

**sanwa®**

**PDR4000**

**EARTH TESTER**

**INSTRUCTION MANUAL**

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## [1] SAFETY PRECAUTIONS

**Before use, read the following safety precautions.**

Thank you for purchasing the Sanwa PDR4000 earth 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

### 1-2 Warning Instructions 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 400 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 barrier 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 tester 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. Wear insulating protective gear when using the tester with equipment containing a hazardous live part. Also be sure to observe your local and national safety rules.
15. Always use the tester 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>ACV</b>	E - S(P)	AC 400 V	AC 400 V
$\Omega$	E - S(P)	Voltage input prohibited	AC 400 V
$\Omega$	E - H(C)	Voltage input prohibited	Voltage input prohibited

## [2] APPLICATIONS AND FEATURES

### 2-1 Applications

This is an Earth Tester designed for measurement within the range specified as CAT.II 400 V / CAT.III 300 V in IEC61010.

### 2-2 Features

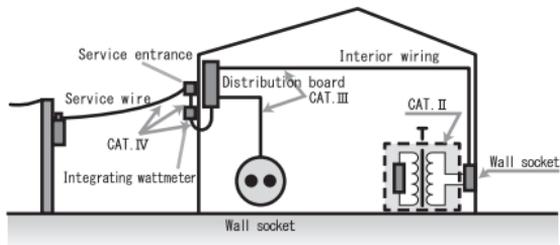
- Safety design compliant to IEC61010.
- 3-pole / 2-pole earth resistance measurement.
- High portability carrying case
- Backlight function

## Measurement categories (Overvoltage categories)

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

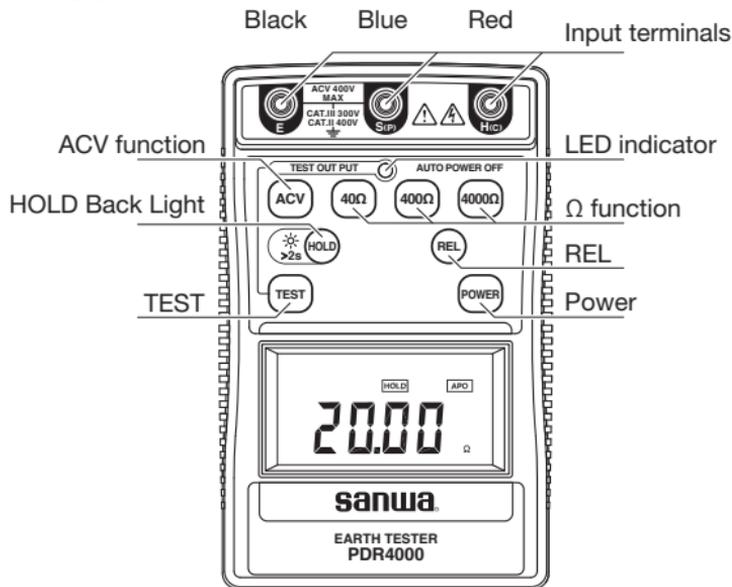
CAT. III: Primary circuit of equipment that inputs power directly from the distributor and the circuit from the distributor to the mains socket.

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

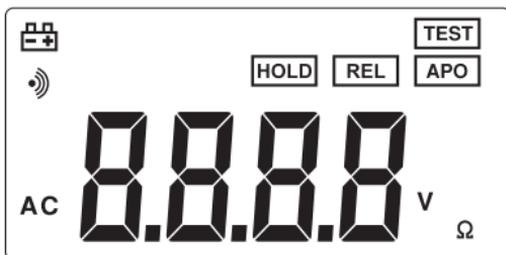


## [3] NAMES OF COMPONENT UNITS

### 3-1 MAIN Unit



## 3-2 Display



## 3-3 Accessories

Test Lead set (TL-67) Black 5 m, Blue 10 m & Red 15 m  
Auxiliary electrode x 2 pcs (CL-ER4000)

## 3-4 Optional Accessories

Test Lead for 2 pole method (TL-68)



# [4] DESCRIPTION OF FUNCTIONS

## 4-1 Power on/off: POWER button

Press the POWER button to turn on and off the tester.

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

Press the **TEST** button to start and stop the earth resistance measurement in 40  $\Omega$ , 400  $\Omega$  and 4000  $\Omega$  function.

\* The measurement of the ACV function is possible without using the **TEST** button.

## 4-3 Data Hold function: HOLD button

When the HOLD button is pressed, the current display is hold on the display with the **HOLD** symbol. The display will not be changed even when the input varies thereafter. Press the button again to cancel the Data Hold function and turn off the **HOLD** symbol on the display. This function is not available in case “- - - -” is displayed.

\* The Data Hold function is also canceled when the function/range is changed or press the TEST button to stop measurement.

#### 4-4 Backlight function: HOLD Button

Press and hold the HOLD button for 2 seconds to turn the display backlight on. Press and hold the button for 2 seconds again to extinguish it. The backlight also goes off in 30 seconds after it is turned on.

#### 4-5 Relative value function: REL button

The function is used to cancel resistance of test leads for earth resistance measurement. When the REL button is pressed, the current value sets to 0 as reference value with  symbol on the display. When the button is pressed again,  symbol turns off and the relative value measurement is canceled. (See 5-4)

#### 4-6 Auto Power Off (APO) function

The Auto Power Off function turns the tester off automatically in about 10 minutes after the last operation. To turn on the tester, press POWER button. To disable this function, press and hold the TEST button when power on the tester.  symbol turns off in the display.

\* The Auto Power Off function is automatically canceled during earth resistance measurement.

#### 4-7 Low battery indication

When the voltage of the batteries drops below about 7.8 V, the  symbol turns on the display. Replace with new batteries (all of 6 pcs.) since accuracy is not guaranteed. The voltage drops below about 6.0 V, “bAtt” is indicated on the display and any measurement can not be performed.

### [5] MEASUREMENT PROCEDURE

#### WARNING

1. Pay attention to electric shock during earth resistance measurement, which generate up to around 50 V.
2. Never use the tester if the tester, test lead or alligator clip is damaged or broken.

#### CAUTION

Carefully handle auxiliary earth electrode, whose tip is sharp shape.

## 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 and alligator clips are free from irregularities such as wire disconnection and crack.
- Batteries : Install the batteries before using the tester for the first time. If the  symbol turns on the display, replace the batteries with new ones.(see 6-4)  
\* If nothing is displayed, the batteries may be exhausted totally.
- Also check that the tester and your hands are not moistened by water, etc.

## 5-2 Interference voltage measurement (ACV)

Function	Measurement range	Accuracy	Remarks
ACV	0.0~400.0 V	$\pm(2 \%rdg+3 dgt)$	OL indicates on the display when 400.0 voltage or more input.

\* The accuracy-guaranteed: 40~500 Hz

Procedure :

- ① Connect the black test lead plug into E terminal and blue test lead plug into S(P) terminal.
- ② Set the function to AC V.
- ③ Connect the test leads to the object measured.
- ④ Read the displayed value (there is no need of pressing the TEST button).

Notes :

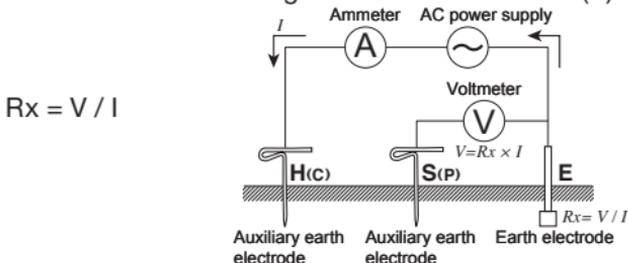
- The interference voltage is higher than 10 V, the earth resistance measurement can not be performed.
- DC element in interference voltage is not detected in this function.

### 5-3 Principles of earth resistance measurement

This tester uses two methods to measure earth resistance, which are 3-pole and 2-pole.

Normal earth resistance measurement uses 3-pole method, which use 2 auxiliary earth electrodes into the ground.

Earth resistance is measured by the potential drop method. First apply AC voltage between E and H(C) to measure current "I". Second measure voltage "V" between E and S(P).



2-pole method is used when the earth system is known or there is an known earth resistance, which is very low against object to measure.

Note:

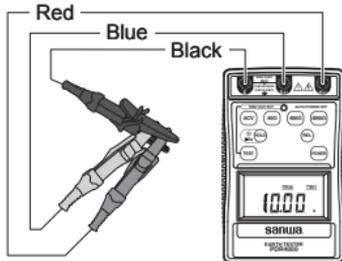
Optional accessory (TL-68) is required for 2-pole method.

### 5-4 Zero adjustment

Before earth resistance measurement, set zero (0.00  $\Omega$ ) reading to cancel resistance of test leads.

Procedure :

- ① Set the function to 40  $\Omega$ .
- ② Connect the black plug into E terminal, blue plug into S(P) terminal and red plug into H(C).
- ③ Alligator clips are shorted as illustrated, then press TEST button.
- ④ Press REL button, reading becomes 0.00 with **REL** symbol.



During earth resistance measurement press **REL** button again or change function, **REL** function will be canceled.

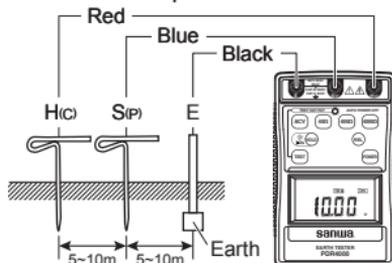
Note:

If reading is 5  $\Omega$  or less when pressing REL function, test lead may be broken.

## 5-5 Earth resistance measurement: 3-pole method

### 5-5-1 Preparation

- ① Connect the black test lead plug into E terminal, blue test lead plug into S(P) terminal and red plug into H(C).
- ② As illustrated below, place S(P) and H(C) auxiliary earth electrode into the ground and clip the Earth by E in one line at 5 to 10 m interval. It is better to put each test leads a little away.



Note:

Please place the auxiliary earth electrode as much as possible into the moist area. If you place it into a place where there are many pebbles, sandy lands, dry place, please add water and damp it.

On the concrete, lay the auxiliary earth electrode and measure it with water and a damp cloth. But asphalt can not be measured because water does not penetrate.

If the auxiliary earth electrode resistance is too high to measure, add water to it, insert deeper, clean it. If it does not decrease due to the characteristics of the soil, please rework to another place.

### 5-5-2 Interference voltage check ACV

After preparation, check interference voltage at ACV function first. The voltage is between E and S(P). If reading is 10 V or more, earth resistance measurement can not be performed.

In this case power off equipment in the earth system, which may be connected to ground to avoid leakage current flow.

### 5-5-3 Measurement

- ① Set the function to 40  $\Omega$ /400  $\Omega$ /4000  $\Omega$
- ② Press the TEST button to make earth resistance measurement.

During the measurement, LED indicator lights and TEST symbol turns on.

- ③ Press the TEST button again to stop the measurement.
- ④ Explanation when displaying values other than numbers
  - In case of overload, the display is "O.L."
  - When the resistance of the auxiliary earth electrode H (C) exceeds about 12 k $\Omega$ , the display is "- - - -".
  - If there is no measuring current due to disconnection of E and H (C), the display will be "- - - -".
  - It will give unstable reading when S (P) is disconnection. If you replace S (P) and H (C) on the terminal, you may notice connection failure.  
If the indication is "- - - -", rework to place auxiliary earth electrode into the ground again (See 5-5-1). Also "bAŁŁ" may be displayed  when turns on the display.
- ⑤ When the measurement is over, clean the auxiliary earth electrode with wet cloth, etc. Please keep it drying to avoid rusting.

## 5-6 Earth resistance measurement: 2-pole method

In the 2-pole method, very low earth resistance is used instead of the auxiliary earth electrode. It is metal pipes such as water supply, neutral wire of commercial power supply, etc. The display value in this method stands by following formula.

$$RE (\text{display value}) = R_x (\text{earth resistance}) + r_e (\text{Low Earth resistance})$$

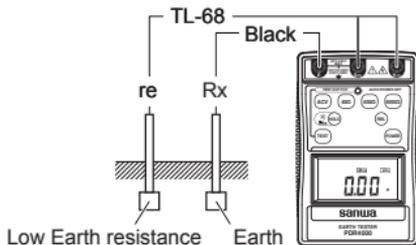
If you know Low Earth resistance ( $r_e$ ), subtract it from reading and find the true value.

$$R_x = RE - r_e$$

### 5-6-1 Preparation

Optional accessory TL-68 is required.

- ① Verify no voltage is existed on the Low Earth resistance.
- ② Connect the black plug into E terminal, TL-68 is connected into S(P) and H(C) terminals.
- ③ Clip black test lead on E and TL-68 on the Low Earth resistance.



### 5-6-2 Measurement

#### ⚠ CAUTION

Before measurement, make sure that sensitivity of leakage circuit breaker is large enough against 2 mA, which is maximum measuring current of the tester.

- ① Set the function to 40  $\Omega$ /400  $\Omega$ /4000  $\Omega$ .
- ② Press the TEST button to make earth resistance measurement. During the measurement, LED indicator lights and **TEST** symbol turns on.
- ③ Press the TEST button again to stop the measurement.

Explanation when displaying values other than numbers

- In case of overload, the display is "O.L."

- When the resistance of the auxiliary earth electrode H (C) exceeds about 12 k $\Omega$ , the display is "- - - -".

## [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
  - Is the the test leads not damaged or the core wire not exposed at any place of the test leads?

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

### 6-2 Calibration

The manufacturer may conduct the calibration and inspection. For more information, please contact the dealers.

### 6-3 Cleaning and storage

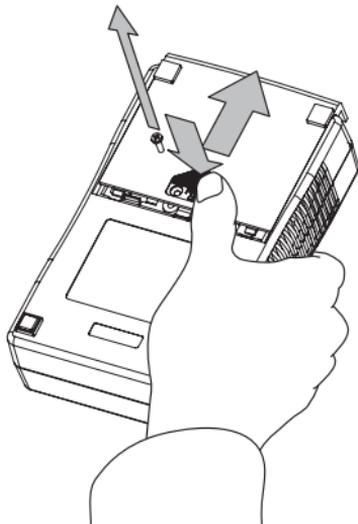
#### CAUTION

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 placed 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.

## 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 until it turns idle.
- ② Press and push the battery lid as illustrated, and then remove it.
- ③ Replace the six 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 web site

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

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

## [8] SPECIFICATION

### 8-1 General specifications

AC detection method	Average value (AC coupling)	
Display	Max. 4000 counts	
Sampling rate	Approx. 2 times/sec.	
Overload indication	ACV	"OL" displayed
	$\Omega$	"OL" or "- - -" displayed
Range selection	Manual	
Low battery indication	 symbol displayed when battery voltage drops at approx.7.8 V or less. (Out of accuracy guaranteed.) "bAtE" displayed when battery voltage drops at approx.6.0 V or less.	

Operating environmental conditions	Altitude 2000 m or below, indoor use, pollution degree II
Operating temperature/humidity ranges	0-40 °C, max. relative humidity 85 % (no condensation)
Storage temperature/humidity range	-20-60 °C, max. relative humidity 90 %, no condensation (with batteries removed) (Batteries should be removed before storage for a long period.)
Power supply	R6P 1.5 V × 6pcs
Auto Power Off	Power OFF in about 10 minutes after last operation.
Power consumption	Approx. 18 VA (measurement at 5000 V/ approx. 1.8 MΩ)
Possible number of measurements	4000 times 3-pole method measure 10 Ω, 5 seconds continuous, 25 seconds interval
Dimensions & mass	163(H) × 102(W) × 50(D) approx. 440 g(incl. batteries)
Year of production	Initial 2 digits of the main unit serial No. indicate the last two digits of year (20**).
IP rate	IP30
Standard	IEC61010-1 CAT.II 400 V/III 300 V IEC61010-2-030, IEC61010-2-033, IEC61010-031 IEC61557-1, -5
EMC, RoHS	IEC61326(EMC),EN50581(RoHS)
Accessory	TL-67: Test lead set (black 5 m x 1pc., blue 10 m x 1pc., red 15 m x 1pc.) CL-ER4000: Auxiliary earth electrode x 2pcs C-PDR4000: Carrying case Manual Battery: R6P(1.5 V) x 6pcs.
Optional accessory	For 2-pole method: TL-68

## 8-2 Measuring Ranges and Accuracies

Accuracy-guaranteed temperature/humidity ranges :  $23 \pm 5$  °C,  
no more than 75 %RH (without condensation)

rdg : Reading. dgt : Lowest digit.

### Interference voltage V (ACV)

Function	Measurement range	Accuracy
ACV	0.0 ~ 400.0 V	$\pm(2.0 \% \text{rdg} + 3 \text{dgt})$

Accuracy-guaranteed frequencies: 40~500 Hz sinewave, input impedance approx.  $2 \text{ M}\Omega$

### Earth resistance $40 \Omega/400 \Omega/4000 \Omega$

Resistance of auxiliary earth electrode:  $100 \Omega \pm 5\%$ , Interference voltage:

0 V(Specific uncertainty A)

Function	Measurement range	Accuracy
40 $\Omega$	0.00 ~ 10.00	$\pm(2.0 \% \text{rdg} + 10 \text{dgt})$
	10.01 ~ 40.00 $\Omega$	$\pm(2.0 \% \text{rdg} + 3 \text{dgt})$
400 $\Omega$	0.0 ~ 400.0 $\Omega$	
4000 $\Omega$	0 ~ 3000 $\Omega$	
	3001 ~ 4000 $\Omega$	Out of accuracy guaranteed

Measuring frequency: 820 Hz

Measuring current at the short circuit: approx. 2 mA

Accuracy guaranteed: Resistance of Auxiliary earth electrode below approx. 12 k $\Omega$

### Accuracy calculation method

Example) 400.0  $\Omega$  measurement

Displayed value : 100.0  $\Omega$

Range and accuracy :  $\pm(2.0 \% \text{rdg} + 3 \text{dgt})$  in 400.0  $\Omega$  range

Error :  $\pm(400.0 \Omega \times 2.0 \% + 3 \text{dgt}) = \pm 8.3 \Omega$

True value : 400.0  $\Omega \pm 8.3 \Omega$  (391.7 to 408.3  $\Omega$ )

\* In the 400.0  $\Omega$  range, the 3 dgt corresponds to 0.3  $\Omega$ .

### Operating uncertainty (IEC61557-5)

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.

The maximum operating uncertainty should be within  $\pm 30\%$ .

Operational uncertainty ( $B$ ) is calculated by the following formula according to the intrinsic uncertainty ( $A$ ) and variation ( $En$ ) by the uncertainty from operating condition.

The maximum operating uncertainty should be within  $\pm 30\%$ .

$$B = \pm (|A| + 1.15 \sqrt{E_1^2 + E_2^2 + E_3^2 + E_4^2 + E_5^2})$$

Condition and Ranges under the maximum operating uncertainty

Significant parameter	Ranges
$E_1$ : Position	Horizontal $\pm 90^\circ$
$E_2$ : Supply voltage	Before $\frac{E_2}{E_1}$ turns on
$E_3$ : Temperature	0 °C ~ 40 °C
$E_4$ : Series interference voltage	0 ~ 10 V : 50/60 Hz ~ 3 V : 400 Hz ~ 6 V : DCV
$E_5$ : Resistance of electrodes and auxiliary earth electrodes	~ 10 k $\Omega$

Measurement range

40  $\Omega$  : 5.00~40.00  $\Omega$

400  $\Omega$  : 20.0~400.0  $\Omega$

4000  $\Omega$  : 200~4000  $\Omega$

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

**sanwa**®

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