

# sanwa®

## KP1

### VOLT TESTER

#### INSTRUCTION MANUAL

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This manual employs soy ink.

01-1410 2040 6010

## [1] SAFETY PRECAUTIONS

Before use, read the following safety precautions.

Thank you for purchasing our voltage tester equipped with the electric field detection facility model KP1.

Before use, please read this manual thoroughly to ensure correct and safe use. After reading it, keep it together with the product for reference to it when necessary.

Using the product in a manner not specified in this manual may cause damage to the protection function of the product.

The instructions given under the headings of "⚠WARNING" and "⚠CAUTION" must be followed to prevent accidental burn and electric shock.

### 1-1 Explanation of warning symbols

The meanings of the symbols used in this manual and attached to the product are as follows:

⚠ : Very important instructions for safe use.

•The warning messages are intended to prevent accidents to operating personnel such as burn and electric shock.

•The caution messages are intended to prevent incorrect handling which may damage the product.

⚠ : Refer to Instruction Manual before use

☐ : Double or reinforced insulation    ⚡ : Ground  
 ))) : Circuit continuity buzzer        ✱ : Backlight

### 1-2 Warning instructions for safe use

#### ⚠ WARNING

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

1. This instrument is a voltage tester equipped with the electric field detection facility. Do not use it with an electric circuit exceeding 1000 V.
2. Voltages over DC 70 V or AC 33 V rms (46.7 V peak) are hazardous to human body. Take care so as not to touch them.
3. Never input signals exceeding the maximum rated input value (see 1-3).
4. Never use the instrument for measuring a line connected to equipment that may generate induced or surge voltage (such as a motor) because an input exceeding the maximum allowable overload input may be applied.
5. Never use the instrument if the instrument or test leads are damaged or broken.
6. Never use the instrument with the case or battery lid removed.
7. During measurement, do not hold the instrument by a position on the test pin side of the barrier on the test probe.

8. Never use the instrument when it is wet or with wet hands.
9. Never attempt repair or modification, except for battery replacement.
10. Perform start-up inspection and inspect the instrument at least once a year.
11. This instrument is for indoor use only.
12. Do not use the instrument in a method other than specified. Otherwise, the protection function may be spoiled.

#### ⚠ CAUTION

1. Accurate measurement may be impossible near a source of strong magnetic field such as a transformer or large-current line, near a source of electromagnetic wave such as a wireless device or near a charged object.
2. This instrument may malfunction or the measurement result may become abnormal if this instrument is used with a special waveform such as that of an inverter circuit.

### 1-3 Overload protection

| Mode                                 | Display | Max. rated input | Max. overload protection input |
|--------------------------------------|---------|------------------|--------------------------------|
| Self-test                            | SELF    | AC/ DC 1000 V    | 1050 V rms,<br>1450 V peak     |
| Auto-identifying voltage measurement | Auto    |                  |                                |
| Electric field detection             | EF      |                  |                                |

## [2] APPLICATIONS AND FEATURES

### 2-1 Applications

This instrument is a voltage tester of the RMS value response type equipped with the electric field detection facility. It is designed for measurements in the ranges specified by IEC 61010-1 CAT. IV 600 V and CAT. III 1000 V.

Recent multiinstruments have been increasing the facilities and becoming capable of measuring a larger variety of items in simpler ways. Nevertheless, this trend also means that the risk of operation mistake is increasing because of the presence of facilities that are not required by all of the users.

This instrument has been designed to meet the actual needs of the fields of electrical equipment maintenance by prioritizing the usage without operation mistakes, reducing the size for higher portability and limiting the facilities to voltage measurement and electric field detection while complying with safety standards. It is suitable for voltage measurement and electric field detection of low-voltage lines and equipment.

### 2-2 Features

- Safe use with low-voltage equipment — IEC61010 CAT. IV 600 V and CAT. III 1000 V compatibility.
- Single-button system — Easy operation for preventing operation mistakes.
- Auto identification of AC or DC voltage — AC measurement in true RMS value.
- Easy identification of 24 V type FA control panel voltage — The backlight color changes at 20 V or more.
- Auto hold — The result of the last measurement is held automatically.
- Self-test — Checking failures of the LCD or disconnection of a lead wire.
- AC electric field detection — Both contact and noncontact methods are available.
- Designed to fit the chest pocket of the working uniform.
- LED light for illuminating the working site.

### Measurement Category (Overvoltage Category)

**Measurement Category II (CAT. II):**

Line on the primary side of equipment with power cord to be connected to the receptacle.

**Measurement Category III (CAT. III):**

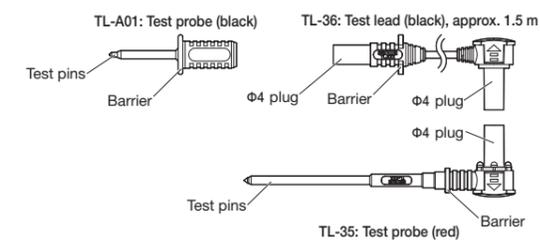
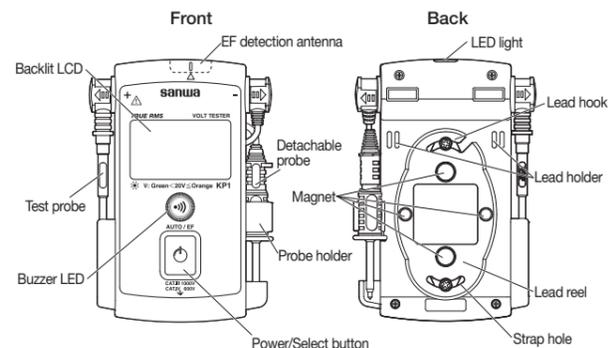
Line from the primary side or branch of equipment which directly takes in electricity from a distribution board to the receptacle.

**Measurement Category IV (CAT. IV):**

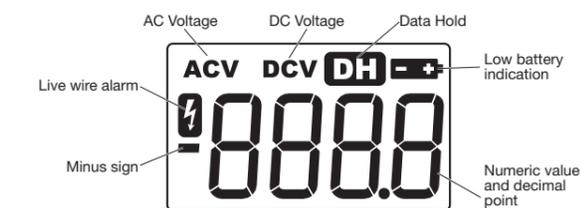
Line from the service conductor to the distribution board.

## [3] NAME OF COMPONENT UNITS

### 3-1 Main unit and test leads

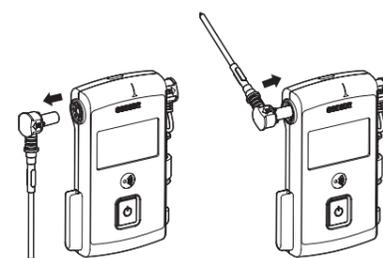


### 3-2 Display



## [4] DESCRIPTION OF FUNCTIONS

### 4-1 Changing the measuring probe angle



The angle of the measuring probe can be changed by removing it from the main body, positioning it in the desired angle and inserting it straight into the main body.

Be sure to insert the measuring probe all the way until it is fixed.

### 4-2 Power/Select button

The function of the Power/Select button varies depending on the period it is pressed. In this manual, we use the term "push" for the action of pressing the button temporarily and the term "hold" for the action of pressing and holding the button for more than one second.

Hold this button to turn the instrument ON/OFF. Note that the instrument cannot be turned OFF while it is accepting an input.

Push the button while the instrument is ON to switch the measurement modes.

The instrument is in the self-test mode ( SELF displayed) when it is turned ON. Thereafter, each press of this button switches the modes in the following cycle. (For the description of each mode, see [5] MEASUREMENT PROCEDURE.)

Auto-identifying voltage measurement mode ( Auto displayed) ⇒ EF mode ( EF displayed) ⇒ Auto-identifying voltage measurement mode ⇒ ... (repeat)

### 4-3 Auto power OFF

When the instrument is left without input for about one minute since the last operation, Auto power OFF turns automatically the display and the power of the instrument OFF. To recover from the auto power OFF, hold the Power/Select button for more than one second.

### 4-4 Low battery alarm

When the built-in batteries have been discharged and the battery voltage has dropped to below about 2.5 V, mark appears on the display. When this mark appears, replace both of the two batteries with new ones.

If the battery voltage drops below about 2.2 V, appears on the LCD and the instrument becomes unable to continue measurement.

### 4-5 Backlight and LED light

The LCD green backlight and the LED light light when the instrument is turned ON. The backlight color changes to orange when the input is AC or DC and 20 V or more, or when the AC live wire is detected in the EF mode.

\* The light cannot be turned OFF except by turning the instrument OFF.

### 4-6 Self-test

This self-test checks disconnection of the test lead wires, lack of display segments and failure of the buzzer and buzzer LED light.

For details, see 5-2 Self-test mode.

### 4-7 AC/DC auto-identifying voltage measurement

When an input of 5 V or more is applied in the self-test or auto-identifying voltage measurement mode, the instrument automatically identifies whether the input is an AC or DC voltage and displays the measured value.

### 4-8 Auto hold

When the probe is separated from the measurement target during auto-identifying voltage measurement or when the input drops below about 5 V, the instrument automatically holds the last measurement value displayed on the LCD. During auto hold, appears on the LCD and the displayed value flashes.

\* A numeric value other than the measured value may appear momentarily before the held value is displayed, but this is not malfunction.

### 4-9 EF (Electric Field) detection: EF button

This EF detection identifies the presence of voltage in a simple manner by detecting an electric field generated by an AC voltage.

For details, see 5-4 EF (Electric Field) detection.

### 4-10 AC detection method

This instrument employs the RMS (Root-Mean-Square) method and indicates the magnitude of AC current as the same amount of work as DC. RMS values of sinusoidal waves and such non-sinusoidal waves as square and chopping waves can be measured by the true RMS circuit. (The input signal measurement value is used as the scale of the actual input signal power so it is therefore measured as a more effective value than the value obtained by average detection.)

### 4-11 CF (Crest Factor)

The CF (Crest Factor) indicates the peak value of a signal divided by its RMS value. With most common waveforms such as sinusoidal and chopping waves, the CF is relatively low.

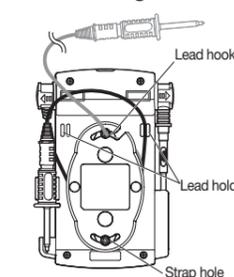
With waveforms similar to pulse trains with low duty cycle, the CF is high. For the voltages and CFs of typical waveforms, see the table below.

The CR of measurements should be 2 or less.

|                 | Input Waveform | 0 to PEAK Vp | Root Mean Square Value Vrms         | Average Value Vavg              | Crest Factor Vp/Vrms       | Form Factor Vrms/Vavg             |
|-----------------|----------------|--------------|-------------------------------------|---------------------------------|----------------------------|-----------------------------------|
| Sinusoidal wave |                | Vp           | $\frac{Vp}{\sqrt{2}}$<br>=0.707 Vp  | $\frac{2 Vp}{\pi}$<br>=0.637 Vp | $\sqrt{2}$<br>=1.414       | $\frac{\pi}{2\sqrt{2}}$<br>=1.111 |
| Square wave     |                | Vp           | Vp                                  | Vp                              | 1                          | 1                                 |
| Chopping wave   |                | Vp           | $\frac{Vp}{\sqrt{3}}$<br>=0.577 Vp  | $\frac{Vp}{2}$<br>=0.5 Vp       | $\sqrt{3}$<br>=1.732       | $\frac{2}{\sqrt{3}}$<br>=1.155    |
| Pulse           |                | Vp           | $\sqrt{\frac{\tau}{2\pi}} \cdot Vp$ | $\frac{\tau}{2\pi} \cdot Vp$    | $\sqrt{\frac{2\pi}{\tau}}$ | $\sqrt{\frac{2\pi}{\tau}}$        |

Voltages of Various Waveforms

### 4-12 Storage of lead



Lead holder: After winding the lead around the lead reel for storage, tuck the remaining section of the lead in this space to prevent spontaneous unwinding.

Lead hook: Hook the lead on these parts when the lead is used without unwinding fully.

Strap hole: Use this hole when attaching a strap or like to the instrument.

## [5] MEASURING PROCEDURE

#### ⚠ WARNING

1. Do not apply an input signal exceeding the maximum rated input value.
2. During measurement, do not hold the instrument by a position on the test pin side of the barrier on the test probe.
3. Use test leads matching the measurement category of the measured point.

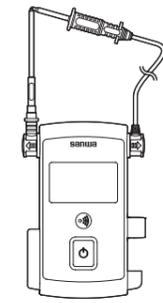
### 5-1 Start-up inspection

Be sure to perform the start-up inspection before proceeding to measurement.

- Exterior check: Check the external view for irregularity caused by dropping, etc.
- Check that the indicator is not lit. If it is lit, replace the batteries with new ones.
- Accessories: Check that the test leads are free of irregularity such as wire disconnection or crack.
- Make sure that the main unit and hand are not wet with water, etc.

\* If the display shows nothing, the batteries may be exhausted completely.

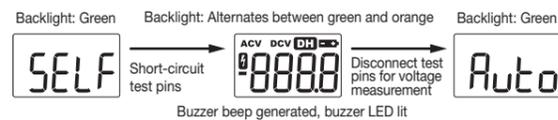
### 5-2 Self-test mode



- 1 The LCD shows  $\Sigma E L F$  when the instrument is turned ON.
- 2 Short-circuit the test pins.
- 3 All of the numeric value segments and marks are displayed on the LCD and the backlight changes color between green and orange alternately. Confirm that the buzzer beeps and that the buzzer LED lights up.

\* The instrument does not enter the self-test mode if the wire of a test lead is disconnected.

- 4 When the test pins are disconnected, the instrument enters the auto-detecting voltage measurement mode, in which the LCD displays  $R_{U}L_{D}$ .



\* When a voltage of 5 V or more is input while  $\Sigma E L F$  appears on the LCD, the instrument enters the auto-detecting voltage measurement mode and displays the value of the input voltage.

### 5-3 Auto-detecting voltage measurement

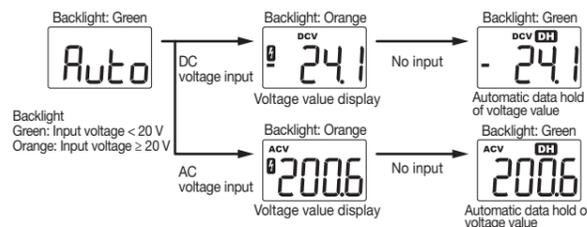
| Function (Auto detection) | Range                                   |
|---------------------------|---|
| DCV                       | 5.0 ~ 999.9 V                           |
| ACV (45 ~ 400 Hz)         | 5.0 ~ 999.9 V                           |
| Circuit continuity        | Threshold 20 k ~ 500 k $\Omega$ or less |

- 1 The LCD displays  $R_{U}L_{D}$  when there is no input.
- 2 When a voltage of 5 V or more is input, the instrument automatically detects whether it is an AC voltage (ACV) or DC voltage (DCV) and displays the corresponding mark together with the measurement value.

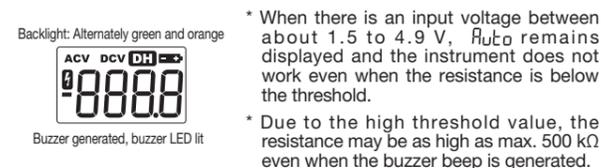
When a voltage of 20 V or more is input, appears on the LCD and the backlight color changes from green to orange.

- 3 When the probe is removed from the measurement target or the input drops below about 5 V, the last measurement value is automatically held displayed on the LCD (data hold). In the data hold status, the mark appears and the held numerical value flashes.

\* The data hold status continues until the next time a voltage is input or auto power OFF is activated.



- 4 When the voltage input is below about 1.5 V and the resistance is below the threshold value, the continuity buzzer beeps and the buzzer LED lights up. All of the numeric value segments and marks are displayed on the LCD and the backlight changes color between green and orange alternately.



### 5-4 EF (Electric Field) detection

#### WARNING

1. Before proceeding to the EF detection, check the proper operation of this instrument using a known power source.
2. During EF detection, do not hold the instrument by a position on the test pin side of the barrier on the probe.
3. Do not touch the power line because it is not always voltage-free but there may be a voltage below the detectable voltage.

- 1 EF detection identifies the presence of AC voltage in a simplified manner, by detecting the electric field generated by it.

The standard detection level is from about 60 to 1000 V AC. When an electric field is detected, the LCD backlight changes color from green to orange, and the number of bars, the intervals of buzzer beeps and the flashing interval of the buzzer LED vary in five steps.

- 2 Push the Power/Select button so that the LCD shows  $\Sigma F$  in the main numerical value display area.

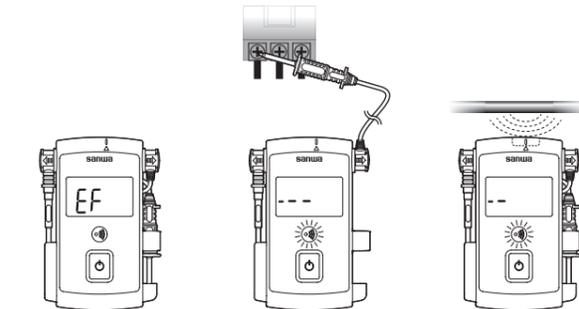
- 3 Check method

• Noncontact type measurement: Position the antenna as shown in the illustration (on the right side of the light when the instrument is viewed from the front).

• Contact type measurement: Bring the test pin (either the black or red one) in contact with the target. More accurate EF detection is possible so that the buzzer does not beep and the display remains  $\Sigma F$  in the grounding phase.

\* In certain cases in which the wiring is long, for example,  $\Sigma F$  may sometimes become “—” even on the grounding side.

\* Due to the high sensitivity, the EF sensing may be activated near an inverter generating high frequencies, even when it is as apart as more than some tens of centimeters from the instrument.



Backlight: Green  
Undetected status

Backlight: Orange  
Detected status  
(Contact type)

Backlight: Orange  
Detected status  
(Noncontact type)

### [6] MAINTENANCE AND INSPECTION

#### WARNING

1. The following instructions are very important for safety. Read this manual thoroughly to ensure correct maintenance.
2. Calibrate and inspect the instrument at least once a year to ensure safety and maintain its accuracy.

#### 6-1 Maintenance and inspection

- 1) Appearance: Is the instrument not damaged due to falling or other cause?

- 2) Test leads:

- Is a plug loose when it is inserted into the measured terminal?
- Is the cord of a test lead damaged?
- Is white coating exposed from the coating of a test lead?

If any of the above problems exists, stop using the instrument and contact us for repair or part replacement.

#### 6-2 Calibration and inspection

For more information, please contact Sanwa's authorized agent / distribute service provider, listed in our website. See section 7-2-4.

#### 6-3 Cleaning and storage

#### CAUTION

1. The panel and case are not resistant to volatile solvent and must not be cleaned with thinner or alcohol. If the instrument gets dirty, wipe with a soft cloth moistened with a small amount of water.
2. The panel and case are not resistant to heat. Do not place the instrument near heat-generating devices.
3. Do not store the instrument in a place where it may be subjected to vibration or where it may fall.
4. Do not store the instrument in places under direct sunlight, or hot, cold or humid places or places where condensation is anticipated.
5. If the instrument will not be used for a long time, remove the batteries.

### 6-4 Battery replacement

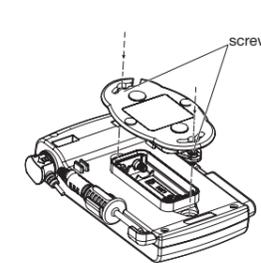
Batteries when the instrument is shipped:

A battery for monitoring has been installed prior to shipment from the factory. It may be discharged before the expiration of the described battery life.

\*The battery for monitoring is a battery used to check the functions and performance of the product.

#### WARNING

1. To avoid electric shock, do not remove the battery cover while an input is applied to the measured terminal or during measurement.
2. Make sure that the instrument is set to OFF before replacing the batteries.



- 1 Unwind the test lead (black) from the lead reel so that the screws are exposed.
- 2 Using a Phillips screwdriver, remove the two battery cover retaining screws.
- 3 Replace both of the two batteries in the battery holder with new ones by taking care of the polarity.
- 4 Attach the battery cover and retaining screws in the original positions.

\* The battery cover incorporates a magnet so care is required when closing it.

### [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 the problem
3. Description of the 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 instrument 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 product, 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 product 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-instrument.co.jp  
E-mail: exp\_sales@sanwa-instrument.co.jp

### [8] SPECIFICATIONS

#### 8-1 General Specifications

|                                       |   |
|---------------------------------------|---|
| Operation method                      | $\Delta$ - $\Sigma$ method  |
| AC detection method                   | True RMS  |
| Display                               | Numerical value: Max. 9999 counts. With backlight (green/orange)  |
| Sampling rate                         | ACV: Approx. 6 times/sec. DCV: Approx. 5 times/sec.   |
| Over-range display                    | "OL" is displayed   |
| Polarity switching                    | Auto (Only "—" is displayed.)   |
| Low battery indication                | The  indicator lights on the display when the supply voltage from the batteries drops below about 2.5 V. $b_{A}L_{E}$ appears on the LCD and the instrument becomes unable to continue measurement.                         |
| Operating environmental conditions    | Altitude no more than 2000 m, indoor use, environmental pollution degree II   |
| Operating temperature/humidity ranges | Temperature: 5 to 40 °C<br>Humidity is as follows (without condensation).<br>5 to 31 °C: Max. 80 %RH<br>31 to 40 °C: Linearly decreases from 80 %RH to 50 %RH.  |
| Storage temperature/humidity ranges   | Temperature -10 to +40 °C: No more than 80 %RH, without condensation<br>Temperature +40 to +50 °C: No more than 70 %RH, without condensation<br>(Remove the batteries when the instrument is not to be used for long time.) |
| Temperature coefficient               | At below 18 °C or above 28 °C, multiply accuracy by x0.15 per 1 °C.   |
| Power supply                          | LR03 ("AAA"-size alkaline battery), 1.5 V x 2   |
| Auto power off                        | The instrument power is turned OFF in about 1 min. after the last operation. Standby current: Approx. 5 $\mu$ A   |
| Current consumption                   | Approx. 20 mA (standby)   |
| Battery life                          | Approx. 20 hours (continuous measurement of 40 V DC)  |
| Dimensions/mass                       | 130(H) $\times$ 90(W) $\times$ 30(D) mm / approx. 205 g (including batteries)   |
| Safety standards                      | IEC61010-1, IEC61010-2-030 CAT. IV 600 V / CAT. III 1000 V, IEC61010-2-33, IEC61010-31  |
| EMC directive                         | IEC61326-1  |
| Accessories                           | Instruction manual, test leads (TL-35: Test probe (red), TL-36: Test lead (black); approx. 1.5 m, TL-A01: Test probe (black))   |

#### 8-2 Measuring ranges and accuracies

Accuracy-guaranteed temperature/humidity ranges:  
23  $\pm$  5 °C, no more than 80 %RH, (without condensation).  
 should not be displayed.

#### Crest factor (CF): < 2

rdg: Reading      dgt: Lowest digit

#### ACV (AC voltage)

Measurement range: 5.0 ~ 999.9 V. Accuracy:  $\pm$ (1.7 %rdg + 5dgt).  
Note: Input impedance approx. 1.7 M $\Omega$  at 160 nF, frequency range 45 ~ 400 Hz

#### DCV (DC voltage)

Measurement range: 5.0 ~ 999.9 V. Accuracy:  $\pm$ (0.7 %rdg + 5dgt).  
Note: Input impedance approx. 1.7 M $\Omega$  at 160 nF

#### Circuit continuity

Open voltage: Approx. 0.6 V DC. Buzzer threshold: 20 ~ 500 k $\Omega$

#### EF (Electric Field) detection

A voltage or electric field of about 60 V or more is detected. The bar graph and intermittent buzzer beeps change in five steps according to the field intensity.

Detection frequency: 50/60 Hz  
Detection antenna: Top of the instrument body (on the right of the LED light)  
Contact type EF detection: + terminal test pins

#### Accuracy calculation method

Example: ACV (AC voltage) measurement  
Displayed value: 100.0 V  
Range and accuracy: 999.9 V range,  $\pm$ (1.7 %rdg + 5dgt)  
Error:  $\pm$ (100.0 V  $\times$  1.7 % + 5dgt) =  $\pm$ 2.2 V  
True value: 100.0 V  $\pm$ 2.2 V (97.8 to 102.2 V)

\* In the 999.9 V range, the 5 digit corresponds to 0.5 V.

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