 15 m

Note : The period in which the insulation resistance is stable varies depending on the length and distribution method of the cable.



## [4] DESCRIPTION OF FUNCTIONS

### 4-1 Power/Function Switch

Turn this switch to turn on and off the power and to switch the measuring functions.

### 4-2 Starting/Stopping Measurement : TEST button

Press and hold the **TEST** button for more than 2 seconds to start the insulation resistance measurement. Press and hold the button for more than 1 second to stop the measurement.

\* The measurement of the AC/DC V functions is possible without using the **TEST** button.

### 4-3 Backlight function : LIGHT Button

Press the **LIGHT** button to turn the display backlight on. Press the button again to extinguish it. The backlight also goes off in 60 seconds after it is turned on.

### 4-4 DAR/PI Display Switching : DISPLAY Button

Press the **DISPLAY** button during or after measurement to switch the display between the DAR (Dielectric Absorption Ratio) and PI (Polarization Index) values. (See **5-5 DAR/PI Measurements** for details.)

### 4-5 Auto Hold

When the insulation resistance measurement is stopped, the last displayed value is held automatically until the next time the **TEST** button is pressed.

\* The Auto Hold display is also canceled when the function switch position is changed.




## 4-6 Auto Power Off





The Auto Power Off function turns the display and tester off automatically in about 10 minutes after the last operation. To return from this status, turn the power switch to OFF then to another position.

\* The Auto Power Off function is defeated during measurement of insulation resistance.

\* A small current flows inside the meter even in the Auto Power Off status. After measurement, always turn the function switch to the OFF position.

## 4-7 Battery Monitor

The indication of the Battery Monitor starts to change as the battery power is consumed. When the displayed symbols decrease, replace the batteries if you are going to begin measurement for a long period. The measurement accuracy is maintained even when the symbol, but the accuracy is no longer guaranteed when the single symbol  starts to blink. For how to replace the batteries, see **6-4 Battery Replacement**.

3 symbols		10.6 V -
2 symbols		8.6-10.5 V
1 symbol		7.6-8.5 V
1 symbol	BLINK	6.9-7.5 V (No accuracy specified)
		6.8 V or below

## [5] MEASUREMENT PROCEDURE

### WARNING


1. Never measure voltage of electric circuits that exceed CAT.IV 600 V/CAT.III 1000 V
2. Do not change the function switch position in the middle of measurement.
3. Keep your fingers behind the finger guards of the test probe and the barrier of the alligator clip.
4. After measurement, release the test leads from the object measured and set the function switch to the OFF position.

 **CAUTION**

Correct measurement may not be performed when using the tester in a ferromagnetic/intense electric field such as a place near a transformer, high-current circuit or a radio, or when measuring a circuit containing a large amount of harmonics such as an inverter.

### 5-1 Start-up Inspection

Check the following items before starting the daily measurement work.

- Appearance check : Check the appearance of the tester to see if it is free from damage caused by falling, etc.
- Accessories : Check that the test leads are free from irregularities such as wire disconnection and crack.
- Batteries : Install the batteries before using the tester for the first time. If the Battery Monitor indicates a single blinking symbol , replace the batteries with new ones.(see 6-4)
  - \* If nothing is displayed, the batteries may be exhausted totally.
- Also check that the meter and your hands are not moistened by water, etc.

### 5-2 Voltage Measurement : AC/DC V

 **WARNING**

1. Never input signals exceeding the maximum rated input value (see 1-3).
2. Use test leads suitable for the measurement category of the object measured.  
When the measurement categories differ between the main unit and test leads, the lower measurement category will be applied.
  - \* Do not attempt to measure a voltage using the hook probe (TL-5K-H) because the large area of the metal-exposed part is dangerous.

This function is capable of distinguishing the input between an AC voltage (ACV) and DC voltage (DCV) automatically.

Function	Measurement range	Accuracy	Note
ACV	30-1000 V	$\pm(3\%rdg+2\ dgt)$	Input over 1000 V causes "OL" to be displayed and the buzzer to beep.
DCV	30-1000 V	$\pm(3\%rdg+2\ dgt)$	

\* The accuracy-guaranteed frequencies of ACV are 50/60 Hz.

Procedure :

- ① Connect the LINE lead (Red) and EARTH (ground) lead (Black).
- ② Set the function switch to AC/DC V.
- ③ Connect the test leads to the object measured.
- ④ Read the displayed value (there is no need of pressing the TEST button).  
In the DCV measurement, the “-” sign is displayed when the Red lead is connected to negative polarity.

Notes :

- When the input is absent or below 30 V, the display shows [Lo] in the main value area.
- When the input is 30 V or more, whether it is an AC voltage (ACV) or DC voltage (DCV) is distinguished and displayed automatically.
- In case ACV and DCV are superimposed, the distinction is based on the voltage with the higher peak value.

### 5-3 Insulation Resistance Measurement

#### **WARNING**

1. Never apply voltage to the input terminals.
2. Wear high voltage insulation gloves.
3. Isolate the power supply to the object measured (circuit) and make sure no voltage is applied to it before measurement.
4. Do not touch the object measured during measurement because the tester generates a high voltage.
5. Connect the EARTH (ground) lead (Black) first and then the LINE lead (Red). When disconnecting the test leads, disconnect the LINE lead first.
6. The tester and measured circuit are charged with high voltage during measurement. To avoid the risk of electric shock, discharge the high voltage from the object measured immediately after measurement (see 5-4).

#### **CAUTION**

1. The measurement terminals of the tester generate a high voltage during insulation resistance measurement.
2. Some objects measured have unstable insulation resistance, in which case their readings become also unstable. The measurement of a capacitive load may sometimes take a long time.
3. In the insulation resistance measurement, the EARTH (ground) terminal becomes “+” and the LINE terminal “-”.

4. When the object measured is grounded, usually connect the EARTH (ground) lead to the grounded side and the LINE lead to the circuit (the value read with this method is lower than that read with the reverse connection).
5. To prevent measurement errors, keep the LINE cord away from the object measured and the ground whenever possible. Particularly, when measuring high resistance of 100 G $\Omega$  or more, the reading can be stabilized by keeping the test cord as apart as possible from each other.
6. The insulation resistance varies widely depending on the temperature and humidity as well as on the test voltage. In general, it decreases as the temperature, humidity or voltage increases.
7. The tester may generate a sound during voltage generation, particularly when the resistance is low. This is not malfunction.

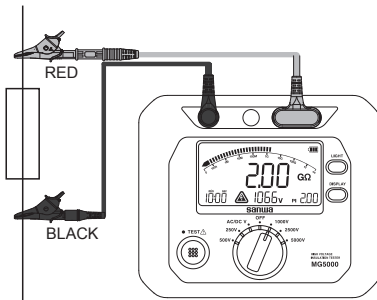
Nominal test voltage	Measurement range	Accuracy	Note
250 V	0.0-104.9 M $\Omega$	$\pm(5\%rdg + 3 dgt)$	OL at 105.0 M $\Omega$ or more
500 V	0.0-99.9 M $\Omega$ 80-1049 M $\Omega$		OL at 1050 M $\Omega$ or more
1000 V	0.0-99.9 M $\Omega$ 80-999 M $\Omega$ 0.80-2.09 G $\Omega$		OL at 2.10 G $\Omega$ or more
2500 V	0.0-99.9 M $\Omega$ 80-999 M $\Omega$ 0.80-9.99 G $\Omega$ 8.0-104.9 G $\Omega$		OL at 105.0 GM $\Omega$ or more
5000 V	0.0-99.9 M $\Omega$ 80-999 M $\Omega$ 0.80-9.99 G $\Omega$ 8.0-99.9 G $\Omega$		OL at 1200 G $\Omega$ or more
	80-1000 G $\Omega$	$\pm 20\%rdg$	
	1001-1199 G $\Omega$	-	

## Procedure :


Ensure that the measured circuit is turned OFF and that no voltage is present in it.

- ① Connect the EARTH (ground) lead (Black) to the EARTH (E) terminal and the LINE lead (Red) to the LINE (L) terminal. Also connect the GUARD terminal if required.  
(When using GUARD, also see **5-7 Using the GUARD Terminal.**)
- ② Set the function switch to the desired test voltage function.
- ③ Connect the test leads to the object measured.
- ④ If a voltage of 30 V or more is present while the object is not measured, the high voltage warning is displayed and the buzzer beep is generated. In this case, the measurement cannot be started by pressing the TEST button. If this happens, check the power supply to the object measured.
- ⑤ Press and hold the TEST button for more than 2 seconds to start the voltage output. When the function uses a voltage of 1000 V or more, intermittent buzzer beeps are generated during measurement to warn about the high voltage generation.
- ⑥ Read the value or bar graph on the display.
- ⑦ To stop the measurement, press and hold the TEST button for more than 1 second. The value displayed at the moment the measurement is stopped is held automatically.
- ⑧ The object measured may be charged even after measurement. Ensure that it is free of voltage charge by referring to **5-4 Discharge Function** and be sure to disconnect the LINE lead before the EARTH (ground) lead.

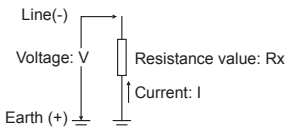
## Example of insulation resistance measurement



Note :



- When the object measured is in the live status ( $\geq 30$  V AC/DC), the display shows the voltage value together with  and a warning tone is generated. In this case, the test voltage is not output by pressing the TEST button. To start measurement, turn the power supply to the object measured OFF or discharge it.
  - The batteries consume rapidly in measurement of resistance lower than rated test voltage x 0.001 M $\Omega$  for a long period. It is recommended to measure low resistances quickly in a short period.  
Example) Lower than 5 M $\Omega$  when the voltage is 5000 V,  
lower than 0.5 M $\Omega$  when it is 500 V.
  - The maximum measurement period is 99 min. 59 seconds. The time display blinks when this limit is exceeded.
- \* Principles of insulation resistance measurement: The tester detects the current flowing through the object measured during application of DC voltage and calculates the resistance value with the following formula.

$$\text{Resistance value} = \text{Voltage} / \text{Current}$$
$$(R_x = V / I)$$



#### 5-4 Discharge Function

When the insulation resistance of a capacitive object is measured, it is charged by the test voltage. This function is provided to discharge the high voltage remaining in the object after measurement.

- 1) When stopping the insulation resistance measurement, keep the test leads connected to the object measured, and press and hold the TEST button for more than 1 second to turn off the power.
- 2) Discharging starts automatically. While the charge is discharged from the object measured, the display shows  together with the voltage value.  disappears when the discharge completes or the charge drops to 29 V or less.

## 5-5 DAR/PI Measurement

This function is used to check the increase over time of the insulation resistance after application of voltage to the object measured.

It automatically calculates and displays the DAR (Dielectric Absorption Ratio), which is one of the insulation judgment criteria, as well as the PI (Polarization Index).

As the increase over time of the leak current of an insulator is affected by absorption of moisture, it is important for diagnosing insulation of cables. The time periods used to obtain the results are different between the DAR and PI.

### 5-5-1 DAR : Dielectric Absorption Ratio

The DAR refers to the ratio between the resistance values at 60 seconds and 30 or 15 seconds after the start of measurement. It is expressed with the following formula.

$$\text{DAR} = \frac{\text{(Resistance at 60 sec. after voltage application)}}{\text{(Resistance at 30 or 15 sec. after voltage application)}}$$

### Changing between the 30 and 15 sec. settings

\* The default period set at the factory is 15 sec.

- 1) With the power/function switch set to OFF, press and hold the DISPLAY button while turn the power/function switch to ON. The display shows "DAR" and "00:30" or "00:15" in the timer area at the bottom left of the panel.
- 2) Each press of the DISPLAY button alternates "00:30" and "00:15".
- 3) The time period displayed at the moment the power switch is set to OFF again is saved.

The current setting can be checked with the operation in step 1).

### 5-5-2 PI : Polarization Index

The PI refers to the ratio between the resistance values at 10 minutes and 1 minute after the start of measurement. It is expressed with the following formula.

$$\text{PI} = \frac{\text{(Resistance at 10 min. after voltage application)}}{\text{(Resistance at 1 min. after voltage application)}}$$

### 5-5-3 DAR/PI measurement procedure

The DAR and PI are measured automatically by the continual insulation resistance measurement. The DAR value is displayed in 1 minute after the start of measurement and the PI value in 10 minutes after.

Since the DAR and PI values are obtained by arithmetic operations, "no" is displayed when the calculation is impossible because the measurement is "0.0 MΩ" or "OL".

#### Example of display during DAR/PI measurement



The display in the area inside the frame varies as follows.

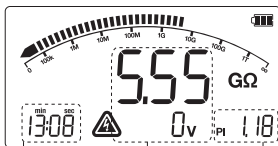
"- - -" is displayed for 1 minute after the start of measurement.

The DAR value is displayed in 1 minute.

The PI value is displayed in 10 minutes.

After 10 minutes, the DAR and PI values can be checked alternately by pressing the DISPLAY button.

#### Example of display after completion of measurement



(A)  
Timer

(B)  
Measured Value  
and Terminal voltage

(C)  
DAR/PI value

After completion of measurement, each press of the DISPLAY button can switch the four values, including the one at the completion of measurement, one at 15 or 30 seconds, one at 1 minute and one at 10 minutes after the start of measurement.

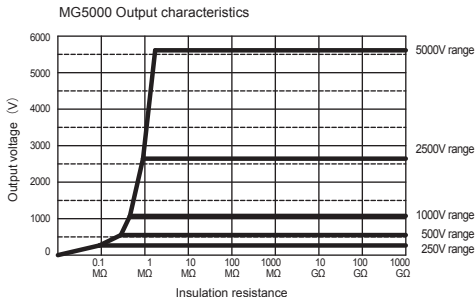


Each press of the button switches the displayed information as follows.

- (1) Results at the completion of measurement :
  - (A) Time of completion of measurement.
  - (B) Value at completion of measurement.
  - (C) DAR or PI value.
- (2) Results at 15 or 30 seconds after the start of measurement :
  - (A) 15 or 30 seconds.
  - (B) Value at 15 or 30 seconds after the start.
  - (C) DAR value.
- (3) Results at 1 minute after the start of measurement :
  - (A) 1 minute.
  - (B) Value at 1 minute after the start.
  - (C) DAR value.
- (4) Results at 10 minutes after the start of measurement:
  - (A) 10 minutes.
  - (B) Value at 10 minutes after the start.
  - (C) PI value.
- (5) Returned to display (1).

\* If the measurement time is insufficient, display (1) is returned by skipping other information.

## 5-6 Voltage Characteristics at Measuring Terminals



\* The batteries consume rapidly in measurement of resistance lower than rated test voltage/3 mA for a long period. It is recommended to measure low resistances quickly in a short period.  
(5000 V/1.8 MΩ, 2500 V/0.9 MΩ, 1000 V/0.36 MΩ, 500 V/0.18 MΩ, 250 V/0.09 MΩ)

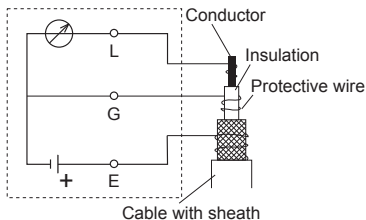
## 5-7 Using the GUARD Terminal

To use the GUARD terminal, connect the GUARD (Green) lead to the GUARD (G) terminal.

When measuring the insulation resistance of a cable, etc., wrap a bare conductor around the insulator surface and connect to the GUARD terminal. This makes it possible to prevent the insulation resistance measurement error that may be produced when the leak current on the surface flows into the current detection area.

Caution : Do not apply a voltage across the EARTH (ground) and GUARD terminals.

Insulation resistance tester



## [6] MAINTENANCE

### ⚠ WARNING

1. This section is very important for safety. Read and understand the following instruction fully and maintain your instrument properly.
2. The instrument must be calibrated and inspected at least once a year to maintain the safety and accuracy.

## 6-1 Maintenance and Inspection

1) Appearance:

- Is the appearance not damaged by falling?

2) Test leads, measurement probe and alligator clip:

- Is the cord of the test leads not damaged or the core wire not exposed at any place of the test leads?
- Is the measurement probe or alligator clip fit tightly?

If any of the above is found with the appearance, do not use the equipment and have it repaired or replaced.

## 6-2 Calibration

The calibration and inspection may be conducted by the dealer. For more information, please contact the dealer.

## 6-3 Cleaning and Storage

### ⚠ CAUTION

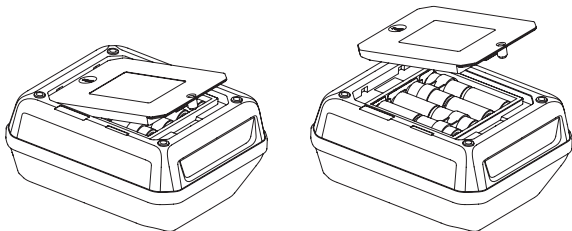
1. The main unit is not resistant to volatile solvent and must not be cleaned with lacquer thinner or alcohol. If it gets dirty, wipe lightly with a soft cloth moistened with a small amount of water.
2. The main unit is not resistant to heat. Do not place it near a source of high heat.
3. Do not store the instrument in a place where it may be subjected to excessive vibrations or from where it may fall.
4. For storing the instrument, avoid hot, cold or humid places or places under direct sunlight or where condensation is anticipated.
5. When the instrument is not to be used for a long period, be sure to remove batteries from it.

Following the above instructions, store the instrument in good environment.

## 6-4 Battery Replacement

### ⚠ WARNING

1. If the battery lid is removed with input applied to the input terminals or in the middle of measurement, you may get electrical shock. Before starting the work, always make sure that no input is applied.
2. Before starting the work, ensure that the function switch is set to OFF.



- ① Using a Phillips screwdriver, turn the battery lid retaining screw (x 1) until it turns idle.
- ② Push the area marked PUSH to lift the battery lid and then remove it.
- ③ Replace the eight batteries by taking care of the polarity
- ④ Attach the battery lid and secure the retaining screw.

## **[7] AFTER-SALE SERVICE**

### **7-1 Warranty and Provision**

Sanwa offers comprehensive warranty services to its end-users and to its product resellers. Under Sanwa's general warranty policy, each instrument is warranted to be free from defects in workmanship or material under normal use for the period of one (1) year from the date of purchase.

This warranty policy is valid within the country of purchase only, and applied only to the product purchased from Sanwa authorized agent or distributor.

Sanwa reserves the right to inspect all warranty claims to determine the extent to which the warranty policy shall apply. This warranty shall not apply to disposables batteries, or any product or parts, which have been subject to one of the following causes:

1. A failure due to improper handling or use that deviates from the instruction manual.
2. A failure due to inadequate repair or modification by people other than Sanwa service personnel.
3. A failure due to causes not attributable to this product such as fire, flood and other natural disaster.
4. Non-operation due to a discharged battery.
5. A failure or damage due to transportation, relocation or dropping after the purchase.

### **7-2 Repair**

Customers are asked to provide the following information when requesting services :

1. Customer name, address, and contact information
2. Description of problem
3. Description of product configuration
4. Model Number
5. Product Serial Number
6. Proof of Date-of-Purchase
7. Where you purchased the product

Please contact Sanwa authorized agent/distributor/service provider, listed in our website, in your country with above information. An instrument sent to Sanwa/agent/distributor without above information will be returned to the customer.

Note :

- 1) Prior to requesting repair, please check the following :  
Capacity of the built-in battery, polarity of installation and discontinuity of the test leads.
- 2) Repair during the warranty period :  
The failed meter will be repaired in accordance with the conditions stipulated in 7-1 Warranty and Provision.
- 3) Repair after the warranty period has expired :
  - If it is expected that servicing can restore the original functioning of the instrument, we will service it for a price upon request of the user.
  - The service charge or transport freight could sometimes become higher than the product price. Please consult us before asking for servicing.
  - The minimum retention period of the servicing performance parts of this instrument is six (6) years after the discontinuation of production. This period is equal to the servicing available period. However, the retention period of a part may be reduced if it becomes unavailable due to discontinuation of production of the part manufacturer, etc.
- 4) Precautions when sending the product to be repaired :  
To ensure the safety of the product during transportation, place the product in a box that is larger than the product 5 times or more in volume and fill cushion materials fully and then clearly mark "Repair Product Enclosed" on the box surface. The cost of sending and returning the product shall be borne by the customer.


### **7-3 SANWA Website**

<http://www.sanwa-meter.co.jp>

E-mail : [exp\\_sales@sanwa-meter.co.jp](mailto:exp_sales@sanwa-meter.co.jp)

## [8] SPECIFICATIONS

### 8-1 General Specifications

AC sensing	Average value
LCD	1200 counts Bar graph : 36 points DAR/PI value : 9.99 Timer : 99 : 59 (min. : sec.)
Sampling rate	Approx. 3 times/sec.
Overload indication	V function : "OL" displayed with buzzer beep Insulation function : "OL" displayed
Range selection	Auto range only
Polarity switching	Auto switching (only "-" is displayed)
Battery Monitor	4-step indication (see 4-7)  blinks at about 7.5 V or less (accuracy no longer guaranteed)
Environmental condition	Altitude 2000 m or below, indoor use, pollution degree II
Operating temperature/humidity	0-40 °C, max. relative humidity 85 % (no condensation)
Storage temperature/humidity	-10-60 °C, max. relative humidity 90 %, no condensation (with batteries removed) (Batteries should be removed before storage for a long period.)
Power supply	"C"-size alkaline battery 1.5 V (LR14) x 8
Auto Power Off	Power OFF in about 10 minutes after last operation.
Max. power consumption	Approx. 18 VA (measurement at 5000 V/ approx. 1.8 M $\Omega$ )
Measurement count	1000 times (5000 V/5 M $\Omega$ measurement, 5 sec. ON/25 sec. OFF)
Dimensions & mass	188(H) x 225(W) x 97(D) mm, approx. 1750 g (batteries included)
Year of production	Initial 2 digits of the main unit serial No. indicates the last two digits of year (20**).
IP class	IP54
Safety standards	IEC61010-1 CAT.III 1000 V/IV 600 V IEC61010-2-030, IEC61010-031. IEC61557-1 & 2

EMC Directive, RoHS Directive	IEC61326 (EMC). EN50581 (RoHS)
Accessories	Instruction manual, test leads (TL-5k) Red/Black/Green, carrying case (C-MG5k), "C"-size alkaline batteries x 8
TL-5k contents	TL-5K-R : 3 m LINE lead (Red) Removable type TL-5K-B : 3 m EARTH (ground) lead (Black) TL-5K-G : 3 m GUARD lead (Green) TL-5K-A : Alligator clip TL-5K-P : Test probe TL-5K-H : Hook probe
Optional accessory	TL-5K-15 : 15 m LINE lead (Red), Removable type

Current consumption (typical value at 12 V of supply voltage)

Function	250 V	500 V	1000 V	2500 V	5000 V	AC/DC V
Output at short-circuit	450 mA					45 mA
Output at rated current	750 mA /0.09 M $\Omega$	500 mA /0.18 M $\Omega$	700 mA /0.36 M $\Omega$	1200 mA /0.9 M $\Omega$	1500 mA /1.8 M $\Omega$	
Output at open-circuit	10 mA	10 mA	30 mA	50 mA	100 mA	
Stand-by	45 mA					
Backlight on	60 mA increases					

Continuous operation time : Approx. 25 hours with 5000 V function and 100 M $\Omega$  load.

## 8-2 Measuring Ranges and Accuracies

Accuracy-guaranteed temperature/humidity ranges : 23  $\pm$ 5  $^{\circ}$ C, no more than 80 %RH (without condensation)

rdg : Reading. dgt : Lowest digit.

### ACV/DCV

Measurement range	Resolution	Accuracy
30-1000 V (50/60 Hz)	1 V	$\pm$ (2.0 %rdg + 3 dgt)
$\pm$ 30- $\pm$ 1000 V DC		

Accuracy-guaranteed frequencies : 50/60 Hz, input impedance approx. 100 M $\Omega$

## Insulation resistance

\* Accuracies of the main unit excluding the effects of test leads on measurements.

Rated output voltage	250 V	500 V	1000 V	2500 V	5000 V	
Measuring Range	0.0 -104.9 MΩ	0.0-99.9 MΩ 80-1049 MΩ	0.0-99.9 MΩ 80-999 MΩ 0.80-2.09 GΩ	0.0-99.9 MΩ 80-999 MΩ 0.80-9.99 GΩ 8.0-104.9 GΩ	0.0-99.9 MΩ 80-999 MΩ 0.80-9.99 GΩ 8.0-99.9 GΩ	80-1000 GΩ (No accuracy 1001-1199 G)
Accuracy	±(5 %rdg + 3 dgt)					±20 %
Open-circuit voltage	DC 250 V 0 %-+20 %	DC 500 V 0 %-+20 %	DC 1000 V 0 %-+20 %	DC 2500 V 0 %-+20 %	DC 5000 V 0 %-+20 %	
Rated current	3 mA ±0.5 mA					
Short-circuit current	3 mA-4 mA					

## Terminal voltage display (Output Voltage monitor)

Measurement range	Resolution	Accuracy
30-6000 V	1 V	±(5 %rdg + 10 dgt)

Note: In the insulation resistance measurement, the voltage used in measuring resistances lower than 5000 V/1.8 MΩ, 2500 V/0.9 MΩ, 1000 V/0.36 MΩ, 500 V/0.18 MΩ or 250 V/0.09 MΩ is out of the accuracy-guaranteed range and handled as a reference value.

This display makes it possible to check the voltage output from the output terminal or the discharge status of the charge accumulated in the object measured.

To measure the voltage, use the AC/DC V function.



## Accuracy calculation method

Example) ACV (AC voltage) measurement

Displayed value : 500 V

Range and accuracy :  $\pm(2.0\% \text{rdg} + 3 \text{dgt})$  in 1000 V range

Error :  $\pm(500 \text{ V} \times 2.0\% + 3 \text{dgt}) = \pm 13 \text{ V}$

True value : 500 V  $\pm 13$  V (487 to 513 V)

\* In the 1000 V range, the 3 dgt corresponds to 3 V.

The product specifications described in this manual and its appearance are subject to change without notice for improvement or other reasons.

## MEMO



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